W3C WoT in a nutshell

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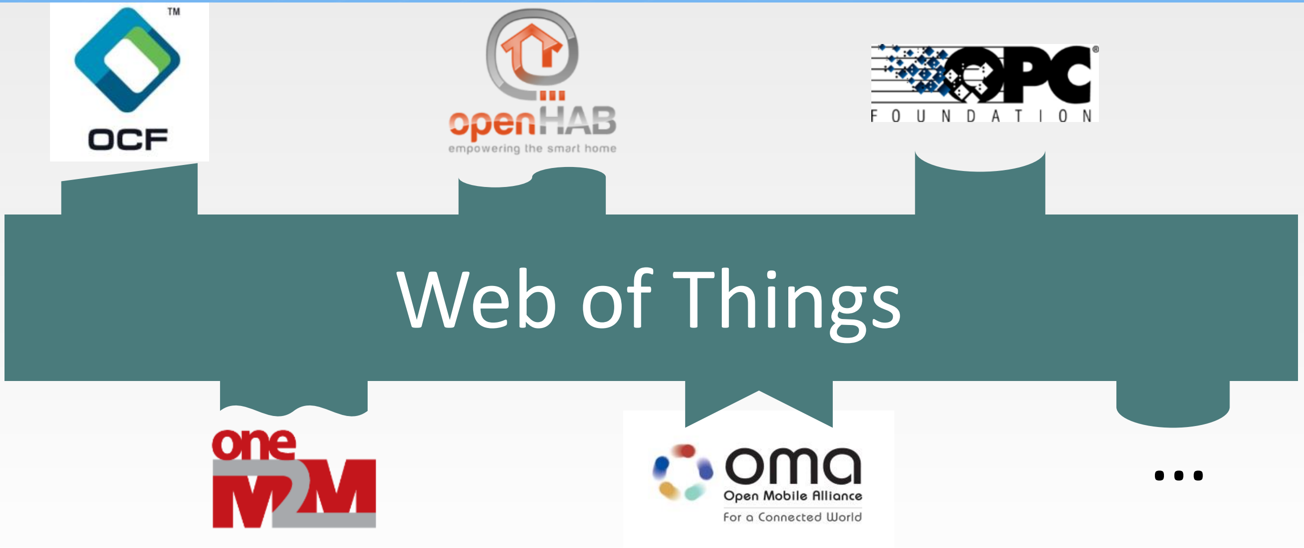
W3C WoT IG Co-chair

24 May 2017, oneM2M Industry Day @ TP#29

- Web of Things (WoT) overview
- WoT Thing Description (TD)
- WoT Scripting API
- WoT work organization & collaboration
- oneM2M-WoT Interworking

W3C WoT Mission

Interconnect the silos = de-silo



Web of Things

“enable easy integration across IoT platforms and application domains”
“complementing available standards”

The Role of W3C in IoT/WoT – Play to the Strengths

Application Developer (WoT focus)	**Application**	Define thing behaviour in terms of their properties, actions and events, using APIs for control of sensor and actuator hardware
	Things	Software objects representing abstract or physical devices and state Abstract thing to thing interaction Semantics and Metadata, Data models and Data
Platform Developer (IoT focus)	**Transfer**	Bindings of abstract messages to mechanisms provided by each protocol, including choice of communication pattern, e.g. pull, push, pub-sub, peer to peer, etc.
	Transport	REST based protocols, e.g. HTTP, CoAP Pub-Sub protocols, e.g. MQTT, XMPP Others, including non IP transports, e.g. Bluetooth
	Network	Underlying communication technology with support for exchange of simple messages (packets) Many technologies designed for different requirements

