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Smart city implementations with Web of Things

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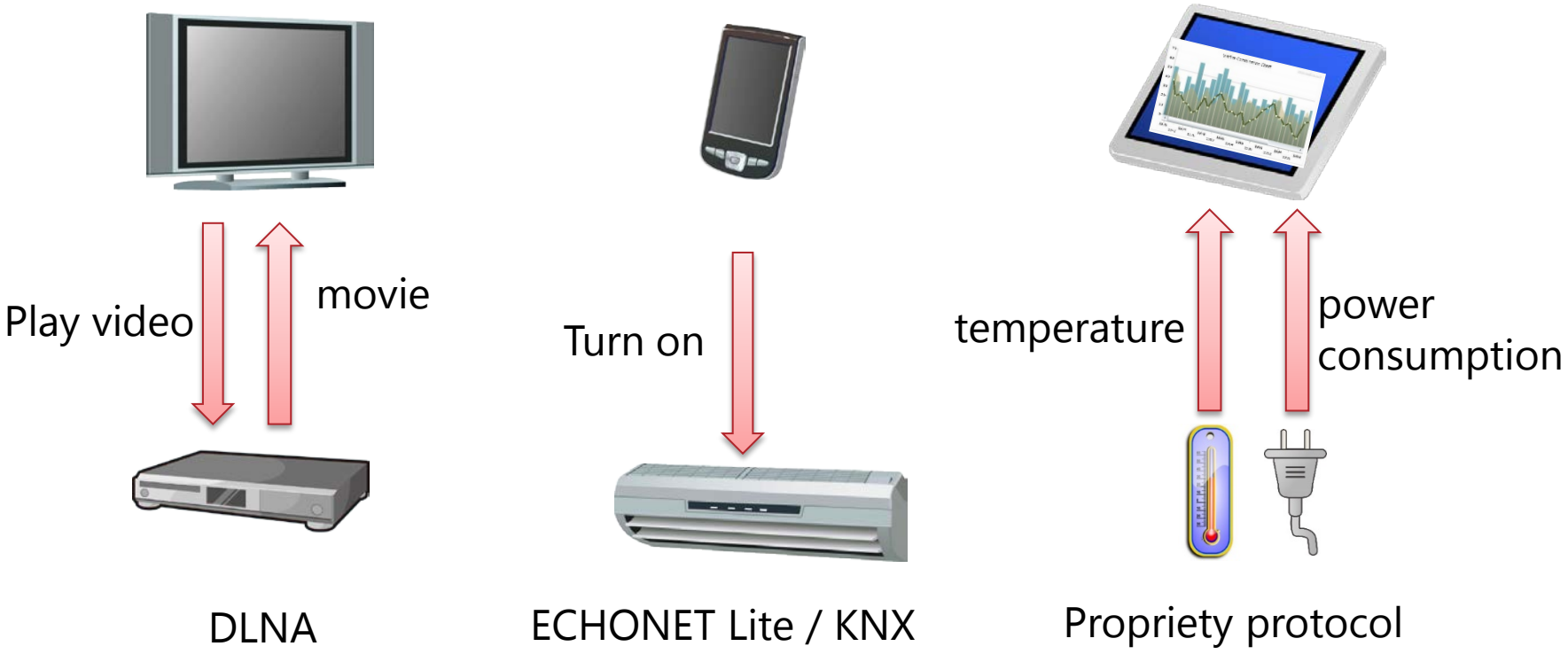
Smart city applications by Fujitsu

- Smart city applications can observe
  - infrastructure such as rivers, manholes, roads and transportation
  - facilities such as factories and shops
  - behavior such as workers, children and pets

