

EEBus UC Technical Specification

Visualization of Aggregated Battery Data

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97

98

99 **1 Scope of the document**

100 This document describes the Use Case "Visualization of Aggregated Battery Data" (short-name:
101 VABD). Chapter 2 specifies the High-Level Use Case. Chapter 3 details the technical solution for SPINE
102 for this Use Case. Within this document, a top-down approach is used to derive the requirements for
103 the technical solution from the High-Level description.

104

105 **1.1 References**

106 **1.1.1 EEBUS documents**

107 **[UseCaseBaseSpecification]** EEBus_UC_TS_UseCaseBaseSpecification.pdf

108 **[ProtocolSpecification]** EEBus_SPINE_TS_ProtocolSpecification.pdf

109 **[ResourceSpecification]** EEBus_SPINE_TS_ResourceSpecification.pdf

110 **[SHIP]** SHIP_Specification_v1.0.0.pdf

111

112 **1.1.2 Normative references**

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

115

116 **1.2 Terms and definitions**

117 **AC**

118 Abbreviation for alternating current

119 **Active sign convention**

120 An electrical current is positive if the current is flowing out of device or component. In this case, the
121 device or component produces electrical power and the active power is greater than zero. An
122 electrical current is negative if the current is flowing into a device or component. In this case, the
123 device or component consumes electrical power and the active power is smaller than zero.

124 **Actor**

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

126 **N/A**

127 Not applicable

128 **Passive sign convention**

129 An electrical current is positive if the current is flowing into a device or component. In this case, the
130 device or component consumes electrical power and the active power is greater than zero. An
131 electrical current is negative if the current is flowing out of a device or component. In this case, the
132 device or component produces electrical power and the active power is smaller than zero.

133 **pct**

134 Abbreviation for percentage

135 Polling

136 Mechanism where data is requested by the client periodically. Typically, polling needs to be repeated
137 frequently by the client to increase the probability to notice all changes from a data server in time.

138 Scenario

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

142 Specialization

143 Reusable data collection for a specific functionality

144 SPINE

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

147 VABD

148 Visualization of Aggregated Battery Data (short name of this Use Case)

149 Visualization Appliance

150 The Actor Visualization Appliance displays particular data of another Actor.

151

152 1.3 Requirements**153 1.3.1 Requirements wording**

154 The following keywords are used:

- 155 - SHALL
- 156 - SHALL NOT
- 157 - SHOULD
- 158 - SHOULD NOT
- 159 - MAY

160 Note: They apply only if written in capital letters.

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

162

163 1.3.2 Mapping of High-Level requirements

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

165 [VABD-xyz]

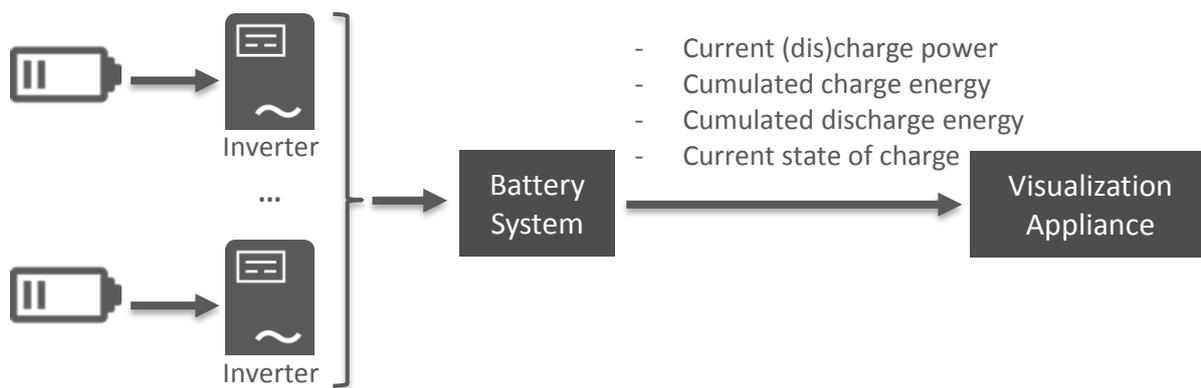
166 e.g.: [VABD-007]

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

170 2 High-Level description

171 2.1 Introduction

172 The Visualization Appliance receives electrical energy or power measurements as well as the state of
 173 charge from a Battery System for visualization. A Battery System aggregates data of one or more
 174 battery inverters at the premises. The combination of inverters and batteries serves to store cheap or
 175 eco-friendly energy for later use and helps to balance the production and consumption at the
 176 premises. Within this Use Case the power consumption and production of the Battery System can be
 177 visualized as well as the state of charge. In addition, the charged or discharged energy since last reset
 178 may be visualized.



179

180 *Figure 1: High-Level Use Case functionality overview*

181

182 *Added value:* The Visualization Appliance may read the most important power and energy values of a
 183 Battery System for user information.

184

185 2.2 User Story as an example

186 The user wants to have an overview over the current usage of the Battery System to evaluate energy
 187 consumption, feed in and state of charge.

188

189 2.3 Actors

190 2.3.1 Visualization Appliance

191 The Actor Visualization Appliance visualizes electrical data from the Actor Battery System to the
 192 customer.

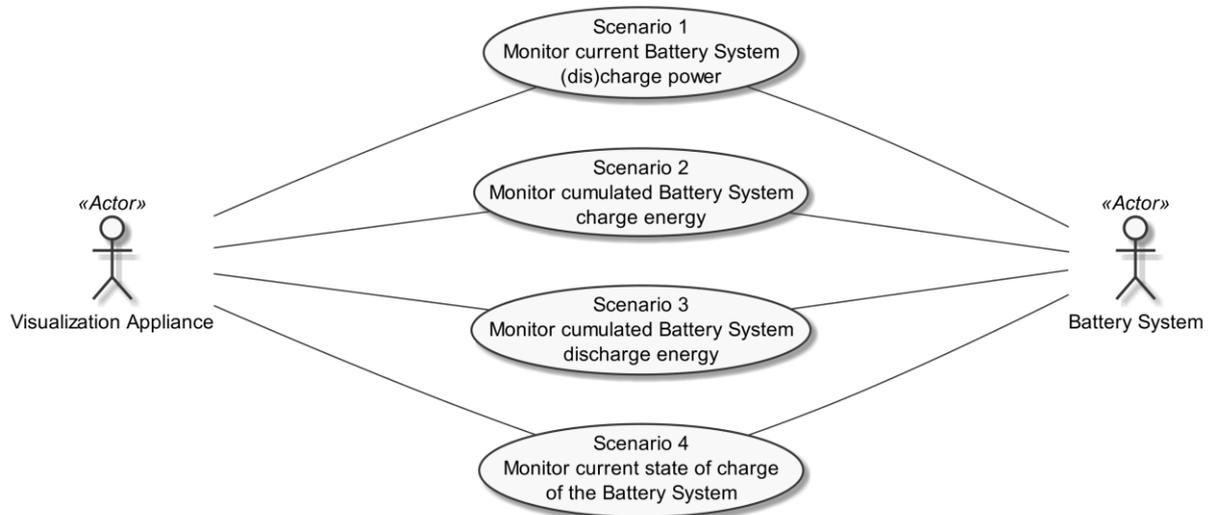
193

194 2.3.2 Battery System

195 The Actor Battery System aggregates data from one or more batterie inverters.

196

197 **2.4 Scenarios**



198
199 *Figure 2: Scenario overview*

200

Scenario number	Scenario name	Visualization Appliance	Battery System
1	Monitor current Battery System (dis)charge power	M	M
2	Monitor cumulated Battery System charge energy	R	R
3	Monitor cumulated Battery System discharge energy	R	R
4	Monitor current state of charge of the Battery System	R	M

201 *Table 1: Scenario implementation requirement for Actors*

202

203 **2.4.1 Scenario 1 - Monitor current Battery System (dis)charge power**

204 **2.4.1.1 Description**

205 The Actor Visualization Appliance receives information on the current electrical power that is
 206 charged to or discharged from a Battery System [VABD-001a]. Only the latest value is exchanged, i.e.
 207 no historical values are available [VABD-001b].

208

209 **2.4.1.2 Conditions**

210 **Triggering Event:**

211 The Actor Visualization Appliance is interested in the (dis)charge power value of the Actor Battery
 212 System.

213 **Pre-condition:**

214 The Actor Visualization Appliance does not know the (dis)charge power value of the Actor Battery
215 System.

216 **Post-condition:**

217 The Actor Visualization Appliance knows the (dis)charge power value of the Actor Battery System.

218

219 **2.4.2 Scenario 2 - Monitor cumulated Battery System charge energy**

220 **2.4.2.1 Description**

221 The Actor Visualization Appliance receives information on the cumulated electrical charge energy
222 [VABD-002a]. The cumulation covers the time since installation or last reset. The cumulated charge
223 energy is independent from discharge processes [VABD-002c]. Only the latest cumulated charge
224 energy is exchanged, i.e. no historical values are available [VABD-002b].

225

226 **2.4.2.2 Conditions**

227 **Triggering Event:**

228 The Actor Visualization Appliance is interested in the cumulated charge energy of the Actor Battery
229 System.

230 **Pre-condition:**

231 The Actor Visualization Appliance does not know the cumulated charge energy of the Actor Battery
232 System.

233 **Post-condition:**

234 The Actor Visualization Appliance knows the cumulated charge energy of the Actor Battery System.

235

236 **2.4.3 Scenario 3 - Monitor cumulated Battery System discharge energy**

237 **2.4.3.1 Description**

238 The Actor Visualization Appliance receives information on the cumulated electrical discharge energy
239 [VABD-003a]. The cumulation covers the time since installation or last reset. The cumulated
240 discharge energy is independent from charge processes [VABD-003c]. Only the latest cumulated
241 discharge energy is exchanged, i.e. no historical values are available [VABD-003b].

242

243 **2.4.3.2 Conditions**

244 **Triggering Event:**

245 The Actor Visualization Appliance is interested in the cumulated discharge energy of the Actor
246 Battery System.

247 **Pre-condition:**

248 The Actor Visualization Appliance does not know the cumulated discharge energy of the Actor
249 Battery System.

250 **Post-condition:**

251 The Actor Visualization Appliance knows the cumulated discharge energy of the Actor Battery
252 System.

253

254 **2.4.4 Scenario 4 - Monitor current state of charge of the Battery System**

255 **2.4.4.1 Description**

256 The Actor Visualization Appliance receives information on the percentage-based state of charge of
257 the Battery System [VABD-004a] where 0% is completely discharged (empty) and 100% is completely
258 charged (full). Only the latest state of charge is exchanged, i.e. no historical values are available
259 [VABD-004b].

260

261 **2.4.4.2 Conditions**

262 **Triggering Event:**

263 The Actor Visualization Appliance is interested in the current state of charge value of the Actor
264 Battery System.

265 **Pre-condition:**

266 The Actor Visualization Appliance does not know the current state of charge value of the Actor
267 Battery System.

268 **Post-condition:**

269 The Actor Visualization Appliance knows the current state of charge value of the Actor Battery
270 System.

271

272 **2.5 Dependencies to other Use Cases**

273 None.

274

275 **2.6 Assumptions and Prerequisites**

276 For a given Battery System it must be known whether the "generator convention" (i.e. "active sign
277 convention") or the "load convention" (i.e. "passive sign convention") applies for electrical data. In
278 case of the "load convention", power and energy are measured with negative values in case of
279 energy production (i.e. discharging) [VABD-005].

280

281 **3 Technical SPINE solution**

282 **3.1 General rules and information**

283 **3.1.1 Underlying technology documents**

284 This technical solution relies on the SPINE Resources Specification version 1.1.0
285 [ResourceSpecification].

286 For interoperable connectivity this technical solution relies on:

- 287 - SPINE Protocol Specification version 1.1.0 [ProtocolSpecification] as application protocol.
- 288 - SHIP Specification version 1.0.0 [SHIP] as transport protocol.

289 Further applicable documents:

- 290 - EEBUS Use Case Base Specification version 1.0.0 [UseCaseBaseSpecification].

291

292 **3.1.2 Use Case discovery rules**

293 Use Case discovery SHOULD be supported by each Actor. If Use Case discovery is supported the
294 following rules SHALL apply:

- 295 - The string content for the Element "nodeManagementUseCaseData. useCaseInformation.
296 useCaseSupport. useCaseName" within the Use Case discovery (please refer to
297 [ProtocolSpecification]) SHALL be "visualizationOfAggregatedBatteryData". The string
298 content SHALL only be defined by this Use Case (regardless of the Use Case version).
- 299 - The string content of the Element "nodeManagementUseCaseData. useCaseInformation.
300 actor" within the Use Case discovery (please refer to [ProtocolSpecification]) SHALL be set to
301 the according value stated within the corresponding Actor's section.
- 302 - An Actor A that is implemented to support this Use Case specification SHALL set the Element
303 "nodeManagementUseCaseData. useCaseInformation. useCaseSupport. useCaseVersion"
304 within the Use Case discovery (please refer to [ProtocolSpecification]) to "1.0.0" (for details
305 on the structure of the Use Case version number please refer to [UseCaseBaseSpecification]).
- 306 - If an Actor A supports multiple versions of this Use Case with the same major version
307 number, only the highest one SHOULD be set within the Use Case discovery.
- 308 - If an Actor A finds a proper counterpart Actor B for this Use Case that supports multiple
309 versions of this Use Case with the same major version number as supported by Actor A, the
310 Actor A SHOULD evaluate from these versions of Actor B only the highest version number.
- 311 - If an Actor A supports multiple versions of this Use Case with different major version
312 numbers, for each major version number only the highest version number SHOULD be set
313 within the Use Case discovery.
- 314 - If an Actor A finds a proper counterpart Actor B for this Use Case that supports only versions
315 with a major version number not implemented by Actor A, it still might be possible to run the
316 Use Case or parts of the Use Case. Therefore, the Actor A should try to evaluate the Actor B
317 as a valid partner for this Use Case.

