

# iot.schema.org

WoT Status Review

October 26, 2018

# Topics

- Work on automating consumed and exposed APIs
- SSN Workshop
- Charter
- Explainer and introductory slides
- Integration with [schema.org](https://schema.org)
- Definition tools
- Work on modeling target ecosystems
- Developer-user tools
- Going forward

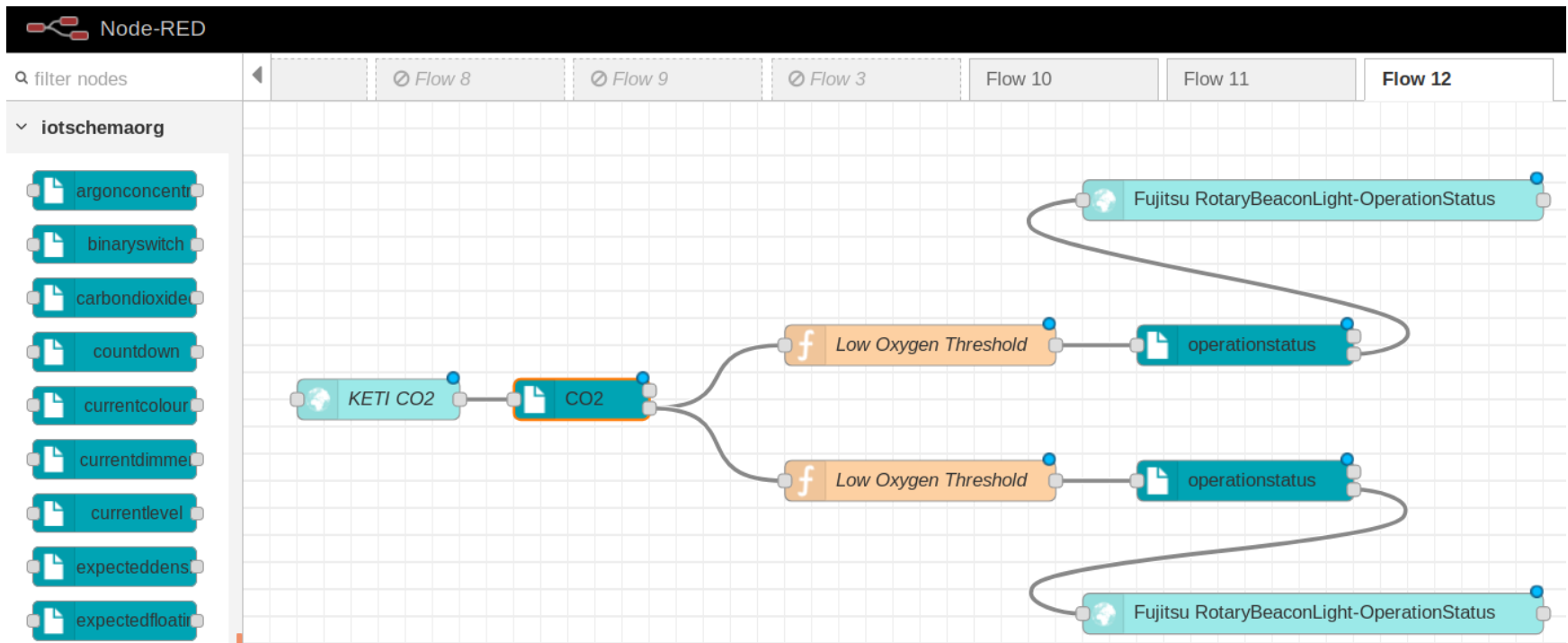
# iot.schema.org for Node-RED

## Semantic Interoperability

- iot.schema.org embedded in Node-RED tool
- Easies use of semantics for WoT developers
- Simplify creation of applications with W3C WoT
- Demonstrates semantic discovery and processing
- Handsome tool for WoT PlugFests

