



LwM2M extension

Coiole IoT Device Management - ThingWorx connector

User's Guide

Document version: 1.4



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Software Change Log

Version	Release Date	Changes
1.0.0	September 21, 2018	Initial Release
1.1.0	October 8, 2018	lwm2mDataModelService improvement – now optionally you can choose the objects whose resources are to be obtained

Introduction and Installation

Extensibility is a core aspect of the architecture and design of ThingWorx. Partners, third parties, and general ThingWorx users can easily add new functionality into the system, seamlessly. Extensions can be in the form of Service (function/method) Libraries, Connector Templates, Widgets, and more. This document provides installation and usage instructions for the LwM2M extension.

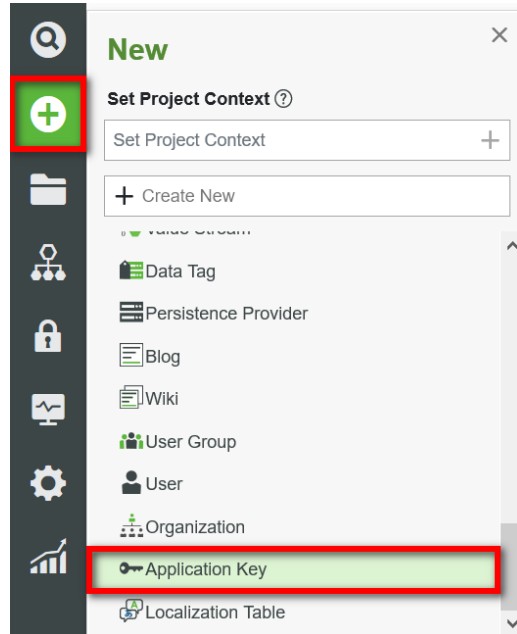
About the LwM2M extension

LwM2M extension allows you to manage your LwM2M devices using ThingWorx. The LwM2M extension for ThingWorx provides bidirectional connectivity between Coiote IoT Device Management and ThingWorx platforms and thus, treating LwM2M devices as Things and using the whole range of ThingWorx platform capabilities, including sophisticated presentation and processing of telemetry data sent by LwM2M clients as well as creation of industrial IoT application and AR experiences based on LwM2M protocol.

The LwM2M extension allows you to synchronize chosen groups of devices managed by Coiote IoT Device Management platform with ThingWorx.

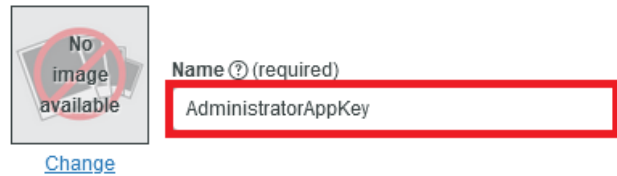
Installing the LwM2M extension

1. From a web browser, launch ThingWorx.
2. Log into ThingWorx as an administrator.
3. You need to generate an Application Key used to authenticate a ThingWorx user that will be used to request ThingWorx rest API calls triggered by Coiote IoT DM platform.
Click on **+New > Application Key**.

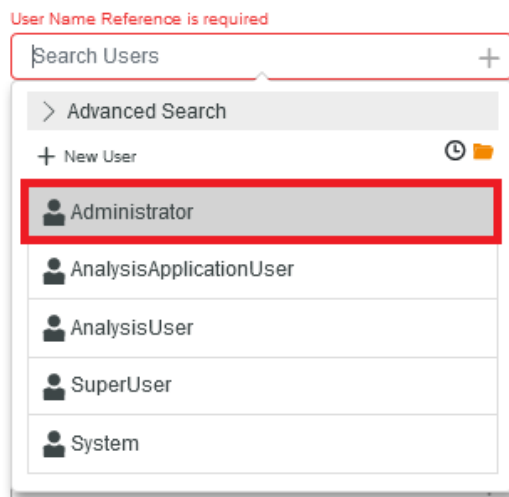


4. Give any name to the application key.

General Information



5. Choose a user going to be associated with this Application Key.



- To increase the level of security, it is recommended to provide the IP address of the Coiote IoT DM platform which is going to be integrated with ThingWorx in “**IP Whitelist**” field. This will allow only this IP address to use this Application Key. If this field is left blank, any IP can use this Application Key.

