ONEM2M
TECHNICAL SPECIFICATION

Document Number	TS-0005-V3.5.1
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Abstract:	Specifies the usage of OMA DM and OMA LwM2M resources and the corresponding message flows including normal cases as well as error cases to fulfill the oneM2M management requirements. • 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 fulfill the oneM2M management requirements.

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

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Contents

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

2.1 Normative 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 reference document (including any amendments) applies.

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

[1] oneM2M TS-0001: "Functional Architecture".

[2] oneM2M TS-0004: "Service Layer Core Protocol Specification".

[3] Open Mobile Alliance™ : "OMA Device Management Protocol", Version 1.3.

NOTE: Available at http://openmobilealliance.org/release/DM/.

[4] Open Mobile Alliance™ : "OMA Device Management Protocol", Version 2.0.

NOTE: Available at http://openmobilealliance.org/release/DM/.

[5] Open Mobile Alliance™ : "OMA LightweightM2M", Version 1.0 08 February 2017.

NOTE: Available at http://openmobilealliance.org/release/LightweightM2M/ .

[6] Open Mobile Alliance™ : "OMA Diagnostics and Monitoring Management Object Framework".

NOTE: Available at http://openmobilealliance.org/release/DiagMon/.

[7] Open Mobile Alliance™ : "OMA Firmware Update Management Object".

NOTE: Available at http://openmobilealliance.org/release/FUMO/.

[8] Open Mobile Alliance™ : "OMA Software Component Management Object".

NOTE: Available at http://openmobilealliance.org/release/SCOMO/.

[9] ETSI TS 103 092: "Machine-to-Machine communications (M2M); OMA DM compatible Management Objects for ETSI M2M".

[10] Open Mobile Alliance™ : "OMA Device Capability Management Object ".

NOTE: Available at http://openmobilealliance.org/release/DCMO/.

[11] Open Mobile Alliance™ : "OMA Management Interface to M2M Requirements".

NOTE: Available at http://openmobilealliance.org/release/M2Minterface/.

[12] ISO 8601:2000: "Data elements and interchange formats -- Information interchange -- Representation of dates and times".

NOTE: Available at http://www.iso.ch/.

[13] W3C Recommendation: "XML Schema Part 2: Datatypes", 02 May 2001.

NOTE: Available at http://www.w3.org/XML/Schema/.

[14] IETF RFC 4122: "A Universally Unique Identifier (UUID) URN Namespace", P. Leach, et al. July 2005.

NOTE: Available at http://www.ietf.org/rfc/rfc4122.txt.

[15] 3GPP TS 23.003: "Numbering, addressing and identification".

[16] BBF: "TR-069 CPE WAN Management Protocol" Issue: 1 Amendment 5, November 2013.

[17] IETF RFC 7252: "The Constrained Application Protocol (CoAP)".

[18] Open Mobile Alliance™ "OMA LightweightM2M - Software Management Object", Version 1.0.

NOTE: Available at http://openmobilealliance.org/release/LWM2M_SWMGMT/

[19] Open Mobile Alliance™: "OMA LightweightM2M – Device Capability Management Object ".

NOTE: Available at http://openmobilealliance.org/release/LWM2M_DevCapMgmt/

[20] OMA-SUP-XML_LWM2M_Cellular_connectivity-V1_0-20170301-D.xml

NOTE: Available at http://www.openmobilealliance.org

[21] OMA LightweightM2M (LwM2M) Object and Resource Registry

NOTE: Available at http://www.openmobilealliance.org/wp/OMNA/LwM2M/LwM2MRegistry.html

[22] oneM2M TS-0022: "Field Device Configuration".

[23] oneM2M TS-0032: "MAF and MEF Interface Specification".

2.2 Informative 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 reference document (including any amendments) applies.

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.

NOTE: Available at http://www.onem2m.org/images/files/oneM2M-Drafting-Rules.pdf.

[i.2] oneM2M TS-0011: "Common Terminology".

3 Definitions

For the purposes of the present document, the terms and definitions given in oneM2M TS-0011 [i.2] apply.

4 Conventions

The keywords "Shall", "Shall not", "May", "Need not", "Should", "Should not" in the present 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 [3] and [4]. Note that OMA DM 1.3 [3] and OMA DM 2.0 [4] use the same data types.

Table 5.1-1 Basic 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 [12] 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 [12] format
xs:float	float	Data type for a single precision 32-bit floating point type as defined in XML Schema 1.0 [13] 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 *mgmtLink* 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.

Table 5.2-1 Map of Identifiers

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 *objectID* 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 *objectPath* attribute in <mgmtObj> resource	URI for the local path in the device where the relevant Management Object is located	Management Objects in the device are uniquely addressed by a URI that is stored in the *objectPath* attribute. Note that DM 1.3 and DM 2.0 uses different Addressing scheme, but they are transparent to the oneM2M service layer.

5.3 Mapping of resources

5.3.0 Introduction

This clause describes how to map <mgmtObj> resources specified in annex D of [1] to the relevant management objects as defined by OMA DM ([3] and [4]). 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 [3] and [4].

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.

Table 5.3.2-1 Resource [firmware]

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
NOTE: 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-scomo:1.0). The attributes of the resource shall be mapped to nodes of the MO as the follows.

Table 5.3.3-1 Resource [software]

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
NOTE: 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.

Table 5.3.4-1 Resource [memory]

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

Table 5.3.5-1 Resource [areaNwkInfo]

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

Table 5.3.6-1 Resource [areaNwkDeviceInfo]

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
NOTE: 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.

Table 5.3.7-1 Resource [battery]

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

Table 5.3.8-1 Resource [deviceInfo] mapping in OMA DM 1.3

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.

Table 5.3.8-2 Resource [deviceInfo] mapping in OMA DM 2.0

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
NOTE: 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.

Table 5.3.9-1 Resource [deviceCapability]

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
NOTE: 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 DiagMon [6] 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.

Table 5.3.10-1 Resource [reboot]

Attribute Name of [reboot]	Mapping to Nodes in Management Object
reboot	"<x>/Operations/Start" Node in Restart MO. The restarting level described at the "<x>/DiagMonConfig/ConfigParms/RestartLevel" Node is up to the implementation.
factoryReset	"<x>/Operations/FactoryReset" Node in LAWMO
NOTE: Here <x> is the interior node that acts as a placeholder for the Restart MO and the LAWMO.	

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.

Table 5.3.11-1 Resource [eventLog]

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

5.3.12 Resource [cmdhPolicy]

5.3.12.0 Introduction

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 oneM2M TS-0001 [1] for a detailed high-level description of the overall structure of the *[cmdhPolicy]* resource, and clause D.12 of TS-0004 [2] for details on the data types of the Resource attributes.

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:2.0). 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 5.3.12.0-1: 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 oneM2M TS-0001 [1] and TS-0004 [2].

The Resource [activeCmdhPolicy] includes an attribute activeCmdhPolicyLink which is mapped to a leaf node *enable* The value of *enable* shall point 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
activeCmdhPolicyLink	<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 which CMDH related parameters will be used by default when a request or response message contains the Event Category parameter but not any other CMDH related parameters and which default Event Category parameter shall be used when none is given in the request or response, see clauses D.12.2 of oneM2M TS-0001 [1] and TS-0004 [2].

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:2.0).

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>/defaultECParamRules

5.3.12.3 Resource [cmdhDefEcValue]

The Resource [cmdhDefEcValue] represents a default value for the **ec** (event category) parameter of an incoming request or response when this parameter is not indicated in the message itself, see clauses D.12.3 of oneM2M TS-0001 [1] and TS-0004 [2].

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:2.0).

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

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

Table 5.3.12.3-1: Resource [cmdhDefEcValue]

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 clauses D.12.4 of oneM2M TS-0001 [1] and TS-0004 [2].

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:2.0).

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
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 in request and response messages for a given setting of the *ec* parameter, see clause D.12.5 of oneM2M TS-0001 [1] and TS-0004 [2].

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:2.0).

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 clauses D.12.6 of oneM2M TS-0001 [1] and TS-0004 [2].

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:2.0).

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
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 clauses D.12.7 of oneM2M TS-0001 [1] and TS-0004 [2].

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:2.0).

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 clauses D.12.8 of oneM2M TS-0001 [1] and TS-0004 [2].

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:2.0).

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

5.3.13 Resource related to Field Device Configuration

5.3.13.1 Introduction

The Resource Types addressed in the present clause represent <mgmtObj> specializations required to configure ADN, ASN and MN in the field domain. These resource types and the related specific procedures are specified in oneM2M TS-0022 [22]. The subclauses below define the mapping to and from a M2M FieldDeviceConfig MO (MFDCMO) (urn:oma:mo:ext-onem2m-mfdcmo:1.0). which is applicable to both, OMA DM 1.3 and OMA DM 2.0. The root node of the MFDCMO is denoted in the following by the leftmost placeholder node <x>.

5.3.13.2 Resource [registration]

The Resource [registration] is used to convey the service layer configuration information needed to register an AE or CSE with a Registrar CSE, see clause 7.1.2 of TS-0022 [22].

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

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

The attributes of an instance of [registration] shall be mapped to nodes of the MFDCMO as shown in Table 5.3.13.2-1.

The mgmtLink attribute of the [registration] resource points to an [authenticationProfile] resource instance which itself is mapped to a <x>/authenticationProfile/<x> node in MFDCMO. The original value of this mgmtLink attribute needs to be translated such that it points to the <x>/authenticationProfile/<x> node in MFDCMO which corresponds to the linked [authenticationProfile] resource instance. The respective node identifier <x>/authenticationProfile/<x> of this [authenticationProfile] resource instance shall be set as the value of the <x>/dataCollection/<x>/authenticationProfile leaf node.

Table 5.3.13.2-1: Resource [registration]

Attribute Name of [registration]	Mapping to Nodes in Management Object
originatorID	<x>/registration/<x>/originatorID
poA	<x>/registration/<x>/poA
appID	<x>/registration/<x>/appID
externalID	<x>/registration/<x>/externalID
triggerRecipientID	<x>/registration/<x>/triggerRecipientID
mgmtLink [authenticationProfile]	<x>/registration/<x>/authenticationProfile

5.3.13.3 Resource [dataCollection]

The Resource [dataCollection] is used to convey the application configuration information needed by an AE to collect data and then transmit the data to a Hosting CSE, see clause 7.1.3 of TS-0022 [22].

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

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

The attributes of an instance of [dataCollection] shall be mapped to nodes of the MFDCMO as shown in Table 5.3.13.3-1.

The mgmtLink attribute of the [dataCollection] resource points to an [authenticationProfile] resource instance which itself is mapped to a <x>/authenticationProfile/<x> node in MFDCMO. The original value of this mgmtLink attribute needs to be translated such that it points to the <x>/authenticationProfile/<x> node in MFDCMO which corresponds to the linked [authenticationProfile] resource instance. The respective node identifier <x>/authenticationProfile/<x> of this [authenticationProfile] resource instance shall be set as the value of the <x>/dataCollection/<x>/authenticationProfile leaf node.

Table 5.3.13.3-1: Resource [dataCollection]

Attribute Name of [dataCollection]	Mapping to Nodes in Management Object
containerPath	<x>/dataCollection/<x>/containerPath
reportingSchedule	<x>/dataCollection/<x>/reportingSchedule
measurementSchedule	<x>/dataCollection/<x>/measurementSchedule
mgmtLink [authenticationProfile]	<x>/dataCollection/<x>/authenticationProfile

5.3.13.4 Resource [authenticationProfile]

The Resource [authenticationProfile] is used to convey the configuration information regarding establishing mutually-authenticated secure communications, see clause 7.1.4 of TS-0022 [22].

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

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

The attributes of an instance of [authenticationProfile] shall be mapped to nodes of the MFDCMO as shown in Table 5.3.13.4-1.

A mgmtLink attribute of the [authenticationProfile] has one or more instantiations. The value of mgmtLink attribute either points to a [trustAnchorCred] resource, or to a [MAFClientRegCfg] resource. An [authenticationProfile] resource does not include mgmtLink attributes to both [trustAnchorCred] and [MAFClientRegCfg] resources. If there are more than one mgmtLink attribute in the [authenticationProfile] resource, these point all to [trustAnchorCred] resource instances.

