

Common Definition Format

One Data Model Liaison Group

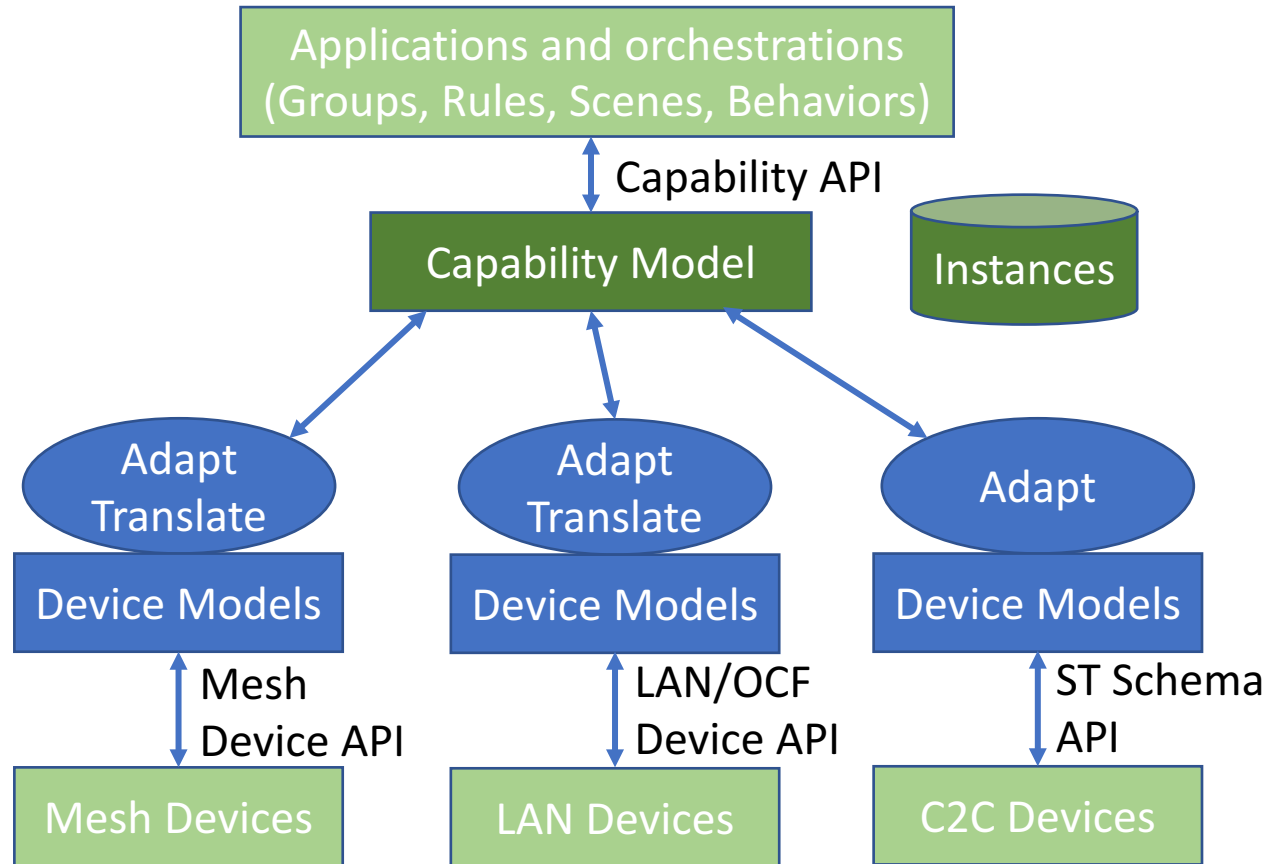
Michael Koster

March 15, 2019

Common Definition Format

- SmartThings Capability Model and Examples
- Common Definition Format
- UML model
- RDF Examples
 - ZCL lighting clusters - mapped capabilities
 - OCF lighting RTs - mapped capabilities
 - ST lighting Capabilities - mapped capabilities
- OCF Protocol Binding

