Schema.org Extensions for IoT (iotschema)

2nd W3C Web of Things Workshop

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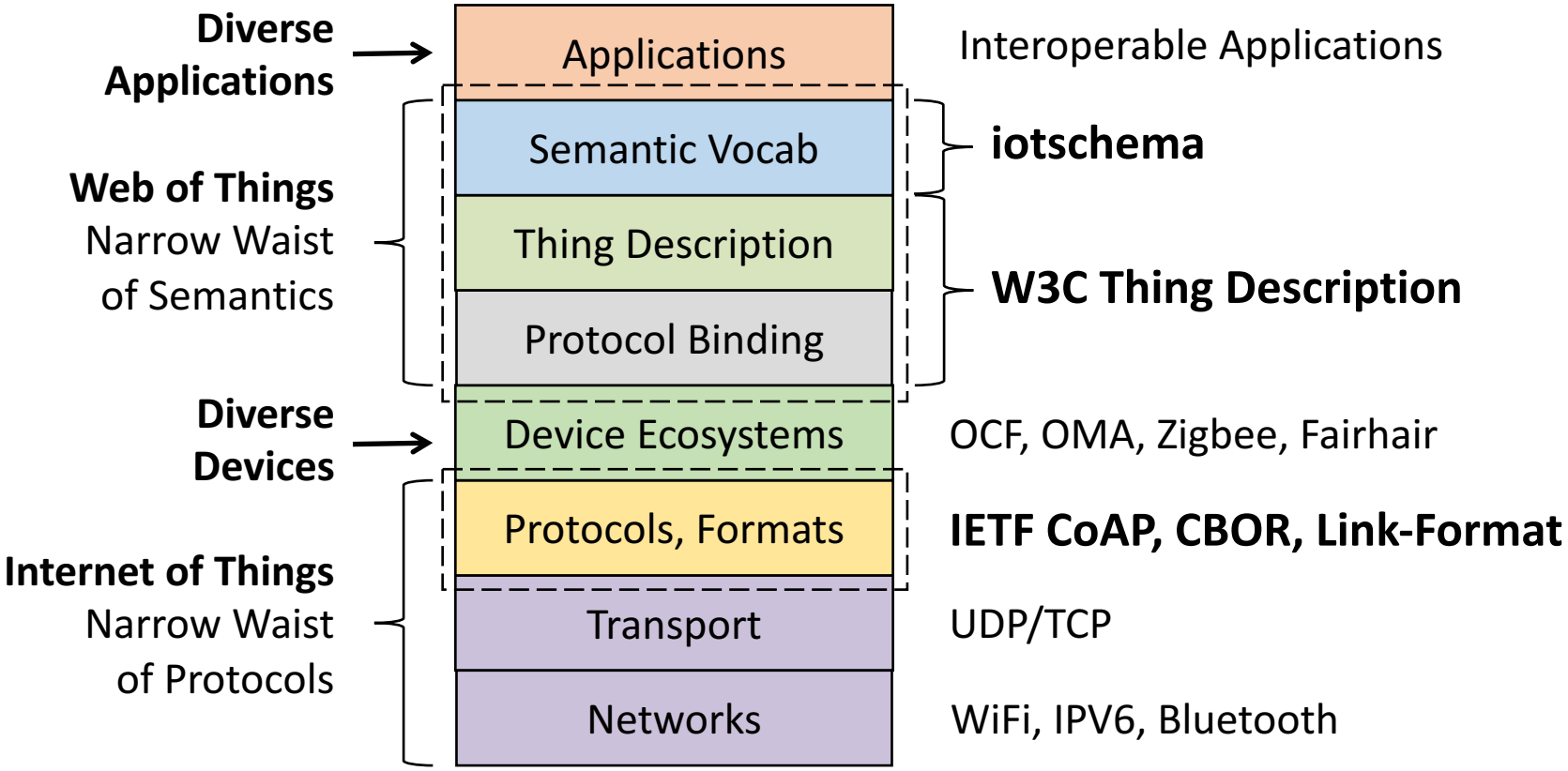
What is **iotschema** ?

