| Document Title | Specification of Persistency |
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**Document Change History**

| Date | Release | Changed by | Description |
|---|---|---|---|
| 2025-11-27 | R25-11 | AUTOSAR Release Management | • Introduced write-only-once semantics<br>• Introduction of APMC<br>• Reworked `ara::per::FileStorage` hierarchy<br>• Several additional small improvements |
| 2024-11-27 | R24-11 | AUTOSAR Release Management | • Improved update sequence, allowing for independent updates of configuration<br>• Storage access type no longer dependent on port type<br>• Renamed error kIsEof as `kEof`, added production errors and log messages<br>• Clarified synchronous behavior of `ara::per::KeyValueStorage::SyncToStorage` and `ara::per::WriteAccessor::SyncToFile`<br>• `ara::per::ReadWriteAccessor` changed to “final” |
| 2023-11-23 | R23-11 | AUTOSAR Release Management | • Improved the clean up and the version handling during update<br>• Removed local handling of `minimumSustainedSize`<br>• Removed constraints regarding storage sync<br>• Formal description of dependencies to other Functional Clusters |

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|---|---|---|---|
| 2022-11-24 | R22-11 | AUTOSAR Release Management | • Fixed security and improved distribution of redundancy<br>• Improved update scenarios, introducing data type migration<br>• Improved handling of large data in Key-Value Storages<br>• Extended and improved error handling, splitting `kOutOfStorageSpace` |
| 2021-11-25 | R21-11 | AUTOSAR Release Management | • Clarified and extended specification of Persistency behavior<br>• Improved configuration of storage location and versioning<br>• kNotInitialized was removed<br>• Deleted move constructors/operators |
| 2020-11-30 | R20-11 | AUTOSAR Release Management | • Replaced POSIX based file access API and improved error handling and symmetry of other APIs<br>• Full support for encryption and redundancy by hashes using Crypto API<br>• Added information to application about safety related problems<br>• Improved installation/update and redundancy |
| 2019-11-28 | R19-11 | AUTOSAR Release Management | • Introduced reset and restore of storages<br>• Introduced storage statistics<br>• Improved compliance with general AUTOSAR concepts<br>• Improved naming and consistency of classes / methods / functions / constants<br>• Changed Document Status from Final to published |

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| 2019-03-29 | 19-03 | AUTOSAR Release Management | • Improved naming of classes / methods / functions<br>• Reworked installation/update<br>• Support for parallel execution in multiple threads<br>• Cleaned up usage of ara::core concepts |
| 2018-10-31 | 18-10 | AUTOSAR Release Management | • Introduction of ara::core types and switch to exceptionless API<br>• Rework of redundancy approach<br>• Support for resource limitation<br>• Improvements and harmonization of KeyValueStorage and FileProxy API |
| 2018-03-29 | 18-03 | AUTOSAR Release Management | • Installation / update of persistent data<br>• Data types supported by KeyValueStorage API |
| 2017-10-27 | 17-10 | AUTOSAR Release Management | • Introduction of AUTOSAR model<br>• Security added<br>• Redundancy added<br>• Rework of FileProxy / Stream API |
| 2017-03-31 | 17-03 | AUTOSAR Release Management | • Initial release |

**Disclaimer**

# Table of Contents

# 1 Introduction and Functional Overview

This specification describes the functionality, API and the configuration for the Functional Cluster Persistency.

The Persistency Functional Cluster will be referenced as Persistency in the remainder of this document.

Persistency offers mechanisms to Adaptive Applications and other Functional Clusters to store information in the non-volatile memory of a machine. The data is available over boot and ignition cycles.

The Persistency will typically be implemented as a library that runs within a Process of an Adaptive Application, with the rights of that Process.

To avoid redundancy in the specification, in the remainder of this document, Adaptive Applications and Functional Clusters that use Persistency will be called Persistency users, while the term Adaptive Application will also be used to denote a Functional Cluster implemented as a Daemon, which is handled similarly to an Adaptive Application.

# 2 Acronyms and Abbreviations

The glossary below includes acronyms and abbreviations that are only relevant within this specification. A general list of acronyms and abbreviations is available in [1].

| Abbreviation / Acronym | Description |
|---|---|
| FS | File Storage |
| KVS | Key-Value Storage |
| MAC | Message Authentication Code |

**Table 2.1: Acronyms and Abbreviations used in the Scope of this Document**

| Term | Description |
|---|---|
| Adaptive Application | Refers to the Adaptive Application defined in [1], or to a Functional Cluster implemented as a Daemon. |
| Adaptive Platform | Refers to the AUTOSAR Adaptive Platform defined in [1]. |
| Adaptive Platform Foundation | Refers to the Adaptive Platform Foundation defined in [1]. |
| Application Design | Refers to the Application Design part of the Manifest defined in [1]. Besides the Application Design, Persistency only uses the Target Configuration part of the Manifest. |
| Contract Version | This version identifies the structural layout of Persistency. The contract version is expected to change when storages are added, removed, or renamed, when their access mode changes, or when the available data types of a Key-Value Storage or the data types of storage elements change. |
| Daemon | Refers to a Functional Cluster implemented as a Daemon. |
| Element | Refers to either a key-value pair of a Key-Value Storage or a file of a File Storage. Used in the specification where something applies to all kinds of storage elements. |
| File | A binary or text file to be stored in a File Storage. |
| File Name | The file name uniquely identifies a file within a File Storage. |
| File Storage | A set of files that are stored persistently. |
| Functional Cluster | Refers to the Functional Cluster defined in [1]. |
| Integrity | Persistency distinguishes data integrity, which is ensured by the configured redundancy, from structural integrity, i.e. the readability of the structure of a Key-Value Storage or File Storage. |
| Key | The key uniquely identifies a key-value pair within a Key-Value Storage. |
| Key-Value Pair | A key with an associated value, to be stored in a Key-Value Storage together with the type of the value. |
| Key-Value Storage | A set of key-value pairs that are stored persistently. |
| Metadata | Additional data about a storage. This metadata is distributed over the storage location and a central location for all storages of a Process. |
| Persistency | The functional cluster described in this document, which handles persistent data of AUTOSAR Adaptive Applications and other functional clusters in File Storages and Key-Value Storages. |
| Persistent Data | Data that is stored in the persistent memory that can be accessed by one Process.<br>Persistency supports different mechanisms to access data in persistent memory. Concurrent access to the data by several Processes is not supported as the data is owned exclusively by one Process. |
| Persistency User | An Adaptive Application or another Functional Cluster that uses Persistency. |

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| Physical Storage | The actual physical memory on which persistent data is stored. This could be a flash device that is accessed directly by Persistency, or a file system of the OS that uses an SSD. |
| Redundancy | Redundancy is used by Persistency to ensure the integrity of stored data. It can be configured to use replication of stored data, CRCs, or Hashes. Typically, only replication will allow to repair corrupted data. |
| Service Interface | Refers to the Service Interface defined in [1]. |
| Software Package | Refers to the Software Package defined in [1]. |
| Storage | Refers to either a Key-Value Storage or a File Storage. Used in the specification where something applies to all kinds of storages. |
| Target Configuration | Refers to the APMC and to the Target Configuration part of the Manifest defined in [1]. Besides the Target Configuration, Persistency only uses the Application Design part of the Manifest. |
| Target Configuration Version | This version identifies the pre-installed content of Persistency. The Target Configuration version is expected to change when pre-installed elements of otherwise unchanged storages are added, removed, or renamed. |
| Update Strategy | Persistency uses update strategies configured on element and storage level. The actual update strategy of an element is derived from Target Configuration parameters for the element and the containing storage defined during design and Target Configuration phase. |
| Value | A value of a key-value pair stored in a Key-Value Storage. |

**Table 2.2: Terms used in the Scope of this Document**

# 3 Related Documentation

## 3.1 Input Documents & Related Standards and Norms

[1] Glossary
AUTOSAR_FO_TR_Glossary

[2] Specification of Adaptive Platform Core
AUTOSAR_AP_SWS_Core

[3] Specification of Manifest
AUTOSAR_AP_TPS_ManifestSpecification

[4] Explanation of Adaptive Platform Software Architecture
AUTOSAR_AP_EXP_SWArchitecture

[5] Specification of Execution Management
AUTOSAR_AP_SWS_ExecutionManagement

[6] Requirements on Persistency
AUTOSAR_AP_RS_Persistency

[7] General Requirements specific to Adaptive Platform
AUTOSAR_AP_RS_General

[8] Specification of Update and Configuration Management
AUTOSAR_AP_SWS_UpdateAndConfigurationManagement

[9] Explanation of Adaptive Platform Design
AUTOSAR_AP_EXP_PlatformDesign

[10] Specification of Cryptography
AUTOSAR_AP_SWS_Cryptography

[11] Specification of Platform Types for Adaptive Platform
AUTOSAR_AP_SWS_PlatformTypes

[12] Specification of Language Binding for modeled AP data types
AUTOSAR_AP_SWS_LanguageBindingForModeledAPdatatypes

## 3.2 Further Applicable Specifications

AUTOSAR provides a core specification [2] which is also applicable for this functional cluster. The chapter [2] 7.1 *"General requirements for all Functional Clusters"* shall be considered an additional and required specification for implementing this functional cluster.

# 4 Constraints and Assumptions

## 4.1 Known Limitations

The Table 10.1 “Correspondence between APMC (M1) elements and MetaModel (M2) elements for FunctionalCluster Persistency” between model elements in the [3, TPS Manifest Specification] and the APMC model elements described in Chapter 10.1 “ Configuration Specification” is in some places misleading due to limitations of the document tooling, e.g. `PersistencyFile.ElementUpdateStrategy.DELETE` should actually only map to `PersistencyElementLevelUpdateStrategyEnum.delete` and not also to `PersistencyCollectionLevelUpdateStrategyEnum.delete`.

## 4.2 Assumptions about the Implementation of Persistency

`Persistency` can be implemented with different internal architectures, and at the same time, `Persistency users` expect a well defined behavior that is independent of the actual implementation of `Persistency`. Therefore, the specification in this document needs to be sufficiently generic to cover the underlying differences. As usual in AUTOSAR Adaptive, the actual implementation is not defined by the specification and is therefore entirely up to the vendor of `Persistency`.

The following subsections list some of the possible implementations of `Persistency`.

### 4.2.1 Library Only

In this scenario, `Persistency` consists solely of a library. The `Application Design` is used to configure the compilation of the library, while the `Target Configuration` is transferred to a configuration file that is read by `Persistency` at run-time.

There is still some freedom regarding the storage of `metadata` and actual data, and regarding the points in time when `elements` of a `storage` are checked regarding redundancy or authenticity or when they are decrypted. E.g. the whole `File Storage` could be checked when it is opened or the single `files` could be checked when they are opened afterwards.

### 4.2.2 Using a Central Daemon

In this scenario, the `Persistency` library connects in the background to a `daemon` via some IPC mechanism. The `Application Design` influences again the compilation of the library part and the `Target Configuration` is transferred to configuration files for the library part and possibly also the `daemon`.

An implementer has the same freedom regarding data storage, encryption, and checks for redundancy and authenticity as in the last scenario. But an additional challenge is

that the communication channel between library and daemon can be lost at any time, resulting in additional potential errors.

### 4.2.3 Based on a File System

Both a library and a daemon can access a storage using the file system services of the operating system. In this case, because AUTOSAR Adaptive is based on POSIX, the file systems will be mounted with specific options that are out of control of the Persistency implementation, but influence the point in time when written data actually appears on the disc. These are further detailed in Appendix C. Without following these advices, it might not be possible to guarantee synchronous behavior for calls like ara::per::KeyValueStorage::SyncToStorage or ara::per::WriteAccessor::SyncToFile.

### 4.2.4 Direct Access to Storage Hardware

Independently of whether a daemon is used or not, Persistency can be implemented to access hardware devices like flash memory directly. These devices have the intrinsic problem that the signal that can be read from each memory cell is reduced over time, mainly influenced by the number of write accesses. In the end, the cell will produce arbitrary values on each read access.

Unfortunately, the distribution of write accesses in typical systems is very uneven. Some parameters might be updated a few times a second, while some code may stay untouched for the whole life time of the ECU. To avoid early read errors, wear leveling should be deployed, such that frequent updates of single data elements are distributed over the whole memory area.

On the other hand, most operating systems include a file system or at least a flash driver that takes care of wear leveling, such that a typical implementation of the Persistency will not have to care about the wear leveling. This use case is therefore not described in any detail in this specification.

# 5 Dependencies to Other Functional Clusters

This chapter defines the dependencies of this functional cluster to other functional clusters. AUTOSAR decided not to standardize interfaces which are exclusively used between functional clusters to allow efficient implementations which might depend e.g., on the used operating system. The goal of this chapter is to provide an informative guideline for the interactions between functional clusters without specifying syntactical details. This ensures compatibility between documents specifying different functional clusters and supports parallel implementation of different functional clusters. Details of internal interfaces are up to the platform provider. Additional internal interfaces, parameters, and return values can be added. A detailed technical architecture documentation of the overall AUTOSAR Adaptive Platform is provided in [4].

## 5.1 Provided Interfaces

This section provides an overview of the public interfaces provided by this functional cluster towards other functional clusters.

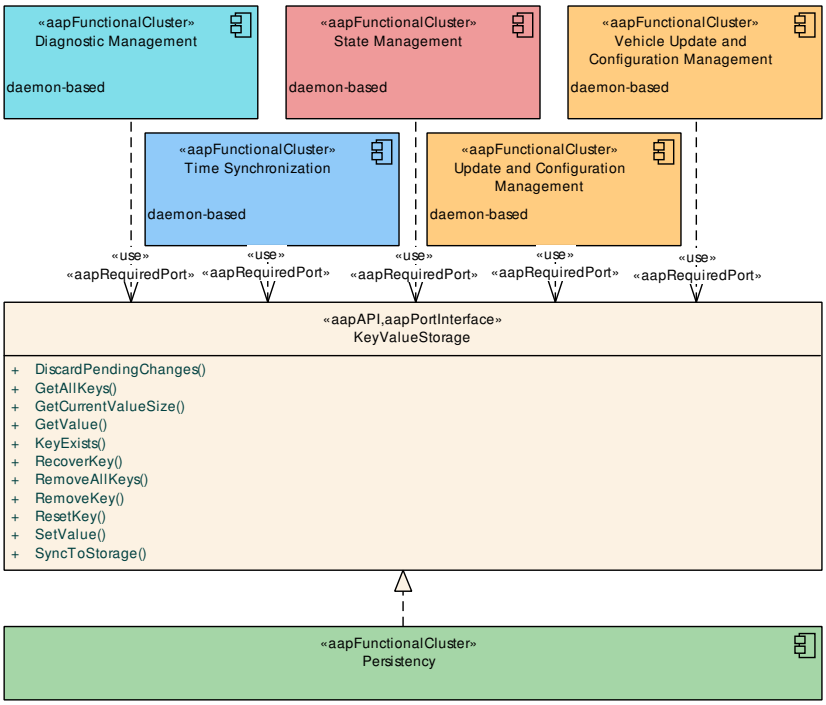



**Figure 5.1: Interfaces Provided by Persistency to Other Functional Clusters**

Figure 5.1 shows the Key-Value Storage interfaces provided by Persistency to other Functional Clusters within the AUTOSAR Adaptive Platform.

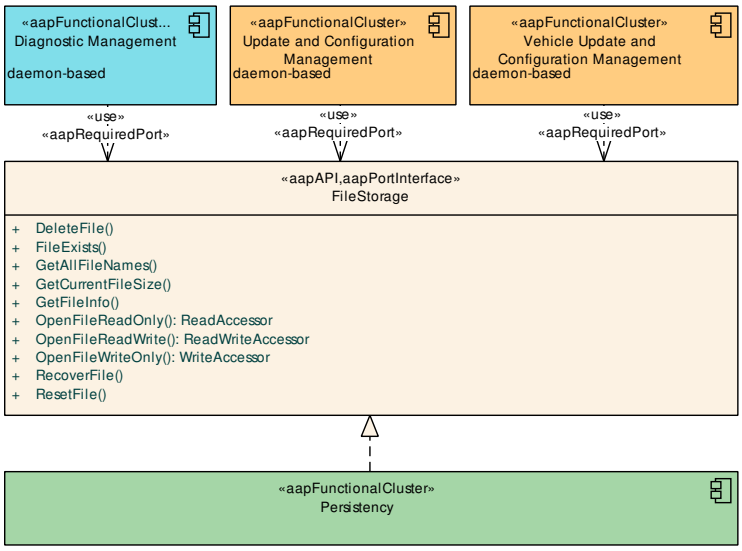



**Figure 5.2: Interfaces Provided by Persistency to Other Functional Clusters**

Figure 5.2 shows the `File Storage` interfaces provided by `Persistency` to other `Functional Clusters` within the AUTOSAR `Adaptive Platform`.

Table 5.1 lists the interfaces provided to other `Functional Clusters` within the AUTOSAR `Adaptive Platform` and provides a rationale.

| *Interface* | *Functional Cluster* | *Purpose* |
|---|---|---|
| `KeyValueStorage Operations` | Remote Persistency | Used to access an underlying `KeyValueStorage`. |
| `FileStorage` | Diagnostic Management | Used to store associated data of diagnostic trouble codes (e.g., freeze frames). |
| | Update and Configuration Management | Used to store files of received software packages. |
| | Vehicle Update and Configuration Management | Used to store files of received vehicle packages. |
| `KeyValueStorage` | Diagnostic Management | Used to store properties of diagnostic trouble codes and diagnostic sessions. |
| | Remote Persistency | Used to access an underlying `KeyValueStorage`. |
| | State Management | Used to store the internal state of `State Management`. |
| | Time Synchronization | Used to store the last received timestamp to enable a faster startup. |
| | Update and Configuration Management | Used to store the internal state of `Update and Configuration Management`. |
| | Vehicle Update and Configuration Management | Used to store the internal state of `Vehicle Update and Configuration Management`. |

**Table 5.1: Interfaces provided to other Functional Clusters**

## 5.2 Required Interfaces

This section provides an overview of the public interfaces required by this functional cluster from other functional clusters.

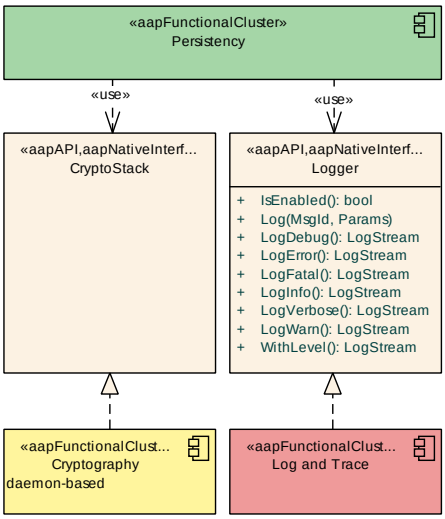



**Figure 5.3: Interfaces required by Persistency from other Functional Clusters**

Figure 5.3 shows the interfaces required by `Persistency` from other `Functional Clusters` within the AUTOSAR `Adaptive Platform`.

Table 5.2 lists the interfaces required from other `Functional Clusters` within the AUTOSAR `Adaptive Platform` and provides a rationale.

| *Functional Cluster* | *Interface* | *Purpose* |
|---|---|---|
| Cryptography | CryptoStack | Used to ensure confidentiality and integrity of the persisted data. |
| Log and Trace | Logger | Used to provide information about errors and internal states and actions of `Persistency`. |

**Table 5.2: Interfaces required from other Functional Clusters**

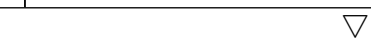
## 5.3 Persistency Specifics

The `Persistency` is (at least partially) compiled as part of an `Executable` of an `Adaptive Application`, and therefore also executed as part of a `Process`, which creates an implicit dependency on the `Execution Management` (see [5, SWS Execution Management]).

# 6 Requirements Tracing

The following tables reference the requirements specified in the [6, RS Persistency] and the [7, RS General], and links to the fulfillments of these. Please note that if column “Satisfied by” is empty for a specific requirement, this means that this requirement is not fulfilled by this document.

| Requirement | Description | Satisfied by |
|---|---|---|
| **[RS_AP_00115]** | Public namespaces | [SWS_PER_00002] |
| **[RS_AP_00119]** | Return values / application errors | [SWS_PER_00042] [SWS_PER_00043] [SWS_PER_00044] [SWS_PER_00046] [SWS_PER_00047] [SWS_PER_00048] [SWS_PER_00049] [SWS_PER_00052] [SWS_PER_00107] [SWS_PER_00110] [SWS_PER_00111] [SWS_PER_00112] [SWS_PER_00113] [SWS_PER_00114] [SWS_PER_00115] [SWS_PER_00116] [SWS_PER_00119] [SWS_PER_00122] [SWS_PER_00125] [SWS_PER_00144] [SWS_PER_00162] [SWS_PER_00163] [SWS_PER_00164] [SWS_PER_00165] [SWS_PER_00166] [SWS_PER_00167] [SWS_PER_00168] [SWS_PER_00313] [SWS_PER_00314] [SWS_PER_00315] [SWS_PER_00323] [SWS_PER_00325] [SWS_PER_00327] [SWS_PER_00329] [SWS_PER_00332] [SWS_PER_00333] [SWS_PER_00334] [SWS_PER_00335] [SWS_PER_00336] [SWS_PER_00337] [SWS_PER_00338] [SWS_PER_00351] [SWS_PER_00352] [SWS_PER_00357] [SWS_PER_00358] [SWS_PER_00360] [SWS_PER_00361] [SWS_PER_00363] [SWS_PER_00364] [SWS_PER_00365] [SWS_PER_00368] [SWS_PER_00370] [SWS_PER_00372] [SWS_PER_00375] [SWS_PER_00376] [SWS_PER_00377] [SWS_PER_00398] [SWS_PER_00399] [SWS_PER_00400] [SWS_PER_00401] [SWS_PER_00402] [SWS_PER_00403] [SWS_PER_00405] [SWS_PER_00406] [SWS_PER_00407] [SWS_PER_00418] [SWS_PER_00419] [SWS_PER_00420] [SWS_PER_00421] [SWS_PER_00422] [SWS_PER_00423] [SWS_PER_00424] [SWS_PER_00426] [SWS_PER_00427] [SWS_PER_00428] [SWS_PER_00429] [SWS_PER_00430] [SWS_PER_00431] [SWS_PER_00434] [SWS_PER_00438] [SWS_PER_00554] [SWS_PER_00567] [SWS_PER_00576] [SWS_PER_00577] [SWS_PER_00591] [SWS_PER_00593] |



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| Requirement | Description | Satisfied by |
|---|---|---|
| **[RS_AP_00120]** | Method and Function names | [SWS_PER_00042] [SWS_PER_00043] [SWS_PER_00044] [SWS_PER_00046] [SWS_PER_00047] [SWS_PER_00048] [SWS_PER_00049] [SWS_PER_00050] [SWS_PER_00052] [SWS_PER_00107] [SWS_PER_00110] [SWS_PER_00111] [SWS_PER_00112] [SWS_PER_00113] [SWS_PER_00114] [SWS_PER_00115] [SWS_PER_00116] [SWS_PER_00119] [SWS_PER_00122] [SWS_PER_00125] [SWS_PER_00144] [SWS_PER_00162] [SWS_PER_00163] [SWS_PER_00164] [SWS_PER_00165] [SWS_PER_00166] [SWS_PER_00167] [SWS_PER_00168] [SWS_PER_00313] [SWS_PER_00314] [SWS_PER_00315] [SWS_PER_00322] [SWS_PER_00323] [SWS_PER_00324] [SWS_PER_00325] [SWS_PER_00326] [SWS_PER_00327] [SWS_PER_00328] [SWS_PER_00329] [SWS_PER_00330] [SWS_PER_00332] [SWS_PER_00333] [SWS_PER_00334] [SWS_PER_00335] [SWS_PER_00336] [SWS_PER_00337] [SWS_PER_00338] [SWS_PER_00350] [SWS_PER_00351] [SWS_PER_00352] [SWS_PER_00355] [SWS_PER_00356] [SWS_PER_00357] [SWS_PER_00358] [SWS_PER_00365] [SWS_PER_00367] [SWS_PER_00368] [SWS_PER_00369] [SWS_PER_00370] [SWS_PER_00371] [SWS_PER_00372] [SWS_PER_00373] [SWS_PER_00374] [SWS_PER_00375] [SWS_PER_00376] [SWS_PER_00377] [SWS_PER_00405] [SWS_PER_00406] [SWS_PER_00407] [SWS_PER_00417] [SWS_PER_00418] [SWS_PER_00419] [SWS_PER_00420] [SWS_PER_00421] [SWS_PER_00422] [SWS_PER_00423] [SWS_PER_00424] [SWS_PER_00426] [SWS_PER_00427] [SWS_PER_00428] [SWS_PER_00429] [SWS_PER_00430] [SWS_PER_00431] [SWS_PER_00433] [SWS_PER_00434] [SWS_PER_00438] [SWS_PER_00459] [SWS_PER_00460] [SWS_PER_00461] [SWS_PER_00462] [SWS_PER_00554] [SWS_PER_00567] [SWS_PER_00568] [SWS_PER_00569] [SWS_PER_00576] [SWS_PER_00577] [SWS_PER_00578] [SWS_PER_00589] [SWS_PER_00590] [SWS_PER_00591] [SWS_PER_00592] [SWS_PER_00593] [SWS_PER_00594] [SWS_PER_00596] [SWS_PER_00597] [SWS_PER_00598] |

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| Requirement | Description | Satisfied by |
|---|---|---|
| **[RS_AP_00121]** | Parameter names | [SWS_PER_00043] [SWS_PER_00044] [SWS_PER_00046] [SWS_PER_00047] [SWS_PER_00052] [SWS_PER_00111] [SWS_PER_00112] [SWS_PER_00113] [SWS_PER_00114] [SWS_PER_00115] [SWS_PER_00116] [SWS_PER_00119] [SWS_PER_00125] [SWS_PER_00144] [SWS_PER_00163] [SWS_PER_00164] [SWS_PER_00165] [SWS_PER_00166] [SWS_PER_00315] [SWS_PER_00322] [SWS_PER_00323] [SWS_PER_00326] [SWS_PER_00327] [SWS_PER_00332] [SWS_PER_00333] [SWS_PER_00334] [SWS_PER_00335] [SWS_PER_00336] [SWS_PER_00337] [SWS_PER_00338] [SWS_PER_00350] [SWS_PER_00351] [SWS_PER_00355] [SWS_PER_00356] [SWS_PER_00367] [SWS_PER_00368] [SWS_PER_00369] [SWS_PER_00370] [SWS_PER_00371] [SWS_PER_00372] [SWS_PER_00375] [SWS_PER_00376] [SWS_PER_00377] [SWS_PER_00405] [SWS_PER_00406] [SWS_PER_00407] [SWS_PER_00420] [SWS_PER_00421] [SWS_PER_00422] [SWS_PER_00423] [SWS_PER_00424] [SWS_PER_00426] [SWS_PER_00427] [SWS_PER_00429] [SWS_PER_00430] [SWS_PER_00431] [SWS_PER_00433] [SWS_PER_00434] [SWS_PER_00438] [SWS_PER_00554] [SWS_PER_00578] [SWS_PER_00590] [SWS_PER_00591] |
| **[RS_AP_00122]** | Type names | [SWS_PER_00146] [SWS_PER_00147] [SWS_PER_00311] [SWS_PER_00312] [SWS_PER_00339] [SWS_PER_00340] [SWS_PER_00342] [SWS_PER_00343] [SWS_PER_00354] [SWS_PER_00359] [SWS_PER_00362] [SWS_PER_00411] [SWS_PER_00412] [SWS_PER_00432] [SWS_PER_00435] [SWS_PER_00436] [SWS_PER_00437] [SWS_PER_00588] [SWS_PER_00595] |
| **[RS_AP_00125]** | Enumerator and constant names | [SWS_PER_00146] [SWS_PER_00147] [SWS_PER_00311] [SWS_PER_00432] [SWS_PER_00435] [SWS_PER_00436] |
| **[RS_AP_00127]** | Usage of ara::core types | [SWS_PER_00042] [SWS_PER_00043] [SWS_PER_00044] [SWS_PER_00046] [SWS_PER_00047] [SWS_PER_00048] [SWS_PER_00049] [SWS_PER_00052] [SWS_PER_00110] [SWS_PER_00111] [SWS_PER_00112] [SWS_PER_00113] [SWS_PER_00114] [SWS_PER_00115] [SWS_PER_00116] [SWS_PER_00119] [SWS_PER_00122] [SWS_PER_00125] [SWS_PER_00165] [SWS_PER_00166] [SWS_PER_00311] [SWS_PER_00312] [SWS_PER_00332] [SWS_PER_00333] [SWS_PER_00334] [SWS_PER_00335] [SWS_PER_00336] [SWS_PER_00337] [SWS_PER_00338] [SWS_PER_00354] [SWS_PER_00356] [SWS_PER_00357] ▽ |

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| Requirement | Description | Satisfied by |
|---|---|---|
| | | △<br>[SWS_PER_00358] [SWS_PER_00365]<br>[SWS_PER_00375] [SWS_PER_00376]<br>[SWS_PER_00377] [SWS_PER_00405]<br>[SWS_PER_00406] [SWS_PER_00407]<br>[SWS_PER_00420] [SWS_PER_00421]<br>[SWS_PER_00422] [SWS_PER_00423]<br>[SWS_PER_00424] [SWS_PER_00426]<br>[SWS_PER_00427] [SWS_PER_00428]<br>[SWS_PER_00429] [SWS_PER_00430]<br>[SWS_PER_00431] [SWS_PER_00433]<br>[SWS_PER_00438] [SWS_PER_00554]<br>[SWS_PER_00567] [SWS_PER_00576]<br>[SWS_PER_00577] [SWS_PER_00578] |
| **[RS_AP_00128]** | Error reporting | [SWS_PER_00044] [SWS_PER_00046]<br>[SWS_PER_00047] [SWS_PER_00048]<br>[SWS_PER_00049] [SWS_PER_00052]<br>[SWS_PER_00111] [SWS_PER_00113]<br>[SWS_PER_00114] [SWS_PER_00115]<br>[SWS_PER_00116] [SWS_PER_00122]<br>[SWS_PER_00332] [SWS_PER_00333]<br>[SWS_PER_00334] [SWS_PER_00335]<br>[SWS_PER_00336] [SWS_PER_00337]<br>[SWS_PER_00338] [SWS_PER_00353]<br>[SWS_PER_00357] [SWS_PER_00358]<br>[SWS_PER_00365] [SWS_PER_00375]<br>[SWS_PER_00376] [SWS_PER_00377]<br>[SWS_PER_00405] [SWS_PER_00406]<br>[SWS_PER_00407] [SWS_PER_00424]<br>[SWS_PER_00426] [SWS_PER_00427]<br>[SWS_PER_00428] [SWS_PER_00429]<br>[SWS_PER_00430] [SWS_PER_00431]<br>[SWS_PER_00438] [SWS_PER_00472]<br>[SWS_PER_00473] [SWS_PER_00474]<br>[SWS_PER_00475] [SWS_PER_00476]<br>[SWS_PER_00536] [SWS_PER_00537]<br>[SWS_PER_00538] [SWS_PER_00539]<br>[SWS_PER_00540] [SWS_PER_00541]<br>[SWS_PER_00542] [SWS_PER_00543]<br>[SWS_PER_00544] [SWS_PER_00545]<br>[SWS_PER_00546] [SWS_PER_00547]<br>[SWS_PER_00548] [SWS_PER_00549]<br>[SWS_PER_00550] [SWS_PER_00551]<br>[SWS_PER_00552] [SWS_PER_00553]<br>[SWS_PER_00554] [SWS_PER_00564]<br>[SWS_PER_00567] [SWS_PER_00576]<br>[SWS_PER_00577] [SWS_PER_00583] |
| **[RS_AP_00129]** | Public types defined by functional clusters shall be designed to allow implementation without dynamic memory allocation | [SWS_PER_00042] [SWS_PER_00044]<br>[SWS_PER_00046] [SWS_PER_00047]<br>[SWS_PER_00048] [SWS_PER_00049]<br>[SWS_PER_00050] [SWS_PER_00052]<br>[SWS_PER_00110] [SWS_PER_00111]<br>[SWS_PER_00113] [SWS_PER_00114]<br>[SWS_PER_00115] [SWS_PER_00116]<br>[SWS_PER_00119] [SWS_PER_00122]<br>[SWS_PER_00322] [SWS_PER_00326]<br>[SWS_PER_00330] [SWS_PER_00332]<br>[SWS_PER_00333] [SWS_PER_00334]<br>[SWS_PER_00335] [SWS_PER_00336]<br>[SWS_PER_00337] [SWS_PER_00338]<br>[SWS_PER_00360] [SWS_PER_00361]<br>[SWS_PER_00363] [SWS_PER_00364]<br>[SWS_PER_00365] [SWS_PER_00367]<br>▽ |

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| Requirement | Description | Satisfied by |
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| | | △<br>[SWS_PER_00369] [SWS_PER_00371]<br>[SWS_PER_00375] [SWS_PER_00376]<br>[SWS_PER_00377] [SWS_PER_00398]<br>[SWS_PER_00399] [SWS_PER_00400]<br>[SWS_PER_00401] [SWS_PER_00402]<br>[SWS_PER_00403] [SWS_PER_00405]<br>[SWS_PER_00406] [SWS_PER_00407]<br>[SWS_PER_00417] [SWS_PER_00424]<br>[SWS_PER_00426] [SWS_PER_00427]<br>[SWS_PER_00428] [SWS_PER_00429]<br>[SWS_PER_00430] [SWS_PER_00431]<br>[SWS_PER_00438] [SWS_PER_00459]<br>[SWS_PER_00460] [SWS_PER_00461]<br>[SWS_PER_00462] [SWS_PER_00554]<br>[SWS_PER_00568] [SWS_PER_00569]<br>[SWS_PER_00589] [SWS_PER_00590]<br>[SWS_PER_00594] [SWS_PER_00596]<br>[SWS_PER_00597] [SWS_PER_00598] |
| **[RS_AP_00134]** | noexcept behavior of class destructors | [SWS_PER_00050] [SWS_PER_00330]<br>[SWS_PER_00417] [SWS_PER_00568]<br>[SWS_PER_00569] [SWS_PER_00594]<br>[SWS_PER_00597] [SWS_PER_00598] |
| **[RS_AP_00135]** | Avoidance of shared ownership | [SWS_PER_00042] [SWS_PER_00043]<br>[SWS_PER_00044] [SWS_PER_00046]<br>[SWS_PER_00047] [SWS_PER_00048]<br>[SWS_PER_00049] [SWS_PER_00052]<br>[SWS_PER_00110] [SWS_PER_00111]<br>[SWS_PER_00112] [SWS_PER_00113]<br>[SWS_PER_00114] [SWS_PER_00115]<br>[SWS_PER_00116] [SWS_PER_00119]<br>[SWS_PER_00122] [SWS_PER_00163]<br>[SWS_PER_00164] [SWS_PER_00165]<br>[SWS_PER_00166] [SWS_PER_00167]<br>[SWS_PER_00168] [SWS_PER_00332]<br>[SWS_PER_00333] [SWS_PER_00334]<br>[SWS_PER_00335] [SWS_PER_00336]<br>[SWS_PER_00337] [SWS_PER_00338]<br>[SWS_PER_00351] [SWS_PER_00355]<br>[SWS_PER_00356] [SWS_PER_00357]<br>[SWS_PER_00358] [SWS_PER_00365]<br>[SWS_PER_00367] [SWS_PER_00368]<br>[SWS_PER_00369] [SWS_PER_00370]<br>[SWS_PER_00371] [SWS_PER_00372]<br>[SWS_PER_00375] [SWS_PER_00376]<br>[SWS_PER_00377] [SWS_PER_00405]<br>[SWS_PER_00406] [SWS_PER_00407]<br>[SWS_PER_00418] [SWS_PER_00419]<br>[SWS_PER_00420] [SWS_PER_00421]<br>[SWS_PER_00422] [SWS_PER_00423]<br>[SWS_PER_00426] [SWS_PER_00427]<br>[SWS_PER_00428] [SWS_PER_00429]<br>[SWS_PER_00430] [SWS_PER_00431]<br>[SWS_PER_00433] [SWS_PER_00438]<br>[SWS_PER_00554] [SWS_PER_00567]<br>[SWS_PER_00576] [SWS_PER_00577]<br>[SWS_PER_00578] |
| **[RS_AP_00136]** | Usage of string types | [SWS_PER_00044] [SWS_PER_00046]<br>[SWS_PER_00119] [SWS_PER_00165]<br>[SWS_PER_00166] [SWS_PER_00332]<br>[SWS_PER_00420] [SWS_PER_00524] |

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| Requirement | Description | Satisfied by |
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| **[RS_AP_00137]** | Connecting run-time interface with model | [SWS_PER_00052] [SWS_PER_00116] [SWS_PER_00333] [SWS_PER_00334] [SWS_PER_00335] [SWS_PER_00336] [SWS_PER_00356] [SWS_PER_00405] [SWS_PER_00406] [SWS_PER_00433] [SWS_PER_00578] |
| **[RS_AP_00139]** | Return type of synchronous function calls | [SWS_PER_00042] [SWS_PER_00043] [SWS_PER_00044] [SWS_PER_00046] [SWS_PER_00047] [SWS_PER_00048] [SWS_PER_00049] [SWS_PER_00052] [SWS_PER_00110] [SWS_PER_00111] [SWS_PER_00112] [SWS_PER_00113] [SWS_PER_00114] [SWS_PER_00115] [SWS_PER_00116] [SWS_PER_00119] [SWS_PER_00122] [SWS_PER_00163] [SWS_PER_00164] [SWS_PER_00165] [SWS_PER_00166] [SWS_PER_00167] [SWS_PER_00168] [SWS_PER_00332] [SWS_PER_00333] [SWS_PER_00334] [SWS_PER_00335] [SWS_PER_00336] [SWS_PER_00337] [SWS_PER_00338] [SWS_PER_00357] [SWS_PER_00358] [SWS_PER_00365] [SWS_PER_00375] [SWS_PER_00376] [SWS_PER_00377] [SWS_PER_00405] [SWS_PER_00406] [SWS_PER_00407] [SWS_PER_00418] [SWS_PER_00419] [SWS_PER_00420] [SWS_PER_00421] [SWS_PER_00422] [SWS_PER_00423] [SWS_PER_00426] [SWS_PER_00427] [SWS_PER_00428] [SWS_PER_00429] [SWS_PER_00430] [SWS_PER_00431] [SWS_PER_00438] [SWS_PER_00554] [SWS_PER_00567] [SWS_PER_00576] [SWS_PER_00577] |
| **[RS_AP_00140]** | Usage of "final specifier" | [SWS_PER_00312] [SWS_PER_00339] [SWS_PER_00340] [SWS_PER_00359] [SWS_PER_00362] |
| **[RS_AP_00141]** | Usage of out parameters | [SWS_PER_00044] |
| **[RS_AP_00143]** | Use 32-bit integral types by default | [SWS_PER_00146] [SWS_PER_00147] [SWS_PER_00432] [SWS_PER_00435] [SWS_PER_00436] |
| **[RS_AP_00144]** | Availability of a named constructor | [SWS_PER_00052] [SWS_PER_00113] [SWS_PER_00114] [SWS_PER_00115] [SWS_PER_00116] [SWS_PER_00375] [SWS_PER_00376] [SWS_PER_00377] [SWS_PER_00429] [SWS_PER_00430] [SWS_PER_00431] |

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| Requirement | Description | Satisfied by |
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| **[RS_AP_00145]** | Availability of special member functions | [SWS_PER_00050] [SWS_PER_00322] [SWS_PER_00323] [SWS_PER_00324] [SWS_PER_00325] [SWS_PER_00326] [SWS_PER_00327] [SWS_PER_00328] [SWS_PER_00329] [SWS_PER_00330] [SWS_PER_00367] [SWS_PER_00368] [SWS_PER_00369] [SWS_PER_00370] [SWS_PER_00371] [SWS_PER_00372] [SWS_PER_00373] [SWS_PER_00374] [SWS_PER_00417] [SWS_PER_00568] [SWS_PER_00569] [SWS_PER_00590] [SWS_PER_00591] [SWS_PER_00592] [SWS_PER_00593] [SWS_PER_00594] [SWS_PER_00597] [SWS_PER_00598] |
| **[RS_AP_00146]** | Classes whose construction requires interaction by the ARA framework | [SWS_PER_00339] [SWS_PER_00340] [SWS_PER_00342] [SWS_PER_00343] [SWS_PER_00459] [SWS_PER_00460] [SWS_PER_00461] [SWS_PER_00462] [SWS_PER_00588] [SWS_PER_00589] [SWS_PER_00595] [SWS_PER_00596] |
| **[RS_AP_00147]** | Classes that are created with an InstanceSpecifier as an argument are not copyable, but at most movable. | [SWS_PER_00052] [SWS_PER_00116] |
| **[RS_AP_00149]** | Error handling for non-initialized Functional Cluster | [SWS_PER_00311] [SWS_PER_00571] |
| **[RS_AP_00153]** | Assignment operators should restrict "this" to lvalues | [SWS_PER_00368] [SWS_PER_00370] [SWS_PER_00372] |
| **[RS_AP_00159]** | usage of "noexcept" specifier | [SWS_PER_00042] [SWS_PER_00043] [SWS_PER_00044] [SWS_PER_00046] [SWS_PER_00047] [SWS_PER_00048] [SWS_PER_00049] [SWS_PER_00050] [SWS_PER_00052] [SWS_PER_00107] [SWS_PER_00110] [SWS_PER_00111] [SWS_PER_00112] [SWS_PER_00113] [SWS_PER_00114] [SWS_PER_00115] [SWS_PER_00116] [SWS_PER_00119] [SWS_PER_00122] [SWS_PER_00125] [SWS_PER_00162] [SWS_PER_00163] [SWS_PER_00164] [SWS_PER_00165] [SWS_PER_00166] [SWS_PER_00167] [SWS_PER_00168] [SWS_PER_00313] [SWS_PER_00314] [SWS_PER_00315] [SWS_PER_00322] [SWS_PER_00323] [SWS_PER_00326] [SWS_PER_00327] [SWS_PER_00330] [SWS_PER_00332] [SWS_PER_00333] [SWS_PER_00334] [SWS_PER_00335] [SWS_PER_00336] [SWS_PER_00337] [SWS_PER_00338] [SWS_PER_00351] [SWS_PER_00352] [SWS_PER_00355] [SWS_PER_00356] [SWS_PER_00357] [SWS_PER_00358] [SWS_PER_00360] [SWS_PER_00361] [SWS_PER_00363] [SWS_PER_00364] [SWS_PER_00365] [SWS_PER_00367] [SWS_PER_00368] [SWS_PER_00369] [SWS_PER_00370] [SWS_PER_00371] [SWS_PER_00372] [SWS_PER_00375] [SWS_PER_00376] [SWS_PER_00377] [SWS_PER_00398] [SWS_PER_00399] [SWS_PER_00400] [SWS_PER_00401] [SWS_PER_00402] [SWS_PER_00403] |

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| Requirement | Description | Satisfied by |
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| | | △<br>[SWS_PER_00405] [SWS_PER_00406]<br>[SWS_PER_00407] [SWS_PER_00417]<br>[SWS_PER_00418] [SWS_PER_00419]<br>[SWS_PER_00420] [SWS_PER_00421]<br>[SWS_PER_00422] [SWS_PER_00423]<br>[SWS_PER_00424] [SWS_PER_00426]<br>[SWS_PER_00427] [SWS_PER_00428]<br>[SWS_PER_00429] [SWS_PER_00430]<br>[SWS_PER_00431] [SWS_PER_00433]<br>[SWS_PER_00438] [SWS_PER_00554]<br>[SWS_PER_00567] [SWS_PER_00568]<br>[SWS_PER_00569] [SWS_PER_00576]<br>[SWS_PER_00577] [SWS_PER_00578]<br>[SWS_PER_00590] [SWS_PER_00591]<br>[SWS_PER_00594] [SWS_PER_00597]<br>[SWS_PER_00598] |
| **[RS_AP_00177]** | AraNotInitializedViolation | [SWS_PER_00574] |
| **[RS_PER_00001]** | Storage of Persistent Data | [SWS_PER_00107] [SWS_PER_00110]<br>[SWS_PER_00111] [SWS_PER_00112]<br>[SWS_PER_00113] [SWS_PER_00114]<br>[SWS_PER_00115] [SWS_PER_00116]<br>[SWS_PER_00119] [SWS_PER_00122]<br>[SWS_PER_00125] [SWS_PER_00144]<br>[SWS_PER_00162] [SWS_PER_00163]<br>[SWS_PER_00164] [SWS_PER_00165]<br>[SWS_PER_00166] [SWS_PER_00167]<br>[SWS_PER_00168] [SWS_PER_00302]<br>[SWS_PER_00303] [SWS_PER_00304]<br>[SWS_PER_00309] [SWS_PER_00335]<br>[SWS_PER_00336] [SWS_PER_00337]<br>[SWS_PER_00338] [SWS_PER_00360]<br>[SWS_PER_00361] [SWS_PER_00363]<br>[SWS_PER_00364] [SWS_PER_00375]<br>[SWS_PER_00376] [SWS_PER_00377]<br>[SWS_PER_00398] [SWS_PER_00399]<br>[SWS_PER_00400] [SWS_PER_00401]<br>[SWS_PER_00402] [SWS_PER_00403]<br>[SWS_PER_00418] [SWS_PER_00419]<br>[SWS_PER_00420] [SWS_PER_00421]<br>[SWS_PER_00422] [SWS_PER_00423]<br>[SWS_PER_00425] [SWS_PER_00428]<br>[SWS_PER_00429] [SWS_PER_00430]<br>[SWS_PER_00431] [SWS_PER_00434]<br>[SWS_PER_00494] [SWS_PER_00495]<br>[SWS_PER_00499] [SWS_PER_00501]<br>[SWS_PER_00502] [SWS_PER_00503]<br>[SWS_PER_00534] [SWS_PER_00535]<br>[SWS_PER_00575] [SWS_PER_00582] |

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| Requirement | Description | Satisfied by |
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| **[RS_PER_00002]** | Retrieval of Persistent Data | [SWS_PER_00049] [SWS_PER_00050] [SWS_PER_00322] [SWS_PER_00323] [SWS_PER_00324] [SWS_PER_00325] [SWS_PER_00339] [SWS_PER_00359] [SWS_PER_00360] [SWS_PER_00361] [SWS_PER_00362] [SWS_PER_00363] [SWS_PER_00364] [SWS_PER_00365] [SWS_PER_00371] [SWS_PER_00372] [SWS_PER_00373] [SWS_PER_00374] [SWS_PER_00398] [SWS_PER_00399] [SWS_PER_00400] [SWS_PER_00401] [SWS_PER_00402] [SWS_PER_00403] [SWS_PER_00459] [SWS_PER_00496] [SWS_PER_00497] [SWS_PER_00498] [SWS_PER_00506] [SWS_PER_00569] [SWS_PER_00582] |
| **[RS_PER_00003]** | Key-Value Storage | [SWS_PER_00042] [SWS_PER_00043] [SWS_PER_00044] [SWS_PER_00046] [SWS_PER_00047] [SWS_PER_00048] [SWS_PER_00052] [SWS_PER_00146] [SWS_PER_00147] [SWS_PER_00331] [SWS_PER_00332] [SWS_PER_00333] [SWS_PER_00334] [SWS_PER_00360] [SWS_PER_00361] [SWS_PER_00363] [SWS_PER_00364] [SWS_PER_00398] [SWS_PER_00399] [SWS_PER_00400] [SWS_PER_00401] [SWS_PER_00402] [SWS_PER_00403] [SWS_PER_00426] [SWS_PER_00427] [SWS_PER_00496] [SWS_PER_00497] [SWS_PER_00498] [SWS_PER_00499] [SWS_PER_00501] [SWS_PER_00502] [SWS_PER_00504] [SWS_PER_00505] [SWS_PER_00534] [SWS_PER_00535] [SWS_PER_00565] [SWS_PER_00566] |
| **[RS_PER_00004]** | File Storage | [SWS_PER_00107] [SWS_PER_00110] [SWS_PER_00111] [SWS_PER_00112] [SWS_PER_00113] [SWS_PER_00114] [SWS_PER_00115] [SWS_PER_00116] [SWS_PER_00119] [SWS_PER_00122] [SWS_PER_00125] [SWS_PER_00144] [SWS_PER_00162] [SWS_PER_00163] [SWS_PER_00164] [SWS_PER_00165] [SWS_PER_00166] [SWS_PER_00167] [SWS_PER_00168] [SWS_PER_00326] [SWS_PER_00327] [SWS_PER_00328] [SWS_PER_00329] [SWS_PER_00330] [SWS_PER_00335] [SWS_PER_00336] [SWS_PER_00337] [SWS_PER_00338] [SWS_PER_00340] [SWS_PER_00342] [SWS_PER_00343] [SWS_PER_00367] [SWS_PER_00368] [SWS_PER_00369] [SWS_PER_00370] [SWS_PER_00375] [SWS_PER_00376] [SWS_PER_00377] [SWS_PER_00417] [SWS_PER_00418] [SWS_PER_00419] [SWS_PER_00420] [SWS_PER_00421] [SWS_PER_00422] [SWS_PER_00423] [SWS_PER_00428] [SWS_PER_00429] [SWS_PER_00430] [SWS_PER_00431] [SWS_PER_00434] [SWS_PER_00435] [SWS_PER_00436] [SWS_PER_00437] [SWS_PER_00438] ▽ |

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| Requirement | Description | Satisfied by |
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| | | △<br>[SWS_PER_00440] [SWS_PER_00441]<br>[SWS_PER_00442] [SWS_PER_00443]<br>[SWS_PER_00444] [SWS_PER_00445]<br>[SWS_PER_00457] [SWS_PER_00458]<br>[SWS_PER_00460] [SWS_PER_00461]<br>[SWS_PER_00462] [SWS_PER_00507]<br>[SWS_PER_00508] [SWS_PER_00509]<br>[SWS_PER_00510] [SWS_PER_00511]<br>[SWS_PER_00512] [SWS_PER_00513]<br>[SWS_PER_00514] [SWS_PER_00515]<br>[SWS_PER_00516] [SWS_PER_00517]<br>[SWS_PER_00518] [SWS_PER_00519]<br>[SWS_PER_00520] [SWS_PER_00521]<br>[SWS_PER_00522] [SWS_PER_00523]<br>[SWS_PER_00524] [SWS_PER_00525]<br>[SWS_PER_00526] [SWS_PER_00527]<br>[SWS_PER_00528] [SWS_PER_00529]<br>[SWS_PER_00530] [SWS_PER_00531]<br>[SWS_PER_00532] [SWS_PER_00533]<br>[SWS_PER_00557] [SWS_PER_00568]<br>[SWS_PER_00570] [SWS_PER_00588]<br>[SWS_PER_00589] [SWS_PER_00590]<br>[SWS_PER_00591] [SWS_PER_00592]<br>[SWS_PER_00593] [SWS_PER_00594]<br>[SWS_PER_00595] [SWS_PER_00596]<br>[SWS_PER_00597] [SWS_PER_00598]<br>[SWS_PER_00599] |
| **[RS_PER_00005]** | Encryption and Decryption | [SWS_PER_00210] [SWS_PER_00211]<br>[SWS_PER_00464] [SWS_PER_00465]<br>[SWS_PER_00559] [SWS_PER_00562]<br>[SWS_PER_00563] |
| **[RS_PER_00008]** | Detection of Data Corruption | [SWS_PER_00221] [SWS_PER_00317]<br>[SWS_PER_00318] [SWS_PER_00319]<br>[SWS_PER_00432] [SWS_PER_00433]<br>[SWS_PER_00439] [SWS_PER_00447]<br>[SWS_PER_00448] [SWS_PER_00480]<br>[SWS_PER_00481] [SWS_PER_00482]<br>[SWS_PER_00483] [SWS_PER_00484]<br>[SWS_PER_00485] [SWS_PER_00486]<br>[SWS_PER_00487] [SWS_PER_00488]<br>[SWS_PER_00489] [SWS_PER_00490]<br>[SWS_PER_00555] [SWS_PER_00558]<br>[SWS_PER_00560] [SWS_PER_00561] |
| **[RS_PER_00009]** | Recovery of Corrupted Data | [SWS_PER_00317] [SWS_PER_00318]<br>[SWS_PER_00319] [SWS_PER_00333]<br>[SWS_PER_00334] [SWS_PER_00335]<br>[SWS_PER_00336] [SWS_PER_00337]<br>[SWS_PER_00338] [SWS_PER_00358]<br>[SWS_PER_00426] [SWS_PER_00427]<br>[SWS_PER_00439] [SWS_PER_00447]<br>[SWS_PER_00448] [SWS_PER_00452]<br>[SWS_PER_00453] [SWS_PER_00454]<br>[SWS_PER_00455] [SWS_PER_00456]<br>[SWS_PER_00477] [SWS_PER_00478]<br>[SWS_PER_00479] [SWS_PER_00555]<br>[SWS_PER_00556] [SWS_PER_00572]<br>[SWS_PER_00573] |

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| Requirement | Description | Satisfied by |
|---|---|---|
| **[RS_PER_00010]** | Configurable Layout of Persistent Data | [SWS_PER_00044] [SWS_PER_00046] [SWS_PER_00047] [SWS_PER_00048] [SWS_PER_00052] [SWS_PER_00113] [SWS_PER_00114] [SWS_PER_00115] [SWS_PER_00116] [SWS_PER_00210] [SWS_PER_00211] [SWS_PER_00251] [SWS_PER_00252] [SWS_PER_00253] [SWS_PER_00254] [SWS_PER_00265] [SWS_PER_00266] [SWS_PER_00267] [SWS_PER_00275] [SWS_PER_00277] [SWS_PER_00281] [SWS_PER_00283] [SWS_PER_00304] [SWS_PER_00317] [SWS_PER_00318] [SWS_PER_00319] [SWS_PER_00321] [SWS_PER_00332] [SWS_PER_00333] [SWS_PER_00334] [SWS_PER_00335] [SWS_PER_00336] [SWS_PER_00375] [SWS_PER_00376] [SWS_PER_00377] [SWS_PER_00378] [SWS_PER_00379] [SWS_PER_00380] [SWS_PER_00382] [SWS_PER_00383] [SWS_PER_00384] [SWS_PER_00385] [SWS_PER_00386] [SWS_PER_00387] [SWS_PER_00388] [SWS_PER_00389] [SWS_PER_00390] [SWS_PER_00391] [SWS_PER_00392] [SWS_PER_00393] [SWS_PER_00394] [SWS_PER_00395] [SWS_PER_00426] [SWS_PER_00427] [SWS_PER_00429] [SWS_PER_00430] [SWS_PER_00431] [SWS_PER_00439] [SWS_PER_00447] [SWS_PER_00448] [SWS_PER_00449] [SWS_PER_00450] [SWS_PER_00451] [SWS_PER_00456] [SWS_PER_00463] [SWS_PER_00464] [SWS_PER_00465] [SWS_PER_00466] [SWS_PER_00467] [SWS_PER_00468] [SWS_PER_00469] [SWS_PER_00470] [SWS_PER_00471] [SWS_PER_00477] [SWS_PER_00478] [SWS_PER_00479] [SWS_PER_00555] [SWS_PER_00556] [SWS_PER_00558] [SWS_PER_00559] [SWS_PER_00560] [SWS_PER_00561] [SWS_PER_00562] [SWS_PER_00563] [SWS_PER_00572] [SWS_PER_00573] [SWS_PER_00580] [SWS_PER_00581] [SWS_PER_00584] [SWS_PER_00585] [SWS_PER_00586] [SWS_PER_00587] |
| **[RS_PER_00011]** | Storage Quota | [SWS_PER_00321] [SWS_PER_00491] [SWS_PER_00492] [SWS_PER_00493] |
| **[RS_PER_00012]** | Installation | [SWS_PER_00251] [SWS_PER_00252] [SWS_PER_00253] [SWS_PER_00254] [SWS_PER_00265] [SWS_PER_00266] [SWS_PER_00267] [SWS_PER_00379] [SWS_PER_00380] [SWS_PER_00382] [SWS_PER_00383] [SWS_PER_00384] [SWS_PER_00385] [SWS_PER_00456] [SWS_PER_00463] [SWS_PER_00469] [SWS_PER_00470] [SWS_PER_00471] [SWS_PER_00477] [SWS_PER_00478] [SWS_PER_00479] [SWS_PER_00556] [SWS_PER_00558] [SWS_PER_00559] [SWS_PER_00572] [SWS_PER_00573] [SWS_PER_00584] [SWS_PER_00585] |

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△

| Requirement | Description | Satisfied by |
|---|---|---|
| **[RS_PER_00013]** | Update | [SWS_PER_00251] [SWS_PER_00275] [SWS_PER_00277] [SWS_PER_00281] [SWS_PER_00283] [SWS_PER_00356] [SWS_PER_00357] [SWS_PER_00378] [SWS_PER_00379] [SWS_PER_00380] [SWS_PER_00386] [SWS_PER_00387] [SWS_PER_00388] [SWS_PER_00389] [SWS_PER_00390] [SWS_PER_00391] [SWS_PER_00392] [SWS_PER_00393] [SWS_PER_00394] [SWS_PER_00395] [SWS_PER_00463] [SWS_PER_00469] [SWS_PER_00470] [SWS_PER_00471] [SWS_PER_00560] [SWS_PER_00561] [SWS_PER_00562] [SWS_PER_00563] [SWS_PER_00576] [SWS_PER_00577] [SWS_PER_00578] [SWS_PER_00579] [SWS_PER_00580] [SWS_PER_00581] [SWS_PER_00586] [SWS_PER_00587] |
| **[RS_PER_00014]** | Rollback | [SWS_PER_00378] [SWS_PER_00396] [SWS_PER_00463] [SWS_PER_00469] [SWS_PER_00470] [SWS_PER_00471] |
| **[RS_PER_00016]** | Cleanup | [SWS_PER_00446] [SWS_PER_00463] [SWS_PER_00470] [SWS_PER_00471] [SWS_PER_00567] |
| **[RS_PER_00017]** | Storage Size | [SWS_PER_00405] [SWS_PER_00406] [SWS_PER_00407] [SWS_PER_00424] [SWS_PER_00554] |
| **[RS_PER_00018]** | Initialization and Shutdown | [SWS_PER_00408] [SWS_PER_00409] [SWS_PER_00574] |
| **[RS_PER_00019]** | Authentication | [SWS_PER_00449] [SWS_PER_00450] [SWS_PER_00451] [SWS_PER_00466] [SWS_PER_00467] [SWS_PER_00468] |

**Table 6.1: Requirements Tracing**

# 7 Functional Specification

## 7.1 The Architecture of Persistency

The Persistency offers two different mechanisms to access persistent memory: Key-Value Storages offer access to a set of keys with associated values (similar to a database), while File Storages offer access to a set of files (similar to a directory of a file system).

The typical usage of the Persistency within an Adaptive Application is depicted in Figure 7.1. As shown there, an Adaptive Application can use a combination of multiple Key-Value Storages and multiple File Storages. Of course, the same applies to other Functional Clusters using Persistency.

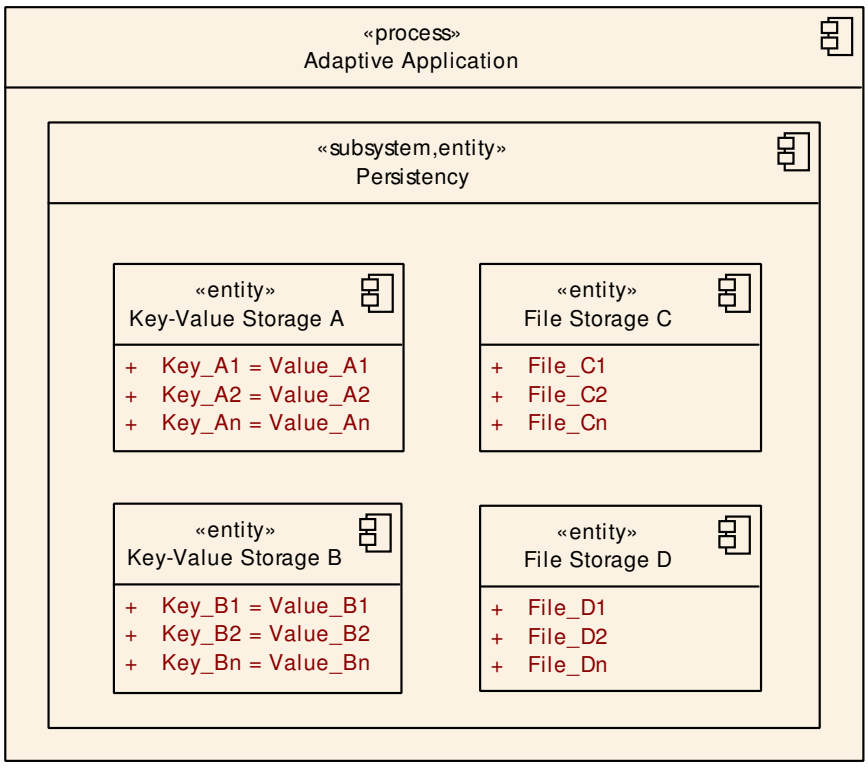


**Figure 7.1: Typical usage of Persistency within an Adaptive Application**

Persistency can also be used directly by other Functional Clusters without involvement of the Adaptive Application. The library part of these Functional Clusters will use dedicated Target Configuration information of Persistency, while Daemons of Functional Clusters can be modeled similarly to Adaptive Applications.

### 7.1.1 Configuration of Persistency

The usage of Persistency by an Adaptive Application is modeled in the Application Design as RPortPrototypes of the AdaptiveApplicationSwCom-

ponentTypes of an Executable which are typed by a PersistencyKeyValueStorageInterface or PersistencyFileStorageInterface. The Target Configuration (see Chapter 10.1) is based on Persistency and is relevant both for Adaptive Applications and when the Persistency is accessed directly by another Functional Cluster.

The API specification holds the classes ara::per::KeyValueStorage and ara::per::FileStorage for access to a Key-Value Storage or a File Storage, respectively. The global functions of these classes receive either the identifier (the fully qualified shortName path) of an RPortPrototype typed by a PersistencyInterface, or the shortName path of a PersistencyKeyValueStorage or PersistencyFileStorage. These identifiers are then used as an ara::core::InstanceSpecifier input parameter (see Chapter 8.5.1.1.2 and Chapter 8.4.2.1.2). Depending on the RPortPrototype.requiredComSpec.accessMode or on the value of PersistencyCommon.FunctionalClusterPersistencyAccess, the Key-Value Storage or File Storage will be accessible as:

**Read Only** if the PersistencyAccessEnum is read or PersistencyCommon.FunctionalClusterPersistencyAccess is READ, or

**Read/Write** if the PersistencyAccessEnum is readWrite or PersistencyCommon.FunctionalClusterPersistencyAccess is READ_WRITE, or

**Write Only** if the PersistencyAccessEnum is write or PersistencyCommon.FunctionalClusterPersistencyAccess is WRITE. Please note that currently read access is not technically constrained on write only storages.

**Write Only Once** if the PersistencyAccessEnum is writeOnlyOnce. This access mode is only supported for storages accessed by Adaptive Applications. The Adaptive Application cannot modify existing elements of a storage, but can add new elements in addition to pre-installed elements. Read access is not limited.

In case of access to Persistency from an Adaptive Application, the Target Configuration contains a dedicated storage configuration for each Process that runs the Executable. The Target Configuration of each storage references the corresponding Process by PersistencyGeneral.ForeignProcessRef, while the Application Design is referenced by PersistencyCommon.PortPrototypeInstanceRef.

**Usage of base classes in the Application Design**

For simplification reasons, the information that applies to both the Key-Value Storages and the File Storages is collected in base classes in the Application Design, namely in PersistencyInterface for PersistencyKeyValueStorageInterface and PersistencyFileStorageInterface.

Likewise, the common information about key-value pairs and files is collected in PersistencyInterfaceElement for PersistencyDataElement and PersistencyFileElement.

In case of access to Persistency from the library part of a Functional Cluster, only the Target Configuration exists, without a mapping to an RPortPrototype. But the Target Configuration still refers to a Process.

### 7.1.2 Configuration of Key-Value Storages

Every Key-Value Storage is represented by a PersistencyKeyValueStorage in the Target Configuration, and, if accessed by the application, in addition by an RPortPrototype typed by a PersistencyKeyValueStorageInterface in the Application Design for the respective AdaptiveApplicationSwComponentType. Every Key-Value Storage can hold multiple key-value pairs. Key-value pairs can be added and removed at run-time by the Persistency user using the Persistency API (see Chapter 8.5.2.1.2.11 and Chapter 8.5.2.1.2.9).

A Key-Value Storage with predefined key-value pairs can be deployed with default data during installation or update of an Adaptive Application. This operation is (indirectly) triggered by the Update and Configuration Management [8] during installation or update using the Target Configuration information and data provided by the software package of the Adaptive Application. See Chapter 7.2.5.

### 7.1.3 Configuration of File Storages

Every File Storage is represented by a PersistencyFileStorage in the target configuration, and, if accessed by the application, in addition by an RPortPrototype typed by a PersistencyFileStorageInterface in the application design for the respective AdaptiveApplicationSwComponentType. Every File Storage can hold multiple files as described in [3]. Similar to the key-value pairs mentioned above, files can be created and deleted at run-time by the Persistency user using the Persistency API (see Chapter 8.4.4.1.2.9ff, Chapter 8.4.4.1.2.12ff, and Chapter 8.4.4.1.2.1).

A File Storage with predefined files with initial content can be deployed during installation or update. This operation is also (indirectly) triggered by the Update and Configuration Management [8]. All needed Target Configuration information and files come with the software package of the Adaptive Application. See Chapter 7.2.5.

## 7.2 General Features of Persistency

**[SWS_PER_00002]**

*Upstream requirements:* RS_AP_00115

⌈All specified classes within the `Persistency` shall reside within the C++ namespace `ara::per`.⌋

### 7.2.1 Error Handling

Error handling in `Persistency` is aligned with the guidelines described in [2]. To this end, the `Persistency` has to implement a set of standard classes and APIs, which are described in this section.

**[SWS_PER_00472]**

*Upstream requirements:* RS_AP_00128

⌈`Persistency` shall use the error codes defined in `ara::per::PerErrc` to report problems to the calling `Persistency user` via `ara::core::Result`. Vendors of `Persistency` may add their own errors to `ara::per::PerErrc`, using codes above 255.⌋

`ara::per::PerErrc` belongs to the `ara::per::PerErrorDomain`, which can be used by a `Persistency user` to classify returned errors.

**[SWS_PER_00473]**

*Upstream requirements:* RS_AP_00128

⌈`ara::per::GetPerDomain` shall return the global `ara::per::PerErrorDomain` object.⌋

To create its own `Persistency` error codes, the `Persistency user` may use `ara::per::MakeErrorCode`.

**[SWS_PER_00474]**

*Upstream requirements:* RS_AP_00128

⌈`ara::per::MakeErrorCode` shall return an `ara::core::ErrorCode` when called with an error code from `ara::per::PerErrc`.⌋

**[SWS_PER_00353]**

*Upstream requirements:* RS_AP_00128

⌈`ara::per::PerErrorDomain::Name` shall return the NUL-terminated string “Per”.⌋

**[SWS_PER_00475]**

*Upstream requirements:* RS_AP_00128

⌈`ara::per::PerErrorDomain::Message` shall return the error message associated with the passed `ara::core::ErrorCode`.⌋

The whole `Persistency` API has been designed to be exception-less. If a `Persistency user` prefers to use exceptions, it may use `ara::per::PerErrorDomain::ThrowAsException`, or simply `ara::core::ErrorDomain::ThrowAsException` or `ara::core::ErrorCode::ThrowAsException`.

**[SWS_PER_00476]**

*Upstream requirements:* RS_AP_00128

⌈`ara::per::PerErrorDomain::ThrowAsException` shall throw an `ara::per::PerException` that is created from the passed error code.⌋

**[SWS_PER_00571]**

*Upstream requirements:* RS_AP_00149

⌈When `Persistency` detects an inconsistency in the `Target Configuration` including invalid or non-existing URIs, it shall treat this situation as a violation as defined in [2] and call `ara::core::Abort`.⌋

#### 7.2.1.1 Handling of General Errors

**[SWS_PER_00536]**

*Upstream requirements:* RS_AP_00128

⌈When a function or method of `Persistency` encounters a problem with the hardware or the underlaying operating system services during the access to a `storage` or an `element` of a `storage`, `Persistency` shall return the error `kPhysicalStorageFailure`.⌋

When `kPhysicalStorageFailure` occurs, the `Persistency user` cannot access the affected `storage` any more. Depending on the system, a reboot might restore the access.

**[SWS_PER_00537]**

*Upstream requirements:* RS_AP_00128

⌈When a method of `Persistency` would modify the underlying `storage`, but the `storage` is configured as read-only, `Persistency` shall return the error `kIllegalWriteAccess`.⌋

**[SWS_PER_00583] Reporting `kIllegalWriteAccess` for write-only-once `storages`**

*Upstream requirements:* RS_AP_00128

⌈When a method of `Persistency` would modify an existing `element`, but the `storage` is configured as write-only-once, `Persistency` shall return the error `kIllegalWriteAccess`.⌋

**[SWS_PER_00538]**

*Upstream requirements:* RS_AP_00128

⌈When a function of `Persistency` is called with an `ara::core::InstanceSpecifier` that is not available in the `Target Configuration`, `Persistency` shall return the error `kStorageNotFound`.⌋

The two previous errors (`kIllegalWriteAccess` and `kStorageNotFound`) occur when the configuration does not match the implemented access to a `storage`. A `Persistency user` might be implemented to be aware of this possibility and react accordingly to the error by avoiding (write) accesses to the `storage`. If the `Persistency user` depends on (write) access to the `storage`, these errors would hint at an incorrect configuration of the `storage`.

**[SWS_PER_00539]**

*Upstream requirements:* RS_AP_00128

⌈When a function or method of `Persistency` detects a fundamental problem in the structure of the `storage` that prevents accessing the `storage`, `Persistency` shall return the error `kIntegrityCorrupted`.⌋

The `Persistency user` can restore a corrupted `storage` by calling `ara::per::RecoverKeyValueStorage`, `ara::per::ResetKeyValueStorage`, `ara::per::RecoverAllFiles`, or `ara::per::ResetAllFiles`. When the `kIntegrityCorrupted` is reported for an `element` of a `storage`, `integrity` can be restored by calling `ara::per::KeyValueStorage::RecoverKey`, `ara::per::KeyValueStorage::ResetKey`, `ara::per::FileStorage::RecoverFile`, or `ara::per::FileStorage::ResetFile`.

When `Persistency` detects insufficient or broken redundancy, it will report `kValidationFailed` as described in [SWS_PER_00221].

**[SWS_PER_00540]**

*Upstream requirements:* RS_AP_00128

⌈When encryption or decryption of `persistent data` fails within a function or method of `Persistency`, `Persistency` shall return the error `kEncryptionFailed`.⌋

**[SWS_PER_00564]**

*Upstream requirements:* RS_AP_00128

⌈When the calculation or verification of the MAC of persistent data fails within a function or method of Persistency, Persistency shall return the error kAuthenticationFailed.⌋

The two previous errors can occur when the configured cryptographic keys or algorithms are not available at run time, or when the storage or the element of a storage is corrupted. The latter case could be detected or even avoided by configuring redundancy.

**[SWS_PER_00541]**

*Upstream requirements:* RS_AP_00128

⌈When a method of Persistency tries to read data from a file, but the position is already at the end, Persistency shall return the error kEof.⌋

This error can typically be dealt with by the Persistency user, and can be avoided by using ara::per::FileAccessor::IsEof.

**[SWS_PER_00542]**

*Upstream requirements:* RS_AP_00128

⌈When a function or method of Persistency would create a file, but the number of existing files already equals the configured PersistencyFileStorageInterface.maxNumberOfFiles of the corresponding File Storage, Persistency shall return the error kTooManyFiles.⌋

This error might occur when a new file is opened for writing, or when a File Storage is updated or when it is recovered after an error. A Persistency user seeing this error might delete some files to be able to create the new file (or files), or reset the File Storage to the initial state using ara::per::ResetAllFiles or ara::per::ResetPersistency.

**[SWS_PER_00543]**

*Upstream requirements:* RS_AP_00128

⌈When a function or method of Persistency would increase the size of a storage or an element of a storage such that the total storage size would exceed the configured PersistencyCommon.MaximumAllowedSize of the storage, Persistency shall return the error kQuotaExceeded.⌋

This error means that the Persistency user tried to store data that exceeds the configured quota of a storage. The Persistency user has to be able to deal with this situation, and either write less data to the affected storage or remove outdated data from this storage, or reset the affected element/storage with a call to ara::per::ResetKeyValueStorage, ara::per::ResetAll-

Files, ara::per::KeyValueStorage::ResetKey, ara::per::FileStorage::ResetFile, or even ara::per::ResetPersistency.

