Introduction of ITU-T Y.4409/Y.2070

A gateway specification for IoT

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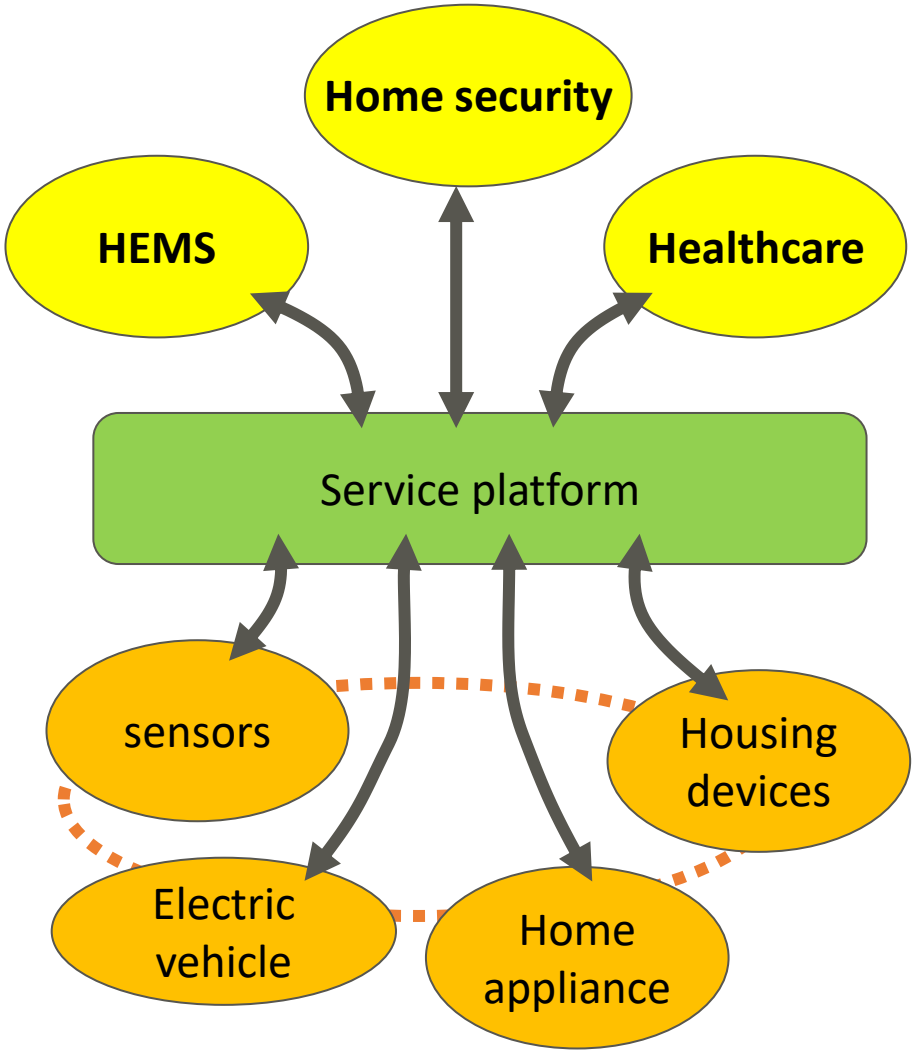
Documents

- Y.4409/Y.2070 (Recommendation)
  - Requirements and architecture of the home energy management system and home network services.
  - https://www.itu.int/rec/T-REC-Y.2070-201501-I/en
  - Approved in SG13 of ITU-T on 2015, and transferred to SG20
- Y.sup57 (informative document)
  - Implement Guideline to Y.4409/Y.2070
  - https://www.itu.int/rec/T-REC-Y.Sup57-201912-I
  - Approved in SG20 of ITU-T on 2019

Background

- Many devices connected
  - Home appliances
  - Housing devices
  - Sensors
  - Electric vehicle
- Many services launched
  - Home Energy Management System
  - Home Security
  - Healthcare
- Service platform must interconnect multi devices and multi services