- An open, publicly available, repository of semantic definitions for connected things
- An extension of schema.org to enable descriptions of things in the physical world and their data
- A community process for contribution and publication of standardized definitions
- A way for domain experts to easily create semantic definitions that are relevant to their application domain

What is **iotschema** (2)

- A layer to bridge between device ecosystems and Semantic Web technologies
- Normalize the device definitions from OCF, oneM2M etc.
- Reuses property and relation types from existing ontologies and definitions
  - SSN, SOSA, SAREF, QUDT
  - Property types for e.g. Feature of Interest, units of measurement
- Annotation vocabulary for WoT Thing Description
  - Common definitions for application-specific Events, Actions, and Properties

Diverse Devices and Applications, Common Protocols and Semantics



Who is **iotschema** for?
For Different IoT Actors

- **Device vendors** will use **iotschema** to publish protocol-neutral definitions of their devices to enable web scale adoption

- **IoT platform providers** will use **iotschema** to make it easy for third party applications to use the platform

- **Application providers** will use **iotschema** to make their applications portable across platforms

- **Domain experts** will use **iotschema** to create domain-specific languages for connected things and their applications

iotschema Semantic Definitions

- Semantic definitions that follow the design patterns and interaction affordances of connected things
- Define a "Capability" that represents – typically – the smallest practical compose-able unit of functionality
- For example, a temperature sensor, or a door lock

iotschema Semantic Definitions

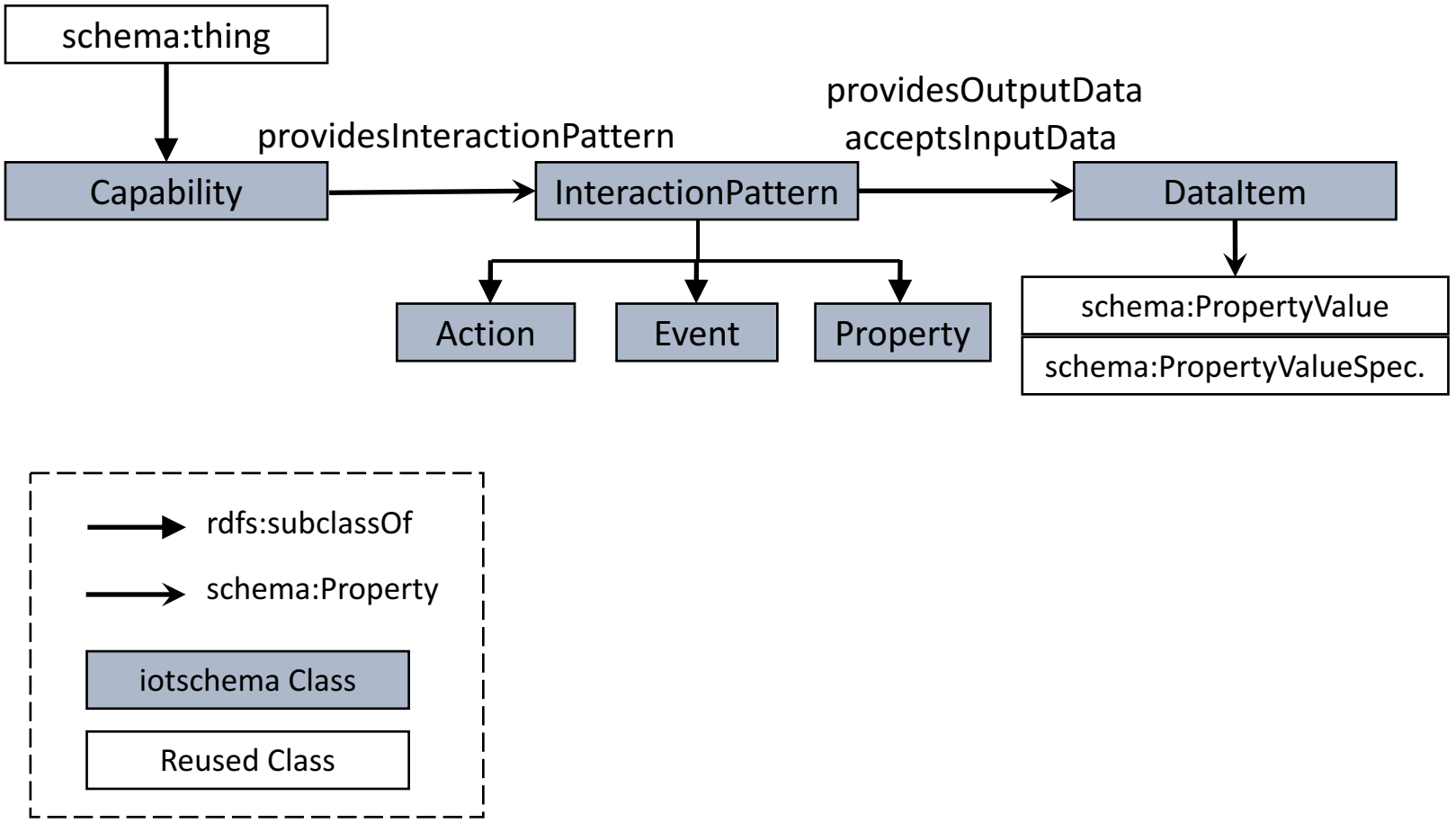
- **iotschema** semantic definitions consist of three categories, or classes, that describe a measurement or actuation, of some physical property or item