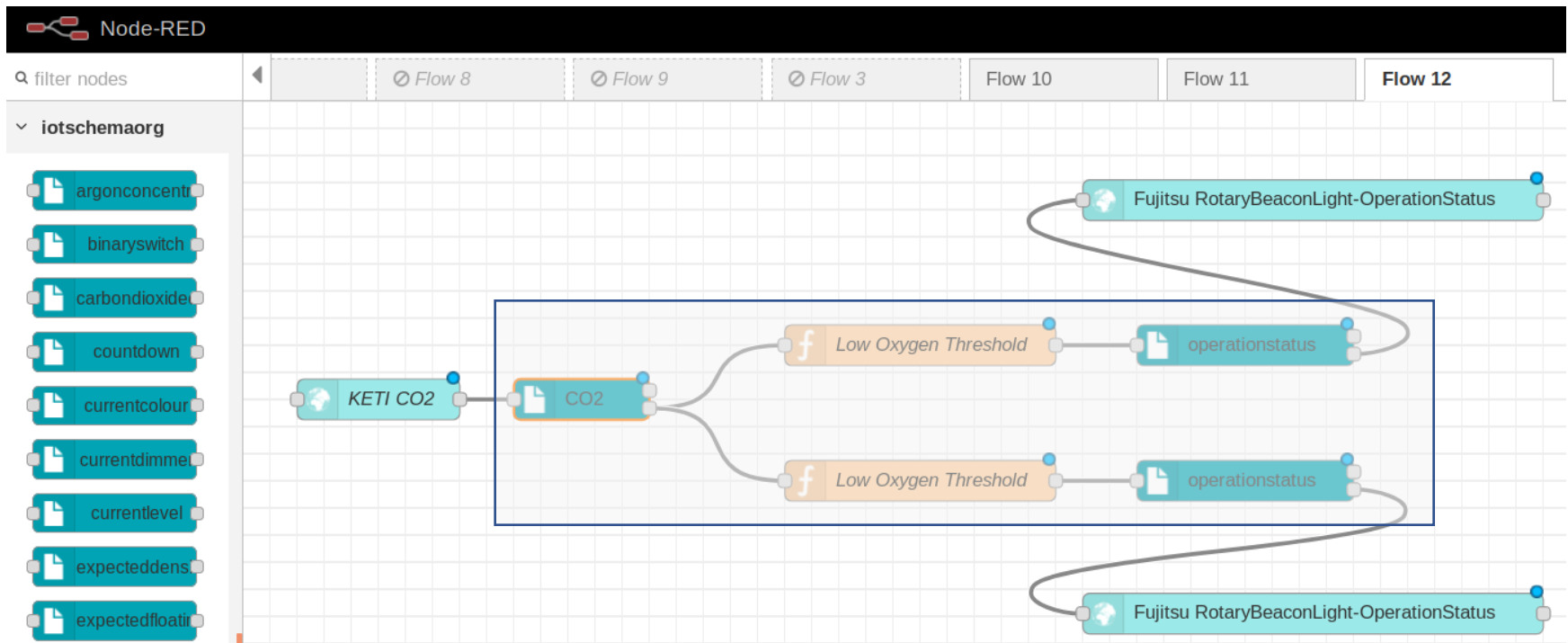
# Example: Controlling Carbon Dioxide

Node-RED Application with W3C WoT Things



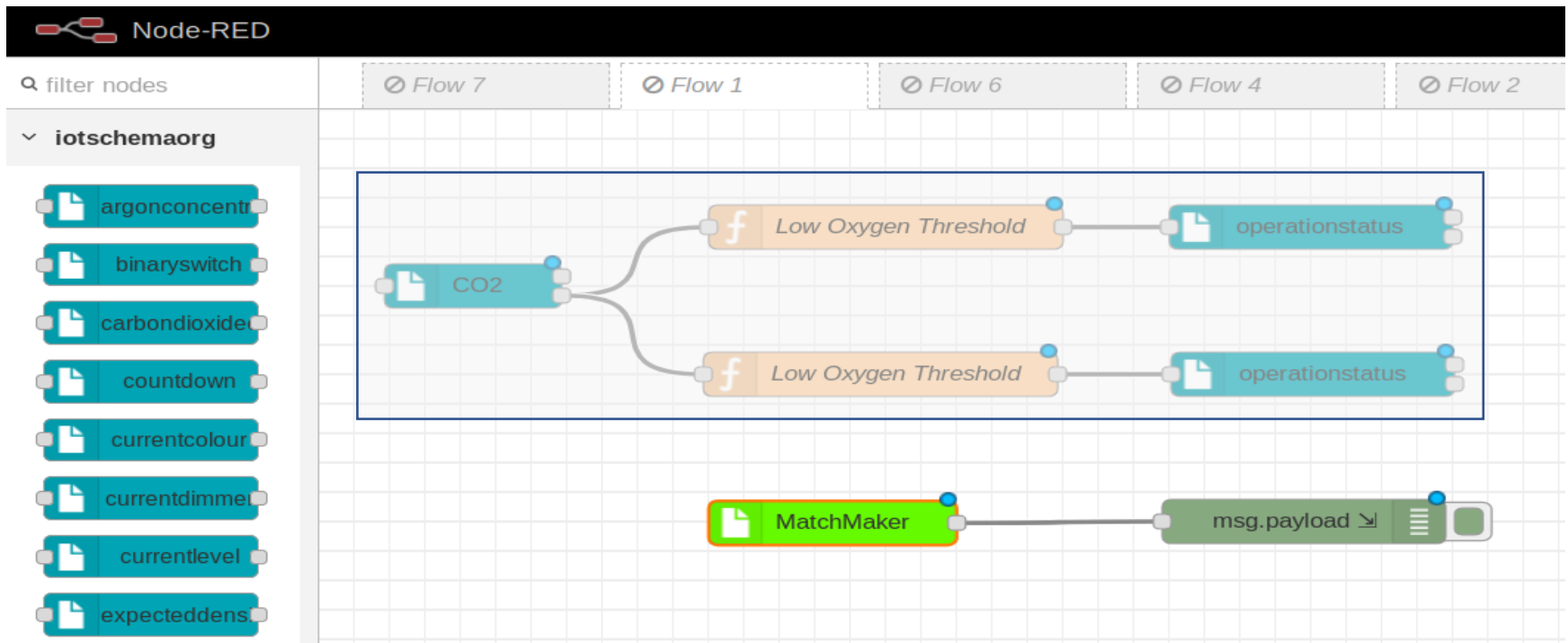
# Example: Controlling Carbon Dioxide

Node-RED Application with W3C WoT Things



# Semantic Recipe

## Reusable Flow Template



MatchMaker:

- finds Things that can implement the Recipe
- based on TD with [iot.schema.org](http://iot.schema.org) mark-ups

# Configure Thing Description Directory

The screenshot displays the Node-RED web interface. On the left, a sidebar lists various IoT schema nodes under the 'iotschemaorg' category, including 'argonconcentr', 'binaryswitch', 'carbondioxide', 'countdown', 'currentcolour', 'currentdimmer', and 'currentlevel'. The main workspace shows a workflow starting with a 'CO2' node, which branches into two 'Low Oxygen Threshold' function nodes. Below these, a 'MatchMaker' node is connected to a 'msg' node. On the right, the 'Edit MatchMaker node' panel is open, showing the 'node properties' section. The 'Name' field is set to 'MatchMaker', and the 'URL' field is set to 'http://localhost:8080/td-lookup/sem', which is highlighted with an orange border. The panel also includes 'Delete', 'Cancel', and 'Done' buttons.

