

Web of Things, IoT, and Publishing

October 2020

Outline

- Internet of Things
 - What is it?
 - What is the value?
- Web of Things
 - Addressing the problem of interoperability
- Publication Use Cases – Discussion
 - NHK Hybridcast Example
 - Educational applications – Interactive science books

Internet of Things (IoT)

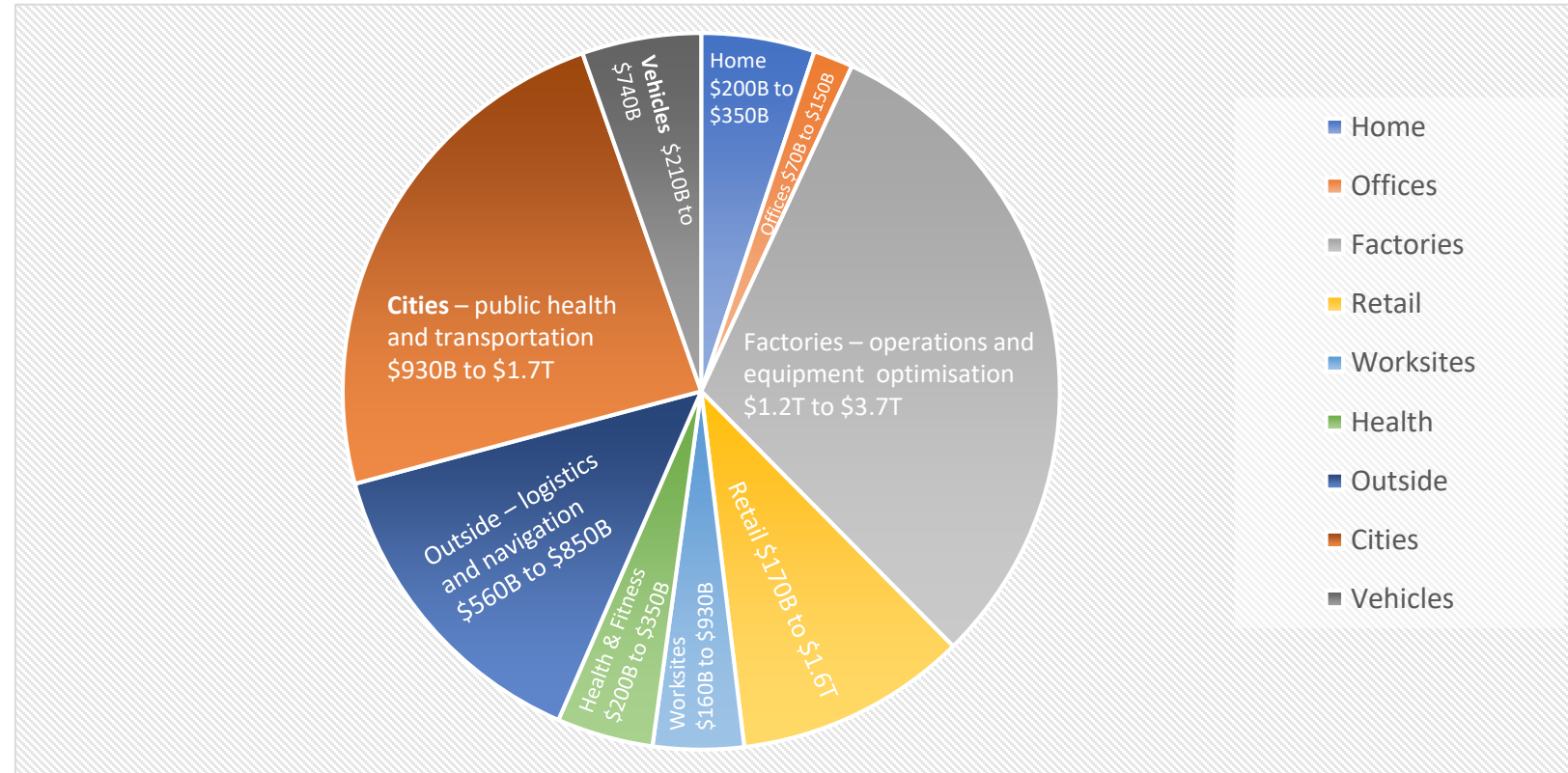
- Network of physical objects: “Things”
- Embedded with sensors, software, and other technologies
- For the purpose of connecting and exchanging data with other devices and systems over the Internet.



