

iot.schema.org

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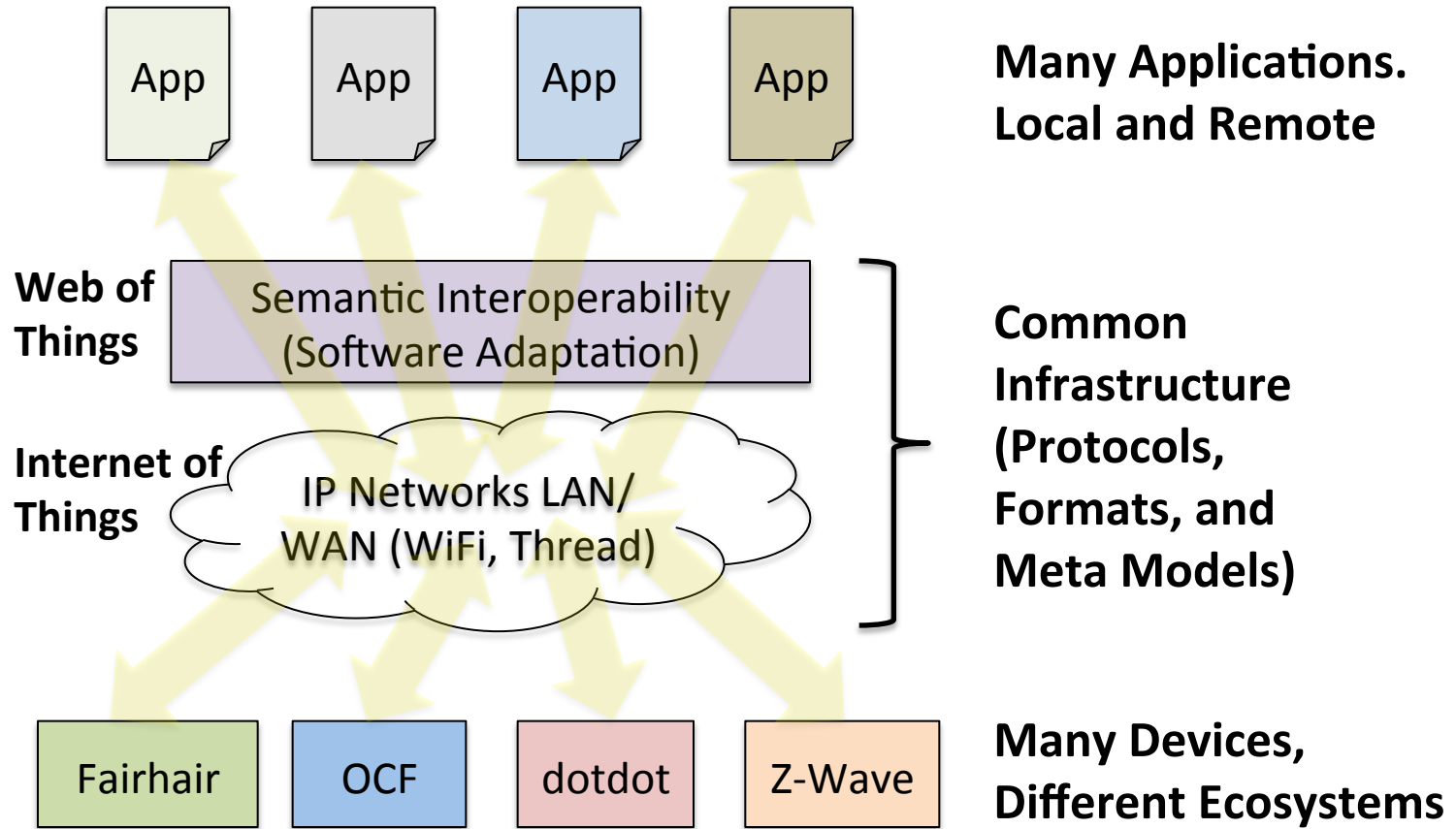
The Problem

- Many standards organizations for connected things:
 - OCF, Zigbee, Z-Wave, Bluetooth, Fairhair
 - Focus on Device Certification
 - Exclusive, require membership to participate
 - Lack focus on common interoperability
 - Compete with each other, focus on verticals
- Each defines a unique device level application layer with dedicated data models, but...
 - Similar high level design patterns
 - Converging on common communication protocols (IPV6, CoAP, et. al.)