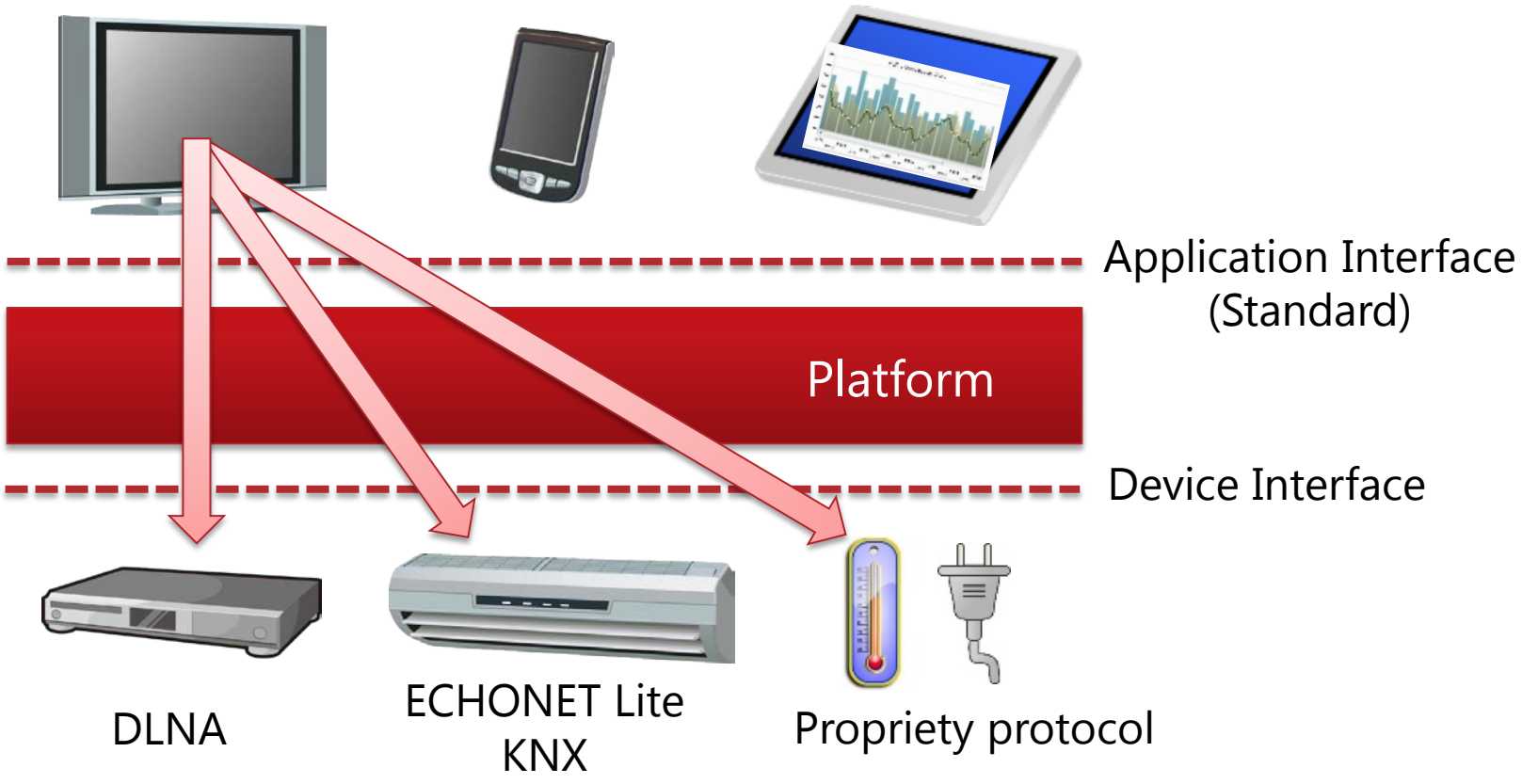
How can devices connect and work?