IP Whitelist ?

12.23.34.45

Client Name ?

Expiration Date ?

- Set the Application Key expiration date. Choose the date in calendar view.

Expiration Date ?

December 2020

Su	Mo	Tu	We	Th	Fr	Sa
29	30	1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31	1	2
3	4	5	6	7	8	9

Today

- Click “**Save**” button.

Application Key: New Application Key - 4 * ? To Do Save Cancel

- After clicking “**Save**”, the application key will be generated and displayed in the “**keyID**” field. Copy this key to the clipboard.

Client Name ?

Key ID ?

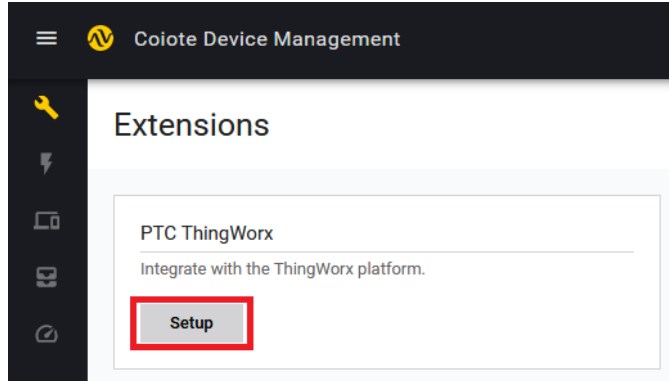
f1c3e23f-4e9b-4f7d-802c-3c2232d11f7c

Expiration Date ?

12/31/2020 12:00 pm

LwM2M extension

10. In a new web browser tab, log into Coiote IoT DM.
11. Go to **Administration > Extensions**.
12. In the “PTC ThingWorx” panel, click “Setup”.



13. Paste copied application key into the “Application key” field.

Integrate with the ThingWorx platform ⊗

Provide ThingWorx platform details:

URL Application key

The ThingWorx platform will have access to all devices belonging to this group:

[Download ThingWorx extension](#)

14. Enter the ThingWorx URL in the “URL” field in format <PROTOCOL>: // <IP or DNS name>: <OPTIONAL PORT>

Integrate with the ThingWorx platform ⊗

Provide ThingWorx platform details:

URL Application key

The ThingWorx platform will have access to all devices belonging to this group:

[Download ThingWorx extension](#)

15. Choose the device group for which the integration with ThingWorx will be applied – by default it is the *root.mt.<tenant_group>.lwm2m.management* – all non-bootstrap device entities of the tenant.

Integrate with the ThingWorx platform ⊗

Provide ThingWorx platform details:

URL Application key

The ThingWorx platform will have access to all devices belonging to this group:

[Download ThingWorx extension](#)

16. If you have not already downloaded the extension, you can do it by clicking “**Download ThingWorx extension**” – this will save the extension file on your disk.

Alternatively, you can download this extension from the PTC Marketplace.

17. Do not click “**Confirm**” yet! First, go back to the ThingWorx platform and import the downloaded extension.

18. Go to **Import/Export > Import**.

Integrate with the ThingWorx platform ⊗

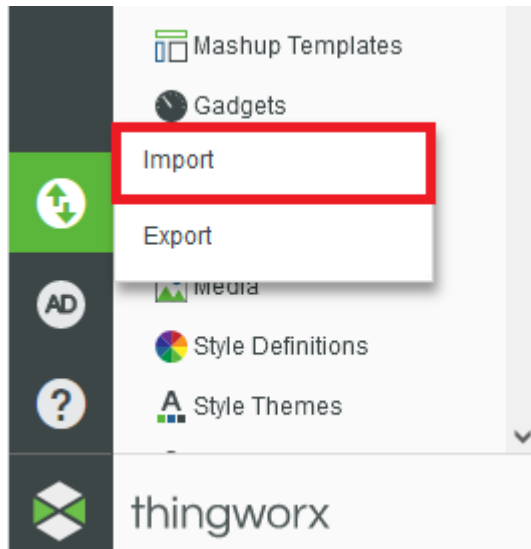
Provide ThingWorx platform details:

URL Application key

The ThingWorx platform will have access to all devices belonging to this group:

▼

[Download ThingWorx extension](#)



- 19. From the Import Option drop-down list choose: **Extension**

Import

Import Option ?

- From File ▲
- From File
- From Thingworx Storage
- Source Control Entities
- Extension**

Provider ?

Import Source ?

Single File ▼

File Name ? (required)

File is required

Browse

- 20. Click **Browse** and select the extension file from your computer's drive. If you did not rename the extension file, it will probably be **Extension.zip** or **LwM2M_extension_<version>.zip**

Import

Import Option ?

Extension ▼

File Name ? (required)

File is required

Browse

Import Validate Close

- 21. Click **Import**.

Import

Import Option ?

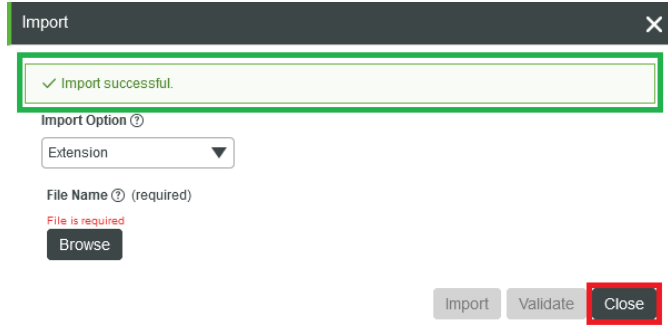
Extension ▼

File Name ? (required)

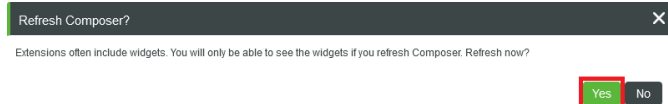
Extension.zip Remove

Import Validate Close

- 22. If an **Import Successful** message does not display, contact your ThingWorx System Administrator. Click **“Close”**.



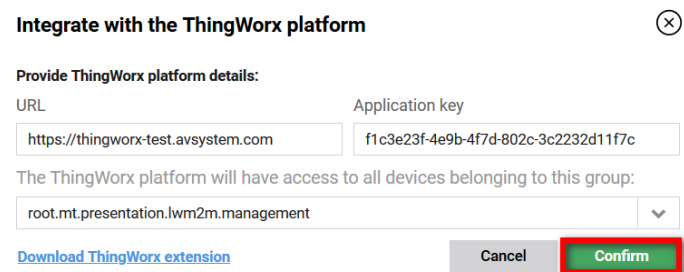
- 23. Click **Yes** to refresh Composer after importing the extension.



- 24. Confirm that the Extension has been imported properly. Check the Application Log for potential problems.

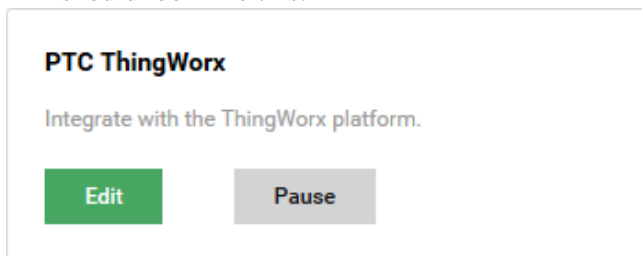
- 25. Now in the Thing Templates tab you should see a template named **“LwM2Mdevice”**, and in the Thing Shapes tab shape **“CoioRest”**.

- 26. Return to Coio IoT DM and click **“Confirm”**.



