

EEBus UC Technical Specification

EV State of Charge

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1 Scope of the document

This document describes the Use Case "EV State of Charge" (short-name: EVSOC). Chapter 2 specifies the High-Level Use Case. Chapter 3 details the technical solution for SPINE for this Use Case. Within this document, a top-down approach is used to derive the requirements for the technical solution from the High-Level description.

1.1 References

1.1.1 EEBUS documents

[ProtocolSpecification] EEBus_SPINE_TS_ProtocolSpecification.pdf

[ResourceSpecification] EEBus_SPINE_TS_ResourceSpecification.pdf

[SHIP] SHIP_Specification_v1.0.0.pdf

1.1.2 Normative references

[RFC2119] IETF RFC 2119: 1997, Key words for use in RFCs to indicate requirement levels
Please see section 1.3.1 for details.

1.2 Terms and definitions

Actor

An Actor models a role within a Use Case definition (e.g. an energy manager or an electric vehicle).

EV

Abbreviation for electric vehicle.

EVSOC

EV State of Charge (short name of this Use Case)

Scenario

Part of a Use Case. Splitting a Use Case into Scenarios helps readers understand the Use Case more quickly. Some Scenarios are mandatory for a Use Case, whereas others may be recommended or optional.

Specialization

Reusable data collection for a specific functionality.

SPINE

Smart Premises Interoperable Neutral-message Exchange: Technical Specification of EEBus Initiative e.V.

1.3 Requirements

1.3.1 Requirements wording

The following keywords are used:

- SHALL
- SHALL NOT
- SHOULD
- SHOULD NOT
- MAY

Note: They apply only if written in capital letters.

For the meaning of the keywords, please refer to [RFC2119].

1.3.2 Mapping of High-Level requirements

Within the High-Level Use Case description, the following abbreviation is used:

[EVSOC-xyz]

e.g.: [EVSOC-007]

The abbreviation is used to mark High-Level requirements or rules of this Use Case with a unique number xyz. These requirements are referenced throughout the technical solution to show how each High-Level requirement is realized in the technical part.

2 High-Level description

2.1 Introduction

This Use Case aims to continuously monitor the state of charge of an electric vehicle (EV). The state of charge can be used to estimate the flexibility of the EV or simply to display the state of charge to a user.

Thenominal capacity and state of health of the EV battery are optional within this Use Case. They are necessary to calculate the usable capacity. If the state of charge is transmitted as a percentage value, the usable capacity is required to calculate the absolute value. If the state of charge is transmitted as an absolute value, the usable capacity is required to calculate the percentage.

Aside from expressing the state of charge as a percentage or energy value, this Use Case also includes the option to express the state of charge as an estimated actual travel range of the EV.

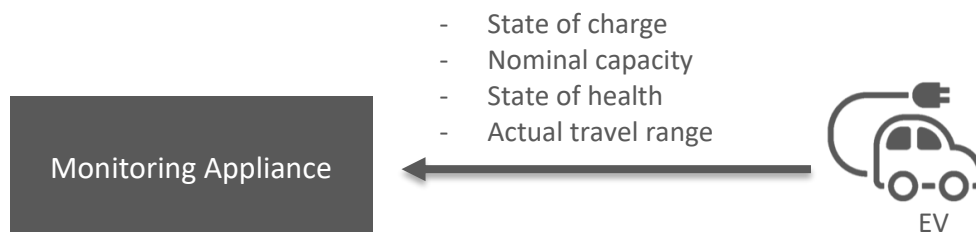


Figure 1: High-Level Use Case functionality overview

If there is more than one battery in the EV, the Battery management system of the EV needs to aggregate the values of the individual batteries.

2.2 Actors

2.2.1 EV

The Actor EV is the electric vehicle that has one or more batteries and can provide the state of charge and further related values to a Monitoring Appliance.

2.2.2 Monitoring Appliance

The Monitoring Appliance presents the data received from the EV towards the user.

2.3 Scenarios

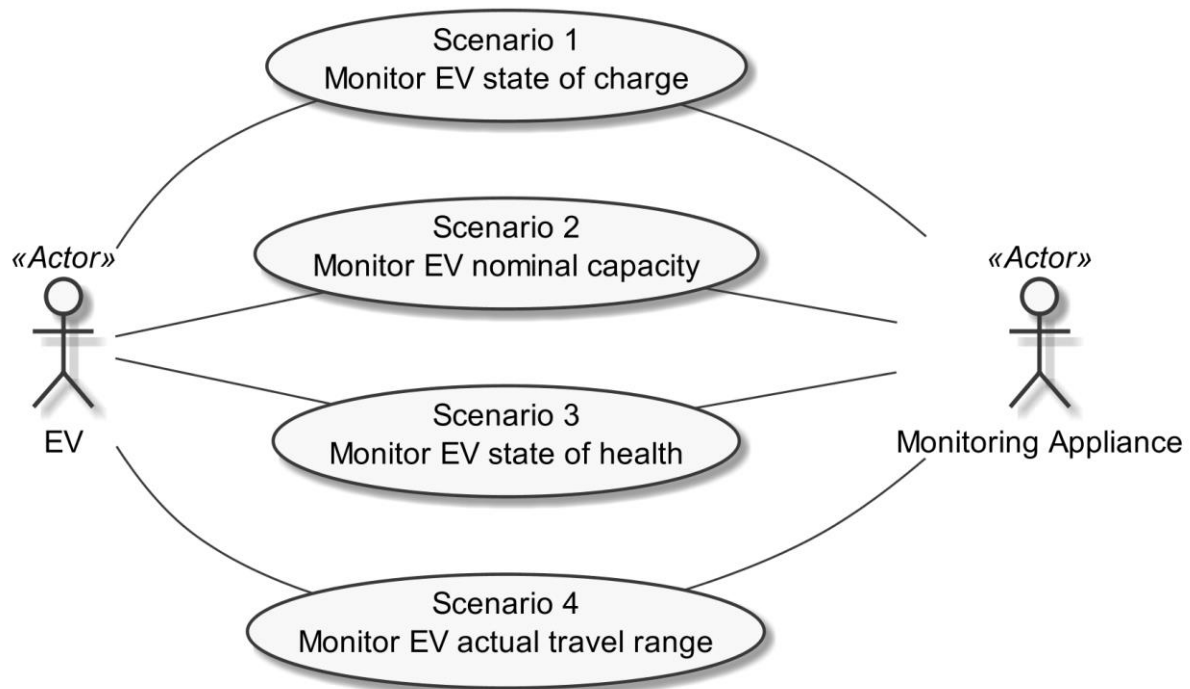


Figure 2: Scenario overview

Scenario number	Scenario name	EV	Monitoring Appliance
1	Monitor EV state of charge	M	M
2	Monitor EV nominal capacity	O	O
3	Monitor EV state of health	O	O
4	Monitor EV actual travel range	O	O

Table 1: Scenario implementation requirements for Actors

2.3.1 Scenario 1 - Monitor EV state of charge

2.3.1.1 Description

The Monitoring Appliance monitors the state of charge of the EV's battery [EVSOC-001]. The state of charge describes how much of the usable capacity has already been charged.

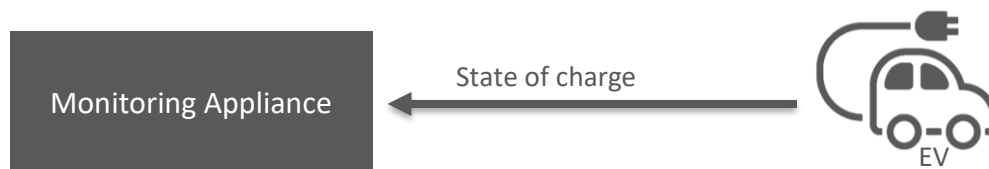


Figure 3: Monitor EV state of charge

2.3.1.2 Conditions

Triggering Event:

The Scenario is typically triggered by connecting the EV to the Monitoring Appliance.

Pre-condition:

The Monitoring Appliance does not know the state of charge of the EV's battery.

Post-condition:

The Monitoring Appliance does know the state of charge of the EV's battery.

2.3.2 Scenario 2 - Monitor EV nominal capacity

2.3.2.1 Description

The Monitoring Appliance retrieves the nominal capacity of the battery of the EV in "Wh" [EVSOC-002].

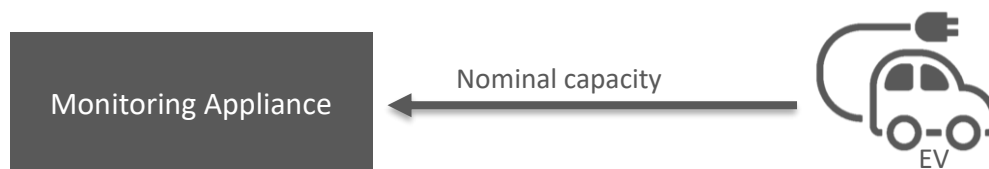


Figure 4: Monitor EV nominal capacity

2.3.2.2 Conditions

Triggering Event:

The Scenario is typically triggered by connecting the EV to the Monitoring Appliance.

Pre-condition:

The Monitoring Appliance does not know the nominal capacity of the EV's battery.

Post-condition:

The Monitoring Appliance does know the nominal capacity of the EV's battery.

2.3.3 Scenario 3 - Monitor EV state of health

2.3.3.1 Description

The Monitoring Appliance monitors the state of health of the battery of the EV [EVSOC-003].

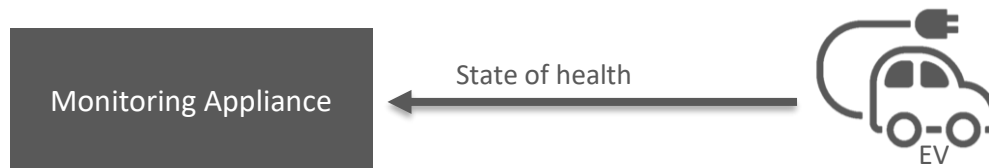


Figure 5: Monitor EV state of health

2.3.3.2 Conditions

Triggering Event:

The Scenario is typically triggered by connecting the EV to the Monitoring Appliance.

Pre-condition:

The Monitoring Appliance does not know the state of health of the EV's battery.

Post-condition:

The Monitoring Appliance does know the state of health of the EV's battery.

2.3.4 Scenario 4 - Monitor EV actual travel range

2.3.4.1 Description

The Monitoring Appliance monitors the actual travel range of the EV based on the charged energy [EVSOC-004].

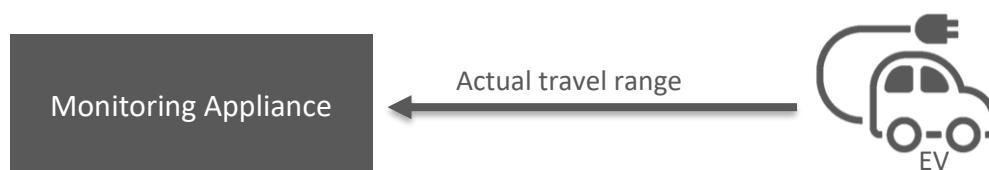


Figure 6: Monitor EV actual travel range

2.3.4.2 Conditions

Triggering Event:

The Scenario is typically triggered by connecting the EV to the Monitoring Appliance.

Pre-condition:

The Monitoring Appliance does not know the actual travel range of the EV.

235 **Post-condition:**

236 The Monitoring Appliance does know the actual travel range of the EV.

237

238 **2.4 Dependencies to other Use Cases**

239 None.

240

241 **2.5 Assumptions and Prerequisites**

242 None.

243

3 Technical SPINE solution

3.1 General rules and information

3.1.1 Underlying technology documents

This technical solution relies on the SPINE Resources Specification version 1.2.0 [ResourceSpecification].