**[SWS_PER_00544]**

*Upstream requirements:* RS_AP_00128

⌈When a function or method of Persistency cannot increase the size of a storage because the physical storage is not sufficient (e.g. file system quoata exceeded or partition full), Persistency shall return the error kOutOfStorageSpace.⌋

This error means that some other storage or even a completely independent Process occupies so much physical storage that Persistency cannot store additional data. This can only happen if PersistencyCommon.MaximumAllowedSize is configured to a higher value than PersistencyCommon.MinimumSustainedSize. The Persistency user has to be able to deal with this situation, and either write less data to the affected storage or remove outdated data from this or another storage, or reset this or another element/storage with a call to ara::per::ResetKeyValueStorage, ara::per::ResetAllFiles, ara::per::KeyValueStorage::ResetKey, ara::per::FileStorage::ResetFile, or even ara::per::ResetPersistency.

### 7.2.2 Parallel Access to Persistent Data

According to [9], the persistent data is local to one Process. Therefore, Persistency will never share persistent data between two (or more) Processes, even of the same Executable. The background of this decision is that Persistency should not provide an additional communication path for Adaptive Applications besides the mechanisms provided by the Functional Cluster Communication Management (e.g. using ara::com).

**[SWS_PER_00309]**

*Upstream requirements:* RS_PER_00001

⌈Persistent data shall always be local to one Process.⌋

If persistent data needs to be accessed by multiple Processes (of the same or different Adaptive Applications), it is the duty of the application designer to provide Service Interfaces for communication.

Persistency is, on the other hand, prepared to handle concurrent access from multiple threads of the same Adaptive Application, running in the context of the same Process. To create shared access to a Key-Value Storage or File Storage, either the ara::per::SharedHandle returned by ara::per::OpenKeyValueStorage and ara::per::OpenFileStorage can be passed on (i.e. copied) to another thread, or ara::per::OpenKeyValueStorage and ara::per::OpenFileStorage can be called in independent threads for the same Key-Value Storage or File Storage, respectively. All operations of the Key-Value Storage and File Storage support concurrent access from multiple threads, though operations like ara::per::RecoverKeyValueStorage and ara::per::ResetKeyValueStorage or ara::per::RecoverAllFiles and ara::per::ResetAllFiles will only succeed when the corresponding Key-Value Storage or File Storage is not opened.

**[SWS_PER_00582] Thread-Safety of the SharedHandle**

*Upstream requirements:* RS_PER_00001, RS_PER_00002

⌈The copy assignment operator (operator=), the move assignment operator (operator=), the copy constructor (SharedHandle), the move constructor (SharedHandle), and the destructor (~SharedHandle) for SharedHandle shall be implemented such that all these operations can take place at the same time in different threads without risking to lose track of the usage of the contained object, which could result in undefined behavior or memory leaks.⌋

Please note: This behavior can be achieved by protecting a counter that is used internally to keep track of the currently existing copies, so that the last one destructing the SharedHandle can safely destruct the embedded object. This is similar to how the C++ shared pointer handles copying/destruction.

**[SWS_PER_00545]**

*Upstream requirements:* RS_AP_00128

⌈When a function of `Persistency` that modifies a `storage` is called while another function that modifies the same `storage` is being executed, `Persistency` shall return the error `kResourceBusy`.⌋

This restriction also applies to global functions like `ara::per::UpdatePersistency`, which will only succeed if no `storage` is open, and no other thread is currently modifying a `storage` with functions like `ara::per::RecoverKeyValueStorage` or `ara::per::ResetAllFiles`.

Access to single `key-value pairs` of a `Key-Value Storage` is possible from multiple threads at the same time, because the operation of `ara::per::KeyValueStorage::GetValue` and `ara::per::KeyValueStorage::SetValue` are atomic, as are those of `ara::per::KeyValueStorage::RemoveKey`, `ara::per::KeyValueStorage::RemoveAllKeys`, `ara::per::KeyValueStorage::SyncToStorage`, and `ara::per::KeyValueStorage::DiscardPendingChanges`.

Access to single `files` of a `File Storage` cannot be shared between multiple threads, because it would be impossible to synchronize read and write accesses and the corresponding change of the seek position in a `file`. Accordingly, the `ara::per::UniqueHandle` returned by the `OpenFile*` APIs can only be moved to another thread, and trying to open an already opened `file` will fail. Likewise, operations like `ara::per::FileStorage::DeleteFile`, `ara::per::FileStorage::RecoverFile`, and `ara::per::FileStorage::ResetFile` will also not be possible on open `files`.

**[SWS_PER_00546]**

*Upstream requirements:* RS_AP_00128

⌈When a method of `ara::per::FileStorage` that opens or modifies a `file` is called while the same `file` is currently open or being modified by another method, `Persistency` shall return the error `kResourceBusy`.⌋

`Files` are implicitly closed when their `ara::per::UniqueHandle` goes out of scope, or when the `File Storage` to which they belong is closed.

**[SWS_PER_00425]**

*Upstream requirements:* RS_PER_00001

⌈When a `File Storage` is closed, because all related `ara::per::SharedHandle`s go out of scope, any `files` which are still open are also closed.⌋

Accessing a `ara::per::UniqueHandle` of a `file` of a closed `File Storage` will result in undefined behavior.

### 7.2.3 Security Concepts

The Persistency supports protection of the authenticity and confidentiality of data stored in a Key-Value Storage or File Storage. Which kind of protection is applied and the used algorithms are decided during Target Configuration. The Persistency user is not aware of this fact.

If confidentiality of data shall be protected, a storage or an element of a storage are encrypted after the creation of the storage and when the storage is saved, and are decrypted when a storage is opened. Therefore, only encrypted data is stored persistently. In case of a read-only storage, encryption is done only once during installation, decryption is done every time the storage is opened. In case of a write-only-once storage, pre-installed elements are encrypted once during installation, and also all other elements are encrypted only once when they are created, while decryption is done every time the storage is opened.

If authenticity of data shall be protected, a message authentication code (MAC) is generated after the creation of a storage and when the storage is saved, and verified when the storage is opened. Therefore, unauthorized modifications to the storage can be detected.

In case of a read-only or write-only-once storage, it is also possible to protect the authenticity of the storage (or an element therein) by calculating a hash value of the data to be protected and comparing this calculated value to a hash value provided in the Target Configuration. For read-only storages, protection can be applied to the whole storage or single elements, while for write-only-once storages, only single elements can be protected. This feature assumes that the authenticity of the processed Target Configuration is protected using other mechanisms (like secure boot).

If authenticity and confidentiality shall be protected, authenticated encryption schemes (like AES GCM) can be used.

**[SWS_PER_00210]**

*Upstream requirements:* RS_PER_00005, RS_PER_00010

⌈If PersistencyCommon.PersistencyCryptoKeySlotProps is configured and PersistencyCryptoKeySlotProps.CryptoKeySlotUsage is set to ENCRYPTION, the Persistency shall encrypt all data related to the storage using the algorithm specified by PersistencyCryptoKeySlotProps.CryptoAlgorithm before storing it to the persistent memory.⌋

**[SWS_PER_00464]**

*Upstream requirements:* RS_PER_00005, RS_PER_00010

⌈If a PersistencyKeyValuePair.PersistencyCryptoKeySlotProps or PersistencyFile.PersistencyCryptoKeySlotProps is configured and PersistencyCryptoKeySlotProps.CryptoKeySlotUsage is set to ENCRYPTION, the Persistency shall encrypt the element data using the algorithm specified by Per-

sistencyCryptoKeySlotProps.CryptoAlgorithm before storing it to the persistent memory.⌋

**[SWS_PER_00211]**

*Upstream requirements:* RS_PER_00005, RS_PER_00010

⌈If a PersistencyCommon.PersistencyCryptoKeySlotProps is configured and PersistencyCryptoKeySlotProps.CryptoKeySlotUsage is set to ENCRYPTION, the Persistency shall decrypt all data related to the storage using the algorithm specified by PersistencyCryptoKeySlotProps.CryptoAlgorithm after reading it from persistent memory.⌋

**[SWS_PER_00465]**

*Upstream requirements:* RS_PER_00005, RS_PER_00010

⌈If a PersistencyKeyValuePair.PersistencyCryptoKeySlotProps or PersistencyFile.PersistencyCryptoKeySlotProps is configured and PersistencyCryptoKeySlotProps.CryptoKeySlotUsage is set to ENCRYPTION, the Persistency shall decrypt the element data using the algorithm specified by PersistencyCryptoKeySlotProps.CryptoAlgorithm after reading it from persistent memory.⌋

**[SWS_PER_00449]**

*Upstream requirements:* RS_PER_00019, RS_PER_00010

⌈If a PersistencyCommon.PersistencyCryptoKeySlotProps is configured and PersistencyCryptoKeySlotProps.CryptoKeySlotUsage is set to VERIFICATION, the Persistency shall create and store a message authentication code (MAC) for all data related to the storage using the algorithm specified by PersistencyCryptoKeySlotProps.CryptoAlgorithm when storing it to the persistent memory.⌋

**[SWS_PER_00466]**

*Upstream requirements:* RS_PER_00019, RS_PER_00010

⌈If a PersistencyKeyValuePair.PersistencyCryptoKeySlotProps or PersistencyFile.PersistencyCryptoKeySlotProps is configured and PersistencyCryptoKeySlotProps.CryptoKeySlotUsage is set to VERIFICATION, the Persistency shall create and store a message authentication code (MAC) for the element data using the algorithm specified by PersistencyCryptoKeySlotProps.CryptoAlgorithm when storing it to the persistent memory.⌋

**[SWS_PER_00450]**

*Upstream requirements:* RS_PER_00019, RS_PER_00010

⌈If a PersistencyCommon.PersistencyCryptoKeySlotProps is configured and PersistencyCryptoKeySlotProps.CryptoKeySlotUsage is set to VERIFICATION, the Persistency shall verify the MAC of all data related to the storage

using the algorithm specified by PersistencyCryptoKeySlotProps.CryptoAlgorithm after reading it from persistent memory.⌋

**[SWS_PER_00467]**

*Upstream requirements:* RS_PER_00019, RS_PER_00010

⌈If a PersistencyKeyValuePair.PersistencyCryptoKeySlotProps or PersistencyFile.PersistencyCryptoKeySlotProps is configured and PersistencyCryptoKeySlotProps.CryptoKeySlotUsage is set to VERIFICATION, the Persistency shall verify the MAC of the element data using the algorithm specified by PersistencyCryptoKeySlotProps.CryptoAlgorithm after reading it from persistent memory.⌋

**[SWS_PER_00451]**

*Upstream requirements:* RS_PER_00019, RS_PER_00010

⌈If PersistencyCommon.PersistencyCryptoKeySlotProps.CryptoVerificationHash is available, the Persistency shall calculate a hash value over all data related to the storage using the hash algorithm specified by PersistencyCryptoKeySlotProps.CryptoAlgorithm and verify that the calculated hash value matches PersistencyCryptoKeySlotProps.CryptoVerificationHash.⌋

**[SWS_PER_00468]**

*Upstream requirements:* RS_PER_00019, RS_PER_00010

⌈If PersistencyKeyValuePair.PersistencyCryptoKeySlotProps.CryptoVerificationHash or PersistencyFile.PersistencyCryptoKeySlotProps.CryptoVerificationHash is available, the Persistency shall calculate a hash value over the element data using the hash algorithm specified by PersistencyCryptoKeySlotProps.CryptoAlgorithm and verify that the calculated hash value matches PersistencyCryptoKeySlotProps.CryptoVerificationHash.⌋

The Persistency will use the services of the Cryptography [10] for all cryptographic operations.

### 7.2.4 Redundancy Concepts

The Persistency shall take care of the integrity of the stored data, both for safety purposes and to prevent data loss. This can be achieved by calculating CRCs or hash values of the stored data, and by creating redundant copies. All these measures effectively create some redundancy for the stored data. The concrete measures to be taken are configurable: The application designer can use PersistencyInterface.redundancy to request redundancy (by setting it to redundant or redundantPerElement), or use PersistencyInterface.redundancyHandling to preselect the actual measures to be taken. In the Target Configuration, the integrator can define the actual measures taken to ensure data integrity using PersistencyRedundancyHandlings. If PersistencyInterface.redundancyHandling is configured, the integrator shall use it as a guidance, but may also choose other, more appropriate measures based on superior knowledge of the final system.

**[SWS_PER_00317]**

*Upstream requirements:* RS_PER_00008, RS_PER_00009, RS_PER_00010

⌈The Persistency shall store redundant information for every storage represented by PersistencyKeyValueStorage or PersistencyFileStorage where PersistencyRedundancyHandling is configured.⌋

The actual handling of the redundancy configured during Target Configuration is described in the following sections, see also [SWS_PER_00318], [SWS_PER_00319], and [SWS_PER_00447].

**[SWS_PER_00221]**

*Upstream requirements:* RS_PER_00008

⌈Persistency shall check the redundant data when accessing stored data. When the stored data is corrupted, Persistency shall try to restore it using the available redundancy. If Persistency is not able to recover using the redundancy, it shall report kValidationFailed.⌋

Depending on the actual implementation, Persistency might access the stored data at different times, e.g. when ara::core::Initialize is called, when a Key-Value Storage is opened, or when a file is accessed. The question whether the redundancy is sufficient for recovery is also implementation specific and can only be safely assumed for PersistencyRedundancyMOutOfN.

When the recovery failed, the Persistency user can choose to use ara::per::RecoverKeyValueStorage, ara::per::KeyValueStorage::RecoverKey, ara::per::RecoverAllFiles, or ara::per::FileStorage::RecoverFile to recover as much as possible and set the corresponding Key-Value Storage or File Storage again into a consistent state.

**[SWS_PER_00452]**

*Upstream requirements:* RS_PER_00009

⌈When `ara::per::RecoverKeyValueStorage` is called, `Persistency` shall restore the `Key-Value Storage` to a consistent state, including `redundancy`. First, the infrastructure of the whole `Key-Value Storage` shall be restored, then `Persistency` shall try to recover all `key-value pairs` available in the `Key-Value Storage` as described in [SWS_PER_00453]. Depending on available information, the whole `Key-Value Storage` might be reset to the initial state as described in [SWS_PER_00456], losing all updated `values` of its `key-value pairs`, or may contain outdated `key-value pairs` after the operation.⌋

**[SWS_PER_00547]**

*Upstream requirements:* RS_AP_00128

⌈When `ara::per::KeyValueStorage::RecoverKey` is called, `Persistency` shall first check whether the `key-value pair` is present in any instance of the `Key-Value Storage`, and otherwise return directly with `kKeyNotFound`.⌋

**[SWS_PER_00453]**

*Upstream requirements:* RS_PER_00009

⌈When `ara::per::KeyValueStorage::RecoverKey` is called for an existing `key-value pair`, `Persistency` shall try to restore the given `key` to a consistent state, including `redundancy`. Depending on available information, the `key` might be removed, reset to the initial `value` as described in [SWS_PER_00477], or might contain an outdated `value` after the operation.⌋

**[SWS_PER_00454]**

*Upstream requirements:* RS_PER_00009

⌈When `ara::per::RecoverAllFiles` is called, `Persistency` shall restore the `File Storage` to a consistent state, including `redundancy`. First, the infrastructure of the whole `File Storage` shall be restored as described in [SWS_PER_00478], then `Persistency` shall try to recover all currently available `files` as described in [SWS_PER_00455]. Depending on available information, the whole `File Storage` might be reset to the initial state, losing all updated content of its `files`, or may contain outdated `files` after the operation.⌋

**[SWS_PER_00548]**

*Upstream requirements:* RS_AP_00128

⌈When `ara::per::FileStorage::RecoverFile` is called, `Persistency` shall first check whether the `file` is present in the `File Storage`, and otherwise return directly with `kFileNotFound`.⌋

**[SWS_PER_00455]**

*Upstream requirements:* RS_PER_00009

⌈When `ara::per::FileStorage::RecoverFile` is called for an existing `file`, `Persistency` shall try to restore the given `file` to a consistent state, including `redundancy`. Depending on available information, the `file` might be removed, reset to the initial state as described in [SWS_PER_00479], or might contain outdated content after the operation.⌋

Of course the `Persistency user` has to validate the restored data in this case.

Or it can use `ara::per::ResetPersistency` (see [SWS_PER_00556]), `ara::per::ResetKeyValueStorage` (see [SWS_PER_00456]), `ara::per::KeyValueStorage::ResetKey` (see [SWS_PER_00477]), `ara::per::ResetAllFiles` (see [SWS_PER_00478]), or `ara::per::FileStorage::ResetFile` (see [SWS_PER_00479]) to reset the corrupted item to the initial state according to the current `Target Configuration`.

The `Adaptive Application` may want to monitor its `storages` for any problem detected by `redundancy`, even if `Persistency` is able to recover by itself. This might be required to e.g. get an early indication of hardware problems or for safety critical `Adaptive Applications`. This monitoring is supported by `Persistency`, which will trigger a callback function of the `Adaptive Application` in case of any problems with the `storages`. To activate this monitoring, the `Adaptive Application` has to register that callback function using `ara::per::RegisterRecoveryReportCallback`.

**[SWS_PER_00480]**

*Upstream requirements:* RS_PER_00008

⌈When `ara::per::RegisterRecoveryReportCallback` is called, `Persistency` shall register the provided function and enable reporting of `redundancy` problems in all `storages` of this `Persistency user`.⌋

`Persistency` may check `redundancy` at different places, e.g. when `ara::core::Initialize` is called, when a `storage` is opened, or when `elements` of the `storage` are accessed. Whenever a problem is detected with `redundancy`, independently of the situation in which the problem appeared or whether the problem could be handled, `Persistency` will inform the `Adaptive Application` about these problems via the registered callback, stating `kKeyValueStorageRecovered`, `kKeyRecovered`, `kFileStorageRecovered`, or `kFileRecovered` when recovery of a `Key-Value Storage`, a `File Storage`, a `key-value pair`, or a `file` was possible, and `kKeyValueStorageRecoveryFailed`, `kKeyRecoveryFailed`, `kFileStorageRecoveryFailed`, or `kFileRecoveryFailed` if not. The callback also reports the affected `storage`, the affected `elements`, and how many copies of these `elements` were affected (the latter only in case `PersistencyRedundancyMOutOfN` is configured).

**[SWS_PER_00481]**

*Upstream requirements:* RS_PER_00008

⌈When a Key-Value Storage is accessed, and a redundancy problem affecting the whole Key-Value Storage is detected that cannot be handled by Persistency (i.e. kValidationFailed is returned), Persistency shall call the registered callback with storage set to the ara::core::InstanceSpecifier of the Key-Value Storage, recoveryReportKind set to kKeyValueStorageRecoveryFailed, an empty ara::core::Vector for reportedElements, and an ara::core::Vector with the indices of the affected redundant instances of the Key-Value Storage in reportedInstances.⌋

**[SWS_PER_00482]**

*Upstream requirements:* RS_PER_00008

⌈When a Key-Value Storage is accessed, and a redundancy problem affecting the whole Key-Value Storage is detected that can be handled by Persistency (i.e. the operation succeeds), Persistency shall call the registered callback with storage set to the ara::core::InstanceSpecifier of the Key-Value Storage, recoveryReportKind set to kKeyValueStorageRecovered, an empty ara::core::Vector for reportedElements, and an ara::core::Vector with the indices of the affected redundant instances of the Key-Value Storage in reportedInstances.⌋

**[SWS_PER_00483]**

*Upstream requirements:* RS_PER_00008

⌈When a File Storage is accessed, and a redundancy problem affecting the whole File Storage is detected that cannot be handled by Persistency (i.e. kValidationFailed is returned), Persistency shall call the registered callback with storage set to the ara::core::InstanceSpecifier of the File Storage, recoveryReportKind set to kFileStorageRecoveryFailed, an empty ara::core::Vector for reportedElements, and an ara::core::Vector with the indices of the affected redundant instances of the File Storage in reportedInstances.⌋

**[SWS_PER_00484]**

*Upstream requirements:* RS_PER_00008

⌈When a File Storage is accessed, and a redundancy problem affecting the whole File Storage is detected that can be handled by Persistency (i.e. the operation succeeds), Persistency shall call the registered callback with storage set to the ara::core::InstanceSpecifier of the File Storage, recoveryReportKind set to kFileStorageRecovered, an empty ara::core::Vector for reportedElements, and an ara::core::Vector with the indices of the affected redundant instances of the File Storage in reportedInstances.⌋

**[SWS_PER_00485]**

*Upstream requirements:* RS_PER_00008

⌈When a Key-Value Storage or one of its keys is accessed, and a redundancy problem affecting a set of keys is detected that cannot be handled by Persistency (i.e. kValidationFailed is returned), Persistency shall call the registered callback with storage set to the ara::core::InstanceSpecifier of the Key-Value Storage, recoveryReportKind set to kKeyRecoveryFailed, an ara::core::Vector with the affected keys in reportedElements, and an ara::core::Vector with the indices of the affected redundant instances of the keys in reportedInstances.⌋

**[SWS_PER_00486]**

*Upstream requirements:* RS_PER_00008

⌈When a Key-Value Storage or one of its keys is accessed, and a redundancy problem affecting a set of keys is detected that can be handled by Persistency (i.e. the operation succeeds), Persistency shall call the registered callback with storage set to the ara::core::InstanceSpecifier of the Key-Value Storage, recoveryReportKind set to kKeyRecovered, an ara::core::Vector with the affected keys in reportedElements, and an ara::core::Vector with the indices of the affected redundant instances of the keys in reportedInstances.⌋

**[SWS_PER_00487]**

*Upstream requirements:* RS_PER_00008

⌈When a redundancy problem of single keys is reported according to [SWS_PER_00485] or [SWS_PER_00486], Persistency shall in general ensure that each entry in reportedElements matches an entry in reportedInstances at the same positions, the two ara::core::Vectors shall have the same size. If several instances of a key are affected, the key may appear several times in reportedElements. As an optimization, if only one key is affected, reportedElements may contain the affected key as single entry, related to all entries of reportedInstances.⌋

**[SWS_PER_00488]**

*Upstream requirements:* RS_PER_00008

⌈When a File Storage or one of its files is accessed, and a redundancy problem affecting a set of files is detected that cannot be handled by Persistency (i.e. kValidationFailed is returned), Persistency shall call the registered callback with storage set to the ara::core::InstanceSpecifier of the File Storage, recoveryReportKind set to kFileRecoveryFailed, an ara::core::Vector with the affected files in reportedElements, and an ara::core::Vector with the indices of the affected redundant instances of the files in reportedInstances.⌋

**[SWS_PER_00489]**

*Upstream requirements:* RS_PER_00008

⌈When a File Storage or one of its files is accessed, and a redundancy problem affecting a set of files is detected that can be handled by Persistency (i.e. the operation succeeds), Persistency shall call the registered callback with storage set to the ara::core::InstanceSpecifier of the File Storage, recoveryReportKind set to kFileRecovered, an ara::core::Vector with the affected files in reportedElements, and an ara::core::Vector with the indices of the affected redundant instances of the files in reportedInstances.⌋

**[SWS_PER_00490]**

*Upstream requirements:* RS_PER_00008

⌈When a redundancy problem of single file is reported according to [SWS_PER_00488] or [SWS_PER_00489], Persistency shall in general ensure that each entry in reportedElements matches an entry in reportedInstances at the same positions, the two ara::core::Vectors shall have the same size. If several instances of a file are affected, the file may appear several times in reportedElements. As an optimization, if only one file is affected, reportedElements may contain the affected file as single entry, related to all entries of reportedInstances.⌋

#### 7.2.4.1 Redundancy Types

The type of redundancy that is applied by the Persistency is defined by the set of PersistencyRedundancyHandlings that are configured for a storage. The level to which redundancy is applied is defined by the possible values of the PersistencyRedundancyHandling.PersistencyRedundancyHandlingScope, which are SCOPE_STORAGE and SCOPE_ELEMENT for a Key-Value Storage and its key-value pairs, or a File Storage and its files, respectively.

**[SWS_PER_00318]**

*Upstream requirements:* RS_PER_00008, RS_PER_00009, RS_PER_00010

⌈In case a PersistencyRedundancyHandling contains PersistencyRedundancyChecksum that in turn contains PersistencyRedundancyCrc, the Persistency shall calculate a CRC value when persisting the storage or an element of the storage (depending on PersistencyRedundancyHandling.PersistencyRedundancyHandlingScope), and shall use this CRC to check the storage or the element when it is read back.⌋

**[SWS_PER_00439]**

*Upstream requirements:* RS_PER_00008, RS_PER_00009, RS_PER_00010

⌈Persistency shall calculate the CRC value using the algorithm defined by PersistencyRedundancyChecksum.RedundancyChecksumAlgorithmFamily with the

bit width defined by PersistencyRedundancyChecksum.RedundancyChecksumLength.⌋

**[SWS_PER_00319]**

*Upstream requirements:* RS_PER_00008, RS_PER_00009, RS_PER_00010

⌈In case a PersistencyRedundancyHandling contains PersistencyRedundancyMOutOfN, the Persistency shall store N copies when persisting the storage or an element of the storage (depending on PersistencyRedundancyHandling.PersistencyRedundancyHandlingScope), and shall check that at least M of the N copies of the storage or the element are identical when it is read back. N is defined by PersistencyRedundancyMOutOfN.RedundancyN, and M is defined by PersistencyRedundancyMOutOfN.RedundancyM.⌋

It is possible to configure more than one UriCollection.Uri for a storage that uses PersistencyRedundancyMOutOfN. In this case, the copies will be distributed over the different locations. The existence of multiple URIs for a single storage is limited to this case by [constr_10366].

**[SWS_PER_00555]**

*Upstream requirements:* RS_PER_00008, RS_PER_00009, RS_PER_00010

⌈In case multiple UriCollection.Uris exist, and PersistencyRedundancyHandling.PersistencyRedundancyHandlingScope is SCOPE_STORAGE, Persistency shall store the copies of the storage in the different locations as follows:

**2** The first location contains the main copy, the second location contains all other copies.

**n** (== RedundancyN) Each copy is placed in a separate location.

⌋

**[SWS_PER_00447]**

*Upstream requirements:* RS_PER_00008, RS_PER_00009, RS_PER_00010

⌈In case a PersistencyRedundancyHandling contains PersistencyRedundancyChecksum that in turn contains PersistencyRedundancyHash, the Persistency shall calculate a hash value when persisting the storage or an element of the storage (depending on PersistencyRedundancyHandling.PersistencyRedundancyHandlingScope), and shall use this hash value to check the storage or the element when it is read back.⌋

**[SWS_PER_00448]**

*Upstream requirements:* RS_PER_00008, RS_PER_00009, RS_PER_00010

⌈Persistency shall calculate the hash value using the algorithm defined by PersistencyRedundancyChecksum.RedundancyChecksumAlgorithmFamily with the bit width defined by PersistencyRedundancyChecksum.RedundancyChecksumLength. If PersistencyRedundancyHash.InitializationVec-

torLength is configured, an initialization vector of this length shall be calculated containing random data and passed to the hash algorithm.⌋

A possible approach to calculate the hash value and the random data would be to use the Cryptography [10]. The integration will have to take care that the configured PersistencyRedundancyChecksum.RedundancyChecksumLength and PersistencyRedundancyHash.InitializationVectorLength are supported by the configured PersistencyRedundancyChecksum.RedundancyChecksumAlgorithmFamily.

### 7.2.5 Installation and Update of Persistent Data

The Update and Configuration Management [8] handles the life cycle of Adaptive Applications with the following phases:

- Installation of new software
- Update of already installed software
- Finalization of updated software after the update succeeded
- Roll-back of updated software after the update failed
- Removal of installed software

For all these phases, persistent data needs to be handled alongside the Adaptive Application. The Adaptive Application may trigger this handling explicitly by calling ara::per::UpdatePersistency during the verification phase that follows the installation or update, or rely on the Persistency to do this implicitly when persistent data is accessed (ara::per::OpenKeyValueStorage/ara::per::OpenFileStorage). In both cases, the Persistency will compare a previously stored contract version and Target Configuration version against the contract version and Target Configuration version of the current Target Configuration, and perform the required action.

Persistency stores information about already installed storages together with version information in a central location.

**[SWS_PER_00463]**
*Upstream requirements:* RS_PER_00010, RS_PER_00012, RS_PER_00013, RS_PER_00014, RS_PER_00016

⌈Persistency shall store information about the installed Key-Value Storages and File Storages in the location denoted by PersistencyGeneral.PersistencyCentralStorageUri for the Process referenced by PersistencyGeneral.ForeignProcessRef. It shall also store the contract version and Target Configuration version of the current Target Configuration in this location.⌋

The Update and Configuration Management can also deploy independent updates of configuration data, if SoftwarePackage.actionType is set to updateConfiguration. Such a configuration update can also include Persistency Target Configuration data. To detect this situation, an Adaptive Application can poll for updates of the Target Configuration using ara::per::CheckForManifestUpdate.

**[SWS_PER_00580] Check for Target Configuration Update**
*Upstream requirements:* RS_PER_00010, RS_PER_00013

⌈When ara::per::CheckForManifestUpdate is called, Persistency shall compare the Target Configuration version of the stored Target Config-

uration against the version that was read during initialization. If the stored version is higher, ara::per::CheckForManifestUpdate shall return true, otherwise false.⌋

When an update is reported, the Adaptive Application can use ara::per::ReloadPersistencyManifest to initiate a re-read of the Target Configuration data, and after that it may trigger an update using ara::per::UpdatePersistency after closing all storages, or simply close and re-open each storage individually.

**[SWS_PER_00581] Reload Persistency Target Configuration**

*Upstream requirements:* RS_PER_00010, RS_PER_00013

⌈When ara::per::ReloadPersistencyManifest is called, Persistency shall reload the Target Configuration data and flag all storages for an update if the Target Configuration version was incremented.⌋

**[SWS_PER_00469]**

*Upstream requirements:* RS_PER_00010, RS_PER_00012, RS_PER_00013, RS_PER_00014

⌈When ara::per::UpdatePersistency is called, the Persistency shall follow [SWS_PER_00382] (for installation), [SWS_PER_00386] and [SWS_PER_00387] (for update), or [SWS_PER_00396] (for roll-back) for each storage configured as PersistencyKeyValueStorage or PersistencyFileStorage in the Target Configuration data.⌋

**[SWS_PER_00470]**

*Upstream requirements:* RS_PER_00010, RS_PER_00012, RS_PER_00013, RS_PER_00014, RS_PER_00016

⌈When a Key-Value Storage is opened by the Persistency user using ara::per::OpenKeyValueStorage, the Persistency shall follow [SWS_PER_00382] (for installation), [SWS_PER_00386] and [SWS_PER_00387] (for update), [SWS_PER_00446] (for finalization), or [SWS_PER_00396] (for roll-back) for this Key-Value Storage configured as PersistencyKeyValueStorage in the Target Configuration data.⌋

**[SWS_PER_00471]**

*Upstream requirements:* RS_PER_00010, RS_PER_00012, RS_PER_00013, RS_PER_00014, RS_PER_00016

⌈When a File Storage is opened by the Persistency user using ara::per::OpenFileStorage, the Persistency shall follow [SWS_PER_00382] (for installation), [SWS_PER_00386] and [SWS_PER_00387] (for update), [SWS_PER_00446] (for finalization), or [SWS_PER_00396] (for roll-back) for each File Storage configured as PersistencyFileStorage in the Target Configuration data.⌋

**[SWS_PER_00378]**

*Upstream requirements:* RS_PER_00010, RS_PER_00013, RS_PER_00014

⌈Persistency shall extract the contract version (PersistencyInterface.contractVersion or PersistencyCommon.ContractVersion) and the Target Configuration version (PersistencyCommon.Version) from the Target Configuration, and store them persistently in the location denoted by PersistencyGeneral.PersistencyCentralStorageUri.⌋

The contract version is used by Persistency to detect a change of the Adaptive Application (see [SWS_PER_00387]), while the Target Configuration version is used to detect a change of the deployed persistent data (see [SWS_PER_00386] and [SWS_PER_00396]).

**[SWS_PER_CONSTR_00001]** ⌈When the contract version (PersistencyInterface.contractVersion or PersistencyCommon.ContractVersion) is increased, the Target Configuration version (PersistencyCommon.Version) needs to be increased, too.⌋

The Target Configuration version is based on ApmcStrongRevisionLabelParamDef and contract version is a StrongRevisionLabelString. All these strings consists of a MajorVersion, a MinorVersion, a PatchVersion, and additional labels for pre-release versions and build information. It is assumed that at least one of the first three will be incremented when the version is changed, while the additional labels might be arbitrary.

**[SWS_PER_CONSTR_00002]** ⌈When the Target Configuration version (PersistencyCommon.Version) or contract version (PersistencyInterface.contractVersion or PersistencyCommon.ContractVersion) is increased, the MajorVersion, MinorVersion, or PatchVersion have to be incremented.⌋

After installation of the Adaptive Application, the Persistency will install predefined persistent data from the Application Design and Target Configuration. There are different possibilities how this persistent data can be defined in the Application Design and Target Configuration:

- Persistent data can be defined by an application designer within PersistencyKeyValueStorageInterface or PersistencyFileStorageInterface.
- Persistent data that was defined by an application designer can be changed and fine-tuned by an integrator within PersistencyKeyValueStorage or PersistencyFileStorage.
- Persistent data can be directly defined by an integrator within PersistencyKeyValueStorage or PersistencyFileStorage.

**[SWS_PER_00379]**

*Upstream requirements:* RS_PER_00010, RS_PER_00012, RS_PER_00013

⌈`Elements` defined in the `PersistencyKeyValuePair` or `PersistencyFile` shall always be preferred over the `elements` defined in the `Application Design` (`PersistencyInterfaceElement`). The latter shall only be used if the former does not exist.⌋

After an update of the `Adaptive Application` or the `Target Configuration`, the `Persistency` will create a backup of the `persistent data`, and then update the existing `persistent data` using one of the following strategies:

- Existing `persistent data` is kept unchanged (`KEEP_EXISTING`/`keepExisting`).
- Existing `persistent data` is replaced (`OVERWRITE`/`overwrite`).
- Existing `persistent data` is removed (`DELETE`/`delete`).
- New `persistent data` is added (`KEEP_EXISTING`/`keepExisting` and `OVERWRITE`/`overwrite`).

The update strategy can be set during `Application Design` or `Target Configuration`, and can be defined for the whole `Key-Value Storage` or `File Storage` and for a single `key-value pair` or `file`. During `Application Design`, the update strategy can be set to `keepExisting` or `delete` (of `PersistencyCollectionLevelUpdateStrategyEnum`) for a `storage` and to `keepExisting`, `overwrite`, or `delete` (of `PersistencyElementLevelUpdateStrategyEnum`) for an `element`. During `Target Configuration`, the update strategy can be set to `KEEP_EXISTING` or `DELETE` (in `PersistencyCommon.UpdateStrategy`) for a `storage` and to `KEEP_EXISTING`, `OVERWRITE`, or `DELETE` (in `PersistencyKeyValuePair.ElementUpdateStrategy` or `PersistencyFile.ElementUpdateStrategy`) for an `element`.

**[SWS_PER_00251]**

*Upstream requirements:* RS_PER_00010, RS_PER_00012, RS_PER_00013

⌈An update strategy defined in the `Target Configuration` data (`PersistencyKeyValuePair.ElementUpdateStrategy` or `PersistencyFile.ElementUpdateStrategy`) shall always be preferred over the update strategy defined in the application design (`PersistencyInterfaceElement.updateStrategy`). The latter shall only be used if the former does not exist.⌋

`PersistencyCommon.UpdateStrategy` is a mandatory parameter and therefore `PersistencyInterface.updateStrategy` is just a recommendation for the `Target Configuration` and never used by `Persistency`.

**[SWS_PER_00380]**

*Upstream requirements:* RS_PER_00010, RS_PER_00012, RS_PER_00013

⌈An update strategy defined for a single element (PersistencyKeyValuePair.ElementUpdateStrategy or PersistencyFile.ElementUpdateStrategy, PersistencyInterfaceElement.updateStrategy) shall always be preferred over the update strategy defined for the enclosing storage (PersistencyCommon.UpdateStrategy). The latter shall only be used if the former does not exist.⌋

When the update succeeded, the Update and Configuration Management will finalize the new Adaptive Application. The Persistency will free the resources allocated by the last backup when it is opened the first time after the update succeeded.

When the update failed, the Update and Configuration Management will revert to the old Adaptive Application and/or Target Configuration. The Persistency will then replace the currently used persistent data by the backup created during the update.

The Adaptive Application can always reset its storages or single elements of the storages to their initial state, using ara::per::ResetPersistency, ara::per::ResetKeyValueStorage, ara::per::KeyValueStorage::ResetKey, ara::per::ResetAllFiles, or ara::per::FileStorage::ResetFile.

**[SWS_PER_00556]**

*Upstream requirements:* RS_PER_00009, RS_PER_00010, RS_PER_00012

⌈When ara::per::ResetPersistency is called, Persistency shall reset all Key-Value Storages and File Storages to the state they would have after installation of the Adaptive Application using the current Target Configuration.⌋

**[SWS_PER_00456]**

*Upstream requirements:* RS_PER_00009, RS_PER_00010, RS_PER_00012

⌈When ara::per::ResetKeyValueStorage is called, Persistency shall reset the Key-Value Storage to the state it would have after installation of the Adaptive Application using the current Target Configuration.⌋

**[SWS_PER_00572]**

*Upstream requirements:* RS_PER_00009, RS_PER_00010, RS_PER_00012

⌈When ara::per::KeyValueStorage::ResetKey is called, Persistency shall first check whether the key-value pair is present in the Target Configuration, and otherwise return directly with kInitValueNotAvailable.⌋

**[SWS_PER_00477]**

*Upstream requirements:* RS_PER_00009, RS_PER_00010, RS_PER_00012

⌈When ara::per::KeyValueStorage::ResetKey is called for a key-value pair that is present in the Target Configuration, Persistency shall reset the

given key to the state it would have after installation of the Adaptive Application using the current Target Configuration.⌋

**[SWS_PER_00478]**

*Upstream requirements:* RS_PER_00009, RS_PER_00010, RS_PER_00012

⌈When ara::per::ResetAllFiles is called, Persistency shall reset the File Storage to the state it would have after installation of the Adaptive Application using the current Target Configuration.⌋

**[SWS_PER_00573]**

*Upstream requirements:* RS_PER_00009, RS_PER_00010, RS_PER_00012

⌈When ara::per::FileStorage::ResetFile is called, Persistency shall first check whether the file is present in the Target Configuration, and otherwise return directly with kInitValueNotAvailable.⌋

**[SWS_PER_00479]**

*Upstream requirements:* RS_PER_00009, RS_PER_00010, RS_PER_00012

⌈When ara::per::FileStorage::ResetFile is called for a file that is present in the Target Configuration, Persistency shall reset the given file to the state it would have after installation of the Adaptive Application using the current Target Configuration.⌋

Finally, when the Adaptive Application is removed, the Update and Configuration Management is responsible to remove the related persistent data as well.

#### 7.2.5.1 Installation of Persistent Data

**[SWS_PER_00382]**

*Upstream requirements:* RS_PER_00010, RS_PER_00012

⌈When a storage is opened by the Persistency user, the Persistency shall check for the existence of any persistent data of this Process. If no persistent data is found, the Persistency shall initialize the persistent data.⌋

Initialization of persistent data is described in Chapter 7.2.5.1.1 and Chapter 7.2.5.1.2.

To be able to update Persistency with changed redundancy, Persistency stores the information about the used redundancy measures within the metadata of each storage. The same applies to the used keys and algorithms for encryption and authentication.

**[SWS_PER_00558]**

*Upstream requirements:* RS_PER_00008, RS_PER_00010, RS_PER_00012

⌈When a new storage is installed, Persistency shall store the information about the used redundancy in the metadata of the storage.⌋

**[SWS_PER_00559]**

*Upstream requirements:* RS_PER_00005, RS_PER_00010, RS_PER_00012

⌈When a new storage is installed, Persistency shall store the information about keys and algorithms used for encryption and authentication in the metadata of the storage.⌋

#### 7.2.5.1.1 Installation of Key-Value Storage

**[SWS_PER_00383] Creation of Key-Value Storages for the Adaptive Application during Installation**

*Upstream requirements:* RS_PER_00010, RS_PER_00012

⌈Persistency shall create a Key-Value Storage for each RPortPrototype typed by a PersistencyKeyValueStorageInterface that is found in the Application Design of a newly installed Adaptive Application.⌋

**[SWS_PER_00584] Creation of Key-Value Storages for other Functional Clusters during Installation**

*Upstream requirements:* RS_PER_00010, RS_PER_00012

⌈Persistency shall create a Key-Value Storage for each PersistencyKeyValueStorage without PersistencyCommon.PortPrototypeInstanceRef that is found in the Target Configuration of a newly installed Adaptive Application.⌋

The Key-Value Storages created by [SWS_PER_00383] are identified at run-time by the shortName path of the RPortPrototype, passed as ara::core::InstanceSpecifier to ara::per::OpenKeyValueStorage.

**[SWS_PER_00252]**

*Upstream requirements:* RS_PER_00010, RS_PER_00012

⌈Persistency shall create an entry in the Key-Value Storage for each PersistencyKeyValueStorageInterface.dataElement and PersistencyKeyValuePair that is found in the Target Configuration of a newly installed or updated Adaptive Application, and for which the update strategy is not delete/DELETE.⌋

Key-Value Storage entries are identified by the key. An entry with identical key might be defined both in the PersistencyKeyValueStorageInterface as dataElement and the PersistencyKeyValueStorage as PersistencyKey-

ValuePair, in which case [SWS_PER_00379] applies. The update strategy is determined according to [SWS_PER_00251] and [SWS_PER_00380].

**[SWS_PER_00253]**

*Upstream requirements:* RS_PER_00010, RS_PER_00012

⌈Entries in the Key-Value Storage shall use the shortName of the PersistencyDataElement and/or PersistencyKeyValuePair as key.⌋

**[SWS_PER_00254]**

*Upstream requirements:* RS_PER_00010, RS_PER_00012

⌈Entries in the Key-Value Storage shall be created with the data type defined by the CppImplementationDataType which types the PersistencyDataElement and/or by the CppImplementationDataType referenced by PersistencyKeyValuePair.ValueDataTypeRef.⌋

**[SWS_PER_00384]**

*Upstream requirements:* RS_PER_00010, RS_PER_00012

⌈Entries in the Key-Value Storage shall be created with the value taken from the ConstantSpecification referenced by PersistencyKeyValuePair.InitValueRef or, if that does not exist, from the PersistencyDataRequiredComSpec.initValue.⌋

**[SWS_PER_CONSTR_00003]** ⌈A Target Configuration is not valid if the value or data type of any PersistencyKeyValuePair or PersistencyDataElement cannot be determined, or if the determined data types are conflicting.⌋

Invalid Target Configurations should be rejected by the tooling.

#### 7.2.5.1.2 Installation of File Storage

**[SWS_PER_00385] Creation of File Storages for the Adaptive Application during Installation**

*Upstream requirements:* RS_PER_00010, RS_PER_00012

⌈Persistency shall create a File Storage for each RPortPrototype typed by a PersistencyFileStorageInterface that is found in the Application Design of a newly installed Adaptive Application.⌋

**[SWS_PER_00585] Creation of File Storages for other Functional Clusters during Installation**

*Upstream requirements:* RS_PER_00010, RS_PER_00012

⌈Persistency shall create a File Storage for each PersistencyFileStorage without PersistencyCommon.PortPrototypeInstanceRef that is found in the Target Configuration of a newly installed Adaptive Application.⌋

The File Storages created by [SWS_PER_00385] are identified at run-time by the shortName path of the RPortPrototype, passed as ara::core::InstanceSpecifier to ara::per::OpenFileStorage.

**[SWS_PER_00265]**

*Upstream requirements:* RS_PER_00010, RS_PER_00012

⌈Persistency shall create a file in the File Storage for each PersistencyFileStorageInterface.fileElement and PersistencyFile that is found in the Target Configuration of a newly installed or updated Adaptive Application, and for which the update strategy is not delete/DELETE.⌋

The files within a File Storage are identified by their file name. A file with the same file name might be defined both in the PersistencyFileStorageInterface as fileElement and the PersistencyFileStorage as PersistencyFile, in which case [SWS_PER_00379] applies. The update strategy is determined according to [SWS_PER_00251] and [SWS_PER_00380].

**[SWS_PER_00266]**

*Upstream requirements:* RS_PER_00010, RS_PER_00012

⌈Files in the File Storage shall use the file name identified by PersistencyFileElement.fileName and/or PersistencyFile.FileName.⌋

**[SWS_PER_00267] Creation of Files in the File Storage**

*Upstream requirements:* RS_PER_00010, RS_PER_00012

⌈Files in the File Storage shall be created with the content taken from the resource (within the installed SoftwarePackage) that is addressed by PersistencyFile.ContentUri or, if that does not exist, by PersistencyFileElement.contentUri. If that does not exist either, an empty file shall be created.⌋

**[SWS_PER_CONSTR_00004]** ⌈A Target Configuration is invalid if the shortNames of a PersistencyFileElement and a PersistencyFile with the same file name differs.⌋

Invalid Target Configurations should be rejected by the tooling.

#### 7.2.5.2 Update of Persistent Data

**[SWS_PER_00386]**

*Upstream requirements:* RS_PER_00010, RS_PER_00013

⌈When a storage is opened by the Persistency user, the Persistency shall compare the Target Configuration version (PersistencyCommon.Version) in the Target Configuration against the stored Target Configuration version. If the Target Configuration version in the Target Configuration is higher than the stored Target Configuration version, the Persistency shall first create a backup of all the persistent data of this Process and then update the data.⌋

Only one set of backup data needs to be kept at any time. When a new update is performed, old backup data could be overwritten. Update of persistent data is described in Chapter 7.2.5.2.1 and Chapter 7.2.5.2.2.

**[SWS_PER_00579] Register Data Update Indication**

*Upstream requirements:* RS_PER_00013

⌈If the Adaptive Application registered a function using ara::per::RegisterDataUpdateIndication, and if the Persistency had to update at least one of its storages according to [SWS_PER_00386], it shall call the registered function for each updated element of each storage that was updated according to [SWS_PER_00386], subject to the registered monitored storages and elements.⌋

**[SWS_PER_00387]**

*Upstream requirements:* RS_PER_00010, RS_PER_00013

⌈If the Adaptive Application registered a function using ara::per::RegisterApplicationDataUpdateCallback, and if the Persistency had to update at least one of its storages according to [SWS_PER_00386], it shall compare the contract version (PersistencyInterface.contractVersion or PersistencyCommon.ContractVersion) in the Target Configuration against the stored contract version. If the contract version in the Target Configuration is higher than the stored contract version, the Persistency shall call the registered function for each storage that was updated according to [SWS_PER_00386].⌋

The function registered by the Adaptive Application using ara::per::RegisterApplicationDataUpdateCallback can be used by the Adaptive Application to update elements of a storage manually. The storage is identified by the ara::core::InstanceSpecifier provided to this function. The Adaptive Application might then, based on the contract version of the stored data provided as second argument to the function, read in the stored data in the old format or with the old type, convert the data, and store it again with the new format or new type expected by the current contract version.

Example: Version $1$ of the Adaptive Application stored the maximum speed in $mph$ as uint8, but version $2$ expects the maximum speed in $km/h$ as uint16. The up-

date callback function will then see that a Key-Value Storage from version 1 of the Persistency has been updated to the current version, and can read in the old maximum speed by ara::per::KeyValueStorage::GetValue as uint8, convert it, and store it as uint16 with ara::per::KeyValueStorage::SetValue after removing the old value with ara::per::KeyValueStorage::RemoveKey.

In case the redundancy configuration or the configuration of encryption and authentication of the updated Target Configuration differs from the old Target Configuration, special care has to be taken to keep the data consistent and readable.

**[SWS_PER_00560]**

*Upstream requirements:* RS_PER_00008, RS_PER_00010, RS_PER_00013

⌈During the update, when the old storage is read, Persistency shall check the redundancy according to the information stored in the metadata of the storage.⌋

**[SWS_PER_00561]**

*Upstream requirements:* RS_PER_00008, RS_PER_00010, RS_PER_00013

⌈When the storage is persisted after the update, Persistency shall use the redundancy configured in the Target Configuration, and store the information about the used redundancy in the metadata of the storage.⌋

Please note that this means that in some situations redundant information might become obsolete and can be removed, e.g. when the new Target Configuration has a lower RedundancyN.

**[SWS_PER_00562]**

*Upstream requirements:* RS_PER_00005, RS_PER_00010, RS_PER_00013

⌈During the update, when the old storage is read, Persistency shall decrypt and verify the signature of the storage or the elements of the storage according to the information stored in the metadata of the storage.⌋

**[SWS_PER_00563]**

*Upstream requirements:* RS_PER_00005, RS_PER_00010, RS_PER_00013

⌈When the storage is persisted after the update, Persistency shall encrypt and sign the storage or the elements of the storage as configured in the Target Configuration, and store the information about the used keys and algorithms in the metadata of the storage.⌋

#### 7.2.5.2.1 Update of Key-Value Storage

**[SWS_PER_00388] Creation of Key-Value Storages for the Adaptive Application during Update**

*Upstream requirements:* RS_PER_00010, RS_PER_00013

⌈When a new RPortPrototype typed by a PersistencyKeyValueStorageInterface is detected in the Application Design of an updated Adaptive Application, the Persistency shall create a Key-Value Storage as specified in [SWS_PER_00383].⌋

**[SWS_PER_00586] Creation of Key-Value Storages for other Functional Clusters during Update**

*Upstream requirements:* RS_PER_00010, RS_PER_00013

⌈When a new PersistencyKeyValueStorage without PersistencyCommon.PortPrototypeInstanceRef is detected in an updated Target Configuration, the Persistency shall create a Key-Value Storage as specified in [SWS_PER_00584].⌋

**[SWS_PER_00389]**

*Upstream requirements:* RS_PER_00010, RS_PER_00013

⌈When a Key-Value Storage cannot be found in an updated Target Configuration (neither as RPortPrototype typed by a PersistencyKeyValueStorageInterface nor as PersistencyKeyValueStorage without PersistencyCommon.PortPrototypeInstanceRef), the Persistency shall remove the corresponding Key-Value Storage.⌋

**[SWS_PER_00390]**

*Upstream requirements:* RS_PER_00010, RS_PER_00013

⌈When a PersistencyKeyValueStorageInterface.dataElement and/or a PersistencyKeyValuePair with a new key is detected in an updated Target Configuration for which the update strategy is not delete/DELETE, the Persistency shall create a new entry in the Key-Value Storage as specified in [SWS_PER_00252], [SWS_PER_00253], [SWS_PER_00254], and [SWS_PER_00384].⌋

**[SWS_PER_00391]**

*Upstream requirements:* RS_PER_00010, RS_PER_00013

⌈When an existing key-value pair cannot be associated with any PersistencyKeyValueStorageInterface.dataElement or PersistencyKeyValuePair in an updated Target Configuration, and the update strategy of the PersistencyKeyValueStorage corresponding to the Key-Value Storage is DELETE, the Persistency shall remove that key-value pair from the Key-Value Storage.⌋

The update strategy is determined according to [SWS_PER_00251].

**[SWS_PER_00275]**

*Upstream requirements:* RS_PER_00010, RS_PER_00013

⌈When an existing key-value pair can be associated with a PersistencyKeyValueStorageInterface.dataElement or PersistencyKeyValuePair in an updated Target Configuration, and the update strategy is overwrite/OVERWRITE, the Persistency shall replace that key-value pair with the new type and value as specified in [SWS_PER_00254] and [SWS_PER_00384].⌋

An entry with identical key might be defined both in the PersistencyKeyValueStorageInterface and the PersistencyKeyValueStorage, in which case [SWS_PER_00379] applies. The update strategy is determined according to [SWS_PER_00251] and [SWS_PER_00380].

**[SWS_PER_00277]**

*Upstream requirements:* RS_PER_00010, RS_PER_00013

⌈When an existing key-value pair can be associated with a PersistencyKeyValueStorageInterface.dataElement or PersistencyKeyValuePair in an updated Target Configuration, and the update strategy is delete/DELETE, the Persistency shall remove that key-value pair from the Key-Value Storage.⌋

Updated key-value pairs with the update strategy keepExisting/KEEP_EXISTING will not be touched during an update. Persistency will neither check the value nor the type of the existing entry.

To support the conversion from one CppImplementationDataType to another (or to a different version of the same type) in the function registered using ara::per::RegisterApplicationDataUpdateCallback, Persistency provides the ability to read data types from a storage that are no longer used by the Adaptive Application. These types are configured in the Application Design as previousDataType of a PersistencyKeyValueDataTypeMapping that references a currently used type as currentDataType.

There are two scenarios in which such a conversion is necessary:

1. An existing data type has been modified for the new Adaptive Application. The data type still uses the same identifier.
2. A new data type was introduced that replaces a data type that is no longer used in the new Adaptive Application. The two data types have different identifiers.

**[SWS_PER_CONSTR_00005]** ⌈In case an existing data type is changed in a new Adaptive Application, Persistency expects PersistencyKeyValueDataTypeMappings referring to a copy of the old data type as previousDataType and the new data type as currentDataType. The name of the old data type shall be formed as follows:

<PersistencyKeyValueDataTypeMapping.currentDataType.shortName>_<PersistencyKeyValueDataTypeMapping.previousContractVersion>.⌋

#### 7.2.5.2.2 Update of File Storage

**[SWS_PER_00392] Creation of File Storages for the Adaptive Application during Update**

*Upstream requirements:* RS_PER_00010, RS_PER_00013

⌈When a new RPortPrototype typed by a PersistencyFileStorageInterface is detected in the Application Design of an updated Adaptive Application, the Persistency shall create a File Storage as specified in [SWS_PER_00385].⌋

**[SWS_PER_00587] Creation of File Storages for other Functional Clusters during Update**

*Upstream requirements:* RS_PER_00010, RS_PER_00013

⌈When a new PersistencyFileStorage without PersistencyCommon.PortPrototypeInstanceRef is detected in an updated Target Configuration, the Persistency shall create a File Storage as specified in [SWS_PER_00585].⌋

**[SWS_PER_00393]**

*Upstream requirements:* RS_PER_00010, RS_PER_00013

⌈When a File Storage cannot be found in an updated Target Configuration (neither as RPortPrototype typed by a PersistencyFileStorageInterface nor as PersistencyFileStorage without PersistencyCommon.PortPrototypeInstanceRef), the Persistency shall remove the corresponding File Storage.⌋

**[SWS_PER_00394]**

*Upstream requirements:* RS_PER_00010, RS_PER_00013

⌈When a PersistencyFileStorageInterface.fileElement and/or PersistencyFile with a new file name is detected in an updated Target Configuration for which the update strategy is not delete/DELETE, the Persistency shall create a new file in the File Storage as specified in [SWS_PER_00265], [SWS_PER_00266], and [SWS_PER_00267].⌋

**[SWS_PER_00395]**

*Upstream requirements:* RS_PER_00010, RS_PER_00013

⌈When an existing file cannot be associated with any PersistencyFileStorageInterface.fileElement or PersistencyFile in an updated Target Configuration, and the update strategy of the PersistencyFileStorage corresponding to the File Storage is delete/DELETE, the Persistency shall remove that file from the File Storage.⌋

The update strategy is determined according to [SWS_PER_00251].

**[SWS_PER_00281]**

*Upstream requirements:* RS_PER_00010, RS_PER_00013

⌈When an existing `file` can be associated with a `PersistencyFileStorageInterface.fileElement` or `PersistencyFile` in an updated `Target Configuration`, and the update strategy is `overwrite`/`OVERWRITE`, the `Persistency` shall replace the content of that `file` with the new content as specified in [SWS_PER_00267].⌋

A `file` with the same `file name` might be defined both in the `PersistencyFileStorageInterface` and the `PersistencyFileStorage`, in which case [SWS_PER_00379] applies. The update strategy is determined according to [SWS_PER_00251] and [SWS_PER_00380].

**[SWS_PER_00283]**

*Upstream requirements:* RS_PER_00010, RS_PER_00013

⌈When an existing `file` can be associated with a `PersistencyFileStorageInterface.fileElement` or `PersistencyFile` in an updated `Target Configuration`, and the update strategy is `delete`/`DELETE`, the `Persistency` shall remove that `file` from the `File Storage`.⌋

Updated `files` with the update strategy `keepExisting`/`KEEP_EXISTING` will not be touched during an update. `Persistency` will not check the content of the existing `file`.

### 7.2.5.3 Finalization of Persistent Data after Successful Update

After installation and update, `Persistency` will usually be called with `ara::per::UpdatePersistency` within the verification phase of the `Adaptive Application`. When this succeeded, the `Adaptive Application` will be finalized by `Update and Configuration Management` and then started again in normal execution mode. In this case, `Persistency` may remove any backups that were created during a preceding update. Because `Persistency` has different update strategies (all `storages` with `ara::per::UpdatePersistency` or single `storages` with `ara::per::OpenKeyValueStorage` and `ara::per::OpenFileStorage`), it is also up to the `Adaptive Application` to decide when the backup data shall be removed, by calling `ara::per::CleanUpPersistency`.

**[SWS_PER_00446]**

*Upstream requirements:* RS_PER_00016

⌈When `ara::per::CleanUpPersistency` is called by the `Adaptive Application`, the `Persistency` shall remove all backup data of the `storage`.⌋

Update of `persistent data` is described in Chapter 7.2.5.2.

#### 7.2.5.4 Roll-Back of Persistent Data after Failed Update

**[SWS_PER_00396]**

*Upstream requirements:* RS_PER_00014

⌈When a storage is opened by the Persistency user, the Persistency shall compare the Target Configuration version (PersistencyCommon.Version) in the Target Configuration against the stored Target Configuration version. If the Target Configuration version in the Target Configuration is lower than the stored Target Configuration version, the Persistency shall compare the Target Configuration version in the Target Configuration against the Target Configuration version stored in backup data. If the Target Configuration versions match, the Persistency shall restore the backup. Otherwise, it shall remove all storages, and re-install the persistent data from the Target Configuration.⌋

Initialization of persistent data is described in Chapter 7.2.5.1.

#### 7.2.5.5 Removal of Persistent Data

Persistency is not able to remove its own data when the Update and Configuration Management removes an Adaptive Application, because the Adaptive Application will not be executed in this case, and therefore Persistency does not run. On the other hand, the Update and Configuration Management may use the information in the Target Configuration (PersistencyGeneral.PersistencyCentralStorageUri and UriCollection) to obtain the locations of persistent data, and, if it has access to the locations, remove it.

### 7.2.6 Resource Management Concepts

The Persistency supports configuration of both an upper and a lower limit for the resources used by a Key-Value Storage or a File Storage.

The lower limit may already be defined by the application developer using PersistencyInterface.minimumSustainedSize. During Target Configuration, the integrator may update the lower limit using MinimumSustainedSize and add an upper limit using MaximumAllowedSize.

The Persistency will actively monitor the upper limit, while the lower limit is expected to be checked during installation of the SoftwarePackage that contains the Executable which uses Persistency.

**[SWS_PER_00321]**

*Upstream requirements:* RS_PER_00010, RS_PER_00011

⌈The Persistency shall ensure that the space actually allocated by a storage never surpasses the amount configured by MaximumAllowedSize.⌋

This could be ensured by supervising all write accesses to persistent data. But the implementation of the Persistency is free to chose other appropriate measures.

The Persistency user can also poll the amount of storage space currently occupied by a complete Key-Value Storage or File Storage by using ara::per::GetCurrentKeyValueStorageSize or ara::per::GetCurrentFileStorageSize, respectively. Naturally, the returned values will not drop below a configured minimum size (MinimumSustainedSize) or rise above a configured maximum size ( MaximumAllowedSize).

**[SWS_PER_00491]**

*Upstream requirements:* RS_PER_00011

⌈ara::per::GetCurrentKeyValueStorageSize shall return the total size of the storage space currently allocated to a Key-Value Storage, including administrative data (apart from data stored in PersistencyGeneral.PersistencyCentralStorageUri), redundant data, and backup data. The reported size may be inaccurate if the Key-Value Storage is currently open, or if another operation is currently being executed on the same storage.⌋

The inaccuracy is mainly due to the fact that metadata of the storage is only updated when the storage is fully synchronized, and predicting the metadata size is sometimes very difficult.

**[SWS_PER_00492]**

*Upstream requirements:* RS_PER_00011

⌈ara::per::GetCurrentFileStorageSize shall return the total size of the storage space currently allocated to a File Storage, including administrative data (apart from data stored in PersistencyGeneral.PersistencyCentralStorageUri),

all its files, redundant data, and backup data. The reported size may be inaccurate if the File Storage is currently open, or if another operation is currently being executed on the same storage.⌋

## 7.3 Key-Value Storage specific Features

To access a Key-Value Storage, the Persistency user has to call ara::per::OpenKeyValueStorage with the ara::core::InstanceSpecifier derived from the Application Design (a shortName path from the Executable to a PortPrototype) or the Target Configuration (an ApmC-Path to PersistencyKeyValueStorage or PersistencyFileStorage). This call will return an ara::per::SharedHandle of an ara::per::KeyValueStorage. The Key-Value Storage is closed when the ara::per::SharedHandle and all of its copies go out of scope, or when ara::core::Deinitialize is called.

**[SWS_PER_00506]**

*Upstream requirements:* RS_PER_00002

⌈When ara::per::OpenKeyValueStorage is called, and Persistency is properly initialized as described in [SWS_PER_00408], Persistency shall create a temporary storage that provides access to the Key-Value Storage identified by the ara::core::InstanceSpecifier, and shall create and return an ara::per::SharedHandle of an ara::per::KeyValueStorage.⌋

If ara::per::OpenKeyValueStorage is called without proper initialization, [SWS_PER_00574] applies.

All operations on a Key-Value Storage will be done in a temporary storage created during the call to ara::per::OpenKeyValueStorage, which the Persistency user can persist using ara::per::KeyValueStorage::SyncToStorage, or reset to the last stored state with ara::per::KeyValueStorage::DiscardPendingChanges.

Therefore, if the Key-Value Storage is just destructed (also implicitly when the Process referenced by PersistencyGeneral.ForeignProcessRef terminates), the Key-Value Storage is not updated, and the next time the Key-Value Storage is accessed, the Persistency user will see the last saved state.

**[SWS_PER_00331]**

*Upstream requirements:* RS_PER_00003

⌈Modifications of a Key-Value Storage that have not been persisted with a call to ara::per::KeyValueStorage::SyncToStorage shall be discarded when the Key-Value Storage is closed or the system is restarted, just as if ara::per::KeyValueStorage::DiscardPendingChanges had been called.⌋

Changes done by any thread (using a copy of the ara::per::SharedHandle) will be immediately visible in all other threads. This also applies to ara::per::KeyValueStorage::DiscardPendingChanges, which resets the key-value pairs in all threads, and to ara::per::KeyValueStorage::SyncToStorage, which persists all changes done by any thread.

**[SWS_PER_00494]**

*Upstream requirements:* RS_PER_00001

⌈When `ara::per::KeyValueStorage::SyncToStorage` is called, `Persistency` shall store all changes permanently that have been done to the `Key-Value Storage` since the last call to this method or since the `Key-Value Storage` was opened. `Persistency` shall also update any configured `redundancy` within this call.⌋

Please note that depending on the implementation of `Persistency`, the configuration of an optionally used file system, and the capabilities of the used `physical storage` device, the actual storage of `key-value pairs` may be delayed. So, in case of an immediate power down directly after this call, the physical data may be updated only partially or not at all. Therefore, data may be lost or, without `redundancy`, data may even be corrupted in this case.

The handling of `redundancy` is described in detail in Chapter 7.2.4.

**[SWS_PER_00495]**

*Upstream requirements:* RS_PER_00001

⌈When `ara::per::KeyValueStorage::DiscardPendingChanges` is called, `Persistency` shall reset the `Key-Value Storage` to the last persisted state, which is the state after the last call to `ara::per::KeyValueStorage::SyncToStorage` or after opening the `Key-Value Storage`.⌋

Single `key-value pairs` of the `Key-Value Storage` are accessed using `ara::per::KeyValueStorage::GetValue` and `ara::per::KeyValueStorage::SetValue`. `ara::per::KeyValueStorage::SetValue` may also be used to create a `key-value pair`.

**[SWS_PER_00496]**

*Upstream requirements:* RS_PER_00002, RS_PER_00003

⌈When `ara::per::KeyValueStorage::GetValue` is called, `Persistency` shall first check whether the `key-value pair` is present in the temporary storage, and otherwise return directly with `kKeyNotFound`.⌋

**[SWS_PER_00497]**

*Upstream requirements:* RS_PER_00002, RS_PER_00003

⌈When `ara::per::KeyValueStorage::GetValue` is called for an existing `key-value pair`, `Persistency` shall check whether the templated data type matches the stored data type, and otherwise return directly with `kDataTypeMismatch`.⌋

**[SWS_PER_00498]**

*Upstream requirements:* RS_PER_00002, RS_PER_00003

⌈When `ara::per::KeyValueStorage::GetValue` is called for an existing `key-value pair` with the correct templated data type, `Persistency` shall return the

stored value of the key-value pair, or, if the value was recently changed by ara::per::KeyValueStorage::SetValue (also in another thread), this new temporary value.⌋

**[SWS_PER_00499]**

*Upstream requirements:* RS_PER_00001, RS_PER_00003

⌈When ara::per::KeyValueStorage::SetValue is called for an existing key-value pair, Persistency shall check whether the templated data type matches the stored data type, and otherwise return directly with kDataTypeMismatch.⌋

**[SWS_PER_00534]**

*Upstream requirements:* RS_PER_00001, RS_PER_00003

⌈When ara::per::KeyValueStorage::SetValue is called for an existing key-value pair with the correct templated data type, Persistency shall store the new value of the key-value pair in the temporary storage.⌋

**[SWS_PER_00501]**

*Upstream requirements:* RS_PER_00001, RS_PER_00003

⌈When ara::per::KeyValueStorage::SetValue is called, and the key-value pair does not exist in the temporary storage, Persistency shall create the key-value pair with the templated data type and the provided value in the temporary storage.⌋

To remove a single key-value pair, the Persistency user may use ara::per::KeyValueStorage::RemoveKey, while ara::per::KeyValueStorage::RemoveAllKeys empties the Key-Value Storage. The type of a key-value pair may be changed by first removing it, and then creating it with the new type.

**[SWS_PER_00502]**

*Upstream requirements:* RS_PER_00001, RS_PER_00003

⌈When ara::per::KeyValueStorage::RemoveKey is called, Persistency shall first check whether the key-value pair is present in the temporary storage, and otherwise return directly with kKeyNotFound.⌋

**[SWS_PER_00535]**

*Upstream requirements:* RS_PER_00001, RS_PER_00003

⌈When ara::per::KeyValueStorage::RemoveKey is called for an existing key-value pair, Persistency shall remove the key-value pair from the temporary storage.⌋

**[SWS_PER_00503]**

*Upstream requirements:* RS_PER_00001

⌈When `ara::per::KeyValueStorage::RemoveAllKeys` is called, `Persistency` shall remove all `key-value pairs` from the temporary storage, resulting in an empty `Key-Value Storage`.⌋

Finally, the `Persistency user` can check for the existence of a single `key` with `ara::per::KeyValueStorage::KeyExists`, check the current size of a `value` using `ara::per::KeyValueStorage::GetCurrentValueSize`, and acquire a list of all currently available `keys` using `ara::per::KeyValueStorage::GetAllKeys`.

**[SWS_PER_00504]**

*Upstream requirements:* RS_PER_00003

⌈`ara::per::KeyValueStorage::KeyExists` shall return true if the `key` is present in the temporary storage, otherwise it shall return false.⌋

**[SWS_PER_00565]**

*Upstream requirements:* RS_PER_00003

⌈When `ara::per::KeyValueStorage::GetCurrentValueSize` is called, `Persistency` shall first check whether the `key-value pair` is present in the temporary `storage`, and otherwise return directly with `kKeyNotFound`.⌋

**[SWS_PER_00566]**

*Upstream requirements:* RS_PER_00003

⌈When `ara::per::KeyValueStorage::GetCurrentValueSize` is called for an existing `key-value pair`, `Persistency` shall return the current size of its `value`.⌋

**[SWS_PER_00505]**

*Upstream requirements:* RS_PER_00003

⌈`ara::per::KeyValueStorage::GetAllKeys` shall return an `ara::core::Vector` of `ara::core::String`, containing all the `keys` that are present in the temporary storage. If the temporary storage is empty, an empty `ara::core::Vector` shall be returned.⌋

### 7.3.1 Supported Data Types in Key-Value Storages

The `Persistency` supports the following classes of data types in the functions `ara::per::KeyValueStorage::GetValue` (templated via `T`), `ara::per::KeyValueStorage::GetValue` with `out` parameter (templated via `T`), and `ara::per::KeyValueStorage::SetValue` (templated via `T`) of a `Key-Value Storage`.

**[SWS_PER_00302]**

*Upstream requirements:* RS_PER_00001

⌈The Persistency shall be able to store all data types described in [11] in a Key-Value Storage.⌋

**[SWS_PER_00303]**

*Upstream requirements:* RS_PER_00001

⌈The Persistency shall be able to store serialized binary data in a Key-Value Storage. Persistency shall accept serialized binary data in the form of an ara::core::Vector of ara::core::Byte or an ara::core::Span of ara::core::Byte.⌋

This allows the Adaptive Application to store custom data types.

Please note that an ara::core::Span of ara::core::Byte cannot be returned by ara::per::KeyValueStorage::GetValue. It can only be passed in to ara::per::KeyValueStorage::SetValue and ara::per::KeyValueStorage::GetValue with out parameter.

**[SWS_PER_00304]**

*Upstream requirements:* RS_PER_00001, RS_PER_00010

⌈The Persistency shall be able to store all CppImplementationDataTypes referenced by PersistencyKeyValueStorageInterface.dataTypeForSerialization or as PersistencyKeyValueStorageInterface.dataElement in the Application Design of a PersistencyKeyValueStorage in the corresponding Key-Value Storage.⌋

The definitions of these data types are generated as described in [12]. Typically, Persistency will generate serializers and deserializers for these types.

## 7.4 File Storage specific Features

To access a File Storage, the Persistency user has to call ara::per::OpenFileStorage with the ara::core::InstanceSpecifier derived from the Application Design (a shortName path from the Executable to an RPortPrototype) or the Target Configuration (an ApmC-Path to PersistencyKeyValueStorage or PersistencyFileStorage). This call will return an ara::per::SharedHandle of an ara::per::FileStorage. The File Storage is closed when the ara::per::SharedHandle and all of its copies go out of scope, or when ara::core::Deinitialize is called.

**[SWS_PER_00507]**

*Upstream requirements:* RS_PER_00004

⌈When ara::per::OpenFileStorage is called, and Persistency is properly initialized as described in [SWS_PER_00408], Persistency shall create the necessary structures to access the File Storage identified by the ara::core::InstanceSpecifier, and create and return an ara::per::SharedHandle of an ara::per::FileStorage.⌋

If ara::per::OpenFileStorage is called without proper initialization, [SWS_PER_00574] applies.

To check for the existence of a single file, the Persistency user may call ara::per::FileStorage::FileExists, and ara::per::FileStorage::GetAllFileNames will return a list of all currently available files of the File Storage.

**[SWS_PER_00508]**

*Upstream requirements:* RS_PER_00004

⌈ara::per::FileStorage::FileExists shall return true if the file is present in the File Storage, otherwise it shall return false.⌋

**[SWS_PER_00509]**

*Upstream requirements:* RS_PER_00004

⌈ara::per::FileStorage::GetAllFileNames shall return an ara::core::Vector of ara::core::String, containing the file names of all the files that are present in the File Storage. If the File Storage is empty, an empty ara::core::Vector shall be returned.⌋

Files may be have been installed with the Adaptive Application or may have been created during an update. To create new files, the Persistency user may use ara::per::FileStorage::OpenFileReadWrite or ara::per::FileStorage::OpenFileWriteOnly, and it can use ara::per::FileStorage::DeleteFile to remove any file.

**[SWS_PER_00510]**

*Upstream requirements:* RS_PER_00004

⌈When `ara::per::FileStorage::DeleteFile` is called, `Persistency` shall first check whether the `file` is present in the `File Storage`, and otherwise return directly with `kFileNotFound`.⌋

**[SWS_PER_00511]**

*Upstream requirements:* RS_PER_00004

⌈When `ara::per::FileStorage::DeleteFile` is called for an existing `file`, `Persistency` shall remove the `file` from the `File Storage`.⌋

To access a `file` of a `File Storage`, the `Persistency user` has to call `ara::per::FileStorage::OpenFileReadWrite`, `ara::per::FileStorage::OpenFileReadOnly`, or `ara::per::FileStorage::OpenFileWriteOnly` with the `file name` of the `file`. These calls will return an `ara::per::UniqueHandle` of `ara::per::ReadAccessor`, `ara::per::WriteAccessor`, or `ara::per::ReadWriteAccessor`.