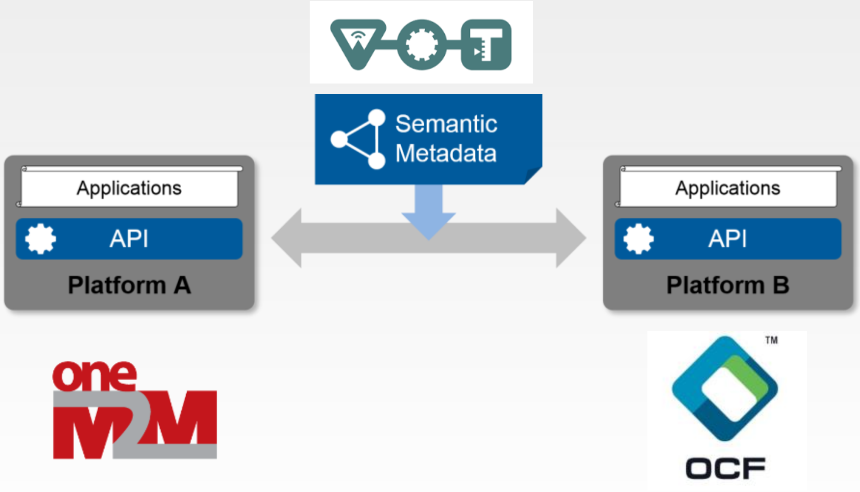
Semantic Metadata is the Key

Metadata enables interoperability

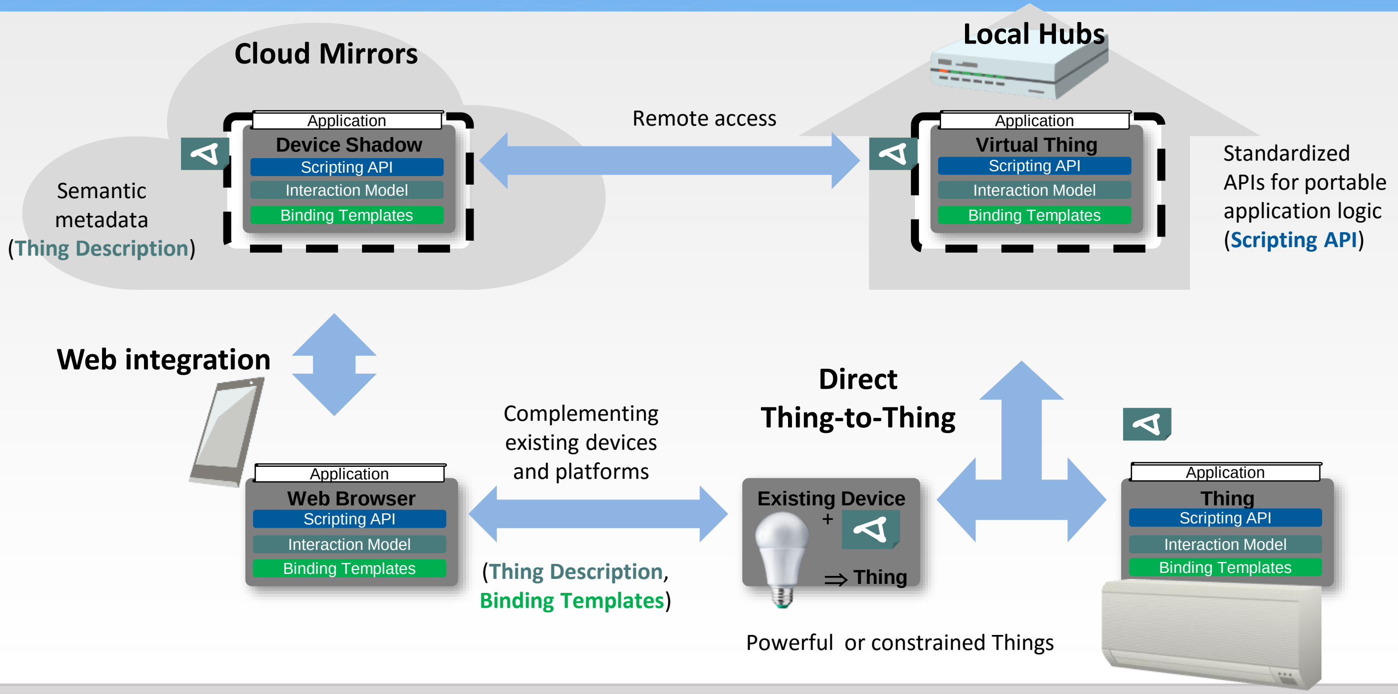
- Describe the interfaces exposed to applications
- Describe the communication and security requirements for accessing things
- Describe the data models, semantics, and domain constraints

Metadata simplifies application development

- Decouples underlying protocols
- Enables automated tooling



W3C WoT Framework



Cloud Mirrors

Application

Device Shadow

Scripting API

Interaction Model

Binding Templates

Semantic metadata (Thing Description)

Remote access

Local Hubs

Application

Virtual Thing

Scripting API

Interaction Model

Binding Templates

Standardized APIs for portable application logic (Scripting API)

Web integration

Application

Web Browser

Scripting API

Interaction Model

Binding Templates

Complementing existing devices and platforms

(Thing Description, Binding Templates)

Direct Thing-to-Thing

Existing Device + ⇒ Thing

Application

Thing

Scripting API

Interaction Model

Binding Templates

Powerful or constrained Things

4 Key Components: W3C WoT Building Blocks

WoT Scripting API:

A standardized API to simplify IoT application development and enable portable scripts across vendors and device, gateway, and cloud platforms.

