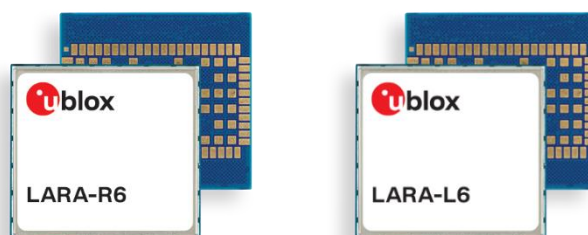




LARA-L6 / LARA-R6 series

LwM2M objects and commands

Application note



Abstract

u-blox cellular modules offer LwM2M options to achieve a few mandatory objects and Firmware Over The Air update (uFOTA). This application note covers details of the mandatory objects and the command options.

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1 LwM2M overview and architecture

Lightweight machine-to-machine (LwM2M) is a secure, efficient, and deployable client-server protocol for managing resource constrained devices on a variety of networks. The module implements the LwM2M client and sits in between the server and the host application. The u-blox client implementation is compliant with LwM2M OMA TS version 1.0 [1].

1.1 LwM2M interfaces

The Open Mobile Alliance (OMA) defines the application layer communication between an LwM2M server and an LwM2M client.

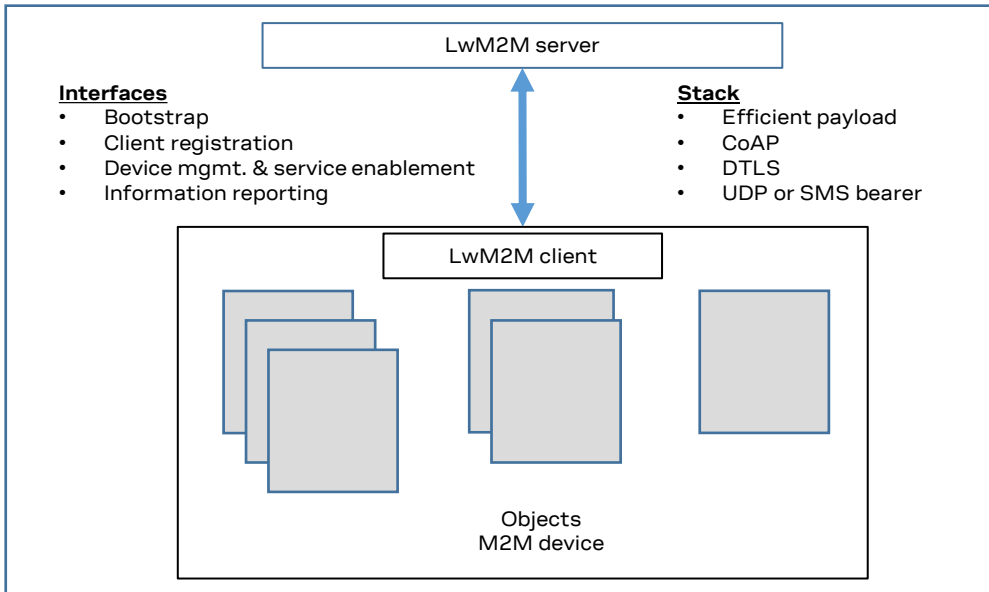


Figure 1: Interfaces between the server and client

- **Bootstrap interface:** Configuration of server’s info, credentials & ACLs
- **Client registration interface:** Informing server about “existence” and supported functionality, e.g., objects, transport bindings.
- **Device management and service enablement interface:** Access object instances and resources
- **Information reporting interface:** Publish/subscribe interaction for observing resources changes.

The LwM2M client connects to the server using the CoAP protocol. For secure connections it uses DTLS with the Pre-Shared Key (PSK).

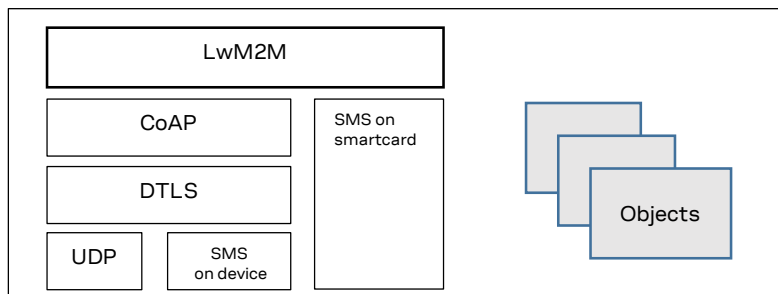


Figure 2: Protocols used in LwM2M

1.2 High level LwM2M client architecture

The LwM2M architecture on the module consists of the modem, LwM2M client, and the LwM2M objects.

An external host or LwM2M server with permission can access the object instances and resources provided by the LwM2M client. A “Write” operation is used to change the value of a resource, the values of an array of resources instances, or the values of multiple resources of an object instance. A “Read” operation is used to access the value of a resource, an array of resource instances, an object instance or all the object instances of an object.

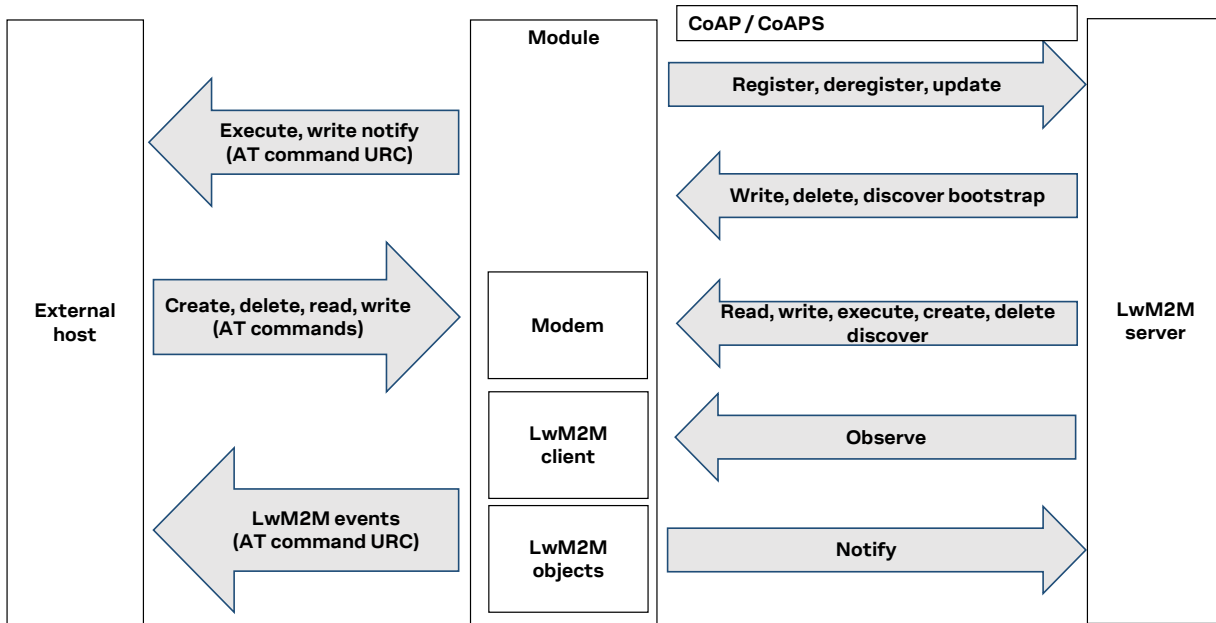


Figure 3: High level architecture

1.3 Objects and resources

LwM2M uses a simple flat data model consisting of object instances and their constituent resources that can be addressed using consistent URI scheme across clients.

