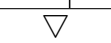
Document Title	Specification of AUTOSAR Run-Time Interface
Document Owner	AUTOSAR
Document Responsibility	AUTOSAR
Document Identification No	923

Document Status	published
Part of AUTOSAR Standard	Classic Platform
Part of Standard Release	R23-11

Document Change History

Date	Release	Changed by	Description
2023-11-23	R23-11	AUTOSAR Release Management	• Extended stopwatch to allow nesting • Added imported types • Editorial changes
2022-11-24	R22-11	AUTOSAR Release Management	• Corrected Error Classification • Introduced ARTI macro with several event parameters • Introduced ARTI class for tracing RTE API and BSW API • Splitted “arti.h” in module depending header files
2021-11-25	R21-11	AUTOSAR Release Management	• Introduced SWS items into specification • Overall review and clarification • ARTI introduced as BSW Module "Arti" • New ARTI API and Errors
2020-11-30	R20-11	AUTOSAR Release Management	• Merged EcuC ArtiXxx containers into one Arti container • Added ARTI for RTE • Changed document status from draft to valid



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2019-11-28	R19-11	AUTOSAR Release Management	• Added expression syntax • Corrected trace macros and ARTI class names • Added and extended several configuration parameters • Corrected SWS item references • Changed Document Status from Final to published
2018-10-31	R4.4.0	AUTOSAR Release Management	• Initial release

Disclaimer

Contents

1 Introduction and functional overview

This specification describes the functionality, API and the configuration for the AUTOSAR Run-Time Interface (“ARTI”) for debugging and tracing AUTOSAR modules.

ARTI defines an interface between build tools and debugging/tracing tools. The debugging/tracing tools shall then forward tracing information to trace/timing analysis tools. The interface shall ease and speed up the debugging, tracing and verification of system behavior as well as round-trip engineering.

Debugging and tracing enables efficient development, integration, optimization and verification of ECU software. For analyzing several aspects - especially timing aspects - it becomes essential to link the debugging and tracing data to the scheduling of an ECU. Knowledge about tasks, interrupts and runnables, in other words: awareness of the operating system (“OS awareness”), is required.

A good interaction of the tool chain provides complete round-trip engineering from model down to hardware and back - covering several software levels and several phases of the V-model.

ARTI shall especially provide

- Support of “OS Awareness”, for example examination of OS specific tasks, threads etc.
- Support of distributes systems and multi-core
- Support of other AUTOSAR modules (e.g. RTE in CP or ARA in AP)
- Support of instrumentation-based tracing and measurement solutions
- Support of TIMEX

The data flow of the tools and the interfaces of ARTI are depicted in figure 1.1.

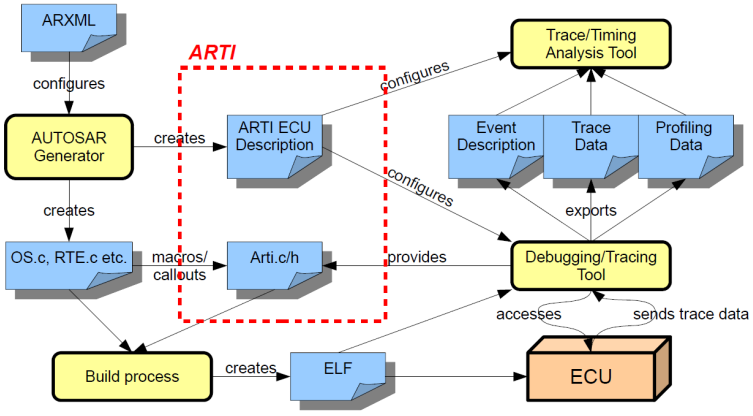

Figure 1.1: ARTI data flow

For some important definitions please read also chapter 1 of RS_FoundationDebugTraceProfile.

To implement the features, ARTI uses a similar approach that the former OSEK-ORTI had, but extends this to current requirements. The tools that generate AUTOSAR modules (e.g. OS, RTE, etc.) have to extend the ECU configuration with internal information about this module and emit the extended configuration as a separate file ("ARTI file"). The information therein shall allow to debug and trace the behavior of this module. Additional tools will collect all ARTI files of an ECU and allow selecting specific items to trace and create tracing hook files for a specific trace channel (e.g. internal buffer, hardware trace buffers, etc.). The build environment creates the final application, which then can be used in the ECU. Debugging and tracing tools can read in the ARTI files and are "AUTOSAR aware", giving additional debugging and tracing features to the developer. These tools can export a trace file, which in turn can be used in trace analysis tools for extended timing analysis, time measurements and optimization runs.

Using the standardized work flow allows interchanging the tools as necessary, and use the tool that fits best for each solution without the need of adapting the work flow.

The work flow of the ARTI file generation and usage is depicted in figure 1.2. ARTI shall only define interfaces within the build process of an AUTOSAR application (i.e. the export of the generators, and the hooks within the AUTOSAR modules). The interfaces for tool communication are post-build and not subject to this specification.

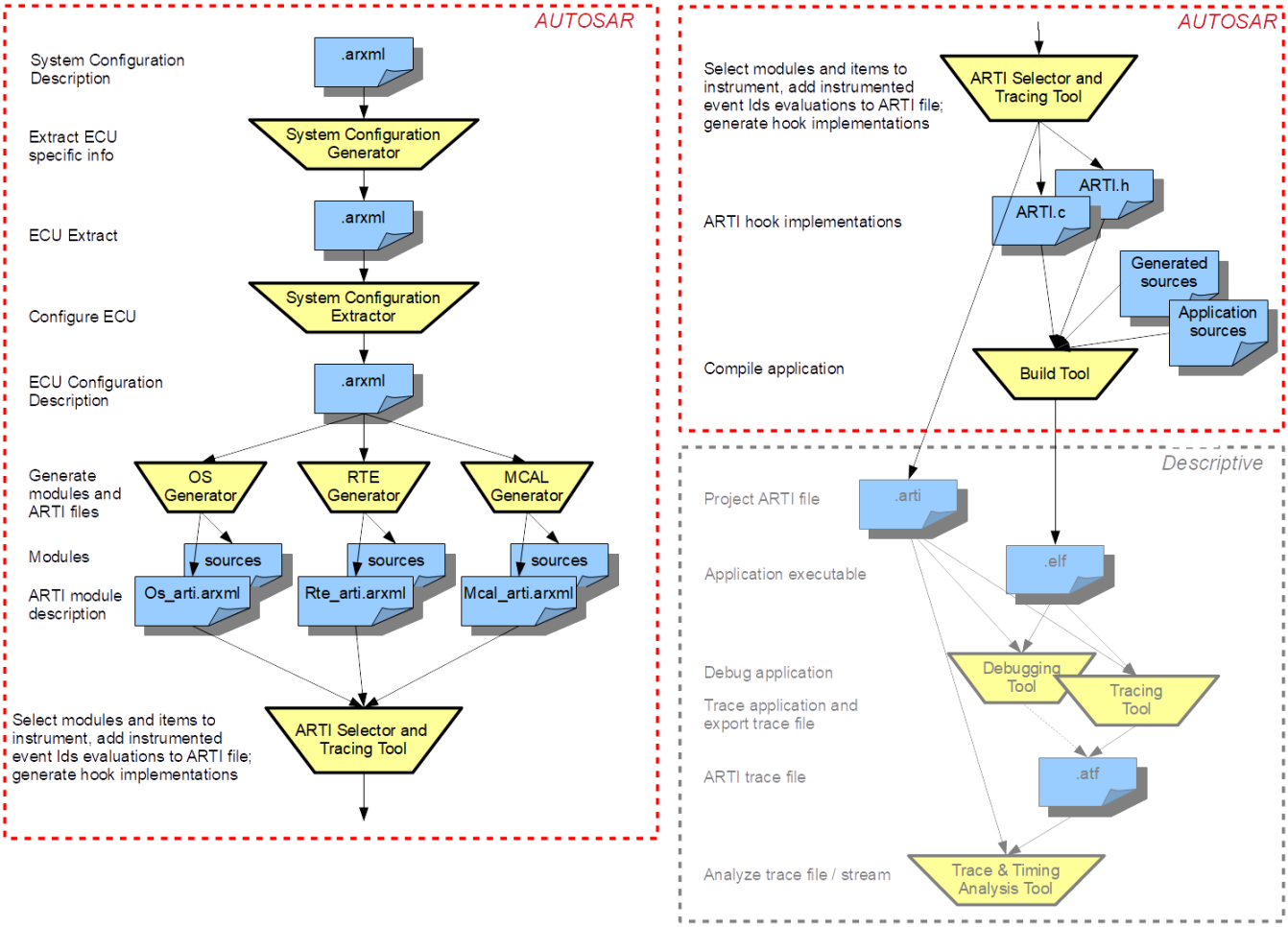

Figure 1.2: ARTI work flow

2 Acronyms and Abbreviations

The glossary below includes acronyms and abbreviations relevant to the ARTI module that are not included in the [1, AUTOSAR glossary].

Abbreviation / Acronym:	Description:
ORTI	"OSEK Run Time Interface", an OSEK specification (in its version 2.2) that defines how debuggers can access OSEK OS internal information.

Terms:	Description:
Debugging	"Debugging" refers to halting a system, either as a whole or in parts, for the purpose of • inspecting the contents of the system in a frozen state • single stepping, setting breakpoints, starting and stopping in C or Assembly code
Tracing	"Tracing" refers to collecting run-time information over a certain period of time • either as a pure software solution, or with hardware assistance • may include processor instruction trace, OS scheduling trace, and/or pure data trace • including time-stamping for further timing analysis
Timing Measurement	"Timing Measurement" refers to capturing of timing information • by instrumentation, e.g. via Pre-/PostTaskHooks or other hooks or callouts or • by dedicated hardware support, e.g. hardware performance counters • does not stop execution
Profiling	"Profiling" refers to the process of gaining timing parameters/timing statistics • of functions, tasks, runnables, modules etc. • possibly with minimum/maximum/average statistics • possibly with worst case analysis • possibly calculated out of trace data, repeated snapshots or Timing Measurement

3 Related documentation

3.1 Input documents & related standards and norms

[1] Glossary
AUTOSAR_FO_TR_Glossary

[2] Specification of Operating System
AUTOSAR_CP_SWS_OS

[3] Specification of RTE Software
AUTOSAR_CP_SWS_RTE

3.2 Related specification

Not applicable yet.

4 Constraints and assumptions

The ARTI concept expects to get an own ARTI module description from each module to be debugged, traced or profiled, e.g. OS and RTE. This allows mixing modules with ARTI support with those without ARTI support. However, as ARTI contains internal information, the implementers of the modules have to provide the ARTI file.

4.1 Limitations

ARTI is supposed to work with debug information created by the compilers. This means each module that supports ARTI needs to be compiled with debug information, and the ARTI file has to use the symbol names created by the compiler.

ARTI introduces new hooks. In order to use them, they shall be incorporated into the module's C code. Either they are put therein statically, or they are put therein dynamically by a generator as configured.

Tracing internal events is very time critical. ARTI focuses on the solutions with the least impact on timing (in some cases with no timing overhead at all), but this depends on the hardware capabilities of the ECU and the tools. ARTI provides examples that describe the possibilities for tracing, depending on the available hardware and software capabilities (see Appendix B).

5 Dependencies to other modules

ARTI depends on OS and RTE module, which refine the ARTI description and hooks for their purposes.

6 Requirements Tracing

The following table references the requirements specified in RS_ClassicPlatformDebugTraceProfile and links to the fulfillment 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_ARTIFO_00014]	ARTI Hooks shall be implemented with minimal intrusion	[SWS_Arti_00017]
[RS_ARTIFO_00015]	ARTI Hooks shall follow a fixed format	[SWS_Arti_00018] [SWS_Arti_00019]
[RS_Arti_00035]	AUTOSAR shall support tracing of arbitrary intervals between a start and a stop event	[SWS_Arti_00001] [SWS_Arti_00002] [SWS_Arti_91000]
[RS_Arti_00036]	AUTOSAR shall support tracing of arbitrary intervals between a start and several stop events	[SWS_Arti_00003] [SWS_Arti_00004]
[RS_Arti_00037]	AUTOSAR shall support tracing of arbitrary values	[SWS_Arti_00005] [SWS_Arti_00006]
[RS_Arti_00038]	AUTOSAR shall support tracing of category 1 interrupts.	[SWS_Arti_00007] [SWS_Arti_00008]
[RS_Arti_00039]	AUTOSAR shall support recording timing events of runnable entities.	[SWS_Arti_00011] [SWS_Arti_00012] [SWS_Arti_00014]
[RS_Arti_00040]	AUTOSAR shall support recording timing events of schedulable entities.	[SWS_Arti_00011] [SWS_Arti_00013] [SWS_Arti_00015]
[RS_Arti_00041]	AUTOSAR shall support recording events from the standardized VFB tracing interface.	[SWS_Arti_00020] [SWS_Arti_00021]
[RS_Arti_00042]	AUTOSAR shall support tracing of entries and exits of BSW modules.	[SWS_Arti_00022] [SWS_Arti_00023]
[RS_Main_01026]	AUTOSAR shall support tracing and profiling on the target and onboard	[SWS_Arti_00016]
[SRS_BSW_00101]	The Basic Software Module shall be able to initialize variables and hardware in a separate initialization function	[SWS_Arti_91004]
[SRS_BSW_00301]	All AUTOSAR Basic Software Modules shall only import the necessary information	[SWS_Arti_91006]
[SRS_BSW_00323]	All AUTOSAR Basic Software Modules shall check passed API parameters for validity	[SWS_Arti_00010]
[SRS_BSW_00330]	It shall be allowed to use macros instead of functions where source code is used and runtime is critical	[SWS_Arti_00017]
[SRS_BSW_00337]	Classification of development errors	[SWS_Arti_00009] [SWS_Arti_91002]
[SRS_BSW_00339]	Reporting of production relevant error status	[SWS_Arti_00009]
[SRS_BSW_00407]	Each BSW module shall provide a function to read out the version information of a dedicated module implementation	[SWS_Arti_91005]

Table 6.1: RequirementsTracing

7 Functional specification

ARTI consists of these functional elements:

- ARTI module description
- ARTI hook implementations

The “ARTI Module Description” is intended to be emitted as an ARXML file. Additional files, such as the “project ARTI file” or “ARTI trace file” may be stored in another file format, whereas this format is beyond AUTOSAR and defined elsewhere.

ARTI is not a traditional software module that creates code and changes the system behavior. Instead ARTI is explicitly designed to *not* affect the overall system behavior. Especially the generation and export of the ARTI module description is intended to not influence the module that generates the ARTI export; ARTI should export information that is already internally available. The exported information will then be post-processed and used by further debugging and tracing tools. However, it might be necessary to introduce some special variables or functions to be able to generate requested information. While this causes some slight impact to the code, it is again the intention not to change the overall behavior of the module using ARTI. The same applies to the hooks: while the hooks itself may have some slight impact on the code base and while the hook implementation (done by the tools consuming ARTI) may have some impact on the timing and on the program flow, it is the intention of ARTI to change the module behavior as little as possible – ideally not at all. Depending on the hook implementation, the behavior may differ. It is the responsibility of the tool vendor to minimize the impact to the behavior of the system.

ARTI shall be defined in a way that it is applicable on the road. If ARTI hooks are implemented, this obviously comes with high safety requirements regarding the implementation of the hooks since e.g. some of the ARTI hooks will be executed in the context of the OS. Special care has to be taken in a multi-core context.

If the implementation of the hooks cannot guarantee safe execution, the ECU must not be used “on the road”. “On the road” here refers to situations where the operation or malfunction might cause danger to persons or property.

7.1 ARTI Module Description

An "ARTI Module Description" is an ARXML file that contains detailed information about a specific module (e.g. OS, RTE, etc.). In particular, this is:

- Constants
  A Constant defines a constant value that is specific to this application or environment. E.g. the number of CPUs used in an ECU could be defined as a constant. Constants are used by a debugger to know about the configuration, or to display the value in a convenient way.
  Constants are referred to by an object information (see "Object Information" be-

low). and are only meaningful in the context of an object.
A Constant is represented by the container ArtiConstant (see chapter 10.7.1).

- Expressions
  An Expression defines how a specific value can be accessed on the target by a debugger to display the current state of the application. Expressions are like C expressions but limited so that they can be evaluated statically. Hence, Expressions allow only accesses to global variables, and only unary, binary and trinary oparators are allowed. Especially accesses to local variables and calls to functions are not allowed. See Appendix C for a full syntax specification of Expressions.
  Expressions are referred to by an object information (see "Object Information" below) and are used to define the evaluation of parameter values therein.
  An Expression is represented by the container ArtiExpression (see chapter 10.7.2).
- Hook definitions
  Hook definitions contain information about which hooks are present in the module and how they look like. These hook definitions are used to create the hook implementation and to trace the information defined by the hook.
  A Hook definition is represented by the container ArtiHook (see chapter 10.7.3).
- Object information
  Objects within a module (e.g. an “OsTask”) get an own representation in the ARTI module description. The object information contains references to the original object as well as references to the expressions and hooks used for this object. All objects of a specific kind are collected in a container. The detailed layout of an object within a specific module is defined in the according SWS.
- Generic components
  ARTI is able to define objects that should show up in a debugger or when tracing, even if those are not standard AUTOSAR objects (e.g. user defined, or additional OS features like semaphores). See chapter 10.3.

7.2 ARTI Hook Implementation

The ARTI hook implementations are generated by a tool that consumes the ARTI description files. They are mainly represented by these files:

- Arti.h
  This file contains the `ARTI_TRACE` macro implementation. The `ARTI_TRACE` macro implementation may expand to a module dependent macro.
- <Mip>_Arti.h This file contains all module dependent macros that are used in the modules supporting ARTI to instrument certain events. It may also contain the implementation of the macro, or may refer to an implementation in Arti.c. <Mip>_Arti.h shall include Arti.h in front of any module specific macro definitions.

- Arti.c
  This file contains the implementation of the API (see chapter 8) and the actual implementation of each macro, if it is not empty or not implemented in the <Mip>_Arti.h file.

All events that are not active will be mapped to an empty macro definition. All events that are active will be expanded to the implementation of the instrumentation. The actual implementation depends on the hardware and software capabilities of the tracing tool. Thus, it depends on the used tracing tool, how the macros are implemented.

Example for the OS module:

The OS source code will include the Os_Arti.h file and use the `ARTI_TRACE` macro.

```
#include "Os_Arti.h"
ARTI_TRACE(NOSUSP, AR_CP_OS, Os, GetCoreId(), OsTask_Activate,
    GetTaskId(MyTask));
```

Listing 7.1: Example: Os_Source.c

The Os_Arti.h file (created by the tool vendor) will include Arti.h and implement the module specific macro.

```
#include "Arti.h"
extern volatile uint32_t arti_os_trace;
#define ARTI_TRACE_AR_CP_OS_TASK_OsTask_Activate(CoreId, TaskId) \
    arti_os_trace = (TaskId<<16) | (ARTI_VALID_OS_SIGNALING<<8) | \
        (ARTI_OSTASK_ACTIVATE<<8) | CoreId ;
```

Listing 7.2: Example: Os_Arti.h

The Arti.h file (created by the tool vendor) will implement the `ARTI_TRACE` macro and expand it to the module specific macro.

```
#define ARTI_TRACE(_contextName, _className, _instanceName, \
        instanceParameter, _eventName, eventParameter) \
    ARTI_TRACE ## _ ## _className ## _ ## \
        _eventName((instanceParameter), (eventParameter))
```

Listing 7.3: Example: Arti.h

The Arti.c file will implement the Arti API (`Arti_Init()` and `Arti_GetVersionInfo()`) and any further code necessary to implement the tracing.

```
volatile uint32_t arti_os_trace;
void Arti_Init (void) {
    arti_os_trace = 0;
}
```

Listing 7.4: Example: Arti.c

7.3 ARTI OS Implementation

ARTI support for OS is specified in [2, SWS OS, chapter 7.16 “ARTI Debug Information”] and [2, SWS OS, chapter 7.17 “ARTI Hook Macros”]. It is related to the application note described in [2, SWS OS, chapter 12.8 , “Debug support”].

7.4 ARTI RTE VFB Trace Client

The ARTI RTE VFB trace client is designed to adapt the VFB tracing mechanism to the ARTI trace. The VFB tracing mechanism provides hooks including parameters for tracing while ARTI trace focuses on minimal intrusive trace using the `ARTI_TRACE` macro.

The ARTI basic software module implements a trace client of the VFB tracing (see AUTOSAR_SWS_RTE chapter 5.11, “VFB Tracing Reference”).

It configures the RTE to generate the hooks for the trace client. These hooks will be mapped to the `ARTI_TRACE` macro with dedicated ARTI trace classes and events.

This mapping is defined in 8.7.2.5.

Restriction: ARTI supports only a subset of the RTE VFB trace client hooks. Thus the [RS_Arti_00041] "AUTOSAR shall support recording events from the standardized VFB tracing interface" is not completely fulfilled and specified. ARTI only supports

- `Rte_Arti_Runnable_<cts>_<reName>_Start`
- `Rte_Arti_Runnable_<cts>_<reName>_Return`
- `Rte_Arti_<api>Hook_<cts>_<ap>_Start`
- `Rte_Arti_<api>Hook_<cts>_<ap>_Return`
- `SchM_Arti_Schedulable_<bsnp>_[<vi>_<ai>_]<entityName>_Start`
- `SchM_Arti_Schedulable_<bsnp>_[<vi>_<ai>_]<entityName>_Return`

7.4.1 RTE VFB Trace Client Configuration

The RTE VFB trace client configuration is done in several steps where RTE generator and ARTI module are interacting. Configuration parameters are exchanged in the EcuC.

1. RTE configuration provides /AUTOSAR/EcucDefs/Rte/RteSwComponentInstance after RTE configuration
2. ARTI creates an own VFB trace client called "Arti" and provides the configuration for the trace client using its own /AUTOSAR/EcucDefs/Rte/RteGeneration/RteVfbTraceClient. Within this container all the /AUTOSAR/EcucDefs/Rte/RteGenera-

tion/RteVfbTraceClient/RteVfbTraceFunction (see AUTOSAR_SWS_RTE RteVfbTraceFunction) are listed for which the ARTI module requests the hooks to be generated. Here ARTI fills out the value and thus generates a 'wishlist' of tracing a certain hook function. Examples are

- to enable trace of all schedulable entity hooks: Rte_Arti_SchM
- to enable trace of all runnable hooks: Rte_Arti_Runnable
- to enable trace of all runnable hooks of a certain component: Rte_Arti_Runnable_MyComponentType where MyComponentType is taken from /AUTOSAR/EcucDefs/Rte/RteSwComponentType
- to enable trace of a runnable hooks of a certain runnable within a certain component: Rte_Arti_Runnable_MyComponentType_MyRunnable where MyRunnable is taken from /AUTOSAR/SoftwareTypes/ComponentTypes/<ApplicationSwComponentType>/<SwcInternalBehavior>/<RunnableEntity>

Within the RteVfbTraceClient container, add an RteVfbTraceHooksRef with an URI pointing to the `ArtiRteVfbTraceHooks` container of the ARTI trace client.

