

EEBus UC Technical Specification

Configuration of DHW Temperature

Version 1.0.0 RC1

Cologne, 2019-11-25

EEBus Initiative e.V.

Butzweilerhofallee 4
50829 Cologne
GERMANY

Rue d'Arlon 25
1050 Brussels
BELGIUM

Phone: +49 221 / 47 44 12 - 20
Fax: +49 221 / 47 44 12 - 1822

info@eebus.org
www.eebus.org

District court: Cologne
VR 17275

Terms of use for publications of EEBus Initiative e.V.**General information**

The specifications, particulars, documents, publications and other information provided by the EEBus Initiative e.V. are solely for general informational purposes. Particularly specifications that have not been submitted to national or international standardisation organisations by EEBus Initiative e.V. (such as DKE/DIN-VDE or IEC/CENELEC/ETSI) are versions that have not yet undergone complete testing and can therefore only be considered as preliminary information. Even versions that have already been published via standardisation organisations can contain errors and will undergo further improvements and updates in future.

Liability

EEBus Initiative e.V. does not assume liability or provide a guarantee for the accuracy, completeness or up-to-date status of any specifications, data, documents, publications or other information provided and particularly for the functionality of any developments based on the above.

Copyright, rights of use and exploitation

The specifications provided are protected by copyright. Parts of the specifications have been submitted to national or international standardisation organisations by EEBus Initiative e.V., such as DKE/DIN-VDE or IEC/CENELEC/ETSI, etc. Furthermore, all rights to use and/or exploit the specifications belong to the EEBus Initiative e.V., Butzweilerhofallee 4, 50829 Cologne, Germany and can be used in accordance with the following regulations:

The use of the specifications for informational purposes is allowed. It is therefore permitted to use information evident from the contents of the specifications. In particular, the user is permitted to offer products, developments and/or services based on the specifications.

Any respective use relating to standardisation measures by the user or third parties is prohibited. In fact, the specifications may only be used by EEBus Initiative e.V. for standardisation purposes. The same applies to their use within the framework of alliances and/or cooperations that pursue the aim of determining uniform standards.

Any use not in accordance with the purpose intended by EEBus Initiative e.V. is also prohibited.

Furthermore, it is prohibited to edit, change or falsify the content of the specifications. The dissemination of the specifications in a changed, revised or falsified form is also prohibited. The same applies to the publication of extracts if they distort the literal meaning of the specifications as a whole.

It is prohibited to pass on the specifications to third parties without reference to these rights of use and exploitation.

It is also prohibited to pass on the specifications to third parties without informing them of the authorship or source.

Without the prior consent of EEBus Initiative e.V., all forms of use and exploitation not explicitly stated above are prohibited.

Table of contents

| | |
|---|----|
| Table of contents..... | 3 |
| List of figures | 4 |
| List of tables | 4 |
| 1 Scope of the document | 5 |
| 1.1 References..... | 5 |
| 1.1.1 EEBUS documents | 5 |
| 1.1.2 Normative references..... | 5 |
| 1.2 Terms and definitions..... | 5 |
| 1.3 Requirements | 6 |
| 1.3.1 Requirements wording..... | 6 |
| 1.3.2 Mapping of High-Level requirements..... | 6 |
| 2 High-Level description..... | 7 |
| 2.1 Introduction..... | 7 |
| 2.2 Actors | 7 |
| 2.2.1 DHW Circuit | 7 |
| 2.2.2 Configuration Appliance | 7 |
| 2.3 Scenarios | 7 |
| 2.3.1 Scenario 1 - Set DHW temperature setpoint..... | 8 |
| 2.4 Dependencies to other Use Cases..... | 8 |
| 2.4.1 "Monitoring of DHW Temperature" | 8 |
| 2.4.2 "Configuration of System Function DHW" | 9 |
| 2.4.3 "Visualization of System Function DHW" | 9 |
| 2.5 Assumptions and Prerequisites..... | 9 |
| 3 Technical SPINE solution | 10 |
| 3.1 General rules and information | 10 |
| 3.1.1 Underlying technology documents | 10 |
| 3.1.2 Use Case discovery rules | 10 |
| 3.1.3 Rules for "Content of Specialization..." tables and "Content of Function..." tables | 11 |
| 3.1.4 Rules for "Feature Types and Functions..." tables | 19 |
| 3.1.5 "Actor ... overview" diagram rules | 20 |
| 3.1.6 Specializations | 21 |
| 3.1.7 Order of messages within the sequence diagrams | 22 |
| 3.1.8 Further information and rules..... | 22 |
| 3.2 Actors | 22 |
| 3.2.1 DHW Circuit | 22 |
| 3.2.2 Configuration Appliance | 27 |
| 3.3 Pre-Scenario communication | 31 |
| 3.3.1 General information | 31 |
| 3.3.2 Detailed discovery | 31 |
| 3.3.3 Binding..... | 33 |
| 3.3.4 Subscription..... | 34 |
| 3.3.5 Dynamic behaviour..... | 34 |
| 3.4 Scenarios | 34 |
| 3.4.1 Scenario 1 - Set DHW temperature setpoint..... | 34 |

List of figures

| | |
|---|----|
| Figure 1: High-Level Use Case functionality overview | 7 |
| Figure 2: Scenario overview | 7 |
| Figure 3: Actor overview example..... | 21 |
| Figure 4: Actor "DHW Circuit" overview | 23 |
| Figure 5: Actor "Configuration Appliance" overview | 28 |
| Figure 6: Pre-Scenario communication - Detailed discovery sequence diagram..... | 32 |
| Figure 7: Pre-Scenario communication - Binding sequence diagram | 33 |
| Figure 8: Pre-Scenario communication - Subscription sequence diagram | 34 |
| Figure 9: Scenario 1 - Initial Scenario communication sequence diagram | 35 |
| Figure 10: Scenario 1 - Runtime Scenario communication sequence diagram..... | 37 |

List of tables

| | |
|---|----|
| Table 1: Scenario implementation requirement for Actors | 8 |
| Table 2: Presence indication description | 11 |
| Table 3: Example table for cardinality indications on Elements and list items..... | 13 |
| Table 4: Content of an example Specialization | 17 |
| Table 5: Presence indication of Feature Types and Functions support | 19 |
| Table 6: Feature Types and Functions used within this Use Case by the Actor DHW Circuit | 24 |
| Table 7: Content of Function "setpointDescriptionListData" at Actor DHW Circuit | 25 |
| Table 8: Content of Function "setpointConstraintsListData" at Actor DHW Circuit | 26 |
| Table 9: Content of Function "setpointListData" at Actor DHW Circuit..... | 26 |
| Table 10: Content of Function "hvacSystemFunctionSetpointRelationListData" at Actor DHW Circuit | 27 |
| Table 11: Content of Specialization "Setpoint_DhwTemperature" at Actor Configuration Appliance | 30 |
| Table 12: Initial Scenario communication content references for Scenario 1 | 36 |
| Table 13: Runtime Scenario communication content references for Scenario 1 | 38 |

1 Scope of the document

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

1.1 References

1.1.1 EEBUS documents

[UseCaseBaseSpecification] EEBus_UC_TS_UseCaseBaseSpecification.pdf

[ProtocolSpecification] EEBus_SPINE_TS_ProtocolSpecification.pdf

[ResourceSpecification] EEBus_SPINE_TS_ResourceSpecification.pdf

[SHIP] SHIP_Specification_v1.0.0.pdf

1.1.2 Normative references

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

1.2 Terms and definitions

Actor

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

CDT

Configuration of DHW Temperature (short name of this Use Case)

CEM

Abbreviation for Customer Energy Manager. A CEM enables energy-optimized operation of connected devices by harmonizing energy demand and availability within a home or premises.