For interoperable connectivity this technical solution relies on:

- SPINE Protocol Specification version 1.2.0 [ProtocolSpecification] as application protocol.
- SHIP Specification version 1.0.0 [SHIP] as transport protocol.

3.1.2 Use Case discovery rules

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 (please refer to [ProtocolSpecification]) SHALL be "evStateOfCharge". The string content SHALL only be defined by this Use Case (regardless of the Use Case version).
- The string content of the Element "nodeManagementUseCaseData. useCaseInformation. actor" within the Use Case discovery (please refer to [ProtocolSpecification]) 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 (please refer to [ProtocolSpecification]) 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.
- If an Actor A finds a proper counterpart Actor B for this Use Case that supports only versions with a major version number not implemented by Actor A, it still might be possible to run the Use Case or parts of the Use Case. Therefore, the Actor A should try to evaluate the Actor B as a valid partner for this Use Case.

3.1.3 Rules for "Content of Specialization..." tables and "Content of Function..." tables

3.1.3.1 General presence indication definitions

Abbreviations for the presence indication of Elements listed in the tables are defined as follows:

Abbreviation	Meaning	Link to requirement keywords
M	Mandatory	SHALL
R	Recommended	SHOULD
O	Optional	MAY

Table 2: Presence indication description

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", please refer to [ProtocolSpecification]). 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).

3.1.3.2 Presence indications for "Content of Specialization..." tables

This section only defines rules for the client side.

Elements that are marked with "M" SHALL be supported by the client in case of readable as well as writeable data. This Element may be optional on the server side.

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

- "R" means that the data SHOULD be supported by the client. In other words: If the server responds with the according Element, the client SHOULD be able to interpret the according Elements.
- "O" means that the data MAY be supported by the client. In other words: If the server responds with the according Element, the client MAY be able to interpret the according Elements.

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

- "R" means that the data SHOULD be written by the client.
- "O" means that the data MAY be written by the client.
- "F" means that the data SHALL NOT be written by the client.

The following applies for Elements that are not listed in the Actor section:

- In case of a received "reply" message: The client MAY ignore the Element.
- In case of a "write" operation to be created: The client MAY set the Element but SHALL consider that the server may ignore the Element.

- In case of a received "notify" message: The client MAY ignore the Element.

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

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

This section 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 need to 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 (permitted values, e.g.). Write operations on Elements that are not writeable MAY result in an error message.

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

3.1.3.4 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 this section we use "X" 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 underneath the 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: These rules apply only under consideration of presence indications and with regards to the given Scenario or Function definition for this Use Case.

The following table is an example to explain this for two different placements.

Scenario [...]: M/R/O [W][C]	Element	Value	[High-Level Mapping] Element and value rules
...
2: M \W	xFeatureType. xListData. xData. (1..3)		
2: M \W	xId	<*(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>	...
...

Table 3: Example table for cardinality indications on Elements and list items

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 1 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.

For the expression "<*(1..)>" of Element "xId" please see section 3.1.3.6.

The remaining fields do not have an explicit cardinality indication.

Note: Cardinality expressions are also used within placeholder expressions as defined in section 3.1.3.6. 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.

3.1.3.5 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 do not need to be 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 do not need to be 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 may 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 according to section 3.1.3.3).

"Changeable" means that the Element's value may 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.

Note: "\W" includes "\C" already.

Note: Depending on the resource a client might need to request a proper binding before the server accepts a "write" operation.

3.1.3.6 "Value" placeholders

3.1.3.6.1 Introduction

Specializations may 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 placeholders that can be referenced:

1. <xM>
2. <xM#S>

where

1. "x" is any alphabetical prefix like "m", "t", "ec", "cc", etc.
2. "M" is a (major) number like "1", "2", "15", etc.
3. "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>". For a given placeholder, only one of the styles can be used.

In addition, there are also styles for placeholders that do not need to be referenced:

1. <*>
2. <*#S>

The second style is only used with so-called cardinality expressions.

3.1.3.6.2 Uniqueness of placeholders

A given placeholder <xM> or <xM#S> 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:

We assume a list item with PRIMARY IDENTIFIER "pId". It also has a SUB IDENTIFIER "sId" with placeholder "<s1>". Then, each occurrence of "<s1>" represents the same value for a given value of pId. This means that "<s1>" of a list item with pId=1 can differ from "<s1>" of a list item with pId=2. But it also means that "<s1>" represents the same value in all list items with pId=1.

Note: Typically, parent Identifiers like "pId" will also be expressed with a placeholder like "<p5>", e.g. In this case, the uniqueness rule applies for "<p5>" likewise.

Note: The uniqueness also applies for placeholders used as FOREIGN IDENTIFIER.

3.1.3.6.3 Placeholder expressions with cardinalities

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

1. <xM#(a..b)>

444 This is equivalent to this explicit definition:

445 At least a and at maximum b placeholders of this list: <xM#1> <xM#2> ... <xM#b>

446 This means that the implementation of a given Use Case (or Scenario) requires a minimum of "a"
447 distinct values of the respective Identifier. In total, there can be up to "b" distinct values of the
448 respective Identifier.

449 Additionally, the following notations may occur:

450 2. <xM#(a..)>

451 This is equivalent to "<xM#(a..b)>" with "b" equal to infinity.

452 3. <xM#(..b)>

453 This is equivalent to "<xM#(a..b)>" with "a" equal to zero.

454 "<xM#(a..)>" has only a lower bound of "a" distinct values, but no upper bound. "<xM#(..b)>", on the
455 other hand, expresses that the Identifier may not be required at all, but it is permitted to have up to
456 "b" distinct values.

457 Similarly, the cardinality can be used for placeholders that are not referenced, i.e. <*#(a..b)> etc.

458 Note: The cardinality does NOT express which of the sub-numbers have to be used! I.e., it does NOT
459 mean that the Identifiers <xM#1> ... <xM#a> are always used and just those with larger sub-numbers
460 (<xM#a+1> ... <xM#b>) are optional. If, for instance, a placeholder expression "<xM#(3..5)>" is given,
461 it may well happen that an implementation makes use of <xM#2>, <xM#4>, and <xM#5> (i.e., it does
462 NOT use <xM#1>, <xM#3>). Which sub-numbers are used usually depends on other parts of a
463 Specialization and their references to required placeholders, which is explained in section 3.1.3.6.4.

464

465 3.1.3.6.4 References to placeholders and relations

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

468 1. e(-><xM>)

469 2. e(-><xM#S>)

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

471 Example: A Specialization contains the Elements "mId" and "phase". "mId" is an Identifier with
472 placeholder definition <m2#(1..3)>. "phase" is a string that permits the values "a", "b", and "c" using
473 this expression:

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

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

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

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

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

- 480 3. <yN->xM>
 481 4. <yN->xM#S>
 482 5. <yN#T->xM>
 483 6. <yN#T->xM#S>

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

485 It is also feasible to associate placeholders with cardinalities:

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

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

488 Note: In this case, the placeholder expressions of yN and xM must have the same cardinality.

489 In some cases, there is a need to express that multiple list items with similar values are feasible or
 490 required, but only particular combinations of these different data are permitted. The following
 491 example shows that several "fData" list items with different "phase" value are required, but that
 492 these list items may only express either the "phase" value combination { "a", "b", "c" } or the "phase"
 493 value combination { "a", "abb", "neutral" }. The permitted combinations are defined in a note below
 494 a table:

Scenario [...]: M/R/O [W][\C]	Element	Value	[High-Level Mapping] 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>)	

495 Table 4: Content of an example Specialization

496 Note: One of the following combinations SHALL be used at least: {<z3#1>, <z3#2>, <z3#3>} or
 497 {<z3#1>, <z3#4>, <z3#5>}.

498

499 3.1.3.7 Rules for content of "Value" column

500 For a given Scenario, the "Value" column may restrict the permitted content of a Function's Element
 501 to one or more particular values. This means that Elements with values deviating from the restriction
 502 (i.e. from the permitted values) do not belong to the respective Scenario and need to be considered
 503 as if the Element is not set. If more than one particular value is permitted for an Element, the values
 504 are in a single line each.

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

- "M" means that the value SHALL be supported. This means the value needs to 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 may be combined with the suffix "(event)" to express that a supported value only has to be supported during a certain event and hence does not need to be present at all times. If the event is not active another value may 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 may set or change an Element on its own (see section 3.1.3.5):
 - o within the tables in the "Server data - Resources" sections:
 - the server SHALL support at least one of the listed values.
 - o within the tables in the "Client data - Specializations" sections:
 - the client SHALL support all listed values.
- In case of Elements that are writable or changeable (see section 3.1.3.5):
 - o within the tables in the "Server data - Resources" sections:
 - the server SHALL support all listed values.
 - o within the tables in the "Client data - Specializations" sections:
 - the client SHALL support at least one of the listed values.

Depending on the Element, different values may be used during runtime. If this is the case, those rules are described within the value rules.

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

3.1.3.8 General information on how to interpret the "Content of Function..." and "Content of Specialization..." tables

Within the "Client data - Specializations" sections each Specialization is described in an own sub-section with the name "Specialization "<name of the Specialization>" (e.g. "Specialization "Measurement_GridFeedInEnergy"). It contains only one table that includes all Elements needed for this Specialization. The different Functions are mentioned in a continuous row, highlighted with grey background colour. This row contains the following parts:

<Feature Type>. <Function>.[<list entry instance name>.]

546 The <list entry instance name> is only included if the <Function> is a list-based Function. An example
 547 could be:

548 DeviceConfiguration. deviceConfigurationKeyValueDescriptionListData.
 549 deviceConfigurationKeyValueDescriptionData.

550 In the following rows, only the names of the Elements are stated, without the prefix described above.

551

552 Within the "Server data - Resources" sections each Feature Type is described in an own sub-section
 553 with the name "Feature Type "<name of the Feature Type>" (e.g. "Feature Type "Measurement"").
 554 It contains sub-sections for each Function named "Function "<name of the Function>" (e.g.
 555 "Function "measurementListData""). These sections contain one table with all Elements needed for
 556 this resource. The list entries are mentioned in a continuous row, highlighted with grey background
 557 colour. This row contains the following parts:

558 <Feature Type>. <Function>.[<list entry instance name>.]

559 The <list entry instance name> is only included if the <Function> is a list-based Function. An example
 560 could be:

561 Measurement. measurementDescriptionListData. measurementDescriptionData.

562 In the following rows, only the names of the Elements are stated, without the prefix described above.

563

564 For both kinds of tables, the following applies:

- 565 - Parent Elements are marked with a dot at the end of the name:
 566 <parent Element>.
 567 E.g.:
 568 value.
- 569 - If there are sub-Elements, they are described in own rows with the name of the parent
 570 Element as prefix, separated by a dot and a blank space:
 571 <parent Element>. <sub-Element>
 572 E.g.:
 573 value. number

574

575 3.1.4 Rules for "Feature Types and Functions..." tables

576 3.1.4.1 Presence indications for "Feature Types and Functions..." tables

577 The following presence indications are used:

Abbreviation	Meaning	Link to requirement keywords
M	Mandatory	SHALL
R	Recommended	SHOULD
O	Optional	MAY

578 Table 5: Presence indication of Feature Types and Functions support

579 If at least one Function of a Feature has the presence indication "M", it is mandatory to support the
580 Feature.

581

582 **3.1.4.2 Rules for "Possible operations" column**

583 Within the "Feature Types and Functions..." tables the column "Possible operations" state whether
584 the Function is read- or writeable (as defined in the detailed discovery mechanism, see
585 [ProtocolSpecification]).