For a mgmtLink attribute pointing to a [trustAnchorCred] resource, the linked [trustAnchorCred] resource instance itself is mapped to a <x>/trustAnchorCred/<x> node in MFDCMO. The respective node identifier <x>/trustAnchorCred/<x> of this [trustAnchorCred] resource instance shall be set as the value of the <x>/authenticationProfile/<x>/trustAnchorCred leaf node.

For a mgmtLink attribute pointing to a [MAFClientRegCfg] resource, the linked [MAFClientRegCfg] resource instance itself is mapped to a <x>/MAFClientRegCfg/<x> node in MFDCMO. The respective node identifier <x>/MAFClientRegCfg/<x> of this [MAFClientRegCfg] resource instance shall be set as the value of the <x>/authenticationProfile/<x>/trustAnchorCred leaf node.

Table 5.3.13.4-1: Resource [authenticationProfile]

Attribute Name of [authenticationProfile]	Mapping to Nodes in Management Object
SUID	<x>/authenticationProfile/<x>/SUID
TLSCiphersuites	<x>/authenticationProfile/<x>/TLSCiphersuites
symmKeyID	<x>/authenticationProfile/<x>/symmKeyID
symmKeyValue	<x>/authenticationProfile/<x>/symmKeyValue
MAFKeyRegLabels	<x>/authenticationProfile/<x>/MAFKeyRegLabels
MAFKeyRegDuration	<x>/authenticationProfile/<x>/MAFKeyRegDuration
mycertFingerprint	<x>/authenticationProfile/<x>/mycertFingerprint
rawPubKeyID	<x>/authenticationProfile/<x>/rawPubKeyID
mgmtLink [trustAnchorCred]	<x>/authenticationProfile/<x>/trustAnchorCred
mgmtLink [MAFClientRegCfg]	<x>/authenticationProfile/<x>/MAFClientRegCfg

5.3.13.5 Resource [trustAnchorCred]

The Resource [trustAnchorCred] represents configuration information regarding certificates provided by certificate authorities used be managed entities to authenticate peer endpoints, see clause 7.1.6 of TS-0022 [22].

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

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

The attributes of an instance of [trustAnchorCred] shall be mapped to nodes of the MFDCMO as shown in Table 5.3.13.5-1.

Table 5.3.13.5-1: Resource [trustAnchorCred]

Attribute Name of [trustAnchorCred]	Mapping to Nodes in Management Object
certFingerprint	<x>/trustAnchorCred/<x>/certFingerprint
URI	<x>/trustAnchorCred/<x>/URI

5.3.13.6 Resource [myCertFileCred]

The Resource [myCertFileCred] represents configuration information regarding certificates presented by the managed entity to remote entities for the establishment of secure communications, see clause 7.1.5 of TS-0022 [22].

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

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

The attributes of an instance of [myCertFileCred] shall be mapped to nodes of the MFDCMO as shown in Table 5.3.13.6-1.

Table 5.3.13.6-1: Resource [myCertFileCred]

Attribute Name of [myCertFileCred]	Mapping to Nodes in Management Object
SUIDs	<x>/myCertFileCred/<x>/SUIDs
myCertFileFormat	<x>/myCertFileCred/<x>/myCertFileFormat
myCertFileContent	<x>/myCertFileCred/<x>/myCertFileContent

5.3.13.7 Resource [MAFClientRegCfg]

The Resource [MAFClientRegCfg] represents configuration information that permits a MAF client to register with a MAF, see clause 7.1.7 of TS-0022 [22].

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

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

The attributes of an instance of [MAFClientRegCfg] shall be mapped to nodes of the MFDCMO as shown in Table 5.3.13.7-1.

The mgmtLink attribute of the [MAFClientRegCfg] resource points to an [authenticationProfile] resource instance which itself is mapped to a <x>/authenticationProfile/<x> node in MFDCMO. The original value of this mgmtLink attribute needs to be translated such that it points to the <x>/authenticationProfile/<x> node in MFDCMO which corresponds to the linked [authenticationProfile] resource instance. The respective node identifier <x>/authenticationProfile/<x> of this [authenticationProfile] resource instance shall be set as the value of the <x>/dataCollection/<x>/authenticationProfile leaf node.

Table 5.3.13.7-1: Resource [MAFClientRegCfg]

Attribute Name of [MAFClientRegCfg]	Mapping to Nodes in Management Object
fqdn	<x>/MAFClientRegCfg/<x>/fqdn
adminFQDN	<x>/MAFClientRegCfg/<x>/adminFQDN
httpPort	<x>/MAFClientRegCfg/<x>/httpPort
coapPort	<x>/MAFClientRegCfg/<x>/coapPort
websocketPort	<x>/MAFClientRegCfg/<x>/websocketPort
mgmtLink [authenticationProfile]	<x>/MAFClientRegCfg/<x>/authenticationProfile

5.3.13.8 Resource [MEFClientRegCfg]

The Resource [MEFClientRegCfg] represents configuration information that permits a MEF client to register with a MEF, see clause 7.1.8 of TS-0022 [22].

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

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

The attributes of an instance of [MEFClientRegCfg] shall be mapped to nodes of the MFDCMO as shown in Table 5.3.13.7-1.

The mgmtLink attribute of the [MEFClientRegCfg] resource points to an [authenticationProfile] resource instance which itself is mapped to a <x>/authenticationProfile/<x> node in MFDCMO. The original value of this mgmtLink attribute needs to be translated such that it points to the <x>/authenticationProfile/<x> node in MFDCMO which corresponds to the linked [authenticationProfile] resource instance. The respective node identifier <x>/authenticationProfile/<x> of this [authenticationProfile] resource instance shall be set as the value of the <x>/dataCollection/<x>/authenticationProfile leaf node.

Table 5.3.13.8-1: Resource [MEFClientRegCfg]

Attribute Name of [MEFClientRegCfg]	Mapping to Nodes in Management Object
fqdn	<x>/MEFClientRegCfg/<x>/fqdn
adminFQDN	<x>/MEFClientRegCfg/<x>/adminFQDN
httpPort	<x>/MEFClientRegCfg/<x>/httpPort
coapPort	<x>/MEFClientRegCfg/<x>/coapPort
websocketPort	<x>/MEFClientRegCfg/<x>/websocketPort
mgmtLink [authenticationProfile]	<x>/MEFClientRegCfg/<x>/authenticationProfile

5.4 Mapping of procedures for management

5.4.1 Mapping for <mgmtObj> Resource Primitives

5.4.1.1 Create Primitive for <mgmtObj> Resource

5.4.1.1.0 Introduction

The Create Request primitive for the <mgmtObj> Resource, as described in [2], shall be mapped to technology specific requests 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 technology specific requests shall always be performed since, on receiving the Create Request primitive, the corresponding technology specific data model 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 technology specific data model objects are successfully created after receiving the Create Request primitive, then the *objectID* and *objectPath* attribute should be properly set based on the created technology specific data model objects.

5.4.1.1.1 Create Response Status Code Mapping

The result of creating the technology specific data model 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; • 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.
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

5.4.1.2.0 Introduction

The Retrieve Request primitive for the <mgmtObj> Resource, as described in [2], shall be mapped to technology specific requests 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 technology specific requests 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 technology specific data model 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: • 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

5.4.1.3.0 Introduction

The Update Request Primitive for <mgmtObj> Resource can be used to modify the technology specific data model objects or to execute the management commands. The mapping in either case shall be different as the following clauses 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 technology specific data model object as specified in clause 6.3. The Update Request primitive for the <mgmtObj> Resource, as described in [2], shall be mapped to technology specific requests 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 technology specific data model 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: • 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 resurce	(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 - 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

5.4.1.3.2.0 Introduction

This is the case that the Update Primitive targets the attribute that is mapped to the executable Node in technology specific data model object as specified in the clause 6.3. The Update Request primitive for the <mgmtObj> Resource, as described in [2], shall be mapped to technology specific requests that execute the Node in the technology specific data model 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 technology specific requests 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 technology specific data model 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: • 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

5.4.1.4.0 Introduction

The Delete Request primitive for the <mgmtObj> Resource, as described in [2], shall be mapped to technology specific requests 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 technology specific data model objects shall be always deleted. They may not be deleted if the technology specific data model 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 technology specific data model 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: • 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

5.4.1.5.0 Introduction

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 table 5.4.1.5.2-1.

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

5.4.2.0 Introduction

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 [7] 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 [8] 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 [6].

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 [9].

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 [9]

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 [6].

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 [3] and [4].

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 [10] 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 5.4.2.8-1: 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 [6].

5.5 DM Server Interactions

5.5.0 Introduction

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

NOTE 2: OMA has started the work item called "Management Interface to M2M" [**Error! Reference source not found.**] 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 [**Error! Reference source not found.**].

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 [11].

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

The present document 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 the present document, and the requirements for the Requests/Responses translation will be specified by [11].

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 [11].

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. When receiving the oneM2M Service Layer Requests, the IN-CSE shall first authorize the Request based on the <accessControlPoilicy> resource associated with the addressed <mgmtObj> resource, Then, among those DM Servers, 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. The DM Server is agnostic of the identity or roles used in the service layer.

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 clause D.12 of the oneM2M functional architecture oneM2M TS-0001 [1] and Annex D.12 of the Service Layer Core Protocol specification TS-0004 [2].

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.

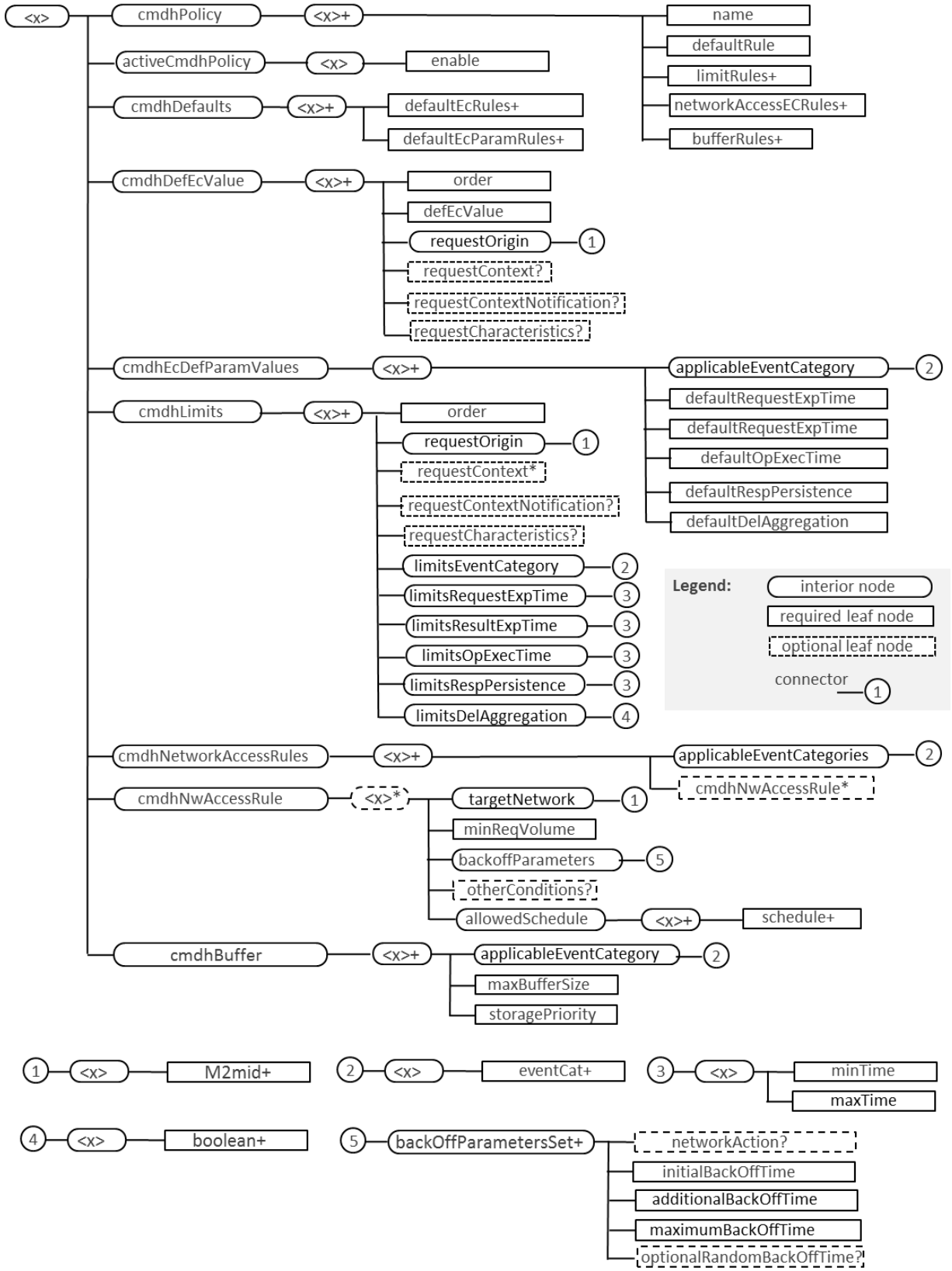

Figure 5.6.1-1: Structure of OMA-DM compatible M2M CMDH Policies MO (MCMDHMO)

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". Detailed information about each of the individual MOs included in the MCMDHMO can be found in clause D.12 of the oneM2M Functional Architecture TS-0001.

