

# Introduction to IPSO Smart Objects

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# The Web

- › Narrow Waist
  - Innovation happening on endpoints.
- › Stateless Interaction
  - REST APIs
  - HTTP client/server model and a request/response communication model.
  - HTTP stateless methods to indicate the server what to do. (GET, POST, PUT, HEAD, DELETE, TRACE).
- › Focus on Resources and Content
  - Support of extensive representation formats (e.g. HTML, JSON, XML etc.)
  - Web content can be anything (HTML files, images, video...) each piece of information is a resource.
- › Uniform Addressing
  - Resources are identified URIs, either by location or by name.
  - Hyperlinks pointing to resources.
  - IP addressing and global DNS.

# Constrained Application Protocol (CoAP)



- › It is a RESTful protocol for constrained devices and networks. Similar to HTTP:

- Client/server & Request/Response
- GET, POST, PUT and DELETE Methods
- Same key concepts (Media types, URL, URN...)

- › The *well-known* URI

`coap://[2001:db8::2:1]/.well-known/core`

- › Resource discovery via the Resource Directory (RD)

Request `coap://HOST_ADDRESS:PORT_NUMBER/PATH?QUERY`

Response `coap://ericsson.com:5683/rd/jorvas/room/541/temperature/`

- › IPv6 oriented (using 6LowPAN)

- › UDP preferred instead of TCP, SMS also possible

- Reliability is ensured by using with different message types:
- *Confirmable* (CON), *non-confirmable* (NON), *acknowledgement* (ACK) and *reset* (RST).

- › Observe/Notify, adding an “observe” flag in the CoAP GET Request

- Introduces a Publish/Subscribe model for constrained devices.

# Web Linking for Constrained Devices

## › RFC6690 Constrained RESTful Environments (CoRE) Link Format.

- Reuses Web Linking RFC5988 for IoT.
- Defines semantic link serialization and M2M content types.
- GET `./well-known/core?optional_query_string`.
- Enables query string parameters for discovery by attribute and relation (rt, if, sz). The response looks like:

`<3303/0/5700>;rt="ipso:temp";ct="0";obs=1`

Resource Type

ContentType

Observable

- Links are discovered using GET with content type “application/link-format”
- JSON representation using GET with content type “application/link-format+json”

# Discovery for Constrained Devices

- › CoRE Link defines
  - Link format
  - Device to device discovery.
- › Resource Directory draft adds
  - Sleepy node support.
  - No multicast needed.
  - Remote lookup, hierarchical and federated distribution.
- › Core Link is also used in RD
  - EP POST (register) resource links to RD.
  - EP PUT (refresh) to RD.
  - EP DELETE (remove) their RD entry.

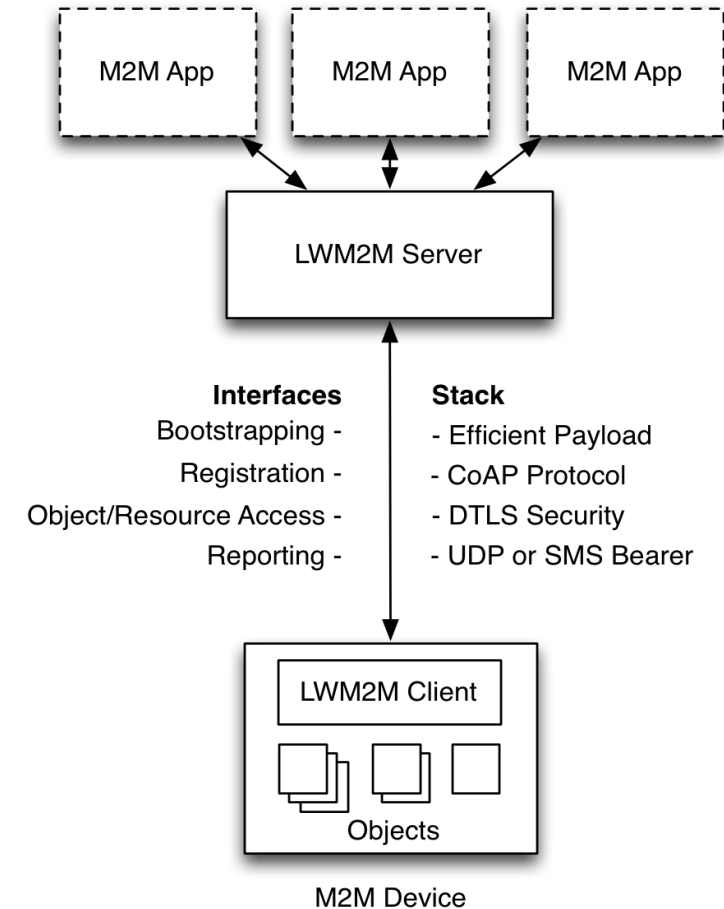
EP	RD
----- GET /.well-known/core?rt=core.rd* ----->	
<----- 2.05 Content "</rd>; rt="core.rd" -----	

