2nd Web of Things Workshop

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A WoT Gateway with device virtualization

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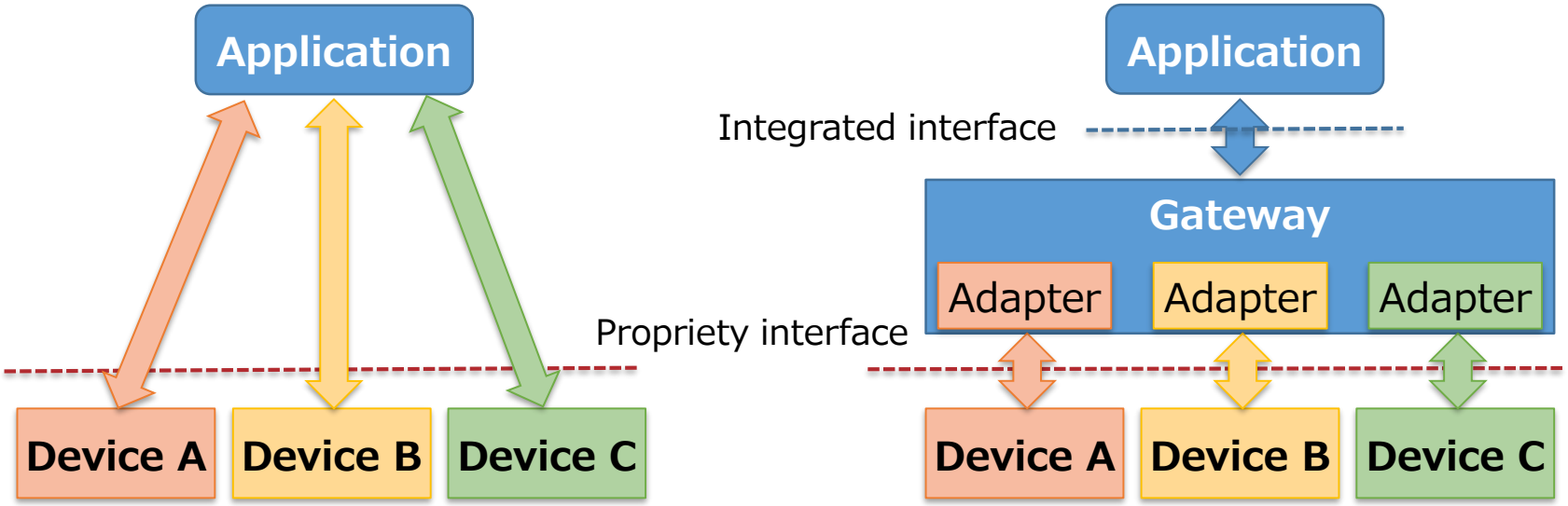
Background

- Various kinds of devices are connected to network.
  - Required accessible from cloud to establish digital transformation.
- Different device interfaces for different fields.
  - Developers need an integrated interface to easily handle many devices at the same time.



Developers are required:

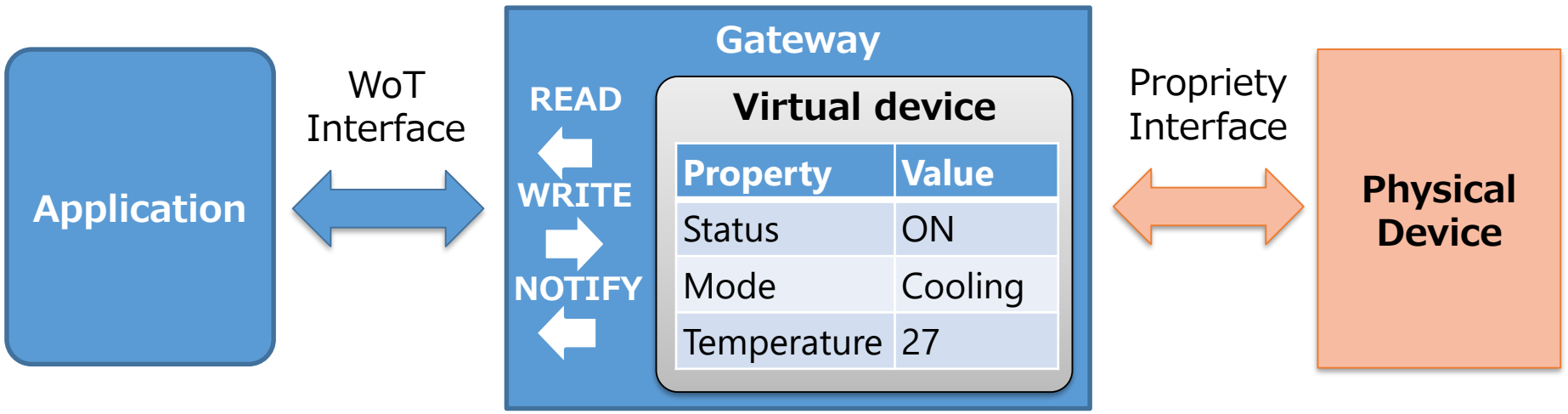
A lot of knowledge of how to operate various interfaces