- Each device is connected with individual protocol for each purpose.
  - DLNA: connects TV set and video recorder
  - ECHONET Lite/KNX: connects smart phone and home appliances
  - Propriety protocol: connects devices do NOT support standard



Issues on device connection

- Users want to use several applications by one device
- Need to introduce **Platform** should support
  - Wide variety of device interfaces / protocols
  - Keeping devices connections stable in area network



Wide variety of device interfaces

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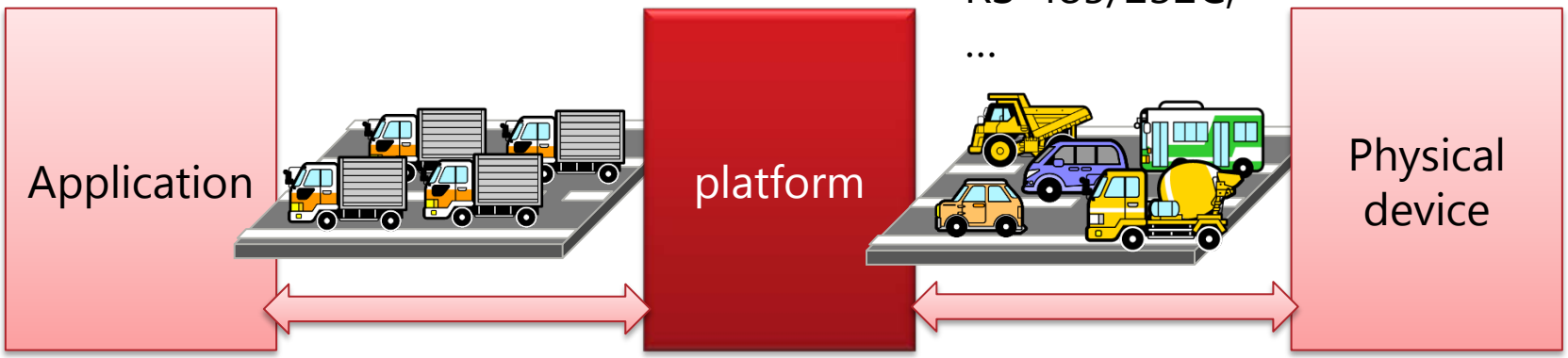
- Platform must absorb interface gap between devices and applications
  - Device interfaces have many transport protocol and data formats
  - Application interface is Web interface, so simple for developers



Web developers: 710,000

Embedded developers: 3,800

(LinkedIn profiles, 2016)

Web based operation to devices

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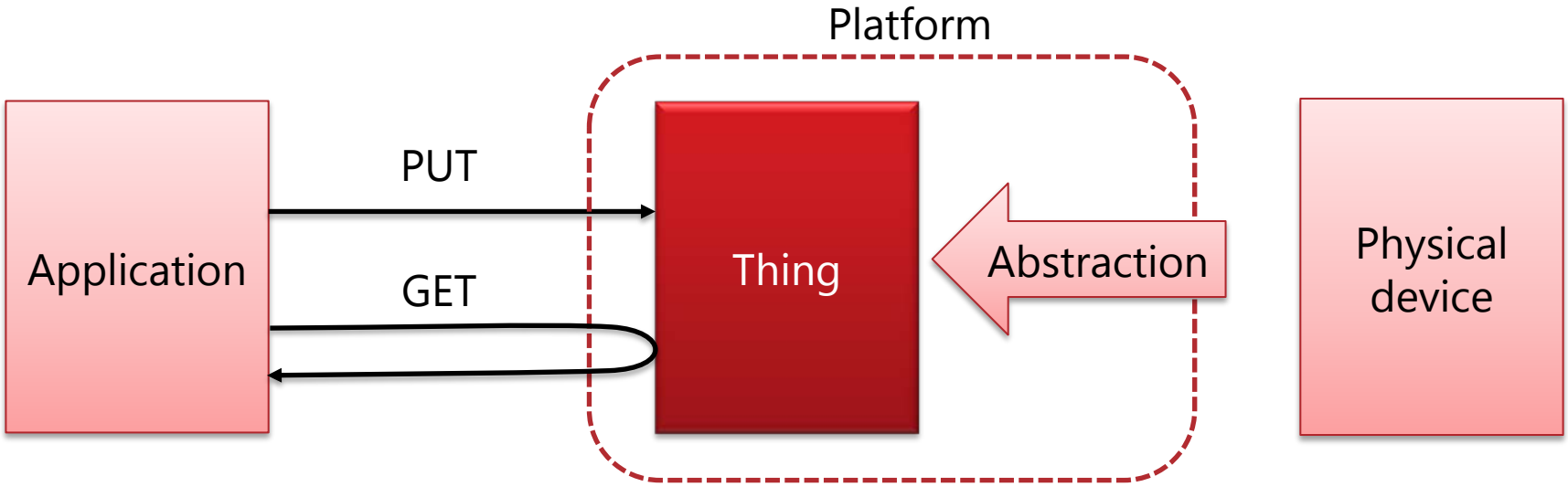
- Web technologies have impact on application developers
  - Operation is so simple for IoT applications to control devices.
  - Application
    - sets values to Thing with PUT method of HTTP
    - gets values from Thing with GET method of HTTP



