



BSI Standards Publication

Standard interface for connecting charging stations to local energy management systems

Part 2: Specific data model mapping

National foreword

This British Standard is the UK implementation of EN IEC 63380-2:2025. It is identical to IEC 63380-2:2025.

The UK participation in its preparation was entrusted to Technical Committee PEL/69, Electric vehicles.

A list of organizations represented on this committee can be obtained on request to its committee manager.

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English Version

Standard interface for connecting charging stations to local
energy management systems - Part 2: Specific data model
mapping
(IEC 63380-2:2025)

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aux systèmes locaux de gestion de l'énergie - Partie 2:
Mise en correspondance avec des modèles de données
spécifiques
(IEC 63380-2:2025)

Standardschnittstelle für das Verbinden von Ladestationen
an lokale Energiemanagementsysteme - Teil 2: Spezifische
Datenmodellzuordnung
(IEC 63380-2:2025)

This European Standard was approved by CENELEC on 2025-08-28. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

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European Committee for Electrotechnical Standardization
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European foreword

The text of document 69/1057/FDIS, future edition 1 of IEC 63380-2, prepared by TC 69 "Electrical power/energy transfer systems for electrically propelled road vehicles and industrial trucks" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN IEC 63380-2:2025.

The following dates are fixed:

- latest date by which the document has to be implemented at national (dop) 2026-09-30 level by publication of an identical national standard or by endorsement
- latest date by which the national standards conflicting with the (dow) 2028-09-30 document have to be withdrawn

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This document has been prepared under a standardization request addressed to CENELEC by the European Commission. The Standing Committee of the EFTA States subsequently approves these requests for its Member States.

Any feedback and questions on this document should be directed to the users' national committee. A complete listing of these bodies can be found on the CENELEC website.

Endorsement notice

The text of the International Standard IEC 63380-2:2025 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standard indicated:

IEC 63402-1:2025	NOTE Approved as EN IEC 63402-1:2025 (not modified)
ISO 15118-2	NOTE Approved as EN ISO 15118-2
ISO 15118-20	NOTE Approved as EN ISO 15118-20

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

NOTE 1 Where an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cencenelec.eu.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 63380-1	-	Standard interface for connecting charging stations to local energy management systems - Part 1: General requirements, use cases and abstract messages	EN IEC 63380-1	-
IEC 63380-3	-	Standard interface for connecting charging stations to local energy management systems - Part 3 Communication protocol and cybersecurity specific aspects	EN IEC 63380-3	-

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**Standard interface for connecting charging stations
to local energy management systems -
Part 2: Specific data model mapping**

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The text of this International Standard is based on the following documents:

Draft	Report on voting
69/1057/FDIS	69/1066/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

A list of all parts in the IEC 63380 series, published under the general title *Standard interface for connecting charging stations to local energy management systems*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn, or
- revised.

INTRODUCTION

The expansion of renewable energy and the simultaneous reduction in conventional generation of electricity result in new power flows and loads on the equipment in the grid and at the house connection point. At the same time, electrical consumers with high power consumption are increasingly being installed in low-voltage systems in private customer systems. These include charging systems for electric vehicles and heat pumps. These two developments can temporarily lead to peak loads and bottlenecks in the network. An expansion of the distribution grids for the comparatively few hours of high simultaneous power consumption is not considered economically sensible. The legislator of energy efficiency has therefore introduced the concept of "network-friendly control of controllable consumer devices".

It is crucial to define a standardized interface for the connected consumers and generating facilities, which also includes the charging infrastructure for electric vehicles. When developing a local, standardized interface, it is important to make a fundamental distinction between the terms power and energy management.

In order to avoid an overload and the associated emergency shutdown due to specified power limits in the property while all consumers are drawing electricity at the same time – especially heating and air conditioning technology as well as charging infrastructure – power management is of great urgency. The maximum load at the grid connection point can therefore be reduced. Accordingly, it is important to give priority to local power management over, for example, optimization of operations and tariffs or desired charging plans.

Furthermore, the tariff-optimized operation can be pursued within the limits specified by the grid infrastructure – controlled by the energy management system. As a consequence, a charging infrastructure will be able to transmit information about procurement and tariff-optimized operation from the local energy management of the property to the electric vehicle so that it can coordinate its charging plan according to local demands. Effective coordination becomes essential if generating systems are used within the property in order to achieve the highest possible self-consumption of electricity.

The long-term goal is to buffer power and energy bottlenecks within a property using the energy stored in the vehicle, which also brings the topic of energy recovery into focus and this aspect needs to be considered during the development of a standardized interface for local power and energy management.

The aim of the IEC 63380 series is to define a standard interface for connecting charging stations to local energy management systems and the information exchange.

The IEC 63380 series specifies use cases, the sequences of information exchange, the data models as well as the communication protocols to be used and includes all aspects of local energy management of charging stations.

The IEC 63380 series covers scenarios where the charging infrastructure is managed by the entity that operates the private electrical network, and local energy management systems are used for local load management.

The IEC 63380 series addresses the energy management in installations with forward and bidirectional charging whereby the overall energy management is ensured by the customer energy manager.

The IEC 63380 series does not cover the secure information exchange between the charging station and the IT backend system(s), such as the management of energy transfer of the charge session, contractual and billing data, provided by the IT backend.

The IEC 63380 series consists of the following structure, describing the interface between charging stations and local energy management systems.

- IEC 63380-1: General requirements, use cases and abstract messages
- IEC 63380-2: Specific data model mapping
- IEC 63380-3: Communication protocol and cybersecurity specific aspects

1 Scope

This part of IEC 63380 defines the secure information exchange between local energy management systems and electric vehicle charging stations. The local energy management systems communicate to the charging station controllers via the resource manager.

This document maps the generic use case functions defined in IEC 63380-1 to specific data model. This edition of this document defines specifically SPINE Resources and ECHONET Lite Resources mapped from the high-level use case functions defined in IEC 63380-1.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 63380-1, *Standard interface for connecting charging stations to local energy management systems - Part 1: General requirements, use cases and abstract messages*

IEC 63380-3¹, *Standard interface for connecting charging stations to local energy management systems - Part 3: Communication protocol and cybersecurity specific aspects*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- IEC Electropedia: available at <https://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

3.1.1

actor

entity that communicates and interacts [1]

3.1.2

binding

concept for connecting functionally matching features

3.1.3

client

role that specifies that a node uses data from a "server" or can request for change

3.1.4

data model

definition of possible data (data structures, values) for the exchange of information (especially for communications systems)

¹ Under preparation. Stage at the date of publication: IEC CDV 63380-3:2024.

3.1.5

device

<specific node> SPINE node that can include a set of entities

Note 1 to entry: Specific node has a "deviceType". With regard to the hierarchy of SPINE nodes a device is a root node for all functionalities offered by a device.

3.1.6

device

<address information> SPINE address part for the (physical) device

Note 1 to entry: Address information shall be written between quotation marks, e.g. "device".

3.1.7

discovery

process of finding appropriate partners for communication

Note 1 to entry: Dependent on the context this can be either finding other devices or examination of a device's potential functionalities.

3.1.8

echonet lite

communication protocol corresponding to layer 5 or higher of the OSI reference model

Note 1 to entry: This protocol is specified in ISO/IEC 14543-4-3 [2].

3.1.9

Energy Management System

EMS

hardware with different functions included according to the system requirements

Note 1 to entry: Every underlying subsystem, to be connected to the EMS, is connected via the RM function. A minimum EMS consists of a CEM and at least one RM [3].

Note 2 to entry: Within this document, "energy management system" always refers to a customer/facility energy management system and not a utility energy management system (see ISO 17800) [4].

Note 3 to entry: For the purposes of this document, an EMS can be either a device located in a user's home or property, or a cloud application. The energy manager enables energy-optimized operation of the devices connected to it by harmonizing energy demand and availability.

[SOURCE: IEC 63402-1:—, 3.1.17]

3.1.10

entity

<specific node> SPINE node that can include a set of (sub-)entities or features

Note 1 to entry: A specific node has an "entityType". With regard to the hierarchy of SPINE nodes an entity is a sub-element of a device.

3.1.11

entity

<address information> SPINE address part for the (logical) entity

Note 1 to entry: The address information part shall be written between quotation marks, e.g. "entity".

3.1.12

feature

<specific node> SPINE node that can include a set of functions (of a class)

Note 1 to entry: A specific node has a "featureType". With regard to the hierarchy of SPINE nodes a feature is a sub-element (i.e. "child") of an entity.

3.1.13

feature

<address information> SPINE address part for one feature

Note 1 to entry: The address part shall be written between quotation marks, e.g. "feature".

3.1.14

function

smallest structure to model "actual data" ("functional data")

Note 1 to entry: Information between communication partners is exchanged via the exchange of functions (as part of a "payload").

Note 2 to entry: Functions usually consist of child elements, each of them holding a piece of information (e.g. "timestamp", "value", etc.).

3.1.15

role

functionality of a feature, usually either "server" (data owner) or "client"

Note 1 to entry: For some special features (e.g. NodeManagement) the role "special" is defined.

3.1.16

scope type

feature type for identifying specific functionalities unambiguously (e.g. "overloadProtection")

3.1.17

server

role that specifies that a node offers its own data to be read or written by a node with role "client"

Note 1 to entry: A server can notify its data to other nodes (with role "client").