DHW

Domestic Hot Water.

DHW Circuit

A DHW Circuit of a house or premises that is controlled by the Configuration Appliance.

Configuration Appliance

The Actor Configuration Appliance configures particular data of another Actor.

HVAC

Heating, Ventilation and Air Conditioning

Monitoring Appliance

The Actor Monitoring Appliance evaluates particular data of another Actor.

112 Scenario

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

116 Specialization

117 Reusable data collection for a specific functionality.

118 SPINE

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

121

122 1.3 Requirements**123 1.3.1 Requirements wording**

124 The following keywords are used:

- 125 - SHALL
- 126 - SHALL NOT
- 127 - SHOULD
- 128 - SHOULD NOT
- 129 - MAY

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

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

132

133 1.3.2 Mapping of High-Level requirements

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

135 [CDT-xyz]

136 e.g.: [CDT-007]

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

140

2 High-Level description

2.1 Introduction

This Use Case enables a Configuration Appliance to set the domestic hot water (DHW) temperature setpoint. The Configuration Appliance may adjust the setpoint according to a user input or based upon algorithms that consider energy optimization tasks as well as DHW consumption profiles (see the related Use Case "Monitoring of DHW Temperature" for details).

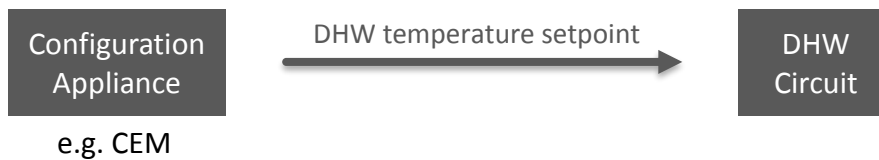


Figure 1: High-Level Use Case functionality overview

Added value: The DHW temperature can be set according to customer input or to minimize heating costs.

2.2 Actors

2.2.1 DHW Circuit

The Actor DHW Circuit represents the DHW Circuit of a house or premises that is controlled by the Configuration Appliance.

2.2.2 Configuration Appliance

The Actor Configuration Appliance configures the DHW temperature of the Actor DHW Circuit.

Note: A CEM is a special kind of Monitoring Appliance or Configuration Appliance.

2.3 Scenarios

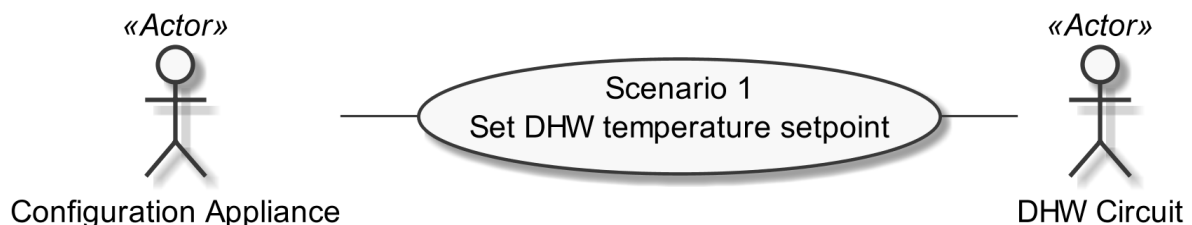


Figure 2: Scenario overview

| Scenario number | Scenario name | Configuration Appliance | DHW Circuit |
|-----------------|------------------------------|-------------------------|-------------|
| 1 | Set DHW temperature setpoint | M | M |

Table 1: Scenario implementation requirement for Actors

2.3.1 Scenario 1 - Set DHW temperature setpoint

2.3.1.1 Description

The Configuration Appliance adjusts the DHW temperature setpoint [CDT-001] in order to optimize comfort and energy consumption or to remotely adapt the DHW temperature according to the user's input.

2.3.1.2 Conditions

Triggering Event:

This Scenario SHALL be triggered if the temperature setpoint needs adjusting. It MAY also be triggered cyclically.

Pre-condition:

The DHW Circuit has an old setpoint value.

Post-condition:

The DHW Circuit has an updated setpoint value.

2.4 Dependencies to other Use Cases

2.4.1 "Monitoring of DHW Temperature"

To manage the DHW Circuit temperature, the Configuration Appliance and DHW Circuit SHOULD also support the Use Case "Monitoring of DHW Temperature". If the Use Case "Monitoring of DHW Temperature" is supported, the values of the Identifier "measurementId" used in the Use Case "Monitoring of DHW Temperature" and this Use Case SHALL be identical. If the Use Case "Monitoring of DHW Temperature" is not supported, the Configuration Appliance and DHW Circuit SHOULD at least support the "measurementDescriptionListData" Function as described in Scenario 1 of the Use Case "Monitoring of DHW Temperature".

The Actor DHW Circuit of this Use Case acts as Actor DHW Circuit within the Use Case "Monitoring of DHW Temperature".

The Actor Configuration Appliance of this Use Case acts as Actor Monitoring Appliance within the Use Case "Monitoring of DHW Temperature".

2.4.2 "Configuration of System Function DHW"

The system functions of the HVAC system that relate to the DHW temperature are changed with the Use Case "Configuration of System Function DHW". It MAY be supported by the Actors of this Use Case.

The Actor DHW Circuit of this Use Case acts as Actor DHW Circuit within the Use Case "Configuration of System Function DHW".

The Actor Configuration Appliance of this Use Case acts as Actor Configuration Appliance within the Use Case "Configuration of System Function DHW".

2.4.3 "Visualization of System Function DHW"

The system functions of the HVAC system that relate to the DHW temperature are visualized with the Use Case "Visualization of System Function DHW". It MAY be supported by the Actors of this Use Case, as long as only one setpoint is used. If more than one setpoint will be used, they can only be distinguished if the according operation modes are linked (see technical solution for details).

Therefore, the Use Case "Visualization of System Function DHW" SHALL be supported by both Actors.

The Actor DHW Circuit of this Use Case acts as Actor DHW Circuit within the Use Case "Visualization of System Function DHW".

The Actor Configuration Appliance of this Use Case acts as Actor Visualization Appliance within the Use Case "Visualization of System Function DHW".

2.5 Assumptions and Prerequisites

None.