**[SWS_PER_00551] Checking for Existance before Opening a File Read-Only**

*Upstream requirements:* RS_AP_00128

⌈When `ara::per::FileStorage::OpenFileReadOnly` (or one of the overloaded versions `ara::per::FileStorage::OpenFileReadOnly` with `ara::per::OpenMode` or `ara::per::FileStorage::OpenFileReadOnly` with `ara::per::OpenMode` and separate buffer) is called, `Persistency` shall first check whether the `file` is present in the `File Storage`, and otherwise return directly with `kFileNotFound`.⌋

**[SWS_PER_00552] Checking Mode before Opening a File Read-Only**

*Upstream requirements:* RS_AP_00128

⌈When `ara::per::FileStorage::OpenFileReadOnly` with `ara::per::OpenMode` (or the overloaded version `ara::per::FileStorage::OpenFileReadOnly` with `ara::per::OpenMode` and separate buffer) is called, `Persistency` shall first check whether the provided mode consists only of either `kAtTheBeginning` or `kAtTheEnd`, and otherwise return directly with `kInvalidOpenMode`.⌋

**[SWS_PER_00512] Opening a File Read-Only**

*Upstream requirements:* RS_PER_00004

⌈When `ara::per::FileStorage::OpenFileReadOnly` (or one of the overloaded versions `ara::per::FileStorage::OpenFileReadOnly` with `ara::per::OpenMode` or `ara::per::FileStorage::OpenFileReadOnly` with `ara::per::OpenMode` and separate buffer) is called for an existing `file` and with a valid `ara::per::OpenMode`, `Persistency` shall create the necessary structures to ac-

cess the file identified by the file name, and create and return an ara::per::UniqueHandle of an ara::per::ReadAccessor.⌋

**[SWS_PER_00553] Checking Mode before Opening a File Write-Only or Read-Write**

*Upstream requirements:* RS_AP_00128

⌈When ara::per::FileStorage::OpenFileReadWrite with ara::per::OpenMode or ara::per::FileStorage::OpenFileWriteOnly with ara::per::OpenMode (or one of the overloaded versions ara::per::FileStorage::OpenFileReadWrite with ara::per::OpenMode and separate buffer or ara::per::FileStorage::OpenFileWriteOnly with ara::per::OpenMode and separate buffer) is called, Persistency shall first check whether the provided mode contains either kAtTheBeginning, possibly combined with kTruncate and kAppend, or kAtTheEnd, possibly combined with kAppend, or only kTruncate. Otherwise, the call shall return directly with kInvalidOpenMode.⌋

**[SWS_PER_00599] Opening a File Write-Only**

*Upstream requirements:* RS_PER_00004

⌈When ara::per::FileStorage::OpenFileWriteOnly (or one of the overloaded versions ara::per::FileStorage::OpenFileWriteOnly with ara::per::OpenMode or ara::per::FileStorage::OpenFileWriteOnly with ara::per::OpenMode and separate buffer) is called with a valid ara::per::OpenMode, Persistency shall create the necessary structures to access the file identified by the file name, and create and return an ara::per::UniqueHandle of an ara::per::WriteAccessor.⌋

**[SWS_PER_00513] Opening a File Read-Write**

*Upstream requirements:* RS_PER_00004

⌈When ara::per::FileStorage::OpenFileReadWrite (or one of the overloaded versions ara::per::FileStorage::OpenFileReadWrite with ara::per::OpenMode or ara::per::FileStorage::OpenFileReadWrite with ara::per::OpenMode and separate buffer) is called with a valid ara::per::OpenMode, Persistency shall create the necessary structures to access the file identified by the file name, and create and return an ara::per::UniqueHandle of an ara::per::ReadWriteAccessor.⌋

The file is closed when the ara::per::UniqueHandle goes out of scope, or when ara::core::Deinitialize is called.

**[SWS_PER_00457] Closing a File**

*Upstream requirements:* RS_PER_00004

⌈When a file is closed, Persistency shall ensure that all changes to the file are persisted. This does not need to be done immediately like when ara::per::WriteAccessor::SyncToFile is called, but may happen at a later time, latest when the file is opened again, or ara::core::Deinitialize is called.⌋

Some of the overloads of the file opening functions receive an ara::per::OpenMode as an argument. OpenModes can be combined using the operators "|" and "|=".

**[SWS_PER_00514]**

*Upstream requirements:* RS_PER_00004

⌈ara::per::operator "|" and ara::per::operator "|=" take two ara::per::OpenMode arguments and return the combined ara::per::OpenMode.⌋

**[SWS_PER_00515]**

*Upstream requirements:* RS_PER_00004

⌈ara::per::FileAccessor::SetPosition shall set the file position to the provided position. If the provided position is located outside of the current content of the file (including the position at the end of the file), ara::per::FileAccessor::SetPosition shall keep the previous file position and return kInvalidPosition.⌋

**[SWS_PER_00516]**

*Upstream requirements:* RS_PER_00004

⌈ara::per::FileAccessor::MovePosition shall move the file position to offset bytes according to the provided origin. If the new position would be located outside of the current content of the file (including the position at the end of the file), ara::per::FileAccessor::MovePosition shall keep the previous file position and return kInvalidPosition.⌋

**[SWS_PER_00517]**

*Upstream requirements:* RS_PER_00004

⌈ara::per::FileAccessor::GetPosition shall return the current read/write position in the file. In the case of an empty file, the position shall be returned as 0.⌋

**[SWS_PER_00518]**

*Upstream requirements:* RS_PER_00004

⌈ara::per::FileAccessor::IsEof shall return true if the position is the last possible position in the file, otherwise false.⌋

ara::per::FileAccessor::IsEof will return true if the current position corresponds to the total file size, which can be obtained separately using ara::per::FileAccessor::GetSize. In other words, true is only returned when the current position is at the position directly after the last character in the file, or if the file is empty.

**[SWS_PER_00519]**

*Upstream requirements:* RS_PER_00004

⌈ara::per::FileAccessor::GetSize shall return the current total size of the file.⌋

Persistency does not care whether the content of a file is text or some binary data, and therefore offers separate methods to access the file content as text or as binary data. To read content from a text file, the Persistency user may use one of the following methods of the ara::per::ReadAccessor class:

**[SWS_PER_00520]**

*Upstream requirements:* RS_PER_00004

⌈ara::per::ReadAccessor::PeekChar shall return the character at the current file position without changing the position.⌋

**[SWS_PER_00521]**

*Upstream requirements:* RS_PER_00004

⌈ara::per::ReadAccessor::GetChar shall return the character at the current file position and advance the position by one.⌋

**[SWS_PER_00522]**

*Upstream requirements:* RS_PER_00004

⌈ara::per::ReadAccessor::ReadText shall read the text from the current position to the end of the file and return it as an ara::core::String. The position shall be set to the end of the file.⌋

**[SWS_PER_00523]**

*Upstream requirements:* RS_PER_00004

⌈ara::per::ReadAccessor::ReadText shall read the n characters of text from the current position and return them as an ara::core::String. The position shall be incremented by n. In case the end of the file is reached during this operation, the available characters shall be returned, and the position shall be set to the end of the file.⌋

**[SWS_PER_00524]**

*Upstream requirements:* RS_PER_00004, RS_AP_00136

⌈ara::per::ReadAccessor::ReadLine shall read all characters until the delimiter (defaulting to the newline character) or the end of the file is reached, and return them as a ara::core::String. The delimiter shall not be included in the returned ara::core::String. The position shall be set to the character following the delimiter or the end of the file.⌋

All these methods return characters with a size of eight bits, which are just so-called code units in case of UTF-8, not code points. Therefore, these methods might return incomplete code points. Persistency itself does not change or interpret the content of a file when accessing it in text mode. It is assumed, though, that files in the File Storage are encoded as UTF-8 (see [RS_AP_00136]). It is also assumed that line endings are handled according to UNIX conventions, i.e. just LF ("\n").

**[SWS_PER_CONSTR_00006]** ⌈If a CppImplementationDataType with category equal to STRING is used as PersistencyDataElement, then the encoding of this string data type is expected to be UTF-8.⌋

This means that a CppImplementationDataType can only be mapped to an ApplicationDataType of category STRING where attribute swDataDefProps.swTextProps.baseType.baseTypeDefinition.baseTypeEncoding is set to the value UTF-8 as defined by [constr_5035]. If a CppImplementationDataType without an ApplicationDataType is used there is no formal description about the UTF-8 encoding in the ServiceInterface description.

The following methods of the ara::per::ReadAccessor class can be used by a Persistency user to read binary content from a file:

**[SWS_PER_00525]**

*Upstream requirements:* RS_PER_00004

⌈ara::per::ReadAccessor::PeekByte shall return the byte at the current file position without changing the position.⌋

**[SWS_PER_00526]**

*Upstream requirements:* RS_PER_00004

⌈ara::per::ReadAccessor::GetByte shall return the byte at the current file position and advance the position by one.⌋

**[SWS_PER_00527]**

*Upstream requirements:* RS_PER_00004

⌈ara::per::ReadAccessor::ReadBinary shall read binary data from the current position to the end of the file and return it as an ara::core::Vector of ara::core::Byte. The position shall be set to the end of the file.⌋

**[SWS_PER_00528]**

*Upstream requirements:* RS_PER_00004

⌈ara::per::ReadAccessor::ReadBinary shall read the n characters of text from the current position and return them as an ara::core::Vector of ara::core::Byte. The position shall be incremented by n. In case the end of the file is reached during this operation, the available bytes shall be returned, and the position shall be set to the end of the file.⌋

To write text to files, the Persistency user may use the ara::per::WriteAccessor::WriteText method or the ara::per::WriteAccessor::operator<< of the ara::per::WriteAccessor class, which treat text in the same way as described above for e.g. ara::per::ReadAccessor::ReadText.

**[SWS_PER_00557]**

*Upstream requirements:* RS_PER_00004

⌈If the file was opened with ara::per::OpenMode set to kAppend, Persistency shall always set the current position to the end of the file before writing data to the file according to [SWS_PER_00529], [SWS_PER_00530], or [SWS_PER_00531].⌋

**[SWS_PER_00529]**

*Upstream requirements:* RS_PER_00004

⌈ara::per::WriteAccessor::WriteText shall write the characters provided as ara::core::StringView to the file at the current position, possibly overwriting current content and advancing the end of the file if necessary. The position shall be set to the character following the last character that was written during this operation, or to the end of the file.⌋

**[SWS_PER_00530]**

*Upstream requirements:* RS_PER_00004

⌈ara::per::WriteAccessor::operator<< shall write the characters provided as ara::core::StringView to the file at the current position, possibly overwriting current content and advancing the end of the file if necessary. The position shall be set to the character following the last character that was written during this operation, or to the end of the file. If an error occurs during this operation, the file content might be partially updated and the resulting file position might not be as expected.⌋

To write binary data to a file, the Persistency user may use the method ara::per::WriteAccessor::WriteBinary of the ara::per::WriteAccessor class. See also [SWS_PER_00557] for ara::per::OpenMode kAppend.

**[SWS_PER_00531]**

*Upstream requirements:* RS_PER_00004

⌈ara::per::WriteAccessor::WriteBinary shall write the bytes provided as ara::core::Span of ara::core::Byte to the file at the current position, possibly overwriting current content and advancing the end of the file if necessary. The position shall be set to the byte following the last byte that was written during this operation, or to the end of the file.⌋

The Persistency user may use ara::per::WriteAccessor::SetFileSize to explicitly set the file size to a defined value in order to truncate a file or to empty it. Enlarging files is not supported by ara::per::WriteAccessor::SetFileSize.

**[SWS_PER_00532]**

*Upstream requirements:* RS_PER_00004

⌈ara::per::WriteAccessor::SetFileSize shall set the file size to the provided value. The read/write position shall be set to the end of the file if the current

position is higher than the new file size. If the provided value is larger than the current file size, ara::per::WriteAccessor::SetFileSize shall return kInvalidSize.⌋

When a Persistency user changed a file, Persistency will ensure that these changes are persisted. This can happen at any time, and latest when the file is closed. To trigger an additional synchronization of the file content to the persistent storage, the Persistency user may call ara::per::WriteAccessor::SyncToFile.

**[SWS_PER_00533]**

*Upstream requirements:* RS_PER_00004

⌈When ara::per::WriteAccessor::SyncToFile is called, Persistency shall store the content of the file. Persistency shall also update any configured redundancy within this call.⌋

Please note that depending on the implementation of Persistency, the configuration of an optionally used file system, and the capabilities of the used physical storage device, the actual storage of the file content may be delayed. So, in case of an immediate power down directly after this call, the physical data may be updated only partially or not at all. Therefore, data may be lost or, without redundancy, data may even be corrupted in this case.

The handling of redundancy is described in detail in Chapter 7.2.4.

### 7.4.1 Access to Additional Information about Files

To gain information about stored files, the Persistency provides the methods ara::per::FileStorage::GetCurrentFileSize and ara::per::FileStorage::GetFileInfo.

The Persistency user can poll the amount of storage space currently occupied by a single file using ara::per::FileStorage::GetCurrentFileSize of an open File Storage.

**[SWS_PER_00549]**

*Upstream requirements:* RS_AP_00128

⌈When ara::per::FileStorage::GetCurrentFileSize is called, Persistency shall first check whether the file is present in the File Storage, and otherwise return directly with kFileNotFound.⌋

**[SWS_PER_00493]**

*Upstream requirements:* RS_PER_00011

⌈When ara::per::FileStorage::GetCurrentFileSize is called for an existing file, Persistency shall return the current size of the passed file. This size

shall reflect only the data contained in the file. In case the file is currently open, Persistency shall return the current size of the file, which might differ from the size of the file in the storage if the last changes are not yet synchronized. Otherwise, if the file is not open, Persistency shall return the size of any existing instance of the file without checking the consistency/validity of the file.⌋

Please note that administrative and redundant information is not included in the file size reported by ara::per::FileStorage::GetCurrentFileSize, while it is included in the total size of the File Storage returned by ara::per::GetCurrentFileStorageSize (see [SWS_PER_00492]).

Using ara::per::FileStorage::GetFileInfo, a Persistency user can acquire information about the time the file was created (creationTime), last modified (modificationTime), and last accessed (accessTime), and how and by whom it was created (fileCreationState) and last modified (fileModificationState).

**[SWS_PER_00550]**

*Upstream requirements:* RS_AP_00128

⌈When ara::per::FileStorage::GetFileInfo is called, Persistency shall first check whether the file is present in the File Storage, and otherwise return directly with kFileNotFound.⌋

**[SWS_PER_00440]**

*Upstream requirements:* RS_PER_00004

⌈When ara::per::FileStorage::GetFileInfo is called for an existing but currently not opened file, Persistency shall gather the required information from any existing instance of the file (without checking the consistency/validity of this file) into a ara::per::FileInfo struct and return it to the Persistency user.⌋

**[SWS_PER_00570]**

*Upstream requirements:* RS_PER_00004

⌈When ara::per::FileStorage::GetFileInfo is called for an existing and currently opened file, Persistency shall return the time when the file was opened for accessTime and creationTime (the latter only if the file was also created at the same time).

For the modificationTime, before the Persistency user wrote anything to the file, Persistency shall return the original modification time. Afterwards, Persistency shall return the time the file was last modified by the Persistency user or ara::per::WriteAccessor::SyncToFile was last called.⌋

In case the Persistency uses a file system of the underlying OS, part of that information (like the creation or access time) can be obtained from the file system. Please note that the time stamps returned by ara::per::FileStorage::GetFileInfo on a closed file might be later than the ones returned by Persistency while the

`file` was still opened, because `Persistency` has no control over the actual point in time at which a file system (if used) updates these time stamps.

**[SWS_PER_00458]**

*Upstream requirements:* RS_PER_00004

⌈If `creationTime`, `modificationTime`, or `accessTime` are not available, they shall be set to $0$.⌋

As an example, the `accessTime` is not available for a read-only `File Storage`, and would therefore be reported as “midnight 1970-01-01”.

## 7.5 Functional Cluster Life-Cycle

Using `ara::core::Initialize` and `ara::core::Deinitialize` defined in [2, SWS Core], the `Adaptive Application` initializes and de-initializes all `Functional Clusters` with direct ARA interfaces (i.e. the `Adaptive Platform Foundation`).

The `Persistency user` is expected not to call any API of `Persistency` (directly or indirectly through other `Functional Clusters`) before initialization with `ara::core::Initialize` or after de-initialization with `ara::core::Deinitialize`, but `Persistency` needs to protect itself against such eventualities.

`ara::per::OpenKeyValueStorage` and `ara::per::OpenFileStorage` as well as other global functions that have the `ara::core::InstanceSpecifier` as an input parameter will check whether they are called before `ara::core::Initialize` was called or after `ara::core::Deinitialize` was called by the `Adaptive Application`. In this case, it is handled as violation according to [SWS_CORE_00021]. All other functions/methods are unprotected, and will therefore result in undefined behavior according to [SWS_CORE_90022].

**[SWS_PER_00574] Check for Initialization**

*Upstream requirements:* RS_PER_00018, RS_AP_00177

⌈`ara::per::UpdatePersistency`, `ara::per::ResetPersistency`, `ara::per::OpenKeyValueStorage`, `ara::per::RecoverKeyValueStorage`, `ara::per::ResetKeyValueStorage`, `ara::per::GetCurrentKeyValueStorageSize`, `ara::per::OpenFileStorage`, `ara::per::RecoverAllFiles`, `ara::per::ResetAllFiles`, and `ara::per::GetCurrentFileStorageSize` shall check whether they are called before `ara::core::Initialize` was called or after `ara::core::Deinitialize` was called by the `Adaptive Application`. If not, `Persistency` shall handle this situation as a violation according to [SWS_CORE_00021].⌋

### 7.5.1 Startup

**[SWS_PER_00408]**

*Upstream requirements:* RS_PER_00018

⌈When `ara::core::Initialize` is called, the `Persistency` shall read in the `Target Configuration` information and prepare the access structures to all `Key-Value Storages` and `File Storages` that are defined in the `Target Configuration`.⌋

### 7.5.2 Shutdown

**[SWS_PER_00409]**

*Upstream requirements:* RS_PER_00018

⌈When `ara::core::Deinitialize` is called, the `Persistency` shall implicitly ensure that all open `files` of all `File Storages` are persisted as though `ara::per::WriteAccessor::SyncToFile` was called and closed as though the `ara::per::UniqueHandle`s were destructed, and that not persisted `values` in all `KeyValue Storages` are dropped as though `ara::per::KeyValueStorage::DiscardPendingChanges` was called. Afterwards, `Persistency` shall free remaining resources that are not exposed by objects held by the `Persistency user`, including but not limited to the configuration of `Persistency`.⌋

## 7.6 Reporting

### 7.6.1 Security Events

This functional cluster does not define any security events.

### 7.6.2 Log Messages

This section lists all non-verbose log messages (i.e., modelled DLT messages) defined by this functional cluster.

#### 7.6.2.1 Log Messages with Details for all Reported Errors

**[SWS_PER_20001] LogMessage StorageNotFound**

*Status:* DRAFT

⌈

| ***Dlt-Message*** | StorageNotFound | | |
|---|---|---|---|
| ***Description*** | The requested Key-Value Storage or File Storage is not configured in the AUTOSAR model | | |
| ***MessageId*** | 0x80008000 | | |
| ***MessageType Info*** | DLT_LOG_ERROR | | |
| ***Dlt-Argument*** | ***ArgumentDescription*** | ***ArgumentType*** | ***ArgumentUnit*** |
| storageName | Affected storage | uint8 [encoding UTF-8] | |

⌋

**[SWS_PER_20002] LogMessage KeyNotFound**

*Status:* DRAFT

⌈

| ***Dlt-Message*** | KeyNotFound | | |
|---|---|---|---|
| ***Description*** | The provided key cannot be not found in the Key-Value Storage | | |
| ***MessageId*** | 0x80008001 | | |
| ***MessageType Info*** | DLT_LOG_INFO | | |
| ***Dlt-Argument*** | ***ArgumentDescription*** | ***ArgumentType*** | ***ArgumentUnit*** |
| storageName | Affected storage | uint8 [encoding UTF-8] | |
| keyName | Affected Key-Value Pair | uint8 [encoding UTF-8] | |

⌋

## [SWS_PER_20003] LogMessage IllegalWriteAccess

*Status:* DRAFT

⌈

| ***Dlt-Message*** | IllegalWriteAccess | | |
|---|---|---|---|
| ***Description*** | The operation could not be performed because the accessed Key-Value Storage or File Storage is configured as read-only or write-only-once | | |
| ***MessageId*** | 0x80008002 | | |
| ***MessageType Info*** | DLT_LOG_ERROR | | |
| ***Dlt-Argument*** | ***ArgumentDescription*** | ***ArgumentType*** | ***ArgumentUnit*** |
| storageName | Affected storage | uint8 [encoding UTF-8] | |

⌋

## [SWS_PER_20004] LogMessage PhysicalStorageFailure

*Status:* DRAFT

⌈

| ***Dlt-Message*** | PhysicalStorageFailure | | |
|---|---|---|---|
| ***Description*** | An error occurred when accessing the physical storage, e.g. because of a corrupted file system or corrupted hardware, or because of insufficient access rights | | |
| ***MessageId*** | 0x80008003 | | |
| ***MessageType Info*** | DLT_LOG_ERROR | | |
| ***Dlt-Argument*** | ***ArgumentDescription*** | ***ArgumentType*** | ***ArgumentUnit*** |
| storageName | Affected storage | uint8 [encoding UTF-8] | |
| storageLocation | Location of the storage in the file system or the address in a flash device | uint8 [encoding UTF-8] | |

⌋

## [SWS_PER_20005] LogMessage IntegrityCorrupted

*Status:* DRAFT

⌈

| ***Dlt-Message*** | IntegrityCorrupted | | |
|---|---|---|---|
| ***Description*** | The structural integrity of the Key-Value Storage or File Storage could not be established. This can happen when the internal structure of a Key-Value Storage or the metadata of a File Storage is corrupted | | |
| ***MessageId*** | 0x80008004 | | |
| ***MessageType Info*** | DLT_LOG_ERROR | | |
| ***Dlt-Argument*** | ***ArgumentDescription*** | ***ArgumentType*** | ***ArgumentUnit*** |
| storageName | Affected storage | uint8 [encoding UTF-8] | |
| storageLocation | Location of the storage in the file system or the address in a flash device | uint8 [encoding UTF-8] | |

⌋

## [SWS_PER_20006] LogMessage ValidationFailed

*Status:* DRAFT

⌈

| ***Dlt-Message*** | ValidationFailed | | |
|---|---|---|---|
| ***Description*** | The validation of redundancy measures failed for a single key-value pair, for the whole Key-Value Storage, for a single file, or for the whole File Storage | | |
| ***MessageId*** | 0x80008005 | | |
| ***MessageType Info*** | DLT_LOG_WARN | | |
| ***Dlt-Argument*** | ***ArgumentDescription*** | ***ArgumentType*** | ***ArgumentUnit*** |
| storageName | Affected storage | uint8 [encoding UTF-8] | |
| elementName | Affected storage element (Key-Value Pair or file) | uint8 [encoding UTF-8] | |

⌋

## [SWS_PER_20007] LogMessage EncryptionFailed

*Status:* DRAFT

⌈

| ***Dlt-Message*** | EncryptionFailed | | |
|---|---|---|---|
| ***Description*** | The encryption or decryption failed for a single key-value pair, for the whole Key-Value Storage, for a single file, or for the whole File Storage | | |
| ***MessageId*** | 0x80008006 | | |
| ***MessageType Info*** | DLT_LOG_WARN | | |
| ***Dlt-Argument*** | ***ArgumentDescription*** | ***ArgumentType*** | ***ArgumentUnit*** |
| storageName | Affected storage | uint8 [encoding UTF-8] | |
| elementName | Affected storage element (Key-Value Pair or file) | uint8 [encoding UTF-8] | |
| keySlotName | Affected key slot | uint8 [encoding UTF-8] | |
| algorithmName | Applied algorithm | uint8 [encoding UTF-8] | |

⌋

## [SWS_PER_20008] LogMessage DataTypeMismatch

*Status:* DRAFT

⌈

| ***Dlt-Message*** | DataTypeMismatch | | |
|---|---|---|---|
| ***Description*** | The provided data type does not match the stored data type | | |
| ***MessageId*** | 0x80008007 | | |
| ***MessageType Info*** | DLT_LOG_ERROR | | |
| ***Dlt-Argument*** | ***ArgumentDescription*** | ***ArgumentType*** | ***ArgumentUnit*** |
| storageName | Affected storage | uint8 [encoding UTF-8] | |
| keyName | Affected Key-Value Pair | uint8 [encoding UTF-8] | |
| providedType | Data type used by the adaptive application to access the Key-Value Pair | uint8 [encoding UTF-8] | |
| storedType | Data type of the stored Key-Value Pair | uint8 [encoding UTF-8] | |

⌋

## [SWS_PER_20009] LogMessage InitValueNotAvailable

*Status:* DRAFT

⌈

| ***Dlt-Message*** | InitValueNotAvailable | | |
|---|---|---|---|
| ***Description*** | The operation could not be performed because no initial value is available | | |
| ***MessageId*** | 0x80008008 | | |
| ***MessageType Info*** | DLT_LOG_INFO | | |
| ***Dlt-Argument*** | ***ArgumentDescription*** | ***ArgumentType*** | ***ArgumentUnit*** |
| storageName | Affected storage | uint8 [encoding UTF-8] | |
| elementName | Affected storage element (Key-Value Pair or file) | uint8 [encoding UTF-8] | |

⌋

## [SWS_PER_20010] LogMessage ResourceBusy

*Status:* DRAFT

⌈

| ***Dlt-Message*** | ResourceBusy | | |
|---|---|---|---|
| ***Description*** | The operation could not be performed because the resource is currently busy | | |
| ***MessageId*** | 0x80008009 | | |
| ***MessageType Info*** | DLT_LOG_INFO | | |
| ***Dlt-Argument*** | ***ArgumentDescription*** | ***ArgumentType*** | ***ArgumentUnit*** |
| storageName | Affected storage | uint8 [encoding UTF-8] | |
| functionName | Affected function or method of the Persistency API | uint8 [encoding UTF-8] | |

⌋

## [SWS_PER_20011] LogMessage OutOfStorageSpace

*Status:* DRAFT

⌈

| ***Dlt-Message*** | OutOfStorageSpace | | |
|---|---|---|---|
| ***Description*** | The physical storage space was exceeded | | |
| ***MessageId*** | 0x8000800a | | |
| ***MessageType Info*** | DLT_LOG_INFO | | |
| ***Dlt-Argument*** | ***ArgumentDescription*** | ***ArgumentType*** | ***ArgumentUnit*** |
| storageName | Affected storage | uint8 [encoding UTF-8] | |

⌋

## [SWS_PER_20012] LogMessage FileNotFound

*Status:* DRAFT

⌈

| ***Dlt-Message*** | FileNotFound | | |
|---|---|---|---|
| ***Description*** | The requested file name cannot be not found in the File Storage | | |
| ***MessageId*** | 0x8000800b | | |
| ***MessageType Info*** | DLT_LOG_INFO | | |
| ***Dlt-Argument*** | ***ArgumentDescription*** | ***ArgumentType*** | ***ArgumentUnit*** |
| storageName | Affected storage | uint8 [encoding UTF-8] | |
| fileName | Affected file | uint8 [encoding UTF-8] | |

⌋

## [SWS_PER_20013] LogMessage InvalidPosition

*Status:* DRAFT

⌈

| ***Dlt-Message*** | InvalidPosition | | |
|---|---|---|---|
| ***Description*** | SetPosition tried to move to a position that is not reachable (i.e. which is smaller than zero or greater than the current size of the file) | | |
| ***MessageId*** | 0x8000800c | | |
| ***MessageType Info*** | DLT_LOG_INFO | | |
| ***Dlt-Argument*** | ***ArgumentDescription*** | ***ArgumentType*** | ***ArgumentUnit*** |
| storageName | Affected storage | uint8 [encoding UTF-8] | |
| fileName | Affected file | uint8 [encoding UTF-8] | |
| position | Read/write position in the file | uint64 | |

⌋

## [SWS_PER_20014] LogMessage Eof

*Status:* DRAFT

⌈

| ***Dlt-Message*** | Eof | | |
|---|---|---|---|
| ***Description*** | The Persistency user tried to read from the end of the file or from an empty file | | |
| ***MessageId*** | 0x8000800d | | |
| ***MessageType Info*** | DLT_LOG_INFO | | |
| ***Dlt-Argument*** | ***ArgumentDescription*** | ***ArgumentType*** | ***ArgumentUnit*** |
| storageName | Affected storage | uint8 [encoding UTF-8] | |
| fileName | Affected file | uint8 [encoding UTF-8] | |
| position | Read/write position in the file | uint64 | |

⌋

## [SWS_PER_20015] LogMessage InvalidOpenMode

*Status:* DRAFT

⌈

| ***Dlt-Message*** | InvalidOpenMode | | |
|---|---|---|---|
| ***Description*** | Opening a file failed because the requested combination of Open Modes is invalid | | |
| ***MessageId*** | 0x8000800e | | |
| ***MessageType Info*** | DLT_LOG_ERROR | | |
| ***Dlt-Argument*** | ***ArgumentDescription*** | ***ArgumentType*** | ***ArgumentUnit*** |
| storageName | Affected storage | uint8 [encoding UTF-8] | |
| fileName | Affected file | uint8 [encoding UTF-8] | |
| openMode | Requested Open Mode for the file | uint8 | |

⌋

## [SWS_PER_20016] LogMessage InvalidSize

*Status:* DRAFT

⌈

| ***Dlt-Message*** | InvalidSize | | |
|---|---|---|---|
| ***Description*** | SetFileSize tried to set a new size that is bigger than the current file size | | |
| ***MessageId*** | 0x8000800f | | |
| ***MessageType Info*** | DLT_LOG_INFO | | |
| ***Dlt-Argument*** | ***ArgumentDescription*** | ***ArgumentType*** | ***ArgumentUnit*** |
| storageName | Affected storage | uint8 [encoding UTF-8] | |
| fileName | Affected file | uint8 [encoding UTF-8] | |
| fileSize | Current size of the file | uint64 | |

⌋

## [SWS_PER_20017] LogMessage TooManyFiles

*Status:* DRAFT

⌈

| ***Dlt-Message*** | TooManyFiles | | |
|---|---|---|---|
| ***Description*** | The maximum number of files was exceeded | | |
| ***MessageId*** | 0x80008010 | | |
| ***MessageType Info*** | DLT_LOG_INFO | | |
| ***Dlt-Argument*** | ***ArgumentDescription*** | ***ArgumentType*** | ***ArgumentUnit*** |
| storageName | Affected storage | uint8 [encoding UTF-8] | |
| fileName | Affected file | uint8 [encoding UTF-8] | |
| fileNumber | Maximum allowed number of files | uint32 | |

⌋

### [SWS_PER_20018] LogMessage QuotaExceeded

*Status:* DRAFT

⌈

| ***Dlt-Message*** | QuotaExceeded | | |
|---|---|---|---|
| ***Description*** | The allocated storage quota was exceeded | | |
| ***MessageId*** | 0x80008011 | | |
| ***MessageType Info*** | DLT_LOG_INFO | | |
| ***Dlt-Argument*** | ***ArgumentDescription*** | ***ArgumentType*** | ***ArgumentUnit*** |
| storageName | Affected storage | uint8 [encoding UTF-8] | |
| quota | Maximum allowed size of the storage | uint64 | |

⌋

### [SWS_PER_20019] LogMessage AuthenticationFailed

*Status:* DRAFT

⌈

| ***Dlt-Message*** | AuthenticationFailed | | |
|---|---|---|---|
| ***Description*** | Calculating or checking of the MAC failed for a single key-value pair, for the whole Key-Value Storage, for a single file, or for the whole File Storage | | |
| ***MessageId*** | 0x80008012 | | |
| ***MessageType Info*** | DLT_LOG_WARN | | |
| ***Dlt-Argument*** | ***ArgumentDescription*** | ***ArgumentType*** | ***ArgumentUnit*** |
| storageName | Affected storage | uint8 [encoding UTF-8] | |
| elementName | Affected storage element (Key-Value Pair or file) | uint8 [encoding UTF-8] | |
| keySlotName | Affected key slot | uint8 [encoding UTF-8] | |
| algorithmName | Applied algorithm | uint8 [encoding UTF-8] | |

⌋

## 7.6.2.2 Log Messages for Reported Redundancy Loss

### [SWS_PER_20020] LogMessage KeyValueStorageRecoveryFailed

*Status:* DRAFT

⌈

| ***Dlt-Message*** | KeyValueStorageRecoveryFailed | | |
|---|---|---|---|
| ***Description*** | A Key-Value Storage was corrupted, an insufficient number of valid copies existed. storage contains the short-name path of the Key-Value Storage, reportedElements is empty, reportedInstances contains the indices of the affected Key-Value Storage copies | | |
| ***MessageId*** | 0x80008013 | | |
| ***MessageType Info*** | DLT_LOG_WARN | | |
| ***Dlt-Argument*** | ***ArgumentDescription*** | ***ArgumentType*** | ***ArgumentUnit*** |

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| | | | |
|---|---|---|---|
| storageName | Affected storage | uint8 [encoding UTF-8] | |
| instanceIndices | Set of affected instances | uint8 [42] | |

⌋

## [SWS_PER_20021] LogMessage KeyValueStorageRecovered

*Status:* DRAFT

⌈

| ***Dlt-Message*** | KeyValueStorageRecovered | | |
|---|---|---|---|
| ***Description*** | A Key-Value Storage was corrupted, but a sufficient number of valid copies existed. storage contains the short-name path of the Key-Value Storage, reportedElements is empty, reportedInstances contains the indices of the affected Key-Value Storage copies | | |
| ***MessageId*** | 0x80008014 | | |
| ***MessageType Info*** | DLT_LOG_INFO | | |
| ***Dlt-Argument*** | ***ArgumentDescription*** | ***ArgumentType*** | ***ArgumentUnit*** |
| storageName | Affected storage | uint8 [encoding UTF-8] | |
| instanceIndices | Set of affected instances | uint8 [42] | |

⌋

## [SWS_PER_20022] LogMessage KeyRecoveryFailed

*Status:* DRAFT

⌈

| ***Dlt-Message*** | KeyRecoveryFailed | | |
|---|---|---|---|
| ***Description*** | A set of key-value pairs was corrupted, an insufficient number of valid copies existed. storage contains the short-name path of the Key-Value Storage, reportedElements contains the list of affected keys, reportedInstances contains the indices of the affected Key-Value Storage or key-value pair copies. In general, the nth key in reportedElements corresponds to the nth index in reported Instances, i.e. a key may be reported several times if several copies are broken. In case only one key-value pair is affected, reported Elements may be provided containing just this key | | |
| ***MessageId*** | 0x80008015 | | |
| ***MessageType Info*** | DLT_LOG_WARN | | |
| ***Dlt-Argument*** | ***ArgumentDescription*** | ***ArgumentType*** | ***ArgumentUnit*** |
| storageName | Affected storage | uint8 [encoding UTF-8] | |
| keyNames | Set of affected Key-Value Pairs | uint8 [42, encoding UTF-8] | |
| instanceIndices | Set of affected instances | uint8 [42] | |

⌋

## [SWS_PER_20023] LogMessage KeyRecovered

*Status:* DRAFT

⌈

| ***Dlt-Message*** | KeyRecovered | | |
|---|---|---|---|
| ***Description*** | A set of key-value pairs was corrupted, but a sufficient number of valid copies existed. storage contains the short-name path of the Key-Value Storage, reportedElements contains the list of affected keys, reportedInstances contains the indices of the affected Key-Value Storage or key-value pair copies. In general, the nth key in reportedElements corresponds to the nth index in reported Instances, i.e. a key may be reported several times if several copies are broken. In case only one key-value pair is affected, reported Elements may be provided containing just this key | | |
| ***MessageId*** | 0x80008016 | | |
| ***MessageType Info*** | DLT_LOG_INFO | | |
| ***Dlt-Argument*** | ***ArgumentDescription*** | ***ArgumentType*** | ***ArgumentUnit*** |
| storageName | Affected storage | uint8 [encoding UTF-8] | |
| keyNames | Set of affected Key-Value Pairs | uint8 [42, encoding UTF-8] | |
| instanceIndices | Set of affected instances | uint8 [42] | |

⌋

## [SWS_PER_20024] LogMessage FileStorageRecoveryFailed

*Status:* DRAFT

⌈

| ***Dlt-Message*** | FileStorageRecoveryFailed | | |
|---|---|---|---|
| ***Description*** | A File Storage was corrupted, an insufficient number of valid copies existed. storage contains the short-name path of the File Storage, reportedElements is empty, reportedInstances contains the indices of the affected File Storage copies | | |
| ***MessageId*** | 0x80008017 | | |
| ***MessageType Info*** | DLT_LOG_WARN | | |
| ***Dlt-Argument*** | ***ArgumentDescription*** | ***ArgumentType*** | ***ArgumentUnit*** |
| storageName | Affected storage | uint8 [encoding UTF-8] | |
| instanceIndices | Set of affected instances | uint8 [42] | |

⌋

## [SWS_PER_20025] LogMessage FileStorageRecovered

*Status:* DRAFT

⌈

| ***Dlt-Message*** | FileStorageRecovered | | |
|---|---|---|---|
| ***Description*** | A File Storage was corrupted, but a sufficient number of valid copies existed. storage contains the short-name path of the File Storage, reportedElements is empty, reportedInstances contains the indices of the affected File Storage copies | | |
| ***MessageId*** | 0x80008018 | | |
| ***MessageType Info*** | DLT_LOG_INFO | | |
| ***Dlt-Argument*** | ***ArgumentDescription*** | ***ArgumentType*** | ***ArgumentUnit*** |

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| | | | |
|---|---|---|---|
| storageName | Affected storage | uint8 [encoding UTF-8] | |
| instanceIndices | Set of affected instances | uint8 [42] | |

⌋

## [SWS_PER_20026] LogMessage FileRecoveryFailed

*Status:* DRAFT

⌈

| ***Dlt-Message*** | FileRecoveryFailed | | |
|---|---|---|---|
| ***Description*** | A set of files was corrupted, an insufficient number of valid copies existed. storage contains the short-name path of the File Storage, reportedElements contains the list of affected file names, reported Instances contains the indices of the affected File Storage or file copies. In general, the nth file name in reportedElements corresponds to the nth index in reportedInstances, i.e. a file name may be reported several times if several copies are broken. In case only one file is affected, reportedElements may be provided containing just this file name | | |
| ***MessageId*** | 0x80008019 | | |
| ***MessageType Info*** | DLT_LOG_WARN | | |
| ***Dlt-Argument*** | ***ArgumentDescription*** | ***ArgumentType*** | ***ArgumentUnit*** |
| storageName | Affected storage | uint8 [encoding UTF-8] | |
| fileNames | Set of affected files | uint8 [42, encoding UTF-8] | |
| instanceIndices | Set of affected instances | uint8 [42] | |

⌋

## [SWS_PER_20027] LogMessage FileRecovered

*Status:* DRAFT

⌈

| ***Dlt-Message*** | FileRecovered | | |
|---|---|---|---|
| ***Description*** | A set of files was corrupted, but a sufficient number of valid copies existed. storage contains the short-name path of the File Storage, reportedElements contains the list of affected file names, reported Instances contains the indices of the affected File Storage or file copies. In general, the nth file name in reportedElements corresponds to the nth index in reportedInstances, i.e. a file name may be reported several times if several copies are broken. In case only one file is affected, reportedElements may be provided containing just this file name | | |
| ***MessageId*** | 0x8000801a | | |
| ***MessageType Info*** | DLT_LOG_INFO | | |
| ***Dlt-Argument*** | ***ArgumentDescription*** | ***ArgumentType*** | ***ArgumentUnit*** |
| storageName | Affected storage | uint8 [encoding UTF-8] | |
| fileNames | Set of affected files | uint8 [42, encoding UTF-8] | |
| instanceIndices | Set of affected instances | uint8 [42] | |

⌋

#### 7.6.2.3 Log Messages for Potentially Unexpected Behavior

### [SWS_PER_20031] LogMessage KeyImplicitlyDeleted

*Status:* DRAFT

⌈

| ***Dlt-Message*** | KeyImplicitlyDeleted | | |
|---|---|---|---|
| ***Description*** | A Key-Value Pair was deleted during recovery | | |
| ***MessageId*** | 0x8000801b | | |
| ***MessageType Info*** | DLT_LOG_WARN | | |
| ***Dlt-Argument*** | ***ArgumentDescription*** | ***ArgumentType*** | ***ArgumentUnit*** |
| storageName | Affected storage | uint8 [encoding UTF-8] | |
| keyName | Affected Key-Value Pair | uint8 [encoding UTF-8] | |

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### [SWS_PER_20032] LogMessage KeyImplicitlyReset

*Status:* DRAFT

⌈

| ***Dlt-Message*** | KeyImplicitlyReset | | |
|---|---|---|---|
| ***Description*** | A Key-Value Pair was set to its initial value during recovery | | |
| ***MessageId*** | 0x8000801c | | |
| ***MessageType Info*** | DLT_LOG_WARN | | |
| ***Dlt-Argument*** | ***ArgumentDescription*** | ***ArgumentType*** | ***ArgumentUnit*** |
| storageName | Affected storage | uint8 [encoding UTF-8] | |
| keyName | Affected Key-Value Pair | uint8 [encoding UTF-8] | |

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### [SWS_PER_20033] LogMessage FileImplicitlyDeleted

*Status:* DRAFT

⌈

| ***Dlt-Message*** | FileImplicitlyDeleted | | |
|---|---|---|---|
| ***Description*** | A file was deleted during recovery | | |
| ***MessageId*** | 0x8000801d | | |
| ***MessageType Info*** | DLT_LOG_WARN | | |
| ***Dlt-Argument*** | ***ArgumentDescription*** | ***ArgumentType*** | ***ArgumentUnit*** |
| storageName | Affected storage | uint8 [encoding UTF-8] | |
| fileName | Affected file | uint8 [encoding UTF-8] | |

⌋

### [SWS_PER_20034] LogMessage FileImplicitlyReset

*Status:* DRAFT

⌈

| ***Dlt-Message*** | FileImplicitlyReset | | |
|---|---|---|---|
| ***Description*** | A file was set to its initial value during recovery | | |
| ***MessageId*** | 0x8000801e | | |
| ***MessageType Info*** | DLT_LOG_WARN | | |
| ***Dlt-Argument*** | ***ArgumentDescription*** | ***ArgumentType*** | ***ArgumentUnit*** |
| storageName | Affected storage | uint8 [encoding UTF-8] | |
| fileName | Affected file | uint8 [encoding UTF-8] | |

⌋

## 7.6.2.4 Log Messages for State Changes

### [SWS_PER_20035] LogMessage PersistencyInitialized

*Status:* DRAFT

⌈

| ***Dlt-Message*** | PersistencyInitialized | | |
|---|---|---|---|
| ***Description*** | Persistency was initialized via ara::core::Initialize | | |
| ***MessageId*** | 0x8000801f | | |
| ***MessageType Info*** | DLT_LOG_INFO | | |
| ***Dlt-Argument*** | ***ArgumentDescription*** | ***ArgumentType*** | ***ArgumentUnit*** |
| No Dlt-arguments available | | | |

⌋

### [SWS_PER_20036] LogMessage PersistencyDeInitialized

*Status:* DRAFT

⌈

| ***Dlt-Message*** | PersistencyDeInitialized | | |
|---|---|---|---|
| ***Description*** | Persistency was de-initialized via ara::core::Deinitialize | | |
| ***MessageId*** | 0x80008020 | | |
| ***MessageType Info*** | DLT_LOG_INFO | | |
| ***Dlt-Argument*** | ***ArgumentDescription*** | ***ArgumentType*** | ***ArgumentUnit*** |
| No Dlt-arguments available | | | |

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#### 7.6.2.5 Log Messages for Storage Access

### [SWS_PER_20037] LogMessage ConfigAccessed

*Status:* DRAFT

⌈

| ***Dlt-Message*** | ConfigAccessed | | |
|---|---|---|---|
| ***Description*** | The Persistency configuration was accessed | | |
| ***MessageId*** | 0x80008021 | | |
| ***MessageType Info*** | DLT_LOG_DEBUG | | |
| ***Dlt-Argument*** | ***ArgumentDescription*** | ***ArgumentType*** | ***ArgumentUnit*** |
| configLocation | Location of the configuration in the file system or the address in a flash device | uint8 [encoding UTF-8] | |
| contractVersion | Contract version of Persistency in the configuration | uint8 [encoding UTF-8] | |
| deployment Version | Deployment version of Persistency in the configuration | uint8 [encoding UTF-8] | |
| checkSum | Checksum of the configuration, 0 if not available | uint64 | |

⌋

### [SWS_PER_20038] LogMessage KvsConfigAccessed

*Status:* DRAFT

⌈

| ***Dlt-Message*** | KvsConfigAccessed | | |
|---|---|---|---|
| ***Description*** | A Key-Value Storage configuration was accessed | | |
| ***MessageId*** | 0x80008022 | | |
| ***MessageType Info*** | DLT_LOG_VERBOSE | | |
| ***Dlt-Argument*** | ***ArgumentDescription*** | ***ArgumentType*** | ***ArgumentUnit*** |
| storageName | Affected storage | uint8 [encoding UTF-8] | |
| isWriteable | The storage is writable | boolean | |
| copies | Number of configured copies of the storage | uint8 | |
| hasCRC | The storage uses a CRC | boolean | |
| hasHash | The storage uses a Hash | boolean | |
| isEncrypted | The storage is encrypted | boolean | |
| isAuthenticated | The storage uses MAC based authentication | boolean | |
| hasPortAccess | The storage was configured for access by an adaptive application | boolean | |

⌋

## [SWS_PER_20039] LogMessage FsConfigAccessed

*Status:* DRAFT

⌈

| ***Dlt-Message*** | FsConfigAccessed | | |
|---|---|---|---|
| ***Description*** | A File Storage configuration was accessed | | |
| ***MessageId*** | 0x80008023 | | |
| ***MessageType Info*** | DLT_LOG_VERBOSE | | |
| ***Dlt-Argument*** | ***ArgumentDescription*** | ***ArgumentType*** | ***ArgumentUnit*** |
| storageName | Affected storage | uint8 [encoding UTF-8] | |
| isWriteable | The storage is writable | boolean | |
| copies | Number of configured copies of the storage | uint8 | |
| hasCRC | The storage uses a CRC | boolean | |
| hasHash | The storage uses a Hash | boolean | |
| isEncrypted | The storage is encrypted | boolean | |
| isAuthenticated | The storage uses MAC based authentication | boolean | |
| hasPortAccess | The storage was configured for access by an adaptive application | boolean | |

⌋

## [SWS_PER_20040] LogMessage CentralLocationAccessed

*Status:* DRAFT

⌈

| ***Dlt-Message*** | CentralLocationAccessed | | |
|---|---|---|---|
| ***Description*** | The central storage location of Persistency was accessed | | |
| ***MessageId*** | 0x80008024 | | |
| ***MessageType Info*** | DLT_LOG_DEBUG | | |
| ***Dlt-Argument*** | ***ArgumentDescription*** | ***ArgumentType*** | ***ArgumentUnit*** |
| location | Location of the central storage in the file system or the address in a flash device | uint8 [encoding UTF-8] | |
| contractVersion | Stored contract version of Persistency | uint8 [encoding UTF-8] | |
| deployment Version | Stored deployment version of Persistency | uint8 [encoding UTF-8] | |

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## [SWS_PER_20041] LogMessage KvsLocationAccessed

*Status:* DRAFT

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| ***Dlt-Message*** | KvsLocationAccessed |
|---|---|
| ***Description*** | A Key-Value Storage location was accessed |
| ***MessageId*** | 0x80008025 |

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| *MessageType Info* | DLT_LOG_DEBUG | | |
|---|---|---|---|
| ***Dlt-Argument*** | ***ArgumentDescription*** | ***ArgumentType*** | ***ArgumentUnit*** |
| storageName | Affected storage | uint8 [encoding UTF-8] | |
| kvsLocations | Set of locations of copies of the storage in the file system or the addresses in a flash device | uint8 [42, encoding UTF-8] | |
| storageSize | Current size of the storage | uint64 | |
| keys | Current number of Key-Value Pairs in the storage | uint32 | |

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## [SWS_PER_20042] LogMessage KvsAccessShared

*Status:* DRAFT

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| ***Dlt-Message*** | KvsAccessShared | | |
|---|---|---|---|
| ***Description*** | A handle to a Key-Value Storage was shared | | |
| ***MessageId*** | 0x80008026 | | |
| ***MessageType Info*** | DLT_LOG_DEBUG | | |
| ***Dlt-Argument*** | ***ArgumentDescription*** | ***ArgumentType*** | ***ArgumentUnit*** |
| storageName | Affected storage | uint8 [encoding UTF-8] | |

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## [SWS_PER_20043] LogMessage KvsAccessFinished

*Status:* DRAFT

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| ***Dlt-Message*** | KvsAccessFinished | | |
|---|---|---|---|
| ***Description*** | A Key-Value Storage was closed | | |
| ***MessageId*** | 0x80008027 | | |
| ***MessageType Info*** | DLT_LOG_DEBUG | | |
| ***Dlt-Argument*** | ***ArgumentDescription*** | ***ArgumentType*** | ***ArgumentUnit*** |
| storageName | Affected storage | uint8 [encoding UTF-8] | |

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## [SWS_PER_20044] LogMessage ValueChanged

*Status:* DRAFT

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| ***Dlt-Message*** | ValueChanged |
|---|---|
| ***Description*** | The value of a Key-Value Pair changed |
| ***MessageId*** | 0x80008028 |
| ***MessageType Info*** | DLT_LOG_VERBOSE |

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| Dlt-Argument | ArgumentDescription | ArgumentType | ArgumentUnit |
|---|---|---|---|
| storageName | Affected storage | uint8 [encoding UTF-8] | |
| keyName | Affected Key-Value Pair | uint8 [encoding UTF-8] | |

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## [SWS_PER_20045] LogMessage KeyCreated

*Status:* DRAFT

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| Dlt-Message | KeyCreated | | |
|---|---|---|---|
| Description | A Key-Value Pair was created | | |
| MessageId | 0x80008029 | | |
| MessageType Info | DLT_LOG_DEBUG | | |
| **Dlt-Argument** | **ArgumentDescription** | **ArgumentType** | **ArgumentUnit** |
| storageName | Affected storage | uint8 [encoding UTF-8] | |
| keyName | Affected Key-Value Pair | uint8 [encoding UTF-8] | |

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## [SWS_PER_20046] LogMessage KeyDeleted

*Status:* DRAFT

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| Dlt-Message | KeyDeleted | | |
|---|---|---|---|
| Description | A Key-Value Pair was deleted | | |
| MessageId | 0x8000802a | | |
| MessageType Info | DLT_LOG_DEBUG | | |
| **Dlt-Argument** | **ArgumentDescription** | **ArgumentType** | **ArgumentUnit** |
| storageName | Affected storage | uint8 [encoding UTF-8] | |
| keyName | Affected Key-Value Pair | uint8 [encoding UTF-8] | |

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## [SWS_PER_20047] LogMessage KeyAccessed

*Status:* DRAFT

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| Dlt-Message | KeyAccessed | | |
|---|---|---|---|
| Description | A Key-Value Pair was accessed | | |
| MessageId | 0x8000802b | | |
| MessageType Info | DLT_LOG_VERBOSE | | |
| **Dlt-Argument** | **ArgumentDescription** | **ArgumentType** | **ArgumentUnit** |
| storageName | Affected storage | uint8 [encoding UTF-8] | |

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| | | | |
|---|---|---|---|
| keyName | Affected Key-Value Pair | uint8 [encoding UTF-8] | |

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## [SWS_PER_20048] LogMessage FsLocationAccessed

*Status:* DRAFT

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| | | | |
|---|---|---|---|
| ***Dlt-Message*** | FsLocationAccessed | | |
| ***Description*** | A File Storage location was accessed | | |
| ***MessageId*** | 0x8000802c | | |
| ***MessageType Info*** | DLT_LOG_DEBUG | | |
| ***Dlt-Argument*** | ***ArgumentDescription*** | ***ArgumentType*** | ***ArgumentUnit*** |
| storageName | Affected storage | uint8 [encoding UTF-8] | |
| fsLocations | Set of locations of copies of the storage in the file system or the addresses in a flash device | uint8 [42, encoding UTF-8] | |
| storageSize | Current size of the storage | uint64 | |
| files | Current number of files in the storage | uint32 | |

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## [SWS_PER_20049] LogMessage FsAccessShared

*Status:* DRAFT

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| | | | |
|---|---|---|---|
| ***Dlt-Message*** | FsAccessShared | | |
| ***Description*** | A handle to a File Storage was shared | | |
| ***MessageId*** | 0x8000802d | | |
| ***MessageType Info*** | DLT_LOG_DEBUG | | |
| ***Dlt-Argument*** | ***ArgumentDescription*** | ***ArgumentType*** | ***ArgumentUnit*** |
| storageName | Affected storage | uint8 [encoding UTF-8] | |

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## [SWS_PER_20050] LogMessage FsAccessFinished

*Status:* DRAFT

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| | | | |
|---|---|---|---|
| ***Dlt-Message*** | FsAccessFinished | | |
| ***Description*** | A File Storage was closed | | |
| ***MessageId*** | 0x8000802e | | |
| ***MessageType Info*** | DLT_LOG_DEBUG | | |
| ***Dlt-Argument*** | ***ArgumentDescription*** | ***ArgumentType*** | ***ArgumentUnit*** |
| storageName | Affected storage | uint8 [encoding UTF-8] | |

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| | | | |
|---|---|---|---|
| storageSize | Current size of the storage | uint64 | |
| files | Current number of files in the storage | uint32 | |

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## [SWS_PER_20051] LogMessage FileLocationAccessed

*Status:* DRAFT

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| | | | |
|---|---|---|---|
| ***DIt-Message*** | FileLocationAccessed | | |
| ***Description*** | A file location was accessed | | |
| ***MessageId*** | 0x8000802f | | |
| ***MessageType Info*** | DLT_LOG_VERBOSE | | |
| ***DIt-Argument*** | ***ArgumentDescription*** | ***ArgumentType*** | ***ArgumentUnit*** |
| storageName | Affected storage | uint8 [encoding UTF-8] | |
| fileName | Affected file | uint8 [encoding UTF-8] | |
| openMode | Requested Open Mode for the file | uint8 | |
| fileSize | Current size of the file | uint64 | |

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## [SWS_PER_20052] LogMessage FileCreated

*Status:* DRAFT

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| | | | |
|---|---|---|---|
| ***DIt-Message*** | FileCreated | | |
| ***Description*** | A file was created | | |
| ***MessageId*** | 0x80008030 | | |
| ***MessageType Info*** | DLT_LOG_DEBUG | | |
| ***DIt-Argument*** | ***ArgumentDescription*** | ***ArgumentType*** | ***ArgumentUnit*** |
| storageName | Affected storage | uint8 [encoding UTF-8] | |
| fileName | Affected file | uint8 [encoding UTF-8] | |

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## [SWS_PER_20053] LogMessage FileDeleted

*Status:* DRAFT

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| | | | |
|---|---|---|---|
| ***DIt-Message*** | FileDeleted | | |
| ***Description*** | A file was deleted | | |
| ***MessageId*** | 0x80008031 | | |
| ***MessageType Info*** | DLT_LOG_DEBUG | | |
| ***DIt-Argument*** | ***ArgumentDescription*** | ***ArgumentType*** | ***ArgumentUnit*** |

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| | | | |
|---|---|---|---|
| storageName | Affected storage | uint8 [encoding UTF-8] | |
| fileName | Affected file | uint8 [encoding UTF-8] | |

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## [SWS_PER_20054] LogMessage FileResized

*Status:* DRAFT

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| ***Dlt-Message*** | FileResized | | |
|---|---|---|---|
| ***Description*** | A file was resized, either explicitly by a call to SetFileSize or implicitly while writing to a file | | |
| ***MessageId*** | 0x80008032 | | |
| ***MessageType Info*** | DLT_LOG_VERBOSE | | |
| ***Dlt-Argument*** | ***ArgumentDescription*** | ***ArgumentType*** | ***ArgumentUnit*** |
| storageName | Affected storage | uint8 [encoding UTF-8] | |
| fileName | Affected file | uint8 [encoding UTF-8] | |
| fileSize | Current size of the file | uint64 | |

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## [SWS_PER_20055] LogMessage FileRead

*Status:* DRAFT

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| ***Dlt-Message*** | FileRead | | |
|---|---|---|---|
| ***Description*** | Data was read from a file | | |
| ***MessageId*** | 0x80008033 | | |
| ***MessageType Info*** | DLT_LOG_VERBOSE | | |
| ***Dlt-Argument*** | ***ArgumentDescription*** | ***ArgumentType*** | ***ArgumentUnit*** |
| storageName | Affected storage | uint8 [encoding UTF-8] | |
| fileName | Affected file | uint8 [encoding UTF-8] | |
| position | Read/write position in the file | uint64 | |
| bytesRead | Bytes of data actually read from the file | uint64 | |
| isBinary | Binary access used | boolean | |

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## [SWS_PER_20056] LogMessage FileWritten

*Status:* DRAFT

⌈

| ***Dlt-Message*** | FileWritten |
|---|---|
| ***Description*** | Data was written to a file |
| ***MessageId*** | 0x80008034 |

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| *MessageType Info* | DLT_LOG_VERBOSE | | |
|---|---|---|---|
| ***Dlt-Argument*** | ***ArgumentDescription*** | ***ArgumentType*** | ***ArgumentUnit*** |
| storageName | Affected storage | uint8 [encoding UTF-8] | |
| fileName | Affected file | uint8 [encoding UTF-8] | |
| position | Read/write position in the file | uint64 | |
| bytesWritten | Bytes of data actually written to the file | uint64 | |
| isBinary | Binary access used | boolean | |

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### [SWS_PER_20057] LogMessage FilePosition

*Status:* DRAFT

⌈

| *Dlt-Message* | FilePosition | | |
|---|---|---|---|
| *Description* | The current position of a file was changed | | |
| *MessageId* | 0x80008035 | | |
| *MessageType Info* | DLT_LOG_VERBOSE | | |
| ***Dlt-Argument*** | ***ArgumentDescription*** | ***ArgumentType*** | ***ArgumentUnit*** |
| storageName | Affected storage | uint8 [encoding UTF-8] | |
| fileName | Affected file | uint8 [encoding UTF-8] | |
| position | Read/write position in the file | uint64 | |

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## 7.6.2.6 Log Messages for Synchronization

### [SWS_PER_20058] LogMessage SyncToFile

*Status:* DRAFT

⌈

| *Dlt-Message* | SyncToFile | | |
|---|---|---|---|
| *Description* | A file was synchronized to the physical device. Note: Also reported by ara:core::Deinitialize | | |
| *MessageId* | 0x80008036 | | |
| *MessageType Info* | DLT_LOG_VERBOSE | | |
| ***Dlt-Argument*** | ***ArgumentDescription*** | ***ArgumentType*** | ***ArgumentUnit*** |
| storageName | Affected storage | uint8 [encoding UTF-8] | |
| fileName | Affected file | uint8 [encoding UTF-8] | |

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### [SWS_PER_20059] LogMessage SyncToStorage

*Status:* DRAFT

⌈

| ***Dlt-Message*** | SyncToStorage | | |
|---|---|---|---|
| ***Description*** | A Key-Value Storage was synchronized to the physical device | | |
| ***MessageId*** | 0x80008037 | | |
| ***MessageType Info*** | DLT_LOG_VERBOSE | | |
| ***Dlt-Argument*** | ***ArgumentDescription*** | ***ArgumentType*** | ***ArgumentUnit*** |
| storageName | Affected storage | uint8 [encoding UTF-8] | |
| syncedKeys | Set of updated Key-Value Pairs | uint8 [42, encoding UTF-8] | |
| storageSize | Current size of the storage | uint64 | |
| keys | Current number of Key-Value Pairs in the storage | uint32 | |

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### [SWS_PER_20060] LogMessage DiscardPendingChanges

*Status:* DRAFT

⌈

| ***Dlt-Message*** | DiscardPendingChanges | | |
|---|---|---|---|
| ***Description*** | Unsynchronized changes of a Key-Value Storage were reverted. Note: Also reported by ara:core::Deinitialize | | |
| ***MessageId*** | 0x80008038 | | |
| ***MessageType Info*** | DLT_LOG_VERBOSE | | |
| ***Dlt-Argument*** | ***ArgumentDescription*** | ***ArgumentType*** | ***ArgumentUnit*** |
| storageName | Affected storage | uint8 [encoding UTF-8] | |
| discardedKeys | Set of changed Key-Value Pairs that were reverted | uint8 [42, encoding UTF-8] | |

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## 7.6.2.7 Log Messages for Information about Updates

### [SWS_PER_20061] LogMessage PersistencyInstalled

*Status:* DRAFT

⌈

| ***Dlt-Message*** | PersistencyInstalled | | |
|---|---|---|---|
| ***Description*** | An adaptive application using Persistency was installed | | |
| ***MessageId*** | 0x80008039 | | |
| ***MessageType Info*** | DLT_LOG_INFO | | |
| ***Dlt-Argument*** | ***ArgumentDescription*** | ***ArgumentType*** | ***ArgumentUnit*** |

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| No Dlt-arguments available |
|---|

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## [SWS_PER_20062] LogMessage PersistencyUpdated

*Status:* DRAFT

⌈

| ***Dlt-Message*** | PersistencyUpdated | | |
|---|---|---|---|
| ***Description*** | The Persistency configuration of an adaptive application was updated | | |
| ***MessageId*** | 0x8000803a | | |
| ***MessageType Info*** | DLT_LOG_INFO | | |
| ***Dlt-Argument*** | ***ArgumentDescription*** | ***ArgumentType*** | ***ArgumentUnit*** |
| No Dlt-arguments available | | | |

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## [SWS_PER_20063] LogMessage PersistencyRolledBack

*Status:* DRAFT

⌈

| ***Dlt-Message*** | PersistencyRolledBack | | |
|---|---|---|---|
| ***Description*** | The Persistency of an adaptive application was rolled back | | |
| ***MessageId*** | 0x8000803b | | |
| ***MessageType Info*** | DLT_LOG_INFO | | |
| ***Dlt-Argument*** | ***ArgumentDescription*** | ***ArgumentType*** | ***ArgumentUnit*** |
| No Dlt-arguments available | | | |

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## [SWS_PER_20064] LogMessage PersistencyReset

*Status:* DRAFT

⌈

| ***Dlt-Message*** | PersistencyReset | | |
|---|---|---|---|
| ***Description*** | All Persistency storages of an adaptive application were reset | | |
| ***MessageId*** | 0x8000803c | | |
| ***MessageType Info*** | DLT_LOG_INFO | | |
| ***Dlt-Argument*** | ***ArgumentDescription*** | ***ArgumentType*** | ***ArgumentUnit*** |
| No Dlt-arguments available | | | |

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## [SWS_PER_20065] LogMessage KvsInstalled

*Status:* DRAFT

⌈

| ***Dlt-Message*** | KvsInstalled | | |
|---|---|---|---|
| ***Description*** | A Key-Value Storage was added during installation or update of an adaptive application | | |
| ***MessageId*** | 0x8000803d | | |
| ***MessageType Info*** | DLT_LOG_INFO | | |
| ***Dlt-Argument*** | ***ArgumentDescription*** | ***ArgumentType*** | ***ArgumentUnit*** |
| storageName | Affected storage | uint8 [encoding UTF-8] | |

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## [SWS_PER_20066] LogMessage KvsRemoved

*Status:* DRAFT

⌈

| ***Dlt-Message*** | KvsRemoved | | |
|---|---|---|---|
| ***Description*** | A Key-Value Storage was removed during update of an adaptive application | | |
| ***MessageId*** | 0x8000803e | | |
| ***MessageType Info*** | DLT_LOG_INFO | | |
| ***Dlt-Argument*** | ***ArgumentDescription*** | ***ArgumentType*** | ***ArgumentUnit*** |
| storageName | Affected storage | uint8 [encoding UTF-8] | |

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## [SWS_PER_20067] LogMessage KvsReset

*Status:* DRAFT

⌈

| ***Dlt-Message*** | KvsReset | | |
|---|---|---|---|
| ***Description*** | A Key-Value Storage was reset | | |
| ***MessageId*** | 0x8000803f | | |
| ***MessageType Info*** | DLT_LOG_DEBUG | | |
| ***Dlt-Argument*** | ***ArgumentDescription*** | ***ArgumentType*** | ***ArgumentUnit*** |
| storageName | Affected storage | uint8 [encoding UTF-8] | |

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## [SWS_PER_20068] LogMessage KeyReset

*Status:* DRAFT

⌈

| ***Dlt-Message*** | KeyReset | | |
|---|---|---|---|
| ***Description*** | A Key-Value Pair was reset | | |
| ***MessageId*** | 0x80008040 | | |
| ***MessageType Info*** | DLT_LOG_DEBUG | | |
| ***Dlt-Argument*** | ***ArgumentDescription*** | ***ArgumentType*** | ***ArgumentUnit*** |
| storageName | Affected storage | uint8 [encoding UTF-8] | |
| keyName | Affected Key-Value Pair | uint8 [encoding UTF-8] | |

⌋

## [SWS_PER_20069] LogMessage FsInstalled

*Status:* DRAFT

⌈

| ***Dlt-Message*** | FsInstalled | | |
|---|---|---|---|
| ***Description*** | A File Storage was added during installation or update of an adaptive application | | |
| ***MessageId*** | 0x80008041 | | |
| ***MessageType Info*** | DLT_LOG_INFO | | |
| ***Dlt-Argument*** | ***ArgumentDescription*** | ***ArgumentType*** | ***ArgumentUnit*** |
| storageName | Affected storage | uint8 [encoding UTF-8] | |

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## [SWS_PER_20070] LogMessage FsRemoved

*Status:* DRAFT

⌈

| ***Dlt-Message*** | FsRemoved | | |
|---|---|---|---|
| ***Description*** | A File Storage was removed during update of an adaptive application | | |
| ***MessageId*** | 0x80008042 | | |
| ***MessageType Info*** | DLT_LOG_INFO | | |
| ***Dlt-Argument*** | ***ArgumentDescription*** | ***ArgumentType*** | ***ArgumentUnit*** |
| storageName | Affected storage | uint8 [encoding UTF-8] | |

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### [SWS_PER_20071] LogMessage FsReset

*Status:* DRAFT

⌈

| ***Dlt-Message*** | FsReset | | |
|---|---|---|---|
| ***Description*** | A File Storage was reset | | |
| ***MessageId*** | 0x80008043 | | |
| ***MessageType Info*** | DLT_LOG_DEBUG | | |
| ***Dlt-Argument*** | ***ArgumentDescription*** | ***ArgumentType*** | ***ArgumentUnit*** |
| storageName | Affected storage | uint8 [encoding UTF-8] | |

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### [SWS_PER_20072] LogMessage FileReset

*Status:* DRAFT

⌈

| ***Dlt-Message*** | FileReset | | |
|---|---|---|---|
| ***Description*** | A file was reset | | |
| ***MessageId*** | 0x80008044 | | |
| ***MessageType Info*** | DLT_LOG_DEBUG | | |
| ***Dlt-Argument*** | ***ArgumentDescription*** | ***ArgumentType*** | ***ArgumentUnit*** |
| storageName | Affected storage | uint8 [encoding UTF-8] | |
| fileName | Affected file | uint8 [encoding UTF-8] | |

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Some of the log messages that are logged during ordinary access to `Persistency` (see Chapter 7.6.2.5) are also logged during installation or update of `Persistency`, namely `CentralLocationAccessed`, `KvsLocationAccessed`, `ValueChanged`, `KeyCreated`, `KeyDeleted`, `FsLocationAccessed`, `FileLocationAccessed`, `FileDeleted`, `FileWritten`.

## 7.6.3 Violation Messages

This section lists all violation messages (i.e., DLT messages logged for Violations according to [SWS_CORE_00021]) defined by this functional cluster.
Please note that concrete implementations might additionally implement Non-Standardized Violations (see also [SWS_CORE_00003]).

#### 7.6.3.1 OutOfMemory

### [SWS_PER_20028] ViolationMessage OutOfMemoryViolation

*Status:* DRAFT

⌈

| ***Dlt-Message*** | OutOfMemoryViolation | | |
|---|---|---|---|
| ***Description*** | Memory allocation failed. | | |
| ***MessageId*** | 0x80008fff | | |
| ***MessageType Info*** | DLT_LOG_FATAL | | |
| ***Dlt-Argument*** | ***ArgumentDescription*** | ***ArgumentType*** | ***ArgumentUnit*** |
| modeledProcessId | Meta-model identifier of the process that caused the violation, i.e., its short name path with '/' as a separator | uint8 [encoding UTF-8] | |
| location | An implementation-defined identifier of the location where the violation was detected, for example {filename}:{linenumber}. | uint8 [encoding UTF-8] | |
| variableName | Affected variable | uint8 [encoding UTF-8] | |
| size | Size of the variable | uint64 | |

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#### 7.6.3.2 CalledWhileUnititialized

### [SWS_PER_20029] ViolationMessage CalledWhileUnititializedViolation

*Status:* DRAFT

⌈

| ***Dlt-Message*** | CalledWhileUnititializedViolation | | |
|---|---|---|---|
| ***Description*** | A named constructor or global function of the Persistency API was called before ara::core::Initialize. | | |
| ***MessageId*** | 0x80008ffe | | |
| ***MessageType Info*** | DLT_LOG_FATAL | | |
| ***Dlt-Argument*** | ***ArgumentDescription*** | ***ArgumentType*** | ***ArgumentUnit*** |
| modeledProcessId | Meta-model identifier of the process that caused the violation, i.e., its short name path with '/' as a separator | uint8 [encoding UTF-8] | |
| location | An implementation-defined identifier of the location where the violation was detected, for example {filename}:{linenumber}. | uint8 [encoding UTF-8] | |
| functionName | Affected function or method of the Persistency API | uint8 [encoding UTF-8] | |

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#### 7.6.3.3 InvalidConfiguration

**[SWS_PER_20030] ViolationMessage InvalidConfigurationViolation**

*Status:* DRAFT

⌈

| ***Dlt-Message*** | InvalidConfigurationViolation | | |
|---|---|---|---|
| ***Description*** | The installed Persistency configuration is unreadable, most likely it is corrupted. | | |
| ***MessageId*** | 0x80008ffd | | |
| ***MessageType Info*** | DLT_LOG_FATAL | | |
| ***Dlt-Argument*** | ***ArgumentDescription*** | ***ArgumentType*** | ***ArgumentUnit*** |
| modeledProcessId | Meta-model identifier of the process that caused the violation, i.e., its short name path with '/' as a separator | uint8 [encoding UTF-8] | |
| location | An implementation-defined identifier of the location where the violation was detected, for example {filename}:{linenumber}. | uint8 [encoding UTF-8] | |

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### 7.6.4 Production Errors

This section lists all production errors (i.e., Diagnostic Events) defined by this functional cluster.