The Functions of Thing are described with JSON/XML.
The application can operate abstract device represented with JSON/XML.

Standard architecture (ITU-T Y.2070)

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Y.2070: Requirements and architecture of home energy management system and home network services

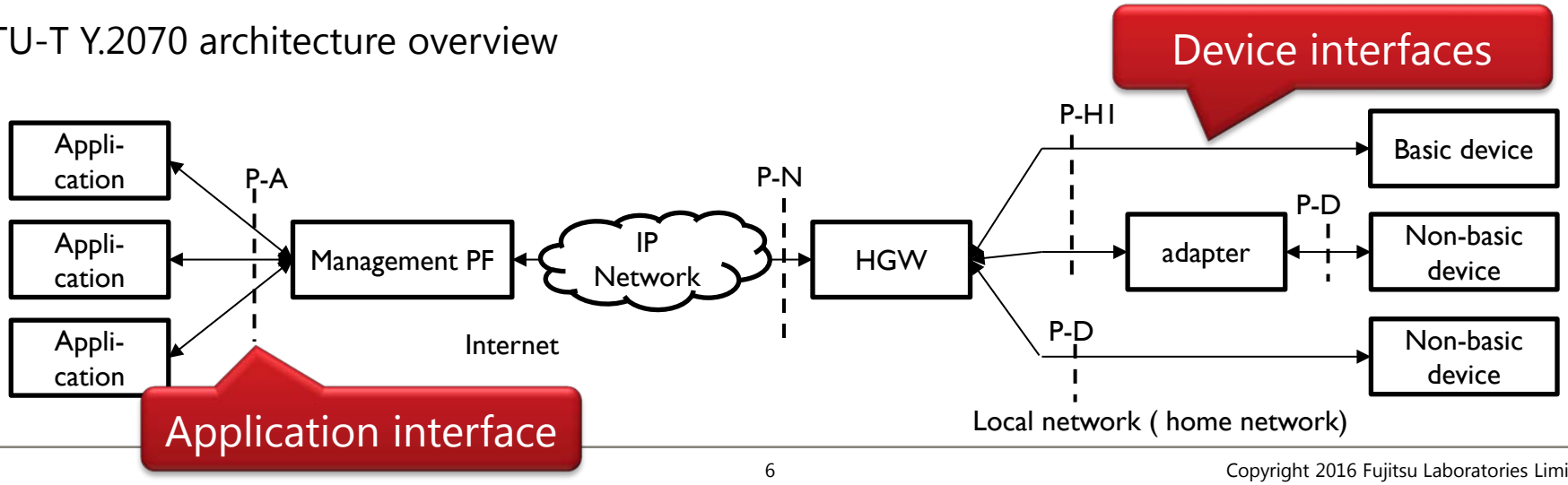
Overview

- Architecture to monitor and control devices connected in local network through gateway from cloud
- This architecture simplified to 3 ways for connection between gateway and devices in area networks