3 Technical SPINE solution

3.1 General rules and information

3.1.1 Underlying technology documents

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

For interoperable connectivity this technical solution relies on:

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

Further applicable documents:

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

3.1.2 Use Case discovery rules

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

- The string content for the Element "nodeManagementUseCaseData. useCaseInformation. useCaseSupport. useCaseName" within the Use Case discovery (please refer to [ProtocolSpecification]) SHALL be "configurationOfDhwTemperature". The string content SHALL only be defined by this Use Case (regardless of the Use Case version).
- The string content of the Element "nodeManagementUseCaseData. useCaseInformation. actor" within the Use Case discovery (please refer to [ProtocolSpecification]) SHALL be set to the according value stated within the corresponding Actor's section.
- An Actor A that is implemented to support this Use Case specification SHALL set the Element "nodeManagementUseCaseData. useCaseInformation. useCaseSupport. useCaseVersion" within the Use Case discovery (please refer to [ProtocolSpecification]) to "1.0.0" (for details on the structure of the Use Case version number please refer to [UseCaseBaseSpecification]).
- If an Actor A supports multiple versions of this Use Case with the same major version number, only the highest one SHOULD be set within the Use Case discovery.
- If an Actor A finds a proper counterpart Actor B for this Use Case that supports multiple versions of this Use Case with the same major version number as supported by Actor A, the Actor A SHOULD evaluate from these versions of Actor B only the highest version number.
- If an Actor A supports multiple versions of this Use Case with different major version numbers, for each major version number only the highest version number SHOULD be set within the Use Case discovery.
- If an Actor A finds a proper counterpart Actor B for this Use Case that supports only versions with a major version number not implemented by Actor A, it still might be possible to run the Use Case or parts of the Use Case. Therefore, the Actor A should try to evaluate the Actor B as a valid partner for this Use Case.

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

3.1.3.1 General presence indication definitions

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

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

Table 2: Presence indication description

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

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

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

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

This section only defines rules for the client side.

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

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

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

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

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

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

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

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

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

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

This section only defines rules for the server side.

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

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

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

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

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

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

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

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

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

3.1.3.4 Cardinality indications on Elements and list items

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

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

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

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

| Scenario [...]: M/R/O [W][C] | Element | Value | [High-Level Mapping] Element and value rules |
|---------------------------------|--|---------------|---|
| ... | ... | ... | ... |
| 2: M \W | xFeatureType. xListData. xData. (1..3) | | |
| 2: M \W | xId | <*(1..)> | PRIMARY IDENTIFIER |
| 2: M \W | timePeriod | | ... |
| 2: M \W | timePeriod. startTime | <xs:duration> | |
| 2: M \W | xSlot. (1..) | | |
| 2: M \W | xSlot. xSlotId | | ... |
| 2: M \W | xSlot. duration | <xs:duration> | ... |
| ... | ... | ... | ... |

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

The field

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

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

2: M \W

denotes that this data set is mandatory for Scenario 2.

The field

xSlot. (1..)

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

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

The remaining fields do not have an explicit cardinality indication.

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

3.1.3.5 Writability and changeability indication

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

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

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

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

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

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

3.1.3.6 "Value" placeholders

3.1.3.6.1 Introduction

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

There are two styles placeholders that can be referenced:

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

where

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

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

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

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

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

3.1.3.6.2 Uniqueness of placeholders

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

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

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

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

3.1.3.6.3 Placeholder expressions with cardinalities

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

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

423 This is equivalent to this explicit definition:

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

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

428 Additionally, the following notations may occur:

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

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

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

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

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

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

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

443

444 3.1.3.6.4 References to placeholders and relations

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

447 1. e(-><xM>)

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

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

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

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

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

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

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

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

- 459 3. <yN->xM>
 460 4. <yN->xM#S>
 461 5. <yN#T->xM>
 462 6. <yN#T->xM#S>

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

464 It is also feasible to associate placeholders with cardinalities:

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

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

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

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

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

474 Table 4: Content of an example Specialization

475 Note: One of the following combinations SHALL be used at least: {<z3#1>, <z3#2>, <z3#3>} or
 476 {<z3#1>, <z3#4>, <z3#5>}.
 477

478 3.1.3.7 Rules for content of "Value" column

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

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

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

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

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

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

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

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

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

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

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

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

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

527 DeviceConfiguration. deviceConfigurationKeyValueDescriptionListData.
 528 deviceConfigurationKeyValueDescriptionData.

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

530

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

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

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

540 Measurement. measurementDescriptionListData. measurementDescriptionData.

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

542

543 For both kinds of tables, the following applies:

- 544 - Parent Elements are marked with a dot at the end of the name:
 545 <parent Element>.
 546 E.g.:
 547 value.
- 548 - If there are sub-Elements, they are described in own rows with the name of the parent
 549 Element as prefix, separated by a dot and a blank space:
 550 <parent Element>. <sub-Element>
 551 E.g.:
 552 value. number

553

554 3.1.4 Rules for "Feature Types and Functions..." tables

555 3.1.4.1 Presence indications for "Feature Types and Functions..." tables

556 The following presence indications are used:

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

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

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

560

561 **3.1.4.2 Rules for "Possible operations" column**

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

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

567 read (M). partial (M)

568 write (M). partial (M)

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

570 read (M). partial (R)

571 write (M). partial (R)

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

573 read (M). partial (O)

574 write (M). partial (O)