318

319 3.1.3 Rules for "Content of Specialization..." tables and "Content of Function..." tables

320 3.1.3.1 General presence indication definitions

321 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

322 *Table 2: Presence indication description*

323 An Actor MAY support Elements that are not listed in the tables. However, another Actor MAY ignore
324 these Elements.

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

328 Note: The indications and the aforementioned rules apply for "complete messages" (so-called "full
329 function exchange", please refer to [ProtocolSpecification]). In contrast, the so-called "restricted
330 function exchange" is designed to permit exchange of specific excerpts of data, i.e. fewer Elements
331 than potentially available from the data owner (partially even not all "mandatory" Elements).

332

333 3.1.3.2 Presence indications for "Content of Specialization..." tables

334 This section only defines rules for the client side.

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

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

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

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

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

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

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

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

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

357

358 **3.1.3.3 Presence indications for "Content of Function..." tables**

359 This section only defines rules for the server side.

360 Elements that are marked with "M" SHALL be supported by the server in case of readable as well as
361 writeable data. In case of writeable data (marked with "M \W") the server does not need to set the
362 Element, because the Element is set only by the client.

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

- 364 - "R" means that the data SHOULD be provided by the server.
- 365 - "O" means that the data MAY be provided by the server.
- 366 - "F" means that the data SHALL NOT be provided by the server.

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

- 368 - "R" means that the data SHOULD be supported. In other words: If the client writes the
369 Element, the server SHOULD accept those messages and the contained Elements.
- 370 - "O" means that the data MAY be supported. In other words: If the client writes the Element,
371 the server MAY accept those messages and the contained Elements.

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

- 373 - In case of a received "read" request: The according Element MAY be set in the reply.
- 374 - In case of a received "write" operation: The server MAY ignore the Element.
- 375 - In case of a "notify" operation to be created: The server MAY set the Element.

376 Note: The server will only accept write operations if the result fulfils the server Function
377 requirements (permitted values, e.g.). Write operations on Elements that are not writeable MAY
378 result in an error message.

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

383

384 **3.1.3.4 Cardinality indications on Elements and list items**

385 A cardinality indication on an Element or list item expresses constraints on the number of
386 occurrences of a given Element or data set. In this section we use "X" as representation for such an
387 Element or data set. Furthermore, "a" and "b" represent constraints. The following rules apply for
388 the occurrence of "X" and its content related to a specific Scenario (see note underneath the list):

- 389 1. X
- 390 No cardinality indication.
- 391 2. X (a..b)
- 392 This means "X" SHALL occur at least "a" times and at maximum "b" times.
- 393 3. X (a..)
- 394 This means "X" SHALL occur at least "a" times and MAY occur more than "a" times.
- 395 4. X (..b)
- 396 This means "X" SHALL occur at maximum "b" times and MAY occur less than "b" times (even
- 397 zero occurrences are permissive).

398 Note: These rules apply only under consideration of presence indications and with regards to the
 399 given Scenario or Function definition for this Use Case.

400 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>	...
...

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

402 The field

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

404 introduces a data pattern (required Elements and values) for "xData" instances used for Scenario 2.
 405 The field itself specifies that such an "xData" instance SHALL occur at least 1 time and at maximum 3
 406 times within "xListData" of Feature Type "xFeatureType". However, this constraint holds only for
 407 Scenario 2 and only if such "xData" are required. In this case, they are required, as the left field

408 2: M \W

409 denotes that this data set is mandatory for Scenario 2.

410 The field

411 xSlot. (1..)

412 expresses that the Element "xSlot" SHALL occur at least one time within its "xData", but MAY occur
 413 more than one time.

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

415 The remaining fields do not have an explicit cardinality indication.

416 Note: Cardinality expressions are also used within placeholder expressions as defined in section
417 3.1.3.6. In many cases such placeholder expressions define the number of required or permitted
418 Elements or list items as they explicitly define how many different values for a given Identifier are
419 required or permitted for a given Scenario.

420

421 **3.1.3.5 Writability and changeability indication**

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

- 424 - Elements that are marked with "\W" are written by a client and SHALL be writeable at the
425 server according to their presence indications. The client is not obliged to read the according
426 data. Received notifications do not need to be evaluated.
- 427 - Elements that are marked with "\C" are changed by a client and SHALL be changeable at the
428 server according to their presence indications. The client is not obliged to read the according
429 data. Received notifications do not need to be evaluated.
- 430 - Elements that are marked with "\RW" are read and written by a client and SHALL be
431 writeable and provided by the server according to their presence indications. Received
432 notifications SHALL be evaluated according to their presence indications.
- 433 - Elements that are marked with "\RC" are read and changed by a client and SHALL be
434 changeable and provided by the server according to their presence indications. Received
435 notifications SHALL be evaluated according to their presence indications.
- 436 - Elements that are not marked are only read by a client and SHALL be provided by the server
437 according to their presence indications. Received notifications SHALL be evaluated according
438 to their presence indications.

439 "Writeable" means that the Element and its value may be written by a client. This includes the
440 possibility to modify (if the Element is already present), create (if the Element is not present yet), and
441 delete the Element. The server SHALL adjust its Function according to the received "write" operation
442 (unless the server cannot accept the "write" operation according to section 3.1.3.3).

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

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

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

449

450 **3.1.3.6 "Value" placeholders**

451 *3.1.3.6.1 Introduction*

452 Specializations may use placeholders to model relations between different Elements or even list
453 items of different Functions. The main purpose is to declare which Identifier values relate to each
454 other. As a Use Case does not prescribe specific values to be used for a given Identifier, a placeholder
455 like "<x1>" can be used in "Value" columns to express the intended relations.

456 There are two styles placeholders that can be referenced:

- 457 1. <xM>
- 458 2. <xM#S>

459 where

- 460 1. "x" is any alphabetical prefix like "m", "t", "ec", "cc", etc.
- 461 2. "M" is a (major) number like "1", "2", "15", etc.
- 462 3. "S" is a sub-number like "1", "7", "10", etc.

463 Examples for the first style are "<ec1>", "<z12>". Examples for the second style are "<p4#2>",
464 "<m22#3>". For a given placeholder, only one of the styles can be used.

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

- 466 1. <*>
- 467 2. <*#S>

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

469

470 *3.1.3.6.2 Uniqueness of placeholders*

471 A given placeholder <xM> or <xM#S> represents the same value throughout a given Use Case
472 specification for a given set of its parent Identifier values. This shall be explained in a brief example:

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

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

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

480

481 *3.1.3.6.3 Placeholder expressions with cardinalities*

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

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

485 This is equivalent to this explicit definition:

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

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

490 Additionally, the following notations may occur:

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

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

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

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

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

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

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

505

506 3.1.3.6.4 References to placeholders and relations

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

509 1. e(-><xM>)

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

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

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

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

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

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

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

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

- 521 3. <yN->xM>
 522 4. <yN->xM#S>
 523 5. <yN#T->xM>
 524 6. <yN#T->xM#S>

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

526 It is also feasible to associate placeholders with cardinalities:

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

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

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

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

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

536 *Table 4: Content of an example Specialization*

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

539

540 3.1.3.7 Rules for content of "Value" column

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

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

- 548 - "M" means that the value SHALL be supported. This means the value needs to be set at a
 549 certain point in time (depending on the value rules) or for a certain Element within a list
 550 entry.
 551 - "R" means that the value SHOULD be supported.
 552 - "O" means that the value MAY be supported.

553 If all possible values of a given mandatory Element are optional or recommended and this Element is
 554 used for the purpose of the respective Scenario, one of the values SHALL be set. If all possible values
 555 of a given optional or recommended Element are optional or recommended, this Element MAY
 556 contain also other values, but then this Element SHALL NOT be considered as part of the respective
 557 Scenario.

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

562 If no presence indication is set for the value, the following rules SHALL be applied:

- 563 - In case of Elements where the server may set or change an Element on its own (see section
 564 3.1.3.5):
 565 o within the tables in the "Server data - Resources" sections:
 566 ▪ the server SHALL support at least one of the listed values.
 567 o within the tables in the "Client data - Specializations" sections:
 568 ▪ the client SHALL support all listed values.
 569 - In case of Elements that are writable or changeable (see section 3.1.3.5):
 570 o within the tables in the "Server data - Resources" sections:
 571 ▪ the server SHALL support all listed values.
 572 o within the tables in the "Client data - Specializations" sections:
 573 ▪ the client SHALL support at least one of the listed values.

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

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

578

579 **3.1.3.8 General information on how to interpret the "Content of Function..." and "Content of** 580 **Specialization..." tables**

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

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

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

589 DeviceConfiguration. deviceConfigurationKeyValueDescriptionListData.
590 deviceConfigurationKeyValueDescriptionData.

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

592

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

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

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

602 Measurement. measurementDescriptionListData. measurementDescriptionData.

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

604

605 For both kinds of tables, the following applies:

606 - Parent Elements are marked with a dot at the end of the name:

607 <parent Element>.

608 E.g.:

609 value.

610 - If there are sub-Elements, they are described in own rows with the name of the parent

611 Element as prefix, separated by a dot and a blank space:

612 <parent Element>. <sub-Element>

613 E.g.:

614 value. number

615

616 3.1.4 Rules for "Feature Types and Functions..." tables

617 3.1.4.1 Presence indications for "Feature Types and Functions..." tables

618 The following presence indications are used:

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

619 *Table 5: Presence indication of Feature Types and Functions support*

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

622

623 **3.1.4.2 Rules for "Possible operations" column**

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

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

629 read (M). partial (M)

630 write (M). partial (M)

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

632 read (M). partial (R)

633 write (M). partial (R)

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

635 read (M). partial (O)

636 write (M). partial (O)

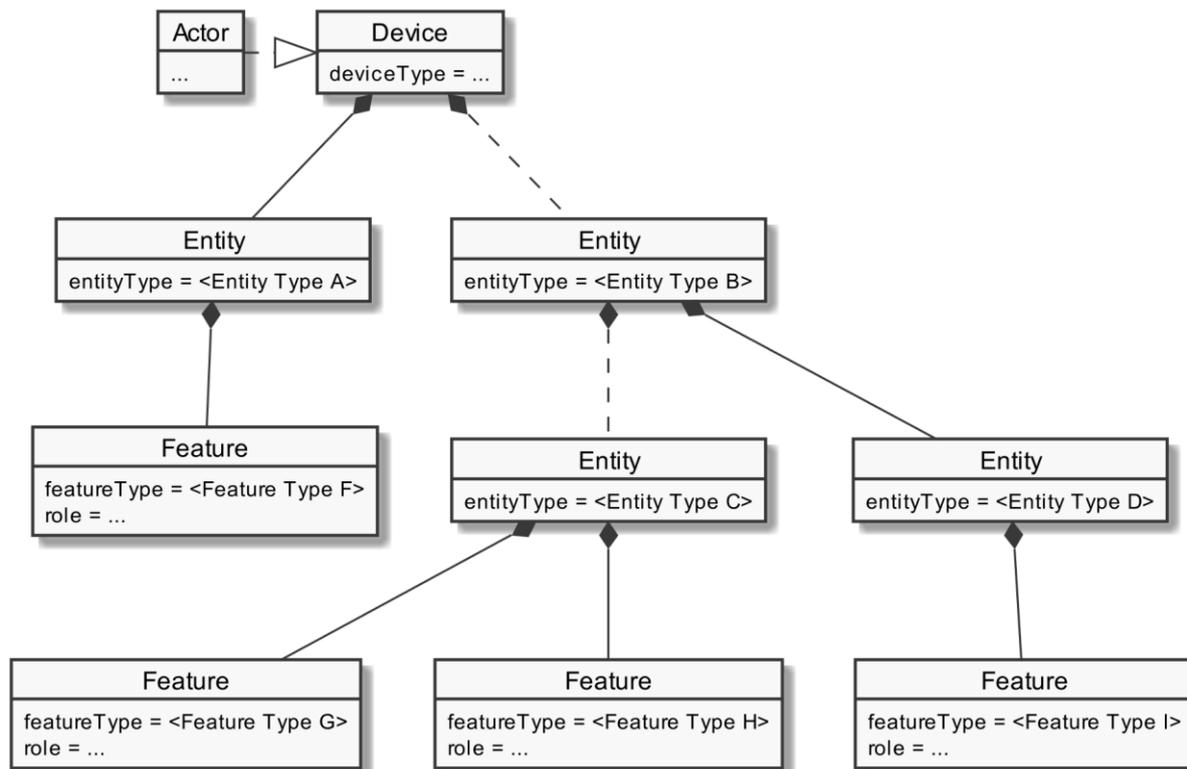
637 The server can decide whether a notification is submitted complete or partial (as described in
638 [ProtocolSpecification]) if not defined differently within this Use Case Specification.

639

640 **3.1.5 "Actor ... overview" diagram rules**

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

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



646

647 *Figure 3: Actor overview example*

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

651 The dashed lines in the figure express that there MAY be additional Entities between the shown
 652 Entities: A vendor's implementation MAY have one or more Entities between "Device" and the Entity
 653 with "<Entity Type B>". Likewise, a vendor's implementation MAY have one or more Entities between
 654 the Entity with "<Entity Type B>" and the Entity with "<Entity Type C>".

655

656 3.1.6 Specializations

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

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

669 generated, transmitted and stored instead of one. Therefore, already existing Specializations
670 specified within [UseCaseBaseSpecification] are used in this Use Case to avoid such problems.

