



TPAC 2019, Sept 2019

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# W3C Web of Things



## *Goal: Support IoT Interoperability via Open Standards*

- **W3C WoT Interest Group (IG)**

<https://www.w3.org/2016/07/wot-ig-charter.html>

- Started spring 2015
- ~200 participants
- Informal work and outreach
- “PlugFest” validation with running code
- Exploration of new building blocks
- “OpenDays” with external speakers
- Liaisons and collaborations with other organizations and SDOs
- *Second Workshop on Web of Things held 3-5 June 2019 in Munich*
- *Charter renewal submitted Sept 2019*

- **W3C WoT Working Group (WG)**

<https://www.w3.org/2016/12/wot-wg-2016.html>

- Started end of 2016 (effectively Feb 2017)
- ~100 participants
- Normative work on specific deliverables
- W3C Patent Policy for royalty-free standards
- Only W3C Members and Invited Experts
- *Architecture and Thing Description were published as Candidate Recommendations on 16 May 2019*
- *Notes published on Protocol Bindings, Security, and Scripting API*
- *Charter renewal in progress; work items and deliverables under discussion*

# W3C Web of Things – Building Blocks

## WoT Architecture

Overarching umbrella with architectural constraints and guidance on how to use and combine building blocks.

### WoT Thing Description (TD)

**JSON-LD** representation format to describe Thing *instances* with **metadata**. Uses **formal interaction model** and **domain-specific vocabularies** to uniformly describe how to use Things, which enables semantic interoperability.

The *index.html* for Things

Properties

Events

Actions

WoT Thing Description

### Security Guidelines

Thing

Behavior

Interaction Affordances

Data Schemas

Security Configuration

Protocol Binding(s)

HTTP  
MQTT ... CoAP

### WoT Scripting API

Standardized **JavaScript** object API for an IoT runtime system **similar to the Web browser**. Provides an interface between applications and Things to simplify IoT application development and enable **portable apps** across vendors, devices, edge, and cloud.

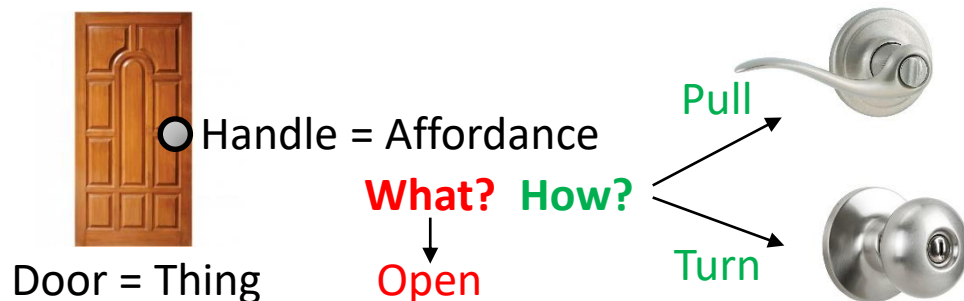
### WoT Binding Templates

Capture how the **formal Interaction Model** is mapped to concrete protocol operations (e.g., CoAP) and platform features (e.g., OCF). These templates are re-used by concrete TDs.

# Published Candidate Recommendations

## • WoT Architecture

- Constraints
  - Things must have TD (W3C WoT)
  - Must use hypermedia controls (general WoT)
    - URIs
    - Standard set of methods
    - Media Types
- Interaction Affordances
  - Metadata of a Thing that shows and describes the possible choices (**what**) to Consumers, thereby suggesting **how** Consumers may interact with the Thing