Req: GET coap://[ff02::1]/.well-known/core?  
rt=core.rd\*

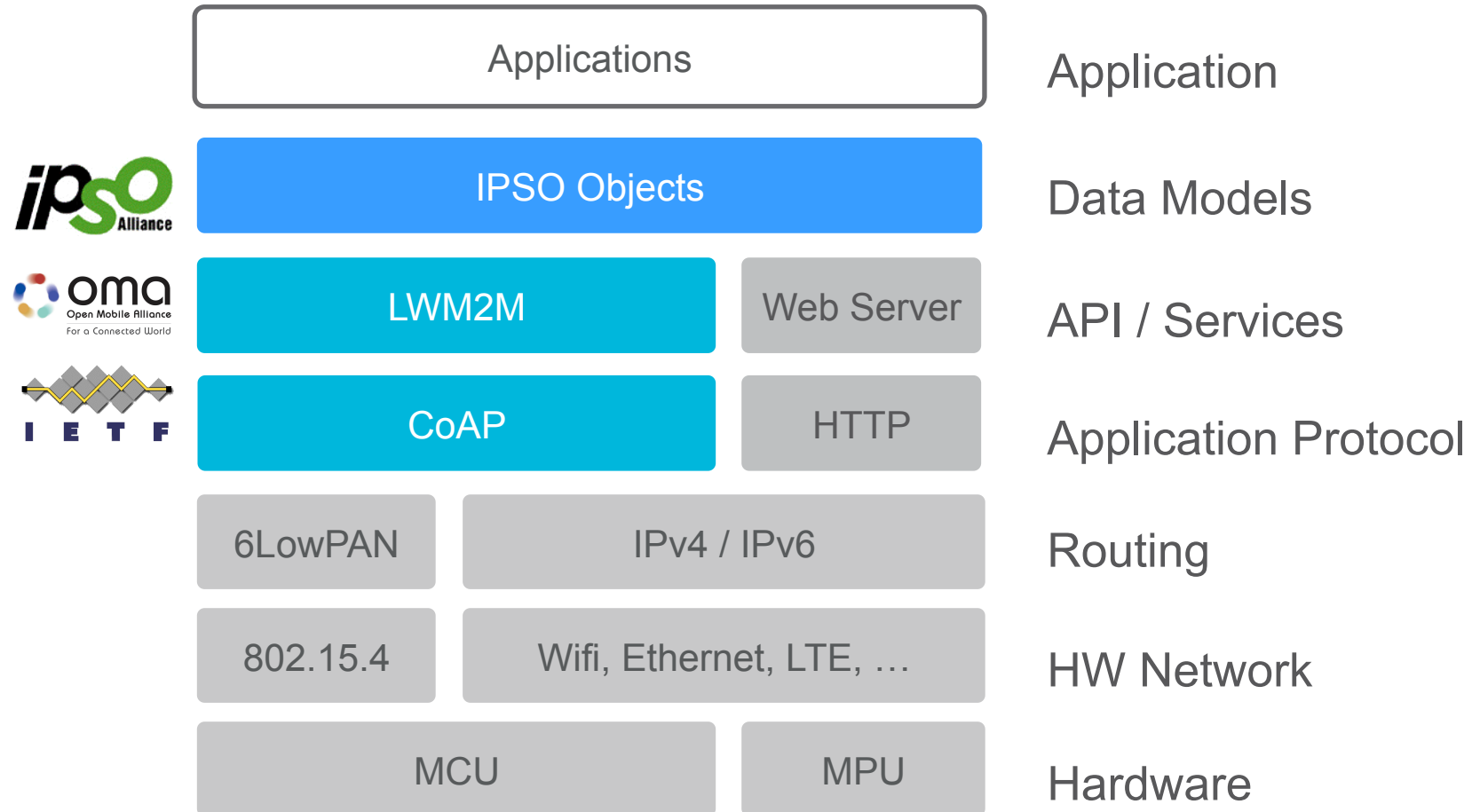
Res: 2.05 Content  
 </rd>;rt="core.rd",  
 </rd-lookup>;rt="core.rd-lookup",  
 </rd-group>;rt="core.rd-group"