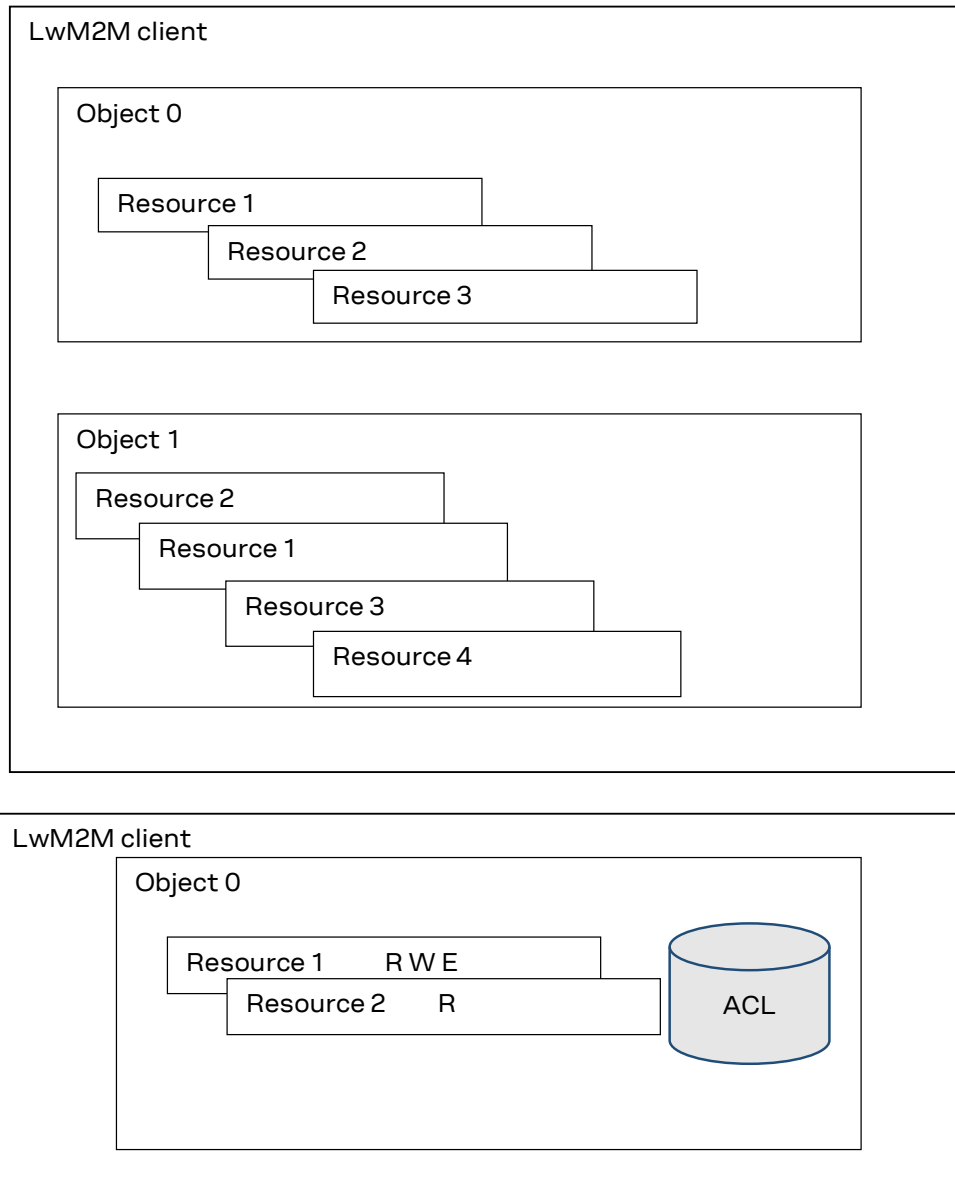


Figure 4: Objects, instances, and resources

- An object can have multiple instances and is a collection of resources.
- A resource is an atomic piece of information that can be read, written, or executed.
- Access control lists (ACLs) define which operations on a given object instance are allowed for which LwM2M server(s).
- A resource can be of the type: string, integer (8 – 64 bit), float, boolean, time, ObjLnk, none.
- Objects/Resources are accessed with simple URI like `{ObjectID}/{ObjectInstance}/{ResourceID}`
E.g.: `/3/0/1` = 3 – Device Object, 0 – Instance of Object, 1 – Manufacturer

2 Objects and categories

For more details on LwM2M and categories, see

<http://www.openmobilealliance.org/wp/OMNA/LwM2M/LwM2MRegistry.html>.

Category	URN	Object ID	Description
oma-label	urn:oma:lwm2m:oma:<id>:<version>	0 – 1023	Objects produced by OMA. Only OMA can use this range
ext-label	urn:oma:lwm2m:ext:<id>:<version>	2048 – 10240	Objects registered by 3 rd party standards organizations or alliances
x-label	urn:oma:lwm2m:x:<id>:<version>	10241 – 26240 26241 – 32768 32769 – 42768	Objects registered by companies or individuals. Objects Produced by Vendors to re-use Block of objects reserved by vendors (Max 50). Private range, Objects will not be published

2.1 Objects supported

Table 1 reports the objects and resources supported by LARA-L6 / LARA-R6 series modules.





Object ID	Name	Resources supported	Notes
0	Security	0, 1, 2, 3, 5, 9, 10, 11, 30000**	** = Only supported in Verizon configuration
1	Server	0, 1, 2, 3, 4, 5, 7, 8, 10, 16, 17, 18, 30000**	** = Only supported in Verizon configuration
2	Access Control	0, 1, 2, 3	
3	Device	0, 1, 2, 3, 4, 5, 6*, 7*, 8*, 9*, 10, 11*, 12, 13, 14*, 15*, 16, 17, 18, 19, 20*, 21*, 30000**	* = Data written by end device ** = Only supported in Verizon configuration
4	Connectivity Monitoring	0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 30000**	** = Only supported in Verizon configuration
5	FW Update	1, 2, 3, 5, 6, 7, 8, 9	
6	Location	0*, 1*, 2*, 3*, 4*, 5*, 6*	* = Data written by end device
7	Connectivity Statistics	0, 1, 2, 3, 4, 5, 6, 7, 8	
8	Lock and Wipe	0*, 1*, 2*, 3*, 4*, 5*	* = Data written by end device
11	APN Connection Profile	0, 1, 3, 24	Only supported in AT&T configuration
14	Software Component	0, 2, 5	
16	Portfolio	0, 1*, 2*, 3*	Only supported in AT&T configuration; * = Data written by end device
3300	Generic Sensor	5601*, 5602*, 5603*, 5604*, 5700*, 5701*, 5750*, 5751*	* = Data written by end device
10308	AT&T extended connectivity	1, 2, 3, 7, 8	Only supported in AT&T configuration

Table 1: LwM2M objects supported by LARA-L6 / LARA-R6 series modules

The client recognizes these objects and provides access to some of the objects. It is up to the individual product on how these objects get populated. In addition, some of these resources cannot be populated by an end device implying it cannot be used by an end device.

In the AT&T configuration (+UMNOPROF: 2) the Object 11 “APN connection profile” is synchronized with APNs defined/displayed via the +CGDCONT AT command. In this way when

creating/deleting an APN by the +CGDCONT AT command, the same will be created/deleted in a dedicated Object 11 resource.

-  In the AT&T configuration (+UMNOPROF: 2) the APN “attm2mglobal” must NOT be deleted from the +CGDCONT list since the deletion of this APN will prevent LwM2M connectivity. This complies to the AT&T requirement CDR-IOT-005 [5]. If an APN is disabled, which sets the Object 11 resource 3 to “false”, then the APN activation will be locally rejected by the AT interface. If the disabled APN is used for attaching the module, it will be automatically replaced with “attm2mglobal”. This complies with the AT&T requirement CDR-DVM-4559 [5].
-  The time resource /3/0/13 is automatically updated and aligned to the module time.
-  Objects /6 Location, /8 Lock and Wipe and /3300 Generic Sensor are not instantiated in a factory default database. These objects and their resources are created via the +ULWM2MCREATE AT command, see section 5.3.1.
-  Object /8 Lock and Wipe is not available in LARA-R6001D-00B-00 and LARA-R6001D-00C1B-00

3 LwM2M impact on module functionality

LwM2M, as embedded application:

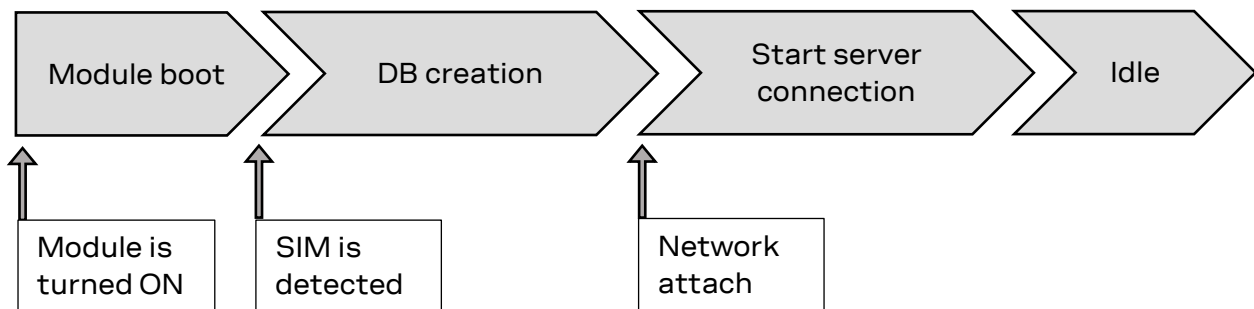
- Autonomously activates PDN and makes data traffic. MNO servers use dedicated APNs, while user-specific servers, like u-blox LwM2M server, uses the user data context.
- Affects power consumption.

The following sections describe main LwM2M procedures and their timings.

- The GCF-PTCRB profile (+UMNOPROF: 201) does not support LwM2M feature.
- Section 3.2 refers to the factory-programmed configuration. It is possible for the LwM2M server/user to add/delete/modify the server's number and connectivity timings.

3.1 LwM2M start sequence: DB creation

At the first boot after an MNO change by the +UMNOPROF AT command, the LwM2M client proceeds with the creation of the LwM2M database. This operation impacts module functionality and requires the host processor to not interfere with it.



- The module is already provisioned with LwM2M DB aligned to the default MNO profile configuration.
- The module deletes the DB file when swapping the +UMNOPROF profile from one to another. The suggested wait time for the DB creation is 10 s for all supported MNO profiles.
- LwM2M client is not functional during the DB file creation, which is a one-time operation.
- It is highly recommended to not remove power or reboot the module during the DB file creation.
- The DB can be erased via the AT+ULWM2M=2 command. At the next reboot, the timings above are applied.

3.2 LwM2M production mode


For environments with critical time constraints like module/device production phase, it is possible to skip LwM2M DB creation by activating the LwM2M production mode, in which the LwM2M client will not start, so the DB creation is skipped.

The LwM2M production mode is tuned with two different settings in the +ULWM2MCONFIGEXT AT command:

- <production_mode>:
 - 0 - The production mode is disabled.
 - 1 - The production mode is enabled if the inserted SIM matches the <production_sim> parameter.
- <production_sim>: string parameter of 5 or 6 digits filtering a special SIM used in production. E.g., if set to "00101", SIMs with IMSI starting by "00101" will not produce any LwM2M activity. An empty string "" means the feature is disabled.

For all MNO profiles, except MNO:90 (Global), factory-programmed values are `<production_mode>=0` and `<production_sim>=""` which means production mode is disabled, i.e., LwM2M always starts. For MNO:90, `<production_sim>="00101"`. This means that in global default configuration, LwM2M will not start if a test SIM is inserted.

The changes apply to the current selected MNO profile only. Reboot the module to apply the settings.

 LwM2M production mode shall be used for simulated and/or controlled environments, not in the field. If enabled, it will stop LwM2M functionality and prevent LwM2M-based services including FOTA. LwM2M is a mandatory requirement for MNO certifications.

3.3 Basic functionality

When active, the client attempts to perform a client-initiated bootstrap (only in Verizon Wireless (+UMNOPROF: 3), AT&T (+UMNOPROF: 2), AT&T FirstNet (+UMNOPROF: 206) configurations). If the bootstrap was already successfully performed, the client would trigger registration to the available servers.