Usage

After successful LwM2M extension configuration according to the instructions described in the [Installing the LwM2M extension](#) chapter, the **Administration > Extensions > PTC ThingWorx** panel in Coio IoT DM should look like this:



LwM2M extension

As soon as any message sent by a device (which belongs to the group that has been selected for the integration) comes to Coiote (e.g. registration or notification message) or when tasks execution is triggered from GUI or rest API, the device will appear as Thing in ThingWorx. Appropriate tasks will add each such device to ThingWorx and define it as a Thing based on **LwM2Mdevice** Thing Template, set the properties of this Thing which match the mandatory LwM2M resources as well as properties that store Coiote IoT DM rest API credentials. The values of the properties corresponding to the mandatory LwM2M resources are updated during every device registration.

LwM2Mdevice Thing Template

LwM2Mdevice Thing Template includes LwM2M device mandatory resources of all mandatory objects accessible by LwM2M management server – these resources are defined as ThingWorx properties. The property category corresponds to the LwM2M object. In the property description there is a full LwM2M resource path.

Example property values of the device belonging to the group integrated with ThingWorx:

The screenshot displays the ThingWorx interface for a device named 'anjay_test'. The 'Properties and Alerts' tab is active, showing a table of properties. The 'LwM2Mdevice' template is expanded, revealing a table of properties. The 'supportedBindingAndModes' property is highlighted with a red box and labeled '2.'. The right-hand sidebar shows the description for 'supportedBindingAndModes', with the value 'Device.0.SupportedBindingAndModes' highlighted and labeled '3. Property description = LwM2M path'.

Name	Actions	Source	Default Value	Value	Alerts	Category	Additional Info
-T- binding				U	+	0	LwM2M Server
-T- coioteRestApiAddress					+	0	
🔒 coioteRestPassword				*****	+	0	
-T- coioteRestUser				thingworx-rest-pszcze...	+	0	
123 errorCode				0	+	0	Device 0 to 8
123 lifetime				60	+	0	LwM2M Server s
📄 notificationStoringWhenDisabled...				☑	+	0	LwM2M Server
123 shortServerId				1	+	0	LwM2M Server 1 to 65535
-T- supportedBindingAndModes				UQ	+	0	Device

The most important part of the **LwM2Mdevice** template is the **CoioteRest** shape which contains Services marked with the “lwm2m” category (including Services useful from the ThingWorx user’s perspective – there are 9 such Services, their names start with “lwm2m”) and Properties used by Services to communicate with the Coiote IoT DM server rest API.

LwM2M extension

Thing: anjay_test @ To Do Save Cancel More

General Information Properties and Alerts **Services** Events Subscriptions Permissions Change History View Relationships

Services Choose category

My Services + Add Duplicate Delete (showing 0 of 0)

Name ^	Actions
No services	

Inherited Services

LwM2MDevice (showing 9 of 14)

Name ^	Actions	Execute	Category
lwm2mCancelAllObserves			lwm2m
lwm2mCancelObserve			lwm2m
lwm2mDataModelService			lwm2m
lwm2mDataModelSimpleService			lwm2m
lwm2mExecute			lwm2m
lwm2mObserve			lwm2m
lwm2mRead			lwm2m
lwm2mReadMultiInstanceResource			lwm2m
lwm2mWrite			lwm2m

lwm2m Services

The names of the most important **CoioteRest** shape Services start with lwm2m. These are:

1. **lwm2mDataModelService** – gets table of the entire LwM2M data model or only resources of the chosen objects, containing detailed information about resources but excluding values update times, cached by Coiote IoT DM server. If you need value update times, use **lwm2mDataModelSimpleService** instead.