Features

- Common application interface for operation to various devices
- Cover various interfaces of devices with simple ways
- Easy to detect problems happened in area networks

ITU-T Y.2070 architecture overview



Sample applications for Y.2070

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- 27 facilities with 28 kinds of 810 devices

Sample application for home

Service provider

Internet

Sample application for school

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 protocol**

Shops (Gas station)

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

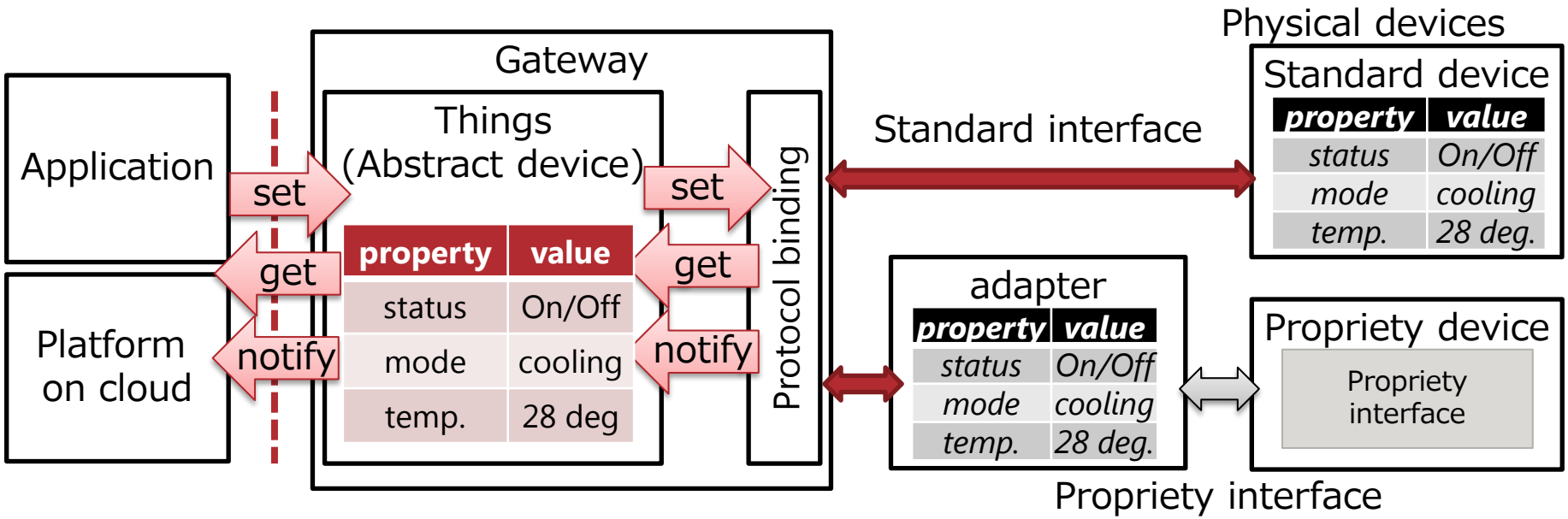
Schools

40 devices connected in 5 schools
Lighting, 5 kinds of sensors with **propriety protocol**

This project was funded by the Japanese Ministry of Internal Affairs and Communications.