Node-RED

filter nodes

Flow 7 Flow 1 Flow 6 Flow 4

iotschemaorg

- argonconcentr
- binaryswitch
- carbondioxide
- countdown
- currentcolour
- currentdimmer
- currentlevel

CO2

Low Oxygen Threshold

Low Oxygen Threshold

MatchMaker

msg

Edit MatchMaker node

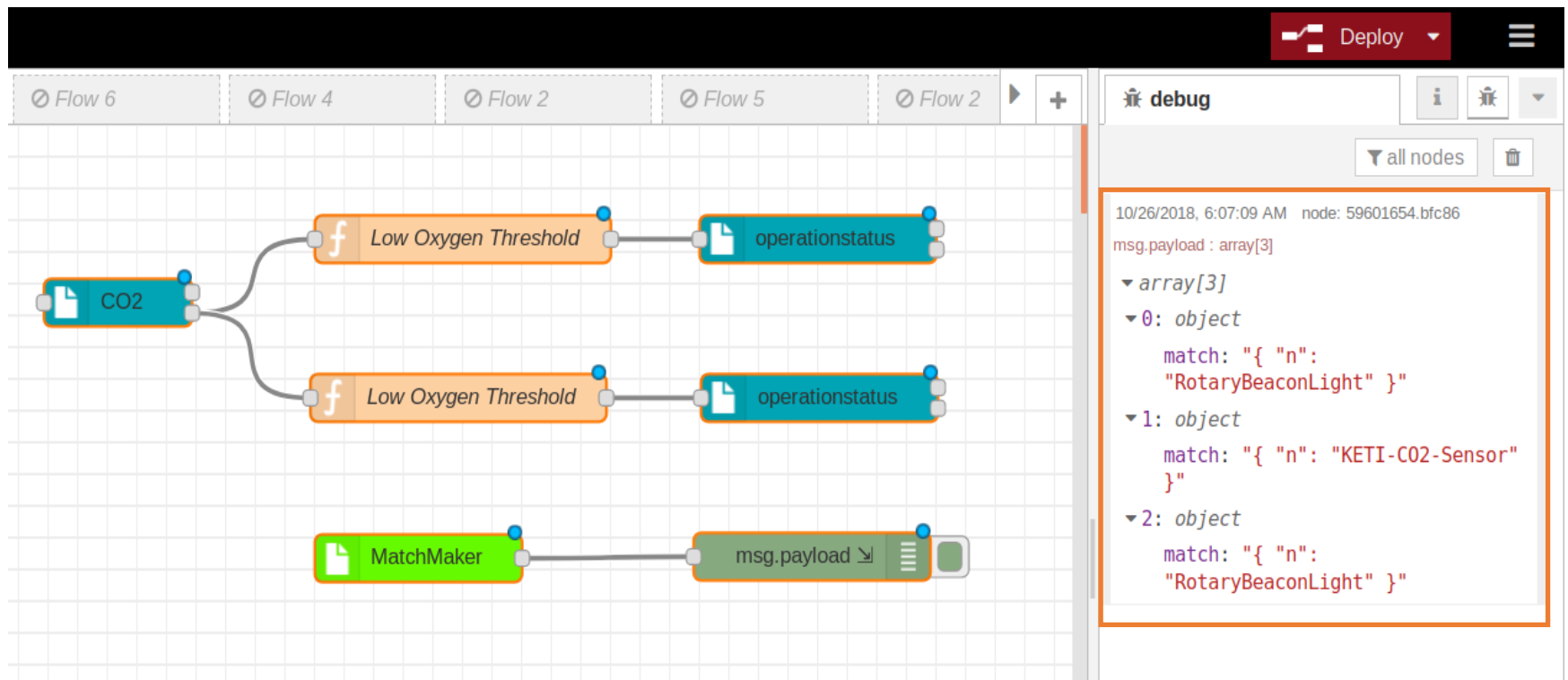
Delete Cancel Done

node properties

Name: MatchMaker

URL: <http://localhost:8080/td-lookup/sem>

# Semantic Discovery of Recipe Ingredients

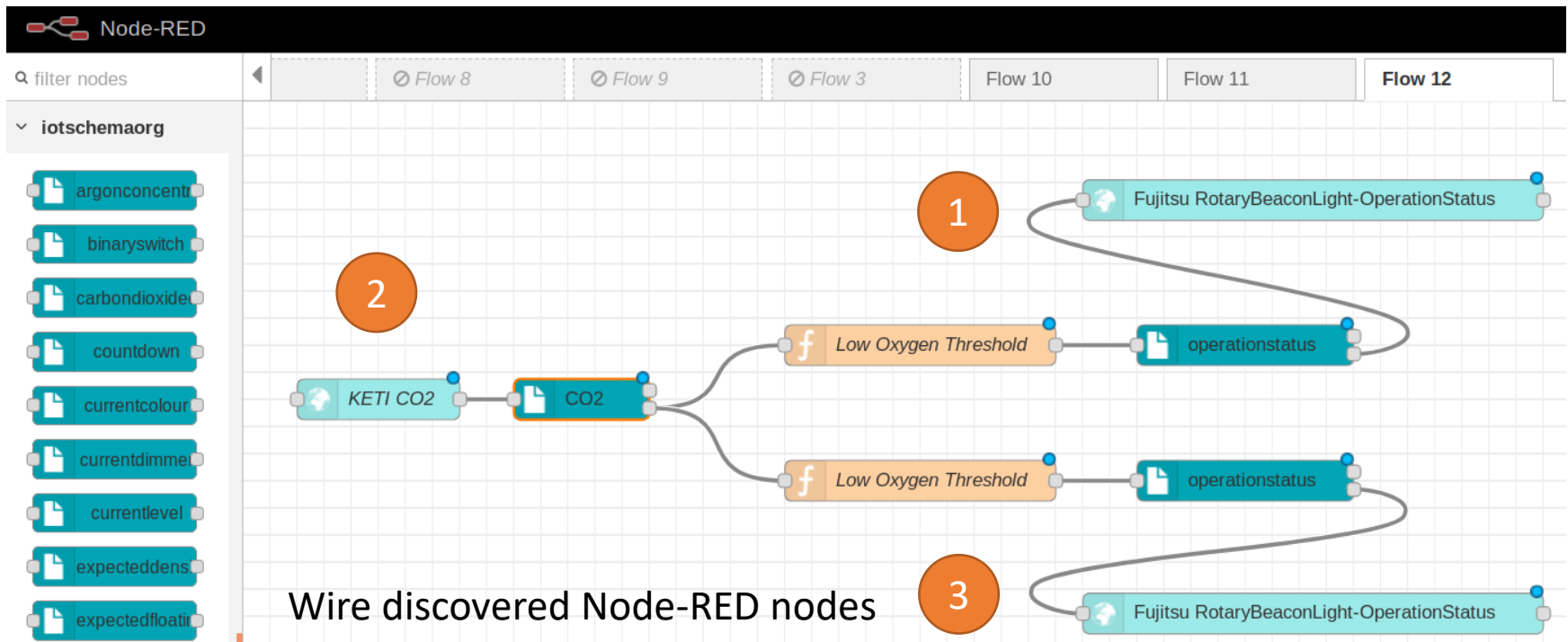


Ingredients are Node-RED Nodes

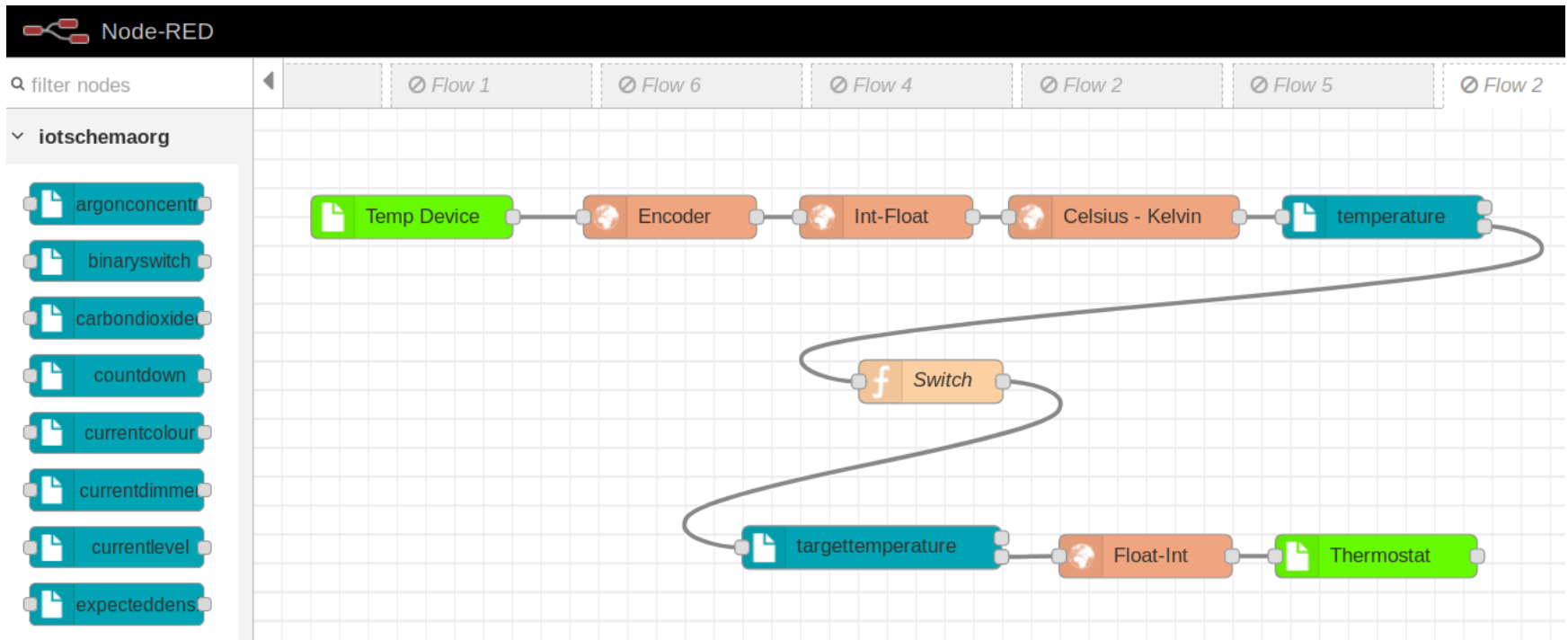


# Example: Controlling Carbon Dioxide

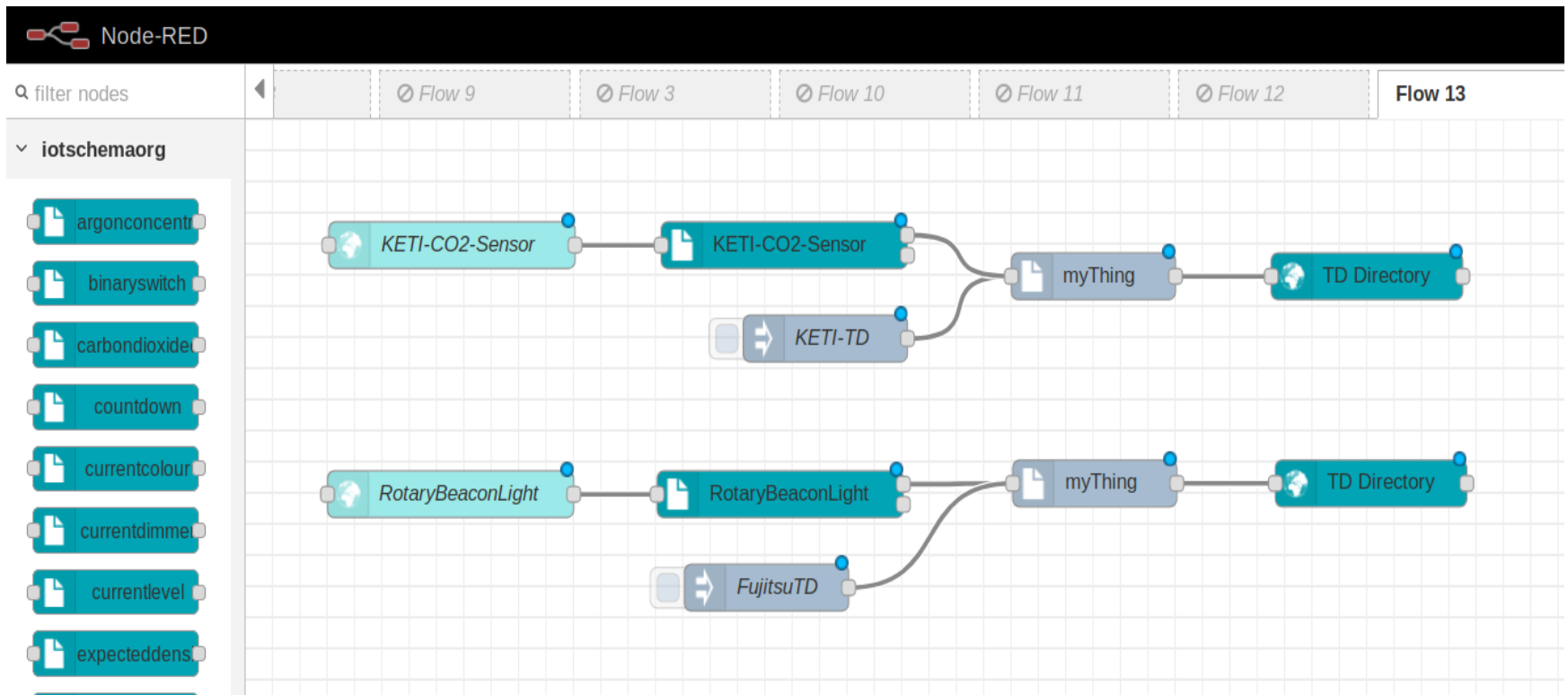
Node-RED Application with W3C WoT Things



