IPSO Smart Object Guideline

Smart Objects Expansion Pack

Internet Protocol for Smart Objects (IPSO) Alliance

Technical Guideline

IPSO Smart Object Committee

27 October, 2015

Copyright 2015

IPSO Alliance

1. Introduction

The availability of Internet Protocol (IP) on constrained devices with memory sizes of 16 kilobytes or less, including IPV6 and 6LowPAN, has made possible a new kind of interoperability for connected devices and Smart Objects.

The IETF specify a set of standard protocols for IP-enabled networks in Constrained Resource Environments (CoRE), including the Constrained resource Application Protocol [2] (CoAP, RFC 7252) applicable to low power and low connection bandwidth devices. CoAP is an application protocol for machines and connected devices, as http is for web browsers, but designed specifically for machine interaction and operation over networks of constrained devices.

IPSO Smart Object Guidelines provide a common design pattern, an object model, that can effectively use the IETF CoAP protocol to provide high level interoperability between Smart Object devices and connected software applications on other devices and services.

Originally based on OMA LWM2M [1] Object model, IPSO Objects expand the definition it by means of reusable resources. IPSO Smart Objects can be registered with the OMA Name Authority (OMNA) enabling some degree of compliance between existing LWM2M and IPSO ones.

The first set of 18 Smart Objects were intended as a "Starter Pack" and as example of how to use Smart Objects on some application specific use cases.

To complement the initial set of objects, this new IPSO Smart Object Expansion Pack was created. The Expansion Pack covers a new set of 16 Common Template sensors, 6 Special template sensors, 5 Actuators and 6 Control switch types.

Some of the new objects are generic in nature, such as voltage, altitude or percentage, while others are more specialized like the Color Object or the Gyrometer Object. New Actuators and Controllers are defined such as timer or buzzer and Joystick and Level. All of these objects were found to be necessary on a variety of use case domains.

The IPSO Alliance is committed to making it easy for people to create new objects based on their use case needs, while promoting reusable and cross-domain standards to as great an extent as is practical.

2. IPSO Smart Object Summary

IPSO Smart Objects are based on the object model specified in OMA LightWeight M2M [1] Chapter 6, Identifiers and Resources.

An IPSO Smart Object is a specified collection of reusable resources (See Table 2, Reusable Resources) that has a well-known object ID (See Table 1, Smart Objects) and which represents a particular type of physical sensor, actuator, connected object or other data source. The reusable resources, which make up the Smart Object, represent static and dynamic properties of the connected physical object and the embedded software contained therein.

This document defines a set of IPSO Smart Objects, which conform to the OMA LWM2M Object Model, and which can be used as data objects, or web objects, to represent common sensors, actuators, and data sources.

Table 1 Summarizes the Objects defined by this Technical Guideline.

Table 1. Smart Objects defined by this Technical Guideline

Type	Object	Object ID
Common Template Sensors	Voltage	3316
	Current	3317
	Frequency	3318
	Depth	3319
	Percentage	3320
	Altitude	3321
	Load	3322
	Pressure	3323
	Loudness	3324
	Concentration	3325
	Acidity	3326
	Conductivity	3327
	Power	3328
	Power Factor	3329
	Rate	3346
	Distance	3330
Special Template Sensors	Energy	3331
	Direction	3332
	Time	3333
	Gyrometer	3334
	Color	3335
	GPS Location	3336
Actuators	Positioner	3337
	Buzzer	3338
	Audio Clip	3339
	Timer	3340
	Addressable Text Display	3341
Controls	On/Off Switch	3342
	Push Button	3347
	Level Control	3343
	Up/Down Control	3344
	Multistate Selector	3348
	Multiple Axis Joystick	3345

3. Common Template Sensors

The following subsections include the new IPSO Objects and their Descriptions. The following Objects use a common template with the same default resource structure shared by all of the basic objects.

Resources:

Resource Name	Resource ID	Access Type	Multiple Instances?	Mandatory	Type	Range or Enumeration	Units	Descriptions
Sensor Value	5700	R	No	Mandatory	Float		Defined by "Units" resource.	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				Reset the Min and Max Measured Values to Current Value

Resource Name	Resource ID	Access Type	Multiple Instances?	Mandatory	Type	Range or Enumeration	Units	Descriptions
Calibration Offset	5535	R,W	No	Optional	Float			Read or Write the calibration offset value
Application Type	5750	R,W	No	Optional	String			The application type of the sensor or actuator as a string depending on the use case.

3.1   IPSO Object: Voltage

Description: This IPSO object should be used with voltmeter sensor to report measured voltage between two points. It also provides resources for minimum and maximum measured values, as well as the minimum and maximum range that can be measured by the sensor. An example measurement unit is volts (ucum: V).

Object Info:

Object	Object ID	Object URN	Multiple Instances?	Description
Voltage	3316	urn:oma:lwm2m:ext:3316	Yes	Voltage, example units = V

3.2   IPSO Object: Current

Description: This IPSO object should be used with an ammeter to report measured electric current in amperes. It also provides resources for minimum and maximum measured values, as well as the minimum and maximum range that can be measured by the sensor. An example measurement unit is volts (ucum: A).