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

676 The SPINE resource description given in the "SPINE resources of the Actor" sections are derived from
677 the Specializations given in the Actor's overview diagram. Please refer to [UseCaseBaseSpecification]
678 for a detailed description of all Specializations.

679

680 **3.1.7 Order of messages within the sequence diagrams**

681 There are several sequence diagrams in this document describing message flows. The order of the
682 messages SHOULD be kept by the communications partners, but there might be cases where a
683 different order makes sense. The communications partners SHALL be able to handle the Scenario
684 functionalities even if the messages are transmitted in a different order by the other Actor(s). The
685 sequence diagrams can be seen as examples.

686

687 **3.1.8 Further information and rules**

688 **3.1.8.1 Frequently used Element rules for the Resource and Specialization tables**

689 This section serves as a collection of rules frequently used by Resource and Specialization tables of
690 the subsequent sections. Each rule applies only where referenced explicitly in the tables.

691 Note: The purpose of this collection is just to reduce the size of the tables. As such, no rule has a
692 meaning without a reference indicating the required rule. A reference looks like "See [Measurement
693 value rules]", e.g.

694

695 **[Measurement value rules]:**

696 SHALL be set if a value is available. Otherwise, the whole list entry SHALL be omitted or the Element
697 *valueState* SHALL be set to "error".

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

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

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

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

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

706

707 **[Scaled number rules]:**

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

709 $\text{number} * 10^{\text{scale}}$

710

711 **[Value state rules]:**

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

715

716 **3.1.8.2 Further rules**

717 A server SHOULD NOT add or remove Entities and Features used within this Use Case during runtime
718 in the detailed discovery.

719

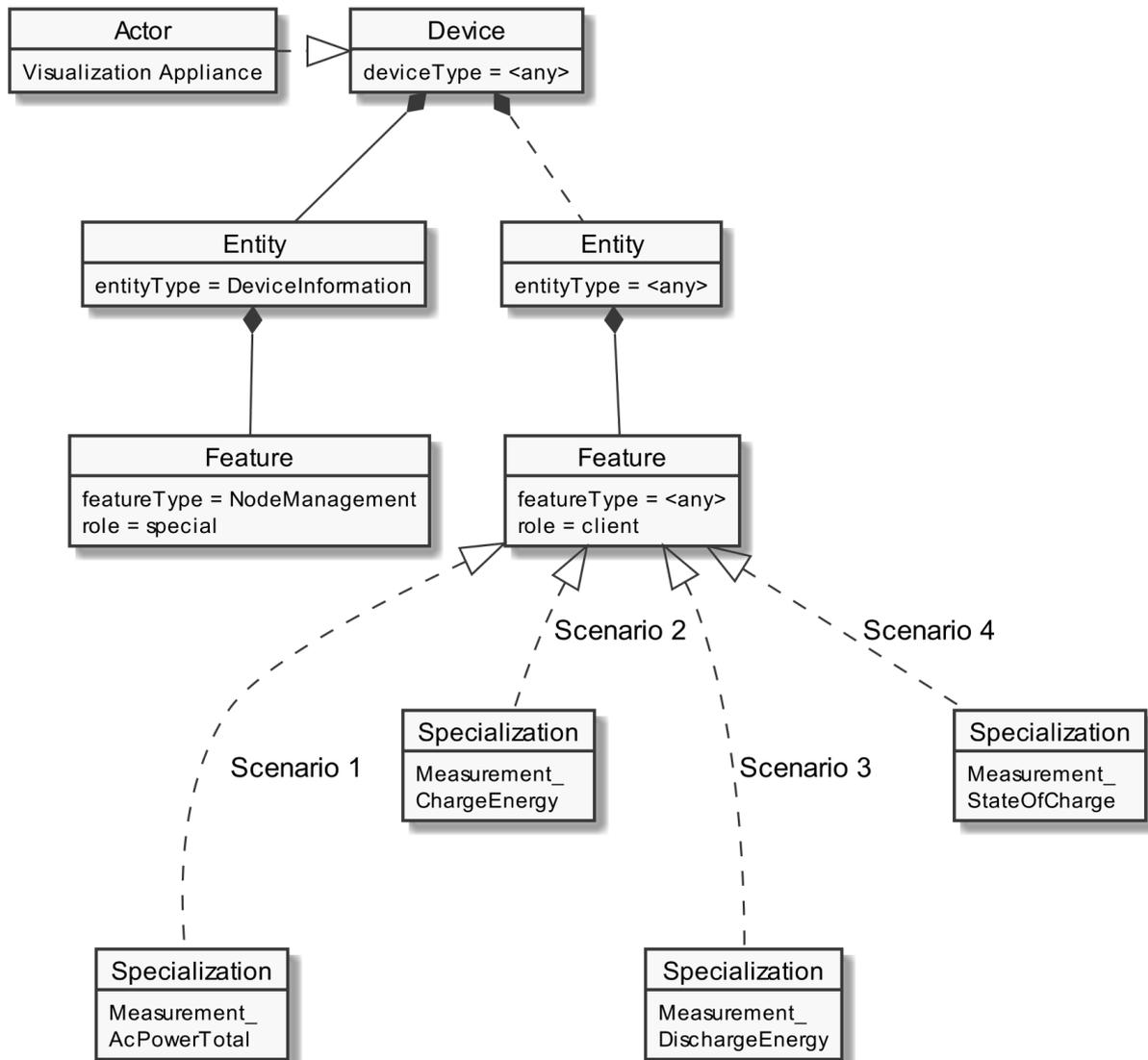
720 **3.2 Actors**

721 **3.2.1 Visualization Appliance**

722 **3.2.1.1 Resource hierarchy**

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

726 The following diagram provides an overview of the Actor Visualization Appliance's resource
727 hierarchy.



728

729 *Figure 4: Actor "Visualization Appliance" overview*

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

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

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

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

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

746

747 3.2.1.2 Server data - Resources

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

749

750 3.2.1.3 Client data - Specializations

751 3.2.1.3.1 Topic "Measurement"

752 3.2.1.3.1.1 Specialization "Measurement_AcPowerTotal"

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	"power"	
1: M	commodityType	"electricity"	
1: M	unit	"W"	
1: M	scopeType	"acPowerTotal"	
1: R	Measurement. measurementConstraintsListData. measurementConstraintsData.		
1: M	measurementId	<m1#(1..1)>	SHALL be set as PRIMARY IDENTIFIER.
1: R	valueRangeMin.		[VABD-005] SHOULD be used. See [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.		[VABD-005] SHOULD be used. See [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. See [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>	[VABD-001b] MAY be used. Only the newest measurement value SHALL be stated. Additional historical values are forbidden.
1: M	value.		[VABD-001a], [VABD-005] See [Measurement value rules]. See [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	"measuredValue"	
		"calculatedValue"	
		"empiricalValue"	
1: M	valueState		[Value state rules]
1: M	ElectricalConnection. electricalConnectionDescriptionListData. electricalConnectionDescriptionData.		
1: M	electricalConnectionId	<ec1#(1..1)>	SHALL be set as PRIMARY IDENTIFIER.
1: M	powerSupplyType	"ac"	
1: M	positiveEnergyDirection	"consume"	[VABD-005]
1: M	ElectricalConnection. electricalConnectionParameterDescriptionListData. electricalConnectionParameterDescriptionData.		
1: M	electricalConnectionId	<ec1#(1..1)>	SHALL be set as PRIMARY IDENTIFIER.
1: M	parameterId	<p1#(1..1)->ec1#1>	SHALL be set as SUB IDENTIFIER.
1: M	measurementId	<m1->p1#1>	SHALL be set as FOREIGN IDENTIFIER.
1: M	voltageType	"ac"	
1: M	acMeasurementType	"real"	

753 Table 6: Content of Specialization "Measurement_AcPowerTotal" at Actor Visualization Appliance

754

755 3.2.1.3.1.2 Spezialisierung "Measurement_ChargeEnergy"

Scenario [...]: M/R/O [W][C]	Element	Value	[High Level Mapping] Element and value rules
2: M	Measurement. measurementDescriptionListData. measurementDescriptionData.		
2: M	measurementId	<m2#(1..1)>	SHALL be set as PRIMARY IDENTIFIER.
2: M	measurementType	"energy"	
2: M	commodityType	"electricity"	
2: M	unit	"Wh"	
2: M	scopeType	"charge"	
2: O	Measurement. measurementConstraintsListData. measurementConstraintsData.		
2: M	measurementId	<m2#(1..1)>	SHALL be set as PRIMARY IDENTIFIER.
2: R	valueRangeMin.		[VABD-005] SHOULD be used. See [Scaled number rules].

2: M	valueRangeMin. number		SHALL be used.
2: M	valueRangeMin. scale		SHALL be interpreted. If absent, a default value of "0" applies.
2: R	valueRangeMax.		[VABD-005] SHOULD be used. See [Scaled number rules].
2: M	valueRangeMax. number		SHALL be used.
2: M	valueRangeMax. scale		SHALL be interpreted. If absent, a default value of "0" applies.
2: R	valueStepSize.		SHOULD be used. See [Scaled number rules].
2: M	valueStepSize. number		SHALL be used.
2: M	valueStepSize. scale		SHALL be interpreted. If absent, a default value of "0" applies.
2: M	Measurement. measurementListData. measurementData.		
2: M	measurementId	<m2#{1..1}>	SHALL be set as PRIMARY IDENTIFIER.
2: M	valueType	"value"	SHALL be set as SUB IDENTIFIER.
2: O	timestamp	<t#{1..1}->m2#1>	[VABD-002b] MAY be used. Only the newest measurement value SHALL be stated. Additional historical values are forbidden.
2: M	value.		[VABD-002a], [VABD-002c], [VABD-005] See [Measurement value rules]. See [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: R	valueSource	"measuredValue"	
		"calculatedValue"	
		"empiricalValue"	
2: M	valueState		[Value state rules]
2: M	ElectricalConnection. electricalConnectionDescriptionListData. electricalConnectionDescriptionData.		
2: M	electricalConnectionId	<ec1#{1..1}>	SHALL be set as PRIMARY IDENTIFIER.
2: M	powerSupplyType	"ac"	
2: M	positiveEnergyDirection	"consume"	[VABD-005]
2: M	ElectricalConnection. electricalConnectionParameterDescriptionListData. electricalConnectionParameterDescriptionData.		
2: M	electricalConnectionId	<ec1#{1..1}>	SHALL be set as PRIMARY IDENTIFIER.
2: M	parameterId	<p2#{1..1}->ec1#1>	SHALL be set as SUB IDENTIFIER.
2: M	measurementId	<m2->p2#1>	SHALL be set as FOREIGN IDENTIFIER.
2: M	voltageType	"ac"	
2: M	acMeasurementType	"real"	

756

Table 7: Content of Specialization "Measurement_ChargeEnergy" at Actor Visualization Appliance

757

758 3.2.1.3.1.3 Specialization "Measurement_DischargeEnergy"

Scenario [...]: M/R/O [\W][\C]	Element	Value	[High Level Mapping] Element and value rules
3: M	Measurement. measurementDescriptionListData. measurementDescriptionData.		
3: M	measurementId	<m3#(1..1)>	SHALL be set as PRIMARY IDENTIFIER.
3: M	measurementType	"energy"	
3: M	commodityType	"electricity"	
3: M	unit	"Wh"	
3: M	scopeType	"discharge"	
3: O	Measurement. measurementConstraintsListData. measurementConstraintsData.		
3: M	measurementId	<m3#(1..1)>	SHALL be set as PRIMARY IDENTIFIER.
3: R	valueRangeMin.		[VABD-005] SHOULD be used. See [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.		[VABD-005] SHOULD be used. See [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. See [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	<m3#(1..1)>	SHALL be set as PRIMARY IDENTIFIER.
3: M	valueType	"value"	SHALL be set as SUB IDENTIFIER.
3: O	timestamp	<t#(1..1)->m3#1>	[VABD-003b] MAY be used. Only the newest measurement value SHALL be stated. Additional historical values are forbidden.
3: M	value.		[VABD-003a], [VABD-003c], [VABD-005] See [Measurement value rules]. See [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]
3: M	ElectricalConnection. electricalConnectionDescriptionListData. electricalConnectionDescriptionData.		
3: M	electricalConnectionId	<ec1#(1..1)>	SHALL be set as PRIMARY IDENTIFIER.
3: M	powerSupplyType	"ac"	
3: M	positiveEnergyDirection	"consume"	[VABD-005]
3: M	ElectricalConnection. electricalConnectionParameterDescriptionListData. electricalConnectionParameterDescriptionData.		
3: M	electricalConnectionId	<ec1#(1..1)>	SHALL be set as PRIMARY IDENTIFIER.
3: M	parameterId	<p3#(1..1)->ec1#1>	SHALL be set as SUB IDENTIFIER.
3: M	measurementId	<m3->p3#1>	SHALL be set as FOREIGN IDENTIFIER.
3: M	voltageType	"ac"	
3: M	acMeasurementType	"real"	

759 Table 8: Content of Specialization "Measurement_DischargeEnergy" at Actor Visualization Appliance

760

761 3.2.1.3.1.4 Specialization "Measurement_StateOfCharge"

Scenario [...]: M/R/O [W][C]	Element	Value	[High Level Mapping] Element and value rules
4: M	Measurement. measurementDescriptionListData. measurementDescriptionData.		
4: M	measurementId	<m4#(1..1)>	SHALL be set as PRIMARY IDENTIFIER.
4: M	measurementType	"percentage"	
4: M	commodityType	"electricity"	
4: M	unit	"pct"	
4: M	scopeType	"stateOfCharge"	
4: R	Measurement. measurementConstraintsListData. measurementConstraintsData.		
4: M	measurementId	<m4#(1..1)>	SHALL be set as PRIMARY IDENTIFIER.
4: R	valueRangeMin.		SHOULD be used. See [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. See [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. See [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	<m4#(1..1)>	SHALL be set as PRIMARY IDENTIFIER.

