



ONE M2M TECHNICAL SPECIFICATION

Document Number	oneM2M-TS-0005-V-2014-08
Document Name:	Management Enablement (OMA)
Date:	2014-08-01
Abstract:	<p>Specifies the usage of OMA DM and OMA LWM2M resources and the corresponding message flows including normal cases as well as error cases to fulfil the oneM2M management requirements.</p> <ul style="list-style-type: none">• Mapping between the oneM2M management related resources and the resources from OMA.• Protocol translation between the oneM2M service layer and OMA. The Mca reference point, ms interface and la interface are possibly involved in this protocol translation.• Resource definitions in OMA to fulfil the oneM2M management requirements.

This Specification is provided for future development work within oneM2M only. The Partners accept no liability for any use of this Specification.

The present document has not been subject to any approval process by the oneM2M Partners Type 1. Published oneM2M specifications and reports for implementation should be obtained via the oneM2M Partners' Publications Offices.

About oneM2M

The purpose and goal of oneM2M is to develop technical specifications which address the need for a common M2M Service Layer that can be readily embedded within various hardware and software, and relied upon to connect the myriad of devices in the field with M2M application servers worldwide.

More information about oneM2M may be found at: <http://www.oneM2M.org>

Copyright Notification

No part of this document may be reproduced, in an electronic retrieval system or otherwise, except as authorized by written permission.

The copyright and the foregoing restriction extend to reproduction in all media.

© 2013, oneM2M Partners Type 1 (ARIB, ATIS, CCSA, ETSI, TTA, TTC).

All rights reserved.

Notice of Disclaimer & Limitation of Liability

The information provided in this document is directed solely to professionals who have the appropriate degree of experience to understand and interpret its contents in accordance with generally accepted engineering or other professional standards and applicable regulations. No recommendation as to products or vendors is made or should be implied.

NO REPRESENTATION OR WARRANTY IS MADE THAT THE INFORMATION IS TECHNICALLY ACCURATE OR SUFFICIENT OR CONFORMS TO ANY STATUTE, GOVERNMENTAL RULE OR REGULATION, AND FURTHER, NO REPRESENTATION OR WARRANTY IS MADE OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE OR AGAINST INFRINGEMENT OF INTELLECTUAL PROPERTY RIGHTS. NO oneM2M PARTNER TYPE 1 SHALL BE LIABLE, BEYOND THE AMOUNT OF ANY SUM RECEIVED IN PAYMENT BY THAT PARTNER FOR THIS DOCUMENT, WITH RESPECT TO ANY CLAIM, AND IN NO EVENT SHALL oneM2M BE LIABLE FOR LOST PROFITS OR OTHER INCIDENTAL OR CONSEQUENTIAL DAMAGES. oneM2M EXPRESSLY ADVISES ANY AND ALL USE OF OR RELIANCE UPON THIS INFORMATION PROVIDED IN THIS DOCUMENT IS AT THE RISK OF THE USER.

Contents

Contents	3
1 Scope	5
2 References	5
2.1 Normative references	5
2.2 Informative references	5
3 Definitions, symbols, abbreviations and acronyms	5
3.1 Definitions	5
3.2 Symbols	6
3.3 Abbreviations	6
3.4 Acronyms	6
4 Conventions	6
5. OMA DM 1.3 and OMA DM 2.0	6
5.1 Mapping of basic data types	6
5.2 Mapping of Identifiers	7
5.3 Mapping of resources	7
5.3.1 General Mapping Assumptions	7
5.3.2 Resource [firmware]	8
5.3.3 Resource [software]	8
5.3.4 Resource [memory]	8
5.3.5 Resource [areaNwkInfo]	8
5.3.6 Resource [areaNwkDeviceInfo]	9
5.3.7 Resource [battery]	9
5.3.8 Resource [deviceInfo]	9
5.3.9 Resource [deviceCapability]	10
5.3.10 Resource [reboot]	10
5.3.11 Resource [eventLog]	10
5.4 Mapping of procedures for management	11
5.4.1 Mapping for <mgmtObj> Resource Primitives	11
5.4.1.1 Create Primitive for <mgmtObj> Resource	11
5.4.1.2 Retrieve Primitive for <mgmtObj> Resource	11
5.4.1.3 Update Primitive for <mgmtObj> Resource	11
5.4.1.3.1 Update Primitive for Replacing Data in the Management Object	12
5.4.1.3.2 Update Primitive for Executing Management Commands	12
5.4.1.4 Delete Primitive for <mgmtObj> Resource	12
5.4.2 oneM2M Resource Specific Procedure Mapping	12
5.5 DM Server Interactions	12
5.5.1 DM Server interaction management	12
5.5.2 Authorization	13
5.6 New Management Objects	13
6. OMA Lightweight M2M 1.0	13
6.1 Mapping of basic data types	13
6.2 Mapping of Identifiers	13
6.2.1 Device identifier	13
6.2.2 Object identifier	13
6.2.3 Object Instance Identifier	14
6.3 Mapping of resources	14
6.3.1 General Mapping Assumptions	14
6.3.2 Resource [memory]	14
6.3.3 Resource [battery]	14
6.3.4 Resource [deviceInfo]	15
6.3.5 Resource [reboot]	15
6.4 Mapping of procedures for management	15
6.4.1 Create primitive for <mgmtObj> Resource	16