The LwM2M client can connect to multiple servers, and it does so with a frequency established by the lifetime. This parameter depends on the operator and is set in the bootstrap process, which is performed only once, the first time the LwM2M client is activated.

Based on the supported operators, namely AT&T (including FirstNet) and Verizon, the operator's bootstrap server configures one (AT&T) or more (Verizon) operating servers to which the LwM2M client then connects periodically, before the lifetime expires (it does it a little more than lifetime / 2).

In addition to the operator-configured servers, the u-blox server is always present. If the selected MNO profile is different from 2 (AT&T), 206 (AT&T FirstNet) or 3 (Verizon), then only the u-blox server is available by default. In this case no bootstrap is performed.

<MNO>	Server	SSID	Lifetime	CID/APN	Notes
2 (AT&T), 206 (AT&T FirstNet)	Device Management	3	24 h	atm2mglobal	Connect at each reboot
3 (Verizon)	Device Management	102	30 d	VZWADMIN	Connect at each reboot
3 (Verizon)	Diagnostic	101	24 h	VZWADMIN	Connect at each reboot
3 (Verizon)	Repository	1000	24 h	Internet (CID 3 by default)	
2 (AT&T), 90 (Global), 206 (AT&T FirstNet)	u-blox LwM2M	721	24 h	Internet (CID 1 by default)	
3 (Verizon)	u-blox LwM2M	721	24h	Internet (CID 3 by default)	


Table 2: servers present in LwM2M database after bootstrap, and their lifetime.

 For the complete list of supported MNO profiles, see the +UMNOPROF AT command description in LARA-L6 / LARA-R6 series AT commands manual [2].

First-time bootstrap

The first time the LwM2M client is turned on, it will bootstrap and connect to the operational servers.

This procedure applies to any change of MNO profile, if the LwM2M client is active (+ULWM2M: 0) and the selected configuration is different from GCF-PTCRB (+UMNOPROF: 201).

 The <MNO> change via the +UMNOPROF AT command must be done with the module in an offline state (+COPS: 2 or +CFUN: 0 or +CFUN: 4). If the module is not offline, the MNO switch may lead to inconsistent LwM2M configuration.

Module already bootstrapped

After bootstrap, the LwM2M client connects to servers following the lifetime timing. The number of servers and the APN/CID used follows [Table 2](#). This table also reports the MNO profiles where the connection to MNO servers is also triggered at each reboot, in compliance with MNO requirements.

3.4 Configuration of APNs and PDNs in LwM2M

3.4.1 Operator-specific servers

With AT&T (including FirstNet) or Verizon MNO configuration, LwM2M by default connects to the MNO-specific servers. Operators prescribe the usage of a dedicated APN for those:

- **Verizon:** Class 2 APN “VZWADMIN” is activated and used for connection to Bootstrap, Device Management (DM) and Diagnostic server. This APN is hardcoded in the VZW APN table, and cannot be deleted or changed.
- **AT&T:** AT&T APN “attiotfirstnet.fn” when FirstNet MNO profile is selected (+UMNOPROF: 206), otherwise AT&T APN “attm2mglobal” is used. It is stored by default in LwM2M object /1 1/0. Even if this resource and its +CGDCONT entry can be deleted and changed by the user, removing this APN is generally prohibited. If the user or application processor re-defines or removes this APN, LwM2M functionality in AT&T will be disrupted, causing AT&T certification invalidation.

3.4.2 Custom servers

In all the MNO configurations, apart from GCF-PTCRB (+UMNOPROF: 201), the LwM2M client will attempt to connect to the u-blox LwM2M server. This connection will use the internet data context, whose context ID (CID) is by default 1 (or 3, with Verizon configuration +UMNOPROF: 3).

Users can set the internet CID to be used for internet data, and can also configure a certain context identifier to be used by each server. The configuration is done by the +ULWM2MCONFIG and +ULWM2MCONFIGEXT AT commands:

Command	Response	Description
AT+ULWM2MCONFIG?	+ULWM2MCONFIG: 721,0,3,255,1,0,0,0,40,0,0,2 +ULWM2MCONFIG: 101,0,3,1,0,1,1,0,60,0,1,2 +ULWM2MCONFIG: 102,1,3,1,0,1,1,1,60,0,1,2 +ULWM2MCONFIG: 1000,0,3,255,0,0,1,0,60,0,1,2 OK	The +ULWM2MCONFIG read command shows the CIDs being used by each server. The 721 and 1000 servers are set to <cid>: 255, which means they will use the CID reported in the +ULWM2MCONFIGEXT read command.
AT+ULWM2MCONFIGEXT?	+ULWM2MCONFIGEXT: 60,20,30,4,3,0,"",0,0,0 OK	The CID is 3, but a different CID can be inserted. It is also possible to define a special CID for each server via the +ULWM2MCONFIG set command.

Servers 101 and 102 do not use CID 1 since they are proprietary Verizon servers. Same applies to server 3 in AT&T. These will use dedicated APNs.

If a CID is indicated for usage with a certain server, the CID must be defined in the +CGDCONT AT command entries.

3.4.2.1 Global configuration

In the global profile configuration (+UMNOPROF: 90) the default internet data CID is 1, which matches the attach EPS bearer.

It is possible to configure LwM2M to use a context ID with value different than the default CID=1 via the +ULWM2MCONFIGEXT AT command with the <GeneralDataCid> parameter.

3.4.2.2 AT&T configuration

AT&T generally adopts the attach CID as a multipurpose APN. The default configuration is 1, which can be changed as above. Configuration changes do not apply to AT&T-specific servers (SSIDs 0, 1, 3). This holds for AT&T and FirstNet.

3.4.2.3 Verizon configuration

Verizon IMS devices have CID 1 as attach IMS and CID 3 as internet data. It is still possible to point a certain server to a different CID, using the configuration above. Configuration changes do not apply to VZW-specific servers (SSIDs 101,102).

3.4.3 Server-based disable and roaming activity

It is possible to selectively disable a LwM2M server with the +ULWM2MCONFIG AT command, with the <server_disabled> parameter. This allows server configuration such that no data may be sent to it in certain conditions:


- <server_disabled>=0 - the server is always enabled
- <server_disabled>=1 - the server is always disabled
- <server_disabled>=2 - the server is disabled only when the module is in roaming cell conditions

To avoid additional costs due to data traffic in roaming conditions, it is possible to configure LwM2M to allow server connections only when in home network.

Factory-programmed configuration allows LwM2M connections to all the available servers, apart from Verizon Wireless (+UMNOPROF: 3) where the client will perform no activity (including FOTA) when in roaming.

It is recommended to disable the MNO-specific servers when in roaming, while keeping the LwM2M client enabled to connect to the u-blox server. This will:

- Provide access to uFOTA feature while in roaming.
- Avoid useless PDN activation attempts for MNO-specific DM APNs probably not accepted by the roaming networks.

 Disabling a server is not recommended as it will prevent LwM2M-based services including FOTA. LwM2M is also a mandatory requirement for MNO certifications.

3.5 Connection tear down timings

LwM2M client will tear down the CID being used for connection in 90 s after the latest successful sent message. This is a pre-defined value suggested for keeping client reachable from the server.

 In Verizon network this timer value is 60 s.

3.6 Enabling LwM2M client and uFOTA

On certain product types, for specific MNO profiles, the LwM2M client or uFOTA server is not enabled by default. Thus, after setting and activating the MNO profile, the LwM2M client may need to be enabled. Also, the uFOTA server may need to be enabled if the host device is to support uFOTA FW delta updates. To check if the LwM2M client and uFOTA is enabled by default for a specific MNO profile, see the appendix, “Mobile Network Operator profiles”, in the LARA- L6 / LARA-R6 series AT commands manual [2].

Upon setting the MNO profile, the default LwM2M and uFOTA setting can be checked to see if they are enabled.

Command	Response	Description
Check LwM2M client and uFOTA status		
AT+ULWM2M?	+ULWM2M: 0 OK	Upon boot, read +ULWM2M to check the <activation_mode> parameter of LwM2M client. In this example, the response is 0, meaning enabled.
AT+ULWM2MCONFIG?	+ULWM2MCONFIG: 721,0,1,255,1,0,0,0,40,0,0,0 OK	Verify if uFOTA is enabled. In this example the parameters: <server_id>: 721 <server_disabled>:0 This indicates uFOTA server ID 721 is enabled.

If MNO profile 2 (AT&T) or 206 (AT&T FirstNet) has LwM2M disabled, it can be enabled with the following steps, with the option to enable uFOTA too.

Command	Response	Description
Enabling LwM2M client on MNO profile 2 (AT&T) or 206 (FN) and optionally enabling uFOTA		
AT+ULWM2M=0	OK	Enable LwM2M client.
AT+CFUN=4	OK	Set module to Airplane mode
AT+CFUN=16	OK	Reset the module.
AT+ULWM2MCONFIG=0,0,3,1,0,0,0,0,40,0,0,0	OK	Enable AT&T BS server setting: <server_id>: 0, <server_disabled>=0
AT+ULWM2MCONFIG=3,1,3,1,0,1,1,0,40,0,0,0	OK	Enable AT&T DM server setting: <server_id>: 3, <server_disabled>=0
AT+ULWM2MCONFIG=721,0,3,255,1,0,0,0,40,0,0,0	OK	Optional step: If uFOTA service is desired, enable uFOTA setting: <server_id>: 721, <server_disabled>=0
AT+CFUN=16	OK	Reset the module.
AT+CFUN=1	OK	Exit Airplane by enabling online mode.

If an MNO profile has uFOTA disabled, it can be enabled with the following steps.