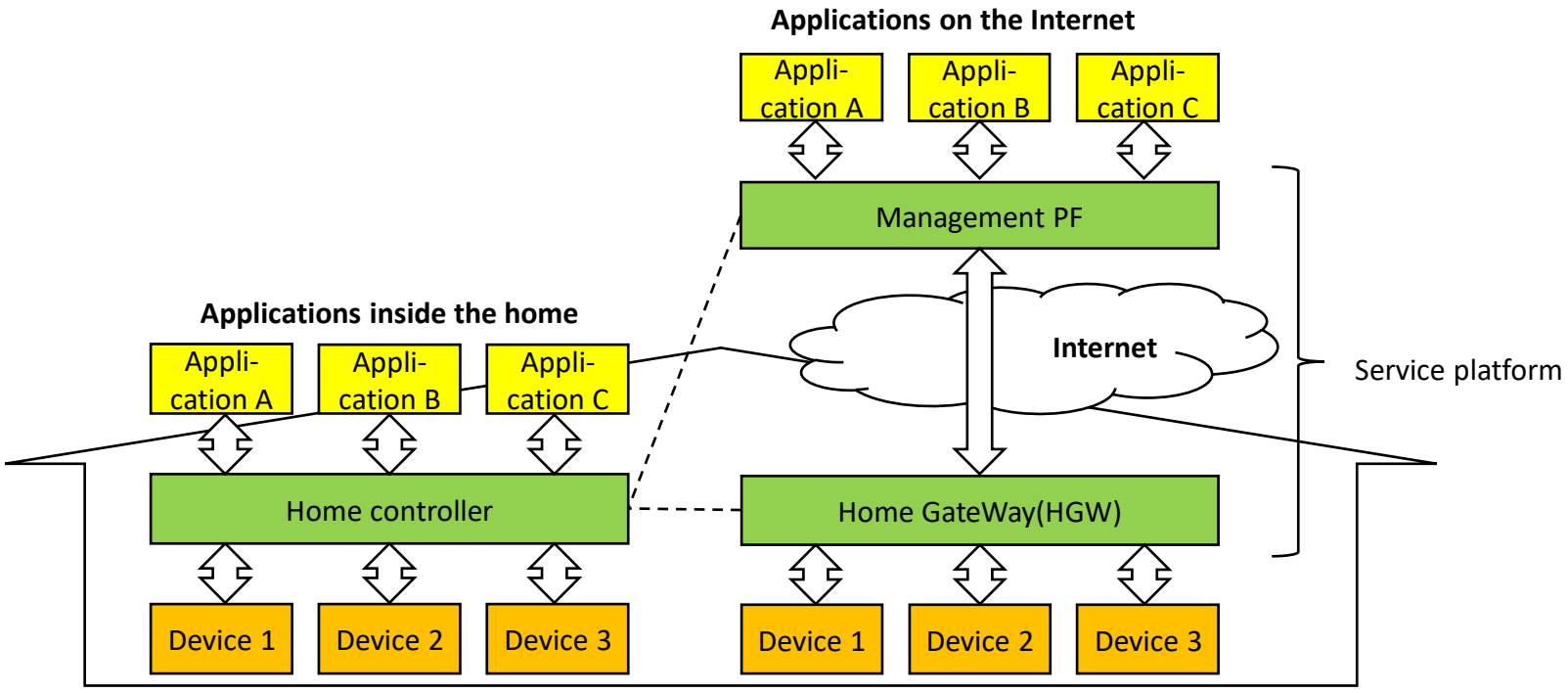


Service platform deployment

- 2 types of deployment of service platforms

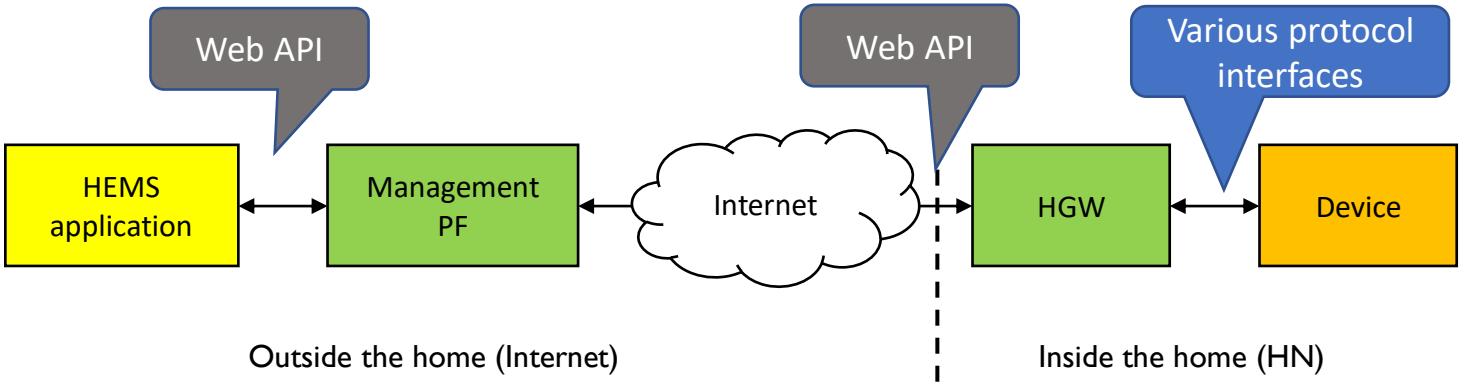
【Aggregate type】
All functions is on Home