  - A **Capability** describes measurement and actuation of some physical variable or set of variables, for example the temperature of something, or the brightness of a light bulb. A Capability has some related Interactions.

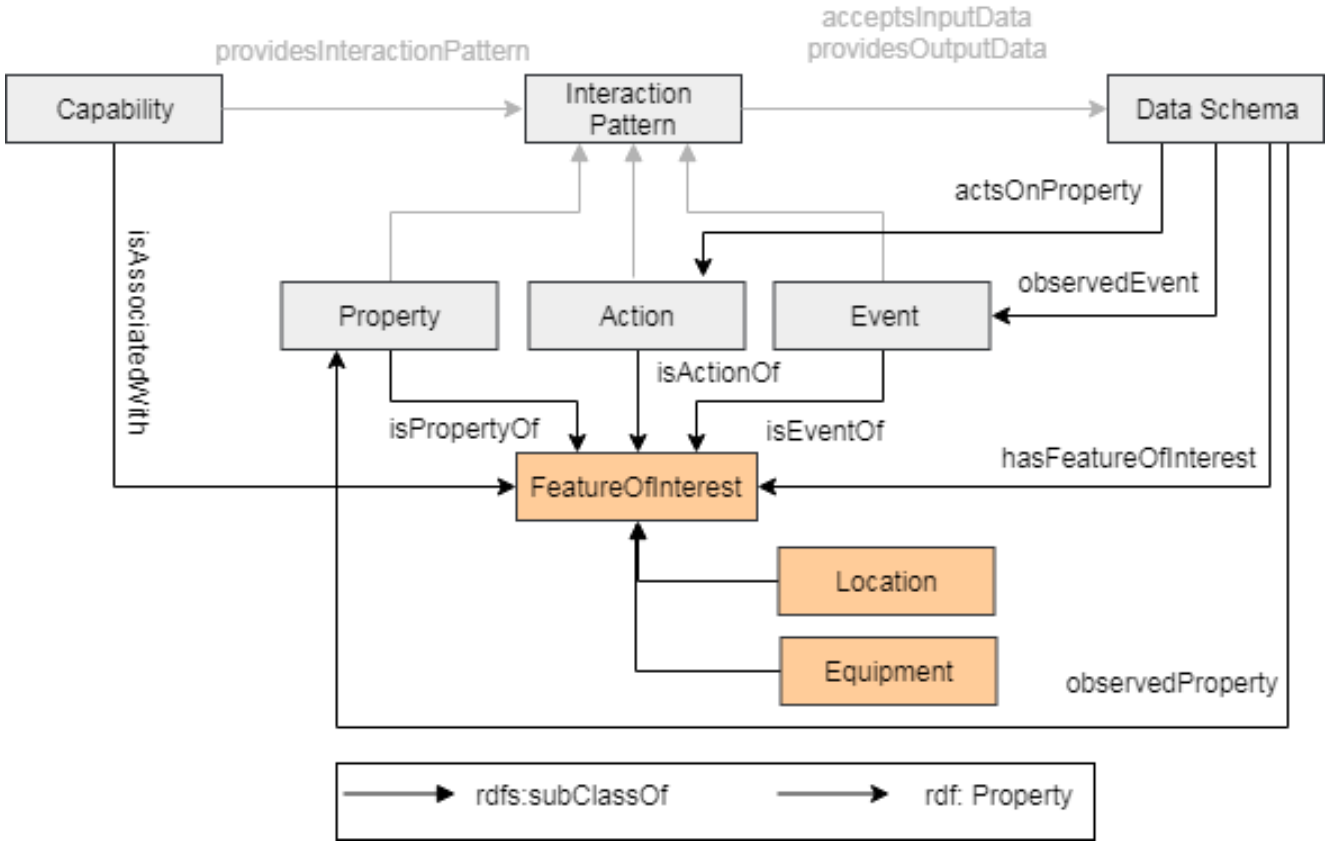
  - An **Interaction (Event, Action, or Property)** describes an affordance to the capability, which may be to read or write a value, or perform a complex action.