4: M	valueType	"value"	SHALL be set as SUB IDENTIFIER.
4: O	timestamp	<t#{1..1}->m4#1>	[VABD-004b] MAY be used. Only the newest measurement value SHALL be stated. Additional historical values are forbidden.
4: M	value.		[VABD-004a] See [Measurement value rules]. See [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]

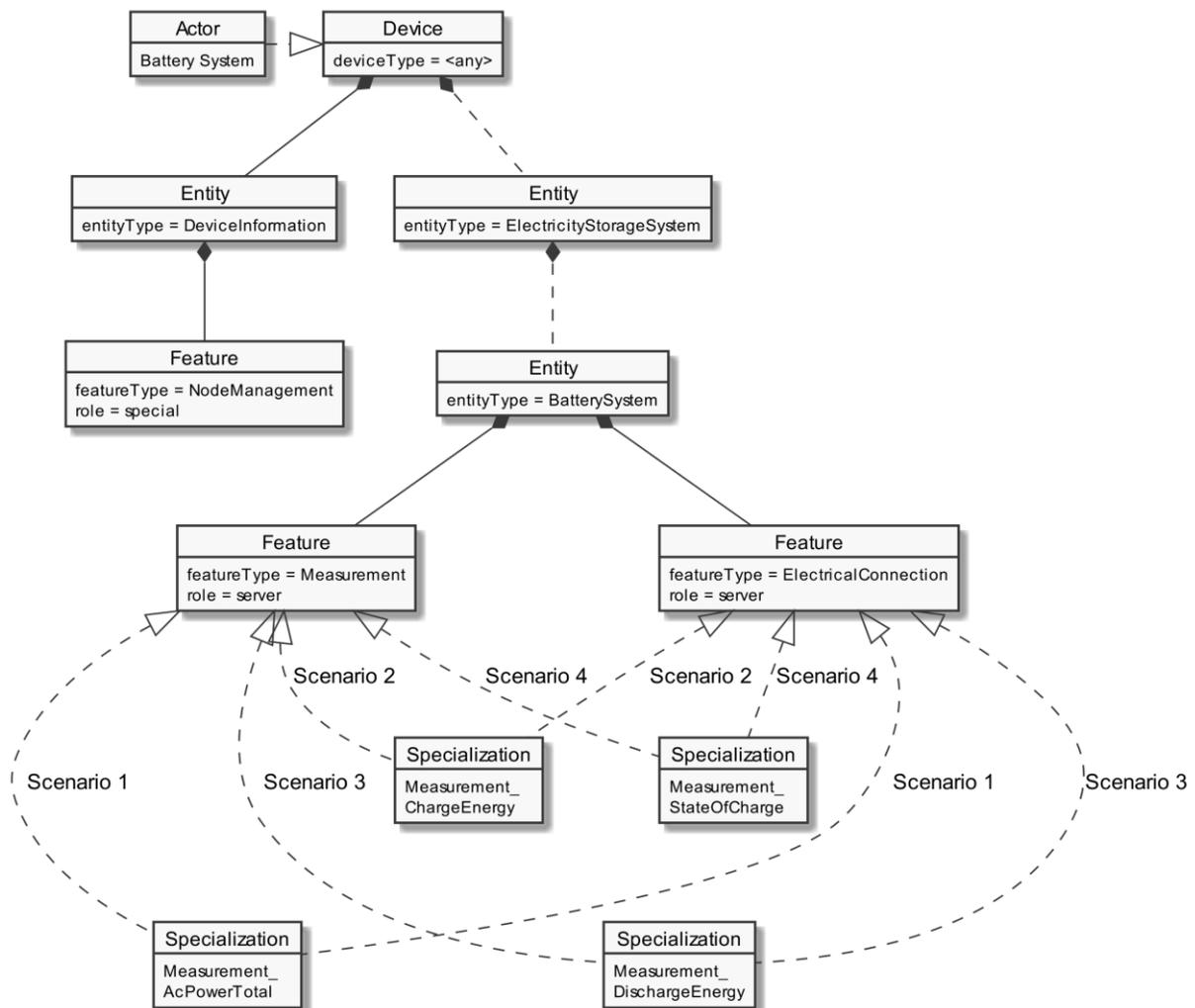
762 *Table 9: Content of Specialization "Measurement_StateOfCharge" at Actor Visualization Appliance*

763

764 **3.2.2 Battery System**765 **3.2.2.1 Resource hierarchy**

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

768 The following diagram provides an overview of the Actor Battery System's resource hierarchy.



769

770 *Figure 5: Actor "Battery System" overview*

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

774 The device type can be freely chosen, but it is recommended to use "ElectricitySupplySystem".

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

778 The Use Case specific data follows behind the entityType "BatterySystem". The Specializations
 779 represent the Scenario specific data that has to be supported for each Scenario and are realized
 780 through the corresponding featureTypes.

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

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

788

789 3.2.2.2 Server data - Resources

790 3.2.2.2.1 Overview

791 Behind the entityType "BatterySystem", the Actor Battery System SHALL offer the Feature Types and
 792 Functions given in the table below.

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

793 *Table 10: Feature Types and Functions used within this Use Case by the Actor Battery System*

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

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

798 The Scenario number shows in which Scenarios the Battery System acts as server and which Feature
 799 Types and Functions are relevant in each Scenario.

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

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

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

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

810

811 3.2.2.2.2 Feature Type "Measurement"

812 3.2.2.2.2.1 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	"power"	
1: M	commodityType	"electricity"	
1: M	unit	"W"	
1: M	scopeType	"acPowerTotal"	
2: M	Measurement. measurementDescriptionListData.	measurementDescriptionData.	
2: M	measurementId	<m2#{1..1}>	SHALL be set as PRIMARY IDENTIFIER.
2: M	measurementType	"energy"	
2: M	commodityType	"electricity"	
2: M	unit	"Wh"	
2: M	scopeType	"charge"	
3: M	Measurement. measurementDescriptionListData.	measurementDescriptionData.	
3: M	measurementId	<m3#{1..1}>	SHALL be set as PRIMARY IDENTIFIER.
3: M	measurementType	"energy"	
3: M	commodityType	"electricity"	
3: M	unit	"Wh"	
3: M	scopeType	"discharge"	
4: M	Measurement. measurementDescriptionListData.	measurementDescriptionData.	
4: M	measurementId	<m4#{1..1}>	SHALL be set as PRIMARY IDENTIFIER.
4: M	measurementType	"percentage"	
4: M	commodityType	"electricity"	
4: M	unit	"pct"	
4: M	scopeType	"stateOfCharge"	

813 Table 11: Content of function "measurementDescriptionListData" at Actor Battery System

814

815 3.2.2.2.2 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.		[VABD-005] SHOULD be used. See [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.		[VABD-005] SHOULD be used. See [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. See [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.
2: O	Measurement. measurementConstraintsListData. measurementConstraintsData.		
2: M	measurementId	<m2#(1..1)>	SHALL be set as PRIMARY IDENTIFIER.
2: R	valueRangeMin.		[VABD-005] SHOULD be used. See [Scaled number rules].
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.		[VABD-005] SHOULD be used. See [Scaled number rules].
2: M	valueRangeMax. number		SHALL be used.
2: O	valueRangeMax. scale		MAY be used. If absent, a default value of "0" applies.
2: R	valueStepSize.		SHOULD be used. See [Scaled number rules].
2: M	valueStepSize. number		SHALL be used.
2: O	valueStepSize. scale		MAY be used. If absent, a default value of "0" applies.

3: O	Measurement. measurementConstraintsListData. measurementConstraintsData.		
3: M	measurementId	<m3#(1..1)>	SHALL be set as PRIMARY IDENTIFIER.
3: R	valueRangeMin.		[VABD-005] SHOULD be used. See [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.		[VABD-005] SHOULD be used. See [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. See [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	<m4#(1..1)>	SHALL be set as PRIMARY IDENTIFIER.
4: R	valueRangeMin.		SHOULD be used. See [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. See [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. See [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.

816 Table 12: Content of function "measurementConstraintsListData" at Actor Battery System

817

818 3.2.2.2.3 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>	[VABD-001b] MAY be used. Only the newest measurement value SHALL be stated. Additional historical values are forbidden.
1: M	value.		[VABD-001a], [VABD-005] See [Measurement value rules]. See [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	"measuredValue"	
		"calculatedValue"	
		"empiricalValue"	
1: R	valueState		[Value state rules]
2: M	Measurement. measurementListData. measurementData.		
2: M	measurementId	<m2#(1..1)>	SHALL be set as PRIMARY IDENTIFIER.
2: M	valueType	"value"	SHALL be set as SUB IDENTIFIER.
2: O	timestamp	<t#(1..1)->m2#1>	[VABD-002b] MAY be used. Only the newest measurement value SHALL be stated. Additional historical values are forbidden.
2: M	value.		[VABD-002a], [VABD-002c], [VABD-005] See [Measurement value rules]. See [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	valueSource	"measuredValue"	
		"calculatedValue"	
		"empiricalValue"	
2: R	valueState		[Value state rules]
3: M	Measurement. measurementListData. measurementData.		
3: M	measurementId	<m3#(1..1)>	SHALL be set as PRIMARY IDENTIFIER.
3: M	valueType	"value"	SHALL be set as SUB IDENTIFIER.
3: O	timestamp	<t#(1..1)->m3#1>	[VABD-003b] MAY be used. Only the newest measurement value SHALL be stated. Additional historical values are forbidden.
3: M	value.		[VABD-003a], [VABD-003c], [VABD-005] See [Measurement value rules]. See [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	<m4#(1..1)>	SHALL be set as PRIMARY IDENTIFIER.
4: M	valueType	"value"	SHALL be set as SUB IDENTIFIER.
4: O	timestamp	<t#(1..1)->m1#1>	[VABD-004b] MAY be used. Only the newest measurement value SHALL be stated. Additional historical values are forbidden.
4: M	value.		[VABD-004a] See [Measurement value rules]. See [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]

819 Table 13: Content of function "measurementListData" at Actor Battery System

820

821 3.2.2.2.3 FeatureType "ElectricalConnection"

822 3.2.2.2.3.1 Function "electricalConnectionDescriptionListData"

Scenario [...]: M/R/O [\W][\C]	Element	Value	[High Level Mapping] Element and value rules
1: M 2: M 3: M	ElectricalConnection. electricalConnectionDescriptionListData. electricalConnectionDescriptionData.		
1: M 2: M 3: M	electricalConnectionId	<ec1#(1..1)>	SHALL be set as PRIMARY IDENTIFIER.
1: M 2: M 3: M	powerSupplyType	"ac"	
1: M 2: M 3: M	positiveEnergyDirection	"consume"	[VABD-005]

823 Table 14: Content of function "electricalConnectionDescriptionListData" at Actor Battery System

824

825 3.2.2.2.3.2 Function "electricalConnectionParameterDescriptionListData"

Scenario [...]: M/R/O [\W][\C]	Element	Value	[High Level Mapping] Element and value rules
1: M	ElectricalConnection. electricalConnectionParameterDescriptionListData. electricalConnectionParameterDescriptionData.		
1: M	electricalConnectionId	<ec1#{1..1}>	SHALL be set as PRIMARY IDENTIFIER.
1: M	parameterId	<p1#{1..1}->ec1#1>	SHALL be set as SUB IDENTIFIER.
1: M	measurementId	<m1->p1#1>	SHALL be set as FOREIGN IDENTIFIER.
1: M	voltageType	"ac"	
1: M	acMeasurementType	"real"	
2: M	ElectricalConnection. electricalConnectionParameterDescriptionListData. electricalConnectionParameterDescriptionData.		
2: M	electricalConnectionId	<ec1#{1..1}>	SHALL be set as PRIMARY IDENTIFIER.
2: M	parameterId	<p2#{1..1}->ec1#1>	SHALL be set as SUB IDENTIFIER.
2: M	measurementId	<m2->p2#1>	SHALL be set as FOREIGN IDENTIFIER.
2: M	voltageType	"ac"	
2: M	acMeasurementType	"real"	
3: M	ElectricalConnection. electricalConnectionParameterDescriptionListData. electricalConnectionParameterDescriptionData.		
3: M	electricalConnectionId	<ec1#{1..1}>	SHALL be set as PRIMARY IDENTIFIER.
3: M	parameterId	<p3#{1..1}->ec1#1>	SHALL be set as SUB IDENTIFIER.
3: M	measurementId	<m3->p3#1>	SHALL be set as FOREIGN IDENTIFIER.
3: M	voltageType	"ac"	
3: M	acMeasurementType	"real"	

826 Table 15: Content of function "electricalConnectionParameterDescriptionListData" at Actor Battery System

827

828 **3.3 Pre-Scenario communication**829 **3.3.1 General information**

830 The Pre-Scenario communication is needed if a client does not know the corresponding addresses on
831 the server or if the required subscriptions or bindings are not active. In this case certain general
832 communication mechanisms SHALL be used within SPINE:

- 833 a) Detailed discovery: allows to discover resource addresses.
834 b) Binding: allows to bind to resource address, which is frequently necessary to obtain write
835 privileges.

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

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

- 839 - E.g. if multiple Scenarios in multiple Use Cases use the same Feature, only one subscription
840 needs to occur.
- 841 - E.g. a complete detailed discovery or a subscription to the NodeManagement Feature needs
842 to occur only once for all Use Cases.