Which Application Layer?

- Applications that are tightly coupled to devices, and device to device applications, will make up a smaller fraction of delivered value of connected things over time
- There will be more value in interoperable applications that can orchestrate behavior across diverse devices and device ecosystems
- More devices will use Internet Protocols (IP) to connect to networks (Internet of Things)
- The job of adapting to different device ecosystems can now be done in software, in different locations
- **Standardize a high level application layer, like the web, that works with all devices (Web of Things)**

Narrow Waist in System Design



What needs to be built?

- Application level semantic interoperability
 - Well known formats to describe common affordances of connected things (What does it do? What can I control?)
 - A way to describe how to interact with connected things from different device ecosystems, which use similar protocols but diverse data models
 - Enable easy implementation of Bridges, Libraries, Translators, Mappings, Bindings, Proxies

iotschema Charter - What

- Extend the schema.org model
- Provide the semantic normalization layer that enables software to interact with the physical world through connected things
- Develop common design patterns that address multiple application domains
- Develop workflow and tools to enable definitions to be constructed for multiple application domains
- Deliver horizontal definitions and vertical definitions
- Adopt common serializations and tools

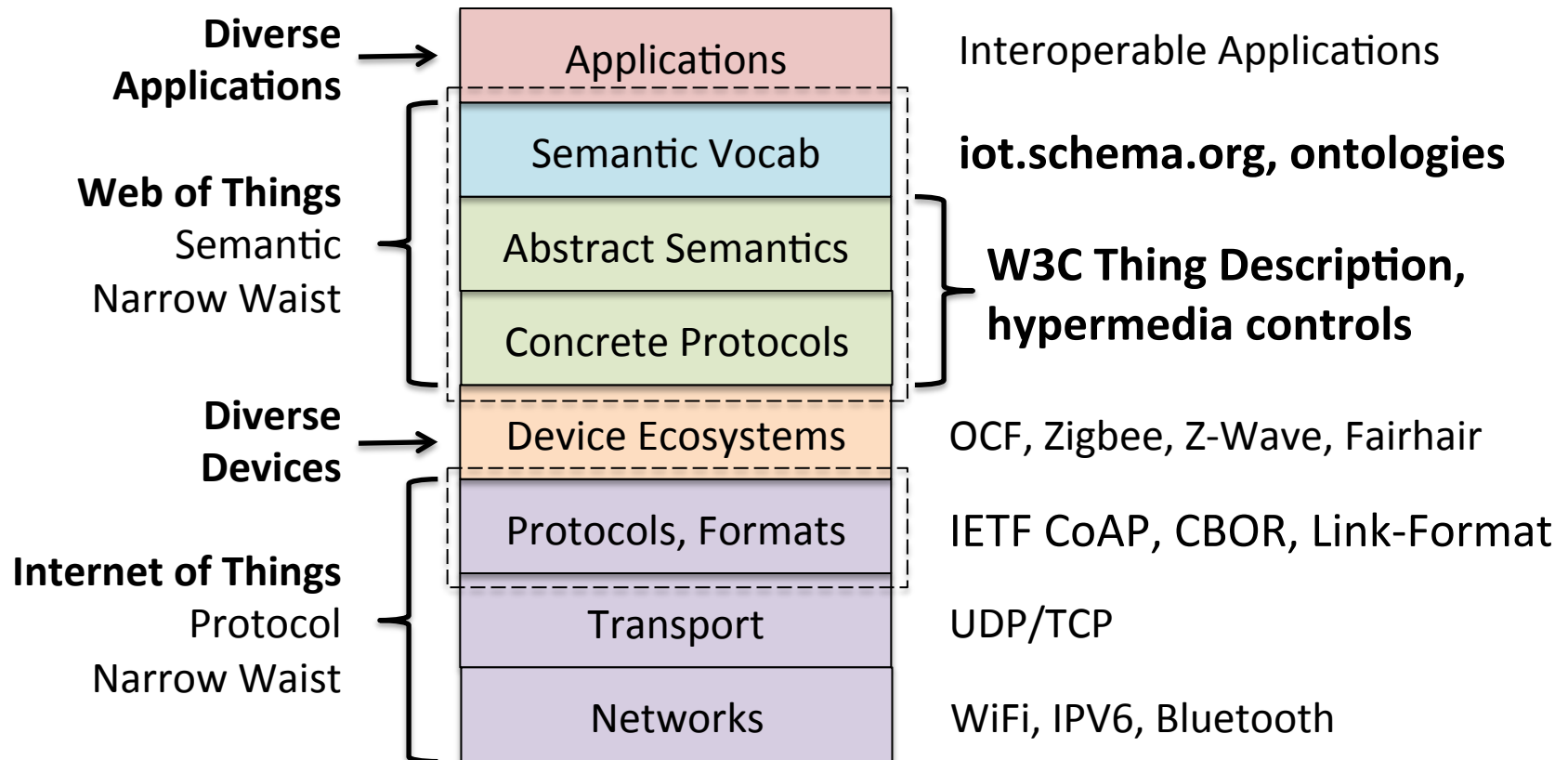
iotschema Charter - How

- Adapt schema.org patterns, integrate with and reuse other ontologies and vocabularies
- Rosetta stone approach based on similarity of traits across different contributed models
- Open community process based on W3C Community Group membership or schema.org membership for contributors
 - W3C Community IPR policy; royalty-free
- Collaborate with other organizations to address broad use cases, drive and participate in Interop events

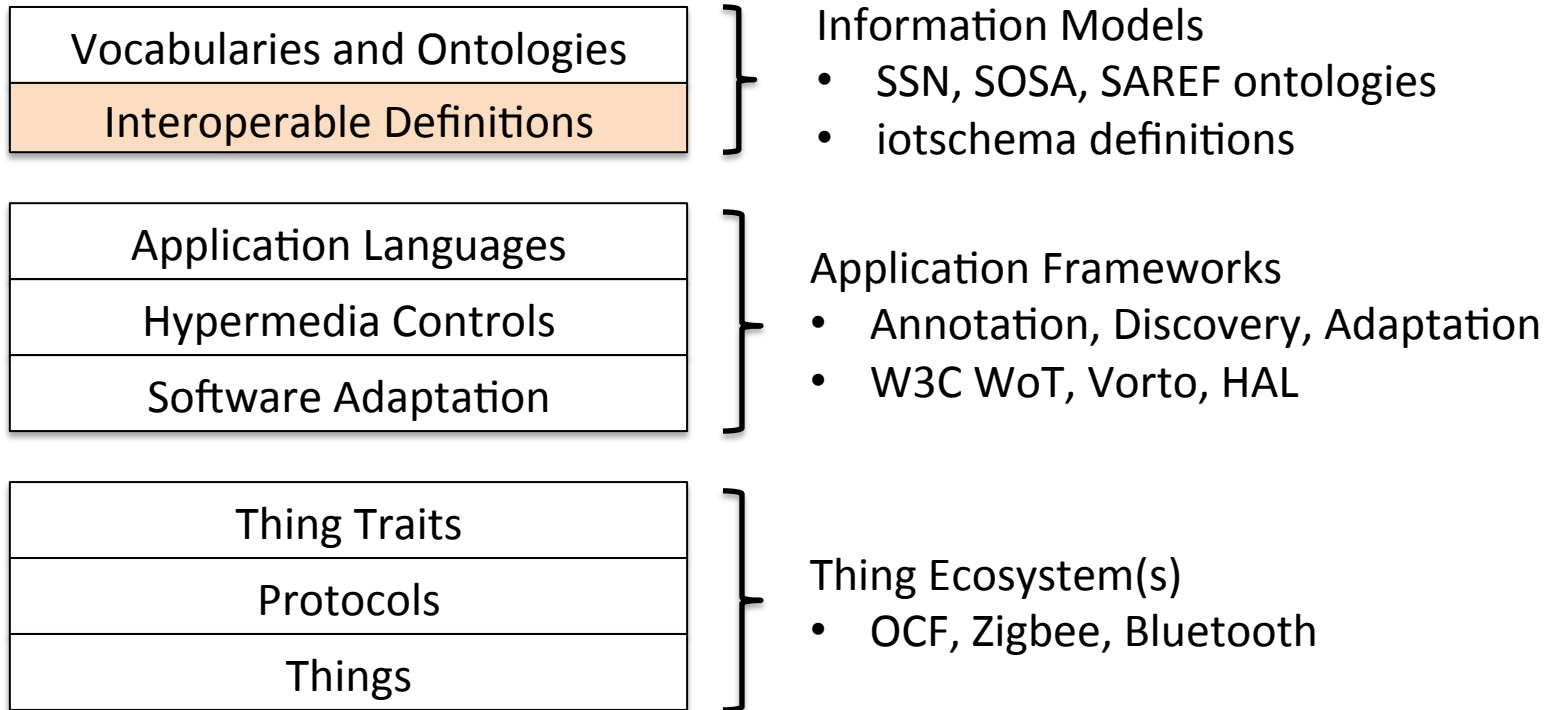
Reuse and Integration with other standards