Wilgenbroed on Flickr / [CC BY](#)

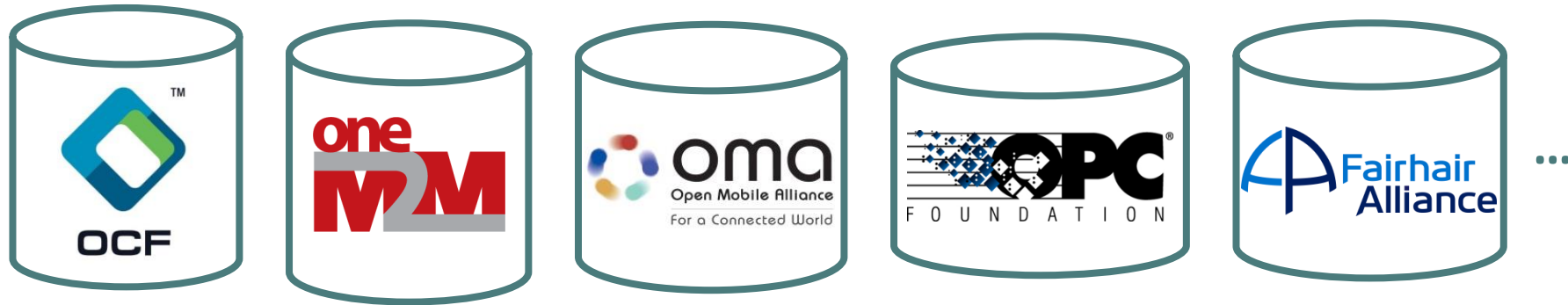
What is the Value of the IoT?

- **Interoperability** is required to capture 40% of total value
- Aggregated value - **\$3.9 trillion to \$11.1 trillion per year in 2025**



- Most of the potential value is in the **data and value added services** rather than the IoT devices and IoT communication technologies.
 - ✓ **Open standards** are needed to overcome fragmentation, connect the silos and unlock the network effect for exponential growth