586 If the "partial" concept (also called "restricted function exchange") SHALL be supported, the
587 following notation is used (separated for read and write access):

588 read (M). partial (M)

589 write (M). partial (M)

590 If the "partial" concept SHOULD be supported, the following notation is used:

591 read (M). partial (R)

592 write (M). partial (R)

593 If the "partial" concept MAY be supported, the following notation is used:

594 read (M). partial (O)

595 write (M). partial (O)

596 The server can decide whether a notification is submitted complete or partial (as described in
597 [ProtocolSpecification]) if not defined differently within this Use Case Specification.

598

599 **3.1.5 "Actor ... overview" diagram rules**

600 Within the "Actor [...] overview" diagrams in the "Actors" sub-sections the complete functionality of
601 this Use Case is provided, including optional Scenarios. Which Scenarios are optional can be found in
602 Table 1. The Actor MAY have more functionality implemented than needed for this Use Case.

603 For the following Actor overview example, a brief description of the graphical symbols will be
604 described.

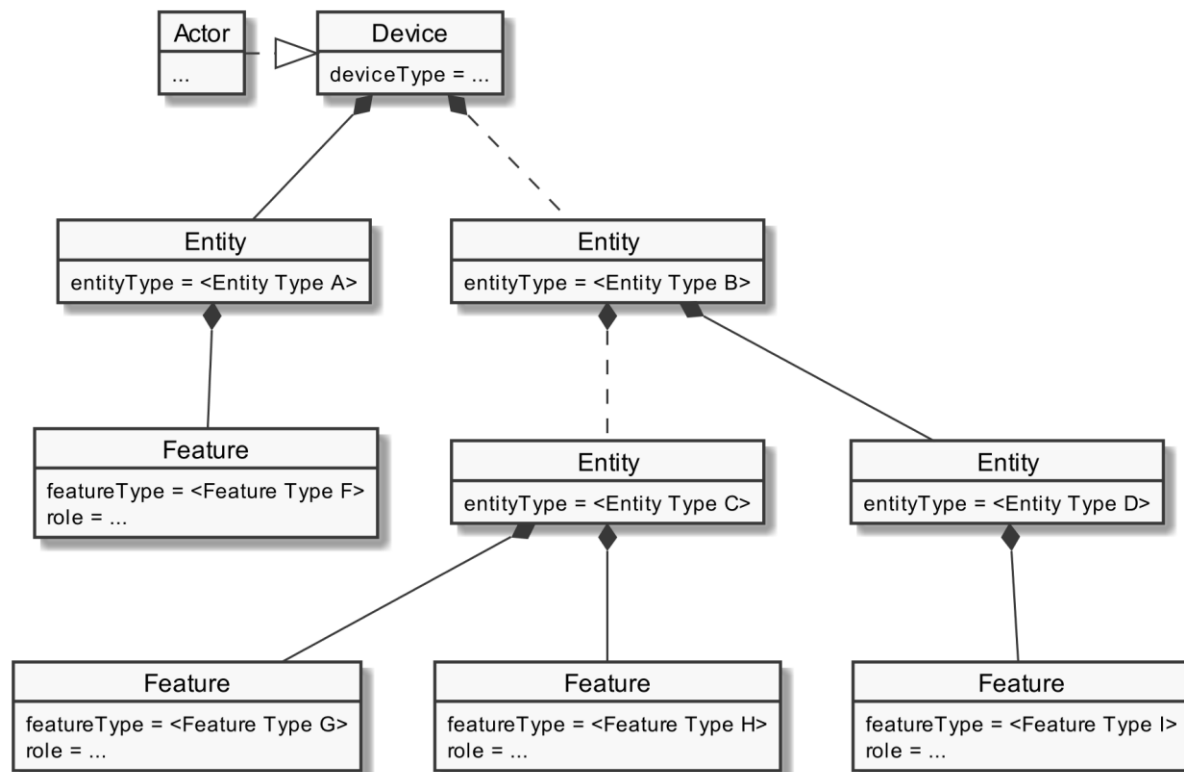


Figure 7: Actor overview example

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 child 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 C>".

3.1.6 Specializations

Within the "Actors" sub-sections, Specializations are referenced. A Specialization describes a dataset necessary to fulfil the specific requirements of a High-Level Use Case and its Scenarios. Often, data from multiple different Features and Functions are needed to fulfil the requirements. Therefore, a Specialization defines a dataset that may encompass multiple related Functions from one or more different Features.

As different Use Cases sometimes share similar requirements, Specializations are also important from a re-usability perspective. This approach is used to improve consistency across Use Cases and avoid multiple variances of basically the same dataset. This is especially important in the case when an implementation supports multiple Use Cases. E.g. if a power measurement is necessary in two different Use Cases, both Use Cases could define slightly different datasets. In this case, the server as well as the client functionality would have to implement both variances if both Use Cases are supported. This means, depending on the number of Use Cases, two or more datasets need to be generated, transmitted and stored instead of one. Therefore, common Specializations are defined to

enable consolidated implementations. Specializations are detailed per Actor, as distinct Actors may use different parts of a Specialization or even have different permissions to change data. In general, this may also depend on the respective Scenario.

If a Feature server can provide the data of a Specialization, the data does not necessarily always need to be available at the Feature server. There might be situations where the user deactivates a Use Case. There may also be other reasons why Use Case data cannot be provided currently. Therefore, a client always needs to be subscribed (as described in section 3.3.4) on the corresponding dataset to stay updated.

The SPINE resource descriptions given in the "SPINE resources of the Actor" sections are derived from the Specializations given in the Actor's overview diagram.

3.1.7 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 might 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.

3.1.8 Further information and rules

3.1.8.1 Frequently used Element rules for the Resource and Specialization tables

This section serves as a collection of rules frequently used by Resource and Specialization tables of the subsequent sections. 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. A reference looks like "See [Measurement value rules]", e.g.

[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*.

665 If set, *measurementDescriptionListData.measurementType* SHALL be set, too.

666

667 **[Value state rules]:**

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

671

672 **[Scaled number rules]:**

673 The sub-Elements "number" and "scale" represent a value according to the following formula:
674 $\text{number} * 10^{\text{scale}}$

675

676 **3.2 Actors**

677 **3.2.1 EV**

678 **3.2.1.1 Resource hierarchy**

679 If Use Case discovery is supported (see section 3.1.2), this Actor SHALL be denoted as "EV" in the
680 Element "nodeManagementUseCaseData.useCaseInformation.actor".

681 The following diagram provides an overview of the Actor EV's resource hierarchy.

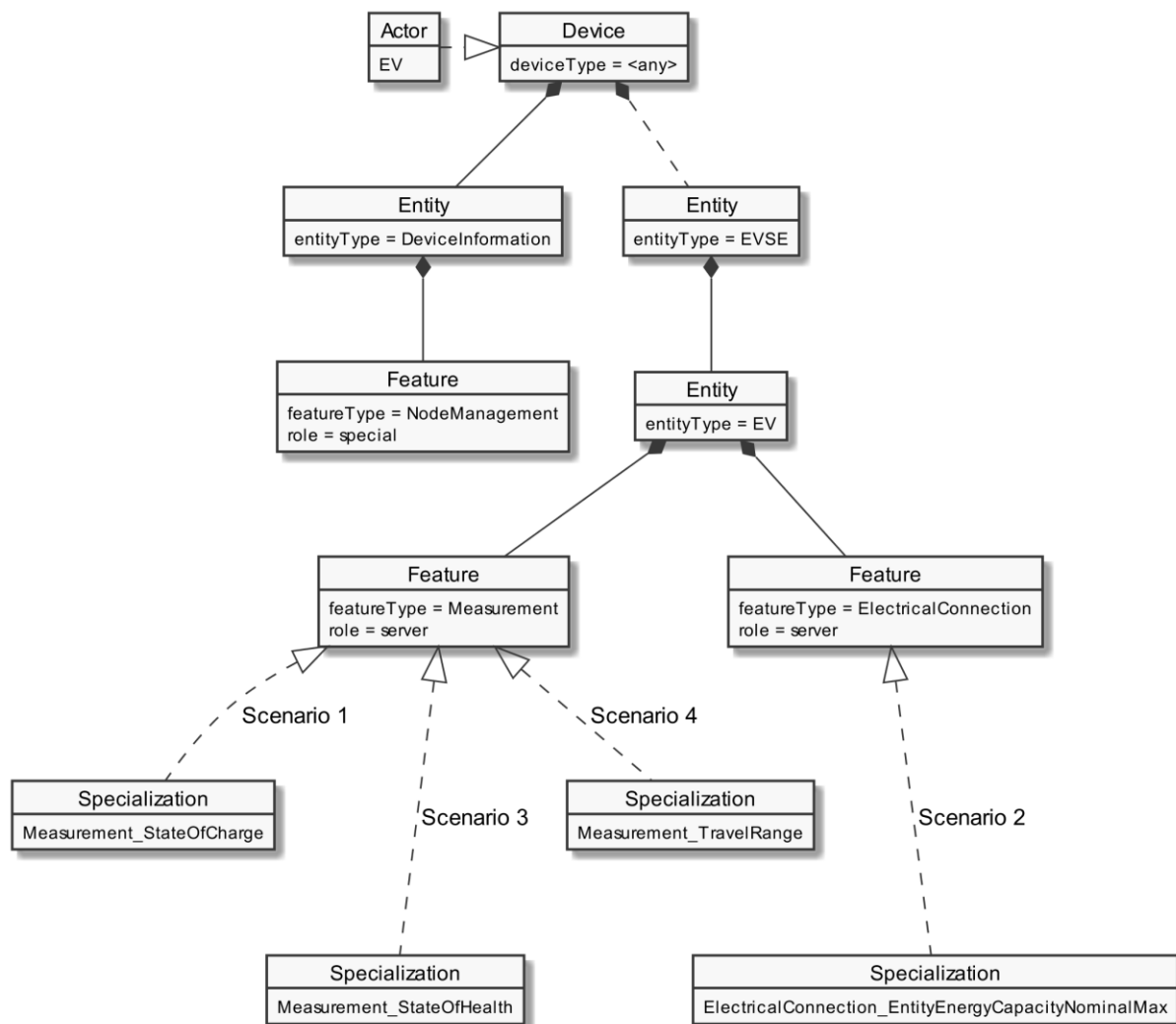


Figure 8: Actor "EV" overview

The "Actor ... overview" diagram rules" section describes how to interpret the diagram above. See the "Specializations" section for more information regarding the Specializations given in the diagram above.

Note: The entityType "DeviceInformation" with the featureType "NodeManagement" is required by the SPINE protocol and therefore SHALL be supported. Both types are added in the figure for completeness but are not directly linked to the Use Case.

The Use Case specific data follows behind the entityType "EV". The Specializations represent the Scenario specific data that must be supported for each Scenario and are realized through the corresponding featureTypes.

If a Specialization is connected to a Feature with the role "client", the Actor has a client role for this data. This means that the Actor accesses the data set described by the Specialization at a corresponding server Feature. Further details are described in the sub-section "Client data - Specializations".

If a Specialization is connected to a Feature with the role "server", the Actor has the server role for this data. This means that the Actor must provide the corresponding data set of the Specialization as part of its Features. Further details are described in the sub-section "Server data - Resources".

3.2.1.2 Server data - Resources

3.2.1.2.1 Overview

Behind the entityType "EV", the Actor EV SHALL offer the Feature Types and Functions given in the table below.

Feature Type	Scenario: M/R/O	Function	Possible operations
Measurement	1: M 3: M 4: M	measurementListData	read (M). partial (R)
	1: M 3: M 4: M	measurementDescriptionListData	read (M). partial (R)
	1: M 3: M 4: M	measurementConstraintsListData	read (M). partial (R)
ElectricalConnection	2: M	electricalConnectionCharacteristicListData	read (M). partial (R)

Table 6: Feature Types and Functions used within this Use Case by the Actor EV

For each of these Feature Types, the following rule applies: There SHALL be at maximum one Feature with the Feature Type in the Entity.