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

577

578 **3.1.5 "Actor ... overview" diagram rules**

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

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

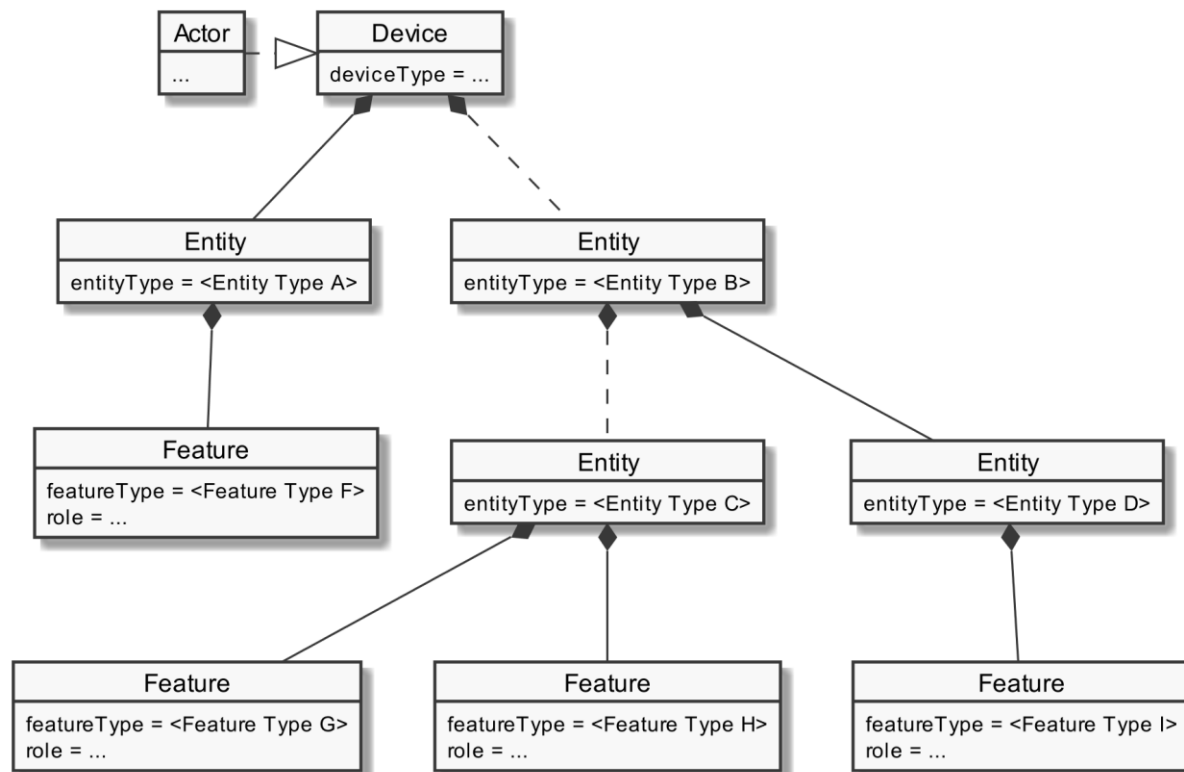


Figure 3: Actor overview example

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

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

3.1.6 Specializations

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

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

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

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

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

3.1.7 Order of messages within the sequence diagrams

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

3.1.8 Further information and rules

3.1.8.1 Frequently used Element rules for the Resource and Specialization tables

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

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

[Scaled number rules]:

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

3.2 Actors

3.2.1 DHW Circuit

3.2.1.1 Resource hierarchy

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

The following diagram provides an overview of the Actor DHW Circuit resource hierarchy.

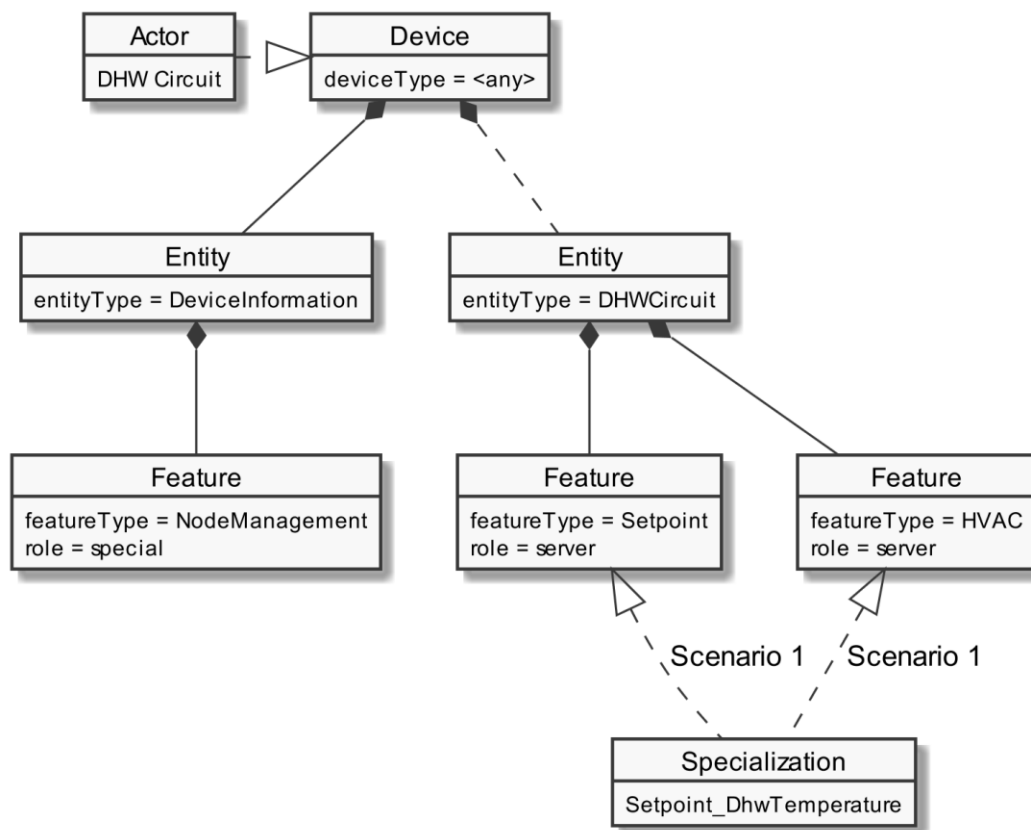


Figure 4: Actor "DHW Circuit" overview

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

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

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

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

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

3.2.1.2 Server data - Resources

3.2.1.2.1 Overview

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

| Feature Type | Scenario: M/R/O | Function | Possible operations |
|--------------|-----------------|--|---|
| Setpoint | 1: M | setpointDescriptionListData | read (M). partial (R) |
| | 1: M | setpointConstraintsListData | read (M). partial (R) |
| | 1: M | setpointListData | read (M). partial (R) write (M). partial (R) |
| HVAC | 1: O * | hvacSystemFunctionSetpointRelationListData | read (M). partial (R) |

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

*: If more than one setpoint is used, the Function hvacSystemFunctionSetpointRelationListData SHALL be supported to distinguish the different setpoint.

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

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

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

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

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

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

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

3.2.1.2.2 Feature Type "Setpoint"

3.2.1.2.2.1 Function "setpointDescriptionListData"

| Scenario [...]: M/R/O [W][C] | Element | Value | [High Level Mapping] Element and value rules |
|---------------------------------|---|------------------|--|
| 1: M | Setpoint. setpointDescriptionListData. setpointDescriptionData. | | |
| 1: M | setpointId | <st1#(1..4)> | SHALL be set as PRIMARY IDENTIFIER. |
| 1: M | measurementId | <m1#(1..1)> | SHALL be set as FOREIGN IDENTIFIER, if the setpoint is linked to a measurement or another Feature that uses the same measurementId as FOREIGN IDENTIFIER. Otherwise it SHALL be omitted. |
| 1: M | setpointType | "valueAbsolute" | SHOULD be set. If omitted, the setpoint SHALL be interpreted as <i>setpointType</i> "valueAbsolute". |
| 1: M | unit | "degC" | |
| | | "degF" | |
| | | "K" | |
| 1: M | scopeType | "dhwTemperature" | |

Table 7: Content of Function "setpointDescriptionListData" at Actor DHW Circuit

Note: For Element "measurementId" consider section 2.4.1.