Only one interface like WoT

Device virtualization on Gateway

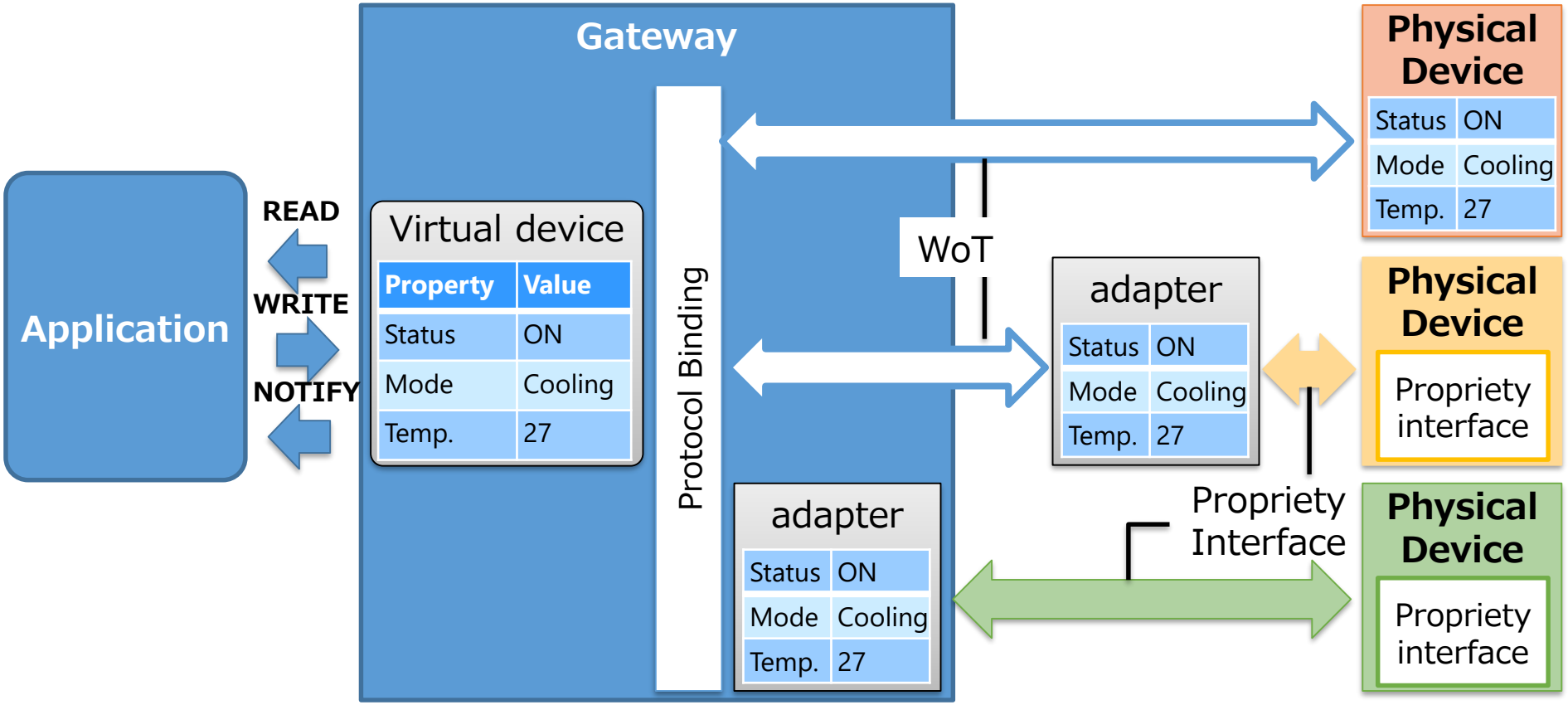
- WoT framework
  - Thing Description: JSON based Information model
  - Handle the properties of the devices to operate physical devices

    READ, WRITE(ACTION), NOTIFY(EVENT)
- How to bring physical devices into the WoT framework
  - Create virtual devices from physical devices using with propriety interfaces



Reducing connection complexity

- Most of devices have a similar structure to TD
  - Properties are described in many ways, like JSON, XML, CSV, etc.
  - Adapters convert description formats and operation protocols



Easy development of adapters

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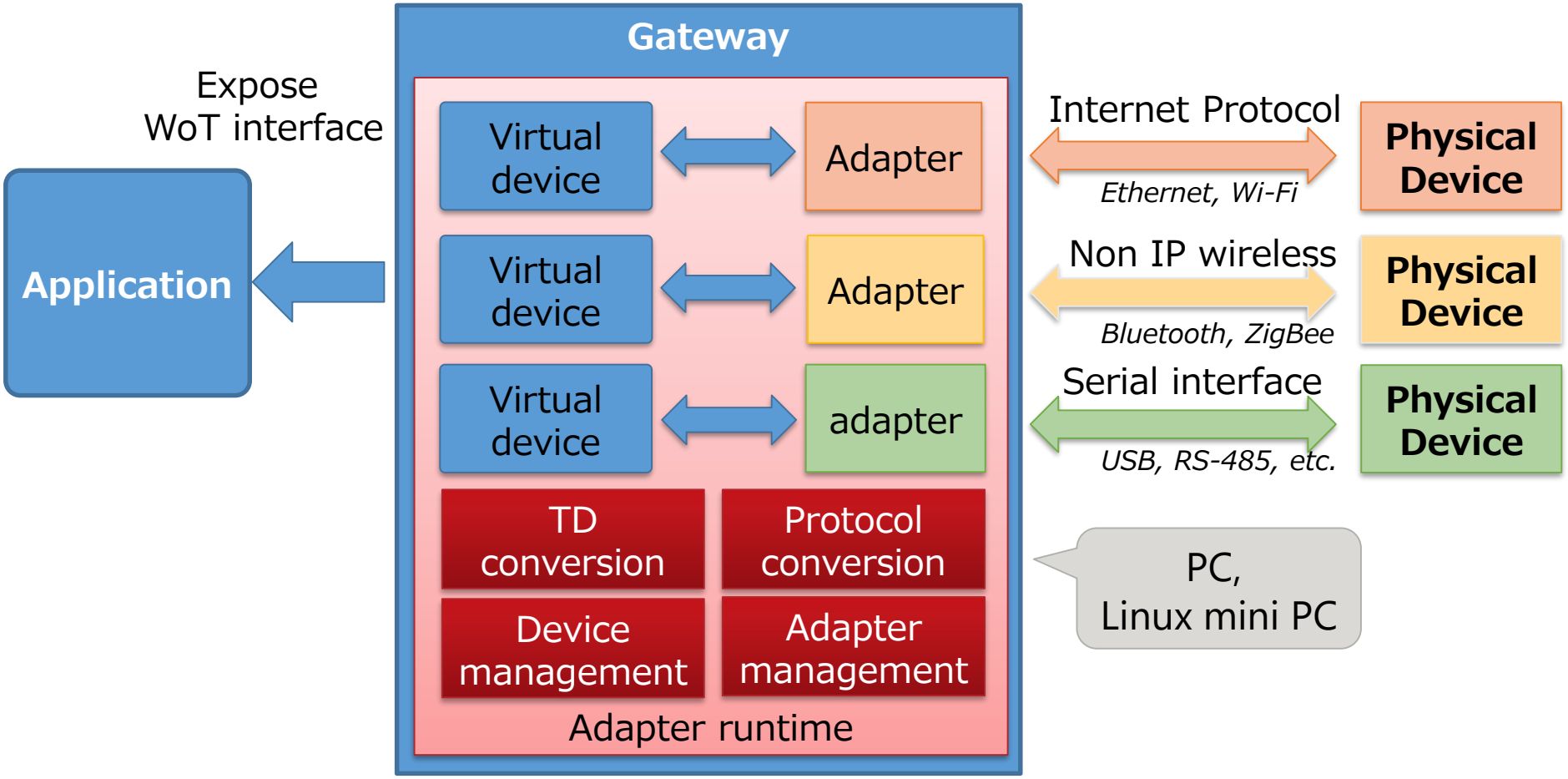
- Some customizations are required for device connectivity
  - No device is compatible to Web of Things now.
  - Gateways need to provide a develop environment of adapters.