- Category: lwm2m
- Inputs:

Name	Description	Base Type	Required	Default Value
Objects	Optional parameter – LwM2M Objects. You can enter Objects whose resources you want to obtain. If you want to get resources of more than 1 object, separate these objects with a comma. If “Objects” parameter is not entered, the entire data model will be received.	STRING		

- Output: INFOTABLE (Type: Just Infotable)

part of a sample result:

Output

Firmware Update.0.Package	Opaque	Single			W	0	true
Firmware Update.0.Package URI	String	Single	bytes	0-255	RW	1	true
Firmware Update.0.State	Integer	Single	0	0-3	R	3	true
Firmware Update.0.Update	None	Single			X	2	true
Firmware Update.0.Update Result	Integer	Single	0	0-9	R	5	true
Location.0.Altitude	Float	Single	0.0	m	R	2	false
Location.0.Latitude	Float	Single	50.083463	Deg	R	0	true
Location.0.Longitude	Float	Single	19.901325	Deg	R	1	true
Location.0.Radius	Float	Single	0.0	m	R	3	false
Location.0.Timestamp	Time	Single	2020-08-05T10:34:15Z		R	5	true
Location.0.Velocity	Opaque	Single	00000000		R	4	false

LwM2M extension

- [lwm2mDataModelSimpleService](#) – gets table of the entire LwM2M data model containing resource name, type, value and value update time cached by Coiote IoT DM server. If you need more details about resources, use [lwm2mDataModelService](#) instead. Unlike the [lwm2mDataModelService](#), this one returns each instance of the multi-instance resource separately in the `Object.Instance.Resource.ResourceInstance` format.
 - Category: lwm2m
 - Inputs: No Inputs
 - Output: INFOTABLE (Type: Just Infotable)

part of a sample result:

Output			+ Data 5
Device.0.Available Power Sources.0	integer	0	2020-06-05T10:34:16.518Z
Device.0.Battery Level	integer	0	2020-06-05T10:34:16.518Z
Device.0.Battery Status	integer	0	2020-06-05T10:34:16.518Z
Device.0.Current Time	time	2020-06-05T10:34:16Z	2020-06-05T10:34:16.518Z
Device.0.Device Type	string		2020-06-05T10:34:16.518Z
Device.0.Error Code.0	integer	0	2020-06-05T10:34:16.518Z
Device.0.ExtDevInfo.0	objInk	/33806/0	2020-06-05T10:34:16.518Z
Device.0.Firmware Version	string	2.2.5	2020-06-05T10:34:16.518Z
Device.0.Hardware Version	string		2020-06-05T10:34:16.518Z
Device.0.Manufacturer	string	Anjay	2020-06-05T10:34:16.518Z
Device.0.Memory Free	integer	0	2020-06-05T10:34:16.518Z
Device.0.Memory Total	integer	0	2020-06-05T10:34:16.518Z
Device.0.Model Number	string	demo-client	2020-06-05T10:34:16.518Z
Device.0.Power Source Current.0	integer	7	2020-06-05T10:34:16.518Z
Device.0.Power Source Voltage.0	integer	31204	2020-06-05T10:34:16.518Z
Device.0.Serial Number	string	anjay_test	2020-06-05T10:34:16.518Z
Device.0.Software Version	string		2020-06-05T10:34:16.518Z
Device.0.Supported Binding and Modes	string	UQ	2020-06-05T10:34:16.518Z
Device.0.Timezone	string	Europe/Warsaw	2020-06-05T10:34:16.518Z
Device.0.UTC Offset	string	+01:00	2020-06-05T10:34:16.518Z

- [lwm2mObserve](#) – initiates Observation request on `lwm2mPath` LwM2M resource or resource-instance and stores received values from notifications in `propertyName` property. This service can be used to launch an observation of both Single and Multiple-Instance resources, however, in case of the latter, received value notifications will not be forwarded to ThingWorx. What is more, setting up an observation of Multi-Instance resource works not only for entire resource, but also for a specific resource instance. Furthermore, with this service you can also set the observation of the whole object or the whole object instance, but without the option of storing content of notifications in properties.

Allowed observation setups – correct lwm2mPath patterns:

lwm2mPath	Allowed	Values stored in properties
Object.Instance.SingleInstanceResource	✓	✓
Object.Instance.MultiInstanceResource	✓	✗
Object.Instance.MultiInstanceResource.Instance	✓	✓
Object.Instance	✓	✗
Object	✓	✗

You can choose any ThingWorx property type to store received values from notifications (e.g. INTEGER, STRING, NUMBER, DATETIME, TEXT, LONG). If entered property already exists, its type will not be changed to type defined in propertyType. Otherwise, a property named propertyName will be created with the propertyType type.