<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 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 the cmdhDefaults MO. This MO defines which CMDH related parameters will be used by default when a request or response message contains the *Event Category* parameter but not any other CMDH related parameters and which default *Event Category* parameter shall be used when none is given in the message.

<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>/defaultECParamRules

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	One	node	Get

This interior node is the parent node of cmdhDefEcValue MOs. This MO defines a default Event Category value to be used when the given conditions are met. This default Event Category is applicable only if it is not indicated in the message itself.

<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. This represents an index which defines the order of processing of multiple cmdhDefEcValue instances.

<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. This represents the default Event Category value to be applied when the conditions given in this instance of the cmdhDefEcValue MO are matched.

<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. This represents a list of message originator IDs that need to be matched.

<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. (i.e. one message originator ID)

<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. This represents context information (e.g. battery status) which needs to be matched.

<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. This node indicates whether or not notification procedures apply.

<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. This node indicates request message parameters that need to be matched.

<x>/cmdhEcDefParamValues/

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

This interior node is the parent node of the cmdhEcDefParamValues MO. This MO defines default settings of Request Expiration Timestamp, Result Expiration Timestamp, Operation Execution Time, Response Persistence and Delivery Aggregation message parameter values to be used for specific Event Categories.

<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>/defaultOpExecTime

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>/cmdhEcDefParamValues/<x>/defaultDelAggregation

Status	Tree Occurrence	Format	Min. Access Types
Required	One	bool	Get

This leaf node contains the defaultDelAggregation 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. This MO defines the allowed limits for CMDH related parameters in request or response messages with a given *Event Category* value.

<x>/cmdhLimits/<x>

Status	Tree Occurrence	Format	Min. Access Types
Required	One	node	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 , i.e. one message originator ID.

<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	chr	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 Timestamp values.

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

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

This leaf node contains the minimal value of the Request Expiration Timestamp 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 value of the Request Expiration Timestamp 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 Timestamp values.

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

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

This leaf node contains the minimal value of the Result Expiration Timestamp parameter 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 value of the Result Expiration Timestamp parameter 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 value of the Operation Execution Time parameter 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 value of the Operation Execution Time parameter 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 value of the Response Persistence parameter 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 value of the Response Persistence parameter 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	One	node	Get

This interior node is the parent node of cmdhNetworkAccessRules MOs. This MO defines the conditions when usage of specific Underlying Networks is allowed for request or response messages with a given *Event Category* value.

<x>/cmdhNetworkAccessRules/<x>

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

This interior placeholder node represents the instances of the cmdhNetworkAccessRulesMO.

<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>/cmdhNetworkAccessRules/<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	One	node	Get

This interior node is the parent node of cmdhNwAccessRule MOs.

<x>/cmdhNwAccessRule/<x>

Status	Tree Occurrence	Format	Min. Access Types
Optional	ZeroOrMore	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	node	Get

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

<x>/cmdhNwAccessRule/<x>/targetNetwork/<x>

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

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

<x>/cmdhNwAccessRule/<x>/targetNetwork/<x>/m2mid

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

Each of these leaf nodes contains one m2mid, representing an identifier for a targetNetwork.

<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 bytes.

<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/backOffParametersSet

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

This interior node represents the root of a backOffParametersSet.

<x>/cmdhNwAccessRule/<x>/backOffParameters/backOffParametersSet/networkAction

Status	Tree Occurrence	Format	Min. Access Types
Optional	ZeroOrOne	int	Get

This leaf node contains an optional networkAction element.

<x>/cmdhNwAccessRule/<x>/backOffParameters/backOffParametersSet/initialBackOffTime

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

This leaf node contains the initialBackOffTime in units of milliseconds.

<x>/cmdhNwAccessRule/<x>/backOffParameters/backOffParametersSet/additionalBackOffTime

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

This leaf node contains the additionalBackOffTime in units of milliseconds.

<x>/cmdhNwAccessRule/<x>/backOffParameters/backOffParametersSet/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>/backOffParameters/backOffParametersSet/optionalRandomBackoffTime

Status	Tree Occurrence	Format	Min. Access Types
Optional	ZeroOrOne	int	Get

This leaf node contains the optionalRandomBackoffTime in units of milliseconds.

<x>/cmdhNwAccessRule/<x>/otherConditions

Status	Tree Occurrence	Format	Min. Access Types
Optional	ZeroOrOne	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 of the cmdhNwAccessRule resource instance.

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

Status	Tree Occurrence	Format	Min. Access Types
Required	OneOrMore	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 the syntax defined for the scheduleElement in the Core Protocol Specification TS-0004.

<x>/cmdhBuffer

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

This interior node is the parent node of the cmdhBuffer MO. This MO defines limits of supported buffer size to be used for storing pending messages with a given Event Category value and their priorities when deletion of messages cannot be avoided.

<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>/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. Buffer Size is defined in units of bytes.

<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.

5.6.2 M2M FieldDeviceConfig (MFDCMO)

The M2M FieldDeviceConfig MO (MFDCMO) resides in the Management Tree of any ADN, ASN or MN which supports Device Management via OMA DM 1.3 and OMA DM 2.0. This MO corresponds to instances of the Field Device Configuration resources specified in oneM2M TS-0022 [22] which all represent specializations of the *mgmtObj* resource type.

This MO maintains information required for registration of AEs and CSEs to their registrar CSE, application configuration parameters which ma be needed by AEs, as well information required to configure security profiles for communication over the Mca and Mcc reference points defined in oneM2M TS-0001 [11], and over the Mmaf and Mmef reference points defined in TS-0032 [23] .

Figure 5.6.2-1 gives the pictorial description of the MFDCMO.

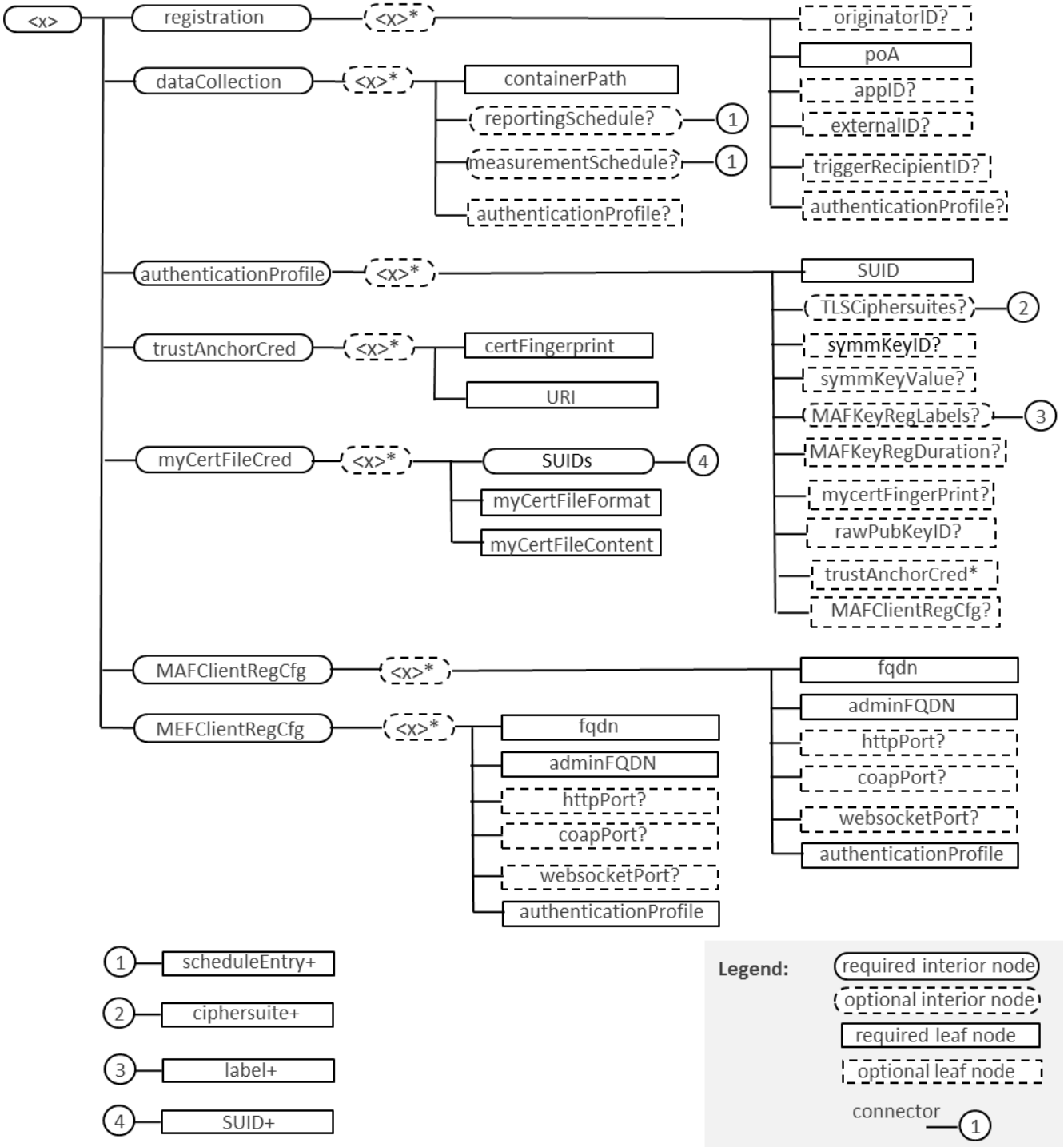

Figure 5.6.2-1: Structure of OMA-DM compatible M2M FieldDeviceConfig MO (MFDCMO)

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 MFDCMO which includes MOs related to field device configuration. The parent node of this node defines the location of this MO in the Management Tree. The Management Object Identifier for the MFDCMO shall be: "urn:oma:mo:ext-onem2m-mfdcmo:1.0". Detailed information about each of the individual MOs included in the MFDCMO can be found in oneM2M specification TS-0022 "Field Device Configuration".

<x>/registration

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

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

<x>/registration/<x>

Status	Tree Occurrence	Format	Min. Access Types
Optional	ZeroOrMore	node	Get

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

<x>/registration/<x>/originatorID

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

This leaf node contains the originatorID attribute of a registration resource instance.

<x>/registration/<x>/poA

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

This leaf node contains the poA attribute of a registration resource instance.

<x>/registration/<x>/appID

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

This leaf node contains the appID attribute of a registration resource instance.

<x>/registration/<x>/externalID

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

This leaf node contains the externalID attribute of a registration resource instance.

<x>/registration/<x>/triggerRecipientID

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

This leaf node contains the triggerRecipientID attribute of a registration resource instance.

<x>/registration/<x>/authenticationProfile

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

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

<x>/dataCollection

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

This interior node is the parent node of a dataCollection MO instance.

<x>/dataCollection/<x>

Status	Tree Occurrence	Format	Min. Access Types
Optional	ZeroOrMore	node	Get

This placeholder node represents an instance of a dataCollection MO.

<x>/dataCollection/<x>/containerPath

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

This leaf node contains the containerPath attribute of a dataCollection resource instance.

<x>/dataCollection/<x>/reportingSchedule

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

This interior node is the parent node of the reportingSchedule attribute of a dataCollection resource instance.

<x>/dataCollection/<x>/reportingSchedule/scheduleEntry

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

Each of these leaf nodes contains a scheduleEntry element of the reportingSchedule attribute of the dataCollection resource instance.

<x>/dataCollection/<x>/measurementSchedule

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

This interior node is the parent node of the measurementSchedule attribute of a dataCollection resource instance.

<x>/dataCollection/<x>/measurementSchedule/scheduleEntry

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

Each of these leaf nodes contains a scheduleEntry element of the measurementSchedule attribute of the dataCollection resource instance.