SmartThings Capability Model



SmartThings Capability Definitions

```
name: Switch
status: live
attributes:
  switch:
    schema:
      type: object
      additionalProperties: false
      properties:
        value:
          $ref: SwitchState
      required: ["value"]
    type: ENUM
  values:
    - 'off'
    - 'on'
  enumCommands:
    - command: 'on'
      value: 'on'
    - command: 'off'
      value: 'off'
commands:
  'off': arguments: []
  'on': arguments: []
public: true
id: switch
ocfResourceType: x.com.st.powerswitch
version: 1
```

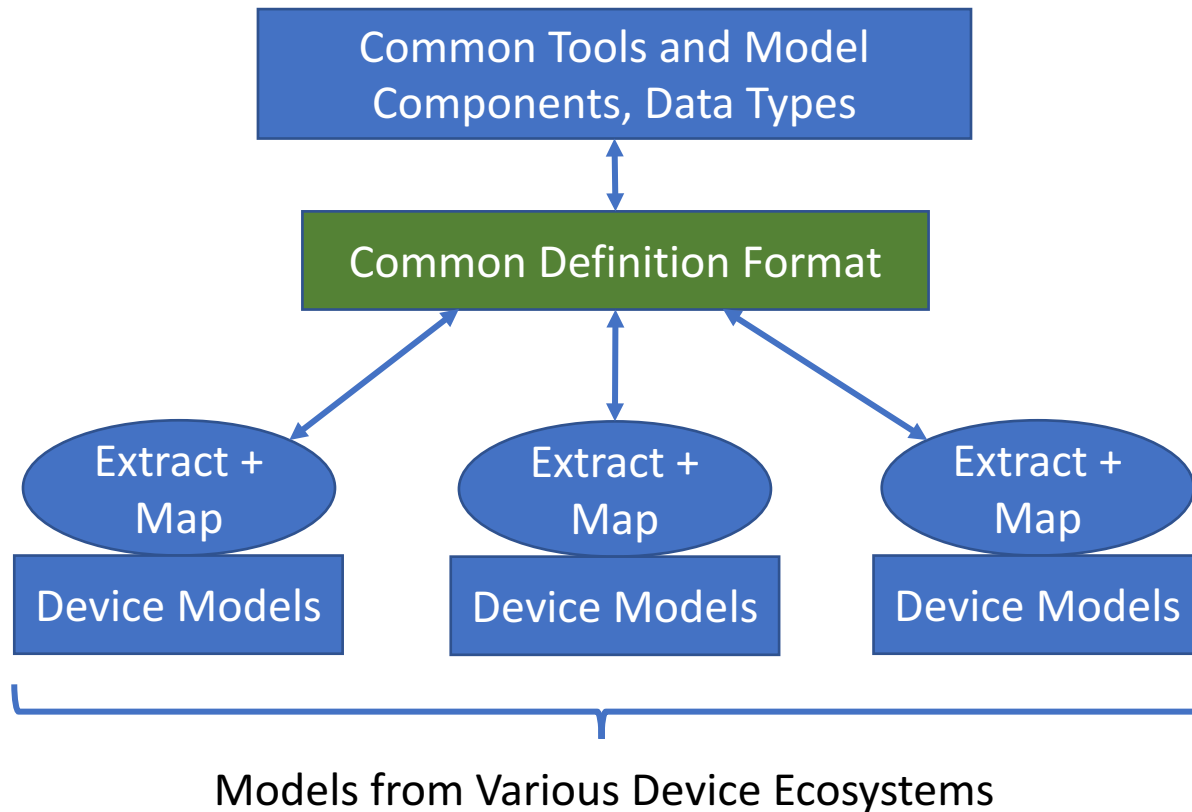
```
name: Switch Level
status: live
attributes:
  level:
    schema:
      $ref: IntegerPercent
      type: NUMBER
      setter: setLevel
commands:
  setLevel:
    arguments:
      - name: level
        schema:
          type: integer
          minimum: 0
          maximum: 100
        type: NUMBER
        required: true
      - name: rate
        schema:
          $ref: PositiveInteger
          type: NUMBER
          required: false
public: true
id: switchLevel
ocfResourceType: oic.r.light.dimming
version: 1
```