## • WoT Thing Description (TD)

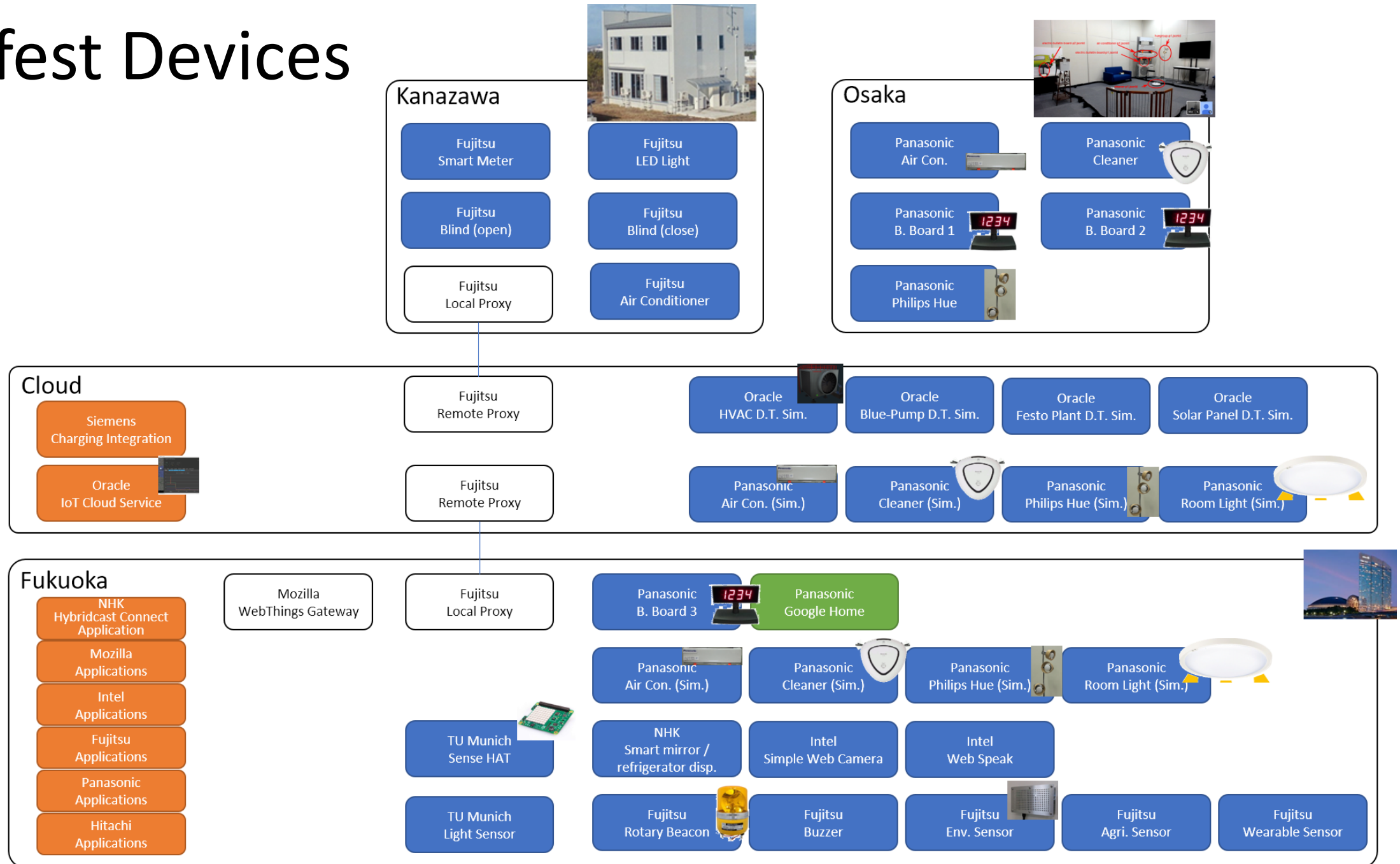
```
{
  "@context": [
    "https://www.w3.org/2019/wot/td/v1",
    { "iot": "http://iotschema.org/" }
  ],
  "id": "urn:dev:org:32473:1234567890",
  "title": "MyLEDThing",
  "description": "RGB LED torchiere",
  "@type": ["Thing", "iot:Light"],
  "securityDefinitions": [{"default": {
    "scheme": "bearer"
  }
}],
  "security": ["default"],
  "properties": {
    "brightness": {
      "@type": ["iot:Brightness"],
      "type": "integer",
      "minimum": 0,
      "maximum": 100,
      "forms": [ ... ]
    }
  },
  "actions": {
    "fadeIn": {
      ...
    }
  }
}
```