【Distribute type】
Application interface and Device interface are separated on Cloud and Home.



4 layer architecture

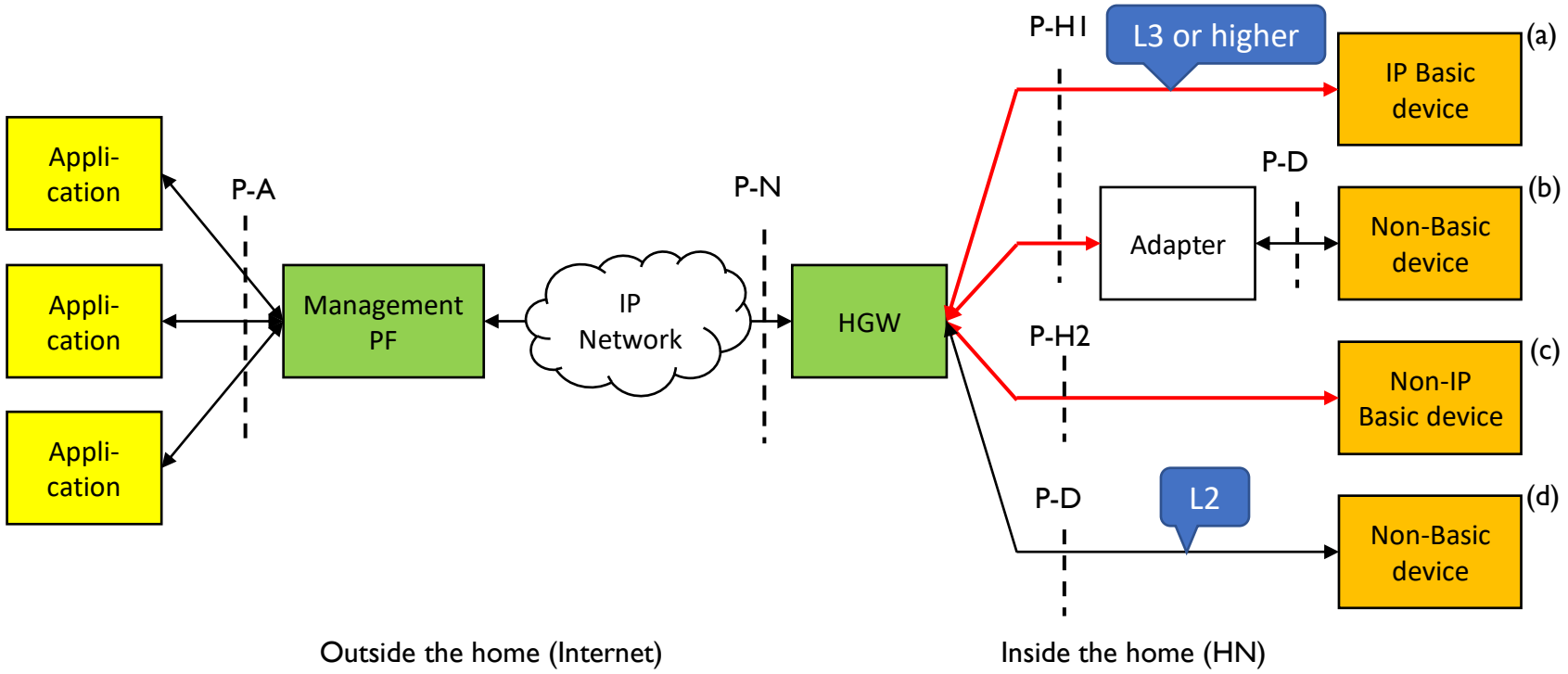
- Gateway can connect various protocol interface devices and provide a Web API to applications.