Object Info:

Object	Object ID	Object URN	Multiple Instances?	Description
Current	3317	urn:oma:lwm2m:ext:3317	Yes	Current, example units = A

3.3   IPSO Object: Frequency

Description: This IPSO object should be used to report frequency measurements. It also provides resources for minimum and maximum measured values, as well as the minimum and maximum range that can be measured by the sensor. An example measurement unit is volts (ucum: Hz).

Object Info:

Object	Object ID	Object URN	Multiple Instances?	Description
Frequency	3318	urn:oma:lwm2m:ext:3318	Yes	Frequency, example units = hertz (Hz)

3.4   IPSO Object: Depth

Description: This IPSO object should be used to report depth measurements. It can, for example, be used to describe a generic rain gauge that measures the accumulated rainfall in millimetres (mm) or in fathoms (fth).

Object Info:

Object	Object ID	Object URN	Multiple Instances?	Description
Depth	3319	urn:oma:lwm2m:ext:3319	Yes	Depth, example units = millimeters (mm)

3.5   IPSO Object: Percentage

Description: This IPSO object should can be used to report measurements relative to a 0-100% scale. For example it could be used to measure the level of a liquid in a vessel or container in units of %.

Object Info:

Object	Object ID	Object URN	Multiple Instances?	Description
Percentage	3320	urn:oma:lwm2m:ext:3320	Yes	Percentage, example units = %

3.6 IPSO Object: Altitude

Description: This IPSO object should be used with an altitude sensor to report altitude above sea level in meters. Note that Altitude can be calculated from the measured pressure given the local sea level pressure. It also provides resources for minimum and maximum measured values, as well as the minimum and maximum range that can be measured by the sensor. An example measurement unit is meters (ucum: m).

Object Info:

Object	Object ID	Object URN	Multiple Instances?	Description
Altitude	3321	urn:oma:lwm2m:ext:3321	Yes	Altitude, example units = meters (m)

3.7 IPSO Object: Load

Description: Description: This IPSO object should be used with a load sensor (as in a scale) to report the applied weight or force. It also provides resources for minimum and maximum measured values, as well as the minimum and maximum range that can be measured by the sensor. An example measurement unit is kilograms (ucum: Kg).

Object Info:

Object	Object ID	Object URN	Multiple Instances?	Description
Load	3322	urn:oma:lwm2m:ext:3322	Yes	Load, example units = kilograms (KG)

3.8 IPSO Object: Pressure

Description: This IPSO object should be used to report pressure measurements. It also provides resources for minimum and maximum measured values, as well as the minimum and maximum range that can be measured by the sensor. An example measurement unit is pascals (ucum: Pa).

Object Info:

Object	Object ID	Object URN	Multiple Instances?	Description
Pressure	3323	urn:oma:lwm2m:ext:3323	Yes	Pressure, example units = pascal (Pa)

3.9　IPSO Object: Loudness

Description: This IPSO object should be used to report loudness or noise level measurements. It also provides resources for minimum and maximum measured values, as well as the minimum and maximum range that can be measured by the sensor. An example measurement unit is decibels (ucum: dB).

Object Info:

Object	Object ID	Object URN	Multiple Instances?	Description
Loudness	3324	urn:oma:lwm2m:ext:3324	Yes	Loudness, example units = decibels (dB)

3.10　IPSO Object: Concentration

Description: This IPSO object should be used to the particle concentration measurement of a medium. It also provides resources for minimum and maximum measured values, as well as the minimum and maximum range that can be measured by the sensor. An example measurement unit is parts per million (ucum: ppm).

Object Info:

Object	Object ID	Object URN	Multiple Instances?	Description
Concentration	3325	urn:oma:lwm2m:ext:3325	Yes	Concentration, example units = Parts per million (ppm)

3.11　IPSO Object: Acidity

Description: This IPSO object should be used to report an acidity measurement of a liquid. It also provides resources for minimum and maximum measured values, as well as the minimum and maximum range that can be measured by the sensor. An example measurement unit is pH.

Object Info:

Object	Object ID	Object URN	Multiple Instances?	Description
Acidity	3326	urn:oma:lwm2m:ext:3326	Yes	Acidity, example units = pH

3.12 IPSO Object: Conductivity

Description: This IPSO object should be used to report a measurement of the electric conductivity of a medium or sample. It also provides resources for minimum and maximum measured values, as well as the minimum and maximum range that can be measured by the sensor. An example measurement unit is Siemens (ucum: S).

Object Info:

Object	Object ID	Object URN	Multiple Instances?	Description
Conductivity	3327	urn:oma:lwm2m:ext:3327	Yes	Conductance, example units = Siemens (S)

3.13 IPSO Object: Power

Description: This IPSO object should be used to report power measurements. It also provides resources for minimum and maximum measured values, as well as the minimum and maximum range that can be measured by the sensor. An example measurement unit is Watts (ucum: W). This resource may be used for either real power or apparent power (units= ucum:VA) measurements. The Application type can be use for reactive power or active power for example.