Problem: Application/Platform Silos



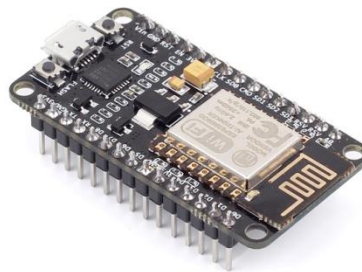
Internet of Things: Connectivity



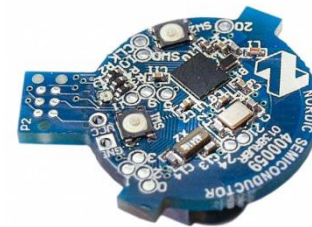
IEEE 802.15.4



Ethernet



Wi-Fi



Bluetooth

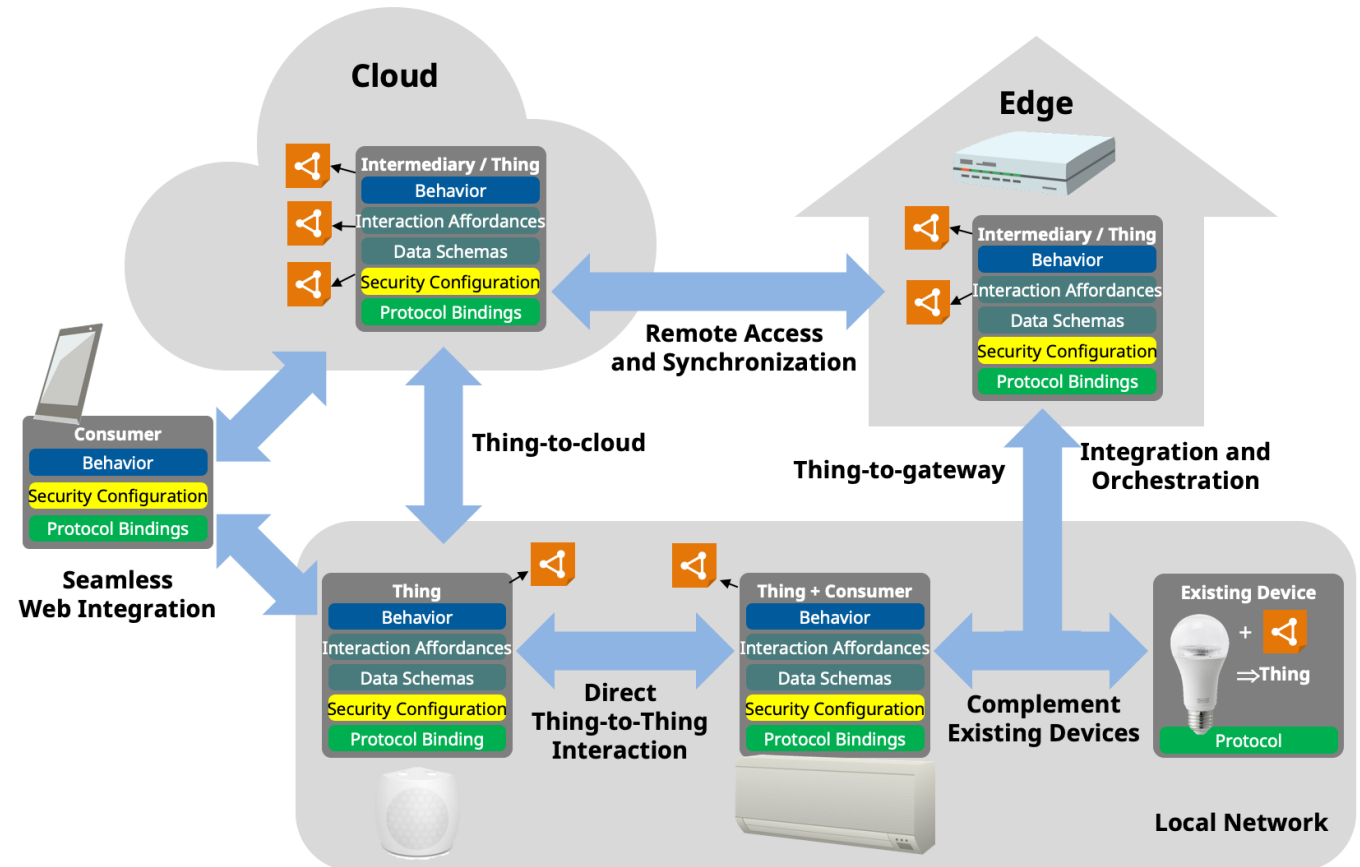


LoRa

...

WoT Goal: Support Interoperability

- Simplify usage
 - Interaction abstraction
- Simplify data ingestion
 - Unified data schemas
- Bridge silos
 - Protocol bindings
- Enable "mashups"
 - Scripting API



Current Work Items

Deliverables	Updates	New
Informative	<ul style="list-style-type: none"> Scripting API Security and Privacy <ul style="list-style-type: none"> Guidelines Best Practices 	<ul style="list-style-type: none"> Use Cases
Normative	<ul style="list-style-type: none"> Architecture Thing Description <ul style="list-style-type: none"> Thing Models 	<ul style="list-style-type: none"> Discovery Interoperability Profiles

Thing Description

- Metadata for IoT services
 - ID, versions, types, creation time, ...
 - Titles, descriptions, ...
- Describes interactions
 - What they are (abstraction)
 - How to use them (protocol binding)
 - How to interpret data (schemas)
- JSON-LD 1.1
 - Vocabulary extensions
 - Semantic annotation (e.g. OneDM)
 - Protocol-specific vocabulary

```
{
  "@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": {
      ...
    }
  }
}
```



New Work Items

Use Cases:

- Expanding catalog of use cases
- Identifying requirements
- Identifying gaps and overlaps
 - Edge computing
 - Geospatial systems
 - Data modeling
 - ...