- Device Object
  - Abstract data model represent functions of the device
  - Tuple of <property, value> is primitive function
  - Simple operations for the tuples: read, write and notify
  - Examples
    - Broadband forum TR-069/TR-181 for network devices like routers
    - ECHONET Lite for home appliances

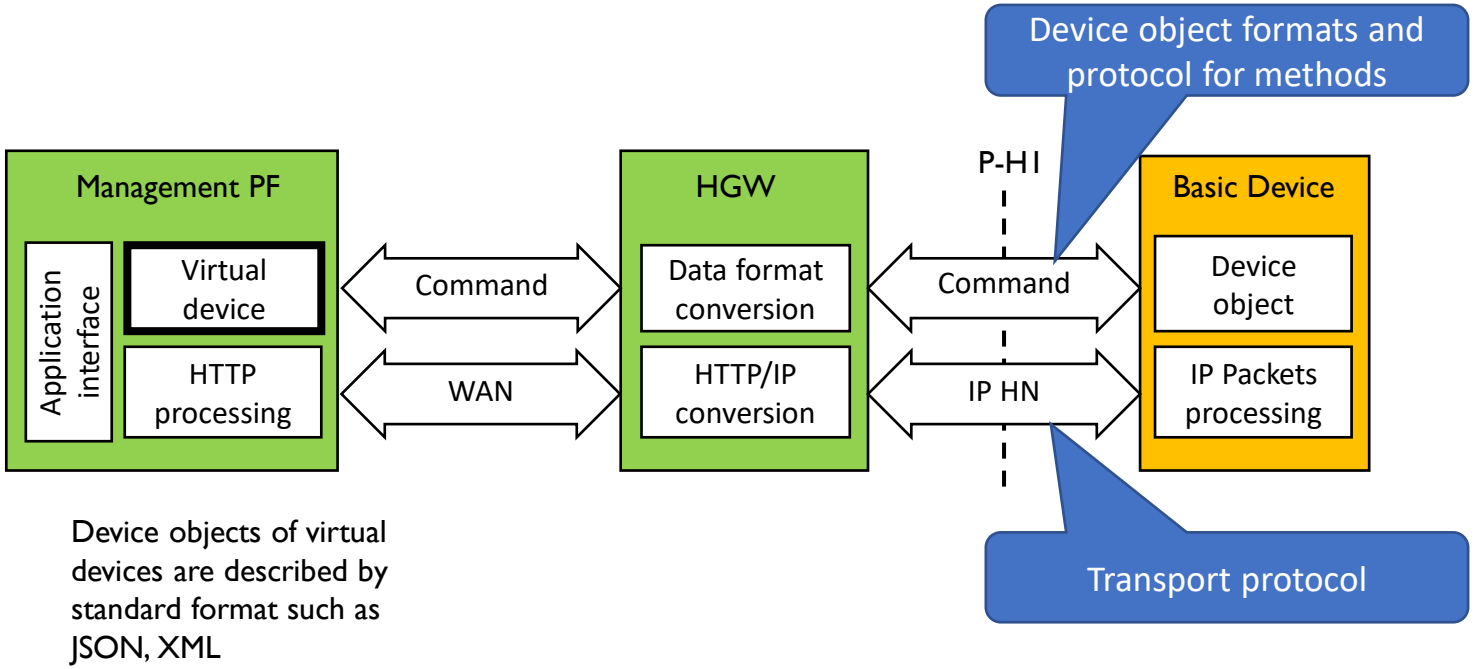
How to connect devices to gateway

- 4 ways to connect devices
  - Separated by IP or non-IP, basic or non-basic device
  - Basic device means having device object (equivalent to TD)