- Layered approach to take existing vocabularies and make definitions that can be applied to existing connected things
- Facilitate end to end semantic interoperability by filling in the gap between devices and ontologies
- Integration with W3C Web of Things and semantic annotation for hypermedia controls
- Common modeling tools and serializations

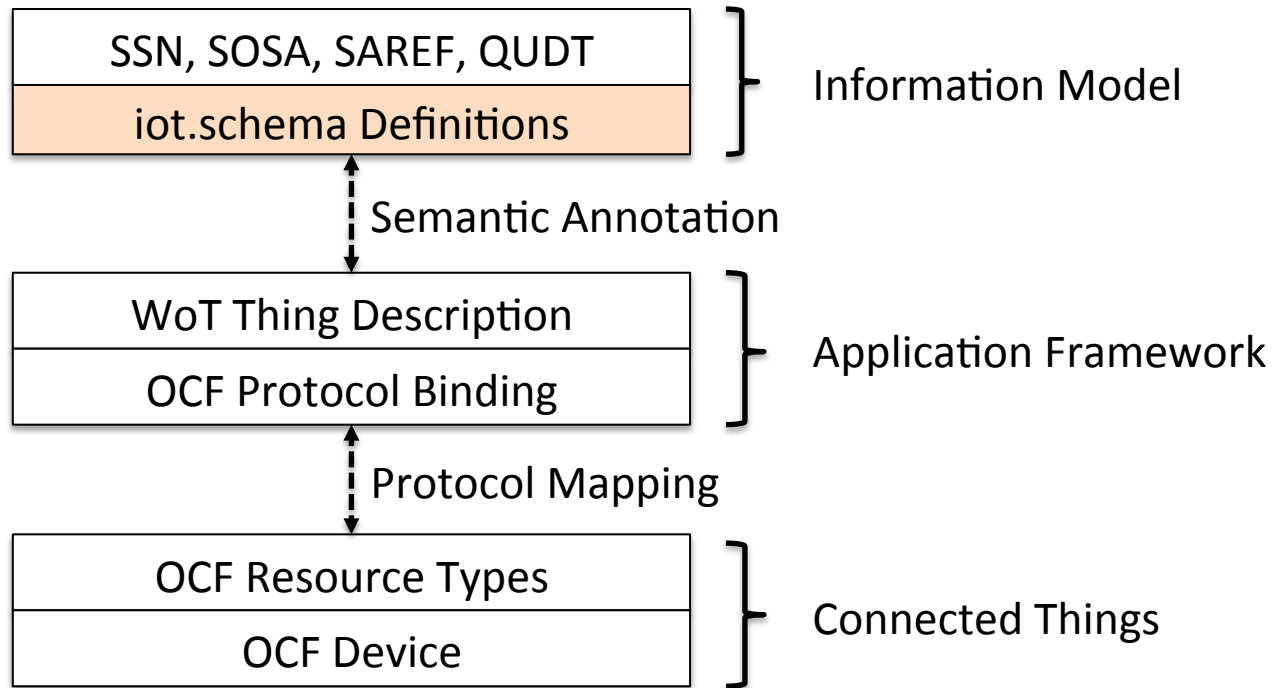
Layers in the Semantic Stack



Semantic Stack Model



Semantic Stack Example



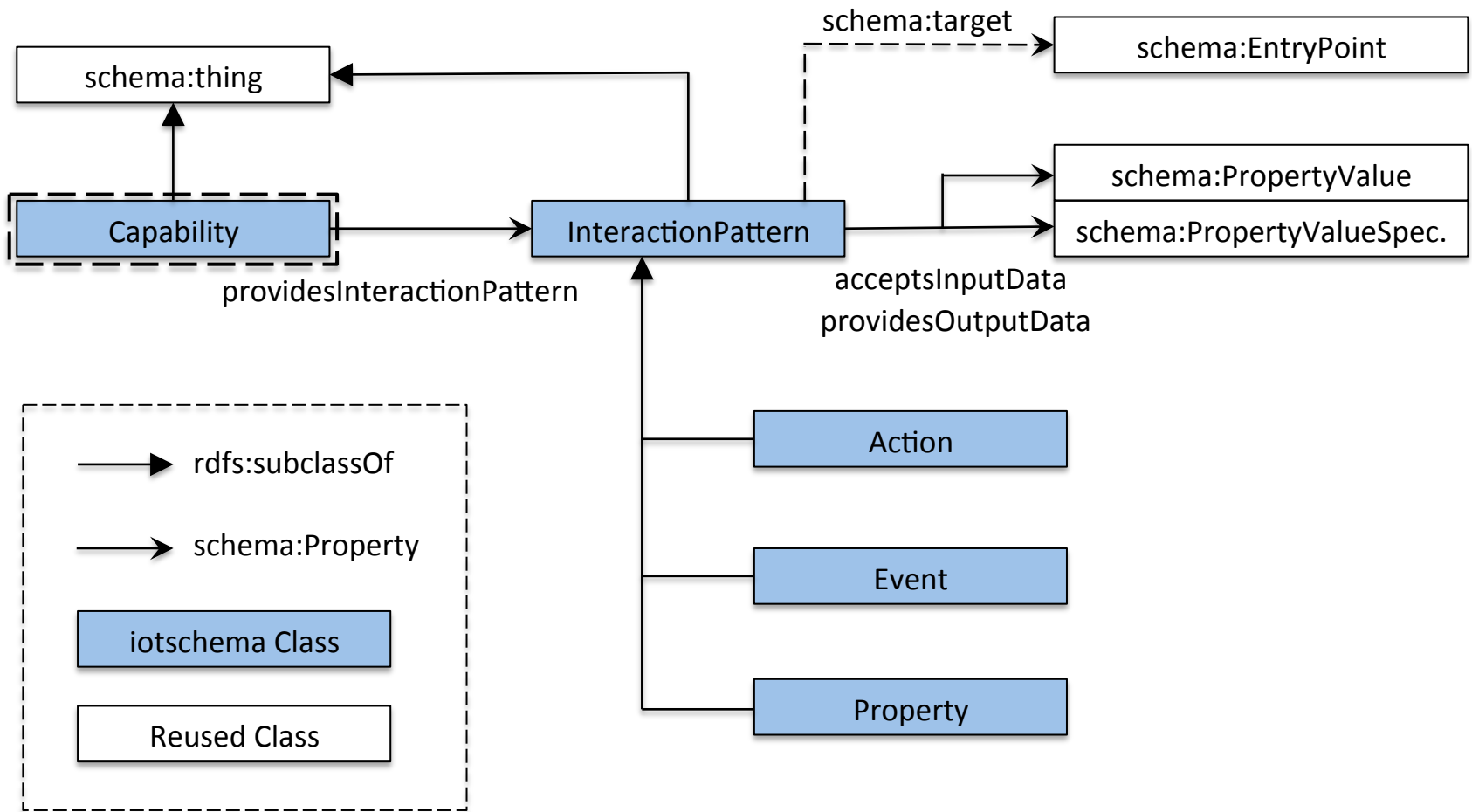
Capability Abstraction

- Connected things expose simple "traits" and functional affordances like REST resources, common command sets
- A capability is an abstraction of something a connected thing can do, like measure temperature or switch on and off
- Capability descriptions can be layered and composed for instances of connected things

Examples of Capabilities

Thing	Capabilities	Properties	Type	Actions
Motion Sensor	Motion Sensing	Motion	Boolean	(read)
Temperature	Temperature Sensing	Temperature	Number	(read)
Light	Switch	SwitchState	Boolean	TurnOn TurnOff
Light	Level Control	Level TransitionTime	Number Number	MoveToLevel MoveLevel StepLevel

iotschema Capability Pattern



Example iotschema Definition

```
"type": "LevelCapability",
"id": "iotschema:LevelCapability",
"subClassOf": "Capability",
"description": "Level Sensing and Control Capability",
