AUTOSAR Rte User Manual

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			5.3 5.4	• Exclusive Area 옵션 설명 추가
			7.1	• 미지원 기능(Generation Phase)에 대한 옵션 안내 정리
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			4.3	• Change Log 추가
			4.4.2 4.5.2	• Data Transformation 관련 내용 추가
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2018-01-26	4.5.1	KiYoung Yun	4.3	• Change Log 추가
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2018-06-29	4.7.0	KiYoung Yun	4.3	• Change Log 추가
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2019-05-08	4.8.0	KiYoung Yun	4.3	• Change Log 추가 및 양식 변경
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2020-04-24	4.10.0.0	KiYoung Yun	4.3	• Change Log 추가
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2020-06-26	4.10.1.0	KiYoung Yun	4.3	• Change Log 추가
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2020-12-21	4.10.3.0	KiYoung Yun	4.3	• Change Log 추가
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			4.4.2.3.1	• ExtendedTask 설정 제약사항 추가
2021-04-07	4.10.4.0	Gongbin Lim	4.3	• Change Log 추가
2021-07-28	4.10.5.0	KiYoung Yun	4.3	• Change Log 추가
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2021-11-23	4.10.6.0	KiYoung Yun	4.3	• Change Log 추가
			All	• AUTOEVER 양식 변경
2021-12-28	4.10.7.0	KiYoung Yun	4.3	• Change Log 추가
2022-06-24	4.11.0.0	KiYoung Yun	4.3	• Change Log 추가
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2022-08-11	4.11.1.0	KiYoung Yun	4.3	• Change Log 추가

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1. Overview

본 문서는 AUTOSAR 표준 개발 방법론에 의해 설계된 Application 디자인 문서 (Software Component Description arxml) 기반의 RTE (Runtime Environment) Layer 에 해당하는 코드 생성을 위한, 설정 및 각종 제반 사항에 대하여 설명한다. AUTOSAR 표준 SRS/SWS 를 기반으로 작성 되었으며, 모듈 사용시 보다 자세한 기능적인 설명이 필요한 경우, 아래 Reference 문서를 참고한다

설정관련 Category 의 해석은 다음과 같다.

- Changeable (C): User 에 의해서 설정 가능한 항목
- Fixed (F): User 에 의한 변경이 불가한 항목
- NotSupported (N): 사용되지 않는 항목

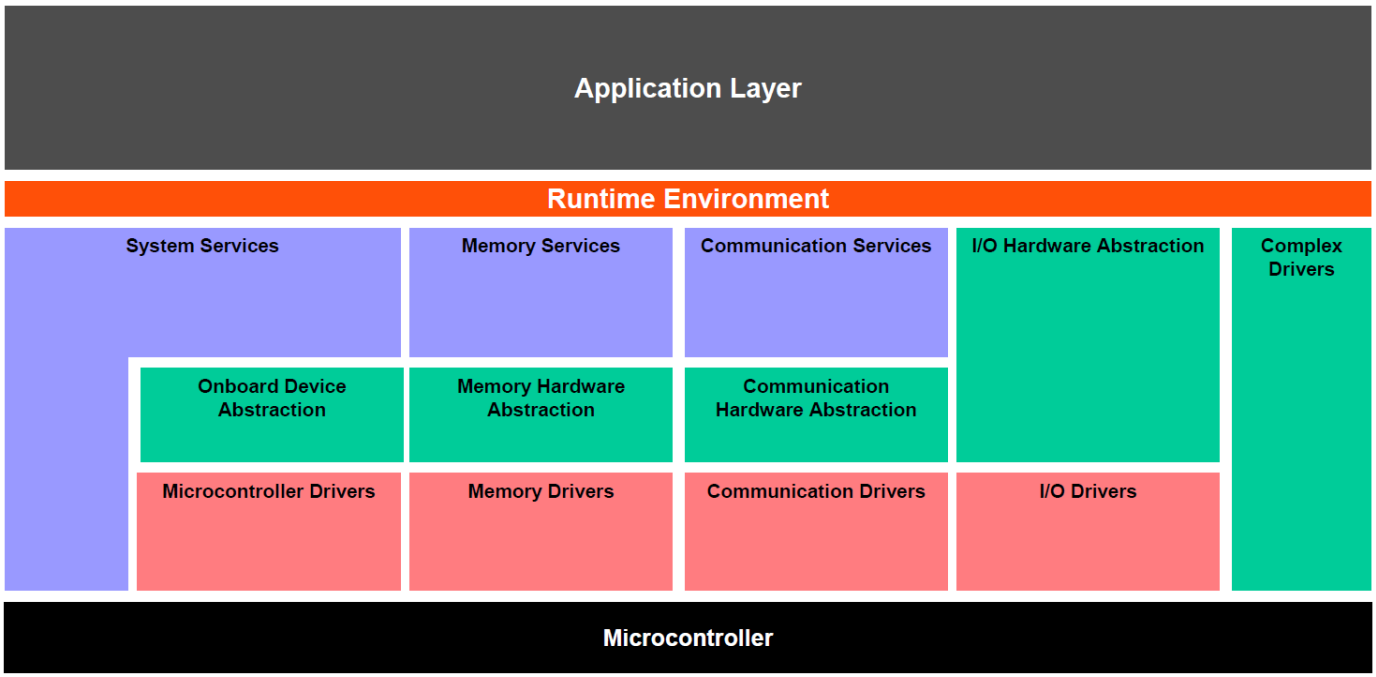
2. Reference

Sl. No.	Title	Version
1.	AUTOSAR SWS RTE.pdf	3.2.0
2.	AUTOSAR TPS SoftwareComponentTemplate.pdf	4.2.0
3.	AUTOSAR TPS SystemTemplate.pdf	4.2.0
4.	AUTOSAR EXP InterruptHandlingExplanation.pdf	1.0.2
5.	AUTOSAR SWS RTE.pdf	4.2.2
6.	AUTOSAR SWS RTE.pdf	4.3.1

3. AUTOSAR System

3.1 Overview of Software Layers

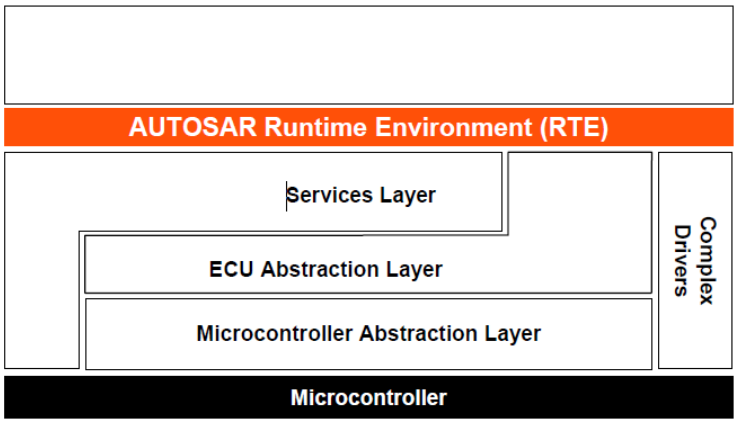
AUTOSAR 플랫폼의 Layered Architecture 는 아래와 같다. AUTOSAR 플랫폼은, Service Layer, ECU Abstraction Layer, Complex Device Drivers 및 Microcontroller Abstraction Layer 로 구분될 수 있다.



3.2 AUTOSAR Runtime Environment (RTE)

RTE 는 특정 ECU 에 통합된, 다수의 Application SW-Component (i.e. Application SW-Component 및 Basic Software 모듈) 간의 glue lyaer 제공을 통하여, Application software (AUTOSAR So ftware Components and/or AUTOSAR Sensor/Actuator components) 간, 또는 Application Software 와 Basic Software Module (ie. OS, Communication Service, etc services 등) 간에 통신 서비스를 담당한다.

- Provide a communication infrastructure for software components
- Arrange for real-time scheduling of software components



4. Product Release Notes

4.1 Overview

이 Chapter 에서는, 현대오토에버 RTE Product 에 대한 release 관련 내용을 제공하는데 목적이 있으며, RTE Software product release version 에 대한, 제한사항 및 특이사항을 기술하고 있다.

4.2 Scope of the release

이 문서에 대한 모든 내용은, 현대오토에버 RTE Product (Rte.exe) Version 1.5.7 에 한정한다.

※ RTE PDF (Parameter Definition File) Version 1.5.4

4.3 Change Logs

4.3.1 Version 1.5.0

- DataType 의 Enumeration Define 문이 관련된 Application Type Header 에만 나오도록 변경.
- EcuExtract CommandLine Option 제거하고 EcucValueCollection 의 EcuExtractRef 를 사용하도록 변경.
- IncludedModeDeclarationGroup 설정을 통한 Mode Definition 및 Type Definition 생성 지원.
- IncludedDataTypeSet 설정을 통한 DataType 의 Enumeration Define 문 생성 지원.
- EcucPartition, ComCallback 설정 오류 관련 Validation Error 강화.
- Rte_MemMap.h Code 관련 Optimization Option 정리.
- SenderReceiver Logic Refactoring.
- ClientServer 의 ApplicationError 에 대한 DET 추가.
- MISRA-C Rule Violation 일부 수정.
- ECUC Configuration Parameter 설정 제한 기능 지원을 위한 Category 추가.

4.3.2 Version 1.5.1

- Rte_Start_<Partition> 함수 내 초기화 순서 정리.
- PerInstance Memory RAM 변수의 Extern 선언을 별도 header 파일에 추가 생성
- Rte Start / Stop 관련 Code Indentation 을 통한 코드 가독성 향상.
- Partition 별 MemorySection 분리 가능하도록 Rte_MemMap.h 정리.
- Misra C Violation 추가 수정.
- Validation Error 추가 및 문구 수정.

4.3.3 Version 1.5.2

- Misra C Violation 관련 정당화 처리 추가. (11.4, 8.8).
- RTE Header 의 Version Check 강화(Autosar Version, Sw Version).
- Blank Line 중복 제거 및 Code Indentation 정리.
- SenderReceiver Interface RamSize 최적화(Rte_Read, Rte_IRead 사용안하는 상황에서 변수 생성 최적화).
- ClientServer Interface RamSize 최적화(InterPartition 상황에서 ClientServer Flag 정리).
- 불필요 Warning 제거(Unconnected Server, CanBeInvokedConcurrently 가 TRUE 상황에서의 Task Mapping Warning 제거)

- Validation 강화(TimingEvent, BswTimingEvent 의 StartOnEventRef 가 없는 경우 Error 발생).
- 불필요한 Memory Section Code 생성 제거.
- Command Line Option 정리.
- Application Error 에서 E_OK 설정하여 사용 가능하도록 기능 추가.
- Com_SendSignal, Com_SendDynSignal, Com_UpdateShadowSignal, Com_ReceiveSignal, Com_ReceiveDynSignal, Com_ReceiveShadowSignal 의 Data Parameter 부분에 Type Casting 추가.

4.3.4 Version 1.5.3

- Client-Server 통신 사용 시, Server 파티션이 Terminate 되었을 경우, Wait 하고 있는 Client 에게 즉시 알려주는 기능 추가 (WaitOsEventRef 설정 시, 설정된 OsEvent 에 대해 PartitionTerminated 라는 Postfix 가 붙은 OsEvent 를 하나 더 생성하여, Client 가 동작하는 OsTask 가 참조하도록 설정해야 함.)
- Client-Server 통신에 대해 Task 우선 순위 정리 (8.3 참조)

4.3.5 Version 1.5.4

- Rte 내부 변수의 MemorySection 정리.
- 서로 다른 Operation 으로 연결된 Client-Server Communication 동작 지원
- ClientServer 통신을 위한 RteWaitOsEventRef 관련 Validation 추가.
- Rte_Write API 의 RTE_E_COM_STOPPED 리턴값 처리 추가.
- Polyspace RunTime Violation 수정.
- Rte_COMCbk Callback 함수 관련 RamSize 최적화(변수의 Stack 이용).
- <SWC>_MemMap.h 의 MCU Dependenct Code 제거.

4.3.6 Version 1.5.5

- Client-Server 통신에서 Port 에서 Reference 하는 Operation 과 Server Call Point 에서 Reference 하는 Operation 이 다를 때 발생하는 Validation Error 추가.
- Polyspace Runtime Violation 수정.
- E2E PW/Callout 옵션 설정 방법 변경
- Inter-Runnable Variable 에서의 불필요 Exclusive Area 사용 코드 최적화.

4.3.7 Version 1.5.6

- SenderReceiver Communication Logic 의 RamSize 최적화. (1:N Case 의 경우 RPort 마다 DataElement 를 위한 Buffer 를 생성하는 방식에서 최적화 가능한 경우에는 공용 Buffer 를 사용하도록 변경)
- HandleTimeoutType 기능 구현. (Com Timeout 발생시에 DataElement 의 값을 초기값으로 변경하는 기능)
- SchM_Init 함수 내에서 OsAlarm 관련 중복 Code 또는 Dummy Code 생성되는 문제 수정.
- Asynchronous Client-Service 통신에서 WaitPoint 사용시에 대한 Validation Error 강화.
- InterPartition 기반 ModeSwitch 의 Initial Mode 처리시에 ModeManager 와 ModeUser 가 혼재되어 있는 경우에 발생하는 Code 생성 오류 수정.

4.3.8 Version 1.5.7

- ApplicationDataType 을 이요한 InterRunnableVariable 에 InitValue 설정 시 코드 생성 오류.

(ApplicationDataType 을 가지는 InterRunnableVariable 에 InitValue 설정 후 Code Generation 시에 Error 가 발생하던 것을 정상적으로 처리하도록 수정.)

- <SWC>_MemMap.h 의 MemorySection 정리. (기존 <PREFIX>_START_SEC_CONST_<ALIGNMENT> 를 생성하지 않던 것을 생성하도록 추가. 기존 <ALIGNMENT>에 BOOLEAN 을 처리하지 않던 것을 생성하도록 추가.)
- OperationInvokedEvent 로 실행되는 Runnable 에서 Implicit SenderReceiver 사용시 Task Body 에 Copy_IWrite, Copy_IRead GlueCode 가 생성안되는 문제 수정. (Runnable 호출 Code 가 Indentation 으로 인하여 여러줄에 걸쳐 있는 경우에 GlueCode 생성을 못하였으나 여러줄에 걸쳐있는 Code 에도 정상 동작하도록 수정.)
- Array DataType 을 가지는 ArTypedPerInstanceMemory 의 CDS Structure Definition 및 변수 처리 오류 수정. (기존 Array DataType 의 ArTypedPerInstanceMemory 의 경우에 CDS Structure Definition 에 Array 주소에 대한 Pointer 로 나왔으나 Array 의 BaseType 에 대한 Pointer 를 가지도록 수정.)
- DataWriteCompletedEvent 로 실행되는 Runnable 에서 사용하기 위한 Rte_IFeedback, DataReceiveErrorEvent Runnable 에서 사용하기 위한 Rte_IStatus API 추가. (기존 DataWriteCompletedEvent 로 실행되는 Runnable 을 위한 Rte_IFeedback, DataReceiveErrorEvent 로 실행되는 Runnable 을 위한 Rte_IStatus API 를 생성하지 않던 것을 생성하도록 추가.)
- M:N Connection 에 대한 Validation 강화. (기존 IntraEcu Connection 에 대해서만 M:N Check 를 하였으나 InterEcu Connection 을 포함하여 M:N Connection Check 를 할 수 있도록 강화.)

4.3.9 Version 4.0.0

- Rte_Start, SchM_Init Function 의 GetCoreID Function 사용 Code 생성 조건을 Os 의 GetCoreID Function 생성 조건과 일치하도록 변경. (기존 OsApplicationCoreAssignment 설정의 유무에서 OsOs 의 NumberOfCores 가 2 이상일 경우로 조건 변경)
- Period 와 RteActivationOffset 의 값이 유효한지 Check 하는 Validation Logic 추가. (Period 와 RteActivationOffset 의 OsCounter 의 OsSecondsPerTick 의 배수인지, 0 ~ OsSecondsPerTick * OsCounterMaxAllowedValue 에 속하는지 Check)
- SenderReceiver Communication 성능 최적화. (같은 Partition 내의 Write, Read 동작을 위한 Runnable 들이 같은 Priority 를 가지거나 하나의 InternalOsResource 를 공유하는 경우에 SuspendOSInterrupts/ResumeOSInterrupts 를 제거하여 성능을 최적화함)
- SenderReceiver 의 Interface 이름이 Signal_ 또는 Return_ 으로 시작하는 경우의 Code 생성 오류 수정. (Interface 이름에 상관없이 IOC API 생성 Code 에 Rte_ Prefix 를 붙이도록 변경)
- Extended OsTask 내 OsEvent Clear 에 대한 최적화 구조 적용

4.3.10 Version 4.1.0

- CompuMethod 의 VT 값이 Invalid C Identifier 인 경우에 ShortLabel 로 Define 문 생성하도록 변경
- CompuMethod 의 Category 가 없는 경우에 Default 로 IDENTICAL 로 처리하도록 적용

4.3.11 Version 4.1.1

- Error Message 포맷 변경 및 상세화
- 두 개 이상의 Runnable 에서 동일한 Port/Operation 에 대한 SynchronousServerCallPoint 를 설정 시 Validation 추가

4.3.12 Version 4.1.2

- Extended Task 에서 Trigger Interface 생성 오류 수정

4.3.13 Version 4.2.0

- ■ RteEvent, BswEvent 의 Data Consistency 보장 코드 적용
- ■ Generation Error 및 Limitation 관련 User Manual Update.

4.3.14 Version 4.2.1

- ■ Sender Receiver 관련 Event Flag 변수 분리
- ■ Inter Runnable Variable 관련 생성 오류 수정

4.3.15 Version 4.2.2

- ■ User Manual 의 RteUsedOsEventRef, RteBswUsedOsEventRef 파라미터의 제한 설명 보충

4.3.16 Version 4.3.0

- 신규 기능
  - ■ SenderReceiver Interface 의 HandleOutOfRange 기능 지원
    Data 값의 Range 범위를 Check 하여 벗어나는 경우에 대해서 User 설정에 따라 무시(Ignore), Min/Max 값으로 변경(Saturate), Init Value 값으로 변경(Default), Invalid Value 값으로 변경(Invalid) 처리를 추가적으로 하는 기능

- 개선 사항
  - ■ MISRA-C 16.10 Rule If a function returns error information, then that error information shall be tested 위반 항목 수정
  - ■ ModeSwitch Interface 의 Initial Mode On Entry 처리 시 Direct Function Call 지원
  - ■ No Partition, Single Partition, Multiple Partition 상황에서의 RteTaskComMapping 설정 오류 Validation 기능 추가.
  - ■ Trigger Interface 의 Event 설정 오류 Validation Error 기능 추가.
  - ■ Trigger Interface 의 SwImplPolicy 와 QueueLength 불일치로 인한 설정 오류 Validation 기능 추가.

4.3.17 Version 4.3.1

- 신규 기능
  - ■ Bolero, Rh850 MCU 를 위한 Rte_MemMap.h 기능 추가

원인	Bolero, RH850 MCU 에서 Rte_MemMap.h 기능을 미지원
동작 영향	RTE Memmory Section 을 MemMap.h 가 아닌 Rte_MemMap.h 로부터 가져옴.
설정 영향	Bolero, Rh850 MCU 를 사용하는 제어기에서는 RTE Generator Option 으로 GenMemMapOption::Ghs Option 을 추가해야 함.
ASW 조치 필요 사항	없음

- 개선 사항
  - ■ Extended OsTask 기반 Timing Event 에 Disabled Mode 오류 수정

원인	Extended OsTask 기반의 TimingEvent 에서 DisabledMode 설정시 관련 Code 가 생성되지 않음.
동작 영향	Extended OsTask 기반의 TimingEvent 에서 DisabledMode 가 정상 동작함.

설정 영향	Bolero, Rh850 MCU 를 사용하는 제어기에서는 RTE Generator Option 으로 GenMemMapOption::Ghs Option 을 추가해야 함.
ASW 조치 필요 사항	없음

■ SynchronizedActivateOffset 기능의 비정상 동작 수정

원인	Rte_Start 시점의 Counter 값에 따라 SetRelAlarm 의 Increment 값이 특정 경우에 0 으로 사용됨. 이 경우 Alarm 에서 Error 가 발생해 동작하지 않음.
동작 영향	Alarm 이 정상 동작함.
설정 영향	없음
ASW 조치 필요 사항	없음

■ Signal Reception Hook 함수 위치 오류 수정

원인	Signal Reception Hook 의 경우, ComReceiveSignal 이전에 호출됨. 사양상 Signal Reception Hook 은 Com_ReceiveSignal 이후에 호출해야 함.
동작 영향	Signal Reception Hook 이 Com_ReceiveSignal 이후에 호출됨.
설정 영향	없음
ASW 조치 필요 사항	없음

4.3.18 Version 4.3.2

- 신규 기능

■ Os Ecud Arxml 파일에 IOC Configuration 을 추가하여 생성할 수 있는 신규 Generator Option 인 -IOC::GenEcudOs 를 추가

원인	Freescale OS 의 경우, Generator 의 입력으로 Ecud Arxml 파일을 하나만 받을 수 있음. 기존 IOC Option 은 별도의 파일로 IOC Configuration 을 생성하기 때문에 사용 불가능함. 하나의 File 에 OsConfiguration 을 통합하여 생성하는 신규 옵션 추가함.
동작 영향	없음
설정 영향	신규 기능 사용 시 Rte Generator 의 옵션으로 -IOC::GenEcudOs 를 추가해야 함.
ASW 조치 필요 사항	없음

- 개선 사항

■ E2E 기능 사용시 CPU 의 Byte Order 와 RTE 의 Byte Order 를 Check 하는 기능 추가

원인	E2E 의 Serialize/Deserialize 사용 시 RTE 의 ByteOrder 를 위한 Generator Option 이 잘못된 경우 문제가 발생할 수 있는 가능성이 있음. CPU 의 Byte Order 와 Check 하여 문제를 조기에 발견할 수 있도록 기능 추가함.
동작 영향	없음
설정 영향	없음
ASW 조치 필요 사항	없음

■ Generation 시에 같은 설정임에도 코드의 순서가 변경되어 생성될 수 있는 가능성 개선

원인	Rte_Write 등의 API Code 가 같은 설정임에도 순서가 변경되어 생성될 수 있는 가능성이 존재함. Sorting 을 통해 같은 순서로 출력될 수 있도록 기능 추가함.
동작 영향	없음
설정 영향	없음
ASW 조치 필요 사항	없음

■ InitialMode 의 OnEntry Event 관련 생성 오류 개선

원인	InitialMode 의 OnEntry Event 관련 DirectFunctionCall 설정 시 생성 함수 이름 오류
동작 영향	컴파일 오류 발생
설정 영향	없음
ASW 조치 필요 사항	없음

■ SynchronizedActivateOffset 기능의 비정상 동작 개선

원인	SynchronizedActivateOffset 계산 중 Interrupt 발생 시 계산 오류 발생 가능
동작 영향	Interrupt 과다 발생시 Task 의 Offset 이 설정된 시점과 차이가 발생할 수 있음.
설정 영향	없음
ASW 조치 필요 사항	없음

■ Task Mapping 이 필요하다는 일부 불필요한 Warning Message 제거

원인	Task Mapping 이 필요하다는 일부 불필요한 Warning Message (WRN 58, 66) 출력 건 삭제
동작 영향	없음
설정 영향	없음
ASW 조치 필요 사항	없음

4.3.19 Version 4.3.3

- 개선 사항

■ 비주기 Extended Task 사용시 ActivateTask 이전에 SetEvent 가 호출될 수 있는 문제 수정

원인	Rte_Start 에서 ActivateTask 이전에 설정된 Alarm 이 ActivateTask 이전에 만료되는 경우 SetEvent 호출되어 ErrorHook 발생
동작 영향	ErrorHook 발생 가능성 제거
설정 영향	없음
ASW 조치 필요 사항	없음

■ Extended Task 기반 RTE 처리를 위한 Task Body 에서 OsEvent 누락 가능성 문제 수정

원인	여러 OsEvent 가 하나의 OsTask 에 연결된 경우, 발생 전인 OsEvent 까지 Clear 처리하여 실제 발생한 OsEvent 의 처리 누락 가능성 존재
동작 영향	OsEvent 처리 누락 가능성 제거
설정 영향	없음
ASW 조치 필요 사항	없음

■ ExplicitInterRunnableVariable 의 InitValue 로 TextValueSpecification 설정 시 에러 발생 수정

원인	InitValue 의 타입이 TextValueSpecification 인 경우 처리 안함
동작 영향	없음
설정 영향	InitValue 의 타입이 TextValueSpecification 인 경우도 설정 가능
ASW 조치 필요 사항	없음

■ RteBswRequiredModeGroupConnection 의 설정 오류에 대한 Validation Error 추가

원인	RteBswRequiredModeGroupConnection 설정 오류 체크 안함
동작 영향	없음
설정 영향	생성 에러 발생 시 설정 변경 필요
ASW 조치 필요 사항	없음

■ SenderReceiverToSignalGroupMapping 의 SenderRecRecordElementMapping 에 중복된

SystemSignalRef 가 존재하는 경우에 대한 Validation Error 추가

원인	SenderRecRecordElementMapping 내 SystemSignalRef 의 중복 체크 안함
동작 영향	없음
설정 영향	생성 에러 발생 시 설정 변경 필요
ASW 조치 필요 사항	없음

■ 하나의 Code Section 내 함수 정의하도록 생성 c 코드 개선

원인	함수 별로 Code Section 을 나누어 정의하던 방식에서, 모든 함수를 하나의 Code Section 으로 정의하도록 개선
동작 영향	없음
설정 영향	없음
ASW 조치 필요 사항	없음

■ Rte Vendor Id 76 으로 변경

원인	Rte.h 내 Vendor Id 76 으로 변경
동작 영향	없음
설정 영향	/Rte/CommonPublishedInformation/VendorId = 76 으로 변경 필요
ASW 조치 필요 사항	없음

4.3.20 Version 4.4.0

- **개선 사항**

■ TriggerInterface 의 InterPartition 간 IOC 지원

원인	파티션간 Trigger 사용 시, IOC 를 통해 Trigger 가 실행되는데, IOC 의 사용에 있어 효율적으로 동작하도록 IOC 사용 방식 개선
동작 영향	없음
설정 영향	없음
ASW 조치 필요 사항	없음

■ Implicit Sender Receiver 의 기능 중 RteImmediateBufferUpdate False 기능 추가.

원인	기존 Runnable 의 앞, 뒤에서 Data 를 실제로 전송하는 방식에 추가하여 Task 의 앞, 뒤에서 Data 를 실제로 전송하는 방식을 사용할 수 있도록 기능 추가
동작 영향	없음
설정 영향	새로 추가한 기능을 사용하고자 할 경우, RTE Generator 의 Option 으로 –ImmediateBufferUpdate=false 를 추가하여야 함. 기존 방식 유지할 경우 설정 변경 없음.
ASW 조치 필요 사항	없음

■ RTE_ALLOW_CROSS_HEADER_INCLUSION 심볼 관련 사용 금지 문구 추가

원인	애플리케이션에서 사용 불가한 RTE_ALLOW_CROSS_HEADER_INCLUSION 심볼에 대해 Rte_<SWC>.h 내 주석으로 사용 금지 문구 추가
동작 영향	없음
설정 영향	없음
ASW 조치 필요 사항	없음

■ Partition Lifecycle API 개선

원인	코드 정리 및 원활한 유지 보수를 위해 Generator 내 Lifecycle API 의 코드 생성 방식 개선
동작 영향	없음

설정 영향	없음
ASW 조치 필요 사항	없음

4.3.21 Version 4.4.1

- 신규 기능
  - ■ 미지원 기능에 대해 Generator 의 Validation 추가

원인	미지원 기능에 대해 Generator 가 에러 없이 파일을 생성하여 잘못된 동작가능. Validation 을 통해 생성 제한
동작 영향	없음
설정 영향	에러 발생 시 설정 변경 필요(미지원기능 설정 제거)
ASW 조치 필요 사항	없음

- 개선 사항
  - ■ Rte Generator 실행 속도 개선

원인	Generator 내의 비효율적인 동작방식(API 복잡도) 개선
동작 영향	없음
설정 영향	없음
ASW 조치 필요 사항	없음

  - ■ Compile warning 방지 위한 alignvar 제거

원인	Green Hills 컴파일러 사용시 Generator 가 Rte_MemMap.h 에 alignvar 출력하지 않도록 함
동작 영향	없음
설정 영향	없음
ASW 조치 필요 사항	없음

  - ■ PerInstanceMemory API 개선

원인	코드 정리 및 원활한 유지 보수를 위해 Generator 내 PerInsatnceMemory API 의 코드 생성 방식 개선
동작 영향	없음
설정 영향	없음
ASW 조치 필요 사항	없음

  - ■ Com Version 2.2.0 이후 Com_PackAndValidateSigGroup API 프로토타입 변경 대응 E2EPW_Read/Write 수정

원인	Com_PackAndValidateSigGroup API 가 Com Version 2.2.0 버전 이후 인자개수가 변경되어 컴파일 에러 발생
동작 영향	없음
설정 영향	없음
ASW 조치 필요 사항	없음

  - ■ 설정에서 자기 자신을 Reference 하는 경우 Out of memory 발생 문제 수정

원인	잘못된 설정으로 자기자신을 Reference 하는 경우, 정확한 오류메세지를 반환하지 않고 Out of memory 발생
동작 영향	없음
설정 영향	에러 발생 시 설정 변경 필요
ASW 조치 필요 사항	없음

■ TimingEvent 의 Period 가 0 일 경우 Division by zero 에러 발생 오류 개선

원인	TimingEvent 의 Period 가 0 일 경우 에러가 발생하여 해당 내용에 대해 Validation 을 추가
동작 영향	없음
설정 영향	에러 발생 시 설정 변경 필요
ASW 조치 필요 사항	없음

■ Mode Switch Interface 사용시, supportsAsynchronousModeSwitch 가 false 일 경우에 대한 Validation 추가

원인	Mode Switch Interface 사용시, supportsAsynchronousModeSwitch 가 false 이고, Task Mapping 이 되어 있지 않을 경우 에러 코드 추가
동작 영향	없음
설정 영향	에러 발생 시 설정 변경 필요
ASW 조치 필요 사항	없음

4.3.22 Version 4.4.2

- 개선 사항

■ 매뉴얼 업데이트

원인	- Interrupt Decoupling Guide 개선 (8.1 참조) - Extended Task 지원 범위 상세화 (4.4 참조)
동작 영향	없음
설정 영향	없음
ASW 조치 필요 사항	없음

4.3.23 Version 4.5.0

- 신규 기능

■ Transformation 기능 개발

원인	E2E 기능 대응 Data Transformation 기능 개발
동작 영향	없음
설정 영향	없음
ASW 조치 필요 사항	없음

- 개선 사항

■ Implicit Sender-Receiver 컴파일 에러 수정

원인	- DataFilter, HandleTimeoutType 사용시 Copy_IRead API 정의가 1 개 이상 생성 - API 중복 검사 방식이 SWC 단위이기 때문에 같은 Copy_IRead API 의 Prototype 이 중복하여 발생 - Critical Section 판별시 다른 SWC 의 Context 를 고려하지 않아 Suspend/Resume Interrupt 가 사용되는 코드와 사용되지 않는 코드가 생성
동작 영향	없음
설정 영향	없음
ASW 조치 필요 사항	없음

■ NonQueuedImplicitSenderReceiver 에서 Runnable Symbol 에 따라 GlueCode 삽입이 여러 번 발생

되는 문제 해결

원인	Generator 가 GlueCode 삽입시 같은 태스크 내에서 의도하지 않았던 비슷한 이름을 지닌 Runnable 에도 GlueCode 가 삽입
동작 영향	없음
설정 영향	없음
ASW 조치 필요 사항	없음

■ SWC 내에 동일한 External Trigger Interface 사용하는 PPort 가 여러 개 있고, 이들의 Sink 가 같은 Task 에 매핑될 경우 이상 동작 코드 생성 개선

원인	RteEvent 에 대한 Flag 를 추가하여 이벤트에 해당하는 Runnable 이 수행되도록 함
동작 영향	없음
설정 영향	없음
ASW 조치 필요 사항	없음

■ ComSignalType 이 UINT8_N 인 GroupSignal 지원

원인	ComSignalType 이 UINT8_N 인 GroupSignal 설정 시 컴파일 오류 발생
동작 영향	없음
설정 영향	없음
ASW 조치 필요 사항	없음

■ Compile Warning 개선

원인	- Rte_GaaEventFlag 변수를 사용하지 않더라도 코드가 생성되어 Compile Warning 발생 - Rte_Mode API 가 Enhanced API 여부와 관계없에 동일한 코드를 생성하여 불필요한 변수를 생성하여 Compile Warning 발생 - Rte_Switch 및 SchM_Switch 내부에서 모드 변경중 재진입을 막기 위한 상태변수에 컴파일러의 최적화가 적용되어 Compile Warning 발생
동작 영향	없음
설정 영향	없음
ASW 조치 필요 사항	없음

■ Validation 내 오류 정보 상세화

원인	- Direct Function Call 이 아닌 BswSchedulableEntity 가 RteBswEventToTaskMapping 이 되어 있지 않은 경우 - SwcModeSwitchEvent 의 Target Mode Declaration 미설정 - M:N 통신 연결 - Union Data Type 에 대한 SenderReceiverToSignalGroupMapping 의 미지원 - Direct Function Call 방식의 Mode Switch Event 경우 PositionInTask 설정 오류
동작 영향	없음
설정 영향	에러 발생 시 설정 변경 필요
ASW 조치 필요 사항	없음

4.3.24 Version 4.5.1

- 개선 사항

■ Transformer 모듈의 Header File Inclusion 변경

원인	- Rte.c 의 Header Inclusion 을 <모듈명>.h 로 변경

동작 영향	없음
설정 영향	없음
ASW 조치 필요 사항	없음

■ Timeout 값 없는 Transmission Acknowledge 설정 지원

원인	Transmission Acknowledge 설정시 Timeout 값을 지정하지 않으면 Transmission Acknowledge 설정이 인식되지 않음
동작 영향	없음
설정 영향	Timeout 값 없는 Transmission Acknowledge 설정 가능
ASW 조치 필요 사항	없음

■ Validation 내 오류 정보 상세화

원인	- PerInstanceParameter 에 InitValue 미정의시
동작 영향	없음
설정 영향	에러 발생 시 설정 변경 필요
ASW 조치 필요 사항	없음

4.3.25 Version 4.6.0

- 신규 기능

■ Transformation Profile 11 지원

원인	E2E Profile 11 대응 Data Transformation 기능 개발
동작 영향	없음
설정 영향	없음
ASW 조치 필요 사항	없음

■ ApplicationPrimitiveDataType 의 카테고리 COM_AXIS, CURVE, MAP 지원

원인	ApplicationPrimitiveDataType 의 카테고리 COM_AXIS, CURVE, MAP 지원
동작 영향	없음
설정 영향	없음
ASW 조치 필요 사항	없음

- 개선 사항

■ TRANSFORMER-ERROR-HANDLING 설정 시, Transformer 의 에러 값 전달

원인	TRANSFORMER-ERROR-HANDLING 설정 시, RTE API 의 transformerError 파라미터 RTE_E_HARD_TRANSFORMER_ERROR / RTE_E_SOFT_TRANSFORMER_ERROR 값이 저장
동작 영향	TRANSFORMER-ERROR-HANDLING 설정 시, RTE API 의 transformerError 파라미터에 Transformer 에러값이 저장
설정 영향	없음
ASW 조치 필요 사항	TRANSFORMER-ERROR-HANDLING 설정 시, RTE API 의 transformerError 파라미터에 RTE_E_HARD_TRANSFORMER_ERROR / RTE_E_SOFT_TRANSFORMER_ERROR 값이 아닌 Transformer 에러값이 저장되므로 이에 따른 ASW 로직 변경 필요

■ 1:N Sender Receiver 통신시 RTE API 에서 사용하는 버퍼 선언 누락 개선

원인	1:N Sender Receiver 통신이면서 Implicit / Explicit Sender Receiver API 혼용 사용시 RTE API 내에서 사용하는 버퍼의 선언이 누락되는 경우 발생
동작 영향	없음

설정 영향	없음
ASW 조치 필요 사항	없음

■ Inter-Runnable Variable 관련 API 코드 개선

원인	코드 정리 및 원활한 유지 보수를 위해 Generator 내 Inter-Runnable Variable 관련 API 의 코드 생성 방식 개선
동작 영향	없음
설정 영향	없음
ASW 조치 필요 사항	없음

4.3.26 Version 4.7.0

- **신규 기능**

■ ApplicationRecordDataType 내에 ApplicationRecordElement 의 카테고리 BOOLEAN 지원

원인	ApplicationRecordDataType 내에 ApplicationRecordElement 의 카테고리 BOOLEAN 미지원
동작 영향	없음
설정 영향	없음
ASW 조치 필요 사항	없음

■ ApplicationPrimitiveDataType 의 카테고리 COM_AXIS, CURVE, MAP 지원

원인	BswModuleDescription 내에 PerInstanceParameter 에 대한 ApplicationPrimitiveDataType 의 카테고리 COM_AXIS, CURVE, MAP 지원 및 Validation 추가
동작 영향	없음
설정 영향	에러 발생 시 설정 변경 필요
ASW 조치 필요 사항	없음

- **개선 사항**

■ Transformer 사용시 Init Value 지원

원인	Transformer 사용시 Init Value 미지원
동작 영향	없음
설정 영향	없음
ASW 조치 필요 사항	없음

■ Trigger API 가 생성되지 않는 문제 수정

원인	다른 SWC 에 PPortPrototype 의 ShortName 과 Trigger Interface 의 Trigger ShortName 이 같은 것이 있을 경우 일부 Rte_Trigger API 가 생성되지 않음. 다른 SWC 에 Runnable 의 ShortName 과 각 InternalTriggeringPiont 의 ShortName 이 같은 것이 있을 경우 일부 Rte_IrTrigger 가 생성되지 않음
동작 영향	없음
설정 영향	없음
ASW 조치 필요 사항	없음

■ Transformation 기능 미사용시 Error Handling 값이 TRANSFORMER-ERROR-HANDLING 로 설정되어 있는 경우 컴파일 에러 수정

원인	Error Handling 값이 TRANSFORMER-ERROR-HANDLING 로 설정되어 있으나 Transformation 기능 미사용시 할 경우 Rte API 내에서 선언되지 않은 변수를 사용하는 코드 생성

동작 영향	없음
설정 영향	없음
ASW 조치 필요 사항	없음

■ 1:N NonQueued Sender Receiver 통신시 RPort 의 Init Value 가 다를 경우 컴파일 에러발생 수정

원인	1:N NonQueued Sender Receiver 통신시 RPort 의 Init Value 가 다를 경우 같은 이름의 변수가 다른 초기값으로 여러 번 선언되어 컴파일 에러 발생
동작 영향	없음
설정 영향	없음
ASW 조치 필요 사항	없음

■ Validation 수정

원인	- Application Value Specification 을 통한 Init Value 설정시 모든 카테고리에 SwArraysize 를 요구 - XfrmImplementationMappingSet 설정시 Data Mapping 설정을 요구 - Signal/SignalGroup 에 TransformationISignal 이 있을 경우 해당 Signal/SignalGroup 에 대한 ComSignal / ComSignalGroup 을 요구
동작 영향	없음
설정 영향	없음
ASW 조치 필요 사항	없음

■ ERR 0000 메시지 일부 개선

원인	설정 오류등으로 인한 에러 발생시 사용자가 확인하기 어려운 ERR 0000 메시지 발생
동작 영향	없음
설정 영향	없음
ASW 조치 필요 사항	없음

4.3.27 Version 4.7.1

- 신규 기능

■ Rte_Receive API 에 대한 executeDespiteDataUnavailability 옵션 지원

원인	Rte_Receive API 에 대한 executeDespiteDataUnavailability 옵션 지원
동작 영향	executeDespiteDataUnavailability 활성화 및 Rte_Receive API 가 non-blocking API 일 경우 Transformer chain 의 모든 Transformer 가 수행되며 모든 Transformer 의 inputBuffer 의 입력 값은 NULL 이고 dataLength 는 0 이 된다.
설정 영향	없음
ASW 조치 필요 사항	없음

- 개선 사항

■ Unsigned 데이터 타입에 Text Value Specification 을 이용하여 Init Value 설정 시 컴파일 에러 수정

원인	Unsigned 데이터 타입에 Text Value Specification 을 통한 Init Value 설정 시 Rte.c 에 Text Value Specification 에서 지정한 초기값과 Suffix U 가 합쳐진 값으로 변수를 초기화 하여 컴파일 에러 발생
동작 영향	없음
설정 영향	없음
ASW 조치 필요 사항	없음

■ DisabledMode 가 적용된 Runnable 이 Mode 를 변환해도 수행되지 않는 문제 수정

원인	Enhanced Mode API 를 사용하지 않거나 Mode Switch Event 에서 OnEntry 나 OnExit 만 사용될 경우, Task 내에서 DisabledMode 검사를 위한 조건문에서 전역변수로 선언되었으나 사용되지 않는 변수를 이용함. 전역변수는 0 으로 초기화되고 DisabledMode 에서 사용되는 TargetMode 값이 0 이 포함되어 있는 경우 조건문은 항상 false 가 되어 Runnable 이 수행되지 않음
동작 영향	없음
설정 영향	없음
ASW 조치 필요 사항	없음

■ Application Header 및 Rte_Hook.h 코드 생성이 일관되도록 수정

원인	Arxml 의 내부 내용은 같으나 순서가 변경된 경우 Application Header 와 Rte_Hook.h 파일의 내용 순서도 변경됨
동작 영향	없음
설정 영향	없음
ASW 조치 필요 사항	없음

■ 1:N Sender Receiver 통신시 일부 ComSpec 에 Init Value 가 지정되지 않을 경우 경고 메시지 출력

원인	1:N Sender Receiver 통신시 대부분의 RPort 에 Init Value 가 지정되어 있으나 몇몇 RPort 에 Init Value 가 지정되어 있지 않을 경우 경고 메시지 출력
동작 영향	없음
설정 영향	경고 발생시 해당 Port 의 ComSpec 에서 Init Value 설정
ASW 조치 필요 사항	없음

■ Rte Generator 의 Rte_Enter, Rte_Exit, SchM_Enter, SchM_Exit 생성 코드 개선

원인	Rte Generator 의 Rte_Enter, Rte_Exit, SchM_Enter, SchM_Exit 생성 코드를 개선하여 유지보수성을 향상
동작 영향	없음
설정 영향	없음
ASW 조치 필요 사항	없음

■ Sender Receiver 통신시 DATA_REFERENCE 타입에 대한 Validation 추가

원인	DATA_REFERENCE 타입의 ImplementationDataType 을 이용한 Sender Receiver 통신시 잘못된 메모리 참조를 방지
동작 영향	없음
설정 영향	에러 발생시 설정 변경
ASW 조치 필요 사항	없음

4.3.28 Version 4.8.0

- 개선 사항

■ Disabled Mode 를 설정한 SchedulableEntity/Runnable 이 Disabled Mode 로 설정한 모드에 진입하거나 빠져나갈 때 실행될 수 있는 문제 수정

원인	SchedulableEntity/Runnable 실행 전 Disabled Mode 를 검사하는 로직에서 이전모드와 다음모드 둘 다 검사해야하나 이전모드 또는 다음모드 둘 중 하나만 검사하는 로직이 생성됨
동작 영향	없음
설정 영향	없음

ASW 조치 필요 사항	없음

■ 동일한 Queued Trigger 를 이용한 External Triggering Event 사용시 Runnable 들이 비정상적으로 호출되는 문제 수정

원인	동일한 Trigger Interface 를 여러 SWC 에서 PPort 로 사용하고 해당 Interface 의 동일한 Queued Trigger 를 이용하여 여러 Sink(수신)측 SWC 의 Runnable 들에 External Trigger Event 로 설정할 경우 AssemblyConnector 의 Provided-Required 연결을 무시하고 해당 Trigger 를 사용하는 모든 SWC 를 Required 로 인식함. Queued Trigger 와 관련된 매크로 선언, 변수 선언 및 Task 본문 생성시 PPort 와 연결되어있는 RPort 의 Runnable 만이 아닌 해당 Trigger 를 사용하는 모든 Runnable 이 호출되도록 코드가 작성됨
동작 영향	없음
설정 영향	없음
ASW 조치 필요 사항	없음

■ Misra-2012 C Violation 관련 수정과 정당화 처리

원인	Misra C Violation 발생
동작 영향	없음
설정 영향	없음
ASW 조치 필요 사항	없음

4.3.29 Version 4.8.1

- 개선 사항

■ 1:N Mode 통신에서 Direct Function Call 로 Runnable 을 호출하는 Rte_Switch/SchM_Switch API 가 PositionInTask 순서대로 Runnable/ScheduleableEntity 를 호출하도록 수정

원인	1:N Mode 통신에서 Direct Function Call 로 Runnable 을 호출하는 Rte_Switch/SchM_Switch API 가 PositionInTask 순서대로 Runnable/ScheduleableEntity 를 호출하지 않고 임의의 순서대로 호출함
동작 영향	없음
설정 영향	없음
ASW 조치 필요 사항	없음

4.3.30 Version 4.9.0.0

- 신규 기능

■ Runnable Entity Trace Events 기능 추가

원인	Runnable Entity Trace Events 기능 미지원
동작 영향	없음
설정 영향	없음
ASW 조치 필요 사항	없음

- 개선 사항

■ Rte.c / Rte_<Partition>.c 파일에 HASH(0xXXXXXXXX) 문구가 출력되어 컴파일에러가 발생하는 문제 수정

원인	Rte.c / Rte_<Partition>.c 파일에 HASH(0xXXXXXXXX) 문구가 출력되어 컴파일에러가 발생
동작 영향	없음

설정 영향	없음
ASW 조치 필요 사항	없음

■ 매뉴얼과 PDF 설정 항목 변경

원인	매뉴얼과, PDF 그리고 제너레이터 동작이 불일치
동작 영향	없음
설정 영향	없음
ASW 조치 필요 사항	없음

4.3.31 Version 4.10.0.0

- 신규 기능

■ -NoRteReceiverPullCB 옵션 신규 추가

원인	Sender Receiver 의 InterPartition 통신시 수신측에서 Rte_ReceiverPullCB API 가 Interrupt Context 에서 수행되어 잦은 데이터 수신시 성능 저하 발생. 특정 Usecase 에서 Rte_ReceiverPullCB 를 사용하지 않고 데이터를 수신할 수 있도록 신규 옵션 및 기능 추가
동작 영향	없음
설정 영향	없음
ASW 조치 필요 사항	없음

- 개선 사항

■ Timing Event 로 구성된 Extended Task 가 PositionInTask 설정대로 Runnable/BswScheduleEntity 를 실행하지 않는 문제 수정

원인	Timing Event 로 구성된 Extended Task 생성시 PositionInTask 값을 숫자가 아닌 문자로 인식하게 한 뒤 정렬하여 Runnable/SchedulableEntity 의 실행순서가 기대와 다르게 정렬됨(ex 1, 5, 22, 34 가 '1', '22', '34', '5' 순으로 정렬)
동작 영향	없음
설정 영향	없음
ASW 조치 필요 사항	없음

■ Server Runnable 에 Argument 가 있는 경우 글루코드가 생성되지 않아 Implicit Sender Receiver 통신이 수행되지 않는 문제 수정

원인	Operation Invoked Event 로 동작하는 Server Runnable 에 Argument 가 있고, Task Mapping 되어 있으며, Data Read Access 또는 Data Write Access 설정이 되어 있는 경우 Task 내 Server Runnable 실행 전/후로 글루코드가 생성되지 않아 Implicit Sender Receiver 통신이 수행되지 않는 문제 발생
동작 영향	없음
설정 영향	없음
ASW 조치 필요 사항	없음

■ 대용량 arxml 지원을 위한 Generator 개선

원인	대용량 arxml 사용시 Out of Memory 발생. Rte 코드 생성과 무관한 <ADMIN-DATA> 태그를 파싱단계에서 제거하여 메모리 사용량 개선
동작 영향	없음
설정 영향	없음
ASW 조치 필요 사항	없음

■ NmPdu / ISignalToIPduMapping 태그 인식 지원

원인	PartialNetwork 지원을 위해 NmPdu/ISignalToIPduMapping 태그 인식 지원.