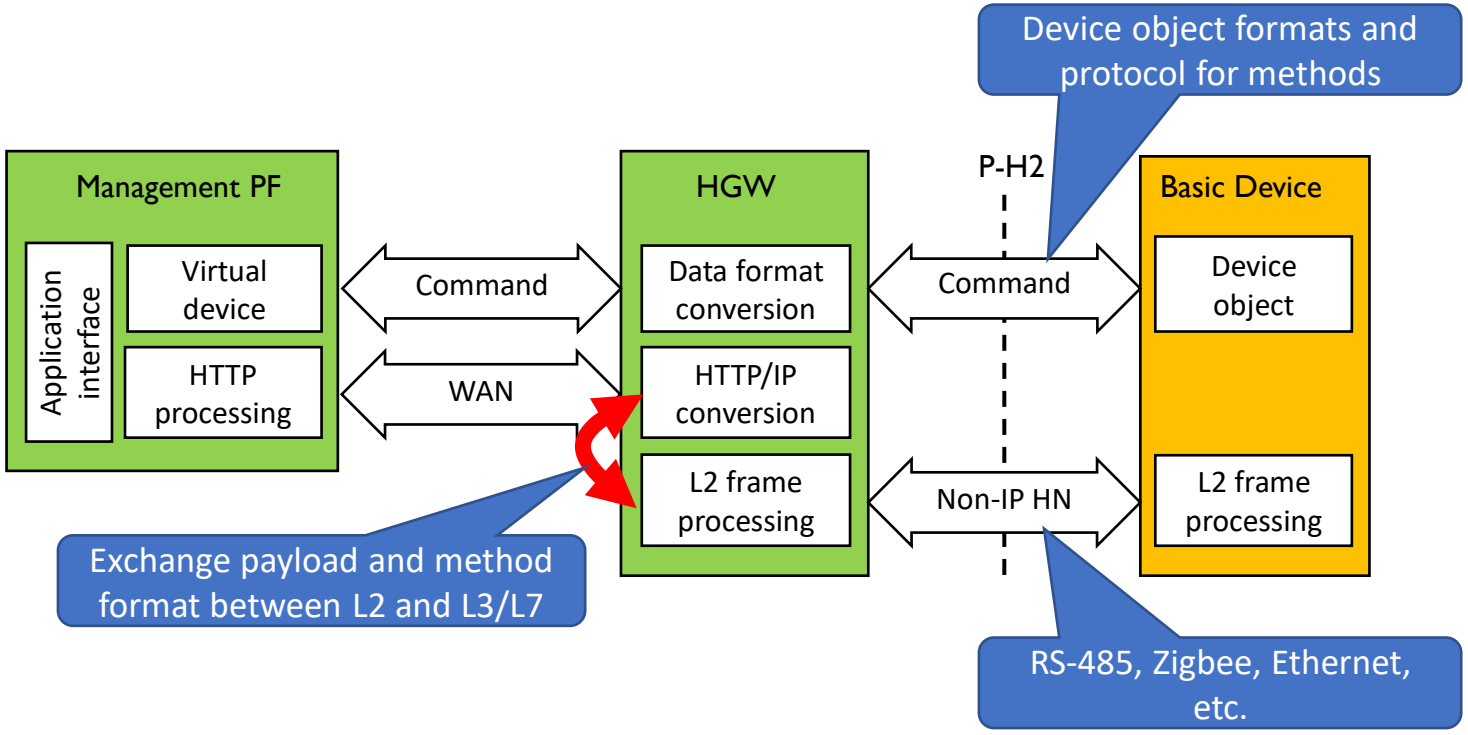
Gateway connection to basic device

- Gateway converts command and transport
  - Propriety format for physical devices and Standard format (e.g. JSON, XML) for virtual devices
  - Protocols to handle the methods: **read, write and notify**
  - Transport protocols for home networks and the Internet