3.1.18

SHIP

Smart Home Internet Protocol

IP-based approach for interoperable connectivity of smart home appliances

3.1.19

SPINE

Smart Premises Interoperable Neutral-message Exchange

neutral message framework to model some typical mechanisms of common communication protocols

3.1.20

subscription

concept that enables the receiving of messages of interest from another device without polling it

3.1.21

use case

specification of a sequence of actions, including variants, which a system (or other entity) can perform, interacting with actors of the system

3.1.22

use case function

function to represent communication steps from the described technical use cases in the form of reusable function

Note 1 to entry: These functions provide the entire information exchange required to implement the considered use cases and user stories.

3.1.23**user story**

complete (but specific) business case described from the perspective of a user

Note 1 to entry: A user story can be separated into several use cases, for example "The user wants to simply charge their EV at home".

3.2 Abbreviated terms

ACK	Acknowledgement
EDT1	Property Value Data (The data size is specified by ELPDC1)
ELDATA	ECHONET Lite Data
ELPDC1	ECHONET Lite Property Data Counter (1 Byte)
ELSV	ECHONET Lite Service
EMAID	E-Mobility Authentication Identifier
EPC1	ECHONET Property (1 Byte)
EV	Electric Vehicle
NACK	Negative Acknowledgment
NECD	Network Enhanced Control Device
OPC	Number of Processing Properties (1 Byte)
PCID	Provisioning Certificate Identifier
SHIP	Smart Home Internet Protocol
SPINE	Smart Premises Interoperable Neutral-message Exchange
UCF	Use Case Function
WMI	World Manufacturer Identifier

4 Overview**4.1 General**

This document defines the mapping of generic use cases and neutral messages defined in IEC 63380-1 to typical data models like SPINE (Smart Premises Interoperable Neutral-Message Exchange), and ECHONET Lite, as shown in Figure 1. The generic use cases defined in IEC 63380-1 can be mapped to other data models.

This edition of this document defines specifically SPINE Resources and ECHONET Lite Resources mapped from the high-level use case functions defined in IEC 63380-1.

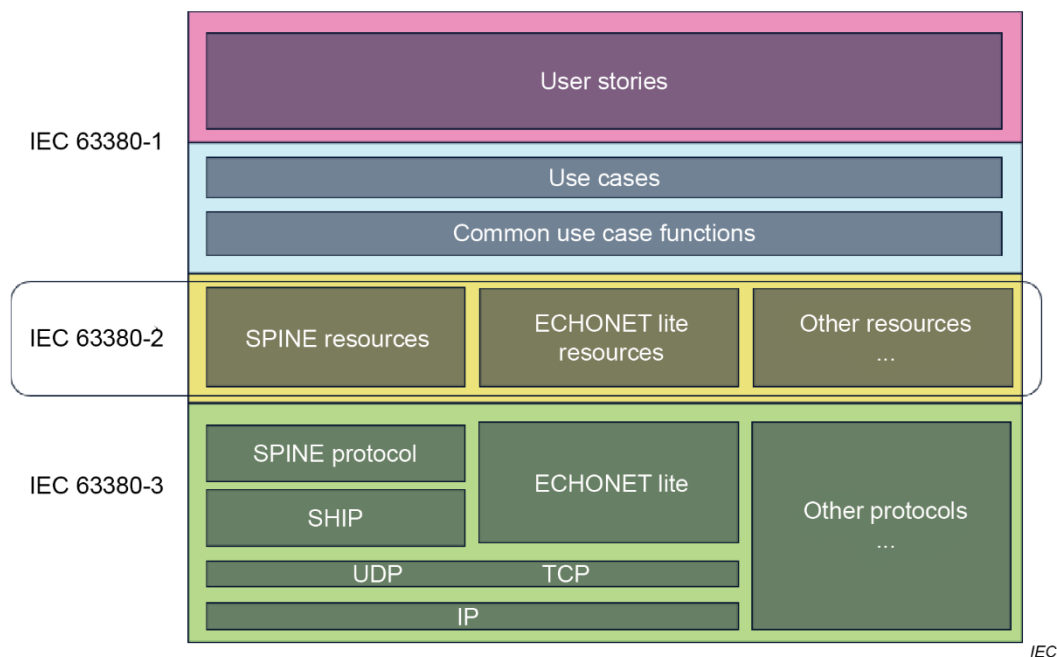


Figure 1 – Overview of resources within IEC 63380-2

4.2 Reading the graphics

4.2.1 General

This document contains several graphical representations. In order to facilitate their interpretation by readers unfamiliar with Unified Modeling Language, 4.2.2 and 4.2.3 provide an introduction.

4.2.2 Hierarchy diagram

Within the "Actor [...] overview" diagrams (see Figure 11 and following diagrams), the complete functionality of the use cases is provided. The actor can have more functionality implemented than needed for this use case. For the following actor overview example in Figure 2, a brief description of the graphical symbols will be described.

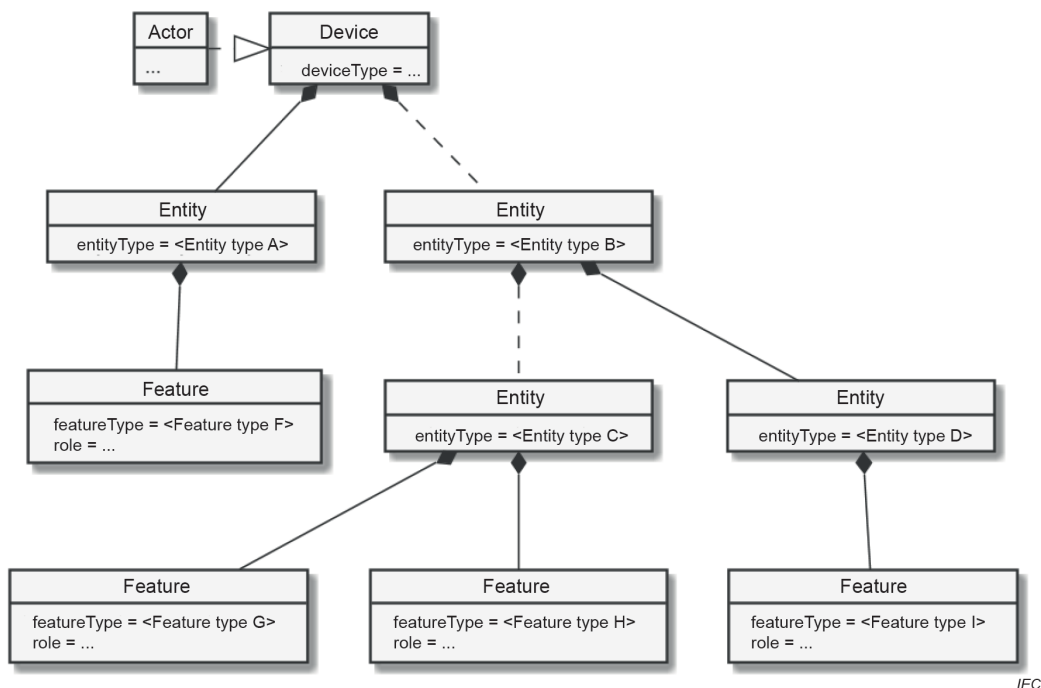


Figure 2 – Actor overview example

The solid lines in the figure represent an immediate parent-childhood relation: the entity with "<Entity Type A>" is a direct child of "Device". The entity with "<Entity Type D>" is a direct child of the entity with "<Entity Type B>". All features are immediate children of the respective entity.

The dashed lines in the figure express that there may be additional entities between the shown entities: a vendor's implementation may have one or more entities between "Device" and the entity with "<Entity Type B>". Likewise, a vendor's implementation may have one or more entities between the entity with "<Entity Type B>" and the entity with "<Entity Type D>".

4.2.3 Sequence diagram

Communication sequence diagrams visualize the messages sent between actors as part of a use case function or scenario, as shown in Figure 3.

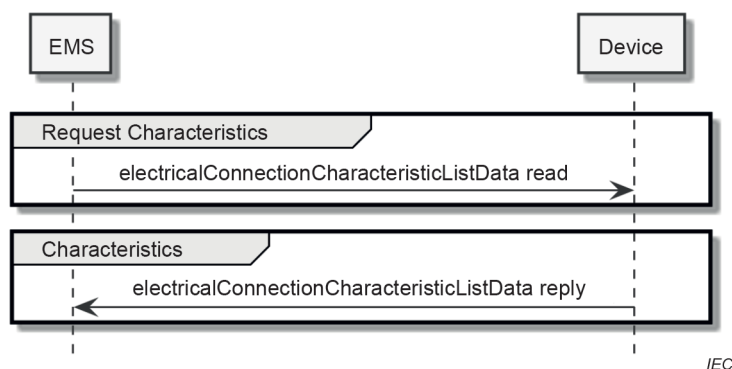


Figure 3 – Example communication sequence diagram

The participating actors are represented by rectangles with their names at the top of the diagram (and optionally at the bottom), as well as by a connecting vertical line.

Horizontal arrows indicate the types of messages sent as well as their direction. In the above example, the first message is a read command of the data structure called "electricalConnectionCharacteristicListData" initiated by the EMS and sent to the device; the second message is the device's reply. Note that time always flows from top to bottom.

4.3 Finding the right information

The use case functions are defined in Clause 5. Each use case function is documented in detail as a SPINE or ECHONET Lite reference solution.

5 Use case function (UCF) details

5.1 General

In the following, the mapping of the use case functions from IEC 63380-1 to SPINE and ECHONET Lite shall be defined. Specifically, it defines SPINE Resources and ECHONET Lite Resources mapped from the high-level use case functions.