WoT Thing Description (TD):

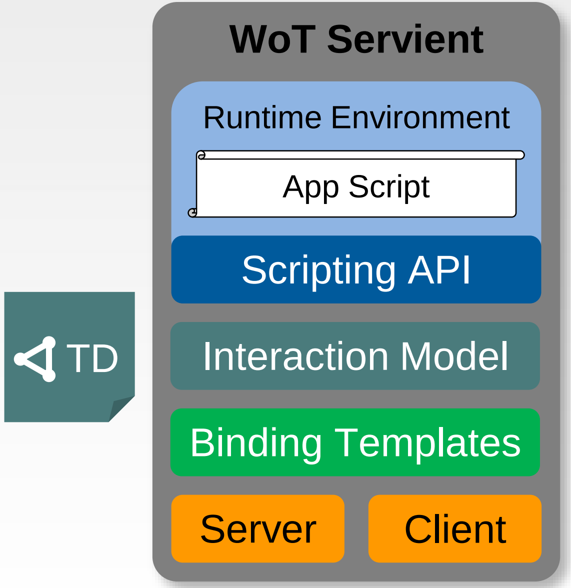
Provides metadata of the interactions, data model, communication, as well as security mechanisms of the Thing

WoT Binding Templates:

The TD also describes the usage of protocols. A vanilla protocol stack can be configured at runtime to produce message that will be understood by the targeted.

Security & Privacy:

W3C WoT does not invent new mechanisms, but ensures that all building blocks provide means to describe the security and privacy mechanisms used in a specific platform and provides adversary testing of Things.



WoT Thing Description

Describe Thing, communication, and security metadata

https://w3c.github.io/wot-thing-description/

TD Example

JSON-LD
(Linked Data)

W3C WoT TD
vocabulary

domain-specific
vocabulary

JSON Schema

```
{
 "@context": [
  "http://w3c.github.io/wot/w3c-wot-td-context.jsonld",
  { "domain": "http://example.org/actuator#" }
 ],
 "@type": "Thing",
 "name": "MyLEDThing",
 "base": "coap://myled.example.com:5683/",
 "security": {
  "cat": "token:jwt",
  "alg": "HS256",
  "as": "https://authority-issuing.example.org"
 },
 "interactions": [
  {
   "@type": ["Property", "domain:onOffStatus"],
   "name": "status",
   "outputData": {"valueType": {"type": "boolean"}},
   "writable": true,
   "links": [
    {
     "href": "pwr"
```

```
"interactions": [
  {
    "@type": ["Property", "domain:onOffStatus"],
    "name": "status",
    "outputData": {"valueType": {"type": "boolean"}},
    "writable": true,
    "links": [
      {
        "href": "pwr",
        "mediaType": "application/exi"
      },
      {
        "href": "http://mytemp.example.com:8080/status",
        "mediaType": "application/json"
      }
    ]
  },
  {
    "@type": ["Action", "domain:fadeIn"],
    "name": "fadeIn",
    "inputData": {
      "valueType": {"type": "integer"},
      "domain:unit": "domain:ms"
    },
    "links": [
      {
        "href": "in",
        "mediaType": "application/exi"
```

Property

Action

```
      "inputData": {
        "valueType": {"type": "integer"},
        "domain:unit": "domain:ms"
      },
      "links": [
        {
          "href": "out",
          "mediaType": "application/exi"
        },
        {
          "href": "http://mytemp.example.com:8080/out",
          "mediaType": "application/json"
        }
      ]
    },
    {
      "@type": ["Event", "domain:alert"],
      "name": "criticalCondition",
      "outputData": {"valueType": {"type": "string"}},
      "links": [
        {
          "href": "ev",
          "mediaType": "application/exi"
        }
      ]
    }
  ]
}
```

Event

(under construction, sources, sinks, …)

WoT Thing Description

- JSON-LD is just one possible representation
  - Good for discussion, accepted by Web people
- TD is a semantic model
  - Backed by RDF and Linked Data vocabularies
  - Yet complexity of Semantic Web can be ignored
- Other formats possible
  - EXI, CBOR, … for machines
  - Custom `application/wot-td+json` for developers
  - Just serializations of the semantic model

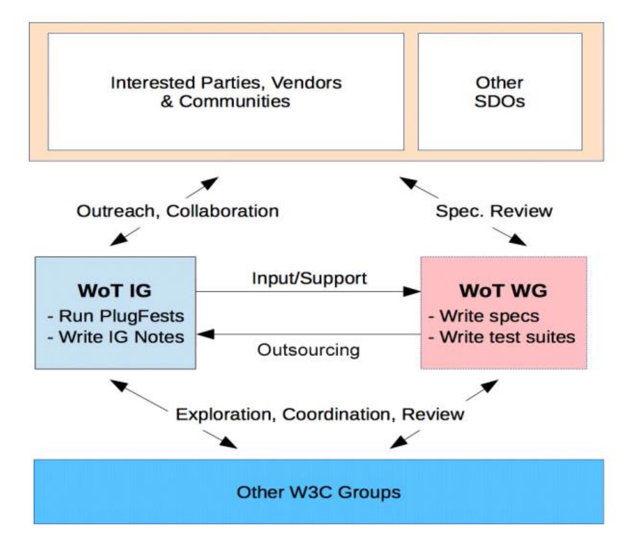
W3C WoT work organization

W3C WoT

Interest Group (IG)

https://www.w3.org/2016/07/wot-ig-charter.html

- Started spring 2015
- 218 participants
- Informal work, outreach
- Use cases, explorative work
- Liaisons and collaborations with other organizations and SDOs
- PlugFests with running code



