



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 | 6 |
| 3 Definitions, symbols, abbreviations and acronyms | 6 |
| 3.1 Definitions | 6 |
| 3.2 Symbols | 6 |
| 3.3 Abbreviations | 6 |
| 3.4 Acronyms | 6 |
| 4 Conventions | 7 |
| 5. OMA DM 1.3 and OMA DM 2.0 | 7 |
| 5.1 Mapping of basic data types | 7 |
| 5.2 Mapping of Identifiers | 7 |
| 5.3 Mapping of resources | 8 |
| 5.3.1 General Mapping Assumptions | 8 |
| 5.3.2 Resource [firmware] | 8 |
| 5.3.3 Resource [software] | 8 |
| 5.3.4 Resource [memory] | 9 |
| 5.3.5 Resource [areaNwkInfo] | 9 |
| 5.3.6 Resource [areaNwkDeviceInfo] | 9 |
| 5.3.7 Resource [battery] | 10 |
| 5.3.8 Resource [deviceInfo] | 10 |
| 5.3.9 Resource [deviceCapability] | 10 |
| 5.3.10 Resource [reboot] | 11 |
| 5.3.11 Resource [eventLog] | 11 |
| 5.3.12 Resource [cmdhPolicy] | 12 |
| 5.3.12.1 Resource [activeCmdhPolicy] | 12 |
| 5.3.12.2 Resource [cmdhDefaults] | 12 |
| 5.3.12.3 Resource [cmdhDefEcValues] | 13 |
| 5.3.12.4 Resource [cmdhEcDefParamValues] | 13 |
| 5.3.12.5 Resource [cmdhLimits] | 14 |
| 5.3.12.6 Resource [cmdhNetworkAccessRules] | 14 |
| 5.3.12.7 Resource [cmdhNwAccessRule] | 15 |
| 5.3.12.8 Resource [cmdhBuffer] | 15 |
| 5.4 Mapping of procedures for management | 16 |
| 5.4.1 Mapping for <mgmtObj> Resource Primitives | 16 |
| 5.4.1.1 Create Primitive for <mgmtObj> Resource | 16 |
| 5.4.1.1.1 Create Response Status Code Mapping | 16 |
| 5.4.1.2 Retrieve Primitive for <mgmtObj> Resource | 18 |
| 5.4.1.2.1 Retrieve Response Status Code Mapping | 18 |
| 5.4.1.3 Update Primitive for <mgmtObj> Resource | 19 |
| 5.4.1.3.1 Update Primitive for Replacing Data in the Management Object | 19 |
| 5.4.1.3.1.1 Update Response Status Code Mapping | 19 |
| 5.4.1.3.2 Update Primitive for Executing Management Commands | 21 |
| 5.4.1.3.2.1 Update Response Status Code Mapping | 21 |
| 5.4.1.4 Delete Primitive for <mgmtObj> Resource | 22 |
| 5.4.1.4.1 Delete Response Status Code Mapping | 23 |
| 5.4.1.5 Notify Primitive Mapping | 24 |
| 5.4.1.5.1 Subscribe | Procedure Mapping for OMA DM 1.3 25 |
| 5.4.1.5.2 Subscribe | Procedure Mapping for OMA DM 2.0 25 |
| 5.4.1.5.3 Notification | Procedure Mapping for OMA DM 1.3 and OMA DM 2.0 26 |
| 5.4.2 Management Resource Specific Procedure Mapping | 26 |
| 5.4.2.1 | Resource [firmware] 26 |

| | | |
|----------|---|-----------|
| 5.4.2.2 | Resource [software] | 27 |
| 5.4.2.3 | Resource [memory] | 28 |
| 5.4.2.4 | Resource [areaNwkInfo] | 28 |
| 5.4.2.5 | Resource [areaNwkDeviceInfo] | 28 |
| 5.4.2.6 | Resource [battery] | 28 |
| 5.4.2.7 | Resource [deviceInfo] | 29 |
| 5.4.2.8 | Resource [deviceCapability] | 29 |
| 5.4.2.9 | Resource [reboot] | 29 |
| 5.4.2.10 | Resource [eventLog] | 29 |
| 5.5 | DM Server Interactions | 30 |
| 5.5.1 | Communication Session Establishment | 30 |
| 5.5.2 | Translation of Requests and Responses between IN-CSE and DM Server | 30 |
| 5.5.3 | Discovery and Subscription for management objects | 30 |
| 5.5.4 | Access Control Management | 30 |
| 5.6 | New Management Objects | 31 |
| 5.6.1 | M2M CMDH Policies MO (MCMMDHMO) | 31 |
| 6. | OMA Lightweight M2M 1.0 | 41 |
| 6.1 | Mapping of basic data types | 41 |
| 6.2 | Mapping of Identifiers | 42 |
| 6.2.1 | Device identifier | 42 |
| 6.2.2 | Object identifier | 42 |
| 6.2.3 | Object Instance Identifier | 42 |
| 6.3 | Mapping of resources | 42 |
| 6.3.1 | General Mapping Assumptions | 42 |
| 6.3.2 | Resource [firmware] | 43 |
| 6.3.3 | Resource [software] | 43 |
| 6.3.4 | Resource [memory] | 44 |
| 6.3.5 | Resource [areaNwkInfo] | 44 |
| 6.3.6 | Resource [areaNwkDeviceInfo] | 44 |
| 6.3.7 | Resource [battery] | 44 |
| 6.3.8 | Resource [deviceInfo] | 45 |
| 6.3.9 | Resource [deviceCapability] | 45 |
| 6.3.10 | Resource [reboot] | 46 |
| 6.3.11 | Resource [eventLog] | 46 |
| 6.4 | Mapping of procedures for management | 46 |
| 6.4.1 | Create primitive for <mgmtObj> Resource | 46 |
| 6.4.2 | Retrieve primitive for <mgmtObj> Resource | 47 |
| 6.4.3 | Update primitive for <mgmtObj> Resource | 47 |
| 6.4.3.1 | Update primitive for replacing data | 47 |
| 6.4.3.2 | Update primitive for execution operation | 47 |
| 6.4.4 | Delete primitive for <mgmtObj> Resource | 48 |
| 6.4.5 | Notify Primitive for <mgmtObj> Resource | 48 |
| 6.4.5.1 | Notify Primitive mapping for subscription to Resource attributes | 48 |
| 6.4.5.2 | Notify Primitive mapping for subscription cancellation to Resource attributes | 49 |
| 6.4.5.3 | Notify Primitive mapping for Notification | 49 |
| 6.4.6 | Management Resource Specific Procedure Mapping | 49 |
| 6.4.6.1 | Resource [firmware] | 49 |
| 6.4.6.2 | Resource [software] | 49 |
| 6.4.6.3 | Resource [memory] | 49 |
| 6.4.6.4 | Resource [battery] | 49 |
| 6.4.6.5 | Resource [deviceInfo] | 50 |
| 6.4.6.6 | Resource [deviceCapability] | 50 |
| 6.4.6.7 | Resource [reboot] | 50 |
| 6.6 | New LWM2M Objects | 51 |
| | <i>Proforma copyright release text block</i> | 52 |
| | <i>Annexes</i> | 53 |
| | Annex <y>: Bibliography | 53 |
| | History | 54 |

1 Scope

The present document specifies the protocol translation and mappings between the oneM2M Service layer and the 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 referenced as OMA DM in the present 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/>
- [7] "OMA Diagnostics and Monitoring Management Object Framework", Version 1.2, Open Mobile Alliance™, <http://www.openmobilealliance.org/>
- [8] "OMA Firmware Update Management Object", Version 1.0.2, Open Mobile Alliance™, <http://www.openmobilealliance.org/>
- [9] "OMA Software Component Management Object", Version 1.0, Open Mobile Alliance™, <http://www.openmobilealliance.org/>
- [10] ETSI TS 103 092: "OMA DM compatible Management Objects for ETSI M2M"
- [11] "OMA Device Capability Management Object ", Version 1.0, Open Mobile Alliance™, <http://www.openmobilealliance.org/>
- [12] "OMA Management Interface to M2M Requirements", Version 1.0, Open Mobile Alliance™, <http://www.openmobilealliance.org/>
- [13] ISO 8601:2000, Data elements and interchange formats -- Information interchange -- Representation of dates and times.
<http://www.iso.ch/>
- [14] "XML Schema Part 2: Datatypes", W3C Recommendation 02 May 2001,
<http://www.w3.org/XML/Schema/>
- [15] "A Universally Unique Identifier (UUID) URN Namespace", P. Leach, et al. July 2005,
<URL:http://www.ietf.org/rfc/rfc4122.txt>
- [16] 3GPP TS 23.003 "Numbering, addressing and identification"

- [17] BBF: "TR-069 CPE WAN Management Protocol" Issue: 1 Amendment 5, November 2013.
- [18] IETF RFC 7252: "The Constrained Application Protocol (CoAP)"

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 with 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] use 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. |
| 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 |
| xs:date | date | Data type for date in ISO 8601 [13] format with the century being included in the year |
| xs:time | time | Data type specifying 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 [14] as the float primitive type |
| xs:nonNegativeInteger | int | Data type for numbers equal or larger than 0, mapped from 64-bit to 32-bit representation |
| xs:positiveInteger | int | Data type for numbers equal or larger than 1, mapped from 64-bit to 32-bit representation |
| xs:long | int | Data type for signed integer numbers, mapped from 64-bit to 32-bit representation. |
| The <i>mgmtLink</i> attribute in the <mgmtObj> Resource | node | 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. |

5.2 Mapping of Identifiers

OMA DM 1.3 and OMA DM 2.0 specify 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. The below table shows the oneM2M identifiers that need 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 has to 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 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 <i>objectID</i> attribute in <mgmtObj> resource. | Management Object Identifier (MOID) | A unique identifier of the management object. Each MO is characterized by a unique MOID, which is generally a URN. |
| The <i>objectPath</i> 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 <i>objectPath</i> 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 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 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 |

Here <x> is an interior node that acts as a placeholder for the FUMO.

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:oma-scom: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) |
| uninstall | /<x>/Inventory/Delivered/<x>/Operations/Remove |
| 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 |

Here <x> is the interior node that groups together the parameters of a Software Component Management Object.

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:oma-diag:memory:1.0). The attributes of the resource shall be mapped to nodes of the MO as follows.

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

Here <x> is the interior node that acts as a placeholder for the Memory MO.

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 follows.

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

Here <x> is the interior parent node for information about a specific M2M Area Networks connecting to the same M2M Gateway.

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 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 |

Here first instance of <x> is the interior node that is the root node for the MANDMO. Second instance of <x> is the interior node that contains information related to a specific M2M Area Network that the device is associated with.

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 |
| batteryStatus | <x>/DiagMonData/<x>/BatteryStatus |

Here first instance of <x> is the interior node that acts as a placeholder for the Battery MO. Second instance of <x> is the placeholder for zero or more instances of battery data.

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 |
| Manufacturer | DevInfo/Man |
| Model | DevInfo/Mod |
| deviceType | DevDetail/DevType |
| fwVersion | DevDetail/FwV |
| swVersion | DevDetail/SwV |
| hwVersion | DevDetail/HwV |

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 |
| Manufacturer | <x>/Man |
| Model | <x>/Mod |
| deviceType | <x>/DevType |
| fwVersion | <x>/FwV |
| swVersion | <x>/SwV |
| hwVersion | <x>/HwV |

Here <x> is the interior node that is the root node for the 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 |
| attached | <x>/Attached |
| capabilityActionStatus | This attribute is managed by the <mgmtObj> resource hosting CSE, and does not need to be mapped to OMA DM management objects. |
| enable | <x>/Operations/Enable |
| disable | <x>/Operations/Disable |

Here <x> is the interior node groups together the parameters of a DCMO for a particular Device Capability.

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 |

Here <x> is the interior node that acts as a placeholder for the Restart MO and the LAWMO.

Editor's Note: The access right mapping needs to be resolved in a general manner in the present document.

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 "trap"
- Trace Logs Management Object (MOID: "urn:oma:mo:oma-diag:tracelog:1.0") if the logTypeId attribute is set to "trace"
- Panic Logs Management Object (MOID: "urn:oma:mo:oma-diag:paniclog:1.1") if the logTypeId attribute is set to "panic"

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 |

Here <x> is the interior node that acts as a placeholder for the respective Management Objects.