6.4.2	Retrieve primitive for <mgmtObj> Resource	16
6.4.3	Update primitive for <mgmtObj> Resource	16
6.4.3.1	Update primitive for replacing data.....	16
6.4.3.2	Update primitive for execution operation	17
6.4.4	Delete primitive for <mgmtObj> Resource.....	17
6.5	LWM2M Server Interactions	17
6.5.1	LWM2M Server interaction management.....	17
6.5.2	Authorization	18
6.6	New LWM2M Objects	18
	<i>Proforma copyright release text block</i>	18
	<i>Annexes</i> 18	
	Annex <y>: Bibliography.....	19
	History	19

1 Scope

The present document specifies the protocol translation and mappings between the oneM2M Service layer and management technologies specified by OMA such as OMA DM 1.3, OMA DM 2.0 and OMA LightweightM2M. Note that OMA DM 1.3 and OMA DM 2.0 are collectively called as OMA DM in this document.

2 References

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

2.1 Normative references

The following referenced documents are necessary for the application of the present document.

- [1] oneM2M TS-0001: “oneM2M Functional Architecture”
- [2] oneM2M TS-0004: “oneM2M Protocol Specification”
- [3] oneM2M TR-0004: “Definitions and Acronyms”
- [4] “OMA Device Management Protocol”, Version 1.3, Open Mobile Alliance™,
<http://www.openmobilealliance.org/>
- [5] “OMA Device Management Protocol”, Version 2.0, Open Mobile Alliance™,
<http://www.openmobilealliance.org/>
- [6] “OMA LightweightM2M”, Version 1.0, Open Mobile Alliance™,
<http://www.openmobilealliance.org/>

2.2 Informative references

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

- [i.1] oneM2M Drafting Rules
(http://member.onem2m.org/Static_pages/Others/Rules_Pages/oneM2M-Drafting-Rules-V1_0.doc)

3 Definitions, symbols, abbreviations and acronyms

For the purposes of the present document, the terms and definitions given in TR-0004 [3] apply. In addition, the terms and definitions defined in this section apply.

3.1 Definitions

Definition format

<defined term>: <definition>

<defined term>[N]: <definition>

example 1: text used to clarify abstract rules by applying them literally

NOTE: This may contain additional information.

3.2 Symbols

Symbol format

<symbol>	<Explanation>
<2 nd symbol>	<2 nd Explanation>
<3 rd symbol>	<3 rd Explanation>

3.3 Abbreviations

Abbreviation format

<ABBREVIATION1>	<Explanation>
<ABBREVIATION2>	<Explanation>
<ABBREVIATION3>	<Explanation>

3.4 Acronyms

Acronym format

<ACRONYM1>	<Explanation>
<ACRONYM2>	<Explanation>
<ACRONYM3>	<Explanation>

4 Conventions

The key words “Shall”, “Shall not”, “May”, “Need not”, “Should”, “Should not” in this document are to be interpreted as described in the oneM2M Drafting Rules [i.1]

5. OMA DM 1.3 and OMA DM 2.0

5.1 Mapping of basic data types

oneM2M has defined the data types that describe the format of the value stored at the attribute. Those oneM2M data types are listed in the below table, and mapped to the data types specified by OMA DM Protocol [4], [5]. Note that OMA DM 1.3 [4] and OMA DM 2.0 [5] uses the same data types.

oneM2M Data Types	Mapping to data types in OMA DM	description
TBD	null	OMA DM Nodes with null data type shall not store any value.
xs:base64Binary	b64	Data type for Base64-encoded binary data
xs:base64Binary	bin	Data type for binary data.
xs:boolean	bool	Data type for Boolean. Detailed Mapping can be given here.
xs:string	chr	Data type for text. The length limitation should be considered for the mapping.
xs:integer	int	Data type for 32-bit signed integer
TBD	xml	Data type for XML data
xs:date	date	Data type for date in ISO 8601 format with the century being included in the year
xs:time	time	Data type for Specifies that the Node value is a time in ISO 8601 format
xs:float	float	Data type for a single precision 32-bit floating point type as defined in XML Schema 1.0 as the float primitive type
The <i>mgmtLink</i> attribute in the <mgmtObj> Resource		The OMA DM 'node' data type describes the format of the Interior Node that can have child Nodes. The mgmtLink attribute in the <mgmtObj> Resource supports the hierarchy of <mgmtObj> Resource. Note that this is not data type mapping.

Editor's Note: The oneM2M data types that is related to <mgmtObj> needs to be listed in the above table.

5.2 Mapping of Identifiers

OMA DM 1.3 and OMA DM 2.0 specifies many identifiers including device identifier, server identifier, client version identifier, manufacturer identifier, etc. To enable the device management using OMA DM Protocol, oneM2M identifiers needs to be mapped to identifiers specified by OMA DM Protocol. Below table shows the oneM2M identifiers that needs to be mapped to OMA DM Protocol.

oneM2M	Mapping to OMA DM Identifiers	Description
M2M-Node-ID.	Device Identifier (i.e., DevId node in DevInfo MO)	In OMA DM, the device identifier is a unique identifier for the device. This value is globally unique and MUST be formatted as a URN. OMA DM Gateways and OMA DM enabled devices are assigned with the device identifiers, and each can be mapped to the M2M-Node-ID. Note: In case that the notion of the device identifier is not supported by the device, the DM Gateway can assign the local identifier for the device, and the M2M-Node-ID should be mapped to this local identifier.
The objectID attribute in <mgmtObj> resource.	MOID	A unique identifier of the management object. Each MO is characterized by a unique MOID, which is generally a URN.
The objectPath attribute in <mgmtObj> resource	URI for the local path in the device where the relevant Management Object is located	Management Objects in the device are uniquely addressed by a URI that is stored in the objectPath attribute. Note that DM 1.3 and DM 2.0 uses different Addressing scheme, but they are transparent to the oneM2M service layer.