5.2 Mapping to SPINE

5.2.1 Concepts

5.2.1.1 General rules and information

5.2.1.1.1 Underlying technology documents

This technical solution shall rely on the SPINE and the SHIP protocols as transport protocol defined in IEC 63380-3.

5.2.1.1.2 Use case discovery rules

5.2.1.1.2.1 General

In this document, a version number format "major.minor.revision" (e.g., 2.7.3) is used. Compatibility is achieved using the same "major" version number. For a given "major" version number, a given "minor" version number denotes backward compatibility to a lower "minor" version number. "revision" is increased if an error is corrected in a backward compatible manner.

5.2.1.1.2.2 Charging station commissioning and configuration

The use case discovery shall be supported by each actor and the following rules shall apply.

- The string content for the element "nodeManagementUseCaseData. useCaseInformation. useCaseSupport. useCaseName" within the use case discovery (SPINE Protocol in IEC 63380-3 shall be referred to) shall be "evseCommissioningAndConfiguration". The string content shall only be defined by this use case.
- The string content of the element "nodeManagementUseCaseData. useCaseInformation. actor" within the use case discovery (refer to SPINE Protocol in IEC 63380-3) shall be set to the according value stated within the corresponding actor's section.
- An actor A that is implemented to support this use case specification shall set the element "nodeManagementUseCaseData. useCaseInformation. useCaseSupport. useCaseVersion" within the use case discovery (refer to SPINE Protocol in IEC 63380-3) to "1.1.0".
- If an actor A supports multiple versions of this use case with the same major version number, only the highest one should be set within the use case discovery.
- If an actor A finds a proper counterpart actor B for this use case that supports multiple versions of this use case with the same major version number as supported by actor A, the actor A should evaluate only the highest version number from these versions of actor B.

- If an actor A supports multiple versions of this use case with different major version numbers, for each major version number only the highest version number should be set within the use case discovery.

5.2.1.1.2.3 Coordinated EV charging

The use case Discovery shall be supported by each actor and the following rules shall apply.

- The string content for the element "nodeManagementUseCaseData. useCaseInformation. useCaseSupport. useCaseName" within the use case discovery (refer to SPINE Protocol in IEC 63380-3) shall be "coordinatedEvCharging". The string content shall only be defined by this use case.
- The string content of the element "nodeManagementUseCaseData. useCaseInformation. actor" within the use case discovery (refer to SPINE Protocol in IEC 63380-3) shall be set to the according value stated within the corresponding actor's section.
- An actor A that is implemented to support this use case specification shall set the element "nodeManagementUseCaseData. useCaseInformation. useCaseSupport. useCaseVersion" within the use case discovery (refer to SPINE Protocol in IEC 63380-3) to "1.1.0".
- If an actor A supports multiple versions of this use case with the same major version number, only the highest one should be set within the use case discovery.
- If an actor A finds a proper counterpart actor B for this use case that supports multiple versions of this use case with the same major version number as supported by actor A, the actor A should evaluate from these versions of actor B only the highest version number.
- If an actor A supports multiple versions of this use case with different major version numbers, for each major version number only the highest version number should be set within the use case discovery.

5.2.1.1.2.4 EV charging electricity measurement

The use case discovery shall be supported by each actor and the following rules shall apply.

- The string content for the element "nodeManagementUseCaseData. useCaseInformation. useCaseSupport. useCaseName" within the use case Discovery (refer to SPINE Protocol in IEC 63380-3) shall be "measurementOfElectricityDuringEvCharging". The string content shall only be defined by this use case.
- The string content of the element "nodeManagementUseCaseData. useCaseInformation. actor" within the use case Discovery (refer to SPINE Protocol in IEC 63380-3) shall be set to the according value stated within the corresponding actor's section.
- An actor A that is implemented to support this use case specification shall set the element "nodeManagementUseCaseData. useCaseInformation. useCaseSupport. useCaseVersion" within the use case discovery (refer to SPINE Protocol in IEC 63380-3) to "1.0.1".
- If an actor A supports multiple versions of this use case with the same major version number, only the highest one should be set within the use case discovery.
- If an actor A finds a proper counterpart actor B for this use case that supports multiple versions of this use case with the same major version number as supported by actor A, the actor A should evaluate from these versions of actor B only the highest version number.
- If an actor A supports multiple versions of this use case with different major version numbers, for each major version number only the highest version number should be set within the use case discovery.

5.2.1.1.2.5 EV charging summary

The use case discovery shall be supported by each actor and the following rules shall apply.

- The string content for the element "nodeManagementUseCaseData. useCaseInformation. useCaseSupport. useCaseName" within the use case discovery (refer to SPINE Protocol in IEC 63380-3) shall be "evChargingSummary". The string content shall only be defined by this use case.

- The string content of the element "nodeManagementUseCaseData. useCaseInformation. actor" within the use case discovery (refer to SPINE Protocol in IEC 63380-3) shall be set to the according value stated within the corresponding actor's section.
- An actor A that is implemented to support this use case specification shall set the element "nodeManagementUseCaseData. useCaseInformation. useCaseSupport. useCaseVersion" within the use case discovery (refer to SPINE Protocol in IEC 63380-3) to "1.1.0".
- If an actor A supports multiple versions of this use case with the same major version number, only the highest one should be set within the use case discovery.
- If an actor A finds a proper counterpart actor B for this use case that supports multiple versions of this use case with the same major version number as supported by actor A, the actor A should evaluate from these versions of actor B only the highest version number.
- If an actor A supports multiple versions of this use case with different major version numbers, for each major version number only the highest version number should be set within the use case discovery.

5.2.1.1.2.6 EV commissioning and configuration

The use case discovery shall be supported by each actor and the following rules shall apply.

- The string content for the element "nodeManagementUseCaseData. useCaseInformation. useCaseSupport. useCaseName" within the use case discovery (refer to SPINE Protocol in IEC 63380-3) shall be "evCommissioningAndConfiguration". The string content shall only be defined by this use case.
- The string content of the element "nodeManagementUseCaseData. useCaseInformation. actor" within the use case discovery (refer to SPINE Protocol in IEC 63380-3) shall be set to the according value stated within the corresponding actor's section.
- An actor A that is implemented to support this use case specification shall set the element "nodeManagementUseCaseData. useCaseInformation. useCaseSupport. useCaseVersion" within the use case discovery (refer to SPINE Protocol in IEC 63380-3) to "1.0.1".
- If an actor A supports multiple versions of this use case with the same major version number, only the highest one should be set within the use case discovery.
- If an actor A finds a proper counterpart actor B for this use case that supports multiple versions of this use case with the same major version number as supported by actor A, the actor A should evaluate from these versions of actor B only the highest version number.
- If an actor A supports multiple versions of this use case with different major version numbers, for each major version number only the highest version number should be set within the use case discovery.

5.2.1.1.2.7 EV state of charge

The use case discovery shall be supported by each actor and the following rules shall apply.

- The string content for the element "nodeManagementUseCaseData. useCaseInformation. useCaseSupport. useCaseName" within the use case discovery (refer to SPINE Protocol in IEC 63380-3) shall be "evStateOfCharge". The string content shall only be defined by this use case.
- The string content of the element "nodeManagementUseCaseData. useCaseInformation. actor" within the use case discovery (refer to SPINE Protocol in IEC 63380-3) shall be set to the according value stated within the corresponding actor's section.
- An actor A that is implemented to support this use case specification shall set the element "nodeManagementUseCaseData. useCaseInformation. useCaseSupport. useCaseVersion" within the use case discovery (refer to SPINE Protocol in IEC 63380-3) to "1.0.0".
- If an actor A supports multiple versions of this use case with the same major version number, only the highest one should be set within the use case discovery.
- If an actor A finds a proper counterpart actor B for this use case that supports multiple versions of this use case with the same major version number as supported by actor A, the actor A should evaluate from these versions of actor B only the highest version number.

- If an actor A supports multiple versions of this use case with different major version numbers, for each major version number only the highest version number should be set within the use case discovery.

5.2.1.1.2.8 Limitation of active power consumption

The use case discovery shall be supported by each actor and the following rules shall apply.

- The string content for the element "nodeManagementUseCaseData. useCaseInformation. useCaseSupport. useCaseName" within the use case discovery (refer to SPINE Protocol in IEC 63380-3) shall be "limitationOfPowerConsumption". The string content shall only be defined by this use case.
- The string content of the element "nodeManagementUseCaseData. useCaseInformation. actor" within the use case discovery (refer to SPINE Protocol in IEC 63380-3) shall be set to the according value stated within the corresponding actor's section.
- An actor A that is implemented to support this use case specification shall set the element "nodeManagementUseCaseData. useCaseInformation. useCaseSupport. useCaseVersion" within the use case discovery (refer to SPINE Protocol in IEC 63380-3) to "1.0.0".
- If an actor A supports multiple versions of this use case with the same major version number, only the highest one should be set within the use case discovery.
- If an actor A finds a proper counterpart actor B for this use case that supports multiple versions of this use case with the same major version number as supported by actor A, the actor A should evaluate from these versions of actor B only the highest version number.
- If an actor A supports multiple versions of this use case with different major version numbers, for each major version number only the highest version number should be set within the use case discovery.

5.2.1.1.2.9 Monitoring of active power consumption

The use case discovery shall be supported by each actor and the following rules shall apply.