  - **Data Item** descriptions contain data types, units, minimum and maximum values, and other information about the data model, for example a shape or schema

iotschema Model



Feature Of Interest Pattern

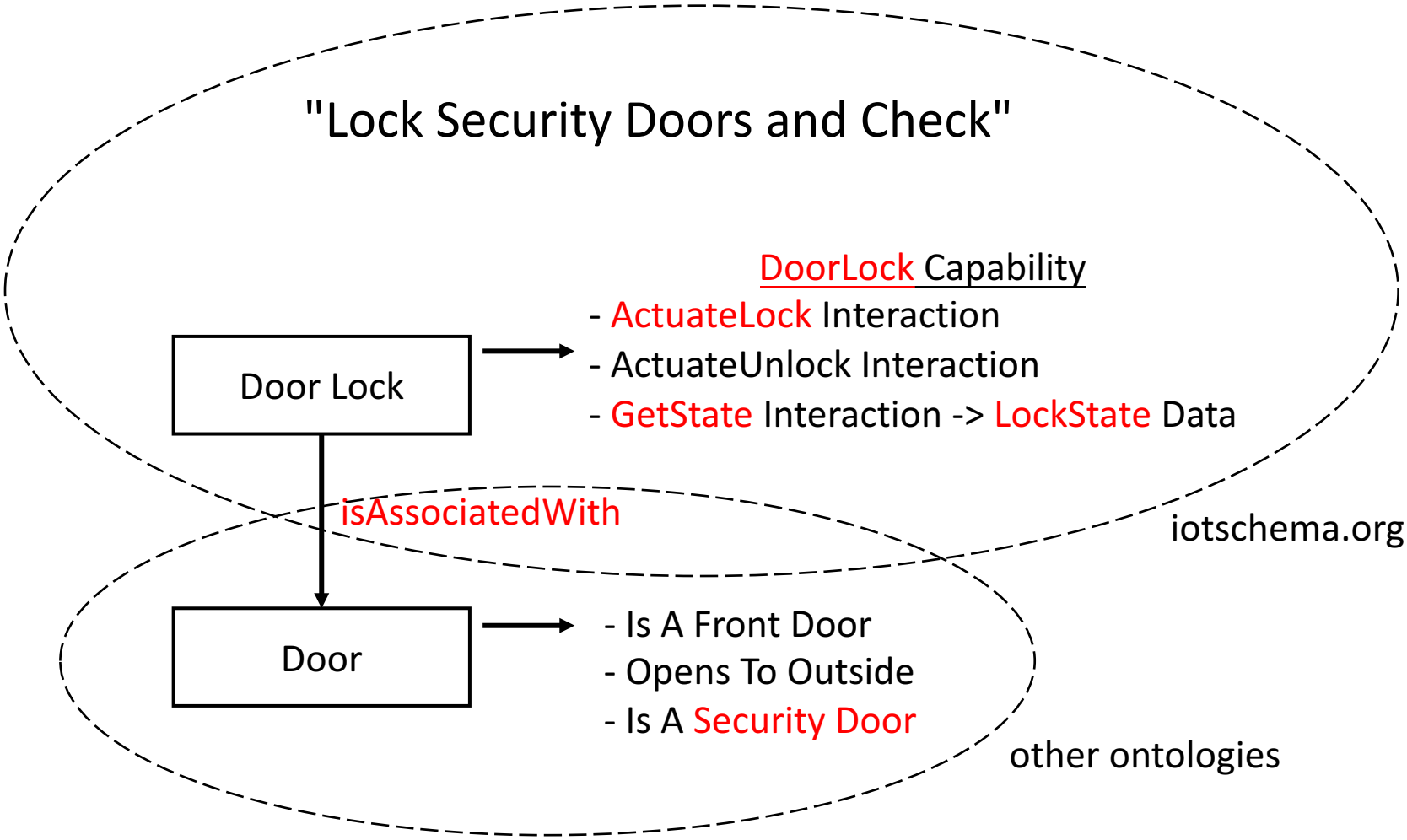


- **iotschema** defines relationships between Capabilities and Features of Interest to describe **connected physical systems**