Architecture:

- Lifecycle
- Updated requirements analysis
 - Based on new use cases
- Alignment with other standards

Discovery:

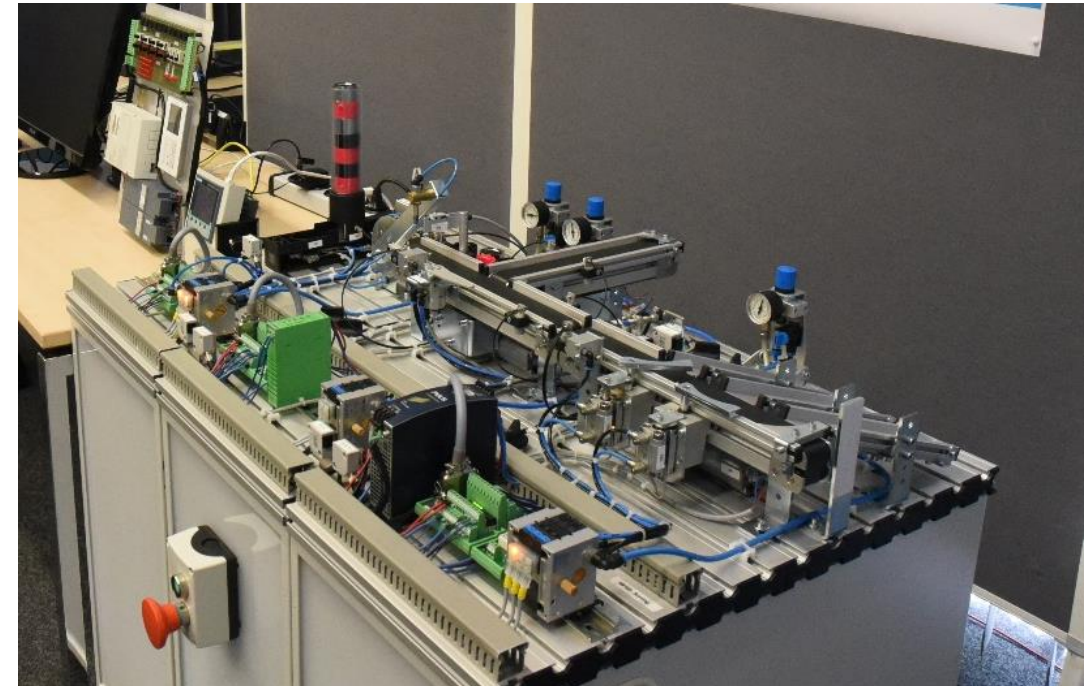
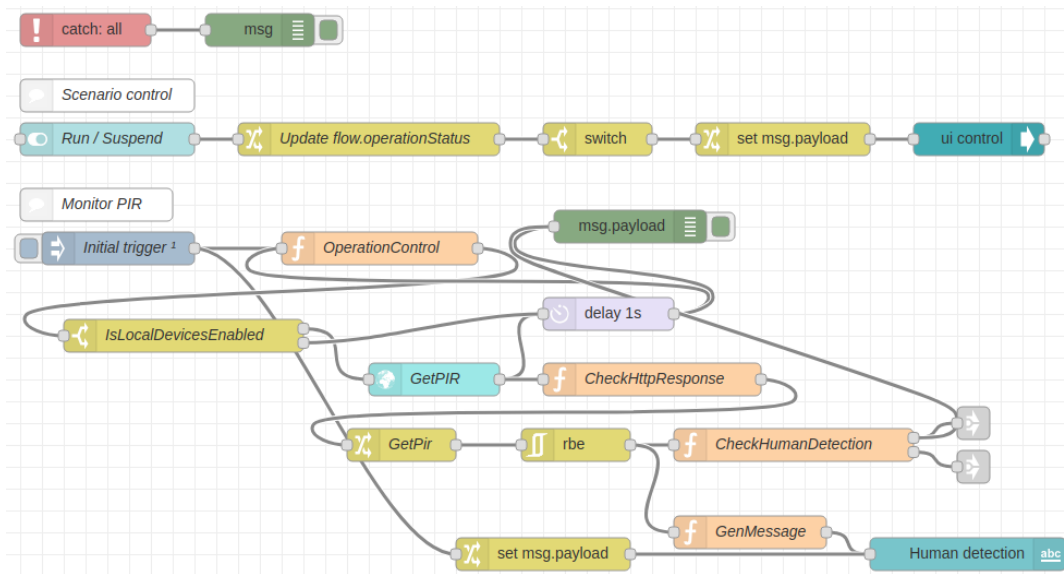
- Define how TDs are distributed
- Both local and global contexts
 - Spatial search not limited to local network
- Two-phase introduction/exploration
- Emphasis on privacy protection
 - Protected queries and exploration services