- The string content for the element "nodeManagementUseCaseData. useCaseInformation. useCaseSupport. useCaseName" within the use case discovery (refer to SPINE Protocol in IEC 63380-3) shall be "monitoringOfPowerConsumption". The string content shall only be defined by this use case.
- The string content of the element "nodeManagementUseCaseData. useCaseInformation. actor" within the use case discovery (refer to SPINE Protocol in IEC 63380-3) shall be set to the according value stated within the corresponding actor's section.
- An actor A that is implemented to support this use case specification shall set the element "nodeManagementUseCaseData. useCaseInformation. useCaseSupport. useCaseVersion" within the use case discovery (refer to SPINE Protocol in IEC 63380-3) to "1.0.0".
- If an actor A supports multiple versions of this use case with the same major version number, only the highest one should be set within the use case discovery.
- If an actor A finds a proper counterpart actor B for this use case that supports multiple versions of this use case with the same major version number as supported by actor A, the actor A should evaluate from these versions of actor B only the highest version number.
- If an actor A supports multiple versions of this use case with different major version numbers, for each major version number only the highest version number should be set within the use case discovery.

5.2.1.1.2.10 Optimization of self-consumption during EV charging

The use case discovery shall be supported by each actor and the following rules shall apply.

- The string content for the element "nodeManagementUseCaseData. useCaseInformation. useCaseSupport. useCaseName" within the use case Discovery (refer to SPINE Protocol in IEC 63380-3) shall be "optimizationOfSelfConsumptionDuringEvCharging". The string content shall only be defined by this use case.

- The string content of the element "nodeManagementUseCaseData. useCaseInformation. actor" within the use case Discovery (refer to SPINE Protocol in IEC 63380-3) shall be set to the according value stated within the corresponding actor's section.
- An actor A that is implemented to support this use case specification shall set the element "nodeManagementUseCaseData. useCaseInformation. useCaseSupport. useCaseVersion" within the use case discovery (refer to SPINE Protocol in IEC 63380-3) to "1.0.1".
- If an actor A supports multiple versions of this use case with the same major version number, only the highest one should be set within the use case discovery.
- If an actor A finds a proper counterpart actor B for this use case that supports multiple versions of this use case with the same major version number as supported by actor A, the actor A should evaluate from these versions of actor B only the highest version number.
- If an actor A supports multiple versions of this use case with different major version numbers, for each major version number only the highest version number should be set within the use case discovery.

5.2.1.1.2.11 Overload protection by EV charging current curtailment

The use case Discovery shall be supported by each actor and the following rules shall apply.

- The string content for the element "nodeManagementUseCaseData. useCaseInformation. useCaseSupport. useCaseName" within the use case Discovery (refer to SPINE Protocol in IEC 63380-3) shall be "overloadProtectionByEvChargingCurrentCurtailment". The string content shall only be defined by this use case.
- The string content of the element "nodeManagementUseCaseData. useCaseInformation. actor" within the use case Discovery (refer to SPINE Protocol in IEC 63380-3) shall be set to the according value stated within the corresponding actor's section.
- An actor A that is implemented to support this use case specification shall set the element "nodeManagementUseCaseData. useCaseInformation. useCaseSupport. useCaseVersion" within the use case discovery (refer to SPINE Protocol in IEC 63380-3) to "1.0.1".
- If an actor A supports multiple versions of this use case with the same major version number, only the highest one should be set within the use case discovery.
- If an actor A finds a proper counterpart actor B for this use case that supports multiple versions of this use case with the same major version number as supported by actor A, the actor A should evaluate from these versions of actor B only the highest version number.
- If an actor A supports multiple versions of this use case with different major version numbers, for each major version number only the highest version number should be set within the use case discovery.

5.2.1.1.2.12 Dynamic bidirectional EV charging

The use case discovery shall be supported by each actor and the following rules shall apply.

- The string content for the element "nodeManagementUseCaseData. useCaseInformation. useCaseSupport. useCaseName" within the use case discovery (refer to SPINE Protocol in IEC 63380-3) shall be "dynamicBidirectionalEvCharging". The string content shall only be defined by this use case.
- The string content of the element "nodeManagementUseCaseData. useCaseInformation. actor" within the use case discovery (refer to SPINE Protocol in IEC 63380-3) shall be set to the according value stated within the corresponding actor's section.
- An actor A that is implemented to support this use case specification shall set the element "nodeManagementUseCaseData. useCaseInformation. useCaseSupport. useCaseVersion" within the use case discovery (refer to SPINE Protocol in IEC 63380-3) to "1.0.0".
- If an actor A supports multiple versions of this use case with the same major version number, only the highest one should be set within the use case discovery.
- If an actor A finds a proper counterpart actor B for this use case that supports multiple versions of this use case with the same major version number as supported by actor A, the actor A should evaluate from these versions of actor B only the highest version number.

- If an actor A supports multiple versions of this use case with different major version numbers, for each major version number only the highest version number should be set within the use case discovery.

5.2.1.1.3 Rules for "Information content" tables

5.2.1.1.3.1 General presence indication definitions

Abbreviations for the presence indication of elements listed in Table 1 are defined as follows.

Table 1 – Presence indication description

Abbreviation	Meaning	Link to requirement keywords
M	Mandatory	Shall
R	Recommended	Should
O	Optional	May
F	Forbidden	Shall not

An actor may support elements that are not listed in the tables. However, another actor may ignore these elements.

The presence indications "M", "R" and "O" are always meant relative to the respective parent element, i.e. if a parent element is optional ("O") and a child is mandatory ("M") the child element can only be present if the parent element is present as well.

NOTE The indications and the aforementioned rules apply for "complete messages" (so-called "full function exchange", refer to SPINE Protocol in IEC 63380-3). In contrast, the so-called "restricted function exchange" is designed to permit exchange of specific excerpts of data, i.e. fewer elements than potentially available from the data owner (partially even not all "mandatory" elements).

In some cases, an element can have a double presence indication, separated by a comma.

Examples:

M, O

M \W, O \W

The description (rules) of the element details in such a case the presence requirement. A typical example is a list-based element where the "first" (or "last") element has a different presence requirement than the other list elements.

5.2.1.1.3.2 Presence indications for "Content of Function..." tables

This subclause only defines rules for the server side.

Elements that are marked with "M" shall be supported by the server in case of readable as well as writeable data. In case of writeable data (marked with "M \W") the server does not set the element, because the element is set only by the client.

The following applies for readable data that is exchanged in a "read/reply" or "notify" operation.

- "R" means that the data should be provided by the server.
- "O" means that the data may be provided by the server.
- "F" means that the data shall not be provided by the server.

The following applies for writeable data that is exchanged in a "write" operation.

- "R" means that the data should be supported. In other words, if the client writes the element, the server should accept those messages and the contained elements.
- "O" means that the data may be supported. In other words, if the client writes the element, the server may accept those messages and the contained elements.

The following applies for elements that are not listed in the actor section:

- In case of a received "read" request: the according element may be set in the reply.
- In case of a received "write" operation: the server may ignore the element.
- In case of a "notify" operation to be created: the server may set the element.

NOTE The server will only accept write operations if the result fulfils the server function requirements (e.g. permitted values). Write operations on elements that are not writeable can result in an error message.

M, R or O can be combined with the suffix "(event)" to express that a supported element or value only shall be supported during a certain event and hence does not present at all times. If the event is not active the element can be omitted or another value can be set. In most cases a High-Level requirement reference for the event is given in the rules column.

5.2.1.1.3.3 Cardinality indications on Elements and list items

A cardinality indication on an element or list item expresses constraints on the number of occurrences of a given element or data set. In 5.2.1.1.3.3, "X" is used as representation for such an element or data set. Furthermore, "a" and "b" represent constraints. The following rules apply for the occurrence of "X" and its content related to a specific scenario (see Note 1 underneath the below list):

- 1) X
No cardinality indication.
- 2) X (a..b)
This means "X" shall occur at least "a" times and at maximum "b" times.
- 3) X (a..)
This means "X" shall occur at least "a" times and may occur more than "a" times.
- 4) X (..b)
This means "X" shall occur at maximum "b" times and may occur less than "b" times (even zero occurrences are permissive).

NOTE 1 These rules apply only under consideration of presence indications and with regards to the given scenario or function definition for the use case.

Table 2 is an example to explain this for two different placements.

Table 2 – Example table for cardinality indications on elements and list items

Scenario [...]: M/R/O [W][C]	Element	Value	Element and value rules
...	...		...
2: M \W	xFeatureType. xListData. xData. (1..3)		
2: M \W	xId	<t#(1..)>	primary identifier
2: M \W	timePeriod		...
2: M \W	timePeriod. startTime	<xs:duration>	
2: M \W	xSlot. (1..)		
2: M \W	xSlot. xSlotId		...
2: M \W	xSlot. duration	<xs:duration>	...
...	...	...	...

The field

- xFeatureType. xListData. xData. (1..3)

introduces a data pattern (required elements and values) for "xData" instances used for scenario 2. The field itself specifies that such an "xData" instance shall occur at least one time and at maximum 3 times within "xListData" of feature type "xFeatureType". However, this constraint holds only for scenario 2 and only if such "xData" are required. In this case, they are required, as the left field

- 2: M \W

denotes that this data set is mandatory for scenario 2.

The field

- xSlot. (1..)

expresses that the element "xSlot" shall occur at least one time within its "xData" but may occur more than one time.

The remaining fields do not have an explicit cardinality indication.

NOTE 2 Cardinality expressions are also used within placeholder expressions as defined in 5.2.1.1.3.5. In many cases such placeholder expressions define the number of required or permitted elements or list items as they explicitly define how many different values for a given identifier are required or permitted for a given scenario.

