

# Semantic Discovery Patterns

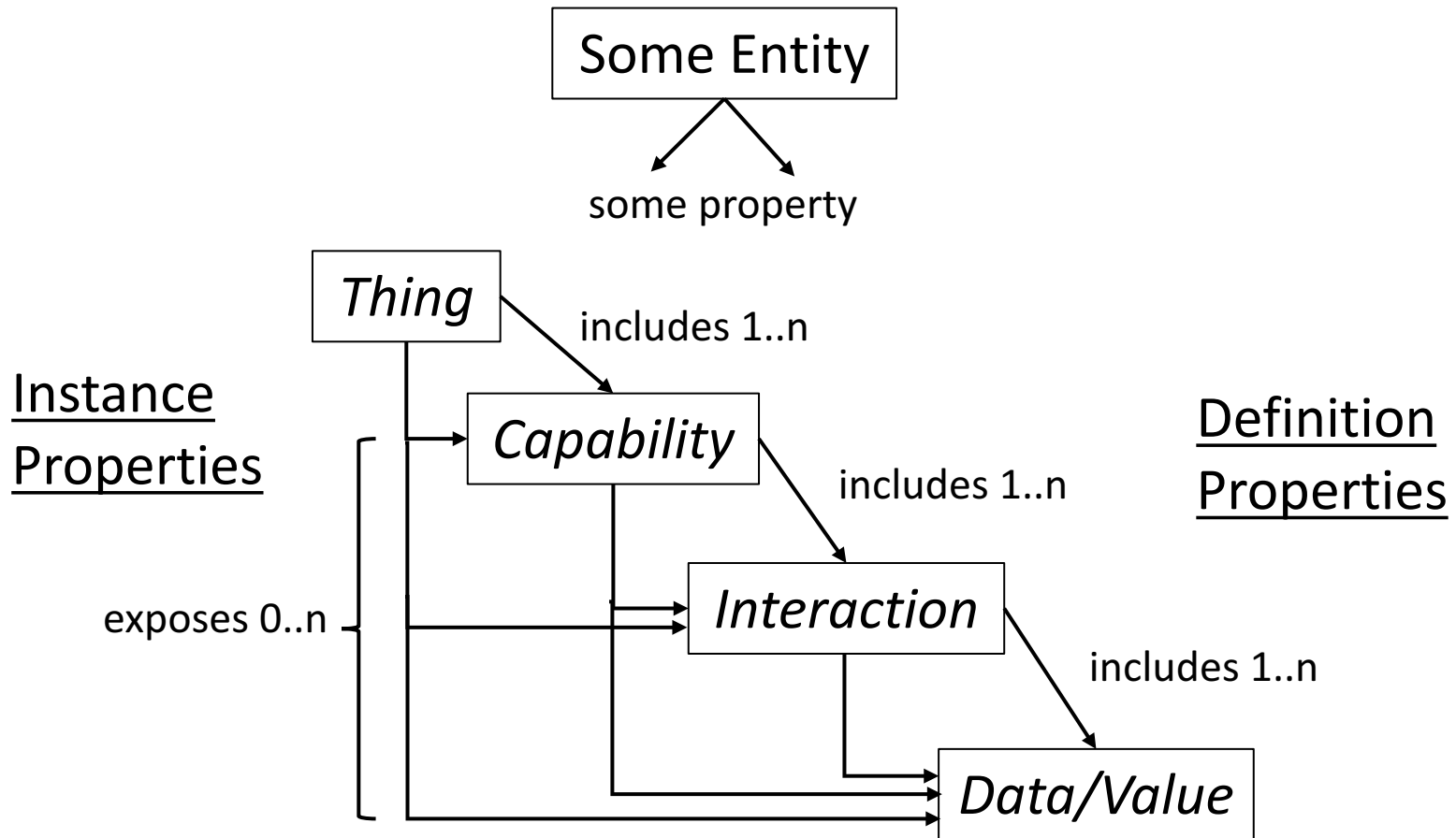
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WISHI March 12, 2018

# iotschema.org – iot.schema.org prototype

- Initial working set of capability definitions
- <http://iotschema.org/docs/full.html>
- Still missing some additional definitions for
  - Thing types (can be defined as a capability that contains other capabilities)
  - Features of Interest and relations for them (New Feature Class)

