LwM2M Interoperability for Utilities

Launch of a new work program at OMA SpecWorks dedicated to Interoperability for Utilities

May 24 & 25, 2023
Agenda

- Introduction and Housekeeping - Seth Newberry
- Why Device Management - Olivier Carmona
- Introduction to LwM2M - Olivier Carmona
- LwM2M Security - Olivier Carmona
- LwM2M Use Cases - Olivier Carmona
- LwM2M Interoperability - Travis Shanahan
- How to Participate - Seth Newberry
- Open Discussion and Q&A
Housekeeping

- Recording and slide deck will be made available for attendees via email and on the OMA SpecWorks website.

- Questions can be asked via the webinar chat and will be answered at the end of the presentation.

- Additional questions can be sent to snewberry@omaorg.org.
Our Presenters

Seth Newberry
General Manager
OMA SpecWorks

Olivier Carmona
VP Sales & Mktg
Ioterop

Travis Shanahan
Senior Research Architect
Itron
Device Management: Why?
Over 400 million smart water meters from dozens of vendors will be available worldwide in 2026* because they:

• Provide accurate billing
• Reduce manual operations by remotely diagnosing anomalies
• Interact with customers beyond billing
• Help customers know their distribution networks thanks to data analytics

*Smart Water Magazine and ABI Research
Other Connected Tools are Also Thriving

- Pressure sensors
- Leakage sensors
- Flow sensors
- Water quality sensors
- Dataloggers
- Smart valves
- And much more

These enable more efficient management of operations and proactive identification and treatment through real-time data.
Proprietary device management makes remote control costly and has a ripple affect with other systems.

Proprietary data formats reduce fluid communication between systems.

Result: Invisible Infrastructure Costs

The number of devices from multiple vendors increases the complexity and cost of combining them in a unique SCADA system.

This combination creates a myriad of security breaches.
The Cost of Infrastructure Maintenance

Operating costs has grown OPEX/CAPEX ratio from 50/50 to 70/30*, due to:

- Too many field operations
- Too much network expertise required at installation or retiring a system
- Too many remote operations done one by one

*Bluefield Research, 2021
Purpose of the Project

OMA is the originator and copyright holder of the LwM2M specification.

LwM2M came to market as a light-weight version of the widely deployed OMA Device Management protocol.

Developed as a less chatty, low power, transport protocol for highly constrained IOT devices.

LwM2M became popular as IOT devices proliferated with a strong following in the utilities space.
Purpose of the Project

OMA is seeing an uptick in members from the utility industry who are interested in LwM2M.

Utility RFPs are increasingly calling out LwM2M in their tenders and utility suppliers are developing around LwM2M at an increasing rate.

Not all the implementations conform to the specification, creating interoperability issues.

OMA wants to provide a single-point-of-reference for this important industry segment.
Introduction to LwM2M
LwM2M Offers Standard Device Management

- **Zero-touch Provisioning**
  LwM2M Bootstrap defines it all, and can also serve to update certificate, decommission,…

- **Remote Update of the Firmware**
  LwM2M protocol defines a finite state machine.

- **Remote Control of a Set of Devices**
  LwM2M offers a set of read, write, execute, observe operations to do it all, plus a set of security layers (DTLS, OSCORE).

- **Data Format Self-Discovery**
  LwM2M protocol provides a data model, easily extensible, but above all it allows to discover the data structure on the fly: no "packet decoder" is needed.

- **Works over NB-IoT**

LightweightM2M specified at OMA

oma SpecWorks For a Connected World
LwM2M in a Nutshell

...is based on LwM2M widely adopted standards

OMA SpecWorks developed LwM2M to address the needs of low-power and low-bandwidth devices. It...

- defines remote diagnostic and remote control
- defines reliable and secure firmware updates
- defines access control to devices
- defines installation of millions of devices

...and it is being adopted globally by telcos, automotive, and... utilities.
LwM2M Concepts

- FW Update
- Connectivity Monitoring
- Location
- Light Control

LwM2M Client  LwM2M Objects  LwM2M Operations  LwM2M Server

READ
WRITE
EXECUTE
NOTIFICATION
LwM2M Objects

• A collection of Resources relevant for a particular use case
• Each resource has a defined semantic, type and allowed operations
• Well-known 16-bit IDs
• Resources and Objects can have multiple Instances
• Objects/Resources are accessed with simple URIs:
  /{Object ID}/{Object Instance}/{Resource ID}
Example: Connected Automatic Door

Two presence sensors and a powered sliding door

Business requirements:
• Door override
• Disabling one or both ways
• Counting the number of activation
LwM2M Objects

- LwM2M is extensible. Devices can implement their own LwM2M Objects
- The LwM2M Server must know the Object layout
- To avoid collisions, several Object ID ranges are defined:

<table>
<thead>
<tr>
<th>Range</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – 1023</td>
<td>Objects produced by the OMA</td>
</tr>
<tr>
<td>2048 – 10240</td>
<td>Objects registered by 3rd party standards organizations</td>
</tr>
<tr>
<td>10241 – 32768</td>
<td>Objects registered by companies or individuals</td>
</tr>
<tr>
<td>32769 – 42768</td>
<td>IDs reserved by vendors. Objects are not published</td>
</tr>
</tbody>
</table>
### Example: The Presence Object in IPSO

<table>
<thead>
<tr>
<th>Object</th>
<th>Object ID</th>
<th>Object URN</th>
<th>Multiple Instances?</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IPSO Presence</td>
<td>3302</td>
<td>urn:oma:lwm2m:ext:3302</td>
<td>Yes</td>
<td>Presence sensor with digital sensing, optional delay parameters</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Resource Name</th>
<th>Resource ID</th>
<th>Access Type</th>
<th>Multiple Instances?</th>
<th>Mandatory</th>
<th>Type</th>
<th>Units</th>
<th>Descriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digital Input State</td>
<td>5500</td>
<td>R</td>
<td>No</td>
<td>Mandatory</td>
<td>Boolean</td>
<td>The current state of the presence sensor</td>
<td></td>
</tr>
<tr>
<td>Digital Input Counter</td>
<td>5501</td>
<td>R</td>
<td>No</td>
<td>Optional</td>
<td>Integer</td>
<td>The cumulative value of active state detected</td>
<td></td>
</tr>
<tr>
<td>Digital Input Counter Reset</td>
<td>5505</td>
<td>E</td>
<td>No</td>
<td>Optional</td>
<td>Opaque</td>
<td>Reset the Counter value</td>
<td></td>
</tr>
<tr>
<td>Sensor Type</td>
<td>5751</td>
<td>R</td>
<td>No</td>
<td>Optional</td>
<td>String</td>
<td>The type of the sensor, for instance PIR type</td>
<td></td>
</tr>
<tr>
<td>Busy to Clear delay</td>
<td>5903</td>
<td>R,W</td>
<td>No</td>
<td>Optional</td>
<td>Integer</td>
<td>Delay from the detection state to the clear state in ms</td>
<td></td>
</tr>
<tr>
<td>Clear to Busy delay</td>
<td>5904</td>
<td>R,W</td>
<td>No</td>
<td>Optional</td>
<td>Integer</td>
<td>Delay from the clear state to the busy state in ms</td>
<td></td>
</tr>
</tbody>
</table>
## Example: A Custom Door Control Object

<table>
<thead>
<tr>
<th>Resource Name</th>
<th>Resource ID</th>
<th>Access Type</th>
<th>Multiple Instances?</th>
<th>Mandatory</th>
<th>Type</th>
<th>Units</th>
<th>Descriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Door State</td>
<td>0</td>
<td>R</td>
<td>No</td>
<td>Yes</td>
<td>Integer</td>
<td>/100</td>
<td>The current opening state of the door. 0: closed. 100: open</td>
</tr>
<tr>
<td>Automatic Mode</td>
<td>1</td>
<td>RW</td>
<td>No</td>
<td>Yes</td>
<td>Boolean</td>
<td></td>
<td>True: automatic mode. False: controlled by the LwM2M Server</td>
</tr>
<tr>
<td>Door Setpoint</td>
<td>2</td>
<td>RW</td>
<td>No</td>
<td>Yes</td>
<td>Integer</td>
<td>/100</td>
<td>The opening setpoint of the door when Mode is not automatic. 0: closed. 100: open</td>
</tr>
<tr>
<td>Closing Delay</td>
<td>3</td>
<td>RW</td>
<td>No</td>
<td>Optional</td>
<td>Integer</td>
<td>ms</td>
<td>Delay to wait before closing the door in the absence of presence detection</td>
</tr>
</tbody>
</table>
Example: Automatic Door Device

Presence #1
- State: false
- Counter: 2453
- Type: "Indoor"

Presence #2
- State: false
- Counter: 2482
- Type: "Outdoor"

Door Control
- State: 0
- Mode: true
- Setpoint: 0
- Delay: 2000

LwM2M Objects

LwM2M Server

READ
WRITE
EXECUTE
NOTIFICATION

LwM2M Operations
LwM2M Streamline Development

LwM2M shortcuts your deployment, allows replication

Without LwM2M:
- Select transport protocol
- Select secure encryption layer
- Build object
- Build installation procedure
- Build 24/7 tool to monitor data feed
- Automate firmware update
- Remotely control device

With LwM2M:
- Install LwM2M client on a device
- Select LwM2M objects
- Use a LwM2M server
- Remotely control any LwM2M device
**LwM2M offers strong business solutions**