Note: As a consequence of the previous rule, an implementation may need to have Feature data from different Scenarios/Specializations or even Use Cases in a given Feature.

The Scenario number shows in which Scenarios the EV acts as server and which Feature Types and Functions are relevant in each Scenario.

A detailed definition of the Elements and values that shall be supported in each Function is given in the following sub-sections.

Note: If in the table above "partial" read is not mentioned or is only optional, it still might be mandatory to support partial notifications. The details of "partial" support are described within the Scenario sections.

Note: The presence indications stated above are meant relative to the ones of the according Scenario stated in Table 1. I.e., if a Scenario is optional ("O") and a Feature Type is mandatory ("M"), the Feature Type need only be supported if the Scenario is supported, too.

Note: Further Features MAY be implemented on the same Entities; also, further Functions MAY be implemented in the used Entities.

722 3.2.1.2.2 Feature Type "Measurement"

723 3.2.1.2.2.1 Function "measurementDescriptionListData"

Scenario [...]: M/R/O [W][C]	Element	Value	[High Level Mapping] Element and value rules
1: M	Measurement. measurementDescriptionListData. measurementDescriptionData.		
1: M	measurementId	<m1#{1..1}>	SHALL be set as PRIMARY IDENTIFIER.
1: M	measurementType	"percentage"	
1: M	commodityType	"electricity"	
1: M	unit	"pct"	
1: M	scopeType	"stateOfCharge"	
3: M	Measurement. measurementDescriptionListData. measurementDescriptionData.		
3: M	measurementId	<m2#{1..1}>	SHALL be set as PRIMARY IDENTIFIER.
3: M	measurementType	"percentage"	
3: M	unit	"pct"	
3: M	scopeType	"stateOfHealth"	
3: M	Measurement. measurementDescriptionListData. measurementDescriptionData.		
4: M	measurementId	<m3#{1..1}>	SHALL be set as PRIMARY IDENTIFIER.
4: M	measurementType	"distance"	
4: M	unit	"m"	
4: M	scopeType	"travelRange"	

724 Table 7: Content of Function "measurementDescriptionListData" at Actor EV

725

726 3.2.1.2.2.2 Function "measurementConstraintsListData"

Scenario [...]: M/R/O [W][C]	Element	Value	[High Level Mapping] 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.
3: R	Measurement. measurementConstraintsListData. measurementConstraintsData.		
3: M	measurementId	<m2#(1..1)>	SHALL be set as PRIMARY IDENTIFIER.
3: R	valueRangeMin.		SHOULD be used. [Scaled number rules]
3: M	valueRangeMin. number		SHALL be used.
3: O	valueRangeMin. scale		MAY be used. If absent, a default value of "0" applies.
3: R	valueRangeMax.		SHOULD be used. [Scaled number rules]
3: M	valueRangeMax. number		SHALL be used.
3: O	valueRangeMax. scale		MAY be used. If absent, a default value of "0" applies.
3: R	valueStepSize.		SHOULD be used. [Scaled number rules]
3: M	valueStepSize. number		SHALL be used.
3: O	valueStepSize. scale		MAY be used. If absent, a default value of "0" applies.
4: R	Measurement. measurementConstraintsListData. measurementConstraintsData.		
4: M	measurementId	<m3#(1..1)>	SHALL be set as PRIMARY IDENTIFIER.
4: R	valueRangeMin.		SHOULD be used. [Scaled number rules]
4: M	valueRangeMin. number		SHALL be used.
4: O	valueRangeMin. scale		MAY be used. If absent, a default value of "0" applies.
4: R	valueRangeMax.		SHOULD be used. [Scaled number rules]
4: M	valueRangeMax. number		SHALL be used.
4: O	valueRangeMax. scale		MAY be used. If absent, a default value of "0" applies.
4: R	valueStepSize.		SHOULD be used. [Scaled number rules]
4: M	valueStepSize. number		SHALL be used.
4: O	valueStepSize. scale		MAY be used. If absent, a default value of "0" applies.

Table 8: Content of Function "measurementConstraintsListData" at Actor EV

729 3.2.1.2.2.3 Function "measurementListData"

Scenario [...]: M/R/O [\W][\C]	Element	Value	[High Level Mapping] Element and value rules
1: M	Measurement. measurementListData. measurementData.		
1: M	measurementId	<m1#(1..1)>	SHALL be set as PRIMARY IDENTIFIER.
1: M	valueType	"value"	SHALL be set as SUB IDENTIFIER.
1: O	timestamp	<t#(1..1)->m1#1>	MAY be used. Only the newest measurement value SHALL be stated. Additional historical values are forbidden.
1: M	value.		[EVSOC-001] [Measurement value rules] [Scaled number rules]
1: M	value. number		SHALL be used.
1: O	value. scale		MAY be used. If absent, a default value of "0" applies.
1: M	valueSource	"calculatedValue"	
3: M	Measurement. measurementListData. measurementData.		
3: M	measurementId	<m2#(1..1)>	SHALL be set as PRIMARY IDENTIFIER.
3: M	valueType	"value"	SHALL be set as SUB IDENTIFIER.
3: O	timestamp	<t#(1..1)->m2#1>	MAY be used. Only the newest measurement value SHALL be stated. Additional historical values are forbidden.
3: M	value.		[EVSOC-003] [Measurement value rules] [Scaled number rules]
3: M	value. number		SHALL be used.
3: O	value. scale		MAY be used. If absent, a default value of "0" applies.
3: M	valueSource	"measuredValue"	
		"calculatedValue"	
		"empiricalValue"	
3: R	valueState		[Value state rules]
4: M	Measurement. measurementListData. measurementData.		
4: M	measurementId	<m3#(1..1)>	SHALL be set as PRIMARY IDENTIFIER.
4: M	valueType	"value"	SHALL be set as SUB IDENTIFIER.
4: O	timestamp	<t#(1..1)->m3#1>	MAY be used. Only the newest measurement value SHALL be stated. Additional historical values are forbidden.
4: M	value.		[EVSOC-004] [Measurement value rules] [Scaled number rules]
4: M	value. number		SHALL be used.
4: O	value. scale		MAY be used. If absent, a default value of "0" applies.
4: M	valueSource	"measuredValue"	
		"calculatedValue"	
		"empiricalValue"	

4: R	valueState		[Value state rules]
------	------------	--	---------------------

Table 9: Content of Function "measurementListData" at Actor EV

3.2.1.2.3 Feature Type "ElectricalConnection"

3.2.1.2.3.1 Function "electricalConnectionCharacteristicListData"

Scenario {...}: M/R/O [W]/[C]	Element	Value	[High Level Mapping] Element and value rules
2: M	ElectricalConnection. electricalConnectionCharacteristicListData. electricalConnectionCharacteristicData.		
2: M	electricalConnectionId	<ec1#(1..1)>	SHALL be set as PRIMARY IDENTIFIER.
2: M	parameterId	<p1#(1..1)->ec1#1>	SHALL be set as SUB IDENTIFIER.
2: M	characteristicId	<cc1#(1..1)->p1#1>	SHALL be set as SUB IDENTIFIER.
2: M	characteristicContext	"entity"	
2: M	characteristicType	"energyCapacityNominalMax"	
2: M	value		[EVSOC-002] [Scaled number rules]
2: M	value. number		SHALL be used.
2: O	value. scale		MAY be used. If absent, a default value of "0" applies.
2: M	unit	"Wh"	

Table 10: Content of Function "electricalConnectionCharacteristicListData" at Actor EV

3.2.1.3 Client data - Specializations

As this Actor has only server functionality, no Specializations are described within this section.

3.2.2 Monitoring Appliance

3.2.2.1 Resource hierarchy

If Use Case discovery is supported (see section 3.1.2) this Actor SHALL be denoted as "MonitoringAppliance" in the Element "nodeManagementUseCaseData. useCaseInformation. actor".

The following diagram provides an overview of the Actor MonitoringAppliance's resource hierarchy.

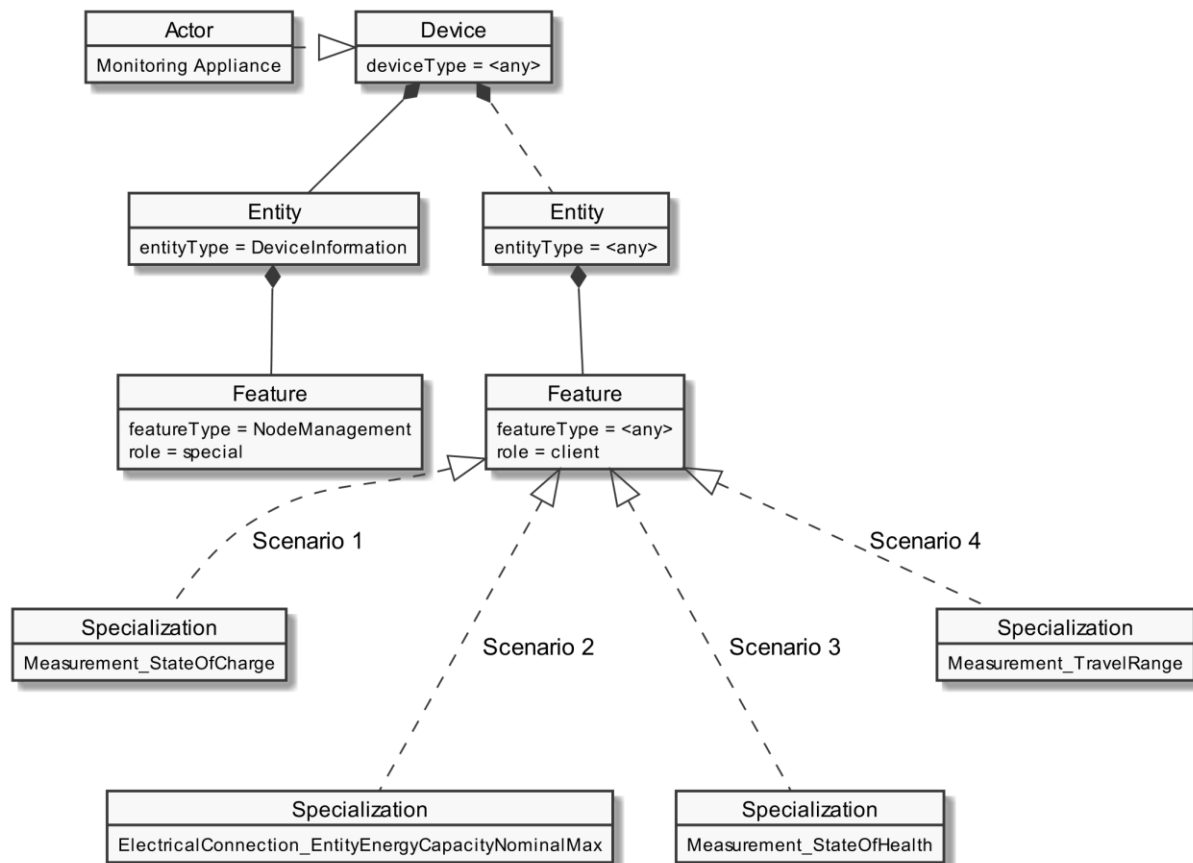


Figure 9: Actor "MonitoringAppliance" overview

The "Actor ... overview" diagram rules" section describes how to interpret the diagram above. See the "Specializations" section for more information regarding the Specializations given in the diagram above.