Interested Parties, Vendors & Communities

Other SDOs

Outreach, Collaboration

Spec. Review

WoT IG
- Run PlugFests
- Write IG Notes

Input/Support

Outsourcing

WoT WG
- Write specs
- Write test suites

Exploration, Coordination, Review

Other W3C Groups

Working Group (WG)

https://www.w3.org/2016/12/wot-wg-2016.html

- Started December 2016
- 71 participants
- Normative work
- Standardization of four initial building blocks identified by the IG

W3C WoT Task Forces

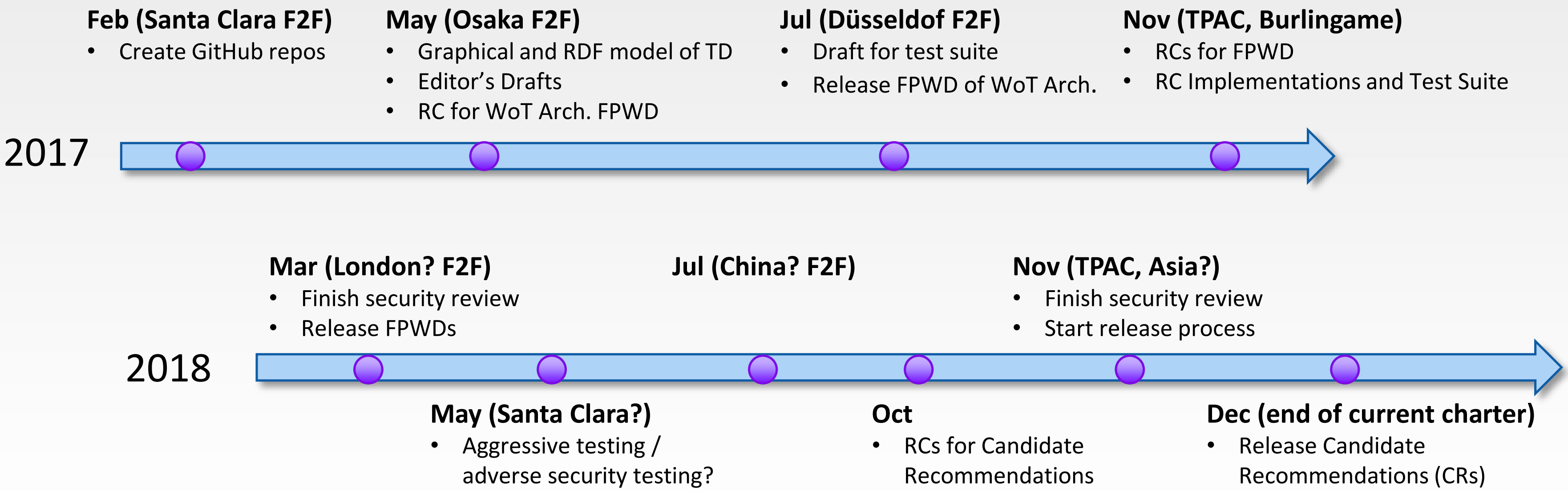
- IG
  - **Current Practices** (has deliverable)
  - Testing (PlugFest scenarios)
  - Thing Lifecycle
  - Synchronization of Servients
  - Linked Data and Semantic Processing
  - Demonstrators
  - Liaison with OCF
  - Liaison with oneM2M (tbc, You're wanted ☺)

- WG
  - **Architecture** (has deliverable)
  - **Thing Description** (has deliverable)
    - Type System (JSON Schema Extensions)
    - Hypermedia (Actions, error handling, …)
  - **Scripting API** (has deliverable)
  - **Binding Templates** (has deliverable)
  - Security & Privacy

W3C WoT Liaisons

- **IETF / IRTF**
  - Established, joint meetings since Nov 2015
- **Open Connectivity Foundation (OCF)**
  - Established, active alignment and joint PlugFest coming up
- **oneM2M**
  - Established, commonality identified and preparing input
- **OPC Foundation**
  - Established, need to agree on strategy etc.
- **Plattform Industrie 4.0**
  - Initial conference calls
- **OpenFog**
  - Initial outreach

WG Roadmap



2017

Feb (Santa Clara F2F)

- Create GitHub repos

May (Osaka F2F)

- Graphical and RDF model of TD
- Editor's Drafts
- RC for WoT Arch. FPWD

Jul (Düsseldof F2F)

- Draft for test suite
- Release FPWD of WoT Arch.