SmartThings DataType Definitions

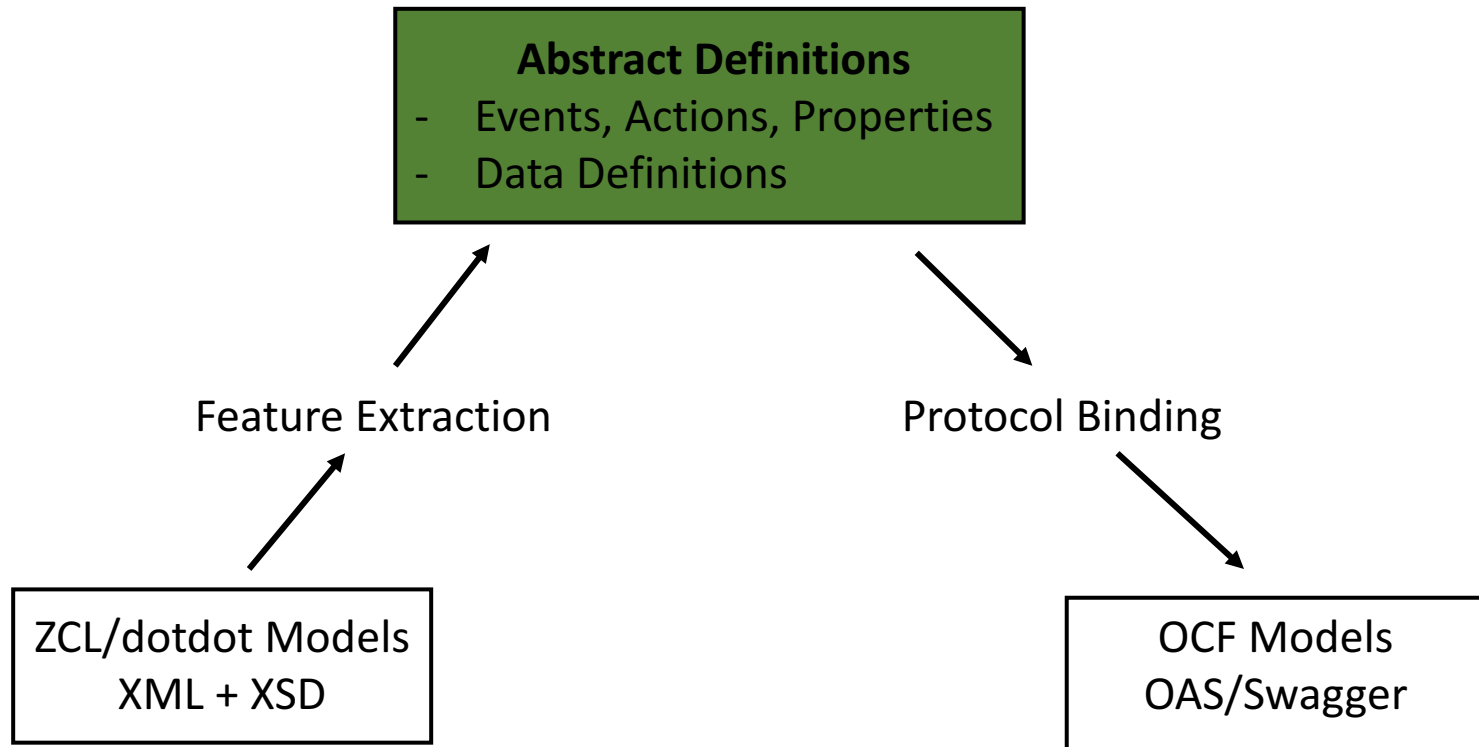
```
title: SwitchState
type: string
enum:
  - 'on'
  - 'off'
```

```
title: IntegerPercent
type: object
additionalProperties: false
properties:
  value:
    type: integer
    minimum: 0
    maximum: 100
  unit:
    type: string
    enum: ['%']
    default: '%'
required: ["value"]
```