동작 영향	없음
설정 영향	없음
ASW 조치 필요 사항	없음

■ CompuMethod 의 Compu Phys to Internal 태그 인식 개선

원인	CompuMethod 의 Compu Direction 이 Compu Phys to Internal 일 때 제너레이터 에러 발생.
동작 영향	없음
설정 영향	없음
ASW 조치 필요 사항	없음

■ 1:N Standard Trigger 통신 제약사항 추가

원인	Os Task 방식으로 동작하는 1:N Standard Trigger 통신 설정시 triggered runnables 들이 동작하지 않을 수 있음.
동작 영향	없음
설정 영향	없음
ASW 조치 필요 사항	없음

4.3.32 Version 4.10.1.0

- 개선 사항

■ Server Runnable 에 Return 값이 있는 경우 글루코드가 정상 생성되지 않아 Implicit Sender Receiver 및 Implicit Inter Runnable Variable 이 수행되지 않는 문제 수정

원인	Operation Invoked Event 로 동작하고 Application Error 를 반환하는 Server Runnable 에 Implicit Sender Receiver 또는 Implicit Inter Runnable Variable 관련 설정이 있는 경우 Server Runnable 실행 전 글루코드가 생성되지 않아 Implicit Sender Receiver 및 Implicit Inter Runnable Variable 의 데이터 수신이 정상적으로 수행되지 않는 문제 발생
동작 영향	없음
설정 영향	없음
ASW 조치 필요 사항	없음

■ Client Server Intra Partition 통신시 Server Runnable 이 Task Mapping 되어 있고, Application Error 를 반환하나 Argument 가 없는 경우 Application Error 가 Rte_Call, Rte_Result 반환값으로 전달되지 않는 문제 수정

원인	Client Server Intra Partition 통신시 Server Runnable 이 Task Mapping 되어 있고, Application Error 를 반환하나 Argument 가 없는 경우 Rte_Call, Rte_Result API 내에 Application Error 를 전달하기 위한 코드가 미생성되어 Application Error 가 Client 에게 전달되지 않음
동작 영향	없음
설정 영향	없음
ASW 조치 필요 사항	없음

■ Client Server Inter Partition 통신시 Server Runnable 이 Application Error 를 반환하는 경우 Application Error 가 Rte_Call, Rte_Result 반환값으로 전달되지 않는 문제 수정

원인	Client Server Inter Partition 통신시 Server Runnable 이 Application Error 를 반환하는 경우 Rte_Call, Rte_Result, Rte_ReceiverPullCB_CsResult API 내에 Application Error 를 전달하기 위한 코드가 미생성되어 Application Error 가 Client 에게 전달되지 않음
동작 영향	없음

설정 영향	없음
ASW 조치 필요 사항	없음

■ InterPartition 통신에 대한 N:1 Client Server 제약사항 추가

원인	N:1 Inter Partition 및 Intra-Inter Partition Client Server 통신 미지원
동작 영향	없음
설정 영향	없음
ASW 조치 필요 사항	없음

■ Extended Task 내에 로컬변수 LddMaskType 을 RTE_ZERO 로 초기화

원인	로컬변수 LddMaskType 을 초기화하지 않고 사용하여 MISRA Violation 발생
동작 영향	없음
설정 영향	없음
ASW 조치 필요 사항	없음

■ Validation 내 오류 정보 상세화

원인	- 에러메세지 출력시 입력 파일 확인 문구 - BswModuleDependencies 내에 지정된 모듈이 없는 경우 - ProvidedEntries 가 같은 BswModuleEntry 를 중복해서 참조하는 경우
동작 영향	없음
설정 영향	에러 발생 시 설정 변경 필요
ASW 조치 필요 사항	없음

4.3.33 Version 4.10.2.0

- 개선 사항

■ Sender Receiver 통신에서 DATA_REFERENCE 사용시 제너레이터 에러 수정

원인	ImplementationDataType 카테고리가 DATA_REFERENCE 이거나 DATA_REFERENCE 를 포함하고 이를 Sender Receiver 통신에서 사용하는 경우 제너레이터 에러가 발생
동작 영향	없음
설정 영향	없음
ASW 조치 필요 사항	없음

■ ComSignalType 이 UINT8_N, UINT8_DYN 이면서 ComBitSize 에 값이 없는 경우 Validation 에러가 나지 않도록 수정

원인	ComSignalType 이 UINT8_N, UINT8_DYN 이면서 ComBitSize 에 값이 없는 경우 Validation 에러 발생
동작 영향	없음
설정 영향	없음
ASW 조치 필요 사항	없음

■ MISRA 및 Run-Time Violation 정당화 및 일부 코드 개선

원인	MISRA 및 Run-Time Violation 발생
동작 영향	없음
설정 영향	없음
ASW 조치 필요 사항	없음

4.3.34 Version 4.10.3.0

- 개선 사항
  - ■ Transformer 사용시 Rte_Read, Rte_IStatus, Rte_Receive API 의 반환값에서 Overlayed Errors 가 손실되는 현상 수정

원인	Transformer 사용시 반환값을 저장하는 변수에 OR 연산자가 아닌 대입연산자가 사용되어 Overlayed Error 가 손실됨
동작 영향	없음
설정 영향	없음
ASW 조치 필요 사항	없음

  - ■ IN/OUT/INOUT 매크로 사용을 위한 ParameterDirection 옵션 추가

원인	IN/OUT/INOUT 매크로 비활성화 및 Rte API/Runnable 에서 생성되지 않게 기본 동작 변경. 해당 매크로를 사용하기 위한 -ParameterDirection 옵션 추가
동작 영향	없음
설정 영향	없음
ASW 조치 필요 사항	없음

  - ■ -Validate 옵션 기본 적용

원인	-Validate 제너레이터 옵션이 기본 동작되도록 제너레이터 수정
동작 영향	-Validate 옵션 기본 동작
설정 영향	없음
ASW 조치 필요 사항	없음

  - ■ Validation 추가

원인	- Inter Ecu Inter Partition 통신 미지원 - Direct Function Call 로 호출되는 RunnableEntity 에 DataReadAccess, DataWriteAccess 설정 미지원 - ExtendedTask 내 여러 RteEvent 가 같은 OsEvent 를 참조하는 설정 미지원
동작 영향	없음
설정 영향	에러시 설정 변경
ASW 조치 필요 사항	없음

  - ■ impldataTypes_ioc.arxml 내에 ImplementationDataType 의 Category 가 지정되도록 변경

원인	impldataTypes_ioc.arxml 내에 ImplementationDataType 의 Category 가 지정되지 않음
동작 영향	없음
설정 영향	없음
ASW 조치 필요 사항	없음

  - ■ Rte 폴더 내 gc.exe 및 Rte.bat 파일 삭제

원인	Rte 가 생성하는 파일들의 들여쓰기 조정을 위해 Rte Generator 와 함께 배포되는 gc.exe 와 Rte.bat 가 사용되지 않음
동작 영향	없음
설정 영향	없음
ASW 조치 필요 사항	없음

4.3.35 Version 4.10.4.0

- 개선 사항
  - ■ 64-bit Rte.exe 배포

원인	DB 용량이 큰 프로젝트 빌드 시, Out of Memory 발생
동작 영향	없음
설정 영향	없음
ASW 조치 필요 사항	없음

4.3.36 Version 4.10.5.0

- 개선 사항
  - ■ Synchronized Offset 관련 Interrupt Disable / Enable 함수 재정의 매크로 추가

원인	컴파일러별로 Interrupt Disable / Enable 하는 함수명이 다름
동작 영향	없음
설정 영향	없음
ASW 조치 필요 사항	없음

  - ■ Rte_Result API 내 Race Condition 방지를 위한 Suspend/Resume Interrupt 코드 추가

원인	함수내 전역변수 접근시 Race Condition 발생 가능성
동작 영향	없음
설정 영향	없음
ASW 조치 필요 사항	없음

  - ■ Misra C Violation 관련 정당화 오타 수정

원인	Misra C Violation 관련 정당화 오타
동작 영향	없음
설정 영향	없음
ASW 조치 필요 사항	없음

  - ■ 매뉴얼 업데이트

원인	- 미지원 API 리턴값 설명 삭제 및 Transformer 관련 리턴값 추가 - RteExpectedActivationPosition, AlarmSetMethodIsRelative 설명 개선 - Synchronized Offset 관련 설명 추가
동작 영향	없음
설정 영향	없음
ASW 조치 필요 사항	없음

4.3.37 Version 4.10.6.0

- 개선 사항
  - ■ InterPartition Client Server 통신시 Argument 가 1 개이고 Direction 이 INOUT 인 경우 컴파일 에러 수정

원인	InterPartition Client Server 통신시 Argument 가 1 개이고, Direction 이 INOUT 인 경우 Rte_Call API 내 if 문의 조건식이 2 개이나 이를 감싸는 괄호가 생성되지 않아 컴파일 에러 발생
동작 영향	없음
설정 영향	없음

ASW 조치 필요 사항	없음

■ Tasking 컴파일러 사용시 NO_INIT 영역 변수를 farnoclear 키워드를 이용하여 섹션을 지정하도록 변경

원인	#pragma noclear 와 farbss 로 섹션지정시 NO_INIT 영역 변수가 UNDEFINED_RAMDATA 로 할당됨
동작 영향	없음
설정 영향	없음
ASW 조치 필요 사항	없음

■ AUTOEVER 양식 변경

원인	사명 변경
동작 영향	없음
설정 영향	없음
ASW 조치 필요 사항	없음

4.3.38 Version 4.10.7.0

- 개선 사항

■ Implicit Sender Receiver 통신에서 초기값 사용시 버퍼를 INIT 영역으로 배치

원인	Implicit Sender Receiver 통신에서 초기값 사용시 버퍼가 CLEARED 영역으로 배치됨
동작 영향	없음
설정 영향	없음
ASW 조치 필요 사항	없음

■ UNECE Cyber Security 법규 대응을 위한 보안 코딩 개선

원인	UNECE Cyber Security 법규 위반 사항 발생
동작 영향	없음
설정 영향	없음
ASW 조치 필요 사항	없음

4.3.39 Version 4.11.0.0

- 신규 기능

■ HandleTimeoutType 의 REPLACE-BY-TIMEOUT-SUBSTITUTION-VALUE 지원

원인	Com 모듈 ComRxDataTimeoutAction 의 SUBSTITUTE 기능 지원
동작 영향	없음
설정 영향	없음
ASW 조치 필요 사항	없음

- 개선 사항

■ 1:N Standard Trigger 통신시 일부 Runnable 이 호출되지 않는 현상 개선

원인	Standard Trigger 통신의 경우 Source 기준으로 EventFlag 가 1 개만 생성되어 Async 로 동작하는 Sink 들이 호출되지 않는 현상이 발생
동작 영향	없음
설정 영향	없음
ASW 조치 필요 사항	없음

■ 파티션을 1 개만 설정할 경우 ModeSwitch Init 처리 및 SchM Lifecycle 관련 컴파일 에러 개선

원인	파티션을 2 개 이상 설정한 경우만을 고려하여 ModeSwitch Init 및 SchM Lifecycle 로직 처리.
동작 영향	없음
설정 영향	없음
ASW 조치 필요 사항	없음

■ BswEntity 내에 ActivationPoint 를 3 개 이상 설정하는 경우 일부 SchM_ActMainFunction API 가 생성되지 않는 문제 개선

원인	Generator Code 내 ActivationPoints 개수 인식 오류
동작 영향	없음
설정 영향	없음
ASW 조치 필요 사항	없음

■ SchM Trigger Queued 1:N 에서 Count 매크로 생성 오류

원인	Generator Code 내에 Count 매크로 생성시 CountLength 값이 아닌 QueueLength 값을 참조
동작 영향	없음
설정 영향	없음
ASW 조치 필요 사항	없음

4.3.40 Version 4.11.1.0

- **개선 사항**

■ UNECE Cyber Security 법규 대응을 위한 보안 코딩 개선

원인	UNECE Cyber Security 법규 위반 사항 발생
동작 영향	없음
설정 영향	없음
ASW 조치 필요 사항	없음

4.4 Limitations

4.4.1 General Description

이 Chapter 에서는, RTE 모듈에서 제공하는 기능 및 동작에 대한 제한 사항을 기술한다.

4.4.2 Limited Function Description in Rte Module

4.4.2.1 Common Limitation in Overall Rte Module

➢ **Only Generation Phase is supported in Rte Generation Process**

Rte 코드생성 프로세스에서, Generation Phase (Bsw Scheduler Generation / Rte Generation Phase) 만 지원한다.

➢ **Minimum Start Interval is not available.**

Runnable 실행 후 동일한 Runnable 을 다시 실행 하기 까지의 최소 시간 간격을 보장해주는 MinimumStartInterval 기능은 지원하지 않는다. (ERR 9013)

- **In Instantiation, 'Multiple Instance' is not supported and only single instance is possible.**
  하나의 SwComponentType 을 가지고 하나의 SwComponentPrototype 을 만드는 Single Instance 만 지원한다. 하나의 SwComponentType 을 가지고 여러 개의 SwComponentPrototype 을 만드는 Multiple Instance 는 지원하지 않는다. (ERR 9004)
- **Periodic RTE Event (i.e. Timing Event / Background Event) can not be mapped into the OsTask which other RTE Events (except for the periodic Rte Event. eg. Operation Invoked Event) mapped also.**
  Timing Event, Background Event 와 같은 주기 Event 는 기타 다른 비주기 RTE Event 와 같은 OsTask 에 Mapping 될 수 없다. (ERR 9007)
- **RunnableEntity shall be scheduled by only RteEvent. Direct function call from application code is not available.**
  RunnableEntity 는 RteEvent 에 의해서만 Scheduling 되어야 한다. Application Code 에서 RunnableEntity 를 직접 호출하는 식으로 사용해서는 안 된다. (WRN 0103)
- **RTE API shall be called only in the RunnableEntity which has Data/ParameterAccess for DataElement.**
  RTE API 는 해당 DataElement 를 위한 DataAccess 나 ParameterAcess 를 가지고 있는 RunnableEntity 에서만 사용되어야 한다. 그렇지 않은 경우에는 DataConsistency 문제가 발생할 수도 있다.

4.4.2.2 Limitation in Rte Interface

4.4.2.2.1 Sender Receiver Interface

- **Compatibility between Implicit Non Queued Sender Receiver and Explicit Non Queued Sender Receiver are not available.**
  PPort 와 RPort 간, 또는 하나의 Port 에 Implicit SenderReceiver 와 Explicit SenderReceiver 의 혼합 사용은 지원하지 않는다.
- **Compatibility between Sender Receiver Interface and Other Interface is not available.**
  Sender Receiver Interface 와 다른 종류의 Interface(NvData Interface 또는 Parameter Interface) 와의 Port Interface Mapping 은 지원하지 않는다. (ERR 9001, ERR 9002)
- **In Implicit Non Queued type Sender Receiver interface, Coherency Group is not available.**
  같은 시점에서의 서로 다른 VariableDataPrototype 에 대한 값을 얻고 싶을 때 사용하기 위한 Coherency Group 은 지원하지 않는다.
- **In Sender Receiver interface, the following functionalities are not available.**
  Data Conversion and Filter
  ※ Data Conversion 은, Data 를 전달/수신 하는 과정에서 Compu Method 에 의해서 정의된 내용을 기반으로,

해석을 달리할 수 있는 기능을 의미한다.

※ Filter 는 특정 조건에 해당하는 Data 에 대해서만 값을 전달해주는 기능을 의미한다.

- **Inter Ecu Communication through Inter Partition is not available.**

  BswModule 이 동작하는 Main Partition 이외의 다른 Sub Partition 에서 SenderReceiver Interface 를 통한 CAN 통신 즉, Inter Ecu Communication 은 지원하지 않는다. (ERR 9018)

- **Rte_IWrite API shall be called every time during an execution of the RunnableEntity if the RunnableEntity has DataWriteAccess.**

  RunnableEntity 에 DataWriteAccess 를 가지고 있는 경우에는 Rte_IWrite API 를 항상 호출해야 한다. DataWriteAccess 가 있지만 Rte_IWrite API 를 호출하지 않는 경우에는 RTE Spec 상 불명확한 값이 전송될 수 있다. RunnableEntity 에서 상황에 따라 값을 전송하거나 안 해야 한다면 Rte_Send API 를 이용하도록 한다.

- **The following functionalities are not available in case an ImplementationDataType with category DATA_REFERENCE is used in Sender Receiver communication**

  - Inter Partition Communication, Inter ECU Communication, Init Value, Invalidation Policy-Replace and Keep, Handle Out Of Range and Etc.

  ※ 다른 파티션간 통신, 다른 ECU 간 통신, 초기값 지정, 무효값 수신시 동작 방식 설정, 지정범위를 넘어선 경우 동작 방식 설정 등등 기본 기능 외에 추가 기능들은 지원되지 않는다.

- **Data Read Access or Data Write Access is not available in a RunnableEntity activated by a Direct Function Call.**

  - Direct Function Call 방식으로 호출되는 RunnableEntity 에 Data Read Access 또는 Data Write Access 설정은 지원되지 않는다. (ERR 9019)

- **REPLACE-BY-TIMEOUT-SUBSTITUTION-VALUE of HandleTimeoutType is not supported with Data Transformation.**

  - HandleTimeoutType 의 REPLACE-BY-TIMEOUT-SUBSTITUTION-VALUE 는 Data Transformation 과 함께 사용할 수 없다.

4.4.2.2.2 Client Server Interface

- **Inter-Ecu Communication is not available.**

  - ECU 간 통신은 지원하지 않는다. (ERR 9015)

- **The following functionalities are not available.**

  - Timeout and Data Conversion

- **N:1(Multiple clients - one server) Inter Partition / Intra-Inter Partition are not supported.**

  - N:1(멀티 클라이언트-1 서버)의 파티션간 통신 및 파티션내-파티션간 통신은 지원하지 않는다.

- **In case of inter partition communication, if the partition of server is stopped or restarting during the operation of the server call, the client cannot be notified.**

- 파티션 간 통신 시, 서버 동작 중 서버가 속한 파티션이 중지되거나 재시작될 경우 클라이언트는 해당 상황에 대해 인지하지 못할 가능성이 있다.

- **If queuing feature has been enabled for server operation, basically the queue mechanism in Rte is operated with Task Ready Queue in OsTask. That is, if during server operation, to handle the additional request has been invoked from client, OsTask which the Server Runnable has been mapped into would be activated in Rte_Call API body. And in Os, for additional activation request from Rte, the Queue counter for this OsTask will be increased because this OsTask has been already Ready state (Queue for this OsTask in OS, should be configured). If the queue in Server operation is needed for application design, please contact to Hyundai AUTOEVER.**

  - 중복의 요청을 처리하기 위해 제공되는 Queue 기능은 OsTask 의 Queue 를 사용하여 제공한다. (사용 시, OS 모듈에서 해당 OsTask 의 Queue Count 값을 CS Queue 개수와 동일하게 설정해야 함) 따라서 OS 에서 OsTask 에 대한 Queue 기능을 제공하지 않는 경우, Rte 에서는 Queue 기능을 제공할 수 없다. 제공되는 OS 에 따라, Rte 에서 Queue 기반의 Client Server 로직 설계시 오동작 가능성이 있으므로 반드시 설계 전에 현대오토에버 상의해야 한다.
  - Bolero MCU 에 대한 플랫폼에서는, Client Server 통신에서 Queue 기능을 사용할 수 없다.

4.4.2.2.3 Trigger Interface

- **The communication based on the Trigger interface between partition with Queue, is not available**

  Inter Partition 간의 Queue 를 이용한 Trigger Interface 기반의 통신은 지원하지 않는다. Queue 를 이용한 Trigger Interface 는 Intra Partition 간의 통신만 지원한다.

- **In Trigger interface, synchronized trigger is not available**

  Application 과 Bsw 모듈이 하나의 Trigger 를 공유하여 Application Runnable Entity 와 Bsw Executable Entity 에 대해 일괄적인 Trigger 를 할 수 있는 Synchronized Trigger 기능은 지원하지 않는다. (ERR 9015)

- **If queuing feature has been enabled for Trigger Sink, basically the queue mechanism in Rte is operated with Task Ready Queue in OsTask. That is, if during Trigger Sink operation, to handle the additional request has been invoked from Trigger Source, OsTask which the Sink Runnable has been mapped into would be activated in Rte_Trigger API body. And in Os, for additional activation request from Rte, the Queue counter for this OsTask will be increased because this OsTask has been already Ready state (Queue for this OsTask in OS, should be configured). If the queue in Trigger Sink is needed for application design, please contact to Hyundai AUTOEVER.**

- 중복의 요청을 처리하기 위해 제공되는 Queue 기능은 OsTask 의 Queue 를 사용하여 제공한다. (사용시, OS 모듈에서 해당 OsTask 의 Queue Count 값을 CS Queue 개수와 동일하게 설정해야 함) 따라서 OS 에서 OsTask 에 대한 Queue 기능을 제공하지 않는 경우, Rte 에서는 Queue 기능을 제공할 수 없다. 제공되는 OS 에 따라, Rte 에서 Queue 기반의 Trigger Sink 로직 설계 시 오동작 가능성이 있으므로 반드시 설계 전에 현대오토에버와 상의해야 한다.
- Bolero MCU 에 대한 플랫폼에서는, Trigger 통신에서 Queue 기능을 사용할 수 없다.

4.4.2.2.4 Mode Switch Interface

- **In Mode Switch Acknowledgement, the following functionalities are not available**

  - Interaction between multi partitions

  ※ 파티션 Terminate / Restart 동작 관련하여, 연관된 파티션에 대한 정보를 전달하는 기능

  - Return timeout (ERR 9006)

  ※ 설정된 Timeout value 값 내에, Mode Switching 작업이 완료되지 않은 경우, E_TIMEOUT return 하는 기능

- **Common Mode Instance**

  Application 와 Bsw 모듈에 설정된 Mode 를 공유하여, 하나의 Mode Instance 를 기반으로 Application 과 Bsw 모듈에 대한 Mode 를 제어할 수 있는 기능 (ERR 9015)

4.4.2.3 Limitation in Rte Events

4.4.2.3.1 General Limitation in Rte Events

- **The following Rte Events cannot be mapped to Extended Tasks.**

  다음의 Rte Events 는 Extended Task 에 연결될 수 없다.

  BackgroundEvent, DataWriteCompletedEvent, OperationInvokedEvent, AsynchronousServerCallReturnsEvent, SwcModeSwitchEvent, ModeSwitchedAckEvent, BswBackgroundEvent, BswModeSwitchEvent, BswModeSwitchedAckEvent

- **Extended Tasks cannot have different kind of Rte Events.**

  Extended Task 내에 서로 다른 종류(타입)의 Rte Event 는 속할 수 없다.

- **Following RteEvents in an ExtendedTask cannot reference the same OsEvent.**

  ExtendedTask 내에 아래의 RteEvent 들은 같은 OsEvent 를 참조할 수 없다.

  Data Received Event, Data Receive Error Event, Data Send Completed Event, Data Write Completed Event, Asynchronous Server Call Resturns Event, Operation Invoked Event, Swc Mode Switch event, Mode Switched Ack Event, External Trigger Occurred Event, Internal Trigger Occurred Event. (ERR 9020)

- **DataReceivedEvent and DataReceivedErrorEvent for implicit Sender-Receiver communication cannot be mapped to Extended Tasks.**

Implicit 방식의 Sender-Receiver 통신에 대해서는 DataReceivedEvent 와 DataReceivedError 는 Extended Task 에 연결될 수 없다.

- **ExternalTriggerOccurredEvent, InternalTriggerOccurredEvent, BswExternalTriggerOccurredEvent, and BswInternalTriggerOccurredEvent for QUEUED triggers cannot be mapped to Extended Tasks.**

  Queue 방식의 Trigger 에 대해서는 ExternalTriggerOccurredEvent, InternalTriggerOccurredEvent, BswExternalTriggerOccurredEvent, BswInternalTriggerOccurredEvent 는 Extended Task 에 연결될 수 없다.

- **Runnables in Extended Task cannot have DataWriteAccess, or DataReadAccess.**

  Extended Task 에 속한 Runnable 은 Implicit 방식의 Sender-Receiver 통신을 사용할 수 없다. DataWriteAccess 또는 DataReadAccess 를 사용할 수 없으며, 이에 따라 Rte_IWrite 또는 Rte_IRead API 를 사용할 수 없다.

- **Runnables in Extended Task cannot have ReadLocalVariables or WriteLocalVariables for ImplicitInterRunnableVariables.**

  Extended Task 에 속한 Runnable 은 Implicit 방식의 InterRunnableVariable 을 사용할 수 없다. ImplicitInterRunnableVariable 에 대한 ReadLocalVariable 또는 WriteLocalVariable 를 사용할 수 없으며, 이에 따라 Rte_IrvIRead 또는 Rte_IrvIWrite API 를 사용할 수 없다.

- **When Rte Events are mapped to Extended Tasks, they cannot have Disabled Modes.**

  Extended Task 에 연결된 Rte Event 는 Disabled Mode 를 설정할 수 없다.

- **Rte Events cannot have ModeDeclaration in the role disabledMode in the ModeGroup of the unconnected RPortPrototype.**

  RteEvent 는 연결되지 않은 RPortPrototype 의 ModeGroup 에 속한 ModeDeclaration 으로 DisabledMode 을 설정할 수 없다.

- **Rte API with wait point (Blocked Type of Rte API) is not available.**

  SW Configuration 에서, Wait Point 설정은 지원하지 않으며, Non Blocked Type 의 Rte API 만 지원한다. (ERR 9003)

4.4.2.3.2 Timing Event

- **Timing Event based on the ScheduleTable, is not supported**

  일정 주기로 동작하는 Runnable 을 수행하기 위한 RteEvent 로 OsScheduleTable 을 이용한 방법은 지원하지 않는다. OsAlarm 을 이용한 TimingEvent 만을 지원한다. (ERR 9010)

4.4.2.3.3 Back Ground Event

- **Back Ground Event is not supported.**

  가장 낮은 Priority 에서 동작하는 Background Activity 를 수행하기 위한 RteEvent 로 현재 지원하지 않는다. (ERR 9005)

4.4.2.4 Limitation in Rte APIs

4.4.2.4.1 Rte_Feedback API

- **Rte_Feedback with blocked option is not available.**

  WaitPoint 가 포함된 Rte_Feedback API 는 지원되지 않는다. (Non-Blocking Type 의 Rte_Feedback API 는 사용 가능 함) (ERR 9003)

  ※ WaitPoint 가 설정되는 경우, Rte_Feedback API Behavior : API 수행 중간에, Wait 상태 (Os 의 WaitEvent 상태로 천이) 로 진입하며, Sender Receiver 통신에 대한 관련 수행이 완료되어 DataSendCompletedEvent 가 발생하면, 해당 Wait Point 이후 작업을 재개

4.4.2.4.2 Rte_SwitchAck API

- **Rte_SwitchAck with blocked option is not available.**

  WaitPoint 가 포함된 Rte_Feedback API 는 지원되지 않는다. (Non-Blocking Type 의 Rte_SwitchAck API 는 사용 가능 함) (ERR 9003)

- **Following values are not returned**

  - RTE_E_TIMEOUT
  - RTE_E_IN_EXCLUSIVE_AREA

  ※ refer to 4.11.2.2.4 also

4.4.2.4.3 Rte_Receive API

- **API with Blocking option is not available.**

  WaitPoint 가 포함된 Rte_Receive API 는 지원되지 않는다. (Non-Blocking Type 의 Rte_Receive API 는 사용 가능 함) (ERR 9003)

  ※ WaitPoint 가 설정되는 경우, Rte_Receive API Behavior : API 수행 중간에, Wait 상태 로 진입하며, Sender Receiver 통신에 대한 관련 수행이 완료되어 DataRecievedEvent 가 발생하면, 해당 Wait Point 이후 작업을 재개

4.4.2.4.4 Rte_Call, Rte_Result API

- **APIs for Inter-Ecu Communication is not available.**

  Rte_Call, Rte_Result API 의 Inter-Ecu 통신은 지원하지 않는다. (ERR 9015)

  ※ refer to 4.4.2.2.2

4.4.2.5 Limitation in Rte LifeCycle and Call-back APIs

4.4.2.5.1 Rte APIs regarding Partition

- **Rte_PartitionTerminated, Rte_PartitionRestarting and Rte_RestartPartition APIs are not supported**

  Memory / Timing Protection Violation 이 발생하는 경우, AUTOSAR OS 의 Protection Hook 함수에 의해 Partition 관련 Rte 함수가 연동되어 동작하는 기능이 지원되지 않는다.

4.4.2.5.2 Rte APIs regarding NvM Service Callback

- **Rte_SetMirror, Rte_GetMirror, Rte_NvMNotifyJobFinished and Rte_NvMNotifyInitBlock APIs are not supported**

  NvDataInterface 기반의 NvM 모듈 Service 에 Access 하는데 사용되는, CallBack 함수는 지원되지 않는다. (ERR 9016)

4.4.2.6 Limitation on Data Transformation

Data Transformation 기능은 AUTOSAR 사양의 4.2.2 를 기반으로 한다. 이 부분에서는 해당 사양에서의 Limitation 을 기술한다.

4.4.2.6.1 General Limitation on Data Transformation

- **Data Transformation for Client-Server and Trigger Communication is not supported.**

  Client-Server 및 Trigger 통신에 대한 Data Transformation 은 지원하지 않는다.

- **Data Transformation for Intra-ECU Communication is not supported.**

  ECU 내의 SW-C 간 통신에 대한 Data Transformation 은 지원하지 않는다.

4.4.2.6.2 TRANSFORMER-ERROR-HANDLING

- **ErrorHandling set to TRANSFORMER-ERROR-HANDLING in PortAPIOption is not supported without using functionality of data transformation.**

  Data transformation 기능 사용 없이 PortAPIOption 의 ErrorHandling 을 TRANSFORMER-ERROR-HANDLING 로 설정하는 것은 지원되지 않는다.

- **Rte_DRead, Rte_Call, Rte_Result and Rte_Trigger don't support the optional OUT parameter transformerError.**

  Rte_DRead, Rte_Call, Rte_Result, 그리고 Rte_Trigger 는 optional OUT 파라미터인 transformerError 를 지원하지 않는다.

4.4.2.7 Limitation in data type

4.4.2.7.1 ApplicationPrimitiveDataType

- **ApplicationPrimitiveDataType with category VAL_BLK, STRING and RES_AXIS is not supported**
  카테고리 VAL_BLK, STRING, RES_AXIS 의 ApplicationPrimitiveDataType 은 지원되지 않는다.
- **ApplicationPrimitiveDataType with category COM_AXIS, CURVE, MAP cannot be mapped to ImplementationDataType except category ARRAY or STRUCTURE.**
  카테고리 COM_AXIS, CURVE, MAP 의 ApplicationPrimitiveDataType 은 카테고리 ARRAY, STURCTURE 가 아닌 ImplementationDataType 와의 매핑은 지원되지 않는다.
- **ApplicationPrimitiveDataType with the category COM_AXIS, CURVE and MAP can be only used in parameter interface and sender receiver interface for Intra-ECU communication, PerInstanceParameter, SharedParameter, ArTypedPerInstanceMemory in SWC, PerInstanceParameter in BSW and parameter access within limited function.**
  카테고리 COM_AXIS, CURVE, MAP 의 Application Primitive Data Type 은 ECU 내 통신을 위한 Parameter Interface 와 Sender Receiver Interface, SWC 내의 PerInstanceParameter, SharedParameter, ArTypedPerInstanceMemory, BSW 내의 PerInstanceParameter 와 Parameter Access 내에서만 한정적인 기능으로 사용 가능하다.
- **ApplicationPrimitiveDataType with the category COM_AXIS, CURVE and MAP is only initialized with ApplicationValueSpecification of InitValue or ConstantValueSpecification.**
  카테고리 COM_AXIS, CURVE, MAP 의 Application Primitive Data Type 은 InitValue 또는 ConstantValueSpecification 의 ApplicationValueSpecification 을 통해서만 초기화 된다.
- **Initialization using ValueGroup in SwValuePhys of SwValueCont or SwAxisCont of ApplicationValueSpecification is not supported.**
  ApplicationValueSpecification 의 SwValueCont 또는 SwAxisCont 내의 ValueGroup 을 통한 초기화는 지원되지 않는다.
- **Validation or Creation from SwRecordLayout to ImplementationDataType is not supported**
  SwRecordLayout 을 통한 ImplementationDataType 의 검증 및 생성은 지원되지 않는다.
- **Functions by configuration in SwDataDefProps about ApplicationPrimitiveDataType with the category COM_AXIS, CURVE, MAP are not supported**
  카테고리 VALUE, BOOLEAN, COM_AXIS, CURVE, MAP 의 Application Primitive Data Type 에 대한 SwDataDefProps 내의 설정들을 통한 기능들은 지원되지 않는다. (DataConstr, CompuMethod 등)

4.4.2.7.2 ImplementationDataType

- **A category FUNCTION_REFERENCE of ImplementationDataType is not supported.**
  ImplementationDataType 의 카테고리 FUNCTION_REFERENCE 는 지원되지 않는다.

4.4.2.8 Limitation in Etc. functionality

4.4.2.8.1 Tracing in VFB Trace

- **VFB Trace functionality for RTE API, COM and OS is not supported.**

  RTE API, COM 그리고 OS VFB Trace 기능은 지원되지 않는다.

- **Client Prefix for multiple clients is not supported.**

  각 Trace Event 의 Multiple Client 위한 Client Prefix 기능은 지원하지 않는다. (ERR 9017)

4.4.2.8.2 Monitoring of runnable execution time

- **RteVirtuallyMappedToTask is not available**

  RunnableEntity 의 Execution Time Monitoring 을 위하여 RteEvent 의 Evaluation 과 Runnable 의 수행 Task 를 분리하여 하기 위한 RteVirtuallyMappedtoTask 는 지원하지 않는다. (ERR 9010)

4.4.2.8.3 DET Error reporting

- **Development Errors (DET) is not supported.**

  Development Errors (DET) 기능은 지원하지 않는다. (ERR 9011)

4.4.2.8.4 Variant Handling

- **Variant Handling is not supported**

  여러 개의 Variant 중에서 PreCompile Time, PostBuild Time 등에서 하나의 Variant 를 선택하여 사용할 수 있도록 하기 위한 Variant Handling 기능은 지원하지 않는다.

4.4.2.8.5 Calibration

- **Double Pointered Method in Calibration, is not available**

  AUTOEVER Platform 에서는 Calibration Method 중 OverlayRam, InitializedRam, SinglePointered Method 만 지원한다. 두 번의 Indirect Access 를 통해 Calibration Parameter 에 접근하는 방식인 Double Pointered Method 는 지원하지 않는다. (ERR 9012)

  ※ Double Pointered Method 의 경우, 상용 Calibration Tool 에서 지원하는 경우 없음

4.4.2.8.6 Exclusive Area

- **Cooperative Runnable Placement can not be configured**

  Cooperative Runnable 이 속한 Task 간의 Preemption 을 막는 Cooperative Runnable Place Method 방식은 지원하지 않는다. (ERR 9009)

  ※ 해당 기능에 대한, 사양 내용 불분명 및 Use case 없음

- **USER_DEFINED_MACRO can not be configured**

  Bsw Exclusive Area 의 Mechanism 중 USER_DEFINED_MACRO 는 지원하지 않는다. (ERR 9009)

- **When using RenesasOS for RH850, both internal resource and standard resource can not be used in the same task.**
  RH850 용 RenesasOS 의 경우, Internal Resource 와 Standard Resource 를 동시에 설정하는 것을 지원하지 않는다. 따라서, Internal Resource 를 사용하고 있는 Task 내에서 OS_RESOURCE 방식의 Exclusive Area 를 사용할 수 없다. 자세한 내용은 RenesasOS 매뉴얼을 참조한다.
- **Run Inside Exclusive Area can not be configured**
  BSW 의 Entity 및 Runnable 이 ExclusiveArea 내에서 동작하는 방식을 지원하지 않는다. (ERR 9003)

4.5 Deviations

4.5.1 General Description

이 Chapter 에서는, AUTOSAR RTE 표준 기능 사양 (version 4.0.3) 대비 구현 방식에 대한 차이 및 미지원 기능에 대하여 설명한다.

4.5.2 Deviation Function Description in Rte Module

4.5.2.1 Common Deviation in Rte Module

- **Not available to generate the Rte API with "indirect type".**
  Direct API Invocation 대신 PortHandle 을 통한 Indirect Invocation 을 위한 Indirect API 는 지원하지 않는다. (ERR 9008)
- **Functionality regarding minimum Start Interval is not available in Runnable configuration**
  Runnable 실행 후 동일한 Runnable 을 다시 실행 하기 까지의 최소 시간 간격을 보장해주는 MinimumStartInterval 기능은 지원하지 않는다 (ERR 9013)

4.5.2.2 Detail deviation in each Rte functionality

- **NvData Interface does not be supported.**
  NvRam Data 를 교환하기 위한 Interface 인 NVData Interface 는 지원하지 않는다. 현재 Nvm Service 는 Autosar 3.0 방식의 ServiceSwComponent Type 을 이용하여 제공한다. (ERR 9016)
- **Rte_Ports, Rte_NPorts and Rte_Port APIs are not supported.**
  Direct API Invocation 대신 PortHandle 을 통한 Indirect Invocation 을 위한 Indirect API 는 지원하지 않는다. (ERR 9008)
  ※ refer to 4.12.2.1
- **Initialization of Union Ar-Type and C-Typed PerInstanceMemory Type is not supported.**
  AutosarDataType 을 이용한 Ar-Typed PerInstanceMemory 와 Native Declaration 을 이용한 C-Typed PerInstanceMemory 가 Union Type 인 경우 Initialization 을 지원하지 않는다.
- **Array C-Typed PerInstanceMemory is not supported.**

Native Declaration 을 이용한 C-Typed PerInstanceMemory 가 Array Type 인 경우는 지원하지 않는다.