5.2.1.1.3.4 Writability and changeability indication

In the same column where the presence indications are denoted, a mark is used to distinguish between writeable, changeable or readable elements:

- Elements that are marked with "W" are written by a client and shall be writeable at the server according to their presence indications. The client is not obliged to read the according data. Received notifications are not evaluated.

- Elements that are marked with "C" are changed by a client and shall be changeable at the server according to their presence indications. The client is not obliged to read the according data. Received notifications are evaluated.
- Elements that are marked with "\RW" are read and written by a client and shall be writeable and provided by the server according to their presence indications. Received notifications shall be evaluated according to their presence indications.
- Elements that are marked with "\RC" are read and changed by a client and shall be changeable and provided by the server according to their presence indications. Received notifications shall be evaluated according to their presence indications.
- Elements that are not marked are only read by a client and shall be provided by the server according to their presence indications. Received notifications shall be evaluated according to their presence indications.

"Writeable" means that the element and its value can be written by a client. This includes the possibility to modify (if the element is already present), create (if the element is not present yet), and delete the element. The server shall adjust its function according to the received "write" operation (unless the server cannot accept the "write" operation).

"Changeable" means that the element's value can be changed by a client. If the element is not present at the resource before, it probably cannot be created by the client via the "write" operation. In this case the server may decline such a message.

Depending on the resource, a client can request a proper binding before the server accepts a "write" operation.

NOTE "\W" includes "C" already.

5.2.1.1.3.5 "Value" placeholders

5.2.1.1.3.5.1 General

Lists of message content can use placeholders to model relations between different elements or even list items of different functions. The main purpose is to declare which identifier values relate to each other. As a use case does not prescribe specific values to be used for a given identifier, a placeholder like "<x1>" can be used in "Value" columns to express the intended relations.

There are two styles to identify a placeholder that can be referenced:

- 1) <xM>
- 2) <xM#S>

where

x is any alphabetical prefix like "m", "t", "ec", "cc", etc.

M is a (major) number like "1", "2", "15", etc.

S is a sub-number like "1", "7", "10", etc.

Examples for the first style are "<ec1>", "<z12>". Examples for the second style are "<p4#2>", "<m22#3>".

NOTE A placeholder with sub-number is used, e.g. if particular values of an element is referenced uniquely. An example in Table 3 shows how different phases ("a", "b", "c", "abc", "neutral") are associated with individual values of <z3#(3..5)>.

5.2.1.1.3.5.2 Uniqueness of placeholders

A given placeholder $\langle xM \rangle$ or $\langle xM\#S \rangle$ represents the same value throughout a given use case specification for a given set of its parent identifier values. This shall be explained in a brief example:

A list item with primary identifier "pld" is assumed. It also has a sub-identifier "sld" with placeholder " $\langle s1 \rangle$ ". Then, each occurrence of " $\langle s1 \rangle$ " represents the same value for a given value of pld. This means that " $\langle s1 \rangle$ " of a list item with pld=1 can differ from " $\langle s1 \rangle$ " of a list item with pld=2. But it also means that " $\langle s1 \rangle$ " represents the same value in all list items with pld=1.

NOTE 1 Typically, parent identifiers like "pld" will also be expressed with a placeholder like " $\langle p5 \rangle$ ", e.g. in this case, the uniqueness rule applies for " $\langle p5 \rangle$ " likewise.

NOTE 2 The uniqueness also applies for placeholders used as foreign identifier.

5.2.1.1.3.5.3 Placeholder expressions with cardinalities

For some identifiers, more than one placeholder is necessary. Several notations are used for this purpose, which make use of cardinality expressions. The general notation is as follows:

$\langle xM\#(a..b) \rangle$

This is equivalent to this explicit definition:

At least a and at maximum b placeholders of this list: $\langle xM\#1 \rangle \langle xM\#2 \rangle \dots \langle xM\#b \rangle$

This means that the implementation of a given use case (or scenario) requires a minimum of "a" distinct values of the respective identifier. In total, there can be up to "b" distinct values of the respective identifier.

Additionally, the following notations can occur:

- 1) $\langle xM\#(a..) \rangle$
This is equivalent to " $\langle xM\#(a..b) \rangle$ " with "b" equal to infinity.
- 2) $\langle xM\#(..b) \rangle$
This is equivalent to " $\langle xM\#(a..b) \rangle$ " with "a" equal to zero.

" $\langle xM\#(a..) \rangle$ " has only a lower bound of "a" distinct value, but no upper bound. " $\langle xM\#(..b) \rangle$ ", on the other hand, expresses that the identifier is not required, but it is permitted to have up to "b" distinct values.

NOTE The cardinality does not express which of the sub-numbers are used: it does not mean that the identifiers $\langle xM\#1 \rangle \dots \langle xM\#a \rangle$ are always used and just those with larger sub-numbers ($\langle xM\#a+1 \rangle \dots \langle xM\#b \rangle$) are optional. If, for instance, a placeholder expression " $\langle xM\#(3..5) \rangle$ " is given, it can happen that an implementation makes use of $\langle xM\#2 \rangle$, $\langle xM\#4 \rangle$, and $\langle xM\#5 \rangle$ (i.e. it does not use $\langle xM\#1 \rangle$, $\langle xM\#3 \rangle$). Which sub-numbers are used usually depends on other parts of a Message and their references to required placeholders, which is explained in 5.2.1.1.3.5.4.

Alternatively, a placeholder of a given identifier with one or more values is numbered explicitly:

$\langle g7 \rangle [\langle g8 \rangle] [\langle g9 \rangle]$

This means there shall be at least one value ($\langle g7 \rangle$) for the respective identifier and that there can be up to two more identifier values: the square brackets around $\langle g8 \rangle$ and $\langle g9 \rangle$ denote optionality.

5.2.1.1.3.5.4 References to placeholders and relations

According to the styles for placeholders that can be referenced, an enumeration value "e" can refer to a particular placeholder:

- 1) e(-><xM>)
- 2) e(-><xM#S>)

This denotes that "e" is to be used with "<xM>" or "<xM#S>", respectively.

Example: A message contains the elements "mId" and "phase". "mId" is an identifier with placeholder definition <m2#(1..3)>. "phase" is a string that permits the values "a", "b", and "c" using this expression:

"a"(-><m2#1>)

"b"(-><m2#2>)

"c"(-><m2#3>)

This expresses that the enumeration value "a" is to be used with the placeholder <m2#1>, "b" is to be used with <m2#2> and "c" with <m2#3>.

Similarly, a placeholder "yN" can refer to a particular placeholder:

- 1) <yN->xM>
- 2) <yN->xM#S>
- 3) <yN#T->xM>
- 4) <yN#T->xM#S>

where "T" is a sub-number of "yN".

It is also feasible to associate placeholders with cardinalities:

<yN#(a..b)->xM#(a..b)>

denotes that <yN#1> is to be used with <xM#1>, <yN#2> is to be used with <xM#2>, etc.

In this case, the placeholder expressions of yN and xM shall have the same cardinality.

In some cases, there is a need to express that multiple list items with similar values are feasible or required, but only particular combinations of these different data are permitted. The following example shows that several "fData" list items with different "phase" value are required, but that these list items can only express either the "phase" value combination { "a", "b", "c" } or the "phase" value combination { "a", "abc", "neutral" }.

The permitted combinations are defined in a note below Table 3:

Table 3 – Content of an example table

Scenario {...]: M/R/O [W][C]	Element	Value	Element and value rules
2: M	F. fListData. fData.		
2: M	zId	<z3#(3..5)>	
2: M	phase	"a"(-><z3#1>)	
		"b"(-><z3#2>)	
		"c"(-><z3#3>)	
		"abc"(-><z3#4>)	
		"neutral"(-><z3#5>)	

NOTE A use case can specify that certain combinations shall be supported. For example, a use case can require that one of the combinations {<z3#1>, <z3#2>, <z3#3>} or {<z3#1>, <z3#4>, <z3#5>} shall be supported.

5.2.1.1.3.6 Rules for content of "Value" column

For a given scenario, the "Value" column can restrict the permitted content of an element to one or more particular values. This means that elements with values deviating from the restriction (i.e. from the permitted values) do not belong to the respective scenario and shall be considered as if the element is not set. If more than one particular value is permitted for an element, the values are in a single line each.

If a presence indication is set for the value (in an additional column before the value), the following rules shall be applied:

- "M" means that the value shall be supported. This means the value shall be set at a certain point in time (depending on the value rules) or for a certain element within a list entry.
- "R" means that the value should be supported.
- "O" means that the value may be supported.

If all possible values of a given mandatory element are optional or recommended and this element is used for the purpose of the respective scenario, one of the values shall be set. If all possible values of a given optional or recommended element are optional or recommended, this element may contain also other values, but then this element shall not be considered as part of the respective scenario.

M, R or O can be combined with the suffix "(event)" to express that a supported value only shall be supported during a certain event and hence is not present at all times. If the event is not active another value can be set. In most cases a high-level requirement reference for the event is given in the rules column.

If no presence indication is set for the value, the following rules shall be applied.

- In case of elements where the server can set or change an element on its own (see 5.2.1.1.3.4):
 - the server shall support at least one of the listed values;
 - the client shall support all listed values.

- In case of elements that are writeable or changeable (see 5.2.1.1.3.4):
 - the server shall support all listed values;
 - the client shall support at least one of the listed values.

Depending on the element, different values can be used during runtime. If this is the case, those rules are defined within the value rules.