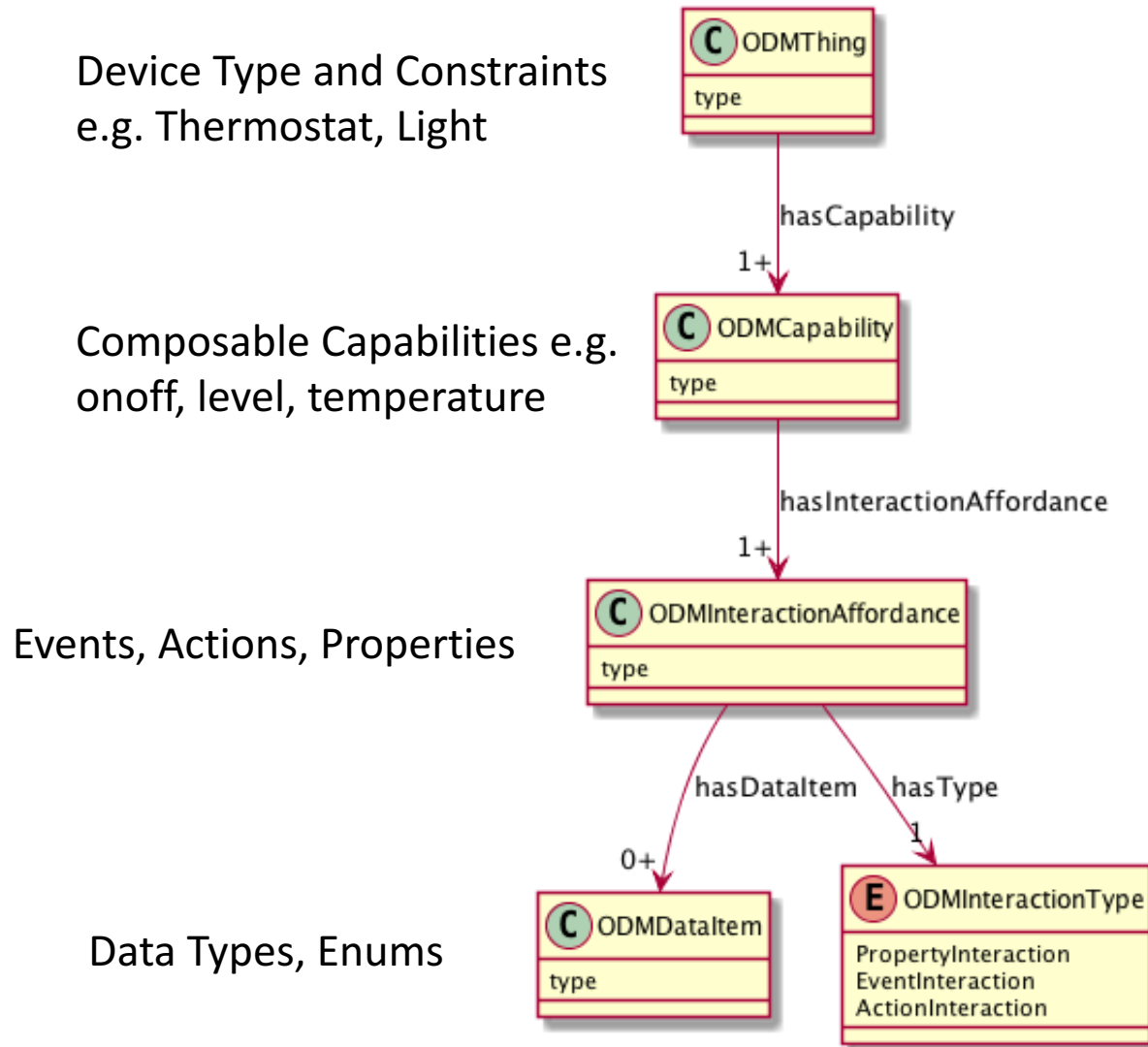
Proposal for a Common Definition Format



Supports This Pattern



UML Model



Examples

- JSON-LD (JSON format with RDF extensions)
- Files for semantic definitions of specific types:
 - Thing (Device level definitions)
 - Capability (onoff, level...)
 - InteractionAffordance (Event, Action, Property)
 - Data Types (value types, enums)
- Definition hierarchy follows the UML model
- Core schema for the UML model in JSON-LD
- Full examples at: <https://github.com/mjkoster/ODM-Examples>
- (TBD) Thing definitions to apply optionality to Capability sets, Interactions, and Data Types

ST Sourced definitions

- ODM InteractionAffordance definitions, manually extracted from some SmartThings Capability definitions
- Attributes map to ODM Property class
- Commands map to ODM Action class

ST Based Capabilities

```
{
  "@id": "st:SwitchCapability",
  "rdfs:subClassOf": "odm:Capability",
  "rdfs:comment": "Basic On/Off Switch Capability",
  "rdfs:label": "SmartThings Switch Capability",
  "odm:hasInteractionAffordance": [
    "st:Switch.valueProperty",
    "st:Switch.onAction",
    "st:Switch.offAction"
  ]
},
{
  "@id": "st:SwitchLevelCapability",
  "rdfs:subClassOf": "odm:Capability",
  "rdfs:comment": "Capability to control the level",
  "rdfs:label": "SmartThings SwitchLevel Capability",
  "odm:hasInteractionAffordance": [
    "st:SwitchLevel.levelProperty",
    "st:SwitchLevel.setLevelAction"
  ]
}
```

Properties, Actions, Events

```
{
  "@id": "st:SwitchLevel.levelProperty",