- **Rte_Invalidate and Rte_IInvalidate is not supported.**

  Invalid Data 를 Receiver Software Component 에 전달하기 위한 Sender Software Component 의 API 인 RTE_Invalidate, Rte_IInvalidate 는 지원하지 않는다.

- **Port Interface Mapping and Compatibility is not supported**

  ※ 서로 다른 인터페이스를 기반으로 설정된 PPort 및 RPort 를 연결하는 경우 사용되는 기능 (ERR 9001, ERR 9002)

- **The number of underscore ('_') of shortname for BswModuleDescription is limited upto one.**

  Rte Generator 의 안정성을 위하여, BswModuleDescription 을 이용하여 Executable Entity 를 구현하고자 할 때, BswModuleDescription Container 의 shortname 이 가지는 '_' 기호의 개수는 1 개 이하로 제한된다.

  E.g. Sensor_CDD1 (O), SensorCDD_1 (O), Sensor_CDD_1 (x)

- **For data transformation, it is assumed that NeedsOriginalData is false and DespiteDataUnavailability is true.**

  Data Transformation 에서 NeedsOriginalData 는 false 로, DespiteDataUnavailability 는 true 로 가정한다.

- **Primitive data types is not supported for Data transformation. Therefore Rte_DRead cannot be used for data transformation.**

  Primitive Data Type 에 대한 Data Transformation 은 지원하지 않는다. 따라서 Rte_DRead API 는 Data Transformation 에 사용될 수 없다.

- **Verification of data structure between ApplicationPrimitiveDataType with the category COM_AXIS, CURVE and MAP and ImplementationDataType mapped to it in DataTypeMappingSet is not supported.**

  DataTypeMappingSet 내에 카테고리 COM_AXIS, CURVE, MAP 의 Application Primitive Data Type 과 이와 매핑된 ImplementationDataType 간의 데이터 구조 검증은 지원되지 않는다.

- **When initialization of ApplicationPrimitiveDataType with category COM_AXIS, CURVE and MAP by using ApplicationValueSpecification, Verification of data structure between ImplementationDataType mapped to the ApplicationPrimitiveDataType and the ApplicationValueSpecification is performed. If ApplicationValueSpecification is configured with SwValueCont only, the category of the ImplementationDataType shall be ARRAY. If ApplicationValueSpecification is configured with SwValueCont and SwAxisCont, the category of the ImplementationDataType shall be STRUCTURE and the STRUCTURE shall contain an ARRAY per an axis or a value each.**

ApplicationValueSpecification 을 이용한 카테고리 COM_AXIS, CURVE, MAP 의 Application Primitive Data Type 의 초기화시, ApplicationPrimitiveDataType 과 매핑된 ImplementationDataType 과 ApplicationValueSpecification 와의 데이터 구조 검증이 수행된다. ApplicationValueSpeficiation 이 SwValueCont 만 설정되어 있는 경우, ImplementationDataType 의 카테고리는 ARRAY 이어야한다. ApplicationValueSpecification 이 SwValueCont 및 SwAxisCont 가 설정되어 있는 경우, ImplementationDataType 의 카테고리는 STRUCTURE 이어야 하며, STRUCTURE 는 각 axis 또는 value 설정마다 1 개의 ARRAY 를 포함해야 한다.

- **When Synchronize Activate Offset is false, Expected Activation Offset is 0 and Alarm Set Methods is Relative is true, the second parameter of SetRelAlarm API is 1 instead of 0 . SetRelAlarm returns an error when the second parameter is 0.**

  Synchronized Activate Offset 이 false 이고 Expected Activation Offset 이 0 이고, Alarm Set Methods is Relative 가 true 인 경우 SetRelAlarm API 의 2 번째 파라미터는 0 대신 1 이 된다. 두번째 파라미터가 0 인 경우 SetRelAlarm 은 에러를 반환한다.

- **REPLACE-BY-TIMEOUT-SUBSTITUTION-VALUE of HandleTimeoutType is AUTOSAR 4.3.X feature applied. ComRxDataTimeoutAction setting of Com module and HandleTimeoutType setting of NonQueuedReceiverComSpec should be the same. TimeoutSubstitutionValue of Com module and TimeoutSubstitutionValue of NonQueuedReceiverComSpec shall match. TimeoutSubstitutionValue passed to Application is provided by Rte.**

  HandleTimeoutType 의 REPLACE-BY-TIMEOUT-SUBSTITUTION-VALUE 기능은 AUTOSAR 4.3.X 스펙을 선 적용하였다. Com 모듈의 ComRxDataTimeoutAction 설정과 NonQueuedReceiverComSpec 의 HandleTimeoutType 설정과 동일해야며 Com 모듈의 TimeoutSubstitutionValue 값과 NonQueuedReceiverComSpec 의 TimeoutSubstitutionValue 값이 일치하여야 한다. Application 에 전달되는 TimeoutSubstitutionValue 값은 Rte 가 제공한다.

5. Configuration Guide

본 Chapter 에서 설명되는 Rte 에 대한 설정 파라미터의 경우, 특별한 코멘트가 없는 경우를 제외하고, AUTOSAR 표준에서 제시하는 파라미터이다.

5.1 RteGeneration

Rte 코드 생성에 관련된 일반적인 내용을 설정한다.

Parameter Name	Value	Category
RteCalibrationSupport[1)]		C
RteDevErrorDetect[2)]	false	F
RteDevErrorDetectUnInit[3)]	false	F
RteVfbTraceClientPrefix[4)]		N
RteVfbTraceEnabled[5)]		C
RteVfbTraceFunction[6)]		C
RteTaskComMapping[7)]		C
RteGenerationMode	COMPATIBILITY_MODE	F
RteIocInteractionReturnValue	RTE_IOC	F
RteMeasurementSupport	false	F
RteOptimizationMode	RUNTIME	F
RteValueRangeCheckEnabled[8)]		C
RteCodeVendorId	-	N
RteToolChainSignificantCharacters	-	N
RteEndToEndProtectionWrapperMode[9)]	-	N

1) **RteCalibrationSupport**
Calibration Method 를 설정한다(None/InitializedRam/SinglePointered/OverlayRam).

2) **RteDevErrorDetect**
Rte 모듈에 대해 DET 기능을 ON/OFF 한다.

3) **RteDevErrorDetectUnInit**
DET 기능을 사용할 때 Rte 의 Init check 기능을 ON/OFF 한다.

4) **RteVfbTraceClientPrefix**
Rte API 에서 추가적인 VfbTraceFunction 을 사용하기 위한 prefix 를 입력한다.

5) **RteVfbTraceEnabled**
Rte 모듈에 대해 Vfb Trace 기능을 ON/OFF 한다.

6) **RteVfbTraceFunction**
VfbTrace Function 을 입력한다.

- RTE API Trace Events : Rte_<API>Hook_<cts>_<ap>_Start (or Return)
- COM: refer to AUTOSAR RTE SWS chapter 5.11.4
- OS Trace Events:
  . Rte_Task_<OsService>_TaskType_<OsTask Name> : OsTask 만을 인자로 하는 Service 인 경우
  . Rte_Task_<OsService>_TaskType_<OsTask Name>_EventMaskType_<OsEvent Name> :

OsTask 만을 인자로 하는 Service 인 경우
. Rte_Task_<OsService 종류>_All : RTE 에서 사용하는 모든 OsTask, OsEvent 에 대하여 Hook 함수를 제공
- Runnable Entity Trace Events : Rte_Runnable_[<client>_]<cts>_<reName>_Start (or Return)
※ Spec 에서 가이드 하는 방식으로는 구현 불가하여, AUTOEVER 에서 자체적으로 위와 같은 설정 규약을 정의하였음
※ refer to chapter 4.4.2.8.1

7) **RteTaskComMapping**
Multi Partition 상황에서 Sub Partition 에서 Com Module 이 존재하는 Main Partition 으로 Communication Data 를 전달하기 위한 목적으로 이용할 OsTask 를 설정한다.

8) **RteValueRangeCheckEnabled**
Rte 모듈에 대해 RangeCheck(HandleOutOfRange) 기능을 ON/OFF 한다.

9) **RteEndToEndProtectionWrapperMode**
E2E Protection Wrapper 관련 설정으로 E2E User Manual 을 참조한다. (E2E 미사용 시 설정 불필요)

5.2 RteSwComponentType

Rte 코드 생성을 위해 SwComponentType 에 대한 정보를 설정한다.

Parameter Name	Value	Category
RteComponentTypeRef[1)]		C
RteImplementationRef	-	N

1) **RteComponentTypeRef**
설정이 필요한 SwComponentType 를 선택한다.

5.2.1 RteComponentTypeCalibration

Calibration 기능을 사용할 때 설정한다.

Parameter Name	Value	Category
RteCalibrationSupportEnabled[1)]		C
RteCalibrationSwAddrMethodRef	-	N

1) **RteCalibrationSupportEnabled**
해당 Software Component 가 ParamterComponentType 이거나 Shared/PerInstance Parameter 가 설정되어 Calibration 기능을 사용할 때 True 로 설정한다.

5.3 RteSwComponentInstance

SW-C Prototype 에 대해 코드 생성을 위해 SW-C Prototype 마다 이 컨테이너를 추가 한다.

Parameter Name	Value	Category
RteSoftwareComponentInstanceRef[1)]		C

1) **RteSoftwareComponentInstanceRef**
코드 생성 할 SW-C Prototype 을 선택한다.

5.3.1 RteEventToTaskMapping

SW-C 에서 Runnable 을 실행하기 위해 설정한 Event 에 대해 OsTask 에 매핑하는 것으로 RTE Event 마다 이 컨테이너를 추가한다.

Parameter Name	Value	Category
RteEventRef [1)]		C
RteMappedToTaskRef[2)]		C
RtePositionInTask[3)]		C
RteUsedOsAlarmRef[4)]		C
RteWaitOsEventRef[6)] (Vendor Specific)		C
RteUsedOsEventRef[5)]		N
RteReceiverUsedOsEventRef (Vendor Specific)		N
RteVirtuallyMappedToTaskRef	-	N
RteActivationOsAlarmRef (Vendor Specific)	-	N
RteActivationOffset	-	N
RteImmediateRestart	-	N
RteOsSchedulePoint	-	N
RteUsedOsSchTblExpiryPointRef	-	N
RteWaitOsAlarmRef (Vendor Specific)		N

1) RteEventRef
설정하고자 하는 RTE Event 를 선택한다.

2) RteMappedToTaskRef
RTE Event 가 실행하는 Runnable 이 속할 OsTask 를 선택한다.

3) RtePositionInTask
한 OsTask 에 여러 Runnable 이 속하게 될 경우, 현재 설정하는 Runnable 의 순서를 정한다. (번호를 지정하며, 0 번부터 먼저 실행된다.)
※ Position In Task 는 동일 OsTask 내에서는 중복이 있어서는 안 된다.

4) RteUsedOsAlarmRef
RTE Event 가 Timing Event 인 경우, 2)에서 선택한 Task 를 Activation 할 OsAlarm 을 선택한다. (따라서, OsAlaram 은 OsAlarmAction 이 ActivateTask 로 선택되어야 하며, ActivateTask 에 선택된 OsTask 는 2)에서 선택된 OsTask 와 동일해야 한다.)
※ Timing Event 가 아닌 경우, 설정 하지 않아도 무방하다.

5) RteUsedOsEventRef
RTE Event 가 Timing Event 이고, 2)에서 선택한 Task 가 Extended Task 일 때, OsAlarm 에 의해 Set 되는 OsEvent 를 선택한다.
※ 따라서, 4)에서 선택한 OsAlaram 은 OsAlarmAction 이 SetEvent 로 선택되어야 하며, SetEvent 에 선택된 OsEvent 는 현재 선택한 OsEvent 와 동일해야 한다.
RTE Event 가 Timing Event 외의 Event 이고, 2)에서 선택한 Task 가 Extended Task 일 때, 해당 OsTask 를 Activate 하도록 설정된 (i.e. OS 설정 참조) OsEvent 를 선택한다.
※ mobilgene C Studio 에서는 해당 파라미터가 설정 가능 항목이지만 Extended Task 기반의 RTE Event 구현은 기본적으로 지원하지 않는다. Extended Task 기반의 RTE Event 구현 필요 시 현대오토에버와 상의 후에만 설정 가

능하다. (Refer to Chapter 4.4.2.1)

6) RteWaitOsEventRef
Client-Server 통신에서 Rte_Call 또는 Rte_Result 에서 Server 의 수행완료를 기다리기 위해 사용되는 OsEvent 를 선택한다.

5.3.2 RteExclusiveAreaImplementation

SW-C 의 Runnable 코드 개발 시, Exclusive Area 를 사용할 때, Exclusive Area 마다 이 컨테이너를 추가한다.

Parameter Name	Value	Category
RteExclusiveAreaRef [1)]		C
RteExclusiveAreaImplMechanism [2)]		C
RteExclusiveAreaOsResourceRef[3)]		C

1) RteExclusiveAreaRef
Software Component 에서 설정한 Exclusive Area 의 경로를 선택한다.

2) RteExclusiveAreaImplMechanism
해당 Exclusive Area 의 동작 방식을 결정한다.
A. ALL_INTERRUPT_BLOCKING: OS 의 SuspendAllInterrupts 와 ResumeAllInterrupts API 를 이용하여 구간내의 모든 Interrupts 를 Block 한다.
B. COOPERATIVE_RUNNABLE_PLACEMENT: 미지원 [선택불가]
C. OS_INTERRUPT_BLOCKING: OS 의 SuspendOsInterrupts 와 ResumeOsInterrupts API 를 이용하여 구간내의 Category2 Interrupt 를 Block 한다.
D. OS_RESOURCE: OS 의 GetResource 와 ReleaseResource API 를 이용하여 구간내의 Critical Section 에 진입한다.
※ SuspendAllInterrupts, ResumeAllInterrupts, SuspendOsInterrupts, ResumeOsInterrupts, ReleaseResource API 에 대한 자세한 내용은 OS 매뉴얼을 참조한다
※ RH850 용 RenesasOS 의 경우, Internal Resource 와 Standard Resource 를 동시에 설정하는 것을 지원하지 않는다. 따라서, Internal Resource 를 사용하고 있는 Task 내에서 OS_RESOURCE 방식의 Exclusive Area 를 사용할 수 없다. 자세한 내용은 RenesasOS 매뉴얼을 참조한다.(Refer to Chapter 4.4.2.6.6)

3) RteExclusiveAreaOsResourceRef
2)의 RteExclusiveAreaImplMechanism 를 OS_RESOURCE 로 설정하였을 때, Exclusive Area 에서 사용할 OsResource 를 선택한다.

5.3.3 RteExternalTriggerConfig

SW-C 간의 External Trigger Communication 을 사용할 때, Queued 방식이라면 Trigger Source SW-C 관련 RteSwComponentIntance 에 이 컨테이너를 추가한다.

Parameter Name	Value	Category
RteSwcTriggerSourceRef[1)]		C
RteTriggerSourceQueueLength[2)]		C

1) RteSwcTriggerSourceRef
Queued 방식으로 사용될 Trigger Instance 를 선택한다.

2) RteTriggerSourceQueueLength
1)의 Trigger Instance 의 Length 값을 입력한다.
※ Queue 기능을 사용하고자 하는 경우, Sink Entity 가 Mapping 될 OsTask 의 Queue 값을 설정해줘야 한다. (해당 설정에 대한 설명은 OS 매뉴얼 참조)
※ Bolero MCU 를 사용하는 플랫폼의 경우, OsTask 의 Multiple Activation 을 지원하지 않기 때문에 (Direct Function Call 이 아닌) Task Activation 방식의 Queue 기능을 사용 시 Maximum QueueLength = 1 이다.

5.3.4 RteInternalTriggerConfig

SW-C 내의 Runnable 간 Internal Trigger Communication 을 사용할 때, Queued 방식이라면 TriggerInstance 가 설정된 SW-C 관련 RteSwComponentIntance 에 이 컨테이너를 추가한다.

Parameter Name	Value	Category
RteSwcTriggerSourceRef[1)]		C
RteTriggerSourceQueueLength[2)]		C

1) RteSwcTriggerSourceRef
Queued 방식으로 사용될 Trigger Instance 를 선택한다.

2) RteTriggerSourceQueueLength
1)의 Trigger Instance 의 Length 값을 입력한다.
※ Queue 기능을 사용하고자 하는 경우, Sink Entity 가 Mapping 될 OsTask 의 Queue 값을 설정해줘야 한다. (해당 설정에 대한 설명은 OS 매뉴얼 참조)
※ Bolero MCU 를 사용하는 플랫폼의 경우, OsTask 의 Multiple Activation 을 지원하지 않기 때문에 (Direct Function Call 이 아닌) Task Activation 방식의 Queue 기능을 사용 시 Maximum QueueLength = 1 이다.

5.3.5 RteNvRamAllocation

Refer to Chapter 4.5 Deviations

Parameter Name	Value	Category
RteNvmRamBlockLocationSymbol	-	N
RteNvmRomBlockLocationSymbol	-	N
RteSwNvRamMappingRef	-	N
RteNvmBlockRef	-	N

5.4 RteBswModuleInstance

BSW 모듈 개발 시 BSW 모듈 마다 이 컨테이너를 추가한다.
※ AUTOSAR BSW 모듈의 Behavior 에 대한 설정 정보가 포함되어 있는 Container 임
※ SWP SRS 정보 및 기본적으로 각 BSW 모듈에 필요한 항목 정보에 대하여 현대오토에버에서 플랫폼 배포 시점에 확정하여 배포하는 내용으로, Application 설계 및 설정 시 변경이 불가 함
※ 단, Application 에서 직접 CDD Layer 의 모듈 개발 시, 현대오토에버와 상의 하에 설정 추가는 가능

Parameter Name	Value	Category
RteBswImplementationRef[1)]		C
RteBswModuleConfigurationRef[2)]		C

1) RteBswImplementationRef
Bsw 모듈에 대한 Implementation 설정 경로를 지정한다.

2) RteBswModuleConfigurationRef
Bsw 모듈에 대한 Configuration 설정 경로를 지정한다.

5.4.1 RteBswEventToTaskMapping

BSW Module Description 에서 Entity 을 실행하기 위해 설정한 Event 에 대해 OsTask 에 매핑하는 것으로 BSW Event 마다 이 컨테이너를 추가한다.

Parameter Name	Value	Category
RteBswEventRef [1)]		C
RteBswMappedToTask Ref [2)]		C
RteBswPositionInTask [3)]		C
RteBswUsedOsAlarmRef[4)]		C
RteBswUsedOsEventRef[5)]		N
RteBswActivationOffset		N
RteBswImmediateRestart	-	N
RteOsSchedulePoint	-	N
RteBswUsedOsSchTblExpiryPointRef	-	N
RteBswActivationOsAlarmRef	-	N
RteBswTimeOutOsAlarmRef	-	N

1) RteBswEventRef
Task 를 매핑할 BSW Event 경로를 지정한다.

2) RteBswMappedToTaskRef
해당 BSW Event 가 호출하는 Entity 가 속할 Task 를 지정한다.

3) RteBswPositionInTask
Task 가 실행될 때 호출하는 Entity 의 순서를 정하기 위해 설정한다.
매핑된 Task 내에서 해당 BSW Event 가 호출하는 Entity 의 순서를 입력한다. (0 부터 실행한다.)
※ Position In Task 는 동일 OsTask 내에서는 중복이 있어서는 안 된다.

4) RteBswUsedOsAlarmRef
BSW Event 가 Timing Event 일 경우, Task 를 실행할 Alarm 을 지정한다.
※ Timing Event 가 아닌 경우, 설정 하지 않아도 무방하다.

5) RteBswUsedOsEventRef
RTE Event 에 매핑된 Task 가 Extended Task 일 경우, Task 를 실행할 Event 를 지정한다.
※ mobilgene C Studio 에서는 해당 파라미터가 설정 가능 항목이지만 Extended Task 기반의 RTE Event 구현은 기본적으로 지원하지 않는다. Extended Task 기반의 RTE Event 구현 필요 시 현대오토에버와 상의 후에만 설정 가능하다. (Refer to Chapter 4.4.2.1)

5.4.2 RteBswExclusiveAreaImpl

BSW 의 Entity 코드 개발 시, Exclusive Area 를 사용할 때, Exclusive Area 마다 이 컨테이너를 추가한다.

Parameter Name	Value	Category
RteBswExclusiveAreaRef[1)]		C
RteExclusiveAreaImplMechanism[2)]		C

Parameter Name	Value	Category
RteBswExclusiveAreaOsResourceRef[3)]		C
SchMEnableMacroName	-	N
SchMDisableMacroName	-	N

1) **RteBswExclusiveAreaRef**
BSW Module Description 에서 설정한 Exclusive Area 의 경로를 선택한다.

2) **RteExclusiveAreaImplMechanism**
해당 Exclusive Area 의 동작 방식을 결정한다.
A. ALL_INTERRUPT_BLOCKING: OS 의 SuspendAllInterrupts 와 ResumeAllInterrupts API 를 이용하여 구간내의 모든 Interrupts 를 Block 한다.
B. COOPERATIVE_RUNNABLE_PLACEMENT: 미지원 [선택불가]
C. OS_INTERRUPT_BLOCKING: OS 의 SuspendOsInterrupts 와 ResumeOsInterrupts API 를 이용하여 구간내의 Category2 Interrupt 를 Block 한다.
D. OS_RESOURCE: OS 의 GetResource 와 ReleaseResource API 를 이용하여 구간내의 Critical Section 에 진입한다.
※ SuspendAllInterrupts, ResumeAllInterrupts, SuspendOsInterrupts, ResumeOsInterrupts, ReleaseResource API 에 대한 자세한 내용은 OS 매뉴얼을 참조한다
※ USER_DEFINED_MACRO 는 지원하지 않는다
※ RH850 용 RenesasOS 의 경우, Internal Resource 와 Standard Resource 를 동시에 설정하는 것을 지원하지 않는다. 따라서, Internal Resource 를 사용하고 있는 Task 내에서 OS_RESOURCE 방식의 Exclusive Area 를 사용할 수 없다. 자세한 내용은 RenesasOS 매뉴얼을 참조한다.(Refer to Chapter 4.4.2.6.6)

3) **RteBswExclusiveAreaOsResourceRef**
2)의 RteExclusiveAreaImplMechanism 를 OS_RESOURCE 로 설정하였을 때, Exclusive Area 에서 사용할 OsResource 를 선택한다.

5.4.3 RteBswRequiredModeGroupConnection

BSW Module Description level 의 Mode Switch 통신을 사용할 때, 해당 Container 를 추가한다.,

Parameter Name	Value	Category
RteBswProvidedModeGroupRef[1)]		C
RteBswRequiredModeGroupRef[2)]		C
RteBswProvidedModeGrpModInstRef[3)]		C

1) **RteBswProvidedModeGroupRef**
providedModeGroupPrototype 을 참조하며, 이는 BSW 간 Mode Switch 통신에서, Manager 역할을 하는 Bsw Module Entity 에 연결되어 있다.
※ Application SWC 간 Mode Switch 통신에서, PPort 역할

2) **RteBswRequiredModeGroupRef**
requiredModeGroupPrototype 을 참조하며, 이는 BSW 간 Mode Switch 통신에서, user 역할을 하는 Bsw Module Entity 에 연결되어 있다.
※ Application SWC 간 Mode Switch 통신에서, RPort 역할

3) **RteBswProvidedModeGrpModInstRef**
위 1), 2) 설정에 의해서 연결된 Mode Switch 에서 사용될 ModeGroupPrototype Instance 를 선택한다

5.4.4 RteBswRequiredTriggerConnection

BSW Module Description level 의 Trigger Communication 을 사용할 때, Release Trigger BSW Module Description 관련 RteBswComponentIntance 에 이 컨테이너를 추가한다.

Parameter Name	Value	Category
RteBswReleasedTriggerRef[1)]		C
RteBswRequiredTriggerRef[2)]		C
RteBswReleasedTriggerModInstRef[3)]		C

1) RteBswReleasedTriggerRef
Released Trigger Instance 를 선택한다.

2) RteBswRequiredTriggerRef
Required Trigger Instance를 선택한다.

3) RteBswReleasedTriggerModInstRef

Released Trigger 를 가지는 BSW Module Description 이 참조된 RteBswComponentIntance 를 선택한다.

5.4.5 RteBswExternalTriggerConfig

BSW Module Description 간 External Trigger Communication 을 사용할 때, Queued 방식이라면 Release Trigger BSW Module Description 관련 RteBswComponentIntance 에 이 컨테이너를 추가한다.

Parameter Name	Value	Category
RteBswTriggerSourceRef [1)]		C
RteBswTriggerSourceQueueLength [2)]		C

1) RteBswTriggerSourceRef
Queued 방식으로 사용될 Release Trigger Instance 를 선택한다.
2) RteBswTriggerSourceQueueLength
1)의 Release Trigger Instance 의 Length 값을 입력한다.
※ Queue 기능을 사용하고자 하는 경우, Sink Runnable 이 Mapping 될 OsTask 의 Queue 값을 설정해줘야 한다. (해당 설정에 대한 설명은 OS 매뉴얼 참조)
※ Bolero MCU 를 사용하는 플랫폼의 경우, OsTask 의 Multiple Activation 을 지원하지 않기 때문에 (Direct Function Call 이 아닌) Task Activation 방식의 Queue 기능을 사용 시 Maximum QueueLength = 1 이다.

5.4.6 RteBswInternalTriggerConfig

BSW Module Description 내 Entity 간 Internal Trigger Communication 을 사용할 때, Queued 방식이라면 Trigger 가 설정되어 있는 BSW Module Description 관련 RteBswComponentIntance 에 이 컨테이너를 추가한다.

Parameter Name	Value	Category
RteBswTriggerSourceRef [1)]		C

Parameter Name	Value	Category
RteBswTriggerSourceQueueLength 2)		C

1) RteBswTriggerSourceRef
   Queued 방식으로 사용될 Release Trigger Instance 를 선택한다.
2) RteBswTriggerSourceQueueLength
   1)의 Release Trigger Instance 의 Length 값을 입력한다.
   ※ Queue 기능을 사용하고자 하는 경우, Sink Runnable 이 Mapping 될 OsTask 의 Queue 값을 설정해줘야 한다. (해당 설정에 대한 설명은 OS 매뉴얼 참조)
   ※ Bolero MCU 를 사용하는 플랫폼의 경우, OsTask 의 Multiple Activation 을 지원하지 않기 때문에 (Direct Function Call 이 아닌) Task Activation 방식의 Queue 기능을 사용 시 Maximum QueueLength = 1 이다.

5.5 RteOsInteraction

RteOsInteraction 설정을 통하여, 특정 OsAlarm 의 Start 방식 및 Offset 인가가 가능하다. AUTOEVER RTE 에서는 특정 OsAlarm 을 Start 시키기 위해서, Absolute (RTE 표준 제공 기능) / Relative (Vendor Specific 제공 기능) 방식을 구분하여 사용할 수 있는데, 해당 설정은 AlarmSetMethodIsRelative (Vendor Specific Parameter) 에 따라 구분된다.
※ 일반적으로, AUTOSAR RTE 표준에서는 RteOsInteraction 설정을 통한, OsAlarm Start 에 대한 동작 정의 시, Absolute 방식을 사용하도록 가이드 하고 있다. Absolute 방식의 경우는 해당 Offset 을 현재 OsAlarm 이 Start 되는 시점에서의 OsCounter 값과 관계 없이, Offset 에 대한 추가 처리 없이 값을 인가한 후, OsCounter 가 해당 Offset 값에 도달하게 되면, 연동되는 OsAlarm 이 Start 되는 방식이다. 이에 반해, 오토에버에서 추가적으로 제공하는 Relative 방식의 경우 현재 OsCounter 값에 Offset 값을 더한 후, (즉, 현재 시점에서 설정된 Offset 값 이후) 해당 OsAlarm 이 Start 되는 방식이며, 이를 구별하여 설정 가능하도록 추가 파라미터를 제공한다.
※ RteOsInteraction 설정을 통해, 특별히 Alarm Start 방식을 지정하지 않은 OsAlarm 의 경우는, RTE 에 의해서 Offset 값은 1 이고 Relative 방식으로 동작 된다.
또한, 특정 OsCounter 기반의 OsAlarm 을 이용하여, 동작하는 Timing Event 의 Offset 의 동기화가 필요한 경우, 아래의 설정을 이용한다 (Vendor Specific 기능).
※ 아래의 설정을 통하여, BSW 모듈에서 사용하는 Timing Event 에 대한 OsTask 와 Application SWC 에서 사용하는 Timing Event 가 mapping 된 OsTask 의 Activate 시점에 대한 Offset 이 동기화 될 수 있다.
기본적으로, BSW 모듈에서 사용되는 Timing Event 는 SchM_Init (Rte_Start 수행 이전 시점) 에서 Alarm 설정을 통해 동작 되며, Application SWC(이하 SWC) 에서 설정된 Timing Event 는 Rte_Start 내에서 동일한 방식으로 동작이 수행된다. 이때 BSW 와 SWC 에서 설정된 Timing Event 에 대한 Offset 정보는 상호간 동기화 되지 않기 때문에, 동기화 된 Offset 기반으로 효율적인 주기 Timing Event 수행 리소스 분배를 원하는 경우, 사용이 권장된다. 또한 각 Timing Event 에 대한 OsAlarm 수행 순서를 오토에버에서 제공하는 파라미터 (i.e. RteExpectedActivationPosition)를 통하여 결정 할 수 있다. (단, BSW 와 SWC Timing Event 간에 대한 동기화는 동일한 OsCounter 사용 시에 만 가능하다.)

※ 해당 기능을 사용하기 전에 반드시 8.6 Synchronized Offset (in Chapter 8. Appendix) 내용을 숙지하고 사용하도록 한다.

Parameter Name	Value	Category
RteSynchronizedActivateOffset 1) (Vendor Specific)		C
RteSynchronizedOsCounterRef 3) (Vendor Specific)		C

1) RteSynchronizedActivateOffset
   특정 OsCounter 에 연동하는 OsAlarm 의 Start 시점에서의 Offset 의 동기화 기능 사용 여부

2) RteSynchronizedOsCounterRef
   Offset 동기화가 수행될 Base OsCounter

5.5.1 RteUsedOsActivation

5.3.1 또는 5.4.1 에서 Timing Event 에 매핑된 OsTask 를 특정 시간에 실행 시키기 위한 Offset 을 지정한다. Offset 지정을 원하는 OsTask 마다 이 컨테이너를 추가한다.

Parameter Name	Value	Category
RteActivationOsAlarmRef[1)]		C
RteActivationOsTaskRef[2)]		C
RteExpectedActivationOffset[3)]		C
RteExpectedActivationPosition[4)] (Vendor Specific)		C
AlarmSetMethodIsRelative[5)] (Vendor Specific)		C
RteExpectedTickDuration		N
RteActivationOsSchTblRef	-	N

1) RteActivationOsAlarmRef
Timing Event 에 대해 매핑된 OsAlarm 을 지정한다.

2) RteActivationOsTaskRef
Timing Event 에 대해 매핑된 OsTask 을 지정한다.

3) RteExpectedActivationOffset
원하는 Offset 을 초 단위로 입력한다.

4) RteExpectedActivationPosition
SchM_Init 또는 Rte_Start 에서 호출되는 OsAlarm 의 순서를 정의한다.
※ RteSynchronizedActivateOffset 설정이 True 인 경우에 값이 지정되야 한다.

5) AlarmSetMethodIsRelative
OsAlarm 의 Start 방식을 Relative Type 으로 설정한다. (설정이 없거나, False 인 경우는 Absolute Type 으로 해당 OsAlarm 을 Start 한다
※ RteSynchronizedActivateOffset 설정이 True 인 경우 항상 Relative Type 으로 동작한다.

	RteSynchronizedActivateOffset == False	RteSynchronizedActivateOffset == True
AlarmSetMethodIsRelative == False	Absolute Type	Relative Type
AlarmSetMethodIsRelative == True	Relative Type	Relative Type

5.5.2 RteModeToScheduleTableMapping

Parameter Name	Value	Category
RteModeSchtblMapModeDeclarationRef	-	N
RteModeScheduleTableRef	-	N

5.5.2.1 RteModeSchtblMapBsw

Parameter Name	Value	Category
RteModeSchtblMapBswProvidedModeGroupRef	-	N

Parameter Name	Value	Category
RteModeSchtblMapBswInstanceRef	-	N

5.5.2.2 RteModeSchtblMapSwc

Parameter Name	Value	Category
RteModeSchtblMapSwcPortRef	-	N
RteModeSchtblMapSwcInstanceRef	-	N

5.6 RteBswGeneral

Parameter Name	Value	Category
RteSchMVersionInfoApi	false	F
RteUseComShadowSignalApi	true	F
SchMUserDefinedfileName	-	N

5.7 CommonPublishedInformation

Parameter Name	Value	Category
ArReleaseVersion	4.0.3	F
ModuleId	2	F
SwVersion	4.11.1	F
VendorApiInfix	-	N
VendorId	-	N

5.8 RteImplicitCommunication

Parameter Name	Value	Category
RteCoherentAccess	-	N
RteImmediateBufferUpdate	-	N
RteVariableReadAccessRef	-	N
RteVariableWriteAccessRef	-	N
RteSoftwareComponentInstanceRef	-	N

5.9 RtePostBuildVariantConfiguration

Parameter Name	Value	Category
RtePostBuildUsedPredefinedVariant	-	N

5.10 RteInitializationBehavior

Parameter Name	Value	Category
RteSectionInitializationPolicy	INIT	N
RteInitializationStrategy	-	N

6. Application Programming Interface (API)

6.1 Type Definitions

6.1.1 Predefined Error Codes

The following list shows all Predefined error codes that are part of Rte.h and used by the RTE Module

- Std_ReturnType

Type:	uint8		
Range	RTE_E_OK	0	No error occurred.
	RTE_E_INVALID	1	Generic application error indicated by signal invalidation in sender receiver communication with isQueued = false on the receiver side.
	RTE_E_COM_STOPPED	128	An IPDU group was disabled while the application was waiting for the transmission acknowledgment. No value is available. This is not considered a fault, since the IPDU group is switched off on purpose. The semantics are as follows: • The OUT buffers of a client or of explicit read APIs are not modified • No runnable with StartOnEvent on a DataReceivedEvent for this DataElement-Prototype is triggered. • The buffers for implicit read access will keep the previous value.
	RTE_E_TIMEOUT	129	A blocking API call returned due to expiry of a local timeout rather than the intended result. OUT buffers are not modified. The interpretation of this being an error depends on the application.
	RTE_E_LIMIT	130	An internal RTE limit has been exceeded. Request could not be handled. OUT buffers are not modified.
	RTE_E_NO_DATA	131	An explicit read API call returned no data. (This is no error.)
	RTE_E_TRANSMIT_ACK	132	Transmission acknowledgement received.
	RTE_E_LOST_DATA	64	An API call for reading received data of isQueued = true indicates that some incoming data has been lost due to an overflow of the receive queue or due to an error of the underlying communication stack.
	RTE_E_MAX_AGE_EXCEEDED	64	An API call for reading received data of isQueued = false indicates that the available data has exceeded the aliveTimeout limit. A COM signal outdated callback will result in this error.
	RTE_E_IN_EXCLUSIVE_AREA	135	The error is returned by a blocking API and indicates that the runnable could not enter a wait state, because one Executable Entity of the current task's call stack has entered or is running in an ExclusiveArea.
	RTE_E_SEG_FAULT	136	The error can be returned by an RTE API, if the parameters contain a direct or indirect reference to memory that is not accessible from the caller's partition.

	RTE_E_NEVER_RECEIVED	133	No data received for the corresponding unqueued data element since system start or partition restart
	RTE_E_UNCONNECTED	134	The port used for communication is not connected.
	RTE_E_OUT_OF_RANGE	137	This can be returned by Rte_Read API, if the received value is out of bounds.
	RTE_E_HARD_TRANSFORMER_ERROR	138	An error during transformation occurred.
	RTE_E_SOFT_TRANSFORMER_ERROR	140	An error during transformation occurred which shall be notified to the SWC but still produces valid data as output (comparable to a warning).
	SCHM_E_OK	0	No error occurred.
	SCHM_E_LIMIT	130	An internal Basic Software Scheduler limit has been exceeded. Request could not be handled. OUT buffers are not modified.
	SCHM_E_NO_DATA	131	An explicit read API call returned no data. (This is no error.)
	SCHM_E_TRANSMIT_ACK	132	Transmission acknowledgement received.
	SCHM_E_IN_EXCLUSIVE_AREA	135	The error is returned by a blocking API and indicates that the schedulable entity could not enter a wait state, because one ExecutableEntity of the current task's call stack has entered or is running in an ExclusiveArea.
	SCHM_E_TIMEOUT	129	The configured timeout exceeds before the intended result was ready.

6.2 Macro Constants

None

6.3 Functions

이 Chapter 내, 각 함수에 대한 Parameter 에서, <Instance>의 경우 Multiple Instance 기반의 시스템 설계가 필요한 경우에 사용되는 Parameter 이다. 현 RTE Product 에서는 이에 대한 기능 (Support Multiple Instance) 을 지원하지 않고 있으므로, 각 함수 사용 시, 해당 Parameter 는 사용되지 않는다.

※ refer to 4.4.2.1

6.3.1 RTE APIs

※ RTE API 중 Return Value 로 Std_ReturnType 를 갖는 API 를 사용 시에는 반드시 Return Value 를 확인하는 로직을 추가해야 한다. Return Value 가 RTE_E_OK 가 아닌 경우 RTE API 요청이 처리 안될 수 있으며, 자세한 사항은 다음의 각 API 별 설명 및 AUTOSAR 문서를 참고한다.

6.3.1.1 Rte_Start

Function Name	Rte_Start
Syntax:	Std_ReturnType Rte_Start (void)

Service ID	0x70	
Sync/Async	NA	
Reentrancy	NA	
Parameters (In)	None	
Parameters (Inout)	None	
Parameters (Out)	None	
Return Value	Std_ReturnType	**RTE_E_OK :** API 호출이 정상적으로 완료되었다. **RTE_E_LIMIT :** 1. 리소스에 대한 사용량 Limit 를 초과하였다. 2. 리소스 할당에 실패했다.
Description	Rte_Start allocates and initializes system resources and communication resources used by the RTE. It is called only once by the ECU state Manager. This service is not invoked from AUTOSAR software components.	
Preconditions	AUTOSAR Com, OS and Memory Services should be initialized.	
Configuration Dependency	The RTE Start API is always created.	

6.3.1.2 Rte_Stop

Function Name	Rte_Stop	
Syntax:	Std_ReturnType Rte_Stop (void)	
Service ID	0x71	
Sync/Async	NA	
Reentrancy	NA	
Parameters (In)	None	
Parameters (Inout)	None	
Parameters (Out)	None	
Return Value	Std_ReturnType	**RTE_E_OK :** API 호출이 정상적으로 완료되었다. **RTE_E_LIMIT :** 리소스 해제에 실패했다.

Description	RTE Stop is used to finalize the RTE itself. This service releases all system and communication resources allocated by the Rte. It is called by the ECU state Manager before the basic software modules required by RTE are shut down.
Preconditions	AUTOSAR Com, OS and Memory Services should be finalized.
Configuration Dependency	The RTE Stop API is always created.

6.3.1.3 Rte_Read

Function Name	Rte_Read	
Syntax:	Std_ReturnType Rte_Read_<p>_<o>([IN Rte_Instance <instance>], OUT <data>, [OUT Rte_TransformerError transformerError]) Where <p> is the port name and <o> the VariableDataPrototype within the sender-receiver interface categorizing the port.	
Service ID	0x19	
Sync/Async	NA	
Reentrancy	NA	
Parameters (In)	<instance>	SW-C instance
Parameters (Inout)	None	
Parameters (Out)	<data>	data element to read
Return Value	Std_ReturnType	**RTE_E_OK :** API 호출이 정상적으로 완료되었다. **RTE_E_INVALID :** DataElement 로 Invalid 한 값이 도착했다. **RTE_E_MAX_AGE_EXCEEDED :** DataElement 가 Timeout 으로 인하여 Expired 되었다. (Overlayed Error 로 다른 Error Code 와 같이 올 수 있다) **RTE_E_NEVER_RECEIVED :** 시스템 시작 또는 파티션 재시작 시점으로부터 DataElement 를 받은 적이 없다. **RTE_E_UNCONNECTED :** Receiver Port 가 Sender Port 와 연결되어 있지 않다. **RTE_E_HARD_TRANSFORMER_ERROR:** 트랜스포머 체인에서 트랜스포머의 리턴값이 hard transformer error 이다. **RTE_E_SOFT_TRANSFORMER_ERROR:**

		트랜스포머 체인에서 최소 하나의 트랜스포머의 리턴값이 soft error 이고 hard error 가 아니다.
Description	Performs an "explicit" read on a sender-receiver communication data element with "data" semantics (swImplPolicy! = queued). The Rte_Read API is used for explicit read by argument.	
Preconditions	Rte_Start API needs to be called before Rte_Read is called.	
Configuration Dependency	If a VariableAccess in the dataReceivePointByArgument role references a required VariableDataPrototype with 'data' semantics.	
Optional Parameter Configuration Dependency	The optional OUT parameter transformerError of the API shall be generated if PortPrototype of port <p> is referenced by a PortAPIOption which has the attribute errorHandling set to transformerErrorHandling.	

6.3.1.4 Rte_DRead

Function Name	Rte_DRead	
Syntax:	<return> Rte_DRead_<p>_<o>([IN Rte_Instance <instance>]) Where <p> is the port name and <o> the VariableDataPrototype within the sender-receiver interface categorizing the port.	
Service ID	0x1A	
Sync/Async	NA	
Reentrancy	NA	
Parameters (In)	<instance>	SW-C instance
Parameters (Inout)	None	
Parameters (Out)	None	
Return Value	Implementation data type	NA
Description	Performs an "explicit" read on a sender-receiver communication data element with "data" semantics (swImplPolicy! = queued). By compatibility, the port may also have a ParameterInterface or an Nv- DataInterface. The Rte_DRead API is used for explicit read by value.	
Preconditions	Rte_Start API needs to be called before Rte_DRead is called.	

Configuration Dependency	A non-blocking Rte_DRead API will be generated if a VariableAccess in the dataReceivePointByValue role references a required VariableDataPrototype with 'data' semantics. This requirement is applicable only for primitive data types.