<table>
<thead>
<tr>
<th>Benefits</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reducing Capital Expenditures</td>
<td>- <strong>Downscale device specifications</strong>, fast-track your time-to-market, and outsource infrastructure management.</td>
</tr>
<tr>
<td>Advanced Security</td>
<td>- Guarantee data and payload enciphering meeting regulator expectations.</td>
</tr>
<tr>
<td>Keep Existing Tools</td>
<td>- Offer a seamless transition from legacy to new generation deployments.</td>
</tr>
<tr>
<td>Reduce Operational Expenditures</td>
<td>- <strong>Reduce on-site maintenance</strong>, automate operations, and accelerate device fixes to save resources.</td>
</tr>
<tr>
<td>Fast-Track Deployment</td>
<td>- Launch your project faster without burdening your internal and development teams.</td>
</tr>
<tr>
<td>Energy Efficiency</td>
<td>- Operate on the most constrained devices as well as on high latency-networks.</td>
</tr>
</tbody>
</table>
## LwM2M provides strong impact overall

<table>
<thead>
<tr>
<th>Smart Metering</th>
<th>Street Lighting</th>
<th>Container Tracking</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Reduces operating costs by up to 30%</td>
<td>• Reduces capital expenditures by up to 50%</td>
<td>• Increases tracker lifetime to several dozen of weeks</td>
</tr>
<tr>
<td>• Increases battery lifetime by up to 30%</td>
<td>• Diminishes communication cost by up to 70%</td>
<td>• Cut maintenance cost by 70%</td>
</tr>
</tbody>
</table>
LwM2M
Security
LwM2M Meets The Needs Of Regulation

Secure interfaces: LwM2M offers encryption with DTLS (with PKI or PSK) and/or OSCORE, both independently reviewed protocols.

No universal passwords: LwM2M bootstrap offers a powerful mechanism solving that. LwM2M access control adds to it.

Remote software / certificate update: LwM2M firmware update.
LwM2M Encryption Layers

Support for Internet Engineering Task Force standards: DTLS & OSCORE.

DTLS / TLS: Encryption at transport level either through Public Shared Keys or Public Key Infrastructure.

OSCORE: Encryption at application level.

LwM2M Device Management Protocol

CoAP Transport Protocol

Oscore Security Protocol

UDP | UDP+DTLS | TCP | TCP+TLS | SMS | SMS+DTLS
LwM2M Bootstrap

Securely onboards your devices implementing your own keys / credentials

To ensure that the login credentials for the device management platform are uniquely known, LwM2M allows device credentials to be changed and the target device management platform to be assigned or changed at the beginning or later.
LwM2M Firmware Update

Fail-safe mechanism that masks many of the complexities and deals with special cases.
LwM2M Use Cases: EDMI Range of LWM2M Devices
EDMI: Range of LWM2M Devices

Why LWm2m?

Typical Water Metering Architectures

- Sigfox
- LoRa
- NB-IoT
- Other

- Europeans Proprietary Protocols -> Hard Wired to their Back Ends
- Chinese Proprietary Protocols -> Dev for free for large orders

Vendors Head End A

Vendors Head End B

Vendors Head End C

Water Utility Core Systems

EDMI Water Solutions Architecture

- Define new objects for new devices
- Re-use to create new products

Any Compliant LWM2m Server

Client Code

- Open Standards – Open Mobile Alliance
- Multiple Transports
- Easy to add new EDMI HW Devices
- Supports 3rd Party LWm2m Devices

Server Code

- Re-Use of Device Management Infrastructure
- Most Efficient Protocol for Constrained Bandwidths
- Designed for Intermittent Connections
- Provisioning, Configuration, Updating, re-used Infrastructure
EDMI Typical Architecture

Application: Meter Data Management / SCADA
Enterprise Asset Management Software

RESTful API over HTTP/HTTPS

LwM2M Server(s)
LwM2M Bootstrap Server

Interfaces
- Registration
- DM & Service Enablement
- Information Reporting

Interfaces
- Bootstrap

LwM2M client
LwM2M Objects
EDMI Device
WEPTECH: LwM2M Gateways
LwM2M Standard Lifecycle Management

Allows device lifecycle whatever brand, whatever device.

Do it once. Use it everywhere.
LwM2M Standard Data Format

Allows device operation interoperability beyond lifecycle management.

- 1,000+ objects to help your business
- Open for contributions
- Maintained by OMA SpecWorks, it also contains objects from IPSO, GSMA, uCIFI, OneM2M, and individuals
- Objects cover the most common Device Management and business use cases
LwM2M Interoperability Tools

- OMA SpecWorks conduct TestFest on a regular basis.
- TestFest results are made available globally on a repository.
Utility-Specific Needs

- Define possibly missing objects.
- Define business use cases.
- Define the associated interoperability documents.