Object Info:

Object	Object ID	Object URN	Multiple Instances?	Description
Power	3328	urn:oma:lwm2m:ext:3328	Yes	Power, example units = Power (W)

3.14 IPSO Object: Power Factor

Description: This IPSO object should be used to report a measurement or calculation of the power factor of a reactive electrical load. Power Factor is normally the ratio of non-reactive power to total power. This object also provides resources for minimum and maximum measured values, as well as the minimum and maximum range that can be measured by the sensor

Object Info:

Object	Object ID	Object URN	Multiple Instances?	Description
Power Factor	3329	urn:oma:lwm2m:ext:3329	Yes	Power Factor, example units = Power (W)

3.15 IPSO Object: Rate

Description: This object type should be used to report a rate measurement, for example the speed of a vehicle, or the rotational speed of a drive shaft. It also provides resources for minimum and maximum measured values, as well as the minimum and maximum range that can be measured by the sensor.An example measurement unit is Feet per Second (ucum:ft_us/s).

Object Info:

Object	Object ID	Object URN	Multiple Instances?	Description
Rate	3346	urn:oma:lwm2m:ext:3346	Yes	Rate, example units = Feet per Second

3.16 IPSO Object: Distance

Description: This IPSO object should be used to report a distance measurement. It also provides resources for minimum and maximum measured values, as well as the minimum and maximum range that can be measured by the sensor. An example measurement unit is Meters (ucum: m).

Object Info:

Object	Object ID	Object URN	Multiple Instances?	Description
Distance	3330	urn:oma:lwm2m:ext:3330	Yes	Distance, example units = meters (m)

4. Special Template Sensors

Some of the new sensor types require new resources other than the ones found in the common template sensor. For this reason they fall in a new category of "Special Template Sensors". The new Resources have been added to the Resource List on Table 2.

4.1   IPSO Object: Energy

Description: This IPSO object should be used to report energy consumption (Cumulative Power) of an electrical load. An example measurement unit is Watt Hours (ucum:W*h).

Object Info:

Object	Object ID	Object URN	Multiple Instances?	Description
Energy	3331	urn:oma:lwm2m:ext:3331	Yes	Energy, example units = Watt Hours (W*h)

Resources:

Resource Name	Resource ID	Access Type	Multiple Instances?	Mandatory	Type	Range or Enumeration	Units	Descriptions
Sensor Value	5805	R	No	Mandatory	Float		Wh	The cumulative active power since the last cumulative energy reset or device start
Units	5701	R	No	Optional	String			Measurement Units Definition e.g. "Cel" for Temperature in Celsius.
Reset Cumulative energy	5822	E	No	Optional				Reset both cumulative active/reactive power

Resource Name	Resource ID	Access Type	Multiple Instances?	Mandatory	Type	Range or Enumeration	Units	Descriptions
Application Type	5750	R,W	No	Optional	String			The application type of the sensor or actuator as a string depending on the use case.

4.2   IPSO Object: Direction

Description: This IPSO object is used to report the direction indicated by a compass, wind vane, or other directional indicator. The units of measure is plane angle degrees (ucum:deg).

Object Info:

Object	Object ID	Object URN	Multiple Instances?	Description
Direction	3332	urn:oma:lwm2m:ext:3332	Yes	Plane angle measurement used as a direction indicator.

Resources:

Resource Name	Resource ID	Access Type	Multiple Instances?	Mandatory	Type	Range or Enumeration	Units	Descriptions
Compass Direction	5705	R	No	Mandatory	Float	0-360	deg	This indicates the compass direction of some phenomenon (i.e. direction of travel, wind direction…).
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.

Resource Name	Resource ID	Access Type	Multiple Instances?	Mandatory	Type	Range or Enumeration	Units	Descriptions
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.
Reset Min and Max Measured Values	5605	E	No	Optional				Reset the Min and Max Measured Values to Current Value.
Application Type	5750	R,W	No	Optional	String			The application type of the sensor or actuator as a string depending on the use case.

4.3   IPSO Object: Time

Description: This IPSO object is used to report the current time in seconds since January 1, 1970 UTC. There is also a fractional time counter that has a range of less than one second.

Object Info:

Object	Object ID	Object URN	Multiple Instances?	Description
Time	3333	urn:oma:lwm2m:ext:3333	Yes	Absolute Unix Time in seconds UTC

Resources:

Resource Name	Resource ID	Access Type	Multiple Instances?	Mandatory	Type	Range or Enumeration	Units	Descriptions

Resource Name	Resource ID	Access Type	Multiple Instances?	Mandatory	Type	Range or Enumeration	Units	Descriptions
Current Time	5506	R, W	No	Mandatory	Time		s	Unix Time. A signed integer representing the number of seconds since Jan 1st, 1970 in the UTC time zone.
Fractional Time	5507	R, W	No	Optional	Float	0-1		For shorter times of a fraction of a second (i.e. 0.23)
Application Type	5750	R, W	No	Optional	String			The application type of the sensor or actuator as a string depending on the use case.