6.3.1.5 Rte_Write

Function Name	Rte_Write	
Syntax:	Std_ReturnType Rte_Write_<p>_<o>([IN Rte_Instance <instance>], IN <data>, [OUT Rte_TransformerError transformerError]) Where <p> is the port name and <o> the VariableDataPrototype within the sender-receiver interface categorizing the port.	
Service ID	0x14	
Sync/Async	NA	
Reentrancy	NA	
Parameters (In)	<instance>	SW-C instance
	<data>	data element to write
Parameters (Inout)	None	
Parameters (Out)	None	
Return Value	Std_ReturnType	**RTE_E_OK :** API 호출이 정상적으로 완료되었다. **RTE_E_COM_STOPPED :** COM Service 의 사용 불가로 인해 Operation 실행이 불가능하다. **RTE_E_HARD_TRANSFORMER_ERROR:** 트랜스포머 체인에서 트랜스포머의 리턴값이 hard transformer error 이다. **RTE_E_SOFT_TRANSFORMER_ERROR:** 트랜스포머 체인에서 최소 하나의 트랜스포머의 리턴값이 soft error 이고 hard error 가 아니다.
Description	Initiate an "explicit" sender-receiver transmission of data elements with "data" semantic (swImplPolicy different from 'queued').	
Preconditions	Rte_Start API needs to be called before Rte_Write is called.	
Configuration Dependency	The presence of a VariableAccess in the dataSendPoint role for a provided VariableDataPrototype with data semantics will result in the generation of an Rte_Write API for the	

	provided VariableDataPrototype.
Optional Parameter Configuration Dependency	The optional OUT parameter transformerError of the API shall be generated if PortPrototype of port <p> is referenced by a PortAPIOption which has the attribute errorHandling set to transformerErrorHandling.

6.3.1.6 Rte_IsUpdated

Function Name	Rte_IsUpdated	
Syntax	boolean Rte_IsUpdated_<p>_<o> ([IN RTE_Instance <instance>]) Where <p> is the port name and <o> the VariableDataPrototype within the sender-receiver interface categorizing the port.	
Service ID	0x30	
Sync/Async	NA	
Reentrancy	NA	
Parameters (In)	<instance>	SW-C instance
Parameters (Inout)	None	
Parameters (Out)	None	
Return Value	boolean	**TRUE :** DataElement 를 마지막으로 읽은 후에 업데이트 되었다. **FALSE :** DataElement 를 마지막으로 읽은 후에 업데이트 되지 않았다.
Description	Indicates if the VariableDataPrototype has been updated or not.	
Preconditions	Rte_Start API needs to be called before Rte_IsUpdated is called.	
Configuration Dependency	The presence of a VariableAccess in the dataReceivePointByArgument or dataReceivePointByValue role referring to the VariableDataPrototype and the enableUpdate attribute is enabled in the NonqueuedReceiverComSpec of the VariableDataPrototype.	

6.3.1.7 Rte_IWrite

Function Name	Rte_IWrite	
Syntax:	void Rte_IWrite_<re>_<p>_<o>([IN RTE_Instance <instance>], IN <data>) Where <re> is the runnable entity name, <p> the port name and <o> the VariableDataPrototype name.	
Service ID	0x22	
Sync/Async	NA	
Reentrancy	NA	
Parameters (In)	<instance>	SW-C instance
	<data>	data to write
Parameters (Inout)	None	
Parameters (Out)	None	
Return Value	None	
Description	Provides write access to the VariableDataPrototypes referenced by VariableAccesses in the dataWriteAccess role.	
Preconditions	Rte_Start API needs to be called before Rte_IWrite is called.	
Configuration Dependency	An Rte_IWrite API will be created for a provided VariableDataPrototype, if the RunnableEntity has a VariableAccess in the dataWriteAccess role referring to this VariableDataPrototype.	

6.3.1.8 Rte_WriteRef

Function Name	Rte_WriteRef
Syntax:	<return reference> Rte_IWriteRef_<re>_<p>_<o>([IN RTE_Instance <instance>]) Where <re> is the runnable entity name, <p> the port name and <o> the VariableDataPrototype name.
Service ID	0x23
Sync/Async	NA
Reentrancy	NA

Parameters (In)	<instance>	SW-C instance
Parameters (Inout)	None	
Parameters (Out)	None	
Return Value	Pointer to implementation data type	NA
Description	Provides a reference to the VariableDataPrototype referenced by a VariableAccess in the dataWriteAccess role.	
Preconditions	Rte_Start API needs to be called before Rte_IWriteRef is called.	
Configuration Dependency	An Rte_IWriteRef API will be created for a provided VariableDataPrototype, if the RunnableEntity has a VariableAccess in the dataWriteAccess role referring to this VariableDataPrototype.	

6.3.1.9 Rte_IRead

Function Name	Rte_IRead	
Syntax:	<return> Rte_IRead_<re>_<p>_<o>([IN Rte_Instance <instance>]) Where <re> is the runnable entity name, <p> the port name and <o> the VariableDataPrototype name.	
Service ID	0x21	
Sync/Async	NA	
Reentrancy	NA	
Parameters (In)	<instance>	SW-C instance
Parameters (Inout)	None	
Parameters (Out)	None	
Return Value	Implementation data type	NA
Description	Provides read access to the VariableDataPrototype referenced by VariableAccess in the dataReadAccess role.	

Preconditions	Rte_Start API needs to be called before Rte_IRead is called.
Configuration Dependency	An Rte_IRead API will be created for a required VariableDataPrototype, if the RunnableEntity has a VariableAccess in the dataReadAccess role referring to this VariableDataPrototype.

6.3.1.10 Rte_IStatus

Function Name	Rte_IStatus	
Syntax:	Std_ReturnType Rte_IStatus_<re>_<p>_<o>([IN Rte_Instance <instance>], [OUT Rte_TransformerError transformerError]) Where <re> is the runnable entity name, <p> the port name and <o> the VariableDataPrototype name.	
Service ID	0x25	
Sync/Async	NA	
Reentrancy	NA	
Parameters (In)	<instance>	SW-C instance
Parameters (Inout)	None	
Parameters (Out)	None	
Return Value	Std_ReturnType	**RTE_E_OK :** API 호출이 정상적으로 완료되었다. **RTE_E_INVALID :** DataElement 로 Invalid 한 값이 도착했다. **RTE_E_MAX_AGE_EXCEEDED :** DataElement 가 Timeout 으로 인하여 Expired 되었다.(Overlayed Error 로 다른 Error Code 와 같이 올 수 있다) **RTE_E_NEVER_RECEIVED :** 시스템 시작 또는 파티션 재시작 시점으로부터 DataElement 를 받은 적이 없다. **RTE_E_UNCONNECTED :** Receiver Port 가 Sender Port 와 연결되어 있지 않다. **RTE_E_HARD_TRANSFORMER_ERROR:** 트랜스포머 체인에서 트랜스포머의 리턴값이 hard transformer error 이다. **RTE_E_SOFT_TRANSFORMER_ERROR:** 트랜스포머 체인에서 최소 하나의 트랜스포머의 리턴값이 soft error 이고 hard error 가 아니다.

Description	Provides the error status of a VariableDataPrototype referenced by a VariableAccess in the dataReadAccess role.
Preconditions	Rte_Start API needs to be called before Rte_IStatus is called.
Configuration Dependency	An Rte_IStatus API will be created for a required VariableDataPrototype, if a RunnableEntity has a VariableAccess in the dataReadAccess role referring to this VariableDataPrototype, and if at the RPortPrototype a NonqueuedReceiverComSpec with either1. the attribute AliveTimeout set to a value greater than zero and/or 2. the attribute handleNeverReceived set to TRUE and/or 3. if at the SenderReceiverInterface classifying the RPort- Prototype an InvalidationPolicy set to keep is specified for this VariableDataPrototype.
Optional Parameter Configuration Dependency	The optional OUT parameter transformerError of the API shall be generated if PortPrototype of port <p> is referenced by a PortAPIOption which has the attribute errorHandling set to transformerErrorHandling.

6.3.1.11 Rte_Mode

Function Name	Rte_Mode	
Syntax:	<return> Rte_Mode_<p>_<o>([IN Rte_Instance <instance>]) Where <m> is the ModeDeclarationGroup name, <p> is the port name, and <o> the ModeDeclarationGroupPrototype name within the ModeSwitchInterface categorizing the port.	
Service ID	0x2C	
Sync/Async	NA	
Reentrancy	NA	
Parameters (In)	<instance>	SW-C instance
Parameters (Inout)	None	
Parameters (Out)	None	
Return Value	Rte_ModeType_<m>	NA

Description	Provides the currently active mode of a mode switch port. ※ Design Decision : If the mode user partition is in stopped or restarting, Rte_Mode (in Mode Manager) shall return RTE_TRANSITION_<ModeDeclarationGroup> (in rte_sws_2731) / If the mode manager partition is in stopped or restarting, Rte_Mode (in Mode User) shall return the mode status which has been updated just before entering in stopped or restarting from Mode manager. (AUTOEVER design decision)
Preconditions	Rte_Start API needs to be called before Rte_Mode is called.
Configuration Dependency	The existence of a ModeAccessPoint will result in the generation of an Rte_Mode API.

6.3.1.12 Rte_Switch

Function Name	Rte_Switch	
Syntax:	Std_ReturnType Rte_Switch_<p>_<o>([IN Rte_Instance <instance>], IN Rte_ModeType_<M> <mode>) Where <p> is the port name and <o> the ModeDeclarationGroup-Prototype within the ModeSwitchInterface categorizing the port.	
Service ID	0x15	
Sync/Async	NA	
Reentrancy	NA	
Parameters (In)	<instance>	SW-C instance
	<mode>	Mode to be switched
Parameters (Inout)	None	
Parameters (Out)	None	
Return Value	Std_ReturnType	**RTE_E_OK:** 모드 변경 요청이 성공적으로 전달되었다. **RTE_E_LIMIT:** Queue 가 Full 이어서 모드 변경 요청이 버려졌다
Description	Initiate a mode switch. The Rte_Switch API call is used for 'explicit' sending of a mode switch notification.	
Preconditions	Rte_Start API needs to be called before Rte_Switch is called.	

Configuration Dependency	The existence of a ModeSwitchPoint will result in the generation of Rte_Switch API.

6.3.1.13 Rte_Call

Function Name	Rte_Call	
Syntax:	Std_ReturnType Rte_Call_<p>_<o>([IN Rte_Instance <instance>], [IN|IN/OUT|OUT] <data_1>... [IN|IN/OUT|OUT] <data_n>) <p>: R-Port 이름 <o>: ClientServerInterface 의 Operation 이름	
Service ID	0x1C	
Sync/Async	NA	
Reentrancy	NA	
Parameters (In)	<instance>	SW-C 인스턴스
	<data_1> to <data_n>	서버 요청 시 클라이언트에서 서버로 전달할 데이터 (ClientServerInterfae 의 Operation 에서 Direction 이 IN 으로 정의된 Argument)
Parameters (Inout)	<data_1> to <data_n>	서버 요청 시 클라이언트에서 서버로 전달 및 서버에서 서비스 수행 후 서버에서 클라이언트로 전달을 동시에 수행하는 데이터 (ClientServerInterfae 의 Operation 에서 Direction 이 INOUT 으로 정의된 Argument)
Parameters (Out)	<data_1> to <data_n>	서버 요청 시 서버에서 서비스 수행 후 서버에서 클라이언트로 전달할 데이터 (ClientServerInterfae 의 Operation 에서 Direction 이 OUT 으로 정의된 Argument) (비동기식(Asynchronous) 방식에서는 사용되지 않음.)
Return Value	Std_ReturnType[1)]	**RTE_E_OK:** API 호출이 정상적으로 완료
		RTE_E_LIMIT: 1. 이전의 API 호출이 종료되지 않음 2. N:1 연결일 경우, 서버 큐가 가득 참
		RTE_E_TIMEOUT: 설정된 타임아웃 이내에 서버로 부터의 응답을 받지 못함 (동기식 (Synchronous) 방식에서만 Return)
		RTE_E_UNCONNECTED: 클라이언트 포트가 서버와 연결되어 있지 않음

		RTE_E_SEG_FAULT: 파라미터로 받은 메모리 주소를 API 를 호출한 파티션에서 사용할 수 없음 (파티션 간 통신에서만 Return)
		<Application Error>[2]: 서버에서 서비스 수행 중 발생한 에러 위에서 RTE_E_OK 를 제외한 에러가 발생하지 않고 서버가 수행이 된 경우 서버의 Return 값을 전달 (동기식 (Synchronous) 방식에서만 Return)
Description	클라이언트-서버 통신을 시작하는 클라이언트 함수이다. 동기식 (Synchronous)과 비동기식(Asynchronous) 방식에서 모두 사용되며, 1. 동기식에서는 서버에 서비스 수행을 요청(요청 데이터 전달)하고, 서비스 수행이 완료되기를 기다리다가 서비스 수행이 완료되면, 응답 데이터를 애플리케이션에 전달하며 종료한다. 2. 비동기식에서는 서버에 서비스 수행을 요청(요청 데이터 전달)을 수행한다.	
Preconditions	Rte_Call 호출 전 Rte_Start 의 호출이 완료되어야 한다.	
Configuration Dependency	SynchronousServerCallPoint/AsynchrnousServerCallPoint 가 RPortPrototype 을 통해 ClientServerOperation 을 참조하고 있을 때 Rte_Call API 가 생성된다.	

1) Direct Function Call 방식에서는 RTE_E_OK, RTE_E_UNCONNECTED, <Application Error>만 Return 한다.
2) <Application Error>는 API 에 해당하는 ClientServerOperation 의 PossibleErrorRef 를 통해 확인 가능하며, BSW 서비스의 Error 에 대한 자세한 내용은 각 모듈 별 매뉴얼을 참조한다.

6.3.1.14 Rte_Result

Function Name	Rte_Result	
Syntax:	Std_ReturnType Rte_Result_<p>_<o> ([IN Rte_Instance <instance>], [IN/OUT|OUT <param 1>]... [IN/OUT|OUT <param n>]) <p>: R-Port 이름 <o>: ClientServerInterface 의 Operation 이름	
Service ID	0x1D	
Sync/Async	NA	
Reentrancy	NA	
Parameters (In)	<instance>	SW-C 인스턴스
Parameters (Inout)	<data_1> to <data_n>	서버 요청 시 클라이언트에서 서버로 전달 및 서버에서 서비스 수행 후 서버에서 클라이언트로 전달을 동시에 수행하는 데이터 (ClientServerInterfae 의 Operation 에서 Direction 이 INOUT 으로 정의된 Argument)

Parameters (Out)	<data_1> to <data_n>	서버 요청 시 서버에서 서비스 수행 후 서버에서 클라이언트로 전달할 데이터 (ClientServerInterfae 의 Operation 에서 Direction 이 OUT 으로 정의된 Argument) (비동기식(Asynchronous) 방식에서는 사용되지 않음.)
Return Value	Std_ReturnType	**RTE_E_OK:** API 호출이 정상적으로 완료
		RTE_E_NO_DATA: Rte_Call 이 호출되지 않았거나 서버의 수행이 완료되지 않음
		RTE_E_TIMEOUT: 설정된 타임아웃 이내에 서버로 부터의 응답을 받지 못함
		RTE_E_UNCONNECTED: 클라이언트 포트가 서버와 연결되어 있지 않음
		RTE_E_SEG_FAULT: 파라미터로 받은 메모리 주소를 API 를 호출한 파티션에서 사용할 수 없음 (파티션 간 통신에서만 Return)
		<Application Error>: 서버에서 서비스 수행 중 발생한 에러 위에서 RTE_E_OK 를 제외한 에러가 발생하지 않고 서버가 수행이 된 경우 서버의 Return 값을 전달
Description	비동기식(Asynchronous) 클라이언트-서버 통신에서 서버의 서비스 수행 결과를 얻는다.	
Preconditions	Rte_Result 호출 전 Rte_Start 의 호출이 완료되어야 한다.	
Configuration Dependency	AsynchronousServerCallResultPoint 가 AsynchrnousServerCallPoint 를 참조하고 있고, AsynchrnousServerCallReturnsEvent 에 WaitPoint 가 설정되어 있지 않을 때, Non-blocking Rte_Result API 가 생성된다. AsynchronousServerCallResultPoint 가 AsynchrnousServerCallPoint 를 참조하고 있고, AsynchrnousServerCallReturnsEvent 에 WaitPoint 가 설정되어 있을 때, Blocking Rte_Result API 가 생성된다. AsynchronousServerCallReturnsEvent 가 RunnableEntity 와 ClientServerOperation 을 참조하고 있을 때 RunnableEntity 는 서버의 서비스 수행이 완료되면 Activation 된다. AsynchronousServerCallReturnsEvent 가 RunnableEntity 를 참	

	조하고, 동시에 WaitPoint 에 의해 참조될 수 없다.

6.3.1.15 Rte_Invalidate

Function Name	Rte_Invalidate	
Syntax:	Std_ReturnType Rte_Invalidate_<p>_<o>([IN Rte_Instance <instance>], [OUT Rte_TransformerError transformerError]) Where <p> is the port name and <o> the VariableDataPrototype within the sender-receiver interface categorizing the port.	
Service ID	0x16	
Sync/Async	NA	
Reentrancy	NA	
Parameters (In)	<instance>	SW-C instance
Parameters (Inout)	NA	
Parameters (Out)	NA	
Return Value	Std_ReturnType	**RTE_E_OK :** API 호출이 정상적으로 완료. **RTE_E_COM_STOPPED :** COM Service 의 사용 불가로 인해 Operation 실행이 불가능하다. **RTE_E_HARD_TRANSFORMER_ERROR:** 트랜스포머 체인에서 트랜스포머의 리턴값이 hard transformer error 이다. **RTE_E_SOFT_TRANSFORMER_ERROR:** 트랜스포머 체인에서 최소 하나의 트랜스포머의 리턴값이 soft error 이고 hard error 가 아니다.
Description	Invalidate a data element for an “explicit” sender-receiver transmission.	
Preconditions	Rte_Start API needs to be called before Rte_Invalidate is called.	
Configuration Dependency	An Rte_Invalidate API will be created for any VariableAccess in the dataSendPoint role that references a provided VariableDataPrototype which associated InvalidationPolicy is set to keep or replace.	

Optional Parameter Configuration Dependency	The optional OUT parameter transformerError of the API shall be generated if PortPrototype of port <p> is referenced by a PortAPIOption which has the attribute errorHandling set to transformerErrorHandling.

6.3.1.16 Rte_IInvalidate

Function Name	Rte_IInvalidate	
Syntax:	void Rte_IInvalidate_<re>_<p>_<o>([IN Rte_Instance <instance>]) Where <re> is the runnable entity name, <p> the port name and <o> the VariableDataPrototype name.	
Service ID	0x24	
Sync/Async	NA	
Reentrancy	NA	
Parameters (In)	<instance>	SW-C instance
Parameters (Inout)	NA	
Parameters (Out)	NA	
Return Value	None	
Description	Invalidate a VariableDataPrototype referenced by a VariableAccess in the dataWriteAccess role.	
Preconditions	Rte_Start API needs to be called before Rte_IInvalidate is called.	
Configuration Dependency	An Rte_IInvalidate API will be created for a provided VariableDataPrototype, if the RunnableEntity has VariableAccesses in the dataWriteAccess role referring to this VariableDataPrototype and the associated Invalidation-Policy of the VariableDataPrototype is set to keep or replace.	

6.3.1.17 Rte_Feedback

Function Name	Rte_Feedback
Syntax:	Std_ReturnType Rte_Feedback_<p>_<o>([IN Rte_Instance <instance>]) Where <p> is the port name and <o> the

	VariableDataPrototype within the sender-receiver interface categorizing the port.	
Service ID	0x17	
Sync/Async	NA	
Reentrancy	NA	
Parameters (In)	<instance>	SW-C instance
Parameters (Inout)	NA	
Parameters (Out)	NA	
Return Value	Std_ReturnType	**RTE_E_NO_DATA :** Data 전송 요청의 결과가 도착하지 않았다. **RTE_E_COM_STOPPED :** COM Service 의 사용 불가로 인해 Operation 실행이 불가능하다. **RTE_E_TIMEOUT :** (Inter-ECU and Inter-Partition only) Timeout 이 발생했다. **RTE_E_TRANSMIT_ACK :** Data 전송 요청을 완료하였다. (Queue Overflow 경우도 포함). **RTE_E_UNCONNECTED :** Sender Port 가 Receiver Port 와 연결되어 있지 않다. **RTE_E_HARD_TRANSFORMER_ERROR:** 트랜스포머 체인에서 트랜스포머의 리턴값이 hard transformer error 이다. **RTE_E_SOFT_TRANSFORMER_ERROR:** 트랜스포머 체인에서 최소 하나의 트랜스포머의 리턴값이 soft error 이고 hard error 가 아니다.
Description	Provide access to acknowledgement notifications for explicit sender receiver communication and to pass error notification to senders.	
Preconditions	Rte_Start API needs to be called before Rte_Feedback is called.	
Configuration Dependency	A blocking Rte_Feedback API will be generated for a provided VariableDataPrototype, if acknowledgement is enabled and a WaitPoint references a DataSendCompletedEvent that in turn references the VariableDataPrototype. A non-blocking Rte_Feedback API will be generated for a provided VariableDataPrototype, if acknowledgement is enabled and a VariableAccess in the dataSendPoint role references the VariableDataPrototype but no WaitPoint	

	references the DataSendCompletedEvent that references the VariableDataPrototype.

6.3.1.18 Rte_IFeedback

Function Name	Rte_IFeedback	
Syntax:	Std_ReturnType Rte_IFeedback_<re>_<p>_<o> ([IN RTE_Instance <instance>]) Where <re> is the runnable entity name, <p> the port name and <o> the VariableDataPrototype within the sender-receiver interface categorizing the port.	
Service ID	0x2F	
Sync/Async	NA	
Reentrancy	NA	
Parameters (In)	<instance>	SW-C instance
Parameters (Inout)	NA	
Parameters (Out)	NA	
Return Value	Std_ReturnType	**RTE_E_NO_DATA :** Data 전송 요청의 결과가 도착하지 않았다. **RTE_E_COM_STOPPED :** COM Service 의 사용 불가로 인해 Operation 실행이 불가능하다. **RTE_E_TIMEOUT :** (Inter-ECU and Inter-Partition only) Timeout 이 발생했다. **RTE_E_TRANSMIT_ACK :** Data 전송 요청을 완료하였다. **RTE_E_UNCONNECTED :** Sender Port 가 Receiver Port 와 연결되어 있지 않다. **RTE_E_HARD_TRANSFORMER_ERROR:** 트랜스포머 체인에서 트랜스포머의 리턴값이 hard transformer error 이다. **RTE_E_SOFT_TRANSFORMER_ERROR:** 트랜스포머 체인에서 최소 하나의 트랜스포머의 리턴값이 soft error 이고 hard error 가 아니다.
Description	Provide access to acknowledgement notifications for implicit sender receiver communication and to pass error notification to senders.	

Preconditions	Rte_Start API needs to be called before Rte_IFeedback is called.
Configuration Dependency	An Rte_IFeedback API will be created for a provided VariableDataPrototype, if acknowledgment is enabled and the RunnableEntity has a VariableAccess in the dataWriteAccess role referring to this VariableDataPrototype. An Rte_IFeedback API will be created for a provided VariableDataPrototype, if acknowledgment is enabled and a DataWriteCompletedEvent references the RunnableEntity as well as the VariableDataPrototype.

6.3.1.19 Rte_Enter

Function Name	Rte_Enter	
Syntax:	void Rte_Enter_<name>([IN Rte_Instance <instance>]) Where <name> is the exclusive area name.	
Service ID	0x2A	
Sync/Async	NA	
Reentrancy	NA	
Parameters (In)	<instance>	SW-C instance
Parameters (Inout)	NA	
Parameters (Out)	NA	
Return Value	None	
Description	Rte_Enter API call is invoked by an AUTOSAR software component to define the start of an exclusive area.	
Preconditions	Rte_Start API needs to be called before Rte_Enter is called.	
Configuration Dependency	An Rte_Enter API will be created for each ExclusiveArea that is declared and which has a canEnterExclusiveArea association.	

6.3.1.20 Rte_Exit

Function Name	Rte_Exit

Syntax:	void Rte_Exit_<name>([IN Rte_Instance <instance>]) Where <name> is the exclusive area name.	
Service ID	0x2B	
Sync/Async	NA	
Reentrancy	NA	
Parameters (In)	<instance>	SW-C instance
Parameters (Inout)	NA	
Parameters (Out)	NA	
Return Value	None	
Description	Rte_Exit API call is invoked by an AUTOSAR software component to define the end of an exclusive area.	
Preconditions	Rte_Start API needs to be called before Rte_Exit is called.	
Configuration Dependency	An Rte_Exit API will be created for each ExclusiveArea that is declared and which has a canEnterExclusiveArea association.	

6.3.1.21 Rte_IrvRead

Function Name	Rte_IrvRead
Syntax:	Primitive Type: <return> Rte_IrvRead_<re>_<o>([IN RTE_Instance <instance>]) Complex type signature: void Rte_IrvRead_<re>_<o>([IN RTE_Instance <instance>], OUT <data>) Where <re> is the name of the runnable entity the API might be used in, <o> is the name of the InterRunnableVariables. The complex type signature is used, if the Implementation-Data Type of the InterRunnableVariable resolves to Array Implementation Data Type or Structure Implementation Data Type, otherwise the primitive type signature is used.
Service ID	0x28
Sync/Async	NA

Reentrancy	NA	
Parameters (In)	<instance>	SW-C instance
Parameters (Inout)	NA	
Parameters (Out)	Complex Type: <data>	data to be read
Return Value	Primitive Type: Implementation Data type Complex Type: NA	NA
Description	Provides read access to the defined InterRunnableVariables with explicit behavior within a component Description.	
Preconditions	Rte_Start API needs to be called before Rte_IrvRead is called.	
Configuration Dependency	An Rte_IrvRead API shall be created for each read InterRunnableVariable using explicit access.	

6.3.1.22 Rte_IrvWrite

Function Name	Rte_IrvWrite	
Syntax:	void Rte_IrvWrite_<re>_<o>([IN RTE_Instance <instance>], IN <data>) Where <re> is the name of the runnable entity the API might be used in, <o> is the name of the InterRunnableVariable to access and <data> is the placeholder for the data the InterRunnableVariable shall be set to.	
Service ID	0x29	
Sync/Async	NA	
Reentrancy	NA	
Parameters (In)	<instance>	SW-C instance
	<data>	data to be written
Parameters (Inout)	NA	
Parameters (Out)	NA	
Return Value	None	

Description	Provides write access to the InterRunnableVariables with explicit behavior within a component description.
Preconditions	Rte_Start API needs to be called before Rte_IrvWrite is called.
Configuration Dependency	An Rte_IrvWrite API shall be created for each written InterRunnableVariable using explicit access.

6.3.1.23 Rte_IrvIRead

Function Name	Rte_IrvIRead	
Syntax:	<return> Rte_IrvIRead_<re>_<o>([IN RTE_Instance <instance>]) Where <re> is the name of the runnable entity the API might be used in, <o> is the name of the VariableDataPrototype in role implicitInterRunnableVariable.	
Service ID	0x26	
Sync/Async	NA	
Reentrancy	NA	
Parameters (In)	<instance>	SW-C instance
Parameters (Inout)	NA	
Parameters (Out)	NA	
Return Value	Implementation data type	NA
Description	Provide read access to the InterRunnableVariables with implicit behavior of an AUTOSAR SW-C.	
Preconditions	Rte_Start API needs to be called before Rte_IrvIRead is called.	
Configuration Dependency	An Rte_IrvIRead API shall be created for each VariableAccess in role readLocalVariable to an implicit-InterRunnableVariable.	

6.3.1.24 Rte_IrvIWrite

Function Name	Rte_IrvIWrite	
Syntax:	void Rte_IrvIWrite_<re>_<o>([IN RTE_Instance <instance>],IN <data>) Where <re> the name of the RunnableEntity is API might be used in, <o> is the name of the VariableDataPrototype in the role implicitInterRunnableVariable to access and <data> is the placeholder for the data the InterRunnableVariable shall be set to.	
Service ID	0x27	
Sync/Async	NA	
Reentrancy	NA	
Parameters (In)	<instance>	SW-C instance
	<data>	data to be written
Parameters (Inout)	NA	
Parameters (Out)	NA	
Return Value	None	
Description	Provide write access to the InterRunnableVariables with implicit behavior of an AUTOSAR SW-C.	
Preconditions	Rte_Start API needs to be called before Rte_IrvIWrite is called.	
Configuration Dependency	An Rte_IrvIWrite API shall be created for each VariableAccess in role writtenLocalVariable to an implicitInterRunnableVariable.	

6.3.1.25 Rte_Trigger

Function Name	Rte_Trigger
Syntax:	without queuing support: void Rte_Trigger_<p>_<o>([IN Rte_Instance <instance>]) with queuing support: Std_ReturnType Rte_Trigger_<p>_<o>([IN Rte_Instance <instance>])

	<p>: P-Port 이름 <o>: Trigger Interface 의 Trigger 이름	
Service ID	0x2D	
Sync/Async	NA	
Reentrancy	NA	
Parameters (In)	<instance>	SW-C 인스턴스
Parameters (Inout)	NA	
Parameters (Out)	NA	
Return Value	Std_ReturnType	RTE_E_OK : API 호출이 정상적으로 완료
		RTE_E_LIMIT : Queued 방식에서 큐가 가득 참
Description	외부 SW-C 의 Runnable(들)을 호출하는 함수이다.	
Preconditions	Rte_Trigger 호출 전 Rte_Start 의 호출이 완료되어야 한다.	
Configuration Dependency	ExternalTriggeringPoint 가 PPortPrototype 을 통해 Trigger 를 참조하고, ExternalTriggerOccurredEvent 가 같은 Trigger 를 참조할 때 Rte_Trigger API 가 생성된다.	

6.3.1.26 Rte_IrTrigger

Function Name	Rte_IrTrigger	
Syntax:	signatwithout queuing support: void Rte_IrTrigger_<re>_<o>([IN Rte_Instance <instance>]) signature with queuing support: Std_ReturnType Rte_IrTrigger_<re>_<o>([IN Rte_Instance <instance>]) <re>: API 를 사용하는 RunnableEntity 이름 <o>: <re>에서 설정한 InternalTriggeringPoint 이름	
Service ID	0x2E	
Sync/Async	NA	
Reentrancy	NA	
Parameters (In)	<instance>	SW-C 인스턴스
Parameters (Inout)	NA	
Parameters (Out)	NA	

Return Value	Std_ReturnType	RTE_E_OK : API 호출이 정상적으로 완료
		RTE_E_LIMIT : Queued 방식에서 큐가 가득 참
Description	SW-C 내부에서 다른 RunnableEntity(들)을 호출하는 함수이다.	
Preconditions	Rte_Trigger 호출 전 Rte_Start 의 호출이 완료되어야 한다.	
Configuration Dependency	호출하는 RunnableEntity 에서 설정한 InternalTriggeringPoint 가 호출될 Runnable 의 InternalTrigger-OccurredEvent 를 참조할 때 Rte_IrTrigger API 가 생성된다.	

6.3.1.27 Rte_Receive

Function Name	Rte_Receive	
Syntax:	Std_ReturnType Rte_Receive_<p>_<o>([IN Rte_Instance <instance>], OUT <data>, [OUT uint16 <length>], [OUT Rte_TransformerError transformerError]) Where <p> is the port name and <o> the data element within the sender-receiver interface categorizing the port	
Service ID	0x1B	
Sync/Async	NA	
Reentrancy	NA	
Parameters (In)	<instance>	SW-C instance
Parameters (Inout)	NA	
Parameters (Out)	data	data element to read
	length	number of elements in the data element
Return Value	Std_ReturnType	**RTE_E_OK :** API 호출이 정상적으로 완료되었다. **RTE_E_NO_DATA :** Data 전송 요청의 결과가 도착하지 않았다. **RTE_E_LOST_DATA:** 일부 Data 를 Queue Overflow 또는 Communication Error 로 인해 잃었다. (Overlayed Error 로 다른 Error Code 와 같이 올 수 있다) **RTE_E_UNCONNECTED :** Receiver Port 가 Sender Port 와 연결되어 있지 않다. **RTE_E_HARD_TRANSFORMER_ERROR:**

		트랜스포머 체인에서 트랜스포머의 리턴값이 hard transformer error 이다. **RTE_E_SOFT_TRANSFORMER_ERROR:** 트랜스포머 체인에서 최소 하나의 트랜스포머의 리턴값이 soft error 이고 hard error 가 아니다.
Description	Initiate an "explicit" sender-receiver transmission of data elements with "data" semantic (swImplPolicy equal to 'queued').	
Preconditions	Rte_Start API needs to be called before Rte_Receive is called.	
Configuration Dependency	Rte_Receive API shall be generated if a VariableAccess in the dataReceivePointByArgument role references a required VariableDataPrototype with 'event' semantics	
Optional Parameter Configuration Dependency	The optional OUT parameter transformerError of the API shall be generated if PortPrototype of port <p> is referenced by a PortAPIOption which has the attribute errorHandling set to transformerErrorHandling.	

6.3.1.28 Rte_SwitchAck

Function Name	Rte_SwitchAck	
Syntax:	Std_ReturnType Rte_SwitchAck_<p>_<o>([IN Rte_Instance <instance>]) Where <p> is the port name and <o> the ModeDeclarationGroupPrototype within the ModeSwitchInterface categorizing the port	
Service ID	0x18	
Sync/Async	NA	
Reentrancy	NA	
Parameters (In)	<instance>	SW-C instance
Parameters (Inout)	NA	
Parameters (Out)	NA	
Return Value	Std_ReturnType	**RTE_E_NO_DATA:** 모드 변경이 진행중이다. **RTE_E_TRANSMIT_ACK:** 모브 변경이 완료되었다. **RTE_E_UNCONNECTED:** Manager Port 가 User Port 와 연결되어 있지 않다.

Description	The Rte_SwitchAck API takes no parameters other than the instance handle – the return value is used to indicate the acknowledgement status to the caller
Preconditions	Rte_Start API needs to be called before Rte_SwitchAck is called.
Configuration Dependency	A blocking Rte_SwitchAck API shall be generated for a provided ModeDeclarationGroupPrototype if acknowledgementis enabled and a WaitPoint references a ModeSwitchedAckEvent that in turn references the ModeDeclarationGroupPrototype

6.3.1.29 Rte_Prm

Function Name	Rte_Prm	
Syntax:	<return> Rte_Prm_<p>_<o>([IN Rte_Instance <instance>]) Where <p> is the port name and <o> is the name of the ParameterDataPrototype within the ParameterInterface categorizing the port	
Service ID	0x20	
Sync/Async	NA	
Reentrancy	NA	
Parameters (In)	<instance>	SW-C instance
Parameters (Inout)	NA	
Parameters (Out)	NA	
Return Value	<return>	NA
Description	The Rte_Prm API provides access to the defined parameter within a ParameterSwComponentType	
Preconditions	Rte_Start API needs to be called before Rte_Prm is called.	
Configuration Dependency	A Rte_Prm API shall be generated if a ParameterAccess references a ParameterDataPrototype in a require PortPrototype	

6.3.1.30 Rte_CData

Function Name	Rte_CData	
Syntax:	<return> Rte_CData_<name>([IN Rte_Instance <instance>]) Where <name> is the calibration parameter name	
Service ID	0x1F	
Sync/Async	NA	
Reentrancy	NA	
Parameters (In)	<instance>	SW-C instance
Parameters (Inout)	NA	
Parameters (Out)	NA	
Return Value	<return>	NA
Description	The Rte_CData API provides access to the defined calibration parameter Within a software-component. The actual data values for a software-component instance may be set after component compilation.	
Preconditions	Rte_Start API needs to be called before Rte_CData is called.	
Configuration Dependency	An Rte_CData API shall be created for each defined ParameterDataPrototype in the role perInstanceParameter or sharedParameter within an AUTOSAR softwarecomponent.	

6.3.1.31 Rte_Send

Function Name	Rte_Send
Syntax:	Std_ReturnType Rte_Send_<p>_<o>([IN Rte_Instance <instance>], IN <data>, [IN uint16 <length>], [OUT Rte_TransformerError transformerError]) Where <p> is the port name and <o> the VariableDataPrototype within the sender-receiver interface categorizing the port
Service ID	0x13
Sync/Async	NA
Reentrancy	NA

Parameters (In)	<instance>	SW-C instance
	<data>	data element to sent
	<length>	number of elements in the data element
Parameters (Inout)	NA	
Parameters (Out)	NA	
Return Value	Std_ReturnType	**RTE_E_OK :** API 호출이 정상적으로 완료되었다. **RTE_E_COM_STOPPED :** COM Service 의 사용 불가로 인해 Operation 실행이 불가능하다. **RTE_E_LIMIT :** (Intra Ecu Communication Only) Full Queue 로 인하여 DataElement 를 전송할 수 없다. **RTE_E_HARD_TRANSFORMER_ERROR:** 트랜스포머 체인에서 트랜스포머의 리턴값이 hard transformer error 이다. **RTE_E_SOFT_TRANSFORMER_ERROR:** 트랜스포머 체인에서 최소 하나의 트랜스포머의 리턴값이 soft error 이고 hard error 가 아니다.
Description	Initiates a sender-receiver communication where the transmission occurs at the point the API call is made transmission	
Preconditions	Rte_Start API needs to be called before Rte_Send is called.	
Configuration Dependency	The Rte_Send APIs may only be used by the runnable that contains the corresponding VariableAccess in the dataSendPoint role	
Optional Parameter Configuration Dependency	The optional OUT parameter transformerError of the API shall be generated if PortPrototype of port <p> is referenced by a PortAPIOption which has the attribute errorHandling set to transformerErrorHandling.	

6.3.1.32 Enhanced Rte_Mode

Function Name	Enhanced Rte_Mode
Syntax:	<return> Rte_Mode_<p>_<o>([IN Rte_Instance <instance>,] OUT <previousmode>, OUT <nextmode>) Where <p> is the port name, and <o> the ModeDeclarationGroup- Prototype name within the ModeSwitchInterface categorizing the

	Port.	
Service ID	0x2C	
Sync/Async	NA	
Reentrancy	NA	
Parameters (In)	<instance>	SW-C instance
Parameters (Inout)	NA	
Parameters (Out)	<previousmode>	
	<nextmode>	
Return Value	RTE_TRANSITION_ <ModeDeclarationGroup>	NA
Description	Provides the currently active mode of a mode switch port and also the mode currently being left and the mode being entered.	
Preconditions	Rte_Start API needs to be called before Enhanced Rte_Mode is called.	
Configuration Dependency	The existence of a ModeAccessPoint given that the attribute enhancedModeApi of the ModeSwitchReceiverComSpec is set to true shall result in the generation of Enhanced Rte_Mode API.	

6.3.2 RTE Call-backs

6.3.2.1 Rte_COMCbkTAck_<Signal>

Function Name	Rte_COMCbk_<Signal>
Syntax:	void Rte_COMCbk_<sn>(void) Where <sn> is a COM signal name.
Service ID	0x95
Sync/Async	NA
Reentrancy	NA
Parameters (In)	NA
Parameters (Inout)	NA
Parameters (Out)	NA

Return Value	None
Description	This callback function indicates that the signal of the primitive data item/event is ready for reception.
Preconditions	NA
Configuration Dependency	Configured in COM: ComNotification as part of ComSignal.

6.3.2.2 Rte_COMCbkTAck_<Signal>

Function Name	Rte_COMCbkTAck_<Signal>
Syntax:	void Rte_COMCbkTAck_<sn>(void) Where <sn> is a COM signal name and “TAck” is literal text indicating transmission acknowledgment.
Service ID	0x90
Sync/Async	NA
Reentrancy	NA
Parameters (In)	NA
Parameters (Inout)	NA
Parameters (Out)	NA
Return Value	None
Description	This callback function indicates that the signal of the primitive data item/event is already handed over by COM to the PDU router.
Preconditions	NA
Configuration Dependency	Configured in COM: ComNotification as part of ComSignal

6.3.2.3 Rte_COMCbkTErr_<Signal>

Function Name	Rte_COMCbkTErr_<Signal>
Syntax:	void Rte_COMCbkTErr_<sn>(void) Where <sn> is a COM signal name and "TErr" is literal text indicating transmission error.
Service ID	0x91
Sync/Async	NA
Reentrancy	NA
Parameters (In)	NA
Parameters (Inout)	NA
Parameters (Out)	NA
Return Value	None
Description	This callback function indicates that an error occurred when the signal of the primitive data item/event was handed over by COM to the PDU router.
Preconditions	NA
Configuration Dependency	Configured in COM: Com-ErrorNotification as part of ComSignal.

6.3.2.4 Rte_COMCbkInv_<Signal>

Function Name	Rte_COMCbkTErr_<Signal>
Syntax:	void Rte_COMCbkInv_<sn>(void) Where <sn> is a COM signal name and "Inv" is literal text indicating signal invalidation.
Service ID	0x92
Sync/Async	NA
Reentrancy	NA
Parameters (In)	NA
Parameters (Inout)	NA
Parameters (Out)	NA

Return Value	None
Description	This callback function indicates that COM has received a signal and passed it as “invalid”.
Preconditions	NA
Configuration Dependency	Configured in Com: Com-InvalidNotification as part of ComSignal.

6.3.2.5 Rte_COMCbkRxTOut_<Signal>

Function Name	Rte_COMCbkRxTOut_<Signal>
Syntax:	void Rte_COMCbkRxTOut_<sn>(void) Where <sn> is a COM signal name and “RxTOut” is literal text indicating reception signal time out.
Service ID	0x93
Sync/Async	NA
Reentrancy	NA
Parameters (In)	NA
Parameters (Inout)	NA
Parameters (Out)	NA
Return Value	None
Description	This callback function indicates that the aliveTimeout after the last successful reception of the signal of the primitive data item/event has expired (data element outdated).
Preconditions	NA
Configuration Dependency	Configured in Com: Com-TimeoutNotification as part of ComSignal.

6.3.2.6 Rte_COMCbkTxTOut_<Signal>

Function Name	Rte_COMCbkTxTOut_<Signal>
Syntax:	void Rte_COMCbkTxTOut_<sn>(void) Where <sn> is a COM signal name and "TxTOut" is literal text indicating transmission failure and time out.
Service ID	0x94
Sync/Async	NA
Reentrancy	NA
Parameters (In)	NA
Parameters (Inout)	NA
Parameters (Out)	NA
Return Value	None
Description	This callback function indicates that the timeout of TransmissionAcknowledgementRequest for sending the signal of the primitive data item/event has expired.
Preconditions	NA
Configuration Dependency	Configured in Com: Com-TimeoutNotification as part of ComSignal.

6.3.2.7 Rte_COMCbk_<SignalGroup>

Function Name	Rte_COMCbk_<SignalGroup>
Syntax:	void Rte_COMCbk_<sg>(void) Where <sg> is the name of the COM signal group, which contains all the signals of the composite data item/event or an operation.
Service ID	0x94
Sync/Async	NA
Reentrancy	NA
Parameters (In)	NA
Parameters (Inout)	NA

Parameters (Out)	NA
Return Value	None
Description	This callback function indicates that the signals of the composite data item/event or the arguments of an operation are ready for reception.
Preconditions	NA
Configuration Dependency	Configured in Com: ComNotification as part of ComSignalGroup.