If a value is placed in parentheses, the corresponding value is a recommendation. The actual value may deviate from this, e.g. "(1024)".

5.2.1.1.4 "Actor ... overview" diagram rules

Within the "Actor [...]" overview diagrams in the "Actors" sub-sections the complete functionality of the use case is provided, including optional scenarios. Which scenarios are optional can be found in the table under "Scenario Support Requirements". The actor may have more functionality implemented than necessary for the use case.

For the following actor overview example in Figure 4, a brief description of the graphical symbols will be given.

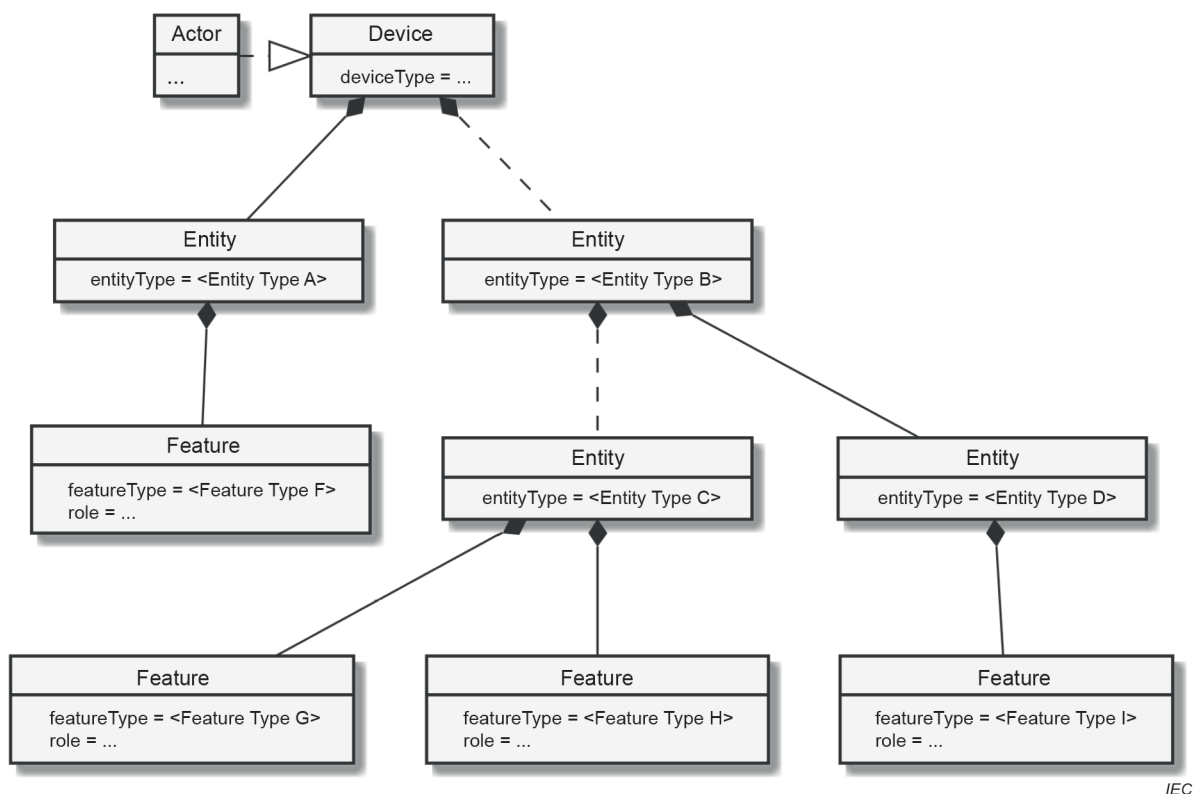


Figure 4 – Actor overview example

The solid lines in Figure 4 represent an immediate parent-childhood relation: the entity with "<Entity Type A>" is a direct child of "Device". The entity with "<Entity Type D>" is a direct child of the entity with "<Entity Type B>". All features are immediate children of the respective entity.

The dashed lines in Figure 4 express that there can be additional entities between the shown entities: a vendor's implementation can have one or more entities between "Device" and the entity with "<Entity Type B>". Likewise, a vendor's implementation can have one or more entities between the entity with "<Entity Type B>" and the entity with "<Entity Type C>".

5.2.1.1.5 Order of messages within the sequence diagrams

There are several sequence diagrams in this document describing message flows. The order of the messages should be kept by the communications partners, but there can be cases where a different order makes sense. The communications partners shall be able to handle the scenario functionalities even if the messages are transmitted in a different order by the other actor(s). The sequence diagrams can be seen as examples.

5.2.1.1.6 Further information and rules

5.2.1.1.6.1 Frequently used element rules

5.2.1.1.6.1 serves as a collection of rules frequently used by the tables of the subsequent subclauses. Each rule applies only where referenced explicitly in the tables.

NOTE The purpose of this collection is just to reduce the size of the tables. As such, no rule has a meaning without a reference indicating the required rule. Examples of references are shown in [Measurement value rules].

[Measurement value rules]:

Shall be set if a value is available. Otherwise, the whole list entry shall be omitted or the element *valueState* shall be set to "error".

If *valueState* is set to "error", but *value* is set, the content of *value* shall be ignored.

If *valueState* is set to "outOfRange", but *value* is set, the content of *value* shall be interpreted as being out of range.

If *valueState* is set to "outOfRange", *measurementConstraintsListData.valueRangeMax* is set and *value* is equal or bigger than *valueRangeMax*, *value* shall be interpreted as above *valueRangeMax*.

If *valueState* is set to "outOfRange", *measurementConstraintsListData.valueRangeMin* is set and *value* is equal or smaller than *valueRangeMin*, *value* shall be interpreted as below *valueRangeMin*.

If set, *measurementDescriptionListData.measurementType* shall be set, too.

[Value state rules]:

The element *valueState* shall be set if its content differs from "normal". This means, if the state of the value is "outOfRange" or "error" this shall be denoted in the *valueState* element. A client shall always consider the content of *valueState*, if set. If omitted, a value of "normal" is assumed.

[String-length rules]:

The string-length should not be longer than 256 characters. If it is longer, the sender shall consider the possibility that the receiver will shorten the string to 256 characters.

[Scaled number rules]:

The sub-elements "number" and "scale" represent a value according to the following formula:

$$\text{number} * 10^{\text{scale}}$$

[Evaluation period rules]:

The "evaluationPeriod" expresses the analysis period for the according value.

5.2.1.1.6.2 Applied sign convention

Throughout the whole use case the "load convention" (i.e. "passive sign convention") is applied for measurement values. This means measured electrical current, active power and exchanged energy are expressed with positive values in case of energy consumption whereas negative values are used in case of energy production. Voltages are measured independent of the energy direction.

5.2.1.1.6.3 Rules regarding the usage of time-related information

All time-related information within the use case shall be presented as absolute times. This means relative times shall not be used, unless the data point only supports relative times (e.g. for a "duration").

NOTE This means the actors have a common understanding of these absolute times. It is strongly recommended that each actor is "sufficiently synchronized" with the official "Coordinated Universal Time" (UTC).

5.2.1.2 Pre-scenario communication

5.2.1.2.1 General information

The pre-scenario communication is necessary if a client does not know the corresponding addresses on the server or if the required subscriptions or bindings are not active. In this case certain general communication mechanisms shall be used within SPINE:

- a) Detailed discovery: allows to discover resource addresses.
- b) Binding: allows to bind to resource address, which is frequently necessary to obtain write privileges.
- c) Subscription: allows to subscribe to resource addresses, which is necessary to receive unsolicited notifications if a resource changes during runtime.

It is possible to combine those steps for multiple scenarios or also multiple use cases:

- for example, if multiple scenarios in multiple use cases use the same feature, only one subscription shall occur;
- for example, a complete detailed discovery or a subscription to the NodeManagement feature shall occur only once for all use cases.

Depending on which entity, feature and functions are used within a scenario, the payload of the corresponding messages can slightly differ, but the basic principles and messages used stay the same.

The subsequent messages shall be exchanged for those parts that have not already been performed since the current connection is established or if those parts are outdated for another reason (e.g. if the detailed discovery is necessary, but the bindings and subscriptions are still active from a previous connection only the detailed discovery messages shall be exchanged). If all pre-scenario communication parts are up-to-date, this section may be skipped, and the implementation can proceed as described in the corresponding "Scenario communication" sections.

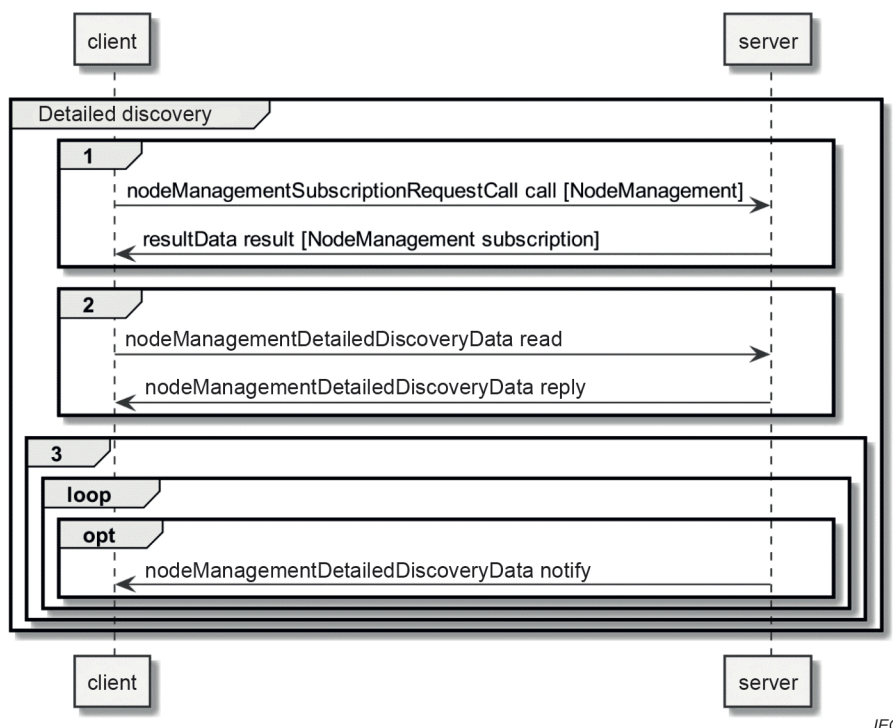
After the connection is re-established (e.g. due to a power loss or a firmware update) the pre-scenario communication shall be performed as well. There can be circumstances where messages from the pre-scenario communication can be exchanged again.