3. Based on this configuration the RTE generator creates the source files containing the trace hooks. The generated hooks are BSW-MODULE-ENTRY where the FUNCTION-PROTOTYPE-EMITTER is "Arti".
4. ARTI generator creates the final trace client based on the BSW-MODULE-ENTRY's for the ARTI trace client. It
   - generates the header file for the mapping of the VFB trace hooks to `ARTI_TRACE` macro. All unused generated hooks are mappend to (void). As part of the mapping, the ARTI module needs to provide a Runnable to RunnableId mapping (see 8.7.2.5, idOf(<reName>)).
   - updates the the RTE's BSWMD with the missing information:
     - extends the BswInternalBehavior of the RTE with each arti hook as function marked with SW-ADDR-METHOD-REF CODE.
     - extends the BSW-MODULE-ENTRY of each hook with the correct SW-SERVICE-IMPL-POLICY (MACRO, INLINE or STANDARD).
     - add the REQUIRED-ARTIFACTS that implement the hooks to the BSW-IMPLEMENTATION.
     - specify the RESOURCE-CONSUMPTION by adding ARTI MEMORY-SECTION that holds the EXECUTABLE-ENTITY-REFS of all hooks and add the SECTION-NAME-PREFIX for the required artifacts.
5. Compile RTE

Example 7.1

1. RTE provides /AUTOSAR/EcucDefs/Rte/RteSwComponentInstance

```
...
<ECUC-CONTAINER-VALUE UUID="cd307f8d-8496-421b-a9e8-571463b08250
    ">
    <SHORT-NAME>ConsumerComponent</SHORT-NAME>
    <DEFINITION-REF DEST="ECUC-PARAM-CONF-CONTAINER-DEF">
        /AUTOSAR/EcucDefs/Rte/RteSwComponentInstance
    </DEFINITION-REF>
    ...
</ECUC-CONTAINER-VALUE>
```

2. ARTI creates VFB trace client

```
...
<ECUC-CONTAINER-VALUE UUID="6de0bb4e-c1ff-4c6c-ae19-3a0f536e7e9e
    ">
    <SHORT-NAME>Arti</SHORT-NAME>
    <DEFINITION-REF DEST="ECUC-PARAM-CONF-CONTAINER-DEF">
        /AUTOSAR/EcucDefs/Rte/RteGeneration/RteVfbTraceClient
    </DEFINITION-REF>
    <PARAMETER-VALUES>
        <ECUC-TEXTUAL-PARAM-VALUE>
            <DEFINITION-REF DEST="ECUC-FUNCTION-NAME-DEF">
                /AUTOSAR/EcucDefs/Rte/RteGeneration/
                RteVfbTraceClient/RteVfbTraceFunction
            </DEFINITION-REF>
            <VALUE>Rte_Arti_Runnable_ConsumerComponent</VALUE>
        </ECUC-TEXTUAL-PARAM-VALUE>
        ...
    </PARAMETER-VALUES>
</ECUC-CONTAINER-VALUE>
...
```

3. Based on this configuration the RTE generator creates the source

```
...
<BSW-MODULE-ENTRY>
    <SHORT-NAME>
        Rte_Arti_Runnable_ConsumerComponent_RE2_Return
    </SHORT-NAME>
    <FUNCTION-PROTOTYPE-EMITTER>Arti</FUNCTION-PROTOTYPE-EMITTER
        >
    <CALL-TYPE>CALLBACK</CALL-TYPE>
</BSW-MODULE-ENTRY>
<BSW-MODULE-ENTRY>
    <SHORT-NAME>
        Rte_Arti_Runnable_ConsumerComponent_RE2_Start
    </SHORT-NAME>
    <FUNCTION-PROTOTYPE-EMITTER>Arti</FUNCTION-PROTOTYPE-EMITTER
        >
    <CALL-TYPE>CALLBACK</CALL-TYPE>
</BSW-MODULE-ENTRY>
...
```

4. ARTI generator updates the RTE's BSWMD with the missing information
   - extends the BswInternalBehavior of the RTE with each arti hook

```
...
<BSW-CALLED-ENTITY>
    <SHORT-NAME>
        Rte_Arti_Runnable_ConsumerComponent_RE2_Start
    </SHORT-NAME>
    <MINIMUM-START-INTERVAL>0.0</MINIMUM-START-INTERVAL>
    <SW-ADDR-METHOD-REF DEST="SW-ADDR-METHOD">
        /AUTOSAR_MemMap/SwAddrMethods/CODE
    </SW-ADDR-METHOD-REF>
    <IMPLEMENTED-ENTRY-REF DEST="BSW-MODULE-ENTRY"
                           BASE="Rte_BSWMD_BswModuleEntrys">
        Rte_Arti_Runnable_ConsumerComponent_RE2_Start
    </IMPLEMENTED-ENTRY-REF>
</BSW-CALLED-ENTITY>
<BSW-CALLED-ENTITY>
    <SHORT-NAME>
        Rte_Arti_Runnable_ConsumerComponent_RE2_Return
    </SHORT-NAME>
    <MINIMUM-START-INTERVAL>0.0</MINIMUM-START-INTERVAL>
    <IMPLEMENTED-ENTRY-REF DEST="BSW-MODULE-ENTRY"
                           BASE="Rte_BSWMD_BswModuleEntrys">
        Rte_Arti_Runnable_ConsumerComponent_RE2_Return
    </IMPLEMENTED-ENTRY-REF>
</BSW-CALLED-ENTITY>
...
```

- extends the BSW-MODULE-ENTRY

```
...
<BSW-MODULE-ENTRY>
    <SHORT-NAME>
        Rte_Arti_Runnable_ConsumerComponent_RE2_Return
    </SHORT-NAME>
    <FUNCTION-PROTOTYPE-EMITTER>Arti</FUNCTION-PROTOTYPE-
       EMITTER>
    <CALL-TYPE>CALLBACK</CALL-TYPE>
    <SW-SERVICE-IMPL-POLICY>INLINE</SW-SERVICE-IMPL-POLICY>
</BSW-MODULE-ENTRY>
<BSW-MODULE-ENTRY>
    <SHORT-NAME>
        Rte_Arti_Runnable_ConsumerComponent_RE2_Start
    </SHORT-NAME>
    <FUNCTION-PROTOTYPE-EMITTER>Arti</FUNCTION-PROTOTYPE-
       EMITTER>
    <CALL-TYPE>CALLBACK</CALL-TYPE>
    <SW-SERVICE-IMPL-POLICY>INLINE</SW-SERVICE-IMPL-POLICY>
</BSW-MODULE-ENTRY>
...
```

- add the REQUIRED-ARTIFACTS

```
...
<BSW-IMPLEMENTATION>
   <SHORT-NAME>Rte</SHORT-NAME>
   <PROGRAMMING-LANGUAGE>C</PROGRAMMING-LANGUAGE>
   <REQUIRED-ARTIFACTS>
```

```
    ...
        <DEPENDENCY-ON-ARTIFACT>
            <SHORT-NAME>Rte_Hook_Arti.h</SHORT-NAME>
            <CATEGORY>MEMMAP</CATEGORY>
            <ARTIFACT-DESCRIPTOR>
                <SHORT-LABEL>Rte_Hook_Arti.h</SHORT-LABEL>
                <CATEGORY>SWHDR</CATEGORY>
            </ARTIFACT-DESCRIPTOR>
            <USAGES>
                <USAGE>COMPILE</USAGE>
            </USAGES>
        </DEPENDENCY-ON-ARTIFACT>
    ...
    </REQUIRED-ARTIFACTS>
    ...
</BSW-IMPLEMENTATION>
...
```

- specify the RESOURCE-CONSUMPTION

```
...
<RESOURCE-CONSUMPTION>
    ...
    <MEMORY-SECTION>
        <SHORT-NAME>RTE_Arti_CODE</SHORT-NAME>
        <EXECUTABLE-ENTITY-REFS>
            <EXECUTABLE-ENTITY-REF DEST="BSW-CALLED-ENTITY"
               BASE="Rte_BSWMD_BswModuleDescriptions">
                Rte/RteInternalBehavior/
                    Rte_Arti_Runnable_ConsumerComponent_RE2_Return

            </EXECUTABLE-ENTITY-REF>
            <EXECUTABLE-ENTITY-REF DEST="BSW-CALLED-ENTITY"
               BASE="Rte_BSWMD_BswModuleDescriptions">
                Rte/RteInternalBehavior/
                    Rte_Arti_Runnable_ConsumerComponent_RE2_Start

            </EXECUTABLE-ENTITY-REF>
        </EXECUTABLE-ENTITY-REFS>
        <PREFIX-REF DEST="SECTION-NAME-PREFIX"
                    BASE="Rte_BSWMD_BswImplementations">
            Rte/ResConsumption/RTE_Arti
        </PREFIX-REF>
        <SW-ADDRMETHOD-REF DEST="SW-ADDR-METHOD">
            /AUTOSAR_MemMap/SwAddrMethods/CODE
        </SW-ADDRMETHOD-REF>
        <SYMBOL>CODE</SYMBOL>
    </MEMORY-SECTION>
    ...
</RESOURCE-CONSUMPTION>
...
```

7.5 Error Classification

Section 7.x "Error Handling" of the document "General Specification of Basic Software Modules" describes the error handling of the Basic Software in detail. Above all, it constitutes a classification scheme consisting of five error types which may occur in BSW modules.

Based on this foundation, the following section specifies particular errors arranged in the respective subsections below.

7.5.1 Development Errors

[SWS_Arti_91002] Definiton of development errors in module Arti ⌈

Type of error	*Related error code*	*Error value*
Initialization of ARTI module failed	ARTI_E_INIT_FAILED	0x01
API parameter checking: invalid pointer	ARTI_E_PARAM_POINTER	0x02

⌋(*SRS_BSW_00337*)

7.5.2 Runtime Errors

There are no runtime errors.

7.5.3 Transient Faults

There are no transient faults.

7.5.4 Production Errors

There are no production errors.

7.5.5 Extended Production Errors

There are no extended production errors.

8 API specification

8.1 Imported types

In this chapter all types included from the following modules are listed:

[SWS_Arti_91006] Definition of imported datatypes of module Arti ⌈

Module	*Header File*	*Imported Type*
Std	Std_Types.h	Std_VersionInfoType

⌋(*SRS_BSW_00301*)

8.2 Type definitions

ARTI does not add any type definitions.

8.3 Symbol definitions

8.3.1 ARTI_STOPWATCH_FLAT, ARTI_STOPWATCH_NESTED

[SWS_Arti_91000] Definition of datatype ARTI_STOPWATCH_FLAT, ARTI_STOPWATCH_NESTED ⌈

Name	ARTI_STOPWATCH_FLAT, ARTI_STOPWATCH_NESTED		
Kind	Enumeration		
Range	ARTI_STOPWATCH_FLAT	0x00u	The stopwatch ignores nesting.
	ARTI_STOPWATCH_NESTED	0x01u	The stopwatch considers nesting.
Description	This value defines how the start and stop event of a stopwatch is evaluated. The symbols ARTI_STOPWATCH_FLAT and ARTI_STOPWATCH_NESTED shall be defined as follows: 1. define ARTI_STOPWATCH_FLAT 0x00u 2. define ARTI_STOPWATCH_NESTED 0x01u		
Available via	Arti.h		

⌋(*RS_Arti_00035*)

8.4 Function definitions

8.4.1 Arti_Init

[SWS_Arti_91004] Definition of API function Arti_Init ⌈

Service Name	Arti_Init

Syntax	`void Arti_Init (`
	`  void`
	`)`

Service ID [hex]	0x00
Sync/Async	Synchronous
Reentrancy	Non Reentrant
Parameters (in)	None
Parameters (inout)	None
Parameters (out)	None
Return value	None
Description	Service to initialize the ARTI module
Available via	Arti.h

⌋(*SRS_BSW_00101*)

The implementation of `Arti_Init` shall be provided by the tool vendor, that implements ARTI hooks.

[SWS_Arti_00009] ⌈If the initialization fails, the function `Arti_Init` shall raise the error `ARTI_E_INIT_FAILED`.⌋(*SRS_BSW_00337, SRS_BSW_00339*) See [SWS_Arti_91002].

8.4.2 Arti_GetVersionInfo

[SWS_Arti_91005] Definition of API function Arti_GetVersionInfo ⌈

Service Name	Arti_GetVersionInfo	

Syntax	`void Arti_GetVersionInfo (`
	`  Std_VersionInfoType* VersionInfoPtr`
	`)`	

Service ID [hex]	0x01	
Sync/Async	Synchronous	
Reentrancy	Reentrant	
Parameters (in)	None	
Parameters (inout)	None	
Parameters (out)	VersionInfoPtr	Pointer to where to store the version information of this module
Return value	None	
Description	Returns the version information of this module.	
Available via	Arti.h	

⌋(*SRS_BSW_00407*)

The implementation of `Arti_GetVersionInfo` shall be provided by the tool vendor, that implements ARTI hooks.

[SWS_Arti_00010] ⌈If the parameter `VersionInfoPtr` is a null pointer, the function `Arti_GetVersionInfo` shall raise the error `ARTI_E_PARAM_POINTER`.⌋*(SRS_BSW_00323)* See [SWS_Arti_91002].

8.5 Callback notifications

ARTI does not provide any callback notifications.

8.6 Scheduled functions

ARTI does not have any functions directly called by Basic Software Scheduler.

8.7 Expected interfaces

In this chapter all interfaces required from other modules are listed.

8.7.1 Mandatory interfaces

8.7.1.1 ARTI Tracing Macro

[SWS_Arti_00017] ARTI Tracing Macro Parameters ⌈ARTI tracing macros shall accept a set of parameters that define the semantics of the macros.⌋*(RS_ARTIFO_00014, SRS_BSW_00330)*

The ARTI tracing macros are used by all modules with ARTI trace capabilities, therefore ARTI based instrumentation can easily be disabled on a global level.

[SWS_Arti_00018] ARTI Tracing Macro Format (single event) ⌈If the event to trace accepts one single event parameter, then ARTI shall use a single event parameter version.⌋*(RS_ARTIFO_00015)*

```
ARTI_TRACE(_contextName, _className, _instanceName,
instanceParameter, _eventName, eventParameter)
```

If there are more event parameters specified, then use the multiple event parameter version specified in chapter 8.7.1.2.

Note: While MISRA-C rules may advise to not to use function-like macros, the usage of a macro is intentionally specified here to improve runtime behavior. See also [SRS_BSW_00330].

Note: The ARTI tracing macros should not contain any BSW module API as parameter within the macro invocation, as the macro expansion does not guarantee a proper evaluation of API calls. Within the implementation of an ARTI macro, special care shall be taken about nesting and possible recursions if it calls BSW module APIs.

Some of the parameters come as tokens (literal text) rather than as symbolic identifiers. This allows a macro definition to concatenate these parameters to more specific and efficient macros. Passing and evaluating all parameters as symbolic identifiers at run-time would be very costly especially by means of run-time consumption.

Here is a possible implementation of the generic `ARTI_TRACE` macro:

```
#define ARTI_TRACE( _contextName, _className, _instanceName, \
                    instanceParameter, _eventName, eventParameter) \
    ARTI_TRACE ## _ ## _className ## _ ## _instanceName \
               ## _ ## _eventName ## _ ## _contextName \
               ( (instanceParameter), (eventParameter) )
```

Such an implementation will generate one hook for all the possible combinations of `_contextName`, `_className`, `_instanceName` and `_eventName` and pass parameters `instanceParameter` and `eventParameter` at run-time only. The parameters' meanings are described in the following.

`_contextName` Token, literal text, name of the context. One of the following:

- **`NOSUSP`** indicating that the hook gets called in a context where interrupts are disabled
- **`SPRVSR`** indicating that the called hook may disable interrupts during this call. The OS functions must not be used for disabling interrupts. Disabling Interrupts can influence the runtime behavior.
- **`USER`** indicating the called hook cannot disable interrupts by itself. If it is necessary to disable interrupts, the appropriate OS functions have to be used. Disabling Interrupts can influence the runtime behavior.

`_className` Token, literal text, name of the class of macros. Classes can be one of the predefined classes (e.g. `AR_CP_OS_TASK`) or user defined. The predefined classes are specified in the SWS of the according BSW module (e.g. SWS_OS).

`_instanceName` Name of an instance

`instanceParameter` Index [uint32] 0..4294967295 of the instance of a particular `_className` and `_instanceName`, the index should start with 0 and be consecutive per `_instanceName`.

`_eventName` Token, literal text, name of the event as defined for a particular class (e.g. `OsTask_Start`).

`eventParameter` A [uint32] 0..4294967295 value as an argument to an event (e.g. Task Index).

All modules which shall support ARTI tracing shall add calls to this macro with the module specific parameters.

The parameters that are marked as *token, literal text* can't be:

- C macros
- variables
- constants
- enumerations

These parameters are meant to be subject of *token concatenation* by the C preprocessor or the trace tool provider (provider of *<Mip>_Arti.h* and *Arti.h*) chooses to map these tokens to symbols within *<Mip>_Arti.h* depending on the trace tool.

Examples:

Examples for _className AR_CP_OS_TASK where _instanceParameter specifies Core ID and _eventParameter specifies Task ID:

1 OS on 2 cores the OS short name is *OsA*, the OS manages three physical CPU cores.

- ```
  ARTI_TRACE(NOSUSP, AR_CP_OS_TASK, OsA, 0, OsTask_Start, 0);
  /* OS OsA start of Task with index 0 on it's own Core 0 */
  ```
- ```
  ARTI_TRACE(NOSUSP, AR_CP_OS_TASK, OsA, 1, OsTask_Start, 0);
  /* OS OsA start of Task with index 0 on it's own Core 1 */
  ```

2 OSs on 1 physical core the OS short names are *OsA* and *OsB*, both run on the same physical CPU core (e.g. Hypervisor)

- ```
  ARTI_TRACE(NOSUSP, AR_CP_OS_TASK, OsA, 0, OsTask_Start, 0);
  /* OS OsA start of Task with index 0 on it's own Core 0 */
  ```
- ```
  ARTI_TRACE(NOSUSP, AR_CP_OS_TASK, OsB, 0, OsTask_Start, 0);
  /* OS OsB start of Task with index 0 on it's own Core 0 */
  ```

2 OSs on 4 cores the OS short names are *OsA* and *OsB* each OS manages two physical CPU cores.

- ```
  ARTI_TRACE(NOSUSP, AR_CP_OS_TASK, OsA, 0, OsTask_Start, 0);
  /* OS OsA start of Task with index 0 on it's own Core 0 */
  ```
- ```
  ARTI_TRACE(NOSUSP, AR_CP_OS_TASK, OsA, 1, OsTask_Start, 0);
  /* OS OsA start of Task with index 0 on it's own Core 1 */
  ```
- ```
  ARTI_TRACE(NOSUSP, AR_CP_OS_TASK, OsB, 0, OsTask_Start, 0);
  /* OS OsB start of Task with index 0 on it's own Core 0 */
  ```
- ```
  ARTI_TRACE(NOSUSP, AR_CP_OS_TASK, OsB, 1, OsTask_Start, 0);
  /* OS OsB start of Task with index 0 on it's own Core 1 */
  ```

2 OSs, 2 virtual cores each and 3 physical cores the OS short names are *OsA* and *OsB* each OS manages two virtual CPU cores (e.g. Hypervisor manages the three physical CPU cores).

- `ARTI_TRACE(NOSUSP, AR_CP_OS_TASK, OsA, 0, OsTask_Start, 0);`
  `/* OS OsA start of Task with index 0 on it's own Core 0 */`
- `ARTI_TRACE(NOSUSP, AR_CP_OS_TASK, OsA, 1, OsTask_Start, 0);`
  `/* OS OsA start of Task with index 0 on it's own Core 1 */`
- `ARTI_TRACE(NOSUSP, AR_CP_OS_TASK, OsB, 0, OsTask_Start, 0);`
  `/* OS OsB start of Task with index 0 on it's own Core 0 */`
- `ARTI_TRACE(NOSUSP, AR_CP_OS_TASK, OsB, 1, OsTask_Start, 0);`
  `/* OS OsB start of Task with index 0 on it's own Core 1 */`

`AMODULE`, a user defined class with a single instance called `AModule1`.

- `ARTI_TRACE(SPRVSR, AMODULE, AModule1, 0, Thing_Start, 123);`

8.7.1.2 ARTI Tracing Macro with Multiple Parameters

If an events accepts more than one parameter, all the specifications in chapter 8.7.1.1 apply, except the following items.

[SWS_Arti_00019] ARTI Tracing Macro Format (multiple events) ⌈If the event to trace accepts more than one parameters, then ARTI shall use the multiple event parameter version.⌋ *(RS_ARTIFO_00015)*

```
ARTI_TRACE_N(_contextName, _className, _instanceName,
instanceParameter, _eventName, numEventParameters, ...)
```

The event parameters' meaning are described in the following.

`numEventParameters` An integer value that defines how many paremters are given in the eventParameterList.

. . . (ellipsis) A comma separated list of event parameters. The event parameters are specified in the ArtiHook configuration container by referencing to an appropriate BswModuleEntry (see chapter 10.7.3).