6.3.2.8 Rte_COMCbkTAck_<SignalGroup>

Function Name	Rte_COMCbkTAck_<SignalGroup>
Syntax:	void Rte_COMCbkTAck_<sg>(void) Where <sg> is COM signal group name and “TAck” is literal text indicating transmission acknowledgment.
Service ID	0x96
Sync/Async	NA
Reentrancy	NA
Parameters (In)	NA
Parameters (Inout)	NA
Parameters (Out)	NA
Return Value	None
Description	This callback function indicates that the signal of the composite data item/event is already handed over by COM to the PDU router.
Preconditions	NA
Configuration Dependency	Configured in Com: ComNotification as part of ComSignalGroup.

6.3.2.9 Rte_COMCbkTErr_<SignalGroup>

Function Name	Rte_COMCbkTErr_<SignalGroup>
Syntax:	void Rte_COMCbkTErr_<sg>(void) Where <sg> is COM signal group name and "TErr" is literal text indicating transmission error.
Service ID	0x97
Sync/Async	NA
Reentrancy	NA
Parameters (In)	NA
Parameters (Inout)	NA
Parameters (Out)	NA
Return Value	None
Description	This callback function indicates that an error occurred when the signal of the composite data item/event was handed over by COM to the PDU router.
Preconditions	NA
Configuration Dependency	Configured in Com: Com-ErrorNotification as part of ComSignalGroup.

6.3.2.10 Rte_COMCbkInv_<SignalGroup>

Function Name	Rte_COMCbkInv_<SignalGroup>
Syntax:	void Rte_COMCbkInv_<sg>(void) Where <sg> is COM signal group name and "Inv" is literal text indicating signal group invalidation.
Service ID	0x98
Sync/Async	NA
Reentrancy	NA
Parameters (In)	NA

Parameters (Inout)	NA
Parameters (Out)	NA
Return Value	None
Description	This callback function indicates that COM has received a signal group and parsed it as “invalid”.
Preconditions	NA
Configuration Dependency	Configured in Com: Com-InvalidNotification as part of ComSignalGroup.

6.3.2.11 Rte_COMCbkRxTOut_<SignalGroup>

Function Name	Rte_COMCbkRxTOut_<SignalGroup>
Syntax:	void Rte_COMCbkRxTOut_<sg>(void) Where <sg> is COM signal group name and “RxTOut” is literal text indicating reception signal time out.
Service ID	0x99
Sync/Async	NA
Reentrancy	NA
Parameters (In)	NA
Parameters (Inout)	NA
Parameters (Out)	NA
Return Value	None
Description	This callback function indicates that the aliveTimeout after the last successful reception of the signal group carrying the composite data item has expired (data element outdated).
Preconditions	NA

Configuration Dependency	Configured in Com: Com-TimeoutNotification as part of ComSignalGroup.

6.3.2.12 Rte_COMCbkTxTOut_<SignalGroup>

Function Name	Rte_COMCbkTxTOut_<SignalGroup>
Syntax:	void Rte_COMCbkTxTOut_<sg>(void) Where <sg> is COM signal group name and "TxTOut" is literal text indicating transmission failure and timeout.
Service ID	0x9A
Sync/Async	NA
Reentrancy	NA
Parameters (In)	NA
Parameters (Inout)	NA
Parameters (Out)	NA
Return Value	None
Description	This callback function indicates that the timeout of TransmissionAcknowledgementRequest for sending the signal group of the composite data item/event has expired.
Preconditions	NA
Configuration Dependency	Configured in Com: Com-TimeoutNotification as part of ComSignalGroup.

6.3.3 BSW Scheduler APIs

6.3.3.1 SchM_Init

Function Name	SchM_Init
Syntax:	void SchM_Init(SchM_ConfigType * ConfigPtr) Where ConfigPtr is the Pointer to selected Post build Configuration.
Service ID	0x00

Sync/Async	NA	
Reentrancy	NA	
Parameters (In)	<ConfigPtr>	
Parameters (Inout)	None	
Parameters (Out)	None	
Return Value	None	
Description	SchM_Init is intended to allocate and initialize system resources used by the Basic Software Scheduler part of the RTE for the core on which it is called. After initialization the scheduling of BswSchedulableEntitys is enabled.	
Preconditions	AUTOSAR Com, OS and Memory Services should be finalized.	
Configuration Dependency	Variant Handling: If post build data set configuration is present, then SchM_Init will have the input parameter 'ConfigPtr' else void will be the input.	

6.3.3.2 SchM_Deinit

Function Name	SchM_Deinit
Syntax:	void SchM_Deinit(void)
Service ID	0x01
Sync/Async	NA
Reentrancy	NA
Parameters (In)	None
Parameters (Inout)	None
Parameters (Out)	None
Return Value	None
Description	SchM_Deinit is used to finalize Basic Software Scheduler part of the RTE of the core on which it is called. This service releases all system resources allocated by the Basic Software Scheduler part on that core.

Preconditions	None
Configuration Dependency	API may only be used after the RTE finalized i.e., after termination of the Rte_Stop.

6.3.3.3 SchM_Enter

Function Name	SchM_Enter
Syntax:	void SchM_Enter_<bsnp>[_<vi>_<ai>]_<name>() Where <bsnp> is the BSW Scheduler Name Prefix of the calling BSW module derived from the BswModuleDescriptions short name, <vi> is the vendorId of the calling BSW module, <ai> vendorApiInfix of the calling BSW module and <name> name is the exclusive area name. The sub part in squared brackets [_<vi>_<ai>] is omitted if no vendorApiInfix is defined for the Basic Software Module.
Service ID	0x03
Sync/Async	NA
Reentrancy	NA
Parameters (In)	None
Parameters (Inout)	None
Parameters (Out)	None
Return Value	None
Description	The SchM_Enter API call is invoked by an AUTOSAR BSW module to define the start of an exclusive area.
Preconditions	SchM_Init API needs to be called before SchM_Enter is called.
Configuration Dependency	This API is created for each ExclusiveArea that is declared in the BswBehavior and which has a CanEnterExclusiveArea association. Variant Handling: if variation point is configured, API will be generated depending on the variation point condition by formula. Note: For post build configuration API may be generated, which is inactive due to the evaluated condition by formula resulting to FALSE.

6.3.3.4 SchM_Exit

Function Name	SchM_Exit
Syntax:	Void SchM_Exit_<bsnp>[_<vi>_<ai>]_<name>() Where <bsnp> is the BSW Scheduler Name Prefix of the calling BSW module derived from the BswModuleDescriptions short name, <vi> is the vendorId of the calling BSW module, <ai> vendorApiInfix of the calling BSW module and <name> name is the exclusive area name. The sub part in squared brackets [_<vi>_<ai>] is omitted if no vendorApiInfix is defined for the Basic Software Module.
Service ID	0x04
Sync/Async	NA
Reentrancy	NA
Parameters (In)	NA
Parameters (Inout)	None
Parameters (Out)	None
Return Value	None
Description	The SchM_Exit API call is invoked by an AUTOSAR BSW module to define the end of an exclusive area.
Preconditions	Schm_Init and SchM_Enter API needs to be called before SchM_Exit is called.
Configuration Dependency	This API is created for each ExclusiveArea that is declared in the BswBehavior and which has a CanEnterExclusiveArea association. Variant Handling: if variation point is configured, API will be generated depending on the variation point condition by formula. Note: For post build configuration API may be generated, which is inactive due to the evaluated condition by formula resulting to FALSE.

6.3.3.5 SchM_Mode

Function Name	SchM_Mode	
Syntax:	SchM_Mode_<bsnp>[_<vi>_<ai>]_<name>() Where <bsnp> is the BSW Scheduler Name Prefix of the calling BSW module derived from the BswModuleDescriptions short name, <vi> is the vendorId of the calling BSW module, <ai> vendorApiInfix of the calling BSW module and <name> name is the mode group.	
Service ID	0x07	
Sync/Async	NA	
Reentrancy	NA	
Parameters (In)	NA	
Parameters (Inout)	None	
Parameters (Out)	None	
Return Value	Rte_ModeType_<M>	NA
Description	Provides the currently active mode of a required (requiredModeGroup) ModeDeclarationGroupPrototype.	
Preconditions	SchM_Init API needs to be called before SchM_Mode is called.	
Configuration Dependency	The existence of an accessedModeGroup association to a providedModeGroup or requiredModeGroup ModeDeclarationGroupPrototype will result in the generation of a SchM_Mode API.	

6.3.3.6 SchM_Switch

Function Name	SchM_Switch
Syntax:	Std_ReturnType SchM_Switch_<bsnp>[_<vi>_<ai>]_<name>(IN Rte_ModeType_<M> <mode>) Where <bsnp> is the BSW Scheduler Name Prefix of the calling BSW module derived from the BswModuleDescriptions short name, <vi> is the vendorId of the calling BSW module, <ai> vendorApiInfix of the calling BSW module and <name> name is the mode group.

Service ID	0x06	
Sync/Async	NA	
Reentrancy	NA	
Parameters (In)	<mode>	
Parameters (Inout)	None	
Parameters (Out)	None	
Return Value	Std_ReturnType	**SCHM_E_OK:** 모드 변경 요청이 성공적으로 전달되었다. **SCHM_E_LIMIT:** Queue 가 Full 이어서 모드 변경 요청이 버려졌다
Description	Initiate a mode switch. The SchM_Switch API call is used for sending a mode switch notification by a Basic Software Module.	
Preconditions	SchM_Init API needs to be called before SchM_Switch is called.	
Configuration Dependency	The existence of a managedModeGroup association to a providedModeGroup ModeDeclarationGroupPrototype will result in the generation of a SchM_Switch API.	

6.3.3.7 SchM_Trigger

Function Name	SchM_Trigger
Syntax:	without queuing support: void SchM_Trigger_<bsnp>[_<vi>_<ai>]_<name>() with queuing support: Std_ReturnType SchM_Trigger_<bsnp>[_<vi>_<ai>]_<name>() <bsnp> BSW Scheduler Name Prefix 이름. 설정되어 있지 않은 경우 BswModuleDescription 이름. <vi> 호출하는 BSW module 의 VendorId 값 <ai> 호출하는 BSW module 의 vendorApiInfix 값 <Name> ReleasedTrigger 이름
Service ID	0x09
Sync/Async	NA
Reentrancy	NA
Parameters (In)	NA
Parameters (Inout)	None

Parameters (Out)	None	
Return Value	with queuing support: Std_ReturnType	with queuing support: RTE_E_OK : API 호출이 정상적으로 완료
		with queuing support: RTE_E_LIMIT : Queued 방식에서 큐가 가득 참
Description	외부 BswModuleDescription 의 BswSchedulableEntity(들)을 호출하는 함수이다.	
Preconditions	SchM_Trigger 호출 전 SchM_Init API 의 호출이 완료되어야 한다.	
Configuration Dependency	Source 단의 IssuedTrigger 가 ReleasedTrigger 를 참조하고, Sink 단의 IssuedTrigger 가 RequiredTrigger 를 참조하며, BswExternalTriggerConfig 에서 ReleasedTrigger 를 참조하고, BswRequiredTriggerConnection 에서 두 Trigger 를 맵핑시킬 때 SchM_Trigger API 가 생성된다.	

6.3.3.8 Enhanced SchM_Mode

Function Name	Enhanced SchM_Mode	
Syntax:	<return> SchM_Mode_<bsnp>[_<vi>_<ai>]_<name>(OUT<previousmode>,OUT <nextmode>) <bsnp> is the BSW Scheduler Name Prefix <vi> is the vendorId of the calling BSW module, <ai> vendorApiInfix of the calling BSW module and <name> is the required (requiredModeGroup) ModeDeclarationGroupPrototype name.	
Service ID	0x07	
Sync/Async	NA	
Reentrancy	NA	
Parameters (In)	NA	
Parameters (Inout)	None	
Parameters (Out)	<previousmode>	
	<nextmode>	
Return Value	Rte_ModeType_<M>	NA

Description	Provides the currently active mode of a mode switch port and also the mode currently being left and the mode being entered.
Preconditions	SchM_Init API needs to be called before Enhanced SchM_Mode is called.
Configuration Dependency	accessedModeGroup association to a providedModeGroup or requiredModeGroup ModeDeclarationGroupPrototype given that the attribute enhancedModeApi of the BswModeSenderPolicy set to true shall result in the generation of an Enhanced SchM_Mode API

6.3.3.9 SchM_ActMainFunction

Function Name	SchM_ActMainFunction	
Syntax:	without queuing support: void SchM_ActMainFunction_<bsnp>[_<vi>_<ai>]_<name>() with queuing support: Std_ReturnType SchM_ActMainFunction_<bsnp>[_<vi>_<ai>]_<name>() Where here <bsnp> is the BSW Scheduler Name Prefix, <vi> is the vendorId of the calling BSW module, <ai> vendorApiInfix of the calling BSW module and <name> is the associated BswInternalTriggeringPoint short name. <bsnp> BSW Scheduler Name Prefix 이름. 설정되어 있지 않은 경우 BswModuleDescription 이름. <vi> 호출하는 BSW module 의 VendorId 값 <ai> 호출하는 BSW module 의 vendorApiInfix 값 <Name> BswInternalTriggeringPoint 이름	
Service ID	0x05	
Sync/Async	NA	
Reentrancy	NA	
Parameters (In)	NA	
Parameters (Inout)	None	
Parameters (Out)	None	
Return Value	with queuing support: Std_ReturnType	with queuing support: RTE_E_OK : API 호출이 정상적으로 완료
		with queuing support: RTE_E_LIMIT

		: Queued 방식에서 큐가 가득 참
Description	BswModuleDescription 내부에서 다른 BswSchedulableEntity (들)을 호출하는 함수이다.	
Preconditions	SchM_ActMainFunction 호출 전 SchM_Init API 의 호출이 완료되어야 한다.	
Configuration Dependency	ActivationPoint 가 InternalTriggeringPoint 를 참조하고, BswInternalTriggerOccurredEvent 가 InternalTriggeringPoint 를 참조하며 BswInternalTriggerConfig 에서 InternalTriggeringPoint 를 참조할 때, SchM_ActMainFunction API 가 생성된다.	

6.3.3.10 SchM_SwitchAck

Function Name	SchM_SwitchAck	
Syntax:	Std_ReturnType SchM_SwitchAck_<bsnp>[_<vi>_<ai>]_<name>() <bsnp> is the BSW Scheduler Name Prefix, <vi> is the vendorId of the calling BSW module, <ai> vendorApiInfix of the calling BSW module and <name> is the required (requiredModeGroup) ModeDeclarationGroupPrototype name.	
Service ID	0x08	
Sync/Async	NA	
Reentrancy	NA	
Parameters (In)	NA	
Parameters (Inout)	None	
Parameters (Out)	None	
Return Value	Std_ReturnType	**SCHM_E_NO_DATA:** API 수행시 에러가 발생하지 않았다. **SCHM_E_TRANSMIT_ACK:** 모드 전환시 BswSchedulableEntitys 가 실행되고 disabling mode 가 새 모드로 전환되었다.
Description	The SchM_SwitchAck API takes no parameters – the return value is used to indicate the acknowledgement status to the caller.	
Preconditions	SchM_Init API needs to be called before SchM_SwitchAck is called.	

Configuration Dependency	Acknowledgement is enabled for a provided (providedModeGroup) ModeDeclarationGroupPrototype by the presence of an ackRequest attribute of the BswModeSender-Policy

6.3.3.11 Schm_CData

Function Name	Schm_CData	
Syntax:	void Schm_CData_<bsnp>[_<vi>_<ai>]_<name>() Where here <bsnp> is the BSW Scheduler Name Prefix, <vi> is the vendorId of the calling BSW module, <ai> vendorApiInfix of the calling BSW module and <Name> is the shortName of the ParameterDataPrototype.	
Service ID	NA	
Sync/Async	NA	
Reentrancy	NA	
Parameters (In)	NA	
Parameters (Inout)	None	
Parameters (Out)	None	
Return Value	Implementation Data Type	NA
Description	The Schm_CData API provides access to the defined calibration parameter Within a Basic Software Module. The actual data values for A Basic Software Module instance may be set after component compilation.	
Preconditions	SchM_Init API needs to be called before Schm_CData is called.	
Configuration Dependency	An Schm_CData API shall be created for each defined ParameterDataPrototype in the role perInstanceParameter	

6.3.4 E2E APIs

6.3.4.1 Single channel wrapper routines

6.3.4.1.1 E2EPW_Write

Function Name	E2EPW_Write		
Syntax:	uint32 E2EPW_Write_<p>_<o>(Rte_Instance <instance>, <data>) Where <p> is the port name and <o> the VariableDataPrototype name.		
Service ID	NA		
Sync/Async	Synchronous		
Reentrancy	Non Reentrant		
Parameters (In)	<instance>	SW-C instance	
Parameters (Inout)	<data>	Data to be protected and sent	
Parameters (Out)	NA		
Return Value	uint32		The byte 0(lowest byte) is the status of Rte_Write function: RTE_E_COM_STOPPED RTE_E_SEG_FAULT The byte 1 is the status of runtime checks done within E2E Protection Wrapper function: E2E_E_INPUTERR_NULL E2E_E_INTERR E2E_E_OK E2E_E_INVALID The byte 2 is the return value of E2E_PXXProtect function: E2E_E_INPUTERR_NULL E2E_E_INPUTERR_WRONG E2E_E_INTERR E2E_E_OK E2E_E_INVALID RTE_E_OK The byte 3 is a placeholder for future use and takes the following values: E2E_E_OK E2E_E_INVALID
Description	Initiates a safe explicit sender-receiver transmission of a safety-related data Element with data semantic. It protects data with E2E Library function E2E_PXXProtect and then it calls the corresponding Rte_Write function.		
Preconditions	E2EPW_WriteInit needs to be called before E2EPW_Write.		

Configuration Dependency	This Api will be generated if USES-END-TO-END-PROTECTION is set to true in the PROVIDED-COM-SPEC of corresponding P-PORT-PROTOTYPE and END-TO-END profile should be configured for this P-PORT-PROTOTYPE and VARIABLE-DATA-PROTOTYPE.

6.3.4.1.2 E2EPW_Read

Function Name	E2EPW_Read	
Syntax:	uint32 E2EPW_Read_<p>_<o>(Rte_Instance <instance>, <data>) Where <p> is the port name and <o> the VariableDataPrototype name.	
Service ID	NA	
Sync/Async	Synchronous	
Reentrancy	Non Reentrant	
Parameters (In)	<instance>	SW-C instance
Parameters (Inout)	NA	
Parameters (Out)	<data>	Data to received
Return Value	uint32	The byte 0(lowest byte) is the status of Rte_Read function: RTE_E_INVALID RTE_E_MAX_AGE_EXCEEDED RTE_E_NEVER_RECEIVED RTE_E_UNCONNECTED RTE_E_OK The byte 1 is the status of runtime checks done within E2E Protection Wrapper function, plus including bit extension checks: E2E_E_INPUTERR_NULL E2E_E_INPUTERR_WRONG E2EPW_E_DESERIALIZATION E2E_E_INTERR E2E_E_OK E2E_E_INVALID The byte 2 is the return value of E2E_PXXProtect function: E2E_E_INPUTERR_NULL E2E_E_INPUTERR_WRONG E2E_E_INTERR E2E_E_OK

		E2E_E_INVALID RTE_E_OK The byte 3 is the value of E2E_PXXReceiverStatusType Enumeration, representing the result of the verification of the Data in E2E Profile XX, determines by the Check function. E2EPXXSTATUS_NONEWDATA E2EPXXSTATUS_WRONGCRC E2EPXXSTATUS_INITIAL E2EPXXSTATUS_REPEATED E2EPXXSTATUS_OKSOMELOST E2EPXXSTATUS_OK E2EPXXSTATUS_WRONGSEQUENCE E2E_E_INVALID
Description	Performs safe explicit sender-receiver transmission of a safety-related communication data element with data semantic. The function calls optionally the corresponding function RTE_IsUpdated, Then it calls corresponding function Rte_Read and then checks received data with E2E_PXXCheck.	
Preconditions	E2EPW_ReadInit needs to be called before E2EPW_Read.	
Configuration Dependency	This Api will be generated if USES-END-TO-END-PROTECTION is set to true in the REQUESTED-COM-SPEC of corresponding R-PORT-PROTOTYPE and END-TO-END profile should be configured for this R-PORT-PROTOTYPE and VARIABLE-DATA-PROTOTYPE.	

6.3.4.1.3 E2EPW_WriteInit

Function Name	E2EPW_WriteInit	
Syntax:	uint8 E2EPW_WriteInit_<p>_<o>(Rte_Instance <instance>) Where <p> is the port name and <o> the VariableDataPrototype name.	
Service ID	0x15	
Sync/Async	Synchronous	
Reentrancy	Non Reentrant	
Parameters (In)	<instance>	SW-C instance
Parameters (Inout)	NA	
Parameters (Out)	NA	

Return Value	uint8	E2E_E_INTERR E2E_E_OK
Description	The function reinitializes the corresponding data structure after a detected error or at start up.	
Preconditions	Rte_Start API needs to be called before E2E_WriteInit is called.	
Configuration Dependency	This Api will be generated if USES-END-TO-END-PROTECTION is set to true in the PROVIDED-COM-SPEC of corresponding P-PORT-PROTOTYPE and END-TO-END profile should be configured for this P-PORT-PROTOTYPE and VARIABLE-DATA-PROTOTYPE.	

6.3.4.1.4 E2EPW_ReadInit

Function Name	E2EPW_WriteInit	
Syntax:	uint8 E2EPW_ReadInit_<p>_<o>(Rte_Instance <instance>) Where <p> is the port name and <o> the VariableDataPrototype name.	
Service ID	0x16	
Sync/Async	Synchronous	
Reentrancy	Non Reentrant	
Parameters (In)	<instance>	SW-C instance
Parameters (Inout)	NA	
Parameters (Out)	NA	
Return Value	uint8	E2E_E_INTERR E2E_E_OK
Description	The function reinitializes the corresponding data structure after a detected error or at start up.	
Preconditions	Rte_Start API needs to be called before E2E_ReadInit is called.	

Configuration Dependency	This Api will be generated if USES-END-TO-END-PROTECTION is set to true in the REQUESTED-COM-SPEC of corresponding R-PORT-PROTOTYPE and END-TO-END profile should be configured for this R-PORT-PROTOTYPE and VARIABLE-DATA-PROTOTYPE.

6.3.4.2 Redundant wrapper routines

6.3.4.2.1 E2EPW_Write1

Function Name	E2EPW_WriteInit	
Syntax:	uint32 E2EPW_Write1_<p>_<o>(Rte_Instance <instance>, <data>) Where <p> is the port name and <o> the VariableDataPrototype name.	
Service ID	NA	
Sync/Async	Synchronous	
Reentrancy	Non Reentrant	
Parameters (In)	<instance>	SW-C instance
Parameters (Inout)	<data>	Data to be protected and sent
Parameters (Out)	NA	
Return Value	uint32	The byte 0(lowest byte) is equal to E2E_E_OK (because Rte_Write is not invoked) The byte 1 is the status of runtime checks done within E2E Protection Wrapper function: E2E_E_INPUTERR_NULL E2E_E_INPUTERR_WRONG E2E_E_INTERR E2E_E_OK E2E_E_INVALID The byte 2 is the return value of E2E_PXXProtect function: E2E_E_INPUTERR_NULL E2E_E_INPUTERR_WRONG E2E_E_INTERR E2E_E_OK E2E_E_INVALID RTE_E_OK The byte 3 is a placeholder for future use and takes the following values:

		E2E_E_OK E2E_E_INVALID
Description	It protects data with E2E Library function E2E_PXXProtect. It does not call the corresponding Rte_Write function.	
Preconditions	E2EPW_WriteInit needs to be called before E2EPW_Write1.	
Configuration Dependency	This Api will be generated if USES-END-TO-END-PROTECTION is set to true in the PROVIDED-COM-SPEC of corresponding P-PORT-PROTOTYPE and END-TO-END profile should be configured for this P-PORT-PROTOTYPE and VARIABLE-DATA-PROTOTYPE.	

6.3.4.2.2 E2EPW_Write2

Function Name	E2EPW_Write2	
Syntax:	uint32 E2EPW_Write2_<p>_<o>(Rte_Instance <instance>, <data>) Where <p> is the port name and <o> the VariableDataPrototype name.	
Service ID	NA	
Sync/Async	Synchronous	
Reentrancy	Non Reentrant	
Parameters (In)	<instance>	SW-C instance
Parameters (Inout)	<data>	Data to be protected and sent
Parameters (Out)	NA	
Return Value	uint32	The byte 0(lowest byte) is the status of Rte_Write function: RTE_E_COM_STOPPED RTE_E_SEG_FAULT RTE_E_OK The byte 1 is the status of runtime Protects done within E2E Protection Wrapper function: E2E_E_INPUTERR_NULL E2E_E_INPUTERR_WRONG E2E_E_INTERR E2E_E_OK E2E_E_REDUNDANCY

		The byte 2 is the return value of E2E_PXXProtect function: E2E_E_INPUTERR_NULL E2E_E_INPUTERR_WRONG E2E_E_INTERR E2E_E_OK E2E_E_INVALID The byte 3 is a placeholder for future use and takes the following values: E2E_E_OK E2E_E_INVALID
Description	Initiates a safe explicit sender-receiver transmission of a safety-related data element with data semantic. It protects data with E2E Library function E2E_PXXProtect, compares the computed control fields with ones computed by Write1, and then it calls the corresponding Rte_Write function.	
Preconditions	E2EPW_WriteInit needs to be called before E2EPW_Write2.	
Configuration Dependency	This Api will be generated if USES-END-TO-END-PROTECTION is set to true in the PROVIDED-COM-SPEC of corresponding P-PORT-PROTOTYPE and END-TO-END profile should be configured for this P-PORT-PROTOTYPE and VARIABLE-DATA-PROTOTYPE.	

6.3.4.2.3 E2EPW_Read1

Function Name	E2EPW_Read1	
Syntax:	uint32 E2EPW_Read1_<p>_<o>(Rte_Instance <instance>, <data>) Where <p> is the port name and <o> the VariableDataPrototype name.	
Service ID	NA	
Sync/Async	Synchronous	
Reentrancy	Non Reentrant	
Parameters (In)	<instance>	SW-C instance
Parameters (Inout)	NA	
Parameters (Out)	<data>	Data to received
Return Value	uint32	The byte 0 (lowest byte) is the status of Rte_Read function: RTE_E_INVALID RTE_E_MAX_AGE_EXCEEDED RTE_E_NEVER_RECEIVED

		RTE_E_UNCONNECTED RTE_E_OK The byte 1 is the status of runtime checks done within E2E Protection Wrapper function: E2E_E_INPUTERR_NULL E2E_E_INTERR E2EPW_E_DESERIALIZATION E2E_E_OK E2E_E_INVALID The byte 2 is the return value of E2E_PXXCheck function: E2E_E_INPUTERR_NULL E2E_E_INPUTERR_WRONG E2E_E_INTERR E2E_E_OK E2E_E_INVALID The byte 3 is value of E2E_PXXReceiverStatusType Enumeration, representing the result of the verification of the Data in E2E Profile XX, determined by the check function. E2EPXXSTATUS_NONEWDATA E2EPXXSTATUS_WRONGCRC E2EPXXSTATUS_INITIAL E2EPXXSTATUS_REPEATED E2EPXX_STATUS_OK E2EPXXSTATUS_OKSOMELOST E2EPXXSTATUS_WRONGSEQUENCE E2E_E_INVALID
Description	Performs safe explicit sender-receiver transmission of a safety-related communication data element with data semantic. The function calls optionally the corresponding function RTE_IsUpdated, Then it calls corresponding function Rte_Read and then checks received data with E2E_PXXCheck.	
Preconditions	E2EPW_ReadInit needs to be called before E2EPW_Read1.	
Configuration Dependency	This Api will be generated if USES-END-TO-END-PROTECTION is set to true in the REQUESTED-COM-SPEC of corresponding R-PORT-PROTOTYPE and END-TO-END profile should be configured for this R-PORT-PROTOTYPE and VARIABLE-DATA-PROTOTYPE.	

6.3.4.2.4 E2EPW_Read2

Function Name	E2EPW_Read2	
Syntax:	uint32 E2EPW_Read2_<p>_<o>(Rte_Instance<instance>, <data>) Where <p> is the port name and <o> the VariableDataPrototype name.	
Service ID	NA	
Sync/Async	Synchronous	
Reentrancy	Non Reentrant	
Parameters (In)	<instance>	SW-C instance
Parameters (Inout)	NA	
Parameters (Out)	<data>	Data to received
Return Value	uint32	The byte 0 (lowest byte) equal to RTE_E_OK (because Rte_Read is not invoked) The byte 1 is the status of runtime checks done within E2E Protection Wrapper function: E2E_E_INPUTERR_NULL E2E_E_INTERR E2EPW_E_DESERIALIZATION E2E_E_OK E2E_E_INVALID The byte 2 is the return value of E2E_PXXCheck function: E2E_E_INPUTERR_NULL E2E_E_INPUTERR_WRONG E2E_E_INTERR E2E_E_OK E2E_E_INVALID The byte 3 is value of E2E_PXXReceiverStatusType Enumeration, representing the result of the verification of the Data in E2E Profile XX, determined by the check function. E2EPXXSTATUS_NONEWDATA E2EPXXSTATUS_WRONGCRC E2EPXXSTATUS_INITIAL E2EPXXSTATUS_REPEATED E2EPXXSTATUS_OK E2EPXXSTATUS_OKSOMELOST E2EPXXSTATUS_WRONGSEQUENCE

		E2E_E_INVALID
Description	The function re-checks the data received with corresponding function Read1 by means of execution of E2E_PXXCheck.	
Preconditions	E2EPW_ReadInit needs to be called before E2EPW_Read2.	
Configuration Dependency	This Api will be generated if USES-END-TO-END-PROTECTION is set to true in the REQUESTED-COM-SPEC of corresponding R-PORT-PROTOTYPE and END-TO-END profile should be configured for this R-PORT-PROTOTYPE and VARIABLE-DATA-PROTOTYPE.	

6.3.4.3 E2E COM CALLOUTS

6.3.4.3.1 IPDU_e2EProtect_<IPDU ID>

Function Name	IPDU_e2EProtect_<IPDU ID>	
Syntax:	FUNC(Boolean, COM_APPL_CODE) IPDU_e2EProtect_<IPDU ID>(PduIdType id, P2VAR (uint8, AUTOMATIC, COM_VAR_NOINIT) ipduData)	
Service ID	NA	
Sync/Async	Synchronous	
Reentrancy	Non Reentrant	
Parameters (In)	<instance>	SW-C instance
	<IPDU ID>	Pdu Id
	<ipduData>	Pdu Data
Parameters (Inout)	NA	
Parameters (Out)	NA	
Return Value	Boolean	TRUE FALSE
Description	Initiates a safe explicit sender-receiver transmission of a safety-related data Element with data semantic. It protects data with E2E Library function E2E_PXXProtect and then it calls the corresponding Rte_Write function.	

Preconditions	NA
Configuration Dependency	This Api will be generated if END-TO-END-PROTECTION-I-SIGNAL-I-PDU is configured in PROVIDED-COM-SPEC.

6.3.4.3.2 IPDU_E2Echeck_<IPDU ID>

Function Name	IPDU_E2Echeck_<IPDU ID>	
Syntax:	FUNC(Boolean, COM_APPL_CODE) IPDU_e2ECheck_<IPDU ID>(PduIdType id, P2CONST (uint8, AUTOMATIC, COM_VAR_NOINIT) ipduData)	
Service ID	NA	
Sync/Async	Synchronous	
Reentrancy	Non Reentrant	
Parameters (In)	<instance>	SW-C instance
	<id>	Pdu Id
	<ipduData>	Pdu Data
Parameters (Inout)	NA	
Parameters (Out)	NA	
Return Value	Boolean	TRUE FALSE
Description	Initiates a safe explicit sender-receiver transmission of a safety-related data Element with data semantic. It protects data with E2E Library function E2E_PXXCheck and then it calls the corresponding Rte_Read function.	
Preconditions	NA	
Configuration Dependency	This Api will be generated if END-TO-END-PROTECTION-I-SIGNAL-I-PDU is configured in PROVIDED-COM-SPEC.	

7. Generator

7.1 Generator Option

Options	*Description*
-O/-Output	Output Directory 를 설정한다.
-I/-Input	Input Directory 를 설정한다.(하위 폴더를 포함한 Input Directory 의 모든 Arxml 을 Input 으로 처리한다.)
-L/-Log	Generation 과정에 대한 로그를 파일로 출력한다. (Rte.log)
-H/-Help	사용법에 대한 도움말을 화면에 출력한다.
-V/-Version	CopyRight 정보와 Tool Version 을 화면에 출력한다.
-GenMemMap	Application 의 MemMap Header 를 생성한다. ([AppISWC]_MemMap.h)
-GenMemMapOption::Tasking	Tasking Compiler 를 위한 Rte_MemMap.h Header File 을 생성한다.
-GenMemMapOption::Ghs	GreenHill Compiler 를 위한 Rte_MemMap.h Header File 을 생성한다.
-GenMemMapOption::GhsFreescale	GreenHill Compiler 를 위한 Rte_MemMap.h Header File 을 생성한다(Freescale OS 에서 제공하는 Os_memmap.h Header File 을 이용).
-StrictConfigChk	모든 Validation Check 를 생략한다.
-StrictUnconnRPortChk	Unconnected RPort 에 대한 Validation Check 를 생략한다.
-StrictInitValChk	InitialValue 에 대한 Validation Check 를 생략한다.
-INT	DataConversion 시에 Integer 값만을 사용한다.
-IOC	Inter Partition Communication 을 위한 Ioc Arxml 을 생성한다.
-IOC::GenEcudOs	Inter Partition Communication 을 위한 Osloc Configuration 을 기존의 Os Ecud Arxml 에 추가한 Gen_Ecud_Os.arxml 을 생성한다.
-Validate	강화된 Validation Check 를 실행한다.
-OsSecPerTick=[OsSecondsPerTickValue]	OsSecondsPerTick 값을 모든 Counter 에 적용한다.
-OsSecPerHwTick=[OsSecondsPerTickValue]	OsSecondsPerTick 값을 모든 HwCounter 에 적용한다.
-CustomPrefix	Os Object 에 대한 AUTOEVER 의 Default Prefix 를 생략한다. (OsConf_[OsObjectType])
-TaskPrefix=[OsTaskPrefixString]	Task 의 Prefix 를 지정한다. 이 옵션은 CustomPrefix Option 과 같이 사용되어야 한다.
-ErrorMsgOnly	Error Message 만 출력한다.(Warning 생략)
-ImmediateBufferUpdate=[true/false]	True 인 경우에는, Runnable 의 앞, 뒤에서 실제로 Data 를 전송한다. False 인 경우에는 Same Preemption Area 에 속한 경우에는

	Runnable 의 앞, 뒤에서 실제로 전송하고 Other Preemption Area 에 속한 경우에는 Task 의 앞, 뒤에서 실제로 전송한다.
-ImplicitSRMacro	Implicit Sender Receiver 의 GlueCode 를 Function 형태가 아닌 Macro 형태로 출력한다.
-NoRteReceiverPullCB	특정 유스케이스에서 Rte_ReceiverPullCB 사용을 줄여 Sender Receiver Inter Partition 통신에 대한 최적화된 코드를 생성한다.
-ParameterDirection	IN, OUT, INOUT 매크로 사용을 활성화하며 Rte API 와 Runnable Prototype 생성시 IN, OUT, INOUT 매크로를 사용한다.

7.2 Generator Error Message

Number	*Message*
1	Name of output directory is not given along with -O option. Name of input directory is not given along. with -Input option. This error occurs, when the output directory is not mentioned along with -O/-OUTPUT option.
	The input file <file name> is repeated more than once. Tool provides the above warning, if the input ECU Configuration Description File having same name is repeated twice. * This Error can be reported whenever the generator faces both error conditions.
2	Option is Invalid. This error occurs, when the options given on command line are other than (-O/-OUTPUT, -V/-VERSION, -H/-HELP, -L/-LOG, -GenMemMap, -C /-CONTRACT, - BSC / -BASIC SOFTWARE SCHEDULER CONTRACT PHASE, - PCC / - PREBUILD DATA SET CONTRACT PHASE, -BSG / -BASIC SOFTWARE SCHEDULER GENERATION PHASE, -G / - RTE GENERATION PHASE, - PCG / -PREBUILD DATA SET GENERATION PHASE, - PBG / - POST BUILD DATA SET GENERATION PHASE, -EXCLFUNC, -E2E_SINGLE, -E2E_REDUNDANT, -E2E_BYPASS, -CSMACRO, StrictConfigChk, StrictUnconnRPortChk, StrictInitValChk,-Error, -IOC).
3	Invalid output directory <output directory name> as the file with same name exists. This error occurs, if the name of the output directory mentioned is same as that of filename in the working directory.
4	The input directory path <input_dir> provided along with <-i/-input> option does not exist. This error occurs, if the input directory path <$input_dir> provided along with <-i/-input> option does not exist.
5	Invalid output directory. This error occurs, if the mentioned output directory is Invalid.
6	File <file name> does not exist. This error occurs, if input file name mentioned in the command line is not present in the working directory.
7	The ECU Configuration Description File / Atomic SW-Component Description File are not provided as input to the Tool. This error occurs, if output directory is mentioned along with –O option but ECU Configuration Description File / Atomic SW-Component Description File is not provided as input to the Generation Tool.

8	Cannot open <file name> file. This error occurs, when Log file (Rte.log) could not be opened.
9	Both -CONTRACT and -GENERATION options are specified. Rte Generation Tool can execute in one phase at a time. This error occurs when both -CONTRACT and -GENERATION options are specified. Rte Generation Tool can execute in one phase at a time.
10	The LOWER-LIMIT value <VALUE> and UPPER-LIMIT value <VALUE> in COMPU-SCALE for ENUM Datatype <DATA TYPE> should be identical as the category is TEXTTABLE. Tool will provide an error message if the value configured for lower limit and upper limit of a compu scale are different when the category is TEXTTABLE.
11	The VT value configured within the COMPU-CONST class has to be unique in the whole AUTOSAR system. Tool will provide an error message if the value configured for VT element of each compu const class is not unique.
12	ClientId (NUMERICAL-VALUE-SPECIFICATION) is not configured for the Request, under the container ISIGNAL for corresponding SYSTEM-SIGNAL. This error occurs if, ClientId (NUMERICAL-VALUE-SPECIFICATION) is not configured for the Request, under the container ISIGNAL for corresponding SYSTEM-SIGNAL.
13	More than one MODE-DECLARATION-GROUPS configured with same SHORT-NAME <ShortName> and different MODE-DECLARATIONS. Tool will provide an error message if multiple ModeDeclarationGroups with same short name but different ModeDeclarations are configured.
14	BASE-TYPE-REF or IMPL-TYPE-REF parameter is not configured for IMPLEMENTATION-DATA-TYPE-ELEMENT<Path> within the SW-POINTER-TARGET-PROPS. This error occurs, if the parameter Sw-Base-Type or Impl-type-ref is not configured within the container Sw-Target-Props of Sw-Definition-Condition.
15	The SYS-REF Parameter value <VALUE> in SW-SYSCOND for this <'PATH'> is not valid. This error occurs, if the Reference value in SW-SYSCOND of (RUNNABLE ENTITY, BSW-SCHEDULABLE-ENTITY, and EXCLUSIVE AREA) specified is not valid.
	The VENDOR-ID parameter in BSW-IMPLEMENTATIONis not configured for BSW-MODULE-DESCRIPTION * This Error can be reported whenever the generator faces both error conditions.
16	Both SchmEnableMacroname and SchMDisableMacroName should be configured, when BswExArealmpl is configured as USER_DEFINED_MACRO <Exclusive Area Path>. This error occurs, if either SchmEnableMacroname or SchMDisableMacroName is not configured when BswExArealmpl is configured as USER-DEFINED-MACRO.
17	The SHORT-NAME <Shortname> for all POST-BUILD-VARIANT-CRITERION must be unique. Tool will provide an error message if duplicate name exists for post build variant criterions.
18	The SHORT-NAME <Shortname> across SW-SYSTEMCONST must be unique. Tool will provide an error message if duplicate name exists for Sw-System-Const.
19	HANDLE-OUT-OF-RANGE-STATUS should not be set to INDICATE for the Queued Receiver Com Spec.

	Tool will provide an error message if HANDLE-OUT-OF-RANGE-STATUS is set to INDICATE for the Queued Receiver Com Spec.
20	The POST-BUILD-VARIANT-CRITERION-VALUE-SET-REF parameter is not configured in PREDEFINED-VARIANT <pre_path>. Tool will provide an error message if Post Build variant criterion value set reference is not set.
21	More than one same SHORT-NAME <Short name> in SW-SYSTEMCONSTANT-VALUE-SET value exists. Tool will provide an error message if duplicate pre-compile criterion value is present.
22	The SW-SYSTEMCONSTANT-VALUE-SET-REF parameter is not configured in SW-SYSTEMCONSTANT-VALUE-SET <Shortname>. Tool will provide an error message if sw-systemconstant value set path is not referred in Sw-System-Constant-Value-Set.
23	More than one Background task is configured. This error occurs, if more than one background task exists.
24	Background Task is not having the lowest priority of the core. This error occurs, if Background Task is not assigned lowest priority.
25	More than one OsAlarm is referred to activate the same Basic Task. This error occurs, if more than one OsAlarm reference is configured to activate the basic task basic.
26	Different OsAlarms or OsScheduleTableExpiryPoints should be referred to set the OsEvents in all the RteEventtoTaskMappings which are mapped to same extended task. If All the RteEventtoTaskMappings are referring different OsEvents Different Period or Offset values are configured to set the same OsEvent. This error occurs, if in an extended task RteEventtoTaskMapping or RteBswEventtoTaskMapp--Ings should refer to different OsAlarms or OsScheduleTableExpiryPoints.
27	Event Type <EventType> is referred in more than one RteBswEventToTaskMapping. This error occurs, if in an Event is referred in more than one RteBswEventtoTaskMappings.
28	The 'RteEventRef' configured in 'RteEventtoTaskMapping' or "RteBswEventto--TaskMappings" is not a valid. Tool will provide an error message if the event in RteEventRef configured is not a valid.
29	The parameters RteUsedOsAlarmRef and RteUsedOsScheduleTableExpiryPoint -Ref or RteBswUsedOsAlarmRef and RteBswUsedOsScheduleTableExpiryPointRef should not be configured when the RTE Event or BSW Event referred using the parameter 'Rteevent' is not TIMING-EVENT or BACKGROUND-EVENT. Tool will provide an error message if the Event mapped in RteEventRef/RteBswEventRef of RteEventtoTaskMapping/RteBswEventtoTaskMapping is neither a TIMINIG-EVENT Nor BACKGROUND-EVENT in Which OsAlarm or ScheduleTableExpiryPoint is referring.
30	Duplicate RtePositionInTask configured for OsTask<PATH>. Tool will provide an error message if same RtePositionInTask is configured for an OsTask.
31	Both the parameters RteUsedOsAlarmRef/RteBswUsedOsAlarmRef and RteUsedOsScheduleTableExpiryPointRef/ RteBswUsedOsScheduleTableExpiryPointRef are configured, while the RteEventRef/ RteBswEventRef are referring to TIMING-EVENT or BACKGROUND-EVENT in RteEventtoTaskMapping/ RteBswEventtoTaskMapping.