Deployment scenario

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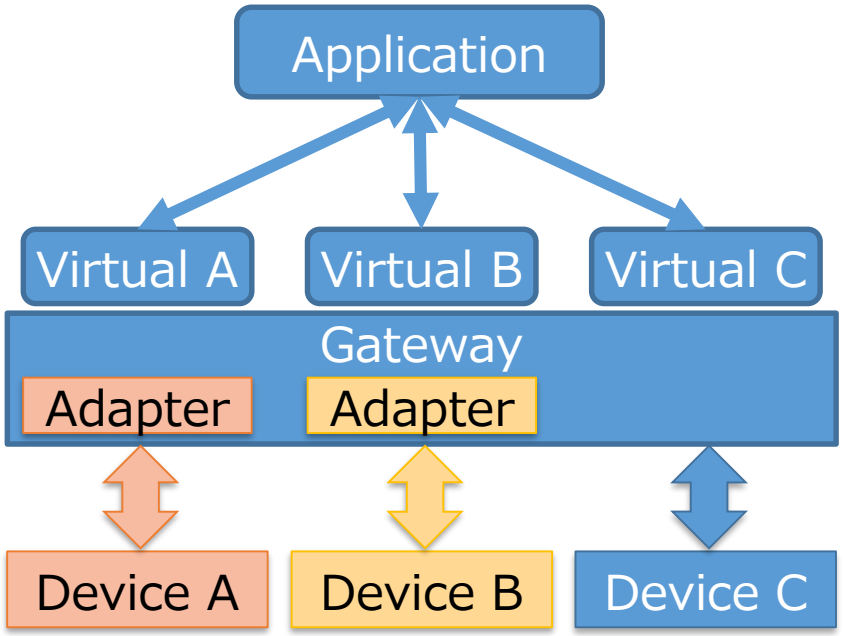
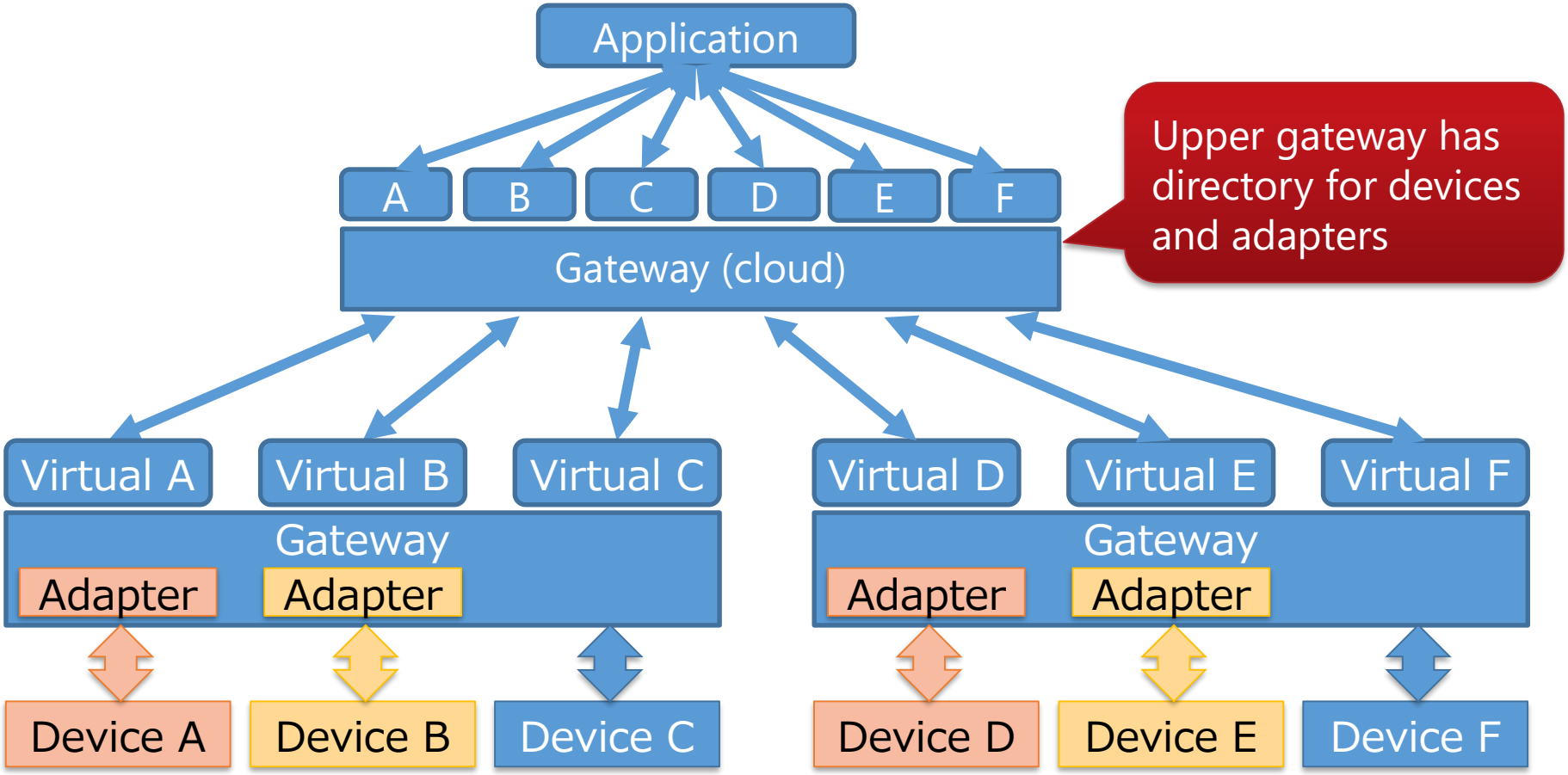
- Simplest scenario
  - Physical devices connect the gateway with propriety interfaces
  - Gateway creates WoT virtual devices and exposes to applications



Device A & B: Non WoT devices　　Device C: WoT device

Multi-layered gateways

- Large scale system requires multi-layered gateways
  - Mainly lower gateway connects devices, upper gateway aggregates lower gateways