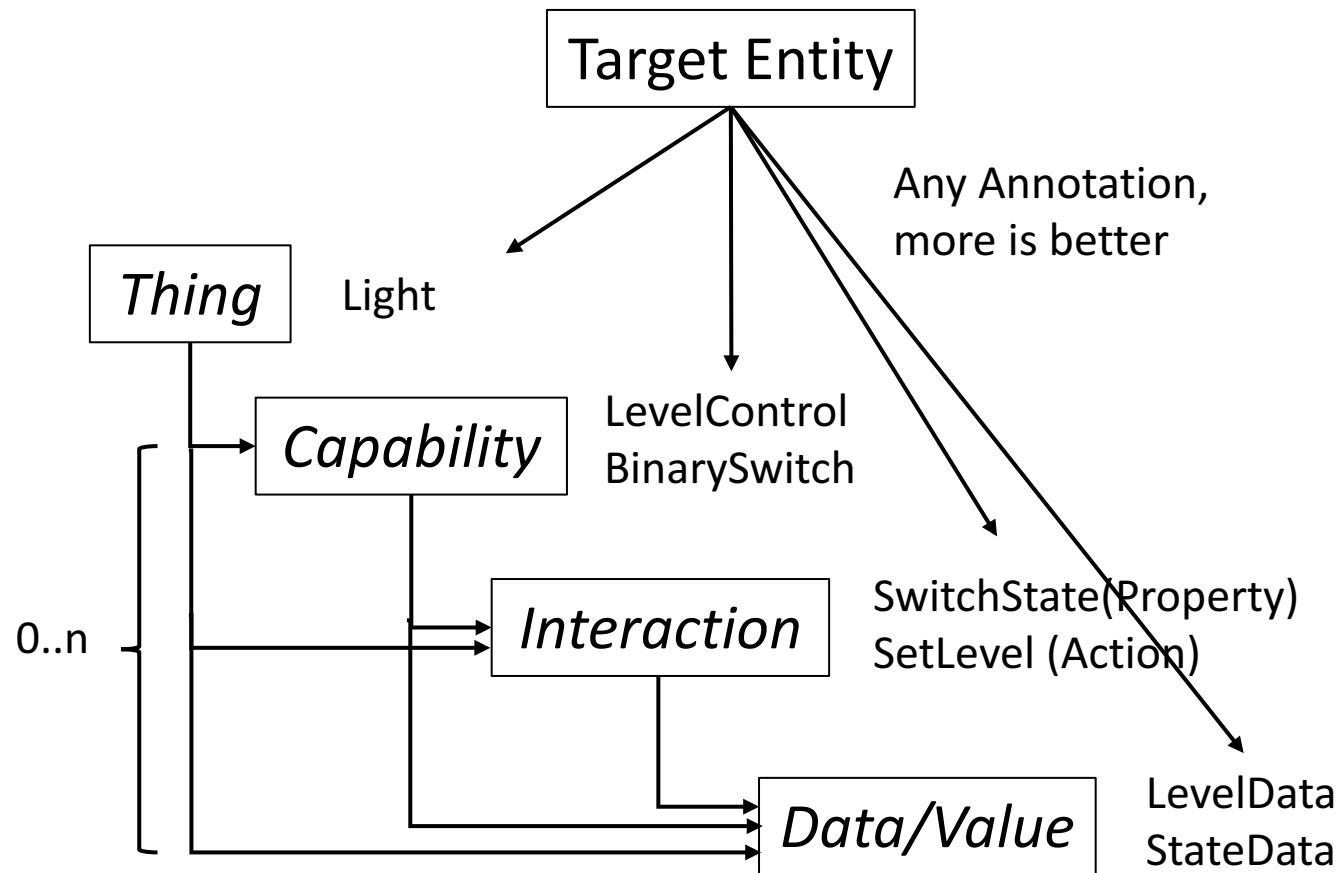
# Loose Hierarchy of Definitions that supports diverse bindings



# The Meaning of Interaction Class

- In the general sense, Interactions represent "verbs" that are applicable to (a Property of) a Feature of Interest, invoking some process:
  - Observe Temperature (proxy for sensing)
  - Read Settings (retrieve property values)
  - Open Valve (actuation)
  - Lock Door (actuation)
- Events, Actions, and Properties are convenience classes that are used for modeling interactions, which also carry explicit constraints when used in W3C Thing Description documents (td:Event, etc.)