Observation attributes will be configured on the device according to the data provided as inputs of this service – the lwm2mPath resource attributes already existing on the device will be overwritten. So, for example, if a device’s resource attributes values before running this service are as follows:

pmin = 60
 pmax = 300
 gt – not set
 lt – not set
 st – not set

using this service to configure observations on this resource without setting any attributes will remove all observation attributes of this resource on the device!

- Category: lwm2m
- Inputs:

Name	Description	Base Type	Required	Default Value
lwm2mPath	LwM2M datamodel Path	STRING	✓	
propertyName	ThingWorx property name	STRING	✓	
propertyType	ThingWorx property type	STRING (BASETYPE+NAME)	✓	
MinimumPeriod	The Minimum Period Attribute indicates the minimum time in seconds the LwM2M Client MUST wait between two notifications. If a notification of an observed Resource is supposed to be generated but it is before pmin expiry, notification MUST be sent as soon as pmin expires according to OMA LwM2M technical specification.	INTEGER		
MaximumPeriod	The Maximum Period Attribute indicates the maximum time in seconds the LwM2M Client MAY wait between two notifications. When this “Maximum Period” expires after the last notification, a new notification MUST be sent according to OMA LwM2M technical specification.	INTEGER		
GreaterThan	This “gt” Attribute defines a threshold high value. When this Attribute is present, the LwM2M Client MUST notify the Server each time the Observed Resource value crosses this threshold with respect to pmin parameter and valid “Change Value Conditions” according to OMA LwM2M technical specification.	NUMBER		

LessThan	This "lt" Attribute defines a threshold low value. When this Attributes is present, the LwM2M Client MUST notify the Server each time the Observed Resource value crosses this threshold with respect to pmin parameter and valid "Change Value Conditions" according to OMA LwM2M technical specification.	NUMBER		
Step	This "Step" Attribute defines a minimum change value between two notifications. When this Attribute is present, the Change Value Condition will occur when the value variation since the last notification of the Observed Resource, is greater or equal to the "Step" Attribute value. When the "Step" Change Value Condition occurs, the LwM2M Client MUST notify the Server with respect to pmin parameter and "Valid Value Conditions" according to OMA LwM2M technical specification.	NUMBER		

4. [lwm2mCancelObserve](#) – cancels observation of the lwm2mPath Object, Instance, Resource or Resource-Instance regardless of whether this observation was configured using ThingWorx or not.

Allowed lwm2mPath patterns:

lwm2mPath	Allowed
Object.Instance.SingleInstanceResource	✓
Object.Instance.MultiInstanceResource	✓
Object.Instance.MultiInstanceResource.Instance	✓
Object.Instance	✓
Object	✓

- Category: lwm2m
- Inputs:

Name	Description	Base Type	Required	Default Value
lwm2mPath	LwM2M datamodel Path	STRING	✓	

5. [lwm2mCancelAllObserves](#) – cancels all observations set by Coiote IoT DM server integrated with the ThingWorx platform from which this service was run (including observations configured by this ThingWorx for example by using lwm2mObserve service).
 - Category: lwm2m
 - Inputs: No Inputs

6. **lwm2mRead** – performs Read operation on lwm2mPath LwM2M resource and stores received value in propertyName property. This service can read any Single-Instance Resource value or a specific resource instance value of Multiple-Instance resource. In order to obtain a value of the entire Multi-Instance Resource, use lwm2mReadMultiInstanceResource service instead.