5.3 Mapping of resources

This section describes how to map <mgmtObj> resources specified in the Annex D of [1] to the relevant management objects as defined by OMA DM ([4], [5]). Since OMA DM 1.3 and OMA DM 2.0 use the same management objects except standard management objects, the resource mappings can be considered regardless of the specific version of the OMA DM Protocol.

5.3.1 General Mapping Assumptions

OMA DM Protocol implements the management functionalities by using the Management Objects. Management Object is a collection of Nodes which are related for providing certain management functionalities. For example,

SCOMO is for the software management, and FUMO is for the firmware update, and so on. The individual management operations such as firmware update, software management can be achieved by manipulating the corresponding Management Object. Since oneM2M <mgmtObj> Resources are for providing specific management functionalities, oneM2M <mgmtObj> Resources shall be mapped to Management Objects specified by OMA DM [4], [5].

5.3.2 Resource [firmware]

The resource [firmware] is for firmware management in the service layer. Regardless of OMA DM 1.3 and OMA DM 2.0, the resource shall be mapped to FUMO (urn:oma:mo:omafumo:1.0). The attributes of the resource shall be mapped to nodes of the MO as the follows.

Attribute Name of [firmware]	Mapping to Nodes in Management Object
version	<x>/PkgVersion
name	<x>/PkgName
URL	<x>/DownloadAndUpdate/PkgURL
update	<x>/DownloadAndUpdate
updateStatus	<x>/State

5.3.3 Resource [software]

The resource [software] is for software management in the service layer. Regardless of OMA DM 1.3 and OMA DM 2.0, the resource shall be mapped to SCOMO (urn:oma:mo:omascomo:1.0). The attributes of the resource shall be mapped to nodes of the MO as the follows.

Attribute Name of [software]	Mapping to Nodes in Management Object
version	<x>/Inventory/Deployed/<x>/Version
name	<x>/Download/<x>/Name (when the software package is not ready for install) <x>/Inventory/Delivered/<x>/Name (when the software package is ready for install) <x>/Deployed/<x>/Name (when the software package is already installed)
URL	<x>/Download/<x>/PkgURL
install	<x>/Download/<x>/Operations/DownloadInstall (when the software package is not yet available) <x>/Inventory/Delivered/<x>/Operations/Install (when the software package has already been downloaded)
installStatus	<x>/Download/<x>/Status (started install when the software package is not yet available) <x>/Inventory/Delivered/<x>/Status (started install when the software package has already been downloaded)
activate	<x>/Inventory/Deployed/<x>/Operations/Activate
deactivate	<x>/Inventory/Deployed/<x>/Operations/Deactivate
activeStatus	<x>/Inventory/Deployed/<x>/Status

5.3.4 Resource [memory]

The resource [memory] is for acquire information about the total memory or available memory of the device. Regardless of OMA DM 1.3 and OMA DM 2.0, the resource shall be mapped to memory information of DiagMO (urn:oma:mo:omadiag:memory:1.0). The attributes of the resource shall be mapped to nodes of the MO as the follows.

Attribute Name of [memory]	Mapping to Nodes in Management Object
memAvailable	<x>/DiagMonData/RAMAvail
memTotal	<x>/DiagMonData/RAMTotal

5.3.5 Resource [areaNwkInfo]

The resource [areaNwkInfo] is for managing the area network. Regardless of OMA DM 1.3 and OMA DM 2.0, the resource shall be mapped to MANMO (urn:oma:mo:ext-etsi-manmo:1.0). The attributes of the resource shall be mapped to nodes of the MO as the follows.

Attribute Name of [areaNwkInfo]	Mapping to Nodes in Management Object
areaNwkType	M2MAreaNwkInfo/AreaNwks/<x>/AreaNwkType
listOfDevices	M2MAreaNwkInfo/AreaNwks/<x>/ListOfDevices

5.3.6 Resource [areaNwkDeviceInfo]

The resource [areaNwkDeviceInfo] is for managing the device of the area network as well as acquiring information about devices in the area network. Regardless of OMA DM 1.3 and OMA DM 2.0, the resource shall be mapped to MANDMO (urn:oma:mo:ext-etsi-mandmo:1.0). The attributes of the resource shall be mapped to nodes of the MO as the follows.

Attribute Name of [areaNwkDeviceInfo]	Mapping to Nodes in Management Object
devId	DevInfo/DevId
devType	DevDetail/DevType
areaNwkId	<x>/AreaNwks/<x>/AreaNwkID
sleepInterval	<x>/AreaNwks/<x>/SleepInterval
sleepDuration	<x>/AreaNwks/<x>/SleepDuration
status	<x>/AreaNwks/<x>/Status
listOfNeighbors	<x>/AreaNwks/<x>/Groups/ListOfDeviceNeighbors

Editor's Note: The description of which procedures are used to maintain the resource is FFS.

