Case study report on i-House experiments using intermediate service platform based on OSGi technology

This work was done as part of the R&D project “Development of energy saving home networking technologies“ organized by ‘Ministry of Internal Affairs and Communications, Japan’.
Aim of this project

- Develop a **platform** that can produce various kinds of **home network services** easily at lower cost.
- And promote **standardization** to realize such platform

**Key concept: “Intermediate service platform”**
- Bridge between service providers and home networks
Approach of “Intermediate service PF”

- Provide both service providers and users with functions needed to produce home network services. (i.e. “Cloud service” for building home network services.)
- Two Layer structure:
  - Service depend/related: Service Management platform
  - Service-independent: Home network management platform
Core technology on this PF: OSGi

- OSGi-PF is adopted as core function of home network management PF

- Many services in this project were realized by installing new modules (bundles) to one HGW.
  ➔ Services & bundles used in the project (next slide)

- New services are flexibly and easily added or deleted on demand by OSGi PF working together with other functions in the “intermediate PF”. (service portal function and service contract management function)
  ➔ Experimental study (explained later)
## Services & bundles used in the project

| №  | Participating Group | Services                              | File Name                                                      | Bundle-SymbolicName                  |
|----|---------------------|---------------------------------------|                                                               |                                   |
| 1  | Group-A             | Home Control                          | Domoware_UPnP_Base_Driver_Extra_1.0.0.jar                      | Domoware_UPnP_Base_Driver_Extra     |
| 2  | Group-A             | Home Control                          | Domoware_UPnP_Base_Driver_3.0.2.jar                           | Domoware_UPnP_Base_Driver           |
| 3  | Group-A             | Home Control                          | FNS_UPnPController_1.0.0.0.jar                                | FNS_UPnPController                  |
| 4  | Group-A             | Home Control                          | FNS_HGMLParser_1.0.0.0.jar                                    | FNS_HGMLParser                      |
| 5  | Group-A             | Home Control                          | FNS_NetworkGateway_1.0.0.0.jar                                | FNS_NetworkGateway                  |
| 6  | Group-B             | Home network support                  | deviceStatusChk.jar                                           | jp.co.melco.isl.hgw.bundle.device.statusChk |
| 7  | Group-B             | Home network support                  | upnpMonitor.jar                                               | jp.co.melco.isl.hgw.bundle.device.upnpMonitor |
| 8  | Group-B             | Home network support                  | httpProxy.jar                                                 | jp.co.melco.isl.hgw.bundle.device.httpProxy |
| 9  | Group-B             | Home network support                  | deviceMng.jar                                                 | jp.co.melco.isl.hgw.bundle.device.mng  |
| 10 | Group-C             | emergency earthquake reporting        | jp.astom.quake.jar                                            | jp.astom.quake                      |
| 11 | Group-C             | emergency earthquake reporting        | Domoware_UPnP_Base_Driver_3.0.2.jar                          | Domoware_UPnP_Base_Driver           |
| 12 | Group-D             | Security / health care visualization services | SensorDataSendBundle_1.0.0.jar                        | SensorDataSendBundle                |
| 13 | Group-D             | Security / health care visualization services | Domoware_UPnP_Base_Driver_3.0.2.jar                          | Domoware_UPnP_Base_Driver           |
| 14 | Group-D             | Security / health care visualization services | Domoware_UPnP_Base_Driver_Extra_1.0.0.jar                      | Domoware_UPnP_Base_Driver_Extra     |
| 15 | Group-E             | Health check                          | KAVDevice_Control_Bundle_1.0.0.jar                            | KAVDevice_Control_Bundle            |
| 16 | Group-E             | Health check                          | Domoware_UPnP_Base_Driver_3.0.2.jar                          | Domoware_UPnP_Base_Driver           |
| 17 | Group-E             | Health check                          | Domoware_UPnP_Base_Driver_Extra_1.0.0.jar                     | Domoware_UPnP_Base_Driver_Extra     |
**OSGi service aggregation platform (OSAP)**

- **OSAP** is a platform to deliver / manage OSGi bundles remotely developed by NTT R&D.
- **OSAP** was used as OSGi-PF in this project.
Overview of experimental study

◇ Date: 4th March, 2010
◇ Place: Ishikawa science park, Ishikawa pref., Japan
  - i–House
    - real house; 4 bedrooms with 1 living and dining room
  - Facilities in i–House
    - Solar power generation
    - Power storage
    - Direct power feeding systems
    - Sensors
    - Various home appliance
i-House: Experimental Facility

External view of i-House

Photovoltaic cells

Controllable devices

Air-Conditioner, Light, electric shutter, curtains

Electricity Outlet
Protocol installed on devices in ‘i–House’

- Various devices in ‘i–House’ are activated as Echonet devices.
  - Sensors (temperature, humidity, and illumination intensity)
  - A/C outlets, Air–Conditioner, Lights, electric shutters, curtains
- Echonet is a standard designed for control of home appliances.
  - Specified by “echonet consortium”.
- All echonet devices are recognized as UPnP device objects on HGW via the Echonet–UPnP protocol conversion gateway.

![Home network diagram]
### Participating companies and their themes in ‘i-house’

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### Theme: Environments for service providers: Service scenario creation tool

- Fujitsu Nagano System
- ATR

1 F Living/Dining

2 F Master Bedroom

1 F Bedroom

Security / health care visualization services

Home network support

1 F Living/Dining

2 F Master Bedroom

1 F Bedroom

1 F Living/Dining

2 F Master Bedroom

1 F Bedroom

Security / health care visualization services

Home network support
Overview (1) : Experimental study by NTT

◊ Procedure of service subscription with Intermediate PF

1. End-user can select a service from a list of available services by service portal function. (①、②)
2. The service management function decides if the selected service is available by checking the state of resources on HGW. (③)
3. When the subscription is accepted, the OSGi PF is activated to install the corresponding bundles to HGW. (④、⑤)
Overview (2): Experimental study by NTT

- Execution of sample AP: “Home control service based on emergency earthquake reporting”

4. An emergency earthquake reporting alert is triggered at the server manually. (⑥)

5. After HGW receives the signal from the server, it sends the control commands to the devices based on AP bundles. (⑦)

6. The devices work by following the commands.
Emergency earthquake reporting

- Provide information about seismic center, scale, and the time: immediate estimation after the earthquake occurs.
- The information is presumed to come from P-waves captured at an observation point near the seismic center.
- This service has been available for the public since 2007 in Japan.

1. Earthquake occurs
2. Detect P-wave
3. Decide the hypocenter (by the Office)
4. Receive the signal / Calculate / Display the result

Seismometer

Service Provider

P-wave: Initial tremor
Devices used in this AP

- TV (User portal)
- Visualization tool
- Warning Lamp
- Electricity Outlet
Summary

• Case study report at i–House based on nation R&D project

• Successfully visualized the mechanism of “intermediate service PF” to produce various kinds of home network services flexibly.

• OSGi was adopted as the core technology for “intermediate service PF” and its effective application was verified through experiments.