<x>/dataCollection/<x>/authenticationProfile

Status	Tree Occurrence	Format	Min. Access Types

Optional	ZeroOrOne	chr	Get

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

<x>/authenticationProfile

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

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

<x>/authenticationProfile/<x>

Status	Tree Occurrence	Format	Min. Access Types
Optional	ZeroOrMore	node	Get

This placeholder node represents an instance of an authenticationProfile MO.

<x>/authenticationProfile/<x>/SUID

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

This leaf node contains the SUID attribute of an authenticationProfile resource instance.

<x>/authenticationProfile/<x>/TLSCiphersuites

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

This interior node is the parent node of the TLSCiphersuites attribute of an authenticationProfile resource instance.

<x>/authenticationProfile/<x>/TLSCiphersuites/ciphersuite

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

Each of these leaf nodes contains a ciphersuite element in hexchar format of the TLSCiphersuites attribute of the authenticationProfile resource instance.

<x>/authenticationProfile/<x>/symmKeyID

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

This leaf node contains the symmKeyID attribute of an authenticationProfile resource instance.

<x>/authenticationProfile/<x>/symmKeyValue

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

This leaf node contains the symmKeyValue attribute of an authenticationProfile resource instance.

<x>/authenticationProfile/<x>/MAFKeyRegLabels

Status	Tree Occurrence	Format	Min. Access Types

Optional	ZeroOrOne	node	Get

This interior node is the parent node of the MAFKeyRegLabels attribute of an authenticationProfile resource instance.

<x>/authenticationProfile/<x>/MAFKeyRegLabels/label

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

Each of these leaf nodes contains a label element of the MAFKeyRegLabels attribute of the authenticationProfile resource instance.

<x>/authenticationProfile/<x>/MAFKeyRegDuration

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

This leaf node contains the MAFKeyRegDuration attribute of an authenticationProfile resource instance.

<x>/authenticationProfile/<x>/mycertFingerprint

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

This leaf node contains the mycertFingerprint attribute of an authenticationProfile resource instance.

<x>/authenticationProfile/<x>/rawPubKeyID

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

This leaf node contains the rawPubKeyID attribute of an authenticationProfile resource instance.

<x>/authenticationProfile/<x>/trustAnchorCred

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

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

<x>/authenticationProfile/<x>/MAFClientRegCfg

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

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

<x>/trustAnchorCred

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

This interior node is the parent node of a trustAnchorCred MO instance.

<x>/trustAnchorCred/<x>

Status	Tree Occurrence	Format	Min. Access Types
Optional	ZeroOrMore	node	Get

This placeholder node represents an instance of a trustAnchorCred MO.

<x>/trustAnchorCred/<x>/certFingerprint

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

This leaf node contains the certFingerprint attribute of a trustAnchorCred resource instance.

<x>/trustAnchorCred/<x>/URI

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

This leaf node contains the URI attribute of a trustAnchorCred resource instance.

<x>/myCertFileCred

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

This interior node is the parent node of a myCertFileCred MO instance.

<x>/myCertFileCred/<x>

Status	Tree Occurrence	Format	Min. Access Types
Optional	ZeroOrMore	node	Get

This placeholder node represents an instance of a myCertFileCred MO.

<x>/myCertFileCred/<x>/SUIDs

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

This interior node is the parent node of the SUIDs attribute of a myCertFileCred resource instance.

<x>/myCertFileCred/<x>/SUIDs/SUID

Status	Tree Occurrence	Format	Min. Access Types
Required	OneOrMore	int	Get

Each of these leaf nodes contains a SUID element of the SUIDs attribute of the myCertFileCred resource instance.

<x>/myCertFileCred/<x>/myCertFileFormat

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

This leaf node contains the myCertFileFormat attribute of an authenticationProfile resource instance.

<x>/myCertFileCred/<x>/myCertFileContent

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

This leaf node contains the myCertFileContent attribute of a myCertFileCred resource instance.

<x>/MAFClientRegCfg

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

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

<x>/MAFClientRegCfg/<x>

Status	Tree Occurrence	Format	Min. Access Types
Optional	ZeroOrMore	node	Get

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

<x>/MAFClientRegCfg/<x>/fqdn

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

This leaf node contains the fqdn attribute of a MAFClientRegCfg resource instance.

<x>/MAFClientRegCfg/<x>/adminFQDN

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

This leaf node contains the adminFQDN attribute of a MAFClientRegCfg resource instance.

<x>/MAFClientRegCfg/<x>/httpPort

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

This leaf node contains the httpPort attribute of a MAFClientRegCfg resource instance.

<x>/MAFClientRegCfg/<x>/coapPort

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

This leaf node contains the coapPort attribute of a MAFClientRegCfg resource instance.

<x>/MAFClientRegCfg/<x>/websocketPort

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

This leaf node contains the websocketPort attribute of a MAFClientRegCfg

resource instance.

<x>/MAFClientRegCfg/<x>/authenticationProfile

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

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

<x>/MEFClientRegCfg

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

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

<x>/MEFClientRegCfg/<x>

Status	Tree Occurrence	Format	Min. Access Types
Optional	ZeroOrMore	node	Get

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

<x>/MEFClientRegCfg/<x>/fqdn

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

This leaf node contains the fqdn attribute of a MEFClientRegCfg resource instance.

<x>/MEFClientRegCfg/<x>/adminFQDN

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

This leaf node contains the adminFQDN attribute of a MEFClientRegCfg resource instance.

<x>/MEFClientRegCfg/<x>/httpPort

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

This leaf node contains the httpPort attribute of a MEFClientRegCfg resource instance.

<x>/MEFClientRegCfg/<x>/coapPort

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

This leaf node contains the coapPort attribute of a MEFClientRegCfg resource instance.

<x>/MEFClientRegCfg/<x>/websocketPort

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

This leaf node contains the websocketPort attribute of a MEFClientRegCfg resource instance.

<x>/MEFClientRegCfg/<x>/authenticationProfile

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

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

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 [5] (shortened in OMA LwM2M).

Table 6.1-1 Basic data types

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.
The mgmtLink attribute in the <mgmtObj> Resource	Objlink	The OMA LwM2M Objlink data type describes the format of a reference to an Object Instance. The mgmtLink attribute in the <mgmtObj> Resource supports the hierarchy of <mgmtObj> Resource.

6.2 Mapping of Identifiers

6.2.0 Introduction

OMA LwM2M [5] 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 [5], oneM2M identifiers needs to be mapped to identifiers specified by OMA LwM2M [5].

6.2.1 Device identifier

A unique identifier is assigned to the Device and referenced as Endpoint Client Name in OMA LwM2M [5].This value is globally unique and is formatted as a URN.

Several URN formats are recommended in OMA LwM2M [5] as UUID URN defined in [14], OPS URN defined in [16], IMEI URN defined in [15].

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

6.2.2 Object identifier

In OMA LwM2M [5], 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[:{version}] **(**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 *objectIDs* attribute which can contain several references to OMA LwM2M [5] Object identifiers expressed as OMNA registered URN.

6.2.3 Object Instance Identifier

OMA LwM2M [5] 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 *objectIDs* as described in previous clause.

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

6.2.0 Introduction

This clause describes how to map the <mgmtObj> Resources specified in the annex D of [1] to the relevant Objects specified in OMA LwM2M [5].

6.3.1 General Mapping Assumptions

OMA LwM2M [5] 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 *objectIDs* as defined in clause 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 [5] resource.

In case the *objectPath* is multiple (several Object Instances are referenced in that Resource), a specified couple composed of one element of the *objectIDs* 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 [5] 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:

Table 6.3.2-1 Context of resource [firmware]

Context	Mapping
objectIDs	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.

Table 6.3.2-2 Attributes of resource [firmware]

Attribute Name of [firmware]	Mapping to resources in LwM2M Device Object Instance
version	7 PkgVersion
name	6 Pkgname
URL	1 PackageURI
update	2 Update
updateStatus	5 UpdateResult

6.3.3 Resource [software]

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

The context of this Resource is the following.

Table 6.3.3-1 Context of resource [software]

Context	Mapping
objectIDs	urn:oma:lwm2m:oma:9
objectPath	/9/{i}

The attributes of this Resource shall be mapped to specific resources of the LwM2M Software Management Object (urn:oma:lwm2m:oma:9 [18])

Table 6.3.3-2 Attributes of resource [software]

Attribute Name of [software]	Mapping to resources in LwM2M Software management Device Object Instance
version	1 Version of the software package
name	0 Name of the software package
URL	3 Package URI
install	4 Install
uninstall	6 Uninstall
installStatus	9 Update Result
activate	10 Activate
deactivate	11 Deactivate
activeStatus	12 ActivationState

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.

Table 6.3.4-1 Context of resource [memory]

Context	Mapping
objectIDs	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:

Table 6.3.4-1 Attributes of resource [memory]

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 the present document.

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 .

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.

Table 6.3.7-1 Context of resource [battery]

Context	Mapping
objectIDs	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.

Table 6.3.7-2 Attributes of resource [battery]

Attribute Name of [battery]	Mapping to resources in LwM2M Device Object Instance
batteryLevel	9 current battery level as percentage
batteryStatus	20 contains the internal battery status

m2m:batteryStatus [2]
"NORMAL"
"CHARGING"
"CHARGE-COMPLETE"
"DAMAGED"
"LOW-BATTERY"
"NOT-INSTALLED"
"UNKNOWN"

Battery Status	Description
0	The battery is operating normally and not on power.
1	The battery is currently charging.
2	The battery is fully charged and still on power.
3	The battery has some problem.
4	The battery is low on charge.
5	The battery is not installed.
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.

Table 6.3.8-1 Context of resource [deviceInfo]

Context	Mapping
objectIDs	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.

Table 6.3.8-2 Attributes of resource [deviceInfo]

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 Management Object (urn:oma:lwm2m:oma:15 [19])

The context of this Resource is the following.

Table 6.3.9-1 Context of resource [deviceCapability]

Context	Mapping
objectIDs	urn:oma:lwm2m:oma:15
objectPath	/15/{i}

The attributes of this Resource shall be mapped to specific resources of the LwM2M Device Capability Management Object as follows.

Table 6.3.9-2 Attributes of resource [deviceCapability]

Attribute Name of [deviceCapability]	Mapping to resources in LwM2M Device Object Instance	
capabilityName	2	Property
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.

Table 6.3.10-1 Context of resource [reboot]

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

The attributes of this Resource shall be mapped to LwM2M Device Object Instance as follows.

Table 6.3.10-2 Attributes of resource [reboot]

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. For OMA LwM2M, this Resource shall be mapped to one instance of LwM2M Event Log Object (LwM2M Object: {20}).

The context of this Resource is as follows.

Table 6.3.11-1 Context of resource [eventLog]

Context	Mapping
objectIDs	urn:oma:lwm2m:oma:{20}
objectPath	/{20}/{i}

The attributes of this Resource shall be mapped to LwM2M Device Object Instance as follows.

Table 6.3.11-2 Attributes of resource [eventLog]

Attribute Name of [eventLog]	Mapping to resources in LwM2M Object Instance
logTypeId	4010 LogClass: 1 (system) if the logTypeId of oneM2M [eventLog] resource is “System”; 2 (security) if the logTypeId of oneM2M [eventLog] resource is “Security”; 3 or 6 (event of charging) if the logTypeId of oneM2M [eventLog] resource is “Event”. The charging event shall be mapped to 6; generic events shall be mapped to 3; 4 (trace) if the logTypeId of oneM2M [eventLog] resource is “Trace”; 5 (panic) if the logTypeId of oneM2M [eventLog] resource is “Panic”.
logData	4014 LogData The log data is mapped transparently without any transformation. The data format is considered as unspecified opaque (sequence of bytes) in LwM2M. The LwM2M ‘LogDataFormat’ resource (4015) is not used for the mapping.
logStatus	4013 LogStatus: oneM2M logStatus attribute is translated as follows to LwM2M LogStatus Resource 0 : when logging activity is started (oneM2M logStatus : 1) 1 : when logging activity is stopped without error (oneM2M logStatus : 2) 3 : when logData attribute must be ignored (oneM2M logStatus :4) 5 : when logging activity is stopped with error (oneM2M logStatus :5) 128 (0x80) : when the status of the logging activity is unknown (oneM2M logStatus :3)
logStart	4011 LogStart: When oneM2M logStart attribute is set to “True”, CSE shall execute the LogStart command without argument (default)
logStop	4012 LogStop: When oneM2M logStop attribute is set to “True”, CSE shall execute the LogStop command without argument (default)

6.3.12 Resource [cmdhPolicy]

6.3.12.0 Introduction

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.