3.2.1.2.2.2 Function "setpointConstraintsListData"

| Scenario [...]: M/R/O [W][C] | Element | Value | [High Level Mapping] Element and value rules |
|---------------------------------|---|--------------|--|
| 1: M | Setpoint. setpointConstraintsListData. setpointConstraintsData. | | |
| 1: M | setpointId | <st1#(1..4)> | SHALL be set as PRIMARY IDENTIFIER. |
| 1: M | setpointRangeMin. | | The setpoint value SHALL NOT be smaller than setpointRangeMin. [Scaled number rules] |
| 1: M | setpointRangeMin. number | | SHALL be used. |
| 1: O | setpointRangeMin. scale | | MAY be used. If absent, a default value of "0" applies. |
| 1: M | setpointRangeMax. | | The setpoint value SHALL NOT be larger than setpointRangeMax. [Scaled number rules] |

| | | | |
|------|--------------------------|--|--|
| 1: M | setpointRangeMax. number | | SHALL be used. |
| 1: O | setpointRangeMax. scale | | MAY be used. If absent, a default value of "0" applies. |
| 1: R | setpointStepSize. | | SHOULD be used if values are only supported in a certain stepsize. Values that do not match the step size SHALL be rounded by the server. [Scaled number rules] |
| 1: M | setpointStepSize. number | | SHALL be used. |
| 1: O | setpointStepSize. scale | | MAY be used. If absent, a default value of "0" applies. |

Table 8: Content of Function "setpointConstraintsListData" at Actor DHW Circuit

3.2.1.2.2.3 Function "setpointListData"

| Scenario [...]: M/R/O [\W][\C] | Element | Value | [High Level Mapping] Element and value rules |
|-----------------------------------|---|--------------|---|
| 1: M | Setpoint. setpointListData. setpointData. | | |
| 1: M | setpointId | <st1#(1..4)> | SHALL be set as PRIMARY IDENTIFIER. |
| 1: M | value. | | [CDT-001] [Scaled number rules] |
| 1: M \C | value. number | | SHALL be used. |
| 1: M \C | value. scale | | MAY be used. If absent, a default value of "0" applies. |

Table 9: Content of Function "setpointListData" at Actor DHW Circuit

3.2.1.2.3 Feature Type "HVAC"

3.2.1.2.3.1 Function "hvacSystemFunctionSetpointRelationListData"

| Scenario [...]: M/R/O [\W][\C] | Element | Value | [High Level Mapping] Element and value rules |
|-----------------------------------|--|--------------|---|
| 1: O * ¹ | HVAC. hvacSystemFunctionSetpointRelationListData. hvacSystemFunctionSetpointRelationData. | | |
| 1: M * ³ | systemFunctionId | <sf1#(1..1)> | SHALL be set as PRIMARY IDENTIFIER. |
| 1: M * ⁴ | operationModelId. | <om1#(1..4)> | SHALL be set as SUB IDENTIFIER. |

| | | | |
|------|----------------------------------|--------------------------|-------------------------------------|
| 1: M | setpointId (1..4) * ² | <st1#(1..4)->om1#(1..4)> | SHALL be set as FOREIGN IDENTIFIER. |
|------|----------------------------------|--------------------------|-------------------------------------|

Table 10: Content of Function "hvacSystemFunctionSetpointRelationListData" at Actor DHW Circuit

*¹: If more than one setpoint is used within this Use Case, the Function hvacSystemFunctionSetpointRelationListData SHALL be supported to distinguish the different setpoint.

*²: More than one setpointId can be stated per list entry of the Function hvacSystemFunctionSetpointRelationListData. Each setpointId can be linked to more than one operationModelId. But each setpointId needs a unique link to a combination of systemFunctionId and operationModelId. Example: setpointId 1 is linked to systemFunctionId 1 ("dhw") and operationModelId 2 ("on"). setpointId 2 is linked to systemFunctionId 1 ("dhw") and operationModelId 4 ("eco"). But both setpointIds are also linked to systemFunctionId 1 ("dhw") and operationModelId 1 ("auto").

*³: The systemFunctionId SHALL be the same used within the Use Case "Visualization of System Function DHW" for the system function "dhw".

*⁴: Only operationModelIds used within the Use Case "Visualization of System Function DHW" SHALL be used.

3.2.1.3 Client data - Specializations

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

3.2.2 Configuration Appliance

3.2.2.1 Resource hierarchy

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

The following diagram provides an overview of the Actor Configuration Appliance resource hierarchy.

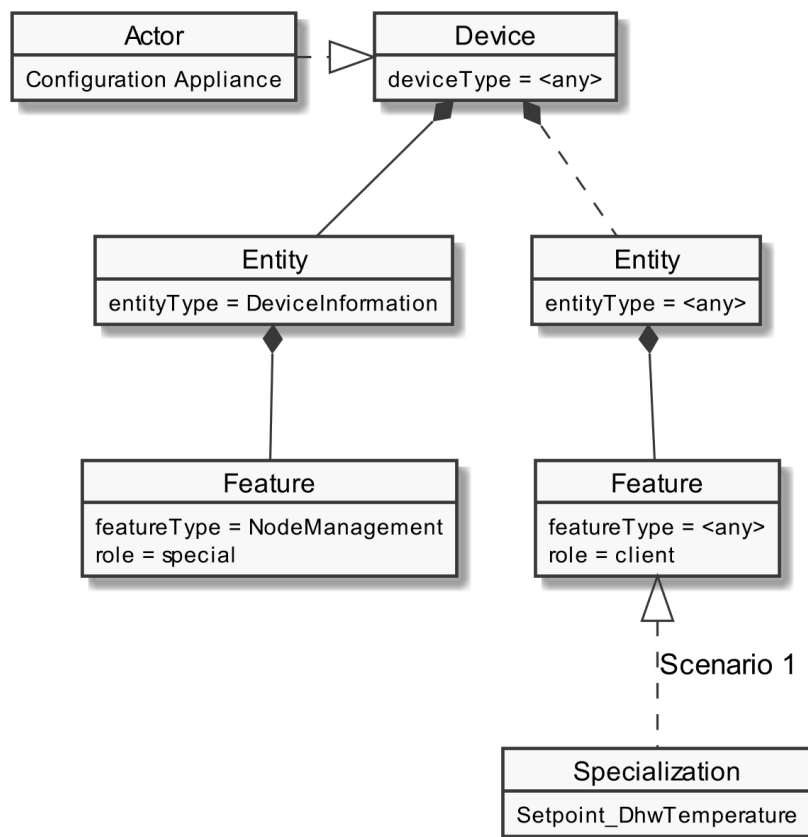


Figure 5: Actor "Configuration Appliance" overview

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

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

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

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

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

3.2.2.2 Server data - Resources

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

745

746 **3.2.2.3 Client data - Specializations**747 **3.2.2.3.1 Topic "Setpoint"**748 **3.2.2.3.1.1 Specialization "Setpoint_DhwTemperature"**