  "rdfs:comment": "The current level setting",
  "rdfs:label": "SwitchLevel levelProperty",
  "@type": "odm:PropertyInteraction",
  "rdfs:subClassOf": "odm:InteractionAffordance",
  "odm:hasDataItem": "st:SwitchLevel.levelData"
},
{
  "@id": "st:SwitchLevel.setLevelAction",
  "rdfs:comment": "Action to set the level",
  "rdfs:label": "SwitchLevel setLevelAction",
  "@type": "odm:ActionInteraction",
  "rdfs:subClassOf": "odm:InteractionAffordance",
  "odm:hasDataItem": [
    "st:SwitchLevel.levelData"
    "st:SwitchLevel.rateData"
  ]
}
```

Data Items

```
{
  "@id": "st:Switch.valueData",
  "rdfs:comment": "value data for Switch (on/off string
encoding)",
  "rdfs:label": "SmartThings SwitchLevel.levelData",
  "rdfs:subClassOf": "odm:DataItem",
  "odm:DataItemType": "js:string",
  "js:enum": ["on", "off"]
},
{
  "@id": "st:SwitchLevel.levelData",
  "rdfs:comment": "Level data for SwitchLevel",
  "rdfs:label": "SmartThings SwitchLevel.levelData",
  "rdfs:subClassOf": "odm:DataItem",
  "odm:DataItemType": "js:integer",
  "js:minimum": 0,
  "js:maximum": 100
},
{
  "@id": "st:SwitchLevel.rateData",
  "rdfs:comment": "Rate time data for setLevelAction",
  "rdfs:label": "SmartThings SwitchLevel.rateData",
  "rdfs:subClassOf": "odm:DataItem",
  "odm:DataItemType": "js:integer",
  "js:minimum": 0,
  "js:maximum": 65535
}
```

ZCL Sourced definitions

- ODM InteractionAffordances, manually extracted from ZCL definitions
- Attributes map to ODM Property class
- Commands map to ODM Action class