#### 7.6.4.1 PER_E_HARDWARE

**[SWS_PER_10001] Diagnostic Event: Reading from or writing to the Storage failed**

*Status:* DRAFT

⌈

| ***Diagnostic Event (Error Name)*** | PER_E_HARDWARE |
|---|---|
| ***Description*** | Reading from or writing to the Storage failed |
| ***Failed condition*** | Persistency returns kPhysicalStorageFailure from any executed function or method, or a daemon has problems accessing the stored data. |
| ***Passed condition*** | Persistency executes a function or method successfully that can report kPhysical StorageFailure, or a daemon accessed the stored data successfully. |

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#### 7.6.4.2 PER_E_INTEGRITY_FAILED

**[SWS_PER_10002] Diagnostic Event: The structure of the Storage was destroyed**

*Status:* DRAFT

⌈

| ***Diagnostic Event (Error Name)*** | PER_E_INTEGRITY_FAILED |
|---|---|
| ***Description*** | The structure of the Storage was destroyed |
| ***Failed condition*** | Persistency returns kIntegrityCorrupted from any executed function or method, or a daemon detects a structural corruption in the stored data. |
| ***Passed condition*** | Persistency executes a function or method successfully that can report kIntegrity Corrupted, or a daemon accessed the stored data successfully. |

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#### 7.6.4.3 PER_E_LOSS_OF_REDUNDANCY

**[SWS_PER_10003] Diagnostic Event: Redundancy of the Storage was lost**

*Status:* DRAFT

⌈

| ***Diagnostic Event (Error Name)*** | PER_E_LOSS_OF_REDUNDANCY |
|---|---|
| ***Description*** | Redundancy of the Storage was lost |
| ***Failed condition*** | Persistency returns kValidationFailed from any executed function or method, or a daemon detects loss of redundancy of the stored data. |
| ***Passed condition*** | Persistency executes a function or method successfully that can report kValidation Failed, or a daemon accessed the stored data successfully. |

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# 8 API Specification

This chapter provides a reference of the APIs defined by this functional cluster. The API is described in the following chapters in tables. Table 8.1 explains the content that is described in such an API table.

| | | |
|---|---|---|
| ***Kind:*** | Defines the kind of the declaration that this API table describes. The following values are supported:<br>• class (Declaration of a class)<br>• function (Declaration of a member or non-member function)<br>• struct (Declaration of a structure)<br>• type alias (Declaration of a type alias)<br>• enumeration (Declaration of an enumeration)<br>• variable (Declaration of a variable) | |
| ***Port Interfaces:*** | States that the C++ API `class` is the related C++ API binding for the given modeled sub-class of `PortInterface` | |
| ***Header File:*** | Defines the header file to be included according to [SWS_CORE_90001] | |
| ***Forwarding Header File:*** | Defines the forwarding header file to be included according to [SWS_CORE_90001] | |
| ***Scope:*** | Defines the scope that may be a C++ `namespace` (in case of a `class` or non-member function) or a `class` declaration (in case of a member) | |
| ***Symbol:*** | C++ symbol name | |
| ***Thread Safety:*** | Defines whether a function is thread-safe, not thread-safe, or conditional according to [SWS_CORE_13200] and [SWS_CORE_13202] | |
| ***Syntax:*** | Description of C++ syntax | |
| ***Template Param:*** | Template parameter (0..*) | Template parameter(s) used to parameterize the template |
| ***Parameters (in):*** | Parameter declaration (0..*) | Parameter(s) that are passed to the function |
| ***Parameters (out):*** | Parameter declaration (0..*) | Parameter(s) that are returned to the caller |
| ***Return Value:*** | Return type | Type of the value that the function returns |
| ***Exception Safety:*** | Defines whether a function is exception-safe, not exception safe or conditionally exception safe | |
| ***Exceptions:*** | List of C++ `Exception`s that may be thrown by the function | |
| ***Violations:*** | List of violations that may raised by the function | |
| ***Errors:*** | Error type (0..*) | List of defined `ara::core::ErrorCode`s that may be returned by the function with their recoverability class defined in [RS_AP_00160]. APIs can be extended with vendor-specific error codes. These are not standardized by AUTOSAR |
| ***Description:*** | Brief description of the function | |

**Table 8.1: Explanation of an API table**

The APIs for accessing `File Storages` and `Key-Value Storage` are completely separate, and therefore divided into separate sections. Additional sections describe common functionality.

The API of `Persistency` is designed around the `ara::per::SharedHandle` and `ara::per::UniqueHandle`, which are returned by factory functions like `ara::per::OpenKeyValueStorage` or `ara::per::FileStorage::OpenFileReadWrite`. The classes defined in this chapter cannot be constructed directly by the `Persistency user`, and consequently the default constructors are considered to be not publicly accessible (i.e. to be deleted, private, or protected).

## 8.1 PortInterface to API Class Binding

This table shows the `API class` binding for each `PortInterface` owned by this functional cluster and those functions taking an `ara::core::InstanceSpecifier` argument, designated to "construct" that class. These constructing functions may be any combination of special-member constructors, named constructor members or non-member factory constructors.

| Port Interface | API Class / Function |
|---|---|
| `PersistencyFileStorageInterface` | [SWS_PER_00340] Definition of API class ara::per::FileStorage |
| `PersistencyKeyValueStorageInterface` | [SWS_PER_00339] Definition of API class ara::per::KeyValueStorage |

**Table 8.2: PortInterface (sub-class) to API class / function binding**

## 8.2 General Features of Persistency

### 8.2.1 ara::core Types

The `ara::per` API is based heavily on the `ara::core` types defined in [2].

`ara::core::Result` is used wherever possible, and because of this, most methods are defined as `noexcept`.

Consequently, in situations where memory cannot be allocated for new objects, the `Persistency` shall terminate the `Process` by calling `ara::core::Abort` (see [2]).

## 8.3 Header: ara/per/file_accessor.h

### 8.3.1 Non-Member Types

#### 8.3.1.1 Enumeration: Origin

**[SWS_PER_00146] Definition of API enum ara::per::Origin**

*Upstream requirements:* RS_PER_00003, RS_AP_00122, RS_AP_00125, RS_AP_00143

⌈

| | | |
|---|---|---|
| ***Kind:*** | enumeration | |
| ***Header file:*** | #include "ara/per/file_accessor.h" | |
| ***Forwarding header file:*** | #include "ara/per/per_fwd.h" | |
| ***Scope:*** | namespace ara::per | |
| ***Symbol:*** | Origin | |
| ***Underlying type:*** | std::uint32_t | |
| ***Syntax:*** | `enum class Origin : std::uint32_t {...};` | |
| ***Values:*** | kBeginning | = 0 |

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| | | |
|---|---|---|
| | | Seek from the beginning of the file. |
| | kCurrent | = 1 |
| | | Seek from the current position. |
| | kEnd | = 2 |
| | | Seek from the end of the file. |
| ***Description:*** | Specification of origin used in MovePosition. | |

⌋

### 8.3.2 Class: FileAccessor

**[SWS_PER_00588] Definition of API class ara::per::FileAccessor**

*Upstream requirements:* RS_PER_00004, RS_AP_00122, RS_AP_00146

⌈

| | |
|---|---|
| ***Kind:*** | class |
| ***Header file:*** | #include "ara/per/file_accessor.h" |
| ***Forwarding header file:*** | #include "ara/per/per_fwd.h" |
| ***Scope:*** | namespace ara::per |
| ***Symbol:*** | FileAccessor |
| ***Syntax:*** | `class FileAccessor {...};` |
| ***Description:*** | FileAccessor contains a common basis for ReadAccessor and WriteAccessor.<br>It provides methods for checking and setting the current position in the file (GetPosition, Set Position, MovePosition, IsEof) and for checking the current size of the file (GetSize). |

⌋

#### 8.3.2.1 Public Member Functions

##### 8.3.2.1.1 Special Member Functions

###### 8.3.2.1.1.1 Copy Constructor

**[SWS_PER_00592] Definition of API function ara::per::FileAccessor::FileAccessor**

*Upstream requirements:* RS_PER_00004, RS_AP_00120, RS_AP_00145

⌈

| | |
|---|---|
| ***Kind:*** | function |
| ***Header file:*** | #include "ara/per/file_accessor.h" |
| ***Scope:*** | `class ara::per::FileAccessor` |
| ***Syntax:*** | `FileAccessor (const FileAccessor &)=delete;` |
| ***Description:*** | The copy constructor for FileAccessor shall not be used. |

⌋

#### 8.3.2.1.1.2 Default Constructor

### [SWS_PER_00589] Definition of API function ara::per::FileAccessor::FileAccessor

*Upstream requirements:* RS_PER_00004, RS_AP_00120, RS_AP_00129, RS_AP_00146

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| | |
|---|---|
| ***Kind:*** | function |
| ***Header file:*** | #include "ara/per/file_accessor.h" |
| ***Scope:*** | `class ara::per::FileAccessor` |
| ***Syntax:*** | `FileAccessor ()=delete;` |
| ***Description:*** | The default constructor for FileAccessor shall not be used. |

⌋

#### 8.3.2.1.1.3 Move Constructor

### [SWS_PER_00590] Definition of API function ara::per::FileAccessor::FileAccessor

*Upstream requirements:* RS_PER_00004, RS_AP_00120, RS_AP_00121, RS_AP_00129, RS_AP_00145, RS_AP_00159

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| | |
|---|---|
| ***Kind:*** | function |
| ***Header file:*** | #include "ara/per/file_accessor.h" |
| ***Scope:*** | `class ara::per::FileAccessor` |
| ***Syntax:*** | `FileAccessor (FileAccessor &&ra)=delete;` |
| ***Description:*** | The move constructor for FileAccessor shall not be used. |

⌋

#### 8.3.2.1.1.4 Copy Assignment Operator

### [SWS_PER_00593] Definition of API function ara::per::FileAccessor::operator=

*Upstream requirements:* RS_PER_00004, RS_AP_00119, RS_AP_00120, RS_AP_00145

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| | |
|---|---|
| ***Kind:*** | function |
| ***Header file:*** | #include "ara/per/file_accessor.h" |
| ***Scope:*** | `class ara::per::FileAccessor` |
| ***Syntax:*** | `FileAccessor & operator= (const FileAccessor &)=delete;` |
| ***Description:*** | The copy assignment operator for FileAccessor shall not be used. |

⌋

#### 8.3.2.1.1.5 Move Assignment Operator

**[SWS_PER_00591] Definition of API function ara::per::FileAccessor::operator=**

*Upstream requirements:* RS_PER_00004, RS_AP_00119, RS_AP_00120, RS_AP_00121, RS_AP_00145, RS_AP_00159

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| | |
|---|---|
| ***Kind:*** | function |
| ***Header file:*** | #include "ara/per/file_accessor.h" |
| ***Scope:*** | `class ara::per::FileAccessor` |
| ***Syntax:*** | `FileAccessor & operator= (FileAccessor &&ra)=delete;` |
| ***Description:*** | The move assignment operator for FileAccessor shall not be used. |

⌋

#### 8.3.2.1.1.6 Destructor

**[SWS_PER_00594] Definition of API function ara::per::FileAccessor::~FileAccessor**

*Upstream requirements:* RS_PER_00004, RS_AP_00120, RS_AP_00129, RS_AP_00134, RS_AP_00145, RS_AP_00159

⌈

| | |
|---|---|
| ***Kind:*** | function |
| ***Header file:*** | #include "ara/per/file_accessor.h" |
| ***Scope:*** | `class ara::per::FileAccessor` |
| ***Syntax:*** | `virtual ~FileAccessor () noexcept;` |
| ***Exception Safety:*** | exception safe |
| ***Thread Safety:*** | not thread-safe |
| ***Description:*** | Destructor for FileAccessor. |

⌋

#### 8.3.2.1.2 Member Functions

##### 8.3.2.1.2.1 GetPosition

**[SWS_PER_00162] Definition of API function ara::per::FileAccessor::GetPosition**

*Upstream requirements:* RS_PER_00001, RS_PER_00004, RS_AP_00119, RS_AP_00120, RS_AP_00159

⌈

| | | |
|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/file_accessor.h" | |
| ***Scope:*** | `class ara::per::FileAccessor` | |
| ***Syntax:*** | `std::uint64_t GetPosition () const noexcept;` | |
| ***Return value:*** | std::uint64_t | The current position in the file in bytes from the beginning of the file. |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | not thread-safe | |
| ***Description:*** | Returns the current position relative to the beginning of the file.<br>The returned position may be at the end of the file. | |

⌋

##### 8.3.2.1.2.2 GetSize

**[SWS_PER_00424] Definition of API function ara::per::FileAccessor::GetSize**

*Upstream requirements:* RS_PER_00017, RS_AP_00119, RS_AP_00120, RS_AP_00121, RS_AP_00127, RS_AP_00128, RS_AP_00129, RS_AP_00159

⌈

| | | |
|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/file_accessor.h" | |
| ***Scope:*** | `class ara::per::FileAccessor` | |
| ***Syntax:*** | `std::uint64_t GetSize () const noexcept;` | |
| ***Return value:*** | std::uint64_t | The current size of the file in bytes. |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | not thread-safe | |
| ***Description:*** | Returns the current size of a file in bytes. | |

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#### 8.3.2.1.2.3 IsEof

### [SWS_PER_00107] Definition of API function ara::per::FileAccessor::IsEof

*Upstream requirements:* RS_PER_00001, RS_PER_00004, RS_AP_00119, RS_AP_00120, RS_AP_00159

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| | | |
|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/file_accessor.h" | |
| ***Scope:*** | `class ara::per::FileAccessor` | |
| ***Syntax:*** | `bool IsEof () const noexcept;` | |
| ***Return value:*** | bool | True if the current position is at the end of the file, false otherwise. |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | not thread-safe | |
| ***Description:*** | Checks if the current position is at end of file. | |

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#### 8.3.2.1.2.4 MovePosition

### [SWS_PER_00164] Definition of API function ara::per::FileAccessor::MovePosition

*Upstream requirements:* RS_PER_00001, RS_PER_00004, RS_AP_00119, RS_AP_00120, RS_AP_00121, RS_AP_00135, RS_AP_00139, RS_AP_00159

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| | | |
|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/file_accessor.h" | |
| ***Scope:*** | `class ara::per::FileAccessor` | |
| ***Syntax:*** | `ara::core::Result< std::uint64_t > MovePosition (Origin origin, std::int64_t offset) noexcept;` | |
| ***Parameters (in):*** | origin | Starting point from which to move 'offset' bytes. |
| | offset | Offset in bytes relative to 'origin'. Can be positive in case of k Beginning and kCurrent and negative in case of kCurrent and k End. In case of kCurrent, an offset of zero will not change the current position. In case of kEnd, an offset of zero will set the position to the end of the file. |
| ***Return value:*** | ara::core::Result< std::uint64_t > | A Result containing the new position in bytes from the beginning of the file. In case of an error, it contains any of the errors defined below, or a vendor specific error. |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | not thread-safe | |
| ***Errors:*** | PerErrc::kInvalidPosition | rollback_semantics |
| | | Returned if the resulting position is lower than zero or beyond the end of the file. |
| ***Description:*** | Moves the current position in the file relative to the Origin.<br>In case of an error, the current position is not changed. | |

⌋

#### 8.3.2.1.2.5 SetPosition

### [SWS_PER_00163] Definition of API function ara::per::FileAccessor::SetPosition

*Upstream requirements:* RS_PER_00001, RS_PER_00004, RS_AP_00119, RS_AP_00120, RS_AP_00121, RS_AP_00135, RS_AP_00139, RS_AP_00159

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| | | |
|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/file_accessor.h" | |
| ***Scope:*** | `class ara::per::FileAccessor` | |
| ***Syntax:*** | `ara::core::Result< void > SetPosition (std::uint64_t position) noexcept;` | |
| ***Parameters (in):*** | position | Current position in the file in bytes from the beginning of the file. |
| ***Return value:*** | ara::core::Result< void > | A Result of void. In case of an error, it contains any of the errors defined below, or a vendor specific error. |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | not thread-safe | |
| ***Errors:*** | PerErrc::kInvalidPosition | rollback_semantics |
| | | Returned if the given position is beyond the end of the file. |
| ***Description:*** | Sets the current position relative to the beginning of the file.<br>In case of an error, the current position is not changed. | |

⌋

## 8.4 Header: ara/per/file_storage.h

### 8.4.1 Non-Member Types

#### 8.4.1.1 Enumeration: FileCreationState

### [SWS_PER_00435] Definition of API enum ara::per::FileCreationState

*Upstream requirements:* RS_PER_00004, RS_AP_00122, RS_AP_00125, RS_AP_00143

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| | | |
|---|---|---|
| ***Kind:*** | enumeration | |
| ***Header file:*** | #include "ara/per/file_storage.h" | |
| ***Forwarding header file:*** | #include "ara/per/per_fwd.h" | |
| ***Scope:*** | namespace ara::per | |
| ***Symbol:*** | FileCreationState | |
| ***Underlying type:*** | std::uint32_t | |
| ***Syntax:*** | `enum class FileCreationState : std::uint32_t {...};` | |
| ***Values:*** | kCreatedDuring Installation | = 1 |
| | | The file was created by Persistency after installation of the Adaptive Application or after ResetPersistency. |
| | kCreatedDuringUpdate | = 2 |
| | | The file was created by Persistency during an update. |

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| | | |
|---|---|---|
| | kCreatedDuringReset | = 3 |
| | | The file was re-created due to a call to ResetFile or ResetAllFiles. |
| | kCreatedDuring Recovery | = 4 |
| | | The file was re-created by Persistency after a corruption was detected. |
| | kCreatedByApplication | = 5 |
| | | The file was created by the Persistency user. |
| ***Description:*** | This enumeration describes how and when a file was created. | |

⌋

### 8.4.1.2 Enumeration: FileModificationState

**[SWS_PER_00436] Definition of API enum ara::per::FileModificationState**

*Upstream requirements:* RS_PER_00004, RS_AP_00122, RS_AP_00125, RS_AP_00143

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| | | |
|---|---|---|
| ***Kind:*** | enumeration | |
| ***Header file:*** | #include "ara/per/file_storage.h" | |
| ***Forwarding header file:*** | #include "ara/per/per_fwd.h" | |
| ***Scope:*** | namespace ara::per | |
| ***Symbol:*** | FileModificationState | |
| ***Underlying type:*** | std::uint32_t | |
| ***Syntax:*** | `enum class FileModificationState : std::uint32_t {...};` | |
| ***Values:*** | kModifiedDuringUpdate | = 2 |
| | | The file was last modified by Persistency during an update. |
| | kModifiedDuringReset | = 3 |
| | | The file was last modified by Persistency due to a call to ResetFile or ResetAllFiles. |
| | kModifiedDuring Recovery | = 4 |
| | | The file was last modified by Persistency after a corruption was detected. |
| | kModifiedByApplication | = 5 |
| | | The file was last modified by the Persistency user. |
| ***Description:*** | This enumeration describes how and when a file was last modified. | |

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#### 8.4.1.3 Enumeration: OpenMode

**[SWS_PER_00147] Definition of API enum ara::per::OpenMode**

*Upstream requirements:* RS_PER_00003, RS_AP_00122, RS_AP_00125, RS_AP_00143

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| | | |
|---|---|---|
| ***Kind:*** | enumeration | |
| ***Header file:*** | #include "ara/per/file_storage.h" | |
| ***Forwarding header file:*** | #include "ara/per/per_fwd.h" | |
| ***Scope:*** | namespace ara::per | |
| ***Symbol:*** | OpenMode | |
| ***Underlying type:*** | std::uint32_t | |
| ***Syntax:*** | `enum class OpenMode : std::uint32_t {...};` | |
| ***Values:*** | kAtTheBeginning | = 1 << 0 |
| | | Sets the seek position to the beginning of the file when the file is opened. This mode cannot be combined with kAtTheEnd. |
| | kAtTheEnd | = 1 << 1 |
| | | Sets the seek position to the end of the file when the file is opened. This mode cannot be combined with kAtTheBeginning or kTruncate. |
| | kTruncate | = 1 << 2 |
| | | Removes existing content when the file is opened. This mode cannot be combined with kAtTheEnd. |
| | kAppend | = 1 << 3 |
| | | Append to the end. Always seeks to the end of the file before writing. |
| ***Description:*** | This enumeration defines how a file shall be opened.<br>The values can be combined (using \| and \|=) as long as they do not contradict each other. | |

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### 8.4.2 Non-Member Functions

#### 8.4.2.1 Other

##### 8.4.2.1.1 GetCurrentFileStorageSize

**[SWS_PER_00406] Definition of API function ara::per::GetCurrentFileStorageSize**

*Upstream requirements:* RS_PER_00017, RS_AP_00119, RS_AP_00120, RS_AP_00121, RS_AP_00127, RS_AP_00128, RS_AP_00129, RS_AP_00135, RS_AP_00137, RS_AP_00139, RS_AP_00159

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| | |
|---|---|
| ***Kind:*** | function |
| ***Header file:*** | #include "ara/per/file_storage.h" |
| ***Scope:*** | namespace ara::per |

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| | | |
|---|---|---|
| ***Syntax:*** | `ara::core::Result< std::uint64_t > GetCurrentFileStorageSize (const ara::core::InstanceSpecifier &fs) noexcept;` | |
| ***Parameters (in):*** | fs | The shortName path of a PortPrototype typed by a PersistencyFileStorageInterface. |
| ***Return value:*** | ara::core::Result< std::uint64_t > | A Result containing the occupied space in bytes. In case of an error, it contains any of the errors defined below, or a vendor specific error. |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | thread-safe | |
| ***Errors:*** | PerErrc::kStorageNotFound | rollback_semantics |
| | | Returned if the passed InstanceSpecifier does not match any PersistencyFileStorageInterface configured for this Executable. |
| | PerErrc::kPhysicalStorageFailure | rollback_semantics |
| | | Returned if access to the physical storage fails. |
| ***Description:*** | Returns the space in bytes currently occupied by a File Storage.<br>The returned size includes all metadata and the space used for redundancy and backups.<br>The returned size is only guaranteed to be accurate if the File Storage is not opened and no other operation on the File Storage takes place at the same time. | |

⌋

### 8.4.2.1.2 OpenFileStorage

## [SWS_PER_00116] Definition of API function ara::per::OpenFileStorage

*Upstream requirements:* RS_PER_00001, RS_PER_00004, RS_PER_00010, RS_AP_00119, RS_AP_00120, RS_AP_00121, RS_AP_00127, RS_AP_00128, RS_AP_00129, RS_AP_00135, RS_AP_00137, RS_AP_00139, RS_AP_00144, RS_AP_00147, RS_AP_00159

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| | | |
|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/file_storage.h" | |
| ***Scope:*** | namespace ara::per | |
| ***Syntax:*** | `ara::core::Result< SharedHandle< FileStorage > > OpenFileStorage (const ara::core::InstanceSpecifier &fs) noexcept;` | |
| ***Parameters (in):*** | fs | The shortName path of a PortPrototype typed by a PersistencyFileStorageInterface. |
| ***Return value:*** | ara::core::Result< SharedHandle< FileStorage > > | A Result containing a SharedHandle for the File Storage. In case of an error, it contains any of the errors defined below, or a vendor specific error. |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | thread-safe | |
| ***Errors:*** | PerErrc::kStorageNotFound | rollback_semantics |
| | | Returned if the passed InstanceSpecifier does not match any PersistencyFileStorageInterface configured for this Executable. |
| | PerErrc::kPhysicalStorageFailure | no_rollback_semantics |
| | | Returned if access to the physical storage fails. |

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| | | |
|---|---|---|
| | PerErrc::kIntegrity Corrupted | rollback_semantics |
| | | Returned if stored data cannot be read because the structural integrity is corrupted. |
| | PerErrc::kValidation Failed | rollback_semantics |
| | | Returned if the validity of stored data cannot be ensured. |
| | PerErrc::kEncryption Failed | rollback_semantics |
| | | Returned if the decryption of stored data fails. |
| | PerErrc::kResourceBusy | rollback_semantics |
| | | Returned if CleanUpPersistency, or ResetPersistency is currently being executed, or if RecoverAllFiles or ResetAllFiles is currently being executed for the same File Storage. Also, while Update Persistency is currently being executed, this error is returned when OpenFileStorage is called outside of the callback registered via RegisterApplicationDataUpdateCallback, or if the used Instance Specifier differs from the one provided by the callback. |
| | PerErrc::kOutOfStorage Space | no_rollback_semantics |
| | | Returned if the available physical storage space is insufficient for the files that are added/updated during an implicit update of the File Storage. |
| | PerErrc::kTooManyFiles | rollback_semantics |
| | | Returned if the files that are added during an implicit update of the File Storage would exceed the configured maxNumberOfFiles. |
| | PerErrc::kQuota Exceeded | rollback_semantics |
| | | Returned if the files that are added/updated during an implicit update of the File Storage would exceed the configured maximum AllowedSize. |
| | PerErrc::kAuthentication Failed | rollback_semantics |
| | | Returned if checking the MAC of stored data fails. |
| ***Description:*** | Opens a File Storage.<br>OpenFileStorage will fail with kResourceBusy when the File Storage is currently being modified by a call from another thread to UpdatePersistency, CleanUpPersistency, ResetPersistency, RecoverAllFiles, or ResetAllFiles.<br>Because multiple threads can access the same File Storage concurrently, the File Storage might not be closed when the SharedHandle returned by this function goes out of scope. It will only be closed when all SharedHandles that refer to the same File Storage went out of scope. | |

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### 8.4.2.1.3 RecoverAllFiles

## [SWS_PER_00335] Definition of API function ara::per::RecoverAllFiles

*Upstream requirements:* RS_PER_00001, RS_PER_00004, RS_PER_00009, RS_PER_00010, RS_AP_00119, RS_AP_00120, RS_AP_00121, RS_AP_00127, RS_AP_00128, RS_AP_00129, RS_AP_00135, RS_AP_00137, RS_AP_00139, RS_AP_00159

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| | |
|---|---|
| ***Kind:*** | function |
| ***Header file:*** | #include "ara/per/file_storage.h" |
| ***Scope:*** | namespace ara::per |

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| | | |
|---|---|---|
| ***Syntax:*** | `ara::core::Result< void > RecoverAllFiles (const ara::core::InstanceSpecifier &fs) noexcept;` | |
| ***Parameters (in):*** | fs | The shortName path of a PortPrototype typed by a PersistencyFileStorageInterface. |
| ***Return value:*** | ara::core::Result< void > | A Result of void. In case of an error, it contains any of the errors defined below, or a vendor specific error. |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | thread-safe | |
| ***Errors:*** | PerErrc::kStorageNotFound | rollback_semantics |
| | | Returned if the passed InstanceSpecifier does not match any PersistencyFileStorageInterface configured for this Executable. |
| | PerErrc::kPhysicalStorageFailure | no_rollback_semantics |
| | | Returned if access to the physical storage fails. |
| | PerErrc::kEncryptionFailed | rollback_semantics |
| | | Returned if the encryption of stored data fails. |
| | PerErrc::kResourceBusy | rollback_semantics |
| | | Returned if UpdatePersistency, CleanUpPersistency, or Reset Persistency is currently being executed, or if ResetAllFiles is currently being executed for the same File Storage, or a Shared Handle of the same File Storage is currently in use. |
| | PerErrc::kOutOfStorageSpace | no_rollback_semantics |
| | | Returned if the available physical storage space is insufficient for the recovered files. |
| | PerErrc::kQuotaExceeded | rollback_semantics |
| | | Returned if the recovered files would exceed the configured maximumAllowedSize of the File Storage. |
| | PerErrc::kAuthenticationFailed | rollback_semantics |
| | | Returned if calculating the MAC of stored data fails. |
| ***Description:*** | Recovers a File Storage, including all files.<br>RecoverAllFiles recovers a File Storage when the redundancy checks fail.<br>It will fail with kResourceBusy when the File Storage is currently open, or when it is modified by a call from another thread to UpdatePersistency, CleanUpPersistency, ResetPersistency, RecoverAllFiles, or ResetAllFiles.<br>This method does a best-effort recovery of all files. After recovery, files might show outdated or initial content, or might be lost. | |

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#### 8.4.2.1.4 ResetAllFiles

### [SWS_PER_00336] Definition of API function ara::per::ResetAllFiles

*Upstream requirements:* RS_PER_00001, RS_PER_00004, RS_PER_00009, RS_PER_00010, RS_AP_00119, RS_AP_00120, RS_AP_00121, RS_AP_00127, RS_AP_00128, RS_AP_00129, RS_AP_00135, RS_AP_00137, RS_AP_00139, RS_AP_00159

⌈

| | | |
|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/file_storage.h" | |
| ***Scope:*** | namespace ara::per | |
| ***Syntax:*** | `ara::core::Result< void > ResetAllFiles (const ara::core::InstanceSpecifier &fs) noexcept;` | |
| ***Parameters (in):*** | fs | The shortName path of a PortPrototype typed by a PersistencyFileStorageInterface. |
| ***Return value:*** | ara::core::Result< void > | A Result of void. In case of an error, it contains any of the errors defined below, or a vendor specific error. |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | thread-safe | |
| ***Errors:*** | PerErrc::kStorageNotFound | rollback_semantics |
| | | Returned if the passed InstanceSpecifier does not match any PersistencyFileStorageInterface configured for this Executable. |
| | PerErrc::kPhysicalStorageFailure | no_rollback_semantics |
| | | Returned if access to the physical storage fails. |
| | PerErrc::kEncryptionFailed | rollback_semantics |
| | | Returned if the encryption of stored data fails. |
| | PerErrc::kResourceBusy | rollback_semantics |
| | | Returned if UpdatePersistency, CleanUpPersistency, or ResetPersistency is currently being executed, or if RecoverAllFiles is currently being executed for the same File Storage, or a Shared Handle of the same File Storage is currently in use. |
| | PerErrc::kOutOfStorageSpace | no_rollback_semantics |
| | | Returned if the available physical storage space is insufficient for the initial files. |
| | PerErrc::kAuthenticationFailed | rollback_semantics |
| | | Returned if calculating the MAC of stored data fails. |
| ***Description:*** | Resets a File Storage, including all files.<br>ResetAllFiles resets a File Storage to the initial state, containing only the files which were deployed from the `Target Configuration`, with their initial content. Afterwards, the File Storage will appear as if it was newly installed from the current `Target Configuration`.<br>It will fail with kResourceBusy when the File Storage is currently open, or when it is modified by a call from another thread to UpdatePersistency, CleanUpPersistency, ResetPersistency, RecoverAllFiles, or ResetAllFiles. | |

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#### 8.4.2.1.5 operator|

### [SWS_PER_00144] Definition of API function ara::per::operator|

*Upstream requirements:* RS_PER_00001, RS_PER_00004, RS_AP_00119, RS_AP_00120, RS_AP_00121

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| | | |
|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/file_storage.h" | |
| ***Scope:*** | namespace ara::per | |
| ***Syntax:*** | `constexpr OpenMode operator\| (OpenMode left, OpenMode right);` | |
| ***Parameters (in):*** | left | First OpenMode modifiers. |
| | right | Second OpenMode modifiers. |
| ***Return value:*** | OpenMode | returns Merged OpenMode modifiers. |
| ***Exception Safety:*** | not exception safe | |
| ***Thread Safety:*** | thread-safe | |
| ***Description:*** | Merges two OpenMode modifiers into one. | |

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#### 8.4.2.1.6 operator|=

### [SWS_PER_00434] Definition of API function ara::per::operator|=

*Upstream requirements:* RS_PER_00001, RS_PER_00004, RS_AP_00119, RS_AP_00120, RS_AP_00121

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| | | |
|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/file_storage.h" | |
| ***Scope:*** | namespace ara::per | |
| ***Syntax:*** | `OpenMode & operator\|= (OpenMode &left, const OpenMode &right);` | |
| ***Parameters (in):*** | left | Left OpenMode modifiers. |
| | right | Right OpenMode modifiers. |
| ***Return value:*** | OpenMode & | returns The modified OpenMode. |
| ***Exception Safety:*** | not exception safe | |
| ***Thread Safety:*** | thread-safe | |
| ***Description:*** | Merges an OpenMode modifier into this OpenMode. | |

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### 8.4.3 Struct: FileInfo

**[SWS_PER_00437] Definition of API class ara::per::FileInfo**

*Upstream requirements:* RS_PER_00004, RS_AP_00122

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| | |
|---|---|
| ***Kind:*** | struct |
| ***Header file:*** | #include "ara/per/file_storage.h" |
| ***Forwarding header file:*** | #include "ara/per/per_fwd.h" |
| ***Scope:*** | namespace ara::per |
| ***Symbol:*** | FileInfo |
| ***Syntax:*** | `struct FileInfo {...};` |
| ***Description:*** | This structure contains additional information on a file returned by GetFileInfo. |

⌋

#### 8.4.3.1 Public Member Variables

##### 8.4.3.1.1 accessTime

**[SWS_PER_00443] Definition of API variable ara::per::FileInfo::accessTime**

*Upstream requirements:* RS_PER_00004

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| | |
|---|---|
| ***Kind:*** | variable |
| ***Header file:*** | #include "ara/per/file_storage.h" |
| ***Scope:*** | `struct ara::per::FileInfo` |
| ***Symbol:*** | accessTime |
| ***Type:*** | std::uint64_t |
| ***Syntax:*** | `std::uint64_t accessTime;` |
| ***Description:*** | Time in nanoseconds since midnight 1970-01-01 UTC at which the file was last accessed. |

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##### 8.4.3.1.2 creationTime

**[SWS_PER_00441] Definition of API variable ara::per::FileInfo::creationTime**

*Upstream requirements:* RS_PER_00004

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| | |
|---|---|
| ***Kind:*** | variable |
| ***Header file:*** | #include "ara/per/file_storage.h" |
| ***Scope:*** | `struct ara::per::FileInfo` |

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| | |
|---|---|
| ***Symbol:*** | creationTime |
| ***Type:*** | std::uint64_t |
| ***Syntax:*** | `std::uint64_t creationTime;` |
| ***Description:*** | Time in nanoseconds since midnight 1970-01-01 UTC at which the file was created. |

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#### 8.4.3.1.3 fileCreationState

### [SWS_PER_00444] Definition of API variable ara::per::FileInfo::fileCreationState

*Upstream requirements:* RS_PER_00004

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| | |
|---|---|
| ***Kind:*** | variable |
| ***Header file:*** | #include "ara/per/file_storage.h" |
| ***Scope:*** | `struct ara::per::FileInfo` |
| ***Symbol:*** | fileCreationState |
| ***Type:*** | FileCreationState |
| ***Syntax:*** | `FileCreationState fileCreationState;` |
| ***Description:*** | Information on how and by whom the file was created. |

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#### 8.4.3.1.4 fileModificationState

### [SWS_PER_00445] Definition of API variable ara::per::FileInfo::fileModification State

*Upstream requirements:* RS_PER_00004

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| | |
|---|---|
| ***Kind:*** | variable |
| ***Header file:*** | #include "ara/per/file_storage.h" |
| ***Scope:*** | `struct ara::per::FileInfo` |
| ***Symbol:*** | fileModificationState |
| ***Type:*** | FileModificationState |
| ***Syntax:*** | `FileModificationState fileModificationState;` |
| ***Description:*** | Information on how and by whom the file was last modified. |

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#### 8.4.3.1.5 modificationTime

### [SWS_PER_00442] Definition of API variable ara::per::FileInfo::modificationTime

*Upstream requirements:* RS_PER_00004

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| | |
|---|---|
| ***Kind:*** | variable |
| ***Header file:*** | #include "ara/per/file_storage.h" |
| ***Scope:*** | `struct ara::per::FileInfo` |
| ***Symbol:*** | modificationTime |
| ***Type:*** | std::uint64_t |
| ***Syntax:*** | `std::uint64_t modificationTime;` |
| ***Description:*** | Time in nanoseconds since midnight 1970-01-01 UTC at which the file was last modified. |

⌋

## 8.4.4 Class: FileStorage

### [SWS_PER_00340] Definition of API class ara::per::FileStorage

*Upstream requirements:* RS_PER_00004, RS_AP_00122, RS_AP_00140, RS_AP_00146

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| | |
|---|---|
| ***Kind:*** | class |
| ***Port Interfaces:*** | `PersistencyFileStorageInterface` |
| ***Header file:*** | #include "ara/per/file_storage.h" |
| ***Forwarding header file:*** | #include "ara/per/per_fwd.h" |
| ***Scope:*** | namespace ara::per |
| ***Symbol:*** | FileStorage |
| ***Syntax:*** | `class FileStorage final {...};` |
| ***Description:*** | The File Storage contains a set of files identified by their file names. |

⌋

#### 8.4.4.1 Public Member Functions

##### 8.4.4.1.1 Special Member Functions

###### 8.4.4.1.1.1 Move Constructor

**[SWS_PER_00326] Definition of API function ara::per::FileStorage::FileStorage**

*Upstream requirements:* RS_PER_00004, RS_AP_00120, RS_AP_00121, RS_AP_00129, RS_AP_00145, RS_AP_00159

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| | |
|---|---|
| ***Kind:*** | function |
| ***Header file:*** | #include "ara/per/file_storage.h" |
| ***Scope:*** | `class ara::per::FileStorage` |
| ***Syntax:*** | `FileStorage (FileStorage &&fs)=delete;` |
| ***Description:*** | The move constructor for FileStorage shall not be used. |

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###### 8.4.4.1.1.2 Default Constructor

**[SWS_PER_00460] Definition of API function ara::per::FileStorage::FileStorage**

*Upstream requirements:* RS_PER_00004, RS_AP_00120, RS_AP_00129, RS_AP_00146

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| | |
|---|---|
| ***Kind:*** | function |
| ***Header file:*** | #include "ara/per/file_storage.h" |
| ***Scope:*** | `class ara::per::FileStorage` |
| ***Syntax:*** | `FileStorage ()=delete;` |
| ***Description:*** | The default constructor for FileStorage shall not be used. |

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###### 8.4.4.1.1.3 Copy Constructor

**[SWS_PER_00328] Definition of API function ara::per::FileStorage::FileStorage**

*Upstream requirements:* RS_PER_00004, RS_AP_00120, RS_AP_00145

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| | |
|---|---|
| ***Kind:*** | function |
| ***Header file:*** | #include "ara/per/file_storage.h" |
| ***Scope:*** | `class ara::per::FileStorage` |
| ***Syntax:*** | `FileStorage (const FileStorage &)=delete;` |

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|---|---|
| ***Description:*** | The copy constructor for FileStorage shall not be used. |

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#### 8.4.4.1.1.4 Copy Assignment Operator

**[SWS_PER_00329] Definition of API function ara::per::FileStorage::operator=**

*Upstream requirements:* RS_PER_00004, RS_AP_00119, RS_AP_00120, RS_AP_00145

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| | |
|---|---|
| ***Kind:*** | function |
| ***Header file:*** | #include "ara/per/file_storage.h" |
| ***Scope:*** | `class ara::per::FileStorage` |
| ***Syntax:*** | `FileStorage & operator= (const FileStorage &)=delete;` |
| ***Description:*** | The copy assignment operator for FileStorage shall not be used. |

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#### 8.4.4.1.1.5 Move Assignment Operator

**[SWS_PER_00327] Definition of API function ara::per::FileStorage::operator=**

*Upstream requirements:* RS_PER_00004, RS_AP_00119, RS_AP_00120, RS_AP_00121, RS_AP_00145, RS_AP_00159

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| | |
|---|---|
| ***Kind:*** | function |
| ***Header file:*** | #include "ara/per/file_storage.h" |
| ***Scope:*** | `class ara::per::FileStorage` |
| ***Syntax:*** | `FileStorage & operator= (FileStorage &&fs)=delete;` |
| ***Description:*** | The move assignment operator for FileStorage shall not be used. |

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#### 8.4.4.1.1.6 Destructor

### [SWS_PER_00330] Definition of API function ara::per::FileStorage::~FileStorage

*Upstream requirements:* RS_PER_00004, RS_AP_00120, RS_AP_00129, RS_AP_00134, RS_AP_00145, RS_AP_00159

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| | |
|---|---|
| ***Kind:*** | function |
| ***Header file:*** | #include "ara/per/file_storage.h" |
| ***Scope:*** | `class ara::per::FileStorage` |
| ***Syntax:*** | `~FileStorage () noexcept;` |
| ***Exception Safety:*** | exception safe |
| ***Thread Safety:*** | not thread-safe |
| ***Description:*** | Destructor for FileStorage. |

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### 8.4.4.1.2 Member Functions

#### 8.4.4.1.2.1 DeleteFile

### [SWS_PER_00111] Definition of API function ara::per::FileStorage::DeleteFile

*Upstream requirements:* RS_PER_00001, RS_PER_00004, RS_AP_00119, RS_AP_00120, RS_AP_00121, RS_AP_00127, RS_AP_00128, RS_AP_00129, RS_AP_00135, RS_AP_00139, RS_AP_00159

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| | | |
|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/file_storage.h" | |
| ***Scope:*** | `class ara::per::FileStorage` | |
| ***Syntax:*** | `ara::core::Result< void > DeleteFile (ara::core::StringView fileName) noexcept;` | |
| ***Parameters (in):*** | fileName | File name of the file. May correspond to the PersistencyFile.file Name of a configured file. |
| ***Return value:*** | ara::core::Result< void > | A Result of void. In case of an error, it contains any of the errors defined below, or a vendor specific error. |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | thread-safe | |
| ***Errors:*** | PerErrc::kIllegalWrite Access | rollback_semantics |
| | | Returned if the File Storage is configured as read-only. |
| | PerErrc::kPhysical StorageFailure | no_rollback_semantics |
| | | Returned if access to the physical storage fails. |
| | PerErrc::kIntegrity Corrupted | rollback_semantics |
| | | Returned if stored data cannot be written because the structural integrity is corrupted. |

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|---|---|---|
| | PerErrc::kEncryption Failed | rollback_semantics |
| | | Returned if the encryption or decryption of stored data fails. |
| | PerErrc::kResourceBusy | rollback_semantics |
| | | Returned if the file is open, or if RecoverFile or ResetFile with the same file name is currently being executed. |
| | PerErrc::kFileNotFound | rollback_semantics |
| | | Returned if the provided file does not exist in the File Storage. |
| | PerErrc::kAuthentication Failed | rollback_semantics |
| | | Returned if calculating or checking the MAC of stored data fails. |
| ***Description:*** | Deletes a file from this File Storage.<br>This operation will fail with kResourceBusy when the file is currently open. | |

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### 8.4.4.1.2.2 FileExists

### [SWS_PER_00112] Definition of API function ara::per::FileStorage::FileExists

*Upstream requirements:* RS_PER_00001, RS_PER_00004, RS_AP_00119, RS_AP_00120, RS_AP_00121, RS_AP_00127, RS_AP_00135, RS_AP_00139, RS_AP_00159

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| | | |
|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/file_storage.h" | |
| ***Scope:*** | `class ara::per::FileStorage` | |
| ***Syntax:*** | `ara::core::Result< bool > FileExists (ara::core::StringView fileName) const noexcept;` | |
| ***Parameters (in):*** | fileName | File name of the file. May correspond to the PersistencyFile.file Name of a configured file. |
| ***Return value:*** | ara::core::Result< bool > | A Result containing true if the file could be located or false if it couldn't. In case of an error, it contains any of the errors defined below, or a vendor specific error. |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | thread-safe | |
| ***Errors:*** | PerErrc::kPhysical StorageFailure | rollback_semantics |
| | | Returned if access to the physical storage fails. |
| | PerErrc::kIntegrity Corrupted | rollback_semantics |
| | | Returned if stored data cannot be read because the structural integrity is corrupted. |
| | PerErrc::kValidation Failed | rollback_semantics |
| | | Returned if the validity of stored data cannot be ensured. |
| | PerErrc::kEncryption Failed | rollback_semantics |
| | | Returned if the decryption of stored data fails. |
| | PerErrc::kAuthentication Failed | rollback_semantics |
| | | Returned if checking the MAC of stored data fails. |

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|---|---|
| ***Description:*** | Checks if a file exists in this File Storage.<br>The result is only accurate if no file is added or deleted at the same time. E.g. when a file is removed in another thread directly after this function returned "true", the result is not valid anymore. |

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#### 8.4.4.1.2.3 GetAllFileNames

**[SWS_PER_00110] Definition of API function ara::per::FileStorage::GetAllFileNames**

*Upstream requirements:* RS_PER_00001, RS_PER_00004, RS_AP_00119, RS_AP_00120, RS_AP_00127, RS_AP_00129, RS_AP_00135, RS_AP_00139, RS_AP_00159

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| | | |
|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/file_storage.h" | |
| ***Scope:*** | `class ara::per::FileStorage` | |
| ***Syntax:*** | `ara::core::Result< ara::core::Vector< ara::core::String > > GetAllFileNames () const noexcept;` | |
| ***Return value:*** | ara::core::Result< ara::core::Vector< ara::core::String > > | A Result containing a list of available file names. In case of an error, it contains any of the errors defined below, or a vendor specific error. |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | thread-safe | |
| ***Errors:*** | PerErrc::kPhysicalStorageFailure | rollback_semantics |
| | | Returned if access to the physical storage fails. |
| | PerErrc::kIntegrityCorrupted | rollback_semantics |
| | | Returned if stored data cannot be read because the structural integrity is corrupted. |
| | PerErrc::kValidationFailed | rollback_semantics |
| | | Returned if the validity of stored data cannot be ensured. |
| | PerErrc::kEncryptionFailed | rollback_semantics |
| | | Returned if the decryption of stored data fails. |
| | PerErrc::kAuthenticationFailed | rollback_semantics |
| | | Returned if checking the MAC of stored data fails. |
| ***Description:*** | Returns a list of all currently available file names of this File Storage.<br>The list of file names is only accurate if no file is added or deleted at the same time. | |

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#### 8.4.4.1.2.4 GetCurrentFileSize

### [SWS_PER_00407] Definition of API function ara::per::FileStorage::GetCurrentFileSize

*Upstream requirements:* RS_PER_00017, RS_AP_00119, RS_AP_00120, RS_AP_00121, RS_AP_00127, RS_AP_00128, RS_AP_00129, RS_AP_00135, RS_AP_00139, RS_AP_00159

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| | | |
|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/file_storage.h" | |
| ***Scope:*** | `class ara::per::FileStorage` | |
| ***Syntax:*** | `ara::core::Result< std::uint64_t > GetCurrentFileSize (ara::core::StringView fileName) const noexcept;` | |
| ***Parameters (in):*** | fileName | File name of the file. May correspond to the PersistencyFile.file Name of a configured file. |
| ***Return value:*** | ara::core::Result< std::uint64_t > | A Result containing the occupied space in bytes. In case of an error, it contains any of the errors defined below, or a vendor specific error. |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | thread-safe | |
| ***Errors:*** | PerErrc::kPhysical StorageFailure | rollback_semantics |
| | | Returned if access to the physical storage fails. |
| | PerErrc::kIntegrity Corrupted | rollback_semantics |
| | | Returned if stored data cannot be read because the structural integrity is corrupted. |
| | PerErrc::kEncryption Failed | rollback_semantics |
| | | Returned if the decryption of stored data fails. |
| | PerErrc::kFileNotFound | rollback_semantics |
| | | Returned if the provided file does not exist in the File Storage. |
| ***Description:*** | Returns the space in bytes currently occupied by the content of a file of this File Storage. The returned size might be inaccurate if any of the instances of a file is invalid or if another operation on the file takes place at the same time. | |

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#### 8.4.4.1.2.5 GetFileInfo

### [SWS_PER_00438] Definition of API function ara::per::FileStorage::GetFileInfo

*Upstream requirements:* RS_PER_00004, RS_AP_00119, RS_AP_00120, RS_AP_00121, RS_AP_00127, RS_AP_00128, RS_AP_00129, RS_AP_00135, RS_AP_00139, RS_AP_00159

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| | |
|---|---|
| ***Kind:*** | function |
| ***Header file:*** | #include "ara/per/file_storage.h" |
| ***Scope:*** | `class ara::per::FileStorage` |

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| | | |
|---|---|---|
| ***Syntax:*** | `ara::core::Result< FileInfo > GetFileInfo (ara::core::StringView fileName) const noexcept;` | |
| ***Parameters (in):*** | fileName | File name of the file. May correspond to the PersistencyFile.fileName of a configured file. |
| ***Return value:*** | ara::core::Result< FileInfo > | A Result containing a FileInfo struct. In case of an error, it contains any of the errors defined below, or a vendor specific error. |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | thread-safe | |
| ***Errors:*** | PerErrc::kPhysicalStorageFailure | rollback_semantics |
| | | Returned if access to the physical storage fails. |
| | PerErrc::kIntegrityCorrupted | rollback_semantics |
| | | Returned if stored data cannot be read because the structural integrity is corrupted. |
| | PerErrc::kEncryptionFailed | rollback_semantics |
| | | Returned if the decryption of stored data fails. |
| | PerErrc::kFileNotFound | rollback_semantics |
| | | Returned if the provided file does not exist in the File Storage. |
| ***Description:*** | Returns additional information on a file of this File Storage.<br>The returned FileInfo struct contains information about the times when the file was created, last modified, and last accessed, and about how and by whom the file was created and last modified. The modificationTime, accessTime, and fileModificationState returned in the FileInfo are only accurate if the file is currently not open. | |

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### 8.4.4.1.2.6 OpenFileReadOnly

**[SWS_PER_00114] Definition of API function ara::per::FileStorage::OpenFileReadOnly**

*Upstream requirements:* RS_PER_00001, RS_PER_00004, RS_PER_00010, RS_AP_00119, RS_AP_00120, RS_AP_00121, RS_AP_00127, RS_AP_00128, RS_AP_00129, RS_AP_00135, RS_AP_00139, RS_AP_00144, RS_AP_00159

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| | | |
|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/file_storage.h" | |
| ***Scope:*** | `class ara::per::FileStorage` | |
| ***Syntax:*** | `ara::core::Result< UniqueHandle< ReadAccessor > > OpenFileReadOnly (ara::core::StringView fileName, OpenMode mode) noexcept;` | |
| ***Parameters (in):*** | fileName | File name of the file. May correspond to the PersistencyFile.fileName of a configured file. |
| | mode | Mode with which the file shall be opened. |
| ***Return value:*** | ara::core::Result< UniqueHandle< ReadAccessor > > | A Result containing a UniqueHandle for the file. In case of an error, it contains any of the errors defined below, or a vendor specific error. |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | thread-safe | |

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| | | |
|---|---|---|
| ***Errors:*** | PerErrc::kPhysical StorageFailure | rollback_semantics |
| | | Returned if access to the physical storage fails. |
| | PerErrc::kIntegrity Corrupted | rollback_semantics |
| | | Returned if stored data cannot be read because the structural integrity is corrupted. |
| | PerErrc::kValidation Failed | rollback_semantics |
| | | Returned if the validity of stored data cannot be ensured. |
| | PerErrc::kEncryption Failed | rollback_semantics |
| | | Returned if the decryption of stored data fails. |
| | PerErrc::kResourceBusy | rollback_semantics |
| | | Returned if the file is already open, or if DeleteFile, RecoverFile, or ResetFile with the same file name is currently being executed. |
| | PerErrc::kFileNotFound | rollback_semantics |
| | | Returned if the provided file does not exist in the File Storage. |
| | PerErrc::kInvalidOpen Mode | rollback_semantics |
| | | Returned if the passed mode contains an invalid combination of modes. |
| | PerErrc::kAuthentication Failed | rollback_semantics |
| | | Returned if checking the MAC of stored data fails. |
| ***Description:*** | Opens a file of this File Storage for reading with a defined mode.<br>If not otherwise specified by the provided mode, the file is opened with the seek position set to the beginning (corresponding to kAtTheBeginning).<br>The file will be closed when the returned UniqueHandle goes out of scope. | |

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### 8.4.4.1.2.7 OpenFileReadOnly

### [SWS_PER_00376] Definition of API function ara::per::FileStorage::OpenFileReadOnly

*Upstream requirements:* RS_PER_00001, RS_PER_00004, RS_PER_00010, RS_AP_00119, RS_AP_00120, RS_AP_00121, RS_AP_00127, RS_AP_00128, RS_AP_00129, RS_AP_00135, RS_AP_00139, RS_AP_00144, RS_AP_00159

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| | | |
|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/file_storage.h" | |
| ***Scope:*** | `class ara::per::FileStorage` | |
| ***Syntax:*** | `ara::core::Result< UniqueHandle< ReadAccessor > > OpenFileReadOnly (ara::core::StringView fileName) noexcept;` | |
| ***Parameters (in):*** | fileName | File name of the file. May correspond to the PersistencyFile.file Name of a configured file. |
| ***Return value:*** | ara::core::Result< UniqueHandle< Read Accessor > > | A Result containing a UniqueHandle for the file. In case of an error, it contains any of the errors defined below, or a vendor specific error. |
| ***Exception Safety:*** | exception safe | |

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| | | |
|---|---|---|
| ***Thread Safety:*** | thread-safe | |
| ***Errors:*** | PerErrc::kPhysical StorageFailure | rollback_semantics |
| | | Returned if access to the physical storage fails. |
| | PerErrc::kIntegrity Corrupted | rollback_semantics |
| | | Returned if stored data cannot be read because the structural integrity is corrupted. |
| | PerErrc::kValidation Failed | rollback_semantics |
| | | Returned if the validity of stored data cannot be ensured. |
| | PerErrc::kEncryption Failed | rollback_semantics |
| | | Returned if the decryption of stored data fails. |
| | PerErrc::kResourceBusy | rollback_semantics |
| | | Returned if the file is already open, or if DeleteFile, RecoverFile, or ResetFile with the same file name is currently being executed. |
| | PerErrc::kFileNotFound | rollback_semantics |
| | | Returned if the provided file does not exist in the File Storage. |
| | PerErrc::kAuthentication Failed | rollback_semantics |
| | | Returned if checking the MAC of stored data fails. |
| ***Description:*** | Opens a file of this File Storage for reading.<br>The file is opened with the seek position set to the beginning (corresponding to kAtThe Beginning).<br>The file will be closed when the returned UniqueHandle goes out of scope. | |

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### 8.4.4.1.2.8 OpenFileReadOnly

**[SWS_PER_00430] Definition of API function ara::per::FileStorage::OpenFile ReadOnly**

*Upstream requirements:* RS_PER_00001, RS_PER_00004, RS_PER_00010, RS_AP_00119, RS_AP_00120, RS_AP_00121, RS_AP_00127, RS_AP_00128, RS_AP_00129, RS_AP_00135, RS_AP_00139, RS_AP_00144, RS_AP_00159

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|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/file_storage.h" | |
| ***Scope:*** | `class ara::per::FileStorage` | |
| ***Syntax:*** | `ara::core::Result< UniqueHandle< ReadAccessor > > OpenFileReadOnly (ara::core::StringView fileName, OpenMode mode, ara::core::Span< ara::core::Byte > buffer) noexcept;` | |
| ***Parameters (in):*** | fileName | File name of the file. May correspond to the PersistencyFile.file Name of a configured file. |
| | mode | Mode with which the file shall be opened. |
| | buffer | Memory to be used for block-wise reading. |
| ***Return value:*** | ara::core::Result< UniqueHandle< Read Accessor > > | A Result containing a UniqueHandle for the file. In case of an error, it contains any of the errors defined below, or a vendor specific error. |

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|---|---|---|
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | thread-safe | |
| ***Errors:*** | PerErrc::kPhysical StorageFailure | rollback_semantics |
| | | Returned if access to the physical storage fails. |
| | PerErrc::kIntegrity Corrupted | rollback_semantics |
| | | Returned if stored data cannot be read because the structural integrity is corrupted. |
| | PerErrc::kValidation Failed | rollback_semantics |
| | | Returned if the validity of stored data cannot be ensured. |
| | PerErrc::kEncryption Failed | rollback_semantics |
| | | Returned if the decryption of stored data fails. |
| | PerErrc::kResourceBusy | rollback_semantics |
| | | Returned if the file is already open, or if DeleteFile, RecoverFile, or ResetFile with the same file name is currently being executed. |
| | PerErrc::kFileNotFound | rollback_semantics |
| | | Returned if the provided file does not exist in the File Storage. |
| | PerErrc::kInvalidOpen Mode | rollback_semantics |
| | | Returned if the passed mode contains an invalid combination of modes. |
| | PerErrc::kAuthentication Failed | rollback_semantics |
| | | Returned if checking the MAC of stored data fails. |
| ***Description:*** | Opens a file of this File Storage for reading with a user provided buffer.<br>If not otherwise specified by the provided mode, the file is opened with the seek position set to the beginning (corresponding to kAtTheBeginning).<br>The provided buffer will be used by the ReadAccessor to implement block-wise reading to speed up multiple small accesses to the file.<br>The file will be closed when the returned UniqueHandle goes out of scope. | |

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### 8.4.4.1.2.9 OpenFileReadWrite

**[SWS_PER_00375] Definition of API function ara::per::FileStorage::OpenFileReadWrite**

*Upstream requirements:* RS_PER_00001, RS_PER_00004, RS_PER_00010, RS_AP_00119, RS_AP_00120, RS_AP_00121, RS_AP_00127, RS_AP_00128, RS_AP_00129, RS_AP_00135, RS_AP_00139, RS_AP_00144, RS_AP_00159

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|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/file_storage.h" | |
| ***Scope:*** | `class ara::per::FileStorage` | |
| ***Syntax:*** | `ara::core::Result< UniqueHandle< ReadWriteAccessor > > OpenFileReadWrite (ara::core::StringView fileName) noexcept;` | |
| ***Parameters (in):*** | fileName | File name of the file. May correspond to the PersistencyFile.file Name of a configured file. |

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| ***Return value:*** | ara::core::Result< UniqueHandle< Read WriteAccessor > > | A Result containing a UniqueHandle for the file. In case of an error, it contains any of the errors defined below, or a vendor specific error. |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | thread-safe | |
| ***Errors:*** | PerErrc::kIllegalWrite Access | rollback_semantics |
| | | Returned if the File Storage is configured as read-only, or if it is configured as write-only-once and the key already exists. |
| | PerErrc::kPhysical StorageFailure | no_rollback_semantics |
| | | Returned if access to the physical storage fails. |
| | PerErrc::kIntegrity Corrupted | rollback_semantics |
| | | Returned if stored data cannot be read because the structural integrity is corrupted. |
| | PerErrc::kValidation Failed | rollback_semantics |
| | | Returned if the validity of stored data cannot be ensured. |
| | PerErrc::kEncryption Failed | rollback_semantics |
| | | Returned if the decryption of stored data fails. |
| | PerErrc::kResourceBusy | rollback_semantics |
| | | Returned if the file is already open, or if DeleteFile, RecoverFile, or ResetFile with the same file name is currently being executed. |
| | PerErrc::kOutOfStorage Space | no_rollback_semantics |
| | | Returned if the available physical storage space is insufficient for a new file. |
| | PerErrc::kTooManyFiles | rollback_semantics |
| | | Returned if the number of files would get larger than the configured maxNumberOfFiles when the file is created. |
| | PerErrc::kAuthentication Failed | rollback_semantics |
| | | Returned if checking the MAC of stored data fails. |
| ***Description:*** | Opens a file of this File Storage for reading and writing.<br>The file is opened with the seek position set to the beginning (corresponding to kAtThe Beginning).<br>If the file does not exist, it is created.<br>The file will be closed when the returned UniqueHandle goes out of scope. | |

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#### 8.4.4.1.2.10 OpenFileReadWrite

**[SWS_PER_00429] Definition of API function ara::per::FileStorage::OpenFileReadWrite**

*Upstream requirements:* RS_PER_00001, RS_PER_00004, RS_PER_00010, RS_AP_00119, RS_AP_00120, RS_AP_00121, RS_AP_00127, RS_AP_00128, RS_AP_00129, RS_AP_00135, RS_AP_00139, RS_AP_00144, RS_AP_00159

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|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/file_storage.h" | |
| ***Scope:*** | `class ara::per::FileStorage` | |
| ***Syntax:*** | `ara::core::Result< UniqueHandle< ReadWriteAccessor > > OpenFileReadWrite (ara::core::StringView fileName, OpenMode mode, ara::core::Span< ara::core::Byte > buffer) noexcept;` | |
| ***Parameters (in):*** | fileName | File name of the file. May correspond to the PersistencyFile.file Name of a configured file. |
| | mode | Mode with which the file shall be opened. |
| | buffer | Memory to be used for block-wise reading/writing. |
| ***Return value:*** | ara::core::Result< UniqueHandle< ReadWriteAccessor > > | A Result containing a UniqueHandle for the file. In case of an error, it contains any of the errors defined below, or a vendor specific error. |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | thread-safe | |
| ***Errors:*** | PerErrc::kIllegalWriteAccess | rollback_semantics |
| | | Returned if the File Storage is configured as read-only, or if it is configured as write-only-once and the key already exists. |
| | PerErrc::kPhysicalStorageFailure | no_rollback_semantics |
| | | Returned if access to the physical storage fails. |
| | PerErrc::kIntegrityCorrupted | rollback_semantics |
| | | Returned if stored data cannot be read because the structural integrity is corrupted. |
| | PerErrc::kValidationFailed | rollback_semantics |
| | | Returned if the validity of stored data cannot be ensured. |
| | PerErrc::kEncryptionFailed | rollback_semantics |
| | | Returned if the decryption of stored data fails. |
| | PerErrc::kResourceBusy | rollback_semantics |
| | | Returned if the file is already open, or if DeleteFile, RecoverFile, or ResetFile with the same file name is currently being executed. |
| | PerErrc::kOutOfStorageSpace | no_rollback_semantics |
| | | Returned if the available physical storage space is insufficient for a new file. |
| | PerErrc::kInvalidOpenMode | rollback_semantics |
| | | Returned if the passed mode contains an invalid combination of modes. |
| | PerErrc::kTooManyFiles | rollback_semantics |
| | | Returned if the number of files would get larger than the configured maxNumberOfFiles when the file is created. |

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| | PerErrc::kAuthentication Failed | rollback_semantics |
| | | Returned if checking the MAC of stored data fails. |
| ***Description:*** | Opens a file of this File Storage for reading and writing with a user provided buffer.<br>If not otherwise specified by the provided mode, the file is opened with the seek position set to the beginning (corresponding to kAtTheBeginning).<br>The provided buffer will be used by the ReadWriteAccessor to implement block-wise reading and writing to speed up multiple small accesses to the file.<br>If the file does not exist, it is created.<br>The file will be closed when the returned UniqueHandle goes out of scope. | |

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### 8.4.4.1.2.11 OpenFileReadWrite

**[SWS_PER_00113] Definition of API function ara::per::FileStorage::OpenFileReadWrite**

*Upstream requirements:* RS_PER_00001, RS_PER_00004, RS_PER_00010, RS_AP_00119, RS_AP_00120, RS_AP_00121, RS_AP_00127, RS_AP_00128, RS_AP_00129, RS_AP_00135, RS_AP_00139, RS_AP_00144, RS_AP_00159

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|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/file_storage.h" | |
| ***Scope:*** | `class ara::per::FileStorage` | |
| ***Syntax:*** | `ara::core::Result< UniqueHandle< ReadWriteAccessor > > OpenFileReadWrite (ara::core::StringView fileName, OpenMode mode) noexcept;` | |
| ***Parameters (in):*** | fileName | File name of the file. May correspond to the PersistencyFile.fileName of a configured file. |
| | mode | Mode with which the file shall be opened. |
| ***Return value:*** | ara::core::Result< UniqueHandle< ReadWriteAccessor > > | A Result containing a UniqueHandle for the file. In case of an error, it contains any of the errors defined below, or a vendor specific error. |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | thread-safe | |
| ***Errors:*** | PerErrc::kIllegalWriteAccess | rollback_semantics |
| | | Returned if the File Storage is configured as read-only, or if it is configured as write-only-once and the key already exists. |
| | PerErrc::kPhysicalStorageFailure | no_rollback_semantics |
| | | Returned if access to the physical storage fails. |
| | PerErrc::kIntegrityCorrupted | rollback_semantics |
| | | Returned if stored data cannot be read because the structural integrity is corrupted. |
| | PerErrc::kValidationFailed | rollback_semantics |
| | | Returned if the validity of stored data cannot be ensured. |
| | PerErrc::kEncryptionFailed | rollback_semantics |
| | | Returned if the decryption of stored data fails. |
| | PerErrc::kResourceBusy | rollback_semantics |

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| | | Returned if the file is already open, or if DeleteFile, RecoverFile, or ResetFile with the same file name is currently being executed. |
| | PerErrc::kOutOfStorage Space | no_rollback_semantics |
| | | Returned if the available physical storage space is insufficient for a new file. |
| | PerErrc::kInvalidOpen Mode | rollback_semantics |
| | | Returned if the passed mode contains an invalid combination of modes. |
| | PerErrc::kTooManyFiles | rollback_semantics |
| | | Returned if the number of files would get larger than the configured maxNumberOfFiles when the file is created. |
| | PerErrc::kAuthentication Failed | rollback_semantics |
| | | Returned if checking the MAC of stored data fails. |
| ***Description:*** | Opens a file of this File Storage for reading and writing with a defined mode.<br>If not otherwise specified by the provided mode, the file is opened with the seek position set to the beginning (corresponding to kAtTheBeginning).<br>If the file does not exist, it is created.<br>The file will be closed when the returned UniqueHandle goes out of scope. | |

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### 8.4.4.1.2.12 OpenFileWriteOnly

**[SWS_PER_00431] Definition of API function ara::per::FileStorage::OpenFileWriteOnly**

*Upstream requirements:* RS_PER_00001, RS_PER_00004, RS_PER_00010, RS_AP_00119, RS_AP_00120, RS_AP_00121, RS_AP_00127, RS_AP_00128, RS_AP_00129, RS_AP_00135, RS_AP_00139, RS_AP_00144, RS_AP_00159

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| | | |
|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/file_storage.h" | |
| ***Scope:*** | `class ara::per::FileStorage` | |
| ***Syntax:*** | `ara::core::Result< UniqueHandle< WriteAccessor > > OpenFileWriteOnly (ara::core::StringView fileName, OpenMode mode, ara::core::Span< ara::core::Byte > buffer) noexcept;` | |
| ***Parameters (in):*** | fileName | File name of the file. May correspond to the PersistencyFile.file Name of a configured file. |
| | mode | Mode with which the file shall be opened. |
| | buffer | Memory to be used for block-wise writing. |
| ***Return value:*** | ara::core::Result< UniqueHandle< Write Accessor > > | A Result containing a UniqueHandle for the file. In case of an error, it contains any of the errors defined below, or a vendor specific error. |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | thread-safe | |
| ***Errors:*** | PerErrc::kIllegalWrite Access | rollback_semantics |

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| | | Returned if the File Storage is configured as read-only, or if it is configured as write-only-once and the key already exists. |
| | PerErrc::kPhysical StorageFailure | no_rollback_semantics |
| | | Returned if access to the physical storage fails. |
| | PerErrc::kIntegrity Corrupted | rollback_semantics |
| | | Returned if stored data cannot be read because the structural integrity is corrupted. |
| | PerErrc::kValidation Failed | rollback_semantics |
| | | Returned if the validity of stored data cannot be ensured. |
| | PerErrc::kEncryption Failed | rollback_semantics |
| | | Returned if the decryption of stored data fails. |
| | PerErrc::kResourceBusy | rollback_semantics |
| | | Returned if the file is already open, or if DeleteFile, RecoverFile, or ResetFile with the same file name is currently being executed. |
| | PerErrc::kOutOfStorage Space | no_rollback_semantics |
| | | Returned if the available physical storage space is insufficient for a new file. |
| | PerErrc::kInvalidOpen Mode | rollback_semantics |
| | | Returned if the passed mode contains an invalid combination of modes. |
| | PerErrc::kTooManyFiles | rollback_semantics |
| | | Returned if the number of files would get larger than the configured maxNumberOfFiles when the file is created. |
| | PerErrc::kAuthentication Failed | rollback_semantics |
| | | Returned if checking the MAC of stored data fails. |
| ***Description:*** | Opens a file of this File Storage for writing with a user provided buffer.<br>If not otherwise specified by the provided mode, the file is truncated (corresponding to k Truncate).<br>The provided buffer will be used by the ReadWriteAccessor to implement block-wise writing to speed up multiple small accesses to the file.<br>If the file does not exist, it is created.<br>The file will be closed when the returned UniqueHandle goes out of scope. | |

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### 8.4.4.1.2.13 OpenFileWriteOnly

### [SWS_PER_00377] Definition of API function ara::per::FileStorage::OpenFileWriteOnly

*Upstream requirements:* RS_PER_00001, RS_PER_00004, RS_PER_00010, RS_AP_00119, RS_AP_00120, RS_AP_00121, RS_AP_00127, RS_AP_00128, RS_AP_00129, RS_AP_00135, RS_AP_00139, RS_AP_00144, RS_AP_00159

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| ***Kind:*** | function |
| ***Header file:*** | #include "ara/per/file_storage.h" |
| ***Scope:*** | `class ara::per::FileStorage` |

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| ***Syntax:*** | `ara::core::Result< UniqueHandle< WriteAccessor > > OpenFileWriteOnly (ara::core::StringView fileName) noexcept;` | |
| ***Parameters (in):*** | fileName | File name of the file. May correspond to the PersistencyFile.file Name of a configured file. |
| ***Return value:*** | ara::core::Result< UniqueHandle< Write Accessor > > | A Result containing a UniqueHandle for the file. In case of an error, it contains any of the errors defined below, or a vendor specific error. |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | thread-safe | |
| ***Errors:*** | PerErrc::kIllegalWrite Access | rollback_semantics |
| | | Returned if the File Storage is configured as read-only, or if it is configured as write-only-once and the key already exists. |
| | PerErrc::kPhysical StorageFailure | no_rollback_semantics |
| | | Returned if access to the physical storage fails. |
| | PerErrc::kIntegrity Corrupted | rollback_semantics |
| | | Returned if stored data cannot be read because the structural integrity is corrupted. |
| | PerErrc::kValidation Failed | rollback_semantics |
| | | Returned if the validity of stored data cannot be ensured. |
| | PerErrc::kEncryption Failed | rollback_semantics |
| | | Returned if the decryption of stored data fails. |
| | PerErrc::kResourceBusy | rollback_semantics |
| | | Returned if the file is already open, or if DeleteFile, RecoverFile, or ResetFile with the same file name is currently being executed. |
| | PerErrc::kOutOfStorage Space | no_rollback_semantics |
| | | Returned if the available physical storage space is insufficient for a new file. |
| | PerErrc::kTooManyFiles | rollback_semantics |
| | | Returned if the number of files would get larger than the configured maxNumberOfFiles when the file is created. |
| | PerErrc::kAuthentication Failed | rollback_semantics |
| | | Returned if checking the MAC of stored data fails. |
| ***Description:*** | Opens a file of this File Storage for writing.<br>The file is truncated (corresponding to kTruncate).<br>If the file does not exist, it is created.<br>The file will be closed when the returned UniqueHandle goes out of scope. | |

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#### 8.4.4.1.2.14 OpenFileWriteOnly

### [SWS_PER_00115] Definition of API function ara::per::FileStorage::OpenFileWriteOnly

*Upstream requirements:* RS_PER_00001, RS_PER_00004, RS_PER_00010, RS_AP_00119, RS_AP_00120, RS_AP_00121, RS_AP_00127, RS_AP_00128, RS_AP_00129, RS_AP_00135, RS_AP_00139, RS_AP_00144, RS_AP_00159

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| | | |
|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/file_storage.h" | |
| ***Scope:*** | `class ara::per::FileStorage` | |
| ***Syntax:*** | `ara::core::Result< UniqueHandle< WriteAccessor > > OpenFileWriteOnly (ara::core::StringView fileName, OpenMode mode) noexcept;` | |
| ***Parameters (in):*** | fileName | File name of the file. May correspond to the PersistencyFile.file Name of a configured file. |
| | mode | Mode with which the file shall be opened. |
| ***Return value:*** | ara::core::Result< UniqueHandle< Write Accessor > > | A Result containing a UniqueHandle for the file. In case of an error, it contains any of the errors defined below, or a vendor specific error. |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | thread-safe | |
| ***Errors:*** | PerErrc::kIllegalWrite Access | rollback_semantics |
| | | Returned if the File Storage is configured as read-only, or if it is configured as write-only-once and the key already exists. |
| | PerErrc::kPhysical StorageFailure | no_rollback_semantics |
| | | Returned if access to the physical storage fails. |
| | PerErrc::kIntegrity Corrupted | rollback_semantics |
| | | Returned if stored data cannot be read because the structural integrity is corrupted. |
| | PerErrc::kValidation Failed | rollback_semantics |
| | | Returned if the validity of stored data cannot be ensured. |
| | PerErrc::kEncryption Failed | rollback_semantics |
| | | Returned if the decryption of stored data fails. |
| | PerErrc::kResourceBusy | rollback_semantics |
| | | Returned if the file is already open, or if DeleteFile, RecoverFile, or ResetFile with the same file name is currently being executed. |
| | PerErrc::kOutOfStorage Space | no_rollback_semantics |
| | | Returned if the available physical storage space is insufficient for a new file. |
| | PerErrc::kInvalidOpen Mode | rollback_semantics |
| | | Returned if the passed mode contains an invalid combination of modes. |
| | PerErrc::kTooManyFiles | rollback_semantics |
| | | Returned if the number of files would get larger than the configured maxNumberOfFiles when the file is created. |
| | PerErrc::kAuthentication Failed | rollback_semantics |

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| | | Returned if checking the MAC of stored data fails. |
| ***Description:*** | Opens a file of this File Storage for writing with a defined mode.<br>If not otherwise specified by the provided mode, the file is truncated (corresponding to k Truncate).<br>If the file does not exist, it is created.<br>The file will be closed when the returned UniqueHandle goes out of scope. | |

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### 8.4.4.1.2.15 RecoverFile

**[SWS_PER_00337] Definition of API function ara::per::FileStorage::RecoverFile**

*Upstream requirements:* RS_PER_00001, RS_PER_00004, RS_PER_00009, RS_AP_00119, RS_AP_00120, RS_AP_00121, RS_AP_00127, RS_AP_00128, RS_AP_00129, RS_AP_00135, RS_AP_00139, RS_AP_00159