5.3.12 Resource [cmdhPolicy]

The Resource Type [cmdhPolicy] represents a set of rules associated with a specific CSE that govern the behaviour of that CSE regarding rejecting, buffering and sending request or response messages via the Mcc reference point. See clause D.12 of TS-0001 [1] for a detailed high-level description of the overall structure of the [cmdhPolicy] resource.

Regardless of OMA DM 1.3 and OMA DM 2.0, this resource shall be mapped to M2M cmdhPolicies MO (MCMDHMO) (urn:oma:mo:ext-onem2m-mcmdhmo:1.0). The root node of the MCMDHMO is denoted in the following by the leftmost placeholder node <x>

The Resource Type [cmdhPolicy] is a multi-instance Resource where each instance of the Resource shall map to an instance of a <x>/cmdhPolicy/<x> node.

The attributes of an instance of [cmdhPolicy] shall be mapped to nodes of the MCMDHMO as follows.

Table 5.3.12-1: Resource [cmdhPolicy]

| Attribute Name of [cmdhPolicy] | Mapping to Nodes in Management Object |
|--------------------------------|---|
| Name | <x>/cmdhPolicy/<x>/name |
| cmdhDefaults | <x>/cmdhPolicy/<x>/defaultRule |
| cmdhLimits | <x>/cmdhPolicy/<x>/limitRules |
| cmdhNetworkAccessRules | <x>/cmdhPolicy/<x>/networkAccessECRules |
| cmdhBuffer | <x>/cmdhPolicy/<x>/bufferRules |

5.3.12.1 Resource [activeCmdhPolicy]

The Resource [activeCmdhPolicy] provides a link to the currently active set of CMDH policies, see clause D.12.1 of TS-0001 [1].

The Resource [activeCmdhPolicy] includes an attribute *enable* which points to the currently active instance of a <x>/cmdhPolicy node.

Table 5.3.12.1-1: Resource [activeCmdhPolicy]

| Attribute Name of [activeCmdhPolicy] | Mapping to Nodes in Management Object |
|--------------------------------------|--|
| cmdhPolicy | <x>/activeCmdhPolicy/<x>/enable At most one <cmdhPolicy> instance shall be enabled at a time. Hence, there can only be a single instance of the activeCmdhPolicy whose enable parameter points to the active CMDH policy. |

5.3.12.2 Resource [cmdhDefaults]

The Resource [cmdhDefaults] defines default CMDH policy values, see clause D.12.2 of TS-0001 [1].

Regardless of OMA DM 1.3 and OMA DM 2.0, this resource shall be mapped to M2M cmdhPolicies MO (MCMDHMO) (urn:oma:mo:ext-onem2m-mcmdhmo:1.0).

The Resource [cmdhDefaults] is a multi-instance Resource where each instance of the Resource shall map to an instance of the <x>/cmdhDefaults/<x> node.

The attributes of an instance of [cmdhDefaults] shall be mapped to nodes of the MCMDHMO as follows.

Table 5.3.12.2-1: Resource [cmdhDefaults]

| Attribute Name of [cmdhDefaults] | Mapping to Nodes in Management Object |
|----------------------------------|---|
| cmdhDefEcValue | <x>/cmdhDefaults/<x>/defaultECRules |
| cmdhEcDefParamValues | <x>/cmdhDefaults/<x>/defaultECParmRules |

5.3.12.3 Resource [cmdhDefEcValues]

The Resource [cmdhDefEcValues] represents a default value for the **ec** (event category) parameter of an incoming request, see clause D.12.3 of TS-0001 [1].

Regardless of OMA DM 1.3 and OMA DM 2.0, this resource shall be mapped to M2M cmdhPolicies MO (MCMDHMO) (urn:oma:mo:ext-onem2m-mcmdhmo:1.0).

The Resource [cmdhDefEcValues] is a multi-instance Resource where each instance of the Resource shall map to an instance of the <x>/cmdhDefEcValues/<x> node.

The attributes of an instance of [cmdhDefEcValues] shall be mapped to nodes of the MCMDHMO as follows.

Table 5.3.12.3-1: Resource [cmdhDefEcValues]

| Attribute Name of [cmdhDefEcValues] | Mapping to Nodes in Management Object |
|-------------------------------------|---|
| Order | <x>/cmdhDefEcValue/<x>/order |
| defEcValue | <x>/cmdhDefEcValue/<x>/defEcValue |
| requestOrigin | <x>/cmdhDefEcValue/<x>/requestOrigin |
| requestContext | <x>/cmdhDefEcValue/<x>/requestContext |
| requestContextNotification | <x>/cmdhDefEcValue/<x>/requestContextNotification |
| requestCharacteristics | <x>/cmdhDefEcValue/<x>/requestCharacteristics |

5.3.12.4 Resource [cmdhEcDefParamValues]

The Resource [cmdhEcDefParamValues] represents a specific set of default values for the CMDH related parameters **rqet** (request expiration timestamp), **rset** (result expiration timestamp), **oet** (operational execution time), **rp** (response persistence) and **da** (delivery aggregation) that are applicable for a given **ec** (event category) if these parameters are not specified in the request, see clause D.12.4 of TS-0001 [1].

Regardless of OMA DM 1.3 and OMA DM 2.0, this resource shall be mapped to M2M cmdhPolicies MO (MCMDHMO) (urn:oma:mo:ext-onem2m-mcmdhmo:1.0).

The Resource [cmdhEcDefParamValues] is a multi-instance Resource where each instance of the Resource shall map to an instance of the <x>/cmdhEcDefParamValues/<x> node.

The attributes of an instance of [cmdhEcDefParamValues] shall be mapped to nodes of the MCMDHMO as follows.

Table 5.3.12.4-1: Resource [cmdhEcDefParamValues]

| Attribute Name of [cmdhEcDefParamValues] | Mapping to Nodes in Management Object |
|--|--|
| applicableEventCategory | <x>/cmdhEcDefParamValues/<x>/applicableEventCategory |
| defaultRequestExpTime | <x>/cmdhEcDefParamValues/<x>/defaultRequestExpTime |
| defaultResultExpTime | <x>/cmdhEcDefParamValues/<x>/defaultResultExpTime |

| Attribute Name of [cmdhEcDefParamValues] | Mapping to Nodes in Management Object |
|--|---|
| defaultOpExecTime | <x>/cmdhEcDefParamValues/<x>/defaultOpExecTime |
| defaultRespPersistence | <x>/cmdhEcDefParamValues/<x>/defaultRespPersistence |
| defaultDelAggregation | <x>/cmdhEcDefParamValues/<x>/defaultDelAggregation |

5.3.12.5 Resource [cmdhLimits]

The Resource [cmdhLimits] represents limits for CMDH related parameter values, see clause D.12.5 of TS-0001 [1].

Regardless of OMA DM 1.3 and OMA DM 2.0, this resource shall be mapped to M2M cmdhPolicies MO (MCMDHMO) (urn:oma:mo:ext-onem2m-mcmdhmo:1.0).

The Resource [cmdhLimits] is a multi-instance Resource where each instance of the Resource shall map to an instance of the <x>/cmdhLimits/<x> node.

The attributes of an instance of [cmdhLimits] shall be mapped to nodes of the MCMDHMO as follows.

Table 5.3.12.5-1: Resource [cmdhLimits]

| Attribute Name of [cmdhLimits] | Mapping to Nodes in Management Object |
|--------------------------------|---|
| Order | <x>/cmdhLimits/<x>/order |
| requestOrigin | <x>/cmdhLimits/<x>/requestOrigin |
| requestContext | <x>/cmdhLimits/<x>/requestContext |
| requestContextNotification | <x>/cmdhLimits/<x>/requestContextNotification |
| requestCharacteristics | <x>/cmdhLimits/<x>/requestCharacteristics |
| limitsEventCategory | <x>/cmdhLimits/<x>/limitsEventCategory |
| limitsRequestExpTime | <x>/cmdhLimits/<x>/limitsRequestExpTime |
| limitsResultExpTime | <x>/cmdhLimits/<x>/limitsResultExpTime |
| limitsOpExecTime | <x>/cmdhLimits/<x>/limitsOpExecTime |
| limitsRespPersistence | <x>/cmdhLimits/<x>/limitsRespPersistence |
| limitsDelAggregation | <x>/cmdhLimits/<x>/limitsDelAggregation |

5.3.12.6 Resource [cmdhNetworkAccessRules]

The Resource [cmdhNetworkAccessRules] defines the usage of underlying networks for forwarding information to other CSEs during processing of CMDH-related requests in a CSE, see clause D.12.6 of TS-0001 [1].

Regardless of OMA DM 1.3 and OMA DM 2.0, this resource shall be mapped to M2M cmdhPolicies MO (MCMDHMO) (urn:oma:mo:ext-onem2m-mcmdhmo:1.0).

The Resource [cmdhNetworkAccessRules] is a multi-instance Resource where each instance of the Resource shall map to an instance of the <x>/cmdhNetworkAccessRules/<x> node.

The attributes of an instance of [cmdhNetworkAccessRules] shall be mapped to nodes of the MCMDHMO as follows.

Table 5.3.12.6-1: Resource [cmdhNetworkAccessRules]

| Attribute Name of [cmdhNetworkAccessRules] | Mapping to Nodes in Management Object |
|--|---------------------------------------|
|--|---------------------------------------|

| Attribute Name of [cmdhNetworkAccessRules] | Mapping to Nodes in Management Object |
|--|--|
| applicableEventCategories | <x>/cmdhLimits/<x>/applicableEventCategories |
| cmdhNwAccessRule | <x>/cmdhLimits/<x>/NetworkAccessRule |

5.3.12.7 Resource [cmdhNwAccessRule]

The Resource [cmdhNwAccessRule] define limits in usage of specific underlying networks for forwarding information to other CSEs during processing of CMDH-related requests, see clause D.12.7 of TS-0001 [1].

Regardless of OMA DM 1.3 and OMA DM 2.0, this resource shall be mapped to M2M cmdhPolicies MO (MCMDHMO) (urn:oma:mo:ext-onem2m-mcmdhmo:1.0).

The Resource [cmdhNwAccessRule] is a multi-instance Resource where each instance of the Resource shall map to an instance of the <x>/cmdhNwAccessRule/<x> node.

The attributes of an instance of [cmdhNwAccessRule] shall be mapped to nodes of the MCMDHMO as follows.

Table 5.3.12.7-1: Resource [cmdhNwAccessRule]

| Attribute Name of [cmdhNwAccessRule] | Mapping to Nodes in Management Object |
|--------------------------------------|--|
| targetNetwork | <x>/cmdhNwAccessRule/<x>/targetNetwork |
| minReqVolume | <x>/cmdhNwAccessRule/<x>/minReqVolume |
| backOffParameters | <x>/cmdhNwAccessRule/<x>/backOffParameters |
| otherConditions | <x>/cmdhNwAccessRule/<x>/otherConditions |
| allowedSchedule | <x>/cmdhNwAccessRule/<x>/allowedSchedule |

5.3.12.8 Resource [cmdhBuffer]

The Resource [cmdhBuffer] represents limits in usage of buffers for temporarily storing information that needs to be forwarded to other CSEs during processing of CMDH-related requests in a CSE, see clause D.12.8 of TS-0001 [1].

Regardless of OMA DM 1.3 and OMA DM 2.0, this resource shall be mapped to M2M cmdhPolicies MO (MCMDHMO) (urn:oma:mo:ext-onem2m-mcmdhmo:1.0).

The Resource [cmdhBuffer] is a multi-instance Resource where each instance of the Resource shall map to an instance of the <x>/cmdhBuffer/<x>/ node.

The attributes of an instance of [cmdhBuffer] shall be mapped to nodes of the MCMDHMO as follows.

Table 5.3.12.8-1: Resource [cmdhBuffer]

| Attribute Name of [cmdhBuffer] | Mapping to Nodes in Management Object |
|--------------------------------|--|
| applicableEventCategory | <x>/cmdhNwAccessRule/<x>/applicableEventCategory |
| maxBufferSize | <x>/cmdhNwAccessRule/<x>/maxBufferSize |
| storagePriority | <x>/cmdhNwAccessRule/<x>/storagePriority |

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 always be 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 the case where 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.