iotschema Conceptual Integration with other ontologies

- SSN, SOSA, SAREF concepts can extend a definition
- Feature of Interest concepts and property types to describe location, equipment, or other classifiers
  - For example: BrickSchema definitions from Haystack
- Quantity and Units constraints can use QUDT concepts and appropriate identifiers

Connect things to the real world



How is **iotschema** used?

- Annotation of Thing Descriptions (W3C Web of Things)
- A Thing Description represents a thing that can be annotated with **iotschema** capability terms
- Thing Descriptions have Action, Event, and Property Interaction definitions that can be annotated with **iotschema** Interaction class terms
- Thing Descriptions have DataSchema elements that can be annotated with **iotschema** Data Item class terms and constraints, such as data type, units
- Thing Description enables applications to interact with connected things independent of protocol and platform

How is **iotschema** used?

Capability

iotschema.org

About

TemperatureSensing

Canonical URL: http://iotschema.org/TemperatureSensing

Capability > TemperatureSensing

A capability for temperature sensing

Property	Expected Type	Description
Properties from TemperatureSensing		
temperature	Temperature	A property that relates a capability with its Temperature interaction pattern.
Properties from Capability		
providesInteractionPattern	InteractionPattern	A property that relates a capability with its interaction patterns.
isAssociatedWith	FeatureOfInterest	A relation between a Capability and the entity it belongs to.

Interaction Pattern

Temperature

Canonical URL: http://iotschema.org/Temperature

InteractionPattern > Property > Temperature

Temperature interaction property

Property	Expected Type	Description
Properties from Temperature		
providesTemperatureData	TemperatureData	A property that relates an Interaction Pattern with its output TemperatureData.
Properties from Property		
isObservedBy	Sensor	Relation between a PropertyValue and the Sensor which is able to observe it.
writable	Boolean	Property to specify writability of a property.
observable	Boolean	Property to specify observability of a property.
isPropertyOf	FeatureOfInterest	Relation between a Property and the entity it belongs to.
Properties from InteractionPattern		
providesOutputData	PropertyValue or PropertyValueSpecification	Property for Output Data from an Interaction.
acceptsInputData	PropertyValue or PropertyValueSpecification	Property for Input Data of an Interaction.
capability	Capability	A property that relates an interaction pattern with its capability .

Data Schema

TemperatureData

Canonical URL: http://iotschema.org/TemperatureData

TemperatureData

Temperature data

Property	Expected Type	Description
Properties from TemperatureData		
maxValue	Number	The upper value of some characteristic or property.
minValue	Number	The lower value of some characteristic or property.
temperatureUnitCode	TemperatureUnit	A property that relates TemperatureData with its unit.
numberDataType	Number	The data with value type Number.

Instances of Temperature may appear as values for the following properties

Property	On Types	Description
temperature	TemperatureSensing or AirConditioner or Thermostat	A property that relates a capability with its Temperature interaction pattern.

