Semantic Technology Landscape

T2TRG/WISHI

June 30, 2020

Overview of semantic models

- 14 SDO and vendor IoT modeling frameworks
- OneDM information model
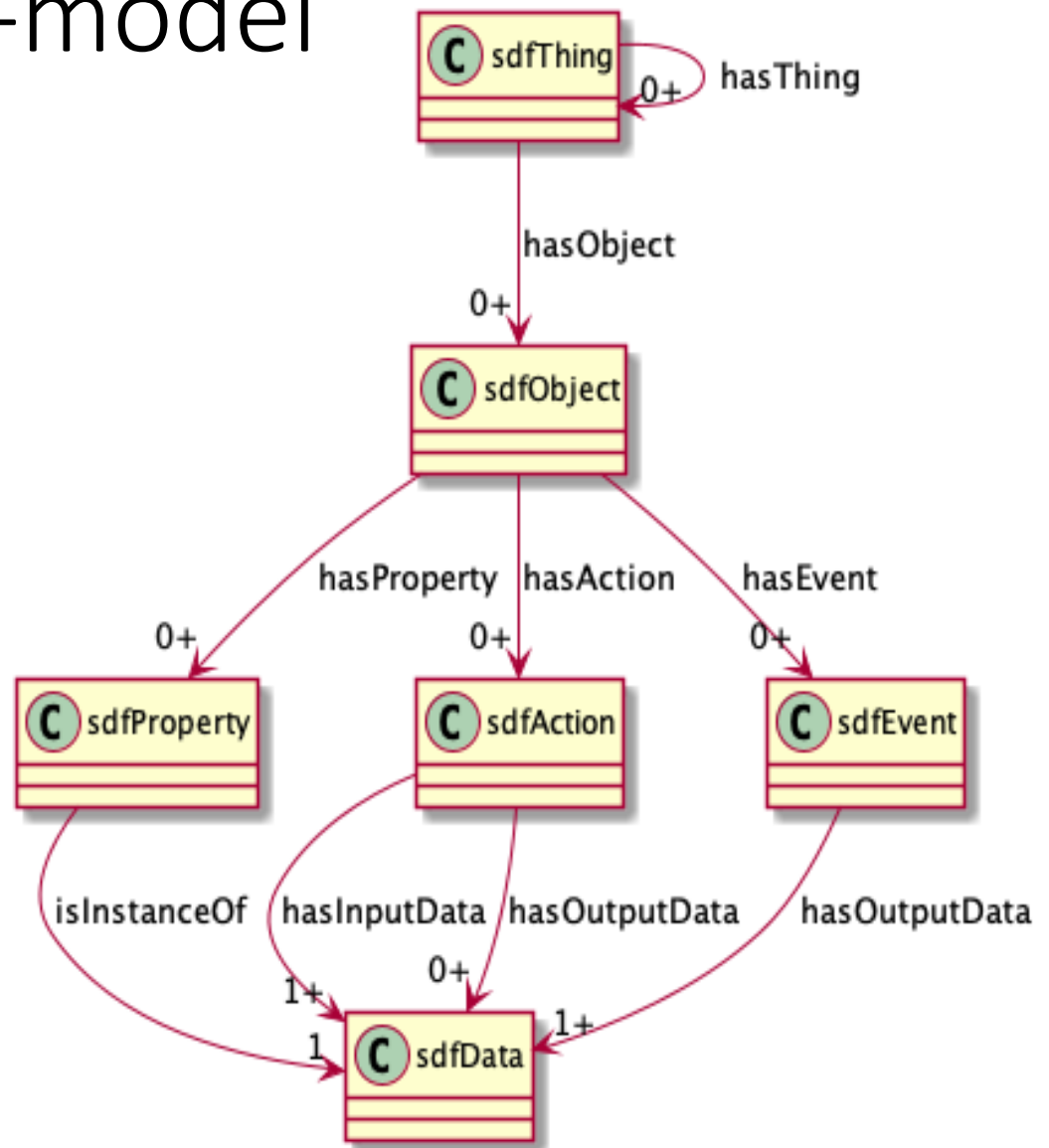- OneDM example with W3C Thing Description

Meta-model survey

- Find the common factors across IoT semantic models currently used in industry

- Focus on semantic types and interaction affordances

- Collect other information e.g. Governance, IPR and licensing

- OneDM is purpose-built to support the common design patterns found in these models