# Plugfest, Use Cases, and Demos

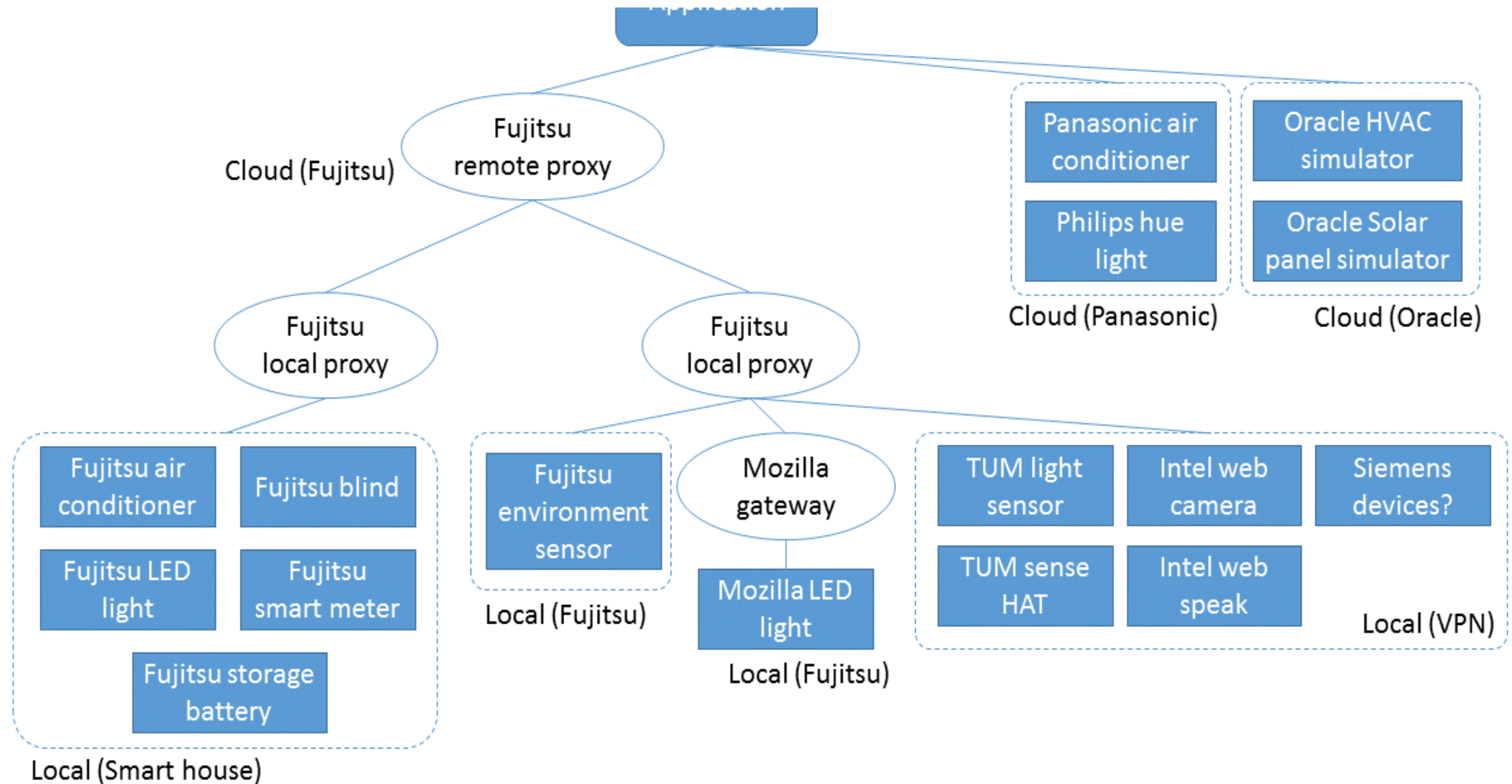


# Plugfest Devices





# Scenario 1: Home/Building



48: [EM] {room:br  
49: [EM] {actorId:  
50: [EM] {room:qu  
51: [EM] {room:co  
52: [EM] {room:de



ORACLE IoT Digital Twin Simulator

CONTROLS

- EVENTS
- NOTION FAILURE
- SHORT CIRCUIT
- NOT WORKING

ALERTS

SEND ALERTS TO

DEVICE MONITORING

STATUS

OUTPUT TEMPERATURE

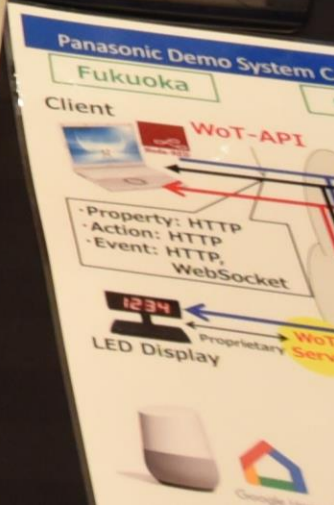
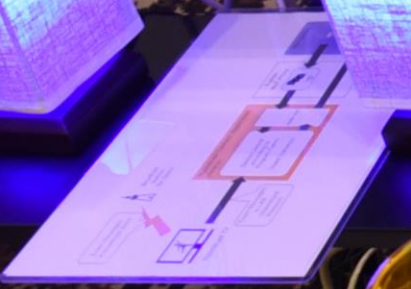
IN VOLTAGE