5.3.7 Resource [battery]

The Resource [battery] is to provide battery related information. Regardless of OMA DM 1.3 and OMA DM 2.0, this Resource shall be mapped to Battery Info Management Object (MOID: "urn:oma:mo:oma-diag:batteryinfo:1.0"). The attributes of this Resource shall be mapped to Nodes in the Management Object as follows:

Attribute Name of [battery]	Mapping to Nodes in Management Object
batteryLevel	"<x>/DiagMonData/<x>/BatteryLevel" Node
batteryStatus	"<x>/DiagMonData/<x>/BatteryStatus" Node

5.3.8 Resource [deviceInfo]

The Resource [deviceInfo] is to provide device related information. For OMA DM 1.3, this Resource shall be mapped to DevInfo MO (MOID: "urn:oma:mo:oma-dm-devinfo:1.1") and DevDetail MO (MOID: "urn:oma:mo:oma-dm-devdetail:1.1"). The attributes of this Resource shall be mapped to Nodes in two Management Objects as follows:

Attribute Name of [deviceInfo]	Mapping to Nodes in Management Object
deviceLabel	"DevInfo/DevId" Node in DevInfo MO
Manufacturer	"DevInfo/Man" Node in DevInfo MO
Model	"DevInfo/Mod" Node in DevInfo MO
deviceType	"DevDetail/DevType" Node in DevDetail MO
fwVersion	"DevDetail/FwV" Node in DevDetail MO
swVersion	"DevDetail/SwV" Node in DevDetail MO
hwVersion	"DevDetail/HwV" Node in DevDetail MO

For OMA DM 2.0, this Resource shall be mapped to DevInfo MO (MOID: "urn:oma:mo:oma-dm-devinfo:1.2"). The attributes of this Resource shall be mapped to Nodes in the Management Object as follows:

Attribute Name of [deviceInfo]	Mapping to Nodes in Management Object
deviceLabel	"<x>/DevID" Node
Manufacturer	"<x>/Man" Node in DevInfo MO
Model	"<x>/Mod" Node in DevInfo MO
deviceType	"<x>/DevType" Node in DevInfo MO
fwVersion	"<x>/FwV" Node in DevInfo MO
swVersion	"<x>/SwV" Node in DevInfo MO
hwVersion	"<x>/HwV" Node in DevInfo MO

5.3.9 Resource [deviceCapability]

The Resource [deviceCapability] is to manage the device capabilities such USB, camera, etc. Regardless of OMA DM 1.3 and OMA DM 2.0, this Resource shall be mapped to Device Capability Management Object (MOID: "urn:oma:mo:oma-dcmo:1.0"). The attributes of this Resource shall be mapped to Nodes in the Management Object as follows:

Attribute Name of [deviceCapability]	Mapping to Nodes in Management Object
capabilityName	"<x>/Property" Node in DCMO
attached	"<x>/Attached" Node in DCMO
capabilityActionStatus	"<x>/Enabled" Node in DCMO
enable	"<x>/Operations/Enable" Node in DCMO
disable	"<x>/Operations/Disable" Node in DCMO

5.3.10 Resource [reboot]

The Resource [reboot] is to reboot the device. Regardless of OMA DM 1.3 and OMA DM 2.0, this Resource shall be mapped to Restart Management Object (MOID: "urn:oma:mo:oma-diag:restart:1.0") that is specified in Diag Mon [ref] and Lock and Wipe Management Object (MOID: "urn:oma:mo:oma-lawmo:1.0"). The attributes of this Resource shall be mapped to Nodes in the Management Objects as follows:

Attribute Name of [reboot]	Mapping to Nodes in Management Object
reboot	"<x>/Operations/Start" Node in Restart MO. The restarting level described at the "<x>/DiagMonConfig/ConfigParms/RestartLevel" Node is up to the implementation.
factoryReset	"<x>/Operations/FactoryReset" Node in LAWMO

Note: which procedures shall be invoked when the "reboot" is TBD and shall be specified (better if handled in a general way)

Note: access right mapping needs to be resolved in a general manner in TS-0005.

5.3.11 Resource [eventLog]

The Resource [eventLog] is to record the event log for the device. Regardless of OMA DM 1.3 and OMA DM 2.0, this Resource shall be mapped to several Management Objects according to the logTypeId attribute of this Resource as follows:

- Trap Event Logging Function Management Object (MOID: "urn:oma:mo:oma-diag:trapeventlogging:1.1") if the logTypeId attribute is set to "TBD"
- Trace Logs Management Object (MOID: "urn:oma:mo:oma-diag:tracelog:1.0") if the logTypeId attribute is set to "TBD"
- Panic Logs Management Object (MOID: "urn:oma:mo:oma-diag:paniclog:1.1") if the logTypeId attribute is set to "TBD"

The attributes of this Resource shall be mapped to Nodes in above Management Objects as follows:

Attribute Name of [eventLog]	Mapping to Nodes in Management Object
logTypeId	This attribute is not mapped to Nodes in Management Object. Instead, this attribute specifies the log type, and based on the log type, the actual Management Object mapped to this Resource is decided.
logData	"<x>/DiagMonData/log" Node for Trap Event Logging Function MO and Trace Logs MO. "<x>/DiagMonData/PanicLog" Node for Panic Logs MO
logActionStatus	"<x>/Status" Node for Trap Event Logging Function MO, Trace Logs MO and Panic Logs MO
logStart	"<x>/Operations/Start" Node for Trap Event Logging Function MO, Trace Logs MO and Panic Logs MO
logStop	"<x>/Operations/Stop" Node for Trap Event Logging Function MO, Trace Logs MO and Panic Logs MO

5.4 Mapping of procedures for management

5.4.1. Mapping for <mgmtObj> Resource Primitives

5.4.1.1 Create Primitive for <mgmtObj> Resource

The Create Request primitive for the <mgmtObj> Resource, as described in [2], shall be mapped to external management operations that create the corresponding OMA DM Management Objects. Depending on the type of the <mgmtObj> Resource (i.e., [memory], [battery], [deviceInfo], etc.), the associated OMA DM Management Object as specified in the clause 6.3 should be created. Creating OMA DM Management Object can be performed by the Protocol Command Add in OMA DM 1.3 and HGET in OMA DM 2.0.

Receiving Create Request primitive does not imply that the mapped external management operations shall be always performed since, on receiving the Create Request primitive, the corresponding external management objects may already exist in the device. For instance, after discovering the external management objects, the DMG in MN or ASN creates <mgmtObj> Resource in the IN-CSE, and in this case the IN-CSE does not need to create the external management objects.

In case that the external management objects are successfully created after receiving the Create Request primitive, then the *objectID* and *objectPath* attribute should be properly set based on the created external management objects.

The result of creating the external management object should be mapped to the Create Response primitive for the <mgmtObj> Resource as indicated by the status code mapping in the clause x.y.

5.4.1.2 Retrieve Primitive for <mgmtObj> Resource

The Retrieve Request primitive for the <mgmtObj> Resource, as described in [2], shall be mapped to external management operations that retrieve the corresponding OMA DM Management Objects. Depending on the type of the <mgmtObj> Resource (i.e., [memory], [battery], [deviceInfo], etc.), the associated OMA DM Management Object as specified in the clause 6.3 shall be retrieved. Retrieving OMA DM Management Object can be performed by the Protocol Command Get in OMA DM 1.3 and HPUT/HPOST/GET in OMA DM 2.0.

The result of retrieving the external management object should be mapped to the Retrieve Response primitive for the <mgmtObj> Resource as indicated by the status code mapping in the clause x.y.

In case of OMA DM 2.0, note that the mapped external management operations may be implemented either by using HPUT, HPOST or GET. If the GET command is used, the requested data is carried within the OMA DM Session; otherwise the requested data is directly embedded within the HTTP message.

5.4.1.3 Update Primitive for <mgmtObj> Resource

The Update Request Primitive for <mgmtObj> Resource can be used to modify the external management objects or to execute the management commands. The mapping in either cases shall be different as the following sections.

5.4.1.3.1 Update Primitive for Replacing Data in the Management Object

This is the case that the Update Primitive targets the attribute that is mapped to the non-executable Node in external management object as specified in the clause 6.3. The Update Request primitive for the <mgmtObj> Resource, as described in [2], shall be mapped to external management operations that replace the data in the corresponding OMA DM Management Objects. Depending on the type of the <mgmtObj> Resource (i.e., [memory], [battery], [deviceInfo], etc.), the associated OMA DM Management Object as specified in the clause 6.3 shall be updated. Replacing data in OMA DM Management Object can be performed by the Protocol Command Replace in OMA DM 1.3 and HGET in OMA DM 2.0.

The result of replacing data in the external management object should be mapped to the Update Response primitive for the <mgmtObj> Resource as indicated by the status code mapping in the clause x.y.

5.4.1.3.2 Update Primitive for Executing Management Commands

This is the case that the Update Primitive targets the attribute that is mapped to the executable Node in external management object as specified in the clause 6.3. The Update Request primitive for the <mgmtObj> Resource, as described in [2], shall be mapped to external management operations that execute the Node in the external management object. Depending on the type of the <mgmtObj> Resource (i.e., [memory], [battery], [deviceInfo], etc.), the Node in the associated OMA DM Management Object as specified in the clause 6.3 shall be executed. Executing the Node in OMA DM Management Object can be performed by the Protocol Command Exec in OMA DM 1.3 and EXEC in OMA DM 2.0.

The mapped external management operations may be executed either by the synchronous or asynchronous reporting as specified by OMA DM 1.3 and OMA DM 2.0. Selecting the synchronous or asynchronous reporting is implementation issue, and is independent on whether the Update Primitive is requested as blocking or non-blocking.

The result of executing the Node in the external management object should be mapped to the Update Response primitive for the <mgmtObj> Resource as indicated by the status code mapping in the clause x.y.

5.4.1.4 Delete Primitive for <mgmtObj> Resource

The Delete Request primitive for the <mgmtObj> Resource, as described in [2], shall be mapped to external management operations that delete the corresponding OMA DM Management Objects. Depending on the type of the <mgmtObj> Resource (i.e., [memory], [battery], [deviceInfo], etc.), the associated OMA DM Management Object as specified in the clause 6.3 should be deleted. Deleting OMA DM Management Object can be performed by the Protocol Command Delete in OMA DM 1.3 and DELETE in OMA DM 2.0.