4.4   IPSO Object: Gyrometer

Description: This IPSO Object is used to report the current reading of a gyrometer sensor in 3 axes. It provides tracking of the minimum and maximum angular rate in all 3 axes. An example unit of measure is radians per second (ucum:rad/s).

Object Info:

Object	Object ID	Object URN	Multiple Instances?	Description
Gyrometer	3334	urn:oma:lwm2m:ext:3334	Yes	3 axis gyrometer rate measurement

Resources:

Resource Name	Resource ID	Access Type	Multiple Instances?	Mandatory	Type	Range or Enumeration	Units	Descriptions
X Value	5702	R	No	Mandatory	Float		Defined by "Units" resource.	The measured value along the X axis.
Y Value	5703	R	No	Optional	Float		Defined by "Units" resource.	The measured value along the Y axis.
Z Value	5704	R	No	Optional	Float		Defined by "Units" resource.	The measured value along the Z axis.

Resource Name	Resource ID	Access Type	Multiple Instances?	Mandatory	Type	Range or Enumeration	Units	Descriptions
Sensor Units	5701	R	No	Optional	String			Measurement Units Definition e.g. "Cel" for Temperature in Celsius.
Min X Value	5508	R	No	Optional	Float		Defined by "Units" resource.	The minimum measured value along the X axis.
Max X Value	5509	R	No	Optional	Float		Defined by "Units" resource.	The maximum measured value along the X axis.
Min Y Value	5510	R	No	Optional	Float		Defined by "Units" resource.	The minimum measured value along the Y axis.
Max Y Value	5511	R	No	Optional	Float		Defined by "Units" resource.	The maximum measured value along the Y axis.
Min Z Value	5512	R	No	Optional	Float		Defined by "Units" resource.	The minimum measured value along the Z axis.
Max Z Value	5513	R	No	Optional	Float		Defined by "Units" resource.	The maximum measured value along the Z axis.
Reset Min and Max Measured Values	5605	E	No	Optional				Reset the Min and Max Measured Values to Current Value.
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

Resource Name	Resource ID	Access Type	Multiple Instances?	Mandatory	Type	Range or Enumeration	Units	Descriptions
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
Application Type	5750	R,W	No	Optional	String			The application type of the sensor or actuator as a string depending on the use case.

4.5 IPSO Object: Colour

Description: This IPSO object should be used to report the measured value of a colour sensor in some colour space described by the units resource.

Object Info:

Object	Object ID	Object URN	Multiple Instances?	Description
Colour	3335	urn:oma:lwm2m:ext:3335	Yes	Colour sensor measurement

Resources:

Resource Name	Resource ID	Access Type	Multiple Instances?	Mandatory	Type	Range or Enumeration	Units	Descriptions
Colour	5706	R,W	No	Mandatory	String		Defined by "Units" resource.	A string representing a value in some color space.
Units	5701	R	No	Optional	String			Measurement Units Definition e.g. "Cel" for Temperature in Celsius.
Application Type	5750	R,W	No	Optional	String			The application type of the sensor or actuator as a string depending on the use case.

4.6   IPSO Object: GPS Location

Description: This IPSO object represents GPS coordinates. This object is compatible with the LWM2M management object for location, but uses reusable resources.

Object Info:

Object	Object ID	Object URN	Multiple Instances?	Description
Location	3336	urn:oma:lwm2m:ext:3336	Yes	Location in GPS Coordinates

Resources:

Resource Name	Resource ID	Access Type	Multiple Instances?	Mandatory	Type	Range or Enumeration	Units	Descriptions
Latitude	5513	R	No	Mandatory	String		Defined by "Units" resource.	The decimal notation of latitude, e.g. -43.5723 [World Geodetic System 1984].
Longitude	5514	R	No	Mandatory	String			The decimal notation of longitude, e.g. 153.21760 [World Geodetic System 1984].
Altitude	5515	R	No	Optional	String			The decimal notation of altitude in meters above sea level.
Uncertainty	5516	R	No	Optional	String			The accuracy of the position in meters.

Resource Name	Resource ID	Access Type	Multiple Instances ?	Mandatory	Type	Range or Enumer ation	Units	Descriptions
Compass Direction	5705	R	No	Optional	Float	0-360	Degrees	Measured Direction
Velocity	5517	R	No	Optional	Opaque			The velocity of the device as defined in 3GPP 23.032 GAD specification. This set of values may not be available if the device is static.
Timestamp	5518	R	No	Optional	Time			The timestamp of when the location measurement was performed.
Application Type	5750	R,W	No	Optional	String			The application type of the sensor or actuator as a string depending on the use case.

5. Actuators

Actuators are devices that create an action in the physical or virtual world, based on a supplied input value or command.

5.1   IPSO Object: Positioner

Description: This IPSO object should be used with a generic position actuator from 0 to 100%. This resource optionally allows setting the transition time for an operation that changes the position of the actuator, and for reading the remaining time of the currently active transition.