ZCL Example

```
{
  "@id": "zcl:LevelCapability",
  "rdfs:subClassOf": "odm:Capability",
  "rdfs:comment": "Level Control Capability",
  "rdfs:label": "ZCL Level Capability",
  "odm:hasInteractionAffordance": [
    "zcl.Level.CurrentLevelProperty",
    "zcl.Level.RemainingTimeProperty",
    "zcl.Level.OnOffTransitionTimeProperty",
    "zcl.Level.OnLevelProperty",
    "zcl.Level.OnTransitionTimeProperty",
    "zcl.Level.OffTransitionTimeProperty",
    "zcl.Level.DefaultMoveRateProperty",
    "zcl.Level.MoveToLevelAction",
    "zcl.Level.MoveAction",
    "zcl.Level.StepAction",
    "zcl.Level.StopAction",
    "zcl.Level.MoveToLevelWithOnOffAction",
    "zcl.Level.MoveWithOnOffAction",
    "zcl.Level.StepWithOnOffAction"
  ]
}
```

ZCL Example

```
{
  "@id": "zcl.Level.MoveToLevelAction",
  "rdfs:comment": "Action move to a given level",
  "rdfs:label": "ZCL Level.MoveToLevelAction",
  "@type": "odm:ActionInteraction",
  "rdfs:subClassOf": "odm:InteractionAffordance",
  "odm:hasDataItem": [
    "zcl:Level.LevelData",
    "zcl:Level.TransitionTimeData"
  ]
},
{
  "@id": "zcl.Level.MoveAction",
  "rdfs:comment": "Action move at a given rate",
  "rdfs:label": "ZCL Level.MoveAction",
  "@type": "odm:ActionInteraction",
  "rdfs:subClassOf": "odm:InteractionAffordance",
  "odm:hasDataItem": [
    "zcl:Level.MoveModeData",
    "zcl:Level.RateData"
  ]
},
```


ZCL Example

```
{
  "@id": "zcl:Level.OffTransitionTimeData",
  "rdfs:comment": "Off Transition Time Data",
  "rdfs:label": "ZCL Level.OffTransitionTimeData",
  "rdfs:subClassOf": "odm:DataItem",
  "odm:DataItemType": "js:integer",
  "js:minimum": 0,
  "js:maximum": 65534
},
{
  "@id": "zcl:Level.DefaultMoveRateData",
  "rdfs:comment": "Default Move Rate Data",
  "rdfs:label": "ZCL Level.DefaultMoveRateData",
  "rdfs:subClassOf": "odm:DataItem",
  "odm:DataItemType": "js:integer",
  "js:minimum": 0,
  "js:maximum": 254
}
```

OCF Sourced definitions

- ODM InteractionAffordances, manually extracted from OCF Resource Type definitions
- Properties map to ODM Property class
- Actions added for simple cases like brightness change with ramp time

OCF Example

```
{
  "@id": "ocf:BinarySwitchCapability",
  "rdfs:subClassOf": "odm:Capability",
  "rdfs:comment": "On/Off Switch Capability",
  "rdfs:label": "OCF BinarySwitch Capability",
  "odm:hasInteractionAffordance": [
    "ocf:BinarySwitch.valueProperty",
    "ocf.BinarySwitch.OnAction",
    "ocf.BinarySwitch.OffAction"
  ]
},
{
  "@id": "ocf:BrightnessCapability",
  "rdfs:subClassOf": "odm:Capability",
  "rdfs:comment": "Capability to control the
brightness",
  "rdfs:label": "OCF Brightness Capability",
  "odm:hasInteractionAffordance": [
    "ocf:Brightness.BrightnessProperty",
    "ocf:Brightness.SetBrightnessAction"
  ]
},
```