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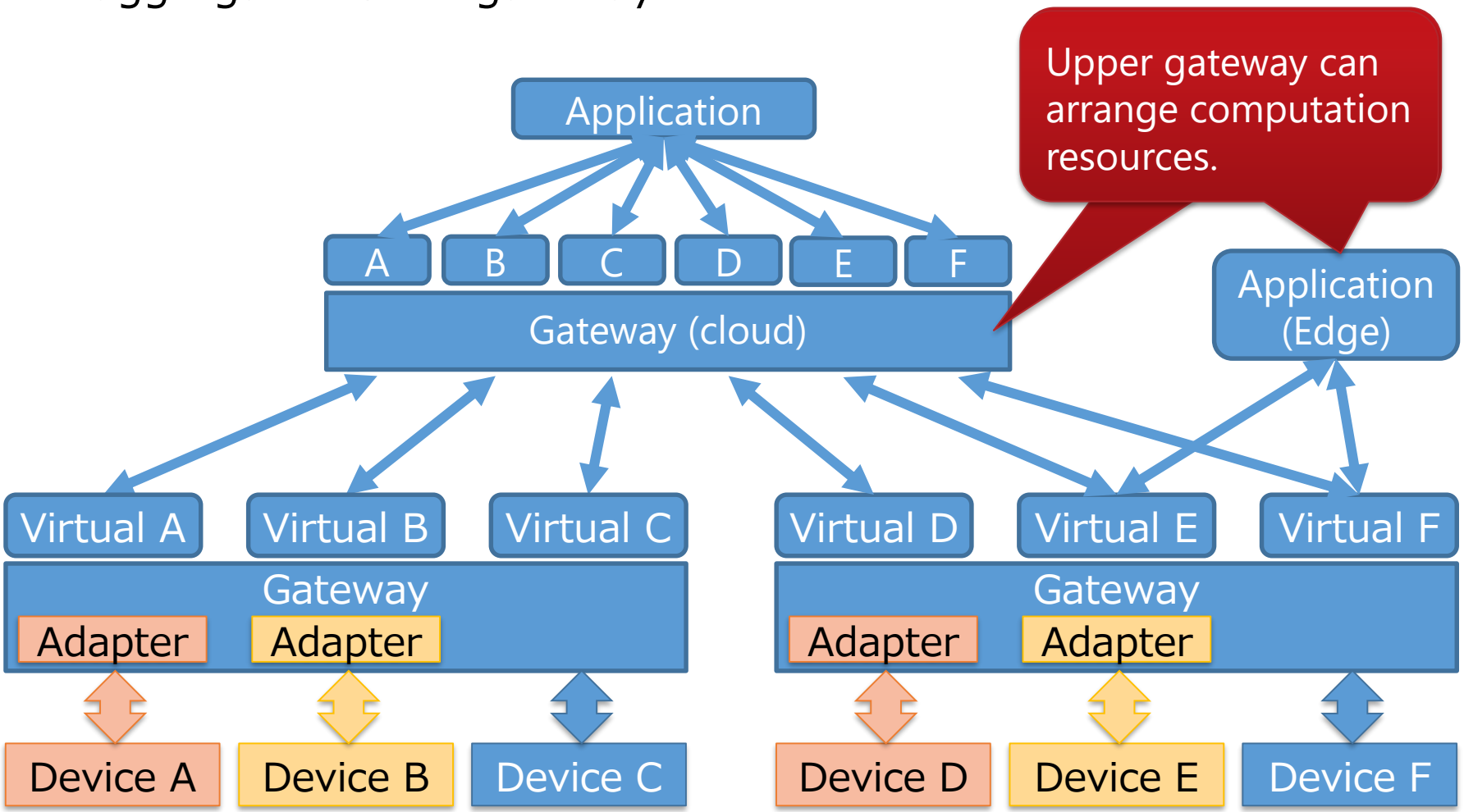

Experimental fields for our gateways

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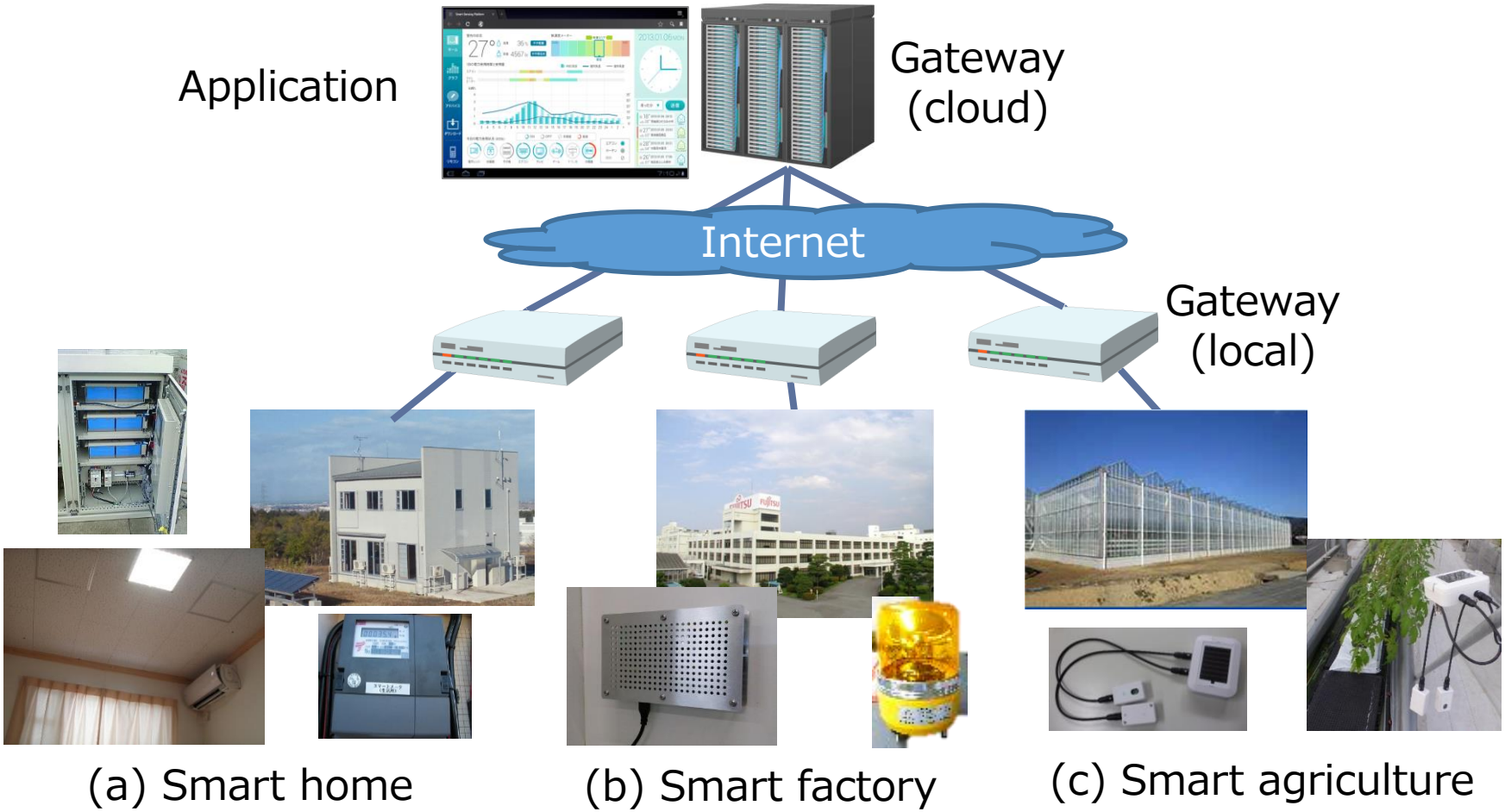
- Over 1,400 devices are connected in 3 kinds of fields.
  - Smart home, Smart factory, and Smart Agriculture



This project is supported by Ministry of Internal Affairs and Communications.