# Target can use any annotation - iotschema provides intrinsic context



# W3C Thing Description Example

```
{
  "@context": [
    "http://iotschema.org/w3c-wot-td-context.jsonld",
    "http://iotschema.org/w3c-wot-common-context.jsonld",
    {"iot": "http://iotschema.org/context.jsonld",
     "http": "http://www.w3.org/2011/http#"}
  ],
  "base": "http://0m2m.net:1880",
  "@type": [ "Thing", "iot:Light", "iot:BinarySwitch", "iot:LevelControl" ],
  "name": "Lamp",
  "interaction": [
    {
      "name": "Switch State",
      "@type": [ "Property", "iot:SwitchState" ],
      "schema": {
        "type": "object",
        "field": [
          {
            "name": "on",
            "@type": [ "iot:StateData" ],
            "schema": {
              "type": "boolean"
            }
          }
        ]
      }
    }
  ],
},
```

```
"form": [  
  {  
    "href": "/light",  
    "mediatype": "application/json",  
    "rel": "readProperty",  
    "http:methodName": "GET"  
  },  
]
```



# LWM2M Semantic Annotation

## Example using CoRE Link-Format and CoRE Resource Directory

# LWM2M Example (e.g. Leshan)

LWM2M Registry Contains:

</3311> (Light Control)

</3311/0>

</3311/1>

</3311/0/5850> (On/Off)

</3311/0/5851> (Dimmer)

</3311/1/5850>

</3311/1/5851>

# Semantic Index using CoRE RD

An example endpoint registered with RD as a semantic index:

```
<http://iotschema.org/common>;rel=describedBy;uri-  
prefix="iot";type="application/ld+json application/json",  
</3311>;con=coaps://[2001:DB8::1]:5684;type=vnd.oma.lwm2m+cbor,  
</3311/0/>;st="iot:Light iot:BinarySwitch iot:LevelControl",  
</3311/0/>;anchor="iot:LivingRoom";rel="iot:LocationContains",  
</3311/0/5850>;st="iot:SwitchState iot:StateData",  
</3311/0/5851>;st="iot:CurrentLevel iot:LevelData",  
</3311/1/>;st="iot:Light iot:BinarySwitch iot:LevelControl",  
</3311/1/>;anchor="iot:Kitchen";rel="iot:LocationContains",  
</3311/1/5850>;st="iot:SwitchState iot:StateData",  
</3311/1/5851>;st="iot:CurrentLevel iot:LevelData",
```

# RD Lookup for Semantic Discovery

The application can form discovery queries and construct a semantic graph using the link target attribute "st" and the iotchema definition as a template.

**GET http://0m2m.net:8008/.well-known/core**

```
<http://0m2m.net:8008/rd>;rt=core.rd,  
<http://0m2m.net:8008/rd-lookup/res>;rt=core.rd-lookup-res,  
<http://iotschema.org/common/>;rel=describedBy;uri-  
prefix="iot";type="application/ld+json application/json"
```

**GET http://0m2m.net:8008/rd-**

**lookup/res?st="iot:Luminary"&st="iot:LevelControl"**

```
<coaps://[2001:DB8::1]:5684/3311/0>;st="iot:Luminary"  
"iot:BinarySwitch" "iot:LevelControl",  
<coaps://[2001:DB8::1]:5684/3311/1>;st="iot:Luminary"  
"iot:BinarySwitch" "iot:LevelControl",
```

**GET http://0m2m.net:8008/rd-**

**lookup/res?anchor="iot:Kitchen"&rel="iot:LocationContains"**

```
<coaps://[2001:DB8::1]:5684/3311/1/>;anchor="iot:Kitchen";rel=  
"iot:LocationContains"
```

# RD Lookup for Semantic Discovery

**GET**

**http://0m2m.net:8008/rd/sem?href=3311/1/\*&st="iot:CurrentLevel"**  
**<coaps://[2001:DB8::1]:5684/3311/1/5851>;st="iot:CurrentLevel"**  
**"iot:LevelData"**

**GET http://0m2m.net:8008/rd/sem?href=3311/1/\*&st="iot:UnitType"**  
**<coaps://[2001:DB8::1]:5684/3311/1/5701>;st="iot:UnitType"**

# Resource Directory Prototype

- Based on Machine Hypermedia Toolkit (Python)
- Supports link-format+json and http
- Simple CRUD collection interface with rudimentary query filtering based on key-value target attributes
- A little work could improve use for RD
  - Add server-specified URI option to CREATE (may be done)
  - Build a registration lifetime timer client to count down time to live from lifetime and remove expired endpoints
  - Minor tweaks to the "content handler" e.g. PUT to refresh time to live
  - Build a lookup handler