Receiving Delete Request primitive does not imply that the corresponding external management objects shall be always deleted. They may not be deleted if the external management objects are used by entities such as the Device Management Server.

The result of deleting the external management object should be mapped to the Delete Response primitive for the <mgmtObj> Resource as indicated by the status code mapping in the clause x.y.

5.4.2 oneM2M Resource Specific Procedure Mapping

5.5 DM Server Interactions

Editor's Note: The section specifies the action taken for the DMG CSE to communicate with the Management Server by using the ms interface. The server interaction can be different depending on the device management technology. The server interaction might include the establishment, maintenance, usage and termination of communication to the Management Server defined in OMA DM.

5.5.1 DM Server interaction management

Editor's Note: Describes the management of communication between oneM2M service layer and DM Server. The management includes the establishment and termination of session when needed. The management also includes necessary procedure to utilize the existing sessions.

5.5.2 Authorization

Editor's Note: The section specifies the mapping of authorization rules defined in oneM2M and OMA standards.

5.6 New Management Objects

Editor's Note: The section specifies the definition of new data models if needed based on the requirements of oneM2M. The definition of new data models in this section need to be liaised to OMA to create corresponding MOs in OMA DM.

6. OMA Lightweight M2M 1.0

6.1 Mapping of basic data types

oneM2M has defined the data types that describe the format of the value stored at the attribute. Those oneM2M data types are listed in the below table, and mapped to the data types specified by OMA Lightweight M2M 1.0 [6] (shortened in OMA LWM2M)

oneM2M Data Types	Mapping to data types in OMA LWM2M	description
xs:string	String	UTF-8 string
xs:integer	Integer	ASCII signed integer 1, 2,4, or 8 bytes
xs:boolean	Boolean	Data type for BooleanASCII value 0 or 1
xs:float	Float	A 32 or 64-bit floating point value. The valid range of the value for a Resource SHOULD be defined.
xs:base64Binary	Opaque	A sequence of binary octets, the minimum and/or maximum length of the octets MAY be defined.
xs:dateTime	Time	Unix Time. A signed integer representing the number of seconds since Jan 1st, 1970 in the UTC time zone.

Editor's Note: the description part should provide more information on how the mapping can occur. E.g., how to map between Time and xs:dateTime which have different format. Not repeat the existing explanations.

Editor's Note: the mapping is only listed in the above table that are needed.

6.2 Mapping of Identifiers

OMA LWM2M [6] defines specific identifiers for entities (e.g. End Point Client Name or Device Identifier, Server identifier, Objects identifiers ..) To enable the device management using OMA LWM2M [6], oneM2M identifiers needs to be mapped to identifiers specified by OMA LWM2M [6].

6.2.1 Device identifier

A unique identifier is assigned to the Device and referenced as Endpoint Client Name in OMA LWM2M [6]. This value is globally unique and is formatted as a URN.

Several URN formats are recommended in OMA LWM2M [6] as UUID URN defined in [RFC4122], OPS URN defined in [TR-069], IMEI URN defined in [3GPP-TS_23.003].

This Device identifiers shall map onto the oneM2M Node Identifier (M2M-Node-ID)

6.2.2 Object identifier

In OMA LWM2M [6], each object is characterized by a unique identifier represented by an integer. This identifier is provided by OMNA (OMA Naming Authority) and is registered as a unique URN :

urn:oma:lwm2m:{oma,ext,x}:objectID (e.g. the LWM2M 1.0 Device Object (ObjectID:3) is registered as urn:oma:lwm2m:oma:3).

The context of a given oneM2M <mgmtObj> Resource is represented by the objectId attribute which can contain several references to OMA LWM2M [6] Object identifiers expressed as OMNA registered URN.

6.2.3 Object Instance Identifier

OMA LWM2M [6] permits objects to have multiple object instances where each object instance is contained in the objectPath attribute of the <mgmtObj> Resource within the context of the Resource's objectId as described in previous section.

The objectPath attribute in <mgmtObj> Resource contains one (or several) element(s) representing the local path(s) where the Object Instance(s) are located.

6.3 Mapping of resources

This section describes how to map the <mgmtObj> Resources specified in the Annex D of [1] to the relevant Objects specified in OMA LWM2M [6].

6.3.1 General Mapping Assumptions

OMA LWM2M[6] implements the functionalities of the device management and M2M service enablement as Objects. An Object is a collection of resources which are related to a specific management functionality. For example the Firmware Update Object contains all the resources used for firmware update purpose. Before to be able of fulfilling its role, an Object shall be firstly instantiated into an Object Instance.

Since <mgmtObj> Resources are for providing specific management functionalities, the attributes of a given <mgmtObj> Resource shall be mapped to the resources of one or several LWM2M Object Instances within the context of the Resource's objectId as defined in sub-section 6.2.2..

The objectPath is a local context which has to be combined with a given <mgmtObj> Resource's attribute for realizing the final mapping to the targeted OMA LWM2M [6] resource.