Note: The entityType "DeviceInformation" with the featureType "NodeManagement" is required by the SPINE protocol and therefore SHALL be supported. Both types are added in the figure for completeness but are not directly linked to the Use Case.

The Use Case specific data follows behind any entityType. The Specializations represent the Scenario specific data that must be supported for each Scenario and are realized through the corresponding featureTypes.

If a Specialization is connected to a Feature with the role "client", the Actor has a client role for this data. This means that the Actor accesses the data set described by the Specialization at a corresponding server Feature. Further details are described in the sub-section "Client data - Specializations".

If a Specialization is connected to a Feature with the role "server", the Actor has the server role for this data. This means that the Actor must provide the corresponding data set of the Specialization as part of its Features. Further details are described in the sub-section "Server data - Resources".

3.2.2.2 Server data - Resources

As this Actor has only client functionality, no resources are described within this section.

3.2.2.3 Client data - Specializations

3.2.2.3.1 Topic "ElectricalConnection"

3.2.2.3.1.1 Specialization "ElectricalConnection_EntityEnergyCapacityNominalMax"

Scenario [...]: M/R/O [W][C]	Element	Value	[High Level Mapping] Element and value rules
2: M	ElectricalConnection. electricalConnectionCharacteristicListData. electricalConnectionCharacteristicData.		
2: M	electricalConnectionId	<ec1#{1..1}>	SHALL be set as PRIMARY IDENTIFIER.
2: M	parameterId	<p1#{1..1}->ec1#1>	SHALL be set as SUB IDENTIFIER.
2: M	characteristicId	<cc1#{1..1}->p1#1>	SHALL be set as SUB IDENTIFIER.
2: M	characteristicContext	"entity"	
2: M	characteristicType	"energyCapacityNominalMax"	
2: M	value		[EVSOC-002] [Scaled number rules]
2: M	value. number		SHALL be used.
2: M	value. scale		SHALL be interpreted. If absent, a default value of "0" applies.
2: M	unit	"Wh"	

Table 11: Content of Specialization "ElectricalConnection_EntityEnergyCapacityNominalMax"

3.2.2.3.2 Topic "Measurement"

3.2.2.3.2.1 Specialization "Measurement_StateOfCharge"

Scenario [...]: M/R/O [W][C]	Element	Value	[High-Level Mapping] Element and value rules
1: M	Measurement. measurementDescriptionListData. measurementDescriptionData.		
1: M	measurementId	<m1#{1..1}>	SHALL be set as PRIMARY IDENTIFIER.
1: M	measurementType	"percentage"	
1: M	commodityType	"electricity"	
1: M	unit	"pct"	
1: M	scopeType	"stateOfCharge"	

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: M	valueRangeMin. scale		SHALL be interpreted. 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: M	valueRangeMax. scale		SHALL be interpreted. 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: M	valueStepSize. scale		SHALL be interpreted. If absent, a default value of "0" applies.
1: M	Measurement. measurementListData. measurementData.		
1: M	measurementId	<m1#{1..1}>	SHALL be set as PRIMARY IDENTIFIER.
1: M	valueType	"value"	SHALL be set as SUB IDENTIFIER.
1: O	timestamp	<t#{1..1}->m1#1>	MAY be used. Only the newest measurement value SHALL be stated. Additional historical values are forbidden.
1: M	value.		[EVSOC-001] [Measurement value rules] [Scaled number rules]
1: M	value. number		SHALL be used.
1: M	value. scale		SHALL be interpreted. If absent, a default value of "0" applies.
1: R	valueSource	"calculatedValue"	

Table 12: Content of Specialization "Measurement_StateOfCharge" at Actor Monitoring Appliance

3.2.2.3.2.2 Specialization "Measurement_StateOfHealth"

Scenario {...}: M/R/O [W][C]	Element	Value	[High-Level Mapping] Element and value rules
3: M	Measurement. measurementDescriptionListData. measurementDescriptionData.		
3: M	measurementId	<m2#{1..1}>	SHALL be set as PRIMARY IDENTIFIER.
3: M	measurementType	"percentage"	
3: M	unit	"pct"	
3: M	scopeType	"stateOfHealth"	

3: R	Measurement. measurementConstraintsListData. measurementConstraintsData.		
3: M	measurementId	<m2#{1..1}>	SHALL be set as PRIMARY IDENTIFIER.
3: R	valueRangeMin.		SHOULD be used. [Scaled number rules]
3: M	valueRangeMin. number		SHALL be used.
3: M	valueRangeMin. scale		SHALL be interpreted. If absent, a default value of "0" applies.
3: R	valueRangeMax.		SHOULD be used. [Scaled number rules]
3: M	valueRangeMax. number		SHALL be used.
3: M	valueRangeMax. scale		SHALL be interpreted. If absent, a default value of "0" applies.
3: R	valueStepSize.		SHOULD be used. [Scaled number rules]
3: M	valueStepSize. number		SHALL be used.
3: M	valueStepSize. scale		SHALL be interpreted. If absent, a default value of "0" applies.
3: M	Measurement. measurementListData. measurementData.		
3: M	measurementId	<m2#{1..1}>	SHALL be set as PRIMARY IDENTIFIER.
3: M	valueType	"value"	SHALL be set as SUB IDENTIFIER.
3: O	timestamp	<t#{1..1}->m2#1>	MAY be used. Only the newest measurement value SHALL be stated. Additional historical values are forbidden.
3: M	value.		[EVSOC-003] [Measurement value rules] [Scaled number rules]
3: M	value. number		SHALL be used.
3: M	value. scale		SHALL be interpreted. If absent, a default value of "0" applies.
3: R	valueSource	"measuredValue"	
		"calculatedValue"	
		"empiricalValue"	
3: M	valueState		[Value state rules]

Table 13: Content of Specialization "Measurement_StateOfHealth" at Actor Monitoring Appliance

3.2.2.3.2.3 Specialization "Measurement_TravelRange"

Scenario [{...}]: M/R/O [W][C]	Element	Value	[High Level Mapping] Element and value rules
4: M	Measurement. measurementDescriptionListData. measurementDescriptionData.		
4: M	measurementId	<m3#{1..1}>	SHALL be set as PRIMARY IDENTIFIER.
4: M	measurementType	"distance"	

4: M	unit	"m"	
4: M	scopeType	"travelRange"	
4: R	Measurement. measurementConstraintsListData. measurementConstraintsData.		
4: M	measurementId	<m3#(1..1)>	SHALL be set as PRIMARY IDENTIFIER.
4: R	valueRangeMin.		SHOULD be used. [Scaled number rules]
4: M	valueRangeMin. number		SHALL be used.
4: M	valueRangeMin. scale		SHALL be interpreted. If absent, a default value of "0" applies.
4: R	valueRangeMax.		SHOULD be used. [Scaled number rules]
4: M	valueRangeMax. number		SHALL be used.
4: M	valueRangeMax. scale		SHALL be interpreted. If absent, a default value of "0" applies.
4: R	valueStepSize.		SHOULD be used. [Scaled number rules]
4: M	valueStepSize. number		SHALL be used.
4: M	valueStepSize. scale		SHALL be interpreted. If absent, a default value of "0" applies.
4: M	Measurement. measurementListData. measurementData.		
4: M	measurementId	<m3#(1..1)>	SHALL be set as PRIMARY IDENTIFIER.
4: M	valueType	"value"	SHALL be set as SUB IDENTIFIER.
4: O	timestamp	<t#(1..1)->m3#1>	MAY be used. Only the newest measurement value SHALL be stated. Additional historical values are forbidden.
4: M	value.		[EVSOC-004] [Measurement value rules] [Scaled number rules]
4: M	value. number		SHALL be used.
4: M	value. scale		SHALL be interpreted. If absent, a default value of "0" applies.
4: R	valueSource	"measuredValue"	
		"calculatedValue"	
		"empiricalValue"	
4: M	valueState		[Value state rules]

Table 14: Content of Specialization "Measurement_TravelRange" at Actor Monitoring Appliance

3.3 Pre-Scenario communication

3.3.1 General information

The Pre-Scenario communication is needed 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.

789 c) Subscription: allows to subscribe to resource addresses, which is necessary to receive
790 unsolicited notifications if a resource changes during runtime.

791 It is possible to combine those steps for multiple Scenarios or also multiple Use Cases:

- 792 - E.g. if multiple Scenarios in multiple Use Cases use the same Feature, only one subscription
793 needs to occur.
- 794 - E.g. a complete detailed discovery or a subscription to the NodeManagement Feature needs
795 to occur only once for all Use Cases.

796 Depending on which Entity, Feature and Functions are used within a Scenario the payload of the
797 corresponding messages may slightly differ, but the basic principles and messages used stay the
798 same.

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

805 After the connection is re-established (e.g. due to a power loss or a firmware update) the Pre-
806 Scenario communication SHALL be performed as well. There may be circumstances where messages
807 from the Pre-Scenario communication may be exchanged again.

808 Often the necessary messages of different Scenarios can be combined, so that only one single
809 message is needed instead of multiple messages for the different Scenarios. This also is the case for
810 the Pre-Scenario communication. In most cases only one "read" operation on the detailed discovery
811 is necessary, as well as only one subscription request or binding request is needed for each Feature.
812 Often multiple Scenarios within a Use Case access the same Feature, so only one subscription or
813 binding is necessary.

814

815 3.3.2 Detailed discovery

816 For the functionality where a client already has current detailed discovery information (i.e.
817 independent of this Use Case or any Scenario of it) the remainder of this section SHOULD be skipped.

818 Otherwise, the following procedure SHALL be performed in the given order:

- 819 1. If a client is not subscribed to the primary NodeManagement instance, the client SHALL
820 acquire a subscription according to the figure provided within this sub-section.
- 821 2. A client SHALL read the detailed discovery information according to the figure provided
822 within this sub-section. It SHALL keep the received information as far as it concerns
823 mandatory and supported optional Entity Types, Feature Types and Functions of this Use
824 Case that are needed by the client. This means that a client may choose how to store the
825 necessary information. E.g. a client Actor can store the information how to address the
826 necessary Features of the implemented Scenarios but may 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 this Use Case.