Object Info:

Object	Object ID	Object URN	Multiple Instances?	Description
Positioner	3337	urn:oma:lwm2m:ext:3337	Yes	Position actuator in %

Resources:

Resource Name	Resource ID	Access Type	Multiple Instances?	Mandatory	Type	Range or Enumeration	Units	Descriptions
Current Position	5536	R,W	No	Mandatory	Float	0-100	%.	Current position or desired position of a positioner actuator
Transition Time	5537	R,W	No	Optional	Float		s	The time expected to move the actuator to the new position
Remaining Time	5538	R	No	Optional	Float		s	The time remaining in an operation
Min Measured Value	5601	R	No	Optional	Float	Same as Measured Value	Same as Measured Value	The minimum value set on the actuator since power ON or reset
Max Measured Value	5602	R	No	Optional	Float	Same as Measured Value	Same as Measured Value	The maximum value set on the actuator since power ON or reset
Reset Min and Max Measured Values	5605	E	No	Optional				Reset the Min and Max Measured Values to Current Value
Min Limit	5519	R	No	Optional	Float	Same as Measured Value	Same as Measured Value	The minimum value that can be actuated

Resource Name	Resource ID	Access Type	Multiple Instances?	Mandatory	Type	Range or Enumeration	Units	Descriptions
Max Limit	5520	R	No	Optional	Float	Same as Measured Value	Same as Measured Value	The maximum value that can be actuated
Application Type	5750	R,W	No	Optional	String			The application type of the sensor or actuator as a string depending on the use case.

5.2   IPSO Object: Buzzer

Description: This IPSO object should be used to actuate an audible alarm such as a buzzer, beeper, or vibration alarm. There is a level control for setting the relative loudness of the alarm, and an optional duration control to limit the length of time the alarm sounds when turned on. Each time a "1" is written to the On/Off resource, the alarm will sound again for the configured duration. If no duration is programmed or the setting is zero, writing a "1" to the On/Off resource will result in the alarm sounding continuously until a "0" is written to the On/Off resource.

Object Info:

Object	Object ID	Object URN	Multiple Instances?	Description
Buzzer	3338	urn:oma:lwm2m:ext:3338	Yes	Buzzer, audible alarm, or vibration alarm

Resources:

Resource Name	Resource ID	Access Type	Multiple Instances?	Mandatory	Type	Range or Enumeration	Units	Descriptions
On/Off	5850	R, W	No	Mandatory	Boolean			On/off control, 0=OFF, 1=ON
Level	5548	R, W	No	Optional	Float	0-100	%	Audio volume

								control, float value between 0 and 100 as a percentage.
Duration	5521	R,W	No	Optional	Float		s	The duration of the sound once triggered.
Minimum Off-time	5525	R,W	No	Mandatory	Float		s	The off time when On/Off control remains on
Application Type	5750	R,W	No	Optional	String			The application type of the sensor or actuator as a string depending on the use case.

5.3   IPSO Object: Audio Clip

Description: This IPSO object should be used for a speaker that plays a pre-recorded audio clip or an audio output that is sent elsewhere. For example, an elevator which announces the floor of the building. A resource is provided to store the clip, a level resource controls the relative sound level of the playback, and a duration resource limits the maximum playback time. After the duration time is reached, any remaining samples in the clip are ignored, and the clip player will be ready to play another clip.

Object Info:

Object	Object ID	Object URN	Multiple Instances?	Description
Audio Clip	3339	urn:oma:lwm2m:ext:3339	Yes	Play an audio clip

Resources:

Resource Name	Resource ID	Access Type	Multiple Instances?	Mandatory	Type	Range or Enumeration	Units	Descriptions
Clip	5522	R, W	No	Mandatory	Opaque			Audio Clip that is playable (i.e.

							short audio recording indicating the floor in an elevator)
Trigger	5523	E	No	Optional			Trigger initiating actuation.
Level	5548	R, W	No	Optional	Float	0-100	%	Audio volume control, float value between 0 and 100 as a percentage.
Duration	5524	R,W	No	Optional	Float		s	The duration of the sound once triggered.
Application Type	5750	R,W	No	Optional	String			The application type of the sensor or actuator as a string depending on the use case.

5.4   IPSO Object: Timer

Description: This IPSO object is used to time events and actions, using patterns common to industrial timers. A POST to the trigger resource or On/Off input state change starts the timing operation, and the timer remaining time shows zero when the operation is complete. The patterns supported are One-Shot (mode 1), On-Time or Interval (mode 2), Time delay on pick-up or TDPU (tmode 3), and Time Delay on Drop-Out or TDDO (mode 4). Mode 0 disables the timer, so the output follows the input with no delay. A counter is provided to count occurrences of the timer output changing from 0 to 1. Writing a value of zero resets the counter. The Digital Input State resource reports the state of the timer output.