In case the objectPath is multiple (several Object Instances are referenced in that Resource), a specified couple composed of one element of the objectId list and one element of objectPath list will be associated to a given Resource attribute for realizing the final mapping to the targeted OMA LWM2M [6] resource.

6.3.2 Resource [memory]

The Resource [memory] provides memory related information. For OMA LWM2M, this Resource shall be mapped to the unique Instance of LWM2M Device Object (LWM2M ObjectID: 3) .

The context of this Resource is the following:

Context	Mapping
objectId	urn:oma:lwm2m:oma:3
objectPath	/3/0 (instance 0 of Object 3)

The attributes of this Resource shall be mapped to specific resources of the LWM2M Device Object Instance as follows:

Attribute Name of [memory]	Mapping to resources in LWM2M Device Object Instance
memAvailable	10 : estimated current available amount of memory in KB
memTotal	21 : total amount of storage space in KB in the LWM2M Device

6.3.3 Resource [battery]

The Resource [battery] provides battery related information. For OMA LWM2M, this Resource shall be mapped to the unique Instance of LWM2M Device Object (LWM2M ObjectID: 3).

The context of this Resource is the following

Context	Mapping
objectId	urn:oma:lwm2m:oma:3
objectPath	/3/0

The attributes of this Resource shall be mapped to specific resources of the LWM2M Device Object Instance as follows:

Attribute Name of [battery]	Mapping to resources in LWM2M Device Object Instance
batteryLevel	9 : current battery level as percentage
batteryStatus	20 : contains the battery status

6.3.4 Resource [deviceInfo]

The Resource [deviceInfo] provides device related information. For OMA LWM2M, this Resource shall be mapped to the unique Instance of LWM2M Device Object (LWM2M ObjectID: 3).

The context of this Resource is the following

Context	Mapping
objectId	urn:oma:lwm2m:oma:3
objectPath	/3/0

The attributes of this Resource shall be mapped to specific resources of the LWM2M Device Object Instance as follows:

Attribute Name of [deviceInfo]	Mapping to resources in LWM2M Device Object Instance
deviceLabel	2 : Serial Number
Manufacturer	0 : Manufacturer name
Model	1 : Model Number
deviceType	17 : the class of the device
fwVersion	3 : Firmware Version
swVersion	19 : Software Version of the device
hwVersion	18 : Hardware version of the device

6.3.5 Resource [reboot]

The Resource [reboot] is used for rebooting the device. For OMA LWM2M, this Resource shall be mapped to the unique Instance of LWM2M Device Object (LWM2M ObjectID: 3).

The context of this Resource is the following

Context	Mapping
objectId	urn:oma:lwm2m:oma:3
objectPath	/3/0

The attributes of this Resource shall be mapped to LWM2M Device Object Instance as follows:

Attribute Name of [reboot]	Mapping to resources in LWM2M Object Instance
reboot	4 : reboot the LWM2M Device to restore the Device from unexpected firmware failure
factoryReset	5 : Perform Factory Reset : the LWM2M device return to the same configuration as at the initial deployment.

6.4 Mapping of procedures for management

In this section, the oneM2M Primitives (i.e, Create, Retrieve, Update and Delete) are mapped to logical operations defined in OMA LWM2M. The LWM2M operations involved in that mapping (i.e. Create, Read, Write, Execute and Delete operations) are mapped on CoAP methods [7] . which are all carried as Confirmable CoAP message . In

LWM2M the responses to these operations are carried directly in the Acknowledgement message that acknowledges the request

6.4.1 Create primitive for <mgmtObj> Resource

Depending on the mgmtDefinition attribute of the <mgmtObj> Resource (i.e. [memory], [battery], [deviceInfo], etc.), an instance of the associated LWM2M Object as specified in the clause 6.3 should be created.

Receiving Create Request primitive does not imply that the LWM2M Create operations shall be always performed since, on receiving the Create Request primitive, the corresponding LWM2M Object Instance may already exist in the device.

In case that the LWM2M Object Instance is successfully created after receiving the Create Request primitive, then the objectID and objectPath attributes should be properly set based on the LWM2M Object.

The Create primitive shall map to the OMA LWM2M Create operation and shall return one of the codes described in the following Table.

Table 6.4.1-1 Create Returned Codes Mapping

Primitive Codes	Description	Returned Codes
	"Create" operation is completed successfully	2.01 Created
	Target (i.e., Object) already exists Mandatory Resources are not specified	4.00 Bad Request
	Access Right Permission Denied	4.01 Unauthorized
	URI of "Create" operation is not found	4.04 Not Found,
	Target is not allowed for "Create" operation	4.05 Method Not Allowed

6.4.2 Retrieve primitive for <mgmtObj> Resource

Depending on the mgmtDefinition attribute of the <mgmtObj> Resource (i.e., [memory], [battery], [deviceInfo], etc.), the associated LWM2M Object resources as specified in the clause 6.3 shall be retrieved.

The Retrieve primitive shall map to the LWM2M Read operation and shall return one of the codes described in the following Table.

Table 6.4.2-1 : Retrieve Returned Codes Mapping

Primitive Codes	Description	Returned Codes
	"Retrieve" operation is completed successfully	2.05 Content
	Access Right Permission Denied	4.01 Unauthorized,
	Target of "Retrieve" operation is not found	4.04 Not Found,
	Target is not allowed for "Retrieve" operation	4.05 Method Not Allowed

6.4.3 Update primitive for <mgmtObj> Resource

The Update Request Primitive for <mgmtObj> Resource can be used to modify the resources of a LWM2M Object instance or to execute the action related to a resource of a LWM2M Object instance.