5.4.1.1.1 Create Response Status Code Mapping

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.

Table 5.4.1.1.1-1: OMA DM 1.3 Status Code Mapping

| oneM2M Primitive Status Code | OMA DM 1.3 Status Code | Description |
|-------------------------------|--|--|
| success | (200) OK | The command accessed leaf node and it completed successfully. |
| n/a | (213) Chunked item accepted | Chunked item accepted and buffered. This status code indicates that the request is still on processing. The final status code shall be mapped to the proper oneM2M Primitive status code. |
| error –not executed | (215) Not executed | Command was not executed, as a result of <ul style="list-style-type: none"> User interaction as user chose to abort or cancel, The parent Atomic command failed, causing this command to fail. |
| error – not executed | (216) Atomic roll back OK | Command was inside Atomic element and Atomic failed. This command was rolled back successfully. |
| error - no privilege | (401) Unauthorized | The originator's authentication credentials specify a principal with insufficient rights to complete the command. |
| error – not found | (404) Not Found | The specified data item doesn't exist on the recipient. This may also imply that the stated URI for the location of the new management object cannot be resolved |
| error – not allowed | (405) Command not allowed | Command not allowed. The requested command is not allowed on the target. |
| error – authentication failed | (407) Authentication required | No authentication credentials were specified. A suitable challenge can also be returned. |
| error – mgmt adapter error | (413) Request entity too large | The data item to be transferred is too large (e.g., there are restrictions on the size of data items transferred to the recipient). |
| error – mgmt adapter error | (414) URI too long | URI in command is too long. Either string presenting URI or segment in URI is too long or URI has too many segments. |
| error – Unsupported data type | (415) Unsupported media type or format | The media type or format for the data item is not supported by the recipient. |
| error - already exists | (418) Already exists | The requested Add command failed because the target already exists. |
| error – no storage at device | (420) Device full | The recipient device storage is full. |
| error – mgmt adapter error | (424) Size mismatch | The chunked object was received, but the size of the received object did not match the size declared within the first chunk. |
| error - no privilege | (425) Permission denied | The server does not have the proper ACL permissions. |
| error – mgmt adapter error | (500) Command failed | Non-specific errors created by the recipient while attempting to complete the command. |
| error – not executed | (516) Atomic roll back failed | Command was inside Atomic element and Atomic failed. This command was not rolled back successfully. Server should take action to try to recover client back into original state. |

Table 5.4.1.1.1-2: OMA DM 2.0 Status Code Mapping

| oneM2M Primitive Status Code | OMA DM 2.0 Status Code | Description |
|-------------------------------|------------------------------|---|
| ok | (200) OK | The DM command completed successfully |
| error – bad request | (400) Bad Request | The requested command could not be performed because of malformed syntax in the command. |
| error - no privilege | (403) Forbidden | The requested command failed because the sender does not have adequate access rights on the recipient. |
| error – not found | (404) Not Found | The requested target was not found |
| error – Unsupported data type | (415) Unsupported Media Type | The request is refused because the request uses a format not supported by the requested resource for the requested method |
| error – mgmt adapter error | (419) ServerURI Error | The ServerURI provided causes errors |
| error – internal error | (500) Internal Error | The recipient encountered an unexpected condition which prevented it from fulfilling the request |
| error – unsupported resource | (501) Not Implemented | The recipient does not support the features to fulfil the request. This is the appropriate response when the recipient does not recognize the requested command and is not capable of supporting it for any resource. |
| error – service unavailable | (503) Service Unavailable | The recipient is currently unable to handle the request due to a temporary overloading or maintenance of the recipient. The implication is that this is a temporary condition; which will be alleviated after some delay. |

| oneM2M Primitive Status Code | OMA DM 2.0 Status Code | Description |
|------------------------------|------------------------|--|
| error – no storage | (506) Device Full | The response indicates that the recipient has not enough storage space for the data. |
| error – user rejected | (507) User Rejected | The request is not executed since the user rejected the request. |

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.

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.

5.4.1.2.1 Retrieve Response Status Code Mapping

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.

Table 5.4.1.2.1-1: OMA DM 1.3 Status Code Mapping

| oneM2M Primitive Status Code | OMA DM 1.3 Status Code | Description |
|-------------------------------|--|---|
| success | (200) OK | The command completed successfully. |
| error – not executed | (215) Not executed | Command was not executed, as a result of: <ul style="list-style-type: none"> • User interaction as user chose to abort or cancel, • The parent Atomic command failed, causing this command to fail. |
| success | (217) OK with inherited ACL | The command completed successfully with inherited ACL returned. The Get command was performed to get ACL on a node which has Empty ACL |
| error – mgmt adapter error | (401) Unauthorized | The originator's authentication credentials specify a principal with insufficient rights to complete the command. |
| error – not found | (404) Not found | The specified data item doesn't exist on the recipient. |
| error – not allowed | (405) Command not allowed | The requested command is not allowed on the target. |
| error – unsupported resource | (406) Optional feature not supported | The recipient did not recognize the feature specified after the “?” at the end of the URI. |
| error – mgmt adapter error | (407) Authentication required | No authentication credentials were specified. A suitable challenge can also be returned. |
| error – mgmt adapter error | (413) Request entity too large | The requested data item is too large to be transferred at this time. |
| error – mgmt adapter error | (414) URI too long | URI in command is too long. Either string presenting URI or segment in URI is too long or URI has too many segments. |
| error – unsupported data type | (415) Unsupported media type or format | The media type or format for the data item is not supported by the recipient. |
| error - no privilege | (425) Permission denied | The server does not have the proper ACL permissions. |
| error – not executed | (500) Command failed | Non-specific errors created by the recipient while attempting to complete the command. |

Table 5.4.1.2.1-2: OMA DM 2.0 Status Code Mapping

| oneM2M Primitive Status Code | OMA DM 2.0 Status Code | Description |
|------------------------------|---------------------------|---|
| success | (200) OK | The DM command completed successfully |
| success | (204) No Content | The request was successfully completed but no data is being returned. |
| success | (304) Not Modified | The data requested is not modified. The <mtmbObj> Resource hosting CSE shall return the cached data back to the Originator |
| error – bad request | (400) Bad Request | The requested command could not be performed because of malformed syntax in the command. |
| error - no privilege | (403) Forbidden | The requested command failed because the sender does not have adequate access rights on the recipient. |
| error – not found | (404) Not Found | The requested target was not found |
| error – mgmt adapter error | (406) Not Acceptable | The resource identified by the request is only capable of generating response entities which have content characteristics not acceptable according to the accept headers sent in the request |
| error – mgmt adapter error | (500) Internal Error | The recipient encountered an unexpected condition which prevented it from fulfilling the request |
| error – mgmt adapter error | (501) Not Implemented | The recipient does not support the features to fulfil the request. This is the appropriate response when the recipient does not recognize the requested command and is not capable of supporting it for any resource. |
| error – service unavailable | (503) Service Unavailable | The recipient is currently unable to handle the request due to a temporary overloading or maintenance of the recipient. The implication is that this is a temporary condition; which will be alleviated after some delay. |
| error – user rejected | (507) User Rejected | The request is not executed since the user rejected the request. |

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 case shall be different as the following sections specify.

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 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.

5.4.1.3.1.1 Update Response Status Code Mapping

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.

Table 5.4.1.3.1.1-1: OMA DM 1.3 Status Code Mapping

| oneM2M Primitive Status Code | OMA DM 1.3 Status Code | Description |
|-------------------------------|--|---|
| success | (200) OK | The command accessed an existing leaf node and it completed successfully. |
| n/a | (213) Chunked item accepted | Chunked item accepted and buffered. This status code indicates that the request is still on processing. The final status code shall be mapped to the proper oneM2M Primitive status code. |
| error – not executed | (215) Not executed | Command was not executed, as a result of: <ul style="list-style-type: none"> • User interaction as user chose to abort or cancel, • The parent Atomic command failed, causing this command to fail. |
| error – not executed | (216) Atomic roll back OK | Command was inside Atomic element and Atomic failed. This command was rolled back successfully. |
| error – no privilege | (401) Unauthorized | The originator's authentication credentials specify a principal with insufficient rights to complete the command. |
| error – forbidden | (403) Forbidden | The target of a Replace command is a node that cannot be modified for reasons other than access control (for example, if the node is in use). |
| error – not found | (404) Not Found | The specified data item doesn't exist on the recipient. |
| error – not allowed | (405) Command not allowed | Command not allowed. The requested command is not allowed on the target. Any attempt to add a child node to a leaf node results in a (405) Command not allowed Status. Additionally, Format, Name and Type properties of permanent nodes cannot be changed, if such an attempt is made, (405) Command not allowed status code is sent back. |
| error – mgmt adapter error | (407) Authentication required | No authentication credentials were specified. A suitable challenge can also be returned. |
| error – mgmt adapter error | (413) Request entity too large | The data item to be transferred is too large (e.g., there are restrictions on the size of data items transferred to the recipient). |
| error – mgmt adapter error | (414) URI too long | URI in command is too long. Either string presenting URI or segment in URI is too long or URI has too many segments. |
| error – unsupported data type | (415) Unsupported media type or format | The media type or format for the data item is not supported by the recipient. |
| error – already exist | (418) Already Exists | The requested Replace command failed because the target already exists. |
| error – no storage | (420) Device full | The recipient device storage is full. |
| error – mgmt adapter error | (424) Size mismatch | The chunked object was received, but the size of the received object did not match the size declared within the first chunk. |
| error – no privilege | (425) Permission denied | The server does not have the proper ACL permissions. |
| error – not executed | (500) Command failed | Non-specific errors created by the recipient while attempting to complete the command. |
| error – not executed | (516) Atomic roll back failed | Command was inside Atomic element and Atomic failed. This command was not rolled back successfully. Server should take action to try to recover client back into original state. |

Table 5.4.1.3.1.1-2: OMA DM 2.0 Status Code Mapping

| oneM2M Primitive Status Code | OMA DM 2.0 Status Code | Description |
|-------------------------------|------------------------------|---|
| success | (200) OK | The DM command completed successfully |
| error – bad request | (400) Bad Request | The requested command could not be performed because of malformed syntax in the command. |
| error – no privilege | (403) Forbidden | The requested command failed because the sender does not have adequate access rights on the recipient. |
| error – not found | (404) Not Found | The requested target was not found |
| error – unsupported data type | (415) Unsupported Media Type | The request is refused because the request uses a format not supported by the requested resource for the requested method |
| error – mgmt adapter error | (419) ServerURI Error | The ServerURI provided causes errors |
| error – internal error | (500) Internal Error | The recipient encountered an unexpected condition which prevented it from fulfilling the request |
| error – unsupported resource | (501) Not Implemented | The recipient does not support the features to fulfil the request. This is the appropriate response when the recipient does not recognize the requested command and is not capable of supporting it for any resource. |
| error – service | (503) Service | The recipient is currently unable to handle the request due to a |

| oneM2M Primitive Status Code | OMA DM 2.0 Status Code | Description |
|------------------------------|------------------------|--|
| unavailable | Unavailable | temporary overloading or maintenance of the recipient. The implication is that this is a temporary condition; which will be alleviated after some delay. |
| error – no storage | (506) Device Full | The response indicates that the recipient has not enough storage space for the data. |
| error – user rejected | (507) User Rejected | The request is not executed since the user rejected the request. |

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.

5.4.1.3.2.1 Update Response Status Code Mapping

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.