The macro layout allows a macro definition to concatenate the macro parameters to more specific and efficient macros. Here is a possible implementation of the generic `ARTI_TRACE_N` macro:

```
1 #define ARTI_TRACE_N( _contextName, _className, _instanceName, \
2                       instanceParameter, _eventName, \
3                       _enventParameterCount, ...) \
4     ARTI_TRACE_ ## _enventParameterCount( _contextName, _className, \
5                     _instanceName, instanceParameter, _eventName, \
6                     __VA_ARGS__ )
7 #define ARTI_TRACE_2( _contextName, _className, _instanceName, \
```

```
                        instanceParameter, _eventName, \
                        eventParameter1, eventParameter2) \
    ARTI_TRACE ## _ ## _className ## _ ## _instanceName \
                ## _ ## _eventName ## _2 (instanceParameter, \
                eventParameter1, eventParameter2)
```

Examples using the above macro expansion:

```
#define ARTI_TRACE_AR_CP_RTE_API_SoAd_IfTransmit_Start_2 \
            ( coreId, portId, data ) \
    arti_rteapi_trace = (portId << 16) | (1 << 8) | coreId;
#define ARTI_TRACE_AR_CP_RTE_API_SoAd_IfTransmit_Return_2 \
            ( coreId, portId, data ) \
    arti_rteapi_trace = (portId << 16) | (2 << 8) | coreId;

void Rte_ReadHook_SoAd_Port1_IfTransmit_Start(int data) {
    ARTI_TRACE_N(USER, AR_CP_RTE_API, SoAd, coreId,
        IfTransmit_Start, 2, 1, data);
}
void Rte_ReadHook_SoAd_Port2_IfTransmit_Return(int data) {
    ARTI_TRACE_N(USER, AR_CP_RTE_API, SoAd, coreId,
        IfTransmit_Return, 2, 1, data);
}
```

8.7.2 Optional interfaces

This section defines all interfaces, which are required to fulfill an optional functionality of the module.

8.7.2.1 ARTI Generic Stopwatch

[SWS_Arti_00001] Define USER_STOPWATCH ⌈ARTI shall define a trace class for tracing of arbitrary intervals between a start and a stop event called `USER_STOPWATCH`.⌋ *(RS_Arti_00035)*

A stopwatch can be used to time between two user defined points in an application. The user can put the corresponding `ARTI_TRACE` macro calls of the class `USER_STOPWATCH` anywhere in the code. An arbitrary number of stopwatches are supported by using different instance names (`_instanceName`). Please note that the trace tool provider might put limits on the number of active stopwatches.

The generic stopwatch provides a flat tracing (ignoring recurrent start/stop events and the task context) and a nested tracing (considering nested start/stop events and the task context).

Nested Stopwatch:

A trace tool tracing a stopwatch shall consider nesting, if the `instanceParameter` is set to `ARTI_STOPWATCH_NESTED`. Timing shall be measured between Start and Stop events belonging to the same nesting level and the same task that emits this event.

The task context shall be derived by tracing the OS tasks and Cat2Isrs as defined in the chapter "ARTI Hook Macros" in the SWS_OS. Please note that a started nested stopwatch *cannot* be stopped in another task.

A typical use case of a nested stopwatch is a function trace.

Flat Stopwatch:

A trace tool shall ignore nesting, if the `iinstanceParameter` is set to `ARTI_STOPWATCH_FLAT`. The trace tool shall at least consider the time between the first Start event and the first Stop event in a given sequence and doesn't need to consider nested Start and Stop events. E.g.

1. **`Start`**
2. *`Start`* (ignored, already started)
3. **`Stop`**
4. *`Stop`* (ignored, no matching `START`)
5. **`Start`**
6. **`Stop`**

Only events in **bold** are considered, time is calculated between *1 and 3* and *5 and 6*.

Note: It is not defined if a stopwatch considers cores. It is implementation dependent, if a stopwatch can cross cores or is bound to a specific core.

[SWS_Arti_00002] Macro USER_STOPWATCH ⌈ARTI macros of the class `USER_STOPWATCH` shall compile one of the following templates:⌋ *(RS_Arti_00035)*

```
ARTI_TRACE(_contextName, _className, _instanceName,
instanceParameter, _eventName, eventParameter);
```

```
ARTI_TRACE_N(_contextName, _className, _instanceName,
instanceParameter, _eventName, numEventParameters, ...);
```

Parameter	*Type*	*Description*
_contextName	Token, literal text	see 8.7.1.1
_className	Token, literal text	USER_STOPWATCH
_instanceName	Token, literal text	value that identifies the instance of the stopwatch
instanceParameter	uint32	ARTI_STOPWATCH_FLAT, if nesting is ignored. ARTI_STOPWATCH_NESTED, if nesting is considered.
_eventName	Token, literal text	value that identifies the event of the timer, one of Start or Stop
numEventParameter	uint32	number of given event parameters
eventParameter or "..."	-	arbitrary event parameters

A generic stopwatch can be associated with a C function by providing the function name and file name in the ArtiHookAssociatedFunction and ArtiHookFileName attributes of the ArtiHook container.

Example 8.1

flat stopwatch

```
1 ARTI_TRACE(USER, USER_STOPWATCH, myStopwatch, ARTI_STOPWATCH_FLAT,
      Start, 0);
2 ARTI_TRACE(USER, USER_STOPWATCH, myStopwatch, ARTI_STOPWATCH_FLAT, Stop
      , 0);
```

Example 8.2

nested stopwatch

```
1  static int myFunction (int par1)
2  {
3      int ret;
4      ARTI_TRACE_N (USER, USER_STOPWATCH, myArbFunction1,
           ARTI_STOPWATCH_NESTED, Start, 1, par1);
5      do_something_1();
6      ARTI_TRACE_N (USER, USER_STOPWATCH, myArbStopWatch1,
           ARTI_STOPWATCH_NESTED, Start, 1, myVar);
7      ret = do_something_2();
8      ARTI_TRACE_N (USER, USER_STOPWATCH, myArbStopWatch1,
           ARTI_STOPWATCH_NESTED, Stop, 1, myVar);
9      do_something_3();
10     ARTI_TRACE_N (USER, USER_STOPWATCH, myArbFunction1,
           ARTI_STOPWATCH_NESTED, Stop, 1, ret);
11     return ret;
12 }
```

8.7.2.2 ARTI Generic Dataflow Stopwatch

[SWS_Arti_00003] Define USER_DATAFLOW_STOPWATCH ⌈ARTI shall define a trace class for tracing of arbitrary intervals between a start and several stop events, with the aim to provide insides to a dataflow, called `USER_DATAFLOW_STOPWATCH`.⌋*(RS_Arti_00036)*

A dataflow stopwatch can be used to time between *write* and *read* accesses to a given variable. The user can put the corresponding `ARTI_TRACE` macro calls of the class `USER_DATAFLOW_STOPWATCH` anywhere in the code. An arbitrary number of dataflow stopwatches are supported by using different instance names (`_instanceName`). Please note that the trace tool provider might put limits on the number of active dataflow stopwatches.

The trace tool shall at least consider the time between the last `Write` event, the first `Read` and the last `Read` event in a given sequence and doesn't need to consider nested `Write` and `Read` events. E.g.

1. *`Write`* (ignored as it gets overwritten in 2)
2. **`Write`**
3. **`Read`**
4. **`Write`**
5. **`Read`** (min)
6. *`Read`* (ignored, if only consider min and max)
7. **`Read`** (max)

Only events in **bold** are considered, time is calculated between *2 and 3* and *4 and 5/7*. The time between 4 and the 5 yields the **min** data age time, likewise the time between 4 and 7 yields the **max** data age time for the second sequence.

[SWS_Arti_00004] Macro USER_DATAFLOW_STOPWATCH ⌈ARTI macros of the class `USER_DATAFLOW_STOPWATCH` shall compile the following template:⌋*(RS_Arti_00036)*

```
ARTI_TRACE(_contextName, _className, _instanceName, instanceParameter, _eventName, eventParameter);
```

Parameter	*Type*	*Description*
_contextName	Token, literal text	see 8.7.1.1
_className	Token, literal text	USER_DATAFLOW_STOPWATCH
_instanceName	Token, literal text	value that identifies the instance of the dataflow stopwatch
instanceParameter	uint32	Not used, should be set to 0
_eventName	Token, literal text	value that identifies the event of the timer, one of Write or Read
eventParameter	uint32	Not used, should be set to 0

Example 8.3

```
1 ARTI_TRACE(USER, USER_DATAFLOW_STOPWATCH, myDataflowStopwatch, 0, Write
    , 0);
2 myVariable = 1;
3 ...
4 uint32 temp = myVariable;
5 ARTI_TRACE(USER, USER_DATAFLOW_STOPWATCH, myDataFlowStopwatch, 0, Read,
     0);
```

8.7.2.3 ARTI Generic Datapoint

[SWS_Arti_00005] Define USER_DATAPOINT ⌈ARTI shall define a trace class for tracing of arbitrary values, called USER_DATAPOINT.⌋ *(RS_Arti_00037)*

A *datapoint* provides the possibility to record different values at user defined locations in the code. The user can put the corresponding ARTI_TRACE macro calls of the class USER_DATAPOINT anywhere in the code. An arbitrary number of data points are supported by using different instance names (_instanceName). Please note that the trace tool provider might put limits on the number of active data points. There are predefined event names (_eventName) for different data types as defined by AUTOSAR (see AUTOSAR_SWS_PlatformTypes, e.g. UINT32) this information might be used by the trace tool for optimized storage and visualization.

[SWS_Arti_00006] Macro USER_DATAPOINT ⌈ARTI macros of the class USER_DATAPOINT shall compile the following template:⌋ *(RS_Arti_00037)*

```
ARTI_TRACE(_contextName, _className, _instanceName, instanceParame-
ter, _eventName, eventParameter);
```

Parameter	Type	Description
_contextName	Token, literal text	see 8.7.1.1
_className	Token, literal text	USER_DATAPOINT
_instanceName	Token, literal text	value that identifies the instance of the data point
instanceParameter	uint32	Not used, should be set to 0
_eventName	Token, literal text	Value that identifies the type of the datapoint. The type is a hint for the tool vendor how to interpret the eventParameter, which is always 32bit wide. Shall be one of the following: • BOOLEAN • UINT8 • UINT16 • UINT32 • SINT8 • SINT16 • SINT32 • FLOAT32
eventParameter	uint32	Value that shall be recorded by the event (up to 32-bits)

Example 8.4

```
1 ARTI_TRACE(USER, USER_DATAPOINT, myDatapoint0, 0, UINT32, 2ul);
2 ARTI_TRACE(USER, USER_DATAPOINT, myDatapoint1, 0, SINT8, s8_Data);
```

8.7.2.4 ARTI Category 1 Interrupts

[SWS_Arti_00007] Define AR_CP_ARTI_CAT1ISR ⌈ARTI shall define a trace class for tracing of category 1 interrupts, called AR_CP_ARTI_CAT1ISR.⌋*(RS_Arti_00038)*

ARTI needs to trace all states of category 1 interrupts and all its state transitions. For some timing parameters (e.g. the interrupt pending time), the simple interrupt start/stop is not enough. Tools evaluating the timings need to reconstruct a more complex state diagram by calculating the transitions from history. To be compatible to standard software, AR_CP_ARTI_CAT1ISR refers to this state model, knowing that tools need to postprocess the event flow to get all relevant information. However, if an OS

implementation can provide a more detailed state diagram, ARTI allows to define more events that won't need postprocessing and allow earlier synchronization of the trace if it is truncated (limited trace buffers). This state diagram is then handled with the class `AR_CP_ARTIEXT_CAT1ISR`. If possible, the second state machine is to be preferred.

AR_CP_ARTI_CAT1ISR :

The class `AR_CP_ARTI_CAT1ISR` contains events allowing the tracing of catecory 1 interrupts.

The following state diagram shows the states and transitions:

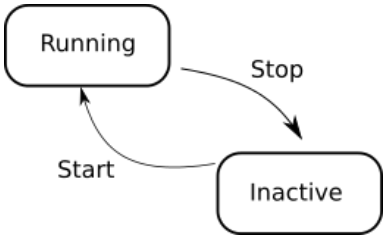

Figure 8.1: ARTI CAT1ISR state machine

Transitions used by ARTI for class `AR_CP_ARTI_CAT1ISR`:

Name	*Transition*	*Event Name*
Start	Inactive -> Running	`OsCat1Isr_Start`
Stop	Running -> Inactive	`OsCat1Isr_Stop`

AR_CP_ARTIEXT_CAT1ISR :

The class `AR_CP_ARTIEXT_CAT1ISR` contains events allowing the tracing of catecory 1 interrupts with an enhanced state model.

The following state diagram shows the state machine as used by ARTI:

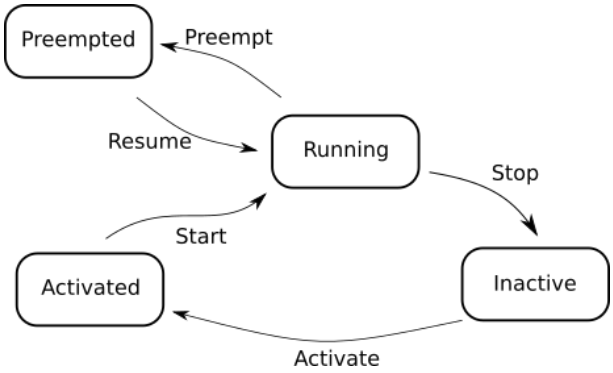

Figure 8.2: ARTI EXT CAT1ISR state machine

States used by ARTI for class `AR_CP_ARTIEXT_CAT1ISR`:

ARTI	*OS*
Inactive	Inactive
Activated	Inactive
Running	Running
Preempted	Running

Transitions used by ARTI for class `AR_CP_ARTIEXT_CAT1ISR`:

Name	*Transition*	*Event Name*
Activate	Inactive -> Activated	`OsCat1Isr_Activate`
Start	Activated -> Running	`OsCat1Isr_Start`
Preempt	Running -> Preempted	`OsCat1Isr_Preempt`
Resume	Preempted -> Running	`OsCat1Isr_Resume`
Stop	Running -> Inactive	`OsCat1Isr_Stop`

[SWS_Arti_00008] Macro AR_CP_ARTI_CAT1ISR ⌈ARTI macros of the classes `AR_CP_ARTI_CAT1ISR` and `AR_CP_ARTIEXT_CAT1ISR` shall compile the following template:⌋*(RS_Arti_00038)*

```
1 ARTI_TRACE(_contextName, AR_CP_ARTI_CAT1ISR, <OS Short Name>, <Core
      Index>, <Event Name>, <Cat1Isr Index>)
2 ARTI_TRACE(_contextName, AR_CP_ARTIEXT_CAT1ISR, <OS Short Name>, <Core
      Index>, <Event Name>, <Cat1Isr Index>)
```

The <Core Index> for any event shall represent the core index where the corresponding Cat1Isr is scheduled on.

The <Event Name> should follow the transition table above.

The <Cat1Isr Index> shall be a numeric identifier of the Cat1Isr.

8.7.2.5 ARTI RTE VFB Trace Client

[SWS_Arti_00011] Generate RTE VFB Trace Client ⌈The ARTI module shall generate an RTE VFB trace client that implements the Runnable Entity Trace Events [3, SWS RTE, chapter 5.11.5.5] and BSW Schedulable Entities Trace Events [3, SWS RTE, chapter 5.11.5.6].⌋*(RS_Arti_00039, RS_Arti_00040)*

[SWS_Arti_00012] Define AR_CP_RTE_RUNNABLE ⌈The Runnable Entity Trace Events shall be mapped to the ARTI Trace Class `AR_CP_RTE_RUNNABLE`.⌋*(RS_Arti_00039)*

[SWS_Arti_00020] Define AR_CP_RTE_API ⌈The RTE API Trace Events shall be mapped to the ARTI Trace Class `AR_CP_RTE_API`.⌋*(RS_Arti_00041)*

[SWS_Arti_00013] Define AR_CP_SCHM_SCHEDULABLE ⌈The BSW Schedulable Entity Trace Events shall be mapped to the ARTI Trace Class `AR_CP_SCHM_SCHEDULABLE`.⌋*(RS_Arti_00040)*

Runnable Entity Trace Events: AR_CP_RTE_RUNNABLE

- `Rte_Arti_Runnable_<cts>_<reName>_Start`
- `Rte_Arti_Runnable_<cts>_<reName>_Return`

RTE API Trace Events: AR_CP_RTE_API

- `Rte_Arti_<api>Hook_<cts>_<ap>_Start`
- `Rte_Arti_<api>Hook_<cts>_<ap>_Return`

BSW Schedulable Entities Trace Events: AR_CP_SCHM_SCHEDULABLE

- `SchM_Arti_Schedulable_<bsnp>_[<vi>_<ai>_]<entityName>_Start`
- `SchM_Arti_Schedulable_<bsnp>_[<vi>_<ai>_]<entityName>_Return`

8.7.2.5.1 Trace Class – AR_CP_RTE_RUNNABLE

[SWS_Arti_00014] Macro AR_CP_RTE_RUNNABLE ⌈ARTI macros of the class `AR_CP_RTE_RUNNABLE` shall compile the following template:⌋*(RS_Arti_00039)*

Runnable Entity Invocation

```
#define Rte_Arti_Runnable_<cts>_<reName>_Start( \
    [const_Rte_CDS_<cts>_ptr]) \
    ARTI_TRACE( _contextName, \
                AR_CP_RTE_RUNNABLE, \
                shortNameOf(<cts>), \
                [const_Rte_CDS_<cts>_ptr]|0, \
                RteRunnable_Start, idOf(<reName>) )
```

Runnable Entity Termination

```
#define Rte_Arti_Runnable_<cts>_<reName>_Return( \
    [const_Rte_CDS_<cts>_ptr]) \
    ARTI_TRACE( _contextName, \
                AR_CP_RTE_RUNNABLE, \
                shortNameOf(<cts>), \
                [const_Rte_CDS_<cts>_ptr]|0, \
                RteRunnable_Return, idOf(<reName>) )
```

<cts> Specifies the component type that is emitted by the RTE. For each component type the mapping is created.

<reName> is the name of the runnable entity. For each name the mapping is created.

shortNameOf() is a hint of the ARTI module the extract use the short name of the element in question.

idOf() is a function of the ARTI module to create an 32-bit ID out of an element. This mapping will also be stored in a type map within ArtiValues and will be referenced by the hook descriptions.

[ ] are optional parameters issued by the RTE. If they do exist then they have to be used. If they do not exist they will be replaced by 0 in the `ARTI_TRACE` macro.

Parameter	*Type*	*Description*
`_contextName`	Token, literal text	see 8.7.1.1, usually this is `USER` for runnables.
`_className`	Token, literal text	`AR_CP_RTE_RUNNABLE`
`_instanceName`	Token, literal text	Is the short name of the `<cts>`, the component type symbol of the `AtomicSwComponentType`
`instanceParameter`	uint32	Is used in case of multiple instanciation. In this case the instance handle as specified in the RTE VFB trace client is used. If single instanciation is used this parameter is 0.
`_eventName`	Token, literal text	value that identifies the event type of the Runnable Entitiy • RteRunnable_Start • RteRunnable_Return
`eventParameter`	uint32	represents the ID of the `<reName>`, the ID of the runnable entity which is generated by the ARTI module.

8.7.2.5.2 Trace Class – AR_CP_SCHM_SCHEDULABLE

[SWS_Arti_00015] Macro AR_CP_SCHM_SCHEDULABLE ⌈ARTI macros of the class `AR_CP_SCHM_SCHEDULABLE` shall compile the following template:⌋*(RS_Arti_00040)*

BSW Schedulable Entities Invocation

```
#define SchM_Arti_Schedulable_<bsnp>_[<vi>_<ai>_]<entityName>_Start() \
    ARTI_TRACE( _contextName, \
                AR_CP_SCHM_SCHEDULABLE, \
                <bsnp>, \
                idOf([<vi>_<ai>])|0, \
                SchMSchedulable_Start, \
                idOf(<entityName>) )
```

BSW Schedulable Entities Termination

```
#define SchM_Arti_Schedulable_<bsnp>_[<vi>_<ai>_]<entityName>
    _Return() \
     ARTI_TRACE( _contextName, \
                 AR_CP_SCHM_SCHEDULABLE, \
                 <bsnp>, \
                 idOf([<vi>_<ai>])|0, \
                 SchMSchedulable_Return, \
                 idOf(<entityName>) )
```

As defined in the RTE specification:

<bsnp> specifies the Basic Software Name Prefix

<vi> is the Vendor ID of the basic software module

<ai> is the Vendor API infix of the basic software module

<entityName> is the name of the BSW Schedulable Entity or Callable Entity

idOf() is a function of the ARTI module to create an 32-bit ID out of an element. This mapping will also be stored in a type map within ArtiValues and will be referenced by the hook descriptions.

[ ] are optional parameters issued by the RTE. If they do exist then they have to be used. If they do not exist they will be replaced by 0 in the `ARTI_TRACE` macro.

Parameter	*Type*	*Description*
`_contextName`	Token, literal text	see 8.7.1.1 usually this is `NOSUSP` for schedulables.
`_className`	Token, literal text	`AR_CP_SCHM_SCHEDULABLE`
`_instanceName`	Token, literal text	The `<bsnp>`, the BSW Scheduler Name Prefix of the basic software module.
`instanceParameter`	uint32	Is used when vendorId and vendorApiInfix of the BSW module are specified. In this case the ARTI module generated an ID for the used pair of vendorIp and vendorApiInfix. If vendorId and vendorApiInfix is not given this parameter is 0.
`_eventName`	Token, literal text	value that identifies the event type of the Schedulable Entitiy • SchmSchedulable_Start • SchmSchedulable_Return
`eventParameter`	uint32	represents the ID of the `<entityName>`, the ID of the schedulable entity which is generated by the ARTI module.

8.7.2.5.3 Trace Class – AR_CP_RTE_API

[SWS_Arti_00021] **Macro AR_CP_RTE_API** ⌈ARTI macros of the class `AR_CP_RTE_API` shall compile the following template:⌋ *(RS_Arti_00041)*

RTE API Start

```
#define Rte_Arti_<api>Hook_<cts>_<ap>_Start( \
    [const_Rte_CDS_<cts> * instance_ptr], param...) \
    ARTI_TRACE_N( USER, \
                  AR_CP_RTE_API, \
                  shortNameOf(<cts>), \
                  <instance_ptr|0>, \
                  <api>_Start, \
                  numberOf( param... ) + 1, \
                  idOf(<ap>), \
                  <param...> )
```

RTE API Return

```
#define Rte_Arti_<api>Hook_<cts>_<ap>_Return( \
    [const_Rte_CDS_<cts> * instance_ptr], param...) \
    ARTI_TRACE_N( USER, \
                  AR_CP_RTE_API, \
                  shortNameOf(<cts>), \
                  <instance_ptr|0>, \
                  <api>_Return, \
                  numberOf( param... ) + 1, \
                  idOf(<ap>), \
                  <param...> )
```

As defined in the RTE specification:

<api> Specifies the name of the function this hook relates to.