# Semantic-Based Adapters



# iot.schema.org: Semantic Mark-Up for W3C WoT Thing Description



# iot.schema.org: Semantic Mark-Up for W3C WoT Thing Description

The image displays the Node-RED web interface. On the left, a sidebar lists nodes under the 'iotschemaorg' category, including 'argonconcent', 'binaryswitch', 'carbondioxide', 'countdown', 'currentcolour', 'currentdimme', 'currentlevel', 'expecteddens', 'expectedfloat', 'expectedflow', and 'expectedtemp'. The main workspace contains a flow with four nodes: 'KETI-CO2-Sensor', 'KETI-CO2-Sensor', 'KETI-TD', and 'RotaryBeaconLight'. The 'KETI-CO2-Sensor' node is selected, and its configuration panel is open on the right. The panel is titled 'Edit carbondioxideconcentration node' and includes a 'Delete' button, 'Cancel' and 'Done' buttons, and a 'node properties' section. The 'node properties' section is highlighted with an orange border and contains the following fields:

- Name: KETI-CO2-Sensor
- Interaction Pattern Type: `iot:CarbonDioxideConcentration`
- Capability: AmbientAir
- Feature Of Interest Type: Room
- Feature Of Interest: `iot:TPAC-Room`
- PropertyType: float
- UnitCode: PartsPerMillion
- Observable: False

# SSN Workshop at ICSW2018

- Presented [iot.schema.org](http://iot.schema.org) at the SSN Workshop last week
- Presentation is in the teleconferences folder
- Discussion:
  - Action, Event, Property terms are badly overloaded
  - When will the definitions be available on [schema.org](http://schema.org)?
  - How do we create and use definitions?
  - What tools are available for definitions and annotation
  - How do we use definitions with existing device ecosystems?