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| | | |
|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/file_storage.h" | |
| ***Scope:*** | `class ara::per::FileStorage` | |
| ***Syntax:*** | `ara::core::Result< void > RecoverFile (ara::core::StringView fileName) noexcept;` | |
| ***Parameters (in):*** | fileName | File name of the file. May correspond to the PersistencyFile.file Name of a configured file. |
| ***Return value:*** | ara::core::Result< void > | A Result of void. In case of an error, it contains any of the errors defined below, or a vendor specific error. |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | thread-safe | |
| ***Errors:*** | PerErrc::kPhysical StorageFailure | no_rollback_semantics |
| | | Returned if access to the physical storage fails. |
| | PerErrc::kEncryption Failed | rollback_semantics |
| | | Returned if the encryption or decryption of stored data fails. |
| | PerErrc::kResourceBusy | rollback_semantics |
| | | Returned if the file is open, or if DeleteFile or ResetFile with the same file name is currently being executed. |
| | PerErrc::kOutOfStorage Space | no_rollback_semantics |
| | | Returned if the available physical storage space is insufficient for the recovered file. |
| | PerErrc::kFileNotFound | rollback_semantics |
| | | Returned if the provided file does not exist in the File Storage. |
| | PerErrc::kQuota Exceeded | rollback_semantics |
| | | Returned if the recovered file would exceed the configured maximumAllowedSize of the File Storage. |
| | PerErrc::kAuthentication Failed | rollback_semantics |
| | | Returned if calculating or checking the MAC of stored data fails. |

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| ***Description:*** | Recovers a file of this File Storage.<br>This method allows to recover a single file when the redundancy checks fail.<br>It will fail with kResourceBusy when the file is currently open.<br>This method does a best-effort recovery of the file. After recovery, the file might show outdated or initial content, or might be lost. |

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### 8.4.4.1.2.16 ResetFile

### [SWS_PER_00338] Definition of API function ara::per::FileStorage::ResetFile

*Upstream requirements:* RS_PER_00001, RS_PER_00004, RS_PER_00009, RS_AP_00119, RS_AP_00120, RS_AP_00121, RS_AP_00127, RS_AP_00128, RS_AP_00129, RS_AP_00135, RS_AP_00139, RS_AP_00159

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|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/file_storage.h" | |
| ***Scope:*** | `class ara::per::FileStorage` | |
| ***Syntax:*** | `ara::core::Result< void > ResetFile (ara::core::StringView fileName) noexcept;` | |
| ***Parameters (in):*** | fileName | File name of the file. May correspond to the PersistencyFile.file Name of a configured file. |
| ***Return value:*** | ara::core::Result< void > | A Result of void. In case of an error, it contains any of the errors defined below, or a vendor specific error. |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | thread-safe | |
| ***Errors:*** | PerErrc::kPhysical StorageFailure | no_rollback_semantics |
| | | Returned if access to the physical storage fails. |
| | PerErrc::kEncryption Failed | rollback_semantics |
| | | Returned if the encryption or decryption of stored data fails. |
| | PerErrc::kInitValueNot Available | rollback_semantics |
| | | Returned if no intitial value was configured for this file. |
| | PerErrc::kResourceBusy | rollback_semantics |
| | | Returned if the file is open, or if DeleteFile or RecoverFile with the same file name is currently being executed. |
| | PerErrc::kOutOfStorage Space | no_rollback_semantics |
| | | Returned if the available physical storage space is insufficient for the initial file. |
| | PerErrc::kTooManyFiles | rollback_semantics |
| | | Returned if the number of files would get larger than the configured maxNumberOfFiles when the file is restored. |
| | PerErrc::kQuota Exceeded | rollback_semantics |
| | | Returned if the initial file would exceed the configured maximum AllowedSize of the File Storage. |
| | PerErrc::kAuthentication Failed | rollback_semantics |
| | | Returned if calculating or checking the MAC of stored data fails. |

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| ***Description:*** | Resets a file of this File Storage to its initial content.<br>ResetFile allows to reset a single file to its initial content. If the file is currently not available in the File Storage, it is re-created. Afterwards, the file will appear in both cases as if it was newly installed from the current `Target Configuration`.<br>It will fail with kResourceBusy when the file is currently open, and with kInitValueNotAvailable when neither `Application Design` nor `Target Configuration` define an initial content for the file. |

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## 8.5 Header: ara/per/key_value_storage.h

### 8.5.1 Non-Member Functions

#### 8.5.1.1 Other

##### 8.5.1.1.1 GetCurrentKeyValueStorageSize

### [SWS_PER_00405] Definition of API function ara::per::GetCurrentKeyValueStorageSize

*Upstream requirements:* RS_PER_00017, RS_AP_00119, RS_AP_00120, RS_AP_00121, RS_AP_00127, RS_AP_00128, RS_AP_00129, RS_AP_00135, RS_AP_00137, RS_AP_00139, RS_AP_00159

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|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/key_value_storage.h" | |
| ***Scope:*** | namespace ara::per | |
| ***Syntax:*** | `ara::core::Result< std::uint64_t > GetCurrentKeyValueStorageSize (const ara::core::InstanceSpecifier &kvs) noexcept;` | |
| ***Parameters (in):*** | kvs | The shortName path of a PortPrototype typed by a PersistencyKeyValueStorageInterface. |
| ***Return value:*** | ara::core::Result< std::uint64_t > | A Result containing the occupied space in bytes. In case of an error, it contains any of the errors defined below, or a vendor specific error. |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | thread-safe | |
| ***Errors:*** | PerErrc::kStorageNotFound | rollback_semantics |
| | | Returned if the passed InstanceSpecifier does not match any PersistencyKeyValueStorageInterface configured for this Executable. |
| | PerErrc::kPhysicalStorageFailure | rollback_semantics |
| | | Returned if access to the physical storage fails. |
| ***Description:*** | Returns the space in bytes currently occupied by a Key-Value Storage.<br>The returned size includes all metadata and the space used for redundancy and backups.<br>The returned size is only guaranteed to be accurate if the Key-Value Storage is not opened and no other operation on the Key-Value Storage takes place at the same time. | |

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#### 8.5.1.1.2 OpenKeyValueStorage

### [SWS_PER_00052] Definition of API function ara::per::OpenKeyValueStorage

*Upstream requirements:* RS_PER_00003, RS_PER_00010, RS_AP_00119, RS_AP_00120, RS_AP_00121, RS_AP_00127, RS_AP_00128, RS_AP_00129, RS_AP_00135, RS_AP_00137, RS_AP_00139, RS_AP_00144, RS_AP_00147, RS_AP_00159

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|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/key_value_storage.h" | |
| ***Scope:*** | namespace ara::per | |
| ***Syntax:*** | `ara::core::Result< SharedHandle< KeyValueStorage > > OpenKeyValueStorage (const ara::core::InstanceSpecifier &kvs) noexcept;` | |
| ***Parameters (in):*** | kvs | The shortName path of a PortPrototype typed by a PersistencyKeyValueStorageInterface. |
| ***Return value:*** | ara::core::Result< SharedHandle< KeyValueStorage > > | A Result containing a SharedHandle for the KeyValueStorage. In case of an error, it contains any of the errors defined below, or a vendor specific error. |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | thread-safe | |
| ***Errors:*** | PerErrc::kStorageNotFound | rollback_semantics |
| | | Returned if the passed InstanceSpecifier does not match any PersistencyKeyValueStorageInterface configured for this Executable. |
| | PerErrc::kPhysicalStorageFailure | no_rollback_semantics |
| | | Returned if access to the physical storage fails. |
| | PerErrc::kIntegrityCorrupted | rollback_semantics |
| | | Returned if stored data cannot be read because the structural integrity is corrupted. |
| | PerErrc::kValidationFailed | rollback_semantics |
| | | Returned if the validity of stored data cannot be ensured. |
| | PerErrc::kEncryptionFailed | rollback_semantics |
| | | Returned if the decryption of stored data fails. |
| | PerErrc::kResourceBusy | rollback_semantics |
| | | Returned if CleanUpPersistency, or ResetPersistency is currently being executed, or if RecoverKeyValueStorage or ResetKeyValueStorage is currently being executed for the same Key-Value Storage. Also, while UpdatePersistency is currently being executed, this error is returned when OpenKeyValueStorage is called outside of the callback registered via RegisterApplicationDataUpdateCallback, or if the used InstanceSpecifier differs from the one provided by the callback. |
| | PerErrc::kOutOfStorageSpace | no_rollback_semantics |
| | | Returned if the available physical storage space is insufficient for the values that are added/updated during an implicit update of the Key-Value Storage. |
| | PerErrc::kQuotaExceeded | rollback_semantics |

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| | | Returned if the values that are added/updated during an implicit update of the Key-Value Storage would exceed the configured maximumAllowedSize. |
| | PerErrc::kAuthentication Failed | rollback_semantics |
| | | Returned if checking the MAC of stored data fails. |
| ***Description:*** | Opens a Key-Value Storage.<br>OpenKeyValueStorage will fail with kResourceBusy when the Key-Value Storage is currently being modified by a call from another thread to UpdatePersistency, CleanUpPersistency, Reset Persistency, RecoverKeyValueStorage, or ResetKeyValueStorage.<br>Because multiple threads can access the same Key-Value Storage concurrently, the Key-Value Storage might not be closed when the SharedHandle returned by this function goes out of scope. It will only be closed when all SharedHandles that refer to the same Key-Value Storage went out of scope. | |

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#### 8.5.1.1.3 RecoverKeyValueStorage

### [SWS_PER_00333] Definition of API function ara::per::RecoverKeyValueStorage

*Upstream requirements:* RS_PER_00003, RS_PER_00009, RS_PER_00010, RS_AP_00119, RS_AP_00120, RS_AP_00121, RS_AP_00127, RS_AP_00128, RS_AP_00129, RS_AP_00135, RS_AP_00137, RS_AP_00139, RS_AP_00159

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| | | |
|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/key_value_storage.h" | |
| ***Scope:*** | namespace ara::per | |
| ***Syntax:*** | `ara::core::Result< void > RecoverKeyValueStorage (const ara::core::InstanceSpecifier &kvs) noexcept;` | |
| ***Parameters (in):*** | kvs | The shortName path of a PortPrototype typed by a PersistencyKeyValueStorageInterface. |
| ***Return value:*** | ara::core::Result< void > | A Result of void. In case of an error, it contains any of the errors defined below, or a vendor specific error. |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | thread-safe | |
| ***Errors:*** | PerErrc::kStorageNotFound | rollback_semantics |
| | | Returned if the passed InstanceSpecifier does not match any PersistencyKeyValueStorageInterface configured for this Executable. |
| | PerErrc::kPhysicalStorageFailure | no_rollback_semantics |
| | | Returned if access to the physical storage fails. |
| | PerErrc::kEncryptionFailed | rollback_semantics |
| | | Returned if the encryption of stored data fails. |
| | PerErrc::kResourceBusy | rollback_semantics |

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| | | Returned if UpdatePersistency, CleanUpPersistency, or Reset Persistency is currently being executed, or if ResetKeyValue Storage is currently being executed for the same Key-Value Storage, or a SharedHandle of the same Key-Value Storage is currently in use. |
| | PerErrc::kOutOfStorage Space | no_rollback_semantics |
| | | Returned if the available physical storage space is insufficient for the recovered values. |
| | PerErrc::kQuota Exceeded | rollback_semantics |
| | | Returned if the recovered values would exceed the configured maximumAllowedSize of the Key-Value Storage. |
| | PerErrc::kAuthentication Failed | rollback_semantics |
| | | Returned if calculating the MAC of stored data fails. |
| ***Description:*** | Recovers a Key-ValueStorage.<br>RecoverKeyValueStorage allows to recover a Key-Value Storage when the redundancy checks fail.<br>It will fail with kResourceBusy when the Key-Value Storage is currently open, or when it is modified by a call from another thread to UpdatePersistency, CleanUpPersistency, Reset Persistency, RecoverKeyValueStorage, or ResetKeyValueStorage.<br>This method does a best-effort recovery of all key-value pairs. After recovery, keys might show outdated or initial value, or might be lost. | |

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#### 8.5.1.1.4 ResetKeyValueStorage

### [SWS_PER_00334] Definition of API function ara::per::ResetKeyValueStorage

*Upstream requirements:* RS_PER_00003, RS_PER_00009, RS_PER_00010, RS_AP_00119, RS_AP_00120, RS_AP_00121, RS_AP_00127, RS_AP_00128, RS_AP_00129, RS_AP_00135, RS_AP_00137, RS_AP_00139, RS_AP_00159

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| | | |
|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/key_value_storage.h" | |
| ***Scope:*** | namespace ara::per | |
| ***Syntax:*** | `ara::core::Result< void > ResetKeyValueStorage (const ara::core::InstanceSpecifier &kvs) noexcept;` | |
| ***Parameters (in):*** | kvs | The shortName path of a PortPrototype typed by a PersistencyKey ValueStorageInterface. |
| ***Return value:*** | ara::core::Result< void > | A Result of void. In case of an error, it contains any of the errors defined below, or a vendor specific error. |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | thread-safe | |
| ***Errors:*** | PerErrc::kStorageNot Found | rollback_semantics |
| | | Returned if the passed InstanceSpecifier does not match any PersistencyKeyValueStorageInterface configured for this Executable. |
| | PerErrc::kPhysical StorageFailure | no_rollback_semantics |
| | | Returned if access to the physical storage fails. |

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| | PerErrc::kEncryption Failed | rollback_semantics |
| | | Returned if the encryption of stored data fails. |
| | PerErrc::kResourceBusy | rollback_semantics |
| | | Returned if UpdatePersistency, CleanUpPersistency, or Reset Persistency is currently being executed, or if RecoverKeyValue Storage is currently being executed for the same Key-Value Storage, or a SharedHandle of the same Key-Value Storage is currently in use. |
| | PerErrc::kOutOfStorage Space | no_rollback_semantics |
| | | Returned if the available physical storage space is insufficient for the initial values. |
| | PerErrc::kAuthentication Failed | rollback_semantics |
| | | Returned if calculating the MAC of stored data fails. |
| ***Description:*** | Resets a Key-Value Storage to the initial state.<br>ResetKeyValueStorage allows to reset a Key-Value Storage to the initial state, containing only key-value pairs which were deployed from the `Target Configuration`, with their initial values. Afterwards, the Key-Value Storage will appear as if it was newly installed from the current `Target Configuration`.<br>It will fail with kResourceBusy when the Key-Value Storage is currently open, or when it is modified by a call from another thread to UpdatePersistency, CleanUpPersistency, Reset Persistency, RecoverKeyValueStorage, or ResetKeyValueStorage. | |

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### 8.5.2 Class: KeyValueStorage

### [SWS_PER_00339] Definition of API class ara::per::KeyValueStorage

*Upstream requirements:* RS_PER_00002, RS_AP_00122, RS_AP_00140, RS_AP_00146

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|---|---|
| ***Kind:*** | class |
| ***Port Interfaces:*** | `PersistencyKeyValueStorageInterface` |
| ***Header file:*** | #include "ara/per/key_value_storage.h" |
| ***Forwarding header file:*** | #include "ara/per/per_fwd.h" |
| ***Scope:*** | namespace ara::per |
| ***Symbol:*** | KeyValueStorage |
| ***Syntax:*** | `class KeyValueStorage final {...};` |
| ***Description:*** | The Key-Value Storage contains a set of keys with associated values. |

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#### 8.5.2.1 Public Member Functions

##### 8.5.2.1.1 Special Member Functions

###### 8.5.2.1.1.1 Move Constructor

**[SWS_PER_00322] Definition of API function ara::per::KeyValueStorage::KeyValueStorage**

*Upstream requirements:* RS_PER_00002, RS_AP_00120, RS_AP_00121, RS_AP_00129, RS_AP_00145, RS_AP_00159

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| | |
|---|---|
| ***Kind:*** | function |
| ***Header file:*** | #include "ara/per/key_value_storage.h" |
| ***Scope:*** | `class ara::per::KeyValueStorage` |
| ***Syntax:*** | `KeyValueStorage (KeyValueStorage &&kvs)=delete;` |
| ***Description:*** | The move constructor for KeyValueStorage shall not be used. |

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###### 8.5.2.1.1.2 Copy Constructor

**[SWS_PER_00324] Definition of API function ara::per::KeyValueStorage::KeyValueStorage**

*Upstream requirements:* RS_PER_00002, RS_AP_00120, RS_AP_00145

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|---|---|
| ***Kind:*** | function |
| ***Header file:*** | #include "ara/per/key_value_storage.h" |
| ***Scope:*** | `class ara::per::KeyValueStorage` |
| ***Syntax:*** | `KeyValueStorage (const KeyValueStorage &)=delete;` |
| ***Description:*** | The copy constructor for KeyValueStorage shall not be used. |

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#### 8.5.2.1.1.3 Default Constructor

**[SWS_PER_00459] Definition of API function ara::per::KeyValueStorage::KeyValueStorage**

*Upstream requirements:* RS_PER_00002, RS_AP_00120, RS_AP_00129, RS_AP_00146

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|---|---|
| ***Kind:*** | function |
| ***Header file:*** | #include "ara/per/key_value_storage.h" |
| ***Scope:*** | `class ara::per::KeyValueStorage` |
| ***Syntax:*** | `KeyValueStorage ()=delete;` |
| ***Description:*** | The default constructor for KeyValueStorage shall not be used. |

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#### 8.5.2.1.1.4 Copy Assignment Operator

**[SWS_PER_00325] Definition of API function ara::per::KeyValueStorage::operator=**

*Upstream requirements:* RS_PER_00002, RS_AP_00119, RS_AP_00120, RS_AP_00145

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| | |
|---|---|
| ***Kind:*** | function |
| ***Header file:*** | #include "ara/per/key_value_storage.h" |
| ***Scope:*** | `class ara::per::KeyValueStorage` |
| ***Syntax:*** | `KeyValueStorage & operator= (const KeyValueStorage &)=delete;` |
| ***Description:*** | The copy assignment operator for KeyValueStorage shall not be used. |

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#### 8.5.2.1.1.5 Move Assignment Operator

**[SWS_PER_00323] Definition of API function ara::per::KeyValueStorage::operator=**

*Upstream requirements:* RS_PER_00002, RS_AP_00119, RS_AP_00120, RS_AP_00121, RS_AP_00145, RS_AP_00159

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| | |
|---|---|
| ***Kind:*** | function |
| ***Header file:*** | #include "ara/per/key_value_storage.h" |
| ***Scope:*** | `class ara::per::KeyValueStorage` |
| ***Syntax:*** | `KeyValueStorage & operator= (KeyValueStorage &&kvs)=delete;` |
| ***Description:*** | The move assignment operator for KeyValueStorage shall not be used. |

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#### 8.5.2.1.1.6 Destructor

### [SWS_PER_00050] Definition of API function ara::per::KeyValueStorage::~KeyValueStorage

*Upstream requirements:* RS_PER_00002, RS_AP_00120, RS_AP_00129, RS_AP_00134, RS_AP_00145, RS_AP_00159

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| | |
|---|---|
| ***Kind:*** | function |
| ***Header file:*** | #include "ara/per/key_value_storage.h" |
| ***Scope:*** | `class ara::per::KeyValueStorage` |
| ***Syntax:*** | `~KeyValueStorage () noexcept;` |
| ***Exception Safety:*** | exception safe |
| ***Thread Safety:*** | not thread-safe |
| ***Description:*** | Destructor for KeyValueStorage. |

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### 8.5.2.1.2 Member Functions

#### 8.5.2.1.2.1 DiscardPendingChanges

### [SWS_PER_00365] Definition of API function ara::per::KeyValueStorage::DiscardPendingChanges

*Upstream requirements:* RS_PER_00002, RS_AP_00119, RS_AP_00120, RS_AP_00127, RS_AP_00128, RS_AP_00129, RS_AP_00135, RS_AP_00139, RS_AP_00159

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| | | |
|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/key_value_storage.h" | |
| ***Scope:*** | `class ara::per::KeyValueStorage` | |
| ***Syntax:*** | `ara::core::Result< void > DiscardPendingChanges () noexcept;` | |
| ***Return value:*** | ara::core::Result< void > | A Result of void. In case of an error, it contains any of the errors defined below, or a vendor specific error. |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | thread-safe | |
| ***Errors:*** | PerErrc::kIllegalWriteAccess | rollback_semantics |
| | | Returned if the Key-Value Storage is configured as read- only, or if it is configured as write-only-once and the key already exists. |
| | PerErrc::kPhysicalStorageFailure | rollback_semantics |
| | | Returned if access to the physical storage fails. |
| | PerErrc::kIntegrityCorrupted | rollback_semantics |
| | | Returned if stored data cannot be read because the structural integrity is corrupted. |
| | PerErrc::kValidationFailed | rollback_semantics |

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| | | Returned if the validity of stored data cannot be ensured. |
| | PerErrc::kEncryption Failed | rollback_semantics |
| | | Returned if the decryption of stored data fails. |
| | PerErrc::kAuthentication Failed | rollback_semantics |
| | | Returned if checking the MAC of stored data fails. |
| ***Description:*** | Removes all pending changes to this Key-Value Storage since the last call to SyncToStorage() or since this Key-Value Storage was opened using OpenKeyValueStorage(). DiscardPendingChanges may be delayed by an ongoing call from another thread to RemoveAll Keys, SyncToStorage, DiscardPendingChanges, SetValue, GetValue, GetCurrentValueSize, RemoveKey, RecoverKey, or ResetKey. | |

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#### 8.5.2.1.2.2 GetAllKeys

### [SWS_PER_00042] Definition of API function ara::per::KeyValueStorage::GetAllKeys

*Upstream requirements:* RS_PER_00003, RS_AP_00119, RS_AP_00120, RS_AP_00127, RS_AP_00129, RS_AP_00135, RS_AP_00139, RS_AP_00159

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| | | |
|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/key_value_storage.h" | |
| ***Scope:*** | `class ara::per::KeyValueStorage` | |
| ***Syntax:*** | `ara::core::Result< ara::core::Vector< ara::core::String > > GetAllKeys () const noexcept;` | |
| ***Return value:*** | ara::core::Result< ara::core::Vector< ara::core::String > > | A Result containing a list of available keys. In case of an error, it contains any of the errors defined below, or a vendor specific error. |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | thread-safe | |
| ***Errors:*** | PerErrc::kPhysical StorageFailure | rollback_semantics |
| | | Returned if access to the physical storage fails. |
| | PerErrc::kIntegrity Corrupted | rollback_semantics |
| | | Returned if stored data cannot be read because the structural integrity is corrupted. |
| | PerErrc::kValidation Failed | rollback_semantics |
| | | Returned if the validity of stored data cannot be ensured. |
| | PerErrc::kEncryption Failed | rollback_semantics |
| | | Returned if the decryption of stored data fails. |
| | PerErrc::kAuthentication Failed | rollback_semantics |
| | | Returned if checking the MAC of stored data fails. |
| ***Description:*** | Returns a list of all currently available keys of this Key-Value Storage.<br>The list of keys is only accurate if no key-value pair is added or deleted at the same time.<br>This method uses transaction semantics, it sees the current state of transaction, not the actual physical storage. | |

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#### 8.5.2.1.2.3 GetCurrentValueSize

**[SWS_PER_00554] Definition of API function ara::per::KeyValueStorage::GetCurrentValueSize**

*Upstream requirements:* RS_PER_00017, RS_AP_00119, RS_AP_00120, RS_AP_00121, RS_AP_00127, RS_AP_00128, RS_AP_00129, RS_AP_00135, RS_AP_00139, RS_AP_00159

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| | | |
|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/key_value_storage.h" | |
| ***Scope:*** | `class ara::per::KeyValueStorage` | |
| ***Syntax:*** | `ara::core::Result< std::uint64_t > GetCurrentValueSize (ara::core::StringView key) const noexcept;` | |
| ***Parameters (in):*** | key | The key to look up. |
| ***Return value:*** | ara::core::Result< std::uint64_t > | A Result containing the size of the value in bytes. In case of an error, it contains any of the errors defined below, or a vendor specific error. |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | thread-safe | |
| ***Errors:*** | PerErrc::kKeyNotFound | rollback_semantics |
| | | Returned if the provided key does not exist in the Key-Value Storage. |
| | PerErrc::kPhysical StorageFailure | rollback_semantics |
| | | Returned if access to the physical storage fails. |
| | PerErrc::kIntegrity Corrupted | rollback_semantics |
| | | Returned if stored data cannot be read because the structural integrity is corrupted. |
| | PerErrc::kValidation Failed | rollback_semantics |
| | | Returned if the validity of stored data cannot be ensured. |
| | PerErrc::kEncryption Failed | rollback_semantics |
| | | Returned if the decryption of stored data fails. |
| | PerErrc::kAuthentication Failed | rollback_semantics |
| | | Returned if checking the MAC of stored data fails. |
| ***Description:*** | Returns the size (in bytes) of the value assigned to a key of this Key-Value Storage. GetCurrentValueSize may be delayed by an ongoing call from another thread to RemoveAllKeys or DiscardPendingChanges, or to SetValue, RemoveKey, RecoverKey, or ResetKey for the same key-value pair. This method uses transaction semantics, it sees the current state of transaction, not the actual physical storage. | |

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#### 8.5.2.1.2.4 GetValue

### [SWS_PER_00044] Definition of API function ara::per::KeyValueStorage::GetValue

*Upstream requirements:* RS_PER_00003, RS_PER_00010, RS_AP_00119, RS_AP_00120, RS_AP_00121, RS_AP_00127, RS_AP_00128, RS_AP_00129, RS_AP_00135, RS_AP_00136, RS_AP_00139, RS_AP_00141, RS_AP_00159

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| | | |
|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/key_value_storage.h" | |
| ***Scope:*** | `class ara::per::KeyValueStorage` | |
| ***Syntax:*** | `template <class T>`<br>`ara::core::Result< void > GetValue (ara::core::StringView key, T &value) const noexcept;` | |
| ***Template param:*** | T | The type of the value that shall be retrieved. |
| ***Parameters (in):*** | key | The key to look up. |
| ***Parameters (out):*** | value | The retrieved value. |
| ***Return value:*** | ara::core::Result< void > | A Result of void. In case of an error, it contains any of the errors defined below, or a vendor specific error. |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | thread-safe | |
| ***Errors:*** | PerErrc::kKeyNotFound | rollback_semantics<br>Returned if the provided key does not exist in the Key-Value Storage. |
| | PerErrc::kPhysicalStorageFailure | rollback_semantics<br>Returned if access to the physical storage fails. |
| | PerErrc::kIntegrityCorrupted | rollback_semantics<br>Returned if stored data cannot be read because the structural integrity is corrupted. |
| | PerErrc::kValidationFailed | rollback_semantics<br>Returned if the validity of stored data cannot be ensured. |
| | PerErrc::kEncryptionFailed | rollback_semantics<br>Returned if the decryption of stored data fails. |
| | PerErrc::kDataTypeMismatch | rollback_semantics<br>Returned if the data type of stored value does not match the templated type. |
| | PerErrc::kAuthenticationFailed | rollback_semantics<br>Returned if checking the MAC of stored data fails. |
| ***Description:*** | Returns the value assigned to a key of this KeyValueStorage.<br>This method should only be used to access very large values repeatedly.<br>GetValue may be delayed by an ongoing call from another thread to RemoveAllKeys or DiscardPendingChanges, or to SetValue, RemoveKey, RecoverKey, or ResetKey for the same key-value pair.<br>This method uses transaction semantics, it sees the current state of transaction, not the actual physical storage. | |

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#### 8.5.2.1.2.5 GetValue

### [SWS_PER_00332] Definition of API function ara::per::KeyValueStorage::GetValue

*Upstream requirements:* RS_PER_00003, RS_PER_00010, RS_AP_00119, RS_AP_00120, RS_AP_00121, RS_AP_00127, RS_AP_00128, RS_AP_00129, RS_AP_00135, RS_AP_00136, RS_AP_00139, RS_AP_00159

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| | | |
|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/key_value_storage.h" | |
| ***Scope:*** | `class ara::per::KeyValueStorage` | |
| ***Syntax:*** | `template <class T>`<br>`ara::core::Result< T > GetValue (ara::core::StringView key) const noexcept;` | |
| ***Template param:*** | T | The type of the value that shall be retrieved. |
| ***Parameters (in):*** | key | The key to look up. |
| ***Return value:*** | ara::core::Result< T > | A Result containing the retrieved value. In case of an error, it contains any of the errors defined below, or a vendor specific error. |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | thread-safe | |
| ***Errors:*** | PerErrc::kKeyNotFound | rollback_semantics |
| | | Returned if the provided key does not exist in the Key-Value Storage. |
| | PerErrc::kPhysicalStorageFailure | rollback_semantics |
| | | Returned if access to the physical storage fails. |
| | PerErrc::kIntegrityCorrupted | rollback_semantics |
| | | Returned if stored data cannot be read because the structural integrity is corrupted. |
| | PerErrc::kValidationFailed | rollback_semantics |
| | | Returned if the validity of stored data cannot be ensured. |
| | PerErrc::kEncryptionFailed | rollback_semantics |
| | | Returned if the decryption of stored data fails. |
| | PerErrc::kDataTypeMismatch | rollback_semantics |
| | | Returned if the data type of stored value does not match the templated type. |
| | PerErrc::kAuthenticationFailed | rollback_semantics |
| | | Returned if checking the MAC of stored data fails. |
| ***Description:*** | Returns the value assigned to a key of this Key-Value Storage.<br>GetValue may be delayed by an ongoing call from another thread to RemoveAllKeys or Discard PendingChanges, or to SetValue, RemoveKey, RecoverKey, or ResetKey for the same key-value pair.<br>This method uses transaction semantics, it sees the current state of transaction, not the actual physical storage. | |

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#### 8.5.2.1.2.6 KeyExists

### [SWS_PER_00043] Definition of API function ara::per::KeyValueStorage::KeyExists

*Upstream requirements:* RS_PER_00003, RS_AP_00119, RS_AP_00120, RS_AP_00121, RS_AP_00127, RS_AP_00135, RS_AP_00139, RS_AP_00159

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| | | |
|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/key_value_storage.h" | |
| ***Scope:*** | `class ara::per::KeyValueStorage` | |
| ***Syntax:*** | `ara::core::Result< bool > KeyExists (ara::core::StringView key) const noexcept;` | |
| ***Parameters (in):*** | key | The key that shall be checked. |
| ***Return value:*** | ara::core::Result< bool > | A Result containing true if the key could be located or false if it couldn't. In case of an error, it contains any of the errors defined below, or a vendor specific error. |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | thread-safe | |
| ***Errors:*** | PerErrc::kPhysicalStorageFailure | rollback_semantics |
| | | Returned if access to the physical storage fails. |
| | PerErrc::kIntegrityCorrupted | rollback_semantics |
| | | Returned if stored data cannot be read because the structural integrity is corrupted. |
| | PerErrc::kValidationFailed | rollback_semantics |
| | | Returned if the validity of stored data cannot be ensured. |
| | PerErrc::kEncryptionFailed | rollback_semantics |
| | | Returned if the decryption of stored data fails. |
| | PerErrc::kAuthenticationFailed | rollback_semantics |
| | | Returned if checking the MAC of stored data fails. |
| ***Description:*** | Checks if a key-value pair exists in this Key-Value Storage.<br>The result is only accurate if no key-value pair is added or deleted at the same time. E.g. when a key-value pair is removed in another thread directly after this function returned "true", the result is not valid anymore.<br>This method uses transaction semantics, it sees the current state of transaction, not the actual physical storage. | |

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#### 8.5.2.1.2.7 RecoverKey

**[SWS_PER_00427] Definition of API function ara::per::KeyValueStorage::RecoverKey**

*Upstream requirements:* RS_PER_00003, RS_PER_00009, RS_PER_00010, RS_AP_00119, RS_AP_00120, RS_AP_00121, RS_AP_00127, RS_AP_00128, RS_AP_00129, RS_AP_00135, RS_AP_00139, RS_AP_00159

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| | | |
|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/key_value_storage.h" | |
| ***Scope:*** | `class ara::per::KeyValueStorage` | |
| ***Syntax:*** | `ara::core::Result< void > RecoverKey (ara::core::StringView key) noexcept;` | |
| ***Parameters (in):*** | key | The key to be recovered. |
| ***Return value:*** | ara::core::Result< void > | A Result of void. In case of an error, it contains any of the errors defined below, or a vendor specific error. |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | thread-safe | |
| ***Errors:*** | PerErrc::kKeyNotFound | rollback_semantics |
| | | Returned if the provided key does not exist in the Key-Value Storage. |
| | PerErrc::kIllegalWrite Access | rollback_semantics |
| | | Returned if the Key-Value Storage is configured as read- only. |
| | PerErrc::kPhysical StorageFailure | no_rollback_semantics |
| | | Returned if access to the physical storage fails. |
| | PerErrc::kIntegrity Corrupted | rollback_semantics |
| | | Returned if stored data cannot be written because the structural integrity is corrupted. |
| | PerErrc::kEncryption Failed | rollback_semantics |
| | | Returned if the encryption or decryption of stored data fails. |
| | PerErrc::kOutOfStorage Space | no_rollback_semantics |
| | | Returned if the available physical storage space is insufficient for the recovered value. |
| | PerErrc::kQuota Exceeded | rollback_semantics |
| | | Returned if the recovered value would exceed the configured maximumAllowedSize of the Key-Value Storage. |
| | PerErrc::kAuthentication Failed | rollback_semantics |
| | | Returned if calculating or checking the MAC of stored data fails. |
| ***Description:*** | Recovers a single key-value pair of this Key Value Storage.<br>This method allows to recover a single key-value pair when the redundancy checks fail.<br>This method does a best-effort recovery of the key-value pair. After recovery, the key-value pair might contain outdated or initial content, or might be lost.<br>RecoverKey may be delayed by an ongoing call from another thread to RemoveAllKeys, SyncTo Storage, or DiscardPendingChanges, or to SetValue, GetValue, GetCurrentValueSize, Remove Key, RecoverKey, or ResetKey for the same key-value pair. | |

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#### 8.5.2.1.2.8 RemoveAllKeys

**[SWS_PER_00048] Definition of API function ara::per::KeyValueStorage::RemoveAllKeys**

*Upstream requirements:* RS_PER_00003, RS_PER_00010, RS_AP_00119, RS_AP_00120, RS_AP_00127, RS_AP_00128, RS_AP_00129, RS_AP_00135, RS_AP_00139, RS_AP_00159

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| | | |
|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/key_value_storage.h" | |
| ***Scope:*** | `class ara::per::KeyValueStorage` | |
| ***Syntax:*** | `ara::core::Result< void > RemoveAllKeys () noexcept;` | |
| ***Return value:*** | ara::core::Result< void > | A Result of void. In case of an error, it contains any of the errors defined below, or a vendor specific error. |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | thread-safe | |
| ***Errors:*** | PerErrc::kIllegalWrite Access | rollback_semantics |
| | | Returned if the Key-Value Storage is configured as read- only. |
| | PerErrc::kPhysical StorageFailure | rollback_semantics |
| | | Returned if access to the physical storage fails. |
| | PerErrc::kIntegrity Corrupted | rollback_semantics |
| | | Returned if stored data cannot be written because the structural integrity is corrupted. |
| | PerErrc::kEncryption Failed | rollback_semantics |
| | | Returned if the encryption or decryption of stored data fails. |
| | PerErrc::kAuthentication Failed | rollback_semantics |
| | | Returned if calculating or checking the MAC of stored data fails. |
| ***Description:*** | Removes all key-value pairs and associated values from this Key-Value Storage.<br>RemoveAllKeys may be delayed by an ongoing call from another thread to RemoveAllKeys, SyncToStorage, DiscardPendingChanges, SetValue, GetValue, GetCurrentValueSize, RemoveKey, RecoverKey, or ResetKey.<br>This method uses transaction semantics, the changes only take effect when SyncToStorage is called. | |

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#### 8.5.2.1.2.9 RemoveKey

**[SWS_PER_00047] Definition of API function ara::per::KeyValueStorage::RemoveKey**

*Upstream requirements:* RS_PER_00003, RS_PER_00010, RS_AP_00119, RS_AP_00120, RS_AP_00121, RS_AP_00127, RS_AP_00128, RS_AP_00129, RS_AP_00135, RS_AP_00139, RS_AP_00159

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| | | |
|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/key_value_storage.h" | |
| ***Scope:*** | `class ara::per::KeyValueStorage` | |
| ***Syntax:*** | `ara::core::Result< void > RemoveKey (ara::core::StringView key) noexcept;` | |
| ***Parameters (in):*** | key | The key to be removed. |
| ***Return value:*** | ara::core::Result< void > | A Result of void. In case of an error, it contains any of the errors defined below, or a vendor specific error. |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | thread-safe | |
| ***Errors:*** | PerErrc::kKeyNotFound | rollback_semantics |
| | | Returned if the provided key does not exist in the Key-Value Storage. |
| | PerErrc::kIllegalWrite Access | rollback_semantics |
| | | Returned if the Key-Value Storage is configured as read- only. |
| | PerErrc::kPhysical StorageFailure | rollback_semantics |
| | | Returned if access to the physical storage fails. |
| | PerErrc::kIntegrity Corrupted | rollback_semantics |
| | | Returned if stored data cannot be written because the structural integrity is corrupted. |
| | PerErrc::kEncryption Failed | rollback_semantics |
| | | Returned if the encryption or decryption of stored data fails. |
| | PerErrc::kAuthentication Failed | rollback_semantics |
| | | Returned if calculating or checking the MAC of stored data fails. |
| ***Description:*** | Removes a key and the associated value from this Key-Value Storage.<br>RemoveKey may be delayed by an ongoing call from another thread to RemoveAllKeys, SyncTo Storage, or DiscardPendingChanges, or to SetValue, GetValue, GetCurrentValueSize, Remove Key, RecoverKey, or ResetKey for the same key-value pair.<br>This method uses transaction semantics, the changes only take effect when SyncToStorage is called. | |

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#### 8.5.2.1.2.10 ResetKey

### [SWS_PER_00426] Definition of API function ara::per::KeyValueStorage::ResetKey

*Upstream requirements:* RS_PER_00003, RS_PER_00009, RS_PER_00010, RS_AP_00119, RS_AP_00120, RS_AP_00121, RS_AP_00127, RS_AP_00128, RS_AP_00129, RS_AP_00135, RS_AP_00139, RS_AP_00159

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| | | |
|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/key_value_storage.h" | |
| ***Scope:*** | `class ara::per::KeyValueStorage` | |
| ***Syntax:*** | `ara::core::Result< void > ResetKey (ara::core::StringView key) noexcept;` | |
| ***Parameters (in):*** | key | The key to be reset. |
| ***Return value:*** | ara::core::Result< void > | A Result of void. In case of an error, it contains any of the errors defined below, or a vendor specific error. |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | thread-safe | |
| ***Errors:*** | PerErrc::kIllegalWriteAccess | rollback_semantics |
| | | Returned if the Key-Value Storage is configured as read- only. |
| | PerErrc::kPhysicalStorageFailure | no_rollback_semantics |
| | | Returned if access to the physical storage fails. |
| | PerErrc::kIntegrityCorrupted | rollback_semantics |
| | | Returned if stored data cannot be written because the structural integrity is corrupted. |
| | PerErrc::kEncryptionFailed | rollback_semantics |
| | | Returned if the encryption or decryption of stored data fails. |
| | PerErrc::kInitValueNotAvailable | rollback_semantics |
| | | Returned if no intitial value was configured for this key. |
| | PerErrc::kOutOfStorageSpace | no_rollback_semantics |
| | | Returned if the available physical storage space is insufficient for the initial value. |
| | PerErrc::kQuotaExceeded | rollback_semantics |
| | | Returned if the initial value would exceed the configured maximum AllowedSize of the Key-Value Storage. |
| | PerErrc::kAuthenticationFailed | rollback_semantics |
| | | Returned if calculating or checking the MAC of stored data fails. |
| ***Description:*** | Resets a key of this Key-Value Storage to its initial value.<br>ResetKey allows to reset a single key to its initial value. If the key is currently not available in the Key-Value Storage, it is re-created. Afterwards, the key-value pair will appear in both cases as if it was newly installed from the current `Target Configuration`.<br>ResetKey will fail with kInitValueNotAvailable when neither `Application Design` nor `Target Configuration` define an initial value for the key.<br>ResetKey may be delayed by an ongoing call from another thread to RemoveAllKeys, SyncTo Storage, or DiscardPendingChanges, or to SetValue, GetValue, GetCurrentValueSize, Remove Key, RecoverKey, or ResetKey for the same key-value pair. | |

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#### 8.5.2.1.2.11 SetValue

**[SWS_PER_00046] Definition of API function ara::per::KeyValueStorage::SetValue**

*Upstream requirements:* RS_PER_00003, RS_PER_00010, RS_AP_00119, RS_AP_00120, RS_AP_00121, RS_AP_00127, RS_AP_00128, RS_AP_00129, RS_AP_00135, RS_AP_00136, RS_AP_00139, RS_AP_00159

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| | | |
|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/key_value_storage.h" | |
| ***Scope:*** | `class ara::per::KeyValueStorage` | |
| ***Syntax:*** | `template <class T>`<br>`ara::core::Result< void > SetValue (ara::core::StringView key, const T &value) noexcept;` | |
| ***Template param:*** | T | The type of the value that shall be set. |
| ***Parameters (in):*** | key | The key to assign the value to. |
| | value | The value to store. |
| ***Return value:*** | ara::core::Result< void > | A Result of void. In case of an error, it contains any of the errors defined below, or a vendor specific error. |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | thread-safe | |
| ***Errors:*** | PerErrc::kIllegalWriteAccess | rollback_semantics |
| | | Returned if the Key-Value Storage is configured as read- only, or if it is configured as write-only-once and the key already exists. |
| | PerErrc::kPhysicalStorageFailure | rollback_semantics |
| | | Returned if access to the physical storage fails. |
| | PerErrc::kIntegrityCorrupted | rollback_semantics |
| | | Returned if stored data cannot be written because the structural integrity is corrupted. |
| | PerErrc::kEncryptionFailed | rollback_semantics |
| | | Returned if the encryption or decryption of stored data fails. |
| | PerErrc::kDataTypeMismatch | rollback_semantics |
| | | Returned if the data type of an already stored value does not match the templated type. |
| | PerErrc::kOutOfStorageSpace | rollback_semantics |
| | | Returned if the available physical storage space is insufficient for the new value. |
| | PerErrc::kQuotaExceeded | rollback_semantics |
| | | Returned if the new value would exceed the configured maximum AllowedSize of the Key-Value Storage. |
| | PerErrc::kAuthenticationFailed | rollback_semantics |
| | | Returned if calculating or checking the MAC of stored data fails. |

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|---|---|
| ***Description:*** | Stores a key-value pair in this Key-Value Storage.<br>If a value already exists and has the same data type as the new value, it is overwritten. If the new value has a different data type than the stored value, kDataTypeMismatch is returned.<br>SetValue may be delayed by an ongoing call from another thread to RemoveAllKeys, SyncTo Storage, or DiscardPendingChanges, or to SetValue, GetValue, GetCurrentValueSize, Remove Key, RecoverKey, or ResetKey for the same key-value pair.<br>This method uses transaction semantics, the changes only take effect when SyncToStorage is called. |

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### 8.5.2.1.2.12 SyncToStorage

### [SWS_PER_00049] Definition of API function ara::per::KeyValueStorage::SyncTo Storage

*Upstream requirements:* RS_PER_00002, RS_AP_00119, RS_AP_00120, RS_AP_00127, RS_-AP_00128, RS_AP_00129, RS_AP_00135, RS_AP_00139, RS_AP_-00159

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| | | |
|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/key_value_storage.h" | |
| ***Scope:*** | `class ara::per::KeyValueStorage` | |
| ***Syntax:*** | `ara::core::Result< void > SyncToStorage () noexcept;` | |
| ***Return value:*** | ara::core::Result< void > | A Result of void. In case of an error, it contains any of the errors defined below, or a vendor specific error. |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | thread-safe | |
| ***Errors:*** | PerErrc::kIllegalWrite Access | rollback_semantics |
| | | Returned if the Key-Value Storage is configured as read- only, or if it is configured as write-only-once and the key already exists. |
| | PerErrc::kPhysical StorageFailure | no_rollback_semantics |
| | | Returned if access to the physical storage fails. |
| | PerErrc::kIntegrity Corrupted | rollback_semantics |
| | | Returned if stored data cannot be written because the structural integrity is corrupted. |
| | PerErrc::kEncryption Failed | rollback_semantics |
| | | Returned if the encryption of stored data fails. |
| | PerErrc::kOutOfStorage Space | no_rollback_semantics |
| | | Returned if the available physical storage space is insufficient for the added/changed values. |
| | PerErrc::kQuota Exceeded | rollback_semantics |
| | | Returned if the added/changed values would exceed the configured maximumAllowedSize of the Key-Value Storage. |
| | PerErrc::kAuthentication Failed | rollback_semantics |
| | | Returned if calculating the MAC of stored data fails. |

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| ***Description:*** | Flushes changed key-value pairs of the Key-Value Storage to the physical storage. SyncToStorage may be delayed by an ongoing call from another thread to RemoveAllKeys, DiscardPendingChanges, SetValue, RemoveKey, RecoverKey, or ResetKey. |

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## 8.6 Header: ara/per/per_error_domain.h

### 8.6.1 Non-Member Types

#### 8.6.1.1 Enumeration: PerErrc

### [SWS_PER_00311] Definition of API enum ara::per::PerErrc

*Upstream requirements:* RS_AP_00122, RS_AP_00125, RS_AP_00127, RS_AP_00149

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| | | |
|---|---|---|
| ***Kind:*** | enumeration | |
| ***Header file:*** | #include "ara/per/per_error_domain.h" | |
| ***Forwarding header file:*** | #include "ara/per/per_fwd.h" | |
| ***Scope:*** | namespace ara::per | |
| ***Symbol:*** | PerErrc | |
| ***Underlying type:*** | ara::core::ErrorDomain::CodeType | |
| ***Syntax:*** | `enum class PerErrc : ara::core::ErrorDomain::CodeType {...};` | |
| ***Values:*** | kStorageNotFound | = 1 |
| | | The requested Key-Value Storage or File Storage is not configured in the AUTOSAR model. |
| | kKeyNotFound | = 2 |
| | | The provided key cannot be not found in the Key-Value Storage. |
| | kIllegalWriteAccess | = 3 |
| | | The operation could not be performed because the accessed Key-Value Storage or File Storage is configured as read-only or write-only-once. |
| | kPhysicalStorageFailure | = 4 |
| | | An error occurred when accessing the physical storage, e.g. because of a corrupted file system or corrupted hardware, or because of insufficient access rights. |
| | kIntegrityCorrupted | = 5 |
| | | The structural integrity of the Key-Value Storage or File Storage could not be established. This can happen when the internal structure of a Key-Value Storage or the metadata of a File Storage is corrupted. |
| | kValidationFailed | = 6 |
| | | The validation of redundancy measures failed for a single key-value pair, for the whole Key-Value Storage, for a single file, or for the whole File Storage. |
| | kEncryptionFailed | = 7 |

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| | | |
|---|---|---|
| | | The encryption or decryption failed for a single key-value pair, for the whole Key-Value Storage, for a single file, or for the whole File Storage. |
| | kDataTypeMismatch | = 8 |
| | | The provided data type does not match the stored data type. |
| | kInitValueNotAvailable | = 9 |
| | | The operation could not be performed because no initial value is available. |
| | kResourceBusy | = 10 |
| | | The operation could not be performed because the resource is currently busy. |
| | kOutOfStorageSpace | = 12 |
| | | The physical storage space was exceeded. |
| | kFileNotFound | = 13 |
| | | The requested file name cannot be not found in the File Storage. |
| | kInvalidPosition | = 15 |
| | | SetPosition tried to move to a position that is not reachable (i.e. which is smaller than zero or greater than the current size of the file). |
| | kEof | = 16 |
| | | The Persistency user tried to read from the end of the file or from an empty file. |
| | kInvalidOpenMode | = 17 |
| | | Opening a file failed because the requested combination of Open Modes is invalid. |
| | kInvalidSize | = 18 |
| | | SetFileSize tried to set a new size that is bigger than the current file size. |
| | kTooManyFiles | = 19 |
| | | The maximum number of files was exceeded. |
| | kQuotaExceeded | = 20 |
| | | The allocated storage quota was exceeded. |
| | kAuthenticationFailed | = 21 |
| | | Calculating or checking of the MAC failed for a single key-value pair, for the whole Key-Value Storage, for a single file, or for the whole File Storage. |
| ***Description:*** | Defines the errors for Persistency.<br>The enumeration values 0 - 255 are reserved for AUTOSAR assigned errors, the stack provider is free to define additional errors starting from 256. | |

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### 8.6.2 Non-Member Functions

#### 8.6.2.1 Other

##### 8.6.2.1.1 GetPerDomain

**[SWS_PER_00352] Definition of API function ara::per::GetPerDomain**

*Upstream requirements:* RS_AP_00119, RS_AP_00120, RS_AP_00159

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| | | |
|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/per_error_domain.h" | |
| ***Scope:*** | namespace ara::per | |
| ***Syntax:*** | `constexpr const ara::core::ErrorDomain & GetPerDomain () noexcept;` | |
| ***Return value:*** | const ara::core::Error Domain & | The global PerErrorDomain object. |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | thread-safe | |
| ***Description:*** | Returns the global PerErrorDomain object. | |

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##### 8.6.2.1.2 MakeErrorCode

**[SWS_PER_00351] Definition of API function ara::per::MakeErrorCode**

*Upstream requirements:* RS_AP_00119, RS_AP_00120, RS_AP_00121, RS_AP_00135, RS_AP_00159

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| | | |
|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/per_error_domain.h" | |
| ***Scope:*** | namespace ara::per | |
| ***Syntax:*** | `constexpr ara::core::ErrorCode MakeErrorCode (PerErrc code, ara::core::ErrorDomain::SupportDataType data) noexcept;` | |
| ***Parameters (in):*** | code | Error code number. |
| | data | Vendor defined data associated with the error. |
| ***Return value:*** | ara::core::ErrorCode | An ErrorCode object. |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | thread-safe | |
| ***Description:*** | Creates an error code. | |

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### 8.6.3 Class: PerErrorDomain

**[SWS_PER_00312] Definition of API class ara::per::PerErrorDomain**

*Upstream requirements:* RS_AP_00122, RS_AP_00127, RS_AP_00140

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| | |
|---|---|
| ***Kind:*** | class |
| ***Header file:*** | #include "ara/per/per_error_domain.h" |
| ***Forwarding header file:*** | #include "ara/per/per_fwd.h" |
| ***Scope:*** | namespace ara::per |
| ***Symbol:*** | PerErrorDomain |
| ***Base class:*** | ara::core::ErrorDomain |
| ***Syntax:*** | `class PerErrorDomain final : public ara::core::ErrorDomain {...};` |
| ***Unique ID:*** | As per `ara::per::PerErrorDomain` in [SWS_CORE_90023] |
| ***Description:*** | Defines the error domain for Persistency. |

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#### 8.6.3.1 Public Member Types

##### 8.6.3.1.1 Type Alias: Errc

**[SWS_PER_00411] Definition of API type ara::per::PerErrorDomain::Errc**

*Upstream requirements:* RS_AP_00122

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| | |
|---|---|
| ***Kind:*** | type alias |
| ***Header file:*** | #include "ara/per/per_error_domain.h" |
| ***Scope:*** | `class ara::per::PerErrorDomain` |
| ***Symbol:*** | Errc |
| ***Syntax:*** | `using Errc = PerErrc;` |
| ***Description:*** | Alias for the error code value enumeration. |

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#### 8.6.3.1.2 Type Alias: Exception

**[SWS_PER_00412] Definition of API type ara::per::PerErrorDomain::Exception**

*Upstream requirements:* RS_AP_00122

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| | |
|---|---|
| ***Kind:*** | type alias |
| ***Header file:*** | #include "ara/per/per_error_domain.h" |
| ***Scope:*** | `class ara::per::PerErrorDomain` |
| ***Symbol:*** | Exception |
| ***Syntax:*** | `using Exception = PerException;` |
| ***Description:*** | Alias for the exception base class. |

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### 8.6.3.2 Public Member Functions

#### 8.6.3.2.1 Special Member Functions

##### 8.6.3.2.1.1 Default Constructor

**[SWS_PER_00313] Definition of API function ara::per::PerErrorDomain::PerErrorDomain**

*Upstream requirements:* RS_AP_00119, RS_AP_00120, RS_AP_00159

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| | |
|---|---|
| ***Kind:*** | function |
| ***Header file:*** | #include "ara/per/per_error_domain.h" |
| ***Scope:*** | `class ara::per::PerErrorDomain` |
| ***Syntax:*** | `PerErrorDomain () noexcept;` |
| ***Exception Safety:*** | exception safe |
| ***Thread Safety:*** | thread-safe |
| ***Description:*** | Creates a PerErrorDomain instance. |

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#### 8.6.3.2.2 Member Functions

##### 8.6.3.2.2.1 Message

**[SWS_PER_00315] Definition of API function ara::per::PerErrorDomain::Message**

*Upstream requirements:* RS_AP_00119, RS_AP_00120, RS_AP_00121, RS_AP_00159

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| | | |
|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/per_error_domain.h" | |
| ***Scope:*** | `class ara::per::PerErrorDomain` | |
| ***Syntax:*** | `const char * Message (CodeType errorCode) const noexcept override;` | |
| ***Parameters (in):*** | errorCode | The error code number. |
| ***Return value:*** | const char * | The message associated with the error code. |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | thread-safe | |
| ***Description:*** | Returns the message associated with the error code. | |

⌋

##### 8.6.3.2.2.2 Name

**[SWS_PER_00314] Definition of API function ara::per::PerErrorDomain::Name**

*Upstream requirements:* RS_AP_00119, RS_AP_00120, RS_AP_00159

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| | | |
|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/per_error_domain.h" | |
| ***Scope:*** | `class ara::per::PerErrorDomain` | |
| ***Syntax:*** | `const char * Name () const noexcept override;` | |
| ***Return value:*** | const char * | As per `ara::per::PerErrorDomain` in [SWS_CORE_90023]. |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | thread-safe | |
| ***Description:*** | Returns the name of the error domain. | |

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#### 8.6.3.2.2.3 ThrowAsException

### [SWS_PER_00350] Definition of API function ara::per::PerErrorDomain::ThrowAsException

*Upstream requirements:* RS_AP_00120, RS_AP_00121

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| | | |
|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/per_error_domain.h" | |
| ***Scope:*** | `class ara::per::PerErrorDomain` | |
| ***Syntax:*** | `void ThrowAsException (const ara::core::ErrorCode &errorCode) const noexcept(false) override;` | |
| ***Parameters (in):*** | errorCode | The error to throw. |
| ***Return value:*** | None | |
| ***Exception Safety:*** | not exception safe | |
| ***Thread Safety:*** | thread-safe | |
| ***Description:*** | Throws the exception associated with the error code.<br>As per [SWS_CORE_10304], this function does not participate in overload resolution when C++ exceptions are disabled in the compiler toolchain. | |

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## 8.6.4 Class: PerException

### [SWS_PER_00354] Definition of API class ara::per::PerException

*Upstream requirements:* RS_AP_00122, RS_AP_00127

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| | |
|---|---|
| ***Kind:*** | class |
| ***Header file:*** | #include "ara/per/per_error_domain.h" |
| ***Forwarding header file:*** | #include "ara/per/per_fwd.h" |
| ***Scope:*** | namespace ara::per |
| ***Symbol:*** | PerException |
| ***Base class:*** | ara::core::Exception |
| ***Syntax:*** | `class PerException : public ara::core::Exception {...};` |
| ***Description:*** | Exception type thrown by Persistency. |

⌋

#### 8.6.4.1 Public Member Functions

##### 8.6.4.1.1 Constructors

###### 8.6.4.1.1.1 PerException

**[SWS_PER_00355] Definition of API function ara::per::PerException::PerException**

*Upstream requirements:* RS_AP_00120, RS_AP_00121, RS_AP_00135, RS_AP_00159

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| | | |
|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/per_error_domain.h" | |
| ***Scope:*** | `class ara::per::PerException` | |
| ***Syntax:*** | `explicit PerException (ara::core::ErrorCode errorCode) noexcept;` | |
| ***Parameters (in):*** | errorCode | The error code. |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | thread-safe | |
| ***Description:*** | Construct a new Persistency exception object containing an error code. | |

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## 8.7 Header: ara/per/read_accessor.h

### 8.7.1 Class: ReadAccessor

**[SWS_PER_00342] Definition of API class ara::per::ReadAccessor**

*Upstream requirements:* RS_PER_00004, RS_AP_00122, RS_AP_00146

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| | |
|---|---|
| ***Kind:*** | class |
| ***Header file:*** | #include "ara/per/read_accessor.h" |
| ***Forwarding header file:*** | #include "ara/per/per_fwd.h" |
| ***Scope:*** | namespace ara::per |
| ***Symbol:*** | ReadAccessor |
| ***Base class:*** | FileAccessor |
| ***Syntax:*** | `class ReadAccessor : public virtual FileAccessor {...};` |
| ***Description:*** | ReadAccessor is used to read file data.<br>It provides binary and text mode methods for checking or getting the current byte/character (PeekByte/PeekChar, GetByte/GetChar) methods for reading a section of a binary/text file (Read Binary/ReadText), a method to read a line of text (ReadLine). |

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#### 8.7.1.1 Public Member Functions

##### 8.7.1.1.1 Special Member Functions

###### 8.7.1.1.1.1 Default Constructor

**[SWS_PER_00461] Definition of API function ara::per::ReadAccessor::ReadAccessor**

*Upstream requirements:* RS_PER_00004, RS_AP_00120, RS_AP_00129, RS_AP_00146

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| | |
|---|---|
| ***Kind:*** | function |
| ***Header file:*** | #include "ara/per/read_accessor.h" |
| ***Scope:*** | `class ara::per::ReadAccessor` |
| ***Syntax:*** | `ReadAccessor ()=delete;` |
| ***Description:*** | The default constructor for ReadAccessor shall not be used. |

⌋

###### 8.7.1.1.1.2 Destructor

**[SWS_PER_00417] Definition of API function ara::per::ReadAccessor::~ReadAccessor**

*Upstream requirements:* RS_PER_00004, RS_AP_00120, RS_AP_00129, RS_AP_00134, RS_AP_00145, RS_AP_00159

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| | |
|---|---|
| ***Kind:*** | function |
| ***Header file:*** | #include "ara/per/read_accessor.h" |
| ***Scope:*** | `class ara::per::ReadAccessor` |
| ***Syntax:*** | `~ReadAccessor () override noexcept;` |
| ***Exception Safety:*** | exception safe |
| ***Thread Safety:*** | not thread-safe |
| ***Description:*** | Destructor for ReadAccessor. |

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#### 8.7.1.1.2 Member Functions

##### 8.7.1.1.2.1 GetByte

**[SWS_PER_00419] Definition of API function ara::per::ReadAccessor::GetByte**

*Upstream requirements:* RS_PER_00001, RS_PER_00004, RS_AP_00119, RS_AP_00120, RS_AP_00135, RS_AP_00139, RS_AP_00159

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| | | |
|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/read_accessor.h" | |
| ***Scope:*** | `class ara::per::ReadAccessor` | |
| ***Syntax:*** | `ara::core::Result< ara::core::Byte > GetByte () noexcept;` | |
| ***Return value:*** | ara::core::Result< ara::core::Byte > | A Result containing a byte. In case of an error, it contains any of the errors defined below, or a vendor specific error. |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | not thread-safe | |
| ***Errors:*** | PerErrc::kPhysicalStorageFailure | rollback_semantics |
| | | Returned if access to the physical storage fails. |
| | PerErrc::kValidationFailed | rollback_semantics |
| | | Returned if the validity of stored data cannot be ensured. |
| | PerErrc::kEncryptionFailed | rollback_semantics |
| | | Returned if the decryption of stored data fails. |
| | PerErrc::kEof | rollback_semantics |
| | | Returned if the current position is at the end of the file or if the file is empty. |
| | PerErrc::kAuthenticationFailed | rollback_semantics |
| | | Returned if checking the MAC of stored data fails. |
| ***Description:*** | Returns the byte at the current position of the file, advancing the current position.<br>In case of an error, the current position is not changed. | |

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##### 8.7.1.1.2.2 GetChar

**[SWS_PER_00168] Definition of API function ara::per::ReadAccessor::GetChar**

*Upstream requirements:* RS_PER_00001, RS_PER_00004, RS_AP_00119, RS_AP_00120, RS_AP_00135, RS_AP_00139, RS_AP_00159

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| | | |
|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/read_accessor.h" | |
| ***Scope:*** | `class ara::per::ReadAccessor` | |
| ***Syntax:*** | `ara::core::Result< char > GetChar () noexcept;` | |
| ***Return value:*** | ara::core::Result< char > | A Result containing a character. In case of an error, it contains any of the errors defined below, or a vendor specific error. |

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| | | |
|---|---|---|
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | not thread-safe | |
| ***Errors:*** | PerErrc::kPhysical StorageFailure | rollback_semantics |
| | | Returned if access to the physical storage fails. |
| | PerErrc::kValidation Failed | rollback_semantics |
| | | Returned if the validity of stored data cannot be ensured. |
| | PerErrc::kEncryption Failed | rollback_semantics |
| | | Returned if the decryption of stored data fails. |
| | PerErrc::kEof | rollback_semantics |
| | | Returned if the current position is at the end of the file or if the file is empty. |
| | PerErrc::kAuthentication Failed | rollback_semantics |
| | | Returned if checking the MAC of stored data fails. |
| ***Description:*** | Returns the character at the current position of the file, advancing the current position.<br>In case of an error, the current position is not changed. | |

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### 8.7.1.1.2.3 PeekByte

### [SWS_PER_00418] Definition of API function ara::per::ReadAccessor::PeekByte

*Upstream requirements:* RS_PER_00001, RS_PER_00004, RS_AP_00119, RS_AP_00120, RS_AP_00135, RS_AP_00139, RS_AP_00159

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| | | |
|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/read_accessor.h" | |
| ***Scope:*** | `class ara::per::ReadAccessor` | |
| ***Syntax:*** | `ara::core::Result< ara::core::Byte > PeekByte () const noexcept;` | |
| ***Return value:*** | ara::core::Result< ara::core::Byte > | A Result containing a byte. In case of an error, it contains any of the errors defined below, or a vendor specific error. |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | not thread-safe | |
| ***Errors:*** | PerErrc::kPhysical StorageFailure | rollback_semantics |
| | | Returned if access to the physical storage fails. |
| | PerErrc::kValidation Failed | rollback_semantics |
| | | Returned if the validity of stored data cannot be ensured. |
| | PerErrc::kEncryption Failed | rollback_semantics |
| | | Returned if the decryption of stored data fails. |
| | PerErrc::kEof | rollback_semantics |
| | | Returned if the current position is at the end of the file or if the file is empty. |
| | PerErrc::kAuthentication Failed | rollback_semantics |
| | | Returned if checking the MAC of stored data fails. |

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|---|---|
| ***Description:*** | Returns the byte at the current position of the file.<br>The current position is not changed. |

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#### 8.7.1.1.2.4 PeekChar

### [SWS_PER_00167] Definition of API function ara::per::ReadAccessor::PeekChar

*Upstream requirements:* RS_PER_00001, RS_PER_00004, RS_AP_00119, RS_AP_00120, RS_AP_00135, RS_AP_00139, RS_AP_00159

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| | | |
|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/read_accessor.h" | |
| ***Scope:*** | `class ara::per::ReadAccessor` | |
| ***Syntax:*** | `ara::core::Result< char > PeekChar () const noexcept;` | |
| ***Return value:*** | ara::core::Result< char > | A Result containing a character. In case of an error, it contains any of the errors defined below, or a vendor specific error. |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | not thread-safe | |
| ***Errors:*** | PerErrc::kPhysical StorageFailure | rollback_semantics |
| | | Returned if access to the physical storage fails. |
| | PerErrc::kValidation Failed | rollback_semantics |
| | | Returned if the validity of stored data cannot be ensured. |
| | PerErrc::kEncryption Failed | rollback_semantics |
| | | Returned if the decryption of stored data fails. |
| | PerErrc::kEof | rollback_semantics |
| | | Returned if the current position is at the end of the file or if the file is empty. |
| | PerErrc::kAuthentication Failed | rollback_semantics |
| | | Returned if checking the MAC of stored data fails. |
| ***Description:*** | Returns the character at the current position of the file.<br>The current position is not changed. | |

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#### 8.7.1.1.2.5 ReadBinary

### [SWS_PER_00422] Definition of API function ara::per::ReadAccessor::ReadBinary

*Upstream requirements:* RS_PER_00001, RS_PER_00004, RS_AP_00119, RS_AP_00120, RS_AP_00121, RS_AP_00127, RS_AP_00135, RS_AP_00139, RS_AP_00159

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| | | |
|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/read_accessor.h" | |
| ***Scope:*** | `class ara::per::ReadAccessor` | |
| ***Syntax:*** | `ara::core::Result< ara::core::Vector< ara::core::Byte > > ReadBinary (std::uint64_t n) noexcept;` | |
| ***Parameters (in):*** | n | Number of bytes to read. |
| ***Return value:*** | ara::core::Result< ara::core::Vector< ara::core::Byte > > | A Result containing a Vector of Byte. In case of an error, it contains any of the errors defined below, or a vendor specific error. |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | not thread-safe | |
| ***Errors:*** | PerErrc::kPhysicalStorageFailure | rollback_semantics |
| | | Returned if access to the physical storage fails. |
| | PerErrc::kValidationFailed | rollback_semantics |
| | | Returned if the validity of stored data cannot be ensured. |
| | PerErrc::kEncryptionFailed | rollback_semantics |
| | | Returned if the decryption of stored data fails. |
| | PerErrc::kEof | rollback_semantics |
| | | Returned if the current position is at the end of the file or if the file is empty. |
| | PerErrc::kAuthenticationFailed | rollback_semantics |
| | | Returned if checking the MAC of stored data fails. |
| ***Description:*** | Reads a number of bytes into a Vector of Byte, starting from the current position.<br>The current position is advanced accordingly.<br>If the end of the file is reached, the number of returned bytes can be less than the requested number, and the current position is set to the end of the file.<br>In case of an error, the current position is not changed. | |

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#### 8.7.1.1.2.6 ReadBinary

### [SWS_PER_00421] Definition of API function ara::per::ReadAccessor::ReadBinary

*Upstream requirements:* RS_PER_00001, RS_PER_00004, RS_AP_00119, RS_AP_00120, RS_AP_00121, RS_AP_00127, RS_AP_00135, RS_AP_00139, RS_AP_00159

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| | | |
|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/read_accessor.h" | |
| ***Scope:*** | `class ara::per::ReadAccessor` | |
| ***Syntax:*** | `ara::core::Result< ara::core::Vector< ara::core::Byte > > ReadBinary () noexcept;` | |
| ***Return value:*** | ara::core::Result< ara::core::Vector< ara::core::Byte > > | A Result containing a Vector of Byte. In case of an error, it contains any of the errors defined below, or a vendor specific error. |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | not thread-safe | |
| ***Errors:*** | PerErrc::kPhysical StorageFailure | rollback_semantics |
| | | Returned if access to the physical storage fails. |
| | PerErrc::kValidation Failed | rollback_semantics |
| | | Returned if the validity of stored data cannot be ensured. |
| | PerErrc::kEncryption Failed | rollback_semantics |
| | | Returned if the decryption of stored data fails. |
| | PerErrc::kEof | rollback_semantics |
| | | Returned if the current position is at the end of the file or if the file is empty. |
| | PerErrc::kAuthentication Failed | rollback_semantics |
| | | Returned if checking the MAC of stored data fails. |
| ***Description:*** | Reads all remaining bytes into a Vector of Byte, starting from the current position.<br>The current position is set to the end of the file.<br>In case of an error, the current position is not changed. | |

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#### 8.7.1.1.2.7 ReadLine

### [SWS_PER_00119] Definition of API function ara::per::ReadAccessor::ReadLine

*Upstream requirements:* RS_PER_00001, RS_PER_00004, RS_AP_00119, RS_AP_00120, RS_AP_00121, RS_AP_00127, RS_AP_00129, RS_AP_00135, RS_AP_00136, RS_AP_00139, RS_AP_00159

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| | |
|---|---|
| ***Kind:*** | function |
| ***Header file:*** | #include "ara/per/read_accessor.h" |
| ***Scope:*** | `class ara::per::ReadAccessor` |

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| | | |
|---|---|---|
| ***Syntax:*** | `ara::core::Result< ara::core::String > ReadLine (char delimiter='\n') noexcept;` | |
| ***Parameters (in):*** | delimiter | The character that is used as delimiter. |
| ***Return value:*** | ara::core::Result< ara::core::String > | A Result containing a String. In case of an error, it contains any of the errors defined below, or a vendor specific error. |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | not thread-safe | |
| ***Errors:*** | PerErrc::kPhysical StorageFailure | rollback_semantics |
| | | Returned if access to the physical storage fails. |
| | PerErrc::kValidation Failed | rollback_semantics |
| | | Returned if the validity of stored data cannot be ensured. |
| | PerErrc::kEncryption Failed | rollback_semantics |
| | | Returned if the decryption of stored data fails. |
| | PerErrc::kEof | rollback_semantics |
| | | Returned if the current position is at the end of the file or if the file is empty. |
| | PerErrc::kAuthentication Failed | rollback_semantics |
| | | Returned if checking the MAC of stored data fails. |
| ***Description:*** | Reads a complete line of characters into a String, advancing the current position accordingly.<br>The end of the line is demarcated by the delimiter, or by "\\n" (ASCII 0x0a) if that parameter is omitted. The delimiter itself is not included in the returned String.<br>Only Unicode code points with one character (code unit) can be used as delimiters. The returned string may start with an incomplete Unicode code point in case the current read position is in the middle of a code point.<br>If the end of the file is reached, the remaining characters are returned and the current position is set to the end of the file.<br>In case of an error, the current position is not changed. | |

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### 8.7.1.1.2.8 ReadText

### [SWS_PER_00420] Definition of API function ara::per::ReadAccessor::ReadText

*Upstream requirements:* RS_PER_00001, RS_PER_00004, RS_AP_00119, RS_AP_00120, RS_AP_00121, RS_AP_00127, RS_AP_00135, RS_AP_00136, RS_AP_00139, RS_AP_00159

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| | | |
|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/read_accessor.h" | |
| ***Scope:*** | `class ara::per::ReadAccessor` | |
| ***Syntax:*** | `ara::core::Result< ara::core::String > ReadText () noexcept;` | |
| ***Return value:*** | ara::core::Result< ara::core::String > | A Result containing a String. In case of an error, it contains any of the errors defined below, or a vendor specific error. |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | not thread-safe | |
| ***Errors:*** | PerErrc::kPhysical StorageFailure | rollback_semantics |
| | | Returned if access to the physical storage fails. |

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|---|---|---|
| | PerErrc::kValidation Failed | rollback_semantics |
| | | Returned if the validity of stored data cannot be ensured. |
| | PerErrc::kEncryption Failed | rollback_semantics |
| | | Returned if the decryption of stored data fails. |
| | PerErrc::kEof | rollback_semantics |
| | | Returned if the current position is at the end of the file or if the file is empty. |
| | PerErrc::kAuthentication Failed | rollback_semantics |
| | | Returned if checking the MAC of stored data fails. |
| ***Description:*** | Reads all remaining characters into a String, starting from the current position.<br>The returned string may start with an incomplete Unicode code point in case the current read position is in the middle of a code point.<br>The current position is set to the end of the file.<br>In case of an error, the current position is not changed. | |

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### 8.7.1.1.2.9 ReadText

### [SWS_PER_00165] Definition of API function ara::per::ReadAccessor::ReadText

*Upstream requirements:* RS_PER_00001, RS_PER_00004, RS_AP_00119, RS_AP_00120, RS_AP_00121, RS_AP_00127, RS_AP_00135, RS_AP_00136, RS_AP_00139, RS_AP_00159

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| | | |
|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/read_accessor.h" | |
| ***Scope:*** | `class ara::per::ReadAccessor` | |
| ***Syntax:*** | `ara::core::Result< ara::core::String > ReadText (std::uint64_t n) noexcept;` | |
| ***Parameters (in):*** | n | Number of characters to read. |
| ***Return value:*** | ara::core::Result< ara::core::String > | A Result containing a String. In case of an error, it contains any of the errors defined below, or a vendor specific error. |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | not thread-safe | |
| ***Errors:*** | PerErrc::kPhysical StorageFailure | rollback_semantics |
| | | Returned if access to the physical storage fails. |
| | PerErrc::kValidation Failed | rollback_semantics |
| | | Returned if the validity of stored data cannot be ensured. |
| | PerErrc::kEncryption Failed | rollback_semantics |
| | | Returned if the decryption of stored data fails. |
| | PerErrc::kEof | rollback_semantics |
| | | Returned if the current position is at the end of the file or if the file is empty. |
| | PerErrc::kAuthentication Failed | rollback_semantics |
| | | Returned if checking the MAC of stored data fails. |