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

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

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

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

861

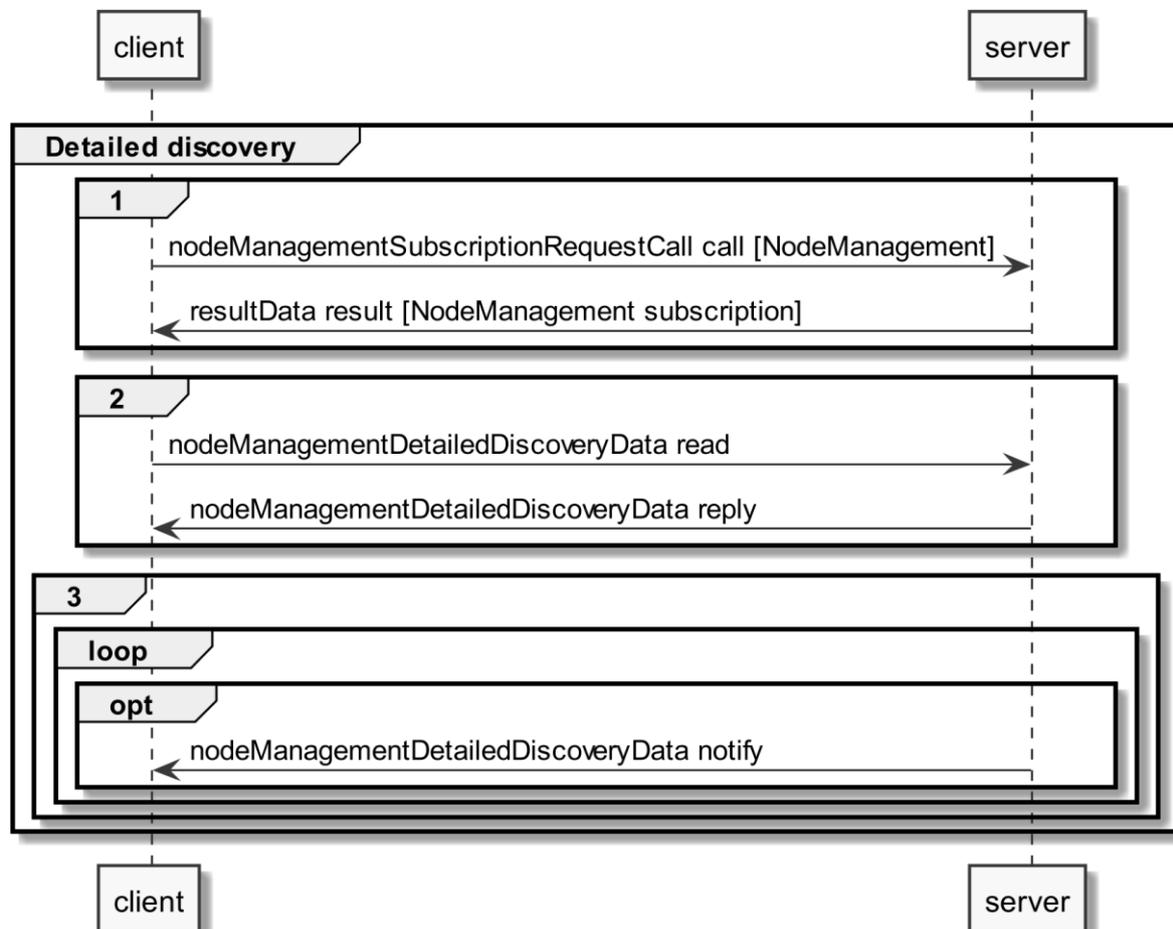
862 3.3.2 Detailed discovery

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

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

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

- 874 3. If and as long as a client has a subscription to the detailed discovery information of an Actor
 875 and receives proper notifications, it SHALL consider (i.e. integrate into the kept detailed
 876 discovery information) the received information as far as it concerns mandatory and
 877 supported optional Entity Types, Feature Types and Functions of this Use Case.



878

879 *Figure 6: Pre-Scenario communication - Detailed discovery sequence diagram*

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

883 If all functionality is present at all times: The "nodeManagementDetailedDiscoveryData reply"
 884 message contains at least the mandatory Entities and Features given in the "Actor [...] overview"
 885 diagrams as well as the used Functions and their "possible operations" described in section 3.2 and
 886 its sub-sections.

887 If functionality is added or removed dynamically: The "nodeManagementDetailedDiscoveryData
 888 reply" message does not need to contain all mandatory Entities and Features given in the "Actor [...]
 889 overview" diagrams as well as all needed Functions and their "possible operations" described in
 890 section 3.2 and its sub-sections. However, as soon as the functionality is available it will be
 891 announced via a "nodeManagementDetailedDiscoveryData notify" message.

892 For the nodeManagementDetailedDiscoveryData read Function it is recommended to use a partial
 893 read with separated Selectors that may use one of the following Elements:

- 894 - entityType
- 895 - featureType

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

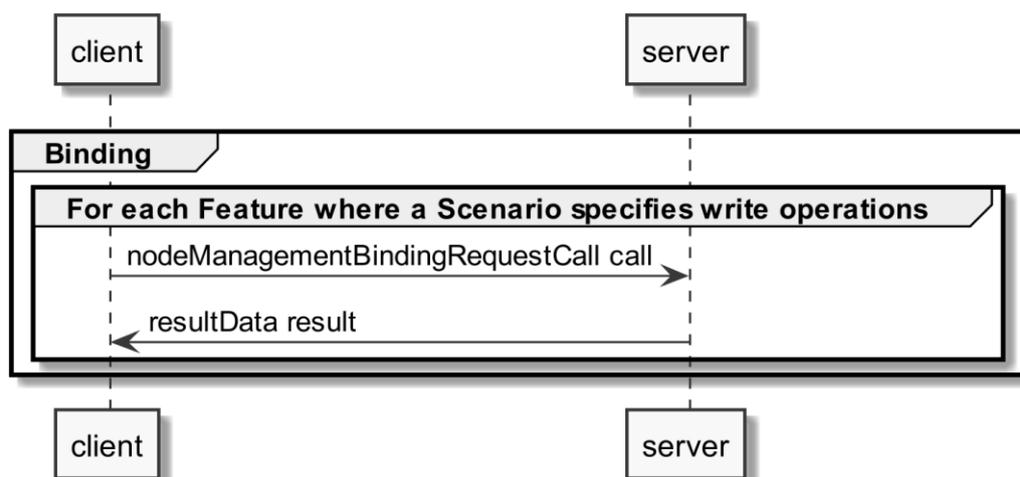
899 A "partial" notify SHALL be supported without using Selectors and Elements. Partial "delete" notify
 900 SHOULD also be supported with separated Selectors that may use one of the following Elements:

- 901 - entityAddress
- 902 - featureAddress

903

904 3.3.3 Binding

905 A server SHALL support binding for all Features that contain writeable or changeable data. Before a
 906 write on a Function of a Feature occurs, the client SHALL create a binding to the corresponding
 907 Feature. For this the nodeManagementBindingRequestCall Function is used as shown in the following
 908 sequence diagram:



909

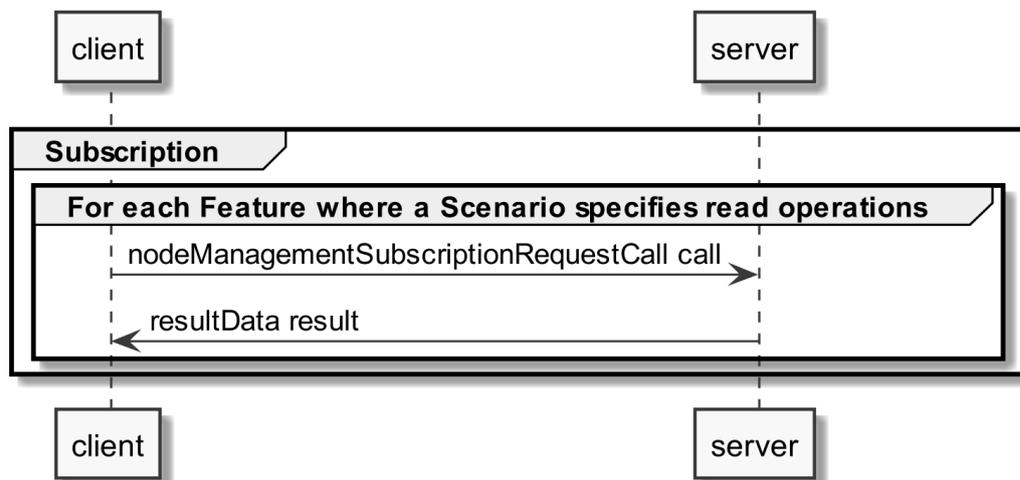
910 *Figure 7: Pre-Scenario communication - Binding sequence diagram*

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

914

915 3.3.4 Subscription

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



920

921 *Figure 8: Pre-Scenario communication - Subscription sequence diagram*

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

925 If functionality is added or removed dynamically, subscription may not be possible at all times on the
 926 required Functions. A client SHALL retry its subscription procedure again when receiving according
 927 updated detailed discovery information.

928

929 3.3.5 Dynamic behaviour

930 In case Entities or Features are removed, a nodeManagementDetailedDiscoveryData "notify" is
 931 transmitted that informs about the deleted Entities and Features. All existing binding or subscription
 932 entries on the deleted Features SHALL be deleted by each device.

933 In case Entities or Features are added the Pre-Scenario communication starts with transmitting a
 934 nodeManagementDetailedDiscoveryData "notify" that contains the added Entities and Features.

935

936 3.4 Scenarios

937 3.4.1 Scenario 1 - Monitor current Battery System (dis)charge power

938 3.4.1.1 Pre-Scenario communication

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

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

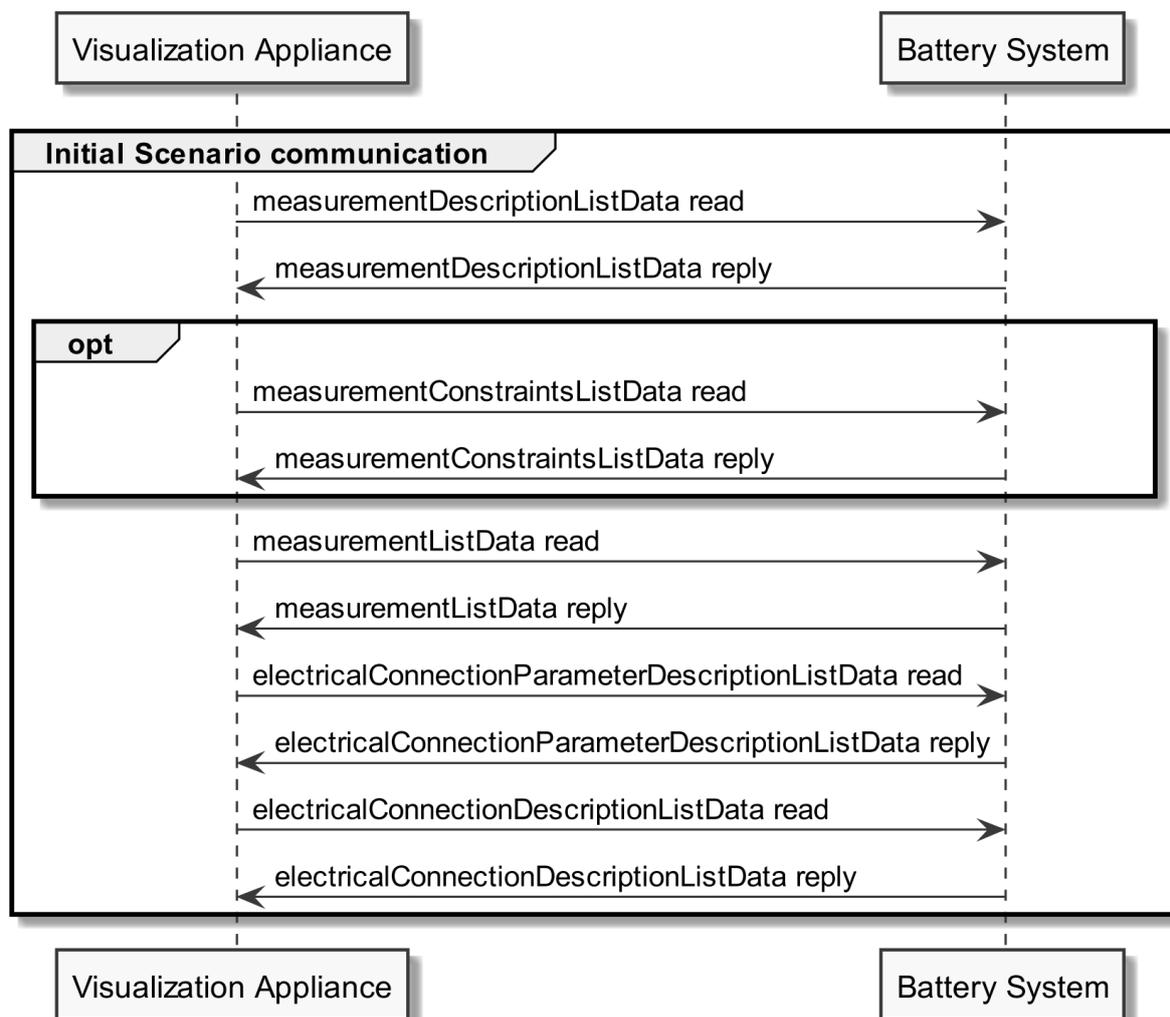
948 soon as the address of a required resource is known, the Initial Scenario communication for this
 949 resource MAY start already, even if the addresses of other required resources are not known yet.