Command	Response	Description
Enable uFOTA on MNO profile 3 (VZW) or 5 (TMO)		
AT+ULWM2MCONFIG=721,0,1,3,1,0,0,0,0,0,0,0	OK	Enable uFOTA setting: <server_id>: 721, <server_disabled>=0
AT+CFUN=16	OK	Reset the module
Enable uFOTA on all other MNO profiles		
AT+ULWM2M=0	OK	Enable LwM2M client.
AT+CFUN=16	OK	Reset the module
AT+ULWM2MCONFIG=721,0,1,255,1,0,0,0,40,0,0,0	OK	Enable uFOTA setting: <server_id>: 721, <server_disabled>=0
AT+CFUN=16	OK	Reset the module

For the above guidelines to enable LwM2M client or uFOTA server, all configurations are persistent except:

- For modules that support the Backup & Restore feature, in the event of a Restore, configurations change to the setting on the Backup copy:

- To allow restore at desired configuration, configure Backup action after the LwM2M client has been set by the +UBKUPDATA AT command. For more details of backup and restore feature, see u-blox LARA-R6-L6 series application development guide application note [\[4\]](#),
- MNO profile change via the +UMNOPROF AT command, then the settings will reset the default MNO profile configuration. This is also valid for resetting the same MNO profile already configured.
- FW update may reset settings to the target FW defaults.
 - Check target FW release notes for details and actions required.
 - If LwM2M client is disabled in the target FW, it is required to enable LwM2M client again via AT+ULWM2M=0 command. This will allow the FW update process (uFOTA) to conclude properly.

4 AT commands

For detailed AT command descriptions, see LARA- L6 / LARA-R6 series AT commands manual [2].




4.1 Shut-down and start-up

The LwM2M client starts up along with the module.

AT+ULWM2M=0 and AT+ULWM2M=1 commands save the enabled flag in NVM, while the AT+ULWM2M=2 command performs a reset of the LwM2M client.

Command	Response	Description
Disable LwM2M client		
AT+ULWM2M=1	OK	Disables the LwM2M client. The setting will be effective after reboot.
AT+CFUN=16	OK	Reboot the module.
Enable LwM2M client		
AT+ULWM2M=0	OK	Enables the LwM2M client. The setting will be effective after reboot.
AT+CFUN=16	OK	Reboot the module to restart the LwM2M client.
Restore LwM2M client		
AT+ULWM2M=2	OK	Erases the persistent data of the LwM2M client. A reboot is needed.
AT+CFUN=16	OK	Reboot the module to restart the LwM2M client.

Table 3: Stop and restore LwM2M client procedure

-  In the GCF-PTCRB (+UMNOPROF: 201) configuration, the LwM2M client does not start regardless of the +ULWM2M AT command configuration.
-  Changing the MNO profile (followed by a module reboot by the +CFUN AT command) back and forth also re-initializes the LwM2M client to the factory-programmed settings for the MNO profile.
-  The LwM2M client keeps separate configuration sets for AT&T (+UMNOPROF: 2), Verizon (+UMNOPROF: 3) and for all other cases. If the +ULWM2MCONFIG or +ULWM2MCONFIGEXT AT commands have been previously issued, the MNO switch via +UMNOPROF AT command will select another set of configurations, but it does not erase the previous configuration. If an MNO is selected back and forth, the same configuration will be restored at the same MNO.

4.1.1 LwM2M client initialization URCs

To enable +ULWM2MSTAT URCs for LwM2M client initialization complete status (<event>=5), set the <verbosity_mask> parameter in the +ULWM2MSTAT command.

Command	Response	Description
AT+ULWM2MSTAT=1, 2	OK	Turn on the URC (Client initialization only).
AT+ULWM2MSTAT=1, 3	OK	Turn on the URC (Client initialization and activity).
URCs		
	+ULWM2MSTAT: 5, 1	LwM2M initialization started
	+ULWM2MSTAT: 5, 2	LwM2M initialization finished
	+ULWM2MSTAT: 5, 3	LwM2M initialization stopped due to production mode

4.1.2 LwM2M server connection status URCs

It is possible to enable +ULWM2MSTAT URCs for LwM2M server connection status (<event>=6). This is done by setting the <verbosity_mask> parameter in the +ULWM2MSTAT command.

Command	Response	Description
AT+ULWM2MSTAT=1,4	OK	Turn on the URC (server connection status only).
URCs		
	+ULWM2MSTAT: 6,721,0,"coaps://ucsplwm2m.services.u-blox.com:5684"	LwM2M server connection created
	+ULWM2MSTAT: 6,721,1,1254,4588	LwM2M server connection suspended
	+ULWM2MSTAT: 6,721,2,"coaps://ucsplwm2m.services.u-blox.com:5684"	LwM2M server connection resumed
	+ULWM2MSTAT: 6,721,3,715,443	LwM2M server connection closed

4.2 Viewing existing objects

The +ULWM2MLIST AT command can be used to list all the objects and respective instances of the device.

Command	Response	Description
AT+ULWM2MLIST="/"	+ULWM2MLIST: "/0/10","/1/10","/2/0","/2/1","/2/2","/2/3","/2/4","/2/6","/2/7","/2/8","/3/0","/4/0","/5/0","/6","/7/0","/11/0","/14/0","/16/0","/3300","/10308" OK	List all the objects and object instances on the device. The response /3300 means this object has no instances yet but the object ID is available for use.

4.3 Registration status and timer


The last registration time for each server is maintained in persistent storage, to calculate the need of a registration update by comparing it with the current time and the server lifetime. Changing the module time would affect this calculation. A forced registration might be needed.

4.3.1 Registration query and forcing a registration

The LwM2M client will register with the list of servers that have been configured in the “Server” object. The below command can be used to check the status on the registration if URCs are turned off. It may also report information that are not available via URC, such as a server being in “update needed” state.

Command	Response	Description
AT+ULWM2MREG?	+ULWM2MREG: 721,2,86281 OK	Server ID 721 is successfully registered (<status>=2) and the client will register once again in 86281 s.
Force a registration		
AT+ULWM2MREG=123	OK	Force a registration to server ID 123.
Force the bootstrap and registration		
AT+ULWM2MREG=0	OK	Force a bootstrap and attempt registration on all configured servers.

The +ULWM2MREG read command might respond with an error result code while the LwM2M process are coming up after a reset. It could take ~60 s after a restart to respond back without an error result code.

 An error result code may be provided while trying to force the registration if the module has not registered previously.

4.3.2 Registration URC


URCs have been added to indicate the registration state of the LwM2M client. The +ULWM2MSTAT AT command can be used to turn on the URC which will show up every ~60 s. For detailed descriptions of the status codes, see the LARA- R6 / LARA-L6 series AT commands manual [2].

Command	Response	Description
AT+ULWM2MSTAT=1	OK	Turn on the URC (disabled by default).
AT+ULWM2MSTAT=0	OK	Turn off the URC.
URCs		
	+ULWM2MSTAT: 1, 721, 3	Event 1 is a registration status. Status 3 means registration failed with the u-blox server with server ID 721.
	+ULWM2MSTAT: 1, 721, 2	Status 2 means registration success with the u-blox server with server ID 721.
	+ULWM2MSTAT: 2, 721, 86305	Event 2 means registration interval. Re-registration will happen in 86305 s to u-blox server with server ID 721.

4.3.3 Forcing a deregistration.


The LwM2M client can be instructed to de-register with the list of servers that have been configured in the “Server” object. The below command can be used to force deregistration from a server, or deregistration from all servers using option 0.

Command	Response	Description
Force a de-registration		
AT+ULWM2MDEREG=123	OK	Force a deregistration from server ID 123.
Force a de-registration from all servers		
AT+ULWM2MDEREG=0	OK	Force a de-registration from all servers configured.

 Once the deregistration has taken place, it is not possible to re-register again unless the module is reset by the +CFUN AT command.

4.4 Limit or disable the u-blox LwM2M server

There are two options to change the periodic connection (24 h default lifetime) to u-blox LwM2M server (SSID 721). The first option is that host application shuts down the LwM2M client by the +ULWM2M AT command at boot-up. The other option is to either extend the lifetime or disable the server. The server is mainly used for uFOTA functionality.

 This action will limit or block uFOTA functionality, it will be impossible to deliver FOTA updates managed via LwM2M.

The server object is disabled with following sequence:

Command	Response	Description
Check for current configuration		
AT+ULWM2MCONFIG?	+ULWM2MCONFIG: 0,0,3,1,0,0,0,0,40,0,0,0 +ULWM2MCONFIG: 1,1,3,1,0,1,1,0,40,0,0,0 +ULWM2MCONFIG: 2,1,3,1,0,1,1,0,40,0,0,0 +ULWM2MCONFIG: 3,1,3,1,0,1,1,0,40,0,0,0 +ULWM2MCONFIG: 721,0,3,255,1,0,0,0,40,0,0,0 OK	List of all server(s) configuration
Disable the u-blox server		
AT+ULWM2MCONFIG=721,0,3,255,1,0,0,0,40,0,0,1	OK	Disable u-blox server (server ID = 721)
Reboot		
AT+CFUN=15	OK	Reboot to apply the new configuration
Confirm u-blox server disabled		
AT+ULWM2MCONFIG?	+ULWM2MCONFIG: 0,0,3,1,0,0,0,0,40,0,0,0 +ULWM2MCONFIG: 1,1,3,1,0,1,1,0,40,0,0,0 +ULWM2MCONFIG: 2,1,3,1,0,1,1,0,40,0,0,0 +ULWM2MCONFIG: 3,1,3,1,0,1,1,0,40,0,0,0 +ULWM2MCONFIG: 721,0,3,255,1,0,0,0,40,0,0,1 OK	List of all server(s) configuration. Confirm that u-blox server is disabled

The lifetime is modified with following sequence:

Command	Response	Description
Check server lifetime value		
AT+ULWM2MREAD="/1/10"	+ULWM2MREAD: {"bn":"/1/10","e":[{"n":"0","v":721}, {"n":"1","v":<lifetime value>}] OK	Confirm present lifetime value for server ID 721
Write server lifetime		
AT+ULWM2MWRITE="{\"bn\":\"/1/10\", \"e\": [{\"n\":\"1\", \"v\":2592000}]}"	OK	Lifetime changed for /1/10. Set to suggested 30 days.
Wait at least 40s		
AT+CFUN=15	OK	Reboot to apply the new configuration
Confirm updated server lifetime value		
AT+ULWM2MREAD="/1/10"	+ULWM2MREAD: {"bn":"/1/10","e":[{"n":"0","v":721}, {"n":"1","v":2592000}] OK	Confirm applied lifetime value to server ID 721

Upon changing of the server lifetime, the client will perform a registration update to the listed servers, to notify the change. Registration update success is not mandatory for the change to apply.