Object Info:

Object	Object ID	Object URN	Multiple Instances?	Description
Timer	3340	urn:oma:lwm2m:ext:3340	Yes	Industrial timer emulation

Resources:

Resource Name	Resource ID	Access Type	Multiple Instances?	Mandatory	Type	Range or Enumeration	Units	Descriptions
Duration	5521	R,W	No	Mandatory	Float		s	The duration of the time delay.
Remaining Time	5538	R	No	Optional	Float		s	The time remaining in an operation
Minimum Off-time	5525	R,W	No	Optional	Float		s	The duration of the rearm delay (i.e. the delay from the end of one cycle until the beginning of the next, the inhibit time).
Trigger	5523	E	No	Optional				Trigger initiating actuation.
On/Off	5850	R, W	No	Optional	Boolean			On/off control for the timer input, 0=OFF, 1=ON
Digital Input Counter	5501	R	No	Optional	Integer			The number of times the input transitions from off to on
Cumulative Time	5544	R, W	No	Optional	Float		s	The total time in seconds that the timer input is true. Writing a 0 resets the time
Digital State	5543	R	No	Optional	Boolean			The current state of the timer output
Counter	5534	R,W	No	Optional	Integer			Counts the number of times the timer output transitions from 0 to 1
Mode	5526	R,W	No	Optional	Integer	0-4		Type of timer

								pattern used.
Application Type	5750	R,W	No	Optional	String			The application type of the sensor or actuator as a string depending on the use case.

5.5   IPSO Object: Addressable Text Display

Description: This IPSO object is used to send text to a text-only or text mode graphics display. POSTing a string of text to the text resource causes it to be displayed at the selected X and Y locations on the display. If X or Y are set to a value greater than the size of the display, the position "wraps around" to the modulus of the setting and the display size. Likewise, if the text string overflows the display size, the text "wraps around" and displays on the next line down or, if the last line has been written, wraps around to the top of the display. Brightness and Contrast controls are provided to allow control of various display types including STN and DSTN type LCD character displays. POSTing an empty payload to the Clear Display resource causes the display to be erased.

Object Info:

Object	Object ID	Object URN	Multiple Instances?	Description
Addressable Text Display	3341	urn:oma:lwm2m:ext:3341	No	For writing to a text-only or text mode graphics display

Resources:

Resource Name	Resource ID	Access Type	Multiple Instances?	Mandatory	Type	Range or Enumeration	Units	Descriptions
Text	5527	R, W	No	Mandatory	String			A string of text.
X Coordinate	5528	R,W	No	Optional	Integer			X coordinate
Y Coordinate	5529	R, W	No	Optional	Integer			Y coordinate
Max X Coordinate	5545	R	No	Optional	Integer			The highest X coordinate the display supports before wrapping to the next line

Max Y Coordinate	5546	R	No	Optional	Integer			The highest Y coordinate the display supports before wrapping to the top line
Clear Display	5530	E	No	Optional				Command to clear the display.
Level	5548	R, W	No	Optional	Float	0-100	%	Brightness control, float value between 0 and 100 as a percentage.
Contrast	5531	R, W	No	Optional	Float	0-100	%	Proportional control, integer value between 0 and 100 as a percentage.
Application Type	5750	R,W	No	Optional	String			The application type of the sensor or actuator as a string depending on the use case.

6. Controls

Controls are devices which are actuated by a person or agent in order to change the state of a resource or resources. An example of a control is an on/off switch that a person uses to turn a light on or off.

6.1   IPSO Object: On/Off Switch

Description: This IPSO object should be used with an On/Off switch to report the state of the switch.

Object Info:

Object	Object ID	Object URN	Multiple Instances?	Description
On/Off switch	3342	urn:oma:lwm2m:ext:3342	Yes	Used for On/Off control actions

Resources:

Resource Name	Resource ID	Access Type	Multiple Instances?	Mandatory	Type	Range or Enumeration	Units	Descriptions
Digital Input State	5500	R	No	Mandatory	Boolean			The current state of a digital input.
Digital Input Counter	5501	R	No	Optional	Integer			The number of times the input transitions from 0 to 1
On Time	5852	R, W	No	Optional	Integer		s	The time in seconds since the On command was sent. Writing a value of 0 resets the counter.
Off Time	5853	R, W	No	Optional	Integer		s	The time in seconds since the Off command was sent. Writing a value of 0 resets the counter.
Application Type	5750	R,W	No	Optional	String			The application type of the sensor or actuator as a string depending on the use case.

6.2   IPSO Object: Push Button

Description: This IPSO object is used to report the state of a momentary action push button control and to count the number of times the control has been operated since the last observation.

Object Info:

Object	Object ID	Object URN	Multiple Instances?	Description
Push Button	3347	urn:oma:lwm2m:ext:3347	Yes	Used for momentary initiation of control actions

Resources:

Resource Name	Resource ID	Access Type	Multiple Instances?	Mandatory	Type	Range or Enumeration	Units	Descriptions
Digital Input State	5500	R	No	Mandatory	Boolean			The current state of a digital input.
Digital Input Counter	5501	R	No	Optional	Integer			The number of times the input transitions from 0 to 1
Application Type	5750	R,W	No	Optional	String			The application type of the sensor or actuator as a string depending on the use case.