Often the necessary messages of different scenarios can be combined, so that only one single message is recommended instead of multiple messages for the different scenarios. This also is the case for the pre-scenario communication. In most cases only one "read" operation on the detailed discovery is necessary, as well as only one subscription request or binding request is necessary for each feature. Often multiple scenarios within a use case access the same feature, so only one subscription or binding is necessary.

5.2.1.2.2 Detailed discovery

For the functionality where a client already has current detailed discovery information (i.e. independent of the use case or any scenario of it) the remainder of this section should be skipped. Otherwise, the following procedure shall be performed in the given order.

- 1) If a client is not subscribed to the primary NodeManagement instance, the client shall acquire a subscription according to Figure 5.
- 2) A client shall read the detailed discovery information according to Figure 5. It shall keep the received information as far as it concerns mandatory and supported optional entity Types, feature types and functions of the use case that are required by the client. This means that a client can choose how to store the necessary information, e.g. a client actor can store the information on how to address the necessary features of the implemented scenarios but can discard the entity information.
- 3) If and as long as a client has a subscription to the detailed discovery information of an actor and receives proper notifications, it shall consider (i.e. integrate into the kept detailed discovery information) the received information as far as it concerns mandatory and supported optional entity Types, feature types and functions of the use case.



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Figure 5 – Pre-scenario communication – Detailed discovery sequence diagram

If the "nodeManagementDetailedDiscoveryData read" fails, the client should retry to read the detailed discovery information until the "nodeManagementDetailedDiscoveryData reply" message was received successfully.

If all functionality is present at all times: the "nodeManagementDetailedDiscoveryData reply" message contains at least the mandatory entities and features given in the "Actor [...] overview" diagrams as well as the used functions and their "possible operations" described.

If functionality is added or removed dynamically: the "nodeManagementDetailedDiscoveryData reply" message does not contain all mandatory entities and features given in the "Actor [...] overview" diagrams as well as all necessary functions and their "possible operations". However, as soon as the functionality is available it will be announced via a "nodeManagementDetailedDiscoveryData notify" message.

For the `nodeManagementDetailedDiscoveryData` read function it is recommended to use a partial read with separated selectors that can use one of the following elements:

- `entityType`;
- `featureType`.

Even with the usage of selectors, features, and entities that are not relevant for the use case can still be discovered. However, only features and entities that fulfil the hierarchical order as described within the actors' sections shall be considered for the use case.

A "partial" notify shall be supported without using selectors and elements. Partial "delete" notify should also be supported with separated selectors that can use one of the following elements:

- `entityAddress`;
- `featureAddress`.

5.2.1.2.3 Binding

If binding is required by a scenario that uses features with writeable or changeable data, the server shall support binding for the respective features. Before a write on a function of a feature occurs, the client shall create a binding to the corresponding feature. For this the `nodeManagementBindingRequestCall` function is used as shown in Figure 6.

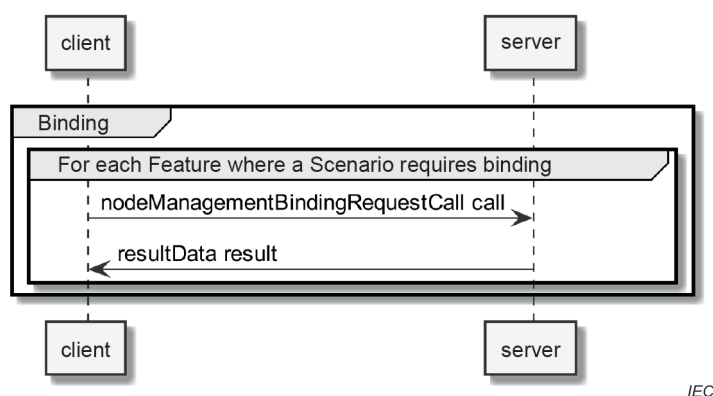
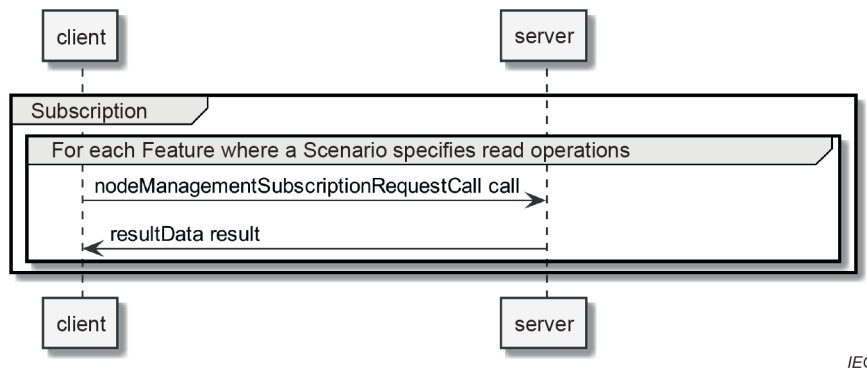


Figure 6 – Pre-scenario communication – Binding sequence diagram

If functionality is added or removed dynamically, binding is not possible at all times on the required functions. A client shall retry to create a binding again when receiving according updated detailed discovery information.

5.2.1.2.4 Subscription

A server shall support subscription for all features that contain readable data that can change during runtime. The client shall create a subscription for all features that the client wants to read. For this the `nodeManagementSubscriptionRequestCall` function is used as shown in Figure 7.



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Figure 7 – Pre-scenario communication – Subscription sequence diagram

If the subscription request fails (e.g. because it is not supported by the server or the maximum number of possible subscriptions is reached), the client should read the data periodically (so-called "polling").

If functionality is added or removed dynamically, subscription is not possible at all times on the required functions. A client shall retry its subscription procedure again when receiving according updated detailed discovery information.

5.2.1.2.5 Dynamic behaviour

In case entities or features are removed, a nodeManagementDetailedDiscoveryData "notify" is transmitted that informs about the deleted entities and features. All existing binding or subscription entries on the deleted features shall be deleted by each device.

In case entities or features are added, the pre-scenario communication starts with transmitting a nodeManagementDetailedDiscoveryData "notify" that contains the added entities and features.

5.2.2 UCF_AC_Measurement

5.2.2.1 Generic sequence diagram

The purpose of this use case function is to allow a charging station to send a measurement of the current power, current, or energy consumption to an EMS, as shown in Figure 8.

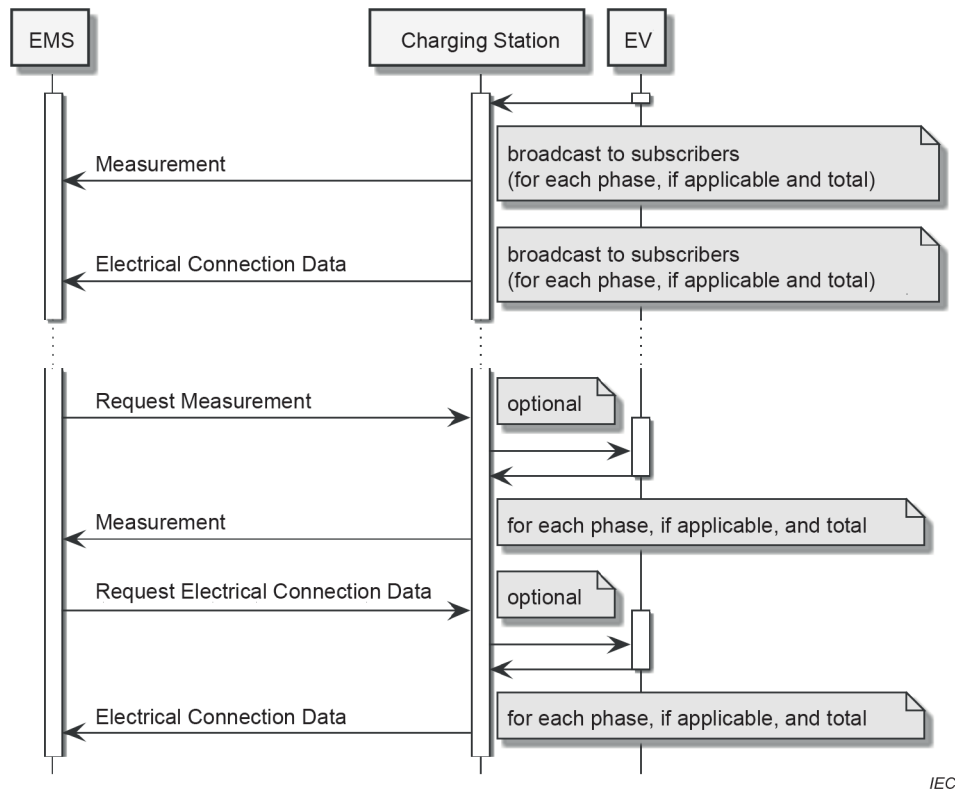


Figure 8 – Messaging sequence for UCF_AC_Measurement

5.2.2.2 SPINE mapping

5.2.2.2.1 Request measurement

5.2.2.2.1.1 General

This is a set of three SPINE partial "read" messages. It is considered best practice to send them in the following sequence, as shown in Figure 9.