Nov (TPAC, Burlingame)

- RCs for FPWD
- RC Implementations and Test Suite

2018

Mar (London? F2F)

- Finish security review
- Release FPWDs

May (Santa Clara?)

- Aggressive testing / adverse security testing?

Jul (China? F2F)

Oct

- RCs for Candidate Recommendations

Nov (TPAC, Asia?)

- Finish security review
- Start release process

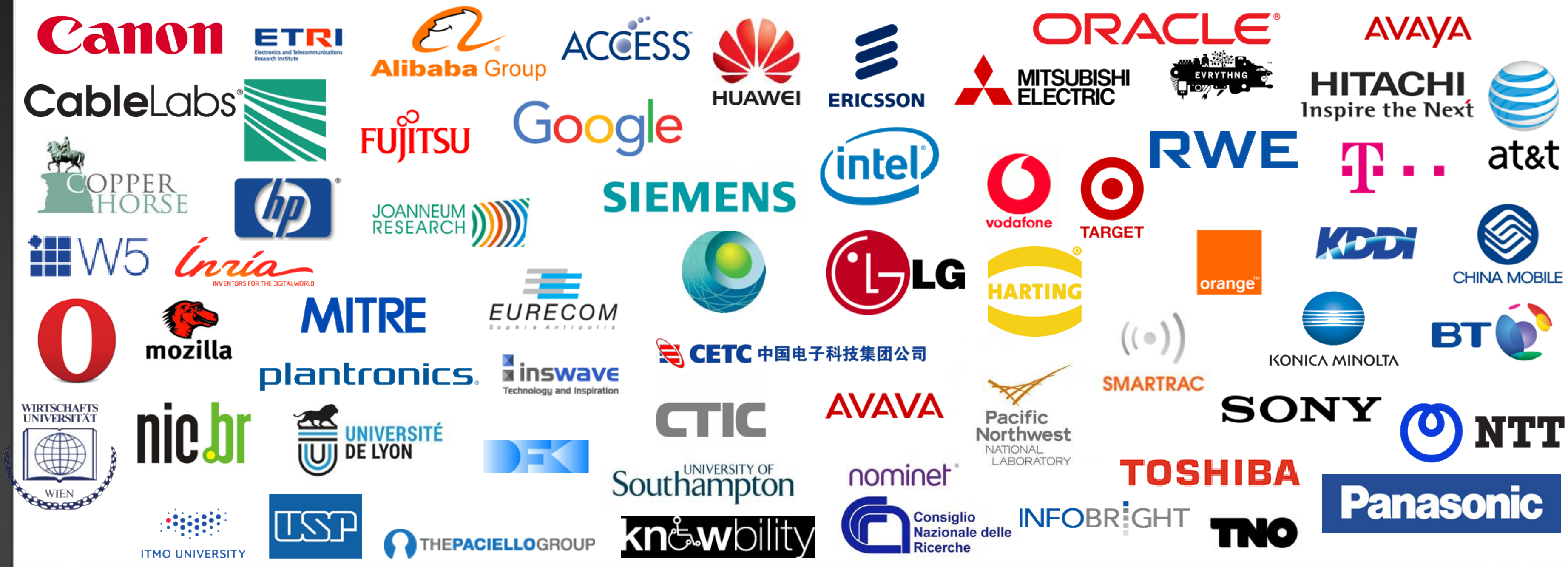
Dec (end of current charter)

- Release Candidate Recommendations (CRs)

W3C WoT Online Resources

- W3C WoT Interest Group
  - https://www.w3.org/WoT/IG/ (blog)
  - https://www.w3.org/2016/07/wot-ig-charter.html (charter)
  - https://lists.w3.org/Archives/Public/public-wot-ig/ (subscribe to mailing list)
- W3C WoT Working Group
  - https://www.w3.org/WoT/WG/ (dashboard)
  - https://www.w3.org/2016/12/wot-wg-2016.html (charter)
- W3C WoT Wiki (IG+WG organizational information)
  - https://www.w3.org/WoT/IG/wiki/Main_Page
- W3C WoT GitHub (IG technical proposals)
  - https://github.com/w3c/wot
- W3C WoT WG Documents
  - https://w3c.github.io/wot-architecture/
  - https://w3c.github.io/wot-thing-description/
  - https://w3c.github.io/wot-scripting-api/
  - https://w3c.github.io/wot-binding-templates/