Meta-model survey – Common Affordance Semantics

Information	OneDM SDF	WoT TD	iotschema	ZCL/dotdot	OCF	SmartThings	LWM2M	Weave	Vorto	UPnP	BLE Mesh	Azure DTDL	oneM2M	OPC UA
Governing body	OneDM Liaison	W3C	W3C/schema.org	Zigbee Alliance	OCF	SmartThings	OMA SpecWorks	Google/Nest	Eclipse	OCF	BT Sig	Microsoft	oneM2M	OPC
Tools License	BSD	Many		Proprietary	BSD	Proprietary		Apache2	Eclipse			MIT	Apache2.0	
Models License	BSD	No Models		BSD	BSD	Proprietary	OMA	Apache2				CC Attr. 4.0		
representation language	JSON	LSON-LD	JSON-LD	XML	JSON	JSON	XML	WDL	vortolang	XML	XML	JSON-LD	XML	XML
Content Format	sdf+json	td+jsonld	jsonld	zcl+xml	swagger+ json	JSON	json	mod+xml	text	text	upnp+xml	xml	jsonld	sdt+xml	opcfoundation
Reference	https://github.com/one-data-model/language	https://www.w3.org/TR/wot-thing-description/	https://github.com/iot-schema-collab/iotschema	https://zigbeealliance.org/wp-content/uploads/zip/dotdot-ip-package.zip	https://openconnectivity.org/developer/specifications/	https://docs.smartthings.com/en/latest/capabilities-reference.html	http://www.openmobilealliance.org/wp/omna/lwm2m/lwm2mregistry.html	https://openweave.io/guides/weave-primer/schema	https://github.com/eclipse/vorto/tree/development/docs	https://openconnectivity.org/developer/specifications/upnp-resources/upnp/	https://www.bluetooth.com/specifications/mesh-specifications/	https://github.com/Azure/IoTPlugandPlay/tree/master/DTDL	http://www.onem2m.org/tr-0039/ipe-and-sdt	https://opcfoundation.org/developer-tools/specifications-unified-architecture

Terminology	OneDM SDF	WoT TD	iotschema	ZCL/dotdot	OCF	SmartThings	LWM2M	Weave	Vorto	UPnP	BLE Mesh	Azure DTDL	oneM2M	OPC UA
Composed Instance	Thing/Thing	Thing	Thing/Thing	Device/EP	Platform/Device	Fingerprint	Registration	Device	Info Model	Device	Device	Capability Model	Device	Device, Server
Atomic Functionality Unit	Object	(Thing)	Capability	Cluster	Resource	Capability	Object	Trait	Function Block	Service	Model	Interface	ModuleClass	Object
Externalized state item	Property	Property	Property	Attribute	Property	Attribute	Resource	Property	Config, Status	State Variable	Attribute	Property	Data Point	Attribute, Variable
External method accepted	Action	Action	Action	Command	POST	Command	Executable Res.	Command	Operation	Action	Write	Command	Action	Method, Program
External signal emitted	Event	Event	Event	Report	Observe data	Device Event	Observe data	Event	Event	Event	Report	Telemetry	Event	Event, Alarm
Reusable data type	Datatype	Datatype	Datatype	Datatype	OAS definition	Datatype	Reusable Res.	Datatype	Datatype	Datatype	Datatype	schema	xsd types	register types

Network Binding	OneDM SDF	WoT TD	iotschema	ZCL/dotdot	OCF	SmartThings	LWM2M	Weave	Vorto	UPnP	BLE Mesh	Azure DTDL	oneM2M	OPC UA
Data Schema	JsonSchema	JsonSchema	External	XML	OAS 2.0	Mapping Files	SenML	WDL	External	XML	XML	DTDL	XSD	
Protocol Binding	External	TD Forms	External	ZCL Commands	OAS 2.0	Device Handlers	CoAP	WDM	External	UPnP defined	BLE GATT	External	External	
Protocols		MQTT,HTTP, CoAP		Zigbee Pro, CoAP	CoAP	Many	CoAP	WDM		HTTP	BLE			

OneDM Meta-model

SDF Example

```json
{
  "info": {
    "title": "Example file for sdf Simple JSON Definition Format",
    "version": "20190424",
    "copyright": "Copyright 2019 Example Corp.\n          All rights reserved.",
    "license": "http://example.com/license"
  },
  "namespace": {
    "cap": "http://onedm.org/exploratory/cap/"
  },
  "defaultNamespace": "cap",
  "sdfObject": {
    "Switch": {
      "sdfAction": {
        "On": { "description": "Action to turn the switch on" },
        "Off": { "description": "Action to turn the switch off" }
      },
      "sdfProperty": {
        "State": {
          "description": "The state of the switch, whether on or off",
          "sdfRef": "#/sdfObject/Switch/sdfData/StateData"
        }
      },
      "sdfData": {
        "StateData": {
          "sdfEnum": {
            "On": {
                "type": "string",
                "const": "on",
                "description": "The on state"
            },
            "Off": {
                "type": "string",
                "const": "off",
                "description": "The off state"
            }
          }
```

W3C TD Example

```json
{
    "@context": [
        "https://www.w3.org/2019/wot/td/v1",
        { "cap": "https://onedm.org/exploratory/cap/" }
    ],
    "id": "00bd91a5-06bd-4cf6-bc02-fe5c2dd5959f",
    "title": "Switch",
    "@type": "cap:#/sdfObject/Switch",
    "securityDefinitions": {"basic_sc": {
        "scheme": "basic",
        "in": "header"
    }},
    "security": ["basic_sc"],
    "properties": {
        "State": {
            "@type": "cap:#/sdfObject/Switch/sdfProperty/State",
            "type": "string",
            "enum": ["on", "off"],
            "forms": [{
                "href": "https://example.com/Switch/State"
            }]
        }
    },
    "actions": {
        "On": {
            "@type": "cap:#/sdfObject/Switch/sdfAction/On",
            "forms": [{
                "href": "https://example.com/Switch/OnAction"
            }]
        },
        "Off": {
            "@type": "cap:#/sdfObject/Switch/sdfAction/On",
            "forms": [{
                "href": "https://example.com/Switch/OffAction"
            }]
        }
    }
}
```