The new lifetime configuration is saved in the NVM. The change can be reverted with any of the following options:

- Re-bootstrap via the AT+ULWM2M=2 command
- Re-bootstrap via server command
- MNO profile change by the +UMNOPROF AT command

The server can be re-enabled with following sequence:

Command	Response	Description
Check for current configuration		
AT+ULWM2MCONFIG?	+ULWM2MCONFIG: 0,0,3,1,0,0,0,0,40 ,0,0,0 +ULWM2MCONFIG: 1,1,3,1,0,1,1,0,40 ,0,0,0 +ULWM2MCONFIG: 2,1,3,1,0,1,1,0,40 ,0,0,0 +ULWM2MCONFIG: 3,1,3,1,0,1,1,0,40 ,0,0,0 +ULWM2MCONFIG: 721,0,3,255,1,0,0, 0,40,0,0,1 OK	List of all server(s) configuration
Enable the u-blox server		
AT+ULWM2MCONFIG=721,0,3,255,1,0,0 ,0,40,0,0,0	OK	Enable u-blox Server (server ID = 721)
Reboot		
AT+CFUN=15	OK	Reboot to apply the new configuration
Confirm u-blox server disabled		
AT+ULWM2MCONFIG?	+ULWM2MCONFIG: 0,0,3,1,0,0,0,0,40 ,0,0,0 +ULWM2MCONFIG: 1,1,3,1,0,1,1,0,40 ,0,0,0 +ULWM2MCONFIG: 2,1,3,1,0,1,1,0,40 ,0,0,0 +ULWM2MCONFIG: 3,1,3,1,0,1,1,0,40 ,0,0,0 +ULWM2MCONFIG: 721,0,3,255,1,0,0, 0,40,0,0,0 OK	List of all server(s) configuration. Confirm that u-blox server is enabled

4.5 Reading and writing to objects

The +ULWM2MREAD and +ULWM2MWRITE AT commands follow the JSON format specified in the OMA technical specification Lightweight M2M [1].

The +ULWM2MREAD AT command can be used to:

- To read the registration timer for an LwM2M server
- To read the previous value of a sensor resource

As shown in the examples below, the +ULWM2MREAD AT command can be used to "Read" an object, object instance, or resource e.g., to read the entire object "/3300/0" which is the generic sensor object.

Command	Response	Description
Reading an instance		
AT+ULWM2MREAD="/3300/0"	+ULWM2MREAD: {"bn":"/3300/0","e": [{"n":"5700","sv":"25"}, {"n":"570 1","sv":"Celsius"}, {"n":"5601","s v":"25"}, {"n":"5602","sv":"25"}, { "n":"5750","sv":"Temperature"}]} OK	Read the object instance 0 for the object 3300.
Reading a resource		
AT+ULWM2MREAD="/3300/0/5601"	+ULWM2MREAD: {"bn":"/3300/0/5601/ ","e":[{"n":"5601","v":0}]} OK	Read the object instance 0's resource 5601 for the object 3300.

There is a character limit of 1040 characters per line. If there is an object with a lot of data, the resources can be read one at a time like the above example.

For application developers: the parsing of the +ULWM2MREAD information text response will need to be handled properly, because JSON permits multiple configurations for URI formatting. The "ID structure" returned by the +ULWM2MREAD AT command might vary based on the query and the object itself. See the examples below for how the "bn" field varies.

Command	Response
Example: when reading the entire object instance, the base name appears as /object/object instance of the portfolio object:	
AT+ULWM2MREAD="/16/0"	+ULWM2MREAD: {"bn":"/16/0/", "e":[{"n":"0/1", "sv":"test2"}, {"n":"0/0", "sv":"test"}, {"n":"3", "v":0}]} OK
When reading the specific resource, note that the base name appears as /object/object instance/resource:	
AT+ULWM2MREAD="/16/0/0"	+ULWM2MREAD: {"bn":"/16/0/0/", "e":[{"n":"1", "sv":"test2"}, {"n":"0", "sv":"test"}]} OK

The +ULWM2MWRITE AT command allows an external host to change the value of a resource, the values of an array of resource instances, or the values of multiple resources from an object instance.

The +ULWM2MWRITE AT command can be typically used to:

- Change the lifetime timer for the LwM2M server
- Write a measurement from a sensor object
- Updating the device location in the location object
- Writing an error code to the device

As shown in the example below, the +ULWM2MWRITE AT command can be used to "Write" to the object instance's resource, for example to write to the object Instance "/3300/0" resource "5700", which could be the generic sensor's object temperature. The contents are in general not immediately saved in non-volatile memory, so it is possible to issue the command with an empty string, in this way the changes are committed to file system, and it is safe to turn off the module.

Command	Response	Description
AT+ULWM2MWRITE="{\"bn\": \" /3300/0 \", \"e\": [{\"n\": \"5700\", \"v\": 100.5}]}"	OK	Write to an object 3300 instance 0's resource 5700 the value of 100.5.
AT+ULWM2MWRITE=""	OK	Save changes in non-volatile memory

4.6 AT&T ODIS functionality

LARA-R6 modules in +UMNOPROF: 2 and +UMNOPROF: 206 configurations are certified for AT&T LwM2M DM. This means they also comply with AT&T requirement "<CDR-DVM-1600> Local Read and Write Access to Host Device Details for an IoT Module".

Modules support the +ODIS AT command; the command allows to populate host device information in LwM2M Host Device Object 10241. The command is present only when AT&T or AT&T FirstNet MNO profiles are selected by the +UMNOPROF AT command.

Within 60 s after the +ODIS command execution, the new setting is saved in file system and is persistent across power cycles. The 60s timer starts if and only if module is once registered to network.

Parameters can be immediately saved by issuing `+ULWM2MWRITE=""` and it is not necessary to wait for 60s timer to expire, since it is saved in NVM.

Host device information contains default values per factory-programmed configuration, as required by AT&T. According to AT&T:

<CDR-DVM-1602> Device Initiated Alert Upon Change to Host Device Detail: [...] The IoT module with a LWM2M client will automatically notify and report the change to the Host Device (ODIS) details inside the LWM2M Portfolio Object if there is a pre-existing Observe command on the LWM2M server.

The +ODIS settings are persistent upon power cycles. However, they need to be re-configured by host application in the following cases:

- Factory reset by the `AT+UFACTORY=1,1` AT command
- LwM2M client reset by `AT+ULWM2M=2` command
- FW update, all methods excluding uFOTA (FW update via LwM2M client)
- MNO profile change by the `+UMNOPROF` AT command

Command	Response	Description
<code>AT+ODIS?</code>	<code>+ODIS: "HMAN0", "HMOD0", "HSW0"</code> OK	Get ODIS factory-programmed values
<code>AT+ODIS="TestID1", "TestMAN1", "TestMOD1", "TestSW1"</code>	OK	Configure ODIS information with custom data. Notice that the first parameter (Host Device ID) is not readable
<code>AT+ODIS?</code>	<code>+ODIS: "TestMAN1", "TestMOD1", "TestSW1"</code> OK	Get custom ODIS data.

4.7 Get notifications from objects

It is possible to enable the `+ULWM2MNOTIFY` URCs for objects-related activity reporting.

The URC will be triggered by server operations on Object /8 Lock and Wipe resources

- 0 state: when changed by the server
- 3 wipe: when executed by the server

Command	Response	Description
<code>AT+ULWM2MNOTIFY=1</code>	OK	Turn on the URC (disabled by default).
<code>AT+ULWM2MNOTIFY=0</code>	OK	Turn off the URC.
URCs		
	<code>+ULWM2MNOTIFY: "/8/0/0"</code>	State resource has been changed
	<code>+ULWM2MNOTIFY: "/8/0/3"</code>	Wipe resource has been executed

The `+ULWM2MNOTIFY` command and object /8 Lock and Wipe are not available in LARA-R6001D-00B-00 and LARA-R6001D-00C1B-00

5 Operational examples

For detailed AT command descriptions, see the LARA-R6 / LARA-L6 series AT commands manual [2].

5.1 Adding an additional server to the client

By default, the module will communicate with server ID 721 which belongs to u-blox as this is defined in the bootstrap object. For testing purposes, an additional server instance can be created for the client to communicate with for e.g. a demo Leshan server. In the following example CoAP / CoAPS URL of a test Leshan server is used.

The +ULWM2MCREATE AT command can be used to add an additional server. The format used for the +ULWM2MCREATE AT command is in a JSON format as defined in the OMA technical specification Lightweight M2M [1]. Notice that if the JSON data contains embedded double quotes, they must be properly escaped with a backslash character "\".

To add a new server, a "Security" object instance and "Server" object instance needs to be created and configured. In addition, a security configuration needs to be applied. In the following example a demo Leshan server hosted by the u-blox support team will be added.

5.1.1 Creating the security object instance

Follow one of the steps listed below to create the security object (i.e., either without DTLS or with DTLS). The added instance can be deleted using the +ULWM2MDELETE AT command (for more details, see section 5.1.3).

 For details, see http://www.openmobilealliance.org/tech/profiles/LWM2M_Security-v1_0.xml.