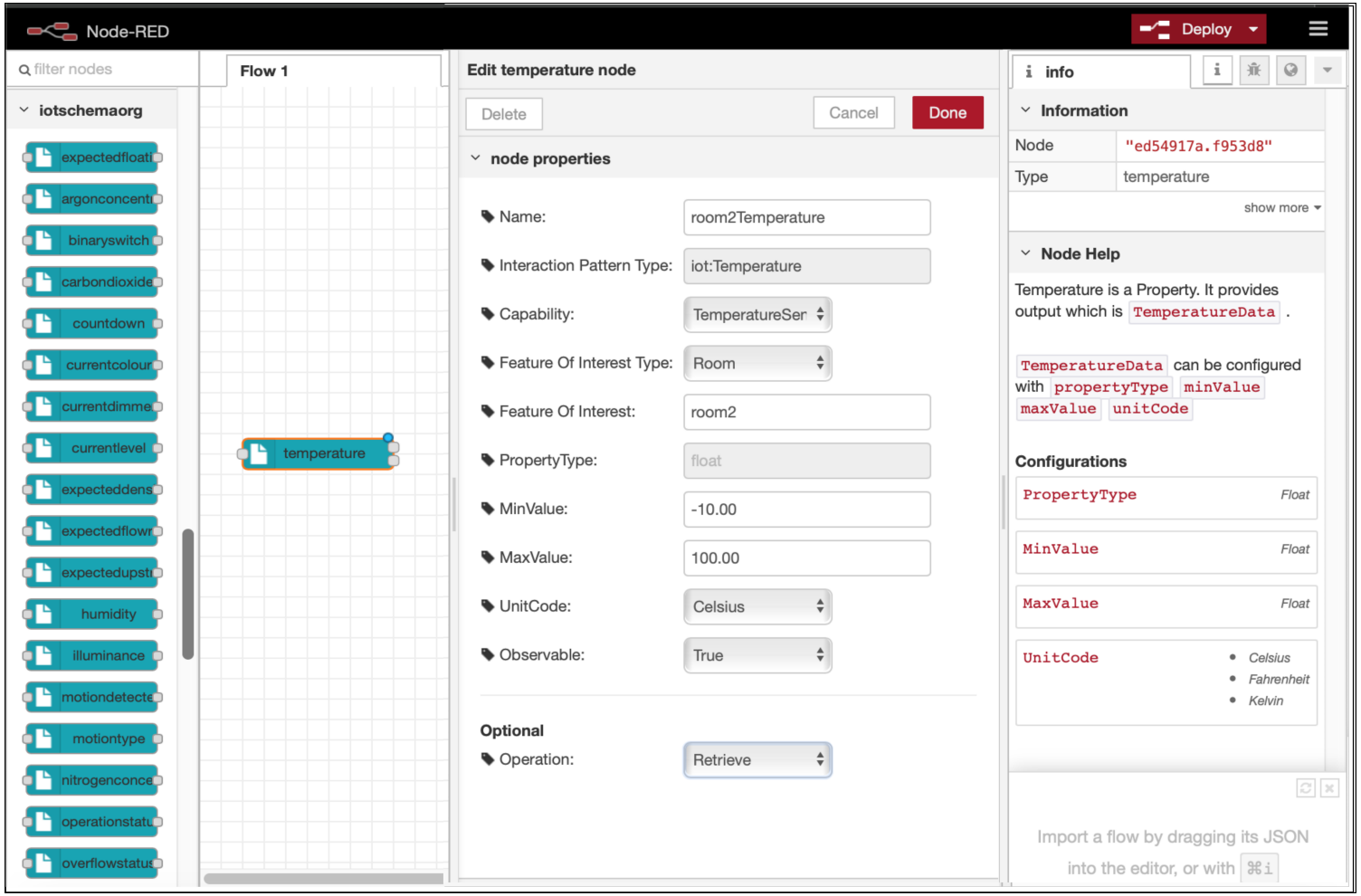
More specific Types

- Air Temperature

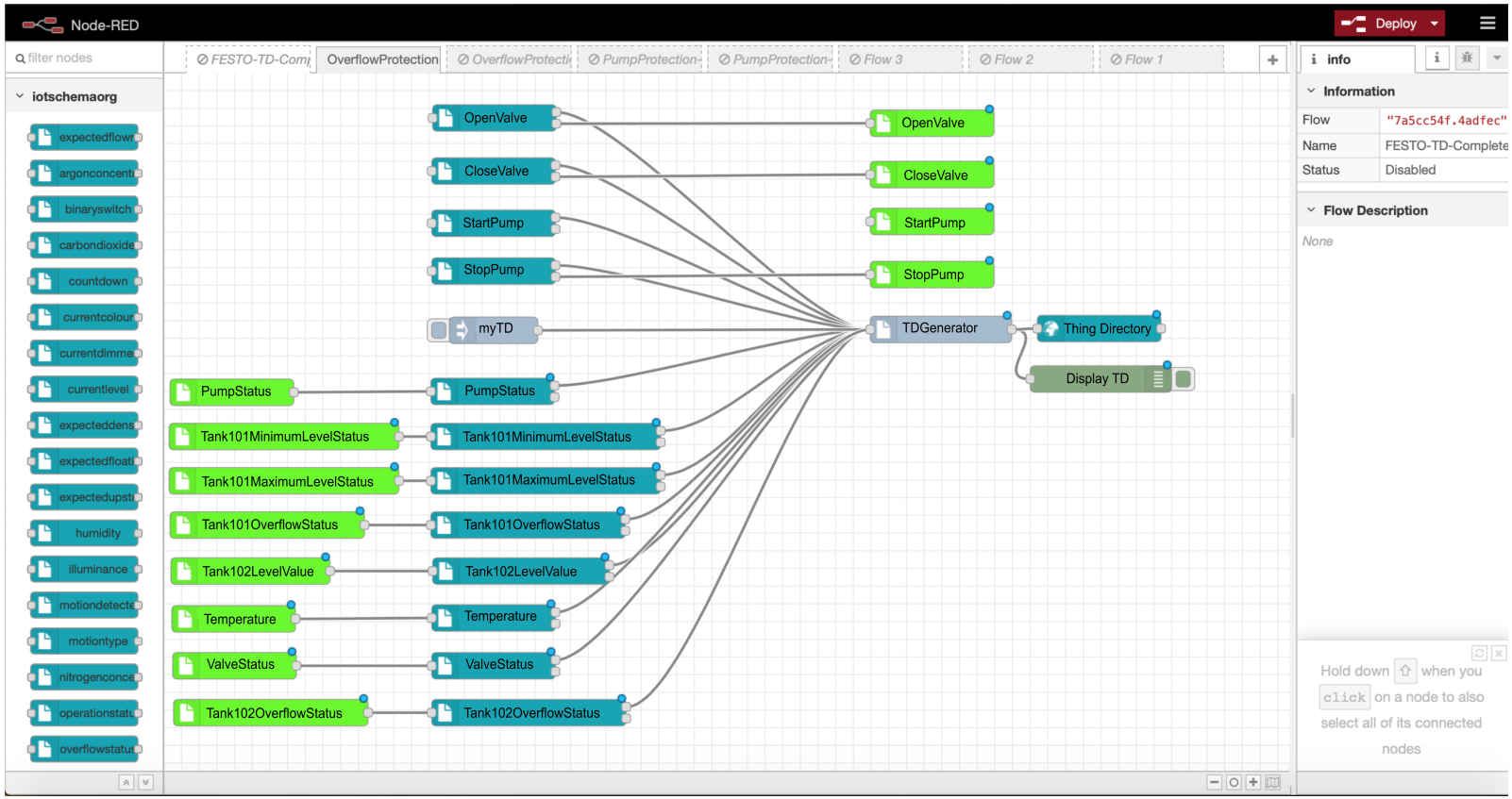
Thing Description Example

```
{ "@context": [      {"iot": http://iotschema.org/ }   ],
   "@type": ["Thing", "iot:TemperatureSensing"],
   "name": "TemperatureSensor",
   "iot:isAssociatedWith" : {"@id": "31.636", "@type": "iot:Room"},
   “properties": {
     “currentTemperature” : {
      "@type": ["iot:Temperature"],
      "isPropertyOf": {"@id": "31.636", "@type": "iot:Room"},
      “properties": { "type":"number",
                    “schema:minValue": 0,   “schema:maxValue” : 50,
                    “schema:unitCode”:”iot:Celsius” },
       ….
} ] }
```

iotschema Node-RED



iotschema Node-RED



Status

- Monthly Teleconferences since mid-2017
- Examples of Definitions in a Github repository
- FoI annotation examples are also in the repo
- Prototypes tested at W3C Web of Things Plugfests and WISHI/IETF Hackathons from mid 2017
- Contributors are ready to begin submitting definitions
- Next steps are to build out tools and processes
- W3C Community Group