The mapping of CMDH Policy Resources on LwM2M Device Management technology is addressed through the definitions of 10 specific LwM2M Objects:

- CmdhPolicy Object
- ActiveCmdhPolicy Object
- CmdhDefaults Object
- CmdhDefEcValue Object
- CmdhEcDefParamsValues Object
- CmdhLimits Object
- CmdhNetworkAccessRules Object
- CmdhNwAccessRule Object
- CmdhBuffer Object
- CmdhBackOffParametersSet Object

These LwM2M Objects are specified in section 6.6.1 of this present document and are registered in OMNA as LwM2M objects.

The Resource Type [cmdhPolicy] is a multi-instance Resource where each instance of the Resource shall map to an instance of the LwM2M cmdhPolicy Object.

The context of this Resource is as follows

Table 6.3.12.0-1: Context of resource [cmdhPolicy]

Context	Mapping
objectIDs	urn:oma:lwm2m:ext:2048
objectPath	/2048/{i}

The attributes of an instance of [cmdhPolicy] shall be mapped to LwM2M resources of a given cmdhPolicy Object instance as follows :

Table 6.3.12.0-2: Attributes of resource [cmdhPolicy]

Attribute Name of [cmdhPolicy]	Mapping to resources in LwM2M Object Instance
name	0 : Name
cmdhDefaults	1 : DefaultRule
cmdLimits	2 : LimitRules
cmdhNwAccRules	3 : NetworkAccessECRules
cmdhBuffer	4 : BufferRules

6.3.12.1 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 *cmdhPolicy* which is mapped on the ActiveLink resource of the LwM2M ActiveCmdhPolicy Object instance pointing to the active instance of the LwM2M CmdhPolicy Object.

The context of this Resource is as follows

Table 6.3.12.1-1: Context of resource [activeCmdhPolicy]

Context	Mapping
objectIDs	urn:oma:lwm2m:ext:2049
objectPath	/2049/0

The attribute of [activeCmdhPolicy] shall be mapped to the resource of the LwM2M ActiveCmdhPolicy Object Instance as follows:

Table 6.3.12.1-2: Attributes of resource [activeCmdhPolicy]

Attribute Name of [activeCmdhPolicy]	Mapping to resources in LwM2M Object Instance
cmdhPolicy	0 : ActiveLink At most one <cmdhPolicy> instance shall be enabled at a time. Hence, there can only be a single instance of the activeCmdhPolicy whose cmdhPolicy attribute points to the active CMDH policy.

6.3.12.2 Resource [cmdhDefaults]

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

The Resource [cmdhDefaults] is a multi-instance Resource where each instance of the Resource shall map to an instance of the LwM2M cmdhDefaults Object.

The context of this Resource is as follows

Table 6.3.12.2-1: Context of resource [cmdhDefaults]

Context	Mapping
objectIDs	urn:oma:lwm2m:ext:2050
objectPath	/2050/{i}

The attributes of an instance of [cmdhDefaults] shall be mapped to the resources of a LwM2M CmdDefaults Object instance as follows:

Table 6.3.12.2-2: Attributes of resource [cmdhDefaults]

Attribute Name of [cmdhDefaults]	Mapping to resources in LwM2M Object Instance
cmdhDefEcValue	0 : DefaultEcRules
cmdhEcDefParamValues	1 : DefaultEcParamRules

6.3.12.3 Resource [cmdhDefEcValue]

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

The context of this Resource is as follows:

Table 6.3.12.3-1: Context of resource [cmdhDefEcValue]

Context	Mapping
objectIDs	urn:oma:lwm2m:ext:2051
objectPath	/2051/{i}

The Resource [cmdhDefEcValue] is a multi-instance Resource where each instance of the Resource shall map to an instance of the LwM2M CmdhDefEcValue Object.

The attributes of an Instance of this Resource shall be mapped to the resources of a LwM2M CmdhDefEcValue Object instance as follows:

Table 6.3.12.3-2: Attributes of resource [cmdhDefEcValue]

Attribute Name of [cmdhDefEcValue]	Mapping to resources in LwM2M Object Instance
order	0 : Order
defEcValue	1 : DefEcValue
requestOrigin	2 : RequestOrigin
requestContext	3 : RequestContext
requestContextNotification	4 : RequestContextNotification
requestCharacteristics	5 : RequestCharacteristics

6.3.12.4 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].

The context of this Resource is as follows:

Table 6.3.12.4-1: Context of resource [cmdhEcDefParamValues]

Context	Mapping
objectIDs	urn:oma:lwm2m:ext:2051
objectPath	/2052/{i}

The Resource [cmdhEcDefParamValues] is a multi-instance Resource where each instance of the Resource shall map to an instance of the LwM2M CmdhEcDefParamValues Object.

The attributes of an instance of [cmdhEcDefParamValues] shall be mapped to the resources of a LwM2M CmdhEcDefParamValues Object instance as follows:

Table 6.3.12.4-2: Attributes of resource [cmdhEcDefParamValues]

Attribute Name of [cmdhEcDefParamValues]	Mapping to resources in LwM2M Object Instance
applicableEventCategory	0 : ApplicableEventCategory
defaultRequestExpTime	1 : DefaultRequestExpTime
defaultResultExpTime	2 : DefaultResultExpTime
defaultOpExecTime	3 : DefaultOpExecTime
default RespPersistence	4 : DefaultRespPersistence
defaultDelAggregation	5 : DefaultDelAggregation

6.3.12.5 Resource [cmdhLimits]

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

The context of this Resource is as follows:

Table 6.3.12.5-1: Context of resource [cmdhLimits]

Context	Mapping
objectIDs	urn:oma:lwm2m:ext:2053
objectPath	/2053/{i}

The Resource [cmdhLimits] is a multi-instance Resource where each instance of the Resource shall map to an instance of the CmdhLimits Object.

The attributes of an instance of [cmdhLimits] shall be mapped to the resources of an instance of the LwM2M CmdhLimits Object as follows:

Table 6.3.12.5-2: Attributes of resource [cmdhLimits]

Attribute Name of [cmdhLimits]	Mapping to resources in LwM2M CmdhLimits Object Instance
order	0 : Order
requestOrigin	1 : RequestOrigin
requestContext	2 : RequestContext
requestContextNotification	3 : RequestContextNotification
requestCharacteristics	4 : RequestCharacteristics
limitsEventCategory	5 : LimitsEventCategory
limitsRequestExpTime	6 : LimitsRequestExpTime
limitsOpExecTime	7 : LimitsOpExecTime
limitsRespPersistence	8 : LimitsRespPersistence
limitsDelAggregation	9 : LimitsDelAggregation

6.3.12.6 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].

The context of this Resource is as follows:

Table 6.3.12.6-1: Context of resource [cmdhNetworkAccessRules]

Context	Mapping
objectIDs	urn:oma:lwm2m:ext:2054
objectPath	/2054/{i}

The Resource [cmdhNetworkAccessRules] is a multi-instance Resource where each instance of the Resource shall map to an instance of one instance of the LwM2M CmdhNetworkAccessRules Object.

The attributes of an instance of [cmdhNetworkAccessRules] shall be mapped to the resources of a LwM2M CmdhNetworkAccessRules Object Instance as follows:

Table 6.3.12.6-2: Attributes of resource [cmdhNetworkAccessRules]

Attribute Name of [cmdhNetworkAccessRules]	Mapping to resources in LwM2M Object Instance
applicableEventCategories	0 : ApplicableEventCategories
cmdhNwAccessRule	1 : NetworkAccessRule

6.3.12.7 Resource [cmdhNwAccessRule]

The Resource [cmdhNwAccessRule] defines 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].

The context of this Resource is as follows:

Table 6.3.12.7-1: Context of resource [cmdhNwAccessRule]

Context	Mapping
objectIDs	urn:oma:lwm2m:ext:2055
objectPath	/2055/{i}

The Resource [cmdhNwAccessRule] is a multi-instance Resource where each instance of the Resource shall map to an instance of the LwM2M CmdhNwAccessRule Object.

The attributes of an instance of [cmdhNwAccessRule] shall be mapped to the resources of a LwM2M cmdhNwAccessRule Object Instance as follows:

Table 6.3.12.7-2: Attributes of resource [cmdhNwAccessRule]

Attribute Name of [cmdhNwAccessRule]	Mapping to resources in LwM2M Object Instance
targetNetwork	0 : TargetNetwork
minReqVolume	1 : MinReqVolume
spreadingWaitTime	2 : SpreadingWaitTime
backOffParameters	3 : BackOffParameters
otherConditions	4 : OtherConditions
allowedSchedule	5 : AllowedSchedule

6.3.12.8 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].

The context of this Resource is as follows:

Table 6.3.12.8-1: Context of resource [cmdhBuffer]

Context	Mapping
objectIDs	urn:oma:lwm2m:ext:2056
objectPath	/2056/{i}

The Resource [cmdhBuffer] is a multi-instance Resource where each instance of the Resource shall map to an instance of the LwM2M CmdhBuffer Object.

The attributes of an instance of [cmdhBuffer] shall be mapped to the resources of an LwM2M cmdhBuffer Object Instance as follows:

Table 6.3.12.8-2: Attributes of resource [cmdhBuffer]

Attribute Name of [cmdhBuffer]	Mapping to resources in LwM2M Object Instance
applicableEventCategory	0 : ApplicableEventCategory
maxBufferSize	1 : MaxBufferSize
storagePriority	2 : StoragePriority

6.4 Mapping of procedures for management

6.4.0 Introduction

In this clause, 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 [17]. 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 table 6.4.1-1.

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
error – Unsupported data type	4.15 Unsupported content format	The specified format is not supported

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 table 6.4.2-1.

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 – bad request	4.00 Bad Request	Undetermined error occurred
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
error– Unsupported data type	4.06 Not Acceptable	None of the preferred Content-Formats can be returned

6.4.3 Update primitive for <mgmtObj> Resource

6.4.3.0 Introduction

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 table 6.4.3.1-1.

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
success	2.31 Continue	
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
error -	4.08 Request Entity incomplete	
error -	4.13 Request Entity too large	
error -	4.15 Unsupported content Format	

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 table 6.4.3.2-1.

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 table 6.4.4-1.

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

6.4.5.0 Introduction

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 table 6.4.5.1-1.

Table 6.4.5.1-1: Notify for Subscription Returned Codes Mapping

oneM2M Primitive Status Code	Returned Codes	Description
success	2.05 Content	Subscription successfully registered (token returned)
error - not allowed	4.00 Bad Request	Undetermined error occurred
error - no privilege	4.01 Unauthorized	Access Right Permission Denied
error – not found	4.04 Not Found	Target Not found
error – not allowed	4.05 Method Not Allowed	Registration not allowed
error -	4.06 Not Acceptable	None of the preferred Content-Formats can be returned

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 is sent from the LwM2M Server to the LwM2M client to end an observation relationship for Object Instance or Resource(s). LwM2M enabler provides two ways for the LwM2M Server to cancel observation :

- At any moment, in specifying in the LwM2M Cancel Observation operation, the Resource,; the Object or the Object Instance(s) for which the Observation has to be un-subscribed. 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 table 6.4.5.3-1.

Table 6.4.5.3-1: Notify for Notification Returned Codes Mapping

oneM2M Primitive Status Code	Returned Codes	Description
success	2.05	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]

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

In addition to the status code mapping for the <mgmtObj> CRUD Operations, no [firmware] specific status code is defined in [5].

6.4.6.2 Resource [software]

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

In addition to the status code mapping for the <mgmtObj> CRUD Operations, no [software] specific status code is defined in [5].

6.4.6.3 Resource [memory]

The generic <mgmtObj> mappings described in the clauses 6.4.1 and 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 [5].

6.4.6.4 Resource [battery]

The generic <mgmtObj> mappings described in the clauses 6.4.1 and 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 [5].

6.4.6.5 Resource [deviceInfo]

The generic <mgmtObj> mappings described in the clauses 6.4.1 and 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 [5].

6.4.6.6 Resource [deviceCapability]

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

In addition to the status code mapping for the <mgmtObj> CRUD Operations, no [deviceCapability] specific status code is defined in [5].