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

952

953 **3.4.1.2 Initial Scenario communication**

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



957

958 *Figure 9: Scenario 1 - Initial Scenario communication sequence diagram*

959 Note: The initiation of the optional sequence part (marked with "opt" in the figure) is optional for the
 960 "Visualization Appliance" even if the "Battery System" can provide the requested Function.

961 The measurementDescriptionListData read SHOULD be a "partial" read operation with the following
 962 Selectors:

- 963 - scopeType = "acPowerTotal"

964 The measurementConstraintsListData read, measurementListData read and
 965 electricalConnectionParameterDescriptionListData read SHOULD be "partial" read operations with
 966 the following Selectors:

967 - measurementId (derived from the measurementDescriptionListData reply)

968 The electricalConnectionDescriptionListData read SHOULD be a "partial" read operation with the
 969 following Selectors:

970 - electricalConnectionId (derived from the electricalConnectionParameterDescriptionListData
 971 reply)

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

973

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

Message name from sequence diagram	Content description in table	Scenario number in table
measurementDescriptionListData reply	Table 11	1
measurementConstraintsListData reply	Table 12	1
measurementListData reply	Table 13	1
electricalConnectionDescriptionListData reply	Table 14	1
electricalConnectionParameterDescriptionListData reply	Table 15	1

976 *Table 16: Initial Scenario communication content references for Scenario 1*

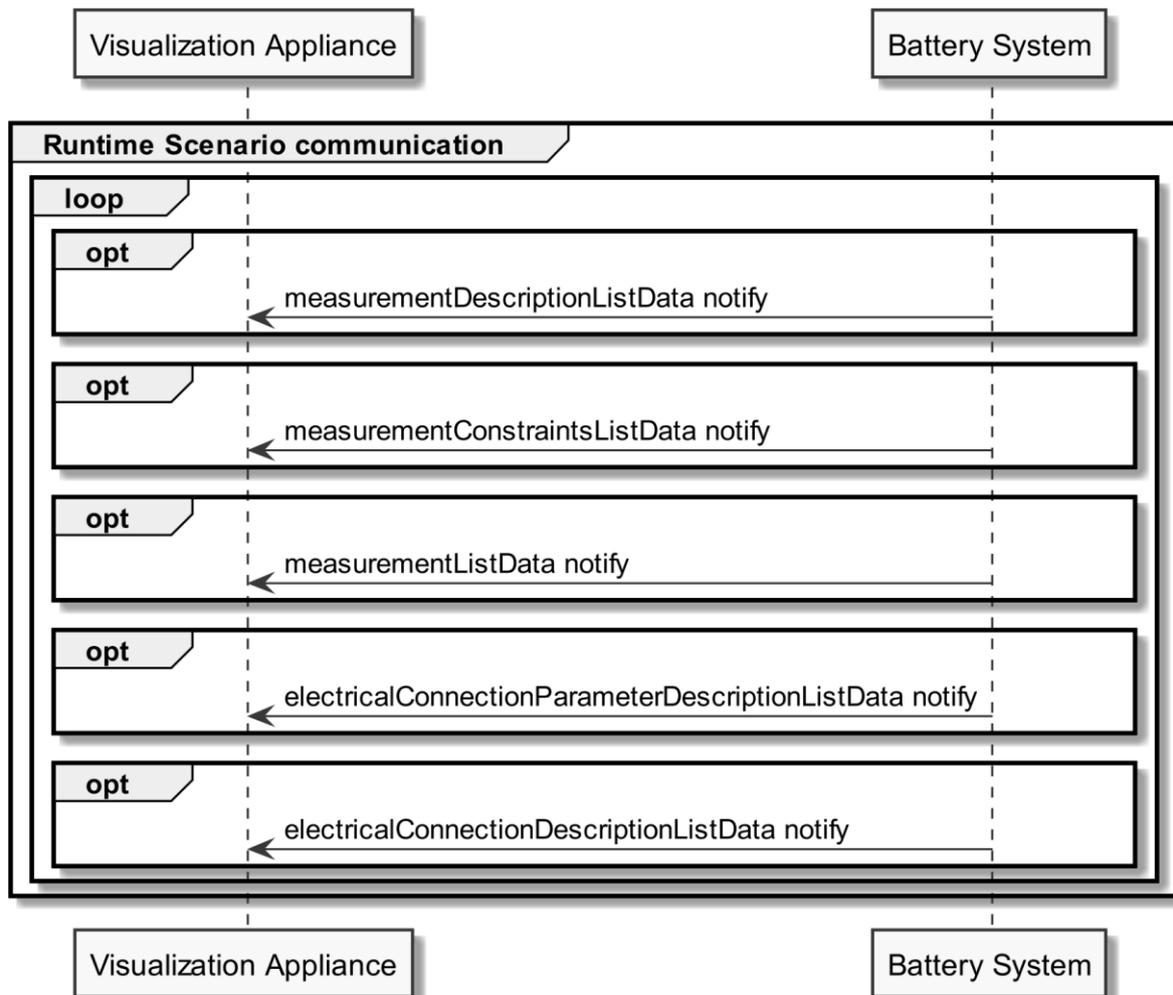
977 Note: Within the Initial Scenario communication, the content required by this Scenario MAY not be
 978 provided completely, but later during Runtime Scenario communication.

979

980 **3.4.1.3 Runtime Scenario communication**

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

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



985

986 *Figure 10: Scenario 1 - Runtime Scenario communication sequence diagram*

987 Note: Normally, in this Scenario only the "measurementListData" Function changes during runtime.
 988 Hence, usually no notifications of the other Functions of this Scenario are sent during runtime.

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

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

- 993 - measurementId

994 For electricalConnectionParameterDescriptionListData notify "partial" delete notifications SHOULD
 995 be supported with the Selectors:

- 996 - electricalConnectionId
- 997 - parameterId
- 998 - measurementId

999 Note: To interpret partial notification messages correctly the information obtained during the Initial
 1000 Scenario communication phase is required.

1001 Note: A read operation ("polling") on all Functions is possible at any time, e.g. if a notification could
1002 not be evaluated.

1003

1004 The following table shows where the required content of the messages of the sequence diagram is
1005 described:

Message name from sequence diagram	Content description in table	Scenario number in table
measurementDescriptionListData notify	Table 11	1
measurementConstraintsListData notify	Table 12	1
measurementListData notify	Table 13	1
electricalConnectionDescriptionListData notify	Table 14	1
electricalConnectionParameterDescriptionListData notify	Table 15	1

1006 *Table 17: Runtime Scenario communication content references for Scenario 1*

1007

1008 **3.4.1.4 Additional information**

1009 Note: In this Scenario solution, the "load convention" (i.e. "passive sign convention") is applied. This
1010 means power and energy values are expressed with positive values in case of energy consumption
1011 (i.e. charging) whereas negative values are used in case of energy production (i.e. discharging)
1012 [VABD-005].

1013 Note: Within this Scenario, only the latest measurement value SHALL be stated ([VABD-001b]).
1014 Additional historical values are forbidden.

1015

1016 **3.4.2 Scenario 2 - Monitor cumulated Battery System charge energy**

1017 **3.4.2.1 Pre-Scenario communication**

- 1018 1. **Detailed discovery:** Actors that act as client within this Scenario, need to know the addresses
1019 of the server Features used in the Initial Scenario communication. If the address of a
1020 particular server Feature is not known, the detailed discovery must be used, as described in
1021 section 3.3.2.
- 1022 2. **Binding:** Binding SHOULD NOT be used for this Scenario.
- 1023 3. **Subscription:** Actors SHALL create a subscription for each server Feature that is relevant for
1024 the corresponding Actor within this Scenario, as described in section 3.3.4.

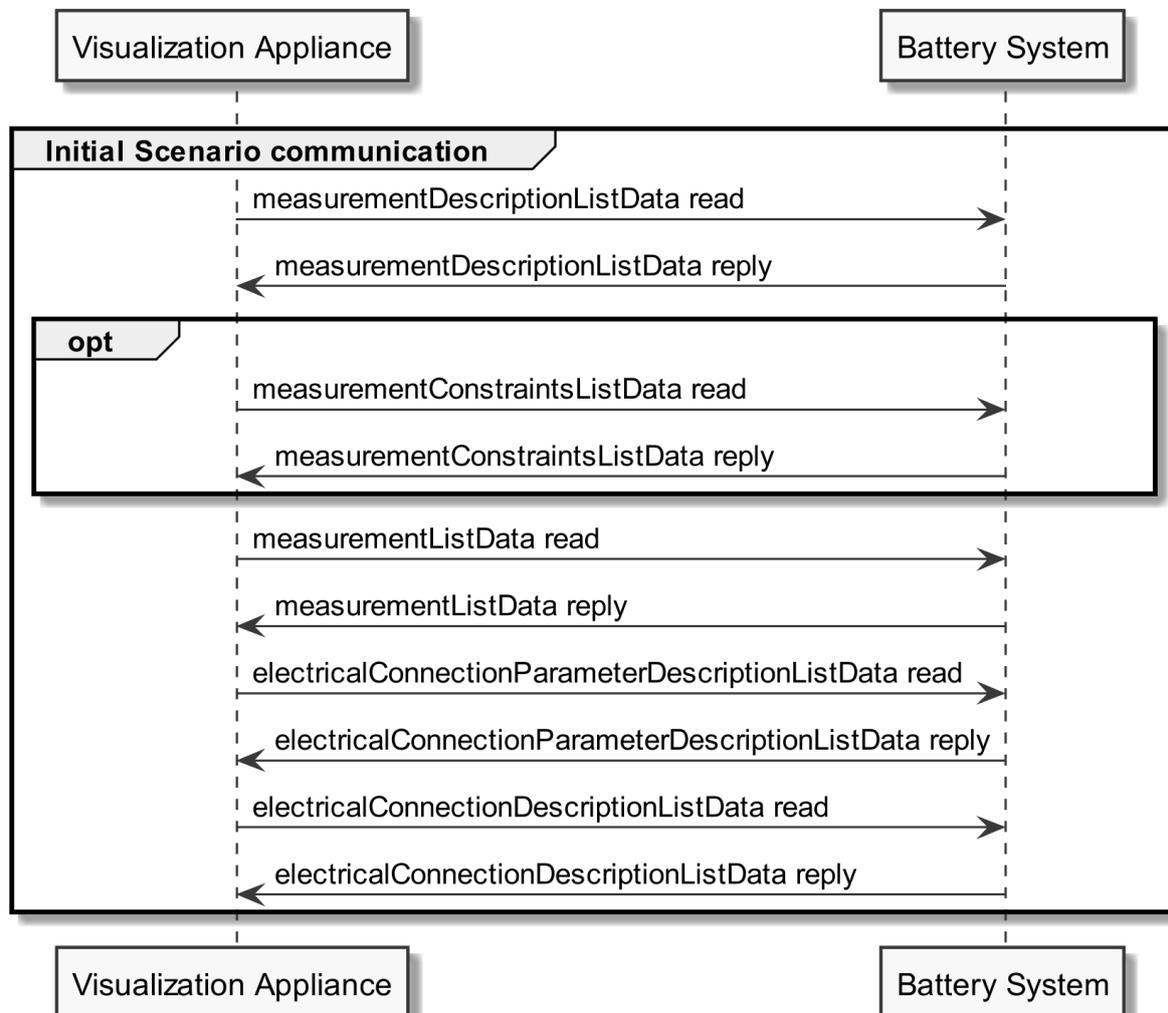
1025 The Initial Scenario communication SHALL start at the latest when the required resources on an Actor
1026 are known and the necessary binding and subscription procedures have been finished. However, as
1027 soon as the address of a required resource is known, the Initial Scenario communication for this
1028 resource MAY start already, even if the addresses of other required resources are not known yet.

1029 If required resources are removed and added again, they are re-discovered, and the Initial Scenario
1030 communication is triggered again for those resources.

1031

1032 **3.4.2.2 Initial Scenario communication**

1033 Each time a (re-)connection is established, even if the Pre-Scenario communication phase is skipped,
 1034 the messages shown in the following sequence diagram SHALL be exchanged, as the corresponding
 1035 resources may have changed in the meantime:



1036

1037 *Figure 11: Scenario 2 - Initial Scenario communication sequence diagram*

1038 Note: The initiation of the optional sequence part (marked with "opt" in the figure) is optional for the
 1039 "Visualization Appliance" even if the "Battery System" can provide the requested Function.