	Tool will provide an error message if both OsAlarm and OsScheduleTableExpiryPoint are referred in RteEventtoTaskMapping or if both OsAlarm and OsScheduleTableExpiryPoint are referred in RteBswEventtoTaskMapping.
32	More than one RteEventtoTaskMappings which are referring to the same Extended OsTask but UsedOsEventRef is not configured in all the RteEventtoTaskMappings in OsTask This error occurs, if in Extended Task same OsTask is referred in RteEventtoTaskMappings but UsedOsEventRef is not configured in all the RteEventtoTaskMappings in OsTask.
33	The OsAlarm and OsScheduleTableExpiryPoint mapped to OsTask <ostask_path >which is not having lowest priority in RteEventtoTaskMapping. Tool will provide an error message if the OsAlarm and OsScheduleTableExpiryPoint are mapped to OsTask which is not having lowest priority in RteEventtoTaskMapping.
34	ActivationOsAlarmRef/ BswActivationOsAlarm Ref should be configured in RteEventtoTaskMapping if minimum start interval is configured > 0. Tool will provide an error message, if ActivationOsAlarmRef/ BswActivationOsAlarm Ref is not configured in RteEventtoTaskMapping even though minimum start interval is configured >0.
35	Runnable Entity is mapped to more than one OsTask, Concurrent activation is forbidden for this i.e. CanBeInvokedConcurrently Attribute set to false i.e. both the tasks can preempt each other. Tool will provide an error message if Runnable Entity is mapped to more than one OsTask when CanBeInvokedConcurrently Attribute Set to false and the mapped tasks have different task schedule settings.
36	START-ON-EVENT-REF referred in <EventType> is not a valid RunnableEntity. Tool will provide an error message if invalid runnable entity consisting of event referring to START-ON-EVENT-REF.
37	Schedulable Entity is mapped to more than one OsTask i.e. CanBeInvokedConcurrently attribute set to false. Tool will provide an error message if BswSchedulable Entity is mapped to more than one OsTask when CanBeInvokedConcurrently Attribute Set to false.
38	START-ON-EVENT-REF referred is not a valid Schedulable Entity Path. Tool will provide an error message if invalid Schedulable Entity path is referred in START-ON-EVENT-REF.
39	OsCounter referred in OsAlarm is not valid Os Counter reference. This error occurs, if there is invalid OsCounter reference in OsAlarm.
40	OsCounter referred in OsScheduleTable is not a valid Os Counter reference. This error occurs, if there is invalid OsCounter reference in OsScheduleTable.
41	Same VARIANT-CRITERION-REF parameter<variant-criterion-ref> is referred more than once in EVALUATED-VARIANT-REFS <Evaluated-variant-ref>. Whenever VARIANT-CRITERION path is referenced in VARIANT-CRITERION-REF parameter of EVALUATED-VARIANT-REFS more than once this error will be thrown.
42	The PREDEFINED-VARIANT-REFS<References> is not configured in ECUC-RESOLVER in ECU file. This error occurs, if post build criterion value set path is referred instead of prebuild criterion value set path in ECUC variant Resolver.
43	Mandatory parameter in container is not configured.

	This error occurs, when the Mandatory parameter in container is not configured.
44	OS Component configuration is not present in the input file(s). This error occurs, if value for RTEEventRef is configured inside RunnableEntityMapping container and OS Component is not present in the input ECU Configuration Description File(s).
45	Mandatory parameter 'parameter name' is not configured in container 'container name'. Tool provides the above error, if the following mandatory parameters are not configured in respective containers. ※ Refer to end of this table
46	Runnable Symbol <Runnable Entity Symbol> provided for the parameter 'RUNNABLE-SYMBOL' should be unique across all the Runnable Entities. This error occurs, if runnable symbol name is not unique across the entire software component description file
47	Enable update value is set to true in NonQueuedRecieverComSpec of Data read access variable type<Com Spec Path>, <Variable Access Path>. This error occurs, if Data Read access variable type is set with enable update true value in NonQueuedRecieverComSpec of R-Port-type.
48	Port <PortPath> is having an M:N connection RTE does not support M:N connections. This error occurs, if port is having multiple sender and multiple receiver connection.
49	Both Synchronous Server Call point and Asynchronous Call point is referring to same client server operation. This error occurs, if Both Synchronous Server Call point and Asynchronous Call point are referring to same client server operation.
50	Interface name is not configured for the Port<Port Path>. This error occurs, if Sender receiver/client server interface path is not configured for the mentioned port.
51	PortPath should be configured for ModeSwitchPoints within the modes. This error occurs, if port is not referred in ModeSwitchPoints configured within modes.
52	The Init value within the Non Queue Receiver Com Spec <port> doesn't match with the variable data prototype init value. This error occurs, when different Init Values are configured within Non Queue Receiver Com Spec and Variable Data Prototype.
53	Vendor Id not configured for the BSW Implementation Data Type<impl_path> This error occurs, when Vendor Id not configured for the BSW Implementation Data Type<impl_path>.
54	The queue type configured for variable Data prototype <path >is of type 'MEASUREMENT-POINT'. This error occurs, when queue type parameter is set to MEASUREMENT-POINT in Variable data prototype.
55	DatatypeMappingset is not configured for <Mode Declaration Group>. This error occurs, when Data Type Mapping Set path is not referred in <Mode Declaration Group>.

56	ServerArgumentImplPolicy should be set to UseArrayBaseType only for the data type of category 'ARRAY'. This error occurs, when ServerArgumentImplPolicy is set to UseArrayBaseType when data type category is not of type 'ARRAY'.
57	WAIT-POINT should not be configured for the RUNNABLE-ENTITY <run_path> which is using Exclusive area in the role RUNS-INSIDE-EXCLUSIVE-AREA. This error occurs, when WAIT-POINT is configured for the RUNNABLE-ENTITY <run_path> which is using Exclusive area in the role RUNS-INSIDE-EXCLUSIVE-AREA
58	ServerArgumentImplPolicy should be set to UseVoid only for the< DATA -TYPE> whose data type category is either of primitive or pointer data type. This error occurs, when ServerArgumentImplPolicy is not set to UseVoid for the PRIMITIVE or POINTER Data Type.
59	Different Queue Length is configured for the P-ports sharing the same Runnable <Run-Symbol>. This error occurs, when a client is request from more than one Server of Port Path.
60	A client <component> cannot request from more than one Server of Port Path. This error occurs, when client port is connected to more than one server port for the same operation element.
61	ClientServerOperation has an ArgumentDataPrototype whose ImplementationDataType is of category DataReference and direction is OUT or INOUT This error occurs, when direction is not configured as OUT/INOUT for Argument data prototype within ClientServerOperation for the Implementation data type of category 'DATA_REFERENCE'.
62	Queue Length in ServerComSpec of P-PORT should be greater than zero<Path>. This error occurs, when Queue Length in ServerComSpec of P-PORT is configured less than zero.
63	The NV Ram Block is not configured in NvBlockDescriptors <Path>. This error occurs, when the Nv Ram Block is not configured in NvBlockDescriptors <Path>.
64	The Data Type referred in RamBlock and RomBlock of NvBlockDescriptors are of different type. This error occurs, when the data types referred in RamBlock and RomBlock of NvBlockDescriptors are of different compatible types.
65	Data type referred in read nv data written nv data and ram block are not of compatible types. This error occurs, when Variable Data Prototype is referred in read NV data and written NV data are not of compatible types.
66	The TransmissionAcknowledgementRequest attribute for transmission acknowledgment for 1: n communication is configured and is invalid. This error occurs, when TransmissionAcknowledgementRequest is configured for P-Port, in case of 1: n communication.
67	Either SYMBOL or SHORT-LABLE or valid c identifier for VT-ELEMENT should be configured for the COMPU-METHOD if the CATEGORY attribute is configured as TEXTTABLE or SCALE_LINEAR_AND_TEXTTABLE or SCALE_RATIONAL_AND_TEXTTABLE. This error occurs, when Either SYMBOL or SHORT-LABLE or valid c identifier for VT-ELEMENT is not configured for the COMPU-METHOD.
68	The timeout value for transmission acknowledgement and wait point is not same which is invalid.

	This error occurs, when the timeout value and the wait point value are not the same.
69	The Event is referencing a RunnableEntity and is referenced by a WaitPoint which is invalid. This error occurs, when the Event <event> is referencing a RunnableEntity and is referenced by a WaitPoint which is invalid.
70	NATIVE-DECLARATION <Path> configured is not a valid-'C' data type. This error occurs, when a Native declaration path provided, is not pointing to a valid 'C' data type.
71	The RunnableEntity that has a WAIT-POINT must not be referenced by an event_actual_name. This error occurs, when RunnableEntity that has a WAIT-POINT is referenced by an event_actual_name.
73	The HANDLE-TERMIATION-AND-RESTART parameter should be set to CAN-BE-TERMINATED-AND-RESTARTED for the SOFTWARE-COMPONENT-PROTOTYPE which mapped to an ECU-PARTITION with PARTITION-CAN-BE-RESTARTED parameter set to true This error occurs, when the HANDLE-TERMIATION-AND-RESTART parameter is not set to CAN-BE-TERMINATED-AND-RESTARTED for the SOFTWARE-COMPONENT-PROTOTYPE which mapped to an ECU-PARTITION with PARTITION-CAN-BE-RESTARTED parameter set to true
74	A single task cannot be mapped to more than one Partition. Task <Task Path> of <Software Component Name> is mapped to the following Partition <Partitions Path>. This error occurs, when a single task is mapped to more than one partition.
75	ExclusiveAreaMechanism parameter is not configured in ExAreaImpl container of ExclusiveAreaRef of <Path>. This error occurs, when ExclusiveAreaImplMechanism parameter is not configured in ExAreaimpl container of ExclusiveAreaRef.
76	The SWC <Path> should have an internal behavior. This error occurs, when mention SWC path does not have an internal behavior.
77	Data Type is not referred in TypeTRef parameter of Per Instance Parameter of given <path>. This error occurs, when Data Type is not referred in TypeTRef parameter of Per Instance Parameter of given <path>.
78	The nativeDeclaration in SwBaseType referred by ImplementatinDataTypes needs to be configured. This error occurs, when native declaration is not configured for the BASE-TYPE.
79	Type parameter is not configured in Per-Instance_Memory of <Path>. This error occurs, when type parameter is not configured in Per-Instance_Memory.
80	TypeDefinition parameter is not configured in Per-Instance_Memory of< Path >. This error occurs, when type definition parameter is not configured in Per-Instance_Memory.
81	Data Type is not referred in TypeTRef parameter of ArTyped-Per-Instance_Memory of< path >. This error occurs, when data type is not referred in TypeTRef parameter of ArTyped-Per-Instance_Memory.
85	OsScheduleTableExpiryPointOffset is not configured in <path>. This error occurs, when OsScheduleTableExpiryPointOffset is not configured in given path.

86	REQUIRE-PORTS <port_path> Should not be configured for PARAMETER-SW-COMPONENT-TYPE <SWC> This error occurs, when REQUIRE-PORTS is configured for PARAMETER-SW-COMPONENT-TYPE <SWC>.
87	OnTransitionValue is not configured for the MODE-DECLARTION_GROUP of Category Type 'EXPLICIT-ORDER' of given <path>. This error occurs, when OnTransitionValue is not configured for the MODE-DECLARTION_GROUP of Category Type 'EXPLICIT-ORDER' of given <path>.
89	Mapping is not possible for the given vdps as DataProtoMapping direction should be PPort to RPort. This error occurs, when the DataProtoMapping direction is not PPort to RPort and Try to map for given vdps.
91	The value configured for the parameter CATEGORY should be either PROFILE_01 or PROFILE_02 or NONE. This error occurs, when the value configured for the parameter CATEGORY will not be either PROFILE_01 or PROFILE_02 or NONE.
92	Counter offset should be configured for the EndToEndProfile. This error occurs, when Counter offset is not configured for the EndToEndProfile.
93	DataIDMode should be configured for the EndToEndProfile. This error occurs, when DataIDMode is not configured for the EndToEndProfile.
94	CrcOffset should be configured for the EndToEndProfile. This error occurs, when CrcOffset is not configured for the EndToEndProfile.
95	DataLength should be configured for the EndToEndProfile. This error occurs, when DataLength is not configured for the EndToEndProfile.
96	Minimum start interval should be a positive number value in runnable path. This error occurs, when Minimum start interval value in runnable entity <Path> is not a positive number.
98	The OsTask path is not referred in RteTaskComMapping container. This error occurs, when The OsTask path is not referred in RteTaskComMapping container.
99	Redundant CRC element found This error occurs, when redundant CRC element found.
100	Redundant COUNTER element found This error occurs, when redundant COUNTER element found.
101	All the R-Ports connected to the specific P-Port should be mapped to same partition. This error occurs, when R-Ports connected to the specific P-Port are not mapped to same partition.
102	All the ModeSwitchEvents of the R-Ports connected to the specific P-Port should be mapped to the same task. This error occurs, when R-Ports connected to the specific P-Port are not mapped to same task.
103	Variable Data Prototype is not referred in Invalidation Policy. This error occurs, when Variable Data Prototype is not referred in Invalidation Policy.

104	Handle Invalid Value is not configured in Invalidation Policy. This error occurs, when Handle Invalid Value is not configured in Invalidation Policy.
105	ModeDisablingDependency cannot be configured for OperationInvokedEvent of <Event Path>. This error occurs, when ModeDisablingDependency is configured for OperationInvokedEvent of mentioned Event Path.
106	Value of a Mode cannot be more than the range of its ModeDeclarationGroup the Mode has the value which is more than the range specified by its ModeDeclarationGroup. This error occurs, when Mode is having the value which is more than the range specified by its ModeDeclarationGroup.
107	The port path configured in ModeScheduleTableMap for Software Component is not a P-Port Path < port_path >. This error occurs, when the port path configured in ModeScheduleTableMap for Software Component is not a P-Port Path.
108	Different Timeout values are configured for the AsynchronousServerCallpoint and for the WaitPoint associated with the AsynchronousServerCallReturnsEvent for this AsynchronousServerCallPoint. Same values should be configured. This error occurs, when the WaitPoint for AsynchronousServerResultCallPoint and timeout for AsynchrnousServerCallPoint is not same.
109	MINIMUM-START-INTERVAL should not be configured and should not set to greater than 0 when CAN-BE-INVOKED-CONCURRENTLY is true. This error occurs, when the MINIMUM-START-INTERVAL is configured when CAN-BE-INVOKED-CONCURRENTLY is true.
110	In DELEGATION-SW-CONNECTOR, INNER PORT path should be SW-COMPONENT-PROTOTYPE and OUTER Port path should be COMPOSITION-SW-COMPONENT-TYPE. But for this DELEGATION-SW-CONNECTOR Inner and Outer port are same
112	The Handle Out Of Range for Queue Receive Com Spec <dataElementRef> should not be INVALIDATE or DEFAULT or EXTERNAL-REPLACEMENT. This error occurs, when the Handle Out Of Range for Queue Receive Com Spec is configured as INVALID or DEFAULT or EXTERNAL-REPLACEMENT.
113	INIT-VALUE should be configured for the VARIABLE-DATA-PROTOTYPE <vdp> when the strictInitialValuesCheck is enabled and SwAddrMethod has a sectionInitializationPolicy set to init. This error occurs, when INIT-VALUE is not configured for the VARIABLE-DATA-PROTOTYPE <vdp> when the strictInitialValuesCheck is enabled and SwAddrMethod has a sectionInitializationPolicy set to init.
114	The INIT-VALUES should be configured for the port in NONQUEUED-RECEIVER-COM-SPEC when filter is configured. This error occurs, when the filter is configured in NONQUEUED-RECEIVER-COM-SPEC and INIT-VALUE is not given in port.
115	RunInsideExclusiveArea is configured for the BswCalledEntity of given path This error occurs, when the RunInsideExclusiveArea is configured for the BswCalledEntity of given path.
116	Runnable Entity or Schedulable Entity mapped to different tasks should have same schedule point settings. This error occurs, when Runnable entity or Schedulable entity <run_ref >mapped to different

	tasks are not having same schedule point settings.
117	Rte Event <eve_path> should not be mapped to only virtual task. This error occurs, when the Rte Event <eve_path> is mapped to only virtual task.
118	IMPLEMENTATION-DATA-TYPE <impl_path> and APPLICATION-DATA-TYPE <appl_data> configured in SWC <swc_name> are referring to compu methods which are having duplicate UPPER-LIMIT or LOWER-LIMIT for their Compu Scales This error occurs, when IMPLEMENTATION-DATA-TYPE and APPLICATION-DATA-TYPE configured in SWC are referring to compu methods which are having duplicate UPPER-LIMIT or LOWER-LIMIT for their Compu Scales.
119	One or more Runnable Entities of same component is mapped to tasks of different partition. The Events in below sw component has been mapped to different partitions This error occurs, when Runnable Entity is mapped to tasks of different partitions.
120	Timing Events which are implemented based on the Schedule table, can not have offset value bigger than zero. This error occurs, when the Runnables of different offset mapped to the same Schedule Table< sched_path > and all offset value must be set as "Zero".
121	BswEvent is mapped only to virtual task. This error occurs, when the Event <eve_path> is not mapped to virtual task <eve_path>.
122	Priority of the OsTask to which the RunnableEntity is mapped should be greater than the priority of the OsTask to which the RunnableEntity is virtually mapped. This error occurs, when the Priority of the OsTask to which the RunnableEntity is mapped not greater than the priority of the OsTask to which the RunnableEntity is virtually mapped.
123	Runnable reference should not be configured for DREvent which is referred in a waitpoint. This error occurs, when the Runnable reference is configured for DREvent which is referred in a waitpoint.
125	DRead should not be configured with composite data types in Runnable Path <run_ref>. This error occurs, when the DRead is configured with composite data types in Runnable Path <run_ref>.
126	Mandatory parameter SHORTLABEL needs to be configured for variation point of RUNNABLE ENTITY of given Path. This error occurs, when the Mandatory parameter SHORTLABEL is not configured for variation point of RUNNABLE ENTITY of given Path.
127	COMPU-DENOMINATOR for compumethod is configured as 0. It should be a non-zero positive number. This error occurs, when the COMPU-DENOMINATOR for comp method <path1> is configured as 0.
128	Data element with SwImplPolicy as queued cannot be accessed in a variable access in role of DataReceivePointByValues. This error occurs, when the Data element with SwImplPolicy as queued has accessed in a variable access in role of DataReceivePointByValues.
130	The P-PORT-PROTOTYPE-REF <comp_port> configured in the PROVIDER-IREF inside ASSEMBLY-CONNECTOR-PROTOTYPE does not belong to the COMPONENT-PROTOTYPE-REF.

	This error occurs, when the P-PORT-PROTOTYPE-REF <comp_port> configured in the PROVIDER-IREF inside ASSEMBLY-CONNECTOR-PROTOTYPE belong to the COMPONENT-PROTOTYPE-REF.
131	The R-PORT-PROTOTYPE-REF <comp_port> configured in the REQUESTER-IREF inside ASSEMBLY-CONNECTOR-PROTOTYPE does not belong to the COMPONENT-PROTOTYPE-REF. This error occurs, when the R-PORT-PROTOTYPE-REF <comp_port> configured in the REQUESTER-IREF inside ASSEMBLY-CONNECTOR-PROTOTYPE is belong to the COMPONENT-PROTOTYPE-REF.
132	COMPONENT-PROTOTYPE-REF parameter should be configured in INNER-PORT-IREF container inside DELEGATION-CONNECTOR-PROTOTYPE. This error occurs, when the COMPONENT-PROTOTYPE-REF parameter is not configured in INNER-PORT-IREF container inside DELEGATION-CONNECTOR-PROTOTYPE.
133	The PORT-PROTOTYPE-REF <$comp_port> configured in the INNER-PORT-IREF inside DELEGATION-CONNECTOR-PROTOTYPE does not belong to the COMPONENT-PROTOTYPE-REF. This error occurs, when the PORT-PROTOTYPE-REF <$comp_port> configured in the INNER-PORT-IREF inside DELEGATION-CONNECTOR-PROTOTYPE belong to the COMPONENT-PROTOTYPE-REF.
134	The OUTER-PORT-REF <comp_port> configured in the DELEGATION-CONNECTOR-PROTOTYPE does not belong to the composition <composition_path>. This error occurs, when the OUTER-PORT-REF <comp_port> configured in the DELEGATION-CONNECTOR-PROTOTYPE belong to the composition <composition_path>.
135	SwImplPolicy is set to MEASUREMENT-POINT for the variable data prototype of Variable Access Path. This error occurs, when the SwImplPolicy is not set to MEASUREMENT-POINT for the variable data prototype of Variable Access Path.
136	COMPU-NUMERATOR V2 for compumethod is configured as 0. It should be a non-zero positive number. This error occurs, when the COMPU-NUMERATOR V2 for comp method <path1> is configured as 0.
137	Invalidation policy is not configured for the variable data prototype of path <vdp_path>. This error occurs, when the Invalidation policy is not configured for the variable data prototype of path <vdp_path>.
139	Symbol name should be unique. This error occurs, when the Symbol name is not unique
140	Symbol Name should be unique if the SHORT-NAME of the SW-COMPONENT is duplicated. This error occurs, when the Symbol Name is not unique if the SHORT-NAME of the SW-COMPONENT is duplicated.
141	INIT-VALUE should not be configured for the PARAMETER-DATA-PROTOTYPE <vdp> when the strictInitialValuesCheck is enabled. This error occurs, when INIT-VALUE is configured for the PARAMETER-DATA-PROTOTYPE when the strictInitialValuesCheck is enabled.
142	Data conversion not possible between a linear data representation and a texttable data representation. This error occurs, when the conversion take place between a linear data representation and a

	texttable data representation.
144	The ModeSwitchEvent Runnable/SchedulableEntity <runnable_path > should not be used by another Event for which ModeDisablingDependency is configured in case of EXTENDED Task This error occurs, when ModeSwitchEvent Runnable/SchedulableEntity < runnable_path > is used by another Event for which ModeDisablingDependency is configured in case of EXTENDED Task
145	Within a ModeSwitch Communication multiple P-PORTS should not be connected to the same R-PORT. This error occurs, when in ModeSwitch Communication multiple P-PORTS are connected to the same R-PORT.
146	In Assembly connector both the provider port <pport_path> and requester port <rport_path> belongs to RPort. This error occurs, when In Assembly connector both the provider port and requester port belongs to RPort.
147	In Delegation connector both the inner port <inner_port_path> and outer port<outer_port_path> should belongs to Provider port or Receiver port. This error occurs, when In Delegation connector both the inner port and outer port are not belongs to Provider port or Receiver port.
148	Queue Length in ModeSwitchSender ComSpec of P-PORT <port_path > should be greater than zero. This error occurs, when Queue Length in ModeSwitchSender ComSpec of P-PORT is less than zero.
149	More than one MODE-DECLARATION-GROUP is configured with same SHORT-NAME <mode_grp_sn> but have different INITIAL-MODES. This error occurs, when More than one MODE-DECLARATION-GROUP is configured with same SHORT-NAME but have different INITIAL-MODES.
150	Runnables/ BswSchedulabelEntities which are called Directly within Rte API's should not be mapped to any Ostask. This error occurs, when Runnables which are called Directly within Rte API's are mapped to any Ostask.
151	The Priority of the Task of the event (which has DISABLED-MODE-IREF) should be higher than the priority of the task f ModeSwitchEvent <ms_event> This error occurs, when The Priority of the Task of the event (which has DISABLED-MODE-IREF) has lower priority than the priority of the task of ModeSwitchEvent.
152	ModeDeclarationGroup is mapped to more than one implementation datatype via DATA-TYPE-MAPPING-SET. This error occurs, when ModeDeclarationGroup is mapped to more than one implementation datatype via DATA-TYPE-MAPPING-SET.
153	A communication path from an AUTOSAR Software Component to an ECU Abstraction located on a remote ECU should not be configured. This error occurs, when a communication path from an AUTOSAR Software Component to an ECU Abstraction located on a remote ECU has configured.
154	The MODE-DECLARATION-GROUP should be mapped to PRIMITIVE Datatype within the container MODE-REQUEST-TYPE-MAP in DATA-TYPE-MAPPING-SET.

	This error occurs, when the MODE-DECLARATION-GROUP is not mapped to PRIMITIVE Datatype within the container MODE-REQUEST-TYPE-MAP in DATA-TYPE-MAPPING-SET.
155	The Event referenced by a WaitPoint should not have DisabledMode Configured. This error occurs, when the Event referenced by a WaitPoint have DisabledMode Configured.
156	TIME-OUT in MODE-SWITCHED-ACK and the TIME-OUT in WAIT-POINT should be same. This error occurs, when TIME-OUT in MODE-SWITCHED-ACK and the TIME-OUT in WAIT-POINT are not same.
157	Initvalues for PARAMETER-REQUIRE-COM-SPEC are not configured for unconnected RPort. This error occurs, when Initvalues for PARAMETER-REQUIRE-COM-SPEC are not configured for unconnected RPort.
158	Require ports<port path> are attached to ParameterSwComponentTypes. However only provider ports must be attached to ParameterSwComponentTypes This error occurs, when require ports are attached to ParameterSwComponentTypes.
159	The port referenced in PORT-PROTOTYPE-REF <port_path> for the VARIABLE-ACCESS <access_path> is not a P-PORT. However it should be a P-PORT. This error occurs, when the port referenced in PORT-PROTOTYPE-REF for the VARIABLE-ACCESS is not a P-PORT.
160	Qlength parameter for sender receiver queued communication should be configured as a non-zero positive value. This error occurs when Qlength parameter for sender receiver queued communication is not configured as a non-zero positive value.
161	External-Replacement reference should be configured for the HANDLE-OUT-OF-RANGE EXTERNAL-REPLACEMENT. This error occurs, when External-Replacement reference is not configured for the HANDLE-OUT-OF-RANGE EXTERNAL-REPLACEMENT.
162	INIT-VALUE should be configured for the Variable Data Prototype of given Path<path>. This error occurs, when INIT-VALUE is not configured for the Variable Data Prototype of given Path.
163	Sw-System-Const value reference is not referred in SYSC-REF in component <comp> of port <port_name>. This error occurs, when Sw-System-Const value reference is not referred in SYSC-REF in component of port.
165	More than one Asynchronous Server Call Result Point should not point to same Asynchronous Server Call Point. This error occurs, when More than one Asynchronous Server Call Result Point pointing to same Asynchronous Server Call Point.
166	Application datatype <app_data> should be mapped to any implementation datatype in data mapping set. This error occurs, when Application datatype <app_data> is not mapped to any implementation datatype in data mapping set.
167	Same implementation datatype <used_data_type [-1]}> is configured twice with different implementation symbol.

	This error occurs, when same implementation datatype is configured twice with different implementation symbol.
168	Two or more Implementation Datatype <impl_name> having same symbol and different type declaration. This error occurs, when Two or more Implementation Datatype <impl_name> having same symbol and different type declaration.
169	Either of the MODE-SWITCH-POINT or the MANAGED-MODE-GROUP should be configured when a MODE-DECLARATION-GROUP-PROTOTYPE is synchronized. This error occurs, when either of the MODE-SWITCH-POINT or the MANAGED-MODE-GROUP is not configured when a MODE-DECLARATION-GROUP-PROTOTYPE is synchronized.
170	Duplicate Component for is Configured. This error occurs, when duplicate Component is configured.
171	IMPLEMENTATION-DATA-TYPE with category DATA_REFERENCE should not be referred in APPLICATION-SW-COMPONENT-TYPE. This error occurs, when IMPLEMENTATION-DATA-TYPE with category DATA_REFERENCE is referred in APPLICATION-SW-COMPONENT-TYPE.
172	DATA-PROTOTYPE which is referring to IMPLEMENTATION-DATA-TYPE with ARRAY-SIZE-SEMANTICS as VARIABLE should not be Unqueued and should be of type uint8. This error occurs, when DATA-PROTOTYPE which is referring to IMPLEMENTATION-DATA-TYPE with ARRAY-SIZE-SEMANTICS as VARIABLE is Unqueued and should be of type uint8.
173	RTE does not support receiving with wait points for VARIABLE-DATA-PROTOTYPE <vdp> when SW-IMPL-POLICY is unqueued. This error occurs, when wait points for VARIABLE-DATA-PROTOTYPE are configured when SW-IMPL-POLICY is unqueued.
174	The ApplicationErrors with same ShortName are configured with different value. This error will occur when ApplicationErrors with same name do have different error Codes ApplicationErrors are conflicting.
175	DataReceivedEvent <event> is referenced by a WaitPoint should not reference a VariableDataPrototype <vdp> referenced by an NvDataInterface. This error occurs, when a DataReceivedEvent is referenced by a WaitPoint and references a VariableDataPrototype Referenced by an NvDataInterface.
176	R-Port with an NvDataInterface <$nvm_interface [-1]> is not connected and no NvRequireComSpec with a initValue. This error occurs, when R-Port with an NvDataInterface is not connected and no NvRequireComSpec with an initValue.
177	ON-EXIT Runnables should not have higher value for the Parameter RtePositionInTask than ON-TRANSITION/ON-ENTRY Runnables. ON-TRANSITION Runnables ($runnable_path) should not have higher value for the Parameter RtePositionInTask than ON-ENTRY Runnables. This error occurs, when ON-TRANSITION or ON-EXIT Runnables have higher value for the Parameter RtePositionInTask than the ON-ENTRY or ON-TRANSITION Runnables.
178	Two or more DataReceivedEvents having same VariableDataPrototype trigger different runnable entities mapped to different tasks. This error occurs, when two or more DataReceivedEvents having same VariableDataPrototype

	trigger different runnable entities mapped to different tasks.
179	Two different runnables which are having wait points connected to the same data received event <dr_eve> should not be mapped to different Os Tasks. This error occurs, when two different runnables which are having wait points connected to the same data received event are mapped to different Os Tasks.
180	More than one DATA-RECEIVED-EVENT under the same INTERNAL-BEHAVIOR which is sharing the same VARIABLE-DATA-PROTOTYPE should not be mapped to different tasks. This error occurs, when More than one DATA-RECEIVED-EVENT under the same INTERNAL-BEHAVIOR which is sharing the same VARIABLE-DATA-PROTOTYPE is mapped to different tasks.
181	Either RteUsedOsAlarmRef or RteUsedOsScheduleTableExpiryPointRef should be configured when the RteEventRef is referring to TIMING-EVENT or BACKGROUND-EVENT in RteEventtoTaskMapping. This error occurs, when Either RteUsedOsAlarmRef or RteUsedOsScheduleTableExpiryPointRef is not configured when the RteEventRef is referring to TIMING-EVENT or BACKGROUND-EVENT in RteEventtoTaskMapping.
184	NativeDeclaration is not configured for the Implementation datatype <value>. This error occurs, when NativeDeclaration is not configured for the Implementation datatype <value>.
185	The same MODE-DECLARATION cannot be referred by both SWC-MODE-SWITCH-EVENT and DISABLED-MODE-IREF. This error occurs, when the same MODE-DECLARATION is referred by both SWC-MODE-SWITCH-EVENT and DISABLED-MODE-IREF.
186	For ON-TRANSITION Events both the MODE-DECLARATIONS should belong to the same MODE-GROUP. This error occurs, when for ON-TRANSITION Events both the MODE-DECLARATIONS are not belonging to the same MODE-GROUP.
187	The interfaces configured for PORT-PROTOTYPE and configured for PORT-PROTOTYPE are not compatible as the number of ModeDeclarations in PORTS is not same. This error occurs, when the interfaces configured for PORT-PROTOTYPE and configured for PORT-PROTOTYPE are not compatible.
188	The interfaces configured for PORT-PROTOTYPE <p_port_path> and configured for PORT-PROTOTYPE <r_port_path>are not compatible as the Shortnames for ModeDeclarations in PORTS are not same. This error occurs, when the interfaces configured for PORT-PROTOTYPE both P port and R port is not compatible as the Shortnames for ModeDeclarations in PORTS are not same.
189	The interfaces configured for PORT-PROTOTYPE <p_port_path> and configured for PORT-PROTOTYPE <r_port_path>are not compatible as the INITIAL-MODE-REF for ModeDeclarations in PORTS are not same. This error occurs, when the interfaces configured for PORT-PROTOTYPE both P port and R port is not compatible as the INITIAL-MODE-REF for ModeDeclarations are not same.
190	More than one IMPLEMENTATION-DATA-TYPE configured with same SHORT-NAME and different NATIVE-DECLARATION. This error occurs, when the More than one IMPLEMENTATION-DATA-TYPE configured with same SHORT-NAME and different NATIVE-DECLARATION.

191	More than one ImplementationDataType whose category is STRUCTURE or UNION have same ShortName but number of ImplementationDataTypeElement are different. This error occurs, when the More than one STRUCTURE or UNION IMPLEMENTATION-DATA-TYPE having same SHORT-NAME but number of elements is different.
192	Invalid value is not specified for the Implementation of given Path. This error occurs, when the Invalid value is not specified for the Implementation of given Path.
193	SW-IMPL-POLICY should be configured as QUEUED for the DATA-ELEMENT which is mapped to PDU with ComIpduType equals to TP. This error occurs, when the SW-IMPL-POLICY is not configured as QUEUED for the DATA-ELEMENT which is mapped to PDU with ComIpduType equals to TP.
194	SUPPORTS-MULTIPLE-INSTANTIATION attribute should be set to true for the SWC-INTERNAL-BEHAVIOR This error occurs, when the SUPPORTS-MULTIPLE-INSTANTIATION attribute is not set to true for the SWC-INTERNAL-BEHAVIOR.
195	ENABLE-TAKE-ADDRESS attribute should be set to false for the PORT-REF since multiple instances are configured for the APPLICATION-SW-COMPONENT. This error occurs, when the ENABLE-TAKE-ADDRESS attribute is set to true.
196	Software Component related information should not be configured in Basic Software Scheduler Generation Phase. This error occurs, when the Software Component related information is configured in Basic Software Scheduler Generation Phase.
197	Duplicate Component is configured in same AR-PACKAGE. This error occurs, when the Duplicate Component is configured in same AR-PACKAGE.
198	Symbol Name should be configured if the SHORT-NAME of the SW-COMPONENT is duplicated. This error occurs, when the Symbol Name is not configured but SHORT-NAME of the SW-COMPONENT is duplicated.
199	Execution instances of Runnable entity are mapped to different preemption areas which is invalid. This error occurs, when the Execution instances of Runnable entity are mapped to different pre-emption.
201	The TARGET-DATA-PROTOTYPE-REF/ Sender-Receiver interface referred in EVENT does not match with the DATA-ELEMENT-REF/ Sender-Receiver interface given in the Port. The Sender-Receiver interface referred in EVENT does not match with the Sender-Receiver interface given in the Port . This error occurs, when The TARGET-DATA-PROTOTYPE-REF/ Sender-Receiver interface referred in EVENT does not match with the DATA-ELEMENT-REF/ Sender-Receiver interface given in the Port.
202	The parameter 'BSW-ENTITY-REF' in the Container 'SWC-BSW-RUNNABLE-MAPPING' within 'SWC-BSW-MAPPING' cannot refer 'CAT-1' BSW-INTERRUPT-ENTITY SWC-BSW-MAPPING. This error occurs, when the parameter 'BSW-ENTITY-REF' in the Container 'SWC-BSW-RUNNABLE-MAPPING' within 'SWC-BSW-MAPPING' not refer 'CAT-1' BSW-INTERRUPT-ENTITY SWC-BSW-MAPPING.

203	The TARGET-DATA-PROTOTYPE-REF/ Sender-Receiver interface referred in VARIABLE-ACCESS does not match with the DATA-ELEMENT-REF/ Sender-Receiver interface given in the Port. This error occurs, when The TARGET-DATA-PROTOTYPE-REF/ Sender-Receiver interface referred in VARIABLE-ACCESS does not match with the DATA-ELEMENT-REF/ Sender-Receiver interface given in the Port
204	The ClientServerInterface configured for PPortPrototype and the ClientServerInterface configured for RPortPrototype are not compatible as the ShortName of Operation configured for both the ClientServerInterfaces are not same. This error occurs, when the interfaces is not configured for 'P-PORT-PROTOTYPE' <p_port_path> and <r_iface> is not configured for 'R-PORT-PROTOTYPE'.
205	The Variable data prototype of Sender Receiver interfaces configured for P-PORT-PROTOTYPE is not compatible with the Variable data prototype of Sender Receiver interfaces configured for R-PORT-PROTOTYPE. This error occurs, when the Variable data prototype of Sender Receiver interfaces configured for P-PORT-PROTOTYPE is not compatible with the Variable data prototype of Sender Receiver interfaces configured for R-PORT-PROTOTYPE
206	The OperationIref configured in OprationInvokedEvent and the OperationIref in ServerComSpec do not match. This error occurs, when Either the OPERATION-IREF configured in OPERATION-INVOKED-EVENT and the OPERATION-IREF in SERVER-COM-SPEC do not match or OPERATION-IREF is not configured in SERVER-COM-SPEC
208	Same SystemSignal cannot be used by more than one Clients System Signal. This error occurs, when Same SystemSignal is used by more than one Clients System Signal.
209	Different PredefinedVariants should not assign different values to the same PostBuildVariantCriterion for the same RtePostBuildVariantConfiguration PredefinedVariants. This error occurs when Different PredefinedVariants are assigning different values to the same PostBuildVariantCriterion for the same RtePostBuildVariantConfiguration PredefinedVariants.
210	Some of OperationInvokedEvents which invoke same Runnable Entity are mapped to different OsTask or same .OsTask with different Position in Task, or are not mapped to OsTask This error occurs, when OperationInvokedEvents mapped to the same runnable are mapped to different task or to the same task with different position in task.
211	The number of elements in the datatype and the number of elements initialized do not match. This error occurs, when the numbers of elements in the datatype and the number of elements initialized are not same.
212	SENDER-RECEIVER-TO-SIGNAL-GROUP-MAPPING is configured for the PRIMITIVE datatype. This error occurs, when SENDER-RECEIVER-TO-SIGNAL-GROUP-MAPPING is configured for PRIMITIVE datatype.
213	SENDER-RECEIVER-TO-SIGNAL-MAPPING is configured for the COMPLEX datatype. This error occurs, when SENDER-RECEIVER-TO-SIGNAL-MAPPING is configured for COMPLEX datatype.
214	The datatype provided in ComSignalType does not match with the datatype provided in ComSignal. This error occurs, when datatype provided in ComSignalType does not match with datatype provided in ComSignal.

215	Number of elements in array does not match with number of signals in signalgroup. This error occurs, when number of elements in array does not match with the number of signals configured in SignalGroup.
216	Number of elements in structure does not match with number of signals in signalgroup. This error occurs, when number of elements in structure does not match with the number of signals configured in SignalGroup.
217	The length of Array does not match with the length provided in ComSignalLength. This error occurs, when length of array is not same as the length configured in ComSignalLength.
218	Sw-System-Const value reference referred in SYSC-REF in SW-SYSCOND of component <component>of port <port> is not valid. This error occurs, when Sw-System-Const value referenced in SYSC-REF in SW-SYSCOND Of component <component name> of port <port name> is not valid.
219	The task referred in EveToTskMap/BswEveToTskMap is invalid as Os container is not present. This error occurs, when the task path specified in EveToTskMap/BswEveToTskMap is invalid as the OsContainer is not present.
220	The MappingDirection for DATA-PROTOTYPE-MAPPING should not be 'SECOND-TO-FIRST' if second data element is used for R port and first data element is used for P port. This error occurs, when the Data-Prototype is from second-to-first when second data element is used for Rport and the first data element is used by Pport.
221	VT-ELEMENT should not be configured for the COMPU-METHOD if the CATEGORY attribute is not configured. This error occurs, when Display format is not configured for the Compu-Method.
222	The MappingDirection for DATA-PROTOTYPE-MAPPING should not be 'FIRST-TO-SECOND' if first data element is used for R port and second data element is used for Pport. This error occurs, when the Data-Prototype is from first-to-second when first data element is used for Rport and the second data element is used by Pport.
223	The START-ON-EVENT-REF Configured in RteEvent is not a Valid RUNNABLE-ENTITY. This error occurs, The Start-On-Event-Ref (Runnable Entity) referred in RteEvent Container is not a valid runnable path.
224	The RteEvent is referred more than once in RteEventToTaskMapping container. This error occurs, when the RteEvent is referred more than once in RteEventToTaskMapping Container
225	Direction given for the IPduPort is invalid. This error occurs, when the Direction is given for the IPduPort is IN and mapping is done for Rport or direction is given for the IPduPort is OUT and mapping is done for Pport.
226	Base type of the configured record element <type_path> is not allowed in E2E configuration. This error occurs, when base type of the configured record element is present in E2E configuration.
227	The VALUE of a MODE-DECLARATION and ON-TRANSITION-VALUE should be unique within a MODE-DECLARATION-GROUP.

	This error occurs, when the VALUE of a MODE-DECLARATION and ON-TRANSITION-VALUE are not unique within a MODE-DECLARATION-GROUP.
231	The Sw-Impl-Policy configured in variable data prototype of NV Data Interface is set to QUEUED. This error occurs, when the Sw-Impl-Policy configured in variable data prototype of NV Data Interface is set to QUEUED.
232	The ImplementationDataType whose category is UNION should have at least two ImplementationDataTypeElement as the sub element. This error occurs, when the Union Element is having less than two sub elements.
233	The ImplementationDataType whose category is STRUCTURE should have at least one ImplementationDataTypeElement as the sub element. This error occurs, when the structure Element is having less than one sub elements.
234	The reference path used for the mention parameter is invalid parameter. This error occurs, when the path of reference parameter is invalid.
235	Type attribute in PerInstanceMemory of 'C' Type of respective path and the Implementation data type shortname should not be same. This error occurs, when the Type attribute in PerInstanceMemory of 'C' Type of respective path and the Implementation data type shortname is same.
236	The Handle Out Of Range for Queue Send Com Spec should not be INVALIDE or DEFAULT or EXTERNAL-REPLACEMENT. This error occurs, when the Handle Out Of Range for Queue Send Com Spec is INVALID or DEFAULT or EXTERNAL-REPLACEMENT.
237	Identical TYPE attribute in Per Instance Memory of 'C' type is configured for the same TYPE DEFINTION of component. This error occurs, when Identical TYPE attribute in Per Instance Memory of 'C' type is configured for the same TYPE DEFINTION of component.
238	The attribute swImplPolicy of a dataElement referenced by a QueuedSenderComSpec must be set to the value queued. This error occurs, when the attribute swImplPolicy of a dataElement referenced by a QueuedSenderComSpec is not set to the value queued.
239	An initial value cannot be specified when the implementation policy is set to queued. This error occurs, when an initial value is specified when the implementation policy is set to queued.
240	RteReceiverUsedOsEventRef parameter should be configured when the RteIocInteractionReturnValue is set to 'RTE_COM' for the Task Path. This error occurs, when RteReceiverUsedOsEventRef parameter is not configured when the RteIocInteractionReturnValue is set to 'RTE_COM' for the Task Path.
241	The TimingEvent and Background Event can not be mapped into OsTask which other RteEvent has been allocated. This error occurs, when the RTE/BSW event is mapped to the ostask path which is same as the task mapped to Timing/Background event or when the Timing event and Background event are mapped to same ostask path.