6.4.6.7 Resource [reboot]

The generic <mgmtObj> mappings described in the clauses 6.4.1 and 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 [5].

6.5 LwM2M Server Interactions

6.5.0 Introduction

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

The present document 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. When receiving the oneM2M Service Layer Requests, the IN-CSE shall first authorize the Request based on the <accessControlPoilicy> resource associated with the addressed <mgmtObj> resource, Then, 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. The LwM2M Server is agnostic of the identity or roles used in the service layer.

6.6 New LwM2M Objects

6.6.0 Introduction

These LwM2M Objects are specified by oneM2M organization. They have to be registered using the process defined by OMNA (Open Mobile Naming Authority).

The Object ID (e.g. "X") of the LwM2M Objects specified here, shall be allocated by OMNA, and will be in the range [2 048 – 10 240]

6.6.1 LwM2M CMDH Policy Objects

6.6.1.0 Introduction

The LwM2M Objects specified here are used for mapping the CMDH Policy Resources defined in oneM2M

This oneM2M CMDH Policy mapping is addressed through the specification of 10 specific LwM2M Objects registered in OMNA:

- CmdhPolicy Object (urn:oma:lwm2m:ext:2048)
- ActiveCmdhPolicy Object (urn:oma:lwm2m:ext:2049)
- CmdhDefaults (urn:oma:lwm2m:ext:2050)
- CmdhDefEcValue Object (urn:oma:lwm2m:ext:2051)
- CmdhEcDefParamsValues Object (urn:oma:lwm2m:ext:2052)
- CmdhLimits Object (urn:oma:lwm2m:ext:2053)
- CmdhNetworkAccessRules Object (urn:oma:lwm2m:ext:2054)
- CmdhNwAccessRule Object (urn:oma:lwm2m:ext:2055)
- CmdhBuffer Object (urn:oma:lwm2m:ext:2056)
- CmdhBackOffParametersSet Object (urn:oma:lwm2m:ext:2057)

6.6.1.1 CmdhPolicy Object

This Object provides links to set of rules associated with a specific CSE that governs the behavior of that CSE regarding rejecting, buffering and sending request or response messages via the Mcc reference point.

Table 6.6.1.1-1: Object definition

Name	Object ID	Instances	Mandatory	Object URN
CmdhPolicy	2048	Multiple	Optional	urn:oma:lwm2m:ext:2048

Table 6.6.1.1-2: Resource definitions

ID	Name	Operations	Instances	Mandatory	Type	Range or Enumeration	Units	Description
0	Name	RW	Single	Mandatory	String			Contains the name of a CmdhPolicy Object Instance
1	DefaultRule	RW	Single	Mandatory	Objlink			1 reference to CmdhDefaults Object Instance
2	LimitRules	RW	Multiple	Mandatory	Objlink			1 or more references to CmdhLimits Object Instances
3	NetworkAccessECRules	RW	Multiple	Mandatory	Objlink			1 or more references to CmdhNetworkAccessRules Object Instances
4	BufferRules	RW	Multiple	Mandatory	Objlink			1 or more references to CmdhBuffer Object Instances

6.6.1.2 ActiveCmdhPolicy Object

This Object provides a link to the currently active set of CMDH policies

Table 6.6.1.2-1: Object definition

Name	Object ID	Instances	Mandatory	Object URN
ActiveCmdhPolicy	2049	Single	Optional	urn:oma:lwm2m:ext:2049

Table 6.6.1.2-2: Resource definitions

ID	Name	Operations	Instances	Mandatory	Type	Range or Enumeration	Units	Description
0	ActiveLink	RW	Single	Mandatory	Objlink			Contains the reference to the CMDH policies (CmdhPolicy Object Instance) currently active for the associated CSE.

6.6.1.3 CmdhDefaults Object

Defines which CMDH related parameters will be used by default when a request or response message contains the *Event Category* parameter but not any other CMDH related parameters and which default *Event Category* parameter shall be used when none is given in the request or response message.

Table 6.6.1.3-1: Object definition

Name	Object ID	Instances	Mandatory	Object URN
CmdhDefaults	2050	Multiple	Optional	urn:oma:lwm2m:ext:2050

Table 6.6.1.3-2: Resource definitions

ID	Name	Operations	Instances	Mandatory	Type	Range or Enumeration	Units	Description
0	DefEcRules	RW	Multiple	Mandatory	Objlink			1 or more references to CmdhDefEcValue Object Instances containing default values for the **ec** (event category) parameter of an incoming request or response when this parameter is not indicated in the message itself
1	EcDefParamRules	RW	Multiple	Mandatory	Objlink			1 or more references to CmdhEcDefParamValues Object Instances

6.6.1.4 CmdhDef EcValues Object

This Object represents default set of values for the Event Category parameter of an incoming request or response message.

Table 6.6.1.4-1: Object definition

Name	Object ID	Instances	Mandatory	Object URN
CmdhDefECValues	2051	Multiple	Optional	urn:oma:lwm2m:ext:2051

Table 6.6.1.4-2: Resource definitions

ID	Name	Operations	Instances	Mandatory	Type	Range or Enumeration	Units	Description
0	Order	RW	Single	Mandatory	Integer			Contains an index defining the order of processing this CmdhDefEcValue Object Instance will be handled
1	DefEcValue	RW	Single	Mandatory	String			Represents the default Event category value to be applied when the conditions given in this Object Instance are matched
2	RequestOrigin	RW	Multiple	Mandatory	String			List of zero or more Local AE-IDs, App-IDs, or the strings “localAE” or “thisCSE”
3	RequestContext	RW	Single	Optional	String			Contains the requestContext information of this Object Instance which needs to be matched
4	RequestContextNotification	RW	Single	Optional	Boolean			Contains true/false flag indicating whether or not notification procedures apply.
5	RequestCharacteristics	RW	Single	Optional	String			Represents conditions pertaining to the request itself, (e.g. the requested ***Response Type***) than needs to be matched

6.6.1.5 CmdhEcDefParamValues Object

This Object represents a specific set of default values for the CMDH related parameters Request Expiration Timestamp, Result Expiration Timestamp, Operational Execution Time, Result Persistence and Delivery Aggregation that are applicable for a given Event Category if these parameters are not specified in the message.

Table 6.6.1.5-1: Object definition

Name	Object ID	Instances	Mandatory	Object URN
CmdhEcParamValues	2052	Multiple	Optional	urn:oma:lwm2m:ext:2052

Table 6.6.1.5-2: Resource definitions

ID	Name	Operations	Instances	Mandatory	Type	Range or Enumeration	Units	Description
0	ApplicableEventCategory	RW	Multiple	Mandatory	Integer			Contains list of Event Category values
1	DefaultRequestExpTime	RW	Single	Mandatory	Integer		ms	Contains the default value for the Request Expiration Timestamp parameter when such a parameter is not set in the request
2	DefaultResultExpTime	RW	Single	Mandatory	Integer		ms	Contains the default value of the Result Expiration Timestamp parameter when such a parameter is not set in the request
3	DefaultOpExecTime	RW	Single	Mandatory	Integer		ms	Contains the default value of the Operation Execution Time parameter when such a parameter is not set in the request
4	DefaultRespPersistence	RW	Single	Mandatory	Integer		ms	Contains the default value of the Result Persistence parameter when such a parameter is not set in the request
5	DefaultDelAggregation	RW	Single	Mandatory	Integer		ms	Contains the default value of the Delivery Aggregation parameter when such a parameter is not set in the request

6.6.1.6 CmdhLimits Object

This Object represents limits for CMDH related parameter values.

Table 6.6.1.6-1: Object definition

Name	Object ID	Instances	Mandatory	Object URN
CmdhLimits	2053	Multiple	Optional	urn:oma:lwm2m:ext:2053

Table 6.6.1.6-2: Resource definitions

ID	Name	Operations	Instances	Mandatory	Type	Range or Enumeration	Units	Description
0	Order	RW	Single	Mandatory	Integer			Contains index indicating in which order the concerned *CmdhLimits Object Instance* will be treated by the CSE to determine a value for the limit parameters.
1	RequestOrigin	RW	Multiple	Mandatory	String			List of zero or more Local AE-IDs, App-IDs, or the strings "localAE" or "thisCSE"
2	RequestContext	RW	Single	Optional	String			Represents the Dynamic Context condition under which CMDH parameter limits defined inside the concerned *CmdhLimits Object Instance* is applicable.
3	RequestContextNotification	RW	Single	Optional	Boolean			Contains true/false flag indicating whether or not notification procedures apply.
4	RequestCharacteristics	RW	Single	Optional	String			Represents conditions pertaining to the request itself, (e.g. the requested ***Response Type***) than needs to be matched
5	LimitsEventCategory	RW	Multiple	Mandatory	Integer			Allowed values for the ***Event Category*** parameter in a request of any of the Originators indicated in the *requestOrigin* attribute.
6	LimitsRequestExpTime	RW	Multiple	Mandatory	Integer	2 Instances	ms	Defines a range of values for the ***Request Expiration Time*** parameter for a request of any Originator indicated in the *requestOrigin* Resource

								Inst 0 : minTime Inst 1: maxTime
7	LimitsResultExpTime	RW	Multiple	Mandatory	Integer	2 Instances	ms	Defines a range of values for the ***Result Expiration Time*** parameter for a request of any Originator indicated in the *requestOrigin* Resource Inst 0 : minTime Inst 1: maxTime
8	LimitsOptExpTime	RW	Multiple	Mandatory	Integer	2 Instances	ms	Defines a range of values for the ***Operation Expiration Time*** parameter for a request of any Originator indicated in the *requestOrigin* Resource Inst 0 : minTime Inst 1: maxTime
9	LimitsRespPersistence	RW	Multiple	Mandatory	Integer	2 Instances	ms	Defines a range of values for the ***Result Persistence*** parameter for a request of any Originator indicated in the *requestOrigin* Resource Inst 0 : minTime Inst 1: maxTime
10	LimitsDelAggregation	RW	Multiple	Mandatory	String			Contains the permitted settings of the ***DeliveryAggregation*** parameter of request primitives. '0' means 'False' '1' means 'True' '0 1' means 'False' or 'True'

6.6.1.7 CmdhNetworkAccessRules Object

This Object defines the usage of underlying networks for forwarding information to other CSEs during processing of CMDH-related requests in a CSE.

Table 6.6.1.7-1: Object definition

Name	Object ID	Instances	Mandatory	Object URN
CmdhNetworkAccessRules	2054	Multiple	Optional	urn:oma:lwm2m:ext:2054

Table 6.6.1.7-2: Resource definitions

ID	Name	Operations	Instances	Mandatory	Type	Range or Enumeration	Units	Description
0	ApplicableEventCategories	RW	Multiple	Mandatory	Integer			Contains a list of Event Category values
1	NetworkAccessRule	RW	Multiple	Optional	Objlink			Contains 0 or more references to CmdhNwAccessRule Object Instances

6.6.1.8 CmdhNwAccessRule Object

This Object defines limits in usage of specific underlying networks for forwarding information to other CSEs during processing of CMDH-related requests in a CSE.

Table 6.6.1.8-1: Object definition

Name	Object ID	Instances	Mandatory	Object URN
CmdhNwAccessRule	2055	Multiple	Optional	urn:oma:lwm2m:ext:2055

Table 6.6.1.8-2: Resource definitions

ID	Name	Operations	Instances	Mandatory	Type	Range or Enumeration	Units	Description
0	TargetNetwork	RW	Multiple	Mandatory	String			Contains identifiers of Underlying networks
1	MinReqVolume	RW	Single	Mandatory	Integer		Byte	Minimum amount of data that needs to be aggregated before any of the Underlying Networks matching with the *targetNetwork* Resource of the current Instance of the *CmdhNwAccessRule* Object can be used for forwarding information to other CSEs.
2	SpreadingWaitTime	RW	Single	Mandatory	Integer		ms	Contains a value in ms such that before accessing the underlying network (typically to forward an incoming request), the CSE will wait for an additional amount of time randomly chosen between 0 and this value
3	BackOffParameters	RW	Single	Mandatory	objlnk			Reference to an Instance of of BackOffParameterSet Object defining parameters that define how usage of any of the Underlying Networks matching with the targetNetwork Resource of that Object Instance, shall be handled when attempts to use such networks have failed.
4	OtherConditions	RW	Single	Mandatory	String			List of additional conditions that need to be fulfilled before any of the Underlying Networks matching with the *TargetNetwork* Resource of this *CmdhNwAccessRule Object Instance* can be used for forwarding information to other CSEs.
5	AllowedSchedule	RW	Multiple	Mandatory	String			Contains time schedules in form of extended crontab syntax defined in Protocol TS-0004

6.6.1.9 CmdhBuffer Object

This Object defines 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.