Table 5.4.1.3.2.1-1: OMA DM 1.3 Status Code Mapping

| oneM2M Primitive Status Code | OMA DM 1.3 Status Code | Description |
|------------------------------|--------------------------------------|---|
| success | (200) OK | The command and the associated Alert action are completed successfully. |
| accepted | (202) Accepted for processing | The request to either run a remote execution of an application or to alert a user or application was successfully received. |
| error – not executed | (215) Not executed | Command was not executed, as a result of: <ul style="list-style-type: none"> • User interaction as user chose to abort or cancel, • The parent Atomic command failed, causing this command to fail. |
| error – no privilege | (401) Unauthorized | The originator's authentication credentials specify a principal with insufficient rights to complete the command. |
| error – mgmt adapter error | (403) Forbidden | Forbidden. The command could not be executed for reasons other than access control rights. |
| error – not allowed | (405) Command not allowed | The requested command is not allowed on the target. |
| error – mgmt adapter error | (406) Optional Feature Not Supported | The specified Exec command is not supported by the recipient. |
| error – mgmt adapter error | (407) Authentication required | No authentication credentials were specified. A suitable challenge can also be returned. |
| error – mgmt adapter error | (414) URI too long | URI in command is too long. Either string presenting URI or segment in URI is too long or URI has too many segments. |
| error – no storage | (420) Device full | There is insufficient space in the recipient management tree for the data item. |
| error – no privilege | (425) Permission denied | The server does not have the proper ACL permissions. |
| error – not executed | (500) Command failed | Non-specific errors created by the recipient while attempting to complete the command. |
| error – mgmt adapter error | (510) Data store failure | Error occurs while the recipient copying the data item within the recipient's management tree. |

Table 5.4.1.3.2.1-2: OMA DM 2.0 Status Code Mapping

| oneM2M Primitive Status Code | OMA DM 2.0 Status Code | Description |
|------------------------------|---------------------------|---|
| success | (200) OK | The DM command completed successfully |
| accepted | (202) Accepted | Accepted for processing. The asynchronous reporting mechanism is used to report the actual results. |
| error – bad request | (400) Bad Request | The requested command could not be performed because of malformed syntax in the command. |
| error – no privilege | (403) Forbidden | The requested command failed because the sender does not have adequate access rights on the recipient. |
| error – not found | (404) Not Found | The requested target was not found |
| error – not allowed | (405) Command Not Allowed | The requested command is not allowed on the node since the node is not executable for the EXEC command and the node is mandatory for the DELETE command |
| error – mgmt adapter error | (419) ServerURI Error | The ServerURI provided causes errors |
| error – internal error | (500) Internal Error | The recipient encountered an unexpected condition which prevented it from fulfilling the request |
| error – not implemented | (501) Not Implemented | The recipient does not support the features to fulfil the request. This is the appropriate response when the recipient does not recognize the requested command and is not capable of supporting it for any resource. |
| error – service unavailable | (503) Service Unavailable | The recipient is currently unable to handle the request due to a temporary overloading or maintenance of the recipient. The implication is that this is a temporary condition; which will be alleviated after some delay. |
| error – user rejected | (507) User Rejected | The request is not executed since the user rejected the request. |

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.

5.4.1.4.1 Delete Response Status Code Mapping

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.

Table 5.4.1.4.1-1: OMA DM 1.3 Status Code Mapping

| oneM2M Primitive Status Code | OMA DM 1.3 Status Code | Description |
|------------------------------|-------------------------------|---|
| success | (200) OK | The command and the associated individual commands were completed successfully. |
| error – not executed | (215) Not executed | Command was not executed, as a result of: <ul style="list-style-type: none"> • User interaction as user chose to abort or cancel, • The parent Atomic command failed, causing this command to fail. |
| error – not executed | (216) Atomic roll back OK | Command was inside Atomic element and Atomic failed. This command was rolled back successfully. |
| error – mgmt adapter error | (401) Unauthorized | The originator's authentication credentials specify a principal with insufficient rights to complete the command. |
| error - forbidden | (403) Forbidden | The target of a Delete command is a node that cannot be deleted for reasons other than access control (for example, if the node is in use). |
| error – not found | (404) Not found | The recipient determined that the data item doesn't exist on the recipient's management tree. |
| error – not allowed | (405) Command not allowed | The requested command is not allowed on the target. |
| error – mgmt adapter error | (407) Authentication required | No authentication credentials were specified. A suitable challenge can also be returned. |
| error - mgmt adapter error | (414) URI too long | URI in command is too long. Either string presenting URI or segment in URI is too long or URI has too many segments. |
| error – no privilege | (425) Permission denied | The server does not have the proper ACL permissions. |
| error – not executed | (500) Command failed | Non-specific error(s) occurred on the recipient while attempting to complete the command. |
| error – not executed | (516) Atomic roll back failed | Command was inside Atomic element and Atomic failed. This command was not rolled back successfully. Server should take action to try to recover client back into original state. |

Table 5.4.1.4.1-2: OMA DM 2.0 Status Code Mapping

| oneM2M Primitive Status Code | OMA DM 2.0 Status Code | Description |
|------------------------------|---------------------------|---|
| success | (200) OK | The DM command completed successfully |
| error – bad request | (400) Bad Request | The requested command could not be performed because of malformed syntax in the command. |
| error – no privilege | (403) Forbidden | The requested command failed because the sender does not have adequate access rights on the recipient. |
| error – not found | (404) Not Found | The requested target was not found |
| error – not allowed | (405) Command Not Allowed | The requested command is not allowed on the node since the node is not executable for the EXEC command and the node is mandatory for the DELETE command |
| error – internal error | (500) Internal Error | The recipient encountered an unexpected condition which prevented it from fulfilling the request |
| error – not implemented | (501) Not Implemented | The recipient does not support the features to fulfil the request. This is the appropriate response when the recipient does not recognize the requested command and is not capable of supporting it for any resource. |
| error – service unavailable | (503) Service Unavailable | The recipient is currently unable to handle the request due to a temporary overloading or maintenance of the recipient. The implication is that this is a temporary condition; which will be alleviated after some delay. |
| error – user rejected | (507) User Rejected | The request is not executed since the user rejected the request. |

5.4.1.5 Notify Primitive Mapping

The Notify Request and Response primitives permit notifications to AE or CSEs that have subscribed to a Resource. When the AE and CSE have been subscribed to the <mgmtObj> Resource, the <mgmtObj> Resource hosting CSE will send the notification to the subscriber if the <mgmtObj> Resource has been changed according to the notification policy. For the notification, the <mgmtObj> resource hosting CSE has the responsibility to update the <mgmtObj> by monitoring the management objects in the device.

5.4.1.5.1 Subscribe Procedure Mapping for OMA DM 1.3

OMA DM 1.3 does not have the subscription mechanism that notifies the DM Server when the management objects in the device have been changed. The optional alerts **DM_TREE_UNCHANGED_ALERT** and the **DM_TREE_CHANGED_ALERT** can indicate the changes occurred in the DM Tree, but those alerts is not sent to the DM Server at the time the changes occurs. The DM Server may use periodic retrieval to monitor changes in management objects. Vendor specific extensions may also be used for the subscription mechanism such as that any changes in management objects can be reported to the DM Server using the generic alerts. In this way, the <mgmtObj> Resource hosting CSE updates the <mgmtObj>, and can send the notification to the subscribers upon changes in the <mgmtObj> Resource.

When a <subscription> Resource for a <mgmtObj> Resource is Created or Updated, the <mgmtObj> Resource hosting CSE shall monitor the changes in the corresponding management objects by using the mechanism described above. In case of the <subscription> Resource deletion, the <mgmtObj> Resource hosting CSE might stop monitoring the management objects in the device. Note that this is not the primitive mapping since there is no such subscribe primitive in OMA DM 1.3.

5.4.1.5.2 Subscribe Procedure Mapping for OMA DM 2.0

OMA DM 2.0 provides the SUB command that subscribe to any change occurring in a certain part of the DM Tree. When a change occurs, the DM Client will send a notification message with the changed management objects that has been subscribed. The <mgmtObj> Resource hosting CSE can use the SUB command to detect the changes in the management object and update the <mgmtObj> Resource. The optional SUB command might not be supported by the device, and in this case, the <mgmtObj> Resource hosting CSE periodically retrieve the management objects.

When a <subscription> Resource for a <mgmtObj> Resource is Created, Deleted or Updated the CSE shall perform the following procedures:

- The <subscription> Resource creation and update shall be mapped to the SUB command if the SUB command is supported. If the SUB command is not supported, the <mgmtObj> Resource hosting CSE shall monitor the changes in the relevant management objects by any means (e.g., the periodic retrieval).
- The <subscription> Resource deletion should be mapped to the UNSUB command if the UNSUB command is supported. In case that the corresponding management objects need to keep to be monitored, the UNSUB command may not be performed. If the UNSUB command is not supported, the <mgmtObj> Resource hosting CSE might stop monitoring the corresponding management objects in the device.

The status code mappings for the SUB/UNSUB commands are described in the following table.

Table 5.4.1.5.2-1: Subscribe Status Code Mapping

| oneM2M Primitive Status Code | OMA DM 2.0 Status Code | Description |
|------------------------------|---------------------------|---|
| success | (200) OK | The DM command completed successfully |
| error – bad request | (400) Bad Request | The requested command could not be performed because of malformed syntax in the command. |
| error - no privilege | (403) Forbidden | The requested command failed because the sender does not have adequate access rights on the recipient. |
| error – not found | (404) Not Found | The requested target was not found |
| error – internal error | (500) Internal Error | The recipient encountered an unexpected condition which prevented it from fulfilling the request |
| error – not implemented | (501) Not Implemented | The recipient does not support the features to fulfil the request. This is the appropriate response when the recipient does not recognize the requested command and is not capable of supporting it for any resource. |
| error – service unavailable | (503) Service Unavailable | The recipient is currently unable to handle the request due to a temporary overloading or maintenance of the recipient. The implication is that this is a temporary condition; which will be alleviated after some delay. |
| error – user rejected | (507) User Rejected | The request is not executed since the user rejected the request. |

5.4.1.5.3 Notification Procedure Mapping for OMA DM 1.3 and OMA DM 2.0

After the subscription procedures are mapped as described in the clause 5.4.1.5.1 and 5.4.1.5.2, the <mgmtObj> Resource hosting CSE is being capable of monitoring changes for management objects in the device. By monitoring those changes for management objects, the <mgmtObj> Resource hosting CSE keeps the <mgmtObj> updated. Those modifications of the <mgmtObj> Resource will trigger the notification message to be sent to the subscribers according to the <subscription> Resource as specified by the [2]. This notification procedure is defined by the oneM2M service layer and independent on the underlying management technologies.

5.4.2 Management Resource Specific Procedure Mapping

In this clause, mappings specific to the Management Resource are described.

5.4.2.1 Resource [firmware]

The generic <mgmtObj> mappings described in the clause 5.4.1 shall apply, and no specific mapping is necessary.

In addition to the status code mapping for the <mgmtObj> CRUD Operations, FUMO [8] specifies the status codes that are exclusive for FUMO. Those status codes will be used only for the execute command, and shall be used only for the oneM2M UPDATE Request. The status code mappings specific to the [firmware] Resource shall be as follows:

Note that the status codes defined in FUMO are common to the OMA DM 1.3 and OMA DM 2.0.

Table 5.4.2.1-1: Firmware MO Status Code Mapping

| oneM2M Primitive Status Code | OMA FUMO Status Code | Description |
|------------------------------|----------------------|--|
| success | 200 | Successful |
| success | 250-299 | Successful – Vendor Specified |
| error – mgmt client error | 400 | Management Client Error |
| error – user cancelled | 401 | User Cancelled |
| error – package error | 402 | Corrupted Firmware Update Package |
| error –package error | 403 | Firmware Update Package – Device Mismatch |
| error –package error | 404 | Failed Firmware Update Package Validation |
| error –package error | 405 | Firmware Update Package Not Acceptable |
| error – download error | 406 | Alternate Download Authentication Failure |
| error –download error | 407 | Alternate Download Request Time-Out |
| error – not implemented | 408 | Not Implemented |
| error – mgmt. adapter error | 409 | Undefined Error |
| error – update failed | 410 | Firmware Update Failed |
| error – bad request | 411 | Malformed or Bad URL |
| error – download error | 412 | Alternate Download Server Unavailable |
| error – client error | 450-499 | Client Error – Vendor Specified |
| error – download error | 500 | Alternate Download Server Error |
| error –download error | 501 | Download fails due to device is out of memory |
| error –update failed | 502 | Firmware update fails due to device out of memory |
| error –download error | 503 | Download fails due to network issues |
| error –download error | 550-599 | Alternate Download Server Error – Vendor Specified |

5.4.2.2 Resource [software]

The generic <mgmtObj> mappings described in the clause 5.4.1 shall apply, and no specific mapping is necessary.