Device platforms for easy adaption

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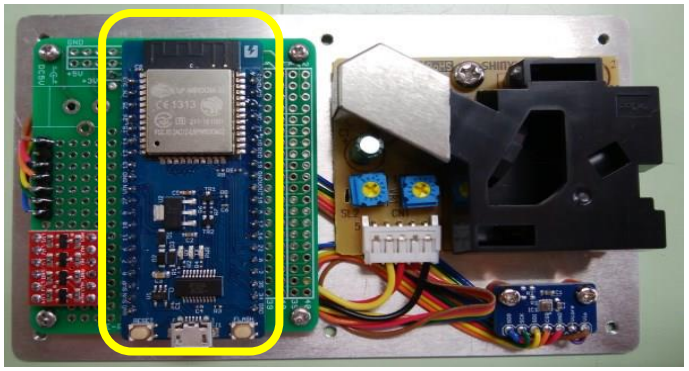
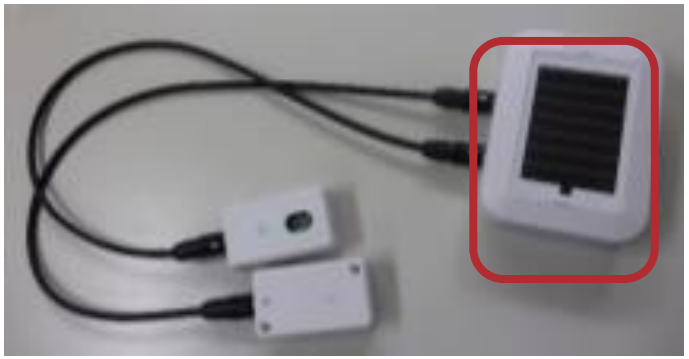
- Two platforms for newly setting up WoT-friendly devices
  - **IP-based** communication module with WoT stack



Wi-Fi communication module with WoT interface stack.

e.g. ESP32 (Espressif systems) has general interfaces like I2C to connect sensor or actuator modules.

  - **Non IP-based** communication module and its gateway adapter

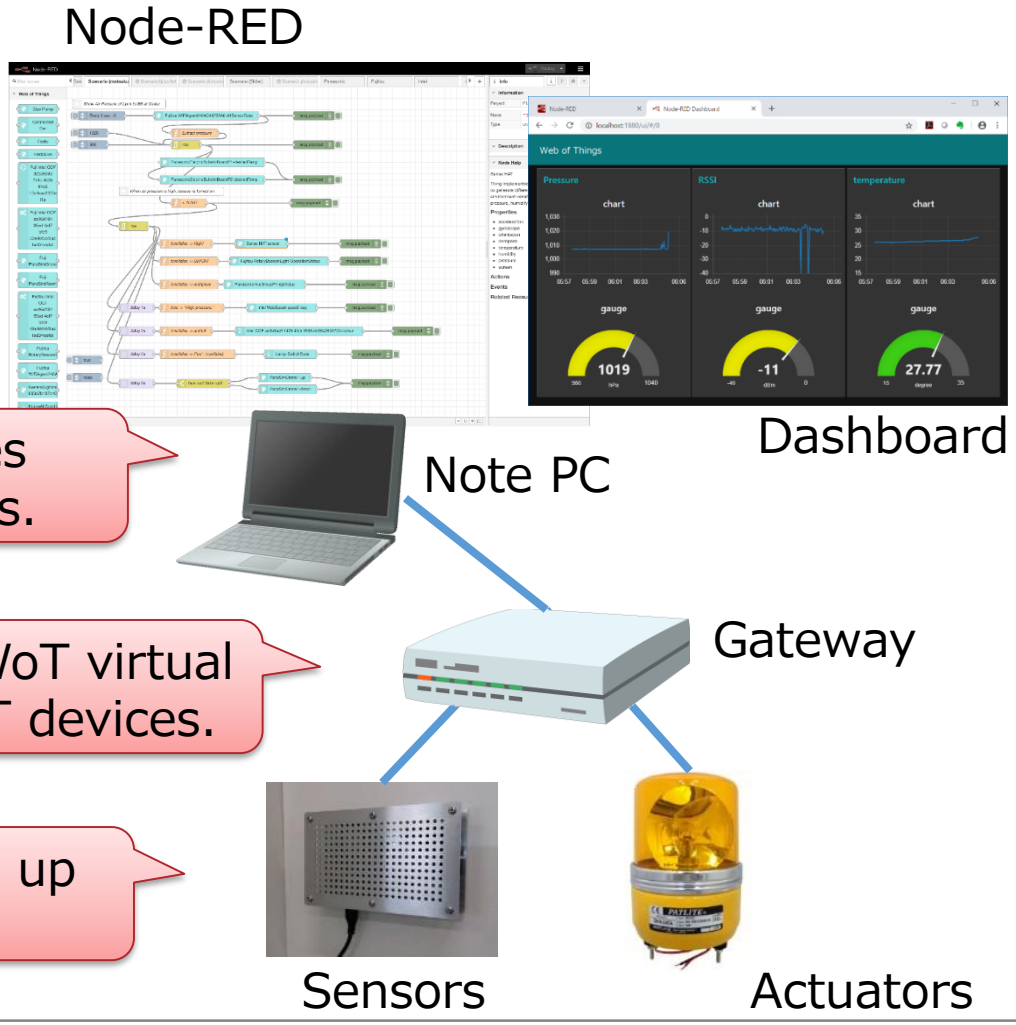


BLE communication modules supporting compact message formats

e.g. BLE module has middleware to send some properties packed within 20 bytes. The module equipped with solar panel and capacitor to keep working for 24 hours

Toward zero configuration

- Integration from devices to applications enables to build up a entire system with zero configuration.



Conclusion and future works for WoT

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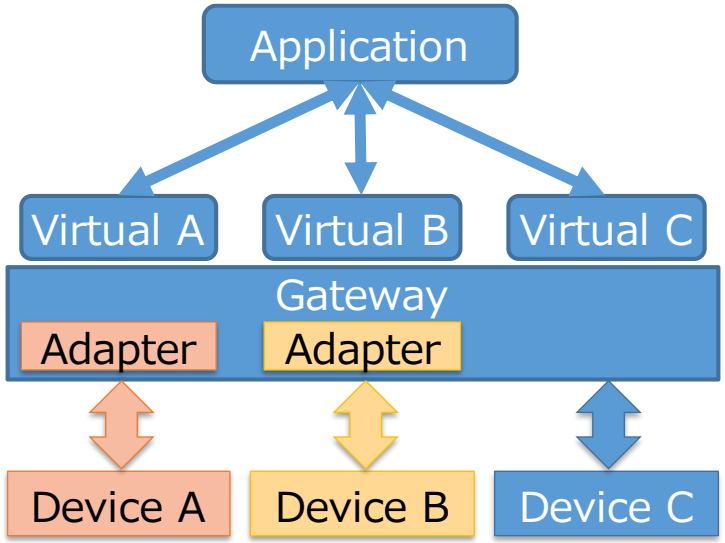
- Our gateways support WoT specifications and expand some features for enhancement.
  - Adaptation framework for non-WoT devices.
  - Exposing integrated interface with virtual devices.
  - Supporting multi-layered gateways for large scale systems.
  - Device management including life cycle management
  - Device platform for setting up WoT friendly devices.