Command	Response	Description
Add a new "Security" object instance for CoAP		
<pre>AT+ULWM2MCREATE="{\"bn\": \" /0/2/ \ \", \"e\": [{\"n\": \"0\", \"sv\": \"co ap://leshan.eclipseprojects.io:56 83\"}, {\"n\": \"1\", \"bv\": false}, {\"n\": \"2\", \"v\": 3}, {\"n\": \"10 \", \"v\": 123}]}\", 123</pre>	OK	<ul style="list-style-type: none"> • coap://leshan.eclipseprojects.io:5683 is the demo Leshan server CoAP URL. • "false" indicates that it is not a bootstrap server • "v":3 indicates its non-secure • 123 is the short server ID • The server ID 123 is specified again in the +ULWM2MCREATE AT command to assign the owner of the object instance in the associated ACL object instance.
Add a new "Security" object instance for CoAPS (DTLS)¹		
<pre>AT+ULWM2MCREATE="{\"bn\": \" /0/2/ \ \", \"e\": [{\"n\": \"0\", \"sv\": \"co aps://leshan.eclipseprojects.io:5 684\"}, {\"n\": \"1\", \"bv\": false} , {\"n\": \"2\", \"v\": 0}, {\"n\": \"3 \", \"sv\": \"MzUyNzUzMDk1Nzg3NjE4\ \"}, {\"n\": \"10\", \"v\": 123}, {\"n\ \": \"5\", \"sv\": \"q83v\"}]}\", 123</pre>	OK	<ul style="list-style-type: none"> • coaps://leshan.eclipseprojects.io:5684 is a demo Leshan server CoAPS URL. • "false" indicates that it is not a bootstrap server • "v":0 indicates its secure • MzUyNzUzMDk1Nzg3NjE4 is the base64 version of 352753095787618 [i.e. IMEI] • :123 is the short server ID • q83v is the base64 format of the HEX string 0xAB,0xCD,0xEF • The server ID 123 is specified again in the +ULWM2MCREATE AT command to assign the owner of the object instance in the associated ACL object instance.

¹ See appendix A for details on how to add a PSK to the Leshan server

- The +ULWM2MREAD AT command cannot be used to read the "/0" object as it is a security object and hence the PSK cannot be seen via the AT command.
- The DTLS cipher suites will be added automatically. The used cipher suites (CS) will be the ones supported by USECMNG.

5.1.2 Creating the server object instance

- For more details, see http://www.openmobilealliance.org/tech/profiles/LWM2M_Server-v1_0.xml.

Command	Response	Description
AT+ULWM2MCREATE="{\"bn\": \"1/2/\", \"e\": [{\"n\": \"0\", \"v\": 123}, {\"n\": \"1\", \"v\": 300}, {\"n\": \"2\", \"v\": 10}, {\"n\": \"3\", \"v\": 60}, {\"n\": \"5\", \"v\": 86400}, {\"n\": \"6\", \"bv\": false}, {\"n\": \"7\", \"sv\": \"UQ\"}], 123	OK	123 is the short server ID. 300 is the life timer (registration timer) value.

5.1.3 Deleting an Instance of an object

The +ULWM2MDELETE AT command allows to delete the created instances. The below command deletes the instance of security object and server object that were created previously. The AT+ULWM2MDEREG=123 command deregisters the module from the server 123 which could be done prior to deleting the instances as shown below.

Command	Response	Description
AT+ULWM2MDELETE="/0/2"	OK	Deleting instance of an object.
AT+ULWM2MDELETE="/1/2"	OK	

- Reboot the module after having executed the above steps.

5.1.4 Security configuration

In addition to the above steps the below configuration step is needed for setting the server connection preferences for the LwM2M client and the security feature. The configuration specifies the PDP identifier, and connection type. When creating a new server, after having issued the +ULWM2MCREATE AT command as described in section 5.1.2 for the server and security object, also issue the +ULWM2MCONFIG AT command to set the server connection preferences.

Command	Response	Description
AT+ULWM2MCONFIG=123,0,1,1,0,0,0,0,40,0,0,0	OK	<ul style="list-style-type: none"> • Server ID 123 is being configured here. • bootstrap_on_failure: 0 means false here and the device will not attempt bootstrap after a failed registration • pdn_type : 1 means IPv4 • pdn_context_id : 1 is the cid It should be noted that the value for this parameter is the index returned by +CGDCONT: 1, "IP", "phone", "10.0.0.1", 0, 0, 0, 0 • usec_psk: 0 here means the device will not use security feature to obtain PSK. • reg_update_boot: 0 here means the device will not perform a registration update to the server after a reboot. • dtls_session_resumption: 0 here means the DTLS session resumption is disabled.

Command	Response	Description
		<ul style="list-style-type: none"> full_registration_after_fota: 0 here means the device will not perform a full registration to the server after a FOTA. DTLS_NAT_time: 40 here means the NAT timer for LwM2M DTLS session re-handshake is 40 seconds. reg_upd_at_PSM_exit: 0 here means the device will not perform a full registration to the server when device turn on as a result of a PSM exit. reg_upd_after_DTLS_handshak: 0 here means the device will not perform a registration update to the server in the case a new DTLS handshake is performed. server_disabled: 0 here means the LwM2M communication to the server is enabled

- Reboot the module to re-initialize for client/server to pick up the above changes.
- If the <usec_psk>=0 in an LwM2M configuration file entry for a particular LwM2M server, provide the PSK and PSK identifier as Base64 encoded values and write the associated LwM2M security object instance.
- If the <usec_psk>=1 for a particular LwM2M server, the PSK and PSK identifier will be generated internally by the USEC application. In this case, new PSK and PSK identifier values are created prior to each full LwM2M registration attempt and are stored in the associated security object instance. In the table in section 5.1.1 {"n":"3","sv":"MzUyNzUzMDk1Nzg3NjE4"} and {"n":"5","sv":"q83v"} need not be issued in the command discussed.

5.1.5 Restart and check URCs

The following example shows the URCs with the new server ID 123 (make sure to toggle the DTR line for the URCs). For detailed URC descriptions, see the LARA-L6 / LARA-R6 series AT commands manual [2].

Command	Response	Description
	+ULWM2MSTAT: 1,123,3	Indicates successful registration.
	+ULWM2MSTAT: 2,123,204	Timer counting down.

If the above steps are successfully performed, the device's IMEI would be seen on the LwM2M server's client page.

5.2 Modifying the registration update timer

For detailed AT command descriptions, see LARA-L6 / LARA-R6 series AT commands manual [2].

Every time the module connects to the LwM2M server, it maintains the connection only for ~30 s and this cannot be modified. However, changing the life timer to a smaller value like 180 s (it shall be greater than 90 s at a minimum due to COAP transmit wait time) will get the client to communicate more often and hence while testing, the objects can be read more often from the server.

The registration timer of server "/1/2" which was the new server ID 123 created in the previous section was configured with 300 s. In the below example, it has been modified to 180 s.

Command	Response	Description
AT+ULWM2MWRITE="{\"bn\": \"/1/2/\",OK \"e\": [{\"n\": \"1\", \"v\": 180}]}"		Change the registration timer to 180 s.

Shorter timers mean communicating with the server more often. Hence the above change to shorter timer is only for a testing purpose. In a production deployment the registration timer would probably be longer, like once an hour or once a day or so depending on the end application.

The below URCs might be received after entering the above command.

Command	Response	Description
	+ULWM2MSTAT: 1,123,3	Indicates successful registration.
	+ULWM2MSTAT: 2,123,90	New registration timer counting down.

To force a registration update (using short server ID), see section 4.3.

5.3 Adding a new instance / resource: generic sensor

The example shown below is for the “Generic Sensor” object. For detailed AT command descriptions, see the LARA-R6 / LARA-L6 series AT commands manual [2].

5.3.1 Creating an object instance

The +ULWM2MCREATE AT command allows to create an object instance and make the given server ID the owner of the object (has full permissions to the object).

In the below example a new instance of the generic sensor object instance is created, and server ID 123 is made the owner of it. In addition, a resource 5750 is also being set to App type “Temperature”.

All the LwM2M servers that the client registers to are aware of all object instances, though they may not have permissions on a given instance.

Command	Response	Description
AT+ULWM2MCREATE="{\"bn\": \"/3300/0\", \"e\": [{\"n\": \"5750\", \"sv\": \"Temperature\"}]}", 123	OK	Create an object instance and populate it with some resources. The server ID is 123 specifies the owner of the object instance. 5750 is a resource for the object 3300's instance 0 and it represents “Temperature”.
AT+ULWM2MLIST="/"	+ULWM2MLIST: "/1/1", "/2/1", "/2/2", "/2/3", "/2/4", "/2/5", "/2/6", "/2/7", "/2/8", "/2/9", "/2/10", "/2/11", "/2/12", "/2/0", "/3/0", "/4/0", "/5/0", "/6", "/7", "/10", "/11/0", "/14/1", "/14/2", "/14/3", "/14/4", "/14/5", "/14/6", "/14/7", "/14/0", "/16", "/0/1", "/3300/0" OK	List all the object and Instances to verify that /3300/0 being listed.

For application developers: applications should limit the creation/deletion of object instances and should not do this too often. Objects are resources that are written to or read from.

- **Data usage:** creation and deletion of an object on the LwM2M client triggers communication between the client and the LwM2M servers. The client controls this activity per the OMA standard.
- **Memory:** memory is finite and creating an object instance uses up memory resources on the module, which is shared with other background processes like uFOTA, security, etc. It is recommended to not perform bulk creation of new object instances but to create and test every single object instance.

- **Error:** the +ULWM2MCREATE AT command might respond with an OK and report an error result code when it has failed to add an instance to the memory due to a lack of resource on the module.

5.3.2 Writing and reading a value to a resource

Command	Response	Description
Write a value to one of the resources		
AT+ULWM2MWRITE="{\"bn\": \"/3300/0\", \"e\": \"\", \"v\": 100.5}"	OK	Write the value of 100.5 to a resource.
Read all resources of the instance		
AT+ULWM2MREAD="/3300/0"	+ULWM2MREAD: {"bn": "/3300/0", "e": [{"n": "5601", "v": 100.5}, {"n": "5602", "v": 100.5}, {"n": "5603", "v": 0}, {"n": "5700", "v": 100.5}, {"n": "5701", "sv": ""}, {"n": "5750", "sv": "Temperature"}, {"n": "5751", "sv": ""}, {"n": "5604", "v": 0}]} OK	Read all the resources of instance 0 of object ID 3300.
URC		
	+ULWM2MSTAT: 3,123,/3300/0/5700	This URC might be seen if the LwM2M server is registered for observing. Specifically, event 3 is a notification that the client is triggering the conditions to send the current value to the server.