<cts> Specifies the component type symbol of the AtomicSwComponentType.

<ap> Specifies the access point name (e.g. port and data element or operation name, exclusive area name, etc.).

shortNameOf() is a hint of the ARTI module the extract use the short name of the element in question.

idOf() is a function of the ARTI module to create an 32-bit ID out of an element. This mapping will also be stored in a type map within ArtiValues and will be referenced by the hook descriptions.

numberOf(params...) is the number of parameters of the related RTE trace hook. This number can be determined by the referenced BswModuleEntry.arguments.

[ ] are parameters issued by the RTE as defined by BswModuleEntry.arguments. If they do exist then they have to be used. If they do not exist they will be replaced by 0 in the `ARTI_TRACE` macro.

Parameter	Type	Description
_contextName	Token, literal text	see 8.7.1.1 usually this is USER.
_className	Token, literal text	AR_CP_RTE_API
_instanceName	Token, literal text	Is the short name of the <cts>, the component type symbol of the AtomicSwComponentType
instanceParameter	uint32	Is used in case of multiple instanciation. In this case the instance handle as specified in the RTE VFB trace client is used. If single instanciation is used this parameter is 0.
_eventName	Token, literal text	value that identifies the event type of the API • <api>_Start • <api>_Return
numEventParameter	uint32	the number of parameters plus one for the ID of the access port
. . . (ellipsis)		First argument is uint32 which represents the ID of the access port which is generated by the ARTI module. Additional arguments are the parameters of the related RTE hook.

8.7.2.5.4 Trace Class – AR_CP_VOID

[SWS_Arti_00016] Macro AR_CP_VOID ⌈ARTI shall provide a macro of the class AR_CP_VOID that compiles to nothing.⌋ *(RS_Main_01026)*

AR_CP_VOID is used to map VFB tracing hooks that are not used by ARTI. Expanding ARTI_TRACE with trace class AR_CP_VOID should result in empty statement that results in no code at all.

Parameter	Type	Description
_contextName	Token, literal text	see 8.7.1.1 this should be USER for AR_CP_VOID.
_className	Token, literal text	AR_CP_VOID
_instanceName	Token, literal text	Not used, set to “”
instanceParameter	uint32	Not used, should be set to 0
_eventName	Token, literal text	Not used, set to “”
eventParameter	uint32	Not used, should be set to 0

8.7.2.6 ARTI BSW Module Interface

[SWS_Arti_00022] Define AR_CP_BSW_API ⌈ARTI shall define a trace class for tracing entries and exits of BSW modules, called AR_CP_BSW_API.⌋*(RS_Arti_00042)*

To allow tracing of BSW modules, the entry and exit points of BSW modules should be populated with ARTI_TRACE macros.

[SWS_Arti_00023] Macro AR_CP_BSW_API ⌈ARTI macros of the class `AR_CP_BSW_API` shall compile the following template:⌋*(RS_Arti_00042)*

```
ARTI_TRACE_N( _contextName, \
        AR_CP_BSW_API, \
        <moduleImplementationPrefix>, \
        0, \
        Bsw_<Start|Return>, \
        numberOf( param... ) + 1, \
        idOf(<service>), \
        <param...> )
```

<moduleImplementationPrefix> represents a module, formed as specified in SWS_BSWGeneral chapter 5.1.1 [SWS_BSW_00102].

numberOf(params...) specifies the number of parameters following in the parantheses. This number can be determinded by the referenced BswModuleEntry.arguments.

idOf(<service) represents the service ID as specified in the function definition of the BSW module.

<param...> is a comma separated list of parameters that are passed to the service (in/inout) or returned by the service (return/out/inout) as defined by BswModuleEntry.arguments.

Parameter	*Type*	*Description*
`_contextName`	Token, literal text	see 8.7.1.1.
`_className`	Token, literal text	`AR_CP_BSW_API`
`_instanceName`	Token, literal text	Is the module implementation prefix of the module beeing called
`instanceParameter`	uint32	Reserved. Set to 0.
`_eventName`	Token, literal text	value that identifies the event type of the API • Bsw_Start • Bsw_Return
`numEventParameter`	uint32	the number of parameters plus one for the ID of the service
. . . (ellipsis)		First argument is uint32 which represents the ID of the service. Additional arguments are the parameters of the related BSW hook.

For example:

```
Std_ReturnType SoAd_IfTransmit(PduIdType TxPduId, const PduInfoType*
    PduInfoPtr)
{
     Std_ReturnType ret = E_OK;
     ARTI_TRACE_N(USER, AR_CP_BSW_API, SoAd_42_ArbitraryApiInfix, 0,
         Bsw_Start, 3, 0x49, TxPduId, PduInfoPtr);
     // do SoAd_IfTransmit actions
     ARTI_TRACE_N(USER, AR_CP_BSW_API, SoAd_42_ArbitraryApiInfix, 0,
         Bsw_Return, 2, 0x49, ret);
     return ret;
}
```

The BSW Module has to provide an BswModuleEntry description defining the arguments and return value of the BSW API. The generated ArtiHook description shall refer to this BswModuleEntry. (See chapter 10.7.3 "ArtiHook").

8.7.3 Configurable interfaces

ARTI does not define configurable interfaces.

8.8 Service Interfaces

ARTI does not provide any service interfaces.

9 Sequence diagrams

Not applicable yet.

10 Configuration specification

This chapter defines configuration parameters and their clustering into containers.

Containers and parameters that are related to the OS module are specified in SWS_OS, chapter "Containers and configuration parameters for ARTI".

10.1 How to read this chapter

For details refer to the chapter 10.1 “Introduction to configuration specification” in SWS_BSWGeneral.

10.2 ARTI Parameters

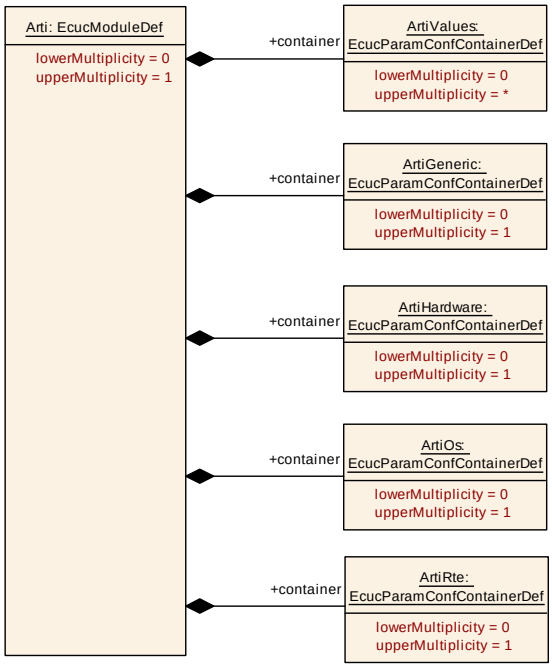

Figure 10.1: Arti Ecuc Module Definition Class Diagram

SWS Item	**[ECUC_Arti_00001]**
Module Name	Arti
Description	The Arti Module serves as a superordinate container collecting all information and parameters concerning ARTI.
Post-Build Variant Support	true
Supported Config Variants	VARIANT-LINK-TIME, VARIANT-POST-BUILD, VARIANT-PRE-COMPILE

Included Containers		
Container Name	**Multiplicity**	**Scope / Dependency**
ArtiGeneric	0..1	The ArtiGeneric container contains definitions for generic objects, i.e. not belonging to a standard AUTOSAR module.
ArtiHardware	0..1	The ArtiHardware container contains ARTI extensions to the EcucHardware module.
ArtiOs	0..1	The ArtiOs container contains ARTI extensions to the EcucDefs/ Os module.
ArtiRte	0..1	The ArtiRte Container contains all parameters for ARTI that are filled by the generators RTE.
ArtiValues	0..*	The ArtiValues container collects all parameter values for ARTI that are filled by the generators (OS, RTE, ...)

10.3 ARTI Generic Container

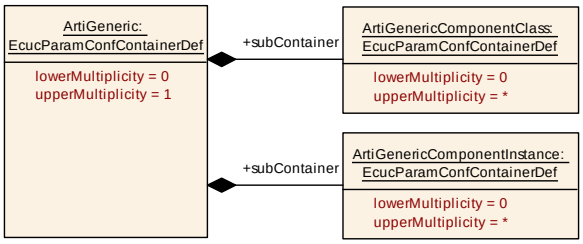

Figure 10.2: ArtiGeneric Ecuc Module Definition Class Diagram

SWS Item	**[ECUC_Arti_00042]**		
Container Name	ArtiGeneric		
Parent Container	Arti		
Description	The ArtiGeneric container contains definitions for generic objects, i.e. not belonging to a standard AUTOSAR module.		
Post-Build Variant Multiplicity	false		
Multiplicity Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Configuration Parameters			

Included Containers		
Container Name	**Multiplicity**	**Scope / Dependency**
ArtiGenericComponentClass	0..*	The class definition describes the layout of the object (similar to a "class" definition in C++).
ArtiGenericComponentInstance	0..*	The instance definition describes a specific instantiated object.

Example 10.1

Examplary Values of the ArtiGeneric Container

```
<AUTOSAR>
  <AR-PACKAGES>
    <AR-PACKAGE>
```

```
<SHORT-NAME>Vendor1</SHORT-NAME>
<ELEMENTS>
  <ECUC-MODULE-CONFIGURATION-VALUES>
    <SHORT-NAME>Vendor1ArtiGeneric</SHORT-NAME>
    <DEFINITION-REF DEST="ECUC-MODULE-DEF">/AUTOSAR/EcucDefs/Arti/
       ArtiGeneric</DEFINITION-REF>
      <ECUC-CONTAINER-VALUE>
        <SHORT-NAME>ArtiGenericComponentClass_AMODULE</SHORT-NAME>
        <DEFINITION-REF DEST="ECUC-PARAM-CONF-CONTAINER-DEF">/AUTOSAR
           /EcucDefs/Arti/ArtiGeneric/ArtiGenericComponentClass</
           DEFINITION-REF>
        <...>
      </ECUC-CONTAINER-VALUE>
      <ECUC-CONTAINER-VALUE>
        <SHORT-NAME>ArtiGenericComponentClass_RteWiperSwc</SHORT-NAME
           >
        <DEFINITION-REF DEST="ECUC-PARAM-CONF-CONTAINER-DEF">/AUTOSAR
           /EcucDefs/Arti/ArtiGeneric/ArtiGenericComponentClass</
           DEFINITION-REF>
        <...>
      </ECUC-CONTAINER-VALUE>
      <ECUC-CONTAINER-VALUE>
        <SHORT-NAME>ArtiGenericComponentClass_Vendor1Task</SHORT-NAME
           >
        <DEFINITION-REF DEST="ECUC-PARAM-CONF-CONTAINER-DEF">/AUTOSAR
           /EcucDefs/Arti/ArtiGeneric/ArtiGenericComponentClass</
           DEFINITION-REF>
        <...>
      </ECUC-CONTAINER-VALUE>
      <ECUC-CONTAINER-VALUE>
        <SHORT-NAME>ArtiGenericComponentInstance_AModule1</SHORT-NAME
           >
        <DEFINITION-REF DEST="ECUC-PARAM-CONF-CONTAINER-DEF">/AUTOSAR
           /EcucDefs/Arti/ArtiGeneric/ArtiGenericComponentInstance</
           DEFINITION-REF>
        <...>
      </ECUC-CONTAINER-VALUE>
      <ECUC-CONTAINER-VALUE>
        <SHORT-NAME>ArtiGenericComponentInstance_TaskHighPriority</
           SHORT-NAME>
        <DEFINITION-REF DEST="ECUC-PARAM-CONF-CONTAINER-DEF">/AUTOSAR
           /EcucDefs/Arti/ArtiGeneric/ArtiGenericComponentInstance</
           DEFINITION-REF>
        <...>
      </ECUC-CONTAINER-VALUE>
      <ECUC-CONTAINER-VALUE>
        <SHORT-NAME>ArtiGenericComponentInstance_Wiper</SHORT-NAME>
        <DEFINITION-REF DEST="ECUC-PARAM-CONF-CONTAINER-DEF">/AUTOSAR
           /EcucDefs/Arti/ArtiGeneric/ArtiGenericComponentInstance</
           DEFINITION-REF>
        <...>
      </ECUC-CONTAINER-VALUE>
    </CONTAINERS>
  </ECUC-MODULE-CONFIGURATION-VALUES>
  <...>
```

10.3.1 ArtiGenericComponentClass

SWS Item	[ECUC_Arti_00043]		
Container Name	ArtiGenericComponentClass		
Parent Container	ArtiGeneric		
Description	The class definition describes the layout of the object (similar to a "class" definition in C++).		
Post-Build Variant Multiplicity	false		
Multiplicity Configuration Class	Pre-compile time	X	All Variants
	Link time	–	
	Post-build time	–	
Configuration Parameters			

SWS Item	[ECUC_Arti_00044]		
Parameter Name	ArtiGenericComponentClassName		
Parent Container	ArtiGenericComponentClass		
Description	Name of the class.		
Multiplicity	1		
Type	EcucStringParamDef		
Default value	–		
Regular Expression	–		
Post-Build Variant Value	false		
Value Configuration Class	Pre-compile time	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: ECU		

Included Containers		
Container Name	Multiplicity	Scope / Dependency
ArtiGenericComponentClass Parameter	0..*	Parameter definition of a class.

SWS Item	[ECUC_Arti_00045]		
Container Name	ArtiGenericComponentClassParameter		
Parent Container	ArtiGenericComponentClass		
Description	Parameter definition of a class.		
Post-Build Variant Multiplicity	false		
Multiplicity Configuration Class	Pre-compile time	X	All Variants
	Link time	–	
	Post-build time	–	
Configuration Parameters			

SWS Item	[ECUC_Arti_00046]
Parameter Name	ArtiGenericComponentClassParameterName
Parent Container	ArtiGenericComponentClassParameter
Description	Name of the parameter.
Multiplicity	1

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Type	EcucStringParamDef		
Default value	–		
Regular Expression	–		
Post-Build Variant Value	false		
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: ECU		

SWS Item	**[ECUC_Arti_00053]**		
Parameter Name	ArtiGenericComponentClassParameterTypeMapRef		
Parent Container	ArtiGenericComponentClassParameter		
Description	Refers to a parameter type to interpret the parameter value.		
Multiplicity	0..1		
Type	Reference to ArtiParameterTypeMap		
Post-Build Variant Multiplicity	false		
Post-Build Variant Value	false		
Multiplicity Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: ECU		

No Included Containers

Example 10.2

Examplary Value of an ArtiGenericComponentClass Container

```
<ECUC-CONTAINER-VALUE>
  <SHORT-NAME>ArtiGenericComponentClass_AMODULE</SHORT-NAME>
  <DEFINITION-REF DEST="ECUC-PARAM-CONF-CONTAINER-DEF">/AUTOSAR/EcucDefs/
      Arti/ArtiGeneric/ArtiGenericComponentClass</DEFINITION-REF>
  <PARAMETER-VALUES>
    <ECUC-TEXTUAL-PARAM-VALUE>
      <DEFINITION-REF DEST="ECUC-STRING-PARAM-DEF">/AUTOSAR/EcucDefs/Arti
          /ArtiGeneric/ArtiGenericComponentClass/
          ArtiGenericComponentClassName</DEFINITION-REF>
      <VALUE>AMODULE</VALUE>
    </ECUC-TEXTUAL-PARAM-VALUE>
  </PARAMETER-VALUES>
  <SUB-CONTAINERS>
    <ECUC-CONTAINER-VALUE UUID="">
      <SHORT-NAME>AMODULE_RUNNINGTHING</SHORT-NAME>
      <DEFINITION-REF DEST="ECUC-PARAM-CONF-CONTAINER-DEF">/AUTOSAR/
          EcucDefs/Arti/ArtiGeneric/ArtiGenericComponentClass/
          ArtiGenericComponentClassParameter</DEFINITION-REF>
      <PARAMETER-VALUES>
```

```
      <ECUC-TEXTUAL-PARAM-VALUE>
        <DEFINITION-REF DEST="ECUC-STRING-PARAM-DEF">/AUTOSAR/EcucDefs/
            Arti/ArtiGeneric/ArtiGenericComponentClass/
            ArtiGenericComponentClassParameter/
            ArtiGenericComponentClassParameterDescription</DEFINITION-
            REF>
        <VALUE>Running Thing</VALUE>
      </ECUC-TEXTUAL-PARAM-VALUE>
      <ECUC-TEXTUAL-PARAM-VALUE>
        <DEFINITION-REF DEST="ECUC-STRING-PARAM-DEF">/AUTOSAR/EcucDefs/
            Arti/ArtiGeneric/ArtiGenericComponentClass/
            ArtiGenericComponentClassParameter/
            ArtiGenericComponentClassParameterName</DEFINITION-REF>
        <VALUE>RUNNINGTHING</VALUE>
      </ECUC-TEXTUAL-PARAM-VALUE>
    </PARAMETER-VALUES>
    <REFERENCE-VALUES>
      <ECUC-REFERENCE-VALUE>
        <DEFINITION-REF DEST="ECUC-REFERENCE-DEF">/AUTOSAR/EcucDefs/
            Arti/ArtiGeneric/ArtiGenericComponentClass/
            ArtiGenericComponentClassParameter/
            ArtiGenericComponentClassParameterTypeMapRef</DEFINITION-REF
            >
        <VALUE-REF DEST="ECUC-CONTAINER-VALUE">/Vendor1/Vendor1Arti/
            ArtiParameterTypeMap_RunningThing</VALUE-REF>
      </ECUC-REFERENCE-VALUE>
    </REFERENCE-VALUES>
  </ECUC-CONTAINER-VALUE>
  <ECUC-CONTAINER-VALUE UUID="">
    <SHORT-NAME>AMOULE_THINGSTART</SHORT-NAME>
    <DEFINITION-REF DEST="ECUC-PARAM-CONF-CONTAINER-DEF">/AUTOSAR/
        EcucDefs/Arti/ArtiGeneric/ArtiGenericComponentClass/
        ArtiGenericComponentClassParameter</DEFINITION-REF>
    <PARAMETER-VALUES>
      <ECUC-TEXTUAL-PARAM-VALUE>
        <DEFINITION-REF DEST="ECUC-STRING-PARAM-DEF">/AUTOSAR/EcucDefs/
            Arti/ArtiGeneric/ArtiGenericComponentClass/
            ArtiGenericComponentClassParameter/
            ArtiGenericComponentClassParameterDescription</DEFINITION-
            REF>
        <VALUE>Thing start</VALUE>
      </ECUC-TEXTUAL-PARAM-VALUE>
      <ECUC-TEXTUAL-PARAM-VALUE>
        <DEFINITION-REF DEST="ECUC-STRING-PARAM-DEF">/AUTOSAR/EcucDefs/
            Arti/ArtiGeneric/ArtiGenericComponentClass/
            ArtiGenericComponentClassParameter/
            ArtiGenericComponentClassParameterName</DEFINITION-REF>
        <VALUE>THING_START</VALUE>
      </ECUC-TEXTUAL-PARAM-VALUE>
    </PARAMETER-VALUES>
    <REFERENCE-VALUES>
      <ECUC-REFERENCE-VALUE>
        <DEFINITION-REF DEST="ECUC-REFERENCE-DEF">/AUTOSAR/EcucDefs/
            Arti/ArtiGeneric/ArtiGenericComponentClass/
            ArtiGenericComponentClassParameter/
```

```
            ArtiGenericComponentClassParameterTypeMapRef</DEFINITION-REF
            >
          <VALUE-REF DEST="ECUC-CONTAINER-VALUE">/Vendor1/Vendor1Arti/
            ArtiParameterTypeMap_ThingStart</VALUE-REF>
        </ECUC-REFERENCE-VALUE>
      </REFERENCE-VALUES>
    </ECUC-CONTAINER-VALUE>
  </SUB-CONTAINERS>
</ECUC-CONTAINER-VALUE>
```

10.3.2 ArtiGenericComponentInstance

SWS Item	[ECUC_Arti_00049]		
Container Name	ArtiGenericComponentInstance		
Parent Container	ArtiGeneric		
Description	The instance definition describes a specific instantiated object.		
Post-Build Variant Multiplicity	false		
Multiplicity Configuration Class	Pre-compile time	X	All Variants
	Link time	–	
	Post-build time	–	
Configuration Parameters			

SWS Item	[ECUC_Arti_00050]		
Parameter Name	ArtiGenericComponentInstanceName		
Parent Container	ArtiGenericComponentInstance		
Description	Name of the instance.		
Multiplicity	1		
Type	EcucStringParamDef		
Default value	–		
Regular Expression	–		
Post-Build Variant Value	false		
Value Configuration Class	Pre-compile time	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: ECU		

SWS Item	[ECUC_Arti_00048]		
Parameter Name	ArtiGenericComponentInstanceClassRef		
Parent Container	ArtiGenericComponentInstance		
Description	Refers to a ArtGenericClass of which this object is instantiated.		
Multiplicity	1		
Type	Reference to ArtiGenericComponentClass		
Post-Build Variant Value	false		
Value Configuration Class	Pre-compile time	X	All Variants
	Link time	–	
	Post-build time	–	

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Scope / Dependency	scope: ECU

Included Containers		
Container Name	**Multiplicity**	**Scope / Dependency**
ArtiGenericComponentInstance Parameter	0..*	Parameter definition of an instance.