# SSN Workshop (contd)

- Presentations on Automotive, Building Management, Home Care use cases
- Clear focus on Feature of Interest concepts
- Gap analysis for Semantic IoT
  - Taxonomy of Observable Properties
  - FoI Vocabularies
  - Sensor/Actuator Vocabulary
  - Vocabulary for processes and procedures

# Organization

- W3C CG Charter
- Introductory materials
  - Explainer
  - Slide set for introduction
  - SSN workshop slides
- Integration with schema.org
  - May not be a sub-domain, e.g. become part of schema.org
  - We need to enable the schema browser for iotschema definitions

# Developer tools

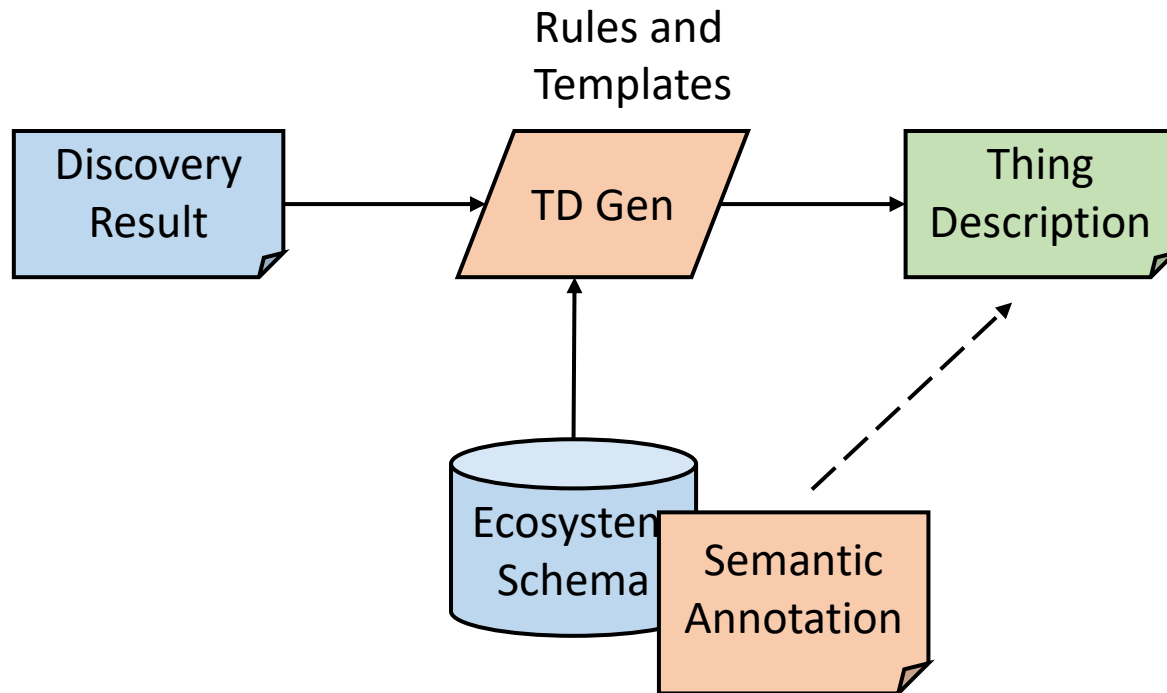
- How to create and maintain definitions
- How to use definitions in deployed systems
- **How to apply definitions to existing device ecosystems and Fol definitions**
  - OMA LWM2M
  - OCF
  - W3C WOT Thing Description
  - Genivi VSS
  - Haystack/Brick
  - What about Amazon Alexa, SmartThings, etc.
  - Other APIs using OAS/Swagger, HAL, JSON Hyperschema



# Applying [iot.schema.org](http://iot.schema.org) definitions to existing ecosystems

- Existing definitions in some machine-readable format
  - XML, JSON-Schema, JSON, others e.g. YAML
- Annotate the definitions with Semantic terms to describe affordances
  - JSON-LD schema can be annotated as in WOT TD
  - Other annotation techniques (WISHI Research)
  - Use existing definition or create new definitions
- Generate hypermedia controls from the annotated definitions
  - TD Generator
  - Other annotations of instances

# Process



# Annotation of a JSON Schema fragment using JSON-LD

```
{
  "type": "object",
  "properties": {
    "name": "bri",
    "@type": ["iot:LevelData" ],
    "type": "integer",
    "min": 0,
    "max": 254
  }
}
```

- Annotated schema is used to generate hypermedia controls for instances
- E.g. a link with a target attribute containing the annotation

# Going Forward

- Set up the CG
- schema.org integration
- Accept definitions for target ecosystems
  - LWM2M/IPSO (Ericsson), OCF, SmartThings
- Would like to work with IIC to create testbeds for semantic interoperability