Allowed lwm2mPath patterns:

lwm2mPath	Allowed	Values stored in properties
Object.Instance.SingleInstanceResource	✓	✓
Object.Instance.MultiInstanceResource	×	
Object.Instance.MultiInstanceResource.Instance	✓	✓
Object.Instance	×	
Object	×	

You can choose any ThingWorx property type to store received value (e.g. INTEGER, STRING, NUMBER, DATETIME, TEXT, LONG). If entered property already exists, its type will not be changed to type defined in propertyType. Otherwise, a property named propertyName will be created with the propertyType type.

- Category: lwm2m
- Inputs:

Name	Description	Base Type	Required	Default Value
lwm2mPath	LwM2M datamodel Path	STRING	✓	
propertyName	ThingWorx property name	STRING	✓	
propertyType	ThingWorx property type	STRING (BASETYPE NAME)	✓	

7. **lwm2mReadMultiInstanceResource** – performs Read operation on lwm2mPath LwM2M Multiple-Instance resource and stores received value in JSON or STRING propertyName property.

Allowed lwm2mPath patterns:

lwm2mPath	Allowed	Values stored in properties
Object.Instance.SingleInstanceResource	×	
Object.Instance.MultiInstanceResource	✓	✓
Object.Instance.MultiInstanceResource.Instance	×	
Object.Instance	×	
Object	×	

You can choose either JSON or STRING ThingWorx property type to store received values. If you do not set the propertyType, it will be JSON by default. If entered property already exists, its type will not be changed to type defined in propertyType. Otherwise, a property named propertyName will be created. This service provides validation of entered inputs.

- Category: lwm2m
- Inputs:

Name	Description	Base Type	Required	Default Value	Valid values or patterns
lwm2mPath	LwM2M datamodel Path	STRING	✓		ObjectName.InstanceNumber.MultiInstanceResourceName
propertyName	ThingWorx property name	STRING	✓		ThingWorx property name pattern (no spaces, leading numbers etc.)
propertyType	ThingWorx property type	STRING (BASETYPE_NAME)		JSON	JSON, STRING

8. **lwm2mWrite** – performs Write operation on lwm2mPath LwM2M resource. This service can modify any Single-Instance Resource value or a specific resource instance value of Multiple-Instance resource.

Allowed lwm2mPath patterns:

lwm2mPath	Allowed
Object.Instance.SingleInstanceResource	✓
Object.Instance.MultiInstanceResource	✗
Object.Instance.MultiInstanceResource.Instance	✓
Object.Instance	✗
Object	✗

- Category: lwm2m
- Inputs:

Name	Description	Base Type	Required	Default Value
lwm2mPath	LwM2M datamodel Path	STRING	✓	
value		STRING	✓	

9. **lwm2mExecute** – performs Execute operation on lwm2mPath LwM2M resource. You can optionally enter execution arguments.

Allowed lwm2mPath patterns:

lwm2mPath	Allowed
Object.Instance.SingleInstanceResource	✓
Object.Instance.MultiInstanceResource	✗
Object.Instance.MultiInstanceResource.Instance	✗
Object.Instance	✗
Object	✗

- Category: lwm2m
- Inputs:

Name	Description	Base Type	Required	Default Value
lwm2mPath	LwM2M datamodel Path	STRING	✓	
executionArguments	Optional execution arguments	STRING		

LwM2M extension

Detailed information about Lightweight Machine to Machine protocol, including the technical specification of LwM2M can be found on the Open Mobile Alliance websites:

- <https://omaspecworks.org/>
- http://www.openmobilealliance.org/wp/Overviews/lightweightm2m_overview.html

Compatibility

This extension was tested for compatibility with the following ThingWorx Platform versions and Operating System:

ThingWorx Platform Versions	ThingWorx 9.1.0-b10877
OS	Ubuntu 18.04.1 LTS

Document Revision History

Revision Date	Version	Description of Change
September 26, 2018	1.0	Initial Version
October 8, 2018	1.1	Updated the lwm2mDataModelService description
June 5, 2020	1.2	Updated installation guide
October 9, 2020	1.3	Added version 9.0.0 of ThingWorx to the compatibility list
June 24, 2021	1.4	Added version 9.1.0 of ThingWorx and updated screenshots