# OMA Lightweight M2M (LWM2M)

- › Based on CoAP (runs on top) and used for management and control of constrained devices
- › Provides a set of interfaces for managing of constrained devices.
  - Bootstrap
  - Registration
  - Information Reporting
  - Device Management
  - Service Enablement
- › Also allows for operations on objects (RWX, Access Control, Observation, Notification)
- › Offers a simple and reusable object based model.



# The Web in constrained devices



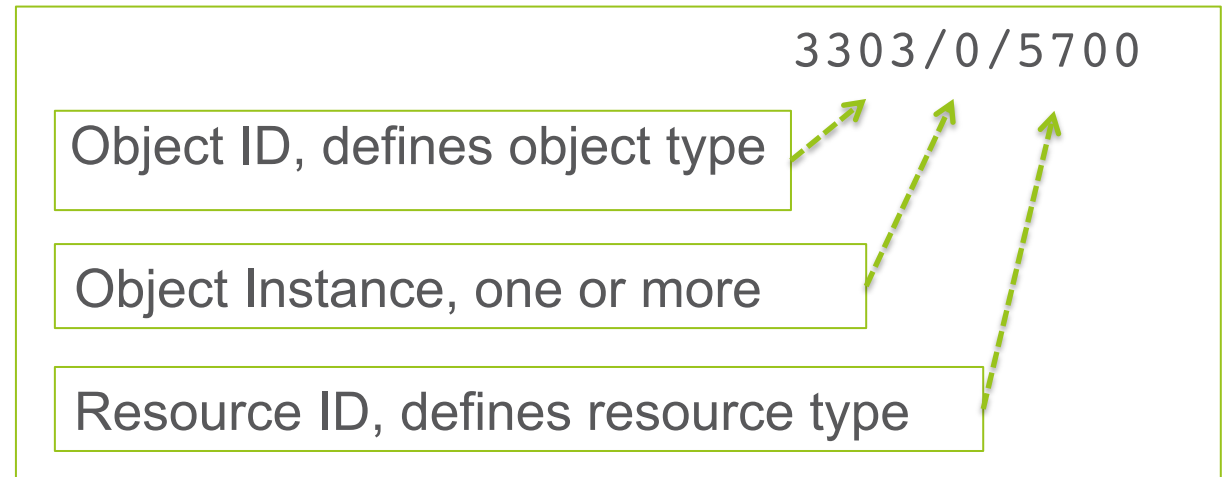
# IPSO Smart Objects

- › Developed by IP for Smart Objects (IPSO) Alliance in the Smart Objects Working Group.
- › Work exclusively on semantic Interoperability across IoT devices and applications.
- › Based on LWM2M Object Model.
- › Reusable Object IDs and Resource IDs.
- › Transport Protocol Independent (CoAP, LWM2M, MQTT, HTTP...) if support addressing, content formats and data types.
- › Encoding Independent (JSON, TLV, SenML...)
- › Basic Objects represent simple sensors and actuators.
- › Basic Starter Pack published on 2014 (Expansion Pack upcoming).
- › Tested over CoAP and LWM2M during IPSO Interoperability test on May 2015 (ARM, Ericsson, Intel, SICS, Yanzi, TUT ...).