Web of Things (WoT)

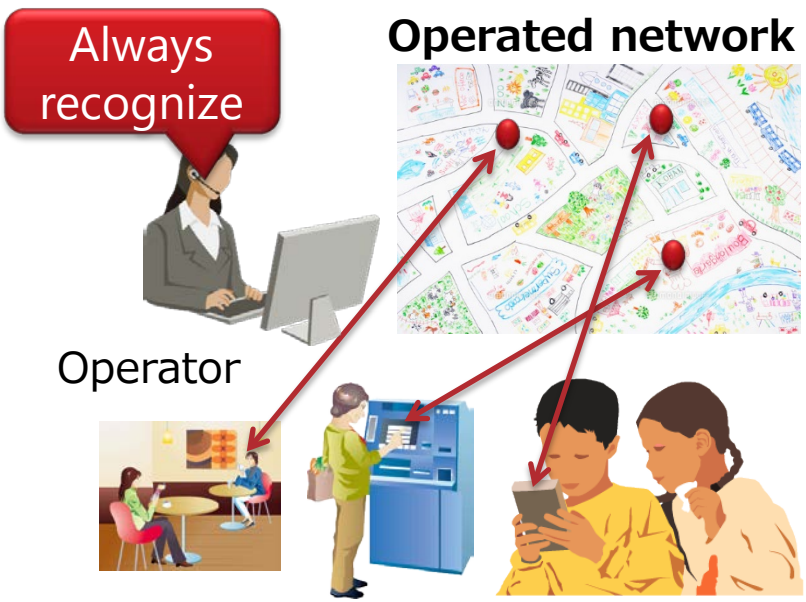
- Detail specification for device abstraction and operation is discussed in W3C Web of Things Interest Group.
  - Physical devices are described as a set of properties in abstract.
  - Each property corresponds to the functions of physical devices
- Initial recommendation will be completed in 2018
  - Siemens, Panasonic, Intel, Fujitsu, and many companies joined.

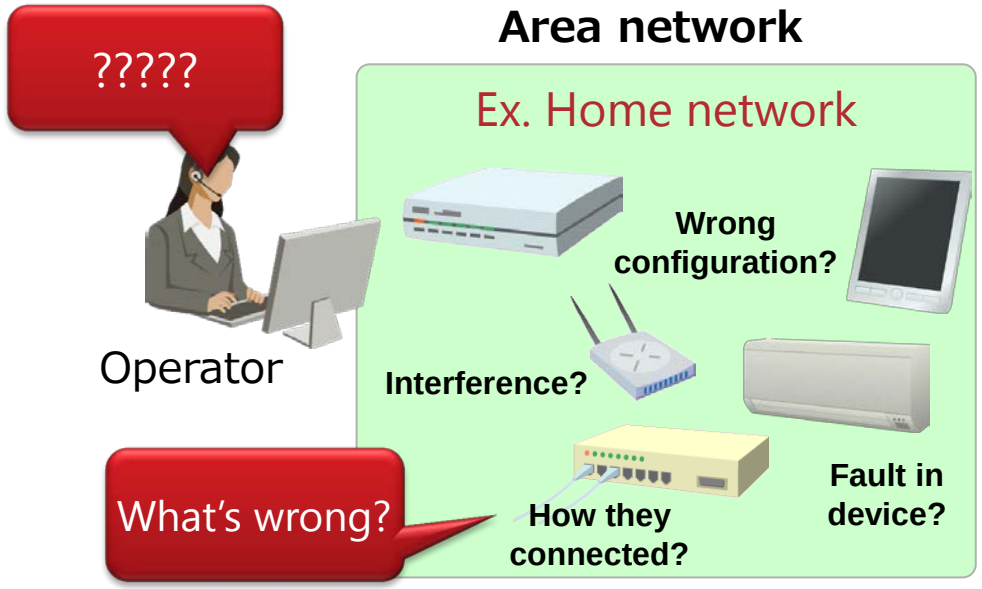


Some standard of device interfaces are based on this idea.

Keeping device connection stable

- Operated networks (ex. LTE) **CAN** remotely recognize
  - places to use with terminals.
  - the current status, such that each of them cannot accept the call.
- Area network **CANNOT** remotely recognize
  - places to use with IoT devices.
  - topology of networks and connected devices.
  - fault occurring in networks and devices.