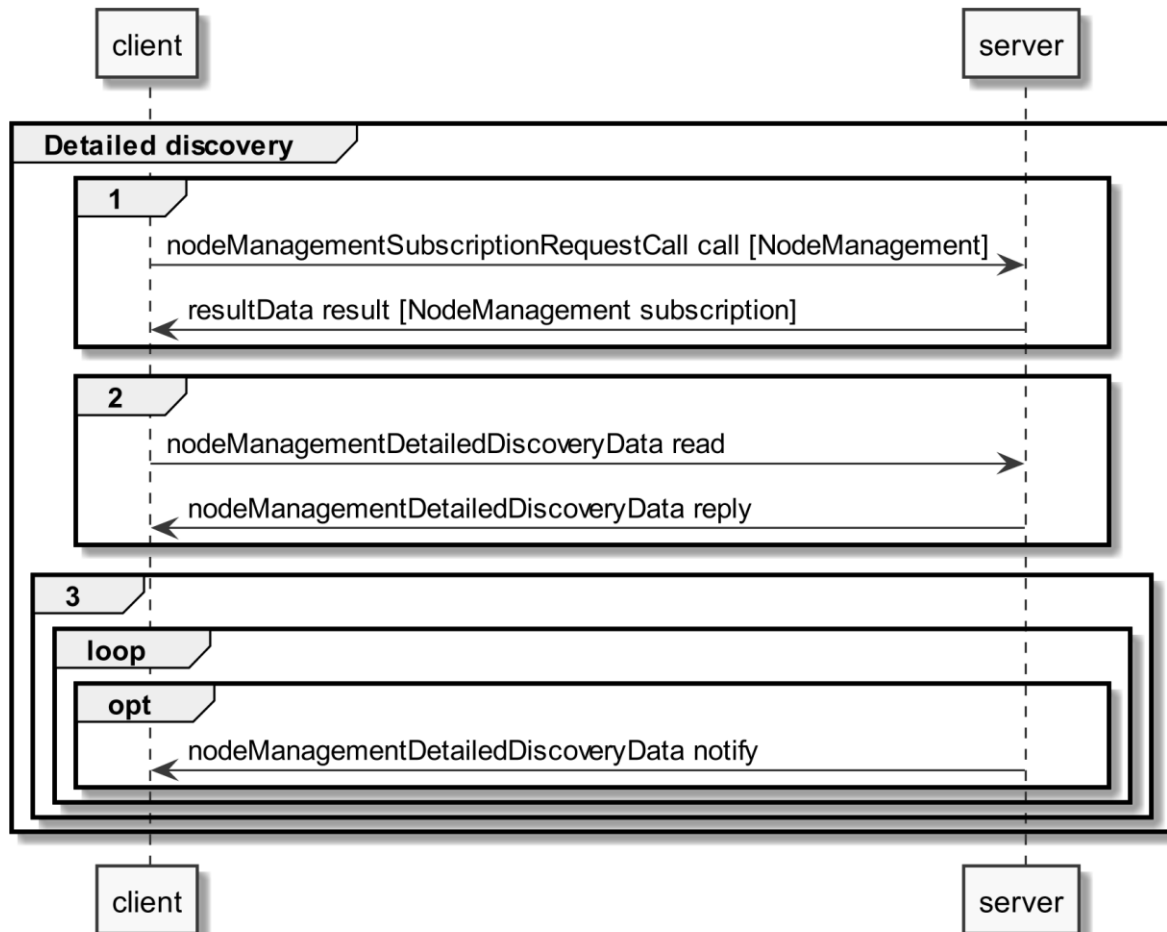


Figure 10: Pre-Scenario communication - Detailed discovery sequence diagram

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 in section 3.2 and its sub-sections.

If functionality is added or removed dynamically: The "nodeManagementDetailedDiscoveryData reply" message does not need to contain all mandatory Entities and Features given in the "Actor [...] overview" diagrams as well as all needed Functions and their "possible operations" described in section 3.2 and its sub-sections. 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 may use one of the following Elements:

- 847 - entityType
- 848 - featureType

849 Note: Even with the usage of Selectors Features and Entities that are not relevant for this Use Case
 850 may be discovered. However, only Features and Entities that fulfil the hierarchical order as described
 851 within the Actors' sections shall be considered for this Use Case.

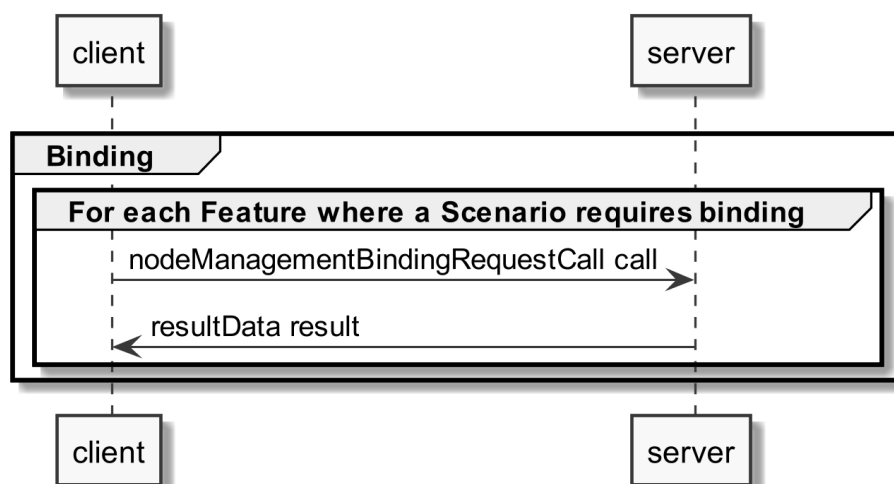
852 A "partial" notify SHALL be supported without using Selectors and Elements. Partial "delete" notify
 853 SHOULD also be supported with separated Selectors that may use one of the following Elements:

- 854 - entityAddress
- 855 - featureAddress

856

857 3.3.3 Binding

858 If binding is required by a Scenario that uses Features with writeable or changeable data, the server
 859 SHALL support binding for the respective Features. Before a write on a Function of a Feature occurs,
 860 the client SHALL create a binding to the corresponding Feature. For this the
 861 nodeManagementBindingRequestCall Function is used as shown in the following sequence diagram:



862

863 *Figure 11: Pre-Scenario communication - Binding sequence diagram*

864 If functionality is added or removed dynamically, binding may not be possible at all times on the
 865 required Functions. A client SHALL retry to create a binding again when receiving according updated
 866 detailed discovery information.

867

868 3.3.4 Subscription

869 A server SHALL support subscription for all Features that contain readable data that may change
 870 during runtime. The client SHALL create a subscription for all Features that the client wants to read.
 871 For this the nodeManagementSubscriptionRequestCall Function is used as shown in the following
 872 sequence diagram:

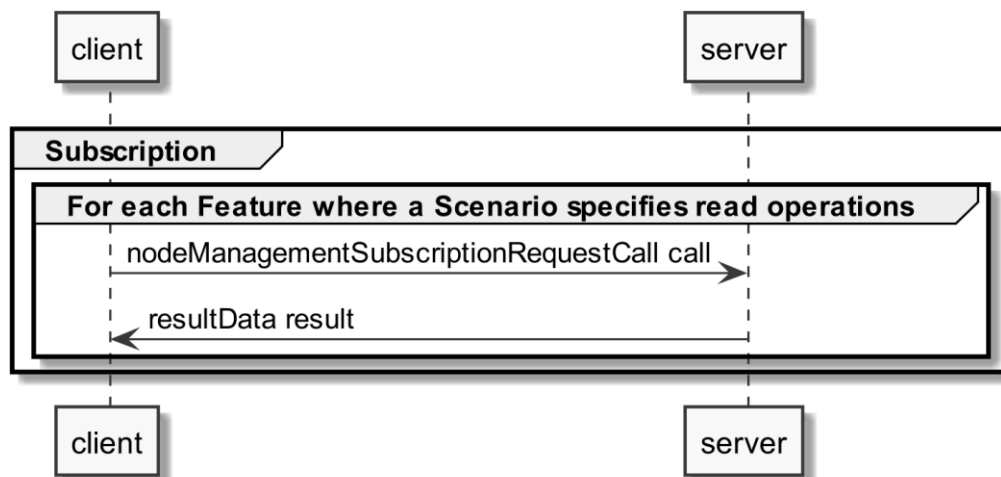


Figure 12: Pre-Scenario communication - Subscription sequence diagram

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 may not be possible at all times on the required Functions. A client SHALL retry its subscription procedure again when receiving according updated detailed discovery information.

3.3.5 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.

3.4 Scenarios

3.4.1 Scenario 1 - Monitor EV state of charge

3.4.1.1 Pre-Scenario communication

1. **Detailed discovery:** Actors that act as client within this Scenario, need to know the addresses of the server Features used in the Initial Scenario communication. If the address of a particular server Feature is not known, the detailed discovery must be used, as described in section 3.3.2.
2. **Binding:** Binding SHOULD NOT be used for this Scenario.
3. **Subscription:** Actors SHALL create a subscription for each server Feature that is relevant for the corresponding Actor within this Scenario, as described in section 3.3.4.

The Initial Scenario communication SHALL start at the latest when the required resources on an Actor are known and the necessary binding and subscription procedures have been finished. However, as

soon as the address of a required resource is known, the Initial Scenario communication for this resource MAY start already, even if the addresses of other required resources are not known yet.

If required resources are removed and added again, they are re-discovered, and the Initial Scenario communication is triggered again for those resources.

3.4.1.2 Initial Scenario communication

Each time a (re-)connection is established, even if the Pre-Scenario communication phase is skipped, the messages shown in the following sequence diagram SHALL be exchanged, as the corresponding resources may have changed in the meantime:

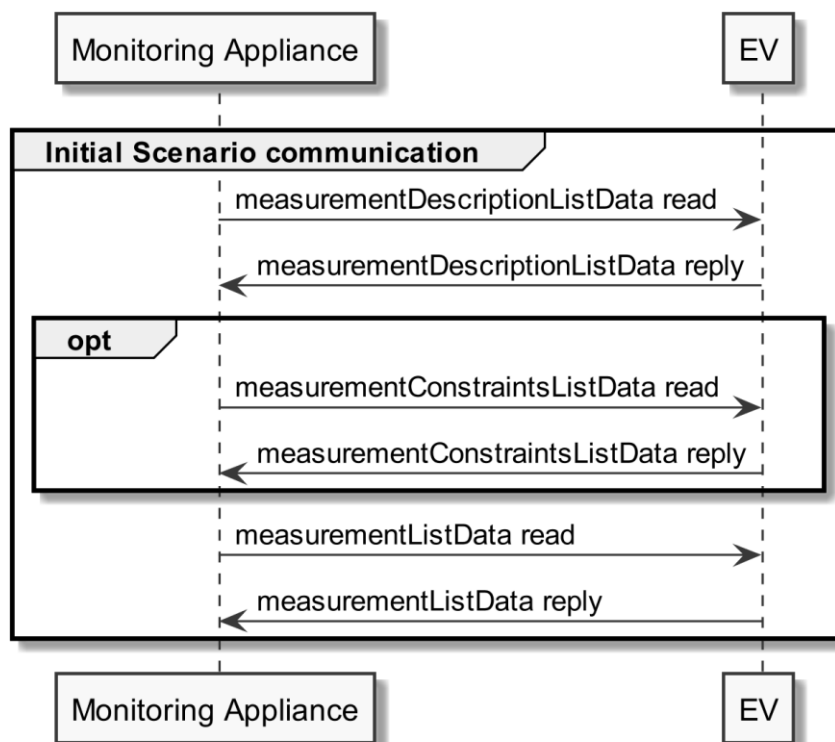


Figure 13: Scenario 1 - Initial Scenario communication sequence diagram

The `measurementDescriptionListData read` SHOULD be a "partial" read operation with the following Selector:

- `scopeType = "stateOfCharge"`

The `measurementConstraintsListData read` and `measurementListData read` SHOULD be "partial" read operations with the following Selector:

- `measurementId` (derived from the `measurementDescriptionListData reply`)

Note: If partial read is not supported, a full read SHALL be performed.

The following table shows where the required content of the messages from the sequence diagram is described:

Message name from sequence diagram	Content description in table	Scenario number in table
measurementDescriptionListData reply	Table 7	1
measurementConstraintsListData reply	Table 8	1
measurementListData reply	Table 9	1

Table 15: Initial Scenario communication content references for Scenario 1

Note: Within the Initial Scenario communication, the content required by this Scenario MAY not be provided completely, but later during Runtime Scenario communication.

3.4.1.3 Runtime Scenario communication

Based on the Initial Scenario communication, the Runtime Scenario communication provides updates during runtime.