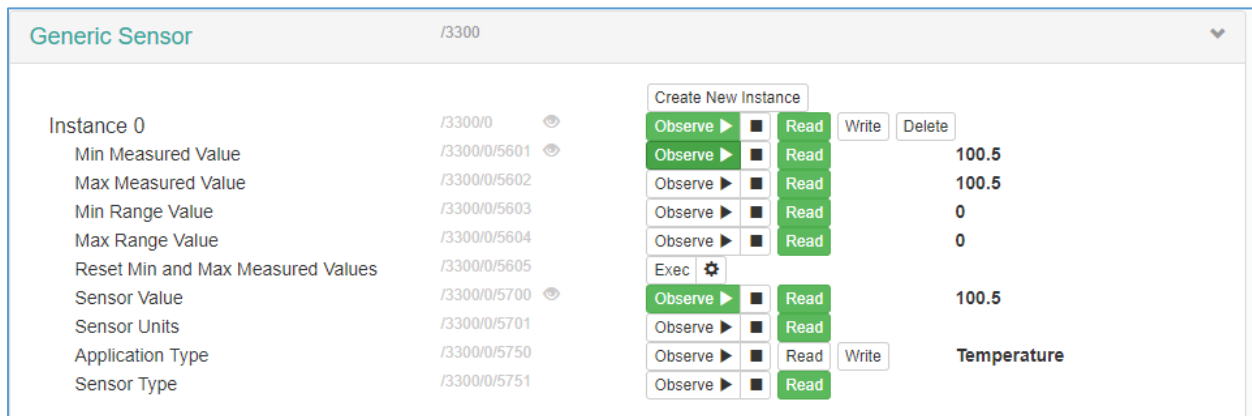


Figure 5: Generic sensor instance on an LwM2M server

The generic sensor object instance should start populating with data on the LwM2M server. Since server ID 123 was associated with the “Generic Sensor Object” instance, the presence of the instance can be visually verified on the previously mentioned Leshan server.

5.4 Reset the module from an LwM2M server

The access control list object ID 2 can be used to specify the permissions for a server to execute actions on an object: For more details, see

http://www.openmobilealliance.org/tech/profiles/LWM2M_Access_Control-v1_0_3.xml.

For example, the device object ID 3 has a resource ID 4 to reboot the module: http://www.openmobilealliance.org/tech/profiles/LWM2M_Device-v1_0_3.xml

Each instance of the access control object corresponds to one object instance's permissions. Resource ID 0 specifies the object ID, and resource ID 1 specifies the object instance ID. If an object instance does not have default access permissions configured, Read-Write-Execute permissions shall be explicitly added for the new server ID.

Permissions are granted at the object instance level. A server may not be granted permissions only to specific resources in an object instance. For example, granting server ID 123 execute permissions on object instance /3/0 can allow the server to perform factory reset (/3/0/5) as well as reboot (/3/0/4).

In the below example are provided permission for the newly added server ID 123 to be able to execute actions on the device object to give it the capability to reboot the module.

Command	Response	Description
AT+ULWM2MREAD="/2/1"	+ULWM2MREAD: {"bn":"/2/1/", "e":[{"n":"0", "v":3}, {"n":"1", "v":0}, {"n":"2/721", "v":15}, {"n":"3", "v":721}]} OK	Read the object ID 2 which is the access control list object.
AT+ULWM2MWRITE="{\"bn\": \" /2/1/ \", \"e\": [{\"n\": \"2/123\", \"v\": 15}]}"	OK	Give permission for server ID 123 to reboot the module. (15 is Read-Write-Execute)
AT+ULWM2MREAD="/2/1"	+ULWM2MREAD: {"bn":"/2/1/", "e":[{"n":"0", "v":3}, {"n":"1", "v":0}, {"n":"2/123", "v":15}, {"n":"2/721", "v":15}, {"n":"3", "v":721}]} OK	To read the object again to verify that the ACL object is modified.

A re-registration could be forced for the above to take effect immediately.

After the above steps, the LwM2M server can execute a reboot on the client.

The module should reset as soon as it receives the execute command from the LwM2M server.

Appendix

A Leshan overview

Download a Leshan demo server on Ubuntu

- `wget https://hudson.eclipse.org/leshan/job/leshan/lastSuccessfulBuild/artifact/leshan-server-demo.jar`

Start up a demo server

- `java -jar ./leshan-server-demo.jar`

Access using: `http://<IP of server>:8080`

- For an external client to be able to communicate to the Leshan server, the CoAP port 5683 and CoAPS port 5684 need to be accessible via UDP.

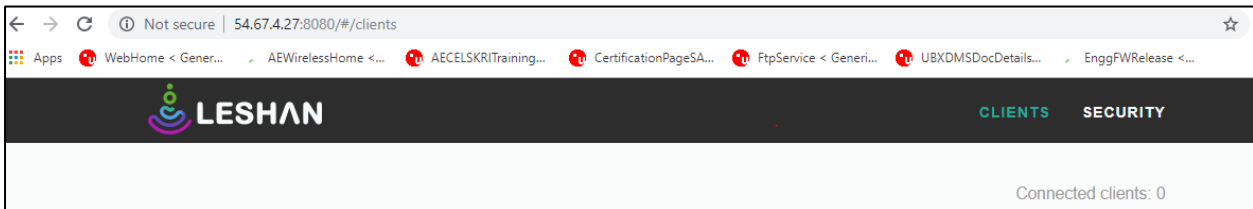


Figure 6: Open server page on a browser

- Point the device to the Leshan server; for more details, see section 5.1.
- If using CoAPS, created a PSK for the client on the Leshan server.
- The key here is given as ABCDEF, whereas in the `+ULWM2MCREATE` AT command a value of `q83v` is the base64-encoded format of the HEX string `0xAB,0xCD,0xEF`.

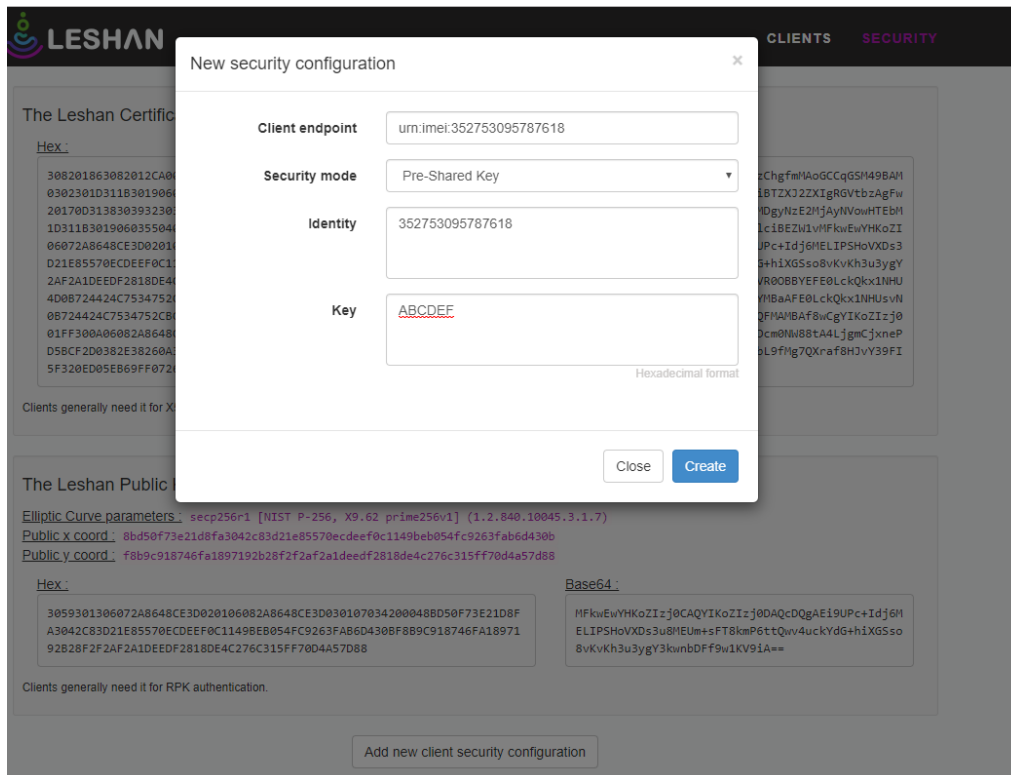


Figure 7: Insert LwM2M device security data

Reading objects using Leshan

Clicking on the **Read** button allows the Leshan server to be able to read the object values from the client.

Instance 2	/1/2		Observe ▶	Read	Write	Delete	
Short Server ID	/1/2/0		Observe ▶	Read			123
Lifetime	/1/2/1		Observe ▶	Read	Write		60
Default Minimum Period	/1/2/2		Observe ▶	Read	Write		10
Default Maximum Period	/1/2/3		Observe ▶	Read	Write		60
Disable	/1/2/4		Exec ⚙				
Disable Timeout	/1/2/5		Observe ▶	Read	Write		86400
Notification Storing When Disabled or Offline	/1/2/6		Observe ▶	Read	Write		false
Binding	/1/2/7		Observe ▶	Read	Write		UQ
Registration Update Trigger	/1/2/8		Exec ⚙				
Resource 30000	/1/2/30000		Observe ▶	Read	Write		0=0,0, 1=1,e

Figure 8 Object 2 data are read by the server from the device

Modifying registration timer

An error can occur on a Leshan server when trying to read an object. This is because of the life timer and the finite window of ~30 s during which the connection is open. The life timer counts down to 0 and then this contact window opens up again.

