Service platform with Web based interface to control devices

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Background

- Many devices connect to Network
  - Home appliances
  - Housing devices
  - Sensors
  - Electric vehicle

- M2M services are newly released
  - Home Energy Management System
  - Home Security
  - Healthcare

- Service platform is required for multi devices and multi service
  - Our work is applied for mainly home devices and some shop facilities
What is service platform?

**Advantage of Service Platform**

- If service platform does not exist, (LEFT) different applications depend on different device interfaces.
- Service platform (RIGHT)
  - provides common interfaces for developers.
  - makes developing application easier.
Deployment of service platform

- 2 types of deployment for service platform

【Aggregate type】
All functions run on one computer

【Distribute type】
Application interface and Device interface run on Cloud and Gateway separately
Functional architecture

- Functions are composed of 3 categories
  - Application execution with Web based interface
  - Device remote operation with Standardized device interface
  - Remote management with device and local network
Devices applicable to service platform

- Basic devices as regular device for service platform
  - logical model of internal status and control item for device mechanical functions
  - same models for same categories even if different manufacturers produce them
    Model is extensible according to special feature for manufacturers

- Basic devices support standardized interface such as ECHONET Lite, KNX, SEP 2.0 ...

  ECHONET Lite: logical models of more than 80 devices are already defined

Example: Air conditioner class

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating status</td>
<td>ON/OFF</td>
</tr>
<tr>
<td>Operating mode</td>
<td>Auto/Cooling/Heating/ ...</td>
</tr>
<tr>
<td>Temperature setting</td>
<td>Temperature value, e.g. 28°C</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Fault occurrence status</td>
<td>Fault YES/NO</td>
</tr>
</tbody>
</table>
Basic device operation

- HGW convert device command between local network and Internet
  - Tuple of <property, value> is data format for controlling device
  - Device command transfers this tuple with IP on local and HTTP on Internet
  - Virtual device on Management PF corresponds to device object of basic device
  - If property of Virtual device is modified by application, then property of basic device is also modified and status of real device is changed

- Application interface is Web based interface
  - Virtual devices is treated as Web resources in our implementation

Web based interface

XML based tuple transferred on HTTP

Dedicated format of tuple transferred on IP

HEMS
Home security

Management PF
Virtual device
HTTP processing

HGW
Data Format Conversion
HTTP / IP Conversion

Command
IP HN

Basic Device
Device object
IP packet processing

Application Interface
WAN
Device operation without device object

- Non basic device can also connect to service platform
  - Adapter have device object instead of non basic device.
  - Device interface conversion on adapter communicate with device on dedicated protocol and convert non basic device to device object.
  - HGW and Non basic device can get all functions of adapter in them.
Sample applications for service platform

- 24 facilities with 28 kinds of 820 devices
- ECHONET Lite is used as a communications protocol

**Sample application for home**
- 200 devices connected
  - Home appliances (e.g. air conditioner, lighting), power equipment (e.g. photovoltaic generation, storage battery, fuel cell), Interior (e.g. controllable windows, curtain), 10 kinds of sensors, smart meter connected with ECHONET Lite

**Experimental smart home**
- 350 devices connected in 15 houses
  - Air conditioner and lighting with ECHONET Lite, 4 kinds of sensors with dedicated protocol

**Residential buildings**
- 220 devices connected in 3 shops
  - Air conditioner, lighting in yard, power equipment, 10 kinds of sensors with ECHONET Lite using adapters

**Shops (Gas station)**
- 40 devices connected in 5 schools
  - Lighting, 5 kinds of sensors with dedicated protocol

**Sample application for school**
- 40 devices connected in 5 schools
Service platform can flexibly connect with multi services and multi devices

- Platform provide Web based interface to control device on local network
- ECHONET Lite is used in our implementation. Other standard can be also applied to this service platform

Framework for Web of things should support existing devices

- Lots of devices have no Web based interfaces.
- One of the framework for WoT should include the idea of this service platform
Air conditioner and lighting in the experimental house located in Kanazawa, Japan will be controlled from here (ITU meeting room) with the HEMS application through the Management PF and the HGW.
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