OCF Example

```
{
  "@id": "ocf:Brightness.brightnessProperty",
  "rdfs:comment": "Brightness Property",
  "rdfs:label": "OCF Brightness.brightnessProperty",
  "@type": "odm:PropertyInteraction",
  "rdfs:subClassOf": "odm:InteractionAffordance",
  "odm:hasDataItem": "ocf:Brightness.brightnessData"
},
{
  "@id": "ocf:Brightness.SetBrightnessAction",
  "rdfs:comment": "Set Brightness Action",
  "rdfs:label": "OCF Brightness.SetBrightnessAction",
  "@type": "odm:ActionInteraction",
  "rdfs:subClassOf": "odm:InteractionAffordance",
  "odm:hasDataItem": [
    "ocf:Brightness.BrightnessData",
    "ocf.RampTime.RampTimeData"
  ]
},
```

OCF Example

```
{
  "@id": "ocf:Brightness.brightnessData",
  "rdfs:comment": "Brightness Data",
  "rdfs:label": "OCF Brightness.brightnessData",
  "rdfs:subClassOf": "odm:DataItem",
  "odm:DataItemType": "js:integer",
  "js:minimum": 0,
  "js:maximum": 255
},
{
  "@id": "ocf:RampTime.ramptimeData",
  "rdfs:comment": "Ramp Time Data",
  "rdfs:label": "OCF RampTime.ramptimeData",
  "rdfs:subClassOf": "odm:DataItem",
  "odm:DataItemType": "js:integer",
  "js:minimum": 0,
  "js:maximum": 65535
},
```

OCF Example

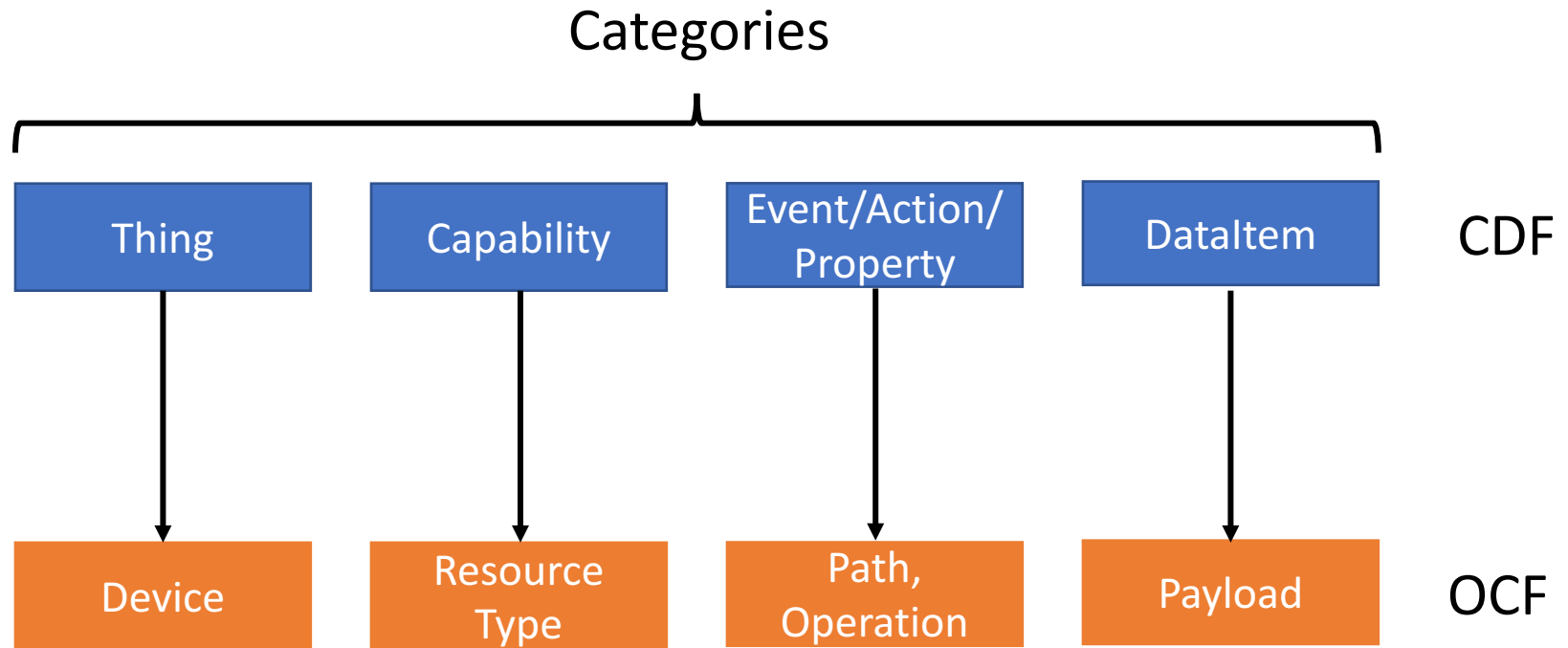
```
{
  "@id": "ocf:BinarySwitch.OnAction",
  "rdfs:comment": "Binary Switch On Action",
  "rdfs:label": "OCF BinarySwitch.valueProperty",
  "@type": "odm.ActionInteraction",
  "rdfs:subClassOf": "odm:InteractionAffordance",
  "odm:hasDataItem": "ocf:BinarySwitch.valueOnData"
},

{
  "@id": "ocf:BinarySwitch.OnValueData",
  "rdfs:comment": "Boolean value for On state",
  "rdfs:label": "OCF BinarySwitch.valueData",
  "rdfs:subClassOf": "odm:DataItem",
  "odm:DataItemType": "js:boolean",
  "js:const": true
},
```