SWS Item	[ECUC_Arti_00051]		
Container Name	ArtiGenericComponentInstanceParameter		
Parent Container	ArtiGenericComponentInstance		
Description	Parameter definition of an instance.		
Post-Build Variant Multiplicity	false		
Multiplicity Configuration Class	Pre-compile time	X	All Variants
	Link time	–	
	Post-build time	–	
Configuration Parameters			

SWS Item	[ECUC_Arti_00047]		
Parameter Name	ArtiGenericComponentInstanceParameterClassParameterRef		
Parent Container	ArtiGenericComponentInstanceParameter		
Description	Refers to an ArtiGenericComponentClassParameter that defines this parameter.		
Multiplicity	0..*		
Type	Reference to ArtiGenericComponentClassParameter		
Post-Build Variant Multiplicity	false		
Post-Build Variant Value	false		
Multiplicity Configuration Class	Pre-compile time	X	All Variants
	Link time	–	
	Post-build time	–	
Value Configuration Class	Pre-compile time	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency			

SWS Item	[ECUC_Arti_00040]		
Parameter Name	ArtiGenericComponentInstanceParameterConstantRef		
Parent Container	ArtiGenericComponentInstanceParameter		
Description	Refers to an ArtiConstant that represents the value of this parameter.		
Multiplicity	0..1		
Type	Reference to ArtiConstant		
Post-Build Variant Multiplicity	false		
Post-Build Variant Value	false		
Multiplicity Configuration Class	Pre-compile time	X	All Variants
	Link time	–	
	Post-build time	–	
Value Configuration Class	Pre-compile time	X	All Variants
	Link time	–	

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	Post-build time	–	
Scope / Dependency			

SWS Item	**[ECUC_Arti_00041]**		
Parameter Name	ArtiGenericComponentInstanceParameterExpressionRef		
Parent Container	ArtiGenericComponentInstanceParameter		
Description	Refers to an ArtiExpression that evaluates the value of this parameter.		
Multiplicity	0..1		
Type	Reference to ArtiExpression		
Post-Build Variant Multiplicity	false		
Post-Build Variant Value	false		
Multiplicity Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency			

SWS Item	**[ECUC_Arti_00052]**		
Parameter Name	ArtiGenericComponentInstanceParameterHookRef		
Parent Container	ArtiGenericComponentInstanceParameter		
Description	Refers to a hook that records this parameter.		
Multiplicity	0..1		
Type	Reference to ArtiHook		
Post-Build Variant Multiplicity	false		
Post-Build Variant Value	false		
Multiplicity Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency			

No Included Containers

Example 10.3

Examplary Value of an ArtiGenericComponentInstance Container

```
<ECUC-CONTAINER-VALUE>
  <SHORT-NAME>ArtiGenericComponentInstance_AModule1</SHORT-NAME>
  <DEFINITION-REF DEST="ECUC-PARAM-CONF-CONTAINER-DEF">/AUTOSAR/EcucDefs/
      Arti/ArtiGeneric/ArtiGenericComponentInstance</DEFINITION-REF>
  <PARAMETER-VALUES>
    <ECUC-TEXTUAL-PARAM-VALUE>
```

```
        <DEFINITION-REF DEST="ECUC-STRING-PARAM-DEF">/AUTOSAR/EcucDefs/Arti
            /ArtiGeneric/ArtiGenericComponentInstance/
            ArtiGenericComponentInstanceName</DEFINITION-REF>
        <VALUE>AModule1</VALUE>
      </ECUC-TEXTUAL-PARAM-VALUE>
    </PARAMETER-VALUES>
    <REFERENCE-VALUES>
      <ECUC-REFERENCE-VALUE>
        <DEFINITION-REF DEST="ECUC-REFERENCE-DEF">/AUTOSAR/EcucDefs/Arti/
            ArtiGeneric/ArtiGenericComponentInstance/
            ArtiGenericComponentInstanceClassRef</DEFINITION-REF>
        <VALUE-REF DEST="ECUC-CONTAINER-VALUE">/Vendor1/Vendor1ArtiGeneric/
            ArtiGenericComponentClass_AMODULE</VALUE-REF>
      </ECUC-REFERENCE-VALUE>
    </REFERENCE-VALUES>
    <SUB-CONTAINERS>
      <ECUC-CONTAINER-VALUE>
        <SHORT-NAME>AModule1_RUNNINGTHING</SHORT-NAME>
        <DEFINITION-REF DEST="ECUC-PARAM-CONF-CONTAINER-DEF">/AUTOSAR/
            EcucDefs/Arti/ArtiGeneric/ArtiGenericComponentInstance/
            ArtiGenericComponentInstanceParameter</DEFINITION-REF>
        <REFERENCE-VALUES>
          <ECUC-REFERENCE-VALUE>
            <DEFINITION-REF DEST="ECUC-REFERENCE-DEF">/AUTOSAR/EcucDefs/
                Arti/ArtiGeneric/ArtiGenericComponentInstance/
                ArtiGenericComponentInstanceParameter/
                ArtiGenericComponentInstanceParameterExpressionRef</
                DEFINITION-REF>
            <VALUE-REF DEST="ECUC-CONTAINER-VALUE">/Vendor1/Vendor1Arti/
                ArtiExpression_ArtiGeneric_AModule1_RunningThing</VALUE-REF>
          </ECUC-REFERENCE-VALUE>
          <ECUC-REFERENCE-VALUE>
            <DEFINITION-REF DEST="ECUC-REFERENCE-DEF">/AUTOSAR/EcucDefs/
                Arti/ArtiGeneric/ArtiGenericComponentInstance/
                ArtiGenericComponentInstanceParameter/
                ArtiGenericComponentInstanceParameterClassParameterRef</
                DEFINITION-REF>
            <VALUE-REF DEST="ECUC-CONTAINER-VALUE">/Vendor1/
                Vendor1ArtiGeneric/ArtiGenericComponentClass_AMODULE/
                AMODULE_RUNNINGTHING</VALUE-REF>
          </ECUC-REFERENCE-VALUE>
        </REFERENCE-VALUES>
      </ECUC-CONTAINER-VALUE>
    </SUB-CONTAINERS>
  </ECUC-CONTAINER-VALUE>
```

10.4 ARTI Hardware Container

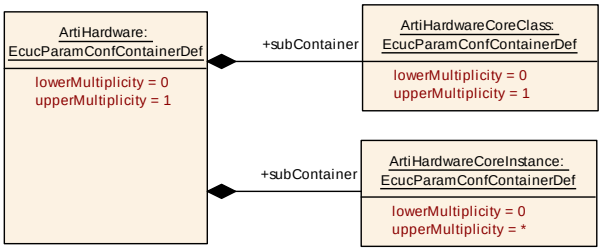

Figure 10.3: ArtiHardware Ecuc Module Definition Class Diagram

The ArtiHardware container is specified in SWS_OS.

10.5 ARTI Os Container

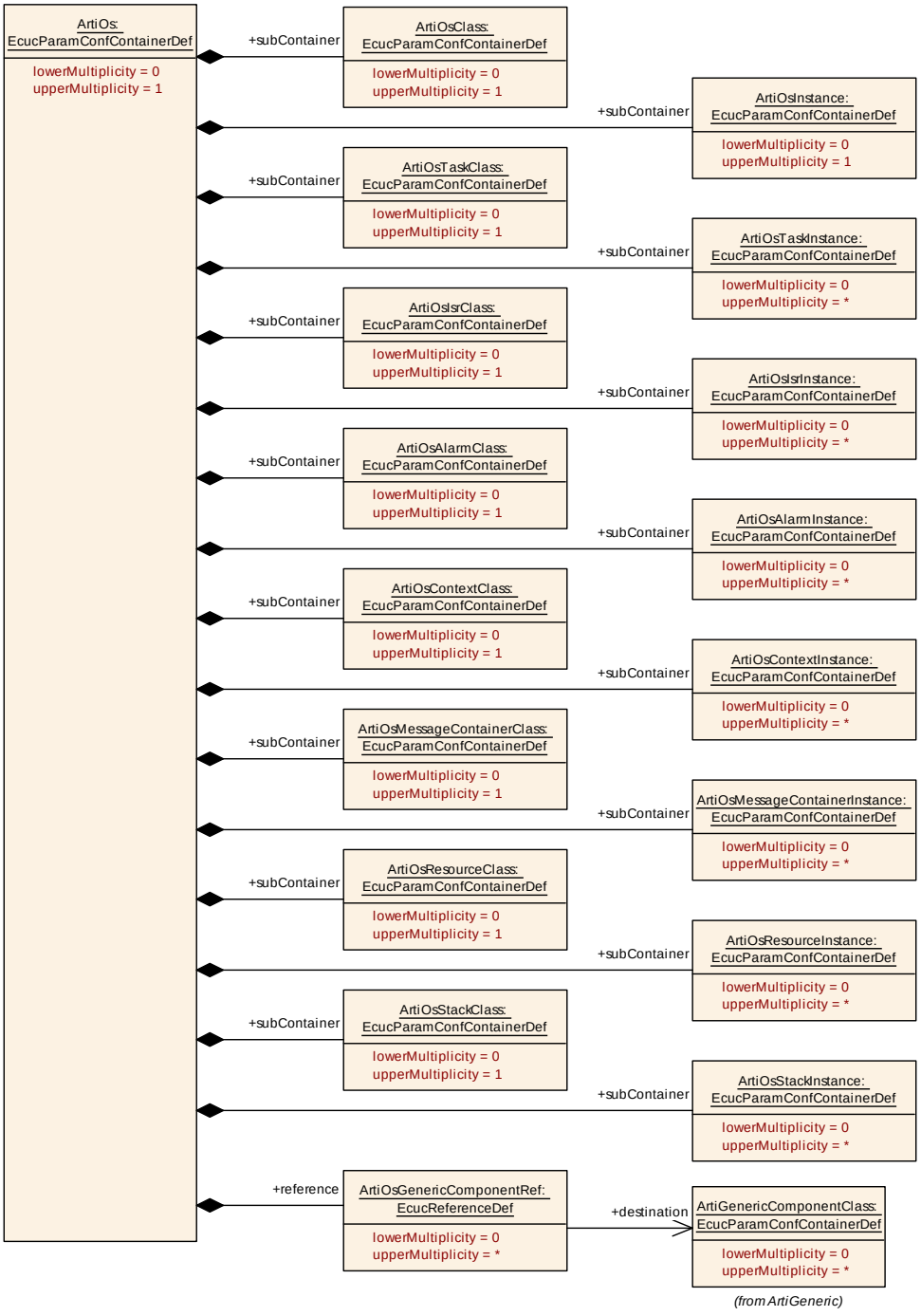

Figure 10.4: ArtiOs Ecuc Module Definition Class Diagram

The ArtiOs container is specified in SWS_OS.

10.6 ARTI Rte Container

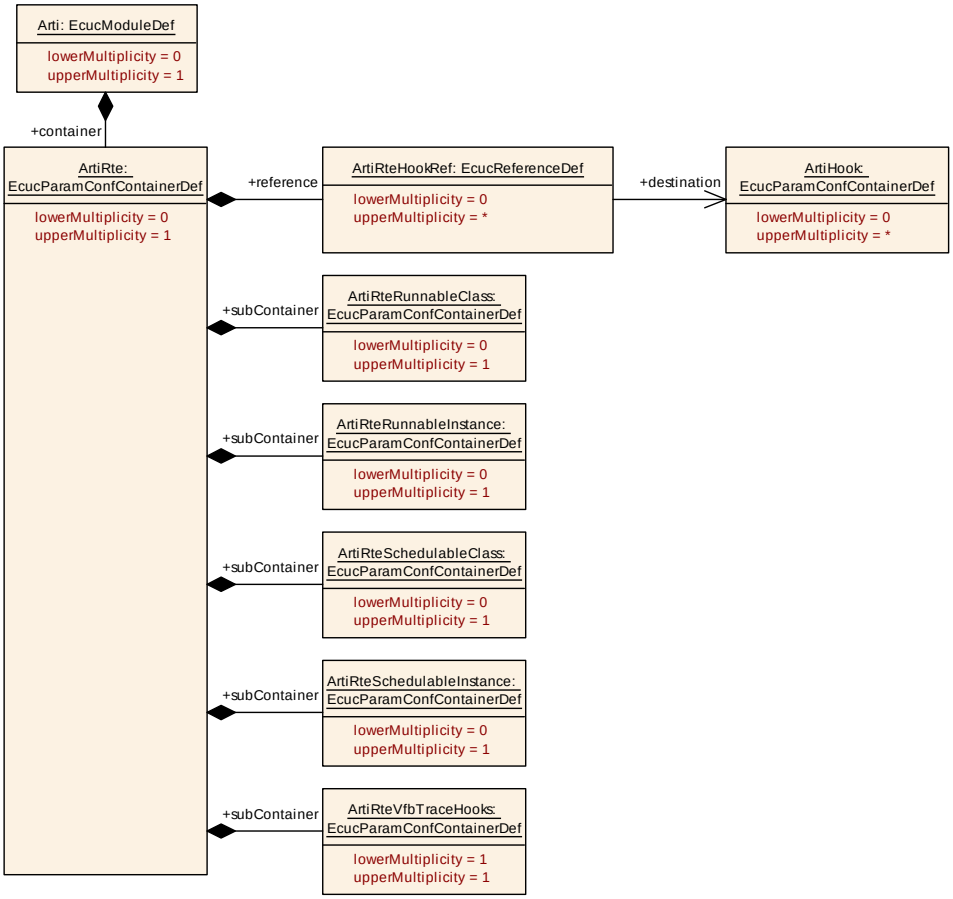

Figure 10.5: ArtiRte Ecuc Module Definition Class Diagram

SWS Item	**[ECUC_Arti_00158]**		
Container Name	ArtiRte		
Parent Container	Arti		
Description	The ArtiRte Container contains all parameters for ARTI that are filled by the generators RTE.		
Post-Build Variant Multiplicity	false		
Multiplicity Configuration Class	**Pre-compile time**	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME
	Post-build time	–	
Configuration Parameters			

SWS Item	**[ECUC_Arti_00159]**
Parameter Name	ArtiRteHookRef
Parent Container	ArtiRte
Description	Refers to an arti hook which is called by the RTE.
Multiplicity	0..*
Type	Reference to ArtiHook
Post-Build Variant Multiplicity	false

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Post-Build Variant Value	false		
Multiplicity Configuration Class	**Pre-compile time**	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME
	Post-build time	–	
Value Configuration Class	**Pre-compile time**	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME
	Post-build time	–	
Scope / Dependency			

Included Containers		
Container Name	**Multiplicity**	**Scope / Dependency**
ArtiRteRunnableClass	0..1	Contains the layout of an ArtiRteRunnable object.
ArtiRteRunnableInstance	0..1	Represents an instance of an ArtiRteRunnable object, extending the BswM RunnableEntity.
ArtiRteSchedulableClass	0..1	Contains the layout of an ArtiRteSchedulable object.
ArtiRteSchedulableInstance	0..1	Represents an instance of an ArtiRteSchedulable object, extending the Rte Schedulable Entity.
ArtiRteVfbTraceHooks	1	This container defines the parent container to which all trace hook containers are added.

10.6.1 ArtiRteRunnableClass

SWS Item	**[ECUC_Arti_00160]**		
Container Name	ArtiRteRunnableClass		
Parent Container	ArtiRte		
Description	Contains the layout of an ArtiRteRunnable object.		
Post-Build Variant Multiplicity	false		
Multiplicity Configuration Class	**Pre-compile time**	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME
	Post-build time	–	
Configuration Parameters			

SWS Item	**[ECUC_Arti_00164]**		
Parameter Name	ArtiRteRunnableClassGenericComponentClassRef		
Parent Container	ArtiRteRunnableClass		
Description	Refers to an ArtiGenericComponentClass that extends the ArtiRteRunnableClass.		
Multiplicity	0..1		
Type	Reference to ArtiGenericComponentClass		
Post-Build Variant Multiplicity	false		
Post-Build Variant Value	false		
Multiplicity Configuration Class	**Pre-compile time**	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME
	Post-build time	–	
Value Configuration Class	**Pre-compile time**	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME

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	Post-build time	–	
Scope / Dependency			

SWS Item	**[ECUC_Arti_00165]**		
Parameter Name	ArtiRteRunnableIdRef		
Parent Container	ArtiRteRunnableClass		
Description	Refers to the ArtiObjectClassParameter that declares the attribute ArtiRteRunnableId Ref in ArtiRteRunnableEntityInstances. This attribute specifies the idOf(reName) mapping.		
Multiplicity	1		
Type	Reference to ArtiObjectClassParameter		
Post-Build Variant Value	false		
Value Configuration Class	**Pre-compile time**	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME
	Post-build time	–	
Scope / Dependency			

No Included Containers

10.6.2 ArtiRteRunnableInstance

SWS Item	**[ECUC_Arti_00161]**		
Container Name	ArtiRteRunnableInstance		
Parent Container	ArtiRte		
Description	Represents an instance of an ArtiRteRunnable object, extending the BswM Runnable Entity.		
Post-Build Variant Multiplicity	false		
Multiplicity Configuration Class	**Pre-compile time**	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME
	Post-build time	–	
Configuration Parameters			

SWS Item	**[ECUC_Arti_00166]**		
Parameter Name	ArtiRteRunnableInstanceSymbol		
Parent Container	ArtiRteRunnableInstance		
Description	Specifies the symbol / function name that implements the runnable.		
Multiplicity	0..1		
Type	EcucStringParamDef		
Default value	–		
Regular Expression	–		
Post-Build Variant Multiplicity	false		
Post-Build Variant Value	false		
Multiplicity Configuration Class	**Pre-compile time**	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME
	Post-build time	–	

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Value Configuration Class	**Pre-compile time**	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME
	Post-build time	–	
Scope / Dependency	scope: ECU		

SWS Item	**[ECUC_Arti_00167]**		
Parameter Name	ArtiRteRunnableInstanceBswRef		
Parent Container	ArtiRteRunnableInstance		
Description	Refers to an Rte Runnable that is beeing extended.		
Multiplicity	0..1		
Type	Foreign reference to RUNNABLE-ENTITY		
Post-Build Variant Multiplicity	false		
Post-Build Variant Value	false		
Multiplicity Configuration Class	**Pre-compile time**	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME
	Post-build time	–	
Value Configuration Class	**Pre-compile time**	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME
	Post-build time	–	
Scope / Dependency	scope: local		

SWS Item	**[ECUC_Arti_00168]**		
Parameter Name	ArtiRteRunnableInstanceGenericComponentInstanceRef		
Parent Container	ArtiRteRunnableInstance		
Description	Refers to an ArtiGenericComponentInstance that extends the ArtiRteRunnable Instance.		
Multiplicity	0..1		
Type	Reference to ArtiGenericComponentInstance		
Post-Build Variant Multiplicity	false		
Post-Build Variant Value	false		
Multiplicity Configuration Class	**Pre-compile time**	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME
	Post-build time	–	
Value Configuration Class	**Pre-compile time**	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME
	Post-build time	–	
Scope / Dependency			

No Included Containers

10.6.3 ArtiRteSchedulableClass

SWS Item	[ECUC_Arti_00162]		
Container Name	ArtiRteSchedulableClass		
Parent Container	ArtiRte		
Description	Contains the layout of an ArtiRteSchedulable object.		
Post-Build Variant Multiplicity	false		
Multiplicity Configuration Class	Pre-compile time	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME
	Post-build time	–	
Configuration Parameters			

SWS Item	[ECUC_Arti_00169]		
Parameter Name	ArtiRteSchedulableClassGenericComponentClassRef		
Parent Container	ArtiRteSchedulableClass		
Description	Refers to an ArtiGenericComponentClass that extends the ArtiRteSchedulableClass.		
Multiplicity	0..1		
Type	Reference to ArtiGenericComponentClass		
Post-Build Variant Multiplicity	false		
Post-Build Variant Value	false		
Multiplicity Configuration Class	Pre-compile time	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME
	Post-build time	–	
Value Configuration Class	Pre-compile time	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME
	Post-build time	–	
Scope / Dependency			

SWS Item	[ECUC_Arti_00170]		
Parameter Name	ArtiRteSchedulableIdRef		
Parent Container	ArtiRteSchedulableClass		
Description	Refers to the ArtiObjectClassParameter that declares the attribute ArtiRteSchmEntityId Ref in ArtiRteSchedulableInstances. This attribute specifies the idOf(entityName) mapping.		
Multiplicity	1		
Type	Reference to ArtiObjectClassParameter		
Post-Build Variant Value	false		
Value Configuration Class	Pre-compile time	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME
	Post-build time	–	
Scope / Dependency			

No Included Containers

10.6.4 ArtiRteSchedulableInstance

SWS Item	[ECUC_Arti_00163]		
Container Name	ArtiRteSchedulableInstance		
Parent Container	ArtiRte		
Description	Represents an instance of an ArtiRteSchedulable object, extending the Rte Schedulable Entity.		
Post-Build Variant Multiplicity	false		
Multiplicity Configuration Class	Pre-compile time	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME
	Post-build time	–	
Configuration Parameters			

SWS Item	[ECUC_Arti_00171]		
Parameter Name	ArtiRteSchedulableInstanceSymbol		
Parent Container	ArtiRteSchedulableInstance		
Description	Specifies the symbol / function name that implements the schedulable.		
Multiplicity	0..1		
Type	EcucStringParamDef		
Default value	–		
Regular Expression	–		
Post-Build Variant Multiplicity	false		
Post-Build Variant Value	false		
Multiplicity Configuration Class	Pre-compile time	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME
	Post-build time	–	
Value Configuration Class	Pre-compile time	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME
	Post-build time	–	
Scope / Dependency	scope: ECU		

SWS Item	[ECUC_Arti_00172]		
Parameter Name	ArtiRteSchedulableInstanceBswRef		
Parent Container	ArtiRteSchedulableInstance		
Description	Refers to an Rte Schedulable that is beeing extended.		
Multiplicity	0..1		
Type	Foreign reference to BSW-SCHEDULABLE-ENITIY		
Post-Build Variant Multiplicity	false		
Post-Build Variant Value	false		
Multiplicity Configuration Class	Pre-compile time	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME
	Post-build time	–	
Value Configuration Class	Pre-compile time	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME
	Post-build time	–	
Scope / Dependency	scope: local		

SWS Item	[ECUC_Arti_00173]		
Parameter Name	ArtiRteSchedulableInstanceGenericComponentInstanceRef		
Parent Container	ArtiRteSchedulableInstance		
Description	Refers to an ArtiGenericComponentInstance that extends the ArtiRteSchedulable Instance.		
Multiplicity	0..1		
Type	Reference to ArtiGenericComponentInstance		
Post-Build Variant Multiplicity	false		
Post-Build Variant Value	false		
Multiplicity Configuration Class	Pre-compile time	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME
	Post-build time	–	
Value Configuration Class	Pre-compile time	X	VARIANT-PRE-COMPILE
	Link time	X	VARIANT-LINK-TIME
	Post-build time	–	
Scope / Dependency			

No Included Containers

10.6.5 ArtiRteVfbTraceHooks

SWS Item	[ECUC_Arti_00177]
Container Name	ArtiRteVfbTraceHooks
Parent Container	ArtiRte
Description	This container defines the parent container to which all trace hook containers are added.
Configuration Parameters	

Included Containers		
Container Name	Multiplicity	Scope / Dependency
RteVfbTraceHook	0..*	This container represents a specific VFB Trace hook. Its Short Name equals the hook function's C symbol.