6.3 IPSO Object: Level Control

Description: This IPSO object should be used with a level control or dimmer to report the state of the control.

Object Info:

Object	Object ID	Object URN	Multiple Instances?	Description
Level	3343	urn:oma:lwm2m:ext:3343	Yes	Used for a continuously variable control or dimmer

Resources:

Resource Name	Resource ID	Access Type	Multiple Instances?	Mandatory	Type	Range or Enumeration	Units	Descriptions
Level	5548	R, W	No	Optional	Float	0-100	%	Proportional control, float value between 0

								and 100 as a percentage.
On Time	5852	R, W	No	Optional	Integer		s	The time in seconds that the level has been on (Level value has to be > 0). Writing a value of 0 resets the counter.
Off Time	5853	R, W	No	Optional	Integer		s	The time in seconds that the level has been off (level value <= 0) Writing a value of 0 resets the counter.
Application Type	5750	R,W	No	Optional	String			The application type of the sensor or actuator as a string depending on the use case.

6.4   IPSO Object: Up/Down Control

Description: This IPSO object is used to report the state of an up/down control element like a pair of push buttons or a rotary encoder. Counters for increase and decrease operations are provided for counting pulses from a quadrature encoder.

Object Info:

Object	Object ID	Object URN	Multiple Instances?	Description
Up/Down Control	3344	urn:oma:lwm2m:ext:3344	Yes	Used to initiate increasing or decreasing control actions

Resources:

Resource Name	Resource ID	Access Type	Multiple Instances?	Mandatory	Type	Range or Enumeration	Units	Descriptions
Increase Input State	5532	R	No	Mandatory	Boolean			Indicates an increase control action
Decrease Input State	5533	R	No	Mandatory	Boolean			Indicates a decrease control action
Up Counter	5541	R,W	No	Optional	Integer			Counts the number of times the increase control has been operated. Writing a 0 resets the counter.
Down Counter	5542	R,W	No	Optional	Integer			Counts the times the decrease control has been operated. Writing a 0 resets the counter.
Application Type	5750	R,W	No	Optional	String			The application type of the sensor or actuator as a string depending on the use case.

6.5   IPSO Object: Multistate Selector

Description: This IPSO object is used to represent the state of a multistate selector switch with a number of fixed positions.

Object Info:

Object	Object ID	Object URN	Multiple Instances?	Description
Multistate Selector	3348	urn:oma:lwm2m:ext:3348	Yes	Used for multistate control actions

Resources:

Resource Name	Resource ID	Access Type	Multiple Instances?	Mandatory	Type	Range or Enumeration	Units	Descriptions
Multistate Input	5547	R	No	Mandatory	Integer			The current state of a multistate input or selector.
Application Type	5750	R,W	No	Optional	String			The application type of the sensor or actuator as a string depending on the use case.

6.6   IPSO Object: Multiple Axis Joystick

Description: This IPSO object can be used to report the position of a shuttle or joystick control. A digital input is provided to report the state of an associated push button.

Object Info:

Object	Object ID	Object URN	Multiple Instances?	Description
Multiple Axis Joystick	3345	urn:oma:lwm2m:ext:3345	Yes	Used for a 1 axis (shuttle) control, 2 axis control, or 3 axis control

Resources:

Resource Name	Resource ID	Access Type	Multiple Instances?	Mandatory	Type	Range or Enumeration	Units	Descriptions
Digital Input State	5500	R	No	Optional	Boolean			The current state of a digital input.

Resource Name	Resource ID	Access Type	Multiple Instances?	Mandatory	Type	Range or Enumeration	Units	Descriptions
Digital Input Counter	5501	R	No	Optional	Integer			The number of times the input transitions from 0 to 1
X Value	5702	R	No	Optional	Float	-100 +100	%	The measured value along the X axis.
Y Value	5703	R	No	Optional	Float	-100 +100	%	The measured value along the Y axis.
Z Value	5704	R	No	Optional	Float	-100 +100	%	The measured value along the Z axis.
Application Type	5750	R,W	No	Optional	String			The application type of the sensor or actuator as a string depending on the use case.

7. Reusable Resource ID Definitions

This section defines new resources registered in the Reusable Resource Registry maintained by OMNA. These resources are used to compose the objects in this guideline and may be reused in future guidelines.

Table 2 Reusable Resource definitions

Resource Name	Resource ID	Access Type	Type	Range or Enumeration	Units	Descriptions
Current Time	5506	R, W	Time		s	Unix Time. A signed integer representing the number of seconds since Jan 1st, 1970 in the UTC time zone.
Fractional Time	5507	R, W	Float	0-1		For shorter times of a fraction of a second (i.e. 0.23)
Min X Value	5508	R	Float		Defined by "Units" resource.	The minimum measured value along the X axis.