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|---|---|
| ***Description:*** | Reads a number of characters into a String, starting from the current position.<br>The returned string may start and/or end with incomplete Unicode code points in case the current read position and/or the last read character (code unit) is in the middle of a code point.<br>The current position is advanced accordingly.<br>If the end of the file is reached, the number of returned characters can be less than the requested number, and the current position is set to the end of the file.<br>In case of an error, the current position is not changed. |

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## 8.8 Header: ara/per/read_write_accessor.h

### 8.8.1 Class: ReadWriteAccessor

#### [SWS_PER_00343] Definition of API class ara::per::ReadWriteAccessor

*Upstream requirements:* RS_PER_00004, RS_AP_00122, RS_AP_00146

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| | |
|---|---|
| ***Kind:*** | class |
| ***Header file:*** | #include "ara/per/read_write_accessor.h" |
| ***Forwarding header file:*** | #include "ara/per/per_fwd.h" |
| ***Scope:*** | namespace ara::per |
| ***Symbol:*** | ReadWriteAccessor |
| ***Base class:*** | ReadAccessor, WriteAccessor |
| ***Syntax:*** | `class ReadWriteAccessor final : public ReadAccessor, public WriteAccessor {...};` |
| ***Description:*** | ReadWriteAccessor is used to read and write file data.<br>It combines the capabilities of the ReadAccessor with the WriteAccessor. |

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#### 8.8.1.1 Public Member Functions

##### 8.8.1.1.1 Special Member Functions

###### 8.8.1.1.1.1 Default Constructor

#### [SWS_PER_00462] Definition of API function ara::per::ReadWriteAccessor::ReadWriteAccessor

*Upstream requirements:* RS_PER_00004, RS_AP_00120, RS_AP_00129, RS_AP_00146

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| | |
|---|---|
| ***Kind:*** | function |
| ***Header file:*** | #include "ara/per/read_write_accessor.h" |
| ***Scope:*** | `class ara::per::ReadWriteAccessor` |

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| | |
|---|---|
| ***Syntax:*** | `ReadWriteAccessor ()=delete;` |
| ***Description:*** | The default constructor for ReadWriteAccessor shall not be used. |

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#### 8.8.1.1.1.2 Destructor

**[SWS_PER_00598] Definition of API function ara::per::ReadWriteAccessor::~ReadWriteAccessor**

*Upstream requirements:* RS_PER_00004, RS_AP_00120, RS_AP_00129, RS_AP_00134, RS_AP_00145, RS_AP_00159

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| | |
|---|---|
| ***Kind:*** | function |
| ***Header file:*** | #include "ara/per/read_write_accessor.h" |
| ***Scope:*** | `class ara::per::ReadWriteAccessor` |
| ***Syntax:*** | `~ReadWriteAccessor () final noexcept;` |
| ***Exception Safety:*** | exception safe |
| ***Thread Safety:*** | not thread-safe |
| ***Description:*** | Destructor for ReadWriteAccessor. |

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## 8.9 Header: ara/per/recovery.h

### 8.9.1 Non-Member Types

#### 8.9.1.1 Enumeration: RecoveryReportKind

**[SWS_PER_00432] Definition of API enum ara::per::RecoveryReportKind**

*Upstream requirements:* RS_PER_00008, RS_AP_00122, RS_AP_00125, RS_AP_00143

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| | | |
|---|---|---|
| ***Kind:*** | enumeration | |
| ***Header file:*** | #include "ara/per/recovery.h" | |
| ***Forwarding header file:*** | #include "ara/per/per_fwd.h" | |
| ***Scope:*** | namespace ara::per | |
| ***Symbol:*** | RecoveryReportKind | |
| ***Underlying type:*** | std::uint32_t | |
| ***Syntax:*** | `enum class RecoveryReportKind : std::uint32_t {...};` | |
| ***Values:*** | kKeyValueStorage<br>RecoveryFailed | = 1 |

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| | | |
|---|---|---|
| | | A Key-Value Storage was corrupted, an insufficient number of valid copies existed. storage contains the short-name path of the Key-Value Storage, reportedElements is empty, reportedInstances contains the indices of the affected Key-Value Storage copies. |
| | kKeyValueStorage Recovered | = 2 |
| | | A Key-Value Storage was corrupted, but a sufficient number of valid copies existed. storage contains the short-name path of the Key-Value Storage, reportedElements is empty, reportedInstances contains the indices of the affected Key-Value Storage copies. |
| | kKeyRecoveryFailed | = 3 |
| | | A set of key-value pairs was corrupted, an insufficient number of valid copies existed. storage contains the short-name path of the Key-Value Storage, reportedElements contains the list of affected keys, reportedInstances contains the indices of the affected Key-Value Storage or key-value pair copies. In general, the nth key in reportedElements corresponds to the nth index in reported Instances, i.e. a key may be reported several times if several copies are broken. In case only one key-value pair is affected, reported Elements may be provided containing just this key. |
| | kKeyRecovered | = 4 |
| | | A set of key-value pairs was corrupted, but a sufficient number of valid copies existed. storage contains the short-name path of the Key-Value Storage, reportedElements contains the list of affected keys, reportedInstances contains the indices of the affected Key-Value Storage or key-value pair copies. In general, the nth key in reportedElements corresponds to the nth index in reported Instances, i.e. a key may be reported several times if several copies are broken. In case only one key-value pair is affected, reported Elements may be provided containing just this key. |
| | kFileStorageRecovery Failed | = 5 |
| | | A File Storage was corrupted, an insufficient number of valid copies existed. storage contains the short-name path of the File Storage, reportedElements is empty, reportedInstances contains the indices of the affected File Storage copies. |
| | kFileStorageRecovered | = 6 |
| | | A File Storage was corrupted, but a sufficient number of valid copies existed. storage contains the short-name path of the File Storage, reportedElements is empty, reportedInstances contains the indices of the affected File Storage copies. |
| | kFileRecoveryFailed | = 7 |
| | | A set of files was corrupted, an insufficient number of valid copies existed. storage contains the short-name path of the File Storage, reportedElements contains the list of affected file names, reported Instances contains the indices of the affected File Storage or file copies. In general, the nth file name in reportedElements corresponds to the nth index in reportedInstances, i.e. a file name may be reported several times if several copies are broken. In case only one file is affected, reportedElements may be provided containing just this file name. |
| | kFileRecovered | = 8 |

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| | | |
|---|---|---|
| | | A set of files was corrupted, but a sufficient number of valid copies existed. storage contains the short-name path of the File Storage, reportedElements contains the list of affected file names, reported Instances contains the indices of the affected File Storage or file copies. In general, the nth file name in reportedElements corresponds to the nth index in reportedInstances, i.e. a file name may be reported several times if several copies are broken. In case only one file is affected, reportedElements may be provided containing just this file name. |
| ***Description:*** | Defines the reported recovery actions. | |

⌋

### 8.9.2 Non-Member Functions

#### 8.9.2.1 Other

##### 8.9.2.1.1 RegisterRecoveryReportCallback

**[SWS_PER_00433] Definition of API function ara::per::RegisterRecoveryReportCallback**

*Upstream requirements:* RS_PER_00008, RS_AP_00120, RS_AP_00121, RS_AP_00127, RS_AP_00135, RS_AP_00137, RS_AP_00159

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| | | |
|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/recovery.h" | |
| ***Scope:*** | namespace ara::per | |
| ***Syntax:*** | `void RegisterRecoveryReportCallback (std::function< void(const ara::core::InstanceSpecifier &storage, ara::per::RecoveryReportKind recoveryReportKind, ara::core::Vector< ara::core::String > reported Elements, ara::core::Vector< std::uint8_t > reportedInstances)> recoveryReportCallback) noexcept;` | |
| ***Parameters (in):*** | recoveryReportCallback | The callback function to be called by Persistency to report errors in the stored data that were corrected using the available redundancy. The function will be called with the shortName path of the affected Key-Value Storage or File Storage in storage and information on what has been corrected, placed in the parameters recoveryReport Kind, reportedElements, and reportedInstances. |
| ***Return value:*** | None | |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | not thread-safe | |
| ***Description:*** | Register a recovery reporting callback with Persistency.<br>This callback can be used in safety-aware Adaptive Applications to detect actions of the Persistency that are related to the correctness of the persisted data and the reliability of the storage. | |

⌋

## 8.10 Header: ara/per/shared_handle.h

### 8.10.1 Class: SharedHandle

**[SWS_PER_00362] Definition of API class ara::per::SharedHandle**

*Upstream requirements:* RS_PER_00002, RS_AP_00122, RS_AP_00140

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| | | |
|---|---|---|
| ***Kind:*** | class | |
| ***Header file:*** | #include "ara/per/shared_handle.h" | |
| ***Forwarding header file:*** | #include "ara/per/per_fwd.h" | |
| ***Scope:*** | namespace ara::per | |
| ***Symbol:*** | SharedHandle | |
| ***Syntax:*** | `template <typename T>`<br>`class SharedHandle final {...};` | |
| ***Template param:*** | typename T | -- |
| ***Description:*** | Handle to a File Storage or Key-Value Storage.<br>A SharedHandle is returned by the functions OpenFileStorage() and OpenKeyValueStorage() and can be passed between threads as needed.<br>It provides the abstraction that is necessary to allow thread-safe implementation of OpenFile Storage() and OpenKeyValueStorage(). | |

⌋

#### 8.10.1.1 Public Member Functions

##### 8.10.1.1.1 Special Member Functions

###### 8.10.1.1.1.1 Move Constructor

**[SWS_PER_00367] Definition of API function ara::per::SharedHandle::SharedHandle**

*Upstream requirements:* RS_PER_00004, RS_AP_00120, RS_AP_00121, RS_AP_00129, RS_AP_00135, RS_AP_00145, RS_AP_00159

⌈

| | | |
|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/shared_handle.h" | |
| ***Scope:*** | `class ara::per::SharedHandle` | |
| ***Syntax:*** | `SharedHandle (SharedHandle &&sh) noexcept;` | |
| ***Parameters (in):*** | sh | The SharedHandle object to be moved. |
| ***Exception Safety:*** | exception safe | |
| ***Description:*** | Move constructor for SharedHandle.<br>The source handle object is invalidated and cannot be used anymore.<br>The operator bool() shall be used to check the state of a handle object before using any other operators of the handle object. | |

⌋

#### 8.10.1.1.1.2 Copy Constructor

**[SWS_PER_00369] Definition of API function ara::per::SharedHandle::SharedHandle**

*Upstream requirements:* RS_PER_00004, RS_AP_00120, RS_AP_00121, RS_AP_00129, RS_AP_00135, RS_AP_00145, RS_AP_00159

⌈

| | | |
|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/shared_handle.h" | |
| ***Scope:*** | `class ara::per::SharedHandle` | |
| ***Syntax:*** | `SharedHandle (const SharedHandle &sh) noexcept;` | |
| ***Parameters (in):*** | sh | The SharedHandle object to be copied. |
| ***Exception Safety:*** | exception safe | |
| ***Description:*** | Copy constructor for SharedHandle. | |

⌋

#### 8.10.1.1.1.3 Copy Assignment Operator

**[SWS_PER_00370] Definition of API function ara::per::SharedHandle::operator=**

*Upstream requirements:* RS_PER_00004, RS_AP_00119, RS_AP_00120, RS_AP_00121, RS_AP_00135, RS_AP_00145, RS_AP_00153, RS_AP_00159

⌈

| | | |
|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/shared_handle.h" | |
| ***Scope:*** | `class ara::per::SharedHandle` | |
| ***Syntax:*** | `SharedHandle & operator= (const SharedHandle &sh) & noexcept;` | |
| ***Parameters (in):*** | sh | The SharedHandle object to be copied. |
| ***Return value:*** | SharedHandle & | The copied SharedHandle object. |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | not thread-safe | |
| ***Description:*** | Copy assignment operator for SharedHandle. | |

⌋

#### 8.10.1.1.1.4 Move Assignment Operator

**[SWS_PER_00368] Definition of API function ara::per::SharedHandle::operator=**

*Upstream requirements:* RS_PER_00004, RS_AP_00119, RS_AP_00120, RS_AP_00121, RS_AP_00135, RS_AP_00145, RS_AP_00153, RS_AP_00159

⌈

| | | |
|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/shared_handle.h" | |
| ***Scope:*** | `class ara::per::SharedHandle` | |
| ***Syntax:*** | `SharedHandle & operator= (SharedHandle &&sh) & noexcept;` | |
| ***Parameters (in):*** | sh | The SharedHandle object to be moved. |
| ***Return value:*** | SharedHandle & | The moved SharedHandle object. |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | not thread-safe | |
| ***Description:*** | Move assignment operator for SharedHandle.<br>The source handle object is invalidated and cannot be used anymore.<br>The operator bool() shall be used to check the state of a handle object before using any other operators of the handle object. | |

⌋

#### 8.10.1.1.1.5 Destructor

**[SWS_PER_00568] Definition of API function ara::per::SharedHandle::~SharedHandle**

*Upstream requirements:* RS_PER_00004, RS_AP_00120, RS_AP_00129, RS_AP_00134, RS_AP_00145, RS_AP_00159

⌈

| | |
|---|---|
| ***Kind:*** | function |
| ***Header file:*** | #include "ara/per/shared_handle.h" |
| ***Scope:*** | `class ara::per::SharedHandle` |
| ***Syntax:*** | `~SharedHandle () noexcept;` |
| ***Exception Safety:*** | exception safe |
| ***Thread Safety:*** | not thread-safe |
| ***Description:*** | Destructor for SharedHandle. |

⌋

#### 8.10.1.1.2 Member Functions

##### 8.10.1.1.2.1 operator bool

**[SWS_PER_00398] Definition of API function ara::per::SharedHandle::operator bool**

*Upstream requirements:* RS_PER_00001, RS_PER_00002, RS_PER_00003, RS_AP_00119, RS_AP_00129, RS_AP_00159

⌈

| | | |
|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/shared_handle.h" | |
| ***Scope:*** | `class ara::per::SharedHandle` | |
| ***Syntax:*** | `explicit operator bool () const noexcept;` | |
| ***Return value:*** | bool | False if the handle is empty, otherwise true. |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | thread-safe | |
| ***Description:*** | Handle state.<br>True if the handle represents a valid object of the templated class, False if the handle is empty (e.g. after a move operation).<br>Using other operators than bool() of an empty handle will result in undefined behavior. | |

⌋

##### 8.10.1.1.2.2 operator*

**[SWS_PER_00403] Definition of API function ara::per::SharedHandle::operator***

*Upstream requirements:* RS_PER_00001, RS_PER_00002, RS_PER_00003, RS_AP_00119, RS_AP_00129, RS_AP_00159

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| | | |
|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/shared_handle.h" | |
| ***Scope:*** | `class ara::per::SharedHandle` | |
| ***Syntax:*** | `const T & operator* () const noexcept;` | |
| ***Return value:*** | const T & | A constant reference to the SharedHandle object. |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | thread-safe | |
| ***Description:*** | Constant dereference operator. | |

⌋

#### 8.10.1.1.2.3 operator*

**[SWS_PER_00402] Definition of API function ara::per::SharedHandle::operator***

*Upstream requirements:* RS_PER_00001, RS_PER_00002, RS_PER_00003, RS_AP_00119, RS_AP_00129, RS_AP_00159

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| | | |
|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/shared_handle.h" | |
| ***Scope:*** | `class ara::per::SharedHandle` | |
| ***Syntax:*** | `T & operator* () noexcept;` | |
| ***Return value:*** | T & | A reference to the SharedHandle object. |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | thread-safe | |
| ***Description:*** | Non-constant dereference operator. | |

⌋

#### 8.10.1.1.2.4 operator->

**[SWS_PER_00363] Definition of API function ara::per::SharedHandle::operator->**

*Upstream requirements:* RS_PER_00001, RS_PER_00002, RS_PER_00003, RS_AP_00119, RS_AP_00129, RS_AP_00159

⌈

| | | |
|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/shared_handle.h" | |
| ***Scope:*** | `class ara::per::SharedHandle` | |
| ***Syntax:*** | `T * operator-> () noexcept;` | |
| ***Return value:*** | T * | A pointer to the SharedHandle object. |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | thread-safe | |
| ***Description:*** | Non-constant arrow operator. | |

⌋

#### 8.10.1.1.2.5 operator->

### [SWS_PER_00364] Definition of API function ara::per::SharedHandle::operator->

*Upstream requirements:* RS_PER_00001, RS_PER_00002, RS_PER_00003, RS_AP_00119, RS_AP_00129, RS_AP_00159

⌈

| | | |
|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/shared_handle.h" | |
| ***Scope:*** | `class ara::per::SharedHandle` | |
| ***Syntax:*** | `const T * operator-> () const noexcept;` | |
| ***Return value:*** | const T * | A constant pointer to the SharedHandle object. |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | thread-safe | |
| ***Description:*** | Constant arrow operator. | |

⌋

## 8.11 Header: ara/per/unique_handle.h

### 8.11.1 Class: UniqueHandle

### [SWS_PER_00359] Definition of API class ara::per::UniqueHandle

*Upstream requirements:* RS_PER_00002, RS_AP_00122, RS_AP_00140

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| | | |
|---|---|---|
| ***Kind:*** | class | |
| ***Header file:*** | #include "ara/per/unique_handle.h" | |
| ***Forwarding header file:*** | #include "ara/per/per_fwd.h" | |
| ***Scope:*** | namespace ara::per | |
| ***Symbol:*** | UniqueHandle | |
| ***Syntax:*** | `template <typename T>`<br>`class UniqueHandle final {...};` | |
| ***Template param:*** | typename T | -- |
| ***Description:*** | Handle to a ReadAccessor or ReadWriteAccessor.<br>A UniqueHandle is returned by the functions OpenFileReadOnly(), OpenFileWriteOnly(), and OpenFileReadWrite(). | |

⌋

#### 8.11.1.1 Public Member Functions

##### 8.11.1.1.1 Special Member Functions

###### 8.11.1.1.1.1 Move Constructor

**[SWS_PER_00371] Definition of API function ara::per::UniqueHandle::UniqueHandle**

*Upstream requirements:* RS_PER_00002, RS_AP_00120, RS_AP_00121, RS_AP_00129, RS_AP_00135, RS_AP_00145, RS_AP_00159

⌈

| | | |
|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/unique_handle.h" | |
| ***Scope:*** | `class ara::per::UniqueHandle` | |
| ***Syntax:*** | `UniqueHandle (UniqueHandle &&uh) noexcept;` | |
| ***Parameters (in):*** | uh | The UniqueHandle object to be moved. |
| ***Exception Safety:*** | exception safe | |
| ***Description:*** | Move constructor for UniqueHandle.<br>The source handle object is invalidated and cannot be used anymore.<br>The operator bool() shall be used to check the state of a handle object before using any other operators of the handle object. | |

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###### 8.11.1.1.1.2 Copy Constructor

**[SWS_PER_00373] Definition of API function ara::per::UniqueHandle::UniqueHandle**

*Upstream requirements:* RS_PER_00002, RS_AP_00120, RS_AP_00145

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| | |
|---|---|
| ***Kind:*** | function |
| ***Header file:*** | #include "ara/per/unique_handle.h" |
| ***Scope:*** | `class ara::per::UniqueHandle` |
| ***Syntax:*** | `UniqueHandle (const UniqueHandle &)=delete;` |
| ***Description:*** | The copy constructor for UniqueHandle shall not be used. |

⌋

#### 8.11.1.1.1.3 Copy Assignment Operator

**[SWS_PER_00374] Definition of API function ara::per::UniqueHandle::operator=**

*Upstream requirements:* RS_PER_00002, RS_AP_00120, RS_AP_00145

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| | |
|---|---|
| ***Kind:*** | function |
| ***Header file:*** | #include "ara/per/unique_handle.h" |
| ***Scope:*** | `class ara::per::UniqueHandle` |
| ***Syntax:*** | `UniqueHandle & operator= (const UniqueHandle &)=delete;` |
| ***Description:*** | The copy assignment operator for UniqueHandle shall not be used. |

⌋

#### 8.11.1.1.1.4 Move Assignment Operator

**[SWS_PER_00372] Definition of API function ara::per::UniqueHandle::operator=**

*Upstream requirements:* RS_PER_00002, RS_AP_00119, RS_AP_00120, RS_AP_00121, RS_AP_00135, RS_AP_00145, RS_AP_00153, RS_AP_00159

⌈

| | | |
|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/unique_handle.h" | |
| ***Scope:*** | `class ara::per::UniqueHandle` | |
| ***Syntax:*** | `UniqueHandle & operator= (UniqueHandle &&uh) & noexcept;` | |
| ***Parameters (in):*** | uh | The UniqueHandle object to be moved. |
| ***Return value:*** | UniqueHandle & | The moved UniqueHandle object. |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | not thread-safe | |
| ***Description:*** | Move assignment operator for UniqueHandle.<br>The source handle object is invalidated and cannot be used anymore.<br>The operator bool() shall be used to check the state of a handle object before using any other operators of the handle object. | |

⌋

#### 8.11.1.1.1.5 Destructor

**[SWS_PER_00569] Definition of API function ara::per::UniqueHandle::~UniqueHandle**

*Upstream requirements:* RS_PER_00002, RS_AP_00120, RS_AP_00129, RS_AP_00134, RS_AP_00145, RS_AP_00159

⌈

| | |
|---|---|
| ***Kind:*** | function |
| ***Header file:*** | #include "ara/per/unique_handle.h" |
| ***Scope:*** | `class ara::per::UniqueHandle` |
| ***Syntax:*** | `~UniqueHandle () noexcept;` |
| ***Exception Safety:*** | exception safe |
| ***Thread Safety:*** | not thread-safe |
| ***Description:*** | Destructor for UniqueHandle. |

⌋

### 8.11.1.1.2 Member Functions

#### 8.11.1.1.2.1 operator bool

**[SWS_PER_00399] Definition of API function ara::per::UniqueHandle::operator bool**

*Upstream requirements:* RS_PER_00001, RS_PER_00002, RS_PER_00003, RS_AP_00119, RS_AP_00129, RS_AP_00159

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| | | |
|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/unique_handle.h" | |
| ***Scope:*** | `class ara::per::UniqueHandle` | |
| ***Syntax:*** | `explicit operator bool () const noexcept;` | |
| ***Return value:*** | bool | False if the handle is empty, otherwise true. |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | thread-safe | |
| ***Description:*** | Handle state.<br>True if the handle represents a valid object of the templated class, False if the handle is empty (e.g. after a move operation).<br>Using other operators than bool() of an empty handle will result in undefined behavior. | |

⌋

#### 8.11.1.1.2.2 operator*

### [SWS_PER_00401] Definition of API function ara::per::UniqueHandle::operator*

*Upstream requirements:* RS_PER_00001, RS_PER_00002, RS_PER_00003, RS_AP_00119, RS_AP_00129, RS_AP_00159

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| | | |
|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/unique_handle.h" | |
| ***Scope:*** | `class ara::per::UniqueHandle` | |
| ***Syntax:*** | `const T & operator* () const noexcept;` | |
| ***Return value:*** | const T & | A constant reference to the UniqueHandle object. |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | thread-safe | |
| ***Description:*** | Constant dereference operator. | |

⌋

#### 8.11.1.1.2.3 operator*

### [SWS_PER_00400] Definition of API function ara::per::UniqueHandle::operator*

*Upstream requirements:* RS_PER_00001, RS_PER_00002, RS_PER_00003, RS_AP_00119, RS_AP_00129, RS_AP_00159

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| | | |
|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/unique_handle.h" | |
| ***Scope:*** | `class ara::per::UniqueHandle` | |
| ***Syntax:*** | `T & operator* () noexcept;` | |
| ***Return value:*** | T & | A reference to the UniqueHandle object. |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | thread-safe | |
| ***Description:*** | Non-constant dereference operator. | |

⌋

#### 8.11.1.1.2.4 operator->

**[SWS_PER_00360] Definition of API function ara::per::UniqueHandle::operator->**

*Upstream requirements:* RS_PER_00001, RS_PER_00002, RS_PER_00003, RS_AP_00119, RS_AP_00129, RS_AP_00159

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| | | |
|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/unique_handle.h" | |
| ***Scope:*** | `class ara::per::UniqueHandle` | |
| ***Syntax:*** | `T * operator-> () noexcept;` | |
| ***Return value:*** | T * | A pointer to the UniqueHandle object. |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | thread-safe | |
| ***Description:*** | Non-constant arrow operator. | |

⌋

#### 8.11.1.1.2.5 operator->

**[SWS_PER_00361] Definition of API function ara::per::UniqueHandle::operator->**

*Upstream requirements:* RS_PER_00001, RS_PER_00002, RS_PER_00003, RS_AP_00119, RS_AP_00129, RS_AP_00159

⌈

| | | |
|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/unique_handle.h" | |
| ***Scope:*** | `class ara::per::UniqueHandle` | |
| ***Syntax:*** | `const T * operator-> () const noexcept;` | |
| ***Return value:*** | const T * | A constant pointer to the UniqueHandle object. |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | thread-safe | |
| ***Description:*** | Constant arrow operator. | |

⌋

## 8.12 Header: ara/per/update.h

### 8.12.1 Non-Member Functions

#### 8.12.1.1 Other

##### 8.12.1.1.1 CheckForManifestUpdate

**[SWS_PER_00576] Definition of API function ara::per::CheckForManifestUpdate**

*Upstream requirements:* RS_PER_00013, RS_AP_00119, RS_AP_00120, RS_AP_00127, RS_AP_00128, RS_AP_00135, RS_AP_00139, RS_AP_00159

⌈

| | | |
|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/update.h" | |
| ***Scope:*** | namespace ara::per | |
| ***Syntax:*** | `ara::core::Result< bool > CheckForManifestUpdate () noexcept;` | |
| ***Return value:*** | ara::core::Result< bool > | A Result containing true if the `Target Configuration` was updated or false if it is unchanged since the last time the `Target Configuration` was read. In case of an error, it contains any of the errors defined below, or a vendor specific error. |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | not thread-safe | |
| ***Errors:*** | `kPhysicalStorageFailure` | rollback_semantics |
| | | Returned if access to the `physical storage` fails during the checking operation. |
| | `kIntegrityCorrupted` | rollback_semantics |
| | | Returned if stored data cannot be read because the structural integrity is corrupted. |
| ***Description:*** | Checks for updates of the `Persistency Target Configuration`.<br>This method can be used to detect configuration updates that are installed by UCM while the `Adaptive Application` that uses `Persistency` is running. To re-read the updated `Target Configuration`, the `Adaptive Application` needs to call `ara::per::ReloadPersistencyManifest`. | |

⌋

##### 8.12.1.1.2 CleanUpPersistency

**[SWS_PER_00567] Definition of API function ara::per::CleanUpPersistency**

*Upstream requirements:* RS_PER_00016, RS_AP_00119, RS_AP_00120, RS_AP_00127, RS_AP_00128, RS_AP_00135, RS_AP_00139, RS_AP_00159

⌈

| | |
|---|---|
| ***Kind:*** | function |
| ***Header file:*** | #include "ara/per/update.h" |
| ***Scope:*** | namespace ara::per |
| ***Syntax:*** | `ara::core::Result< void > CleanUpPersistency () noexcept;` |

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| | | |
|---|---|---|
| ***Return value:*** | ara::core::Result< void > | A Result of void. In case of an error, it contains any of the errors defined below, or a vendor specific error. |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | not thread-safe | |
| ***Errors:*** | `kPhysicalStorageFailure` | rollback_semantics |
| | | Returned if access to the `physical storage` fails during the update operation. |
| | `kIntegrityCorrupted` | rollback_semantics |
| | | Returned if stored data cannot be read because the structural integrity is corrupted. |
| | `kValidationFailed` | rollback_semantics |
| | | Returned if the validity of stored data cannot be ensured. |
| | `kEncryptionFailed` | rollback_semantics |
| | | Returned if the encryption or decryption of stored data fails during the update operation. |
| | `kResourceBusy` | rollback_semantics |
| | | Returned if `ara::per::UpdatePersistency` or `ara::per::ResetPersistency` is currently being executed, or if `ara::per::RecoverKeyValueStorage` or `ara::per::ResetKeyValueStorage` is currently being executed for any `Key-Value Storage`, or if `ara::per::RecoverAllFiles` or `ara::per::ResetAllFiles` is currently being executed for any `File Storage`, or a `ara::per::SharedHandle` of a `Key-Value Storage` or a `File Storage` is currently in use. |
| | `kAuthenticationFailed` | rollback_semantics |
| | | Returned if calculating or checking the `MAC` of stored data fails. |
| ***Description:*** | Removes backup data and other unused data of all `Persistency Key-Value Storages` and `File Storages`. | |

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### 8.12.1.1.3 RegisterApplicationDataUpdateCallback

### [SWS_PER_00356] Definition of API function ara::per::RegisterApplicationDataUpdateCallback

*Upstream requirements:* RS_PER_00013, RS_AP_00120, RS_AP_00121, RS_AP_00127, RS_AP_00135, RS_AP_00137, RS_AP_00159

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| | |
|---|---|
| ***Kind:*** | function |
| ***Header file:*** | #include "ara/per/update.h" |
| ***Scope:*** | namespace ara::per |
| ***Syntax:*** | `void RegisterApplicationDataUpdateCallback (std::function< void(const ara::core::InstanceSpecifier &storage, ara::core::String contractVersion)> appDataUpdateCallback) noexcept;` |

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| | | |
|---|---|---|
| ***Parameters (in):*** | appDataUpdateCallback | The callback function to be called by `Persistency` after an update of persistent data took place. The function will be called with the `shortName` path of an updated `Key-Value Storage` or `File Storage`, and with the `contract version` with which the `Persistency` was last accessed. |
| ***Return value:*** | None | |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | not thread-safe | |
| ***Description:*** | Registers an application data update callback with `Persistency`.<br>The provided callback function will be called by `Persistency` if an update of stored application data might be necessary. This decision is based on the `contract versions`.<br>The `contract version` that last accessed `Persistency` is provided as an argument to the callback, as well as the `ara::core::InstanceSpecifier` referring to the updated `Key-Value Storage` or `File Storage`. Based on this information, the `Adaptive Application` can decide which updates are actually necessary, e.g. a migration from any older `contract version` could be supported, with different steps required for each of these.<br>The provided function will be called from the context of `ara::per::UpdatePersistency`, `ara::per::OpenKeyValueStorage`, or `ara::per::OpenFileStorage`. | |

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#### 8.12.1.1.4 RegisterDataUpdateIndication

### [SWS_PER_00578] Definition of API function ara::per::RegisterDataUpdateIndication

*Upstream requirements:* RS_PER_00013, RS_AP_00120, RS_AP_00121, RS_AP_00127, RS_AP_00135, RS_AP_00137, RS_AP_00159

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| | | |
|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/update.h" | |
| ***Scope:*** | namespace ara::per | |
| ***Syntax:*** | `void RegisterDataUpdateIndication (std::function< void(const ara::core::InstanceSpecifier &updatedStorage, ara::core::StringView updatedElement)> dataUpdateIndication, ara::core::InstanceSpecifier monitoredStorage, ara::core::Vector< ara::core::String > monitoredElements) noexcept;` | |
| ***Parameters (in):*** | dataUpdateIndication | The callback function to be called by `Persistency` after an update of persistent data took place. The function will be called with the `shortName` path of an updated `Key-Value Storage` or `File Storage`, and with the the updated `elements` of the `storage`. |
| | monitoredStorage | A `Key-Value Storage` or `File Storage` for which updates shall be reported. |
| | monitoredElements | A set of `elements` for which updates shall be reported. |
| ***Return value:*** | None | |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | not thread-safe | |
| ***Description:*** | Registers a data update indication callback with `Persistency`.<br>The provided callback function will be called by `Persistency` when an update of stored data happened. It will be called from the context of `ara::per::UpdatePersistency`, `ara::per::OpenKeyValueStorage`, or `ara::per::OpenFileStorage`. | |

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#### 8.12.1.1.5 ReloadPersistencyManifest

### [SWS_PER_00577] Definition of API function ara::per::ReloadPersistencyManifest

*Upstream requirements:* RS_PER_00013, RS_AP_00119, RS_AP_00120, RS_AP_00127, RS_AP_00128, RS_AP_00135, RS_AP_00139, RS_AP_00159

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| | | |
|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/update.h" | |
| ***Scope:*** | namespace ara::per | |
| ***Syntax:*** | `ara::core::Result< void > ReloadPersistencyManifest () noexcept;` | |
| ***Return value:*** | ara::core::Result< void > | A Result of void. In case of an error, it contains any of the errors defined below, or a vendor specific error. |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | not thread-safe | |
| ***Errors:*** | `kPhysicalStorageFailure` | rollback_semantics |
| | | Returned if access to the `physical storage` fails during the read operation. |
| | `kIntegrityCorrupted` | rollback_semantics |
| | | Returned if stored data cannot be read because the structural integrity is corrupted. |
| ***Description:*** | Re-reads the `Target Configuration`.<br>This method can be used to prepare for updates of the `Key-Value Storages` and `File Storages` of `Persistency` after a new `Target Configuration` was installed by UCM while the `Adaptive Application` that uses `Persistency` is running. `Storages` are only updated after closing them, either when they are opened again or by an explicit call to `ara::per::UpdatePersistency`. | |

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#### 8.12.1.1.6 ResetPersistency

### [SWS_PER_00358] Definition of API function ara::per::ResetPersistency

*Upstream requirements:* RS_PER_00009, RS_AP_00119, RS_AP_00120, RS_AP_00127, RS_AP_00128, RS_AP_00135, RS_AP_00139, RS_AP_00159

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| | | |
|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/update.h" | |
| ***Scope:*** | namespace ara::per | |
| ***Syntax:*** | `ara::core::Result< void > ResetPersistency () noexcept;` | |
| ***Return value:*** | ara::core::Result< void > | A Result of void. In case of an error, it contains any of the errors defined below, or a vendor specific error. |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | not thread-safe | |
| ***Errors:*** | `kPhysicalStorageFailure` | no_rollback_semantics |
| | | Returned if access to the `physical storage` fails during the reset operation. |

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| | | |
|---|---|---|
| | kResourceBusy | rollback_semantics |
| | | Returned if ara::per::UpdatePersistency or ara::per::CleanUpPersistency is currently being executed, or if ara::per::RecoverKeyValueStorage or ara::per::ResetKeyValueStorage is currently being executed for any Key-Value Storage, or if ara::per::RecoverAllFiles or ara::per::ResetAllFiles is currently being executed for any File Storage, or a ara::per::SharedHandle of a Key-Value Storage or a File Storage is currently in use. |
| ***Description:*** | Resets all Key-Value Storages and File Storages by entirely removing their content. The Key-Value Storages and File Storages will be re-created when ara::per::OpenFileStorage or ara::per::OpenKeyValueStorage is called next time. | |

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### 8.12.1.1.7 UpdatePersistency

### [SWS_PER_00357] Definition of API function ara::per::UpdatePersistency

*Upstream requirements:* RS_PER_00013, RS_AP_00119, RS_AP_00120, RS_AP_00127, RS_AP_00128, RS_AP_00135, RS_AP_00139, RS_AP_00159

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| | | |
|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/update.h" | |
| ***Scope:*** | namespace ara::per | |
| ***Syntax:*** | ara::core::Result< void > UpdatePersistency () noexcept; | |
| ***Return value:*** | ara::core::Result< void > | A Result of void. In case of an error, it contains any of the errors defined below, or a vendor specific error. |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | not thread-safe | |
| ***Errors:*** | kPhysicalStorage-Failure | no_rollback_semantics |
| | | Returned if access to the physical storage fails during the update operation. |
| | kIntegrityCor-rupted | rollback_semantics |
| | | Returned if stored data cannot be read because the structural integrity is corrupted. |
| | kValidationFailed | rollback_semantics |
| | | Returned if the validity of stored data cannot be ensured. |
| | kEncryptionFailed | rollback_semantics |
| | | Returned if the encryption or decryption of stored data fails during the update operation. |
| | kResourceBusy | rollback_semantics |

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| | | |
|---|---|---|
| | | Returned if `ara::per::CleanUpPersistency` or `ara::per::ResetPersistency` is currently being executed, or if `ara::per::RecoverKeyValueStorage` or `ara::per::ResetKeyValueStorage` is currently being executed for any `Key-Value Storage`, or if `ara::per::RecoverAllFiles` or `ara::per::ResetAllFiles` is currently being executed for any `File Storage`, or a `ara::per::SharedHandle` of a `Key-Value Storage` or a `File Storage` is currently in use. |
| | `kOutOfStorageSpace` | no_rollback_semantics |
| | | Returned if the available `physical storage` space is insufficient for the update. |
| | `kTooManyFiles` | rollback_semantics |
| | | Returned if the files added during the update of any `File Storage` would exceed the configured `PersistencyFileStorageInterface.maxNumberOfFiles`. |
| | `kQuotaExceeded` | rollback_semantics |
| | | Returned if the update would exceed the configured `PersistencyCommon.MaximumAllowedSize` of any `Key-Value Storage` or `File Storage`. |
| | `kAuthentication-Failed` | rollback_semantics |
| | | Returned if calculating or checking the `MAC` of stored data fails. |
| ***Description:*** | Updates all `Persistency Key-Value Storages` and `File Storages` after a new `Target Configuration` was installed.<br>This method can be used to update the persistent data of the `Adaptive Application` during verification phase. | |

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## 8.13 Header: ara/per/write_accessor.h

### 8.13.1 Class: WriteAccessor

### [SWS_PER_00595] Definition of API class ara::per::WriteAccessor

*Upstream requirements:* RS_PER_00004, RS_AP_00122, RS_AP_00146

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| | |
|---|---|
| ***Kind:*** | class |
| ***Header file:*** | #include "ara/per/write_accessor.h" |
| ***Forwarding header file:*** | #include "ara/per/per_fwd.h" |
| ***Scope:*** | namespace ara::per |
| ***Symbol:*** | WriteAccessor |
| ***Base class:*** | FileAccessor |
| ***Syntax:*** | `class WriteAccessor final : public virtual FileAccessor {...};` |
| ***Description:*** | WriteAccessor is used to write file data.<br>It provides the WriteBinary and WriteText methods featuring a Result for controlled, unformatted writing, and the operator<< method for simple formatted writing. It also provides SyncToFile() to flush the buffer of the operating system to the physical storage. |

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#### 8.13.1.1 Public Member Functions

##### 8.13.1.1.1 Special Member Functions

###### 8.13.1.1.1.1 Default Constructor

**[SWS_PER_00596] Definition of API function ara::per::WriteAccessor::WriteAccessor**

*Upstream requirements:* RS_PER_00004, RS_AP_00120, RS_AP_00129, RS_AP_00146

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| | |
|---|---|
| ***Kind:*** | function |
| ***Header file:*** | #include "ara/per/write_accessor.h" |
| ***Scope:*** | `class ara::per::WriteAccessor` |
| ***Syntax:*** | `WriteAccessor ()=delete;` |
| ***Description:*** | The default constructor for WriteAccessor shall not be used. |

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###### 8.13.1.1.1.2 Destructor

**[SWS_PER_00597] Definition of API function ara::per::WriteAccessor::~WriteAccessor**

*Upstream requirements:* RS_PER_00004, RS_AP_00120, RS_AP_00129, RS_AP_00134, RS_AP_00145, RS_AP_00159

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| | |
|---|---|
| ***Kind:*** | function |
| ***Header file:*** | #include "ara/per/write_accessor.h" |
| ***Scope:*** | `class ara::per::WriteAccessor` |
| ***Syntax:*** | `~WriteAccessor () override noexcept;` |
| ***Exception Safety:*** | exception safe |
| ***Thread Safety:*** | not thread-safe |
| ***Description:*** | Destructor for WriteAccessor. |

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#### 8.13.1.1.2 Member Functions

##### 8.13.1.1.2.1 SetFileSize

**[SWS_PER_00428] Definition of API function ara::per::WriteAccessor::SetFileSize**

*Upstream requirements:* RS_PER_00001, RS_PER_00004, RS_AP_00119, RS_AP_00120, RS_AP_00128, RS_AP_00127, RS_AP_00129, RS_AP_00135, RS_AP_00139, RS_AP_00159

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| | | |
|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/write_accessor.h" | |
| ***Scope:*** | `class ara::per::WriteAccessor` | |
| ***Syntax:*** | `ara::core::Result< void > SetFileSize (std::uint64_t size) noexcept;` | |
| ***Parameters (in):*** | size | New size of the file. |
| ***Return value:*** | ara::core::Result< void > | A Result of void. In case of an error, it contains any of the errors defined below, or a vendor specific error. |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | not thread-safe | |
| ***Errors:*** | PerErrc::kPhysical StorageFailure | no_rollback_semantics |
| | | Returned if access to the physical storage fails. |
| | PerErrc::kValidation Failed | rollback_semantics |
| | | Returned if the validity of stored data cannot be ensured. |
| | PerErrc::kEncryption Failed | rollback_semantics |
| | | Returned if the encryption or decryption of stored data fails. |
| | PerErrc::kInvalidSize | rollback_semantics |
| | | Returned if the new size is larger than the current size. |
| | PerErrc::kAuthentication Failed | rollback_semantics |
| | | Returned if calculating or checking the MAC of stored data fails. |
| ***Description:*** | Reduces the size of the file to 'size', effectively removing the current content of the file beyond this size.<br>The current file position is unchanged if it is lower than 'size', or set to the last valid position in the file otherwise. If 'size' is 0, the current file position will also be set to 0. | |

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#### 8.13.1.1.2.2 SyncToFile

### [SWS_PER_00122] Definition of API function ara::per::WriteAccessor::SyncToFile

*Upstream requirements:* RS_PER_00001, RS_PER_00004, RS_AP_00119, RS_AP_00120, RS_AP_00128, RS_AP_00127, RS_AP_00129, RS_AP_00135, RS_AP_00139, RS_AP_00159

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| | | |
|---|---|---|
| ***Kind:*** | function | |
| ***Header file:*** | #include "ara/per/write_accessor.h" | |
| ***Scope:*** | `class ara::per::WriteAccessor` | |
| ***Syntax:*** | `ara::core::Result< void > SyncToFile () noexcept;` | |
| ***Return value:*** | ara::core::Result< void > | A Result of void. In case of an error, it contains any of the errors defined below, or a vendor specific error. |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | not thread-safe | |
| ***Errors:*** | PerErrc::kPhysical StorageFailure | no_rollback_semantics |
| | | Returned if access to the physical storage fails. |
| | PerErrc::kEncryption Failed | rollback_semantics |
| | | Returned if the encryption of stored data fails. |
| | PerErrc::kOutOfStorage Space | no_rollback_semantics |
| | | Returned if the available physical storage space is insufficient for the changed file. |
| | PerErrc::kQuota Exceeded | rollback_semantics |
| | | Returned if the changed file would exceed the configured maximum AllowedSize of the File Storage. |
| | PerErrc::kAuthentication Failed | rollback_semantics |
| | | Returned if calculating the MAC of stored data fails. |
| ***Description:*** | Flushes the current file content to the physical storage. | |

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#### 8.13.1.1.2.3 WriteBinary

### [SWS_PER_00423] Definition of API function ara::per::WriteAccessor::WriteBinary

*Upstream requirements:* RS_PER_00001, RS_PER_00004, RS_AP_00119, RS_AP_00120, RS_AP_00121, RS_AP_00127, RS_AP_00135, RS_AP_00139, RS_AP_00159

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| | |
|---|---|
| ***Kind:*** | function |
| ***Header file:*** | #include "ara/per/write_accessor.h" |
| ***Scope:*** | `class ara::per::WriteAccessor` |

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| | | |
|---|---|---|
| ***Syntax:*** | `ara::core::Result< void > WriteBinary (ara::core::Span< const ara::core::Byte > b) noexcept;` | |
| ***Parameters (in):*** | b | A Span of Byte containing the bytes to be written. |
| ***Return value:*** | ara::core::Result< void > | A Result of void. In case of an error, it contains any of the errors defined below, or a vendor specific error. |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | not thread-safe | |
| ***Errors:*** | PerErrc::kPhysical StorageFailure | no_rollback_semantics |
| | | Returned if access to the physical storage fails. |
| | PerErrc::kValidation Failed | rollback_semantics |
| | | Returned if the validity of stored data cannot be ensured. |
| | PerErrc::kEncryption Failed | rollback_semantics |
| | | Returned if the encryption or decryption of stored data fails. |
| | PerErrc::kOutOfStorage Space | no_rollback_semantics |
| | | Returned if the available physical storage space is insufficient for the changed file. |
| | PerErrc::kQuota Exceeded | rollback_semantics |
| | | Returned if the changed file would exceed the configured maximum AllowedSize of the File Storage. |
| | PerErrc::kAuthentication Failed | rollback_semantics |
| | | Returned if calculating or checking the MAC of stored data fails. |
| ***Description:*** | Writes the content of a Span of Byte to the file.<br>The time when the content is persisted depends on the implementation of Persistency. SyncTo File can be used to force Persistency to persist the file content.<br>In case of an error, the file content might be corrupted, and the current position might or might not have changed.<br>The expected state of the file for each supported error can be expected to be as follows:<br>• kPhysicalStorageFailure: The state of the file is unknown. It could have been entirely destroyed.<br>• kEncryptionFailed: The content of the file and the current position will have been updated, but could not be persisted. The persisted file will reflect an older version of the file.<br>• kOutOfStorageSpace: The content of the file will have been updated, but the part of the operation that exceeded the quota will have been discarded. The current position will be at the end of the file. | |

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### 8.13.1.1.2.4 WriteText

**[SWS_PER_00166] Definition of API function ara::per::WriteAccessor::WriteText**

*Upstream requirements:* RS_PER_00001, RS_PER_00004, RS_AP_00119, RS_AP_00120, RS_AP_00121, RS_AP_00127, RS_AP_00135, RS_AP_00136, RS_AP_00139, RS_AP_00159

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| | |
|---|---|
| ***Kind:*** | function |
| ***Header file:*** | #include "ara/per/write_accessor.h" |
| ***Scope:*** | `class ara::per::WriteAccessor` |

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| | | |
|---|---|---|
| ***Syntax:*** | `ara::core::Result< void > WriteText (ara::core::StringView s) noexcept;` | |
| ***Parameters (in):*** | s | A StringView containing the characters to be written. |
| ***Return value:*** | ara::core::Result< void > | A Result of void. In case of an error, it contains any of the errors defined below, or a vendor specific error. |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | not thread-safe | |
| ***Errors:*** | PerErrc::kPhysical StorageFailure | no_rollback_semantics |
| | | Returned if access to the physical storage fails. |
| | PerErrc::kValidation Failed | rollback_semantics |
| | | Returned if the validity of stored data cannot be ensured. |
| | PerErrc::kEncryption Failed | rollback_semantics |
| | | Returned if the encryption or decryption of stored data fails. |
| | PerErrc::kOutOfStorage Space | no_rollback_semantics |
| | | Returned if the available physical storage space is insufficient for the changed file. |
| | PerErrc::kQuota Exceeded | rollback_semantics |
| | | Returned if the changed file would exceed the configured maximum AllowedSize of the File Storage. |
| | PerErrc::kAuthentication Failed | rollback_semantics |
| | | Returned if calculating or checking the MAC of stored data fails. |
| ***Description:*** | Writes the content of a StringView to the file.<br>The time when the content is persisted depends on the implementation of Persistency. SyncTo File can be used to force Persistency to persist the file content.<br>In case of an error, the file content might be corrupted, and the current position might or might not have changed.<br>The expected state of the file for each supported error can be expected to be as follows:<br>• kPhysicalStorageFailure: The state of the file is unknown. It could have been entirely destroyed.<br>• kEncryptionFailed: The content of the file and the current position will have been updated, but could not be persisted. The persisted file will reflect an older version of the file.<br>• kOutOfStorageSpace: The content of the file will have been updated, but the part of the operation that exceeded the quota will have been discarded. The current position will be at the end of the file. | |

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### 8.13.1.1.2.5 operator<<

### [SWS_PER_00125] Definition of API function ara::per::WriteAccessor::operator<<

*Upstream requirements:* RS_PER_00001, RS_PER_00004, RS_AP_00119, RS_AP_00120, RS_AP_00121, RS_AP_00127, RS_AP_00159

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| | |
|---|---|
| ***Kind:*** | function |
| ***Header file:*** | #include "ara/per/write_accessor.h" |
| ***Scope:*** | `class ara::per::WriteAccessor` |

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| | | |
|---|---|---|
| ***Syntax:*** | `WriteAccessor & operator<< (ara::core::StringView s) noexcept;` | |
| ***Parameters (in):*** | s | The StringView containing the characters to be written. |
| ***Return value:*** | WriteAccessor & | The WriteAccessor object. |
| ***Exception Safety:*** | exception safe | |
| ***Thread Safety:*** | not thread-safe | |
| ***Description:*** | Writes the content of a StringView to the file.<br>This operator is just a comfort feature for non-safety critical Persistency users. If an error occurs during this operation, it is silently ignored. | |

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# 9 Service Interfaces

This functional cluster does not define any provided or required service interfaces.

# 10 Configuration

The design time configuration model of this functional cluster is defined in [3]. This chapter defines `Target Configuration`, the default values for attributes, and semantic constraints for elements specified in [3] that are part of the configuration model of this functional cluster.

## 10.1 Configuration Specification

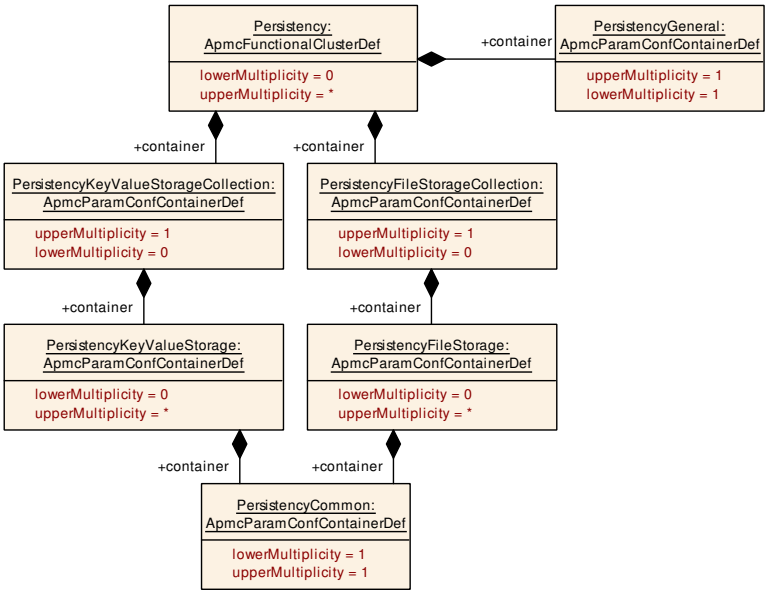


**Figure 10.1: Top-level Persistency Configuration**

### [APMC_PER_00001] Definition of ApmcFunctionalClusterDef Persistency ⌈

| | |
|---|---|
| **Functional Cluster Name** | Persistency |
| **Description** | This functional cluster definition represents the configuration of an instance of Persistency on the AUTOSAR Adaptive Platform. |

| **Included Containers** | | |
|---|---|---|
| **Container Name** | **Multiplicity** | **Dependency** |
| PersistencyFileStorageCollection | 0..1 | This container represents the collection of file storages in the context of the enclosing Persistency functional cluster. |
| PersistencyGeneral | 1 | This container provides configuration elements that apply to the entire Persistency instance. |
| PersistencyKeyValueStorage Collection | 0..1 | This container represents the collection of key-value storages in the context of the enclosing Persistency functional cluster. |

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### 10.1.1 General Configuration

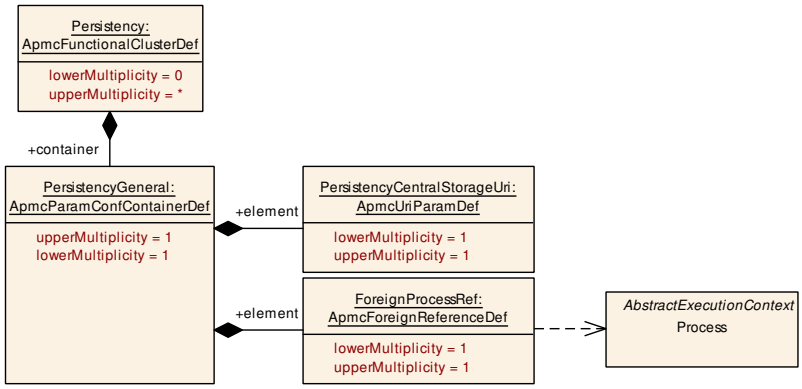


**Figure 10.2: Persistency General Configuration**

### [APMC_PER_00040] Definition of ApmcParamConfContainerDef Persistency General ⌈

| | |
|---|---|
| **Container Name** | PersistencyGeneral |
| **Parent Container** | Persistency |
| **Description** | This container provides configuration elements that apply to the entire Persistency instance. |
| **Multiplicity** | 1 |
| **Configuration Parameters** | |

| **Included Parameters** | | |
|---|---|---|
| **Parameter Name** | **Multiplicity** | **Apmc ID** |
| PersistencyCentralStorageUri | 1 | [APMC_PER_00047] |
| ForeignProcessRef | 1 | [APMC_PER_00049] |

| **No Included Containers** |
|---|

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### [APMC_PER_00047] Definition of ApmcUriParamDef PersistencyCentralStorage Uri ⌈

| | |
|---|---|
| **Parameter Name** | PersistencyCentralStorageUri |
| **Parent Container** | PersistencyGeneral |
| **Description** | This parameter defines the location of the central storage of this Persistency instance as a URI. |
| **Multiplicity** | 1 |
| **Type** | ApmcUriParamDef |
| **Default value** | – |

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**[APMC_PER_00049] Definition of ApmcForeignReferenceDef ForeignProcessRef**
⌈

| Parameter Name | ForeignProcessRef |
|---|---|
| Parent Container | PersistencyGeneral |
| Description | This reference represents the process for which the configuration of the key-value storages and file storages contained in this Persistency instance is relevant.<br>This reference is only needed until the SWS Execution Management has been migrated to APMC. |
| Multiplicity | 1 |
| Type | Foreign reference to |

⌋

### 10.1.2 File Storage

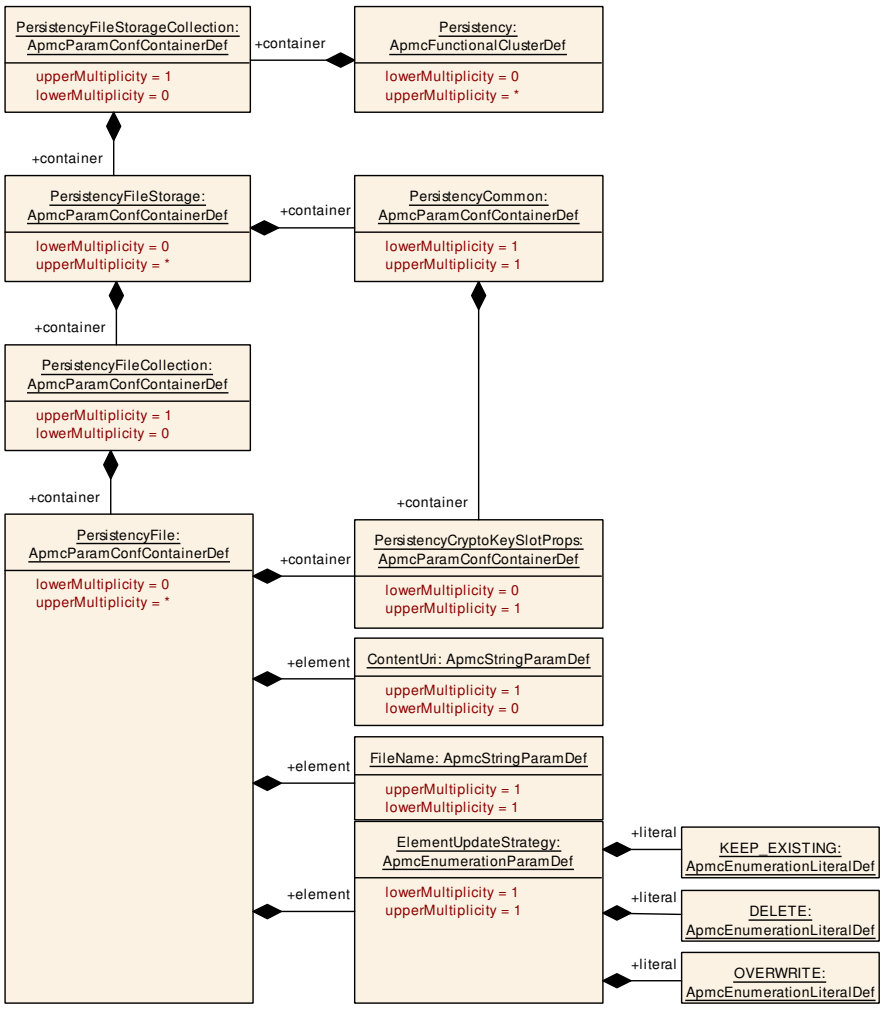


**Figure 10.3: Persistency File Storage Configuration**

**[APMC_PER_00003] Definition of ApmcParamConfContainerDef PersistencyFile StorageCollection** ⌈

| Container Name | PersistencyFileStorageCollection |
|---|---|
| Parent Container | Persistency |
| Description | This container represents the collection of file storages in the context of the enclosing Persistency functional cluster. |
| Multiplicity | 0..1 |
| Configuration Parameters | |

| No Included Parameters |
|---|

| Included Containers | | |
|---|---|---|
| Container Name | Multiplicity | Dependency |
| PersistencyFileStorage | 0..* | This container represents the configuration of one file storage in the context of the enclosing file storage collection. |

⌋

## [APMC_PER_00005] Definition of ApmcParamConfContainerDef PersistencyFile Storage ⌈

| Container Name | PersistencyFileStorage |
|---|---|
| Parent Container | PersistencyFileStorageCollection |
| Description | This container represents the configuration of one file storage in the context of the enclosing file storage collection. |
| Multiplicity | 0..* |
| Configuration Parameters | |

| No Included Parameters |
|---|

| Included Containers | | |
|---|---|---|
| Container Name | Multiplicity | Dependency |
| PersistencyCommon | 1 | This container represents common configuration options that are relevant for the enclosing file storage or key-value storage. |
| PersistencyFileCollection | 0..1 | This container represents the collection of files in the context of the enclosing file storage. |

⌋

## [APMC_PER_00015] Definition of ApmcParamConfContainerDef PersistencyFile Collection ⌈

| Container Name | PersistencyFileCollection |
|---|---|
| Parent Container | PersistencyFileStorage |
| Description | This container represents the collection of files in the context of the enclosing file storage. |
| Multiplicity | 0..1 |
| Configuration Parameters | |

| No Included Parameters |
|---|

| Included Containers | | |
|---|---|---|
| **Container Name** | **Multiplicity** | **Dependency** |
| PersistencyFile | 0..* | This container represents a file in the context of the enclosing file collection. |

⌋

### [APMC_PER_00016] Definition of ApmcParamConfContainerDef PersistencyFile ⌈

| Container Name | PersistencyFile |
|---|---|
| Parent Container | PersistencyFileCollection |
| Description | This container represents a file in the context of the enclosing file collection. |
| Multiplicity | 0..* |
| Configuration Parameters | |

| Included Parameters | | |
|---|---|---|
| **Parameter Name** | **Multiplicity** | **Apmc ID** |
| ContentUri | 0..1 | [APMC_PER_00017] |
| ElementUpdateStrategy | 1 | [APMC_PER_00036] |
| FileName | 1 | [APMC_PER_00018] |

| Included Containers | | |
|---|---|---|
| **Container Name** | **Multiplicity** | **Dependency** |
| PersistencyCryptoKeySlotProps | 0..1 | This container represents the configuration of the usage of a crypto key slot for one storage or element. This container is only relevant for the interaction between persistency and the crypto functional cluster. |

⌋

### [APMC_PER_00017] Definition of ApmcStringParamDef ContentUri ⌈

| Parameter Name | ContentUri |
|---|---|
| Parent Container | PersistencyFile |
| Description | This attribute represents the URI that identifies the initial content of the PersistencyFile. |
| Multiplicity | 0..1 |
| Type | ApmcStringParamDef |
| Default value | – |
| Verbatim String | – |

⌋

### [APMC_PER_00036] Definition of ApmcEnumerationParamDef ElementUpdate Strategy ⌈

| Parameter Name | ElementUpdateStrategy |
|---|---|
| Parent Container | PersistencyFile, PersistencyKeyValuePair |
| Description | This attribute can be used to specify the update strategy on element level, i.e. for a single key-value pair or file. |

▽

△

| | | |
|---|---|---|
| **Multiplicity** | 1 | |
| **Type** | ApmcEnumerationParamDef | |
| **Range** | DELETE | The update strategy is to delete the value of the respective data item. |
| | KEEP_EXISTING | The update strategy is to keep the existing value of the respective data item. |
| | OVERWRITE | The update strategy is to overwrite the value of this element. |

⌋

### [APMC_PER_00018] Definition of ApmcStringParamDef FileName ⌈

| | |
|---|---|
| **Parameter Name** | FileName |
| **Parent Container** | PersistencyFile |
| **Description** | This attribute holds filename part of the storage location for the PersistencyFile, e.g. file on the file system. |
| **Multiplicity** | 1 |
| **Type** | ApmcStringParamDef |
| **Default value** | – |
| **Verbatim String** | – |

⌋

### 10.1.3 Key-Value Storage

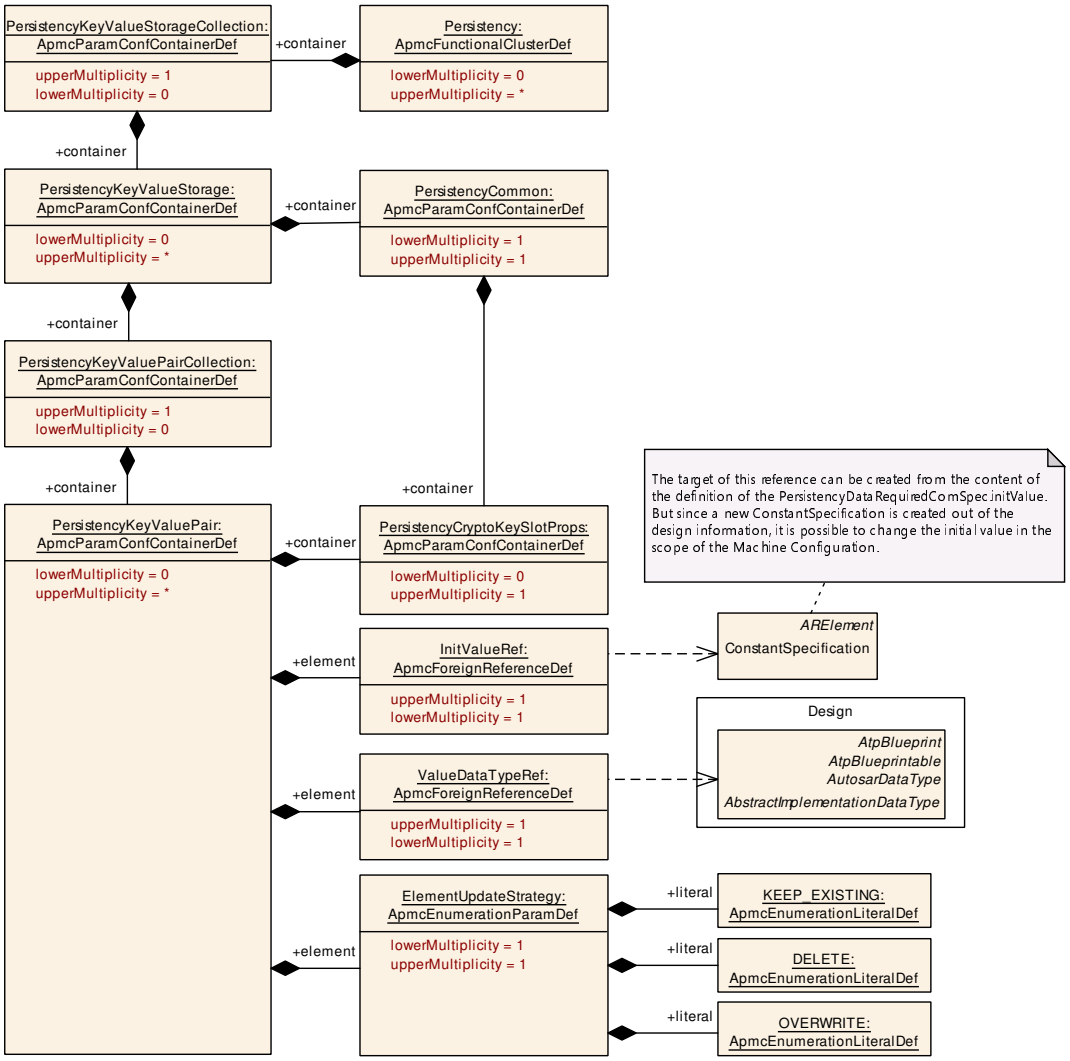


**Figure 10.4: Persistency Key Value Storage Configuration**

## [APMC_PER_00002] Definition of ApmcParamConfContainerDef PersistencyKeyValueStorageCollection ⌈

| | |
|---|---|
| **Container Name** | PersistencyKeyValueStorageCollection |
| **Parent Container** | Persistency |
| **Description** | This container represents the collection of key-value storages in the context of the enclosing Persistency functional cluster. |
| **Multiplicity** | 0..1 |
| **Configuration Parameters** | |

| |
|---|
| **No Included Parameters** |

| Included Containers | | |
|---|---|---|
| **Container Name** | **Multiplicity** | **Dependency** |
| PersistencyKeyValueStorage | 0..* | This container represents the configuration of one key-value storage in the context of the enclosing key-value storage collection. |

⌋

### [APMC_PER_00004] Definition of ApmcParamConfContainerDef PersistencyKeyValueStorage ⌈

| Container Name | PersistencyKeyValueStorage |
|---|---|
| Parent Container | PersistencyKeyValueStorageCollection |
| Description | This container represents the configuration of one key-value storage in the context of the enclosing key-value storage collection. |
| Multiplicity | 0..* |
| Configuration Parameters | |

| No Included Parameters |
|---|

| Included Containers | | |
|---|---|---|
| **Container Name** | **Multiplicity** | **Dependency** |
| PersistencyCommon | 1 | This container represents common configuration options that are relevant for the enclosing file storage or key-value storage. |
| PersistencyKeyValuePairCollection | 0..1 | This container represents the collection of key-value pairs in the context of the enclosing key-value storage. |

⌋

### [APMC_PER_00019] Definition of ApmcParamConfContainerDef PersistencyKeyValuePairCollection ⌈

| Container Name | PersistencyKeyValuePairCollection |
|---|---|
| Parent Container | PersistencyKeyValueStorage |
| Description | This container represents the collection of key-value pairs in the context of the enclosing key-value storage. |
| Multiplicity | 0..1 |
| Configuration Parameters | |

| No Included Parameters |
|---|

| Included Containers | | |
|---|---|---|
| **Container Name** | **Multiplicity** | **Dependency** |
| PersistencyKeyValuePair | 0..* | This container represents a key-value pair in the context of the enclosing key-value collection. |

⌋

### [APMC_PER_00020] Definition of ApmcParamConfContainerDef PersistencyKeyValuePair ⌈

| Container Name | PersistencyKeyValuePair |
|---|---|
| Parent Container | PersistencyKeyValuePairCollection |
| Description | This container represents a key-value pair in the context of the enclosing key-value collection. |
| Multiplicity | 0..* |
| Configuration Parameters | |

| Included Parameters | | |
|---|---|---|
| **Parameter Name** | **Multiplicity** | **Apmc ID** |
| ElementUpdateStrategy | 1 | [APMC_PER_00036] |
| InitValueRef | 1 | [APMC_PER_00021] |
| ValueDataTypeRef | 1 | [APMC_PER_00022] |

| Included Containers | | |
|---|---|---|
| **Container Name** | **Multiplicity** | **Dependency** |
| PersistencyCryptoKeySlotProps | 0..1 | This container represents the configuration of the usage of a crypto key slot for one storage or element. This container is only relevant for the interaction between persistency and the crypto functional cluster. |

⌋

For parameter table [APMC_PER_00036] ElementUpdateStrategy, see definition below container PersistencyFile.