References

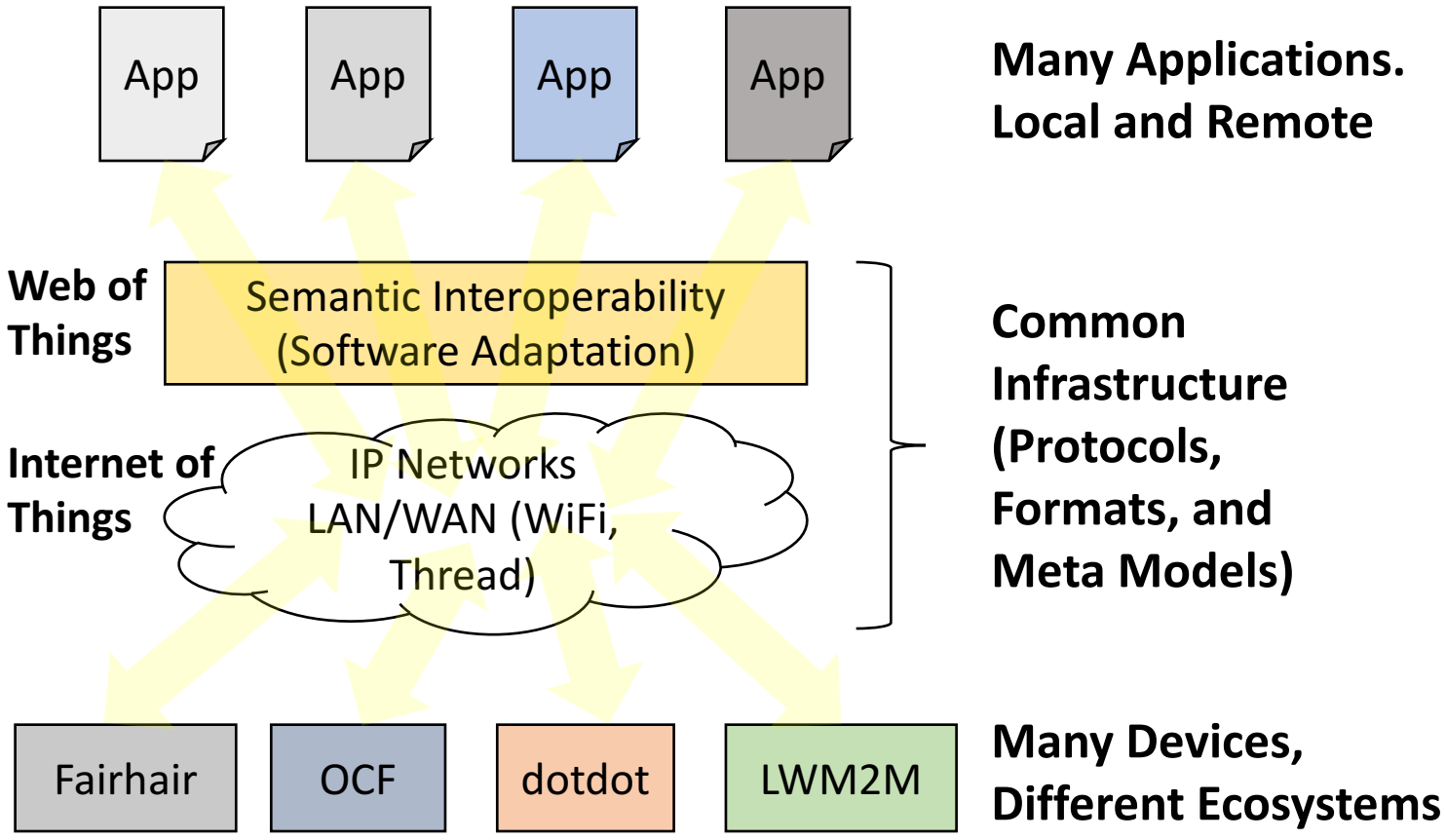
- **iotschema** links
  - https://github.com/iot-schema-collab/teleconferences/blob/master/README.md
  - https://github.com/iot-schema-collab/intro-materials
  - https://github.com/iot-schema-collab/teleconferences

- iotschema Node-RED project
  - https://github.com/iot-schema-collab/iotschema-node-red

- W3C Community Group
  - https://www.w3.org/community/iotschema/
  - Provides an IPR framework for contribution

Thank you

Narrow Waist in System Design



Feature of Interest Integration

- **Features Of Interest** (FoI) describe the real-world targets of sensing and actuation

- Definitions may be developed in iot.schema.org, or more likely will come from domain experts
  - GENIVI/VSS is a Specification for Automotive Features of Interest, called Branches, and actuation/measurement points, called Attributes and Signals
  - BrickSchema is an adaptation of Haystack that defines Features of Interest of buildings and actuation or measurement points
- **iotschema** defines relationships between Capabilities and Features of Interest to describe **connected physical systems**