In addition to the status code mapping for the <mgmtObj> CRUD Operations, SCOMO [9] specifies the status codes that are exclusive for SCOMO. Those status codes will be used only for the execute command, and shall be used only for the oneM2M UPDATE Request. The status code mappings specific to the [software] Resource shall be as follows:

Note that the status codes defined in SCOMO are common to the OMA DM 1.3 and OMA DM 2.0.

Table 5.4.2.2-1: SCOMO Status Code Mapping

| oneM2M Primitive Status Code | OMA SCOMO Status Code | Description |
|------------------------------|-----------------------|--|
| success | 1200 | Successful |
| success | 1250-1299 | Successful – Vendor Specified |
| error – client error | 1400 | Client Error |
| error – user rejected | 1401 | User cancelled |
| error – download error | 1402 | Download Failed |
| error – download error | 1403 | Alternate Download Authentication Failure |
| error – download error | 1404 | Download failed due to Device is out of memory |
| error – update error | 1405 | Install Failed |
| error – update error | 1406 | Install failed due to Device out of memory |
| error – package error | 1407 | Failed package validation |
| error – not executed | 1408 | Remove failed |
| error – not executed | 1409 | Activate failed |
| error – not executed | 1410 | Deactivate failed |
| error – not implemented | 1411 | Not Implemented |
| error – unknown error | 1412 | Undefined Error |
| error – not executed | 1413 | Operation rejected – unsupported environment |
| error – client error | 1450-1499 | Client Error – Vendor Specified |
| error – download error | 1500 | Alternate Download Server Error |
| error – download error | 1501 | Alternate Download Server Unavailable |
| error – download error | 1550-1599 | Alternate Download Server Error – Vendor Specified |

5.4.2.3 Resource [memory]

The generic <mgmtObj> mappings described in the clause 5.4.1 shall apply, and no specific mapping is necessary.

In addition to the status code mapping for the <mgmtObj> CRUD Operations, no [memory] specific status codes are defined in [7].

5.4.2.4 Resource [areaNwkInfo]

The generic <mgmtObj> mappings described in the clause 5.4.1 shall apply, and no specific mapping is necessary.

In addition to the status code mapping for the <mgmtObj> CRUD Operations, no [areaNwkDeviceInfo] specific status codes are defined in [10].

5.4.2.5 Resource [areaNwkDeviceInfo]

The generic <mgmtObj> mappings described in the clause 5.4.1 shall apply, and no specific mapping is necessary.

In addition to the status code mapping for the <mgmtObj> CRUD Operations, no [areaNwkDeviceInfo] specific status codes are defined in [10].

5.4.2.6 Resource [battery]

The generic <mgmtObj> mappings described in the clause 5.4.1 shall apply, and no specific mapping is necessary.

In addition to the status code mapping for the <mgmtObj> CRUD Operations, no [battery] specific status codes are defined in [7].

5.4.2.7 Resource [deviceInfo]

The generic <mgmtObj> mappings described in the clause 5.4.1 shall apply, and no specific mapping is necessary.

In addition to the status code mapping for the <mgmtObj> CRUD Operations, no [deviceInfo] specific status codes are defined in [4] and [5].

5.4.2.8 Resource [deviceCapability]

The generic <mgmtObj> mappings described in the clause 5.4.1 shall apply, and no specific mapping is necessary.

In addition to the status code mapping for the <mgmtObj> CRUD Operations, DCMO [11] specifies the status codes that are exclusive for DCMO. Those status codes will be used only for the execute command, and shall be used only for the oneM2M UPDATE Request. The status code mappings specific to the [deviceCapability] Resource shall be as follows:

Note that the status codes defined in DCMO are common to the OMA DM 1.3 and OMA DM 2.0.

Table 5.4.2.3-1: DCMO Status Code Mapping

| oneM2M Primitive Status Code | OMA DCMO Status Code | Description |
|------------------------------|----------------------|---|
| success | 1200 | Operation Succeeds |
| success | 1201 | Device Capability is enabled and attached |
| success | 1202 | Device Capability is enabled and detached |
| success | 1203 | Device Capability is disabled and User is not allowed to re-enable it |
| success | 1204 | Device Capability is disabled and User is allowed to re-enable it |
| error – client error | 1400 | Client Error |
| error – user rejected | 1401 | User cancelled |
| error – not executed | 1402 | Operation Failed |
| error – client error | 1450–1499 | Client Error – Vendor Specific |

5.4.2.9 Resource [reboot]

The generic <mgmtObj> mappings described in the clause 5.4.1 shall apply, and no specific mapping is necessary.

The status code mappings specific for executing the *reboot* attribute in the [reboot] Resource does not require additional mapping other than the status code mapping for the <mgmtObj> CRUD Operations.

In addition to the status code mapping for the <mgmtObj> CRUD Operations, the status code mappings specific for executing the *factoryReset* attribute in the [reboot] shall be as follows: Those status codes will be used only for the execute command, and shall be used only for the oneM2M UPDATE Request.

Note that the status codes defined in LAWMO are common to the OMA DM 1.3 and OMA DM 2.0.

Table 5.4.2.9-1: LAWMO Status Code Mapping

| oneM2M Primitive Status Code | OMA LAWMO Status Code | Description |
|------------------------------|-----------------------|---------------------------------|
| success | 1200 | Operation Succeeded |
| success | 1250–1299 | Successful – Vendor Specified |
| error – client error | 1400 | Client Error |
| error – user rejected | 1401 | User cancelled |
| error – client error | 1450–1499 | Client Error – Vendor Specified |

5.4.2.10 Resource [eventLog]

The generic <mgmtObj> mappings described in the clause 5.4.1 shall apply, and no specific mapping is necessary.

In addition to the status code mapping for the <mgmtObj> CRUD Operations, no [eventLog] specific status codes are defined in [7].

5.5 DM Server Interactions

This clause describes how the IN-CSE interacts with a DM Server in order to manage the devices. To interact with the DM Server, the IN-CSE needs to establish the communication session with the DM Server, translate requests/responses and notifications between the IN-CSE and the DM Server and discover the management objects in the device and Management Resources in the IN-CSE.

Note: The DM Server interaction is applicable to the case that the DM Server is external to the IN-CSE.

Note: OMA has started the work item called "Management Interface to M2M" [12] whose scope is to define requirements for an interface between the DM Server and the Machine to Machine (M2M) systems on top. This Northbound Interface (NBI) allows M2M service layer to access the DM Server functionality. The requirements for the interaction between the IN-CSE and the DM Server will be specified in [12].

5.5.1 Communication Session Establishment

The communication session can be initiated by the IN-CSE or by the DM Server. The IN-CSE can initiate the communication session if the IN-CSE needs to interact with the management objects in the device through the DM Server (e.g., an IN-AE sends firmware update Requests by using the [firmware] Resource in the IN-CSE). On the other hands, the DM Server can initiate the communication session if the DM Server detects changes of management objects that the DM Server manages or needs to notify events to the IN-CSE that occurred in the device. In this case, the notifications of management object changes or events can be limited to the cases that the IN-CSE has expressed interests.

The multiple communication sessions can be established between the IN-CSE and the DM Server depending on the communication environments and the protocols to be used for the communication session. The requirements for the communication session between the IN-CSE and the DM Server will be specified by [12].

Note: Both OMA DM 1.3 and DM 2.0 support the concept of the management session, but the established communication session between the IN-CSE and the DM Server does not imply the immediate management session establishment between the DM Server and the DM Client.

5.5.2 Translation of Requests and Responses between IN-CSE and DM Server

This specification specifies how oneM2M service layer protocol regarding the device management shall be mapped to OMA DM protocol. The interaction between the IN-CSE and the DM Server lies between these two protocols and the Requests/Responses from those two protocols shall be properly translated by the interactions between the IN-CSE and the DM Server. Specifications for Requests/Responses translations between the IN-CSE and the DM Server is out-of-scope of this specification, and the requirements for the Requests/Responses translation will be specified by [12].

5.5.3 Discovery and Subscription for management objects

Being triggered by oneM2M service layer, the interactions between the IN-CSE and the DM Server can provide the following functionalities:

- Discovery of management objects in the devices of interest
- Subscription to management objects for being notified for the interested events

With the discovery and the subscription to the management objects in the device, the IN-CSE can be capable to synchronize the <mgmtObj> Management Resources with management objects in the device.

Note that requirements for the discovery and subscription for management objects will be specified by [12].

5.5.4 Access Control Management

For a device under managements, the IN-CSE can have multiple DM Servers that can connect to the device. Among those DM Servers, when receiving the oneM2M service layer Requests, the IN-CSE needs to select the proper DM Server that can successfully perform the received Request based on the access rights that each DM Server has. The interaction between the IN-CSE and the DM Server can be used to discover the access rights that the DM Server has.

5.6 New Management Objects

5.6.1 M2M CMDH Policies MO (MCMDHMO)

The M2M CMDH Policies MO (MCMDHMO) resides in the Management Tree of any ASN or MN which support Device Management via OMA DM 1.3 and OMA DM 2.0. This MO corresponds to instances of the cmdhPolicy resource and its child resources which all represent subtypes of the *mgmtObj* resource type, as specified in Annex D.12 of the oneM2M functional architecture TS-0001 [1].

This MO maintains information regarding the remote provisioning and management of CMDH policies.

Figure 5.6.1-1 gives the pictorial description of the MCMDHMO.

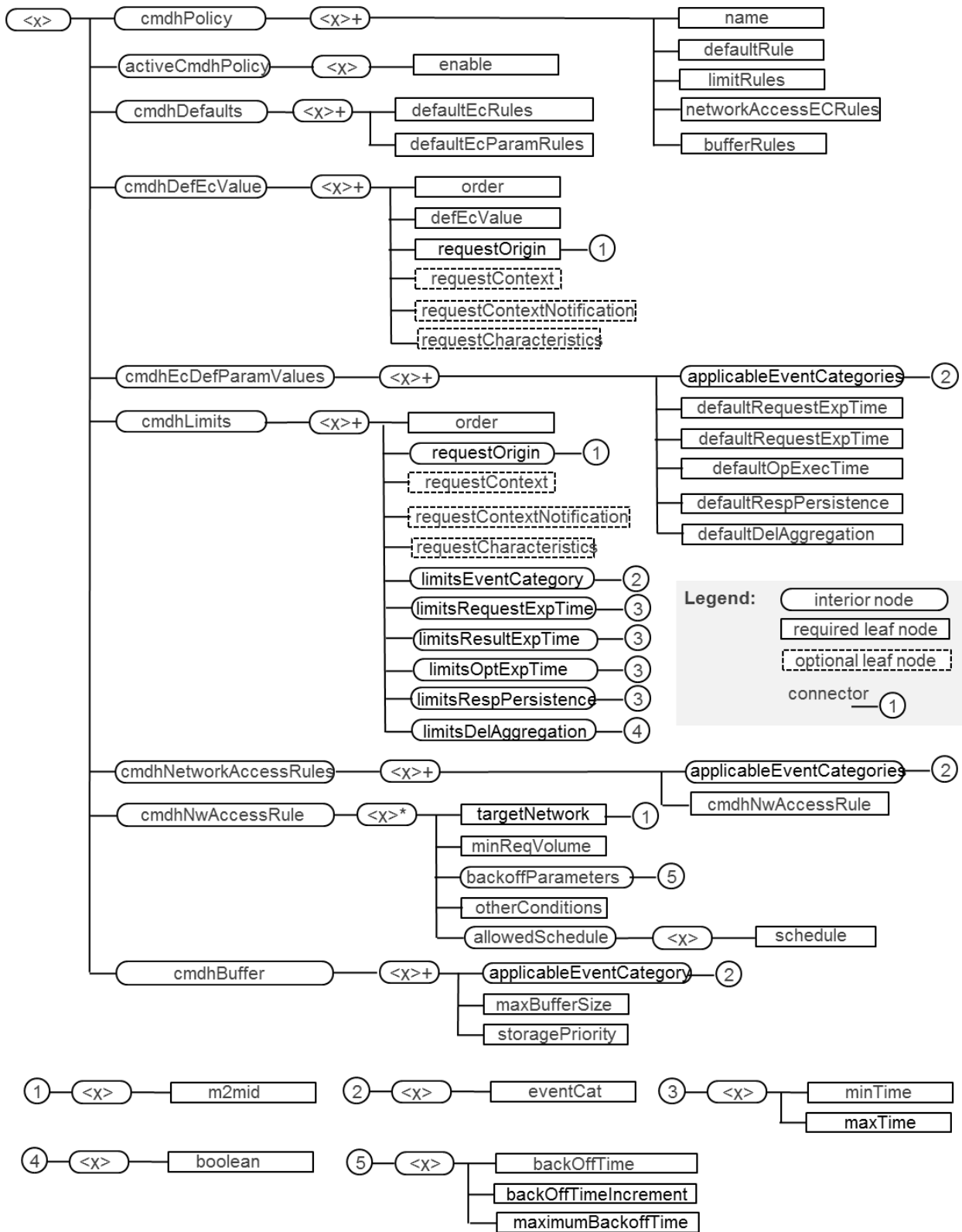


Figure 5.6.1-1: Structure of OMA-DM compatible M2M CMDH Policies MO (MCMDHMO)

The various nodes within this MO are described as follows.