| Scenario [...]: M/R/O [W][C] | Element | Value | [High Level Mapping] Element and value rules |
|---------------------------------|---|------------------|--|
| 1: M | Setpoint. setpointDescriptionListData. setpointDescriptionData. | | |
| 1: M | setpointId | <st1#(1..4)> | SHALL be set as PRIMARY IDENTIFIER. |
| 1: M | measurementId | <m1#(1..1)> | SHALL be set as FOREIGN IDENTIFIER, if the setpoint is linked to a measurement or another Feature that uses the same measurementId as FOREIGN IDENTIFIER. Otherwise it SHALL be omitted. |
| 1: M | setpointType | "valueAbsolute" | SHOULD be set. If omitted, the setpoint SHALL be interpreted as <i>setpointType</i> "valueAbsolute". |
| 1: M | unit | "degC" | |
| | | "degF" | |
| | | "K" | |
| 1: M | scopeType | "dhwTemperature" | |
| 1: M | Setpoint. setpointConstraintsListData. setpointConstraintsData. | | |
| 1: M | setpointId | <st1#(1..4)> | SHALL be set as PRIMARY IDENTIFIER. |
| 1: M | setpointRangeMin. | | The setpoint value SHALL NOT be smaller than setpointRangeMin. [Scaled number rules] |
| 1: M | setpointRangeMin. number | | SHALL be used. |
| 1: M | setpointRangeMin. scale | | SHALL be interpreted. If absent, a default value of "0" applies. |
| 1: M | setpointRangeMax. | | The setpoint value SHALL NOT be larger than setpointRangeMax. [Scaled number rules] |
| 1: M | setpointRangeMax. number | | SHALL be used. |
| 1: M | setpointRangeMax. scale | | SHALL be interpreted. If absent, a default value of "0" applies. |
| 1: M | setpointStepSize. | | SHOULD be used if values are only supported in a certain stepsize. Values that do not match the step |

| | | | |
|---------------------|--|--------------------------|--|
| | | | size SHALL be rounded by the server. [Scaled number rules] |
| 1: M | setpointStepSize. number | | SHALL be used. |
| 1: M | setpointStepSize. scale | | SHALL be interpreted. If absent, a default value of "0" applies. |
| 1: M | Setpoint. setpointListData. setpointData. | | |
| 1: M | setpointId | <st1#(1..4)> | SHALL be set as PRIMARY IDENTIFIER. |
| 1: M | value. | | [CDT-001] [Scaled number rules] |
| 1: M \C | value. number | | SHALL be used. |
| 1: M \C | value. scale | | MAY be used. If absent, a default value of "0" applies. |
| 1: O * ¹ | HVAC. hvacSystemFunctionSetpointRelationListData. hvacSystemFunctionSetpointRelationData. | | |
| 1: M | systemFunctionId * ³ | <sf1#(1..1)> | SHALL be set as PRIMARY IDENTIFIER. |
| 1: M | operationModelId. * ⁴ | <om1#(1..4)> | SHALL be set as SUB IDENTIFIER. |
| 1: M | setpointId (1..4) * ² | <st1#(1..4)->om1#(1..4)> | SHALL be set as FOREIGN IDENTIFIER. |

Table 11: Content of Specialization "Setpoint_DhwTemperature" at Actor Configuration Appliance

*¹: If more than one setpoint is used within this Use Case, the Function hvacSystemFunctionSetpointRelationListData SHALL be supported to distinguish the different setpoint.

*²: More than one setpointId can be stated per list entry of the Function hvacSystemFunctionSetpointRelationListData. Each setpointId can be linked to more than one operationModelId. But each setpointId needs a unique link to a combination of systemFunctionId and operationModelId. Example: setpointId 1 is linked to systemFunctionId 1 ("dhw") and operationModelId 2 ("on"). setpointId 2 is linked to systemFunctionId 1 ("dhw") and operationModelId 4 ("eco"). But both setpointIds are also linked to systemFunctionId 1 ("dhw") and operationModelId 1 ("auto").

*³: The systemFunctionId SHALL be the same used within the Use Case "Visualization of System Function DHW" for the system function "DHW".

*⁴: Only operationModelIds used within the Use Case "Visualization of System Function DHW" SHALL be used.

Note: For Element "measurementId" consider section 2.4.1.

3.3 Pre-Scenario communication

3.3.1 General information

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

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

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

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

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

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

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

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

3.3.2 Detailed discovery

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

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

1. If a client is not subscribed to the primary NodeManagement instance, the client SHALL acquire a subscription according to the figure provided within this sub-section.
2. A client SHALL read the detailed discovery information according to the figure provided within this sub-section. It SHALL keep the received information as far as it concerns mandatory and supported optional Entity Types, Feature Types and Functions of this Use Case that are needed by the client. This means that a client may choose how to store the necessary information. E.g. a client Actor can store the information how to address the necessary Features of the implemented Scenarios but may discard the Entity information.
3. If and as long as a client has a subscription to the detailed discovery information of an Actor and receives proper notifications, it SHALL consider (i.e. integrate into the kept detailed discovery information) the received information as far as it concerns mandatory and supported optional Entity Types, Feature Types and Functions of this Use Case.