242	RTE does not support multiple instances for the component and partition. This error occurs, when the multiple instances for the component along with partition is configured.
243	MAX-DELTA-COUNTER-INIT should be configured for the EndToEndProfile <Path> This error occurs, when the MAX-DELTA-COUNTER-INIT is not configured for EndToEndProfile
244	The value for DATA-ID should be in the range of 0-65535/0-255 when category is PROFILE_01/PROFILE_02 for the EndToEndProfile <Path> This error occurs, when the value for DATA-ID is not in the range of 0-65535/0-255 when category is PROFILE_01/ PROFILE_02 respectively for the EndToEndProfile
245	The value for DATA-LENGTH should be in the range of 0-65535/0-240 when Category is PROFILE_02/PROFILE_01 respectively for the EndToEndProfile <Path>. This error occurs, when the value for DATA-LENGTH is not in the range of 0-65535/0-240 when category is PROFILE_01/ PROFILE_02 respectively for the EndToEndProfile
246	The value for CRC-OFFSET should be in the range of 0-65535 when category is PROFILE_01 for the EndToEndProfile <Path>. This error occurs, when the value for CRC-OFFSET is not in the range of 0-65535 when category is PROFILE_01 for the EndToEndProfile.
247	The value for DATA-ID-MODE should be in the range of 0-2 when category is PROFILE_01 for the EndToEndProfile <Path>. This error occurs, when the value for DATA-ID-MODE is not in the range of 0-2 when category is PROFILE_01 for the EndToEndProfile.
248	The value for COUNTER-OFFSET should be in the range of 0-65535 when category is PROFILE_01 for the EndToEndProfile <Path>. This error occurs, when the value for COUNTER-OFFSET is not in the range of 0-65535 when category is PROFILE_01 for the EndToEndProfile.
249	The value for MAX-DELTA-COUNTER-INIT should be in the range of 0-14/ 0-15, when category is PROFILE_01/PROFILE_02 respectively for the EndToEndProfile <Path>. This error occurs, when the value for MAX-DELTA-COUNTER-INIT is not in the range of 0-14/ 0-15 when category is PROFILE_01/ PROFILE_02 respectively for the EndToEndProfile
250	There should be exact 1/16 DATA-IDs when the category is PROFILE_01/ PROFILE_02 respectively for the EndToEndProfile <Path>. This error occurs, when the DATA-IDs are not exactly 1 for PROFILE_01 or 16 for PROFILE_02 for the EndToEndProfile
251	The Mandatory Parameter RtelocInteractionReturnValue is not configured for <ECU Generation Path> This error occurs, when the RtelocInteractionReturnValue is not configured for given Generation path.
252	BSW-MODE-SWITCHED-ACK-EVENT should be configured when TIMEOUT value is greater than zero For the PROVIDED-MODE-GROUP <Path>. This error occurs, when the BSW-MODE-SWITCHED-ACK-EVENT is not configured when TIMEOUT value is greater than zero.
253	BSW-MODE-SWITCHED-ACK-EVENT should be mapped to an Extended Task when TIMEOUT value is greater than zero.

	This error occurs, when the BSW-MODE-SWITCHED-ACK-EVENT is not mapped to an Extended Task when TIMEOUT value is greater than zero.
254	All the BSW-MODE-SWITCH-EVENT<Event Paths> of the REQUIRED-MODE-GROUP connected to the specific PROVIDED-MODE-GROUP should be mapped to the same task <Task Path>. This error occurs, when All the BSW-MODE-SWITCH-EVENT of the REQUIRED-MODE-GROUP connected to a specific PROVIDED-MODE-GROUP are not mapped to the same task.
255	Task mapped to BSW-MODE-SWITCHED-ACK-EVENT <Event Path> should have higher priority than the Task priority of BSW-MODE-SWITCH-EVENT <Event Path> when TIMEOUT is greater than zero. This error occurs, when the task mapped to BSW-MODE-SWITCHED-ACK-EVENT has less priority than task priority of BSW- MODE-SWITCH-EVENT when TIMEOUT is greater than zero.
258	Position in Task is not configured for Event <Event Path> and Task<Task Path>. This error occurs, when PositionInTask is not configured for the mentioned event and task path.
259	Com notification is not configured for <Isignaltolpdu mapping path> since com notification is mandatory for configuration that has one system signal shared by many isignals for receiving System signal <system signal path>. This error occurs, when ComNotifictation is not configured when the configuration has one system signal shared by many isignals for the receiving System signal.
261	Timeout value should be zero for the AsynchronousServerCallPoint as WaitPoint is not configured.. This error occurs, when waitpoint is not configured if timeout is configured for client server asynchronous communication.
262	RteWaitOsEventRef in RteEventToTaskMapping should be configured for the AsynchronousServerCallReturnsEvent as WaitPoint is configured. This error occurs, when WaitOsEveRef is not configured if timeout configured is greater than zero for client server asynchronous communication,
263	The interfaces <p_iface> configured for P-PORT-PROTOTYPE <p_port_path> and <r_iface> configured for R-PORT-PROTOTYPE<r_port_path>are not compatible as the SHORT-NAMES for 'VARIABLE-DATA-PROTOTYPE' configured for both the interfaces are not same. This error occurs, when interfaces <p_iface> configured for P-PORT-PROTOTYPE <p_port_path> and <r_iface> configured for R-PORT-PROTOTYPE<r_port_path>are not compatible as the SHORT-NAMES for 'VARIABLE-DATA-PROTOTYPE' configured for both the interfaces are not same.
264	AsynchronousServerCallResultPoint not configured for the AsynchronousServerCallPoint. This error occurs, when the Result point is not configured for the Call api for the mentioned call point.
265	Result Point is not triggerred by any event.
266	Result Point and Call point are configured in the same runnable entity. However the the call point and corresponding result point should always be configured in different runnable entities.
300	In synchronous mode switching, Mode Switched Event's runnable which is called in OsTask should be mapped to one OsTask at least. This error occurs, when the runnable for Mode Switch Event in synchronous mode switching, is not mapped into any OsTask.
301	The task which Mode Manager with RteEvent has been mapped into should .have lower task priority than the task for Mode User with ModeSwitchEvent.

	This error occurs, when OsTask which the mode manager is allocated in, has the higher priority than OsTask for Mode User.
302	The Software Component which has the R-Ports connected to the specific P-Port, is not allocated in any partition. The Software Component name regarding R-Ports <Port Name> must be located in one of partition be configured. This error occurs, when Software Component with one of port (between PPort and RPort) is not allocated in any partition.
304	Eventhough ModeSwitchAck Event is configured in <SWC>, there is no configuration for Mode Switched Ack Request in the Com Spec regarding this Port <Port Path> This error occurs, when the ModeSwitchAck Event is configured in SWC without configuration regarding Mode Switched Ack Request in Com Spec in related Port.
305	The Configuration for Exclusive Area Implementation for <Exclusive Area>, should be done in Rte configuration This error occurs, when the exclusive area implementation is not done during Rte configuration, even though this is referenced by runnable to permit this runnable be running in Exclusive area.
306	In AUTOSAR 4.0.3 standard, the BSW modules distribution on multi partitions is not supported except for the EcuM module. Therefore the BswModuleExecution parameter in EcuC, must be enabled for only one partition. This error occurs, when the BswModuleExecution for each partition, is enabled in over than one partition.
307	The disabledMode Configuration for "Event Name" will not be working properly. Because mode switch point for this mode instance, is not configured in any runnable. This error occurs, when the DisabledMode for specific Rte Event has been configured without any mode switch point configuration for this mode instance.
308	When the synchronized activate offset among OsAlarms based on one specific OsCounter is enabed, the MaxAllowedCounterValue for this OsCounter, should be set with proper value This error occurs, when the MaxAllowedCounterValue is not configured or is not set with proper value.
309	In Enhanced Mode, ImplementationDataType which mapped to ModeDeclarationGroup should have uint8 or uint16 type. This error occurs, when ImplementationDataType which mapped ModeDeclarationGroup does not have uint8 or uint16 type while enhanced mode set to be true.
310	OsAlarm in ActivaionOsAlarmRef must not be duplicated, <ActivaionOsAlarmRef> is referenced more than twice in UsedOsActivaion. This error occurs, when referenced OsAlarm in ActivationOsAlarmRef in RteOsInteraction is duplicated.
311	When the Synchronized Activate Offset among OsAlarms based on one specific OsCounter is enabled the activation order (start alarm) should be defined amongs each alarm to give the value in ExpectedActivationPosition. <RteUsedOsActivaion> This error occurs, when OsAlarm with Synchronized Activate Offset, is configured and the order for setting the alarm among OsAlarms is not defined via ExpectedActivationPosition.
312	When the Synchronized Activate Offset among OsAlarms based on one specific OsCounter is enabled (Setting True) via SynchronizedActivateOffset configuration, the referenced OsCounter which OsAlarm will be synchronized, must be defined vai SynchronizedOsCounterRef <OsInteract Path> <File Name>

	This error occurs, when SynchronizedActivateOffset is set as true without any Counter which should be referenced via SynchronizedOsCounterRef in OsInteract.
313	The Background Event can not be mapped to the OsTask which is same as the task mapped to TimingEvent. This error occurs, when both background event and timing event are mapped into same OsTask at the sametime
314	Either RteUsedOsAlarmRef or RteUsedOsScheduleTableExpiry-PointRef should be configured in all the RteEventToTaskMappings which are referring to the same OsTask. This error occurs, when to trigger the TimingEvent, either OsAlarm or SchedulePointExpiryPoint has been configured and if trigger source for whole of Timing Events are not same.
315	The ProvidedModeGroup path configured in ModeScheduleTableMap for BSW module is not a ProvidedModeGroup. This error occurs, when the port type in PortRef in ModeScheduleTableMap is not Provided
316	PortPath should be configured for ModeAccessPoints within MODE-ACCESS-POINT. This error occurs, when Port has not been referenced in ModeAccessPoints.
401	RteMappedToTaskRef of EventToTaskMapping for OperationInvokedEvent should be configured if CanBeInvokedConcurrently is false. This error occurs, when OsTask is not mapped to OperationInvokedEvent which starts a server runnable with false value on CanBeInvokedConcurrently parameter.
403	When timeout, inter-partition client-server communication, minimum start interval, or etc is used, RteWaitOsEventRef in RteEventToTaskMapping for the client runnable should be configured for the SynchronousServerCallPoint. Configure RteWaitOsEventRef in RteEventToTaskMapping for the client runnable.
404	If timeout is configured for SynchronousServerCallPoint, RteWaitOsAlarmRef in RteEventToTaskMapping for the client runnable should be configured for the SynchronousServerCallPoint. Assign a OsAlarm to RteWaitOsAlarmRef in RteEventToTaskMapping which invokes the client runnable.
405	When timeout for SynchronousServerCallPoint is used, OsAlarm referenced by RteWaitOsAlarmRef should have OsAlarmSetEvent of OsAlarmAction. Choose the OsAlarmSetEvent for OsAlarmAction and set the OsEventRef.
406	ValueTypeTRef of PortDefinedArgumentValue does not exist. Configure ValueTypeTRef in PortDefinedArgumentValue.
407	PortDefinedArgumentValue in PortApiOption does not have any value. Fill the Value of PortDefinedArgumentValue.
408	The ValueTypeTRef of PortDefinedArgumentValue is incorrect. Configure the correct value for ValueTypeTRef of PortDefinedArgumentValue. .For example, if the referenced path by ValueTypeTRef is ImplementationDataType, .then check whether the ImplementationDataType exists,.and if ApplicationDataType, then check whether the mapping to ImplementationDataType is correct.
409	ImplementationDataType referred by an ArgumentDataPrototype in Operation of ClientServerInterface does not exist.

	Check the configuration of ImplementationDataType referred by the ArgumentDataPrototype.
410	If ImplementationDataType is equal to a name of one of the Platform or Standard Types predefined in AUTOSAR code, nativeDeclaration in the SwBaseType shall not be configured or be same as base types of Platform or Standard Types. Change the ShortName of ImplementationDataType different from ShortNames of Platform or Standard Types, or make nativeDeclaration in SwBaseType be same as them of Platform or Standard Types.
411	BaseTypeRef ImplementationDataTypeRef needs to be configured for ImplementationDataTypes. Configure BaseTypeRef or ImplementationDataTypeRef in ImplementationDataType
413	ClientServerOperation(or ClientServerInterface) is duplicated. Remove duplicated ClientServerOperation or ClientServerInterface.
414	ArgumentDataPrototype of ClientServerOperaion is duplicated. Remove duplicated ArgumentDataPrototype or change ShortName.
415	For each asynchronous invocation of an operation prototype only one AsynchronousServerCallReturnsEvent shall be passed to the client component by the RTE. The AsynchronousServerCallReturnsEvent shall indicate either that the transmission was successful or that the transmission was not successful. Remove the other AsynchronousServerCallReturnsEvents except for one.
418	RteMappedToTaskRef for AsynchronousServerCallReturnsEvent is not configured If AsynchronousServerCallReturnsEvent is used for activation of a RunnableEntity, RteMappedToTaskRef of RteEventToTaskMapping for the AsynchronousServerCallReturnsEvent should be configured.
419	There is no Implementation Data Type or .Application Data Type which is mapped to ImplementationDataType for an ArgumentDataPrototype of the Operation in ClientServerInterface. Check the configuration of ImplementationDataType referred by an ArgumentDataPrototype of the Operation.
421	If the SynchronousServerCallPoint is configured on a RunnableEntity, .then the OsTaskSchedule of the OsTask mapped to the RunnableEntity should be FULL. Change the value of the OsTaskSchedule of an OsTask to 'FULL'.
422	The OsTaskPriority value of the OsTask mapped to the RunnableEntity where SynchronousServerCallPoint (client) is configured should be greater than the OsTaskPriority value of the OsTask mapped to OperationInvokedEvent (server). Adjust OsTaskPriority values of OsTasks to meet the priority condition of OsTasks (client > server).
423	Category of EndToEndProfile should be configured as either PROFILE_01 or PROFILE_02 Configure Category correctly (PROFILE_01/PROFILE_02)
424	The OsTaskPriority value of the OsTask mapped to the RunnableEntity where AsynchronousServerCallPoint (client) is configured should be greater than the OsTaskPriority value of the OsTask mapped to AsynchronousServerCallResultPoint (result). Adjust OsTaskPriority values of OsTasks to meet the priority condition of OsTasks (client > result).

425	The OsTaskPriority value of the OsTask mapped to the RunnableEntity where AsynchronousServerCallResultPoint (result) is configured should be greater than the OsTaskPriority value of the OsTask mapped to OperationInvokedEvent (server). Adjust OsTaskPriority values of OsTasks to meet the priority condition of OsTasks (result > server).
426	When OsEvent is used, The OsTask should have the OsEvent. Add the OsEvent to the OsEventRef of the OsTask.
427	RteEndToEndProtectionWrapperMode in RteGeneration shall be confiured as either SINGLE or REDUNDANT. Configure RteEndtoEndProectionWrapperMode correctly (SINGLE/REDUNDANT).
428	The ClientServerInterface referenced by RequiredInterfaceTRef of RPortPrototype does not include the ClientServerOperation refereced by OperationIRef of SynchronousServerCallPoint. Select the ClientServerOperation for OperationIRef of SynchronousServerCallPoint, which should be included the ClientServerInterface referenced by RequiredInterfaceTRef of RPortPrototype.
429	The RteUsedOsEventRef in RteEventToTaskMapping should be configured if the RunnableEntity has AsynchronousServerCallResultPoint (result) and the corresponding WaitPoint. Set the OsEvent to RteUsedOsEventRef in RteEventToTaskMapping for RunnableEntity which has AsynchronousServerCallResultPoint.
450	Context RPort is not configured for ExternalTriggerOccurredEvent. Context RPort should be configured for ExternalTriggerOccurredEvent
451	Target Trigger is not configured for ExternalTriggerOccurredEvent. Target Trigger should be configured for ExternalTriggerOccurredEvent.
452	TriggerInterface for this P-port is not configured. Valid TriggerInterface shall be configured for this P-port.
453	P-port specified by a TriggerInterface is connected to an R-port with an incompatible interface and no TriggerInterfaceMapping for this pair of interfaces is associated with the connection. TriggerInterfaces of connected P/R-port should be compatible and TriggerInterfaceMapping should be associated with this connection.
454	The same Trigger in a Trigger Sink should not be connected to multiple Trigger Sources. (N:1 communication is not supported.) Do not connect a ReleasedTrigger to multiple BswTriggerConnections.
455	The same Trigger in a Trigger Sink should not be connected to multiple Trigger Sources. (N:1 communication is not supported.) Do not connect a Trigger Sink to multiple Trigger Sources.
456	If RunnableEntity has MinimumStartInterval or QueueLentgh is configured, RunnableEntity should be mapped to at least one OsTask. RunnableEntity should be mapped to at least one OsTask.
457	If RunnableEntity has not MinimumStartInterval and QueueLentgh is not configured, RunnableEntity should not be mapped to any OsTask. RunnableEntity should not be mapped to any OsTask.
458	Rte Generator does not support Queued External Trigger in case of Inter Partition Communication.

	Do not configure Queued External Trigger in case of Inter Partition Communication.
459	A BswTriggerDirectImplementation is specified and an ExecutableEntity that is activated by an ExternalTriggerOccurredEvent associated to a connected Trigger of the TriggerSource is mapped to an OS task different from the one defined by the task attribute of the BswTriggerDirectImplementation. Map ExternalTriggerOccurredEvent of EventToTaskMapping to Task attribute of the BswTriggerDirectImplementation
460	A SynchronizedTrigger should not be referenced by more than one type of access method, where the type is one of the followings: ExternalTriggeringPoint, IssuedTrigger and BswTriggerDirectImplementation. Please select one of the followings. 1) Do not use BswTrigger for the IssuedTrigger which is defined in SynchronizedTrigger. 2) Do not use SwcTrigger for the ExternalTriggeringPoint which is defined in SynchronizedTrigger. 3) Do not connect BswTrigger and SwcTrigger for SynchronizedTrigger.
461	A SynchronizedTrigger should not be referenced by more than one type of access method, where the type is one of the followings: ExternalTriggeringPoint, IssuedTrigger and BswTriggerDirectImplementation. Please select one of the followings. 1) Do not use BswTrigger for the IssuedTrigger which is defined in SynchronizedTrigger. 2) Do not use SwcTrigger for the ExternalTriggeringPoint which is defined in SynchronizedTrigger. 3) Do not connect BswTrigger and SwcTrigger for SynchronizedTrigger.
462	A SynchronizedTrigger should not be referenced by more than one type of access method, where the type is one of the followings: ExternalTriggeringPoint, IssuedTrigger and BswTriggerDirectImplementation. Please select one of the followings. 1) Do not use BswTrigger for the IssuedTrigger which is defined in SynchronizedTrigger. 2) Do not use BswTrigger for the BswTriggerDirectImplementation which is defined in SynchronizedTrigger.
463	A Trigger of ReleasedTrigger shall not be referenced by both a IssuedTrigger and a BswTriggerDirectImplementation. Do not use same Trigger of ReleasedTrigger in both IssuedTrigger and BswTriggerDirectImplementation.
464	'SwImplPolicy' shall be configured to 'QUEUED' in case of 'RteBswTriggerSourceQueueLength' > 0. To use Queued Bsw External Trigger, please configure 'SwImplPolicy' to 'QUEUED'.
465	'SwImplPolicy' shall not be configured to 'QUEUED' in case of 'RteBswTriggerSourceQueueLength' = 0. To use Non Queued Bsw External Trigger, please do not configure 'SwImplPolicy' to 'QUEUED'.
466	'SwImplPolicy' shall be configured to 'QUEUED' in case of 'RteBswTriggerSourceQueueLength' > 0. To use Queued Bsw Internal Trigger, please configure 'SwImplPolicy' to 'QUEUED'.
467	'SwImplPolicy' shall not be configured to 'QUEUED' in case of 'RteBswTriggerSourceQueueLength' = 0.

	To use Non Queued Bsw Internal Trigger, please do not configure 'SwImplPolicy' to 'QUEUED'.
468	'SwImplPolicy' shall be configured to 'QUEUED' in case of 'RteTriggerSourceQueueLength' > 0. To use Queued External Trigger, please configure 'SwImplPolicy' to 'QUEUED'.
469	'SwImplPolicy' shall not be configured to 'QUEUED' in case of 'RteTriggerSourceQueueLength' = 0. To use Non Queued External Trigger, please do not configure 'SwImplPolicy' to 'QUEUED'.
470	'SwImplPolicy' shall be configured to 'QUEUED' in case of 'RteTriggerSourceQueueLength' > 0. To use Queued Internal Trigger, please configure 'SwImplPolicy' to 'QUEUED'.
471	'SwImplPolicy' shall not be configured to 'QUEUED' in case of 'RteTriggerSourceQueueLength' = 0. To use Non Queued Internal Trigger, please do not configure 'SwImplPolicy' to 'QUEUED'.
472	There is no valid BswExternalTriggerEvent. Please configure BswExternalTriggerEvent.
473	There is no RteBswEventToTaskMapping for BswExternalTriggerEvent. Please configure RteBswEventToTaskMapping for BswExternalTriggerEvent.
474	There is no valid BswInternalTriggerEvent. Please configure BswInternalTriggerEvent.
475	There is no RteBswEventToTaskMapping for BswInternalTriggerEvent. Please configure RteBswEventToTaskMapping for BswInternalTriggerEvent.
476	There is no valid RteExternalTriggerEvent. Please configure RteExternalTriggerEvent.
477	There is no RteEventToTaskMapping for RteExternalTriggerEvent. Please configure RteEventToTaskMapping for RteExternalTriggerEvent.
478	There is no valid RteInternalTriggerEvent. Please configure RteInternalTriggerEvent.
479	There is no RteEventToTaskMapping for RteInternalTriggerEvent. Please configure RteEventToTaskMapping for RteInternalTriggerEvent.
501	There is a EcucPartition which has no ShortName
502	EcucPartitionBswModuleExecution shall be set.
503	PartitionCanBeRestarted shall be set.
504	Software component path in the EcucPartitionSoftwareComponentInstanceRef is not valid.
505	ShortName of RteBswModuleInstance is empty.
506	BswImplRef of RteBswModuleInstance is empty.
507	BswModuleConfigRef of RteBswModuleInstance is empty.

508	There is an OsAppAlarmRef which is double referenced.
509	There is an OsAppCounterRef which is double referenced.
510	There is an OsAppIsrRef which is double referenced.
511	There is an OsAppTaskRef which is double referenced.
512	OsAppEcucPartRefOsAppEcucPartRef of OsApplication is invalid.
513	There is a mismatching between partition of SwComponentInstance and task of OsApplication.
514	There is a mismatching between partition of SwComponentInstance and alarm of OsApplication.
515	DataReceivedEvent, DataReceiveErrorEvent, DataSendCompletedEvent, DataWriteCompletedEvent shall be mapped to OsTask.
516	There is a mismatching OsSchedulePoint configuration of events which reference same runnable entity.
517	RteMappedToTaskRef is not set but OsSchedulePoint is set.
518	OsSchedulePoint shall be set as None if OsTask is full preemptive.
519	There is a mismatching OsSchedulePoint configuration of events which reference same runnable entity.
520	RteBswMappedToTaskRef is not set but OsSchedulePoint is set.
521	OsSchedulePoint shall be set as None if OsTask is full preemptive.
522	SwComponent Event shall not be mapped to OsTask which is used by Bsw Module.
523	RteExclusiveAreaImplMechanism is COOPERATIVE_RUNNABLE_PLACEMENT. But RteBswExclusiveAreaOsResourceRef is not set.
524	RteExclusiveAreaImplMechanism is OS_RESOURCE. But RteBswExclusiveAreaOsResourceRef is not set.
525	RteExclusiveAreaImplMechanism is COOPERATIVE_RUNNABLE_PLACEMENT. But RteExclusiveAreaOsResourceRef is not set.
526	RteExclusiveAreaImplMechanism is OS_RESOURCE. But RteExclusiveAreaOsResourceRef is not set.
527	System Signal is not mapped to ISignal.
528	ISignal is not mapped to ISignalToIPduMapping.
529	ISignalToIPduMapping is not mapped to ComSignal.
530	The RteMappedToTaskRef of RteEventToTaskMapping has invalid reference.
531	VariableAccessRef of RteVariableReadAccessRef is invalid.
532	VariableAccessRef of RteVariableWriteAccessRef is invalid.

533	Coherency Group shall be mapped to same ostask.
534	The RteMappedToTaskRef of RteEventToTaskMapping has invalid reference.
535	Format of OsSecPerTick is not valid.
536	Format of OsSecPerHwTick is not valid.
537	Format of TaskPrefix is not valid.
540	StartOnEvent cannot reference runnable of other SwComponent or InternalBehavior.
541	ParameterSwComponentType shall not have InternalBehavior.
542	ParameterSwComponentType shall not have require port.
543	SupportMultipleInstance is not set. SwComponent cannot created more than once.
544	ParameterSwComponentType cannot created more than once.
545	BswBehaviorRef of SwcBswMapping is empty.
546	SwcBehaviorRef of SwcBswMapping is empty.
547	SwcBswMapping is only valid when software component type is ServiceSwComponentType or EcuAbstractionSwComponentType or ComplexDeviceDriverSwComponentType.
548	CompositionSwComponentType shall not be multiple instantiated.
549	There is a infinite loop of hierarchy.
550	ParameterSwComponentType does not support inter-partition communication.
551	There is no SwComponentType for the name.
552	There is no PortPrototype for the path.
553	There is no interface for the path.
554	There is no VariableDataPrototype for the path.
555	There is an error for determining queued or not.
556	There is no SwComponentPrototype for the path.
557	There is an error for getting Rte_Send Function Name.
558	There is an error for getting Rte_Receive Function Name.
559	InitValue is invalid.

560	The NvmWriteRamBlockToNvm and NvmReadRamBlockFromNvm parameters set to the Rte_GetMirror and Rte_SetMirror API of the NvBlockDescriptor when NvmBlockUseSyncMechanism is enabled
561	InvalidValue of ApplicationDataType is invalid.
562	InvalidValue of ImplementationDataType is invalid.
563	PortPrototype path is invalid.
564	TypeTRef of ApplicationArrayElement is invalid.
565	TypeTRef of ApplicationRecordElement is invalid.
566	TypeTRef for InitValue is invalid.
571	RootSwCompositionPrototype of System is empty.
572	SoftwareCompositionTRef of RootSwCompositionPrototype is empty.
575	There is no PortPrototype for the path.
581	There is no RteEvent for the RunnableEntity.
582	There is no RteEventToTaskMapping for the RteEvent which uses implicit sender receiver communication.
583	There is no RteMappedtoTaskRef for the RteEvent which uses implicit sender receiver communication.
584	Different execution instances of a runnable entity, which use implicit data access, shall not be mapped to different Preemption Areas.
585	ImplementationDataType Path is invalid.
586	ApplicationDataType Path is invalid.
591	OsEvent has been used for more than one RTE Event.
592	The format of RTE Generator Version is not correct.
593	There is no ISignalIPdu for the path.
594	ISignal and DataElement of PortPrototype shall have same HandleOutOfRange configuration.
595	OsCounter has no value of OsSecondsPerTick. You can also set OsSecondsPerTick for Counter by using -OsSecPerTick option.
596	OsCounterMaxAllowedValue shall be greater than or equal to OsAlarm's Offset.
597	OsCounterMaxAllowedValue shall be greater than or equal to OsAlarm's Period.
598	OsCounterMaxAllowedValue shall be greater than or equal to OsScheduleTable's Offset.
605	TypeTRef in SwComponentPrototype is empty or invalid.

	TypeTRef in SwComponentPrototype shall be set with valid SwComponentType Path.
606	TypeTRef in VariableDataPrototype is empty or invalid. TypeTRef in VariableDataPrototype shall be set with valid DataType Path.
607	TypeTRef in ParameterDataPrototype is empty or invalid. TypeTRef in ParameterDataPrototype shall be set with valid DataType Path.
612	TypeTRef in ModeGroup is empty or invalid. TypeTRef in ModeGroup shall be set with valid ModeDeclarationGroup Path.
613	TypeTRef in ModeDeclarationGroupPrototype is empty or invalid. TypeTRef in ModeDeclarationGroupPrototype shall be set with valid ModeDeclarationGroup Path.
614	ProvidedInterfaceTRef/RequiredInterfaceTRef in PPortPrototype/RPortPrototype is empty or invalid. ProvidedInterfaceTRef/RequiredInterfaceTRef in PPortPrototype/RPortPrototype shall be set with valid Interface Path.
615	Category in ApplicationValueSpec/AutosarDataType/CompuMethod/EndToEndProfile/ModeDeclarationGroup is empty or invalid. Category in ApplicationValueSpec/AutosarDataType/CompuMethod/EndToEndProfile/ModeDeclarationGroup shall be set with valid value.
616	The number of SwcInternalBehavior in SwComponentType is not 1. The number of SwcInternalBehavior in SwComponentType shall be 1.
619	RteMappedToTaskRef in RteEventToTaskMapping is empty or invalid. RteMappedToTaskRef in RteEventToTaskMapping shall be set with valid OsTask Path. ※8.7 Guide for RteEvent 참조
620	ContextComponentRef in PPortInCompositionInstanceRef/ProviderIRef/RequesterIRef/RPortInCompositionInstanceRef is empty or invalid. ContextComponentRef in PPortInCompositionInstanceRef/ProviderIRef/RequesterIRef/RPortInCompositionInstanceRef shall be set with valid SwComponentPrototype path.
621	LowerLimit in CompuScale/InternalConstrs/PhysConstrs is empty. LowerLimit in CompuScale/InternalConstrs/PhysConstrs shall be set.
622	UpperLimit in CompuScale/InternalConstrs/PhysConstrs is empty. UpperLimit in CompuScale/InternalConstrs/PhysConstrs shall be set.
624	Even though IntervalType is not INFINITE, Value in Limit is empty. If IntervalType is not INFINITE, Value in Limit shall be set.
625	InternalConstr in DataConstrRule is empty. InternalConstr in DataConstrRule shall be set.
627	The number of DataConstrRule in DataConstr is not 1.

	The number of DataConstrRule in DataConstr shall be 1.
628	Even though DataType is used for HandleOutOfRange, DataConstrRef in SwDataDefProps is empty. If DataType is used for HandleOutOfRange, DataConstrRef in SwDataDefProps shall be set.
629	SwDataDefProps in AutosarDataType is empty, even though DataType is used for HandleOutOfRange. SwDataDefProps in AutosarDataType shall be set, if DataType is used for HandleOutOfRange.
630	SwDataDefProps in ArgumentDataPrototype/AutosarDataType/SwPointerTargetProps/VariableDataPrototype is empty. SwDataDefProps in ArgumentDataPrototype/AutosarDataType/SwPointerTargetProps/VariableDataPrototype shall be set.
631	RteGeneration in RTE ECU Configuration is empty. RteGeneration in RTE ECU Configuration shall be set.
632	ComIPduDirection in ComIPdu is empty or invalid. ComIPduDirection in ComIPdu shall be set with valid value.
633	ImplementedEntryRef in BswEntity is empty or invalid. ImplementedEntryRef in BswEntity shall be set with valid BswModuleEntry path.
636	RteInitializationBehavior in RTE ECU Configuration is empty. RteInitializationBehavior in RTE ECU Configuration shall be set.
637	EcucPartition of BswModuleDescription/SwComponentPrototype/OsTask is empty or invalid. EcucPartition of BswModuleDescription/SwComponentPrototype/OsTask shall be set.
638	RteTaskComMapping in RteGeneration is empty or invalid. RteTaskComMapping in RteGeneration shall be set with valid OsTask path.
639	Symbol in CompuScale/RunnableEntity/SchedulerNamePrefix is empty or invalid. Symbol in CompuScale/RunnableEntity/SchedulerNamePrefix shall be set with valid value.
640	OsApplication of EcucPartition/OsAlarm/OsTask/SwComponentPrototype is empty or invalid. OsApplication of EcucPartition/OsAlarm/OsTask/SwComponentPrototype shall be set.
641	BswBehaviorRef in SwcBswMapping is empty or invalid. BswBehaviorRef in SwcBswMapping shall be set with valid BswInternalBehavior path.
642	BswEntityRef in SwcBswRunnableMapping is empty or invalid. BswEntityRef in SwcBswRunnableMapping shall be set with valid BswEntity path.
643	StartsOnEventRef in BswEvent is empty or invalid. StartsOnEventRef in BswEvent shall be set with BswSchedulableEntity.
644	StartOnEventRef in RteEvent is empty or invalid. StartOnEventRef in RteEvent shall be set with valid RunnableEntity path.
645	ComSignalType in ComGroupSignal/ComSignal is empty or invalid.

	ComSignalType in ComGroupSignal/ComSignal shall be set with valid value.
646	ParameterRef in ParameterComSpec is empty or invalid. "ParameterRef in ParameterComSpec shall be set with valid ParameterDataPrototype path.
647	DataElementRef in SenderComSpec/ReceiverComSpec/InvalidationPolicy is empty or invalid. DataElementRef in SenderComSpec/ReceiverComSpec/InvalidationPolicy shall be set with valid VariableDataPrototype path.
648	There is no RteEventToTaskMapping for RteEvent. RteEventToTaskMapping for RteEvent shall be exist.
649	EventSourceRef in DataSendeCompletedEvent / DataWriteCompletedEvent / AsynchronousServerCallReturnsEvent / ModeSwitchedAckEvent / InternalTriggerOccurredEvent is empty or invalid. EventSourceRef DataSendeCompletedEvent / DataWriteCompletedEvent / AsynchronousServerCallReturnsEvent / ModeSwitchedAckEvent / InternalTriggerOccurredEvent shall be set with valid value.
650	Path of AutosarObject is duplicated. Path of AutosarObject shall be uniqueue.
651	Value in Limit / ModeDeclaration / NumValueSpec / TextValueSpec / V is empty or invalid. Value in Limit / ModeDeclaration / NumValueSpec / TextValueSpec / V shall be set with valid value.
652	PhysConstr in DataConstrRule is empty. PhysConstr in DataconstrRule shall be set.
653	ServiceId in BswModuleEntry is empty. ServiceId in BswModuleEntry shall be set.
654	ComIPduSignalProcessing in ComIPdu is empty. ComIPduSignalProcessing in ComIPdu shall be set.
655	Even though there is no EcucPartition or single EcucPartition, RteTaskComMapping in RteGeneration is set. If there is no EcucPartition or single EcucPartition, RteTaskComMapping in RteGeneration shall not be set.
656	SwBaseTypeRef in SwDataDefProps is empty or invalid. SwBaseTypeRef in SwDataDefProps shall be set with valid SwBaseType path.
657	ModuleId in BswModuleDescription and ModuleId in BswModuleDescription is same. ModuleId in BswModuleDescription and ModuleId in BswModuleDescription shall be different.
659	ServiceId in BswModuleEntry and ServiceId in BswModuleEntry is same. ServiceId in BswModuleEntry and ServiceId in BswModuleEntry shall be different.
660	TargetPPortRef in PPortInCompositionInstanceRef / ProviderIRef is empty or invalid. TargetPPortRef in PPortInCompositionInstanceRef / ProviderIRef shall be set with valid PPortPrototype path.
661	"TargetRPortRef in RPortInCompositionInstanceRef / RequesterIRef is empty or invalid.

	TargetRPortRef in RPortInCompositionInstanceRef / RequesterIRef shall be set with valid RPortPrototype path.
662	PPortPrototype and RPortPrototype are not compatible. PPortPrototype and RPortPrototype shall be compatible.
663	ContextPortRef in ModelRef is empty or invalid. ContextPortRef in ModelRef shall be set with valid PortPrototype path.
664	ProviderIRef in AssemblySwConnector is empty. ProviderIRef in AssemblySwConnector shall be set.
665	RequesterIRef in AssemblySwConnector is empty. RequesterIRef in AssemblySwConnector shall be set.
666	InnerPortIRef in AssemblySwConnector is empty. InnerPortIRef in DelegationSwConnector shall be set.
667	PPortInCompositionInstanceRef in InnerPortIRef is empty. PPortInCompositionInstanceRef in InnerPortIRef shall be set.
668	RPortInCompositionInstanceRef in InnerPortIRef is empty. RPortInCompositionInstanceRef in InnerPortIRef shall be set.
669	There is a M:N connection. RTE does not support M:N connections. M:N connections shall be removed.
670	ShortName in AutosarObject is duplicated. ShortName in AutosarObject shall be unique.
671	ShortName in AutosarObject is empty or invalid. ShortName in AutosarObject shall be set.
672	OperationIref in OperationInvokedEvent / ServerCallPoint is empty. OperationIref in OperationInvokedEvent / ServerCallPoint shall be set.
673	ContextPPortRef in ModeGroupIRef / OperationIref / PTriggerInAtomicSwcTypeInstanceRef is empty or invalid. ContextPPortRef in ModeGroupIRef / OperationIref / PTriggerInAtomicSwcTypeInstanceRef shall be set with valid PPortPrototype path.
674	TargetProvidedOperationRef in OperationIref is empty or invalid. TargetProvidedOperationRef in OperationIref shall be set with valid ClientServerOperation path.
675	ModelRef in SwcModeSwitchEvent is empty. ModelRef in SwcModeSwitchEvent shall be set.
676	ContextModeDeclarationGroupPrototypeRef in ModelRef is empty or invalid. ContextModeDeclarationGroupPrototypeRef in ModelRef shall be set with valid ModeGroup path.
677	TriggerIRef in ExternalTriggerOccurredEvent is empty. TriggerIRef in ExternalTriggerOccurredEvent shall be set.
678	ContextRPortRef in DataIRef/OperationIref/RTriggerInAtomicSwcInstanceRef is empty or invalid.

	ContextRPortRef in DataIRef/OperationIref/RTriggerInAtomicSwcInstanceRef shall be set with valid RPortPrototype path.
679	ModeGroup in ModeSwitchInterface is empty. ModeGroup in ModeSwitchInterface shall be set.
680	RteBswImplementationRef in RteBswModuleInstance is empty or invalid. RteBswImplementationRef in RteBswModuleInstance shall be set with valid BswImplementation path.
681	RteBswImplementationRef in RteBswModuleInstance is duplicated. RteBswImplementationRef in RteBswModuleInstance shall be unique.
682	RteBswModuleConfigurationRef in RteBswModuleInstance is empty or invalid. RteBswModuleConfigurationRef in RteBswModuleInstance shall be set with valid BswModuleDescription path.
683	RteSoftwareComponentInstanceRef in RteSwComponentInstance is empty or invalid. RteSoftwareComponentInstanceRef in RteSwComponentInstance shall be set with valid SwComponentPrototype path.
684	RteSoftwareComponentInstanceRef in RteSwComponentInstance andRteSoftwareComponentInstanceRef in RteSwComponentInstance are same. RteSoftwareComponentInstanceRef in RteSwComponentInstance andRteSoftwareComponentInstanceRef in RteSwComponentInstance shall not be same.
685	There is no EcucPartition in which BswModuleExecution is true. There shall be an EcucPartition in which BswModuleExecution is true.
686	The number of EcucValueCollection is not 1. The number of EcucValueCollection shall be 1.
687	The number of OsOs is not 1. The number of OsOs shall be 1.
688	RteBswModuleConfigurationRef in RteBswModuleInstance and RteBswModuleConfigurationRef in RteBswModuleInstance is same. RteBswModuleConfigurationRef in RteBswModuleInstance and RteBswModuleConfigurationRef in RteBswModuleInstance shall not be same.
689	The number of RteGeneration is not 1. The number of RteGeneration shall be 1.
690	The number of RteInitializationBehavior is not 1. The number of RteInitializationBehavior shall be 1.
691	ISignalRef in ISignalToIPduMapping and ISignalRef in ISignalToIPduMapping is same. ISignalRef in ISignalToIPduMapping and ISignalRef in ISignalToIPduMapping shall not be same.
692	ISignalGroupRef in ISignalToIPduMapping and ISignalGroupRef in ISignalToIPduMapping is same. ISignalGroupRef in ISignalToIPduMapping and ISignalGroupRef in ISignalToIPduMapping shall not be same.
693	TargetTriggerRef in PTriggerInAtomicSwcTypeInstanceRef/RTriggerInAtomicSwcInstanceRef is empty or invalid.

	TargetTriggerRef in PTriggerInAtomicSwcTypeInstanceRef/RTriggerInAtomicSwcInstanceRef shall be set with valid Trigger path.
694	SwComponentPrototype for the SwComponentType is not exist. SwComponentPrototype for the SwComponentType shall be exist.
695	BehaviorRef in SwcImplementationandBehaviorRef in SwcImplementationis Same. BehaviorRef in SwcImplementationandBehaviorRef in SwcImplementationshall not be Same.
697	SystemSignal is not mapped to ISignal. SystemSignal shall be mapped to ISignal.
698	ISignal is not mapped to ISignalToIPduMapping. ISignal shall be mapped to ISignalToIPduMapping.
699	SystemSignalGroup is not mapped to ISignalGroup. SystemSignalGroup shall be mapped to ISignalGroup.
700	ISignalGroup is not mapped to ISignalToIPduMapping. ISignalGroup shall be mapped to ISignalToIPduMapping.
701	There are different definitions of the ImplementationDataTypes which have a same short name. There shall be a same definitions of the ImplementationDataTypes which have a same short name.
702	ComIPdu for the ComSignal/ComSignalGroup is not exist. ComIPdu for the ComSignal/ComSignalGroup shall be exist.
703	ImplementationDataTypeElement in ImplementationDataType/ImplementationDataTypeElement is empty. ImplementationDataTypeElement in ImplementationDataType/ImplementationDataTypeElement shall be set.
704	BswModuleEntryRef in BswModuleEntryRefConditional is empty or invalid. BswModuleEntryRef in BswModuleEntryRefConditional shall be set with valid BswModuleEntry path.
705	Direction of ComSignal/ComSignalGroup/ISignalIPdu cannot be determined. Please check Direction of ComIPdu for ComSignal/ComSignalGroup/ISignalIPdu.
706	ImplementationDataTypeRef in DataTypeMap/SwDataDefProps is empty or invalid. ImplementationDataTypeRef in DataTypeMap/SwDataDefProps shall be set with valid ImplementationDataType path.
707	QueueLength in QueuedReceiverComSpec/ServerComSpec is empty or invalid. QueueLength in QueuedReceiverComSpec/ServerComSpec shall be set with valid value.
708	BswModuleDescriptionRef in BswModuleDescriptionRefConditional is empty or invalid. BswModuleDescriptionRef in BswModuleDescriptionRefConditional shall be set with valid BswModuleDescription path.
709	Even though ImplementationDataType/ImplementationDataTypeElement is Array, the number of ImplementationDataTypeElement is not 1. If ImplementationDataType/ImplementationDataTypeElement is Array, the number of ImplementationDataTypeElement shall be 1.