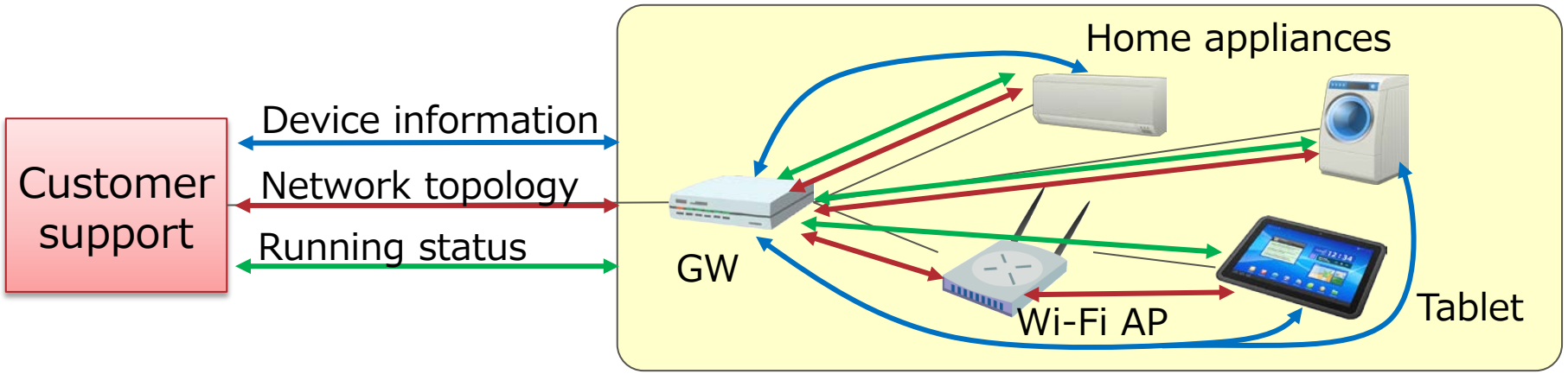


Management for area network

- Customer supports want to know

  (1) devices connected (2) network topology, and (3) fault occurred
- Obtain what devices connected to network are
  - Get it directly using standard protocols such as DLNA, ECHONET Lite, UPnP, …
- Recognize current network topology frequently changed
  - Collect information of neighbor devices using standard protocol.

  EX. ITU-T G.9973
- Detect fault occurred and identify where it did
  - Get running status of networks and devices and analyze them