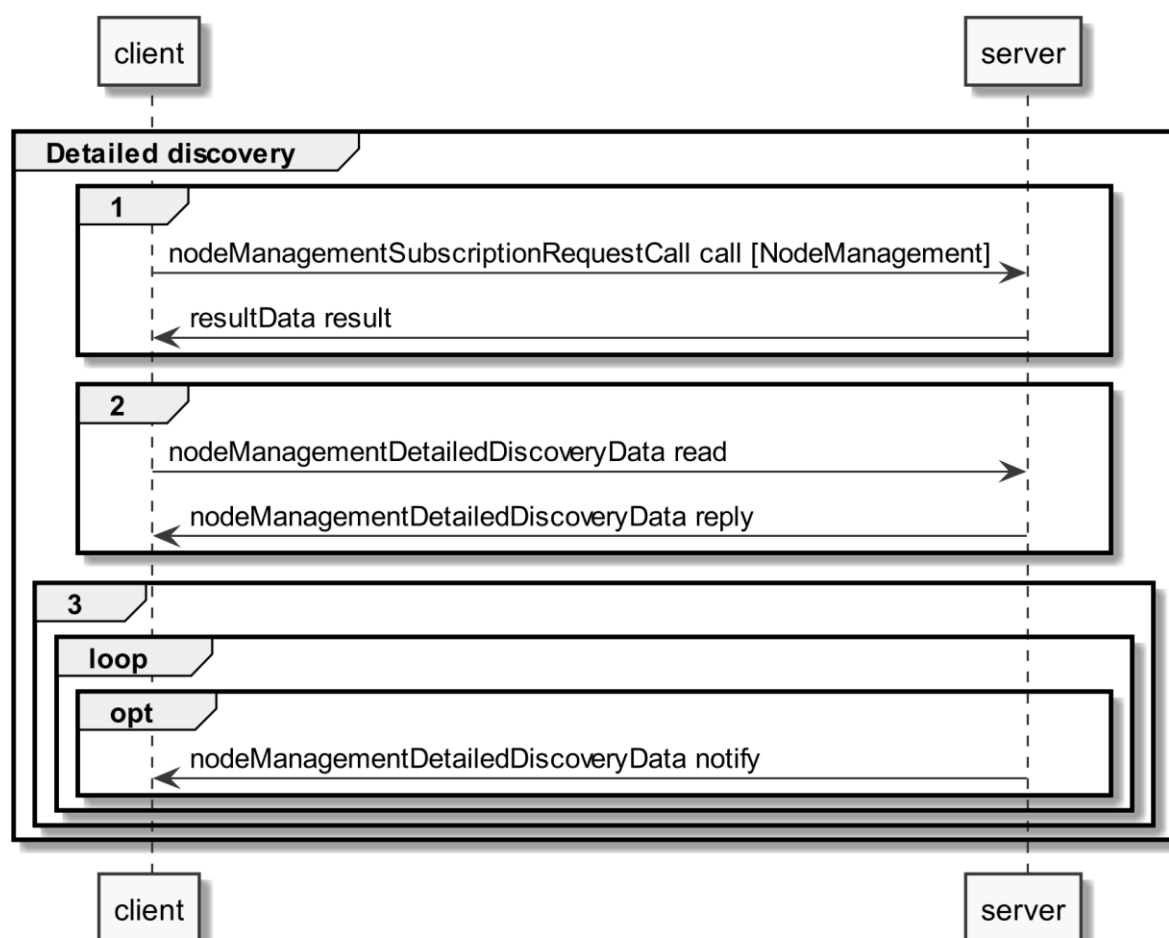


Figure 6: Pre-Scenario communication - Detailed discovery sequence diagram

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

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

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

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

- entityType
- featureType

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

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

- entityAddress
- featureAddress

3.3.3 Binding

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

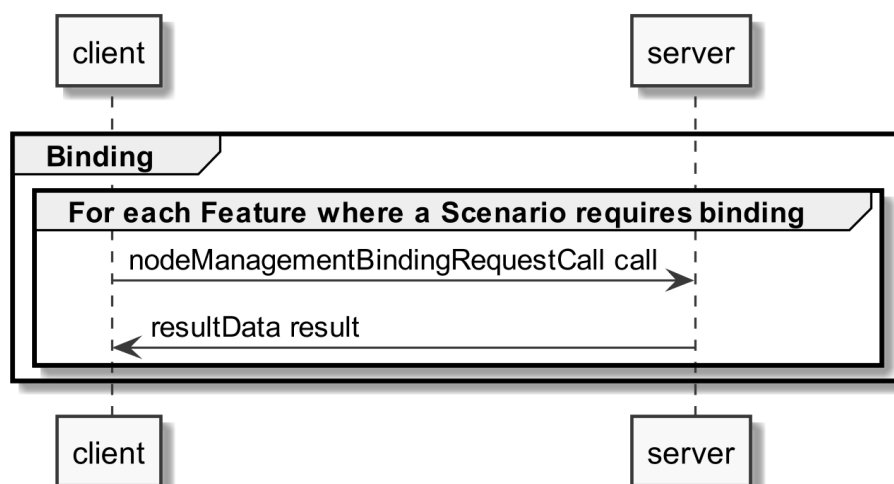


Figure 7: Pre-Scenario communication - Binding sequence diagram

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

3.3.4 Subscription

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

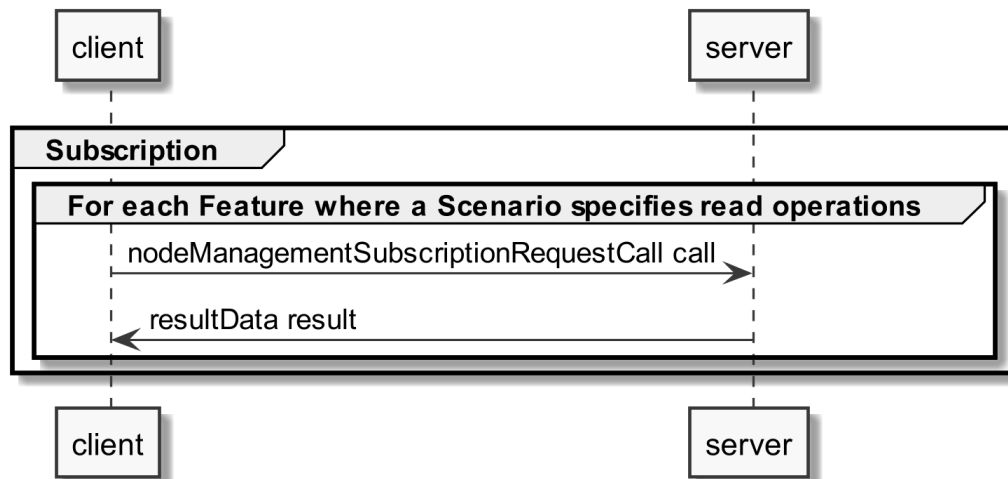


Figure 8: Pre-Scenario communication - Subscription sequence diagram

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

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

3.3.5 Dynamic behaviour

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

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

3.4 Scenarios

3.4.1 Scenario 1 - Set DHW temperature setpoint

3.4.1.1 Pre-Scenario communication

1. **Detailed discovery:** Actors that act as client within this Scenario need to know the addresses of the server Features used in the Initial Scenario communication. If the address of a particular server Feature is not known, the detailed discovery must be used, as described in section 3.3.2.

2. **Binding:** Binding SHOULD NOT be used for this Scenario.
3. **Subscription:** Actors SHALL create a subscription for each server Feature that is relevant for the corresponding Actor within this Scenario, as described in section 3.3.4.