Contact

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Describing Legacy Data in Thing Description

Takuki Kamiya, Ryuichi Matsukura (Fujitsu)

6/4/2019

IoT Integration – WoT's Approach

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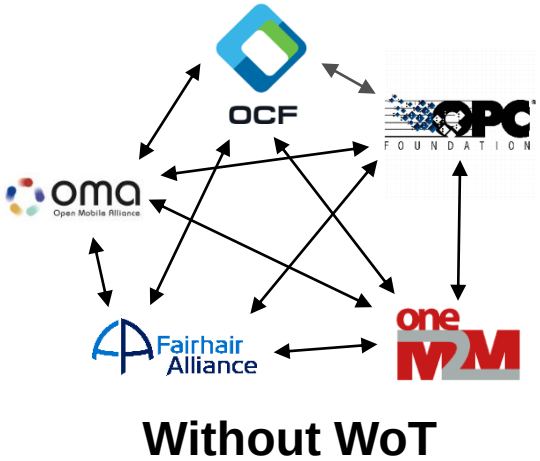
- WoT (Web of Things) is not yet another IoT standard.
  - There are no shortage of IoT standards each building a peculiar eco-system.
- WoT aims to serve as a common description layer above all the IoT eco-systems.
  - WoT shares the Web's nature of common platform
- Recent publication of W3C WoT documents (i.e. Thing Description and Architecture) is the first step towards the goal.
  - TD (Thing Description) is the center piece of WoT architecture.



WoT Thing Description (TD) Constructs

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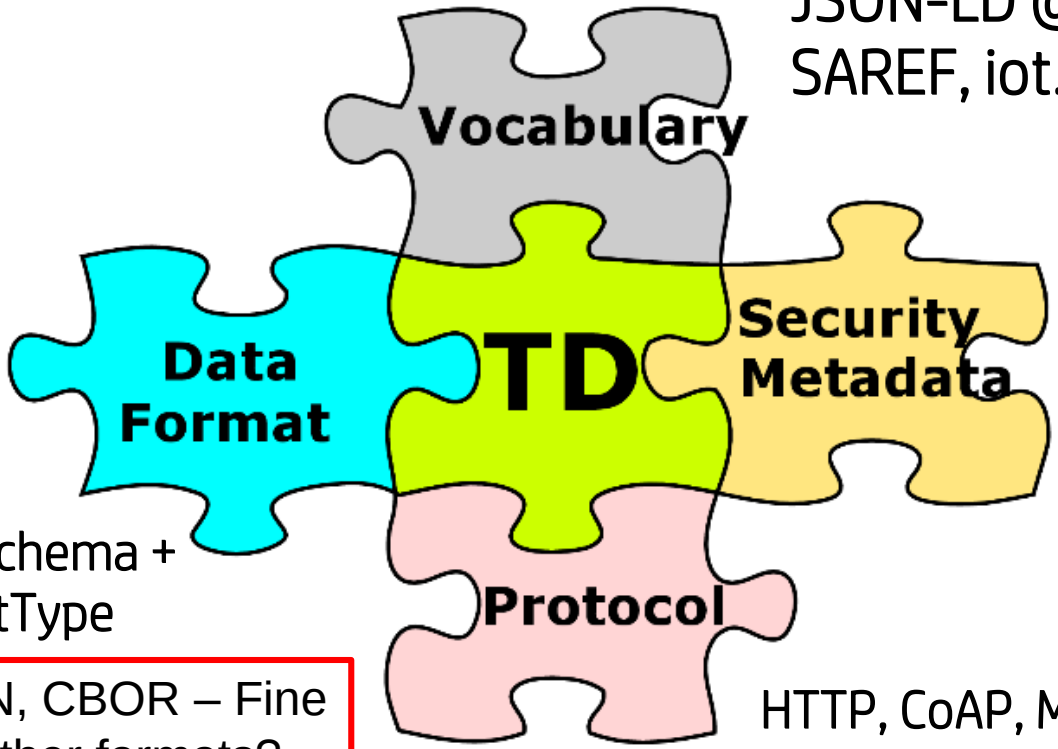


JSON-LD @context
SAREF, iot.schema.org, etc.

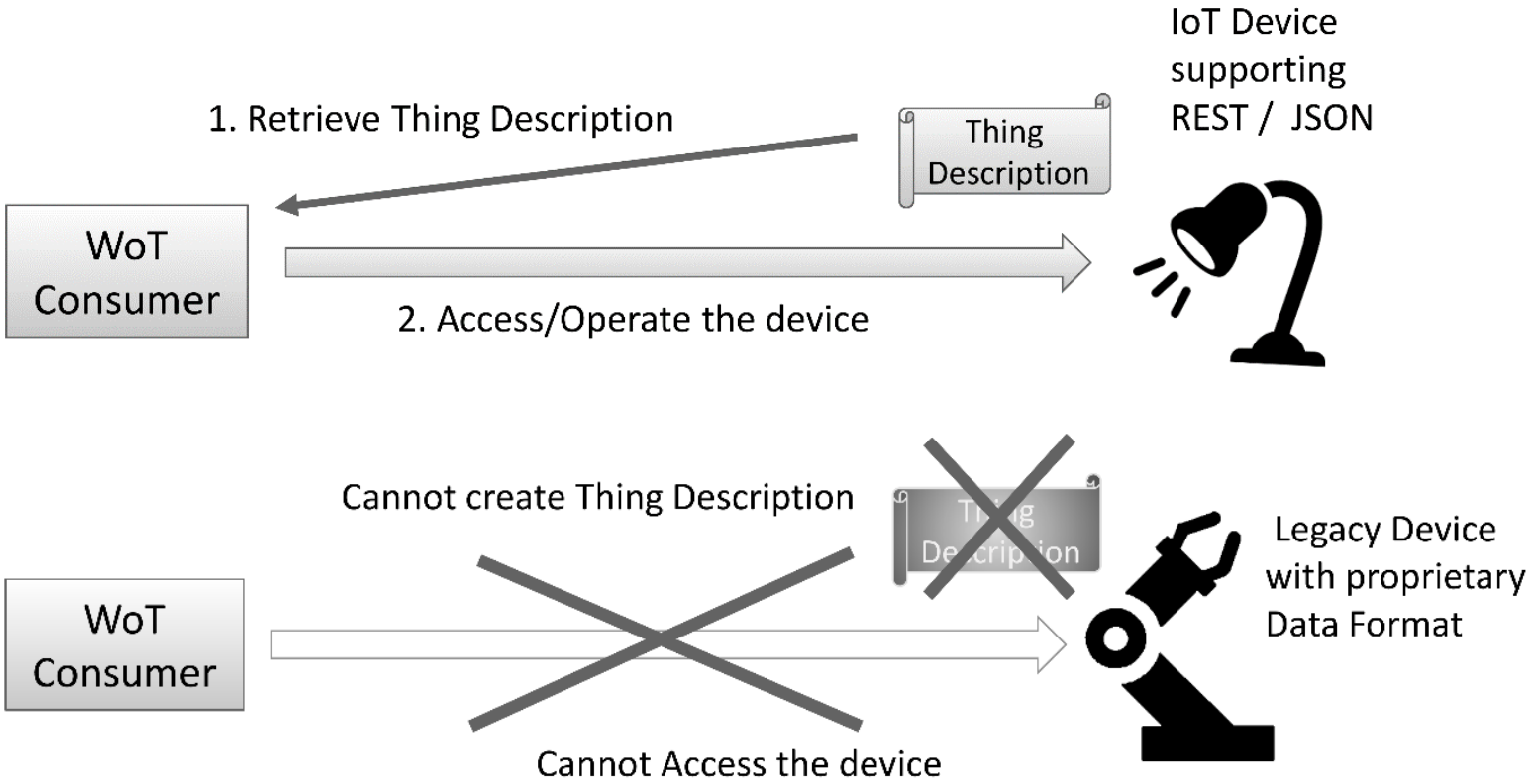
Bearer Authentication,
Basic Authentication,
etc.