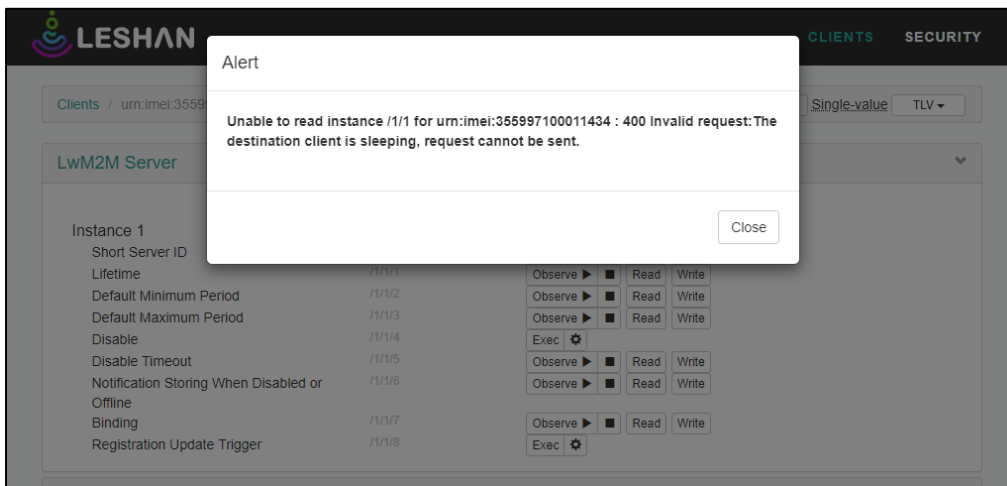


Figure 9: Error reading an object

For more details, see section [5.2](#).

To reboot the client

For more details, see section 5.4.

Under the “Device” object as shown in the below picture, click on the **Exec**.

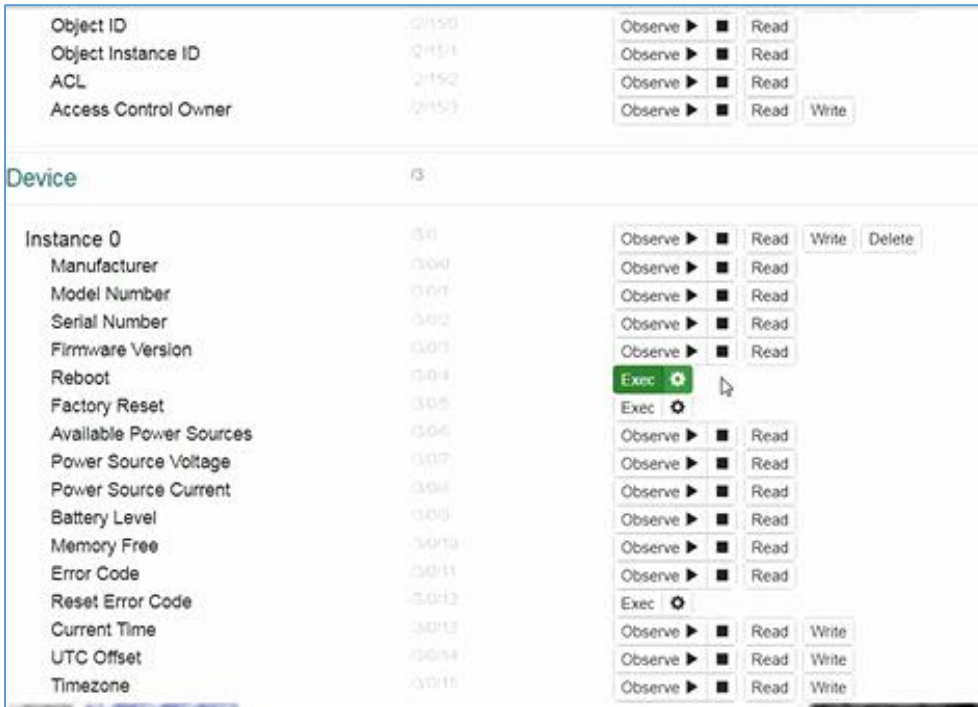


Figure 10: Reboot option on device object

CoAP messaging on Leshan

The Leshan web application can display the CoAP messages going across the client and server. These can be used for debugging purposes.

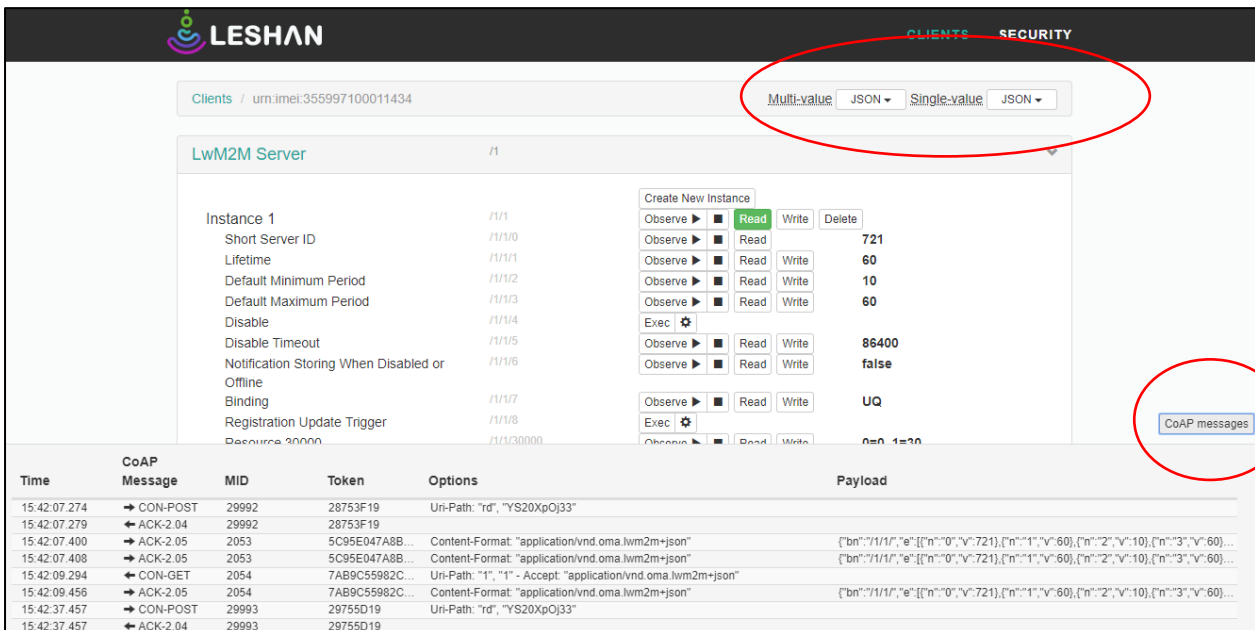



Figure 11: COAP messages exchanged between server and client

B Disabling LwM2M for AT&T on LARA-R6 series

 Appendix applies to **LARA-R6001D-00B-00, LARA-R6401D-00B-00, and LARA-R6401-00B-00**. These type numbers are certified for AT&T LwM2M.

For any related AT&T MNO profile that have LwM2M enabled, it may be required by AT&T MNO to disable them. For details on MNO profiles, see LARA-R6 series AT commands manual [\[2\]](#).

To disable the support for AT&T LwM2M servers (and optionally u-blox uFOTA), apply the following AT command sequence.


Command	Response	Description
AT+ULWM2MCONFIG=0,0,3,1,0,0,0,0,4 0,0,0,1	OK	Disable AT&T server SSID 0
AT+ULWM2MCONFIG=1,1,3,1,0,1,1,0,4 0,0,0,1	OK	Disable AT&T server SSID 1
AT+ULWM2MCONFIG=3,1,3,1,0,1,1,0,4 0,0,0,1	OK	Disable AT&T server SSID 3
AT+ULWM2MCONFIG=721,0,3,255,1,0,0 ,0,40,0,0,1	OK	Optionally disable u-blox uFOTA server SSID 721 if uFOTA is not used. It can be enabled again, as described in section 3.6 .
AT+ULWM2MCONFIG?	+ULWM2MCONFIG: 0,0,3,1,0,0,0,0,40,0,0,1 +ULWM2MCONFIG: 1,1,3,1,0,1,1,0,40,0,0,1 ULWM2MCONFIG: 3,1,3,1,0,1,1,0,40,0,0,1 +ULWM2MCONFIG: 721,0,3,255,1,0,0,0,40,0,0,1 OK	Read configuration to confirm last parameter <server_disabled> is set correctly to 1.
AT+ULWM2M=1	OK	Note that switching MNO profiles will override this setting (LwM2M client enabled/disabled), but won't affect the servers setting.
AT+CFUN=16	OK	Reboot the module for new setting to take effect.

C Glossary

Abbreviation	Definition
3GPP	3rd Generation Partnership Project
ACL	Access Control List
APN	Access Point Name
AT	AT Command Interpreter Software Subsystem, or attention
CID	Context ID
CoAP	Constrained Application Protocol
DB	Database
FOTA	Firmware Over The Air
IMEI	International Mobile Equipment Identity
IP	Internet Protocol
NRE	Non-Recurring Expense
PSK	Pre-Shared Key
TX	Transmission
UDP	User Datagram Protocol
uFOTA	u-blox FOTA
UL	Uplink
URC	Unsolicited Result Code

Related documentation

- [1] OMA technical specification Lightweight M2M, V1_0-20170208-A
- [2] u-blox LARA-R6-L6 series AT commands manual, [UBX-21046719](#)
- [3] u-blox LARA-R6-L6 series firmware update with uFOTA, FOAT and EasyFlash application note, [UBX-22008011](#)
- [4] u-blox LARA-R6-L6 series application development guide application note, [UBX-22001850](#)
- [5] AT&T device requirements document n. 13340

 For regular updates to u-blox documentation and to receive product change notifications, register on our homepage (www.u-blox.com).

Revision history

Revision	Date	Name	Comments
R01	27-May-2022	mreb, aoli	Initial release
R02	04-Apr-2023	clee, acom	Extended the document applicability to LARA-L6 series modules
R03	03-Jan-2024	clee	Added Appendix section "Disabling LwM2M for AT&T on LARA-R6 series"

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