# Upcoming Teleconferences

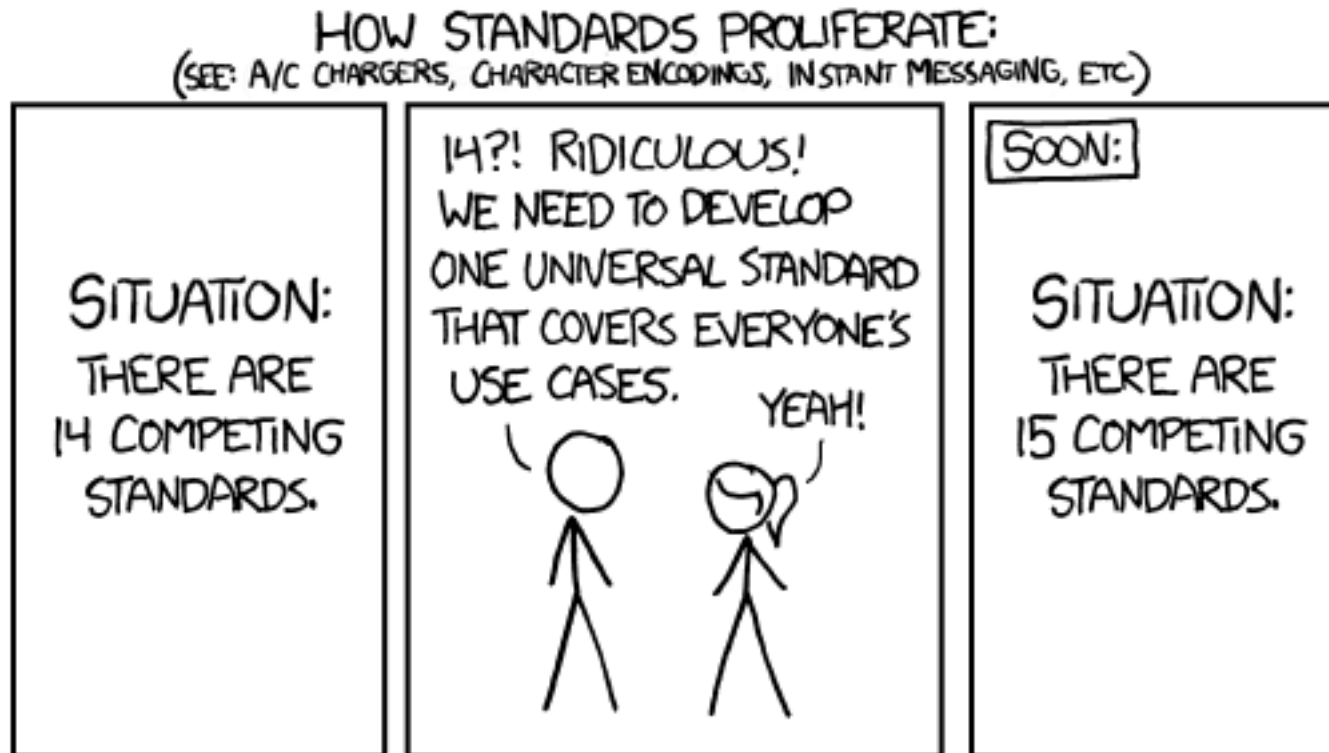
- Dr. Amelie Gyrard – Semantic Web of Things
  - Industry-wide survey of existing definitions
- Bruce Nordman – Lawrence Berkeley Laboratory
  - Device descriptions for energy monitoring