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

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

3.4.1.2 Initial Scenario communication

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

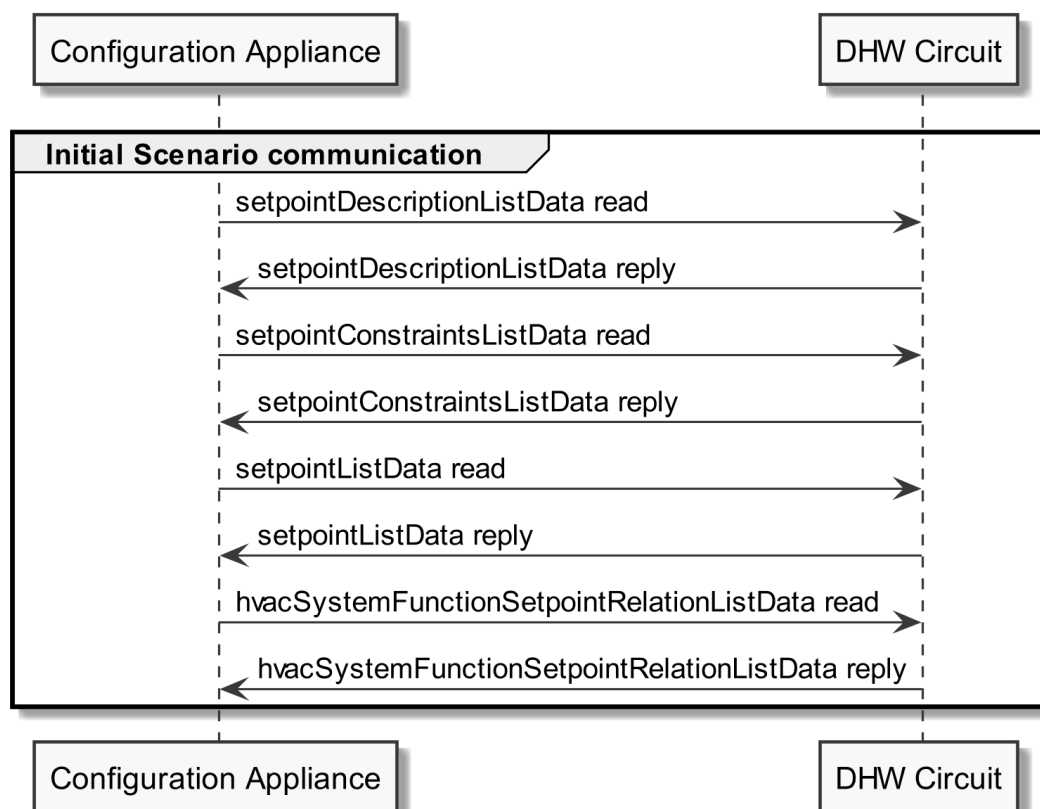


Figure 9: Scenario 1 - Initial Scenario communication sequence diagram

The `setpointDescriptionListsData read` SHOULD be a "partial" read operation with the following Selectors:

- `scopeType = "dhwTemperature"`

The `setpointConstraintsListsData` and `setpointListData read` SHOULD be "partial" read operations with the following Selectors:

- setpointId (derived from setpointDescriptionListsData reply)

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

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

| Message name from sequence diagram | Content description in table | Scenario number in table |
|--|------------------------------|--------------------------|
| setpointDescriptionListsData reply | Table 7 | 1 |
| setpointConstraintsListsData reply | Table 8 | 1 |
| setpointListData reply | Table 9 | 1 |
| hvacSystemFunctionSetpointRelationListData reply | Table 10 | 1 |

Table 12: Initial Scenario communication content references for Scenario 1

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

3.4.1.3 Runtime Scenario communication

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

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

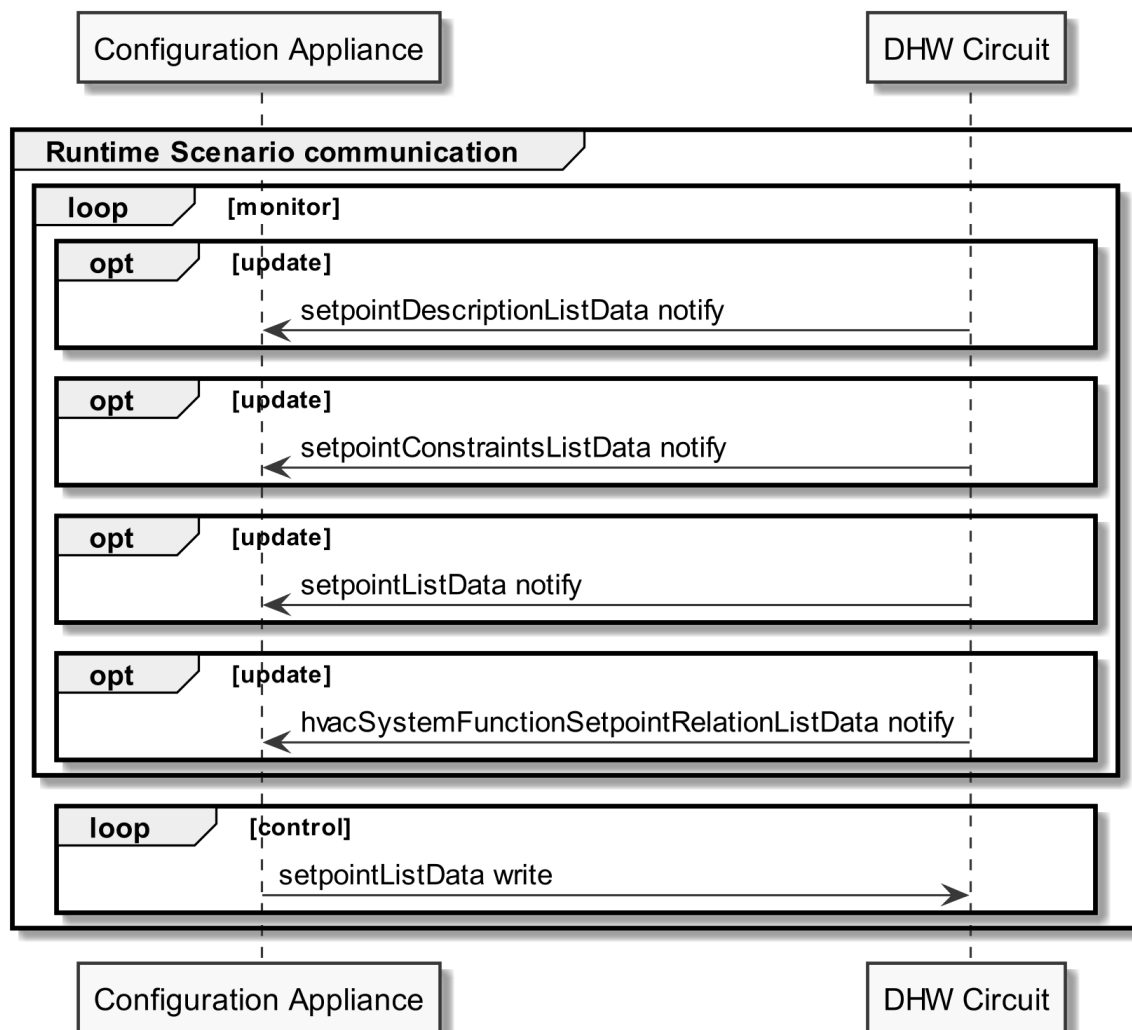


Figure 10: Scenario 1 - Runtime Scenario communication sequence diagram

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

For setpointDescriptionListsData, setpointConstraintsListsData, and setpointListData, "partial" delete notifications SHOULD be supported with the Selector:

- setpointId

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

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

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

| Message name from sequence diagram | Content description in table | Scenario number in table |
|---|------------------------------|--------------------------|
| setpointDescriptionListsData notify | Table 7 | 1 |
| setpointConstraintsListsData notify | Table 8 | 1 |
| setpointListData notify | Table 9 | 1 |
| hvacSystemFunctionSetpointRelationListData notify | Table 10 | 1 |

Table 13: Runtime Scenario communication content references for Scenario 1

3.4.1.4 Additional information

None.