IN VOLTAGE

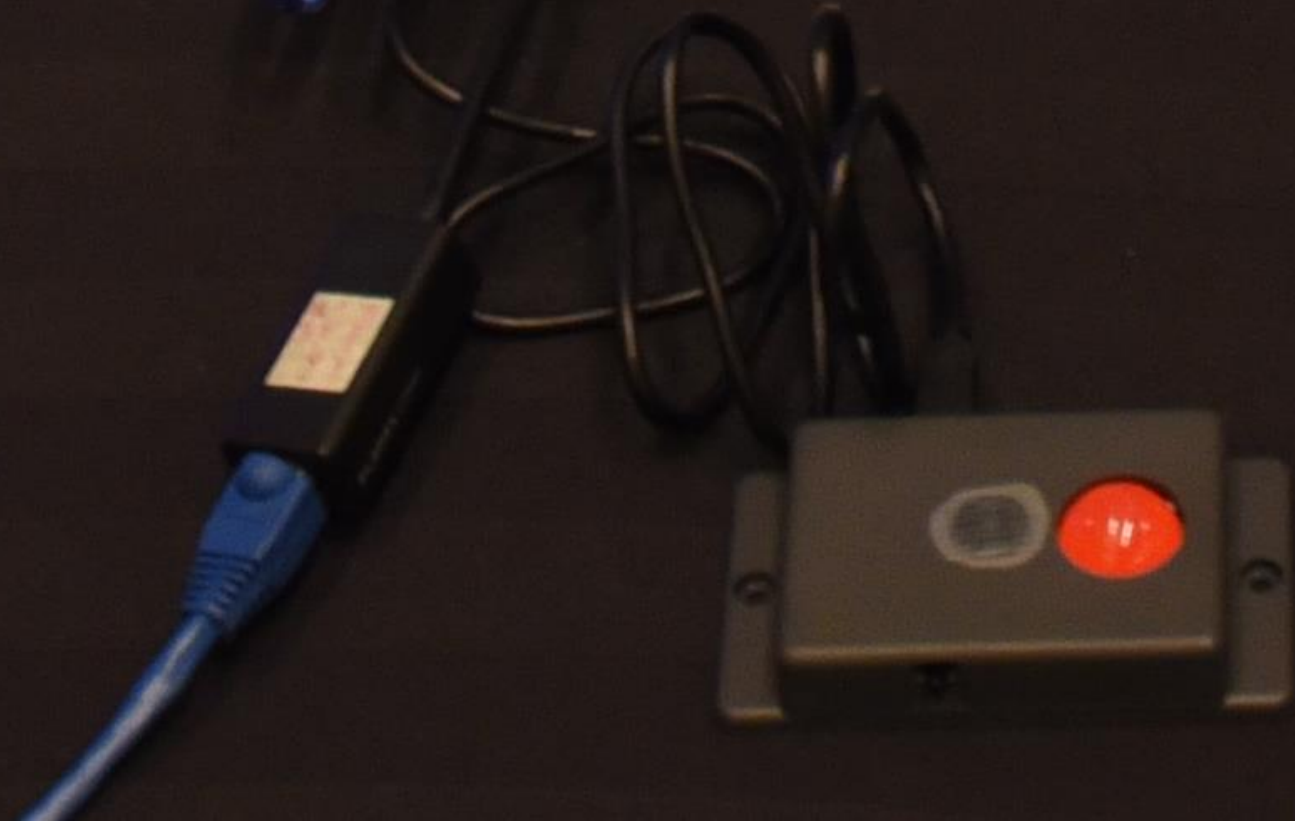
IN VOLTAGE

IN VOLTAGE

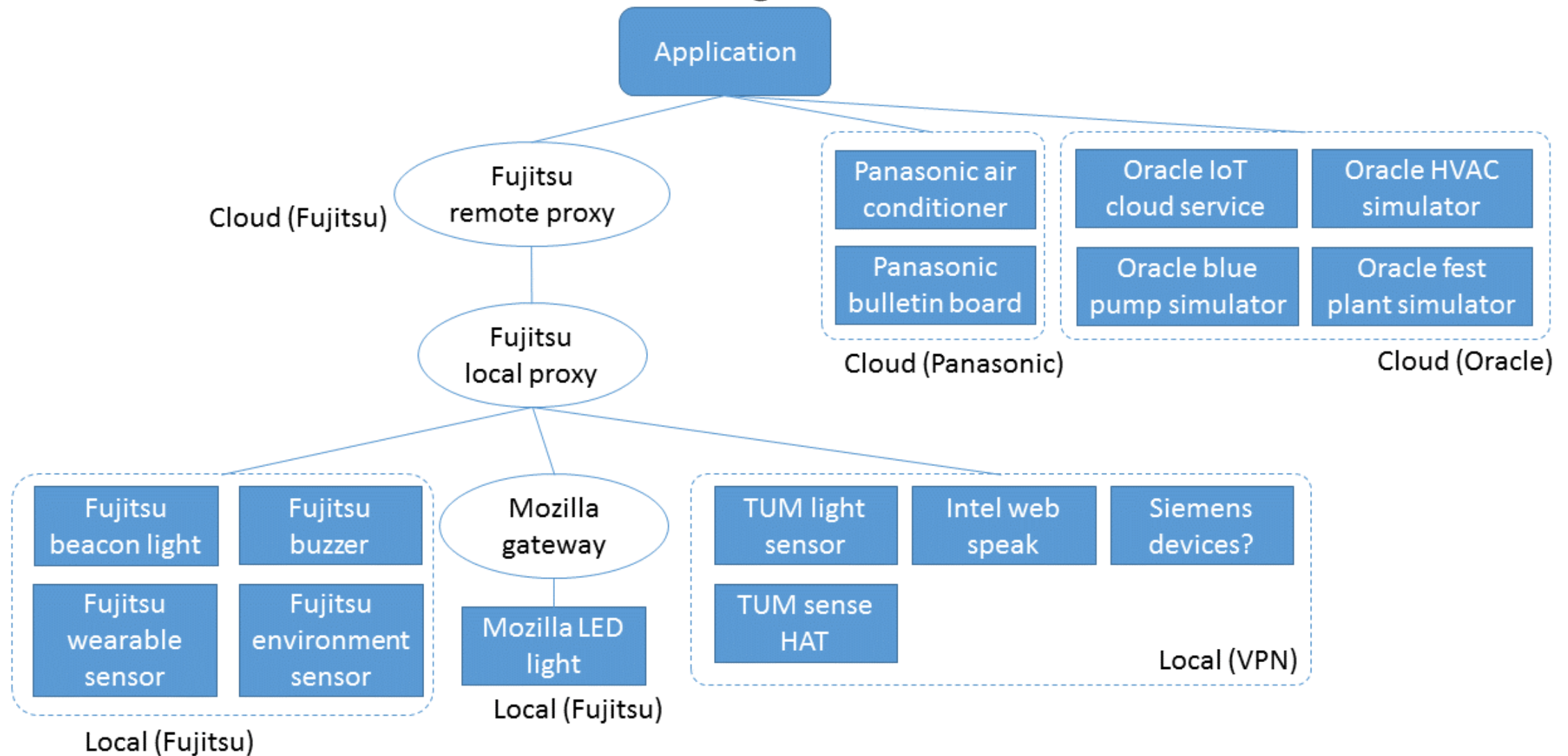
8.938







# Scenario 2: Industrial



Chromium Web Browser

Node-RED Dashboard - Chromium

Node-RED x Node-RED Dashboard x +

localhost:1880/ui/#!/Z?socketId=ym8xdk8nSxhKgUGIAAAA

Industrial integration

WiFi sensor

Accel

Temperature

Humidity

Air pressure

Sense HAT

Gyro

Accel

Compass

Environ HAT

Heading

LightLevel

Compass

IoT Digital Twin Simulator - Chromium

IoT Digital Twin Simulator x +

https://w3ctest.iadstg.iot.ocs.oraclecloud.com/ds/?root=device&id=54326C2A-FDEC-4E97-9A58-7C93F67...

ORACLE IoT Digital Twin Simulator

CONTROLS

EVENTS

ALERTS

DEVICE STATUS

DATA CHART

DEVICE MONITORING

STATUS

HVAC HVAC\_Fujitsu

54326C2A-FDEC-4E97-9A...