### [APMC_PER_00021] Definition of ApmcForeignReferenceDef InitValueRef ⌈

| Parameter Name | InitValueRef |
|---|---|
| Parent Container | PersistencyKeyValuePair |
| Description | This aggregation represents the ability to define an initial value for the value side of the key-value pair. Please note that it does not make sense to configure an initial value if the configuration parameter UpdateStrategy within the container PersistencyCommon is set to the value DELETE. |
| Multiplicity | 1 |
| Type | Foreign reference to |

⌋

### [APMC_PER_00022] Definition of ApmcForeignReferenceDef ValueDataTypeRef ⌈

| Parameter Name | ValueDataTypeRef |
|---|---|
| Parent Container | PersistencyKeyValuePair |
| Description | This reference represents the data type applicable for the value of the key-value pair. |
| Multiplicity | 1 |
| Type | Foreign reference to |

⌋

### 10.1.4 Common Configuration

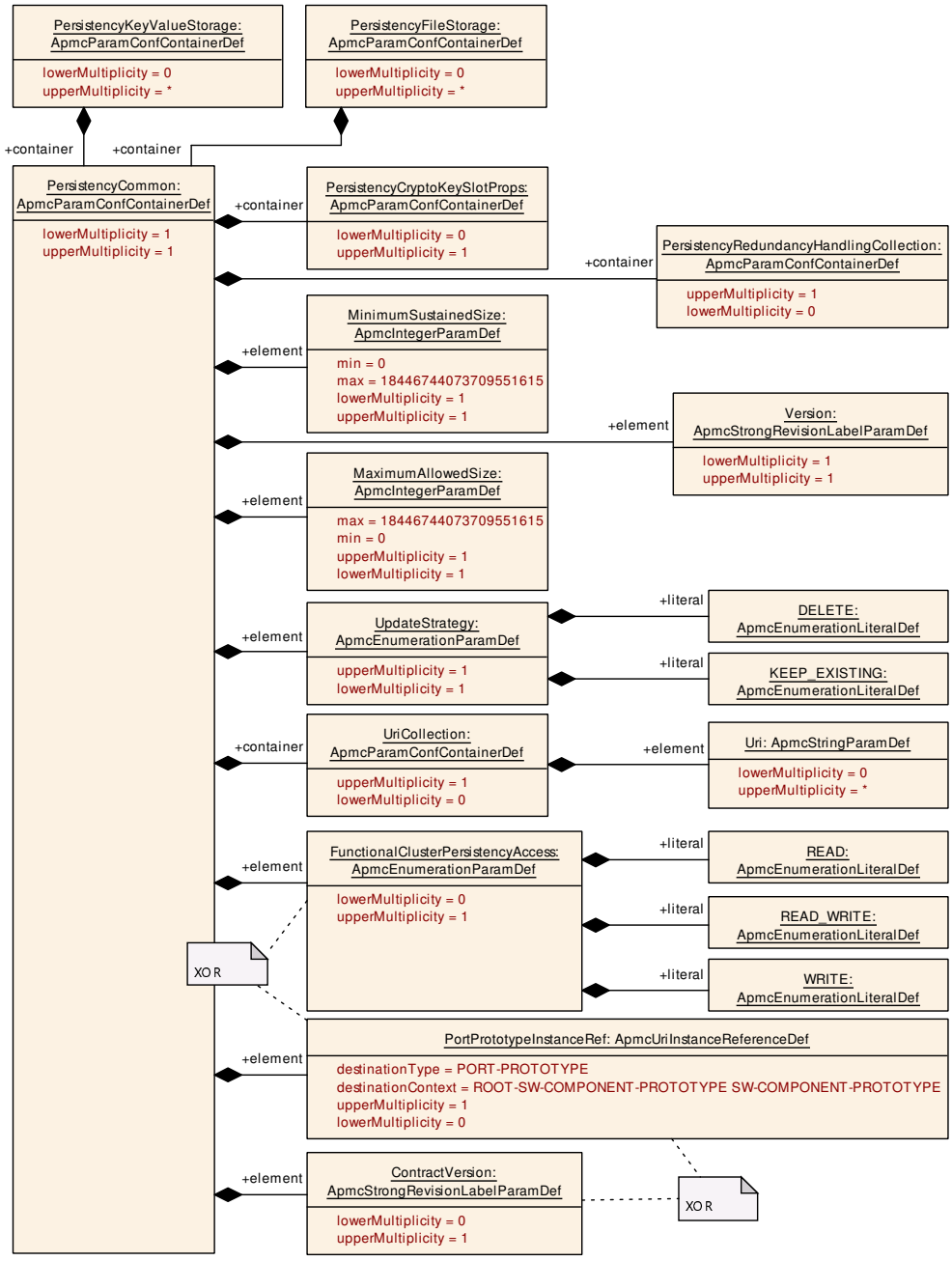


**Figure 10.5: Persistency Common Configuration**

**[APMC_PER_00006] Definition of ApmcParamConfContainerDef Persistency Common** ⌈

| Container Name | PersistencyCommon |
|---|---|
| Parent Container | PersistencyFileStorage, PersistencyKeyValueStorage |
| Description | This container represents common configuration options that are relevant for the enclosing file storage or key-value storage. |
| Multiplicity | 1 |
| Configuration Parameters | |

| Included Parameters | | |
|---|---|---|
| **Parameter Name** | **Multiplicity** | **Apmc ID** |
| ContractVersion | 0..1 | [APMC_PER_00046] |
| FunctionalClusterPersistencyAccess | 0..1 | [APMC_PER_00012] |
| MaximumAllowedSize | 1 | [APMC_PER_00009] |
| MinimumSustainedSize | 1 | [APMC_PER_00008] |
| UpdateStrategy | 1 | [APMC_PER_00010] |
| Version | 1 | [APMC_PER_00007] |
| PortPrototypeInstanceRef | 0..1 | [APMC_PER_00014] |

| Included Containers | | |
|---|---|---|
| **Container Name** | **Multiplicity** | **Dependency** |
| PersistencyCryptoKeySlotProps | 0..1 | This container represents the configuration of the usage of a crypto key slot for one storage or element. This container is only relevant for the interaction between persistency and the crypto functional cluster. |
| PersistencyLogging | 0..* | This container provides the configuration for one log sink used by Persistency.<br>This modeling will change once the log & tracs functional cluster has migrated to APMC, |
| PersistencyRedundancyHandlingCollection | 0..1 | This container represents the collection of redundancy handling configurations that are used by the enclosing Persistency instance. |
| UriCollection | 0..1 | This container represents a collection of URIs representing storage locations for the enclosing key-value storage or file storage. Multiple locations are only required and useful if the storage uses M out of N redundancy. |

⌋

## [APMC_PER_00046] Definition of ApmcStrongRevisionLabelParamDef Contract Version ⌈

| Parameter Name | ContractVersion |
|---|---|
| Parent Container | PersistencyCommon |
| Description | This parameter represents the contract version. This version changes if a semantical change happens. The existence of this parameter is mutually exclusive to the existence of PortPrototypeInstanceRef. |
| Multiplicity | 0..1 |
| Type | ApmcStrongRevisionLabelParamDef |
| Default value | – |

⌋

### [APMC_PER_00012] Definition of ApmcEnumerationParamDef FunctionalClusterPersistencyAccess ⌈

| Parameter Name | FunctionalClusterPersistencyAccess | |
|---|---|---|
| Parent Container | PersistencyCommon | |
| Description | This parameter represents the definition of the persistency access of all kinds of persisted data at run-time in the context of the enclosing key-value storage or file storage.<br>The existence of this parameter is mutually exclusive to the existence of PortPrototype InstanceRef because it is only used for the interaction between persistency and another functional cluster. | |
| Multiplicity | 0..1 | |
| Type | ApmcEnumerationParamDef | |
| Range | READ | Only read access to the storage is possible. |
| | READ_WRITE | Read and write access to the storage is possible. |
| | WRITE | Only write access to the storage is possible. |

⌋

### [APMC_PER_00009] Definition of ApmcIntegerParamDef MaximumAllowedSize ⌈

| Parameter Name | MaximumAllowedSize | |
|---|---|---|
| Parent Container | PersistencyCommon | |
| Description | The value of this configuration parameter represents the maximum available size (unit: bytes) allowed at target-configuration time for the enclosing key-value storage or file storage. | |
| Multiplicity | 1 | |
| Type | ApmcIntegerParamDef | |
| Range | 0 .. 18446744073709551615 | |
| Default value | – | |

⌋

### [APMC_PER_00008] Definition of ApmcIntegerParamDef MinimumSustainedSize ⌈

| Parameter Name | MinimumSustainedSize | |
|---|---|---|
| Parent Container | PersistencyCommon | |
| Description | This configuration parameter shall be used to specify the global update strategy of the respective key-value storage or file storage. | |
| Multiplicity | 1 | |
| Type | ApmcIntegerParamDef | |
| Range | 0 .. 18446744073709551615 | |
| Default value | – | |

⌋

### [APMC_PER_00010] Definition of ApmcEnumerationParamDef UpdateStrategy ⌈

| Parameter Name | UpdateStrategy | |
|---|---|---|
| Parent Container | PersistencyCommon | |
| Description | This configuration parameter shall be used to specify the global update strategy of the respective key-value storage or file storage. | |
| Multiplicity | 1 | |
| Type | ApmcEnumerationParamDef | |
| Range | DELETE | The update strategy is to delete the value of the respective data item. |
| | KEEP_EXISTING | The update strategy is to keep the existing value of the respective data item. |

⌋

### [APMC_PER_00007] Definition of ApmcStrongRevisionLabelParamDef Version ⌈

| Parameter Name | Version |
|---|---|
| Parent Container | PersistencyCommon |
| Description | This configuration parameter represents the version of the enclosing key-value storage or file storage |
| Multiplicity | 1 |
| Type | ApmcStrongRevisionLabelParamDef |
| Default value | – |

⌋

### [APMC_PER_00014] Definition of ApmcUriInstanceReferenceDef PortPrototype InstanceRef ⌈

| Parameter Name | PortPrototypeInstanceRef |
|---|---|
| Parent Container | PersistencyCommon |
| Description | This reference represents the applicable PortPrototype that is associated with the key-value storage or file storage.<br>The existence of this instance ref is mutually exclusive to the existence of Contract Version.<br>The existence of this instance ref is mutually exclusive to the existence of Functional ClusterPersistencyAccess. |
| Multiplicity | 0..1 |
| Type | Instance reference to PORT-PROTOTYPE context:<br>ROOT-SW-COMPONENT-PROTOTYPE SW-COMPONENT-PROTOTYPE |

⌋

### [APMC_PER_00011] Definition of ApmcParamConfContainerDef UriCollection ⌈

| Container Name | UriCollection |
|---|---|
| Parent Container | PersistencyCommon |
| Description | This container represents a collection of URIs representing storage locations for the enclosing key-value storage or file storage. Multiple locations are only required and useful if the storage uses M out of N redundancy. |
| Multiplicity | 0..1 |
| Configuration Parameters | |

| Included Parameters | | |
|---|---|---|
| **Parameter Name** | **Multiplicity** | **Apmc ID** |
| Uri | 0..* | [APMC_PER_00035] |

| No Included Containers |
|---|

⌋

### [APMC_PER_00035] Definition of ApmcStringParamDef Uri ⌈

| Parameter Name | Uri |
|---|---|
| Parent Container | UriCollection |
| Description | This attribute holds the storage location for either a file storage or a key-value storage. |
| Multiplicity | 0..* |
| Type | ApmcStringParamDef |
| Default value | – |
| Verbatim String | – |

⌋

## 10.1.5 CryptoKeySlot Configuration

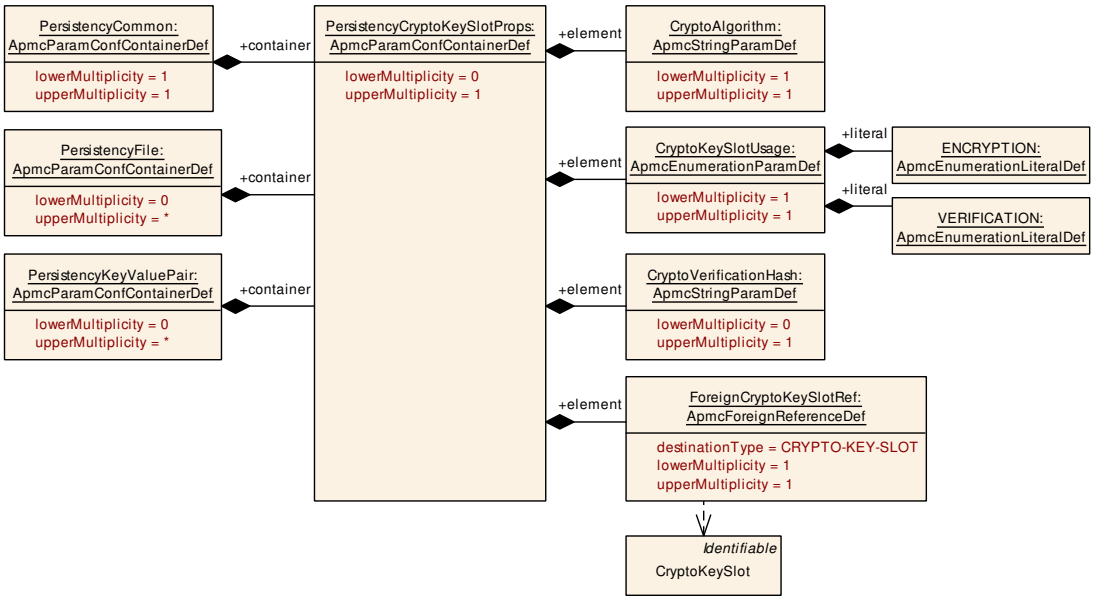


**Figure 10.6: Persistency CryptoKeySlot Configuration**

### [APMC_PER_00042] Definition of ApmcParamConfContainerDef Persistency CryptoKeySlotProps ⌈

| Container Name | PersistencyCryptoKeySlotProps |
|---|---|
| Parent Container | PersistencyCommon, PersistencyFile, PersistencyKeyValuePair |
| Description | This container represents the configuration of the usage of a crypto key slot for one storage or element. This container is only relevant for the interaction between persistency and the crypto functional cluster. |
| Multiplicity | 0..1 |
| Configuration Parameters | |

| Included Parameters | | |
|---|---|---|
| **Parameter Name** | **Multiplicity** | **Apmc ID** |
| CryptoAlgorithm | 1 | [APMC_PER_00044] |
| CryptoKeySlotUsage | 1 | [APMC_PER_00043] |
| CryptoVerificationHash | 0..1 | [APMC_PER_00045] |
| ForeignCryptoKeySlotRef | 1 | [APMC_PER_00048] |

| No Included Containers |
|---|

⌋

### [APMC_PER_00044] Definition of ApmcStringParamDef CryptoAlgorithm ⌈

| Parameter Name | CryptoAlgorithm |
|---|---|
| Parent Container | PersistencyCryptoKeySlotProps |
| Description | This parameter defines the cryptographic algorithm used for hashing, encryption, decryption, signature/MAC verification, or MAC generation. |
| Multiplicity | 1 |
| Type | ApmcStringParamDef |
| Default value | – |
| Verbatim String | – |

⌋

### [APMC_PER_00043] Definition of ApmcEnumerationParamDef CryptoKeySlotUsage ⌈

| Parameter Name | CryptoKeySlotUsage | |
|---|---|---|
| Parent Container | PersistencyCryptoKeySlotProps | |
| Description | This parameter defines the purpose for which the key slot is used. | |
| Multiplicity | 1 | |
| Type | ApmcEnumerationParamDef | |
| Range | ENCRYPTION | The key slot is used for encryption. |
| | VERIFICATION | The key slot is used for verification. |

⌋

### [APMC_PER_00045] Definition of ApmcStringParamDef CryptoVerificationHash ⌈

| Parameter Name | CryptoVerificationHash |
|---|---|
| Parent Container | PersistencyCryptoKeySlotProps |
| Description | This parameter defines a fixed hash of the storage that can be used to verification that a read-only storage was not changed after installation or update. |
| Multiplicity | 0..1 |
| Type | ApmcStringParamDef |
| Default value | – |
| Verbatim String | – |

⌋

### [APMC_PER_00048] Definition of ApmcForeignReferenceDef ForeignCryptoKeySlotRef ⌈

| Parameter Name | ForeignCryptoKeySlotRef |
|---|---|
| Parent Container | PersistencyCryptoKeySlotProps |
| Description | This reference identifies the CryptoKeySlot used for securing the enclosed key-value storage, file storage, key-value-pair, or file.<br>This reference is only temporarily needed until the Crypto Functional Cluster has been migrated to APMC. |
| Multiplicity | 1 |
| Type | Foreign reference to CRYPTO-KEY-SLOT |

⌋

## 10.1.6 Logging

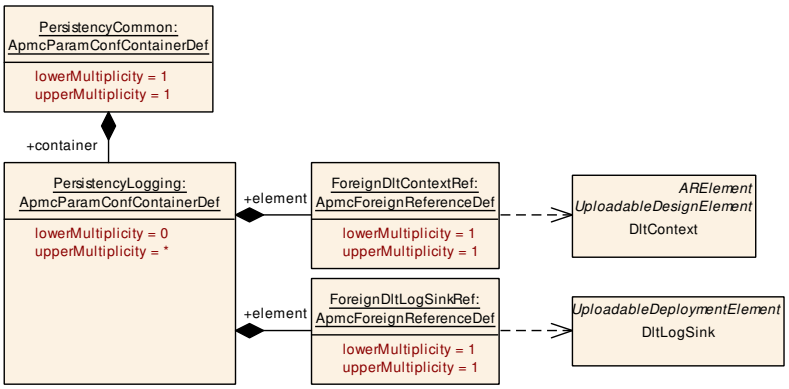


**Figure 10.7: Persistency Logging Configuration**

### [APMC_PER_00050] Definition of ApmcParamConfContainerDef Persistency Logging ⌈

| Container Name | PersistencyLogging |
|---|---|
| Parent Container | PersistencyCommon |
| Description | This container provides the configuration for one log sink used by Persistency.<br>This modeling will change once the log & tracs functional cluster has migrated to APMC, |
| Multiplicity | 0..* |
| Configuration Parameters | |

| Included Parameters | | |
|---|---|---|
| **Parameter Name** | **Multiplicity** | **Apmc ID** |
| ForeignDltContextRef | 1 | [APMC_PER_00051] |
| ForeignDltLogSinkRef | 1 | [APMC_PER_00052] |

| No Included Containers |
|---|

⌋

## [APMC_PER_00051] Definition of ApmcForeignReferenceDef ForeignDltContextRef ⌈

| Parameter Name | ForeignDltContextRef |
|---|---|
| Parent Container | PersistencyLogging |
| Description | This reference identifies the DLT context. |
| Multiplicity | 1 |
| Type | Foreign reference to |

⌋

## [APMC_PER_00052] Definition of ApmcForeignReferenceDef ForeignDltLogSinkRef ⌈

| Parameter Name | ForeignDltLogSinkRef |
|---|---|
| Parent Container | PersistencyLogging |
| Description | This reference identifies the DLT log sink. |
| Multiplicity | 1 |
| Type | Foreign reference to |

⌋

### 10.1.7 Redundancy

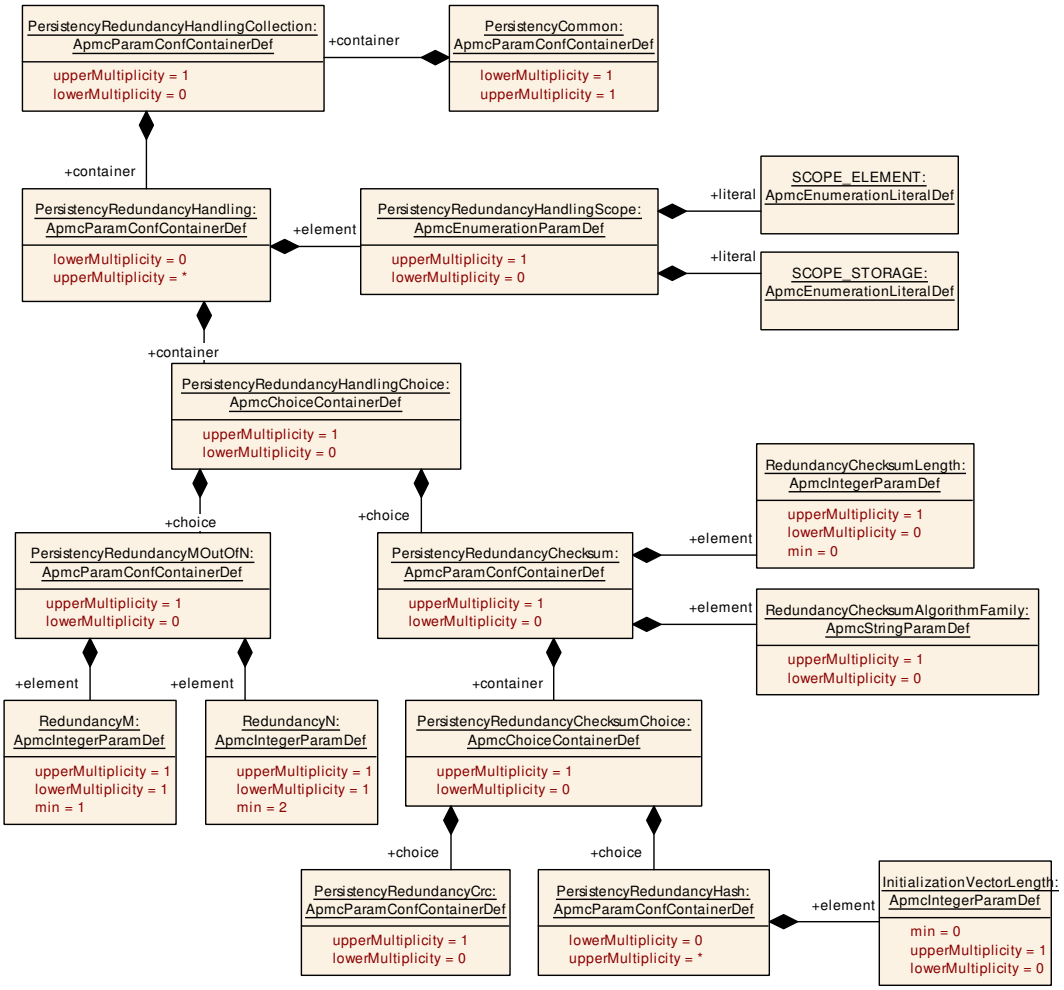


**Figure 10.8: Persistency Redundancy Handling Configuration**

## [APMC_PER_00023] Definition of ApmcParamConfContainerDef PersistencyRedundancyHandlingCollection ⌈

| | |
|---|---|
| **Container Name** | PersistencyRedundancyHandlingCollection |
| **Parent Container** | PersistencyCommon |
| **Description** | This container represents the collection of redundancy handling configurations that are used by the enclosing Persistency instance. |
| **Multiplicity** | 0..1 |
| **Configuration Parameters** | |

| |
|---|
| **No Included Parameters** |

| **Included Containers** | | |
|---|---|---|
| **Container Name** | **Multiplicity** | **Dependency** |
| PersistencyRedundancyHandling | 0..* | This container defines a specific redundancy handling configuration. Note that it is explicitly foreseen that an integrator may overrule the design decision regarding persistency based on superior knowledge only available at target-configuration time. |

⌋

### [APMC_PER_00024] Definition of ApmcParamConfContainerDef PersistencyRedundancyHandling ⌈

| | |
|---|---|
| **Container Name** | PersistencyRedundancyHandling |
| **Parent Container** | PersistencyRedundancyHandlingCollection |
| **Description** | This container defines a specific redundancy handling configuration. Note that it is explicitly foreseen that an integrator may overrule the design decision regarding persistency based on superior knowledge only available at target-configuration time. |
| **Multiplicity** | 0..* |
| **Configuration Parameters** | |

| **Included Parameters** | | |
|---|---|---|
| **Parameter Name** | **Multiplicity** | **Apmc ID** |
| PersistencyRedundancyHandlingScope | 0..1 | [APMC_PER_00025] |

| **Included Containers** | | |
|---|---|---|
| **Container Name** | **Multiplicity** | **Dependency** |
| PersistencyRedundancyHandlingChoice | 0..1 | This container provides a choice of different redundancy mechanisms. |

⌋

### [APMC_PER_00025] Definition of ApmcEnumerationParamDef PersistencyRedundancyHandlingScope ⌈

| | | |
|---|---|---|
| **Parameter Name** | PersistencyRedundancyHandlingScope | |
| **Parent Container** | PersistencyRedundancyHandling | |
| **Description** | This parameter controls the scope on which the redundancy handling is applied. | |
| **Multiplicity** | 0..1 | |
| **Type** | ApmcEnumerationParamDef | |
| **Range** | SCOPE_ELEMENT | The redundancy handling shall be applied on element level (for all key-value pairs and files). |
| | SCOPE_STORAGE | The redundancy handling shall be applied on storage level (for the whole key-value storage and file storage). |

⌋

### [APMC_PER_00026] Definition of ApmcChoiceContainerDef PersistencyRedundancyHandlingChoice ⌈

| | |
|---|---|
| **Choice Container Name** | PersistencyRedundancyHandlingChoice |
| **Parent Container** | PersistencyRedundancyHandling |
| **Description** | This container provides a choice of different redundancy mechanisms. |
| **Multiplicity** | 0..1 |

| **No Included Parameters** |
|---|

| Container Choices | | |
|---|---|---|
| **Container Name** | **Multiplicity** | **Dependency** |
| PersistencyRedundancyChecksum | 0..1 | This container provides the ability to describe redundancy via a checksum approach. |
| PersistencyRedundancyMOutOfN | 0..1 | This container provides the ability to describe redundancy via an "M out of N" approach. In this case N is the number of copies created and M is the minimum number of identical copies required for a reliable read access to the data. |

⌋

## [APMC_PER_00027] Definition of ApmcParamConfContainerDef PersistencyRedundancyMOutOfN ⌈

| | |
|---|---|
| **Container Name** | PersistencyRedundancyMOutOfN |
| **Parent Container** | PersistencyRedundancyHandlingChoice |
| **Description** | This container provides the ability to describe redundancy via an "M out of N" approach. In this case N is the number of copies created and M is the minimum number of identical copies required for a reliable read access to the data. |
| **Multiplicity** | 0..1 |
| **Configuration Parameters** | |

| Included Parameters | | |
|---|---|---|
| **Parameter Name** | **Multiplicity** | **Apmc ID** |
| RedundancyM | 1 | [APMC_PER_00028] |
| RedundancyN | 1 | [APMC_PER_00029] |

| No Included Containers |
|---|

⌋

## [APMC_PER_00028] Definition of ApmcIntegerParamDef RedundancyM ⌈

| | |
|---|---|
| **Parameter Name** | RedundancyM |
| **Parent Container** | PersistencyRedundancyMOutOfN |
| **Description** | This configuration parameter represents the "M" coordinate in the "M out of N" scheme. |
| **Multiplicity** | 1 |
| **Type** | ApmcIntegerParamDef |
| **Range** | 1 .. 18446744073709551615 |
| **Default value** | – |

⌋

## [APMC_PER_00029] Definition of ApmcIntegerParamDef RedundancyN ⌈

| | |
|---|---|
| **Parameter Name** | RedundancyN |
| **Parent Container** | PersistencyRedundancyMOutOfN |
| **Description** | This configuration parameter represents the "N" coordinate in the "M out of N" scheme. |
| **Multiplicity** | 1 |
| **Type** | ApmcIntegerParamDef |

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| | | |
|---|---|---|
| **Range** | 2 .. 18446744073709551615 | |
| **Default value** | – | |

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## [APMC_PER_00030] Definition of ApmcParamConfContainerDef PersistencyRedundancyChecksum ⌈

| | |
|---|---|
| **Container Name** | PersistencyRedundancyChecksum |
| **Parent Container** | PersistencyRedundancyHandlingChoice |
| **Description** | This container provides the ability to describe redundancy via a checksum approach. |
| **Multiplicity** | 0..1 |
| **Configuration Parameters** | |

| **Included Parameters** | | |
|---|---|---|
| **Parameter Name** | **Multiplicity** | **Apmc ID** |
| RedundancyChecksumAlgorithmFamily | 0..1 | [APMC_PER_00038] |
| RedundancyChecksumLength | 0..1 | [APMC_PER_00037] |

| **Included Containers** | | |
|---|---|---|
| **Container Name** | **Multiplicity** | **Dependency** |
| PersistencyRedundancyChecksumChoice | 0..1 | This container provides a choice of different checksum approaches. |

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## [APMC_PER_00038] Definition of ApmcStringParamDef RedundancyChecksumAlgorithmFamily ⌈

| | |
|---|---|
| **Parameter Name** | RedundancyChecksumAlgorithmFamily |
| **Parent Container** | PersistencyRedundancyChecksum |
| **Description** | This attribute identifies the algorithm family that is used to execute the CRC/Hash. |
| **Multiplicity** | 0..1 |
| **Type** | ApmcStringParamDef |
| **Default value** | – |
| **Verbatim String** | – |

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## [APMC_PER_00037] Definition of ApmcIntegerParamDef RedundancyChecksumLength ⌈

| | |
|---|---|
| **Parameter Name** | RedundancyChecksumLength |
| **Parent Container** | PersistencyRedundancyChecksum |
| **Description** | This parameter describes the length of the CRC/Hash in the unit bits. |
| **Multiplicity** | 0..1 |
| **Type** | ApmcIntegerParamDef |

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|---|---|---|
| **Range** | 0 .. 18446744073709551615 | |
| **Default value** | – | |

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## [APMC_PER_00031] Definition of ApmcChoiceContainerDef PersistencyRedundancyChecksumChoice ⌈

| | |
|---|---|
| **Choice Container Name** | PersistencyRedundancyChecksumChoice |
| **Parent Container** | PersistencyRedundancyChecksum |
| **Description** | This container provides a choice of different checksum approaches. |
| **Multiplicity** | 0..1 |

| **No Included Parameters** |
|---|

| **Container Choices** | | |
|---|---|---|
| **Container Name** | **Multiplicity** | **Dependency** |
| PersistencyRedundancyCrc | 0..1 | This container is used to configure a CRC-based ckecksum. |
| PersistencyRedundancyHash | 0..* | This container is used to configure a hash-based ckecksum. |

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## [APMC_PER_00032] Definition of ApmcParamConfContainerDef PersistencyRedundancyCrc ⌈

| | |
|---|---|
| **Container Name** | PersistencyRedundancyCrc |
| **Parent Container** | PersistencyRedundancyChecksumChoice |
| **Description** | This container is used to configure a CRC-based ckecksum. |
| **Multiplicity** | 0..1 |
| **Configuration Parameters** | |

| **No Included Parameters** |
|---|

| **No Included Containers** |
|---|

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## [APMC_PER_00033] Definition of ApmcParamConfContainerDef PersistencyRedundancyHash ⌈

| | |
|---|---|
| **Container Name** | PersistencyRedundancyHash |
| **Parent Container** | PersistencyRedundancyChecksumChoice |
| **Description** | This container is used to configure a hash-based ckecksum. |
| **Multiplicity** | 0..* |
| **Configuration Parameters** | |

| Included Parameters | | |
|---|---|---|
| **Parameter Name** | **Multiplicity** | **Apmc ID** |
| InitializationVectorLength | 0..1 | [APMC_PER_00034] |

| No Included Containers |
|---|

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**[APMC_PER_00034] Definition of ApmcIntegerParamDef InitializationVectorLength** ⌈

| **Parameter Name** | InitializationVectorLength | |
|---|---|---|
| **Parent Container** | PersistencyRedundancyHash | |
| **Description** | Length of the initialization vector in bits. | |
| **Multiplicity** | 0..1 | |
| **Type** | ApmcIntegerParamDef | |
| **Range** | 0 .. 18446744073709551615 | |
| **Default value** | – | |

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### 10.1.8 Correspondence Table

The following table lists the corresponding model elements for the APMC-based `Target Configuration` and for the legacy M2-based `Target Configuration`. In Chapter 7, only the APMC-based configuration elements are used.

Readers interested to read Chapter 7 may use the table to understand how the M2-based legacy approach corresponds to the APMC-based configuration elements.

| M1 Model Element | M2 Model Element |
|---|---|
| Persistency | PersistencyDeployment |
| PersistencyCommon.ContractVersion | FunctionalClusterInteractsWithPersistencyDeploymentMapping.contractVersion |
| PersistencyCommon.FunctionalClusterPersistencyAccess | FunctionalClusterInteractsWithPersistencyDeploymentMapping.persistencyAccess |
| PersistencyCommon.FunctionalClusterPersistencyAccess.READ | FunctionalClusterPersistencyAccessEnum.read |
| PersistencyCommon.FunctionalClusterPersistencyAccess.READ_WRITE | FunctionalClusterPersistencyAccessEnum.readWrite |
| PersistencyCommon.FunctionalClusterPersistencyAccess.WRITE | FunctionalClusterPersistencyAccessEnum.write |
| PersistencyCommon.MaximumAllowedSize | PersistencyDeployment.maximumAllowedSize |
| PersistencyCommon.MinimumSustainedSize | PersistencyDeployment.minimumSustainedSize |
| PersistencyCommon.PortPrototypeInstanceRef | PersistencyPortPrototypeToDeploymentMapping |
| PersistencyCommon.UpdateStrategy | PersistencyDeployment.updateStrategy |
| PersistencyCommon.UpdateStrategy.DELETE | PersistencyCollectionLevelUpdateStrategyEnum.delete |

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| M1 Model Element | M2 Model Element |
|---|---|
| PersistencyCommon.UpdateStrategy.DELETE | PersistencyElementLevelUpdateStrategyEnum.delete |
| PersistencyCommon.UpdateStrategy.KEEP_EXISTING | PersistencyCollectionLevelUpdateStrategyEnum.keepExisting |
| PersistencyCommon.UpdateStrategy.KEEP_EXISTING | PersistencyElementLevelUpdateStrategyEnum.keepExisting |
| PersistencyCommon.Version | PersistencyDeployment.version |
| PersistencyCommon.PersistencyCryptoKeySlotProps | PersistencyDeploymentToCryptoKeySlotMapping |
| PersistencyCommon.PersistencyCryptoKeySlotProps | PersistencyDeploymentElementToCryptoKeySlotMapping |
| PersistencyCryptoKeySlotProps.CryptoAlgorithm | PersistencyDeploymentElementToCryptoKeySlotMapping.cryptoAlgorithmString |
| PersistencyCryptoKeySlotProps.CryptoAlgorithm | PersistencyDeploymentToCryptoKeySlotMapping.cryptoAlgorithmString |
| PersistencyCryptoKeySlotProps.CryptoKeySlotUsage | PersistencyDeploymentElementToCryptoKeySlotMapping.keySlotUsage |
| PersistencyCryptoKeySlotProps.CryptoKeySlotUsage | PersistencyDeploymentToCryptoKeySlotMapping.keySlotUsage |
| PersistencyCryptoKeySlotProps.CryptoKeySlotUsage.ENCRYPTION | CryptoKeySlotUsageEnum.encryption |
| PersistencyCryptoKeySlotProps.CryptoKeySlotUsage.VERIFICATION | CryptoKeySlotUsageEnum.verification |
| PersistencyCryptoKeySlotProps.CryptoVerificationHash | PersistencyDeploymentElementToCryptoKeySlotMapping.verificationHash |
| PersistencyCryptoKeySlotProps.CryptoVerificationHash | PersistencyDeploymentToCryptoKeySlotMapping.verificationHash |
| PersistencyCryptoKeySlotProps.ForeignCryptoKeySlotRef | PersistencyDeploymentElementToCryptoKeySlotMapping.cryptoKeySlot |
| PersistencyCryptoKeySlotProps.ForeignCryptoKeySlotRef | PersistencyDeploymentToCryptoKeySlotMapping.cryptoKeySlot |
| PersistencyLogging | PersistencyDeploymentToDltLogSinkMapping |
| PersistencyLogging.ForeignDltContextRef | PersistencyDeploymentToDltLogSinkMapping.dltContext |
| PersistencyLogging.ForeignDltLogSinkRef | PersistencyDeploymentToDltLogSinkMapping.logSink |
| PersistencyRedundancyHandlingCollection | PersistencyDeployment.redundancyHandling |
| PersistencyRedundancyHandling | PersistencyRedundancyHandling |
| PersistencyRedundancyHandling.PersistencyRedundancyHandlingScope | PersistencyRedundancyHandling.scope |
| PersistencyRedundancyHandling.PersistencyRedundancyHandlingScope.SCOPE_ELEMENT | PersistencyRedundancyHandlingScopeEnum.persistencyRedundancyHandlingScopeElement |
| PersistencyRedundancyHandling.PersistencyRedundancyHandlingScope.SCOPE_STORAGE | PersistencyRedundancyHandlingScopeEnum.persistencyRedundancyHandlingScopeStorage |
| PersistencyRedundancyChecksum | PersistencyRedundancyChecksum |
| PersistencyRedundancyChecksum.RedundancyChecksumAlgorithmFamily | PersistencyRedundancyChecksum.algorithmFamily |
| PersistencyRedundancyChecksum.RedundancyChecksumLength | PersistencyRedundancyChecksum.length |
| PersistencyRedundancyCrc | PersistencyRedundancyCrc |
| PersistencyRedundancyHash | PersistencyRedundancyHash |

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| M1 Model Element | M2 Model Element |
|---|---|
| PersistencyRedundancyHash. InitializationVectorLength | PersistencyRedundancyHash. initializationVectorLength |
| PersistencyRedundancyMOutOfN | PersistencyRedundancyMOutOfN |
| PersistencyRedundancyMOutOfN.RedundancyM | PersistencyRedundancyMOutOfN.m |
| PersistencyRedundancyMOutOfN.RedundancyN | PersistencyRedundancyMOutOfN.n |
| UriCollection | PersistencyDeployment.deploymentUri |
| UriCollection.Uri | PersistencyDeploymentUri.uri |
| PersistencyFileCollection | PersistencyFileStorage.file |
| PersistencyFile | PersistencyFile |
| PersistencyFile.ContentUri | PersistencyFile.contentUri |
| PersistencyFile.ElementUpdateStrategy | PersistencyDeploymentElement.updateStrategy |
| PersistencyFile.ElementUpdateStrategy.DELETE | PersistencyCollectionLevelUpdateStrategyEnum.delete |
| PersistencyFile.ElementUpdateStrategy.DELETE | PersistencyElementLevelUpdateStrategyEnum. delete |
| PersistencyFile.ElementUpdateStrategy.KEEP_ EXISTING | PersistencyCollectionLevelUpdateStrategyEnum.keepExisting |
| PersistencyFile.ElementUpdateStrategy.KEEP_ EXISTING | PersistencyElementLevelUpdateStrategyEnum. keepExisting |
| PersistencyFile.ElementUpdateStrategy. OVERWRITE | PersistencyElementLevelUpdateStrategyEnum. overwrite |
| PersistencyFile.FileName | PersistencyFile.fileName |
| PersistencyFile.PersistencyCryptoKeySlotProps | PersistencyDeploymentToCryptoKeySlotMapping |
| PersistencyFile.PersistencyCryptoKeySlotProps | PersistencyDeploymentElementToCryptoKeySlotMapping |
| PersistencyGeneral.ForeignProcessRef | ProcessToMachineMapping.process |
| PersistencyGeneral. PersistencyCentralStorageUri | ProcessToMachineMapping. persistencyCentralStorageURI |
| PersistencyKeyValuePairCollection | PersistencyKeyValueStorage.keyValuePair |
| PersistencyKeyValuePair | PersistencyKeyValuePair |
| PersistencyKeyValuePair. ElementUpdateStrategy | PersistencyDeploymentElement.updateStrategy |
| PersistencyKeyValuePair. ElementUpdateStrategy.DELETE | PersistencyCollectionLevelUpdateStrategyEnum.delete |
| PersistencyKeyValuePair. ElementUpdateStrategy.DELETE | PersistencyElementLevelUpdateStrategyEnum. delete |
| PersistencyKeyValuePair. ElementUpdateStrategy.KEEP_EXISTING | PersistencyCollectionLevelUpdateStrategyEnum.keepExisting |
| PersistencyKeyValuePair. ElementUpdateStrategy.KEEP_EXISTING | PersistencyElementLevelUpdateStrategyEnum. keepExisting |
| PersistencyKeyValuePair. ElementUpdateStrategy.OVERWRITE | PersistencyElementLevelUpdateStrategyEnum. overwrite |
| PersistencyKeyValuePair.InitValueRef | PersistencyKeyValuePair.initValue |
| PersistencyKeyValuePair.ValueDataTypeRef | PersistencyKeyValuePair.valueDataType |
| PersistencyKeyValuePair. PersistencyCryptoKeySlotProps | PersistencyDeploymentToCryptoKeySlotMapping |
| PersistencyKeyValuePair. PersistencyCryptoKeySlotProps | PersistencyDeploymentElementToCryptoKeySlotMapping |

**Table 10.1: Correspondence between APMC (M1) elements and MetaModel (M2) elements for FunctionalCluster Persistency**

## 10.2 Default Values

This functional cluster does not define any default values for attributes specified in [3].

## 10.3 Semantic Constraints

This section defines semantic constraints for the configuration elements of `Persistency` defined in the [3, TPS Manifest Specification] that need to be observed by the tooling which creates/processes this part of the `Application Design`. There are also several additional constraints on the `Persistency` configuration that are defined in the [3, TPS Manifest Specification].

**[SWS_PER_CONSTR_00007] Configurable Namespace for Persistency** ⌈`PersistencyInterface.namespace` shall never exist.⌋

# A Mentioned Manifest Elements

This chapter contains the remaining set of meta-class tables which are not shown directly in the main body of this document.

This chapter is generated.

| **Class** | ***AbstractPersistencyRequireComSpec*** (abstract) | | | |
|---|---|---|---|---|
| **Note** | This meta-class acts as a bas-class of persistency-related ComSpec classes.<br>This Class is only used by the AUTOSAR Adaptive Platform. | | | |
| **Base** | *ARObject*, *RPortComSpec* | | | |
| **Subclasses** | PersistencyDataRequiredComSpec, PersistencyFileRequiredComSpec | | | |
| **Aggregated by** | *AbstractRequiredPortPrototype*.requiredComSpec, PortPrototypeBlueprint.requiredComSpec | | | |
| **Attribute** | **Type** | **Mult.** | **Kind** | **Note** |
| accessMode | PersistencyAccessEnum | 0..1 | attr | This attribute controls how persistent data can be accessed. |

**Table A.1: AbstractPersistencyRequireComSpec**

| **Class** | ***AbstractRequiredPortPrototype*** (abstract) | | | |
|---|---|---|---|---|
| **Note** | This abstract class provides the ability to become a required PortPrototype. | | | |
| **Base** | *ARObject*, *AtpBlueprintable*, *AtpFeature*, *AtpPrototype*, *Identifiable*, *MultilanguageReferrable*, *PortPrototype*, *Referrable* | | | |
| **Subclasses** | PRPortPrototype, RPortPrototype | | | |
| **Aggregated by** | *AtpClassifier*.atpFeature, *SwComponentType*.port | | | |
| **Attribute** | **Type** | **Mult.** | **Kind** | **Note** |
| requiredComSpec | RPortComSpec | * | aggr | Required communication attributes, one for each interface element.<br>**Stereotypes:** atpSplitable<br>**Tags:** atp.Splitkey=requiredComSpec.dataElement, requiredComSpec.getter, requiredComSpec.modeGroup, requiredComSpec.operation, requiredComSpec.parameter, requiredComSpec.setter, requiredComSpec.variable |

**Table A.2: AbstractRequiredPortPrototype**

| **Class** | **AdaptiveApplicationSwComponentType** | | | |
|---|---|---|---|---|
| **Note** | This meta-class represents the ability to support the formal modeling of application software on the AUTOSAR adaptive platform. Consequently, it shall only be used on the AUTOSAR adaptive platform.<br>**Tags:** atp.recommendedPackage=AdaptiveApplicationSwComponentTypes<br>This Class is only used by the AUTOSAR Adaptive Platform. | | | |
| **Base** | *ARElement*, *ARObject*, *AtpBlueprint*, *AtpBlueprintable*, *AtpClassifier*, *AtpType*, *CollectableElement*, *Identifiable*, *MultilanguageReferrable*, *PackageableElement*, *Referrable*, *SwComponentType* | | | |
| **Aggregated by** | ARPackage.element | | | |
| **Attribute** | **Type** | **Mult.** | **Kind** | **Note** |

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| **Class** | **AdaptiveApplicationSwComponentType** | | | |
|---|---|---|---|---|
| internalBehavior | AdaptiveSwcInternal Behavior | 0..1 | aggr | This aggregation represents the internal behavior of the AdaptiveApplicationSwComponentType for the AUTOSAR adaptive platform.<br>**Stereotypes:** atpSplitable; atpVariation<br>**Tags:**<br>atp.Splitkey=internalBehavior.shortName, internal Behavior.variationPoint.shortLabel<br>vh.latestBindingTime=preCompileTime |

**Table A.3: AdaptiveApplicationSwComponentType**

| **Class** | **ApmcStrongRevisionLabelParamDef** | | | |
|---|---|---|---|---|
| **Note** | This meta-class represents an restricted string parameter for the specification of a strong revision label on the "definition" side of the target-configuration.<br>This class enforces a pattern which requires three integer numbers separated by a dot, representing from left to right MajorVersion, MinorVersion, PatchVersion and additional labels for pre-release version and build metadata.<br>Legal patterns are for example: 1.0.0-alpha+001 1.0.0+20130313144700 1.0.0-beta+exp.sha.5114f85<br>**Tags:** atp.Status=candidate<br>This Class is only used by the AUTOSAR Adaptive Platform. | | | |
| **Base** | *ARObject*, *ApmcAbstractDefinition*, *ApmcAbstractRestrictedStringParamDef*, *ApmcConfiguration ElementDef*, *ApmcContainerElementDef*, *ApmcDefinitionElement*, *ApmcParameterDef*, *Identifiable*, *MultilanguageReferrable*, *Referrable* | | | |
| **Aggregated by** | ApmcParamConfContainerDef.element | | | |
| **Attribute** | **Type** | **Mult.** | **Kind** | **Note** |
| defaultValue | StrongRevisionLabel String | 0..1 | attr | This attribute implements the default value of the strong revision label.<br>**Tags:** atp.Status=candidate |

**Table A.4: ApmcStrongRevisionLabelParamDef**

| **Class** | ***ApplicationDataType*** (abstract) | | | |
|---|---|---|---|---|
| **Note** | `ApplicationDataType` defines a data type from the application point of view. Especially it should be used whenever something "physical" is at stake.<br>An `ApplicationDataType` represents a set of values as seen in the application model, such as measurement units. It does not consider implementation details such as bit-size, endianess, etc.<br>It should be possible to model the application level aspects of a VFB system by using `ApplicationDataType`s only. | | | |
| **Base** | *ARElement*, *ARObject*, *AtpBlueprint*, *AtpBlueprintable*, *AtpClassifier*, *AtpType*, *AutosarDataType*, *CollectableElement*, *Identifiable*, *MultilanguageReferrable*, *PackageableElement*, *Referrable* | | | |
| **Subclasses** | *ApplicationCompositeDataType*, ApplicationPrimitiveDataType | | | |
| **Aggregated by** | ARPackage.element | | | |
| **Attribute** | **Type** | **Mult.** | **Kind** | **Note** |
| – | – | – | – | – |

**Table A.5: ApplicationDataType**

| **Class** | ***AutosarDataType*** (abstract) |
|---|---|
| **Note** | Abstract base class for user defined AUTOSAR data types for software. |
| **Base** | *ARElement*, *ARObject*, *AtpClassifier*, *AtpType*, *CollectableElement*, *Identifiable*, *Multilanguage Referrable*, *PackageableElement*, *Referrable* |
| **Subclasses** | *AbstractImplementationDataType*, *ApplicationDataType* |

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| **Class** | ***AutosarDataType*** (abstract) | | | |
|---|---|---|---|---|
| ***Aggregated by*** | ARPackage.element | | | |
| ***Attribute*** | ***Type*** | ***Mult.*** | ***Kind*** | ***Note*** |
| swDataDef Props | SwDataDefProps | 0..1 | aggr | The properties of this AutosarDataType. **Stereotypes:** atpSplitable **Tags:** atp.Splitkey=swDataDefProps |

**Table A.6: AutosarDataType**

| **Class** | ***BaseType*** (abstract) | | | |
|---|---|---|---|---|
| ***Note*** | This abstract meta-class represents the ability to specify a platform dependent base type. | | | |
| ***Base*** | *ARElement*, *ARObject*, *CollectableElement*, *Identifiable*, *MultilanguageReferrable*, *Packageable Element*, *Referrable* | | | |
| ***Subclasses*** | SwBaseType | | | |
| ***Aggregated by*** | ARPackage.element | | | |
| ***Attribute*** | ***Type*** | ***Mult.*** | ***Kind*** | ***Note*** |
| baseType Definition | BaseTypeDefinition | 1 | aggr | This is the actual definition of the base type. **Tags:** xml.roleElement=false xml.roleWrapperElement=false xml.sequenceOffset=20 xml.typeElement=false xml.typeWrapperElement=false |

**Table A.7: BaseType**

| **Class** | **BaseTypeDirectDefinition** | | | |
|---|---|---|---|---|
| ***Note*** | This BaseType is defined directly (as opposite to a derived BaseType) | | | |
| ***Base*** | *ARObject*, *BaseTypeDefinition* | | | |
| ***Aggregated by*** | *BaseType*.baseTypeDefinition | | | |
| ***Attribute*** | ***Type*** | ***Mult.*** | ***Kind*** | ***Note*** |
| baseType Encoding | BaseTypeEncoding String | 0..1 | attr | This specifies, how an object of the current BaseType is encoded, e.g. in an ECU within a message sequence. **Tags:** xml.sequenceOffset=90 |
| baseTypeSize | PositiveInteger | 0..1 | attr | Describes the length of the data type specified in the container in bits. **Tags:** xml.sequenceOffset=70 |
| byteOrder | ByteOrderEnum | 0..1 | attr | This attribute specifies the byte order of the base type. **Tags:** xml.sequenceOffset=110 |
| memAlignment | PositiveInteger | 0..1 | attr | This attribute describes the alignment of the memory object in bits. E.g. "8" specifies, that the object in question is aligned to a byte while "32" specifies that it is aligned four byte. If the value is set to "0" the meaning shall be interpreted as "unspecified". **Tags:** xml.sequenceOffset=100 |

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| *Class* | **BaseTypeDirectDefinition** | | | |
|---|---|---|---|---|
| native Declaration | NativeDeclarationString | 0..1 | attr | This attribute describes the declaration of such a base type in the native programming language, primarily in the Programming language C. This can then be used by a code generator to include the necessary declarations into a header file. For example<br>BaseType with shortName: "MyUnsignedInt" native Declaration: "unsigned short"<br>Results in<br>typedef unsigned short MyUnsignedInt;<br>If the attribute is not defined the referring Implementation DataTypes will not be generated as a typedef by RTE.<br>If a nativeDeclaration type is given it shall fulfill the characteristic given by basetypeEncoding and baseType Size.<br>This is required to ensure the consistent handling and interpretation by software components, RTE, COM and MCM systems.<br>**Tags:** xml.sequenceOffset=120 |

**Table A.8: BaseTypeDirectDefinition**

| *Class* | **ConstantSpecification** | | | |
|---|---|---|---|---|
| *Note* | Specification of a constant that can be part of a package, i.e. it can be defined stand-alone.<br>**Tags:** atp.recommendedPackage=ConstantSpecifications | | | |
| *Base* | *ARElement*, *ARObject*, *CollectableElement*, *Identifiable*, *MultilanguageReferrable*, *Packageable Element*, *Referrable* | | | |
| *Aggregated by* | ARPackage.element | | | |
| *Attribute* | *Type* | *Mult.* | *Kind* | *Note* |
| valueSpec | ValueSpecification | 0..1 | aggr | Specification of an expression leading to a value for this constant.<br>**Stereotypes:** atpSplitable<br>**Tags:** atp.Splitkey=valueSpec |

**Table A.9: ConstantSpecification**

| *Class* | ***CppImplementationDataType*** (abstract) | | | |
|---|---|---|---|---|
| *Note* | This meta-class represents the way to specify a reusable data type definition taken as a the basis for a C++ language binding<br>This Class is only used by the AUTOSAR Adaptive Platform. | | | |
| *Base* | *ARElement*, *ARObject*, *AbstractImplementationDataType*, *AtpBlueprint*, *AtpBlueprintable*, *AtpClassifier*, *AtpType*, *AutosarDataType*, *CollectableElement*, *CppImplementationDataTypeContextTarget*, *Identifiable*, *MultilanguageReferrable*, *PackageableElement*, *Referrable* | | | |
| *Subclasses* | CustomCppImplementationDataType, StdCppImplementationDataType | | | |
| *Aggregated by* | ARPackage.element | | | |
| *Attribute* | *Type* | *Mult.* | *Kind* | *Note* |
| arraySize | PositiveInteger | 0..1 | attr | This attribute can be used to specify the array size if the enclosing CppImplementationDataType has array semantics.<br>**Stereotypes:** atpVariation<br>**Tags:** vh.latestBindingTime=preCompileTime |
| headerFile | String | 0..1 | attr | Configuration of the Header File with the custom class declaration. |

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| ***Class*** | ***CppImplementationDataType*** (abstract) | | | |
|---|---|---|---|---|
| namespace (ordered) | SymbolProps | * | aggr | This aggregation allows for the definition an own namespace for the enclosing CppImplementationData Type. |
| subElement (ordered) | CppImplementation DataTypeElement | * | aggr | This represents the collection of sub-elements of the enclosing CppImplementationDataType |
| template Argument (ordered) | CppTemplateArgument | * | aggr | This aggregation allows for the specification of properties of template arguments |
| typeEmitter | NameToken | 0..1 | attr | This attribute can be taken to control how the respective CppImplementationDataType is contributed to the language binding. |
| typeReference | CppImplementation DataType | 0..1 | ref | This reference shall be defined to define a type reference (a.k.a. typedef). |

**Table A.10: CppImplementationDataType**

| ***Class*** | **Executable** | | | |
|---|---|---|---|---|
| ***Note*** | This meta-class represents an executable program.<br>**Tags:** atp.recommendedPackage=Executables<br>This Class is only used by the AUTOSAR Adaptive Platform. | | | |
| ***Base*** | *ARElement*, *ARObject*, *AtpClassifier*, *CollectableElement*, *Identifiable*, *MultilanguageReferrable*, *PackageableElement*, *Referrable*, *UploadableDesignElement*, *UploadablePackageElement* | | | |
| ***Aggregated by*** | ARPackage.element | | | |
| ***Attribute*** | ***Type*** | ***Mult.*** | ***Kind*** | ***Note*** |
| implementation Props | Executable ImplementationProps | * | aggr | This aggregation contains the collection of implementation-specific properties necessary to properly build the enclosing Executable. |
| minimumTimer Granularity | TimeValue | 0..1 | attr | This attribute describes the minimum timer resolution (TimeValue of one tick) that is required by the Executable. |
| reporting Behavior | ExecutionState ReportingBehavior Enum | 0..1 | attr | this attribute controls the execution state reporting behavior of the enclosing Executable. |
| rootSw Component Prototype | RootSwComponent Prototype | 0..1 | aggr | This represents the root SwCompositionPrototype of the Executable. This aggregation is required (in contrast to a direct reference of a SwComponentType) in order to support the definition of instanceRefs in Executable context. |
| suspendToRam Awareness | SuspendToRam AwarenessEnum | 0..1 | attr | This attribute describes the type of awareness of the enclosing Executable to suspend-to-RAM functionality.<br>**Tags:** atp.Status=candidate |
| version | StrongRevisionLabel String | 0..1 | attr | Version of the executable. |

**Table A.11: Executable**

| ***Class*** | ***Identifiable*** (abstract) |
|---|---|
| ***Note*** | Instances of this class can be referred to by their identifier (within the namespace borders). In addition to this, Identifiables are objects which contribute significantly to the overall structure of an AUTOSAR description. In particular, Identifiables might contain Identifiables. |
| ***Base*** | *ARObject*, *MultilanguageReferrable*, *Referrable* |

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| **Class** | **Identifiable** (abstract) | | | |
|---|---|---|---|---|
| **Subclasses** | ARPackage, *AbstractDoIpLogicAddressProps*, *AbstractEvent*, *AbstractFunctionalClusterDesign*, *AbstractImplementationDataTypeElement*, *AbstractSecurityEventFilter*, *AbstractSecurityIdsmInstance Filter*, *AbstractServiceInstance*, *AbstractSignalBasedToISignalTriggeringMapping*, AdaptiveSwcInternal Behavior, ApApplicationEndpoint, *ApmcAbstractDefinition*, *ApmcConfigurationElementDef*, *Apmc ContainerElementValue*, ApmcContainerValue, ApmcEnumerationLiteralDef, ApplicationEndpoint, ApplicationError, AppliedStandard, ArtifactChecksum, ArtifactLocator, *AtpBlueprint*, *AtpBlueprintable*, *AtpClassifier*, *AtpFeature*, AutosarOperationArgumentInstance, AutosarVariableInstance, *BuildAction Entity*, BuildActionEnvironment, Chapter, CheckpointTransition, ClientIdDefinition, ClientServer Operation, Code, *CollectableElement*, ComManagementMapping, *CommConnectorPort*, *CommunicationConnector*, *CommunicationController*, Compiler, ConsistencyNeeds, ConsumedEvent Group, CouplingPort, *CouplingPortAbstractShaper*, *CouplingPortStructuralElement*, CryptoCertificate, CryptoCertificateGroup, CryptoKeySlot, CryptoKeySlotDesign, CryptoKeySlotUsageDesign, Crypto Provider, *CryptoServiceMapping*, DataPrototypeGroup, DataPrototypeTransformationPropsIdent, Data Transformation, *DdsAbstractServiceInstanceElementCp*, DdsCpDomain, DdsCpPartition, DdsCpQos Profile, DdsCpTopic, DdsDomainRange, DependencyOnArtifact, *DiagEventDebounceAlgorithm*, *DiagnosticAbstractSovdContent*, DiagnosticAuthTransmitCertificateEvaluation, DiagnosticConnected Indicator, DiagnosticDataElement, DiagnosticDebounceAlgorithmProps, DiagnosticExtendedDataRecord Element, DiagnosticFunctionInhibitSource, DiagnosticParameterElement, *DiagnosticRoutineSubfunction*, DiagnosticSovdMethodPrimitive, DltApplication, DltArgument, DltArgumentProps, DltMessage, DoIp Interface, DoIpLogicAddress, DoIpLogicalAddress, DoIpNetworkConfigurationDesign, DoIpRouting Activation, E2EProfileConfiguration, End2EndEventProtectionProps, End2EndMethodProtectionProps, EthernetWakeupSleepOnDatalineConfig, EventHandler, EventMapping, ExclusiveArea, *Executable Entity*, *ExecutionTime*, FMAttributeDef, FMFeatureMapAssertion, FMFeatureMapCondition, FMFeature MapElement, FMFeatureRelation, FMFeatureRestriction, FMFeatureSelection, FieldMapping, FireAnd ForgetMethodMapping, FlexrayArTpNode, FlexrayTpPduPool, *FrameTriggering*, GeneralParameter, GlobalSupervision, GlobalTimeGateway, *GlobalTimeMaster*, *GlobalTimeSlave*, *HealthChannel*, *Heap Usage*, HwAttributeDef, HwAttributeLiteralDef, HwPin, HwPinGroup, *IEEE1722TpAcfBus*, *IEEE1722Tp AcfBusPart*, IPSecRule, IPv6ExtHeaderFilterList, ISignalToIPduMapping, ISignalTriggering, *Ident Caption*, ImpositionTime, InternalTriggeringPoint, Keyword, LifeCycleState, Linker, MacAddressVlan Membership, MacMulticastGroup, MacSecKayParticipant, McDataInstance, MemorySection, Memory Usage, MethodMapping, ModeDeclaration, ModeDeclarationMapping, ModeSwitchPoint, ModeSwitch SenderComSpecProps, NetworkEndpoint, *NmCluster*, *NmNode*, *PackageableElement*, Parameter Access, PduActivationRoutingGroup, PduToFrameMapping, PduTriggering, PerInstanceMemory, *PersistencyDeploymentElement*, *PersistencyInterfaceElement*, *PhmSupervision*, *PhysicalChannel*, Port Group, *PortInterfaceMapping*, ProcessToMachineMapping, Processor, ProcessorCore, PskIdentityToKey SlotMapping, QueuedReceiverComSpecProps, ResourceConsumption, ResourceGroup, RootSwCluster DesignComponentPrototype, RootSwComponentPrototype, RootSwCompositionPrototype, Rpt Component, RptContainer, RptExecutableEntity, RptExecutableEntityEvent, RptExecutionContext, Rpt Profile, RptServicePoint, RunnableEntityGroup, *SdgAttribute*, SdgClass, SecOcJobMapping, SecOcJob Requirement, SecureCommunicationAuthenticationProps, *SecureCommunicationDeployment*, Secure CommunicationFreshnessProps, SecurityEventContextDataElement, SecurityEventContextProps, Server ComSpecProps, *ServiceInterfaceDeploymentElement*, ServiceInterfaceElementSecureComConfig, *ServiceNeeds*, SignalServiceTranslationEventProps, SignalServiceTranslationProps, SocketAddress, SoftwarePackageStep, SomeipEventGroup, SomeipProvidedEventGroup, SomeipTpChannel, *Stack Usage*, *StateManagementActionItem*, StateManagementActionList, StateManagementStateNotification, *StateManagementStateRequest*, StaticSocketConnection, StructuredReq, SupervisionCheckpoint, SupervisionMode, SupervisionModeCondition, SwGenericAxisParamType, SwServiceArg, SwcService Dependency, SystemMapping, *TimeBaseResource*, *TimingClock*, TimingClockSyncAccuracy, Timing Condition, *TimingConstraint*, *TimingDescription*, TimingExtensionResource, TimingModeInstance, Tls CryptoCipherSuite, TlsCryptoCipherSuiteProps, TlsJobMapping, Topic1, TpAddress, TraceableTable, TraceableText, *TracedFailure*, TransformationISignalPropsIdent, *TransformationProps*, Transformation Technology, Trigger, UcmDescription, UcmRetryStrategy, UcmStep, UriDescription, VariableAccess, VariationPointProxy, VehicleRolloutStep, ViewMap, VlanConfig, WaitPoint | | | |
| ***Attribute*** | ***Type*** | ***Mult.*** | ***Kind*** | ***Note*** |
| adminData | AdminData | 0..1 | aggr | This represents the administrative data for the identifiable object.<br>**Stereotypes:** atpSplitable<br>**Tags:**<br>atp.Splitkey=adminData<br>xml.sequenceOffset=-40 |

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| ***Class*** | ***Identifiable*** (abstract) | | | |
|---|---|---|---|---|
| annotation | Annotation | * | aggr | Possibility to provide additional notes while defining a model element (e.g. the ECU Configuration Parameter Values). These are not intended as documentation but are mere design notes.<br>**Tags:** xml.sequenceOffset=-25 |
| category | CategoryString | 0..1 | attr | The category is a keyword that specializes the semantics of the Identifiable. It affects the expected existence of attributes and the applicability of constraints.<br>**Tags:** xml.sequenceOffset=-50 |
| desc | MultiLanguageOverview Paragraph | 0..1 | aggr | This represents a general but brief (one paragraph) description what the object in question is about. It is only one paragraph! Desc is intended to be collected into overview tables. This property helps a human reader to identify the object in question.<br>More elaborate documentation, (in particular how the object is built or used) should go to "introduction".<br>**Tags:** xml.sequenceOffset=-60 |
| introduction | DocumentationBlock | 0..1 | aggr | This represents more information about how the object in question is built or is used. Therefore it is a DocumentationBlock.<br>**Tags:** xml.sequenceOffset=-30 |
| uuid | String | 0..1 | attr | The purpose of this attribute is to provide a globally unique identifier for an instance of a meta-class. The values of this attribute should be globally unique strings prefixed by the type of identifier. For example, to include a DCE UUID as defined by The Open Group, the UUID would be preceded by "DCE:". The values of this attribute may be used to support merging of different AUTOSAR models. The form of the UUID (Universally Unique Identifier) is taken from a standard defined by the Open Group (was Open Software Foundation). This standard is widely used, including by Microsoft for COM (GUIDs) and by many companies for DCE, which is based on CORBA. The method for generating these 128-bit IDs is published in the standard and the effectiveness and uniqueness of the IDs is not in practice disputed. If the id namespace is omitted, DCE is assumed. An example is "DCE:2fac1234-31f8-11b4-a222-08002b34c003". The uuid attribute has no semantic meaning for an AUTOSAR model and there is no requirement for AUTOSAR tools to manage the timestamp.<br>**Tags:** xml.attribute=true |

**Table A.12: Identifiable**

| ***Enumeration*** | **PersistencyAccessEnum** |
|---|---|
| ***Note*** | This enumeration provides standardized ways of how persistent data can be accessed. |
| ***Aggregated by*** | *AbstractPersistencyRequireComSpec*.accessMode |
| ***Literal*** | ***Description*** |
| read | Access to persistent data is read-only.<br>**Tags:** atp.EnumerationLiteralIndex=0<br>This EnumerationLiteral is only used by the AUTOSAR Adaptive Platform. |
| readWrite | Persistent data can both be written and read.<br>**Tags:** atp.EnumerationLiteralIndex=2<br>This EnumerationLiteral is only used by the AUTOSAR Adaptive Platform. |

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| *Enumeration* | **PersistencyAccessEnum** |
|---|---|
| write | Access to persistent data is write-only.<br>**Tags:** atp.EnumerationLiteralIndex=1<br>This EnumerationLiteral is only used by the AUTOSAR Adaptive Platform. |
| writeOnlyOnce | The elements of this storage are prevented from being changed after first initialization.<br>**Tags:** atp.EnumerationLiteralIndex=3<br>This EnumerationLiteral is only used by the AUTOSAR Adaptive Platform. |

**Table A.13: PersistencyAccessEnum**

| *Enumeration* | **PersistencyCollectionLevelUpdateStrategyEnum** |
|---|---|
| ***Note*** | This enumeration provides possible values for the update strategy on interface/storage level.<br>This Enumeration is only used by the AUTOSAR Adaptive Platform. |
| ***Aggregated by*** | *PersistencyDeployment*.updateStrategy, *PersistencyInterface*.updateStrategy |
| ***Literal*** | ***Description*** |
| delete | The update strategy is to delete all values on the level of the respective collection.<br>**Tags:** atp.EnumerationLiteralIndex=1 |
| keepExisting | The update strategy is to keep the existing values on the level of the respective collection.<br>**Tags:** atp.EnumerationLiteralIndex=0 |

**Table A.14: PersistencyCollectionLevelUpdateStrategyEnum**

| *Class* | **PersistencyDataElement** | | | |
|---|---|---|---|---|
| ***Note*** | This meta-class represents the ability to formally specify a piece of data that is subject to persistency in the context of the enclosing PersistencyKeyValueStorageInterface.<br>PersistencyDataElement represents also a key-value pair of the deployed PersistencyKeyValueStorage and provides an initial value.<br>This Class is only used by the AUTOSAR Adaptive Platform. | | | |
| ***Base*** | *ARObject*, *AtpFeature*, *AtpPrototype*, *AutosarDataPrototype*, *DataPrototype*, *Identifiable*, *MultilanguageReferrable*, *PersistencyInterfaceElement*, *Referrable* | | | |
| ***Aggregated by*** | *AtpClassifier*.atpFeature, PersistencyKeyValueStorageInterface.dataElement | | | |
| ***Attribute*** | ***Type*** | ***Mult.*** | ***Kind*** | ***Note*** |
| – | – | – | – | – |

**Table A.15: PersistencyDataElement**

| *Class* | **PersistencyDataRequiredComSpec** | | | |
|---|---|---|---|---|
| ***Note*** | This meta-class represents the ability to define port-specific attributes for supporting use cases of data persistency on the required side.<br>This Class is only used by the AUTOSAR Adaptive Platform. | | | |
| ***Base*** | *ARObject*, *AbstractPersistencyRequireComSpec*, *RPortComSpec* | | | |
| ***Aggregated by*** | *AbstractRequiredPortPrototype*.requiredComSpec, PortPrototypeBlueprint.requiredComSpec | | | |
| ***Attribute*** | ***Type*** | ***Mult.*** | ***Kind*** | ***Note*** |
| dataElement | PersistencyDataElement | 0..1 | ref | This refrence represents the PersistencyDataElement for which the PersistencyDataRequiredComSpec applies.<br>**Stereotypes:** atpIdentityContributor |
| initValue | ValueSpecification | 0..1 | aggr | This aggregation represents the definition of an initial value for the PersistencyDataElement referenced by the enclosing PersistencyDataRequiredComSpec |

**Table A.16: PersistencyDataRequiredComSpec**

| *Enumeration* | **PersistencyElementLevelUpdateStrategyEnum** |
|---|---|
| ***Note*** | This enumeration provides possible values for the update strategy on element level.<br>This Enumeration is only used by the AUTOSAR Adaptive Platform. |
| ***Aggregated by*** | *PersistencyDeploymentElement*.updateStrategy, *PersistencyInterfaceElement*.updateStrategy |
| ***Literal*** | ***Description*** |
| delete | The update strategy is to delete the value of the respective data item.<br>**Tags:** atp.EnumerationLiteralIndex=2 |
| keepExisting | The update strategy is to keep the existing value of the respective data item.<br>**Tags:** atp.EnumerationLiteralIndex=1 |
| overwrite | The update strategy is to overwrite the respective data item.<br>**Tags:** atp.EnumerationLiteralIndex=0 |

**Table A.17: PersistencyElementLevelUpdateStrategyEnum**

| *Class* | **PersistencyFileElement** | | | |
|---|---|---|---|---|
| ***Note*** | This meta-class has the ability to represent a file at design time such that it is possible to configure the behavior for accessing the represented file at run-time.<br>This Class is only used by the AUTOSAR Adaptive Platform. | | | |
| ***Base*** | *ARObject*, *Identifiable*, *MultilanguageReferrable*, *PersistencyInterfaceElement*, *Referrable* | | | |
| ***Aggregated by*** | PersistencyFileStorageInterface.fileElement | | | |
| ***Attribute*** | ***Type*** | ***Mult.*** | ***Kind*** | ***Note*** |
| contentUri | UriString | 0..1 | attr | This attribute represents the URI that identifies the initial content of the PersistencyFile. |
| fileName | String | 0..1 | attr | This attribute holds the filename part of the storage location, e.g. file on the file system. |

**Table A.18: PersistencyFileElement**

| *Class* | **PersistencyFileStorageInterface** | | | |
|---|---|---|---|---|
| ***Note*** | This meta-class provides the ability to implement a PortInterface for supporting persistency use cases for files.<br>**Tags:** atp.recommendedPackage=PersistencyFileStorageInterfaces<br>This Class is only used by the AUTOSAR Adaptive Platform. | | | |
| ***Base*** | *ARElement*, *ARObject*, *AtpBlueprint*, *AtpBlueprintable*, *AtpClassifier*, *AtpType*, *CollectableElement*, *Identifiable*, *MultilanguageReferrable*, *PackageableElement*, *PersistencyInterface*, *PortInterface*, *Referrable* | | | |
| ***Aggregated by*** | ARPackage.element | | | |
| ***Attribute*** | ***Type*** | ***Mult.*** | ***Kind*** | ***Note*** |
| fileElement | PersistencyFileElement | * | aggr | This aggregation represents the collection of Persistency FileStorages in the context of the enclosing Persistency FileStorageInterface. |
| maxNumberOf Files | PositiveInteger | 0..1 | attr | This attribute represents the definition of an upper bound for the handling of files at run-time in the context of the enclosing PersistencyFileStorageInterface. |

**Table A.19: PersistencyFileStorageInterface**

| *Class* | ***PersistencyInterface*** (abstract) |
|---|---|
| ***Note*** | This meta-class provides the abstract ability to define a PortInterface for the support of persistency use cases.<br>This Class is only used by the AUTOSAR Adaptive Platform. |

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| **Class** | ***PersistencyInterface*** (abstract) | | | |
|---|---|---|---|---|
| **Base** | *ARElement*, *ARObject*, *AtpBlueprint*, *AtpBlueprintable*, *AtpClassifier*, *AtpType*, *CollectableElement*, *Identifiable*, *MultilanguageReferrable*, *PackageableElement*, *PortInterface*, *Referrable* | | | |
| **Subclasses** | PersistencyFileStorageInterface, PersistencyKeyValueStorageInterface | | | |
| **Aggregated by** | ARPackage.element | | | |
| ***Attribute*** | ***Type*** | ***Mult.*** | ***Kind*** | ***Note*** |
| contractVersion | StrongRevisionLabelString | 0..1 | attr | This attribute represents the contract version that is used to determine whether the Persistency configuration experienced structural changes and is also used for the check for data type compatibility. |
| minimumSustainedSize | PositiveInteger | 0..1 | attr | The value of this attribute represents the minimum size (unit: bytes) required at design time for the enclosing PersistencyInterface. |
| redundancy | PersistencyRedundancyEnum | 0..1 | attr | This attribute represents a requirement towards the redundancy of storage. |
| redundancyHandling | PersistencyRedundancyHandling | * | aggr | This aggregation represents the chosen approaches to handle redundancy for the various use cases implemented by subclasses<br>**Stereotypes:** atpSplitable<br>**Tags:** atp.Splitkey=redundancyHandling |
| updateStrategy | PersistencyCollectionLevelUpdateStrategyEnum | 0..1 | attr | This attribute can be used to specify the update strategy of the respective PersistencyInterface as a whole. |

**Table A.20: PersistencyInterface**

| **Class** | ***PersistencyInterfaceElement*** (abstract) | | | |
|---|---|---|---|---|
| **Note** | This meta-class provides the abstract ability to define an element of a PortInterface for the support of persistency use cases.<br>This Class is only used by the AUTOSAR Adaptive Platform. | | | |
| **Base** | *ARObject*, *Identifiable*, *MultilanguageReferrable*, *Referrable* | | | |
| **Subclasses** | PersistencyDataElement, PersistencyFileElement | | | |
| ***Attribute*** | ***Type*** | ***Mult.*** | ***Kind*** | ***Note*** |
| updateStrategy | PersistencyElementLevelUpdateStrategyEnum | 0..1 | attr | This attribute can be used to specify the update strategy of the respective PersistencyInterfaceElement. |

**Table A.21: PersistencyInterfaceElement**

| **Class** | **PersistencyKeyValueDataTypeMapping** | | | |
|---|---|---|---|---|
| **Note** | This meta-class represents the ability to define a mapping between an existing data type in a key-value-storage stored by a previous version to a new data type used on application software level in the current version.<br>This Class is only used by the AUTOSAR Adaptive Platform. | | | |
| **Base** | *ARObject*, *Describable* | | | |
| **Aggregated by** | PersistencyKeyValueStorageInterface.dataTypeMapping | | | |
| ***Attribute*** | ***Type*** | ***Mult.*** | ***Kind*** | ***Note*** |
| currentDataType | AutosarDataType | 0..1 | ref | This reference identifies the current data type for an existing key-value-pair in the context of the enclosing PersistencyKeyValueStorageInterface. |
| previousContractVersion | StrongRevisionLabelString | 0..1 | attr | This attribute identifies the contract version in which the previousDataType was used. |

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| *Class* | **PersistencyKeyValueDataTypeMapping** | | | |
|---|---|---|---|---|
| previousData Type | AutosarDataType | 0..1 | ref | This reference identifies the previous data type in a key-value-pair existing in the context of the enclosing PersistencyKeyValueStorageInterface. |

**Table A.22: PersistencyKeyValueDataTypeMapping**

| *Class* | **PersistencyKeyValueStorageInterface** | | | |
|---|---|---|---|---|
| ***Note*** | This meta-class provides the ability to implement a `PortInterface` for supporting persistency use cases for data.<br>**Tags:** atp.recommendedPackage=PersistencyKeyValueStorageInterfaces<br>This Class is only used by the AUTOSAR Adaptive Platform. | | | |
| ***Base*** | *ARElement*, *ARObject*, *AtpBlueprint*, *AtpBlueprintable*, *AtpClassifier*, *AtpType*, *CollectableElement*, *Identifiable*, *MultilanguageReferrable*, *PackageableElement*, *PersistencyInterface*, *PortInterface*, *Referrable* | | | |
| ***Aggregated by*** | ARPackage.element | | | |
| ***Attribute*** | ***Type*** | ***Mult.*** | ***Kind*** | ***Note*** |
| dataElement | PersistencyData Element | * | aggr | This aggregation represents the collection of Persistency DataElements in the context of the enclosing Persistency KeyValueStorageInterface. |
| dataTypeFor Serialization | AbstractImplementation DataType | * | ref | This reference identifies the AbstractImplementationData Types that shall be supported for storing in a key-value storage in addition to the types already determined from tha aggregation of PersistencyDataElement. |
| dataType Mapping | PersistencyKeyValue DataTypeMapping | 0..1 | aggr | This aggregation provides a collection of replacement rules for data types used in the context of the enclosing PersistencyKeyValueStorageInterface. |