Web of Things Participants

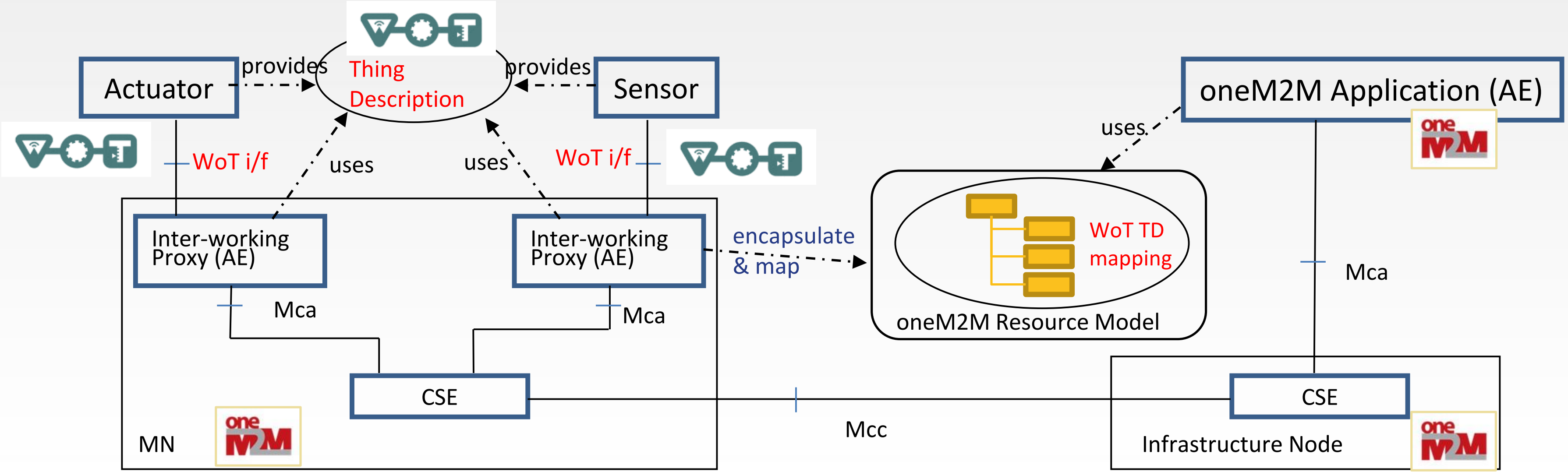


oneM2M-WoT Interworking

Preliminary thoughts for discussion

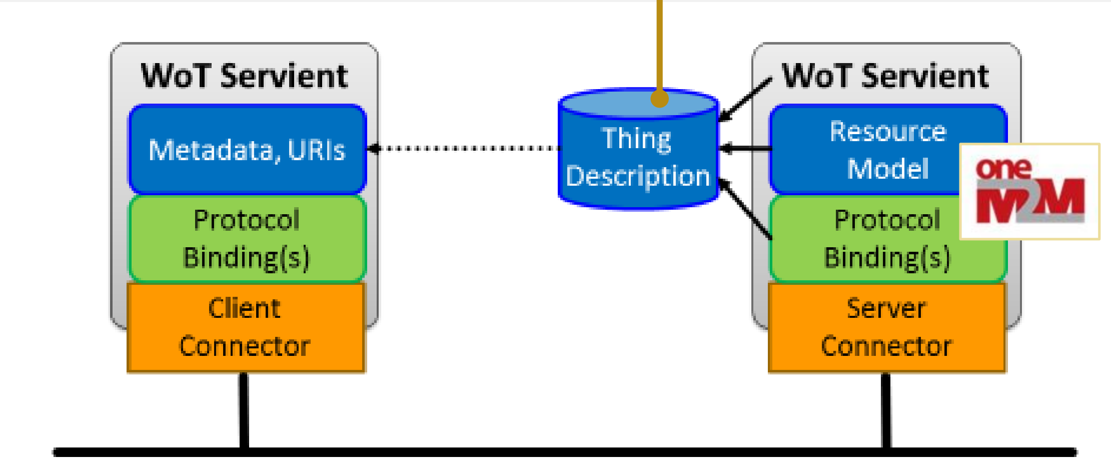
Interworking: WoT→oneM2M

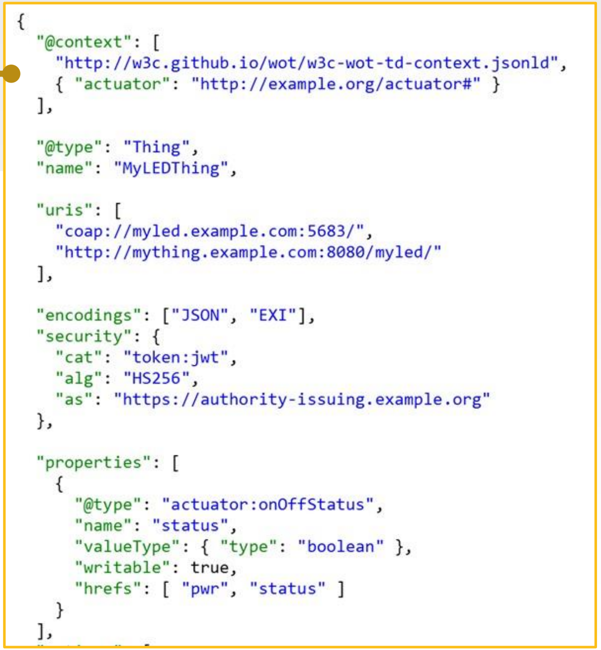
- Exposing the WoT interface (described in TD) to oneM2M systems
  - Benefit: WoT services/data can be consumed by oneM2M applications



Interworking: oneM2M→WoT

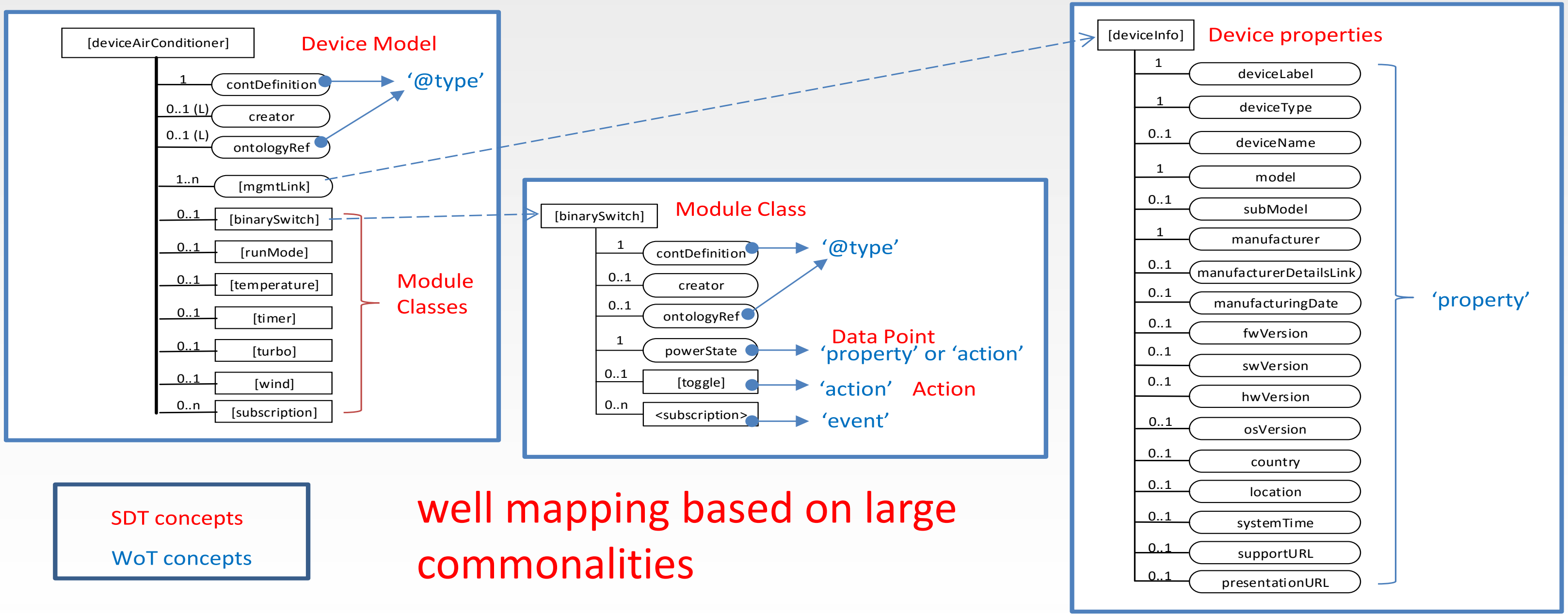
- Exposing oneM2M interfaces to WoT systems
  - Benefit: oneM2M services/data can be consumed by WoT Servients





```
{
  "@context": [
    "http://w3c.github.io/wot/w3c-wot-td-context.jsonld",
    { "actuator": "http://example.org/actuator#" }
  ],

  "@type": "Thing",
  "name": "MyLEDThing",

  "uris": [
    "coap://myled.example.com:5683/",
    "http://mything.example.com:8080/myled/"
  ],

  "encodings": ["JSON", "EXI"],
  "security": {
    "cat": "token:jwt",
    "alg": "HS256",
    "as": "https://authority-issuing.example.org"
  },

  "properties": [
    {
      "@type": "actuator:onOffStatus",
      "name": "status",
      "valueType": { "type": "boolean" },
      "writable": true,
      "hrefs": [ "pwr", "status" ]
    }
  ],
```

oneM2M HAIM vs. WoT



[deviceAirConditioner]