"providesInteractionPattern": {
  "level": {
    "type": "Property",
    "name": "level",
    "acceptsInputData": {
      "type": "schema:Number",
      "schema:valueName": "level",
      "schema:unitCode": "ucum:%"
    },
    "providesOutputData": {
      "type": "schema:Number",
      "schema:valueName": "level",
      "schema:unitCode": "ucum:%"
    }
  }
},
```

Example Definition (cont'd)

```
"moveToLevel": {
  "type": "Action",
  "name": "moveToLevel",
  "acceptsInputData": {
    "level": {
      "type": "schema:Number",
      "schema:valueName": "level",
      "schema:unitCode": "ucum:%"
    },
    "transitionTime": {
      "type": "schema:Number",
      "schema:valueName": "transitionTime",
      "schema:unitCode": "ucum:s"
    }
  }
}
```


Example Instance – TD Interaction

```
{
  "semtype": ["action", "sch:movetolevel"];
  "name": "set brightness level",
  "inputdata": {
    "type": "object"
    "properties": {
      "level": {
        "type": "number",
        "semtype": "sch:level"
      },
      "time": {
        "type": "number",
        "semtype": "sch:transitiontime"
      }
    }
  },
  "links": [
    (protocol goes here)
  ]
}
```

Example Instance – TD Protocol

```
links: [  
  {  
    "href": "coap:10.0.0.17:8000/light/brightness",  
    "mediatype": "application/vnd.ocf+cbor",  
    "method": "ocf.update",  