**Table A.23: PersistencyKeyValueStorageInterface**

| *Enumeration* | **PersistencyRedundancyEnum** |
|---|---|
| ***Note*** | This meta-class provides a way to specify in which way redundancy shall be applied on collection level.<br>This Enumeration is only used by the AUTOSAR Adaptive Platform. |
| ***Aggregated by*** | *PersistencyInterface*.redundancy |
| ***Literal*** | ***Description*** |
| none | This value represents the requirement that redundancy measures are not applied on persistency storage level.<br>**Tags:** atp.EnumerationLiteralIndex=1 |
| redundant | This value represents the requirement that redundancy measures are applied on persistency storage level.<br>The nature of the redundant persistent storage is not further qualified and subject to integrator decisions.<br>**Tags:** atp.EnumerationLiteralIndex=0 |
| redundantPer Element | This value represents the requirement that redundancy measures are applied on key-value level of a key-value storage or on file level of a file storage.<br>The nature of the redundancy used on the persistent storage is not further qualified and subject to integrator decisions.<br>**Tags:** atp.EnumerationLiteralIndex=2 |

**Table A.24: PersistencyRedundancyEnum**

| **Class** | ***PortInterface*** (abstract) | | | |
|---|---|---|---|---|
| **Note** | Abstract base class for an interface that is either provided or required by a port of a software component. | | | |
| **Base** | *ARElement*, *ARObject*, *AtpBlueprint*, *AtpBlueprintable*, *AtpClassifier*, *AtpType*, *CollectableElement*, *Identifiable*, *MultilanguageReferrable*, *PackageableElement*, *Referrable* | | | |
| **Subclasses** | *AbstractRawDataStreamInterface*, *AbstractSuspendToRamInterface*, *AbstractSynchronizedTimeBase Interface*, ClientServerInterface, *CryptoInterface*, *DataInterface*, *DiagnosticPortInterface*, FirewallState SwitchInterface, *IdsmAbstractPortInterface*, LogAndTraceInterface, ModeSwitchInterface, Network ManagementPortInterface, *PersistencyInterface*, *PlatformHealthManagementInterface*, ServiceInterface, *StateManagementPortInterface*, TriggerInterface | | | |
| **Aggregated by** | ARPackage.element | | | |
| ***Attribute*** | ***Type*** | ***Mult.*** | ***Kind*** | ***Note*** |
| namespace (ordered) | SymbolProps | * | aggr | This represents the SymbolProps used for the definition of a hierarchical namespace applicable for the generation of code artifacts out of the definition of a ServiceInterface.<br>**Stereotypes:** atpSplitable<br>**Tags:** atp.Splitkey=namespace.shortName<br>This Attribute is only used by the AUTOSAR Adaptive Platform. |

**Table A.25: PortInterface**

| **Class** | ***PortPrototype*** (abstract) | | | |
|---|---|---|---|---|
| **Note** | Base class for the ports of an AUTOSAR software component.<br>The aggregation of PortPrototypes is subject to variability with the purpose to support the conditional existence of ports. | | | |
| **Base** | *ARObject*, *AtpBlueprintable*, *AtpFeature*, *AtpPrototype*, *Identifiable*, *MultilanguageReferrable*, *Referrable* | | | |
| **Subclasses** | *AbstractProvidedPortPrototype*, *AbstractRequiredPortPrototype* | | | |
| **Aggregated by** | *AtpClassifier*.atpFeature, *SwComponentType*.port | | | |
| ***Attribute*** | ***Type*** | ***Mult.*** | ***Kind*** | ***Note*** |
| clientServer Annotation | ClientServerAnnotation | * | aggr | Annotation of this `PortPrototype` with respect to client/ server communication. |
| delegatedPort Annotation | DelegatedPort Annotation | 0..1 | aggr | Annotations on this delegated port. |
| ioHwAbstraction Server Annotation | IoHwAbstractionServer Annotation | * | aggr | Annotations on this IO Hardware Abstraction port. |
| modePort Annotation | ModePortAnnotation | * | aggr | Annotations on this mode port. |
| nvDataPort Annotation | NvDataPortAnnotation | * | aggr | Annotations on this non voilatile data port. |
| parameterPort Annotation | ParameterPort Annotation | * | aggr | Annotations on this parameter port. |
| portPrototype Props | PortPrototypeProps | 0..1 | aggr | This attribute allows for the definition of further qualification of the semantics of a PortPrototype.<br>This Attribute is only used by the AUTOSAR Adaptive Platform. |
| senderReceiver Annotation | SenderReceiver Annotation | * | aggr | Collection of annotations of this ports sender/receiver communication.<br>**Stereotypes:** atpSplitable<br>**Tags:** atp.Splitkey=senderReceiverAnnotation |
| triggerPort Annotation | TriggerPortAnnotation | * | aggr | Annotations on this trigger port. |

**Table A.26: PortPrototype**

| **Class** | **Process** | | | |
|---|---|---|---|---|
| **Note** | This meta-class provides information required to execute the referenced `Executable`.<br>**Tags:** atp.recommendedPackage=Processes<br>This Class is only used by the AUTOSAR Adaptive Platform. | | | |
| **Base** | *ARElement*, *ARObject*, *AbstractExecutionContext*, *AtpClassifier*, *CollectableElement*, *Identifiable*, *MultilanguageReferrable*, *PackageableElement*, *Referrable*, *UploadableDeploymentElement*, *Uploadable PackageElement* | | | |
| **Aggregated by** | ARPackage.element | | | |
| **Attribute** | **Type** | **Mult.** | **Kind** | **Note** |
| design | ProcessDesign | 0..1 | ref | This reference represents the identification of the design-time representation for the Process that owns the reference. |
| executable | Executable | * | ref | Reference to executable that is executed in the process.<br>**Stereotypes:** atpUriDef |
| functionCluster Affiliation | String | 0..1 | attr | This attribute specifies which functional cluster the Process is affiliated with. |
| numberOf RestartAttempts | PositiveInteger | 0..1 | attr | This attribute defines how often a process shall be restarted if the start fails.<br>numberOfRestartAttempts = "0" OR Attribute not existing, start once<br>numberOfRestartAttempts = "1", start a second time |
| preMapping | Boolean | 0..1 | attr | This attribute describes whether the executable is preloaded into the memory. |
| processState Machine | ModeDeclarationGroup Prototype | 0..1 | aggr | Set of Process States that are defined for the process. This attribute is used to support the modeling of execution dependencies that utilize the condition of process state. Please note that the process states may not be modeled arbitrarily at any stage of the AUTOSAR workflow because the supported states are standardized in the context of the SWS Execution Management [5]. |
| stateDependent StartupConfig | StateDependentStartup Config | * | aggr | Applicable startup configurations. |

**Table A.27: Process**

| **Class** | **RPortPrototype** | | | |
|---|---|---|---|---|
| **Note** | Component port requiring a certain port interface. | | | |
| **Base** | *ARObject*, *AbstractRequiredPortPrototype*, *AtpBlueprintable*, *AtpFeature*, *AtpPrototype*, *Identifiable*, *MultilanguageReferrable*, *PortPrototype*, *Referrable* | | | |
| **Aggregated by** | *AtpClassifier*.atpFeature, *SwComponentType*.port | | | |
| **Attribute** | **Type** | **Mult.** | **Kind** | **Note** |
| required Interface | PortInterface | 0..1 | tref | The interface that this port requires.<br>**Stereotypes:** isOfType |

**Table A.28: RPortPrototype**

| **Class** | ***Referrable*** (abstract) |
|---|---|
| **Note** | Instances of this class can be referred to by their identifier (while adhering to namespace borders). |
| **Base** | *ARObject* |
| **Subclasses** | *AtpDefinition*, BswDistinguishedPartition, *BswModuleCallPoint*, BswModuleClientServerEntry, Bsw VariableAccess, CouplingPortTrafficClassAssignment, *CppImplementationDataTypeContextTarget*, *DiagnosticEnvModeElement*, EthernetPriorityRegeneration, ExclusiveAreaNestingOrder, *HwDescription Entity*, *ImplementationProps*, ModeTransition, *MultilanguageReferrable*, NmNetworkHandle, Pnc MappingIdent, *SingleLanguageReferrable*, SoConIPduIdentifier, SomeipRequiredEventGroup, Tp ConnectionIdent |

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| *Class* | ***Referrable*** (abstract) | | | |
|---|---|---|---|---|
| ***Attribute*** | ***Type*** | ***Mult.*** | ***Kind*** | ***Note*** |
| shortName | Identifier | 1 | attr | This specifies an identifying shortName for the object. It needs to be unique within its context and is intended for humans but even more for technical reference.<br>**Stereotypes:** atpIdentityContributor<br>**Tags:**<br>xml.enforceMinMultiplicity=true<br>xml.sequenceOffset=-100 |
| shortName Fragment | ShortNameFragment | * | aggr | This specifies how the Referrable.shortName is composed of several shortNameFragments.<br>**Tags:** xml.sequenceOffset=-90 |

**Table A.29: Referrable**

| *Class* | **ServiceInterface** | | | |
|---|---|---|---|---|
| ***Note*** | This represents the ability to define a PortInterface that consists of a heterogeneous collection of methods, events and fields.<br>**Tags:** atp.recommendedPackage=ServiceInterfaces<br>This Class is only used by the AUTOSAR Adaptive Platform. | | | |
| ***Base*** | *ARElement*, *ARObject*, *AtpBlueprint*, *AtpBlueprintable*, *AtpClassifier*, *AtpType*, *CollectableElement*, *Identifiable*, *MultilanguageReferrable*, *PackageableElement*, *PortInterface*, *Referrable* | | | |
| ***Aggregated by*** | ARPackage.element | | | |
| ***Attribute*** | ***Type*** | ***Mult.*** | ***Kind*** | ***Note*** |
| event | VariableDataPrototype | * | aggr | This represents the collection of events defined in the context of a ServiceInterface.<br>**Stereotypes:** atpSplitable; atpVariation<br>**Tags:**<br>atp.Splitkey=event.shortName, event.variationPoint.shortLabel<br>vh.latestBindingTime=blueprintDerivationTime<br>xml.sequenceOffset=30 |
| field | Field | * | aggr | This represents the collection of fields defined in the context of a ServiceInterface.<br>**Stereotypes:** atpSplitable; atpVariation<br>**Tags:**<br>atp.Splitkey=field.shortName, field.variationPoint.shortLabel<br>vh.latestBindingTime=blueprintDerivationTime<br>xml.sequenceOffset=40 |
| majorVersion | PositiveInteger | 0..1 | attr | Major version of the service contract.<br>**Tags:** xml.sequenceOffset=10 |
| method | ClientServerOperation | * | aggr | This represents the collection of methods defined in the context of a ServiceInterface.<br>**Stereotypes:** atpSplitable; atpVariation<br>**Tags:**<br>atp.Splitkey=method.shortName, method.variationPoint.shortLabel<br>vh.latestBindingTime=blueprintDerivationTime<br>xml.sequenceOffset=50 |
| minorVersion | PositiveInteger | 0..1 | attr | Minor version of the service contract.<br>**Tags:** xml.sequenceOffset=20 |

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| *Class* | **ServiceInterface** | | | |
|---|---|---|---|---|
| trigger | Trigger | * | aggr | This represents the collection of triggers defined in the context of a ServiceInterface.<br>**Stereotypes:** atpSplitable; atpVariation<br>**Tags:**<br>atp.Splitkey=trigger.shortName, trigger.variation Point.shortLabel<br>vh.latestBindingTime=blueprintDerivationTime<br>xml.sequenceOffset=60 |

**Table A.30: ServiceInterface**

| *Class* | **SoftwarePackage** | | | |
|---|---|---|---|---|
| ***Note*** | This meta-class represents the ability to formalize the content of a software package.<br>**Tags:** atp.recommendedPackage=SoftwarePackages<br>This Class is only used by the AUTOSAR Adaptive Platform. | | | |
| ***Base*** | *ARElement*, *ARObject*, *CollectableElement*, *Identifiable*, *MultilanguageReferrable*, *Packageable Element*, *Referrable*, *UploadableDeploymentElement*, *UploadablePackageElement* | | | |
| ***Aggregated by*** | ARPackage.element | | | |
| ***Attribute*** | ***Type*** | ***Mult.*** | ***Kind*** | ***Note*** |
| actionType | SoftwarePackageAction TypeEnum | 0..1 | attr | This attribute defines the action to be taken in the step of processing the enclosing SoftwarePackage. |
| activationAction | SoftwarePackage ActivationActionEnum | 0..1 | attr | This attribute governs the action to be taken after the installation of the SoftwareCluster completed. |
| artifactLocator | ArtifactLocator | 0..1 | aggr | This attribute identifies the software package at configuration time, out of the context of an AUTOSAR model. |
| compressed Software PackageSize | PositiveInteger | 0..1 | attr | This size represents the size of the compressed Software Package. |
| deltaPackage Applicable Version | StrongRevisionLabel String | 0..1 | attr | This attribute identifies the version of the included SoftwareCluster for which the enclosing SoftwarePackage can be used as a delta update |
| estimated DurationOf Operation | TimeValue | 0..1 | attr | This attribute provides an estimation about how long the operation of the SoftwarePackage is going to take for its transfer, processing and activation when updated standalone (not within an update campaign) |
| minimum SupportedUcm Version | RevisionLabelString | 0..1 | attr | This attribute identifies the minimum supported version of the UCM for this SoftwarePackage. |
| packagerId | PositiveInteger | 0..1 | attr | This attribute identifies Id of the organization that provides the packager generating the SoftwarePackage. |
| packager Signature | CryptoService Certificate | 0..1 | ref | This reference identifies the certificate that represents the packager's signature. |
| primary DownloadUri | UriDescription | 0..1 | aggr | This attribute represents the description of the primary download location.<br>**Stereotypes:** atpSplitable<br>**Tags:** atp.Splitkey=primaryDownloadUri.shortName |
| purposeOf Update | Documentation | 0..1 | ref | The referenced Documentation is supposed to provide a description of the purpose of the update. |
| secondary DownloadUri | UriDescription | * | aggr | This attribute represents the description of the secondary download locations.<br>**Stereotypes:** atpSplitable<br>**Tags:** atp.Splitkey=secondaryDownloadUri.shortName |

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| *Class* | **SoftwarePackage** | | | |
|---|---|---|---|---|
| softwareCluster | SoftwareCluster | 0..1 | ref | This reference identifies the SoftwareCluster that belongs to the SoftwarePackage. The nature of this relation is actually more like an aggregation than a reference. But the relation is still modelled as a reference because two ARElements cannot aggregate each other. |
| uncompressed SoftwareCluster Size | PositiveInteger | 0..1 | attr | This attribute gives an indication about the storage that has to be available on the target. |

**Table A.31: SoftwarePackage**

| *Enumeration* | **SoftwarePackageActionTypeEnum** |
|---|---|
| *Note* | This enumeration provides a choice of possible actions for the handling of a software package. This Enumeration is only used by the AUTOSAR Adaptive Platform. |
| *Aggregated by* | SoftwarePackage.actionType |
| *Literal* | *Description* |
| install | Do a clean installation of a SoftwareCluster.<br>**Tags:** atp.EnumerationLiteralIndex=1 |
| remove | Remove a SoftwareCluster.<br>**Tags:** atp.EnumerationLiteralIndex=2 |
| update | Update a previously installed SoftwareCluster.<br>**Tags:** atp.EnumerationLiteralIndex=0 |
| update Configuration | Execute a configuration update.<br>**Tags:** atp.EnumerationLiteralIndex=3 |

**Table A.32: SoftwarePackageActionTypeEnum**

| *Primitive* | **StrongRevisionLabelString** |
|---|---|
| *Note* | This primitive represents a revision label which identifies an object under version control. It represents a pattern which requires three integer numbers separated by a dot, representing from left to right Major Version, MinorVersion, PatchVersion and additional labels for pre-release version and build metadata. Legal patterns are for example: 1.0.0-alpha+001 1.0.0+20130313144700 1.0.0-beta+exp.sha.5114f85<br>**Tags:**<br>xml.xsd.customType=STRONG-REVISION-LABEL-STRING<br>xml.xsd.pattern=(0\|[1-9]\d*)\.(0\|[1-9]\d*)\.(0\|[1-9]\d*)(-((0\|[1-9]\d*\|\d*[a-zA-Z-][0-9a-z A-Z-]*)(\.(0\|[1-9]\d*\|\d*[a-zA-Z-][0-9a-zA-Z-]*))*))?(\+([0-9a-zA-Z-]+(\.[0-9a-zA-Z-]+)*))?<br>xml.xsd.type=string |

**Table A.33: StrongRevisionLabelString**

| **Class** | «atpVariation» **SwDataDefProps** |
|---|---|
| **Note** | This class is a collection of properties relevant for data objects under various aspects. One could consider this class as a "pattern of inheritance by aggregation". The properties can be applied to all objects of all classes in which SwDataDefProps is aggregated.<br>Note that not all of the attributes or associated elements are useful all of the time. Hence, the process definition (e.g. expressed with an OCL or a Document Control Instance MSR-DCI) has the task of implementing limitations.<br>SwDataDefProps covers various aspects:<br>• Structure of the data element for calibration use cases: is it a single value, a curve, or a map, but also the recordLayouts which specify how such elements are mapped/converted to the DataTypes in the programming language (or in AUTOSAR). This is mainly expressed by properties like swRecordLayout and swCalprmAxisSet<br>• Implementation aspects, mainly expressed by swImplPolicy, swVariableAccessImplPolicy, swAddr Method, swPointerTagetProps, baseType, implementationDataType and additionalNativeTypeQualifier<br>• Access policy for the MCD system, mainly expressed by swCalibrationAccess<br>• Semantics of the data element, mainly expressed by compuMethod and/or unit, dataConstr, invalid Value<br>• Code generation policy provided by swRecordLayout<br>**Tags:** vh.latestBindingTime=codeGenerationTime |
| **Base** | *ARObject* |
| **Aggregated by** | *AutosarDataType*.swDataDefProps, CompositeNetworkRepresentation.networkRepresentation, Cpp ImplementationDataTypeElement.swDataDefProps, *DataPrototype*.swDataDefProps, DataPrototype TransformationProps.networkRepresentationProps, DiagnosticDataElement.swDataDefProps, Diagnostic EnvDataElementCondition.swDataDefProps, DiagnosticExtendedDataRecordElement.swDataDefProps, DiagnosticSovdPrimitiveContentElement.swDataDefProps, DltArgumentProps.networkRepresentation, FlatInstanceDescriptor.swDataDefProps, ImplementationDataTypeElement.swDataDefProps, InstantiationDataDefProps.swDataDefProps, ISignal.networkRepresentationProps, McDataInstance. resultingProperties, ParameterAccess.swDataDefProps, PerInstanceMemory.swDataDefProps, *Receiver ComSpec*.networkRepresentation, SecurityEventContextDataElement.networkRepresentation, *Sender ComSpec*.networkRepresentation, SomeipDataPrototypeTransformationProps.networkRepresentation, SwPointerTargetProps.swDataDefProps, SwServiceArg.swDataDefProps, SwSystemconst.swDataDef Props, SystemSignal.physicalProps |

| ***Attribute*** | ***Type*** | ***Mult.*** | ***Kind*** | ***Note*** |
|---|---|---|---|---|
| additionalNative TypeQualifier | NativeDeclarationString | 0..1 | attr | This attribute is used to declare native qualifiers of the programming language which can neither be deduced from the baseType (e.g. because the data object describes a pointer) nor from other more abstract attributes. Examples are qualifiers like "volatile", "strict" or "enum" of the C-language. All such declarations have to be put into one string.<br>**Tags:** xml.sequenceOffset=235 |
| annotation | Annotation | * | aggr | This aggregation allows to add annotations (yellow pads ...) related to the current data object.<br>**Tags:**<br>xml.roleElement=true<br>xml.roleWrapperElement=true<br>xml.sequenceOffset=20<br>xml.typeElement=false<br>xml.typeWrapperElement=false |
| baseType | SwBaseType | 0..1 | ref | Base type associated with the containing data object.<br>**Tags:** xml.sequenceOffset=50 |
| compuMethod | CompuMethod | 0..1 | ref | Computation method associated with the semantics of this data object.<br>**Tags:** xml.sequenceOffset=180 |
| dataConstr | DataConstr | 0..1 | ref | Data constraint for this data object.<br>**Tags:** xml.sequenceOffset=190 |
| displayFormat | DisplayFormatString | 0..1 | attr | This property describes how a number is to be rendered e.g. in documents or in a measurement and calibration system.<br>**Tags:** xml.sequenceOffset=210 |

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| *Class* | «atpVariation» **SwDataDefProps** | | | |
|---|---|---|---|---|
| display Presentation | DisplayPresentation Enum | 0..1 | attr | This attribute controls the presentation of the related data for measurement and calibration tools. |
| implementation DataType | AbstractImplementation DataType | 0..1 | ref | This association denotes the ImplementationDataType of a data declaration via its aggregated SwDataDefProps. It is used whenever a data declaration is not directly referring to a base type. Especially<br>• redefinition of an ImplementationDataType via a "typedef" to another ImplementationDatatype<br>• the target type of a pointer (see SwPointerTarget Props), if it does not refer to a base type directly<br>• the data type of an array or record element within an ImplementationDataType, if it does not refer to a base type directly<br>• the data type of an SwServiceArg, if it does not refer to a base type directly<br>**Tags:** xml.sequenceOffset=215 |
| invalidValue | ValueSpecification | 0..1 | aggr | Optional value to express invalidity of the actual data element.<br>**Tags:** xml.sequenceOffset=255 |
| stepSize | Float | 0..1 | attr | This attribute can be used to define a value which is added to or subtracted from the value of a DataPrototype when using up/down keys while calibrating. |
| swAddrMethod | SwAddrMethod | 0..1 | ref | Addressing method related to this data object. Via an association to the same SwAddrMethod it can be specified that several DataPrototypes shall be located in the same memory without already specifying the memory section itself.<br>**Tags:** xml.sequenceOffset=30 |
| swAlignment | AlignmentType | 0..1 | attr | The attribute describes the intended typical alignment of the DataPrototype. If the attribute is not defined the alignment is determined by the swBaseType size and the memoryAllocationKeywordPolicy of the referenced Sw AddrMethod.<br>**Tags:** xml.sequenceOffset=33 |
| swBit Representation | SwBitRepresentation | 0..1 | aggr | Description of the binary representation in case of a bit variable.<br>**Tags:** xml.sequenceOffset=60 |
| swCalibration Access | SwCalibrationAccess Enum | 0..1 | attr | Specifies the read or write access by MCD tools for this data object.<br>**Tags:** xml.sequenceOffset=70 |
| swCalprmAxis Set | SwCalprmAxisSet | 0..1 | aggr | This specifies the properties of the axes in case of a curve or map etc. This is mainly applicable to calibration parameters.<br>**Tags:** xml.sequenceOffset=90 |
| swComparison Variable | SwVariableRefProxy | * | aggr | Variables used for comparison in an MCD process.<br>**Tags:**<br>xml.sequenceOffset=170<br>xml.typeElement=false |
| swData Dependency | SwDataDependency | 0..1 | aggr | Describes how the value of the data object has to be calculated from the value of another data object (by the MCD system).<br>**Tags:** xml.sequenceOffset=200 |

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| *Class* | «atpVariation» **SwDataDefProps** | | | |
|---|---|---|---|---|
| swHostVariable | SwVariableRefProxy | 0..1 | aggr | Contains a reference to a variable which serves as a host-variable for a bit variable. Only applicable to bit objects.<br>**Tags:**<br>xml.sequenceOffset=220<br>xml.typeElement=false |
| swImplPolicy | SwImplPolicyEnum | 0..1 | attr | Implementation policy for this data object.<br>**Tags:** xml.sequenceOffset=230 |
| swIntended Resolution | Numerical | 0..1 | attr | The purpose of this element is to describe the requested quantization of data objects early on in the design process.<br>The resolution ultimately occurs via the conversion formula present (compuMethod), which specifies the transition from the physical world to the standardized world (and vice-versa) (here, "the slope per bit" is present implicitly in the conversion formula).<br>In the case of a development phase without a fixed conversion formula, a pre-specification can occur through swIntendedResolution.<br>The resolution is specified in the physical domain according to the property "unit".<br>**Tags:** xml.sequenceOffset=240 |
| swInterpolation Method | Identifier | 0..1 | attr | This is a keyword identifying the mathematical method to be applied for interpolation. The keyword needs to be related to the interpolation routine which needs to be invoked.<br>**Tags:** xml.sequenceOffset=250 |
| swIsVirtual | Boolean | 0..1 | attr | This element distinguishes virtual objects. Virtual objects do not appear in the memory, their derivation is much more dependent on other objects and hence they shall have a swDataDependency .<br>**Tags:** xml.sequenceOffset=260 |
| swPointerTarget Props | SwPointerTargetProps | 0..1 | aggr | Specifies that the containing data object is a pointer to another data object.<br>**Tags:** xml.sequenceOffset=280 |
| swRecord Layout | SwRecordLayout | 0..1 | ref | Record layout for this data object.<br>**Tags:** xml.sequenceOffset=290 |
| swRefresh Timing | MultidimensionalTime | 0..1 | aggr | This element specifies the frequency in which the object involved shall be or is called or calculated. This timing can be collected from the task in which write access processes to the variable run. But this cannot be done by the MCD system.<br>So this attribute can be used in an early phase to express the desired refresh timing and later on to specify the real refresh timing.<br>**Tags:** xml.sequenceOffset=300 |
| swTextProps | SwTextProps | 0..1 | aggr | the specific properties if the data object is a text object.<br>**Tags:** xml.sequenceOffset=120 |
| swValueBlock Size | Numerical | 0..1 | attr | This represents the size of a Value Block<br>**Stereotypes:** atpVariation<br>**Tags:**<br>vh.latestBindingTime=preCompileTime<br>xml.sequenceOffset=80 |

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| *Class* | «atpVariation» **SwDataDefProps** | | | |
|---|---|---|---|---|
| swValueBlock SizeMult (ordered) | Numerical | * | attr | This attribute is used to specify the dimensions of a value block (VAL_BLK) for the case that that value block has more than one dimension.<br>The dimensions given in this attribute are ordered such that the first entry represents the first dimension, the second entry represents the second dimension, and so on.<br>For one-dimensional value blocks the attribute swValue BlockSize shall be used and this attribute shall not exist.<br>**Stereotypes:** atpVariation<br>**Tags:** vh.latestBindingTime=preCompileTime |
| unit | Unit | 0..1 | ref | Physical unit associated with the semantics of this data object. This attribute applies if no compuMethod is specified. If both units (this as well as via compuMethod) are specified the units shall be compatible.<br>**Tags:** xml.sequenceOffset=350 |
| valueAxisData Type | ApplicationPrimitive DataType | 0..1 | ref | The referenced ApplicationPrimitiveDataType represents the primitive data type of the value axis within a compound primitive (e.g. curve, map). It supersedes CompuMethod, Unit, and BaseType.<br>**Tags:** xml.sequenceOffset=355 |

**Table A.34: SwDataDefProps**

| *Class* | **SwTextProps** | | | |
|---|---|---|---|---|
| *Note* | This meta-class expresses particular properties applicable to strings in variables or calibration parameters. | | | |
| *Base* | *ARObject* | | | |
| *Aggregated by* | SwDataDefProps.swTextProps | | | |
| *Attribute* | *Type* | *Mult.* | *Kind* | *Note* |
| arraySize Semantics | ArraySizeSemantics Enum | 0..1 | attr | This attribute controls the semantics of the arraysize for the array representing the string in an `ImplementationDataType`.<br>It is there to support a safe conversion between `ApplicationDataType` and `ImplementationDataType`, even for variable length strings as required e.g. for Support of SAE J1939. |
| baseType | SwBaseType | 0..1 | ref | This is the base type of one character in the string. In particular this baseType denotes the intended encoding of the characters in the string on level of `ApplicationDataType`.<br>**Tags:** xml.sequenceOffset=30 |
| swFillCharacter | Integer | 0..1 | attr | Filler character for text parameter to pad up to the maximum length `swMaxTextSize`.<br>The value will be interpreted according to the encoding specified in the associated base type of the data object, e.g. 0x30 (hex) represents the ASCII character zero as filler character and 0 (dec) represents an end of string as filler character.<br>The usage of the fill character depends on the `arraySizeSemantics`.<br>**Tags:** xml.sequenceOffset=40 |

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| *Class* | **SwTextProps** | | | |
|---|---|---|---|---|
| swMaxTextSize | Integer | 0..1 | attr | Specifies the maximum text size in characters. Note the size in bytes depends on the encoding in the corresponding `baseType`.<br>**Stereotypes:** atpVariation<br>**Tags:**<br>vh.latestBindingTime=preCompileTime<br>xml.sequenceOffset=20 |

**Table A.35: SwTextProps**

# B Mentioned APMC Elements

For the sake of completeness, this chapter contains a set of APMC element tables representing APMC elements mentioned in the context of this document but which are not contained directly in the scope of this document.

This chapter is generated.

# C Demands and Constraints on Base Software (normative)

This chapter lists the demands or constraints of this functional cluster for the Base Software on which the AUTOSAR Adaptive Platform is running on (usually a POSIX-compatible operating system).

In many cases, `Persistency` uses advanced hardware and software facilities like caching and buffering, that may lead to data loss in case the ECU is switched off immediately after data was written. Using `redundancy`, data consistency can still be established, but to minimize the time in which a change of stored data can be lost, an integrator has to configure the system appropriately. A final guidance on how to configure the system has to be provided by a software supplier together with an implementation of `Persistency`, because it is highly dependent on the actual implementation. Still, this chapter gives some guidance on what is probably needed based on the implementation variants described in Chapter 4.2.

## C.1 Based on a File System

In this scenario, `Persistency` will probably use the POSIX `fsync()` function. Unfortunately, `fsync()` just ensures that the POSIX subsystem flushes all buffers, but does not in all cases ensure that the file system also clears its caches, and in addition not all file systems are able to ensure that hardware device caches are flushed as well. Therefore, in some cases the actual transmission of the changed information to the hardware will happen asynchronously, i.e. after the methods `ara::per::KeyValueStorage::SyncToStorage` or `ara::per::WriteAccessor::SyncToFile` return to the application.

**[SWS_PER_00575] Synchronous Sync**

*Upstream requirements:* RS_PER_00001

⌈**Type:** Demand

**Description:** To achieve synchronous behavior of `ara::per::KeyValueStorage::SyncToStorage` or `ara::per::WriteAccessor::SyncToFile`, an integrator of an adaptive application that uses `Persistency` has to ensure that a suitable file system is used and configured in a way that either all changes result in immediate changes to the hardware storage, or that `fsync()` has completely synchronous behavior.

**Rationale:** `Persistency` implementations that use a file system will usually rely on `fsync()` for ensuring synchronous behavior of `ara::per::KeyValueStorage::SyncToStorage` or `ara::per::WriteAccessor::SyncToFile`.

**Supporting Material:** Documentation of POSIX `fsync()`.⌋

## C.2 Direct Access to Storage Hardware

In this scenario, `Persistency` has very tight control of the operations of the hardware, and can take care of synchronous behavior of the methods `ara::per::KeyValueStorage::SyncToStorage` or `ara::per::WriteAccessor::SyncToFile`. Any additional necessities for the integration in the system are expected to be provided with the documentation of the specific implementation.

# D Platform Extension Interfaces (normative)

This functional cluster does not specify any Platform Extension Interfaces.

# E Not Implemented Requirements

This chapter lists all functional requirements specified in the corresponding requirement specifications that are not implemented or violated by this specification and provides a rationale.

**[SWS_PER_NA_00002] Invalid Specifier Requirements Not Applicable to this Specification**

*Upstream requirements:* RS_AP_00170, RS_AP_00171, RS_AP_00172

⌈Having Persistency return an error allows for flexible handling of not configured storages, and reduces the dependency of the code on a specific configuration.⌋

**[SWS_PER_NA_00003] Access Sharing Requirements Not Applicable to this Specification**

*Upstream requirements:* RS_AP_00173

⌈Persistency allows opening the same storage twice, the access is handled through a SharedHandle.⌋

# F Change History of AUTOSAR Traceable Items

This chapter provides an overview of the history of constraints and specification items. Please note that the lists in this chapter also include constraints and specification items that have been removed from the specification in a later version. These constraints and specification items do not appear as hyperlinks in the document.

## F.1 Traceable Item History of this Document According to AUTOSAR Release R25-11

### F.1.1 Added Specification Items in R25-11

[APMC_PER_00001] [APMC_PER_00002] [APMC_PER_00003] [APMC_PER_00004] [APMC_PER_00005] [APMC_PER_00006] [APMC_PER_00007] [APMC_PER_00008] [APMC_PER_00009] [APMC_PER_00010] [APMC_PER_00011] [APMC_PER_00012] [APMC_PER_00014] [APMC_PER_00015] [APMC_PER_00016] [APMC_PER_00017] [APMC_PER_00018] [APMC_PER_00019] [APMC_PER_00020] [APMC_PER_00021] [APMC_PER_00022] [APMC_PER_00023] [APMC_PER_00024] [APMC_PER_00025] [APMC_PER_00026] [APMC_PER_00027] [APMC_PER_00028] [APMC_PER_00029] [APMC_PER_00030] [APMC_PER_00031] [APMC_PER_00032] [APMC_PER_00033] [APMC_PER_00034] [APMC_PER_00035] [APMC_PER_00036] [APMC_PER_00037] [APMC_PER_00038] [APMC_PER_00040] [APMC_PER_00042] [APMC_PER_00043] [APMC_PER_00044] [APMC_PER_00045] [APMC_PER_00046] [APMC_PER_00047] [APMC_PER_00048] [APMC_PER_00049] [APMC_PER_00050] [APMC_PER_00051] [APMC_PER_00052] [SWS_PER_00583] [SWS_PER_00584] [SWS_PER_00585] [SWS_PER_00586] [SWS_PER_00587] [SWS_PER_00588] [SWS_PER_00589] [SWS_PER_00590] [SWS_PER_00591] [SWS_PER_00592] [SWS_PER_00593] [SWS_PER_00594] [SWS_PER_00595] [SWS_PER_00596] [SWS_PER_00597] [SWS_PER_00598] [SWS_PER_00599]

### F.1.2 Changed Specification Items in R25-11

[SWS_PER_00042] [SWS_PER_00043] [SWS_PER_00044] [SWS_PER_00046] [SWS_PER_00047] [SWS_PER_00048] [SWS_PER_00049] [SWS_PER_00052] [SWS_PER_00107] [SWS_PER_00111] [SWS_PER_00113] [SWS_PER_00115] [SWS_PER_00116] [SWS_PER_00122] [SWS_PER_00125] [SWS_PER_00146] [SWS_PER_00162] [SWS_PER_00163] [SWS_PER_00164] [SWS_PER_00166] [SWS_PER_00210] [SWS_PER_00211] [SWS_PER_00251] [SWS_PER_00252] [SWS_PER_00254] [SWS_PER_00265] [SWS_PER_00266] [SWS_PER_00267] [SWS_PER_00275] [SWS_PER_00277] [SWS_PER_00281] [SWS_PER_00283] [SWS_PER_00304] [SWS_PER_00311] [SWS_PER_00317] [SWS_PER_00318] [SWS_PER_00319] [SWS_PER_00321] [SWS_PER_00332] [SWS_PER_00333]

[SWS_PER_00334] [SWS_PER_00335] [SWS_PER_00336] [SWS_PER_00337] [SWS_PER_00338] [SWS_PER_00339] [SWS_PER_00340] [SWS_PER_00342] [SWS_PER_00343] [SWS_PER_00357] [SWS_PER_00358] [SWS_PER_00365] [SWS_PER_00367] [SWS_PER_00369] [SWS_PER_00371] [SWS_PER_00375] [SWS_PER_00377] [SWS_PER_00378] [SWS_PER_00379] [SWS_PER_00380] [SWS_PER_00383] [SWS_PER_00384] [SWS_PER_00385] [SWS_PER_00386] [SWS_PER_00387] [SWS_PER_00388] [SWS_PER_00389] [SWS_PER_00390] [SWS_PER_00391] [SWS_PER_00392] [SWS_PER_00393] [SWS_PER_00394] [SWS_PER_00395] [SWS_PER_00396] [SWS_PER_00408] [SWS_PER_00417] [SWS_PER_00423] [SWS_PER_00424] [SWS_PER_00426] [SWS_PER_00427] [SWS_PER_00428] [SWS_PER_00429] [SWS_PER_00431] [SWS_PER_00439] [SWS_PER_00447] [SWS_PER_00448] [SWS_PER_00449] [SWS_PER_00450] [SWS_PER_00451] [SWS_PER_00456] [SWS_PER_00463] [SWS_PER_00464] [SWS_PER_00465] [SWS_PER_00466] [SWS_PER_00467] [SWS_PER_00468] [SWS_PER_00469] [SWS_PER_00470] [SWS_PER_00471] [SWS_PER_00477] [SWS_PER_00478] [SWS_PER_00479] [SWS_PER_00491] [SWS_PER_00492] [SWS_PER_00513] [SWS_PER_00538] [SWS_PER_00543] [SWS_PER_00554] [SWS_PER_00555] [SWS_PER_00556] [SWS_PER_00561] [SWS_PER_00563] [SWS_PER_00571] [SWS_PER_00572] [SWS_PER_00573] [SWS_PER_00576] [SWS_PER_00577] [SWS_PER_00580] [SWS_PER_00581] [SWS_PER_20003] [SWS_PER_20028] [SWS_PER_20029] [SWS_PER_20030]

### F.1.3 Deleted Specification Items in R25-11

[SWS_PER_00413] [SWS_PER_00414] [SWS_PER_00415] [SWS_PER_00416]

### F.1.4 Added Constraints in R25-11

none

### F.1.5 Changed Constraints in R25-11

[SWS_PER_CONSTR_00001] [SWS_PER_CONSTR_00002] [SWS_PER_-CONSTR_00003] [SWS_PER_CONSTR_00004]

### F.1.6 Deleted Constraints in R25-11

none

## F.2 Traceable Item History of this Document According to AUTOSAR Release R24-11

### F.2.1 Added Specification Items in R24-11

[SWS_PER_00574] [SWS_PER_00575] [SWS_PER_00576] [SWS_PER_00577]
[SWS_PER_00578] [SWS_PER_00579] [SWS_PER_00580] [SWS_PER_00581]
[SWS_PER_00582] [SWS_PER_10001] [SWS_PER_10002] [SWS_PER_10003]
[SWS_PER_20001] [SWS_PER_20002] [SWS_PER_20003] [SWS_PER_20004]
[SWS_PER_20005] [SWS_PER_20006] [SWS_PER_20007] [SWS_PER_20008]
[SWS_PER_20009] [SWS_PER_20010] [SWS_PER_20011] [SWS_PER_20012]
[SWS_PER_20013] [SWS_PER_20014] [SWS_PER_20015] [SWS_PER_20016]
[SWS_PER_20017] [SWS_PER_20018] [SWS_PER_20019] [SWS_PER_20020]
[SWS_PER_20021] [SWS_PER_20022] [SWS_PER_20023] [SWS_PER_20024]
[SWS_PER_20025] [SWS_PER_20026] [SWS_PER_20027] [SWS_PER_20028]
[SWS_PER_20029] [SWS_PER_20030] [SWS_PER_20031] [SWS_PER_20032]
[SWS_PER_20033] [SWS_PER_20034] [SWS_PER_20035] [SWS_PER_20036]
[SWS_PER_20037] [SWS_PER_20038] [SWS_PER_20039] [SWS_PER_20040]
[SWS_PER_20041] [SWS_PER_20042] [SWS_PER_20043] [SWS_PER_20044]
[SWS_PER_20045] [SWS_PER_20046] [SWS_PER_20047] [SWS_PER_20048]
[SWS_PER_20049] [SWS_PER_20050] [SWS_PER_20051] [SWS_PER_20052]
[SWS_PER_20053] [SWS_PER_20054] [SWS_PER_20055] [SWS_PER_20056]
[SWS_PER_20057] [SWS_PER_20058] [SWS_PER_20059] [SWS_PER_20060]
[SWS_PER_20061] [SWS_PER_20062] [SWS_PER_20063] [SWS_PER_20064]
[SWS_PER_20065] [SWS_PER_20066] [SWS_PER_20067] [SWS_PER_20068]
[SWS_PER_20069] [SWS_PER_20070] [SWS_PER_20071] [SWS_PER_20072]

### F.2.2 Changed Specification Items in R24-11

[SWS_PER_00050] [SWS_PER_00052] [SWS_PER_00116] [SWS_PER_00119]
[SWS_PER_00165] [SWS_PER_00167] [SWS_PER_00168] [SWS_PER_00311]
[SWS_PER_00313] [SWS_PER_00315] [SWS_PER_00330] [SWS_PER_00343]
[SWS_PER_00350] [SWS_PER_00355] [SWS_PER_00367] [SWS_PER_00368]
[SWS_PER_00369] [SWS_PER_00370] [SWS_PER_00371] [SWS_PER_00372]
[SWS_PER_00383] [SWS_PER_00385] [SWS_PER_00388] [SWS_PER_00389]
[SWS_PER_00392] [SWS_PER_00393] [SWS_PER_00417] [SWS_PER_00418]
[SWS_PER_00419] [SWS_PER_00420] [SWS_PER_00421] [SWS_PER_00422]
[SWS_PER_00537] [SWS_PER_00541] [SWS_PER_00568] [SWS_PER_00569]

### F.2.3 Deleted Specification Items in R24-11

[SWS_PER_00410]

### F.2.4 Added Constraints in R24-11

[SWS_PER_CONSTR_00007]

### F.2.5 Changed Constraints in R24-11

none

### F.2.6 Deleted Constraints in R24-11

none

## F.3 Traceable Item History of this Document According to AUTOSAR Release R23-11

### F.3.1 Added Specification Items in R23-11

[SWS_PER_00567] [SWS_PER_00568] [SWS_PER_00569] [SWS_PER_00570] [SWS_PER_00571] [SWS_PER_00572] [SWS_PER_00573]

### F.3.2 Changed Specification Items in R23-11

[SWS_PER_00049] [SWS_PER_00050] [SWS_PER_00052] [SWS_PER_00116] [SWS_PER_00122] [SWS_PER_00146] [SWS_PER_00147] [SWS_PER_00311] [SWS_PER_00312] [SWS_PER_00323] [SWS_PER_00327] [SWS_PER_00330] [SWS_PER_00333] [SWS_PER_00334] [SWS_PER_00335] [SWS_PER_00336] [SWS_PER_00339] [SWS_PER_00340] [SWS_PER_00342] [SWS_PER_00343] [SWS_PER_00354] [SWS_PER_00356] [SWS_PER_00357] [SWS_PER_00358] [SWS_PER_00359] [SWS_PER_00362] [SWS_PER_00378] [SWS_PER_00386] [SWS_PER_00387] [SWS_PER_00396] [SWS_PER_00407] [SWS_PER_00409] [SWS_PER_00411] [SWS_PER_00412] [SWS_PER_00414] [SWS_PER_00417] [SWS_PER_00432] [SWS_PER_00435] [SWS_PER_00436] [SWS_PER_00437] [SWS_PER_00438] [SWS_PER_00440] [SWS_PER_00441] [SWS_PER_00442] [SWS_PER_00443] [SWS_PER_00444] [SWS_PER_00445] [SWS_PER_00446] [SWS_PER_00447] [SWS_PER_00448] [SWS_PER_00463] [SWS_PER_00477] [SWS_PER_00479] [SWS_PER_00518] [SWS_PER_00533]

### F.3.3 Deleted Specification Items in R23-11

[SWS_PER_00320]

### F.3.4 Added Constraints in R23-11

none

### F.3.5 Changed Constraints in R23-11

[SWS_PER_CONSTR_00001] [SWS_PER_CONSTR_00002] [SWS_PER_-CONSTR_00005]

### F.3.6 Deleted Constraints in R23-11

none

## F.4 Traceable Item History of this Document According to AUTOSAR Release R22-11

### F.4.1 Added Specification Items in R22-11

[SWS_PER_00044] [SWS_PER_00536] [SWS_PER_00537] [SWS_PER_00538]
[SWS_PER_00539] [SWS_PER_00540] [SWS_PER_00541] [SWS_PER_00542]
[SWS_PER_00543] [SWS_PER_00544] [SWS_PER_00545] [SWS_PER_00546]
[SWS_PER_00547] [SWS_PER_00548] [SWS_PER_00549] [SWS_PER_00550]
[SWS_PER_00551] [SWS_PER_00552] [SWS_PER_00553] [SWS_PER_00554]
[SWS_PER_00555] [SWS_PER_00556] [SWS_PER_00557] [SWS_PER_00558]
[SWS_PER_00559] [SWS_PER_00560] [SWS_PER_00561] [SWS_PER_00562]
[SWS_PER_00563] [SWS_PER_00564] [SWS_PER_00565] [SWS_PER_00566]
[SWS_PER_CONSTR_00005] [SWS_PER_CONSTR_00006]

### F.4.2 Changed Specification Items in R22-11

[SWS_PER_00042] [SWS_PER_00043] [SWS_PER_00046] [SWS_PER_00047]
[SWS_PER_00048] [SWS_PER_00049] [SWS_PER_00052] [SWS_PER_00110]
[SWS_PER_00111] [SWS_PER_00112] [SWS_PER_00113] [SWS_PER_00114]
[SWS_PER_00115] [SWS_PER_00116] [SWS_PER_00119] [SWS_PER_00122]
[SWS_PER_00165] [SWS_PER_00166] [SWS_PER_00167] [SWS_PER_00168]
[SWS_PER_00210] [SWS_PER_00211] [SWS_PER_00303] [SWS_PER_00311]
[SWS_PER_00332] [SWS_PER_00333] [SWS_PER_00334] [SWS_PER_00335]
[SWS_PER_00336] [SWS_PER_00337] [SWS_PER_00338] [SWS_PER_00357]
[SWS_PER_00358] [SWS_PER_00365] [SWS_PER_00370] [SWS_PER_00375]
[SWS_PER_00376] [SWS_PER_00377] [SWS_PER_00390] [SWS_PER_00394]
[SWS_PER_00405] [SWS_PER_00406] [SWS_PER_00407] [SWS_PER_00418]
[SWS_PER_00419] [SWS_PER_00420] [SWS_PER_00421] [SWS_PER_00422]

[SWS_PER_00423] [SWS_PER_00426] [SWS_PER_00427] [SWS_PER_00428] [SWS_PER_00429] [SWS_PER_00430] [SWS_PER_00431] [SWS_PER_00438] [SWS_PER_00440] [SWS_PER_00449] [SWS_PER_00450] [SWS_PER_00451] [SWS_PER_00453] [SWS_PER_00455] [SWS_PER_00464] [SWS_PER_00465] [SWS_PER_00466] [SWS_PER_00467] [SWS_PER_00468] [SWS_PER_00491] [SWS_PER_00492] [SWS_PER_00493] [SWS_PER_00512] [SWS_PER_00513] [SWS_PER_00529] [SWS_PER_00530] [SWS_PER_00531] [SWS_PER_NA]

### F.4.3 Deleted Specification Items in R22-11

none

## F.5 Traceable Item History of this Document According to AUTOSAR Release R21-11

### F.5.1 Added Specification Items in R21-11

[SWS_PER_00452] [SWS_PER_00453] [SWS_PER_00454] [SWS_PER_00455] [SWS_PER_00456] [SWS_PER_00457] [SWS_PER_00458] [SWS_PER_00459] [SWS_PER_00460] [SWS_PER_00461] [SWS_PER_00462] [SWS_PER_00463] [SWS_PER_00464] [SWS_PER_00465] [SWS_PER_00466] [SWS_PER_00467] [SWS_PER_00468] [SWS_PER_00469] [SWS_PER_00470] [SWS_PER_00471] [SWS_PER_00472] [SWS_PER_00473] [SWS_PER_00474] [SWS_PER_00475] [SWS_PER_00476] [SWS_PER_00477] [SWS_PER_00478] [SWS_PER_00479] [SWS_PER_00480] [SWS_PER_00481] [SWS_PER_00482] [SWS_PER_00483] [SWS_PER_00484] [SWS_PER_00485] [SWS_PER_00486] [SWS_PER_00487] [SWS_PER_00488] [SWS_PER_00489] [SWS_PER_00490] [SWS_PER_00491] [SWS_PER_00492] [SWS_PER_00493] [SWS_PER_00494] [SWS_PER_00495] [SWS_PER_00496] [SWS_PER_00497] [SWS_PER_00498] [SWS_PER_00499] [SWS_PER_00501] [SWS_PER_00502] [SWS_PER_00503] [SWS_PER_00504] [SWS_PER_00505] [SWS_PER_00506] [SWS_PER_00507] [SWS_PER_00508] [SWS_PER_00509] [SWS_PER_00510] [SWS_PER_00511] [SWS_PER_00512] [SWS_PER_00513] [SWS_PER_00514] [SWS_PER_00515] [SWS_PER_00516] [SWS_PER_00517] [SWS_PER_00518] [SWS_PER_00519] [SWS_PER_00520] [SWS_PER_00521] [SWS_PER_00522] [SWS_PER_00523] [SWS_PER_00524] [SWS_PER_00525] [SWS_PER_00526] [SWS_PER_00527] [SWS_PER_00528] [SWS_PER_00529] [SWS_PER_00530] [SWS_PER_00531] [SWS_PER_00532] [SWS_PER_00533] [SWS_PER_00534] [SWS_PER_00535] [SWS_PER_CONSTR_00001] [SWS_PER_CONSTR_00002]

### F.5.2 Changed Specification Items in R21-11

[SWS_PER_00042] [SWS_PER_00043] [SWS_PER_00046] [SWS_PER_00047]
[SWS_PER_00048] [SWS_PER_00049] [SWS_PER_00052] [SWS_PER_00110]
[SWS_PER_00111] [SWS_PER_00112] [SWS_PER_00113] [SWS_PER_00114]
[SWS_PER_00115] [SWS_PER_00116] [SWS_PER_00119] [SWS_PER_00122]
[SWS_PER_00163] [SWS_PER_00164] [SWS_PER_00165] [SWS_PER_00166]
[SWS_PER_00167] [SWS_PER_00168] [SWS_PER_00210] [SWS_PER_00211]
[SWS_PER_00221] [SWS_PER_00251] [SWS_PER_00252] [SWS_PER_00265]
[SWS_PER_00275] [SWS_PER_00277] [SWS_PER_00281] [SWS_PER_00283]
[SWS_PER_00311] [SWS_PER_00317] [SWS_PER_00318] [SWS_PER_00319]
[SWS_PER_00320] [SWS_PER_00321] [SWS_PER_00322] [SWS_PER_00323]
[SWS_PER_00326] [SWS_PER_00327] [SWS_PER_00331] [SWS_PER_00332]
[SWS_PER_00333] [SWS_PER_00334] [SWS_PER_00335] [SWS_PER_00336]
[SWS_PER_00337] [SWS_PER_00338] [SWS_PER_00357] [SWS_PER_00358]
[SWS_PER_00365] [SWS_PER_00375] [SWS_PER_00376] [SWS_PER_00377]
[SWS_PER_00378] [SWS_PER_00379] [SWS_PER_00380] [SWS_PER_00382]
[SWS_PER_00383] [SWS_PER_00385] [SWS_PER_00386] [SWS_PER_00387]
[SWS_PER_00391] [SWS_PER_00395] [SWS_PER_00396] [SWS_PER_00405]
[SWS_PER_00406] [SWS_PER_00407] [SWS_PER_00410] [SWS_PER_00413]
[SWS_PER_00414] [SWS_PER_00418] [SWS_PER_00419] [SWS_PER_00420]
[SWS_PER_00421] [SWS_PER_00422] [SWS_PER_00423] [SWS_PER_00426]
[SWS_PER_00427] [SWS_PER_00428] [SWS_PER_00429] [SWS_PER_00430]
[SWS_PER_00431] [SWS_PER_00432] [SWS_PER_00433] [SWS_PER_00438]
[SWS_PER_00446] [SWS_PER_00447] [SWS_PER_00449] [SWS_PER_00450]
[SWS_PER_00451]

### F.5.3 Deleted Specification Items in R21-11

[SWS_PER_00222] [SWS_PER_00397]

## F.6 Traceable Item History of this Document According to AUTOSAR Release R20-11

### F.6.1 Added Specification Items in R20-11

[SWS_PER_00411] [SWS_PER_00412] [SWS_PER_00413] [SWS_PER_00414]
[SWS_PER_00415] [SWS_PER_00416] [SWS_PER_00417] [SWS_PER_00418]
[SWS_PER_00419] [SWS_PER_00420] [SWS_PER_00421] [SWS_PER_00422]
[SWS_PER_00423] [SWS_PER_00424] [SWS_PER_00425] [SWS_PER_00426]
[SWS_PER_00427] [SWS_PER_00428] [SWS_PER_00429] [SWS_PER_00430]
[SWS_PER_00431] [SWS_PER_00432] [SWS_PER_00433] [SWS_PER_00434]
[SWS_PER_00435] [SWS_PER_00436] [SWS_PER_00437] [SWS_PER_00438]
[SWS_PER_00439] [SWS_PER_00440] [SWS_PER_00441] [SWS_PER_00442]

[SWS_PER_00443] [SWS_PER_00444] [SWS_PER_00445] [SWS_PER_00446] [SWS_PER_00447] [SWS_PER_00448] [SWS_PER_00449] [SWS_PER_00450] [SWS_PER_00451]

### F.6.2 Changed Specification Items in R20-11

[SWS_PER_00042] [SWS_PER_00043] [SWS_PER_00046] [SWS_PER_00047] [SWS_PER_00048] [SWS_PER_00049] [SWS_PER_00052] [SWS_PER_00107] [SWS_PER_00110] [SWS_PER_00111] [SWS_PER_00112] [SWS_PER_00113] [SWS_PER_00114] [SWS_PER_00115] [SWS_PER_00116] [SWS_PER_00119] [SWS_PER_00122] [SWS_PER_00125] [SWS_PER_00144] [SWS_PER_00146] [SWS_PER_00147] [SWS_PER_00162] [SWS_PER_00163] [SWS_PER_00164] [SWS_PER_00165] [SWS_PER_00166] [SWS_PER_00167] [SWS_PER_00168] [SWS_PER_00210] [SWS_PER_00211] [SWS_PER_00251] [SWS_PER_00252] [SWS_PER_00265] [SWS_PER_00266] [SWS_PER_00267] [SWS_PER_00275] [SWS_PER_00277] [SWS_PER_00281] [SWS_PER_00283] [SWS_PER_00304] [SWS_PER_00311] [SWS_PER_00312] [SWS_PER_00317] [SWS_PER_00318] [SWS_PER_00319] [SWS_PER_00332] [SWS_PER_00333] [SWS_PER_00334] [SWS_PER_00335] [SWS_PER_00336] [SWS_PER_00337] [SWS_PER_00338] [SWS_PER_00339] [SWS_PER_00340] [SWS_PER_00342] [SWS_PER_00343] [SWS_PER_00356] [SWS_PER_00357] [SWS_PER_00358] [SWS_PER_00365] [SWS_PER_00375] [SWS_PER_00376] [SWS_PER_00377] [SWS_PER_00378] [SWS_PER_00379] [SWS_PER_00380] [SWS_PER_00383] [SWS_PER_00385] [SWS_PER_00388] [SWS_PER_00389] [SWS_PER_00390] [SWS_PER_00391] [SWS_PER_00392] [SWS_PER_00393] [SWS_PER_00394] [SWS_PER_00395] [SWS_PER_00396] [SWS_PER_00405] [SWS_PER_00406] [SWS_PER_00407] [SWS_PER_00409] [SWS_PER_CONSTR_00004]

### F.6.3 Deleted Specification Items in R20-11

[SWS_PER_00106] [SWS_PER_00108] [SWS_PER_00124] [SWS_PER_00126] [SWS_PER_00127] [SWS_PER_00128] [SWS_PER_00140] [SWS_PER_00141] [SWS_PER_00142] [SWS_PER_00143] [SWS_PER_00145] [SWS_PER_00180] [SWS_PER_00181] [SWS_PER_00182] [SWS_PER_00341] [SWS_PER_00344] [SWS_PER_00345] [SWS_PER_00346] [SWS_PER_00347] [SWS_PER_00348] [SWS_PER_00349] [SWS_PER_00366] [SWS_PER_00381] [SWS_PER_00404] [SWS_PER_CONSTR_00002]

## F.7 Traceable Item History of this Document According to AUTOSAR Release R19-11

### F.7.1 Added Specification Items in R19-11

[SWS_PER_00398] [SWS_PER_00399] [SWS_PER_00400] [SWS_PER_00401] [SWS_PER_00402] [SWS_PER_00403] [SWS_PER_00404] [SWS_PER_00405] [SWS_PER_00406] [SWS_PER_00407] [SWS_PER_00408] [SWS_PER_00409] [SWS_PER_00410]

### F.7.2 Changed Specification Items in R19-11

[SWS_PER_00049] [SWS_PER_00113] [SWS_PER_00114] [SWS_PER_00115] [SWS_PER_00144] [SWS_PER_00145] [SWS_PER_00146] [SWS_PER_00147] [SWS_PER_00163] [SWS_PER_00164] [SWS_PER_00303] [SWS_PER_00317] [SWS_PER_00318] [SWS_PER_00319] [SWS_PER_00323] [SWS_PER_00327] [SWS_PER_00345] [SWS_PER_00351] [SWS_PER_00365] [SWS_PER_00368] [SWS_PER_00370] [SWS_PER_00372]

### F.7.3 Deleted Specification Items in R19-11

[SWS_PER_00044] [SWS_PER_CONSTR_00001]

## F.8 Traceable Item History of this Document According to AUTOSAR Release 19-03

### F.8.1 Added Specification Items in 19-03

[SWS_PER_00349] [SWS_PER_00350] [SWS_PER_00351] [SWS_PER_00352] [SWS_PER_00353] [SWS_PER_00354] [SWS_PER_00355] [SWS_PER_00356] [SWS_PER_00357] [SWS_PER_00358] [SWS_PER_00359] [SWS_PER_00360] [SWS_PER_00361] [SWS_PER_00362] [SWS_PER_00363] [SWS_PER_00364] [SWS_PER_00365] [SWS_PER_00366] [SWS_PER_00367] [SWS_PER_00368] [SWS_PER_00369] [SWS_PER_00370] [SWS_PER_00371] [SWS_PER_00372] [SWS_PER_00373] [SWS_PER_00374] [SWS_PER_00375] [SWS_PER_00376] [SWS_PER_00377] [SWS_PER_00378] [SWS_PER_00379] [SWS_PER_00380] [SWS_PER_00381] [SWS_PER_00382] [SWS_PER_00383] [SWS_PER_00384] [SWS_PER_00385] [SWS_PER_00386] [SWS_PER_00387] [SWS_PER_00388] [SWS_PER_00389] [SWS_PER_00390] [SWS_PER_00391] [SWS_PER_00392] [SWS_PER_00393] [SWS_PER_00394] [SWS_PER_00395] [SWS_PER_00396] [SWS_PER_00397] [SWS_PER_CONSTR_00001] [SWS_PER_CONSTR_00002] [SWS_PER_CONSTR_00003] [SWS_PER_CONSTR_00004]

### F.8.2 Changed Specification Items in 19-03

[SWS_PER_00042] [SWS_PER_00043] [SWS_PER_00044] [SWS_PER_00046]
[SWS_PER_00047] [SWS_PER_00048] [SWS_PER_00049] [SWS_PER_00052]
[SWS_PER_00110] [SWS_PER_00111] [SWS_PER_00112] [SWS_PER_00113]
[SWS_PER_00114] [SWS_PER_00115] [SWS_PER_00116] [SWS_PER_00119]
[SWS_PER_00127] [SWS_PER_00128] [SWS_PER_00144] [SWS_PER_00145]
[SWS_PER_00251] [SWS_PER_00252] [SWS_PER_00253] [SWS_PER_00254]
[SWS_PER_00265] [SWS_PER_00266] [SWS_PER_00267] [SWS_PER_00275]
[SWS_PER_00277] [SWS_PER_00281] [SWS_PER_00283] [SWS_PER_00304]
[SWS_PER_00311] [SWS_PER_00312] [SWS_PER_00313] [SWS_PER_00314]
[SWS_PER_00315] [SWS_PER_00322] [SWS_PER_00323] [SWS_PER_00326]
[SWS_PER_00327] [SWS_PER_00328] [SWS_PER_00329] [SWS_PER_00330]
[SWS_PER_00332] [SWS_PER_00333] [SWS_PER_00334] [SWS_PER_00335]
[SWS_PER_00336] [SWS_PER_00337] [SWS_PER_00338] [SWS_PER_00340]

### F.8.3 Deleted Specification Items in 19-03

[SWS_PER_00160] [SWS_PER_00161] [SWS_PER_00255] [SWS_PER_00256]
[SWS_PER_00257] [SWS_PER_00258] [SWS_PER_00259] [SWS_PER_00260]
[SWS_PER_00261] [SWS_PER_00262] [SWS_PER_00264] [SWS_PER_00268]
[SWS_PER_00269] [SWS_PER_00270] [SWS_PER_00271] [SWS_PER_00272]
[SWS_PER_00273] [SWS_PER_00274] [SWS_PER_00276] [SWS_PER_00278]
[SWS_PER_00279] [SWS_PER_00280] [SWS_PER_00282] [SWS_PER_00284]
[SWS_PER_00285] [SWS_PER_00300] [SWS_PER_00301] [SWS_PER_00316]

## F.9 Traceable Item History of this Document According to AUTOSAR Release 18-10

### F.9.1 Added Specification Items in 18-10

[SWS_PER_00309] [SWS_PER_00311] [SWS_PER_00312] [SWS_PER_00313]
[SWS_PER_00314] [SWS_PER_00315] [SWS_PER_00316] [SWS_PER_00317]
[SWS_PER_00318] [SWS_PER_00319] [SWS_PER_00320] [SWS_PER_00321]
[SWS_PER_00322] [SWS_PER_00323] [SWS_PER_00324] [SWS_PER_00325]
[SWS_PER_00326] [SWS_PER_00327] [SWS_PER_00328] [SWS_PER_00329]
[SWS_PER_00330] [SWS_PER_00331] [SWS_PER_00332] [SWS_PER_00333]
[SWS_PER_00334] [SWS_PER_00335] [SWS_PER_00336] [SWS_PER_00337]
[SWS_PER_00338] [SWS_PER_00339] [SWS_PER_00340] [SWS_PER_00341]
[SWS_PER_00342] [SWS_PER_00343] [SWS_PER_00344] [SWS_PER_00345]
[SWS_PER_00346] [SWS_PER_00347] [SWS_PER_00348] [SWS_PER_NA]

### F.9.2 Changed Specification Items in 18-10

[SWS_PER_00042] [SWS_PER_00043] [SWS_PER_00044] [SWS_PER_00046]
[SWS_PER_00047] [SWS_PER_00048] [SWS_PER_00049] [SWS_PER_00050]
[SWS_PER_00052] [SWS_PER_00106] [SWS_PER_00107] [SWS_PER_00108]
[SWS_PER_00110] [SWS_PER_00111] [SWS_PER_00112] [SWS_PER_00113]
[SWS_PER_00114] [SWS_PER_00115] [SWS_PER_00116] [SWS_PER_00119]
[SWS_PER_00122] [SWS_PER_00124] [SWS_PER_00125] [SWS_PER_00126]
[SWS_PER_00127] [SWS_PER_00128] [SWS_PER_00140] [SWS_PER_00141]
[SWS_PER_00142] [SWS_PER_00143] [SWS_PER_00144] [SWS_PER_00145]
[SWS_PER_00147] [SWS_PER_00160] [SWS_PER_00161] [SWS_PER_00163]
[SWS_PER_00164] [SWS_PER_00165] [SWS_PER_00166] [SWS_PER_00180]
[SWS_PER_00181] [SWS_PER_00182] [SWS_PER_00210] [SWS_PER_00211]

### F.9.3 Deleted Specification Items in 18-10

[SWS_PER_00004] [SWS_PER_00041] [SWS_PER_00080] [SWS_PER_00129]
[SWS_PER_00130] [SWS_PER_00131] [SWS_PER_00132] [SWS_PER_00133]
[SWS_PER_00134] [SWS_PER_00148] [SWS_PER_00169] [SWS_PER_00170]
[SWS_PER_00171] [SWS_PER_00172] [SWS_PER_00173] [SWS_PER_00174]
[SWS_PER_00175] [SWS_PER_00176] [SWS_PER_00200] [SWS_PER_00201]
[SWS_PER_00220] [SWS_PER_00250] [SWS_PER_00500] [SWS_PER_UNUSED]

## F.10 Traceable Item History of this Document According to AUTOSAR Release 18-03

### F.10.1 Added Specification Items in 18-03

[SWS_PER_00080] [SWS_PER_00146] [SWS_PER_00147] [SWS_PER_00148]
[SWS_PER_00162] [SWS_PER_00163] [SWS_PER_00164] [SWS_PER_00165]
[SWS_PER_00166] [SWS_PER_00167] [SWS_PER_00168] [SWS_PER_00169]
[SWS_PER_00170] [SWS_PER_00171] [SWS_PER_00172] [SWS_PER_00173]
[SWS_PER_00174] [SWS_PER_00175] [SWS_PER_00176] [SWS_PER_00180]
[SWS_PER_00181] [SWS_PER_00182] [SWS_PER_00250] [SWS_PER_00251]
[SWS_PER_00252] [SWS_PER_00253] [SWS_PER_00254] [SWS_PER_00255]
[SWS_PER_00256] [SWS_PER_00257] [SWS_PER_00258] [SWS_PER_00259]
[SWS_PER_00260] [SWS_PER_00261] [SWS_PER_00262] [SWS_PER_00264]
[SWS_PER_00265] [SWS_PER_00266] [SWS_PER_00267] [SWS_PER_00268]
[SWS_PER_00269] [SWS_PER_00270] [SWS_PER_00271] [SWS_PER_00272]
[SWS_PER_00273] [SWS_PER_00274] [SWS_PER_00275] [SWS_PER_00276]
[SWS_PER_00277] [SWS_PER_00278] [SWS_PER_00279] [SWS_PER_00280]
[SWS_PER_00281] [SWS_PER_00282] [SWS_PER_00283] [SWS_PER_00284]
[SWS_PER_00285] [SWS_PER_00300] [SWS_PER_00301] [SWS_PER_00302]
[SWS_PER_00303] [SWS_PER_00304] [SWS_PER_UNUSED]

### F.10.2 Changed Specification Items in 18-03

[SWS_PER_00004] [SWS_PER_00113] [SWS_PER_00114] [SWS_PER_00115] [SWS_PER_00132] [SWS_PER_00133] [SWS_PER_00134] [SWS_PER_00201] [SWS_PER_00220] [SWS_PER_00500]

### F.10.3 Deleted Specification Items in 18-03

[SWS_PER_00003] [SWS_PER_00005] [SWS_PER_00006] [SWS_PER_00007] [SWS_PER_00008] [SWS_PER_00010] [SWS_PER_00012] [SWS_PER_00013] [SWS_PER_00014] [SWS_PER_00015] [SWS_PER_00016] [SWS_PER_00017] [SWS_PER_00018] [SWS_PER_00019] [SWS_PER_00020] [SWS_PER_00051] [SWS_PER_00060] [SWS_PER_00061] [SWS_PER_00076] [SWS_PER_00100] [SWS_PER_00101] [SWS_PER_00102] [SWS_PER_00103] [SWS_PER_00104] [SWS_PER_00105] [SWS_PER_00109] [SWS_PER_00117] [SWS_PER_00118] [SWS_PER_00120] [SWS_PER_00121] [SWS_PER_00123] [SWS_PER_00150] [SWS_PER_00151] [SWS_PER_00152] [SWS_PER_00153] [SWS_PER_00154] [SWS_PER_00155] [SWS_PER_00156] [SWS_PER_00157]

## F.11 Traceable Item History of this Document According to AUTOSAR Release 17-10

### F.11.1 Added Specification Items in 17-10

[SWS_PER_00008] [SWS_PER_00100] [SWS_PER_00101] [SWS_PER_00102] [SWS_PER_00103] [SWS_PER_00104] [SWS_PER_00105] [SWS_PER_00106] [SWS_PER_00107] [SWS_PER_00108] [SWS_PER_00109] [SWS_PER_00110] [SWS_PER_00111] [SWS_PER_00112] [SWS_PER_00113] [SWS_PER_00114] [SWS_PER_00115] [SWS_PER_00116] [SWS_PER_00117] [SWS_PER_00118] [SWS_PER_00119] [SWS_PER_00120] [SWS_PER_00121] [SWS_PER_00122] [SWS_PER_00123] [SWS_PER_00124] [SWS_PER_00125] [SWS_PER_00126] [SWS_PER_00127] [SWS_PER_00128] [SWS_PER_00129] [SWS_PER_00130] [SWS_PER_00131] [SWS_PER_00132] [SWS_PER_00133] [SWS_PER_00134] [SWS_PER_00140] [SWS_PER_00141] [SWS_PER_00142] [SWS_PER_00143] [SWS_PER_00144] [SWS_PER_00145] [SWS_PER_00150] [SWS_PER_00151] [SWS_PER_00152] [SWS_PER_00153] [SWS_PER_00154] [SWS_PER_00155] [SWS_PER_00156] [SWS_PER_00157] [SWS_PER_00160] [SWS_PER_00161] [SWS_PER_00200] [SWS_PER_00201] [SWS_PER_00210] [SWS_PER_00211] [SWS_PER_00220] [SWS_PER_00221] [SWS_PER_00222] [SWS_PER_00500]

### F.11.2 Changed Specification Items in 17-10

[SWS_PER_00003] [SWS_PER_00004] [SWS_PER_00010] [SWS_PER_00013] [SWS_PER_00014] [SWS_PER_00016] [SWS_PER_00017] [SWS_PER_00041] [SWS_PER_00042] [SWS_PER_00043] [SWS_PER_00044] [SWS_PER_00046] [SWS_PER_00047] [SWS_PER_00048] [SWS_PER_00049] [SWS_PER_00050] [SWS_PER_00051] [SWS_PER_00060] [SWS_PER_00061] [SWS_PER_00076]

### F.11.3 Deleted Specification Items in 17-10

[SWS_PER_00011] [SWS_PER_00021] [SWS_PER_00022] [SWS_PER_00023] [SWS_PER_00024] [SWS_PER_00025] [SWS_PER_00026] [SWS_PER_00027] [SWS_PER_00028] [SWS_PER_00029] [SWS_PER_00040] [SWS_PER_00045] [SWS_PER_00053] [SWS_PER_00054] [SWS_PER_00055] [SWS_PER_00056] [SWS_PER_00057] [SWS_PER_00058] [SWS_PER_00059] [SWS_PER_00062] [SWS_PER_00066] [SWS_PER_00069] [SWS_PER_00070] [SWS_PER_00071] [SWS_PER_00072] [SWS_PER_00073] [SWS_PER_00074] [SWS_PER_00075] [SWS_PER_00077] [SWS_PER_00078]

## F.12 Traceable Item History of this Document According to AUTOSAR Release 17-03

### F.12.1 Added Specification Items in 17-03

[SWS_PER_00002] [SWS_PER_00003] [SWS_PER_00004] [SWS_PER_00005] [SWS_PER_00006] [SWS_PER_00007] [SWS_PER_00010] [SWS_PER_00011] [SWS_PER_00012] [SWS_PER_00013] [SWS_PER_00014] [SWS_PER_00015] [SWS_PER_00016] [SWS_PER_00017] [SWS_PER_00018] [SWS_PER_00019] [SWS_PER_00020] [SWS_PER_00021] [SWS_PER_00022] [SWS_PER_00023] [SWS_PER_00024] [SWS_PER_00025] [SWS_PER_00026] [SWS_PER_00027] [SWS_PER_00028] [SWS_PER_00029] [SWS_PER_00040] [SWS_PER_00041] [SWS_PER_00042] [SWS_PER_00043] [SWS_PER_00044] [SWS_PER_00045] [SWS_PER_00046] [SWS_PER_00047] [SWS_PER_00048] [SWS_PER_00049] [SWS_PER_00050] [SWS_PER_00051] [SWS_PER_00052] [SWS_PER_00053] [SWS_PER_00054] [SWS_PER_00055] [SWS_PER_00056] [SWS_PER_00057] [SWS_PER_00058] [SWS_PER_00059] [SWS_PER_00060] [SWS_PER_00061] [SWS_PER_00062] [SWS_PER_00066] [SWS_PER_00069] [SWS_PER_00070] [SWS_PER_00071] [SWS_PER_00072] [SWS_PER_00073] [SWS_PER_00074] [SWS_PER_00075] [SWS_PER_00076] [SWS_PER_00077] [SWS_PER_00078]

### F.12.2 Changed Specification Items in 17-03

none

### F.12.3 Deleted Specification Items in 17-03

none