We are looking to achieve global industry consensus and as such started two task forces:
- Task force to reach out to utilities to build the most relevant solutions.
- Task force to write those specifications.

Meet on a biweekly basis.
How to Participate
About OMA Specworks

• Established in 2002, OMA has developed hundreds of highly scalable specifications including those found in:
  - Public Safety (Push to Talk over Cellular)
  - Mobile Device Provisioning (OMA Device Management)
  - Location (OMA Secure User Plane)
  - IOT (LightWeight M2M)

• OMA has dozens of Liaison Agreements including:
  - ETSI
  - 3GPP
  - Wi-Sun
  - ATIS
OMA has a robust program of interoperability test events that allow implementers to test their products against other implementations using OMA test cases.

OMA is a California 501(c)3 member-based association. Members contribute financially to the association to support the tools, staff, legal governance and work program that develops the Specifications and Test programs.

OMA has a Board of Directors and a number of active Working Groups where the technical work takes place.

OMA Specifications are developed by the members of the Working Groups under FRAND licensing terms.

The Specifications are publicly available and free for anyone to download.
How To Participate

Companies who wish to participate in creating requirements or technical specifications for the LwM2M Utility IOT program are invited to join the OMA.

Membership allows companies to participate in developing the specifications and test cases and participate in test events. Members have access to the drafts, they may make technical contributions to the specification and may vote on the draft specifications.

A complete list of membership rights is found on the OMA website at: https://omaspecworks.org/membership/membership-benefits/

If your company is interested in participating in this work, please get in touch with Seth Newberry at snewberry@omaorg.org.
Thank you for joining!

Next Steps:
1. You can ask questions in the chat now!
2. We will send you the slide deck and the recording by email.
3. Questions can be sent to snewberry@omaorg.org.
4. Review membership information to participate:
   https://omaspecworks.org/membership/membership-benefits/
Backup

Slides for offline access when distributed after the webinar
Details on LwM2M Features
LwM2M: Much More Than A Transport Protocol

LwM2M provides numerous features, like firmware update or receive only wanted notifications

- LwM2M bootstrap platform, enables you to change the credentials of the devices at the very first boot, and to give the target device management platform at the last moment of the onboarding process

- This platform can be used at any time in case of keys or certificate renewal
LwM2M: Client & Server Interaction

Your device can sleep and send data without actively waiting for a server request.
You can define fallback scenarios if Server is not accessible

You can configure all aspects of client-server interactions to cope even with the most complicated end-to-end architectures:

- Basic Registration rules: configure nominal case, and rule to apply in case of failure
- Fallback rules: define all fallback scenarios, from going back to bootstrap to downgrading the version of the protocol
- Multi-Server management: define prioritization and access rights between all targeted device management servers
LwM2M: Bootstrap Is Compact

Use Bootstrap pack capabilities to enroll and configure your devices without killing your communication cost

• Until LwM2M v.1.1, IOWA enabled you to enroll your devices on a Device Management Server relying on bootstrap and further standard operations for device configurations

• From LwM2M v.1.2, IOWA provides you a more optimized way to provision and configure a device through the Bootstrap pack: one single exchange combining the bootstrap request and the exchange of a single file to configure the device to minimize the communications required
LwM2M: Work Even On Unreliable Connections

CoAP can go through, even on most unreliable networks

- LWM2M Client allows you to define precise CoAP congestion control rules to perform re-connection retries with the server in case of very high latency or network loss. Both retry timers and retry counts are accessible.

- Additionally, LwM2M registration lifetime as well as registration updates can also be configured to avoid performing security handshakes for each connection.
LwM2M: Works On UDP, TCP, SMS, and More

Works on UDP, TCP and even use SMS to trigger device registration, device wake up or other sorts of standard operations
NB IoT & LwM2M
Why Cellular IoT?

• Private, AdHoc Connectivity:
  • Create an infrastructure and maintain it without economies of scale.
  • Advanced Metering Infrastructure

• Public, Internet connectivity:
  • Use the infrastructure of the telecom operators, and benefit from constantly decreasing known rates.
  • Telco Grade Security
  • Bidirectionnal
Why NB-IoT?

- Deep Penetration
- Low Consumption
- Low Cost
- Applications: Metering, lighting, etc.

- Fast motion resistant
- Higher Bandwidth
- Applications: Elevators, cars, etc.
LwM2M Perfect Choice for NB IoT

LwM2M brings to NB-IoT a secure, extensible protocol for device life cycle management

- Device mostly idle
- Up to 20s latency
- 200kbps bandwidth

Requires an asynchronous protocol such as LwM2M

LwM2M & NB-IoT match perfectly