Table 6.6.1.9-1: Object definition

Name	Object ID	Instances	Mandatory	Object URN
CmdhBuffer	2056	Multiple	Optional	urn:oma:lwm2m:ext:2056

Table 6.6.1.9-2: Resource definitions

ID	Name	Operations	Instances	Mandatory	Type	Range or Enumeration	Units	Description
0	ApplicableEventCategory	RW	Multiple	Mandatory	Integer			Contains a list of event category values
1	MaxBufferSize	RW	Single	Mandatory	Integer		Byte	Contains the max Buffer size of the CmdhBuffer Object Instance
2	StoragePriority	RW	Single	Mandatory	Integer	1..10		Storage priority for the buffered data associated to that CmdhBuffer Object Instance. t Buffered requests associated with a lower storage priority shall be purged before buffered requests with a higher storage priority.

6.6.1.10 CmdhBackOffParametersSet Object

This Object defines set of parameters which can be referenced by a specific Instance of the CmdhNwAccessRule Object (ID: 2055)

Table 6.6.1.10-1: Object definition

Name	Object ID	Instances	Mandatory	Object URN
CmdhBackOffParametersSet	2057	Multiple	Optional	urn:oma:lwm2m:ext:2057

Table 6.6.1.10-2: Resource definitions

ID	Name	Operations	Instances	Mandatory	Type	Range or Enumeration	Units	Description
0	NetworkAction	RW	Single	Optional	Integer	1..5		Contains specific action actually attempted on the network (e.g. cellular-registration)
1	InitialBackoffTime	RW	Single	Mandatory	Integer		ms	Regarding the BackOffParameters of a certain CmdhNwAccessRule Object Instance, this Resource contains the value for the Initial wait time.
2	AdditionalBackoffTime	RW	Single	Mandatory	Integer		ms	Regarding the BackOffParameters of a certain CmdhNwAccessRule Object Instance, this Resource contains the value for an additional wait tme.

3	MaximumBackoffTime	RW	Single	Mandatory	Integer		ms	Regarding the BackOffParameters of a certain CmdhNwAccessRule Object Instance, this Resource contains the value for the maximum wait time.
4	OptionalRandomBackoffTime	RW	Multiple	Optional	Integer		ms	Regarding the BackOffParameters of a certain CmdhNwAccessRule Object Instance, this Resource contains the value for an optional random wait time.

6.7 Generic Guidelines for Mapping LwM2M Objects to oneM2M <mgmtObj> Resources

Since there are several LwM2M defined objects and vendor defined LwM2M Objects that currently do not have a corresponding <mgmtObj> specialization defined in this document, the following guidelines have been defined. These guidelines provide interoperability and extensibility between the two standards and ensure seamless interworking of LwM2M clients and servers with oneM2M CSEs and AEs.

Below are the guidelines for generically mapping LwM2M Objects to oneM2M <mgmtObj> resources.

1. For a given LwM2M object that is to be mapped to oneM2M, there shall exist a definition file where information about the LwM2M object is defined. An example of such a definition file is found in [20] and is shown in Annex A for convenience. Using a template oneM2M schema file as shown in Annex B, a corresponding oneM2M <mgmtObj> XSD file shall be created that is compliant with existing oneM2M XSD conventions as defined in [2].

2. The new XSD shall have a base of "m2m:mgmtResource" and inherit all oneM2M defined <mgmtObj> common attributes. In addition, the new mgmtObj resource shall include the oneM2M common types and subscription schema files. The name of both the resource and the schema file shall be the concatenation of the LwM2M Object name. For example, the LwM2M Cellular connectivity object (object ID 10) shall be given the name cellularConnectivity in oneM2M.

3. For each LwM2M resource supported by the LwM2M object to be mapped, the XSD shall support a corresponding oneM2M [objectAttribute] element. The name of the LwM2M resource shall be used for the name of the oneM2M [objectAttribute] but the convention of the name shall follow oneM2M naming conventions, e.g. LwM2M resource name "SMSC address" shall be "smscAddress".

4. The order of the [objectAttribute] attributes shall match the order of the LwM2M resources as specified by the LwM2M object's resource definition file. This order matching is important as it provides an ordered mapping between LwM2M resources and oneM2M attributes. This allows for easier translation of oneM2M [objectAttribute] attributes to the corresponding LwM2M resources whenever a request is made to manage a LwM2M device. The ordering will also help ensure that <mgmtObj> XSD files generated by different developers and for the same LwM2M object are the same.

5. For each [objectAttribute] attribute, the following guidelines shall be followed.

    a. The type definition shall be based on the mapping of basic data types defined in Section 6.1.

    b. The minOccurs and maxOccurs settings shall be based on the multiplicity (i.e. Single vs. Multiple) and the optionality (i.e. Mandatory vs. Optional) of the corresponding LwM2M resource. A mandatory attribute shall have a minOccurs=1, while an optional attribute shall have a minOccurs=0. An attribute with single multiplicity shall have a maxOccurs=1, while an attribute with multiplicity greater than one shall have a maxOccurs set to the specified limit or to *unbounded* if no limit is specified.

6. An example of a oneM2M schema file that is mapped from a LwM2M resource definition file is shown in Annex C. Note the order of the oneM2M resource specific attributes match that of the LwM2M definition file, e.g. activatedProfileNames is mapped to Activated Profile Names even though the LwM2M resource ID is not sequential. As long as the order of the oneM2M attributes match the order of the LwM2M resources, a mapping can be performed provided that both the oneM2M schema file and the LwM2M resource definition are available. This applies to cases where the LwM2M resource ID are out of sequence or even if there is a gap in the sequence of the resource IDs.

7. When creating the <mgmtObj> associated with a LwM2M Object defined by these guidelines, the following rules shall be followed as shown in Table 6.7-1.

    a. *mgmtDefinitions* shall be set to the value "Unspecified".

    b. *mgmtSchema* shall be set to the URI of where the XSD file created in Step 1 is located

    c. *objectIDs* shall be set to the URN of the corresponding LwM2M Object.

    d. *objectPaths* may be included and configured with the prefix of the local path where the LwM2M Object resides on the LwM2M device.

    e. *mgmtLink* may be included if the <mgmtObj> resource links to another <mgmtObj> resource to form a hierarchy of <mgmtObj> resources.

    f. The inclusion of at least one [objectAttribute]. Note the order of the [objectAttribute] must follow the same order as specified by the LwM2M Object's resource definition file.

    g. The *description* attribute may be included to provide more specific information about the functionality of the <mgmtObj>. An example is the string "LwM2M:<object_ID>" to identify the <mgmtObj> is associated with LwM2M and to what Object ID.

Table 6.7-1: <mgmtObj> Resource Specific Attributes

<mgmtObj> Attributes	Create M/O	Description of Value During <mgmtObj> Create
mgmtDefinitions	M	Contains the value corresponding to "Unspecified"
mgmtSchema	O	URI of an XSD file that provides the resource definitions for this <mgmtObj> resource
objectIDs	M	URN of the corresponding LwM2M object
objectPaths	O	Contains the prefix of the local path the LwM2M Object resides at on the LwM2M device. The path will include the LwM2M object instance associated with this <mgmtObj> resource, e.g. /9/2 – this <mgmtObj> maps to software object instance 2.
mgmtLink	O	Contains a link to other <mgmtObj> resources to support a hierarchy of <mgmtObj> resources
[objectAttribute]	M	List of LwM2M resources mapped to oneM2M attributes one for one and in the order specified by the LwM2M Object's resource definitions file.
Description	O	A text description that contains information about the LwM2M Object

These generic guidelines allow for the specification of a new <mgmtObj> schema definitions that may be referenced by the *mgmtSchema* attribute. The new schema definition (e.g. XSD) of the <mgmtObj> specialization shall correspond to a LwM2M Object definition. The *mgmtSchema* shall be configured during the creation of the specialized <mgmtObj> resource. The option to specify a URI in the *mgmtSchema* attribute allows the CSE to support interworking with new LwM2M Objects (e.g., those that were not available at the time of initial deployment of the CSE). This is especially true in the case of vendor specific LwM2M Objects. The URI will point to a location where the schema definition of the new <mgmtObj> specialization can be found and retrieved by the CSE to use.

Annex A (informative):

The following text is duplicated from [20] for convenience to show the information an OMA LWM2M object definition file contains.

<?xml version="1.0" encoding="utf-8"?>

<!--
FILE INFORMATION

OMA Permanent Document
  File: OMA-SUP-XML_LWM2M_Cellular_connectivity-V1_0-20170301-D
  Type: xml

Public Reachable Information
  Path: http://www.openmobilealliance.org/tech/profiles
  Name: LWM2M_Cellular_connectivity-v1_0.xml

NORMATIVE INFORMATION

  Information about this file can be found in the latest revision of

    OMA-TS-LWM2M_ConnMgmt-V1_0

  This is available at http://www.openmobilealliance.org/

  Send comments to technical-comments@mail.openmobilealliance.org

CHANGE HISTORY

01032017 File created

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```
  reference the OMA IPR Policy for patent licensing terms:
  http://www.openmobilealliance.org/ipr.html
-->


<LWM2M xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:noNamespaceSchemaLocation="http://openmobilealliance.org/tech/profiles/LWM2M.xsd">

    <Object ObjectType="MODefinition">

        <Name>Cellular connectivity</Name>

        <Description1><![CDATA[This object specifies resources to enable a device to connect to a 3GPP or 3GPP2
bearer, including GPRS/EDGE, UMTS, LTE, NB-IoT, SMS. For cellular connectivity, this object focuses on Packet
Switched (PS) connectivity and doesn't aim to provide comprehensive Circuit Switched (CS) connectivity management.

]]></Description1>

        <ObjectID>10</ObjectID>

        <ObjectURN>urn:oma:lwm2m:oma:10</ObjectURN>

        <MultipleInstances>Single</MultipleInstances>

        <Mandatory>Optional</Mandatory>

        <Resources>

            <Item ID="11"><Name>Activated Profile Names</Name>

                <Operations>R</Operations>

                <MultipleInstances>Multiple</MultipleInstances>

                <Mandatory>Mandatory</Mandatory>

                <Type>String</Type>

                <RangeEnumeration></RangeEnumeration>

                <Units></Units>

                <Description><![CDATA[Links to instances of the "APN connection profile" object representing every APN
connection profile that has an activated connection to a PDN.]]></Description>

            </Item>

            <Item ID="0"><Name>SMSC address</Name>

                <Operations>RW</Operations>

                <MultipleInstances>Single</MultipleInstances>

                <Mandatory>Optional</Mandatory>

                <Type>String</Type>

                <RangeEnumeration></RangeEnumeration>

                <Units></Units>

                <Description><![CDATA[E.164 address of SMSC.