Running status on wireless networks

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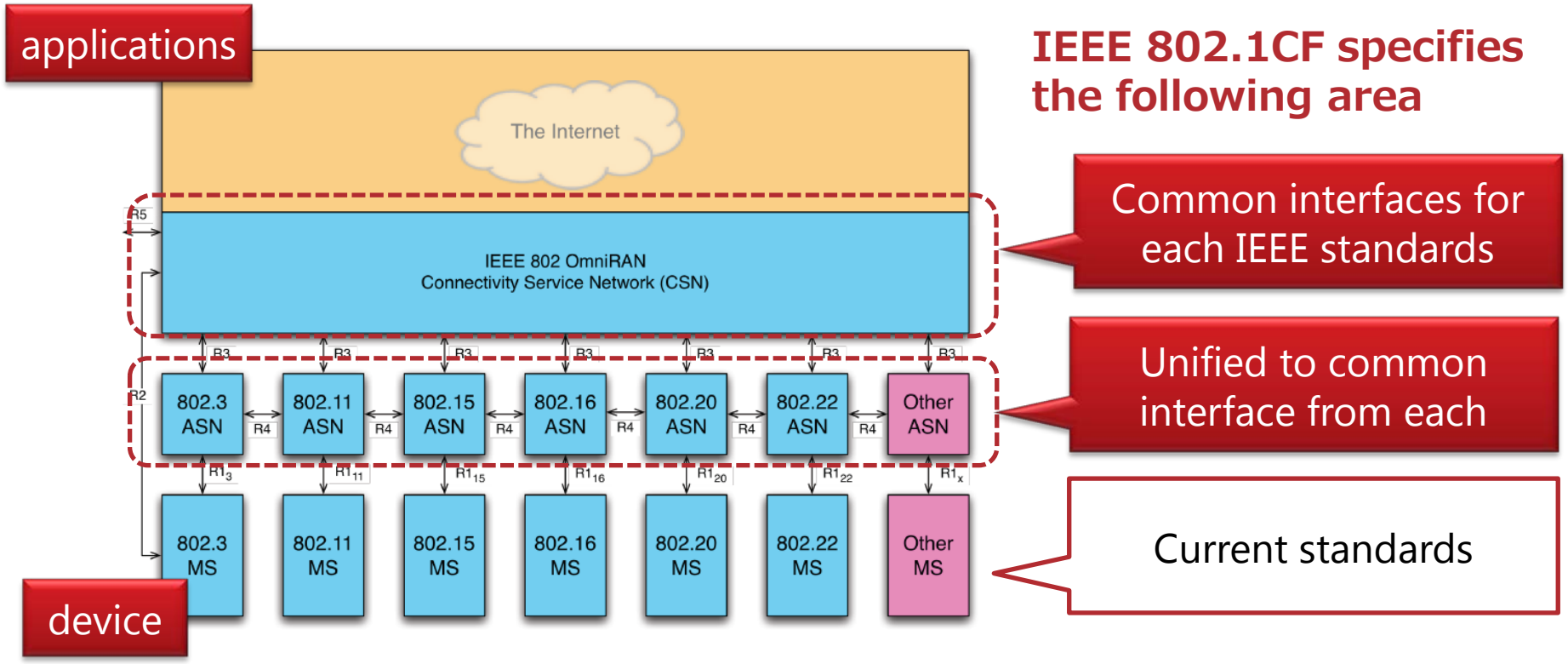
- Many devices connected with family of IEEE standards, however most of them do NOT notice their status.
  - Difficult to know troubles occurred in area networks.
  - IEEE 802.1CF specifies common interfaces for each IEEE standards should have.



Conclusion and Next step

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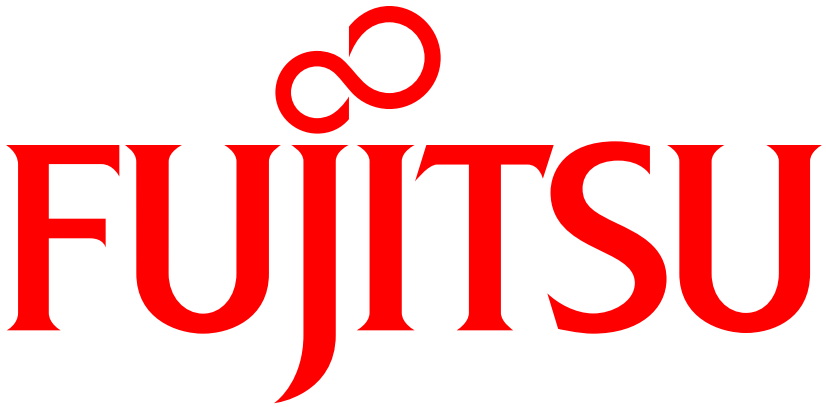
- These standards do NOT intend to dictate every system
  - They provide just framework for Web of Things.
  - Concrete definitions of vocabulary for properties should be specified in some organizations.
- Smart city/IoT business has two aspects of cooperative and competitive.
  - Standard is one of starting points for cooperative works.
- Fujitsu supports customers to setup and operate smart city applications and systems including IoT devices.
  - SSPF: Software for device abstraction and management had been launched in 2011, compatible to Y.2070.
  - IoT platform: Cloud service for IoT applications had started in 2015.
  - We continue to support Web of Things related standardization to build up ecosystem with partners.

Thank you for your attention.



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