OUTPUT TEMPERATURE

FAN VIBRATION

OIL VISCOSITY

MOTOR AMPERAGE

TARGET TEMPERATURE

IoT Digital Twin Simulator - Chromium

Settings x IoT Digital Twin Simulator x +

https://w3ctest.iadstg.iot.ocs.oraclecloud.com/ds/?root=device&id=D142D836-64FF-4A3C-B256-38D10BE...

ORACLE IoT Digital Twin Simulator

EVENTS

CUSTOM DATA

STATUS

Festo Simulator 1 Festo\_...

D142D836-64FF-4A3C-B256...

PUMPSTATUS

TANK101MAXIMUMLEVELSTA

TANK101MINIMUMLEVELSTA

TANK101OVERFLOWSTATUS

TANK102LEVELVALUE

TANK102OVERFLOWSTATUS

VALVESTATUS



# Car Charging

- ☒ 0 kW
- ☐ 15 kW
- ☐ 50 kW



⏸

1h

⌛ 06:00

🌡️ 20 °C

📶 4 Okta

💧 0 mm/hour

< back

Dynamics

Affordances

Models

eCarCharging

HOUSE\_CONNECTOR

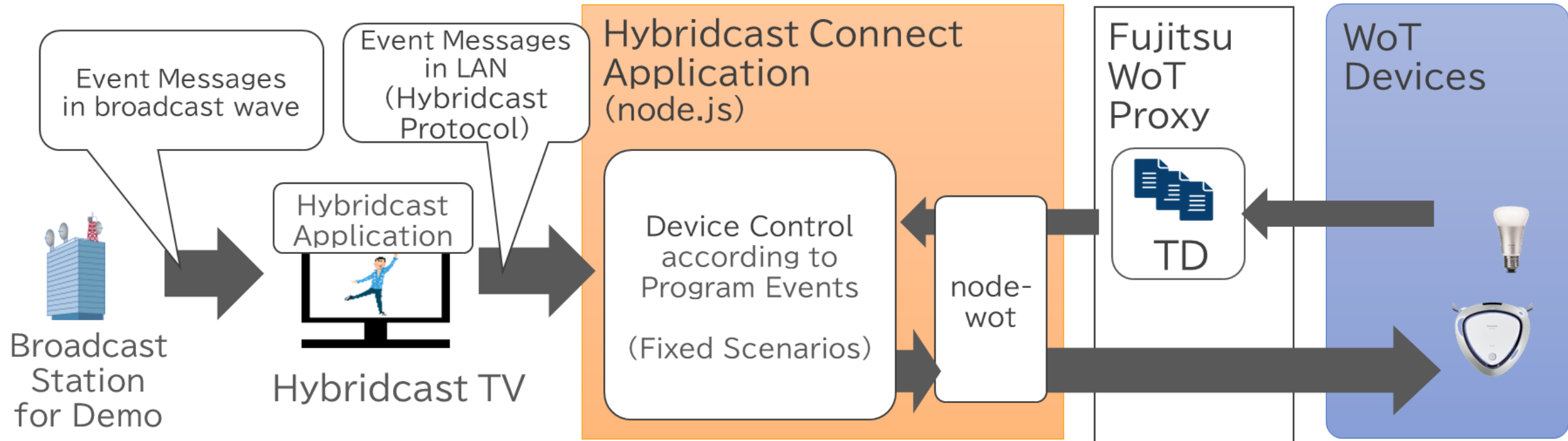
| vel     | Voltage angle   | Total power output | Optional |
|---------|-----------------|--------------------|----------|
| Value 1 | <div>0 kW</div> |                    |          |
| Value 2 | <div>0 kW</div> |                    |          |
| Value 3 | <div>0 kW</div> |                    |          |

Monitoring:

☒

Power level violation

# NHK Hybridcast Integration








asonic

```
44: [EM] {actorId:1234567890}  
45: [EM] {room:quiet}  
46: [EM] {room:cool}  
47: [EM] {room:default}  
48: [EM] {demo:init}  
49: [EM] {program:started}  
50: [EM] {room:bright}  
51: [EM] {actorId:1234567890}  
52: [EM] {room:quiet}  
53: [EM] {room:cool}  
54: [EM] {room:default}  
55: [EM] {demo:init}  
56: [EM] {program:started}  
57: [EM] {room:bright}  
58: [EM] {actorId:1234567890}
```