# IPSO Smart Object Structure

- › Reusable Data Model for Constrained Devices
  - Across domains
- › Reusable resource and object IDs
  - Common definitions for concepts
  - Map to semantic terms e.g. temperature, currentValue
  - IDs are registered with the OMNA
- › Usable in different transport protocols that support
  - URI Addressing
    - › (.../home/weather/3303/0/5700)
  - Data Types
  - Content Formats
  - RWX Operations



# Example 1: IPSO Humidity Sensor

Object	Object ID	Object URN	Multiple Instances?	Description
IPSO Humidity	3304	<b>urn:oma:lwm2m:ext:3304</b>	Yes	Relative humidity sensor, example units = %

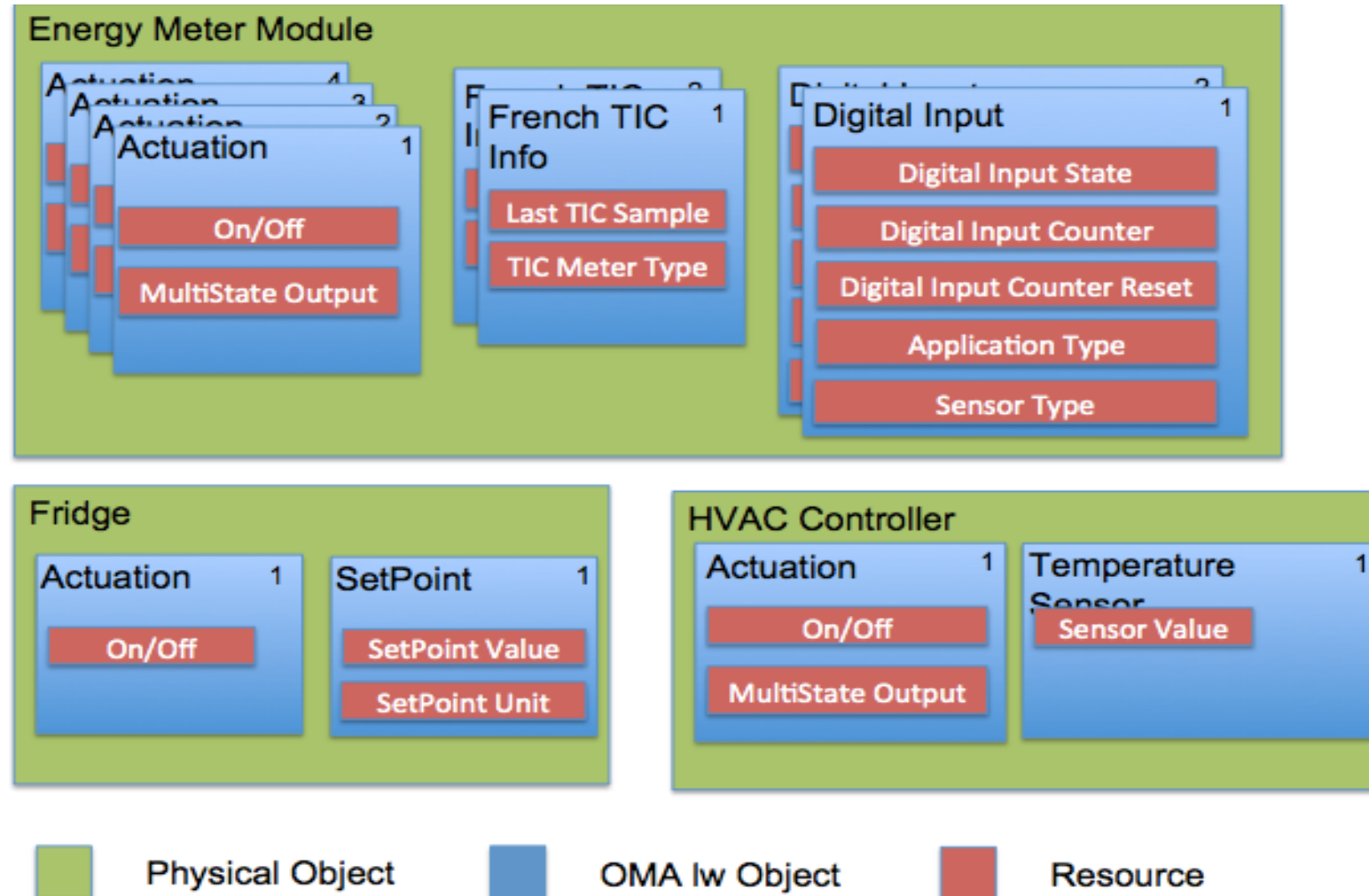
Resource Name	Resource ID	Access Type	Multiple Instances?	Mandatory	Type	Range or Enumeration	Units	Descriptions
Sensor Value	5700	R	No	Mandatory	Float			Last or Current Measured Value from the Sensor
Units	5701	R	No	Optional	String			Measurement Units Definition e.g. "Cel" for Temperature in Celsius.
Min Measured Value	5601	R	No	Optional	Float	Same as Measured Value	Same as Measured Value	The minimum value measured by the sensor since power ON or reset
Max Measured Value	5602	R	No	Optional	Float	Same as Measured Value	Same as Measured Value	The maximum value measured by the sensor since power ON or reset
Min Range Value	5603	R	No	Optional	Float	Same as Measured Value	Same as Measured Value	The minimum value that can be measured by the sensor
Max Range Value	5604	R	No	Optional	Float	Same as Measured Value	Same as Measured Value	The maximum value that can be measured by the sensor
Reset Min and Max Measured Values	5605	E	No	Optional	Opaque			Reset the Min and Max Measured Values to Current Value