Resource Name	Resource ID	Access Type	Type	Range or Enumeration	Units	Descriptions
Max X Value	5509	R	Float		Defined by "Units" resource.	The maximum measured value along the X axis.
Min Y Value	5510	R	Float		Defined by "Units" resource.	The minimum measured value along the Y axis.
Max Y Value	5511	R	Float		Defined by "Units" resource.	The maximum measured value along the Y axis.
Min Z Value	5512	R	Float		Defined by "Units" resource.	The minimum measured value along the Z axis.
Latitude	5513	R	String		Defined by "Units" resource.	The decimal notation of latitude, e.g. -43.5723 [World Geodetic System 1984].
Longitude	5514	R	String			The decimal notation of longitude, e.g. 153.21760 [World Geodetic System 1984].
Altitude	5515	R	String			The decimal notation of altitude in meters above sea level.
Uncertainty	5516	R	String			The accuracy of the position in meters.
Velocity	5517	R	Opaque			The velocity of the device as defined in 3GPP 23.032 GAD specification. This set of values may not be available if the device is static.
Timestamp	5518	R	Time			The timestamp of when the location measurement was performed.
Min Limit	5519	R	Float	Same as Measured Value	Same as Measured Value	The minimum value that can be measured by the sensor.

Resource Name	Resource ID	Access Type	Type	Range or Enumeration	Units	Descriptions
Max Limit	5520	R	Float	Same as Measured Value	Same as Measured Value	The maximum value that can be measured by the sensor
Duration	5521	R,W	Float		s	The duration of the time delay.
Clip	5522	R, W	Opaque			Audio Clip that is playable (i.e. short audio recording indicating the floor in an elevator)
Trigger	5523	E				Trigger initiating actuation.
Duration	5524	R,W	Float		s	The duration of the sound once trigger.
Minimum Off-time	5525	R,W	Float		s	The duration of the rearm delay (i.e. the delay from the end of one cycle until the beginning of the next, the inhibit time)
Mode	5526	R,W	Integer			Used for selecting an enumerated mode
Text	5527	R, W	String			A string of text.
X Coordinate	5528	R,W	Integer			X coordinate
Y Coordinate	5529	R, W	Integer			Y coordinate
Clear Display	5530	E				Command to clear the display.
Contrast	5531	R, W	Float	0-100	%	Proportional control, integer value between 0 and 100 as a percentage.
Increase Input State	5532	R	Boolean			Indicates an increase control action
Decrease Input State	5533	R	Boolean			Indicates a decrease control action

Resource Name	Resource ID	Access Type	Type	Range or Enumeration	Units	Descriptions
Counter	5534	R,W	Integer			Counts the number of times an event has occurred. Writing 0 resets the counter to 0.
Calibration Offset	5535	R,W	Float			Calibration offset value to be used to additively correct the Current Value of the resource
Current Position	5536	R/W	Float	0-100	%	Current position or desired position of a positioner actuator
Transition Time	5537	R,W	Float		s	The time expected to move the actuator to the new position
Remaining Time	5538	R	Float		s	The time remaining in an operation
Max X Coordinate	5539	R	Integer			The highest X coordinate the display supports before wrapping to the next line
Max Y Coordinate	5540	R	Integer			The highest Y coordinate the display supports before wrapping to the top line
Up Counter	5541	R,W	Integer			Counts the number of times the increase control has been operated. Writing a 0 resets the counter.
Down Counter	5542	R,W	Integer			Counts the times the decrease control has been operated. Writing a 0 resets the counter.
Digital State	5543	R	Boolean			The current state of a digital resource
Cumulative Time	5544	RW	Float			The total amount of time a condition has been true. Writing a 0 resets the timer
Max X Coordinate	5545	RW	Integer			The maximum X coordinate value supported

Resource Name	Resource ID	Access Type	Type	Range or Enumeration	Units	Descriptions
Max Y Coordinate	5546	RW	Integer			The maximum Y coordinate value supported
Multistate Input	5547	RW	Integer			Used to represent a multistate variable enumerated input
Level	5548	RW	Float		%	Used to represent a level control such as audio volume

Use Policy

References:

[1] Open Mobile Alliance, "Lightweight Machine to Machine Technical Specification, Draft Version 1.0", OMA-TS-LightweightM2M-V1_0-20131105-D, 05 Nov 2013. Available at:
http://openmobilealliance.hs-sites.com/lightweight-m2m-specification-from-oma

[2] Z. Shelby, K. Hartke, C. Bormann, "The Constrained Application Protocol (CoAP)", RFC 7252, June 2014. Available at: http://tools.ietf.org/html/rfc7252

[3] Fielding, R., Gettys, J., Mogul, J., Frystyk, H., Masinter, L., Leach, P., and T. Berners-Lee, "Hypertext Transfer Protocol -- HTTP/1.1", RFC 2616, June 1999. Available at: http://tools.ietf.org/html/rfc2616

[4] Fielding, R., "Architectural Styles and the Design of Network-based Software Architectures", 2000, University of California, Irvine. Available at:
https://www.ics.uci.edu/~fielding/pubs/dissertation/fielding_dissertation.pdf