 Event Message Received

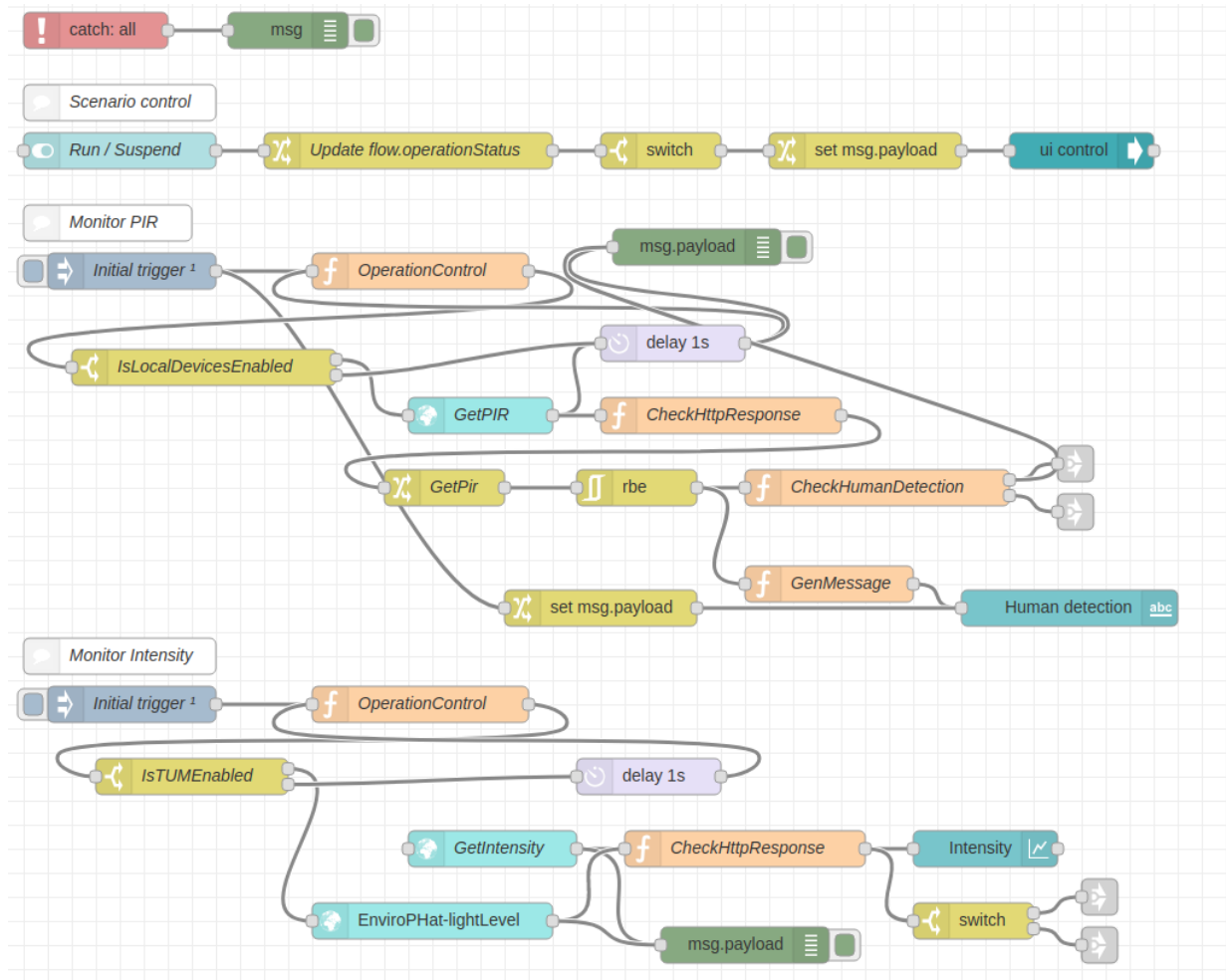
Panasonic

SANWA



# Orchestration

## Node-RED



## node-wot



```
WoTHelpers.fetch("coap://localhost:5683/counter").then( async (td) => {
  // using await for serial execution (note 'async' in then() of fetch())
  try {
```

```
    let thing = await WoT.consume(td);
    console.info("=== TD ===");
    console.info(td);
    console.info("=====");
```

```
// read property #1
```

```
let read1 = await thing.readProperty("count");
console.info("count value is", read1);
```

```
// increment property #1 (without step)
```

```
await thing.invokeAction("increment");
let inc1 = await thing.readProperty("count");
console.info("count value after increment #1 is", inc1);
```

```
// increment property #2 (with step)
```

```
await thing.invokeAction("increment", {'step': 3});
let inc2 = await thing.readProperty("count");
console.info("count value after increment #2 (with step 3) is", inc2);
```