Applicable for 3GPP2 networks where SMSC is not available from a smart card, or for 3GPP/3GPP2 networks to provide
the application with a customer specific SMSC.  The application decides how to use this parameter, e.g. precedence
over UICC based SMSC address.]]></Description>

            </Item>

            <Item ID="1"><Name>Disable radio period</Name>

                <Operations>RW</Operations>

                <MultipleInstances>Single</MultipleInstances>

                <Mandatory>Optional</Mandatory>

                <Type>Integer</Type>

                <RangeEnumeration>0-65535</RangeEnumeration>

                <Units>minutes</Units>
```

<Description><![CDATA[Time period for which the device shall disconnect from cellular radio (PS detach, CS detach if applicable). Can be used to handle network overload situations. The value is a positive integer (0 to 65535), duration can be from 1 minute to 65535 minutes (approximately 45 days). As soon the server writes a value which is >0 the device SHALL disconnect. When the period has elapsed the device MAY reconnect.]]></Description>

</Item>

<Item ID="2"><Name>Module activation code</Name>

<Operations>RW</Operations>

<MultipleInstances>Single</MultipleInstances>

<Mandatory>Optional</Mandatory>

<Type>String</Type>

<RangeEnumeration></RangeEnumeration>

<Units></Units>

<Description><![CDATA[Configurable in case the application needs to issue a code (e.g. via AT command) to activate the module. e.g. “*98”.]]></Description>

</Item>

<Item ID="3"><Name>Vendor specific extensions</Name>

<Operations>R</Operations>

<MultipleInstances>Single</MultipleInstances>

<Mandatory>Optional</Mandatory>

<Type>Objlnk</Type>

<RangeEnumeration></RangeEnumeration>

<Units></Units>

<Description><![CDATA[Links to a vendor specific object.]]></Description>

</Item>

<Item ID="4"><Name>PSM Timer (1)</Name>

<Operations>RW</Operations>

<MultipleInstances>Single</MultipleInstances>

<Mandatory>Optional</Mandatory>

<Type>Integer</Type>

<RangeEnumeration>10min-992 days</RangeEnumeration>

<Units>s</Units>

<Description><![CDATA[Power saving mode (PSM) timer as defined in [3GPP-TS_23.682].

PSM Timer = Extended T3412. Max interval between periodic TAU if there is no other transmission from the device. During most of this time the device is considered as unreachable and can therefore go into a deep sleep mode while keeping the PDN connection(s) active.]]></Description>

</Item>

<Item ID="5"><Name>Active Timer (1)</Name>

<Operations>RW</Operations>

<MultipleInstances>Single</MultipleInstances>

<Mandatory>Optional</Mandatory>

<Type>Integer</Type>

<RangeEnumeration>2sec-31 min</RangeEnumeration>

<Units>s</Units>

<Description><![CDATA[Active timer = T3324 as defined in [3GPP-TS_24.008].

The time the UE has to remain reachable after transitioning to idle state in case there is pending data from the NW to send out. At the end of T3324 UE can go into a deep sleep mode while keeping the PDN connection(s) active.]]></Description>

</Item>

<Item ID="6"><Name>Serving PLMN Rate control</Name>

<Operations>R</Operations>

<MultipleInstances>Single</MultipleInstances>

<Mandatory>Optional</Mandatory>

<Type>Integer</Type>

<RangeEnumeration></RangeEnumeration>

<Units></Units>

<Description><![CDATA[Only for when using Signalling Radio Bearers (c.f. Data over NAS), it indicates the maximum the number of allowed uplink PDU transmissions per 6 minute interval aggregated across all PDN connections. See [3GPP-TS_23.401], octet 3 to 4 of the Serving PLMN rate control IE.]]></Description>

</Item>

<Item ID="7"><Name>eDRX parameters for Iu mode (1)</Name>

<Operations>RW</Operations>

<MultipleInstances>Single</MultipleInstances>

<Mandatory>Optional</Mandatory>

<Type>Opaque</Type>

<RangeEnumeration>8 bits</RangeEnumeration>

<Units></Units>

<Description><![CDATA[Extended DRX parameters (Paging Time Window and eDRX value) for Iu mode which the UE can request from the network. This resource is encoded as octet 3 in [3GPP-TS_24.008, clause 10.5.5.32].]]></Description>

</Item>

<Item ID="8"><Name>eDRX parameters for WB-S1 mode (1)</Name>

<Operations>RW</Operations>

<MultipleInstances>Single</MultipleInstances>

<Mandatory>Optional</Mandatory>

<Type>Opaque</Type>

<RangeEnumeration>8 bits</RangeEnumeration>

<Units></Units>

<Description><![CDATA[Extended DRX parameters (Paging Time Window and eDRX value) for WB-S1 mode which the UE can request from the network. This resource is encoded as octet 3 in [3GPP-TS_24.008, clause 10.5.5.32].]]></Description>

</Item>

<Item ID="9"><Name>eDRX parameters for NB-S1 mode (1)</Name>

<Operations>RW</Operations>

<MultipleInstances>Single</MultipleInstances>

<Mandatory>Optional</Mandatory>

<Type>Opaque</Type>

<RangeEnumeration>8 bits</RangeEnumeration>

<Units></Units>

<Description><![CDATA[Extended DRX parameters (Paging Time Window and eDRX value) for NB-S1 mode which the UE can request from the network. This resource is encoded as octet 3 in [3GPP-TS_24.008, clause 10.5.5.32].]]></Description>

```
        </Item>
        <Item ID="10"><Name>eDRX parameters for A/Gb mode (1)</Name>
            <Operations>RW</Operations>
            <MultipleInstances>Single</MultipleInstances>
            <Mandatory>Optional</Mandatory>
            <Type>Opaque</Type>
            <RangeEnumeration>8 bits</RangeEnumeration>
            <Units></Units>
            <Description><![CDATA[Extended DRX parameters (Paging Time Window and eDRX value) for A/Gb mode which the UE can request from the network. This resource is encoded as octet 3 in [3GPP-TS_24.008, clause 10.5.5.32].]]></Description>
        </Item></Resources>
    <Description2><![CDATA[Notes:

(1) This parameter is controlled by the 3GPP network. A LWM2M server may write a suggested value to this resource. As soon a LWM2M server changes the current value the device then suggests the new value to the network upon the next practical opportunity e.g. by inclusion of the requested value in an Attach or TAU request. In case the network confirms the suggested value then the device shall apply that value. In case the network provides a different value then the value provided by the network shall be applied by the device and the resource value shall be set to that value.

The LWM2M server may use the observe function to be notified upon any changes of PSM or Active timer. By using the observe function the LWM2M server will get notified in case the value suggested by the LWM2M server is not accepted by the network, or, if the value is changed by the network for any reason (e.g. if the device moves into new tracking areas there is no guarantee that the above values remain the same and are not altered by the network).

]]></Description2>
  </Object>
</LWM2M>
```

Annex B (normative):

The following text is a oneM2M template schema file for use when mapping LWM2M object definition files to oneM2M schema files. This template contains the oneM2M copyright notice, the schema namespace information, and the schema include sections that are common for all oneM2M resource schemas. Two XML element sections are reserved for resource specific mappings to interwork LWM2M object definition files to oneM2M mgmtObj resource schemas. These sections represent the oneM2M resource specific attributes and the corresponding announced resources, respectively.

This template contains placeholder oneM2M schema version (i.e. v*X_Y_Z*) and date information (i.e. © 20*XX)*. Based on the targeted version of oneM2M schemas for a given deployment, this placeholder version and date shall be updated to reflect the version of published oneM2M schemas that a schema file is compatible with. The template also contains a placeholder for the XML schema targetNamespace that may be configured with a customized namespace to avoid namespace conflicts if/when needed for a given deployment.

```
<?xml version="1.0" encoding="UTF-8"?>

<!--

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<xs:schema xmlns="http://www.w3.org/2001/XMLSchema-instance" targetNamespace=" <target_name_space>"
    xmlns:m2m="http://www.onem2m.org/xml/protocols" elementFormDefault="unqualified"
    attributeFormDefault="unqualified" xmlns:xs="http://www.w3.org/2001/XMLSchema">

    <xs:include schemaLocation="CDT-commonTypes-vX_Y_Z.xsd" />
    <xs:include schemaLocation="CDT-subscription-vX_Y_Z.xsd" />

    <xs:element name="<LWM2M_Object_Name>" substitutionGroup="m2m:sg_mgmtResource">
    </xs:element>

    <xs:element name="<LWM2M_Object_Name>Annc" substitutionGroup="m2m:sg_announcedMgmtResource">
    </xs:element>
```

```
</xs:schema>
```

Annex C (informative):

The following text shows an example schema file for the LWM2M Cellular connectivity object.

```
<?xml version="1.0" encoding="UTF-8"?>
<!--
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<xs:schema xmlns="http://www.w3.org/2001/XMLSchema-instance"
targetNamespace="http://www.onem2m.org/xml/protocols"
    xmlns:m2m="http://www.onem2m.org/xml/protocols" elementFormDefault="unqualified"
    attributeFormDefault="unqualified" xmlns:xs="http://www.w3.org/2001/XMLSchema">


    <xs:include schemaLocation="CDT-commonTypes-v2_8_0.xsd" />
    <xs:include schemaLocation="CDT-subscription-v2_8_0.xsd" />


    <xs:element name="cellularConnectivity" substitutionGroup="m2m:sg_mgmtResource">
        <xs:complexType>
            <xs:complexContent>
                <!-- Inherit common attributes from mgmtResource  -->
                <xs:extension base="m2m:mgmtResource">
                    <xs:sequence>
                        <!-- Resource Specific Attributes  -->
                        <xs:element name="activatedProfileNames" type="xs:string" minOccurs="1"
maxOccurs="unbounded" />
                        <xs:element name="smscAddress" type="xs:string" minOccurs="0" maxOccurs="1" />
                        <xs:element name="disableRadioPeriod" type="xs:integer" minOccurs="0" maxOccurs="1" />
```

```
                    <xs:element name="moduleActivationCode" type="xs:string" minOccurs="0" maxOccurs="1" />
                    <xs:element name="vendorSpecificExtensions" type="xs:string" minOccurs="0" maxOccurs="1" />
                    <xs:element name="psmTimer" type="xs:integer" minOccurs="0" maxOccurs="1" />
                    <xs:element name="activeTimer" type="xs:integer" minOccurs="0" maxOccurs="1" />
                    <xs:element name="servingPLMNRateControl" type="xs:integer" minOccurs="0" maxOccurs="1" />
                    <xs:element name="eDRXParametersForIuMode" type="xs:base64Binary" minOccurs="0"
maxOccurs="1" />
                    <xs:element name="eDRXParametersForWB-S1Mode" type="xs:base64Binary" minOccurs="0"
maxOccurs="1" />
                    <xs:element name="eDRXParametersForNB-S1Mode" type="xs:base64Binary" minOccurs="0"
maxOccurs="1" />
                    <xs:element name="eDRXParametersForA/GbMode" type="xs:base64Binary" minOccurs="0"
maxOccurs="1" />

                    <!-- Child Resources -->
                    <xs:choice minOccurs="0" maxOccurs="1">
                        <xs:element name="childResource" type="m2m:childResourceRef" maxOccurs="unbounded" />
                        <xs:element ref="m2m:subscription" maxOccurs="unbounded" />
                    </xs:choice>
                </xs:sequence>
            </xs:extension>
        </xs:complexContent>
    </xs:complexType>
</xs:element>

<xs:element name="cellularConnectivityAnnc" substitutionGroup="m2m:sg_announcedMgmtResource">
    <xs:complexType>
        <xs:complexContent>
            <!-- Inherit common attributes from announcedMgmtResource  -->
            <xs:extension base="m2m:announcedMgmtResource">
                <xs:sequence>
                    <!-- Resource Specific Attributes  -->
                    <xs:element name="activatedProfileNames" type="xs:string" minOccurs="1"
maxOccurs="unbounded" />
                    <xs:element name="smscAddress" type="xs:string" minOccurs="0" maxOccurs="1" />
                    <xs:element name="disableRadioPeriod" type="xs:integer" minOccurs="0" maxOccurs="1" />
                    <xs:element name="moduleActivationCode" type="xs:string" minOccurs="0" maxOccurs="1" />
                    <xs:element name="vendorSpecificExtensions" type="xs:string" minOccurs="0" maxOccurs="1" />
                    <xs:element name="psmTimer" type="xs:integer" minOccurs="0" maxOccurs="1" />
                    <xs:element name="activeTimer" type="xs:integer" minOccurs="0" maxOccurs="1" />
                    <xs:element name="servingPLMNRateControl" type="xs:integer" minOccurs="0" maxOccurs="1" />
                    <xs:element name="eDRXParametersForIuMode" type="xs:base64Binary" minOccurs="0"
maxOccurs="1" />
                    <xs:element name="eDRXParametersForWB-S1Mode" type="xs:base64Binary" minOccurs="0"
maxOccurs="1" />
```

```
                    <xs:element name="eDRXParametersForNB-S1Mode" type="xs:base64Binary" minOccurs="0"
maxOccurs="1" />
                    <xs:element name="eDRXParametersForA/GbMode" type="xs:base64Binary" minOccurs="0"
maxOccurs="1" />

                    <!-- Child Resources -->
                    <xs:choice minOccurs="0" maxOccurs="1">
                        <xs:element name="childResource" type="m2m:childResourceRef" maxOccurs="unbounded" />
                        <xs:element ref="m2m:subscription" maxOccurs="unbounded" />
                    </xs:choice>
                </xs:sequence>
            </xs:extension>
        </xs:complexContent>
    </xs:complexType>
</xs:element>
</xs:schema>
```

History

Publication history		
V3.5.1	April 2019	Release 3 - Publication