JSON Schema +
contentType

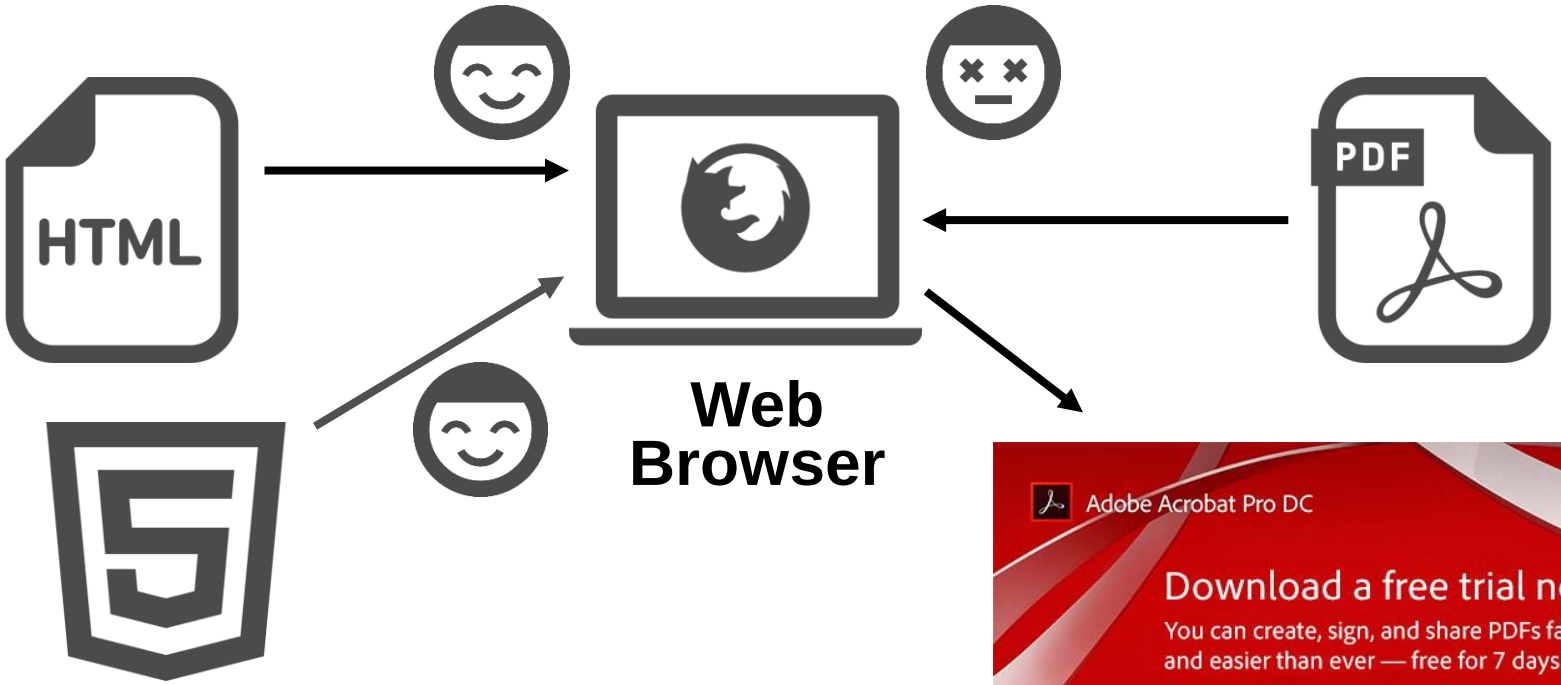
JSON, CBOR – Fine
But other formats?

HTTP, CoAP, MQTT, etc.

Limited Data Format Support of Thing Description



Similar Experience on the Web



CSV (Comma-separated values) Data

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- One of the most popular formats for publishing data on the Web.
  - In particular, the most popular format used in Open Data.

20,	Hello	5\n
99,	Welcome to	10\n
10,	the World!	3\n

Example CSV data

- Native support for CSV in Thing Description
  - Dramatically broaden WoT's ability to describe data on the Web.
  - Provides an uniform way to provide semantic annotation for JSON and CSV.

Native Type Annotation for CSV

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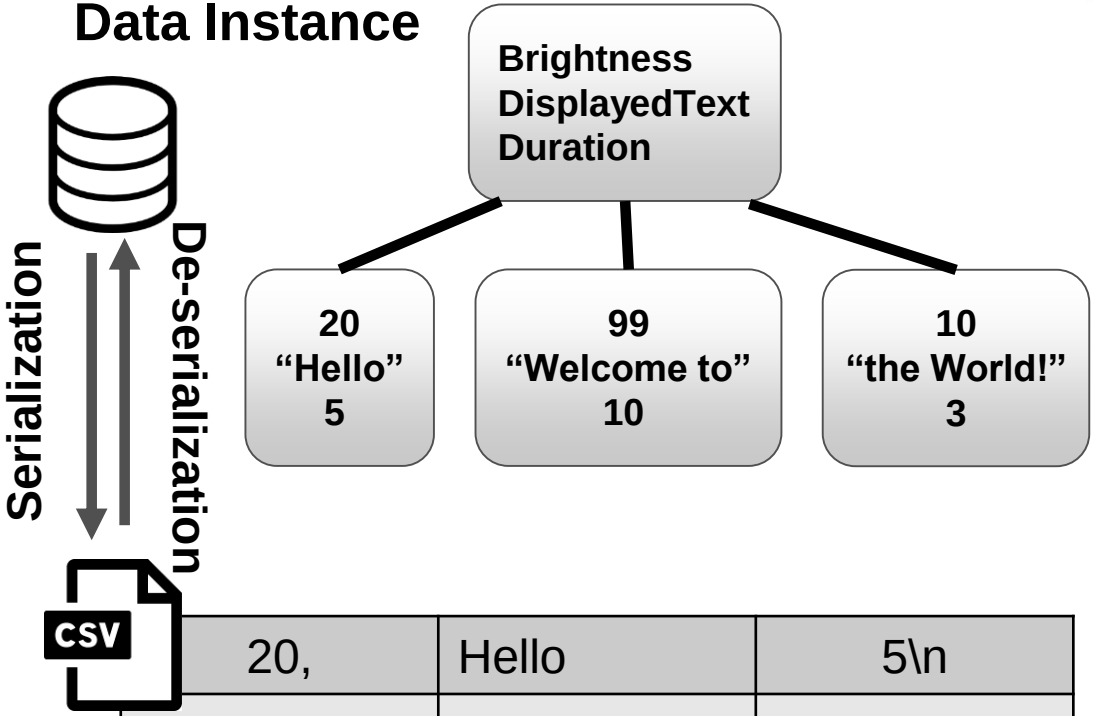
JSON Schema with Native Type annotation

```
{
  "type": "array",
  "items": {
    "type": "object",
    "properties": {
       “Brightness": { "type": "number“ },
       “DisplayedText": { "type": "string"  },
       “Duration": { "type": "integer“ }
    }
    "nativeType": {
       "endDelim": "\n",
       "childEndDelim": ","
    }
  }
}
```