# Example 2: New Reusable Object

Object	Object ID	Object URN	Multiple Instances?	Description
Company Humidity	n	urn:company:ext:1	Yes	Relative humidity sensor, example units = %

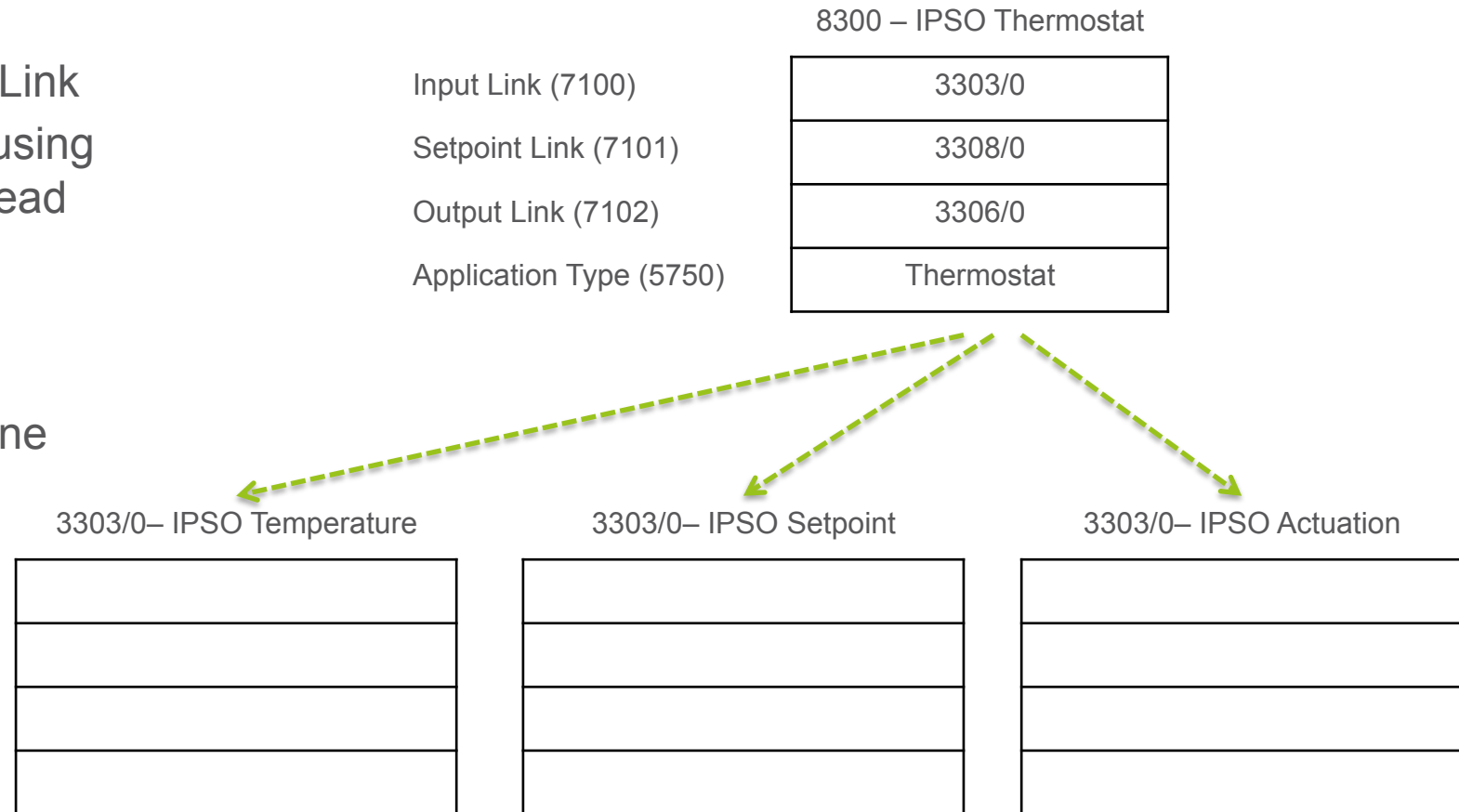
Resource Name	Resource ID	Access Type	Multiple Instances?	Mandatory	Type	Range or Enumeration	Units	Descriptions
Sensor Value	5700	R	No	Mandatory	Float			Last or Current Measured Value from the Sensor
Units	5701	RW	No	Optional	String			Measurement Units Definition e.g. "Cel" for Temperature in Celsius.
Reset Units	12000	E	No	Optional	Opaque			Reset the Min and Max Measured Values to Current Value
On/Off	5850	R, W		Mandatory	Boolean			This resource represents an on/off actuator, which can be controlled, the setting of which is a Boolean value (1,0) where 1 is on and 0 is off.

# Example 3: Composite Object



# IPSO Object Linking

- New LWM2M data type: Object Link
- Composite objects can be built using by referring to other objects instead of explicitly adding resources.
- Similar to the web-like pattern, following links.
- Linked objects are serialized inline using SenML.



# Roadmap

- ☐ UPnP harmonization – from SOAP to REST.
- ☐ Schema.org for registration of instances and schemas
- ☐ BLE/ZigBee harmonization.
- ✓ Draft Smart Object Data Model Design Guide @done (15-03-30)
- ✓ Draft Smart Object Expansion Pack for Basic Objects @done (15-04-30)
- ✓ Set up test servers for IPSO objects (LWM2M + TLV payload) @done (15-06-15)
- ☐ Draft Domain Specific Objects reference designs @due (mid 2015)
- ☐ Publish Smart Object Data Model Design Guided @due(15-07-31)
- ☐ Publish Smart Object Expansion Pack for Basic objects @due(15-07-31)
- ☐ Publish Smart Object Expansion Pack for Composite Objects @due(15-07-31)
- ☐ Publish Smart Object Expansion Pack for Reference Devices @due(15-07-31)
- ☐ IETF 93 – Bits and Bites @due(15-09-1)