Interoperability Profiles:

- Support interoperability
 - Out-of-the-box plug-and-play
- Constrain features
 - Allow for finite, in-advance implementation of consumers

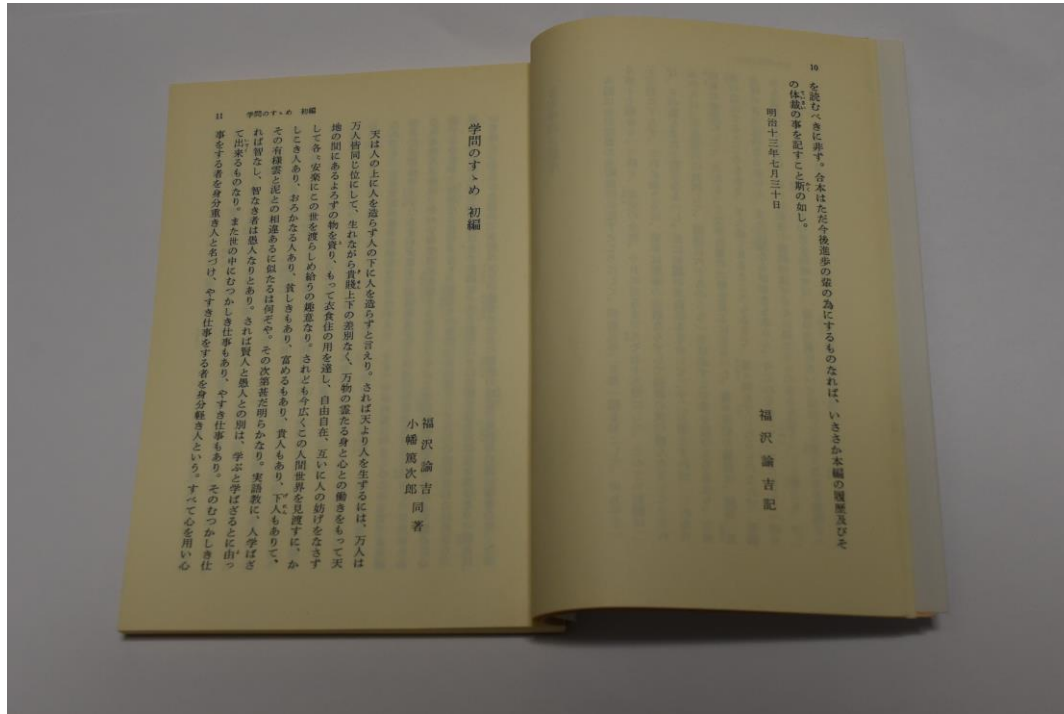
Implementation, Tools, Validation...

- Node-wot
 - Scripting API implementation
- Node-gen
 - Node-RED integration
- Playground
 - TD checker
- Plugfests



Publishing: From Paper Books to E-Books

Paper Books



E-Books



For Discussion: Some Use Cases...