If one of the referenced server Functions' data change, the server SHALL submit the change as shown in the following figure:

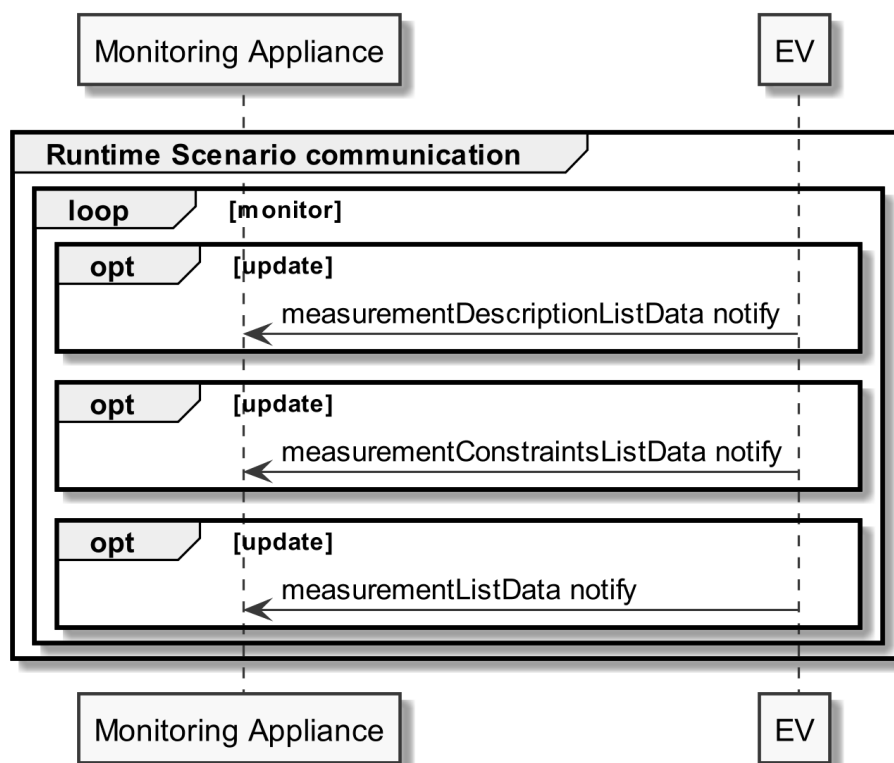


Figure 14: Scenario 1 - Runtime Scenario communication sequence diagram

Partial notifications without Selectors or Elements SHALL be supported for all Functions used in this Scenario.

For measurementDescriptionListData notify, measurementConstraintsListData notify and measurementListData notify "partial" delete notifications SHOULD be supported with the Selector:

- measurementId

Note: To interpret partial notification messages correctly, the information obtained during the Initial Scenario communication phase is required.

Note: A read operation ("polling") on all Functions is possible at any time, e.g. if a notification could not be evaluated.

The following table shows where the required content of the messages of the sequence diagram is described:

Message name from sequence diagram	Content description in table	Scenario number in table
measurementDescriptionListData notify	Table 7	1
measurementConstraintsListData notify	Table 8	1
measurementListData notify	Table 9	1

Table 16: Runtime Scenario communication content references for Scenario 1

3.4.1.4 Additional information

None.

3.4.2 Scenario 2 - Monitor EV nominal capacity

3.4.2.1 Pre-Scenario communication

- Detailed discovery:** Actors that act as client within this Scenario, need to know the addresses of the server Features used in the Initial Scenario communication. If the address of a particular server Feature is not known, the detailed discovery must be used, as described in section 3.3.2.
- Binding:** Binding SHOULD NOT be used for this Scenario.
- Subscription:** Actors SHALL create a subscription for each server Feature that is relevant for the corresponding Actor within this Scenario, as described in section 3.3.4.

The Initial Scenario communication SHALL start at the latest when the required resources on an Actor are known and the necessary binding and subscription procedures have been finished. However, as soon as the address of a required resource is known, the Initial Scenario communication for this resource MAY start already, even if the addresses of other required resources are not known yet.

If required resources are removed and added again, they are re-discovered, and the Initial Scenario communication is triggered again for those resources.

3.4.2.2 Initial Scenario communication

Each time a (re-)connection is established, even if the Pre-Scenario communication phase is skipped, the messages shown in the following sequence diagram SHALL be exchanged, as the corresponding resources may have changed in the meantime:

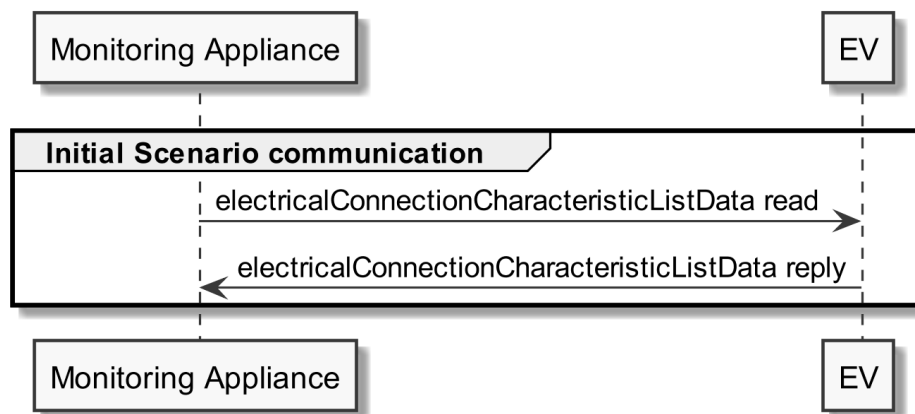


Figure 15: Scenario 2 - Initial Scenario communication sequence diagram

The electricalConnectionCharacteristicListData read SHOULD be a "partial" read operation with the following Selector:

- characteristicType = "energyCapacityNominalMax"

Note: If partial read is not supported, a full read SHALL be performed.

The following table shows where the required content of the messages from the sequence diagram is described:

Message name from sequence diagram	Content description in table	Scenario number in table
electricalConnectionCharacteristicListData reply	Table 10	2

Table 17: Initial Scenario communication content references for Scenario 2

Note: Within the Initial Scenario communication, the content required by this Scenario MAY not be provided completely, but later during Runtime Scenario communication.

3.4.2.3 Runtime Scenario communication

Based on the Initial Scenario communication, the Runtime Scenario communication provides updates during runtime.

If one of the referenced server Functions' data change, the server SHALL submit the change as shown in the following figure:

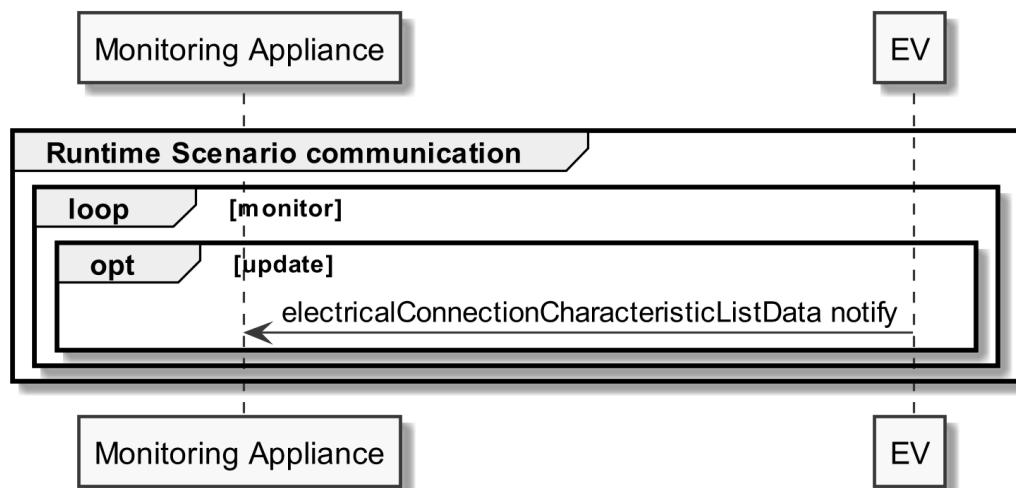


Figure 16: Scenario 2 - Runtime Scenario communication sequence diagram

Partial notifications without Selectors or Elements SHALL be supported for all Functions used in this Scenario.

For electricalConnectionCharacteristicListData notify "partial" delete notifications SHOULD be supported with the Selector:

- electricalConnectionId
- parameterId
- characteristicId

Note: To interpret partial notification messages correctly, the information obtained during the Initial Scenario communication phase is required.

Note: A read operation ("polling") on all Functions is possible at any time, e.g. if a notification could not be evaluated.

The following table shows where the required content of the messages of the sequence diagram is described:

Message name from sequence diagram	Content description in table	Scenario number in table
electricalConnectionCharacteristicListData notify	Table 10	2

Table 18: Runtime Scenario communication content references for Scenario 2

3.4.2.4 Additional information

None.

3.4.3 Scenario 3 - Monitor EV state of health

3.4.3.1 Pre-Scenario communication

1. **Detailed discovery:** Actors that act as client within this Scenario, need to know the addresses of the server Features used in the Initial Scenario communication. If the address of a particular server Feature is not known, the detailed discovery must be used, as described in section 3.3.2.
2. **Binding:** Binding SHOULD NOT be used for this Scenario.
3. **Subscription:** Actors SHALL create a subscription for each server Feature that is relevant for the corresponding Actor within this Scenario, as described in section 3.3.4.

The Initial Scenario communication SHALL start at the latest when the required resources on an Actor are known and the necessary binding and subscription procedures have been finished. However, as soon as the address of a required resource is known, the Initial Scenario communication for this resource MAY start already, even if the addresses of other required resources are not known yet.

If required resources are removed and added again, they are re-discovered, and the Initial Scenario communication is triggered again for those resources.

3.4.3.2 Initial Scenario communication

Each time a (re-)connection is established, even if the Pre-Scenario communication phase is skipped, the messages shown in the following sequence diagram SHALL be exchanged, as the corresponding resources may have changed in the meantime:

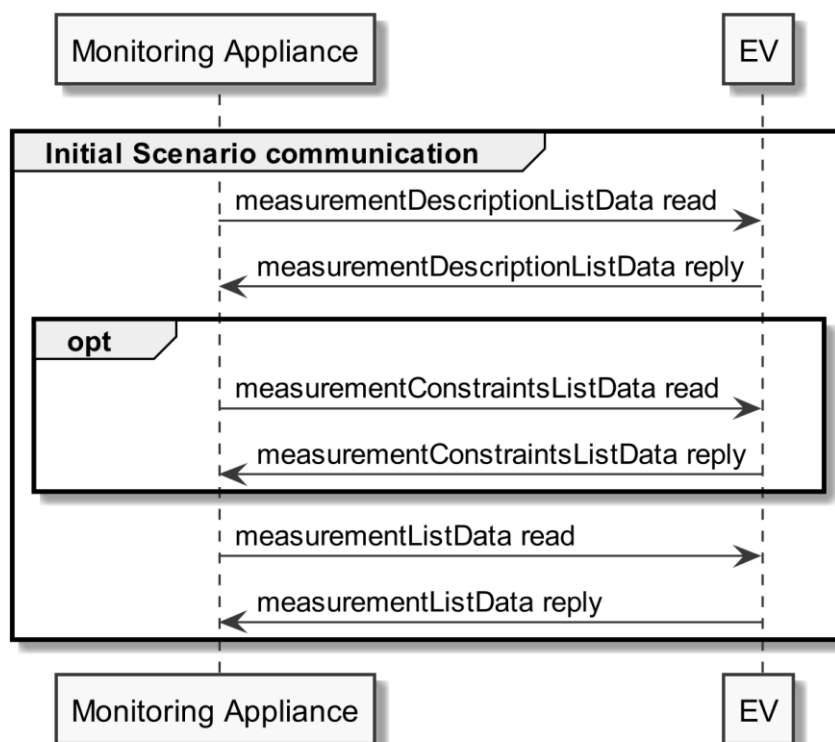


Figure 17: Scenario 3 - Initial Scenario communication sequence diagram

The measurementDescriptionListData read SHOULD be a "partial" read operation with the following Selector:

1033 - scopeType = "stateOfHealth"

1034 The measurementConstraintsListData read and measurementListData read SHOULD be "partial" read
1035 operations with the following Selector:

1036 - measurementId (derived from the measurementDescriptionListData reply)

1037 Note: If partial read is not supported, a full read SHALL be performed.

1038

1039 The following table shows where the required content of the messages from the sequence diagram is
1040 described:

Message name from sequence diagram	Content description in table	Scenario number in table
measurementDescriptionListData reply	Table 7	3
measurementConstraintsListData reply	Table 8	3
measurementListData reply	Table 9	3

1041 *Table 19: Initial Scenario communication content references for Scenario 3*

1042 Note: Within the Initial Scenario communication, the content required by this Scenario MAY not be
1043 provided completely, but later during Runtime Scenario communication.