<x>

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | One | node | Get |

This placeholder node is the root node for the MCMDHMO which includes all MOs related to CMDH Policy management. The parent node of this node defines the location of this MO in the Management Tree. The Management Object Identifier for the MCMDHMO shall be: "urn:oma:mo:ext-onem2m-mcmdhmo:1.0".

<x>/cmdhPolicy

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | One | node | Get |

This interior node is the parent node of instances of cmdhPolicy MOs.

<x>/cmdhPolicy/<x>

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | OneOrMore | node | Get |

This placeholder interior node represents the specific instances of cmdhPolicy MOs.

<x>/cmdhPolicy/<x>/name

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | One | chr | Get |

This leaf node contains the name attribute of a cmdhPolicy resource instance.

<x>/cmdhPolicy/<x>/defaultRule

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | One | chr | Get |

This leaf node includes a reference (mgmntLink) to an instance of a cmdhDefaults node.

<x>/cmdhPolicy/<x>/limitRules

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | OneOrMore | chr | Get |

This leaf node includes a reference (mgmtLink) to an instance of a cmdhLimits node.

<x>/cmdhPolicy/<x>/NetworkAccessECRules

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | OneOrMore | chr | Get |

This leaf node includes a reference (mgmtLink) to an instance of a cmdhNetworkAccess node.

<x>/cmdhPolicy/<x>/bufferRules

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | OneOrMore | chr | Get |

This leaf node includes a reference (mgmntLink) to an instance of a cmdhBuffer node.

<x>/activeCmdhPolicy

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | One | node | Get |

This interior node is the parent node of an activeCmdhPolicy MO instance.

<x>/activeCmdhPolicy/<x>

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | One | node | Get |

This placeholder node represents an instance of a activeCmdhPolicy MO.

<x>/activeCmdhPolicy/<x>/enable

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | One | chr | Get |

This leaf node includes a reference (mgmtLink) to the currently active instance of the cmdhPolicy MO.

<x>/cmdhDefaults

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | One | node | Get |

This interior node is the parent node of instances of cmdhPolicy MOs.

<x>/cmdhDefaults/<x>

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | OneOrMore | node | Get |

This placeholder node represents the instances of cmdhDefaults MOs.

<x>/cmdhDefaults/<x>/defaultECRules

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | OneOrMore | chr | Get |

This leaf node includes a reference (mgmtLink) to an instance of the cmdhDefEcValue MO.

<x>/cmdhDefaults/<x>/defaultECParmRules

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | OneOrMore | chr | Get |

This leaf node includes a reference (mgmtLink) to an instance of the cmdhEcDefParamValue MO.

<x>/cmdhDefEcValue

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | OneOrMore | node | Get |

This interior node is the parent node of cmdhDefEcValue MOs.

<x>/cmdhDefEcValue/<x>

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | OneOrMore | node | Get |

This placeholder interior node represents the instances of the cmdhDefEcValue MOs.

<x>/cmdhDefEcValue/<x>/order

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | One | int | Get |

This leaf node contains the order attribute of the cmdhDefEcValue resource instance.

<x>/cmdhDefEcValue/<x>/defEcValue

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | One | chr | Get |

This leaf node contains the defEcValue attribute of the cmdhDefEcValue resource instance.

<x>/cmdhDefEcValue/<x>/requestOrigin

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | One | node | Get |

This interior node contains the requestOrigin attribute of the cmdhDefEcValue resource instance.

<x>/cmdhDefEcValue/<x>/requestOrigin/<x>

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | One | node | Get |

This placeholder node represents the root of the list of requestOrigin values.

<x>/cmdhDefEcValue/<x>/requestOrigin/<x>/m2mid

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | OneOrMore | chr | Get |

This leaf node contains one list element of the requestOrigin attribute.

<x>/cmdhDefEcValue/<x>/requestContext

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Optional | ZeroOrOne | chr | Get |

This leaf node contains the requestContext attribute of the cmdhDefEcValue resource instance.

<x>/cmdhDefEcValue/<x>/requestContextNotification

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Optional | ZeroOrOne | bool | Get |

This leaf node contains the requestContextNotification attribute of the cmdhDefEcValue resource instance.

<x>/cmdhDefEcValue/<x>/requestCharacteristics

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Optional | ZeroOrOne | chr | Get |

This leaf node contains the requestCharacteristics attribute of the cmdhDefEcValue resource instance.

<x>/cmdhEcDefParamValues/

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | One | node | Get |

This interior node is the parent node of the cmdhEcDefParamValues MO.

<x>/cmdhEcDefParamValues/<x>

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | One | chr | Get |

This interior placeholder node represents the instances of the cmdhEcDefParamValues MOs.

<x>/cmdhEcDefParamValues/<x>/applicableEventCategory

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | One | node | Get |

This interior node contains the applicableEventCategory attribute of the cmdhEcDefParamValues resource instance.

<x>/cmdhEcDefParamValues/<x>/applicableEventCategory/<x>

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | One | node | Get |

This placeholder node represents the root of the list of eventCat values.

<x>/cmdhEcDefParamValues/<x>/applicableEventCategory/<x>/eventCat

| Status | Tree Occurrence | Format | Min. Access Types |
|--------|-----------------|--------|-------------------|
|--------|-----------------|--------|-------------------|

| | | | |
|----------|-----------|-----|-----|
| Required | OneOrMore | chr | Get |
|----------|-----------|-----|-----|

This leaf node contains one eventCat list element of the applicableEventCategory attribute.

<x>/cmdhEcDefParamValues/<x>/defaultResultExpTime

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | One | int | Get |

This leaf node contains the defaultResultExpTime attribute of the cmdhEcDefParamValues resource instance.

<x>/cmdhEcDefParamValues/<x>/defaultOpExpTime

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | One | int | Get |

This leaf node contains the defaultOpExpTime attribute of the cmdhEcDefParamValues resource instance.

<x>/cmdhEcDefParamValues/<x>/defaultRespPersistence

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | One | int | Get |

This leaf node contains the defaultRespPersistence attribute of the cmdhEcDefParamValues resource instance.

<x>/cmdhLimits

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | One | node | Get |

This interior node is the parent node of the cmdhLimits MO.

<x>/cmdhLimits/<x>

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | One | int | Get |

This interior placeholder node represents the instances of the cmdhLimits MO.

<x>/cmdhLimits/<x>/order

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | One | int | Get |

This leaf node contains the order attribute of the cmdhLimits resource instance.

<x>/cmdhLimits/<x>/requestOrigin

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | One | node | Get |

This interior node contains the RequestOrigin attribute of the cmdhLimits resource instance.

<x>/cmdhLimits/<x>/requestOrigin/<x>

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | One | node | Get |

This placeholder node represents the root of the list of requestOrigin values.

<x>/cmdhLimits/<x>/requestOrigin/<x>/m2mid

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | OneOrMore | chr | Get |

This leaf node contains one list element of the requestOrigin attribute.

<x>/cmdhLimits/<x>/RequestContext

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Optional | ZeroOrMore | chr | Get |

This leaf node contains the RequestContext attribute of the cmdhLimits resource instance.

<x>/cmdhLimits/<x>/RequestContextNotification

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Optional | ZeroOrOne | bool | Get |

This leaf node contains the RequestContextNotification attribute of the cmdhLimits resource instance.

<x>/cmdhLimits/<x>/RequestCharacteristics

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Optional | ZeroOrOne | node | Get |

This leaf node contains the RequestCharacteristics attribute of the cmdhLimits resource instance.

<x>/cmdhLimits/<x>/limitsEventCategory

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | One | node | Get |

This interior node contains the limitsEventCategory attribute of the cmdhLimits resource instance.

<x>/cmdhLimits/<x>/limitsEventCategory/<x>

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | One | node | Get |

This placeholder node represents the root of the list of eventCat values.

<x>/cmdhLimits/<x>/limitsEventCategory/<x>/eventCat

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | OneOrMore | chr | Get |

This leaf node contains one eventCat list element of the limitsEventCategory attribute.

<x>/cmdhLimits/<x>/limitsRequestExpTime

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | One | node | Get |

This interior node contains the limitsRequestExpTime attribute of the cmdhLimits resource instance.

<x>/cmdhLimits/<x>/limitsRequestExpTime/<x>

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | One | node | Get |

This placeholder node represents the root of the list of minimal and maximal Request Expiration Time values.

<x>/cmdhLimits/<x>/limitsRequestExpTime/<x>/minTime

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | One | int | Get |

This leaf node contains the minimal Request Expiration Time in units of milliseconds.

<x>/cmdhLimits/<x>/limitsRequestExpTime/<x>/maxTime

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | One | int | Get |

This leaf node contains the maximal Request Expiration Time in units of milliseconds..

<x>/cmdhLimits/<x>/limitsResultExpTime

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | One | node | Get |

This interior node contains the limitsResultExpTime attribute of the cmdhLimits resource instance.

<x>/cmdhLimits/<x>/limitsResultExpTime/<x>

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | One | node | Get |

This placeholder node represents the root of the list of minimal and maximal Result Expiration Time values.

<x>/cmdhLimits/<x>/limitsResultExpTime/<x>/minTime

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | One | int | Get |

This leaf node contains the minimal Result Expiration Time in units of milliseconds.

<x>/cmdhLimits/<x>/limitsResultExpTime/<x>/maxTime

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | One | int | Get |

This leaf node contains the maximal Result Expiration Time in units of milliseconds..

<x>/cmdhLimits/<x>/limitsOpExecTime

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | One | node | Get |

This interior node contains the limitsOpExecTime attribute of the cmdhLimits resource instance.

<x>/cmdhLimits/<x>/limitsOpExecTime/<x>

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | One | node | Get |

This placeholder node represents the root of the list of minimal and maximal Operation Execution Time values.

<x>/cmdhLimits/<x>/limitsOpExecTime/<x>/minTime

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | One | int | Get |

This leaf node contains the minimal Operation Execution Time in units of milliseconds.

<x>/cmdhLimits/<x>/limitsOpExecTime/<x>/maxTime

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | One | int | Get |

This leaf node contains the maximal Operation Execution Time in units of milliseconds..

<x>/cmdhLimits/<x>/limitsRespPersistence

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | One | node | Get |

This interior node contains the limitsRespPersistence attribute of the cmdhLimits resource instance.

<x>/cmdhLimits/<x>/limitsRespPersistence/<x>

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | One | node | Get |

This placeholder node represents the root of the list of minimal and maximal Response Persistence Time values.

<x>/cmdhLimits/<x>/limitsRespPersistence/<x>/minTime

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | One | int | Get |

This leaf node contains the minimal Response Persistence Time in units of milliseconds.

<x>/cmdhLimits/<x>/limitsRespPersistence/<x>/maxTime

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | One | int | Get |

This leaf node contains the maximal Operation Execution Time in units of milliseconds..