1040 The `measurementDescriptionListData read` SHOULD be a "partial" read operation with the following
 1041 Selectors:

- 1042 - `scopeType = "charge"`

1043 The `measurementConstraintsListData read`, `measurementListData read` and
 1044 `electricalConnectionParameterDescriptionListData read` SHOULD be "partial" read operations with
 1045 the following Selectors:

- 1046 - `measurementId` (derived from the `measurementDescriptionListData reply`)

1047 The electricalConnectionDescriptionListData read SHOULD be a "partial" read operation with the
1048 following Selectors:

- 1049 - electricalConnectionId (derived from the electricalConnectionParameterDescriptionListData
1050 reply)

1051 Note: If partial read is not supported a full read SHALL be performed.

1052

1053 The following table shows where the required content of the messages from the sequence diagram is
1054 described:

Message name from sequence diagram	Content description in table	Scenario number in table
measurementDescriptionListData reply	Table 11	2
measurementConstraintsListData reply	Table 12	2
measurementListData reply	Table 13	2
electricalConnectionDescriptionListData reply	Table 14	2
electricalConnectionParameterDescriptionListData reply	Table 15	2

1055 *Table 18: Initial Scenario communication content references for Scenario 2*

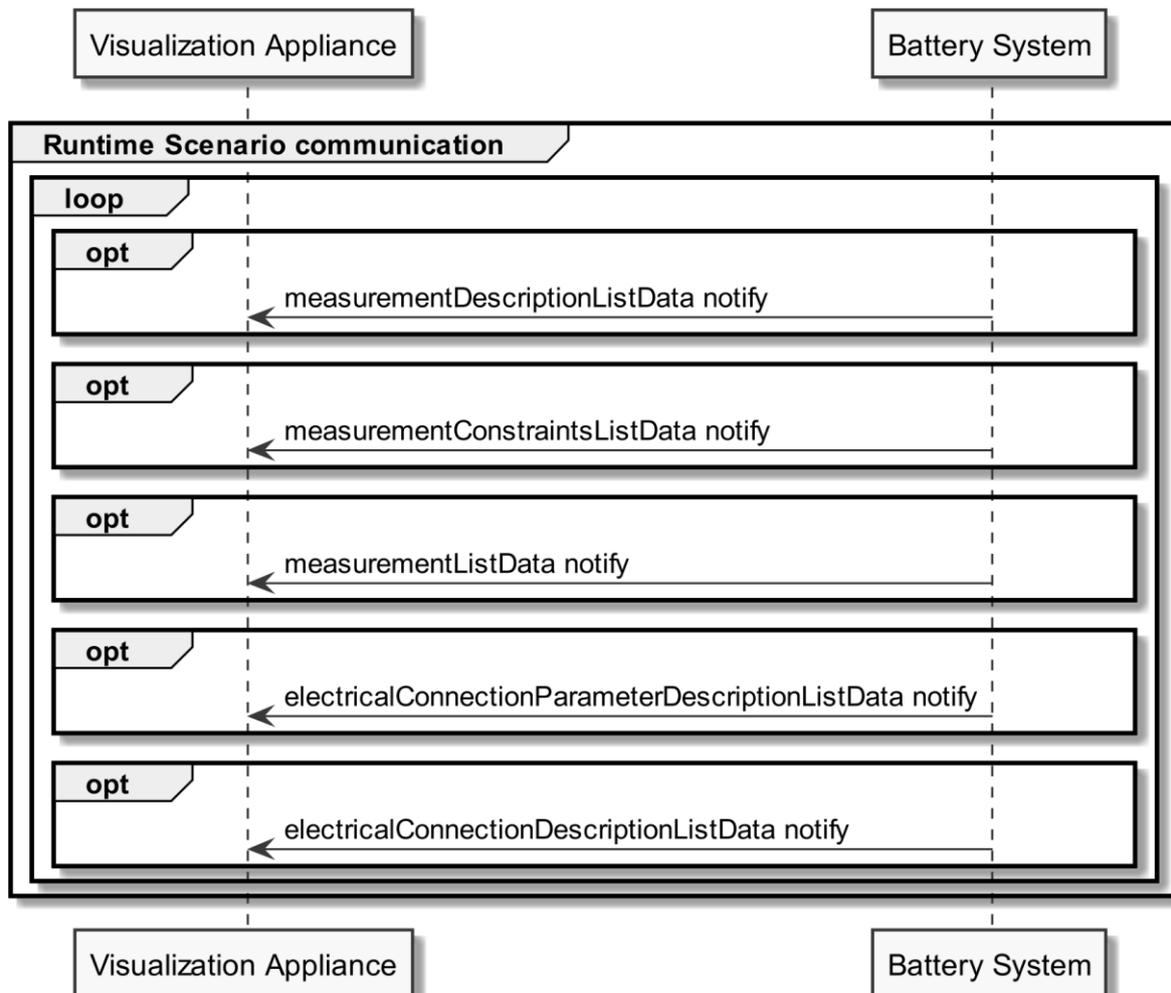
1056 Note: Within the Initial Scenario communication, the content required by this Scenario MAY not be
1057 provided completely, but later during Runtime Scenario communication.

1058

1059 **3.4.2.3 Runtime Scenario communication**

1060 Based on the Initial Scenario communication, the Runtime Scenario communication provides updates
1061 during runtime.

1062 If one of the referenced server Functions' data change, the server SHALL submit the change as shown
1063 in the following figure:



1064

1065 *Figure 12: Scenario 2 - Runtime Scenario communication sequence diagram*

1066 Note: Normally, in this Scenario only the "measurementListData" Function changes during runtime.
 1067 Hence, usually no notifications of the other Functions of this Scenario are sent during runtime.

1068 Partial notifications without Selectors or Elements SHALL be supported for all Functions used in this
 1069 Scenario.

1070 For measurementDescriptionListData notify, measurementConstraintsListData notify and
 1071 measurementListData notify "partial" delete notifications SHOULD be supported with the Selector:

1072 - measurementId

1073 For electricalConnectionParameterDescriptionListData notify "partial" delete notifications SHOULD
 1074 be supported with the Selectors:

1075 - electricalConnectionId

1076 - parameterId

1077 - measurementId

1078 Note: To interpret partial notification messages correctly the information obtained during the Initial
 1079 Scenario communication phase is required.

1080 Note: A read operation ("polling") on all Functions is possible at any time, e.g. if a notification could
1081 not be evaluated.

1082

1083 The following table shows where the required content of the messages of the sequence diagram is
1084 described:

Message name from sequence diagram	Content description in table	Scenario number in table
measurementDescriptionListData notify	Table 11	2
measurementConstraintsListData notify	Table 12	2
measurementListData notify	Table 13	2
electricalConnectionDescriptionListData notify	Table 14	2
electricalConnectionParameterDescriptionListData notify	Table 15	2

1085 *Table 19: Runtime Scenario communication content references for Scenario 2*

1086

1087 **3.4.2.4 Additional information**

1088 Note: In this Scenario solution, the "load convention" (i.e. "passive sign convention") is applied. This
1089 means power and energy values are expressed with positive values in case of energy consumption
1090 (i.e. charging) whereas negative values are used in case of energy production (i.e. discharging)
1091 [VABD-005].

1092 Note: Within this Scenario, only the latest measurement value SHALL be stated ([VABD-002b]).
1093 Additional historical values are forbidden.

1094

1095 **3.4.3 Scenario 3 - Monitor cumulated Battery System discharge energy**

1096 **3.4.3.1 Pre-Scenario communication**

- 1097 1. **Detailed discovery:** Actors that act as client within this Scenario, need to know the addresses
1098 of the server Features used in the Initial Scenario communication. If the address of a
1099 particular server Feature is not known, the detailed discovery must be used, as described in
1100 section 3.3.2.
- 1101 2. **Binding:** Binding SHOULD NOT be used for this Scenario.
- 1102 3. **Subscription:** Actors SHALL create a subscription for each server Feature that is relevant for
1103 the corresponding Actor within this Scenario, as described in section 3.3.4.

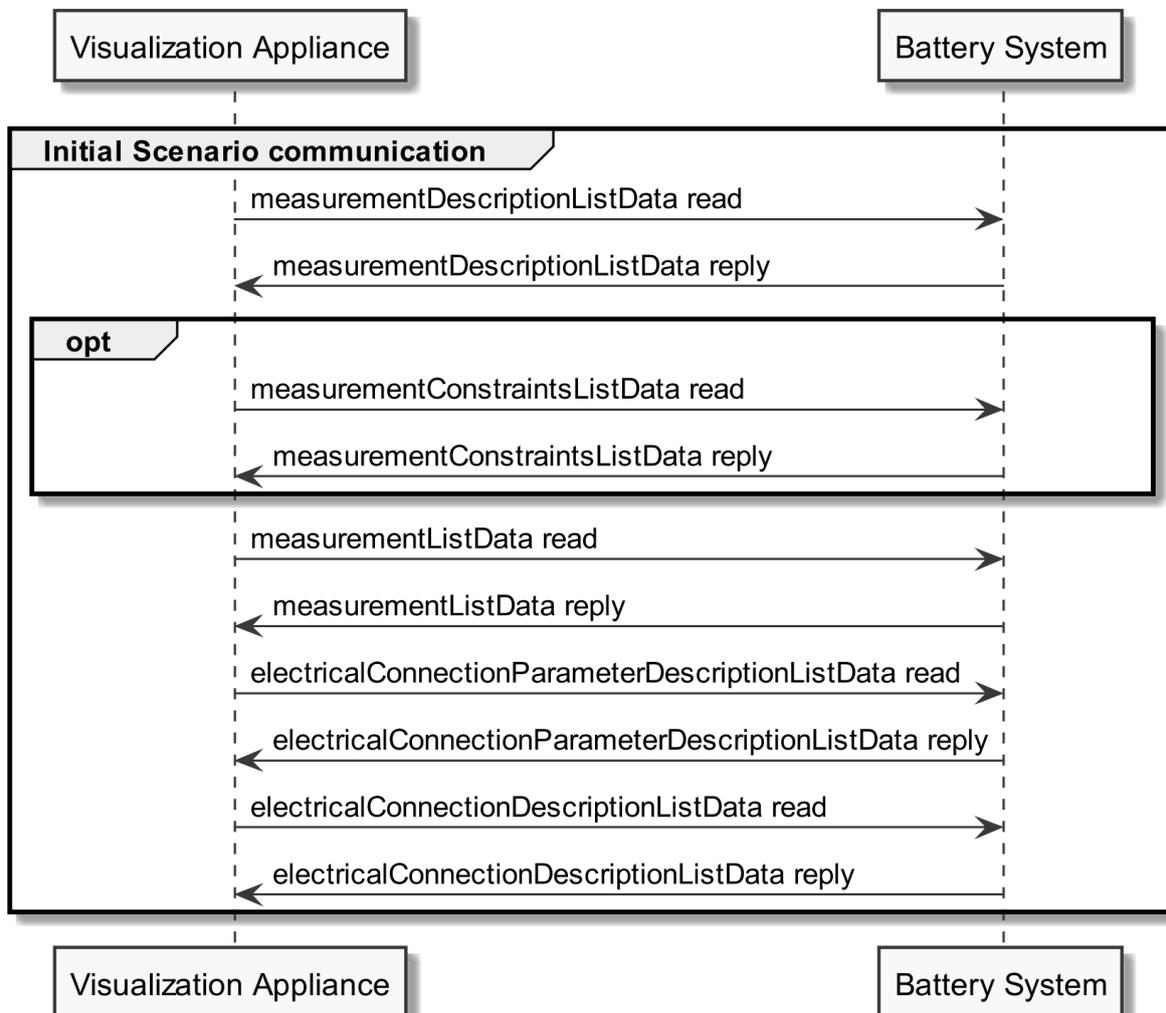
1104 The Initial Scenario communication SHALL start at the latest when the required resources on an Actor
1105 are known and the necessary binding and subscription procedures have been finished. However, as
1106 soon as the address of a required resource is known, the Initial Scenario communication for this
1107 resource MAY start already, even if the addresses of other required resources are not known yet.

1108 If required resources are removed and added again, they are re-discovered, and the Initial Scenario
1109 communication is triggered again for those resources.

1110

1111 **3.4.3.2 Initial Scenario communication**

1112 Each time a (re-)connection is established, even if the Pre-Scenario communication phase is skipped,
 1113 the messages shown in the following sequence diagram SHALL be exchanged, as the corresponding
 1114 resources may have changed in the meantime:



1115

1116 *Figure 13: Scenario 3 - Initial Scenario communication sequence diagram*

1117 Note: The initiation of the optional sequence part (marked with "opt" in the figure) is optional for the
 1118 "Visualization Appliance" even if the "Battery System" can provide the requested Function.

1119 The `measurementDescriptionListData read` SHOULD be a "partial" read operation with the following
 1120 Selectors:

- 1121 - `scopeType = "discharge"`

1122 The `measurementConstraintsListData read`, `measurementListData read` and
 1123 `electricalConnectionParameterDescriptionListData read` SHOULD be a "partial" read operation with
 1124 the following Selectors:

- 1125 - `measurementId` (derived from the `measurementDescriptionListData reply`)

1126 The electricalConnectionDescriptionListData read SHOULD be "partial" read operations with the
1127 following Selectors:

- 1128 - electricalConnectionId (derived from the electricalConnectionParameterDescriptionListData
1129 reply)

1130 Note: If partial read is not supported a full read SHALL be performed.

1131

1132 The following table shows where the required content of the messages from the sequence diagram is
1133 described:

Message name from sequence diagram	Content description in table	Scenario number in table
measurementDescriptionListData reply	Table 11	3
measurementConstraintsListData reply	Table 12	3
measurementListData reply	Table 13	3
electricalConnectionDescriptionListData reply	Table 14	3
electricalConnectionParameterDescriptionListData reply	Table 15	3

1134 *Table 20: Initial Scenario communication content references for Scenario 3*