The mapping in either cases shall be different.

6.4.3.1 Update primitive for replacing data

Depending on the mgmtDefinition attribute of the <mgmtObj> Resource (i.e., [memory], [battery], [deviceInfo], etc.), the associated resource(s) of the LWM2M Object instance as specified in the clause 6.3 shall be updated.

The Update primitive shall map to the LWM2M Write operation and shall return one of the codes described in the following table.

Table 6.4.3.1-1 : Update Returned Codes Mapping

Primitive Codes	Description	Returned Codes
	"Update" operation is completed successfully	2.04 Changed
	The format of data to be updated is different	4.00 Bad Request,
	Access Right Permission Denied	4.01 Unauthorized
	Target of "Update" operation is not found	4.04 Not Found,
	Target is not allowed for "Update" operation	4.05 Method Not Allowed

6.4.3.2 Update primitive for execution operation

This is the case that the Update Primitive targets the attribute that is mapped to a LWM2M resource that supports the Execute operation.

The Update primitive shall map to the LWM2M Execute operation and shall return one of the codes described in the following table

Table 6.4.3.2-1 : Execute Returned Codes Mapping

Primitive Codes	Description	Returned Codes
	"Update" ("Execute") operation is completed successfully	2.04 Changed
	Some issue with the "Update" argument	4.00 Bad Request,
	Access Right Permission Denied	4.01 Unauthorized
	Target of "Update" ("Execute") operation is not found	4.04 Not Found,
	Target is not allowed for "Update" ("Execute") operation	4.05 Method Not Allowed

6.4.4 Delete primitive for <mgmtObj> Resource

Depending on the mgmtDefinition attribute of the <mgmtObj> Resource (i.e., [memory], [battery], [deviceInfo], etc.), the associated LWM2M Object instance as specified in the clause 6.3 should be deleted.

Receiving Delete Request primitive does not imply that the corresponding LWM2M Object Instance shall be always deleted.

The Delete primitive shall map to the LWM2M Delete operation and shall return one of the codes described in the following table.

Table 6.4.4-1 : Delete Returned Codes Mapping

Primitive Codes	Description	Returned Codes
	"Delete" operation is completed successfully	2.02 Deleted
	Target (i.e., Object Instance) is not allowed for "Delete" operation	4.00 Bad Request,
	Access Right Permission Denied	4.01 Unauthorized,
	Target of "Delete" operation is not found	4.04 Not Found,
	Target is not allowed for "Delete" operation	4.05 Method Not Allowed

6.5 LWM2M Server Interactions

Editor's Note: The section specifies the action taken for the DMG CSE to communicate with the Management Server by using the ms interface. The server interaction can be different depending on the device management technology. The server interaction might include the establishment, maintenance, usage and termination of communication to the Management Server defined in OMA LWM2M.

6.5.1 LWM2M Server interaction management

Editor's Note: Describes the management of communication between oneM2M service layer and LWM2M Server. The management includes the establishment and termination of session when needed. The management also includes necessary procedure to utilize the existing sessions.

6.5.2 Authorization

Editor's Note: The section specifies the mapping of authorization rules defined in oneM2M and OMA standards.

6.6 New LWM2M Objects

Editor's Note: The section specifies the definition of new data models if needed based on the requirements of oneM2M. The definition of new data models in this section need to be liaised to OMA to create corresponding Objects in OMA LWM2M.

The following text is to be used when appropriate:

Proforma copyright release text block

This text box shall immediately follow after the heading of an element (i.e. clause or annex) containing a proforma or template which is intended to be copied by the user. Such an element shall always start on a new page.

Notwithstanding the provisions of the copyright clause related to the text of the present document, oneM2M grants that users of the present document may freely reproduce the <proformatype> proforma in this {clause annex} so that it can be used for its intended purposes and may further publish the completed <proformatype>.

<PAGE BREAK>

Annexes

*Each annex **shall** start on a new page (insert a page break between annexes A and B, annexes B and C, etc.).*

*Use the **Heading 9** style for the title and the Normal style for the text.*

Annex <A> (Informative/Normative): *Remove Informative or Normative as appropriate*
Title of annex (style H9)

<Text>

<PAGE BREAK>

Annex (Informative/Normative): *Remove Informative or Normative as appropriate*
Title of annex (style H9)

<Text>

B.1 First clause of the annex (style H1)

<Text>

B.1.1 First subdivided clause of the annex (style H2)

<Text>

<PAGE BREAK>

The following text is to be used when appropriate:

Annex <y>: Bibliography

The annex entitled "Bibliography" is optional.

It shall contain a list of standards, books, articles, or other sources on a particular subject which are not mentioned in the document itself

It shall not include references mentioned in the document.

Use the **Heading 9 style** for the title and B1+ or Normal for the text.

- <Publication>: "<Title>".

OR

<Publication>: "<Title>".

<PAGE BREAK>

History

This clause shall be the last one in the document and list the main phases (all additional information will be removed at the publication stage).

Publication history		
V1.1.1	<dd-Mmm-yyyy>	<Milestone>