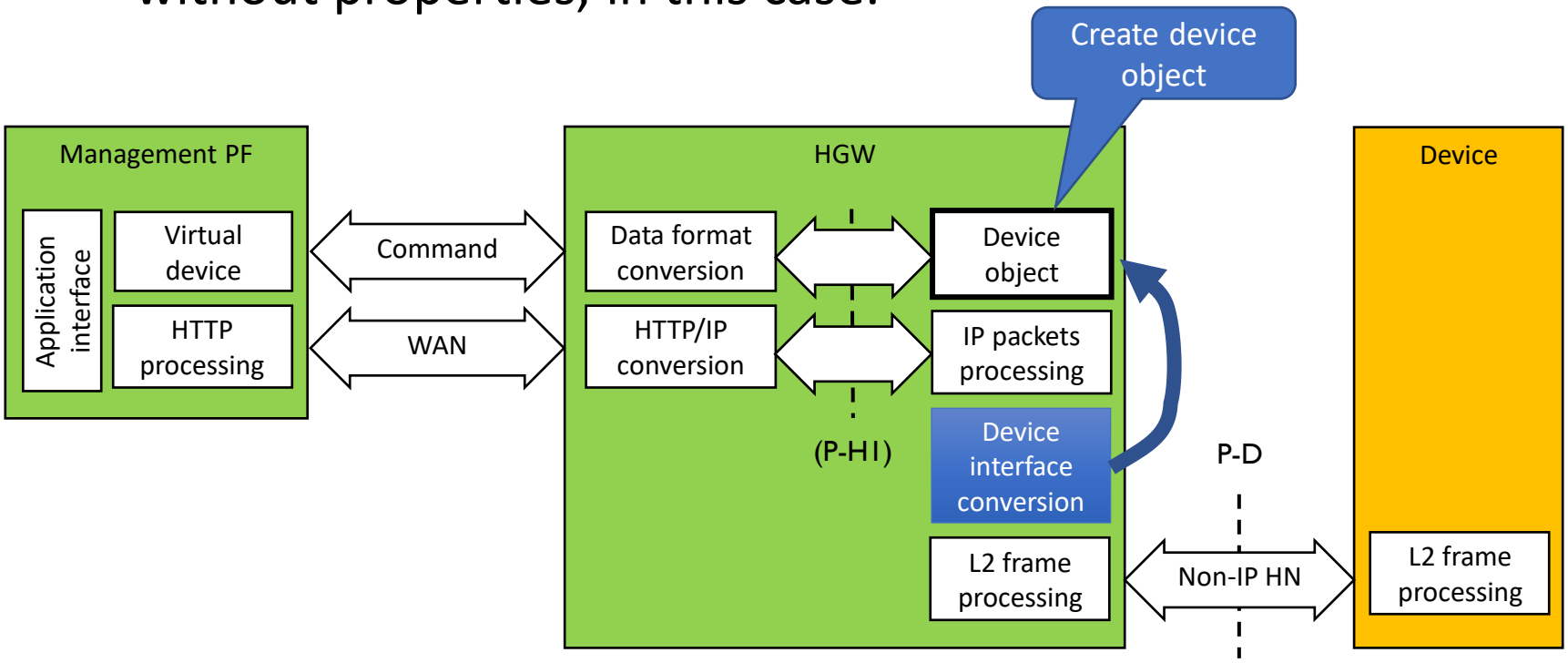
Gateway connection with non-IP device

- Gateway convert command in the same way as IP basic devices
  - Exchange command between **different network layers**



Gateway connection with non-basic dev.

- Gateway creates the device object from the device interface
  - Device interface is specified with **many methods ("verbs")**, without properties, in this case.



In WoT, the physical device can be controlled with using "ACTION" without creating a device object.

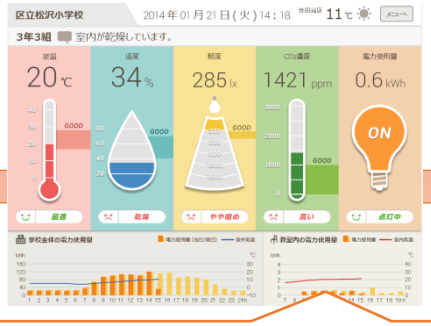
Sample applications (2013-15)

- 28 types, 820 devices were accessed by SOAP/XML with ECHONET vocabulary.

Sample application for home

Service provider

Internet



Sample application for school

Experimental smart 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**

Residential buildings

350 devices connected in 15 houses
Air conditioner and lighting with ECHONET Lite, 4 kinds of sensors with **propriety protocols**

Shops (Gas station)

220 devices connected in 3 shops
Air conditioner, lighting in yard, power equipment, 10 kinds of sensors with **BACnet and propriety protocol**

Schools

40 devices connected in 5 schools
Lighting, 5 kinds of sensors with **Modbus and propriety protocols**