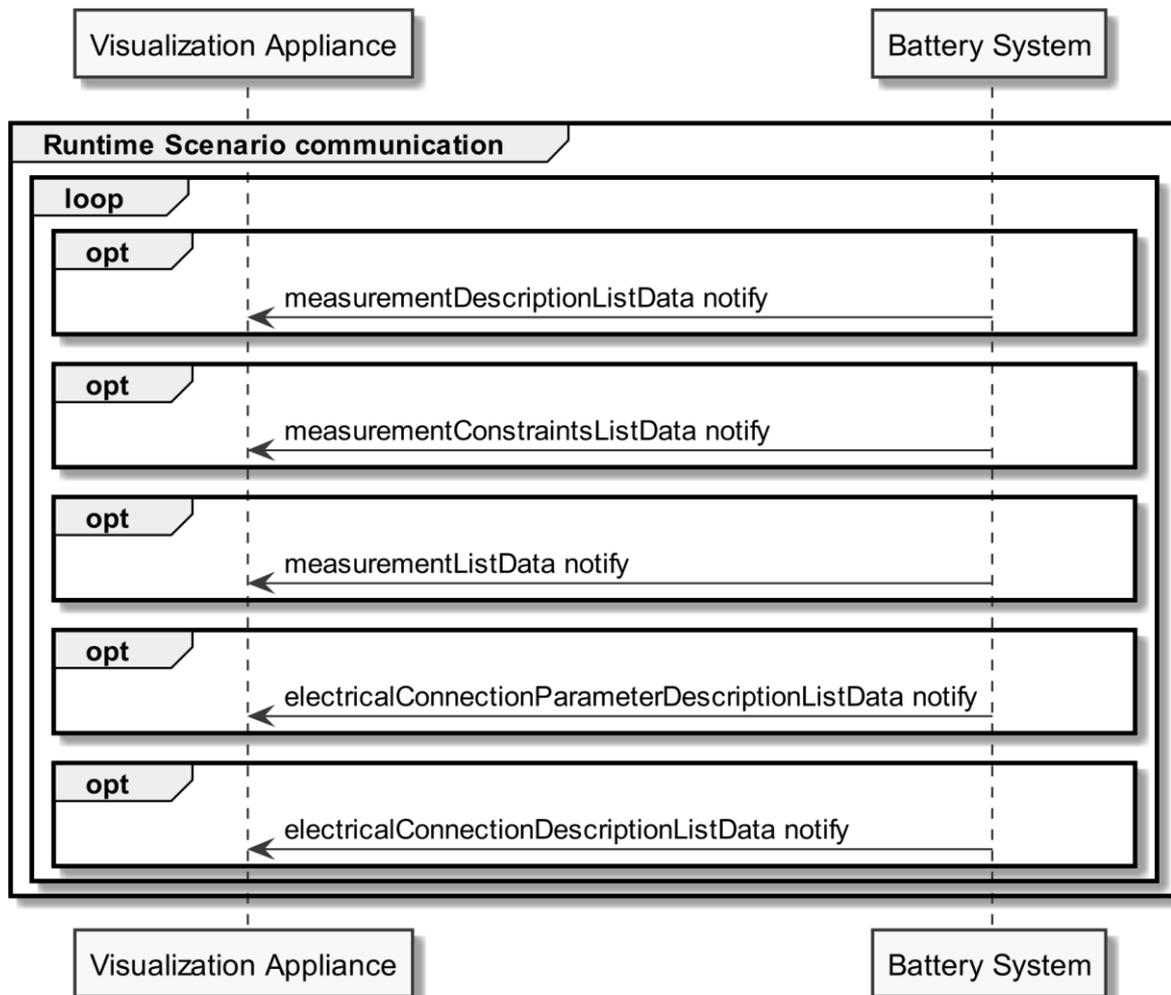
1135 Note: Within the Initial Scenario communication, the content required by this Scenario MAY not be
1136 provided completely, but later during Runtime Scenario communication.

1137

1138 **3.4.3.3 Runtime Scenario communication**

1139 Based on the Initial Scenario communication, the Runtime Scenario communication provides updates
1140 during runtime.

1141 If one of the referenced server Functions' data change, the server SHALL submit the change as shown
1142 in the following figure:



1143

1144 *Figure 14: Scenario 3 - Runtime Scenario communication sequence diagram*

1145 Note: Normally, in this Scenario only the "measurementListData" Function changes during runtime.
 1146 Hence, usually no notifications of the other Functions of this Scenario are sent during runtime.

1147 Partial notifications without Selectors or Elements SHALL be supported for all Functions used in this
 1148 Scenario.

1149 For measurementDescriptionListData notify, measurementConstraintsListData notify and
 1150 measurementListData notify "partial" delete notifications SHOULD be supported with the Selector:

1151 - measurementId

1152 For electricalConnectionParameterDescriptionListData notify "partial" delete notifications SHOULD
 1153 be supported with the Selectors:

1154 - electricalConnectionId

1155 - parameterId

1156 - measurementId

1157 Note: To interpret partial notification messages correctly the information obtained during the Initial
 1158 Scenario communication phase is required.

1159 Note: A read operation ("polling") on all Functions is possible at any time, e.g. if a notification could
1160 not be evaluated.

1161

1162 The following table shows where the required content of the messages of the sequence diagram is
1163 described:

Message name from sequence diagram	Content description in table	Scenario number in table
measurementDescriptionListData notify	Table 11	3
measurementConstraintsListData notify	Table 12	3
measurementListData notify	Table 13	3
electricalConnectionDescriptionListData notify	Table 14	3
electricalConnectionParameterDescriptionListData notify	Table 15	3

1164 *Table 21: Runtime Scenario communication content references for Scenario 3*

1165

1166 **3.4.3.4 Additional information**

1167 Note: In this Scenario solution, the "load convention" (i.e. "passive sign convention") is applied. This
1168 means power and energy values are expressed with positive values in case of energy consumption
1169 (i.e. charging) whereas negative values are used in case of energy production (i.e. discharging)
1170 [VABD-005].

1171 Note: Within this Scenario, only the latest measurement value SHALL be stated ([VABD-003b]).
1172 Additional historical values are forbidden.

1173

1174 **3.4.4 Scenario 4 - Monitor current state of charge of the Battery System**

1175 **3.4.4.1 Pre-Scenario communication**

- 1176 1. **Detailed discovery:** Actors that act as client within this Scenario, need to know the addresses
1177 of the server Features used in the Initial Scenario communication. If the address of a
1178 particular server Feature is not known, the detailed discovery must be used, as described in
1179 section 3.3.2.
- 1180 2. **Binding:** Binding SHOULD NOT be used for this Scenario.
- 1181 3. **Subscription:** Actors SHALL create a subscription for each server Feature that is relevant for
1182 the corresponding Actor within this Scenario, as described in section 3.3.4.

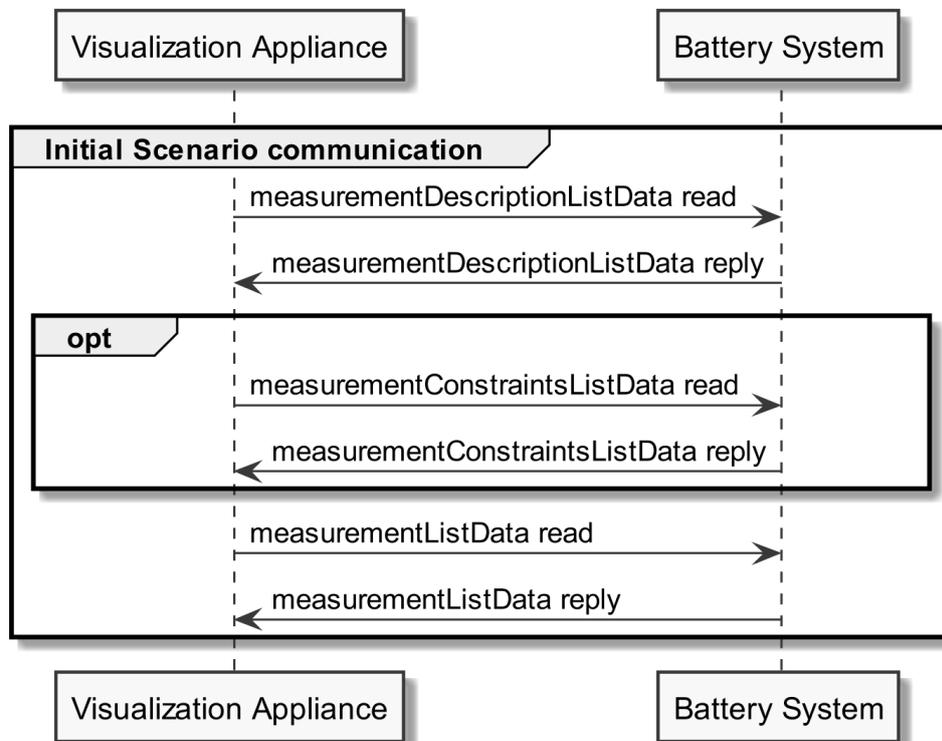
1183 The Initial Scenario communication SHALL start at the latest when the required resources on an Actor
1184 are known and the necessary binding and subscription procedures have been finished. However, as
1185 soon as the address of a required resource is known, the Initial Scenario communication for this
1186 resource MAY start already, even if the addresses of other required resources are not known yet.

1187 If required resources are removed and added again, they are re-discovered, and the Initial Scenario
1188 communication is triggered again for those resources.

1189

1190 **3.4.4.2 Initial Scenario communication**

1191 Each time a (re-)connection is established, even if the Pre-Scenario communication phase is skipped,
 1192 the messages shown in the following sequence diagram SHALL be exchanged, as the corresponding
 1193 resources may have changed in the meantime:



1194

1195 *Figure 15: Scenario 4 - Initial Scenario communication sequence diagram*

1196 Note: The initiation of the optional sequence part (marked with "opt" in the figure) is optional for the
 1197 "Visualization Appliance" even if the "Battery System" can provide the requested Function.

1198 The `measurementDescriptionListData read` SHOULD be a "partial" read operation with the following
 1199 Selectors:

- 1200 - `scopeType = "stateOfCharge"`

1201 The `measurementConstraintsListData read` and `measurementListData read` SHOULD be "partial" read
 1202 operations with the following Selectors:

- 1203 - `measurementId` (derived from the `measurementDescriptionListData reply`)

1204 Note: If partial read is not supported a full read SHALL be performed.

1205

1206 The following table shows where the required content of the messages from the sequence diagram is
 1207 described:

Message name from sequence diagram	Content description in table	Scenario number in table
measurementDescriptionListData reply	Table 11	4
measurementConstraintsListData reply	Table 12	4
measurementListData reply	Table 13	4

1208 *Table 22: Initial Scenario communication content references for Scenario 4*

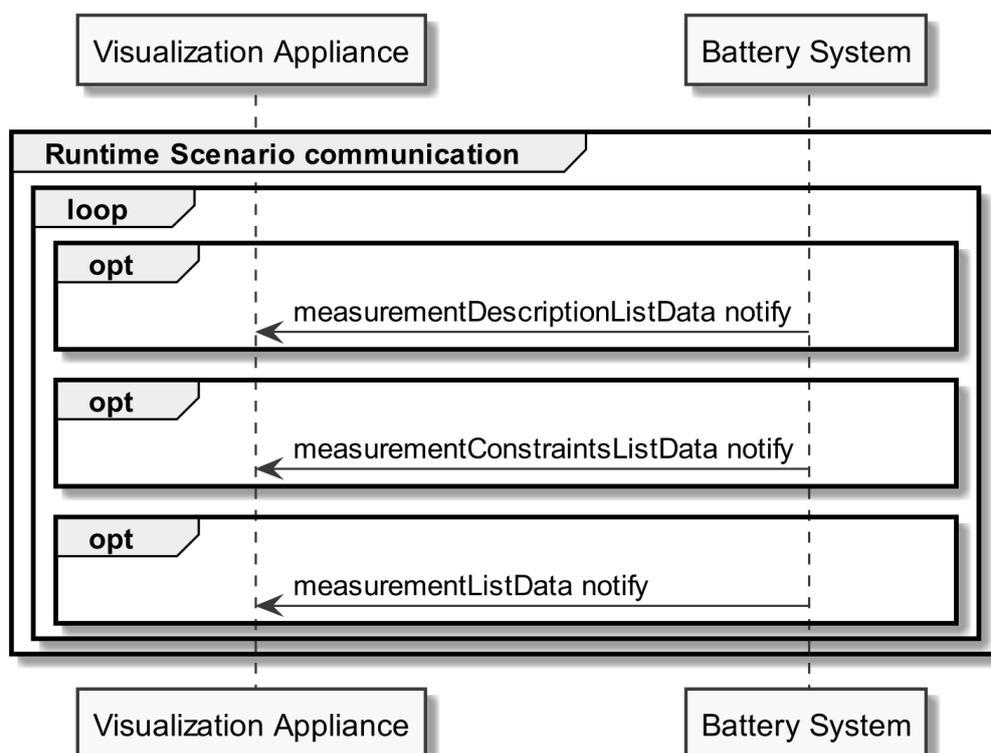
1209 Note: Within the Initial Scenario communication, the content required by this Scenario MAY not be
1210 provided completely, but later during Runtime Scenario communication.

1211

1212 **3.4.4.3 Runtime Scenario communication**

1213 Based on the Initial Scenario communication, the Runtime Scenario communication provides updates
1214 during runtime.

1215 If one of the referenced server Functions' data change, the server SHALL submit the change as shown
1216 in the following figure:



1217

1218 *Figure 16: Scenario 4 - Runtime Scenario communication sequence diagram*

1219 Note: Normally, in this Scenario only the "measurementListData" Function changes during runtime.
1220 Hence, usually no notifications of the other Functions of this Scenario are sent during runtime.

1221 Partial notifications without Selectors or Elements SHALL be supported for all Functions used in this
1222 Scenario.

1223 For measurementDescriptionListData notify, measurementConstraintsListData notify and
1224 measurementListData notify "partial" delete notifications SHOULD be supported with the Selector:

1225 - measurementId

1226 Note: To interpret partial notification messages correctly the information obtained during the Initial
1227 Scenario communication phase is required.

1228 Note: A read operation ("polling") on all Functions is possible at any time, e.g. if a notification could
1229 not be evaluated.

1230

1231 The following table shows where the required content of the messages of the sequence diagram is
1232 described:

Message name from sequence diagram	Content description in table	Scenario number in table
measurementDescriptionListData notify	Table 11	4
measurementConstraintsListData notify	Table 12	4
measurementListData notify	Table 13	4

1233 *Table 23: Runtime Scenario communication content references for Scenario 4*

1234

1235 **3.4.4.4 Additional information**

1236 Note: Within this Scenario, only the latest measurement value SHALL be stated ([VABD-004b]).

1237 Additional historical values are forbidden.

1238