OCF Protocol Binding/Mapping

- Example of an OCF Resource Type definition (OAS/Swagger) file with annotations/extensions for modeling ODM Actions
- Mapping can be done to existing OCF types in some cases using CDF annotation
- OAS target patterns can be generated using templates and annotated with CDF semantics
- Enables an ODM-Capable Bridge or adaptation client to use ODM to generate OCF API calls

OCF Protocol Binding Example



OCF Definition with annotations

```
"title": "Binary Switch",
"version": "v1.1.0-20160519",
"license": {
  "name": "copyright 2016-2017 Open Connectivity
Foundation, Inc. All rights reserved.",
}
},
"@type": "ocf:BinarySwitchCapability",
"schemes": ["http"],
"consumes": ["application/json"],
"produces": ["application/json"],
"paths": {
  "/BinarySwitchResURI" : {
    "@type": [
      "ocf:BinarySwitch.valueProperty",
      "ocf:BinarySwitch.OnAction",
      "ocf:BinarySwitch.OffAction"
    ],

```

OCF Definition with annotated paths and operations

```
"paths": {  
  "/BinarySwitchResURI" : {  
    "@type": [  
      "ocf:BinarySwitch.valueProperty",  
      "ocf:BinarySwitch.OnAction",  
      "ocf:BinarySwitch.OffAction"  
    ],  
    "get": {  
      "@type": "ocf:BinarySwitch.valueProperty",  
    }  
  
    "post": {  
      "@type": [  
        "ocf:BinarySwitch.valueProperty",  
        "ocf:BinarySwitch.OnAction",  
        "ocf:BinarySwitch.OffAction"  
      ],  
    }  
  }  
}
```

OCF Definition with data annotations

```
(...)  
  "minItems": 1,  
  "readOnly": true,  
  "type": "array"  
},  
"value" :  
  {  
    "@type": [  
      "ocf:BinarySwitch.valueData",  
      "ocf:BinarySwitch.OnValueData",  
      "ocf:BinarySwitch.OffValueData"  
    ],  
    "description": "Status of the switch",  
    "type": "boolean"  
  },  
}
```

Example Device Level Definitoin

```
{
  "@id": "st:DimmableLight",
  "rdfs:subClassOf": "odm:Thing",
  "rdfs:comment": "Simple Dimmable Light Bulb",
  "rdfs:label": "SmartThings DimmableLight",
  "odm:hasCapability": [
    "st:SwitchCapability",
    "st:SwitchLevelCapability"
  ]
}
```