Summery

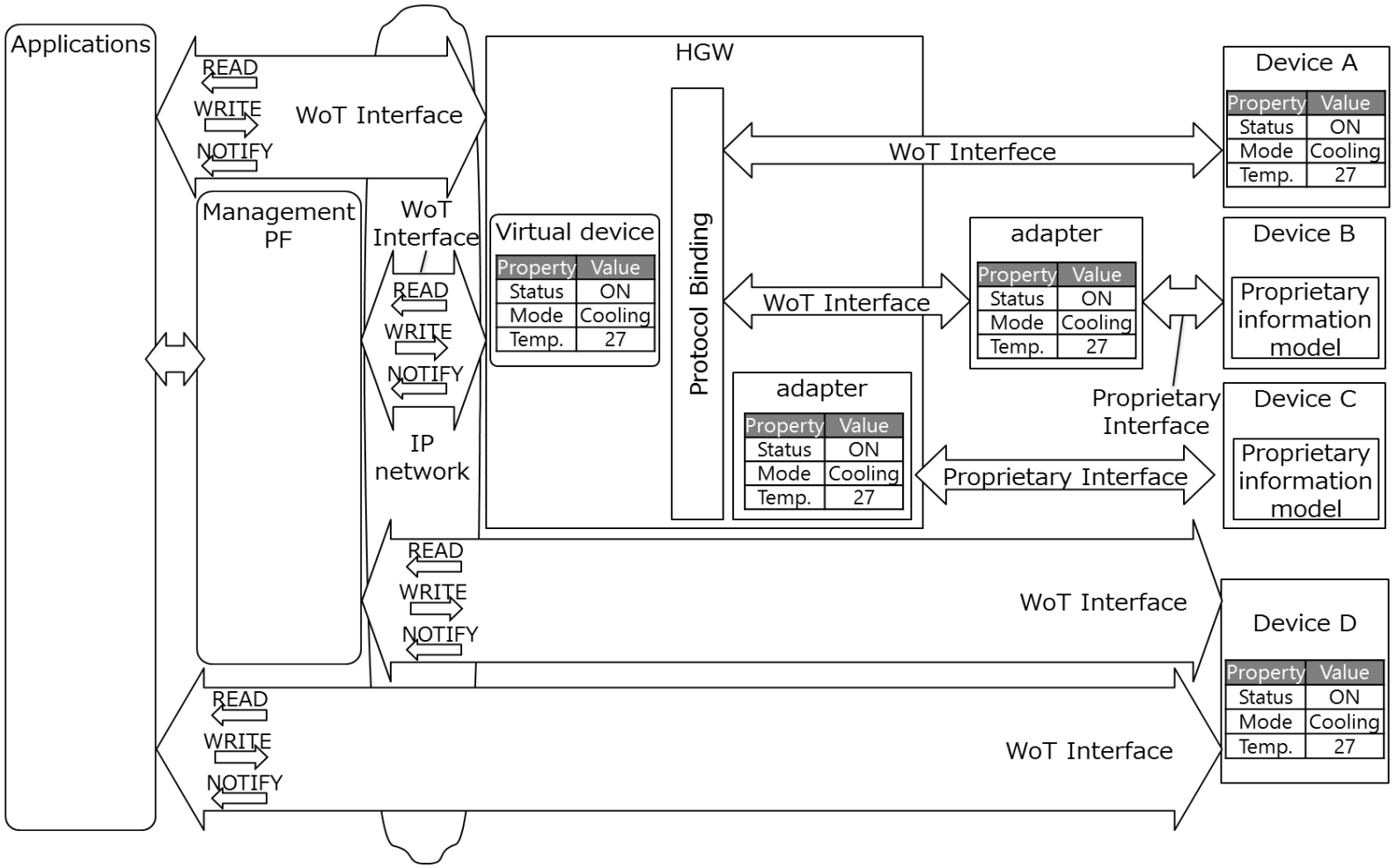
- Architecture document for Smart home
  - Applicable to a general IoT, since no home-specific issues.
  - Includes use cases and requirements.
- 4 layer architecture, resolving the protocol gaps between devices and services.
  - Device object, which is a concept equivalent to Thing Description, is defined.
  - Payloads and methods that operate the object and transport protocols that transfer them are translated for each.
- Our first implementation used SOAP for command described with ECHONET vocabulary.
  - The smart home still works now after changing the interface to WoT.
  - All device operations was executed only by READ, WRITE, NOTIFY, SUBSCRIBE and UNSUBSCRIBE of their properties, no ACTION. So Fujitsu's device descriptions have no ACTION in TD in plugfest.