Data Instance



20,	Hello	5\n
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TLV (Type-Length-Value) Data

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- TLV – Notably ASN.1 is used virtually everywhere
  - 4G/5G, Aerospace and Satellite communication, to Intelligent Transportation, Smart Grid, Healthcare, ASN.1 continues to be the foundation.
  - You can't live a day without using ASN.1
  - Native support for ASN.1 (DER encoding in particular) in Thing Description
    - Dramatically broaden WoT's ability to describe existing M2M data.
    - Provides an uniform way to provide semantic annotation for JSON and CSV.

```
FooQuestion ::= SEQUENCE {
    trackingNumber     5,
    question           "Anybody there?“
}
```

Protocol Data Unit (PDU)

```
30 — type tag indicating SEQUENCE
13 — length in octets of value that follows
  02 — type tag indicating INTEGER
  01 — length in octets of value
    05 — value (5)
  16 — type tag indicating IA5String
  0e — length in octets of value
    41 6e 79 62 6f 64 79
    20 74 68 65 72 65 3f — value
```

DER representation

- DER is self-contained.
- Support in TD should be straight-forward.

Call for Making WoT more Versatile

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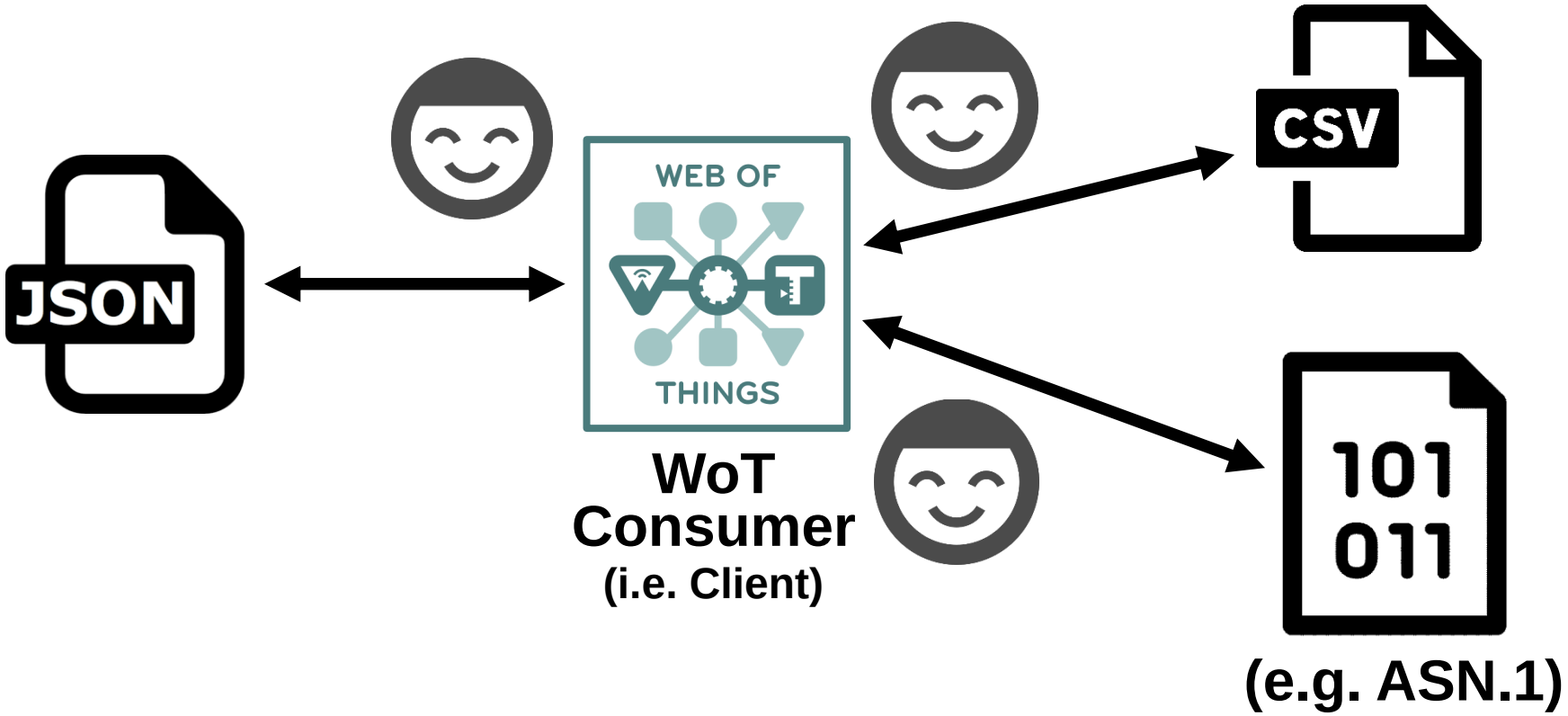

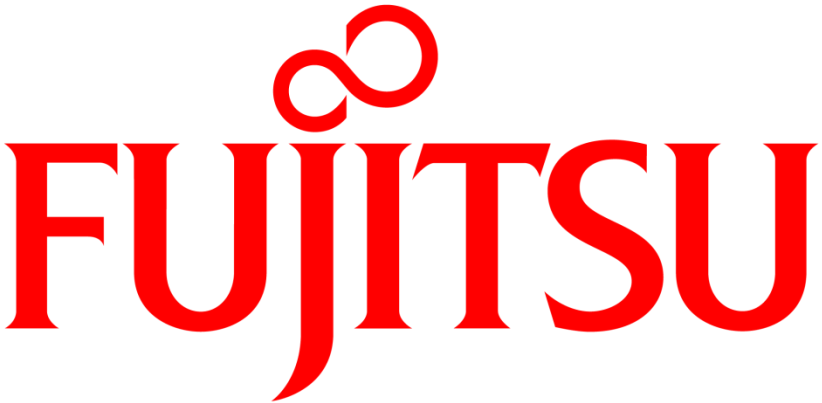

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