10.7 ARTI Values Container

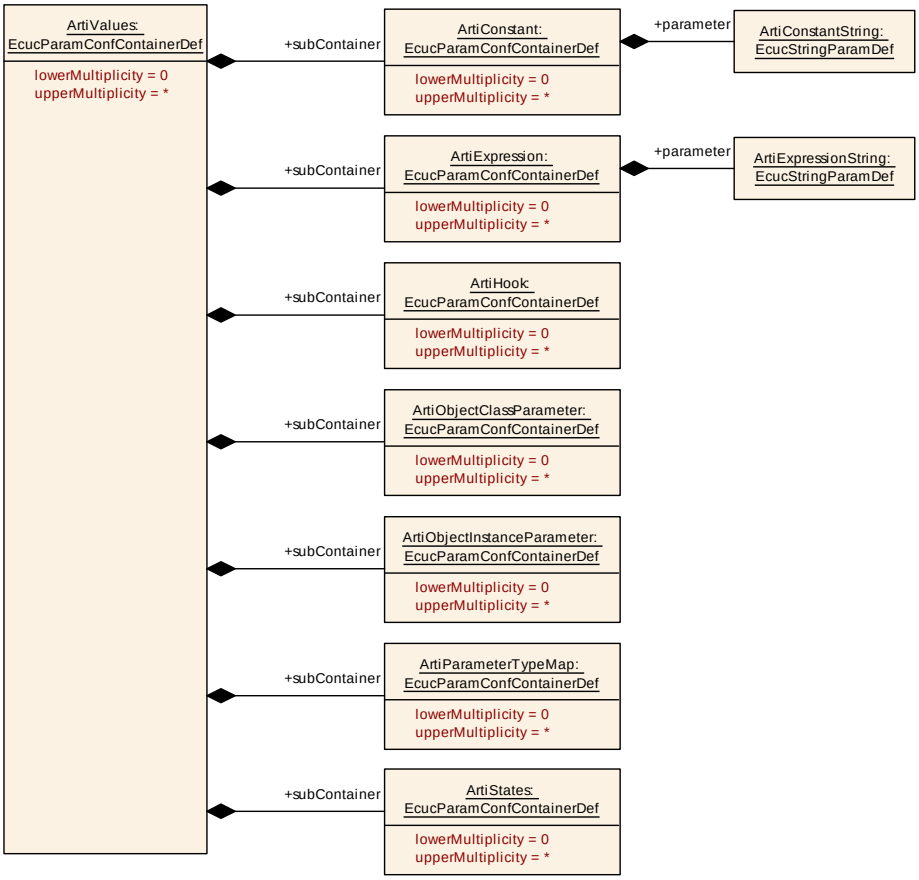

Figure 10.6: ArtiValues Ecuc Module Definition Class Diagram

SWS Item	**[ECUC_Arti_00002]**		
Container Name	ArtiValues		
Parent Container	Arti		
Description	The ArtiValues container collects all parameter values for ARTI that are filled by the generators (OS, RTE, ...)		
Post-Build Variant Multiplicity	false		
Multiplicity Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Configuration Parameters			

Included Containers		
Container Name	**Multiplicity**	**Scope / Dependency**
ArtiConstant	0..*	This container holds a constant value.
ArtiExpression	0..*	This container holds a C like expression that a debugger can evaluate. This is similar to what is already done in ORTI.
ArtiHook	0..*	This container represents an ARTI hook that is present in the module.

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Included Containers		
Container Name	**Multiplicity**	**Scope / Dependency**
ArtiObjectClassParameter	0..*	This container represents a parameter of an Arti object class definition.
ArtiObjectInstanceParameter	0..*	This container represents a parameter of an Arti object instance.
ArtiParameterTypeMap	0..*	A map of key/value pairs to map a parameter value to a display string and/or an Arti or EcuC object.
ArtiStates	0..*	This container contains all states of tasks, isrs... that the EcuC uses.

Example 10.4

Examplary Values of the ArtiValues Container

```
<ECUC-MODULE-CONFIGURATION-VALUES>
  <SHORT-NAME>Vendor1Arti</SHORT-NAME>
  <DEFINITION-REF DEST="ECUC-MODULE-DEF">/AUTOSAR/EcucDefs/Arti/
     ArtiValues</DEFINITION-REF>
  <CONTAINERS>
    <ECUC-CONTAINER-VALUE>
      <SHORT-NAME>ArtiConstant_ArtiSwc_WiperLocation_Front</SHORT-NAME>
      <DEFINITION-REF DEST="ECUC-PARAM-CONF-CONTAINER-DEF">/AUTOSAR/
         EcucDefs/Arti/ArtiValues/ArtiConstant</DEFINITION-REF>
      <...>
    </ECUC-CONTAINER-VALUE>
    <ECUC-CONTAINER-VALUE>
      <SHORT-NAME>ArtiExpression_ArtiHwCore_CurrentTaskOnCore0</SHORT-
         NAME>
      <DEFINITION-REF DEST="ECUC-PARAM-CONF-CONTAINER-DEF">/AUTOSAR/
         EcucDefs/Arti/ArtiValues/ArtiExpression</DEFINITION-REF>
      <...>
    </ECUC-CONTAINER-VALUE>
    <ECUC-CONTAINER-VALUE>
      <SHORT-NAME>ArtiHook_ArtiOs_TaskStart</SHORT-NAME>
      <DEFINITION-REF DEST="ECUC-PARAM-CONF-CONTAINER-DEF">/AUTOSAR/
         EcucDefs/Arti/ArtiValues/ArtiHook</DEFINITION-REF>
      <...>
    </ECUC-CONTAINER-VALUE>
    <ECUC-CONTAINER-VALUE>
      <SHORT-NAME>ArtiObjectClassParameter_ArtiHwCore_CurrentApplication<
         /SHORT-NAME>
      <DEFINITION-REF DEST="ECUC-PARAM-CONF-CONTAINER-DEF">/AUTOSAR/
         EcucDefs/Arti/ArtiValues/ArtiObjectClassParameter</DEFINITION-
         REF>
      <...>
    </ECUC-CONTAINER-VALUE>
    <ECUC-CONTAINER-VALUE>
      <SHORT-NAME>ArtiObjectInstanceParameter_CurrentApplicationOnCore0</
         SHORT-NAME>
      <DEFINITION-REF DEST="ECUC-PARAM-CONF-CONTAINER-DEF">/AUTOSAR/
         EcucDefs/Arti/ArtiValues/ArtiObjectInstanceParameter</DEFINITION
         -REF>
      <...>
```

```
      </ECUC-CONTAINER-VALUE>
      <ECUC-CONTAINER-VALUE>
        <SHORT-NAME>ArtiParameterTypeMap_Core</SHORT-NAME>
        <DEFINITION-REF DEST="ECUC-PARAM-CONF-CONTAINER-DEF">/AUTOSAR/
            EcucDefs/Arti/ArtiValues/ArtiParameterTypeMap</DEFINITION-REF>
        <...>
      </ECUC-CONTAINER-VALUE>
    </CONTAINERS>
  </ECUC-MODULE-CONFIGURATION-VALUES>
  <...>
```

10.7.1 ArtiConstant

SWS Item	[ECUC_Arti_00006]		
Container Name	ArtiConstant		
Parent Container	ArtiValues		
Description	This container holds a constant value.		
Post-Build Variant Multiplicity	false		
Multiplicity Configuration Class	Pre-compile time	X	All Variants
	Link time	–	
	Post-build time	–	
Configuration Parameters			

SWS Item	[ECUC_Arti_00008]		
Parameter Name	ArtiConstantString		
Parent Container	ArtiConstant		
Description	This is the constant value for a specific parameter.		
Multiplicity	1		
Type	EcucStringParamDef		
Default value	–		
Regular Expression	–		
Post-Build Variant Value	false		
Value Configuration Class	Pre-compile time	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: ECU		

No Included Containers

Example 10.5

Examplary Value of an ArtiConstant Container

```
<ECUC-CONTAINER-VALUE>
  <SHORT-NAME>ArtiConstant_ArtiSwc_WiperLocation_Front</SHORT-NAME>
  <DEFINITION-REF DEST="ECUC-PARAM-CONF-CONTAINER-DEF">/AUTOSAR/EcucDefs/
      Arti/ArtiValues/ArtiConstant</DEFINITION-REF>
  <PARAMETER-VALUES>
```

```
      <ECUC-TEXTUAL-PARAM-VALUE>
        <DEFINITION-REF DEST="ECUC-STRING-PARAM-DEF">/AUTOSAR/EcucDefs/Arti
            /ArtiValues/ArtiConstant/ArtiConstantString</DEFINITION-REF>
        <VALUE>Front</VALUE>
      </ECUC-TEXTUAL-PARAM-VALUE>
    </PARAMETER-VALUES>
  </ECUC-CONTAINER-VALUE>
```

10.7.2 ArtiExpression

SWS Item	[ECUC_Arti_00009]		
Container Name	ArtiExpression		
Parent Container	ArtiValues		
Description	This container holds a C like expression that a debugger can evaluate. This is similar to what is already done in ORTI.		
Post-Build Variant Multiplicity	false		
Multiplicity Configuration Class	Pre-compile time	X	All Variants
	Link time	–	
	Post-build time	–	
Configuration Parameters			

SWS Item	[ECUC_Arti_00011]		
Parameter Name	ArtiExpressionString		
Parent Container	ArtiExpression		
Description	This string represents a C like expression that a debugger can evaluate.		
Multiplicity	1		
Type	EcucStringParamDef		
Default value	–		
Regular Expression	–		
Post-Build Variant Value	true		
Value Configuration Class	Pre-compile time	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: ECU		

No Included Containers

Example 10.6

Examplary Value of an ArtiExpression Container

```
<ECUC-CONTAINER-VALUE>
  <SHORT-NAME>ArtiExpression_ArtiHwCore_CurrentTaskOnCore0</SHORT-NAME>
  <DEFINITION-REF DEST="ECUC-PARAM-CONF-CONTAINER-DEF">/AUTOSAR/EcucDefs/
      Arti/ArtiValues/ArtiExpression</DEFINITION-REF>
  <PARAMETER-VALUES>
    <ECUC-TEXTUAL-PARAM-VALUE>
```

```
        <DEFINITION-REF DEST="ECUC-STRING-PARAM-DEF">/AUTOSAR/EcucDefs/Arti
            /ArtiValues/ArtiExpression/ArtiExpressionString</DEFINITION-REF>
        <VALUE>Os_ControlledCoreInfo[0U].RunningTask</VALUE>
      </ECUC-TEXTUAL-PARAM-VALUE>
    </PARAMETER-VALUES>
  </ECUC-CONTAINER-VALUE>
```

10.7.3 ArtiHook

SWS Item	[ECUC_Arti_00012]		
Container Name	ArtiHook		
Parent Container	ArtiValues		
Description	This container represents an ARTI hook that is present in the module.		
Post-Build Variant Multiplicity	false		
Multiplicity Configuration Class	Pre-compile time	X	All Variants
	Link time	–	
	Post-build time	–	
Configuration Parameters			

SWS Item	[ECUC_Arti_00180]		
Parameter Name	ArtiHookAssociatedFunction		
Parent Container	ArtiHook		
Description	Name of the C function that is associated with this hook.		
Multiplicity	0..1		
Type	EcucFunctionNameDef		
Default value	–		
Regular Expression	–		
Post-Build Variant Multiplicity	false		
Post-Build Variant Value	false		
Multiplicity Configuration Class	Pre-compile time	X	All Variants
	Link time	–	
	Post-build time	–	
Value Configuration Class	Pre-compile time	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: local		

SWS Item	[ECUC_Arti_00013]
Parameter Name	ArtiHookClass
Parent Container	ArtiHook
Description	Name of the (schedule) class of macros. Classes can be one of the predefined classes or user defined.
Multiplicity	1
Type	EcucStringParamDef
Default value	–
Regular Expression	–

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Post-Build Variant Value	false		
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: ECU		

SWS Item	**[ECUC_Arti_00014]**		
Parameter Name	ArtiHookContext		
Parent Container	ArtiHook		
Description	Name of the execution context. One of NOSUSP, SPRVSR, or USER. See also chapter "ARTI Tracing Macro".		
Multiplicity	1		
Type	EcucStringParamDef		
Default value	–		
Regular Expression	–		
Post-Build Variant Value	false		
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: ECU		

SWS Item	**[ECUC_Arti_00015]**		
Parameter Name	ArtiHookEventName		
Parent Container	ArtiHook		
Description	The name of the event as defined for a particular class, or an arbitrary name for generic classes.		
Multiplicity	1		
Type	EcucStringParamDef		
Default value	–		
Regular Expression	–		
Post-Build Variant Value	false		
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: ECU		

SWS Item	**[ECUC_Arti_00181]**		
Parameter Name	ArtiHookFileName		
Parent Container	ArtiHook		
Description	File name (possibly with path) where this ArtiHook is implemented.		
Multiplicity	0..1		
Type	EcucStringParamDef		
Default value	–		
Regular Expression	–		
Post-Build Variant Multiplicity	false		
Post-Build Variant Value	false		
Multiplicity Configuration Class	**Pre-compile time**	X	All Variants

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	Link time	–	
	Post-build time	–	
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: ECU		

SWS Item	**[ECUC_Arti_00017]**		
Parameter Name	ArtiHookInstance		
Parent Container	ArtiHook		
Description	Name of an instance of the (schedule) class.		
Multiplicity	1		
Type	EcucStringParamDef		
Default value	–		
Regular Expression	–		
Post-Build Variant Value	false		
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: ECU		

SWS Item	**[ECUC_Arti_00179]**		
Parameter Name	ArtiHookEntryRef		
Parent Container	ArtiHook		
Description	Reference to the BswModuleEntry that describes the parameters of this hook.		
Multiplicity	0..1		
Type	Foreign reference to BSW-MODULE-ENTRY		
Post-Build Variant Multiplicity	false		
Post-Build Variant Value	false		
Multiplicity Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: local		

SWS Item	**[ECUC_Arti_00016]**		
Parameter Name	ArtiHookEventParameterTypeRef		
Parent Container	ArtiHook		
Description	Refers to a parameter type to interpret the hook event number.		
Multiplicity	0..1		
Type	Reference to ArtiParameterTypeMap		
Post-Build Variant Multiplicity	false		
Post-Build Variant Value	false		
Multiplicity Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	

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	Post-build time	–	
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: ECU		

SWS Item	**[ECUC_Arti_00018]**		
Parameter Name	ArtiHookInstanceParameterTypeRef		
Parent Container	ArtiHook		
Description	Refers to a parameter type to interpret the hook instance number.		
Multiplicity	0..1		
Type	Reference to ArtiParameterTypeMap		
Post-Build Variant Multiplicity	false		
Post-Build Variant Value	false		
Multiplicity Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: ECU		

No Included Containers

Example 10.7

Examplary Value of an ArtiHook Container

```
<ECUC-CONTAINER-VALUE>
  <SHORT-NAME>ArtiHook_ArtiOs_TaskStart</SHORT-NAME>
  <DEFINITION-REF DEST="ECUC-PARAM-CONF-CONTAINER-DEF">/AUTOSAR/EcucDefs/
      Arti/ArtiValues/ArtiHook</DEFINITION-REF>
  <PARAMETER-VALUES>
    <ECUC-TEXTUAL-PARAM-VALUE>
      <DEFINITION-REF DEST="ECUC-STRING-PARAM-DEF">/AUTOSAR/EcucDefs/Arti
          /ArtiValues/ArtiHook/ArtiHookClass</DEFINITION-REF>
      <VALUE>AR_CP_OS_TASK</VALUE>
    </ECUC-TEXTUAL-PARAM-VALUE>
    <ECUC-TEXTUAL-PARAM-VALUE>
      <DEFINITION-REF DEST="ECUC-STRING-PARAM-DEF">/AUTOSAR/EcucDefs/Arti
          /ArtiValues/ArtiHook/ArtiHookContext</DEFINITION-REF>
      <VALUE>NOSUSP</VALUE>
    </ECUC-TEXTUAL-PARAM-VALUE>
    <ECUC-TEXTUAL-PARAM-VALUE>
      <DEFINITION-REF DEST="ECUC-STRING-PARAM-DEF">/AUTOSAR/EcucDefs/Arti
          /ArtiValues/ArtiHook/ArtiHookEventName</DEFINITION-REF>
      <VALUE>OsTask_Start</VALUE>
    </ECUC-TEXTUAL-PARAM-VALUE>
    <ECUC-TEXTUAL-PARAM-VALUE>
```

```
        <DEFINITION-REF DEST="ECUC-STRING-PARAM-DEF">/AUTOSAR/EcucDefs/Arti
            /ArtiValues/ArtiHook/ArtiHookInstance</DEFINITION-REF>
        <VALUE>Vendor1OsCore</VALUE>
      </ECUC-TEXTUAL-PARAM-VALUE>
    </PARAMETER-VALUES>
    <REFERENCE-VALUES>
      <ECUC-REFERENCE-VALUE>
        <DEFINITION-REF DEST="ECUC-REFERENCE-DEF">/AUTOSAR/EcucDefs/Arti/
            ArtiValues/ArtiHook/ArtiHookEventParameterTypeRef</DEFINITION-
            REF>
        <VALUE-REF DEST="ECUC-CONTAINER-VALUE">/Vendor1/Vendor1Arti/
            ArtiParameterTypeMap_TaskId</VALUE-REF>
      </ECUC-REFERENCE-VALUE>
      <ECUC-REFERENCE-VALUE>
        <DEFINITION-REF DEST="ECUC-REFERENCE-DEF">/AUTOSAR/EcucDefs/Arti/
            ArtiValues/ArtiHook/ArtiHookInstanceParameterTypeRef</DEFINITION
            -REF>
        <VALUE-REF DEST="ECUC-CONTAINER-VALUE">/Vendor1/Vendor1Arti/
            ArtiParameterTypeMap_Core</VALUE-REF>
      </ECUC-REFERENCE-VALUE>
    </REFERENCE-VALUES>
  </ECUC-CONTAINER-VALUE>
```

10.7.4 ArtiObjectClassParameter

SWS Item	[ECUC_Arti_00020]		
Container Name	ArtiObjectClassParameter		
Parent Container	ArtiValues		
Description	This container represents a parameter of an Arti object class definition.		
Post-Build Variant Multiplicity	false		
Multiplicity Configuration Class	Pre-compile time	X	All Variants
	Link time	–	
	Post-build time	–	
Configuration Parameters			

SWS Item	[ECUC_Arti_00028]		
Parameter Name	ArtiObjectClassParameterTypeMapRef		
Parent Container	ArtiObjectClassParameter		
Description	Refers to a parameter type to interpret the instance parameter value.		
Multiplicity	0..1		
Type	Reference to ArtiParameterTypeMap		
Post-Build Variant Multiplicity	false		
Post-Build Variant Value	false		
Multiplicity Configuration Class	Pre-compile time	X	All Variants
	Link time	–	
	Post-build time	–	
Value Configuration Class	Pre-compile time	X	All Variants

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	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: ECU		

No Included Containers

Example 10.8

Examplary Value of an ArtiObjectClassParameter Container

```
<ECUC-CONTAINER-VALUE>
  <SHORT-NAME>ArtiObjectClassParameter_ArtiHwCore_CurrentTask</SHORT-NAME
     >
  <DEFINITION-REF DEST="ECUC-PARAM-CONF-CONTAINER-DEF">/AUTOSAR/EcucDefs/
     Arti/ArtiValues/ArtiObjectClassParameter</DEFINITION-REF>
  <PARAMETER-VALUES>
    <ECUC-TEXTUAL-PARAM-VALUE>
      <DEFINITION-REF DEST="ECUC-STRING-PARAM-DEF">/AUTOSAR/EcucDefs/Arti
         /ArtiValues/ArtiObjectClassParameter/
         ArtiObjectClassParameterDescription</DEFINITION-REF>
      <VALUE>Current Running AUTOSAR Task</VALUE>
    </ECUC-TEXTUAL-PARAM-VALUE>
  </PARAMETER-VALUES>
  <REFERENCE-VALUES>
    <ECUC-REFERENCE-VALUE>
      <DEFINITION-REF DEST="ECUC-REFERENCE-DEF">/AUTOSAR/EcucDefs/Arti/
         ArtiValues/ArtiObjectClassParameter/
         ArtiObjectClassParameterTypeMapRef</DEFINITION-REF>
      <VALUE-REF DEST="ECUC-CONTAINER-VALUE">/Vendor1/Vendor1Arti/
         ArtiParameterTypeMap_TaskExpr</VALUE-REF>
    </ECUC-REFERENCE-VALUE>
  </REFERENCE-VALUES>
</ECUC-CONTAINER-VALUE>
```

10.7.5 ArtiObjectInstanceParameter

SWS Item	**[ECUC_Arti_00021]**		
Container Name	ArtiObjectInstanceParameter		
Parent Container	ArtiValues		
Description	This container represents a parameter of an Arti object instance.		
Post-Build Variant Multiplicity	false		
Multiplicity Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Configuration Parameters			

SWS Item	[ECUC_Arti_00007]		
Parameter Name	ArtiObjectInstanceParameterConstantRef		
Parent Container	ArtiObjectInstanceParameter		
Description	Refers to a constant representing the value of this parameter.		
Multiplicity	0..1		
Type	Reference to ArtiConstant		
Post-Build Variant Multiplicity	false		
Post-Build Variant Value	false		
Multiplicity Configuration Class	Pre-compile time	X	All Variants
	Link time	–	
	Post-build time	–	
Value Configuration Class	Pre-compile time	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: ECU		

SWS Item	[ECUC_Arti_00010]		
Parameter Name	ArtiObjectInstanceParameterExpressionRef		
Parent Container	ArtiObjectInstanceParameter		
Description	Refers to an expression that evaluates the value of this parameter.		
Multiplicity	0..1		
Type	Reference to ArtiExpression		
Post-Build Variant Multiplicity	false		
Post-Build Variant Value	false		
Multiplicity Configuration Class	Pre-compile time	X	All Variants
	Link time	–	
	Post-build time	–	
Value Configuration Class	Pre-compile time	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: ECU		

SWS Item	[ECUC_Arti_00019]		
Parameter Name	ArtiObjectInstanceParameterHookRef		
Parent Container	ArtiObjectInstanceParameter		
Description	Refers to a hook that records this parameter.		
Multiplicity	0..1		
Type	Reference to ArtiHook		
Post-Build Variant Multiplicity	false		
Post-Build Variant Value	false		
Multiplicity Configuration Class	Pre-compile time	X	All Variants
	Link time	–	
	Post-build time	–	
Value Configuration Class	Pre-compile time	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: ECU		

No Included Containers

Example 10.9

Examplary Value of an ArtiObjectInstanceParameter Container

```
<ECUC-CONTAINER-VALUE>
  <SHORT-NAME>ArtiObjectInstanceParameter_CurrentTaskOnCore0</SHORT-NAME>
  <DEFINITION-REF DEST="ECUC-PARAM-CONF-CONTAINER-DEF">/AUTOSAR/EcucDefs/
     Arti/ArtiValues/ArtiObjectInstanceParameter</DEFINITION-REF>
  <REFERENCE-VALUES>
    <ECUC-REFERENCE-VALUE>
      <DEFINITION-REF DEST="ECUC-REFERENCE-DEF">/AUTOSAR/EcucDefs/Arti/
         ArtiValues/ArtiObjectInstanceParameter/
         ArtiObjectInstanceParameterExpressionRef</DEFINITION-REF>
      <VALUE-REF DEST="ECUC-CONTAINER-VALUE">/Vendor1/Vendor1Arti/
         ArtiExpression_ArtiHwCore_CurrentTaskOnCore0</VALUE-REF>
    </ECUC-REFERENCE-VALUE>
  </REFERENCE-VALUES>
</ECUC-CONTAINER-VALUE>
```

10.7.6 ArtiParameterTypeMap

SWS Item	[ECUC_Arti_00022]		
Container Name	ArtiParameterTypeMap		
Parent Container	ArtiValues		
Description	A map of key/value pairs to map a parameter value to a display string and/or an Arti or EcuC object.		
Post-Build Variant Multiplicity	false		
Multiplicity Configuration Class	Pre-compile time	X	All Variants
	Link time	–	
	Post-build time	–	
Configuration Parameters			

Included Containers		
Container Name	Multiplicity	Scope / Dependency
ArtiParameterTypeMapPair	1..*	A key/value pair to map a parameter value to a display string and/or an Arti or EcuC object.