# SSN Workshop Exit Keynote (condensed)

ISCW 2018

October 9, 2018

# This is the Problem being solved:



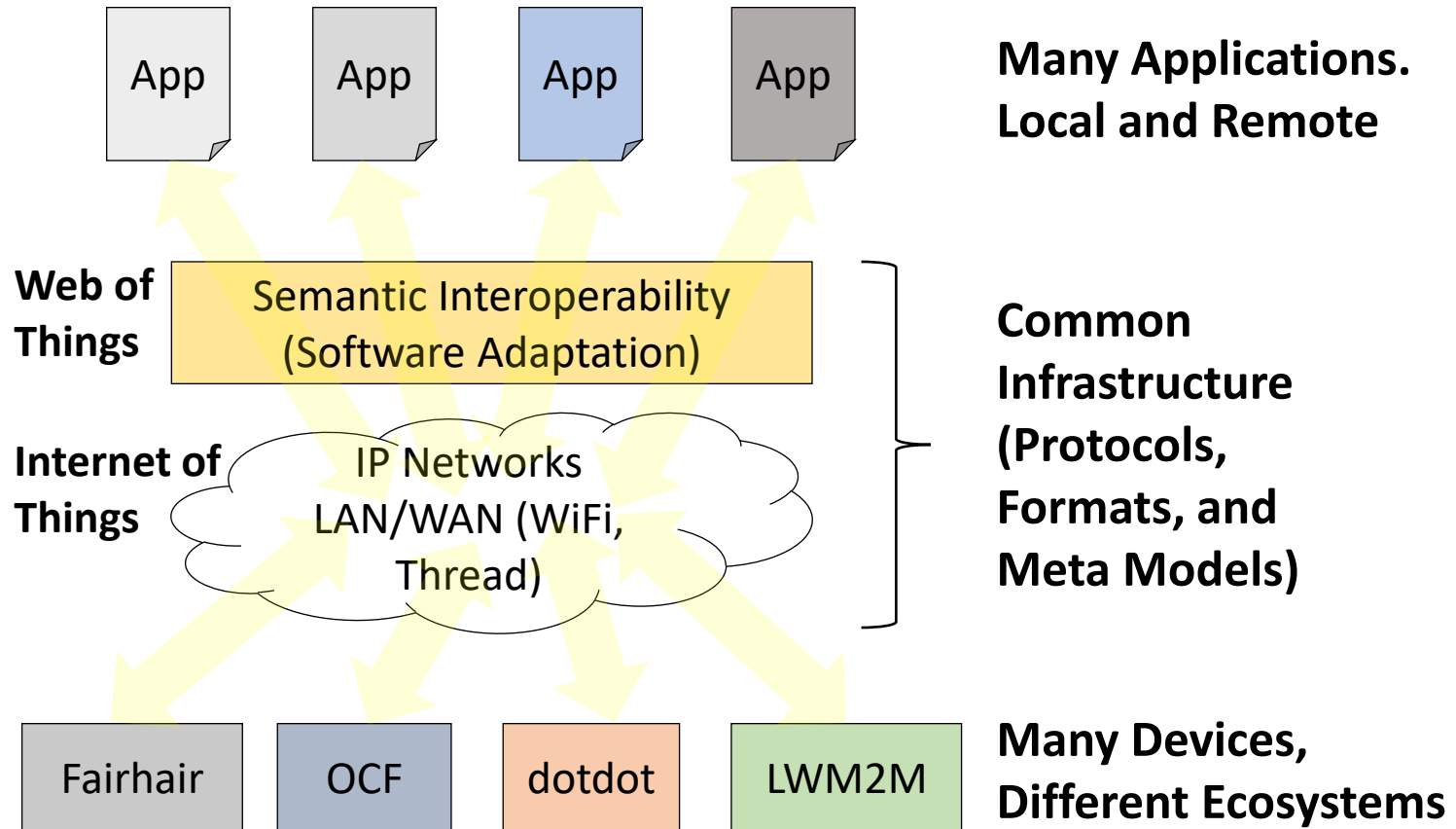
Source: <https://xkcd.com/927/>

# Problem being solved – Semantic Interoperability for IoT

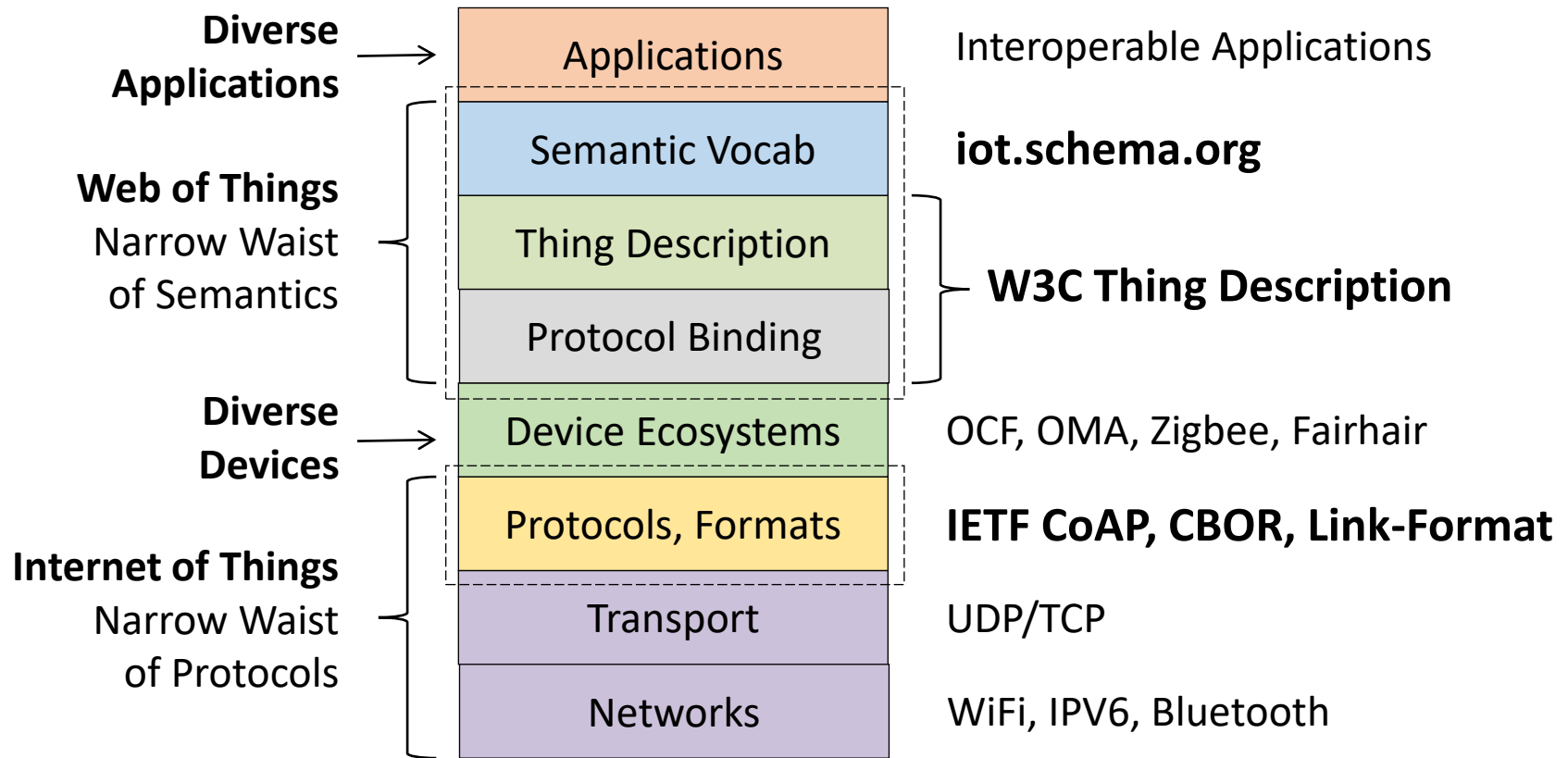
- Acknowledge the diversity of IoT device ecosystems
  - Not another device standard
  - Adaptive to diverse protocol, language, and data models
  - Distill the common and stable operational features
  - Second "narrow waist" for systems above IP networks
- Address the ease of use of Semantic Web for IoT and use of IoT for Semantic Web
  - Not another IoT ontology
  - A conceptual layer that models connected things in relation to existing ontologies



# Narrow Waist in System Design



# Diverse Devices and Applications, Common Protocols and Semantics



# Integration with other Ontologies

Enables Well-Characterized interactions with Physical Entities

Feature of Interest, O&M  
Situation, Provenance



iot.schema.org  
Definition



Software  
Affordances



Quantities, Units, Shapes,  
Property Value Constraint

# Connect things to the real world