    "rt": ["oic.r.brightness", "oic.r.ramptime"],  
    "if": ["oic.if.a", "oic.if.baseline"],  
    "inputschema": {  
      "type": "object",  
      "properties": {  
        "brightness": {  
          "value": "{{level}}"  
        },  
        "ramptime": {  
          "value": "{{time}}"  
        }  
      }  
    }  
  }  
]
```

Where we are in the process

- Formation phase completing
- Initial examples contributed
- Charter and scope defined
- Monthly teleconferences
- Opening collaborative participation in W3C Web of Things Community Group

Collaboration

- Contributions are governed by an open community process
- CC-SA license for contributions
- W3C WoT Community Group for incubation of new definitions
- Collaboration with W3C Web of Things IG/WG in progress

Organization Collaborations

- Outreach to Organizations
- W3C, IETF, OCF, OneM2M, IPSO, Zigbee Alliance, OPC,
- EU 2020 Projects for connected things
- Alignment of goals and objectives, problems to solve
- Contributions of data models and interaction models
- QUDT, SOSA, Haystack as raw materials, so the community can easily put things together

Research Collaboration

- Research on semantic integration in systems
- How to combine multiple ontologies
- How to factor out differences in ontologies
- Semantic annotation for discovery
- How to achieve operational goals by assembling semantically annotated components