Surveyed standards in Y.sup57

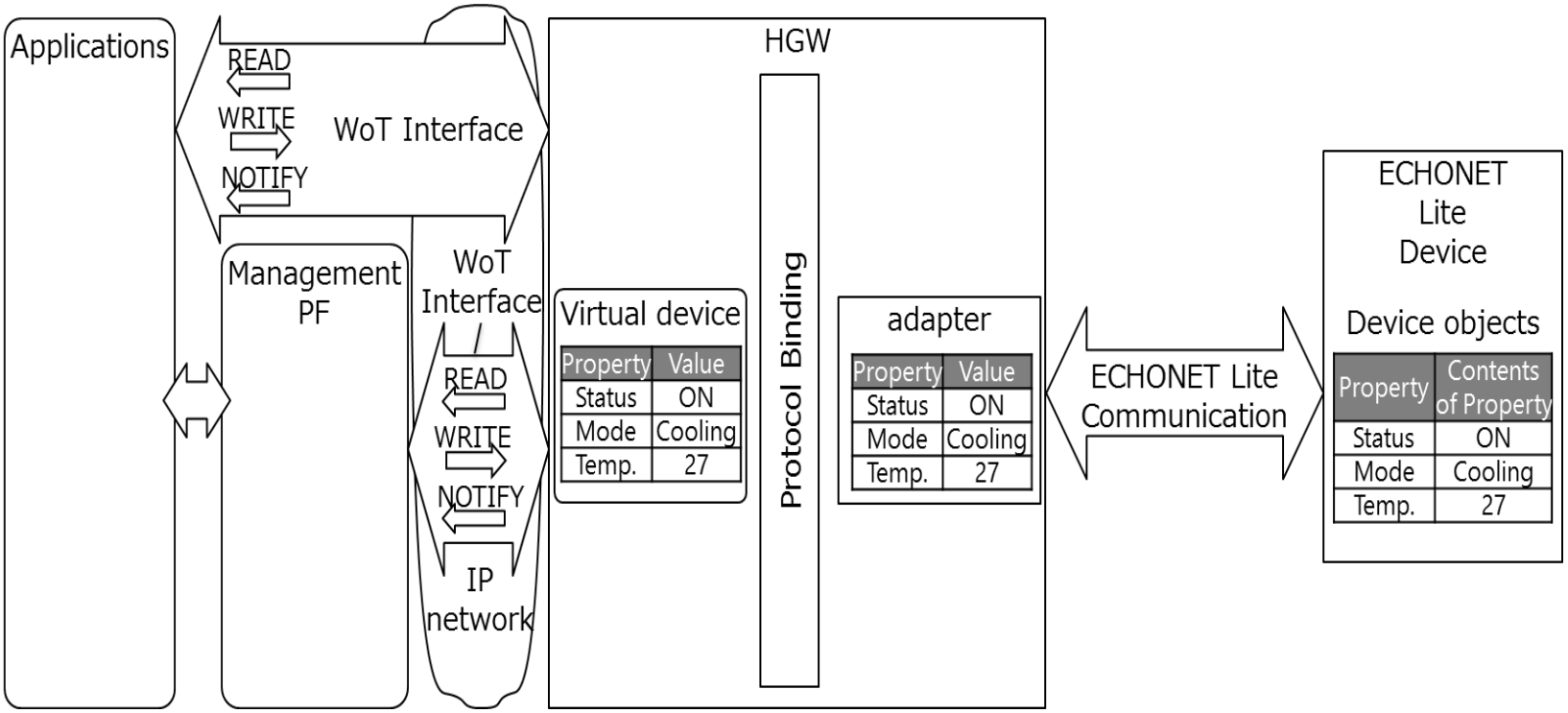
Table 6-1 – Frequently used information models for devices connected to HN

Organization	Standard	Reference for information model
Broadband Forum	TR-181	TR-181 (Device Data Model for TR-069) [b-BBF TR-181]
ECHONET Consortium	ECHONET Lite	Detailed Requirements for ECHONET Device Objects Appendix in [b-ECHONET Lite]
ETSI	NGSI-LD	NGSI-LD Information model [b-ETSI NGSI-LD]
IEC	IEC 61970 series	IEC61970 CIM (Common Information Model) / Energy Management [b-IEC 61970]
ITU-T	ITU-T Y.4500 series	ITU-T Y.4500.23 (Home Appliances Information model and Mapping) [b-ITU-T Y.4500.23]
KNX	KNX	Application Description [b-KNX AD]
Open Connectivity Foundation	OIC Core	OIC Core Smart Home [b-OCF OIC Core]
OMA SpecWorks	LwM2M	Smart Objects [b-OMA SO]
OMA SpecWorks	NGSI	NGSI Information model [b-OMA NGSI]
W3C	WoT	WoT Thing Description [b-W3C WoT TD]
ZigBee Alliance	ZigBee PRO, ZigBee IP	ZigBee Cluster Library [b-ZigBee CL]

Y.4409 example with WoT



Example: ECOHNET connects to WoT



Example: WoT device connect to NSGI