Device Model

1 contDefinition → '@type'

0..1 (L) creator

0..1 (L) ontologyRef → '@type'

1..n [mgmtLink]

0..1 [binarySwitch]

0..1 [runMode]

0..1 [temperature]

0..1 [timer]

0..1 [turbo]

0..1 [wind]

0..n [subscription]

Module Classes

[binarySwitch]

Module Class

1 contDefinition → '@type'

0..1 creator

0..1 ontologyRef → '@type'

1 powerState → Data Point 'property' or 'action'

0..1 [toggle] → 'action' Action

0..n <subscription> → 'event'

[deviceInfo]

Device properties

1 deviceLabel

1 deviceType

0..1 deviceName

1 model

0..1 subModel

1 manufacturer

0..1 manufacturerDetailsLink

0..1 manufacturingDate

0..1 fwVersion

0..1 swVersion

0..1 hwVersion

0..1 osVersion

0..1 country

0..1 location

0..1 systemTime

0..1 supportURL

0..1 presentationURL

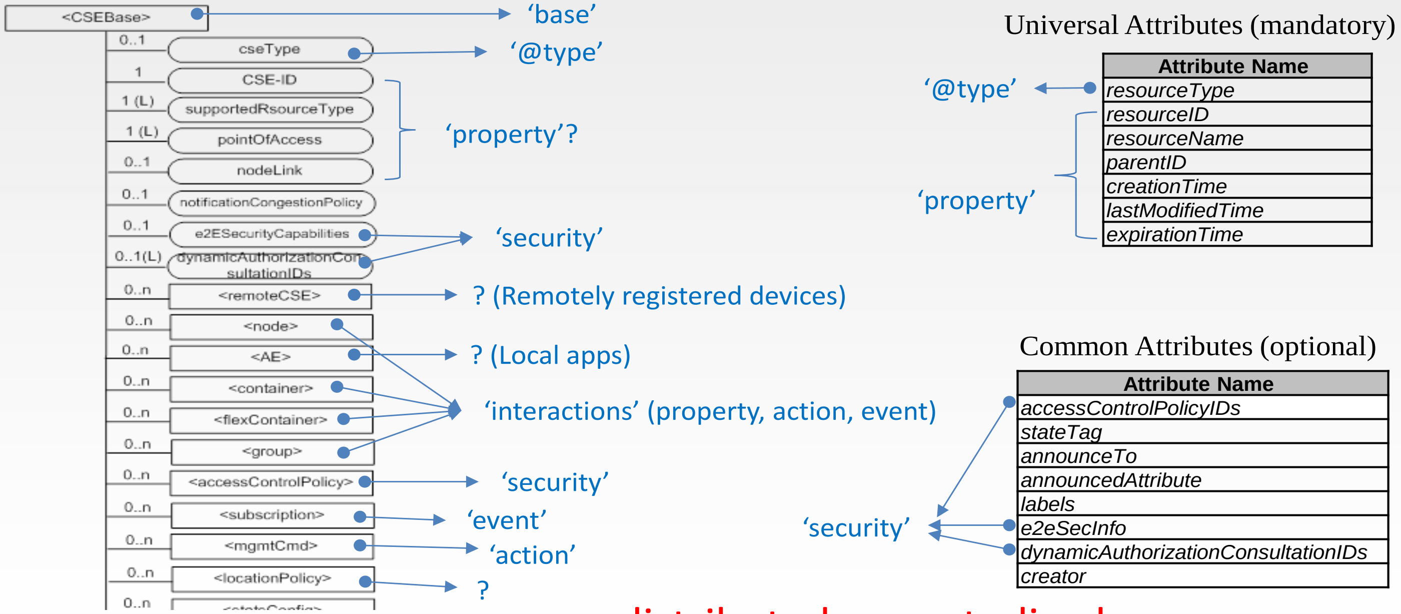
'property'

SDT concepts

WoT concepts

well mapping based on large commonalities

oneM2M general Resource Model vs. WoT



‘base’

‘@type’

‘property’?

‘security’

? (Remotely registered devices)

? (Local apps)

‘interactions’ (property, action, event)

‘security’

‘event’

‘action’

?

Universal Attributes (mandatory)

‘@type’

‘property’

Attribute Name
resourceType
resourceID
resourceName
parentID
creationTime
lastModifiedTime
expirationTime

Common Attributes (optional)

‘security’

Attribute Name
accessControlPolicyIDs
stateTag
announceTo
announcedAttribute
labels
e2eSecInfo
dynamicAuthorizationConsultationIDs
creator

distributed vs centralized

Thanks You!

For more information on W3C see:

www.w3.org