<x>/cmdhLimits/<x>/limitsDelAggregation

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | One | node | Get |

This interior node contains the limitsDelAggregation attribute of the cmdhLimits resource instance.

<x>/cmdhLimits/<x>/limitsDelAggregation/<x>

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | One | node | Get |

This placeholder node represents the root of the list of Delivery Aggregation settings.

<x>/cmdhLimits/<x>/limitsDelAggregation/<x>/boolean

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | OneOrMore | bool | Get |

This leaf node contains the permitted boolean value(s) of the limitsDelAggregation attribute. This list has one or two elements, representing the allowed values of the boolean value space domain.

<x>/cmdhNetworkAccessRules

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | OneOrMore | node | Get |

This interior node is the parent node of cmdhNetworkAccessRules MOs.

<x>/cmdhNetworkAccessRules/<x>

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | OneOrMore | node | Get |

This interior placeholder node represents the instances of the cmdhDefEcValue MO.

<x>/cmdhNetworkAccessRules/<x>/applicableEventCategories

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | One | node | Get |

This interior node contains the applicableEventCategories attribute of the cmdhNetworkAccessRules resource instance.

<x>/cmdhNetworkAccessRules/<x>/applicableEventCategories/<x>

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | One | node | Get |

This placeholder node represents the root of the list of eventCat values.

<x>/cmdhNetworkAccessRules/<x>/applicableEventCategories/<x>/eventCat

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | OneOrMore | chr | Get |

This leaf node contains one eventCat list element of the applicableEventCategories attribute.

<x>/cmdhDefEcValue/<x>/cmdhNwAccessRule

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Optional | ZeroOrMore | chr | Get |

This leaf node includes a reference (mgmtLink) to an instance of the cmdhNwAccessRule MO.

<x>/cmdhNwAccessRule

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | OneOrMore | node | Get |

This interior node is the parent node of cmdhNwAccessRule MOs.

<x>/cmdhNwAccessRule/<x>

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Optional | ZeroOrOne | node | Get |

This interior placeholder node represents instances of the cmdhNwAccessRule MO.

<x>/cmdhNwAccessRule/<x>targetNetwork

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | One | chr | Get |

This leaf node contains the targetNetwork attribute of the cmdhNwAccessRule resource instance.

<x>/cmdhNwAccessRule/<x>minReqVolume

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | One | int | Get |

This leaf node contains the minReqVolume attribute of the cmdhNwAccessRule resource instance in units of byte.

<x>/cmdhNwAccessRule/<x>/backOffParameters

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | One | node | Get |

This interior node contains the backOffParameters attribute of the cmdhNwAccessRule resource instance.

<x>/cmdhNwAccessRule/<x>/backOffParameters/<x>

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | One | node | Get |

This placeholder node represents the root of list backOffParameters list of time values.

<x>/cmdhNwAccessRule/<x>/backOffParameters/<x>/backOffTime

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | One | int | Get |

This leaf node contains the backOffTime in units of milliseconds.

<x>/cmdhNwAccessRule/<x>/backOffParameters/<x>/backOffTimeIncrement

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | One | int | Get |

This leaf node contains the backOffTimeIncrement in units of milliseconds.

<x>/cmdhNwAccessRule/<x>/backOffParameters/<x>/maximumBackoffTime

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | One | int | Get |

This leaf node contains the maximumBackoffTime in units of milliseconds.

<x>/cmdhNwAccessRule/<x>/otherConditions

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | One | chr | Get |

This leaf node contains the otherConditions attribute of the cmdhNwAccessRule resource instance.

<x>/cmdhNwAccessRule/<x>/allowedSchedule

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | One | node | Get |

This interior node represents the root of the allowedSchedule attribute of the cmdhNwAccessRule resource instance.

<x>/cmdhNwAccessRule/<x>/allowedSchedule/<x>

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | One | node | Get |

This placeholder node represents the root of the time schedule.

<x>/cmdhNwAccessRule/<x>/allowedSchedule/<x>/schedule

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | OneOrMore | chr | Get |

This leaf node contains the time schedule in form of extended crontab syntax.

<x>/cmdhBuffer

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | OneOrMore | node | Get |

This interior node is the parent node of the cmdhBuffer MO.

<x>/cmdhBuffer/<x>

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | OneOrMore | node | Get |

This interior placeholder represents the instances of the cmdhBuffer MO.

<x>/cmdhBuffer/<x>/applicableEventCategory

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | One | node | Get |

This interior node contains the applicableEventCategory attribute of the cmdhBuffer resource instance.

<x>/cmdhBuffer/<x>/applicableEventCategory/<x>

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | One | node | Get |

This placeholder node represents the root of the list of eventCat values.

<x>/cmdhBuffer/<x>/applicableEventCategory/<x>/eventCat

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | OneOrMore | chr | Get |

This leaf node contains one eventCat list element of the applicableEventCategory attribute.

<x><x>/cmdhBuffer/<x>/maxBufferSize

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | One | int | Get |

This leaf node contains the maxBufferSize attribute of the cmdhBuffer resource instance.

<x>/cmdhBuffer/<x>/storagePriority

| Status | Tree Occurrence | Format | Min. Access Types |
|----------|-----------------|--------|-------------------|
| Required | One | int | Get |

This leaf node contains the storagePriority attribute of the cmdhBuffer resource instance.

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. |

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 [15], OPS URN defined in [17], IMEI URN defined in [16].

These 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 capable of fulfilling its role, an Object shall be first 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 the *objectPath* list will be associated to a given Resource attribute for realizing the final mapping to the targeted OMA LWM2M [6] resource.

In OMA LWM2M, the Objects Instances are located under the default rootpath (i.e. "/") when this rootpath is not explicitly specified. However, devices might be hosting other resources, that is why the LWM2M has the capability to assign the LWM2M rootpath to an alternative path. In oneM2M this alternate path will be part of a Resource *objectPath* attribute (e.g. "/lwm2mPath /3/0").

6.3.2 Resource [firmware]

The resource [firmware] is for firmware management in the service layer.

The context of this Resource is the following:

| Context | Mapping |
|------------|---|
| objectId | urn:oma:lwm2m:oma:5 Firmware Update Object |
| objectPath | /5/0 |

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

| Attribute Name of [firmware] | Mapping to resources in LWM2M Device Object Instance |
|------------------------------|---|
| version | has to be assigned by Management Adapter when Package installed |
| name | has to be assigned by Management Adapter when Package installed |
| URL | 1 PackageURI |
| update | 2 Update |
| updateStatus | 3 UpdateResult |

6.3.3 Resource [software]

The resource [software] is for software management in the service layer.

Note: The OMA LWM2M Software Management Object is currently under specification at OMA. This resource mapping is provided as an example (Information here are preliminary ones). "X" Object Identifier will be replaced when the official one will be registered in OMNA.

The context of this Resource is the following:

| Context | Mapping |
|------------|---------------------|
| objectId | urn:oma:lwm2m:oma:X |
| objectPath | /X/0 |

The attributes of this Resource shall be mapped to specific resources of the LWM2M Software Management Object when publicly available

| Attribute Name of [software] | Mapping to resources in LWM2M Device Object Instance | |
|------------------------------|---|---------------------------------|
| version | 0 | Version of the software package |
| name | 1 | Name of the software package |
| URL | 2 | Package URI |
| install | 4 | Install / Update |
| uninstall | 6 | Uninstall |
| installStatus | 9 | Update Result |
| activate | Editor's Note : has to be provided when OMA work is completed | |
| deactivate | Editor's Note : has to be provided when OMA work is completed | |
| activeStatus | Editor's Note : has to be provided when OMA work is completed | |

6.3.4 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 as follows:

| 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 |

6.3.5 Resource [areaNwkInfo]

The resource [areaNwkInfo] is for managing the area network.

Note: There is currently no defined LWM2M object yet. This mapping is not available in this current specification.

Editor's Note: It could be specified under the oneM2M authority. Such an Object shall have to be OMNA-registered and specified in this document "clause 6.6 New LWM2M Objects".

6.3.6 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.

Note: There is currently no defined LWM2M object yet. This mapping is not available in this current specification .

Editor's Note: It could be specified under the oneM2M authority. Such an Object shall have to be OMNA-registered and specified in this document "clause 6.6 New LWM2M Objects".

6.3.7 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 as follows

| 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 | | | | | | | | | | | | | | | | |
| m2m:batteryStatus [2] | <table> <tr> <th>Battery Status</th><th>Description</th></tr> <tr> <td>"NORMAL"</td><td>0 The battery is operating normally and not on power.</td></tr> <tr> <td>"CHARGING"</td><td>1 The battery is currently charging.</td></tr> <tr> <td>"CHARGE-COMPLETE"</td><td>2 The battery is fully charged and still on power.</td></tr> <tr> <td>"DAMAGED"</td><td>3 The battery has some problem.</td></tr> <tr> <td>"LOW-BATTERY"</td><td>4 The battery is low on charge.</td></tr> <tr> <td>"NOT-INSTALLED"</td><td>5 The battery is not installed.</td></tr> <tr> <td>"UNKNOWN"</td><td>6 The battery information is not available.</td></tr> </table> | Battery Status | Description | "NORMAL" | 0 The battery is operating normally and not on power. | "CHARGING" | 1 The battery is currently charging. | "CHARGE-COMPLETE" | 2 The battery is fully charged and still on power. | "DAMAGED" | 3 The battery has some problem. | "LOW-BATTERY" | 4 The battery is low on charge. | "NOT-INSTALLED" | 5 The battery is not installed. | "UNKNOWN" | 6 The battery information is not available. |
| Battery Status | Description | | | | | | | | | | | | | | | | |
| "NORMAL" | 0 The battery is operating normally and not on power. | | | | | | | | | | | | | | | | |
| "CHARGING" | 1 The battery is currently charging. | | | | | | | | | | | | | | | | |
| "CHARGE-COMPLETE" | 2 The battery is fully charged and still on power. | | | | | | | | | | | | | | | | |
| "DAMAGED" | 3 The battery has some problem. | | | | | | | | | | | | | | | | |
| "LOW-BATTERY" | 4 The battery is low on charge. | | | | | | | | | | | | | | | | |
| "NOT-INSTALLED" | 5 The battery is not installed. | | | | | | | | | | | | | | | | |
| "UNKNOWN" | 6 The battery information is not available. | | | | | | | | | | | | | | | | |

6.3.8 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 |

6.3.9 Resource [deviceCapability]

The Resource [deviceCapability] is to manage the device capabilities such USB, camera, etc. The Resource [deviceCapability] is mapped to the LWM2M Device Capability Object specified in the clause 6.6.

The context of this Resource is the following:

| Context | Mapping |
|------------|--|
| objectId | urn:oma:lwm2m:ext:420x Editor's Note: 4200 could be registered in OMNA as oneM2M SDO |
| objectPath | /420x/0 |

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

| Attribute Name of [deviceCapability] | Mapping to resources in LWM2M Device Object Instance | |
|--------------------------------------|--|------------|
| capabilityName | 0 | Name |
| attached | 3 | Attached |
| capabilityActionStatus | has to be assigned by Management Adapter | |
| Enable | 5 | opEnable |
| Disable | 6 | op Disable |

6.3.10 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 as follows

| 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. |

6.3.11 Resource [eventLog]

The Resource [eventLog] is to record the event log for the device.

Note: There is currently no defined LWM2M object yet. This mapping is not available in this current specification

Editor's Note: It could be specified under the oneM2M authority. Such an Object shall have to be OMNA-registered and specified in this document "clause 6.6 New LWM2M Objects".

6.4 Mapping of procedures for management

In this section, the oneM2M Primitives (i.e, Create, Retrieve, Update, Delete, and Notify) are mapped to logical operations defined in OMA LWM2M. The LWM2M operations involved in that mapping (i.e. Create, Read, Write, Execute, Delete, Observe, Write Attributes and Notify operations) are mapped on CoAP methods [18] . Create, Read, Write, Execute, Delete, Write Attributes, Observe 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.

LWM2M Notify operation can be mapped on either Confirmable or Non Confirmable CoAP message .This operation includes the changed value of the Object Instance or Resource.