SWS Item	[ECUC_Arti_00023]
Container Name	ArtiParameterTypeMapPair
Parent Container	ArtiParameterTypeMap
Description	A key/value pair to map a parameter value to a display string and/or an Arti or EcuC object.
Post-Build Variant Multiplicity	false

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Multiplicity Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Configuration Parameters			

SWS Item	**[ECUC_Arti_00024]**		
Parameter Name	ArtiParameterTypeMapPairInput		
Parent Container	ArtiParameterTypeMapPair		
Description	The numerical value given by a parameter to translate. When used with ArtiHooks, this parameter is mandatory (multiplicity 1) and its value is limited to the range of 0..65535. This parameter may be used to map the values given by "instanceParameter" and/or the "eventParameter" of the ARTI_TRACE macro.		
Multiplicity	0..1		
Type	EcucIntegerParamDef		
Range	0 .. 18446744073709551615		
Default value	–		
Post-Build Variant Multiplicity	false		
Post-Build Variant Value	false		
Multiplicity Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: ECU		

SWS Item	**[ECUC_Arti_00026]**		
Parameter Name	ArtiParameterTypeMapPairOutput		
Parent Container	ArtiParameterTypeMapPair		
Description	The string to display for the Input value.		
Multiplicity	0..1		
Type	EcucStringParamDef		
Default value	–		
Regular Expression	–		
Post-Build Variant Multiplicity	false		
Post-Build Variant Value	false		
Multiplicity Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: ECU		

SWS Item	[ECUC_Arti_00025]		
Parameter Name	ArtiParameterTypeMapPairInputExpressionRef		
Parent Container	ArtiParameterTypeMapPair		
Description	Refers to an expression that evaluates to a numerical value to translate.		
Multiplicity	0..1		
Type	Reference to ArtiExpression		
Post-Build Variant Multiplicity	false		
Post-Build Variant Value	false		
Multiplicity Configuration Class	Pre-compile time	X	All Variants
	Link time	–	
	Post-build time	–	
Value Configuration Class	Pre-compile time	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: ECU		

SWS Item	[ECUC_Arti_00027]		
Parameter Name	ArtiParameterTypeMapPairOutputRef		
Parent Container	ArtiParameterTypeMapPair		
Description	Choice Reference to ArtiOsTaskInstance, ArtiOsIsrInstance, ArtiStatesTaskState, Os AppMode, ArtiOsContextInstance, or ArtiOsStackInstance.		
Multiplicity	0..1		
Type	Choice reference to [ArtiOsContextInstance, ArtiOsIsrInstance, ArtiOsStackInstance, ArtiOsTaskInstance, ArtiStatesTaskState, OsAppMode]		
Post-Build Variant Multiplicity	false		
Post-Build Variant Value	false		
Multiplicity Configuration Class	Pre-compile time	X	All Variants
	Link time	–	
	Post-build time	–	
Value Configuration Class	Pre-compile time	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: ECU		

No Included Containers

Example 10.10

Examplary Values of an ArtiParameterTypeMap Containers

```
<ECUC-CONTAINER-VALUE>
  <SHORT-NAME>ArtiParameterTypeMap_TaskId</SHORT-NAME>
  <DEFINITION-REF DEST="ECUC-PARAM-CONF-CONTAINER-DEF">/AUTOSAR/EcucDefs/
     Arti/ArtiValues/ArtiParameterTypeMap</DEFINITION-REF>
  <SUB-CONTAINERS>
    <ECUC-CONTAINER-VALUE>
      <SHORT-NAME>TaskHighPrio</SHORT-NAME>
      <DEFINITION-REF DEST="ECUC-PARAM-CONF-CONTAINER-DEF">/AUTOSAR/
         EcucDefs/Arti/ArtiValues/ArtiParameterTypeMap/
         ArtiParameterTypeMapPair</DEFINITION-REF>
```

```
        <PARAMETER-VALUES>
          <ECUC-TEXTUAL-PARAM-VALUE>
            <DEFINITION-REF DEST="ECUC-INTEGER-PARAM-DEF">/AUTOSAR/EcucDefs
                /Arti/ArtiValues/ArtiParameterTypeMap/
                ArtiParameterTypeMapPair/ArtiParameterTypeMapPairInput</
                DEFINITION-REF>
            <VALUE>1</VALUE>
          </ECUC-TEXTUAL-PARAM-VALUE>
          <ECUC-TEXTUAL-PARAM-VALUE>
            <DEFINITION-REF DEST="ECUC-STRING-PARAM-DEF">/AUTOSAR/EcucDefs/
                Arti/ArtiValues/ArtiParameterTypeMap/
                ArtiParameterTypeMapPair/ArtiParameterTypeMapPairOutput</
                DEFINITION-REF>
            <VALUE>HighPriority</VALUE>
          </ECUC-TEXTUAL-PARAM-VALUE>
        </PARAMETER-VALUES>
      </ECUC-CONTAINER-VALUE>
    </SUB-CONTAINERS>
  </ECUC-CONTAINER-VALUE>
  <ECUC-CONTAINER-VALUE>
    <SHORT-NAME>ArtiParameterTypeMap_OsAppMode</SHORT-NAME>
    <DEFINITION-REF DEST="ECUC-PARAM-CONF-CONTAINER-DEF">/AUTOSAR/EcucDefs/
        Arti/ArtiValues/ArtiParameterTypeMap</DEFINITION-REF>
    <SUB-CONTAINERS>
      <ECUC-CONTAINER-VALUE>
        <SHORT-NAME>AppModeDefault</SHORT-NAME>
        <DEFINITION-REF DEST="ECUC-PARAM-CONF-CONTAINER-DEF">/AUTOSAR/
            EcucDefs/Arti/ArtiValues/ArtiParameterTypeMap/
            ArtiParameterTypeMapPair</DEFINITION-REF>
        <PARAMETER-VALUES>
          <ECUC-TEXTUAL-PARAM-VALUE>
            <DEFINITION-REF DEST="ECUC-INTEGER-PARAM-DEF">/AUTOSAR/EcucDefs
                /Arti/ArtiValues/ArtiParameterTypeMap/
                ArtiParameterTypeMapPair/ArtiParameterTypeMapPairInput</
                DEFINITION-REF>
            <VALUE>1</VALUE>
          </ECUC-TEXTUAL-PARAM-VALUE>
          <ECUC-TEXTUAL-PARAM-VALUE>
            <DEFINITION-REF DEST="ECUC-STRING-PARAM-DEF">/AUTOSAR/EcucDefs/
                Arti/ArtiValues/ArtiParameterTypeMap/
                ArtiParameterTypeMapPair/ArtiParameterTypeMapPairOutput</
                DEFINITION-REF>
            <VALUE>OSDEFAULTAPPMODE</VALUE>
          </ECUC-TEXTUAL-PARAM-VALUE>
        </PARAMETER-VALUES>
      </ECUC-CONTAINER-VALUE>
      <ECUC-CONTAINER-VALUE>
        <SHORT-NAME>AppModeNone</SHORT-NAME>
        <DEFINITION-REF DEST="ECUC-PARAM-CONF-CONTAINER-DEF">/AUTOSAR/
            EcucDefs/Arti/ArtiValues/ArtiParameterTypeMap/
            ArtiParameterTypeMapPair</DEFINITION-REF>
        <PARAMETER-VALUES>
          <ECUC-TEXTUAL-PARAM-VALUE>
            <DEFINITION-REF DEST="ECUC-INTEGER-PARAM-DEF">/AUTOSAR/EcucDefs
                /Arti/ArtiValues/ArtiParameterTypeMap/
```

```
            ArtiParameterTypeMapPair/ArtiParameterTypeMapPairInput</
            DEFINITION-REF>
          <VALUE>0</VALUE>
        </ECUC-TEXTUAL-PARAM-VALUE>
        <ECUC-TEXTUAL-PARAM-VALUE>
          <DEFINITION-REF DEST="ECUC-STRING-PARAM-DEF">/AUTOSAR/EcucDefs/
            Arti/ArtiValues/ArtiParameterTypeMap/
            ArtiParameterTypeMapPair/ArtiParameterTypeMapPairOutput</
            DEFINITION-REF>
          <VALUE>OS_APPMODE_NONE</VALUE>
        </ECUC-TEXTUAL-PARAM-VALUE>
      </PARAMETER-VALUES>
    </ECUC-CONTAINER-VALUE>
  </SUB-CONTAINERS>
</ECUC-CONTAINER-VALUE>
<ECUC-CONTAINER-VALUE>
  <SHORT-NAME>ArtiParameterTypeMap_TaskExpr</SHORT-NAME>
  <DEFINITION-REF DEST="ECUC-PARAM-CONF-CONTAINER-DEF">/AUTOSAR/EcucDefs/
    Arti/ArtiValues/ArtiParameterTypeMap</DEFINITION-REF>
  <SUB-CONTAINERS>
    <ECUC-CONTAINER-VALUE>
      <SHORT-NAME>Task_1</SHORT-NAME>
      <DEFINITION-REF DEST="ECUC-PARAM-CONF-CONTAINER-DEF">/AUTOSAR/
        EcucDefs/Arti/ArtiValues/ArtiParameterTypeMap/
        ArtiParameterTypeMapPair</DEFINITION-REF>
      <PARAMETER-VALUES>
        <ECUC-TEXTUAL-PARAM-VALUE>
          <DEFINITION-REF DEST="ECUC-INTEGER-PARAM-DEF">/AUTOSAR/EcucDefs
            /Arti/ArtiValues/ArtiParameterTypeMap/
            ArtiParameterTypeMapPair/ArtiParameterTypeMapPairInput</
            DEFINITION-REF>
          <VALUE>&Task_1</VALUE>
        </ECUC-TEXTUAL-PARAM-VALUE>
        <ECUC-TEXTUAL-PARAM-VALUE>
          <DEFINITION-REF DEST="ECUC-STRING-PARAM-DEF">/AUTOSAR/EcucDefs/
            Arti/ArtiValues/ArtiParameterTypeMap/
            ArtiParameterTypeMapPair/ArtiParameterTypeMapPairOutput</
            DEFINITION-REF>
          <VALUE>Task_1</VALUE>
        </ECUC-TEXTUAL-PARAM-VALUE>
      </PARAMETER-VALUES>
    </ECUC-CONTAINER-VALUE>
  </SUB-CONTAINERS>
</ECUC-CONTAINER-VALUE>
```

10.7.7 ArtiStates

SWS Item	[ECUC_Arti_00029]
Container Name	ArtiStates
Parent Container	ArtiValues

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Description	This container contains all states of tasks, isrs... that the EcuC uses.		
Post-Build Variant Multiplicity	false		
Multiplicity Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Configuration Parameters			

SWS Item	**[ECUC_Arti_00032]**		
Parameter Name	ArtiStatesTaskEnhanced		
Parent Container	ArtiStates		
Description	Set to true, if the OS provides an "enhanced" state model with "READY" split to "Activated", "Preempted", "Released".		
Multiplicity	1		
Type	EcucBooleanParamDef		
Default value	–		
Post-Build Variant Value	false		
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: local		

Included Containers		
Container Name	**Multiplicity**	**Scope / Dependency**
ArtiStatesTaskState	0..*	Each state used by the OS has to be listed as ArtiStatesTask State Parameter with a choice of the states.

SWS Item	**[ECUC_Arti_00030]**		
Container Name	ArtiStatesTaskState		
Parent Container	ArtiStates		
Description	Each state used by the OS has to be listed as ArtiStatesTaskState Parameter with a choice of the states.		
Post-Build Variant Multiplicity	false		
Multiplicity Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Configuration Parameters			

SWS Item	**[ECUC_Arti_00033]**	
Parameter Name	ArtiStatesTaskStateEnum	
Parent Container	ArtiStatesTaskState	
Description	ArtiStatesTaskState choice of the states.	
Multiplicity	1	
Type	EcucEnumerationParamDef	
Range	ArtiTaskStateActivated	activated
	ArtiTaskStatePreempted	preempted
	ArtiTaskStateReady	ready
	ArtiTaskStateReleased	released

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	ArtiTaskStateRunning	running	
	ArtiTaskStateSuspended	suspended	
	ArtiTaskStateWaiting	waiting	
Post-Build Variant Value	false		
Value Configuration Class	**Pre-compile time**	X	All Variants
	Link time	–	
	Post-build time	–	
Scope / Dependency	scope: local		

No Included Containers

10.8 Published Information

For details refer to the chapter 10.3 “Published Information” in SWS_BSWGeneral.

A Not applicable requirements

No content.

B Example

The example provided in this chapter demonstrates how to apply ARTI to an operating system. It also shows how the generic `ARTI_TRACE` macro can be mapped to different tracing implementations. In the example, these first tracing implementations is provided by `VENDOR_A` the second by `VENDOR_B`.

The C code of the example compiles but is not functional. The operating system is boiled down to three functions: `SuspendAllInterrupts`, `ResumeAllInterrupts` and `StartOS`. The application code defined the `main` function and two tasks: `Task_Cylinder0` and `Task_Cylinder1`.

Section B.1 holds all the C code demonstrating the ARTI instrumentation and section B.2 contains the corresponding ARXML code.

B.1 ARTI Instrumentation

B.1.1 ARTI Tool Binding (Arti.h)

```
1  #ifndef _ARTI_H_
2  #define _ARTI_H_
3
4  #include <stdint.h>
5
6  #if defined VENDOR_A
7  /* ARTI Trace Macro */
8  #   define ARTI_TRACE(_contextName, _className, _instanceName,
       instanceParameter, _eventName, event_value) \
9          (void)TraceImpl ## _ ## _className ## _ ## _eventName ## _ ##
              _instanceName ## _ ## _contextName( (instanceParameter), (
              event_value) )
10
11 #elif defined VENDOR_B
12 /* ARTI Trace Macro */
13 #   define ARTI_TRACE(_contextName, _className, _instanceName,
       instanceParameter, _eventName, event_value) \
14         (void)TraceImpl ## _ ## _className ## _ ## _contextName( (
              _instanceName), (instanceParameter), (_eventName), (
              event_value) )
15
16 #else
17 #   define ARTI_TRACE(_contextName, _className, _instanceName,
       instanceParameter, _eventName, event_value) (void)0
18 #endif
19
20
21 #endif /* _ARTI_H_ */
```

Listing B.1: Example for Arti.h

```
1  #ifndef _OS_ARTI_H_
```

```
#define _OS_ARTI_H_

#include "stdint.h"
#include "Arti.h"

#if defined VENDOR_A

/* Prototypes for AR_CP_OS_TASK */
void TraceImpl_AR_CP_OS_TASK_OsTask_Start_OS_SHORT_NAME_SPRVSR(uint32_t instanceParameter, uint32_t event_value);
void TraceImpl_AR_CP_OS_TASK_OsTask_Stop_OS_SHORT_NAME_SPRVSR(uint32_t instanceParameter, uint32_t event_value);

void TraceImpl_AR_CP_OS_TASK_OsTask_Start_OS_SHORT_NAME_USER(uint32_t instanceParameter, uint32_t event_value);
void TraceImpl_AR_CP_OS_TASK_OsTask_Stop_OS_SHORT_NAME_USER(uint32_t instanceParameter, uint32_t event_value);

void TraceImpl_AR_CP_OS_TASK_OsTask_Start_OS_SHORT_NAME_NOSUSP(uint32_t instanceParameter, uint32_t event_value);
void TraceImpl_AR_CP_OS_TASK_OsTask_Stop_OS_SHORT_NAME_NOSUSP(uint32_t instanceParameter, uint32_t event_value);

#elif defined VENDOR_B

/* Prototypes for AR_CP_OS_TASK */
void TraceImpl_AR_CP_OS_TASK_SPRVSR(uint32_t instanceName, uint32_t instanceParameter, uint32_t eventName, uint32_t event_value);
void TraceImpl_AR_CP_OS_TASK_USER(uint32_t instanceName, uint32_t instanceParameter, uint32_t eventName, uint32_t event_value);
void TraceImpl_AR_CP_OS_TASK_NOSUSP(uint32_t instanceName, uint32_t instanceParameter, uint32_t eventName, uint32_t event_value);

#endif

#endif /* _OS_ARTI_H_ */
```

Listing B.2: Example for Os_Arti.h

```
#include <stdint.h>

#include "Os.h"
#include "Arti.h"
#include "Os_Arti.h"

/* Stubs for intrinsics */
#define __disable() ((void)(0))
#define __enable() ((void)(0))

#if defined VENDOR_A

void TraceImpl_AR_CP_OS_TASK_OsTask_Start_OS_SHORT_NAME_SPRVSR(uint32_t instanceParameter, uint32_t event_value)
{
    __disable();
```

```
16      TraceImpl_AR_CP_OS_TASK_OsTask_Start_OS_SHORT_NAME_NOSUSP(
            instanceParameter, event_value);
17      __enable();
18  }
19
20  void TraceImpl_AR_CP_OS_TASK_OsTask_Stop_OS_SHORT_NAME_SPRVSR(uint32_t
        instanceParameter, uint32_t event_value)
21  {
22      __disable();
23      TraceImpl_AR_CP_OS_TASK_OsTask_Stop_OS_SHORT_NAME_NOSUSP(
            instanceParameter, event_value);
24      __enable();
25  }
26
27  void TraceImpl_AR_CP_OS_TASK_OsTask_Start_OS_SHORT_NAME_USER(uint32_t
        instanceParameter, uint32_t event_value)
28  {
29      SuspendAllInterrupts();
30      TraceImpl_AR_CP_OS_TASK_OsTask_Start_OS_SHORT_NAME_NOSUSP(
            instanceParameter, event_value);
31      ResumeAllInterrupts();
32  }
33
34  void TraceImpl_AR_CP_OS_TASK_OsTask_Stop_OS_SHORT_NAME_USER(uint32_t
        instanceParameter, uint32_t event_value)
35  {
36      SuspendAllInterrupts();
37      TraceImpl_AR_CP_OS_TASK_OsTask_Stop_OS_SHORT_NAME_NOSUSP(
            instanceParameter, event_value);
38      ResumeAllInterrupts();
39  }
40
41  void TraceImpl_AR_CP_OS_TASK_OsTask_Start_OS_SHORT_NAME_NOSUSP(uint32_t
        instanceParameter, uint32_t event_value)
42  {
43      (void)instanceParameter; // avoid warning "unused parameter"
44      (void)event_value; // avoid warning "unused parameter"
45
46      // actual tracing code goes here
47  }
48
49  void TraceImpl_AR_CP_OS_TASK_OsTask_Stop_OS_SHORT_NAME_NOSUSP(uint32_t
        instanceParameter, uint32_t event_value)
50  {
51      (void)instanceParameter; // avoid warning "unused parameter"
52      (void)event_value; // avoid warning "unused parameter"
53
54      // actual tracing code goes here
55  }
56
57  #elif defined VENDOR_B
58
59  void TraceImpl_AR_CP_OS_TASK_SPRVSR(uint32_t instanceName, uint32_t
        instanceParameter, uint32_t eventName, uint32_t event_value)
60  {
61      __disable();
```

```
62      TraceImpl_AR_CP_OS_TASK_NOSUSP(instanceName, instanceParameter,
            eventName, event_value);
63      __enable();
64  }
65
66  void TraceImpl_AR_CP_OS_TASK_USER(uint32_t instanceName, uint32_t
        instanceParameter, uint32_t eventName, uint32_t event_value)
67  {
68      SuspendAllInterrupts();
69      TraceImpl_AR_CP_OS_TASK_NOSUSP(instanceName, instanceParameter,
            eventName, event_value);
70      ResumeAllInterrupts();
71  }
72
73  void TraceImpl_AR_CP_OS_TASK_NOSUSP(uint32_t instanceName, uint32_t
        instanceParameter, uint32_t eventName, uint32_t event_value)
74  {
75      (void)instanceName; // avoid warning "unused parameter"
76      (void)instanceParameter; // avoid warning "unused parameter"
77      (void)eventName; // avoid warning "unused parameter"
78      (void)event_value; // avoid warning "unused parameter"
79
80      // actual tracing code goes here
81  }
82
83
84  #else
85
86  #endif
```

Listing B.3: Example for Arti.c

B.1.2 ARTI OS Instrumentation

```
1  #ifndef _OS_H_
2  #define _OS_H_
3
4  #define TASK(_taskname)      void OS_TASK ## _ ## _taskname(void)
5
6  void SuspendAllInterrupts(void);
7  void ResumeAllInterrupts(void);
8
9  void StartOS(void);
10
11 #endif
```