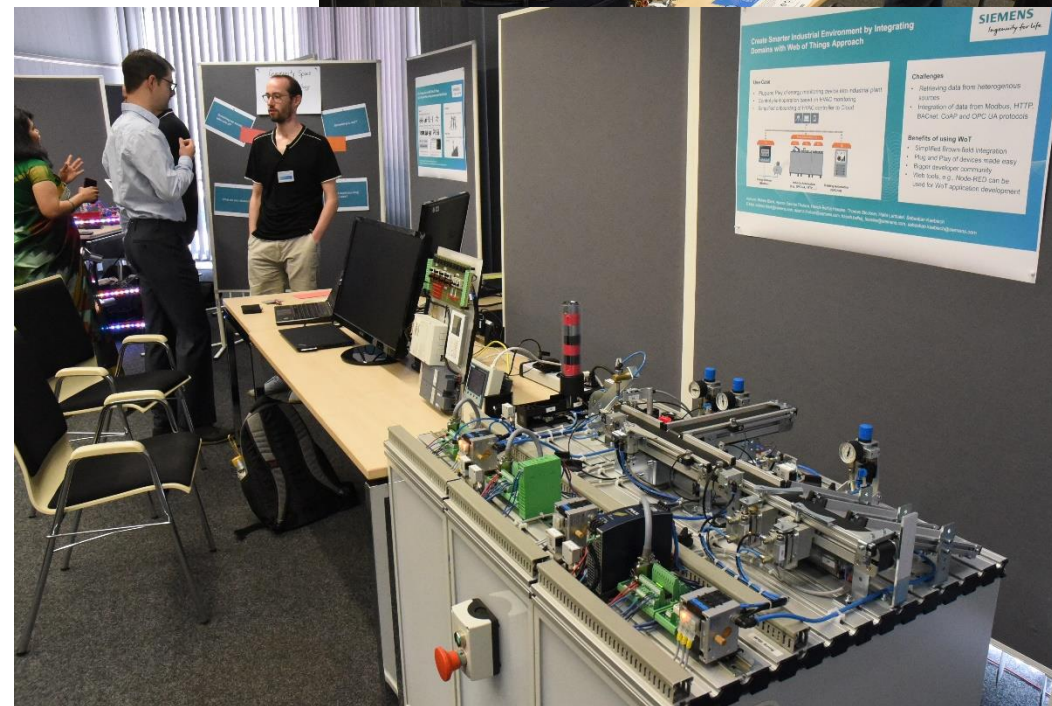
```
// decrement property
```

```
await thing.invokeAction("decrement");
let dec1 = await thing.readProperty("count");
console.info("count value after decrement is", dec1);
```

```
} catch(err) {
  console.error("Script error:", err);
}
```

```
}).catch( (err) => { console.error("Fetch error:", err); });
```

# WoT Workshop: Munich 2019





# W3C WoT Resources

- W3C WoT Wiki
  - <https://www.w3.org/WoT/IG/wiki>  
(IG/WG organizational information)
- W3C WoT Interest Group
  - <https://www.w3.org/2016/07/wot-ig-charter.html>  
(charter)
  - <https://lists.w3.org/Archives/Public/public-wot-ig/>  
(mailing list)
  - <https://github.com/w3c/wot>  
(technical proposals)
- W3C WoT Working Group
  - <https://www.w3.org/2016/12/wot-wg-2016.html>  
(charter)
  - <https://www.w3.org/WoT/WG/>  
(dashboard)
- W3C WoT Candidate Recommendations
  - <https://www.w3.org/TR/wot-architecture/>
  - <https://www.w3.org/TR/wot-thing-description/>
- W3C WoT Working Drafts / Group Notes
  - <https://www.w3.org/TR/wot-binding-templates/>
  - <https://www.w3.org/TR/wot-scripting-api/>
  - <https://www.w3.org/TR/wot-security/>
- W3C WoT Editors' Drafts and Issue Tracker
  - <https://github.com/w3c/wot-architecture/>
  - <https://github.com/w3c/wot-thing-description/>
  - <https://github.com/w3c/wot-binding-templates/>
  - <https://github.com/w3c/wot-scripting-api/>
  - <https://github.com/w3c/wot-security/>
- Reference Implementation: node-wot
  - <https://github.com/eclipse/thingweb.node-wot>



# Contacts

<https://www.w3.org/WoT/WG/>

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