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

| oneM2M Primitive Status Code | Returned Codes | Description |
|------------------------------|-------------------------|---|
| success | 2.01 Created | “Create” operation is completed successfully |
| error - already exists | 4.00 Bad Request | Target (i.e., Object) already exists Mandatory Resources are not specified |
| error – no privilege | 4.01 Unauthorized | Access Right Permission Denied |
| error – not found | 4.04 Not Found, | URI of “Create” operation is not found |
| error – not allowed | 4.05 Method Not Allowed | Target is not allowed for “Create” operation |

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

| oneM2M Primitive Status Code | Returned Codes | Description |
|------------------------------|-------------------------|--|
| success | 2.05 Content | “Retrieve” operation is completed successfully |
| error – no privilege | 4.01 Unauthorized, | Access Right Permission Denied |
| error – not found | 4.04 Not Found, | Target of “Retrieve” operation is not found |
| error – not allowed | 4.05 Method Not Allowed | Target is not allowed for “Retrieve” operation |

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 case 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

| oneM2M Primitive Status Code | Returned Codes | Description |
|------------------------------|-------------------------|---|
| success | 2.04 Changed | “Update” operation is completed successfully |
| error – bad request | 4.00 Bad Request, | The format of data to be updated is different |
| error – no privilege | 4.01 Unauthorized | Access Right Permission Denied |
| error – not found | 4.04 Not Found, | Target of “Update” operation is not found |
| error – not allowed | 4.05 Method Not Allowed | Target is not allowed for “Update” operation |

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

| oneM2M Primitive Status Code | Returned Codes | Description |
|------------------------------|-------------------------|--|
| success | 2.04 Changed | “Update” (“Execute”) operation is completed successfully |
| error – bad request | 4.00 Bad Request, | Some issue with the “Update” argument |
| error – no privilege | 4.01 Unauthorized | Access Right Permission Denied |
| error – not found | 4.04 Not Found, | Target of “Update” (“Execute”) operation is not found |
| error – not allowed | 4.05 Method Not Allowed | Target is not allowed for “Update” (“Execute”) operation |

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 always be 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

| oneM2M Primitive Status Code | Returned Codes | Description |
|------------------------------|-------------------------|--|
| success | 2.02 Deleted | “Delete” operation is completed successfully |
| error – not allowed | 4.00 Bad Request, | Target (i.e., Object Instance) is not allowed for “Delete” operation |
| error – no privilege | 4.01 Unauthorized, | Access Right Permission Denied |
| error – not found | 4.04 Not Found, | Target of “Delete” operation is not found |
| error – not allowed | 4.05 Method Not Allowed | Target is not allowed for “Delete” operation |

6.4.5 Notify Primitive for <mgmtObj> Resource

The Notify primitive permits notifications to Originators that have subscribed to a Resource.

In LWM2M, “subscription for notification” can address: either a specific resource, or all the resources of an Object Instance or all the resources of all the Object Instances of a given Object in the LWM2M Client.

6.4.5.1 Notify Primitive mapping for subscription to Resource attributes. .

The Notify Primitive for subscription shall map to a combination of OMA LWM2M Write Attributes and Observe operations. Write Attributes allows to set notification parameters, e.g. Notification Periodicity.

According to the parameters provided to the Observe operation, : a subscription for change to a specific resource, a subscription for change to an Object instance or a subscription for change to all the Instances of a given Object can be performed.

The LWM2M Observe operation shall return one of the codes described in the following Table.

Table 6.4.5.1-1: Notify for Subscription Returned Codes Mapping

| oneM2M Primitive Status Code | Returned Codes | Description |
|------------------------------|----------------|---|
| | 2.05 | Subscription successfully registered (token returned) |
| | 4.04 | Target Not found |
| | 4.05 | Registration not allowed |

6.4.5.2 Notify Primitive mapping for subscription cancellation to Resource attributes.

The Notify Primitive for cancelling subscription shall map to the OMA LWM2M Cancel Observation operation: this LWM2M Cancel Observation operation may use either the LWM2M Write Attributes operation, or direct CoAP Reset operation (which returns no code)

The Cancel Observation operation shall occur in the response to a LWM2M “Notify” operation

- In using the Write Attributes operation with the “Cancel” parameter, it is possible to un-subscribe notification on a specified LWM2M resource, on a specified Object Instance or on a specified Object.
- In using the CoAP operation, the un-subscription will be performed on the resource, Object Instance or Object of the LWM2M Notify operation which triggered that response

6.4.5.3 Notify Primitive mapping for Notification

The Notify Primitive for Notification shall map to the OMA LWM2M Notify operation which carries the changed value(s) of the Object Instance Resource(s) and the code described in the following Table.

Table 6.4.5.3-1: Notify for Notification Returned Codes Mapping

| oneM2M Primitive Status Code | Returned Codes | Description |
|------------------------------|----------------|--------------------------|
| success | 2.04 | An attribute has changed |

Note: when an Observance has been subscribed to an Object, the Notification will be performed for each Object Instance individually.

6.4.6 Management Resource Specific Procedure Mapping

6.4.6.1 Resource [firmware]

Editor’s note: specific procedure mapping is FFS. To be aligned with OMA progress.

6.4.6.2 Resource [software]

Editor’s note: specific procedure mapping is FFS. To be aligned with OMA progress.

6.4.6.3 Resource [memory]

The generic <mgmtObj> mappings described in the clause 6.4.1 – 6.4.5 shall apply, and no specific mapping is necessary.

In addition to the status code mapping for the <mgmtObj> CRUD Operations, no [memory] specific status codes are defined in [6].

6.4.6.4 Resource [battery]

The generic <mgmtObj> mappings described in the clause 6.4.1 – 6.4.5 shall apply, and no specific mapping is necessary.

In addition to the status code mapping for the <mgmtObj> CRUD Operations, no [battery] specific status codes are defined in [6].

6.4.6.5 Resource [deviceInfo]

The generic <mgmtObj> mappings described in the clause 6.4.1 – 6.4.5 shall apply, and no specific mapping is necessary.

In addition to the status code mapping for the <mgmtObj> CRUD Operations, no [deviceInfo] specific status codes are defined in [6].

6.4.6.6 Resource [deviceCapability]

Editor's note: specific procedure mapping is FFS. To be aligned with OMA progress.

6.4.6.7 Resource [reboot]

The generic <mgmtObj> mappings described in the clause 6.4.1 – 6.4.5 shall apply, and no specific mapping is necessary.

In addition to the status code mapping for the <mgmtObj> CRUD Operations, no [reboot] specific status codes are defined in [6].

6.5 LWM2M Server Interactions

This clause describes how the IN-CSE interacts with a LWM2M Server in order to manage the devices. The interaction between the IN-CSE and the LWM2M Server includes the followings:

- Communication session establishment
- Translations for requests/responses and notifications between the oneM2M service layer and the LWM2M protocol
- Discovery of the LWM2M Objects in the device and Management Resources in the IN-CSE.

Note: The LWM2M Server interaction is applicable to the case that the LWM2M Server is external to the IN-CSE.

6.5.1 Communication Session Establishment

The communication session can be initiated by the IN-CSE or by the LWM2M Server. The IN-CSE can initiate the communication session if the IN-CSE needs to interact with the LWM2M Objects in the device through the LWM2M Server (e.g., an IN-AE sends firmware update Requests by using the [firmware] Resource in the IN-CSE). On the other hands, the LWM2M Server can initiate the communication session if the LWM2M Server detects changes of LWM2M Objects that the LWM2M Server manages or needs to notify events to the IN-CSE that occurred in the device. In this case, the notifications of LWM2M Object changes or events can be limited to the cases that the IN-CSE has expressed interests.

The multiple communication sessions can be established between the IN-CSE and the LWM2M Server depending on the communication environments and the protocols to be used for the communication session.

6.5.2 Translation of Requests and Responses between IN-CSE and LWM2M Server

This specification specifies how oneM2M service layer protocol regarding the device management shall be mapped to OMA LWM2M protocol. The interaction between the IN-CSE and the LWM2M Server lies between these two protocols and the Requests/Responses from those two protocols shall be properly translated by the interactions between the IN-CSE and the LWM2M Server. The Requests/Responses translations between the IN-CSE and the LWM2M Server may be done in any way that satisfies the procedure mappings specified at the clause 6.4.

6.5.3 Discovery and Subscription for LWM2M Objects

Being triggered by oneM2M service layer, the interactions between the IN-CSE and the LWM2M Server can provide the following functionalities:

- Discovery of LWM2M Objects in the devices of interest
- Subscription to LWM2M Objects for being notified for the interested events

With the discovery and the subscription to the LWM2M Objects in the device, the IN-CSE can be capable to synchronize the <mgmtObj> Management Resources with LWM2M Objects in the device.

6.5.4 Access Control Management

For a device under managements, the IN-CSE can have multiple LWM2M Servers that can connect to the device. Among those LWM2M Servers, when receiving the oneM2M service layer Requests, the IN-CSE needs to select the proper LWM2M Server that can successfully perform the received Request based on the access rights that each LWM2M Server has. The interaction between the IN-CSE and the LWM2M Server may be used to discover the access control that the LWM2M Server has for the target device.

6.6 New LWM2M Objects

6.6.1 LWM2M Device Capability Object

Editor's Note: oneM2M will have to be register under OMNA authority as an external SDO provider for OMA LWM2M Objects. The allocated range used here (4200-42XX) for oneM2M SDO is only given as an example

Description

This LWM2M Object is dedicated to manage the device capabilities of a device e.g. USB, camera, etc.

Object definition

| Name | Object ID | Instances | Mandatory | Object URN |
|---------------|-----------|-----------|-----------|------------------------|
| DevCapability | 4200 | Multiple | Optional | urn:oma:lwm2m:ext:4200 |

Resource definitions

| ID | Name | Operations | Instances | Mandatory | Type | Range or Enumeration | Units | Description |
|----|-------------|------------|-----------|-----------|---------|----------------------|-------|---|
| 0 | Property | R | Single | Mandatory | String | | | Property name |
| 1 | Group | R | Single | Optional | String | | | Group name of of Device Capabilities |
| 2 | Description | R | Single | Optional | String | | | Device Capability Description |
| 3 | Attached | R | Single | Optional | Boolean | | | This resource indicates whether the Device Capability is removable and whether it is currently attached to the device. If the leaf exists then the Device Capability is removable. If the value of this node is "True" the Device Capability is currently attached to the device; if the value of this node is "False" the Device Capability is currently detached from the device; |
| 4 | Enabled | R | Single | Mandatory | Boolean | | | This resource indicates whether the Device Capability is enabled regardless whether the Device Capability is attached or not. If the |

| | | | | | | | |
|---|------------|---|--------|-----------|---------|--|---|
| | | | | | | | <p>value of this resource is “True” the Device Capability is in Enabled State. If the value of is “False” the Device Capability is in Disabled State;</p> <p>The ‘Attached’ property is independent of ‘Enabled’ property. A Device Capability MAY have ‘True’ as value for ‘Enabled’ node while having ‘False’ as value for the ‘Attached’ node. That means the Device Capability is still not available and can’t be used until it is attached to the Device, but will be useable once the Device Capability is attached.</p> |
| 5 | opEnable | E | Single | Mandatory | | | <p>This command is used to enable the Device Capability to transfer the Device Capability from Disabled State to Enabled state.</p> <p>In Enabled State, the Device Capability is allowed to work when it is attached to the Device.</p> |
| 6 | opDisable | E | Single | Mandatory | | | <p>This command is used to disable the Device Capability to transfer the Device Capability from Enabled State to Disabled State.</p> <p>In Disabled state the Device Capability is not allowed to work.</p> |
| 7 | DenyUserEn | | Single | Optional | Boolean | | <p>This resource specifies whether the user is able to enable a Device Capability. If this resource is not present or the value is False, the user is allowed to enable the Device Capability. If this resource is present and the value is True, the user is not allowed to enable the Device Capability.</p> |
| 8 | NotifyUser | | Single | Optional | Boolean | | <p>This resource specifies whether the user is notified when enable/disable Primitive is executed. If the resource is not present or the value is ‘False’, the user will not be notified about the result of the operation. If the node is present and the value is ‘True’, the user will be notified about the result of the operation.</p> |

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> |
| | | |
| | | |
| | | |
| | | |