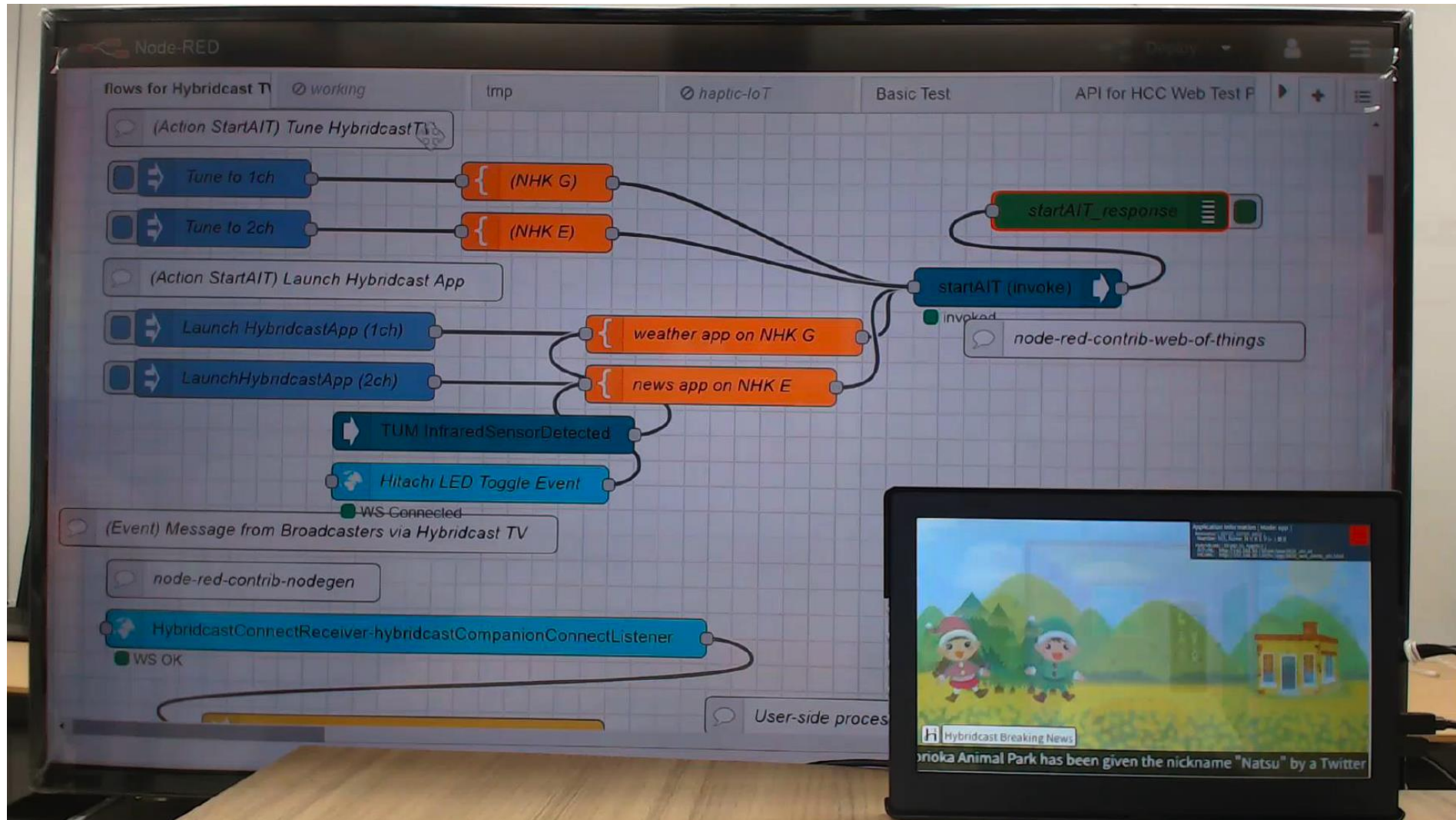
Hybridcast (NHK)