1044

1045 **3.4.3.3 Runtime Scenario communication**

1046 Based on the Initial Scenario communication, the Runtime Scenario communication provides updates
1047 during runtime.

1048 If one of the referenced server Functions' data change, the server SHALL submit the change as shown
1049 in the following figure:

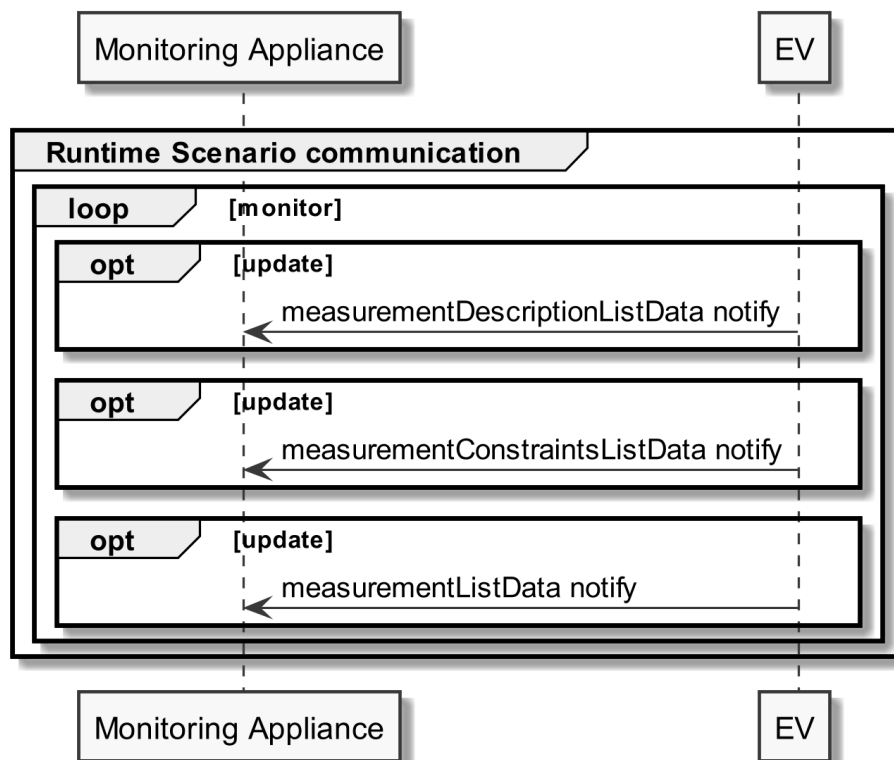


Figure 18: Scenario 3 - Runtime Scenario communication sequence diagram

Partial notifications without Selectors or Elements SHALL be supported for all Functions used in this Scenario.

For measurementDescriptionListData notify, measurementConstraintsListData notify and measurementListData notify "partial" delete notifications SHOULD be supported with the Selector:

- measurementId

Note: To interpret partial notification messages correctly, the information obtained during the Initial Scenario communication phase is required.

Note: A read operation ("polling") on all Functions is possible at any time, e.g. if a notification could not be evaluated.

The following table shows where the required content of the messages of the sequence diagram is described:

Message name from sequence diagram	Content description in table	Scenario number in table
measurementDescriptionListData notify	Table 7	3
measurementConstraintsListData notify	Table 8	3
measurementListData notify	Table 9	3

Table 20: Runtime Scenario communication content references for Scenario 3

1066 **3.4.3.4 Additional information**

1067 None.

1068

1069 **3.4.4 Scenario 4 - Monitor EV actual travel range**

1070 **3.4.4.1 Pre-Scenario communication**

- 1071 1. **Detailed discovery:** Actors that act as client within this Scenario, need to know the addresses
1072 of the server Features used in the Initial Scenario communication. If the address of a
1073 particular server Feature is not known, the detailed discovery must be used, as described in
1074 section 3.3.2.
- 1075 2. **Binding:** Binding SHOULD NOT be used for this Scenario.
- 1076 3. **Subscription:** Actors SHALL create a subscription for each server Feature that is relevant for
1077 the corresponding Actor within this Scenario, as described in section 3.3.4.

1078 The Initial Scenario communication SHALL start at the latest when the required resources on an Actor
1079 are known and the necessary binding and subscription procedures have been finished. However, as
1080 soon as the address of a required resource is known, the Initial Scenario communication for this
1081 resource MAY start already, even if the addresses of other required resources are not known yet.

1082 If required resources are removed and added again, they are re-discovered, and the Initial Scenario
1083 communication is triggered again for those resources.

1084

1085 **3.4.4.2 Initial Scenario communication**

1086 Each time a (re-)connection is established, even if the Pre-Scenario communication phase is skipped,
1087 the messages shown in the following sequence diagram SHALL be exchanged, as the corresponding
1088 resources may have changed in the meantime:

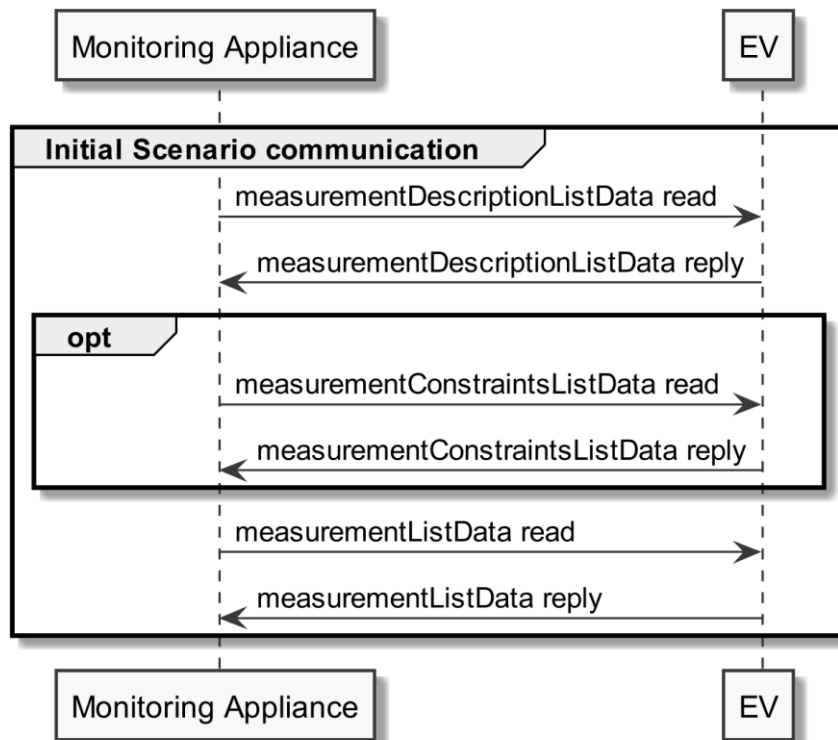


Figure 19: Scenario 4 - Initial Scenario communication sequence diagram

The measurementDescriptionListData read SHOULD be a "partial" read operation with the following Selector:

- scopeType = "travelRange"

The measurementConstraintsListData read and measurementListData read SHOULD be "partial" read operations with the following Selector:

- measurementId (derived from the measurementDescriptionListData reply)

Note: If partial read is not supported, a full read SHALL be performed.

The following table shows where the required content of the messages from the sequence diagram is described:

Message name from sequence diagram	Content description in table	Scenario number in table
measurementDescriptionListData reply	Table 7	4
measurementConstraintsListData reply	Table 8	4
measurementListData reply	Table 9	4

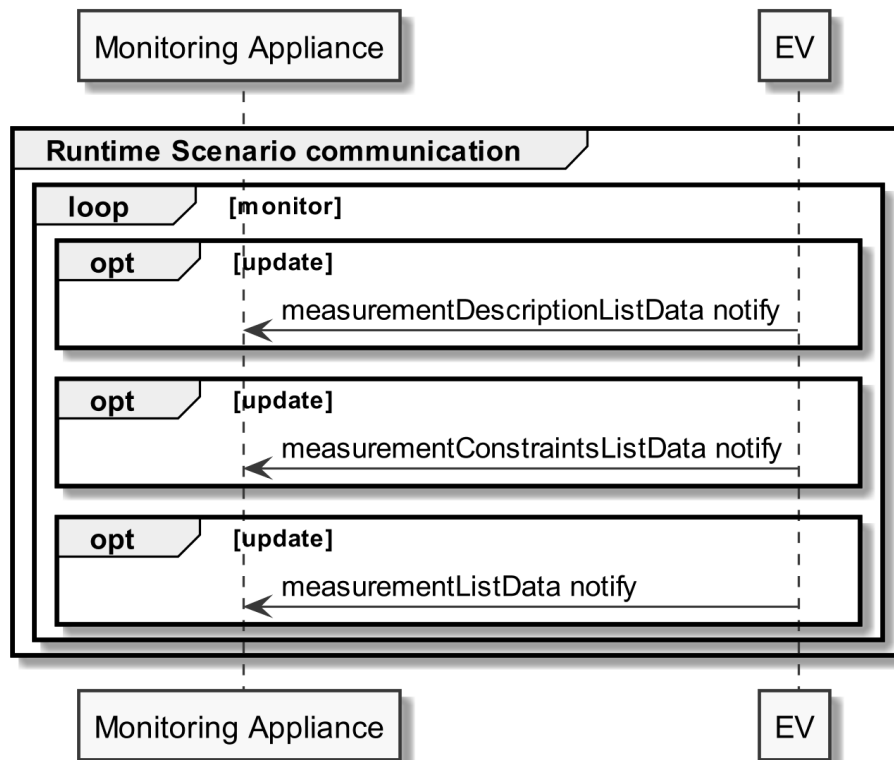
Table 21: Initial Scenario communication content references for Scenario 4

Note: Within the Initial Scenario communication, the content required by this Scenario MAY not be provided completely, but later during Runtime Scenario communication.

1105 3.4.4.3 Runtime Scenario communication

1106 Based on the Initial Scenario communication, the Runtime Scenario communication provides updates
1107 during runtime.

1108 If one of the referenced server Functions' data change, the server SHALL submit the change as shown
1109 in the following figure:



1110
1111 *Figure 20: Scenario 4 - Runtime Scenario communication sequence diagram*

1112 Partial notifications without Selectors or Elements SHALL be supported for all Functions used in this
1113 Scenario.

1114 For measurementDescriptionListData notify, measurementConstraintsListData notify and
1115 measurementListData notify "partial" delete notifications SHOULD be supported with the Selector:

- 1116 - measurementId

1117 Note: To interpret partial notification messages correctly, the information obtained during the Initial
1118 Scenario communication phase is required.

1119 Note: A read operation ("polling") on all Functions is possible at any time, e.g. if a notification could
1120 not be evaluated.

1121

1122 The following table shows where the required content of the messages of the sequence diagram is
1123 described:

Message name from sequence diagram	Content description in table	Scenario number in table
measurementDescriptionListData notify	Table 7	4
measurementConstraintsListData notify	Table 8	4
measurementListData notify	Table 9	4

Table 22: Runtime Scenario communication content references for Scenario 4

3.4.4.4 Additional information

None.