Listing B.4: Example for OS instrumentation header

```
1  #include "user_main.h"
2  #include "Arti.h"
3
4  void SuspendAllInterrupts(void)
5  {
6      // ...
7  }
8
```

```
void ResumeAllInterrupts(void)
{
    // ...
}

void StartOS(void)
{
    const int myCoreId = 0;
    const int OS_TASK_Task_Cylinder0_ID = 2;

    // for testing the ARTI interface, we call the task UserTask1 here
       directly (rather than implementing an OS)
    ARTI_TRACE(NOSUSP, AR_CP_OS_TASK, OS_SHORT_NAME, myCoreId,
       OsTask_Start, OS_TASK_Task_Cylinder0_ID);
    OS_TASK_Task_Cylinder0();
    ARTI_TRACE(NOSUSP, AR_CP_OS_TASK, OS_SHORT_NAME, myCoreId,
       OsTask_Stop,  OS_TASK_Task_Cylinder0_ID);
}
```

Listing B.5: Example for OS instrumentation source

B.1.3 ARTI User Code

```
#ifndef _USER_MAIN_H_
#define _USER_MAIN_H_

#include "os.h"
extern TASK(Task_Cylinder0);
extern TASK(Task_Cylinder1);

#endif
```

Listing B.6: Example for user code header

```
#include <stdlib.h>

#include "os.h"

TASK(Task_Cylinder0)
{
    // inject
}

TASK(Task_Cylinder1)
{
    // inject
}

int main(void)
{
    StartOS();

    exit(EXIT_SUCCESS);

    return -1;
```

```
22  }
```

Listing B.7: Example for user code source

B.2 ARXML Representation of Instrumentation

Example B.1

Examplary value of the ArtiHook container for OsTask_Start

```
<ECUC-CONTAINER-VALUE>
  <SHORT-NAME>ArtiHook_ArtiOs_TaskStart</SHORT-NAME>
  <DEFINITION-REF DEST="ECUC-PARAM-CONF-CONTAINER-DEF">/AUTOSAR/EcucDefs/
      Arti/ArtiValues/ArtiHook</DEFINITION-REF>
  <PARAMETER-VALUES>
    <ECUC-TEXTUAL-PARAM-VALUE>
      <DEFINITION-REF DEST="ECUC-STRING-PARAM-DEF">/AUTOSAR/EcucDefs/Arti
          /ArtiValues/ArtiHook/ArtiHookClass</DEFINITION-REF>
      <VALUE>AR_CP_OS_TASK</VALUE>
    </ECUC-TEXTUAL-PARAM-VALUE>
    <ECUC-TEXTUAL-PARAM-VALUE>
      <DEFINITION-REF DEST="ECUC-STRING-PARAM-DEF">/AUTOSAR/EcucDefs/Arti
          /ArtiValues/ArtiHook/ArtiHookEventName</DEFINITION-REF>
      <VALUE>OsTask_Start</VALUE>
    </ECUC-TEXTUAL-PARAM-VALUE>
    <ECUC-TEXTUAL-PARAM-VALUE>
      <DEFINITION-REF DEST="ECUC-STRING-PARAM-DEF">/AUTOSAR/EcucDefs/Arti
          /ArtiValues/ArtiHook/ArtiHookInstance</DEFINITION-REF>
      <VALUE>OS_SHORT_NAME</VALUE>
    </ECUC-TEXTUAL-PARAM-VALUE>
  </PARAMETER-VALUES>
  <REFERENCE-VALUES>
    <ECUC-REFERENCE-VALUE>
      <DEFINITION-REF DEST="ECUC-REFERENCE-DEF">/AUTOSAR/EcucDefs/Arti/
          ArtiValues/ArtiHook/ArtiHookEventParameterTypeRef</DEFINITION-
          REF>
      <VALUE-REF DEST="ECUC-CONTAINER-VALUE">/Vendor1/Vendor1Arti/
          ArtiParameterTypeMap_TaskCylinderId</VALUE-REF>
    </ECUC-REFERENCE-VALUE>
    <ECUC-REFERENCE-VALUE>
      <DEFINITION-REF DEST="ECUC-REFERENCE-DEF">/AUTOSAR/EcucDefs/Arti/
          ArtiValues/ArtiHook/ArtiHookInstanceParameterTypeRef</DEFINITION
          -REF>
      <VALUE-REF DEST="ECUC-CONTAINER-VALUE">/Vendor1/Vendor1Arti/
          ArtiParameterTypeMap_Core</VALUE-REF>
    </ECUC-REFERENCE-VALUE>
  </REFERENCE-VALUES>
</ECUC-CONTAINER-VALUE>
```

Example B.2

Examplary value of the ArtiOsInstance container using the hooks

```
<ECUC-CONTAINER-VALUE>
  <SHORT-NAME>ArtiOsInstance_Conf</SHORT-NAME>
  <DEFINITION-REF DEST="ECUC-PARAM-CONF-CONTAINER-DEF">/AUTOSAR/EcucDefs/
     Arti/ArtiOs/ArtiOsInstance</DEFINITION-REF>
  <REFERENCE-VALUES>
    <ECUC-REFERENCE-VALUE>
      <DEFINITION-REF DEST="ECUC-REFERENCE-DEF">/AUTOSAR/EcucDefs/Arti/
         ArtiOs/ArtiOsInstance/ArtiOsInstanceEcucRef</DEFINITION-REF>
      <VALUE-REF DEST="ECUC-CONTAINER-VALUE">/Vendor1/Vendor1EcucOs/
         Vendor1Os</VALUE-REF>
    </ECUC-REFERENCE-VALUE>
    <ECUC-REFERENCE-VALUE>
      <DEFINITION-REF DEST="ECUC-REFERENCE-DEF">/AUTOSAR/EcucDefs/Arti/
         ArtiOs/ArtiOsInstance/ArtiOsInstanceHookRef</DEFINITION-REF>
      <VALUE-REF DEST="ECUC-CONTAINER-VALUE">/Vendor1/Vendor1Arti/
         ArtiHook_ArtiOs_TaskStart</VALUE-REF>
    </ECUC-REFERENCE-VALUE>
    <ECUC-REFERENCE-VALUE>
      <DEFINITION-REF DEST="ECUC-REFERENCE-DEF">/AUTOSAR/EcucDefs/Arti/
         ArtiOs/ArtiOsInstance/ArtiOsInstanceHookRef</DEFINITION-REF>
      <VALUE-REF DEST="ECUC-CONTAINER-VALUE">/Vendor1/Vendor1Arti/
         ArtiHook_ArtiOs_TaskStop</VALUE-REF>
    </ECUC-REFERENCE-VALUE>
  </REFERENCE-VALUES>
</ECUC-CONTAINER-VALUE>
```

Example B.3

Examplary value of the ArtiHook container for arbitrary use

```
<ECUC-CONTAINER-VALUE>
  <SHORT-NAME>ArtiHook_IgnitionControl_Cyl0_IgnitionStart</SHORT-NAME>
  <DEFINITION-REF DEST="ECUC-PARAM-CONF-CONTAINER-DEF">/AUTOSAR/EcucDefs/
     Arti/ArtiValues/ArtiHook</DEFINITION-REF>
  <PARAMETER-VALUES>
    <ECUC-TEXTUAL-PARAM-VALUE>
      <DEFINITION-REF DEST="ECUC-STRING-PARAM-DEF">/AUTOSAR/EcucDefs/Arti
         /ArtiValues/ArtiHook/ArtiHookClass</DEFINITION-REF>
      <VALUE>Ignition_Control</VALUE>
    </ECUC-TEXTUAL-PARAM-VALUE>
    <ECUC-TEXTUAL-PARAM-VALUE>
      <DEFINITION-REF DEST="ECUC-STRING-PARAM-DEF">/AUTOSAR/EcucDefs/Arti
         /ArtiValues/ArtiHook/ArtiHookEventName</DEFINITION-REF>
      <VALUE>IgnitionStart</VALUE>
    </ECUC-TEXTUAL-PARAM-VALUE>
    <ECUC-TEXTUAL-PARAM-VALUE>
      <DEFINITION-REF DEST="ECUC-STRING-PARAM-DEF">/AUTOSAR/EcucDefs/Arti
         /ArtiValues/ArtiHook/ArtiHookInstance</DEFINITION-REF>
      <VALUE>Cylinder0</VALUE>
    </ECUC-TEXTUAL-PARAM-VALUE>
  </PARAMETER-VALUES>
</ECUC-CONTAINER-VALUE>
```

Example B.4

Examplary value of an ArtiGenericComponentClass container with parameters holding hooks

```
<ECUC-CONTAINER-VALUE>
  <SHORT-NAME>ArtiGenericComponentClass_IgnitionControl</SHORT-NAME>
  <DEFINITION-REF DEST="ECUC-PARAM-CONF-CONTAINER-DEF">/AUTOSAR/EcucDefs/
     Arti/ArtiGeneric/ArtiGenericComponentClass</DEFINITION-REF>
  <PARAMETER-VALUES>
    <ECUC-TEXTUAL-PARAM-VALUE>
      <DEFINITION-REF DEST="ECUC-STRING-PARAM-DEF">/AUTOSAR/EcucDefs/Arti
         /ArtiGeneric/ArtiGenericComponentClass/
         ArtiGenericComponentClassName</DEFINITION-REF>
      <VALUE>ADIFFERENT</VALUE>
    </ECUC-TEXTUAL-PARAM-VALUE>
  </PARAMETER-VALUES>
  <SUB-CONTAINERS>
    <ECUC-CONTAINER-VALUE UUID="">
      <SHORT-NAME>IgnitionStart</SHORT-NAME>
      <DEFINITION-REF DEST="ECUC-PARAM-CONF-CONTAINER-DEF">/AUTOSAR/
         EcucDefs/Arti/ArtiGeneric/ArtiGenericComponentClass/
         ArtiGenericComponentClassParameter</DEFINITION-REF>
      <PARAMETER-VALUES>
        <ECUC-TEXTUAL-PARAM-VALUE>
          <DEFINITION-REF DEST="ECUC-STRING-PARAM-DEF">/AUTOSAR/EcucDefs/
             Arti/ArtiGeneric/ArtiGenericComponentClass/
             ArtiGenericComponentClassParameter/
             ArtiGenericComponentClassParameterDescription</DEFINITION-
             REF>
          <VALUE>Ignition Start</VALUE>
        </ECUC-TEXTUAL-PARAM-VALUE>
        <ECUC-TEXTUAL-PARAM-VALUE>
          <DEFINITION-REF DEST="ECUC-STRING-PARAM-DEF">/AUTOSAR/EcucDefs/
             Arti/ArtiGeneric/ArtiGenericComponentClass/
             ArtiGenericComponentClassParameter/
             ArtiGenericComponentClassParameterName</DEFINITION-REF>
          <VALUE>IGNITION_START</VALUE>
        </ECUC-TEXTUAL-PARAM-VALUE>
      </PARAMETER-VALUES>
    </ECUC-CONTAINER-VALUE>
    <ECUC-CONTAINER-VALUE UUID="">
      <SHORT-NAME>IgnitionStop</SHORT-NAME>
      <DEFINITION-REF DEST="ECUC-PARAM-CONF-CONTAINER-DEF">/AUTOSAR/
         EcucDefs/Arti/ArtiGeneric/ArtiGenericComponentClass/
         ArtiGenericComponentClassParameter</DEFINITION-REF>
      <PARAMETER-VALUES>
        <ECUC-TEXTUAL-PARAM-VALUE>
          <DEFINITION-REF DEST="ECUC-STRING-PARAM-DEF">/AUTOSAR/EcucDefs/
             Arti/ArtiGeneric/ArtiGenericComponentClass/
             ArtiGenericComponentClassParameter/
             ArtiGenericComponentClassParameterDescription</DEFINITION-
             REF>
          <VALUE>Ignition Stop</VALUE>
        </ECUC-TEXTUAL-PARAM-VALUE>
        <ECUC-TEXTUAL-PARAM-VALUE>
```

```
            <DEFINITION-REF DEST="ECUC-STRING-PARAM-DEF">/AUTOSAR/EcucDefs/
               Arti/ArtiGeneric/ArtiGenericComponentClass/
               ArtiGenericComponentClassParameter/
               ArtiGenericComponentClassParameterName</DEFINITION-REF>
            <VALUE>IGNITION_STOP</VALUE>
          </ECUC-TEXTUAL-PARAM-VALUE>
        </PARAMETER-VALUES>
      </ECUC-CONTAINER-VALUE>
    </SUB-CONTAINERS>
  </ECUC-CONTAINER-VALUE>
```

Example B.5

Examplary value of an ArtiGenericComponentInstance container using the hooks

```
  <ECUC-CONTAINER-VALUE>
    <SHORT-NAME>ArtiGenericComponentInstance_IgnitionCyl0</SHORT-NAME>
    <DEFINITION-REF DEST="ECUC-PARAM-CONF-CONTAINER-DEF">/AUTOSAR/EcucDefs/
       Arti/ArtiGeneric/ArtiGenericComponentInstance</DEFINITION-REF>
    <PARAMETER-VALUES>
      <ECUC-TEXTUAL-PARAM-VALUE>
        <DEFINITION-REF DEST="ECUC-STRING-PARAM-DEF">/AUTOSAR/EcucDefs/Arti
           /ArtiGeneric/ArtiGenericComponentInstance/
           ArtiGenericComponentInstanceName</DEFINITION-REF>
        <VALUE>Ignition Cylinder 0</VALUE>
      </ECUC-TEXTUAL-PARAM-VALUE>
    </PARAMETER-VALUES>
    <REFERENCE-VALUES>
      <ECUC-REFERENCE-VALUE>
        <DEFINITION-REF DEST="ECUC-REFERENCE-DEF">/AUTOSAR/EcucDefs/Arti/
           ArtiGeneric/ArtiGenericComponentInstance/
           ArtiGenericComponentInstanceClassRef</DEFINITION-REF>
        <VALUE-REF DEST="ECUC-CONTAINER-VALUE">/Vendor1/Vendor1ArtiGeneric/
           ArtiGenericComponentClass_IgnitionControl</VALUE-REF>
      </ECUC-REFERENCE-VALUE>
    </REFERENCE-VALUES>
    <SUB-CONTAINERS>
      <ECUC-CONTAINER-VALUE>
        <SHORT-NAME>IgnitionCyl0Start</SHORT-NAME>
        <DEFINITION-REF DEST="ECUC-PARAM-CONF-CONTAINER-DEF">/AUTOSAR/
           EcucDefs/Arti/ArtiGeneric/ArtiGenericComponentInstance/
           ArtiGenericComponentInstanceParameter</DEFINITION-REF>
        <REFERENCE-VALUES>
          <ECUC-REFERENCE-VALUE>
            <DEFINITION-REF DEST="ECUC-REFERENCE-DEF">/AUTOSAR/EcucDefs/
               Arti/ArtiGeneric/ArtiGenericComponentInstance/
               ArtiGenericComponentInstanceParameter/
               ArtiGenericComponentInstanceParameterClassParameterRef</
               DEFINITION-REF>
            <VALUE-REF DEST="ECUC-CONTAINER-VALUE">/Vendor1/
               Vendor1ArtiGeneric/ArtiGenericComponentClass_IgnitionControl
               /IgnitionStart</VALUE-REF>
          </ECUC-REFERENCE-VALUE>
          <ECUC-REFERENCE-VALUE>
```

```
            <DEFINITION-REF DEST="ECUC-REFERENCE-DEF">/AUTOSAR/EcucDefs/
                Arti/ArtiGeneric/ArtiGenericComponentInstance/
                ArtiGenericComponentInstanceParameter/
                ArtiGenericComponentInstanceParameterHookRef</DEFINITION-REF
                >
            <VALUE-REF DEST="ECUC-CONTAINER-VALUE">/Vendor1/Vendor1Arti/
                ArtiHook_IgnitionControl_Cyl0_IgnitionStart</VALUE-REF>
          </ECUC-REFERENCE-VALUE>
        </REFERENCE-VALUES>
      </ECUC-CONTAINER-VALUE>
      <ECUC-CONTAINER-VALUE>
        <SHORT-NAME>IgnitionCyl0Stop</SHORT-NAME>
        <DEFINITION-REF DEST="ECUC-PARAM-CONF-CONTAINER-DEF">/AUTOSAR/
            EcucDefs/Arti/ArtiGeneric/ArtiGenericComponentInstance/
            ArtiGenericComponentInstanceParameter</DEFINITION-REF>
        <REFERENCE-VALUES>
          <ECUC-REFERENCE-VALUE>
            <DEFINITION-REF DEST="ECUC-REFERENCE-DEF">/AUTOSAR/EcucDefs/
                Arti/ArtiGeneric/ArtiGenericComponentInstance/
                ArtiGenericComponentInstanceParameter/
                ArtiGenericComponentInstanceParameterClassParameterRef</
                DEFINITION-REF>
            <VALUE-REF DEST="ECUC-CONTAINER-VALUE">/Vendor1/
                Vendor1ArtiGeneric/ArtiGenericComponentClass_IgnitionControl
                /IgnitionStop</VALUE-REF>
          </ECUC-REFERENCE-VALUE>
          <ECUC-REFERENCE-VALUE>
            <DEFINITION-REF DEST="ECUC-REFERENCE-DEF">/AUTOSAR/EcucDefs/
                Arti/ArtiGeneric/ArtiGenericComponentInstance/
                ArtiGenericComponentInstanceParameter/
                ArtiGenericComponentInstanceParameterHookRef</DEFINITION-REF
                >
            <VALUE-REF DEST="ECUC-CONTAINER-VALUE">/Vendor1/Vendor1Arti/
                ArtiHook_IgnitionControl_Cyl0_IgnitionStop</VALUE-REF>
          </ECUC-REFERENCE-VALUE>
        </REFERENCE-VALUES>
      </ECUC-CONTAINER-VALUE>
    </SUB-CONTAINERS>
  </ECUC-CONTAINER-VALUE>
```

C Expression Syntax

This section describes the grammar of Expressions using the Extended Backus-Naur Form.

```
expression                = logical_OR_expression { '?' expression ':' expression } ;
logical_OR_expression     = logical_AND_expression { '||' logical_AND_expression } ;
logical_AND_expression    = inclusive_OR_expression { '&&' inclusive_OR_expression } ;
inclusive_OR_expression   = exclusive_OR_expression { '|' exclusive_OR_expression } ;
exclusive_OR_expression   = AND_expression { '^' AND_expression } ;
AND_expression            = equality_expression { '&' equality_expression } ;
equality_expression       = relational_expression { ( '==' | '!=' ) relational_expression } ;
relational_expression     = shift_expression { ( '<' | '>' | '<=' | '>=' ) shift_expression } ;
shift_expression          = additive_expression { ( '<<' | '>>' ) additive_expression } ;
additive_expression       = multiplicative_expression { ( '+' | '-' ) multiplicative_expression } ;
multiplicative_expression = cast_expression { ( '*' | '/' | '%' ) cast_expression } ;
cast_expression           = { '(' type_name ')' } unary_expression ;
unary_expression          = postfix_expression | unary_operator cast_expression | 'sizeof' unary_expression | 'sizeof' '(' type_name ')' ;
unary_operator            = '&' | '*' | '+' | '-' | '~' | '!' ;
postfix_expression        = primary_expression { '[' expression ']' | ( '.' | '->' ) appl_identifier } ;
primary_expression        = appl_identifier | constant | '(' expression ')' ;
constant                  = integer_constant | character_constant | floating_constant | enumeration_constant ;
type_name                 = type_specifier { type_specifier } [ '*' ] ;
type_specifier            = 'void' | 'char' | 'short' | 'int' | 'long' | 'float' | 'double' | 'signed' | 'unsigned' | type_def_name ;
type_def_name             = appl_identifier;
```

Where:

`integer_constant`	represents an integer number, where the standard C convention is used for decimal, hexadecimal and octal notation.
`character_constant`	follows the C definition for a character, including the support of all standard escape sequences, such as '\n', '\t' etc.
`floating_constant`	follows the C definition for a floating point number.
`enumeration_constant`	follows the C definition for an "enum" constant.
`appl_identifier`	represents any C identifier and represents application symbols. These symbols rely on symbolic information retrieved from the debug information of the application and must have 'external linkage' scope (e.g. global C variables). The symbol value is only valid after the application has executed its initialization phase (typically this is the system startup code before reaching the applications entry point, which is main() in C). The only exception to this constraint is when using the unary address-operator (&).

Further rules:

- Whitespace (blank, TAB) between terminals is ignored.
- All keywords and identifiers are case-sensitive.

D Change history of AUTOSAR traceable items

D.1 Traceable item history of this document according to AUTOSAR Release R22-11

D.1.1 Added Specification Items in R22-11

Number	Heading
[SWS_Arti_00011]	Generate RTE VFB Trace Client
[SWS_Arti_00012]	Define AR_CP_RTE_RUNNABLE
[SWS_Arti_00013]	Define AR_CP_SCHM_SCHEDULABLE
[SWS_Arti_00014]	Macro AR_CP_RTE_RUNNABLE
[SWS_Arti_00015]	Macro AR_CP_SCHM_SCHEDULABLE
[SWS_Arti_00016]	Macro AR_CP_VOID
[SWS_Arti_00017]	ARTI Tracing Macro Parameters
[SWS_Arti_00018]	ARTI Tracing Macro Format (single event)
[SWS_Arti_00019]	ARTI Tracing Macro Format (multiple events)
[SWS_Arti_00020]	Define AR_CP_RTE_API
[SWS_Arti_00021]	Macro AR_CP_RTE_API
[SWS_Arti_00022]	Define AR_CP_BSW_API
[SWS_Arti_00023]	Macro AR_CP_BSW_API

Table D.1: Added Specification Items in R22-11

D.1.2 Changed Specification Items in R22-11

Number	Heading
[SWS_Arti_00009]	
[SWS_Arti_00010]	
[SWS_Arti_91002]	
[SWS_Arti_91004]	
[SWS_Arti_91005]	

Table D.2: Changed Specification Items in R22-11

D.1.3 Deleted Specification Items in R22-11

none

D.2 Traceable item history of this document according to AUTOSAR Release R23-11

D.2.1 Added Specification Items in R23-11

Number	Heading
[SWS_Arti_91000]	Definition of datatype ARTI_STOPWATCH_FLAT, ARTI_STOPWATCH_NESTED
[SWS_Arti_91006]	Definition of imported datatypes of module Arti

Table D.3: Added Specification Items in R23-11

D.2.2 Changed Specification Items in R23-11

Number	Heading
[SWS_Arti_00002]	Macro USER_STOPWATCH

Table D.4: Changed Specification Items in R23-11

D.2.3 Deleted Specification Items in R23-11

none