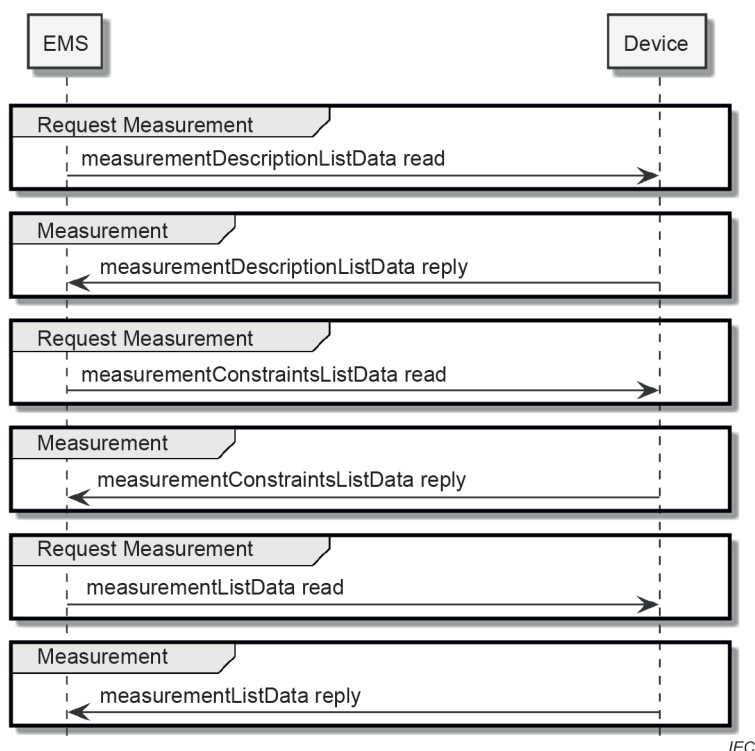


Figure 9 – UCF_AC_Measurement: Request Measurement/ Measurement communication sequence diagram

The messages have the following payload as defined in Table 4 to Table 6:

5.2.2.2.1.2 measurementDescriptionListData read

Table 4 – Content of measurementDescriptionListData read at actor EMS – Use case "Monitoring of Power Consumption", "EV Charging Electricity Measurement"

Element		Value	
function		measurementDescriptionListData	
filter			
	cmdControl	partial	
	measurementDescriptionDataSelectors		
	scopeType	Scope Type	Used for Measurement of:
		acPowerTotal	AC Power (non-phase specific)
		acPower	AC power (phase-specific)
		acEnergyConsumed	Consumed AC energy
		acEnergyProduced	Produced AC energy
		acCurrent	AC current
		acVoltage	AC voltage
		acFrequency	AC frequency
		charge	Charging energy (use cases "EV Charging Electricity Measurement", scenario 3)

5.2.2.2.1.3 measurementConstraintListData read**Table 5 – Content of measurementConstraintListData read at actor EMS**

Element	Value
function	measurementConstraintListData
filter	
cmdControl	partial
measurementConstraintListDataSelectors	
measurementId	measurementId (derived from the measurementDescriptionListData reply)

5.2.2.2.1.4 measurementListData read**Table 6 – Content of measurementListData read at actor EMS**

Element	Value
function	measurementListData
filter	
cmdControl	partial
measurementListDataSelectors	
measurementId	measurementId (derived from the measurementDescriptionListData reply)

These messages are sent during the initial communication phase, as well as on (re-)connect.

5.2.2.2.2 Measurement**5.2.2.2.2.1 General**

For each read from "Request Measurement" above, there is a SPINE "reply" with the following payload, as defined in Table 7 to Table 36:

5.2.2.2.2.2 For power**5.2.2.2.2.2.1 measurementDescriptionListData reply**

Table 7 and Table 8 describe replies for non-phase specific measurements.

Table 7 – Content of measurementDescriptionListData reply or notify at actor device – Power, non-phase specific – Use case "Monitoring of Power Consumption"

Scenario [...]: M/R/O [W][C]	Element	Value	Element and value rules
1: M	Measurement. measurementDescriptionListData. measurementDescriptionData.		
1: M	measurementId	<m1#(1..1)>	Shall be set as primary identifier.
1: M	measurementType	"power"	
1: M	commodityType	"electricity"	
1: M	unit	"W"	
1: M	scopeType	"acPowerTotal"	

Table 8 – Content of measurementDescriptionListData reply or notify at actor device – Power, non-phase specific – Use case "EV Charging Electricity Measurement"

Scenario [...]: M/R/O [W][C]	Element	Value	Element and value rules
2: M	Measurement. measurementDescriptionListData. measurementDescriptionData.		
2: M	measurementId	<x4> [<x5>] [<x6>]	Shall be set as primary identifier.
2: M	measurementType	"power"	
2: M	commodityType	"electricity"	
2: M	unit	"W"	
2: M	scopeType	"acPower"	

Table 9 describes replies for phase specific measurements.

Table 9 – Content of measurementDescriptionListData reply or notify at actor device – Power, phase-specific – Use case "Monitoring of Power Consumption"

Scenario [...]: M/R/O [W][C]	Element	Value	Element and value rules
1: M	Measurement. measurementDescriptionListData. measurementDescriptionData.		
1: M	measurementId	<m2#(1..3)>	Shall be set as primary identifier.
1: M	measurementType	"power"	
1: M	commodityType	"electricity"	
1: M	unit	"W"	
1: M	scopeType	"acPower"	

5.2.2.2.2.2 measurementConstraintsListData reply

Table 10 and Table 11 describe replies for non-phase specific measurement constraints.

Table 10 – Content of measurementConstraintsListData reply or notify at actor device – Power, non-phase specific – Use case "Monitoring of Power Consumption"

Scenario [...]: M/R/O [W][C]	Element	Value	Element and value rules
1: R	Measurement. measurementConstraintsListData. measurementConstraintsData.		
1: M	measurementId	<m1#(1..1)>	Shall be set as primary identifier.
1: R	valueRangeMin.		Should be used. [Scaled number rules]
1: M	valueRangeMin. number		Shall be used.
1: O	valueRangeMin. scale		May be used. If absent, a default value of "0" applies.
1: R	valueRangeMax.		Should be used. [Scaled number rules]
1: M	valueRangeMax. number		Shall be used.
1: O	valueRangeMax. scale		May be used. If absent, a default value of "0" applies.
1: R	valueStepSize.		Should be used. [Scaled number rules]
1: M	valueStepSize. number		Shall be used.
1: O	valueStepSize. scale		May be used. If absent, a default value of "0" applies.

Table 11 – Content of measurementConstraintsListData reply or notify at actor device – Power, non-phase specific – Use case "EV Charging Electricity Measurement"

Scenario [...]: M/R/O [W][C]	Element	Value	Element and value rules
2: R	Measurement. measurementConstraintsListData. measurementConstraintsData.		
2: M	measurementId	<x4> [<x5>] [<x6>]	Shall be set as primary identifier.
2: R	valueRangeMin.		The sub-elements "number" and "scale" represent a value according to the following formula: number * 10 ^{scale}
2: M	valueRangeMin. number		Shall be used.
2: O	valueRangeMin. scale		May be used. If absent, a default value of "0" applies.
2: R	valueRangeMax.		The sub-elements "number" and "scale" represent a value according to the following formula: number * 10 ^{scale}
2: M	valueRangeMax. number		Shall be used.
2: O	valueRangeMax. scale		May be used. If absent, a default value of "0" applies.

Scenario {...}: M/R/O [W][C]	Element	Value	Element and value rules
2: R	valueStepSize.		The sub-elements "number" and "scale" represent a value according to the following formula: number * 10 ^{scale}
2: M	valueStepSize. number		Shall be used.
2: O	valueStepSize. scale		May be used. If absent, a default value of "0" applies.

Table 12 describes replies for phase specific measurement constraints.

Table 12 – Content of measurementConstraintsListData reply or notify at actor device – Power, phase specific – Use case "Monitoring of Power Consumption"

Scenario {...}: M/R/O [W][C]	Element	Value	Element and value rules
1: R	Measurement. measurementConstraintsListData. measurementConstraintsData.		
1: M	measurementId	< m2#{1..3} >	Shall be set as primary identifier.
1: R	valueRangeMin.		Should be used. [Scaled number rules]
1: M	valueRangeMin. number		Shall be used.
1: O	valueRangeMin. scale		May be used. If absent, a default value of "0" applies.
1: R	valueRangeMax.		Should be used. [Scaled number rules]
1: M	valueRangeMax. number		Shall be used.
1: O	valueRangeMax. scale		May be used. If absent, a default value of "0" applies.
1: R	valueStepSize.		Should be used. [Scaled number rules]
1: M	valueStepSize. number		Shall be used.
1: O	valueStepSize. scale		May be used. If absent, a default value of "0" applies.