- TV receiver as IoT control hub
- Data embedded in content
- IoT devices used as means to interact with content
 - Can trigger changes to lighting, sound levels, media control
 - Can be used to trigger novel output devices, eg haptic displays
 - Accessable/customizable controls and input devices for media control

Interactive Notebooks

- A science notebook can not only describe an experiment, it can help run it!
- “Book” can connect to devices, collect and visualize data
- Other kinds of books can use IoT devices in ways similar to hybridcast

Hybridcast



Interactive Notebooks Example: JupyterLab

Lorenz.ipynb

The Lorenz Differential Equations

Before we start, we import some preliminary libraries. We will also import (below) the accompanying `lorenz.py` file, which contains the actual solver and plotting routine.

```
[ ]: %matplotlib inline
from ipywidgets import interactive, fixed
```

We explore the Lorenz system of differential equations:

$$\begin{aligned}\dot{x} &= \sigma(y - x) \\ \dot{y} &= \rho x - y - xz \\ \dot{z} &= -\beta z + xy\end{aligned}$$

Let's change (σ, β, ρ) with ipywidgets and examine the trajectories.

```
[ ]: from lorenz import solve_lorenz
w=interactive(solve_lorenz, sigma=(0.0, 50.0), rho=(0.0,
W
```

For the default set of parameters, we see the trajectories swirling around two points, called attractors.

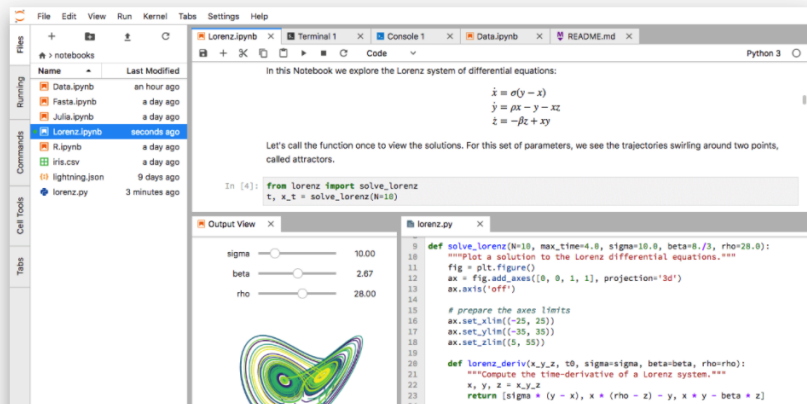
JupyterLab Reference

JupyterLab

[Docs](#) » [JupyterLab Documentation](#) | [Jupyter](#) | [Edit on GitHub](#)

JupyterLab Documentation

JupyterLab is the next-generation web-based user interface for Project Jupyter. [Try it on Binder](#). JupyterLab follows the [Jupyter Community Guides](#).



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>
(old charter)
 - <https://www.w3.org/2019/10/wot-ig-2019.html>
(new 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>
(old charter)
 - <https://www.w3.org/2020/01/wot-wg-charter.html>
(new 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/>
 - <https://github.com/w3c/wot-security-best-practices/>
 - <https://github.com/w3c/wot-profile/>
 - <https://github.com/w3c/wot-discovery/>
- Reference Implementations and Tools: node-wot
 - node-wot: <https://github.com/eclipse/thingweb.node-wot>
 - TD playground: <https://github.com/thingweb/thingweb-playground>

Contacts

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

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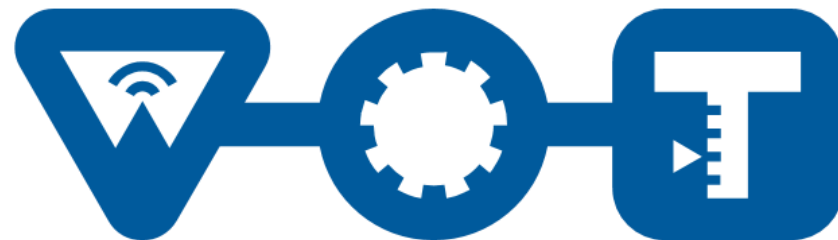
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WEB OF



THINGS