710	QueuedReceiverComSpec in RPortPrototype is empty. QueuedReceiverComSpec in RPortPrototype shall be set.
715	There is no ComSignal for ISignalToIPduMapping. There shall be a ComSignal for ISignalToIPduMapping.
716	There is no ComSignalGroup for ISignalToIPduMapping. There shall be a ComSignalGroup for ISignalToIPduMapping.
717	The number of V in SwValuesPhys is not 1. The number of V in SwValuesPhys shall be 1.
718	Ports of AssemblySwConnector is not compatible. Ports of AssemblySwConnector shall be compatible.
719	ImplementationDataType cannot be resolved for ApplicationDataType. ImplementationDataType shall be resolved for ApplicationDataType.
720	ParameterProvideComSpec in PPortPrototype is empty. ParameterProvideComSpec in PPortPrototype shall be set.
721	ParameterRequireComSpec in RPortPrototype is empty. ParameterRequireComSpec in RPortPrototype shall be set.
722	The number of RootVariableDataPrototypeRef in AutosarVariableInImplDataType is over 1. The number of RootVariableDataPrototypeRef in AutosarVariableInImplDataType shall be 0 or 1.
723	The number of TargetDataPrototypeRef in AutosarVariableInImplDataType is over 1. The number of TargetDataPrototypeRef in AutosarVariableInImplDataType shall be 0 or 1.
724	Even though BswModuleEntry is used as BswCalledEntity, CallType in BswModuleEntry is not REGULAR or CALLBACK. If BswModuleEntry is used as BswCalledEntity, CallType in BswModuleEntry shall be REGULAR or CALLBACK.
725	Even though BswModuleEntry is used as BswInterruptEntity, CallType in BswModuleEntry is not INTERRUPT. If BswModuleEntry is used as BswInterruptEntity, CallType in BswModuleEntry shall be INTERRUPT.
726	Even though BswModuleEntry is used as BswSchedulableEntity, CallType in BswModuleEntry is not SCHEDULED. If BswModuleEntry is used as BswSchedulableEntity, CallType in BswModuleEntry shall be SCHEDULED.
727	Even though BswModuleEntry is used as BswInterruptEntity, ExecutionContext in BswModuleEntry and InterruptCategory in BswInterruptEntity is not matched. If BswModuleEntry is used as BswInterruptEntity, ExecutionContext in BswModuleEntry and InterruptCategory in BswInterruptEntity shall be matched.
728	Even though BswModuleEntry is used as BswSchedulableEntity, ExecutionContext in BswModuleEntry is not TASK. If BswModuleEntry is used as BswSchedulableEntity, ExecutionContext in BswModuleEntry shall be TASK.

729	The number of Period in TimingEvent/BswTimingEvent/DataFilter is not 1. The number of Period in TimingEvent/BswTimingEvent/DataFilter shall be 1.
730	ImplInitValue in CalibrationParameterValue is invalid. ImplInitValue in CalibrationParameterValue shall be valid.
731	ApplInitValue in CalibrationParameterValue is invalid. ApplInitValue in CalibrationParameterValue shall be valid.
732	PossibleErrorRef in ClientServerOperation is invalid. PossibleErrorRef in ClientServerOperation shall be valid.
733	ISignalRef in ISignalToIPduMapping is invalid. ISignalRef in ISignalToIPduMapping shall be set with valid ISignal path.
734	ISignalGroupRef in ISignalToIPduMapping is invalid. ISignalGroupRef in ISignalToIPduMapping shall be set with valid ISignalGroup path.
735	Even though ComSignalType in ComSignal/ComGroupSignal is UINT8_DYN.DynamicLength in SystemSignal is not set true. If ComSignalType in ComSignal/ComGroupSignal is UINT8_DYN.DynamicLength in SystemSignal shall be set true.
736	Even though ComSignalType in ComSignal/ComGroupSignal is not UINT8_DYN.DynamicLength in SystemSignal is set true. If ComSignalType in ComSignal/ComGroupSignal is not UINT8_DYN.DynamicLength in SystemSignal shall not be set true.
737	Even though ComSignalType in ComSignal/ComGroupSignal is UINT8_DYN.ArraySizeSemantics in ImplementationDataType is not VARIABLE-SIZE. If ComSignalType in ComSignal/ComGroupSignal is UINT8_DYN.ArraySizeSemantics in ImplementationDataType shall be VARIABLE-SIZE.
738	Even though ComSignalType in ComSignal/ComGroupSignal is not UINT8_DYN.ArraySizeSemantics in ImplementationDataType is VARIABLE-SIZE. If ComSignalType in ComSignal/ComGroupSignal is not UINT8_DYN.ArraySizeSemantics in ImplementationDataType shall not be VARIABLE-SIZE.
739	ConstantRef in ConstantReference is empty or invalid. ConstantRef in ConstantReference shall be set with valid Constant path.
740	ComSignal/ComSignalGroup for TX is not mapped to PPortPrototype. ComSignal/ComSignalGroup for TX shall be mapped to PPortPrototype.
741	ComSignal/ComSignalGroup for RX is not mapped to RPortPrototype. ComSignal/ComSignalGroup for RX shall be mapped to RPortPrototype.
742	The number of DataConstrRule in DataConstr is not 1. The number of DataConstrRule in DataConstr shall be 1.
743	The number of AutosarVariableIRef in AccessedVariable/ReadNvData/WrittenNvData is not 1. The number of AutosarVariableIRef in AccessedVariable/ReadNvData/WrittenNvData shall be 1.
744	The number of AutosarParameterIRef in AccessedParameter is not 1.

	The number of AutosarParameterIRef in AccessedParameter shall be 1.
745	ComSpec in PortPrototype is empty. ComSpec in PortPrototype shall be set.
746	NonQueuedSenderComSpec in PPortPrototype is empty. NonQueuedSenderComSpec in PPortPrototype shall be set.
747	ComTimeout and TransmissionAcknowledgeTimeout is not matched. ComTimeout and TransmissionAcknowledgeTimeout shall be matched.
748	ConstantSpecification/RecordValueSpec is invalid. ConstantSpecification/RecordValueSpec shall be valid.
749	ComTimeout and AliveTimeout is not matched. ComTimeout and AliveTimeout shall be matched.
750	Even though there is a DataSendCompletedEvent, TransmissionAcknowledge is not set. If there is a DataSendCompletedEvent, TransmissionAcknowledge shall be set.
751	Even though there is a DataWriteCompletedEvent, TransmissionAcknowledge is not set. If there is a DataWriteCompletedEvent, TransmissionAcknowledge shall be set.
752	Even though there is a Rte_COMCbkTAck, TransmissionAcknowledge is not set. If there is a Rte_COMCbkTAck, TransmissionAcknowledge shall be set.
753	There is no OsApplication for EcucPartition. There shall be an OsApplication for EcucPartition.
754	There is multiple AccessedVariable/NvRamBlockElements which have same LocalVariableRef. There shall not be multiple AccessedVariable/NvRamBlockElements which have same LocalVariableRef.
755	ImplementationDataType/ImplementationDataTypeElement is invalid. ImplementationDataType/ImplementationDataTypeElement shall be valid.
756	ValueSpec in InitValue is invalid. ValueSpec in InitValue shall be valid.
757	ImplementationDataType/ImplementationDataTypeElement and ImplementationDataType/ImplementationDataTypeElement are not compatible. ImplementationDataType/ImplementationDataTypeElement and ImplementationDataType/ImplementationDataTypeElement shall be compatible.
758	TriggerInterface and TriggerInterface are not compatible. TriggerInterface and TriggerInterface shall be compatible.
759	DataConstr and DataConstr are not compatible. DataConstr and DataConstr shall be compatible.
760	SenderReceiverInterface and SenderReceiverInterface are not compatible. SenderReceiverInterface and SenderReceiverInterface shall be compatible.
761	NvDataInterface and NvDataInterface are not compatible.

	NvDataInterface and NvDataInterface shall be compatible.
762	Category in ApplicationDataType and Category in ImplementationDataType are not compatible. Category in ApplicationDataType and Category in ImplementationDataType shall be compatible.
763	TypeTRef in RamBlock and TypeTRef in RomBlock are not compatible. TypeTRef in RamBlock and TypeTRef in RomBlock shall be compatible.
764	DataType in VariableDataPrototype and DataType in VariableDataPrototype are not compatible. DataType in VariableDataPrototype and DataType in VariableDataPrototype shall be compatible.
765	PortPrototype has an incompatible ComSpec with Interface. ComSpec shall be compatible with Interface.
766	HandleInvalid in VariableDataPrototype and HandleInvalid in VariableDataPrototype are not compatible. HandleInvalid in VariableDataPrototype and HandleInvalid in VariableDataPrototype shall be compatible.
767	Even though SwComponentType supports multiple instantiation, EnableTakeAddress is used. If SwComponentType supports multiple instantiation, EnableTakeAddress shall not be used.
768	RTE currently does not support initial value of CalibrationParameterValue. Do not use initial value of CalibrationParameterValue.
769	There are multiple RoleBasedPortAssignment which have same role. There shall be single RoleBasedPortAssignment for each role.
770	The number of ModeMapping is over Multiplicity. The number of ModeMapping shall be within Multiplicity.
771	The number of NvBlockNeeds is over Multiplicity. The number of NvBlockNeeds shall be within Multiplicity.
772	The number of RamBlock is over Multiplicity. The number of RamBlock shall be within Multiplicity.
773	The number of RomBlock is over Multiplicity. The number of RomBlock shall be within Multiplicity.
774	The number of CalcRamBlockCrc is over Multiplicity. The number of CalcRamBlockCrc shall be within Multiplicity.
775	The number of RestoreAtStart is over Multiplicity. The number of RestoreAtStart shall be within Multiplicity.
776	The number of StoreAtShutDown is over Multiplicity. The number of StoreAtShutDown shall be within Multiplicity.
777	The number of WritingFrequency is over Multiplicity. The number of WritingFrequency shall be within Multiplicity.
778	The number of NvRamBlockElement is over Multiplicity. The number of NvRamBlockElement shall be within Multiplicity.

779	The number of ReadNvData is over Multiplicity. The number of ReadNvData shall be within Multiplicity.
780	The number of WrittenNvData is over Multiplicity. The number of WrittenNvData shall be within Multiplicity.
781	The number of VariableRef is over Multiplicity. The number of VariableRef shall be within Multiplicity.
782	The number of AutosarVariableInImplDataType is over Multiplicity. The number of AutosarVariableInImplDataType shall be within Multiplicity.
783	The number of OsResourceProperty is over Multiplicity. The number of OsResourceProperty shall be within Multiplicity.
784	The number of InitValue in ParameterComSpec is over Multiplicity. The number of InitValue in ParameterComSpec shall be within Multiplicity.
785	The number of TypeTRef is over Multiplicity. The number of TypeTRef shall be within Multiplicity.
786	The number of PortPrototypeRef in RoleBasedPortAssignment is over Multiplicity. The number of PortPrototypeRef in RoleBasedPortAssignment shall be within Multiplicity.
787	The number of Role is over Multiplicity. The number of Role shall be within Multiplicity.
788	The number of RteVariableReadAccessRef is over Multiplicity. The number of RteVariableReadAccessRef shall be within Multiplicity.
789	The number of RteVariableWriteAccessRef is over Multiplicity. The number of RteVariableWriteAccessRef shall be within Multiplicity.
790	The number of LocalParameterRef is over Multiplicity. The number of LocalParameterRef shall be within Multiplicity.
791	The number of BehaviorRef in SwcImplementation is over Multiplicity. The number of BehaviorRef in SwcImplementation shall be within Multiplicity.
792	The number of SwcBswMappingRef is over Multiplicity. The number of SwcBswMappingRef shall be within Multiplicity.
793	Parameter Interface does not support N:1 communication. Parameter Interface shall be only used for 1:1, 1:N communication.
794	RamBlock in NvBlockDescriptor is empty. RamBlock in NvBlockDescriptor shall be set.
795	QueueLength for PortPrototype and VariableDataPrototype is empty. QueueLength for PortPrototype and VariableDataPrototype shall be set.
796	RTE_COMCbk Function is not used with RPortPrototype. RTE_COMCbk Function shall be used with RPortPrototype.

797	InitValue in NonQueuedSenderComSpec is empty. InitValue in NonQueuedSenderComSpec shall be set.
798	There is no SenderRecArrayElementMapping in SenderRecArrayTypeMapping for the index . SenderRecArrayElementMapping in SenderRecArrayTypeMapping shall be exist for the index .
799	There is no SenderRecRecordElementMapping in SenderRecRecordTypeMapping for ImplementationDataTypeElement. SenderRecRecordElementMapping in SenderRecRecordTypeMapping shall be exist for ImplementationDataTypeElement.
800	Parameter Interface supports only Intra Partition Communication. Do not use Parameter Interface except Intra Partition Communication.
801	SwComponentPrototypes for the SwComponentType is not assigned to the same partition. SwComponentPrototypes for the SwComponentType shall be assigned to the same partition.
802	There is no SenderRecRecordElementMapping in SenderRecRecordTypeMapping for ApplicationRecordElement. SenderRecRecordElementMapping in SenderRecRecordTypeMapping shall be exist for ApplicationRecordElement.
803	The number of TypeTRef in RomBlock is over Multiplicity. The number of TypeTRef in RomBlock shall be within Multiplicity.
804	Even though multiple instance is used, SupportsMultipleInstantiation in InternalBehavior is not set true. If multiple instance is used, SupportsMultipleInstantiation in InternalBehavior shall be set true.
805	Both ISignalRef and ISignalGroupRef in ISignalToIPduMapping exist. Only one of ISignalRef or ISignalGroupRef in ISignalToIPduMapping shall exist.
806	Neither ISignalRef nor ISignalGroupRef in ISignalToIPduMapping exists. One of ISignalRef or ISignalGroupRef in ISignalToIPduMapping shall exist.
807	The number of NvBlockDataMapping in NvBlockDescriptor is not 1. The number of NvBlockDataMapping in NvBlockDescriptor shall be 1.
808	The number of internal OsResource in OsTask is over 1. The number of internal OsResource in OsTask shall be 1.
809	There is an inconsistency between initial values of DataElement and ComSignal/ComSignalGroup. Initial values of DataElement and ComSignal/ComSignalGroup shall be consistent.
810	Unconnected PortPrototype typed with NvDataInterface does not have NvRequireComSpec with a InitValue. Unconnected PortPrototype typed with NvDataInterface shall have NvRequireComSpec with a InitValue.
811	RTE does not support REPLACE/REPLACE-BY-TIMEOUT-SUBSTITUTION-VALUE HandleTimeoutType for the intra ecu communication. RTE does not support REPLACE HandleTimeoutType for the intra ecu communication.

812	HandleTimeoutType and ComRxDataTimeoutAction have inconsistency. HandleTimeoutType and ComRxDataTimeoutAction have inconsistency.
813	Even though HandleTimeoutType is REPLACE/REPLACE-BY-TIMEOUT-SUBSTITUTION-VALUE, ComTimeoutNotification is not set. If HandleTimeoutType is REPLACE/REPLACE-BY-TIMEOUT-SUBSTITUTION-VALUE, ComTimeoutNotification shall be set.
814	Even though HandleTimeoutType is REPLACE, InitValue is not set. If HandleTimeoutType is REPLACE, InitValue shall be set.
815	Even though HandleTimeoutType is REPLACE, AliveTimeout is not set. If HandleTimeoutType is REPLACE, AliveTimeout shall be set.
816	Both RteUsedOsAlarmRef and RteUsedOsSchTblExpiryPointRef in RteEventToTaskMapping exist. Only one of RteUsedOsAlarmRef or RteUsedOsSchTblExpiryPointRef in RteEventToTaskMapping shall exist.
817	Neither RteUsedOsAlarmRef nor RteUsedOsSchTblExpiryPointRef in RteEventToTaskMapping exists. One of RteUsedOsAlarmRef or RteUsedOsSchTblExpiryPointRef in RteEventToTaskMapping shall exist.
818	Both OsAlarmSetEvent and OsAlarmActivateTask in OsAlarmAction exist. Only one of OsAlarmSetEvent or OsAlarmActivateTask in OsAlarmAction shall exist.
819	Neither OsAlarmSetEvent nor OsAlarmActivateTask in OsAlarmAction exists. One of OsAlarmSetEvent or OsAlarmActivateTask in OsAlarmAction shall exist.
820	TimingEvent, DataReceivedEvent, DataReceiveErrorEvent, DataSendCompletedEvent, DataWriteCompletedEvent shall be mapped to OsTask. TimingEvent, DataReceivedEvent, DataReceiveErrorEvent, DataSendCompletedEvent, DataWriteCompletedEvent shall be mapped to OsTask.
821	RteUsedOsEventRef in RteEventToTaskMapping is not set for ExtendedTask. RteUsedOsEventRef in RteEventToTaskMapping shall be set for ExtendedTask.
822	OsTask is not mapped to OsApplication. OsTask shall be mapped to OsApplication.
823	OsAppEcucPartitionRef in OsApplication is empty or invalid. OsAppEcucPartitionRef in OsApplication shall be set with valid EcucPartition path.
824	For using EcucPartition, SwComponentPrototype is not mapped to EcucPartition. For using EcucPartition, SwComponentPrototype shall be mapped to EcucPartition.
825	There is mismatching partition between SwComponentPrototype and OsTask. There is mismatching partition between SwComponentPrototype and OsTask.
826	There is mismatching partition between SwComponentPrototype and OsAlarm. There is mismatching partition between SwComponentPrototype and OsAlarm.
827	OsAlarm is not mapped to OsApplication. OsAlarm shall be mapped to OsApplication.

828	The number of InitValue in RamBlock is over Multiplicity. The number of InitValue in RamBlock shall be within Multiplicity.
829	The number of InitValue in RomBlock is over Multiplicity. The number of InitValue in RomBlock shall be within Multiplicity.
835	The number of ServerCallPoints which have same ContextRPortRef and TargetProvidedOperationRef is over 1. The number of ServerCallPoints which have same ContextRPortRef and TargetProvidedOperationRef shall be 1.
836	The number of ServerCallPoints which have same ContextRPortRef and TargetProvidedOperationRef is over 1. The number of ServerCallPoints which have same ContextRPortRef and TargetProvidedOperationRef shall be 1.
837	ParameterValue of AutosarObject is empty or invalid. ParameterValue of AutosarObject shall be set.
838	ComNotification in ComSignal/ComSignalGroup is empty or invalid. ComNotification in ComSignal/ComSignalGroup shall be set with valid value.
839	ComNotification in ComSignal/ComSignalGroup is empty or invalid. ComNotification in ComSignal/ComSignalGroup shall be set with valid value.
840	ComTimeoutNotification in ComSignal/ComSignalGroup is empty or invalid. ComTimeoutNotification in ComSignal/ComSignalGroup shall be set with valid value.
841	ComTimeoutNotification in ComSignal/ComSignalGroup is empty or invalid. ComTimeoutNotification in ComSignal/ComSignalGroup shall be set with valid value.
842	ComErrorNotification in ComSignal/ComSignalGroup is empty or invalid. ComErrorNotification in ComSignal/ComSignalGroup shall be set with valid value.
843	ComInvalidNotification in ComSignal/ComSignalGroup is empty or invalid. ComInvalidNotification in ComSignal/ComSignalGroup shall be set with valid value.
844	Tx ComSignal/ComSignalGroup has Rte_COMCbk callback function as ComNotification. Tx ComSignal/ComSignalGroup shall not have Rte_COMCbk callback function as ComNotification.
845	Tx ComSignal/ComSignalGroup has Rte_COMCbkInv callback function as ComInvalidNotification. Tx ComSignal/ComSignalGroup shall not have Rte_COMCbkInv callback function as ComInvalidNotification.
846	Tx ComSignal/ComSignalGroup has Rte_COMCbkRxTOut callback function as ComTimeoutNotification. Tx ComSignal/ComSignalGroup shall not have Rte_COMCbkRxTOut callback function as ComTimeoutNotification.
847	Rx ComSignal/ComSignalGroup has Rte_COMCbkTAck callback function as ComNotification. Rx ComSignal/ComSignalGroup shall not have Rte_COMCbkTAck callback function as ComNotification.

848	Rx ComSignal/ComSignalGroup has Rte_COMCbkTErr callback function as ComErrorNotifcation. Rx ComSignal/ComSignalGroup shall not have Rte_COMCbkTErr callback function as ComErrorNotifcation.
849	Rx ComSignal/ComSignalGroup has Rte_COMCbkTxTOut callback function as ComTimeoutNotification. Rx ComSignal/ComSignalGroup shall not have Rte_COMCbkTxTOut callback function as ComTimeoutNotification.
850	QueueLength in ServerComSpec is lesser than or equal to 0. QueueLength in ServerComSpec shall be greater than 0.
851	The number of RteInitializationStrategy in RteInitializationBehavior is over 1. The number of RteInitializationStrategy in RteInitializationBehavior shall be 1.
852	HandleOutOfRange in QueuedSenderComSpec is INVALID or DEFAULT or EXTERNAL-REPLACEMENT. HandleOutOfRange in QueuedSenderComSpec shall not be INVALID or DEFAULT or EXTERNAL-REPLACEMENT.
853	HandleOutOfRangeStatus in ReceiverComSpec is INDICATE. HandleOutOfRangeStatus in ReceiverComSpec shall not be INDICATE.
854	ComSignalType in ComSignal/ComGroupSignal does not match with the ImplementationDataType. ComSignalType in ComSignal/ComGroupSignal shall match with the ImplementationDataType.
855	The number of ApplicationArrayElement in ApplicationArrayDataType is not 1. The number of ApplicationArrayElement in ApplicationArrayDataType shall be 1.
856	CompuMethodRef in SwDataDefProps is set with other categories except VALUE and BOOLEAN. CompuMethodRef in SwDataDefProps shall not be set with other categories except VALUE and BOOLEAN.
857	CompuMethodRef in SwDataDefProps is set with other categories except VALUE and TYPE_REFERENCE. CompuMethodRef in SwDataDefProps shall not be set with other categories except VALUE and TYPE_REFERENCE.
858	DataConstrRef in SwDataDefProps is set with other categories except VALUE and BOOLEAN. DataConstrRef in SwDataDefProps shall not be set with other categories except VALUE and BOOLEAN.
859	DataConstrRef in SwDataDefProps is set with other categories except VALUE. DataConstrRef in SwDataDefProps shall not be set with other categories except VALUE.
860	InvalidValue in SwDataDefProps is set with other categories except VALUE and BOOLEAN. InvalidValue in SwDataDefProps shall not be set with other categories except VALUE and BOOLEAN.
861	InvalidValue in SwDataDefProps is set with other categories except VALUE. InvalidValue in SwDataDefProps shall not be set with other categories except VALUE.
862	CompuMethodRef in SwDataDefProps is set with ApplicationArrayElement or ApplicationRecordElement.

	CompuMethodRef in SwDataDefProps shall not be set with ApplicationArrayElement or ApplicationRecordElement.
863	DataConstrRef in SwDataDefProps is set with ApplicationArrayElement or ApplicationRecordElement. DataConstrRef in SwDataDefProps shall not be set with ApplicationArrayElement or ApplicationRecordElement.
864	InvalidValue in SwDataDefProps is set with ApplicationArrayElement or ApplicationRecordElement. InvalidValue in SwDataDefProps shall not be set with ApplicationArrayElement or ApplicationRecordElement.
865	HandleOutOfRange in QueuedReceiverComSpec is INVALID or DEFAULT or EXTERNAL-REPLACEMENT. HandleOutOfRange in QueuedReceiverComSpec shall not be INVALID or DEFAULT or EXTERNAL-REPLACEMENT.
868	Even though IntervalType in Limit is INFINITE, Value in Limit is not empty. If IntervalType in Limit is INFINITE, Value in Limit shall be empty.
869	RteExpectedActivationOffset in RteUsedOsActivation is not multiples of OsSecondsPerTick in OsCounter. RteExpectedActivationOffset in RteUsedOsActivation shall be multiples of OsSecondsPerTick in OsCounter.
870	RteExpectedActivationOffset in RteUsedOsActivation is not within a range of 0 and OsSecondsPerTick * OsCounterMaxAllowedValue in OsCounter. RteExpectedActivationOffset in RteUsedOsActivation shall be within a range of 0 and OsSecondsPerTick * OsCounterMaxAllowedValue in OsCounter.
871	There are multiple RteEventToTaskMappings which have same RteEventRef in RteSwComponentInstance. There shall not be multiple RteEventToTaskMappings which have same RteEventRef in RteSwComponentInstance.
872	There are multiple RteSectionInitializationPolicies in RteInitializationBehavior. There shall not be multiple RteSectionInitializationPolicies in RteInitializationBehavior.
873	OsTask of RteMappedToTaskRef in RteEventToTaskMapping does not have OsEvent of RteUsedOsEventRef in RteEventToTaskMapping. OsTask of RteMappedToTaskRef in RteEventToTaskMapping shall have OsEvent of RteUsedOsEventRef in RteEventToTaskMapping.
874	RteEventRef in RteEventToTaskMapping is not member of RteSoftwareComponentInstanceRef in RteSwComponentInstance. RteEventRef in RteEventToTaskMapping shall be member of RteSoftwareComponentInstanceRef in RteSwComponentInstance.
875	Even though RteEventRef in RteEventToTaskMapping does not reference TimingEvent, RteActivationOffset in RteEventToTaskMapping is set. If RteEventRef in RteEventToTaskMapping does not reference TimingEvent, RteActivationOffset in RteEventToTaskMapping shall not be set.

876	RteActivationOffset in RteEventToTaskMapping is not multiples of OsSecondsPerTick in OsCounter. RteActivationOffset in RteEventToTaskMapping shall be multiples of OsSecondsPerTick in OsCounter.
877	RteActivationOffset in RteEventToTaskMapping is not within a range of 0 and OsSecondsPerTick * OsCounterMaxAllowedValue in OsCounter. RteActivationOffset in RteEventToTaskMapping shall be within a range of 0 and OsSecondsPerTick * OsCounterMaxAllowedValue in OsCounter.
878	Period in TimingEvent is not multiples of OsSecondsPerTick in OsCounter. Period in TimingEvent shall be multiples of OsSecondsPerTick in OsCounter.
879	Period in TimingEvent is not within a range of 0 and OsSecondsPerTick * OsCounterMaxAllowedValue in OsCounter. Period in TimingEvent shall be within a range of 0 and OsSecondsPerTick * OsCounterMaxAllowedValue in OsCounter.
880	RteVariableWriteAccessRef in RteImplicitCommunication is invalid. RteVariableWriteAccessRef in RteImplicitCommunication shall be valid.
881	RteVariableReadAccessRef in RteImplicitCommunication is invalid. RteVariableReadAccessRef in RteImplicitCommunication shall be valid.
882	OsTask of RteVirtuallyMappedToTaskRef in RteEventToTaskMapping is not activated by OsAlarm of RteUsedOsAlarmRef in RteEventToTaskMapping. OsTask of RteVirtuallyMappedToTaskRef in RteEventToTaskMapping shall be activated by OsAlarm of RteUsedOsAlarmRef in RteEventToTaskMapping.
883	OsTask of RteMappedToTaskRef in RteEventToTaskMapping is not activated by OsAlarm of RteUsedOsAlarmRef in RteEventToTaskMapping. OsTask of RteMappedToTaskRef in RteEventToTaskMapping shall be activated by OsAlarm of RteUsedOsAlarmRef in RteEventToTaskMapping.
884	OsTask of RteVirtuallyMappedToTaskRef in RteEventToTaskMapping does not have OsEvent of RteUsedOsEventRef in RteEventToTaskMapping. OsTask of RteVirtuallyMappedToTaskRef in RteEventToTaskMapping shall have OsEvent of RteUsedOsEventRef in RteEventToTaskMapping.
885	OsTask of RteMappedToTaskRef in RteEventToTaskMapping does not have OsEvent of RteUsedOsEventRef in RteEventToTaskMapping. OsTask of RteMappedToTaskRef in RteEventToTaskMapping shall have OsEvent of RteUsedOsEventRef in RteEventToTaskMapping.
886	RteBswActivationOffset in RteBswEventToTaskMapping is not multiples of OsSecondsPerTick in OsCounter. RteBswActivationOffset in RteBswEventToTaskMapping shall be multiples of OsSecondsPerTick in OsCounter.
887	RteBswActivationOffset in RteBswEventToTaskMapping is not within a range of 0 and OsSecondsPerTick * OsCounterMaxAllowedValue in OsCounter. RteBswActivationOffset in RteBswEventToTaskMapping shall be within a range of 0 and OsSecondsPerTick * OsCounterMaxAllowedValue in OsCounter.

888	Period in BswTimingEvent is not multiples of OsSecondsPerTick in OsCounter. Period in BswTimingEvent shall be multiples of OsSecondsPerTick in OsCounter.
889	Period in BswTimingEvent is not within a range of 0 and OsSecondsPerTick * OsCounterMaxAllowedValue in OsCounter. Period in BswTimingEvent shall be within a range of 0 and OsSecondsPerTick * OsCounterMaxAllowedValue in OsCounter.
890	Even though RteBswEventRef in RteBswEventToTaskMapping does not reference BswTimingEvent, RteBswActivationOffset in RteBswEventToTaskMapping is set. If RteBswEventRef in RteBswEventToTaskMapping does not reference BswTimingEvent, RteBswActivationOffset in RteBswEventToTaskMapping shall not be set.
891	OsTask of RteUsedOsEventRef in RteEventToTaskMapping is not activated by OsAlarm of RteUsedOsAlarmRef in RteEventToTaskMapping. OsTask of RteUsedOsEventRef in RteEventToTaskMapping shall be activated by OsAlarm of RteUsedOsAlarmRef in RteEventToTaskMapping.
892	There are multiple NvRequireComSpecs which have VariableRef in RPortPrototype. There shall not be multiple NvRequireComSpecs which have VariableRef in RPortPrototype.
893	There are multiple ParameterRequireComSpecs of ParameterRef in RPortPrototype. There shall be single ParameterRequireComSpec of ParameterRef in RPortPrototype.
894	There are multiple ReceiverComSpecs which have DataElementRef in RPortPrototype. There shall not be multiple ReceiverComSpecs which have DataElementRef in RPortPrototype.
895	There are multiple ServerComSpecs which have OperationRef in PortPrototype. There shall not be multiple ServerComSpec which have OperationRef in PortPrototype.
896	There are multiple NvProvideComSpecs which have VariableRef in PPortPrototype. There shall not be multiple NvProvideComSpecs which have VariableRef in PPortPrototype.
897	There are multiple ParameterProvideComSpecs which have same ParameterRef in PPortPrototype. There shall not be multiple ParameterProvideComSpecs which have same ParameterRef in PPortPrototype.
898	There are multiple SenderComSpecs which have same DataElementRef in PPortPrototype. There shall not be multiple SenderComSpecs which have same DataElementRef in PPortPrototype.
899	PortPrototype in NvBlockSwComponentType has InterfaceTypeTRef. which references InterfaceIsService in Interface is not FALSE . PortPrototype in NvBlockSwComponentType shall not have InterfaceTypeTRef. which references InterfaceIsService in Interface shall be FALSE .
900	PortPrototype in NvBlockSwComponentType has InterfaceTypeTRef which does not reference NvDataInterface or ClientServerInterface. PortPrototype in NvBlockSwComponentType shall have InterfaceTypeTRef which references NvDataInterface or ClientServerInterface.
901	Even though InvalidationPolicy in VariableDataPrototype is REPLACE, InitValue and InvalidValue is same.

	If InvalidationPolicy in VariableDataPrototype is REPLACE, InitValue and InvalidValue shall be different.
902	Even though implicit Sender-Receiver Communication is used, EnableUpdate in NonQueuedReceiverComSpec is set TRUE. If implicit Sender-Receiver Communication is used, EnableUpdate in NonQueuedReceiverComSpec shall be FALSE.
903	Neither NumericalValueSpecification , ConstantReference, nor ApplicationValueSpecification in InvalidValue exists. One of NumericalValueSpecification , ConstantReference, or ApplicationValueSpecification in InvalidValue shall exist.
904	Both PPortInCompositionInstanceRef and RPortInCompositionInstanceRef in InnerPortIRef exist. Only one of PPortInCompositionInstanceRef or RPortInCompositionInstanceRef in InnerPortIRef shall exist.
905	Neither PPortInCompositionInstanceRef nor RPortInCompositionInstanceRef in InnerPortIRef exists. One of PPortInCompositionInstanceRef or RPortInCompositionInstanceRef in InnerPortIRef shall exist.
906	If ImplementationDataType has Category of ARRAY, RTE does not support ImplementationDataTypeElement which has Category of ARRAY or STRUCTURE. Please use ImplementationDataTypeElement which has Category of TYPE_REFERENCE for multi dimensional array or array of structure.
907	Category in ImplementationDataType is FUNCTION_REFERENCE. Category in ImplementationDataType shall not be FUNCTION_REFERENCE.
908	Category in ApplicationValueSpec is not VALUE or BOOLEAN. Category in ApplicationValueSpec shall be VALUE or BOOLEAN.
909	Category in ApplicationRecordDataType is not STRUCTURE. Category in ApplicationRecordDataType shall be STRUCTURE.
910	Category in ApplicationRecordElement and Category in ApplicationDataType which TypeTRef in ApplicationRecordElement references is not identical. Category in ApplicationRecordElement and Category in ApplicationDataType which TypeTRef in ApplicationRecordElement references shall be identical.
911	Both LocalParameterRef and AutosarParameterRef in AccessedParameter exist. Only one of LocalParameterRef or AutosarParameterRef in AccessedParameter shall exist.
912	Both LocalVariableRef and AutosarVariableIRef in AccessedVariable exist. Only One of LocalVariableRef or AutosarVariableIRef in AccessedVariable shall exist.
913	Neither LocalVariableRef nor AutosarVariableIRef in AccessedVariable exists. One of LocalVariableRef or AutosarVariableIRef in AccessedVariable shall exist.
914	Neither LocalParameterRef nor AutosarParameterRef in AccessedParameter exists. One of LocalParameterRef or AutosarParameterRef in AccessedParameter shall exist.
915	ImplementationDataType of VariableDataPrototype and ImplementationDataType of VariableDataPrototype is inconsistent.

	ImplementationDataType of VariableDataPrototype and ImplementationDataType of VariableDataPrototype shall be consistent.
916	ContextComponentRef in DataElementIRef is empty or invalid. ContextComponentRef in DataElementIRef shall be set with valid SwComponentPrototype path.
917	ContextPortRef in DataElementIRef is empty or invalid. ContextPortRef in DataElementIRef shall be set with valid PortPrototype path.
918	TargetDataPrototypeRef in DataElementIRef is empty or invalid. TargetDataPrototypeRef in DataElementIRef shall be set with valid DataElement Path.
919	RteSoftwareComponentInstanceRef in RteImplicitCommunication is empty. RteSoftwareComponentInstanceRef in RteImplicitCommunication shall be set.
920	RteSoftwareComponentInstanceRef in RteImplicitCommunication is invalid. RteSoftwareComponentInstanceRef in RteImplicitCommunication shall be set with valid SwComponentPrototype path.
921	RteSoftwareComponentInstanceRef in RteImplicitCommunication is duplicated. RteSoftwareComponentInstanceRef in RteImplicitCommunication shall be unique.
922	PortPrototypeRef in AutosarParameterIRef is empty or invalid. PortPrototypeRef in AutosarParameterIRef shall be set with valid PortPrototype Path.
923	PortPrototypeRef in AutosarVariableIRef is empty or invalid. PortPrototypeRef in AutosarVariableIRef shall be set with valid PortPrototype Path.
924	PortPrototypeRef in RoleBasedPortAssignment is empty or invalid. PortPrototypeRef in RoleBasedPortAssignment shall be set with valid PortPrototype Path.
925	TargetDataPrototypeRef in AutosarParameterIRef is empty or invalid. TargetDataPrototypeRef in AutosarParameterIRef shall be set with valid ParameterDataPrototype Path.
926	TargetDataPrototypeRef in AutosarVariableInImplDataType is empty or invalid. TargetDataPrototypeRef in AutosarVariableInImplDataType shall be set with valid VariableDataPrototype Path.
927	TargetDataPrototypeRef in AutosarVariableIRef is empty or invalid. TargetDataPrototypeRef in AutosarVariableIRef shall be set with valid VariableDataPrototype Path.
928	ComSystemTemplateSystemSignalRef in ComSignal is empty or invalid. ComSystemTemplateSystemSignalRef in ComSignal shall be set with valid ISignalToIPduMapping path.
929	ComSystemTemplateSystemSignalRef in ComGroupSignal is empty or invalid. ComSystemTemplateSystemSignalRef in ComGroupSignal shall be set with valid ISignalToIPduMapping path.
930	ComSystemTemplateSystemSignalGroupRef in ComSignalGroup is empty or invalid. ComSystemTemplateSystemSignalGroupRef in ComSignalGroup shall be set with valid ISignalToIPduMapping path.

931	BehaviorRef in BswImplementation is empty or invalid. BehaviorRef in BswImplementation shall be set with valid BswInternalBehavior path.
932	BehaviorRef in SwcImplementation is empty or invalid. BehaviorRef in SwcImplementation shall be set with valid SwcInternalBehavior path.
933	SystemSignalRef in ISignal is empty or invalid. SystemSignalRef in ISignal shall be set with valid SystemSignal path.
934	SystemSignalRef in SenderReceiverToSignalMapping is empty or invalid. SystemSignalRef in SenderReceiverToSignalMapping shall be set with valid SystemSignal Path.
935	SystemSignalRef in SenderRecArrayElementMapping is empty or invalid. SystemSignalRef in SenderRecArrayElementMapping shall be set with valid SystemSignal path.
936	SystemSignalRef in SenderRecRecordElementMapping is empty or invalid. SystemSignalRef in SenderRecRecordElementMapping shall be set with valid SystemSignal path.
937	SystemSignalGroupRef in ISignalGroup is empty or invalid. SystemSignalGroupRef in ISignalGroup shall be set with valid SystemSignalGroup path.
938	SystemSignalGroupRef in SenderReceiverToSignalGroupMapping is empty or invalid. SystemSignalGroupRef in SenderReceiverToSignalGroupMapping shall be set with valid SystemSignalGroup path.
939	SystemSignalRef in SystemSignalGroup is empty. SystemSignalRef in SystemSignalGroup shall be set with valid SystemSignal path.
940	SystemSignalRef in SystemSignalGroup is invalid. SystemSignalRef in SystemSignalGroup shall be set with valid SystemSignal path.
941	SenderRecArrayTypeMapping in SenderReceiverToSignalGroupMapping is empty. SenderRecArrayTypeMapping in SenderReceiverToSignalGroupMapping shall be set.
942	SenderRecRecordTypeMapping in SenderReceiverToSignalGroupMapping is empty. SenderRecRecordTypeMapping in SenderReceiverToSignalGroupMapping shall be set.
950	Index in IndexedArrayElement is empty. Index in IndexedArrayElement shall be set.
951	ImplementationArrayElementRef in IndexedArrayElement is empty. ImplementationArrayElementRef in IndexedArrayElement shall be set.
952	ImplementationArrayElementRef in IndexedArrayElement is set. ImplementationArrayElementRef in IndexedArrayElement shall not be set.
953	ApplicationArrayElementRef in IndexedArrayElement is empty. ApplicationArrayElementRef in IndexedArrayElement shall be set.
954	ApplicationArrayElementRef in IndexedArrayElement is set. ApplicationArrayElementRef in IndexedArrayElement shall not be set.
955	IndexedArrayElement in SenderRecArrayElementMapping is not set. IndexedArrayElement in SenderRecArrayElementMapping shall be set.

956	SenderRecArrayTypeMapping in SenderRecArrayElementMapping is not set. SenderRecArrayTypeMapping in SenderRecArrayElementMapping shall be set.
957	SenderRecArrayTypeMapping in SenderRecArrayElementMapping is set. SenderRecArrayTypeMapping in SenderRecArrayElementMapping shall not be set.
958	SenderRecRecordTypeMapping in SenderRecArrayElementMapping is not set. SenderRecRecordTypeMapping in SenderRecArrayElementMapping shall be set.
959	SenderRecRecordTypeMapping in SenderRecArrayElementMapping is set. SenderRecRecordTypeMapping in SenderRecArrayElementMapping shall not be set.
960	ImplementationRecordElementRef in SenderRecRecordElementMapping is empty. ImplementationRecordElementRef in SenderRecRecordElementMapping shall be set.
961	ImplementationRecordElementRef in SenderRecRecordElementMapping is set. ImplementationRecordElementRef in SenderRecRecordElementMapping shall not be set.
962	ApplicationRecordElementRef in SenderRecRecordElementMapping is empty. ApplicationRecordElementRef in SenderRecRecordElementMapping shall be set.
963	ApplicationRecordElementRef in SenderRecRecordElementMapping is set. ApplicationRecordElementRef in SenderRecRecordElementMapping shall not be set.
964	SenderRecArrayElementMapping for Index in SenderRecArrayTypeMapping does not exist. SenderRecArrayElementMapping for Index in SenderRecArrayTypeMapping shall exist.
965	The number of SenderRecArrayElementMapping in SenderRecArrayTypeMapping is not correct. The number of SenderRecArrayElementMapping in SenderRecArrayTypeMapping shall be correct.
966	The number of SenderRecRecordElementMapping in SenderRecRecordTypeMapping is not correct. The number of SenderRecRecordElementMapping in SenderRecRecordTypeMapping shall be correct.
967	SenderRecRecordElementMapping for ImplementationDataTypeElement in SenderRecArrayTypeMapping does not exist. SenderRecRecordElementMapping for ImplementationDataTypeElement in SenderRecArrayTypeMapping shall exist.
968	SenderRecArrayTypeMapping in SenderReceiverToSignalGroupMapping is set. SenderRecArrayTypeMapping in SenderReceiverToSignalGroupMapping shall not be set.
969	SenderRecRecordTypeMapping in SenderReceiverToSignalGroupMapping is set. SenderRecRecordTypeMapping in SenderReceiverToSignalGroupMapping shall not be set.
970	DataElementIRef in SenderReceiverToSignalMapping is empty. DataElementIRef in SenderReceiverToSignalMapping shall be set.
971	DataElementIRef in SenderReceiverToSignalGroupMapping is empty. DataElementIRef in SenderReceiverToSignalGroupMapping shall be set.
972	Activation in SwcModeSwitchEvent is empty or invalid. Activation in SwcModeSwitchEvent shall be set with valid value.
973	SenderRecRecordElementMapping for ApplicationRecordElement in SenderRecArrayTypeMapping does not exist.

	SenderRecRecordElementMapping for ApplicationRecordElement in SenderRecArrayTypeMapping shall exist.
974	SenderRecRecordTypeMapping in SenderRecRecordElementMapping is set. SenderRecRecordTypeMapping in SenderRecRecordElementMapping shall not be set.
975	SenderRecRecordTypeMapping in SenderRecRecordElementMapping is not set. SenderRecRecordTypeMapping in SenderRecRecordElementMapping shall be set.
976	SenderRecArrayTypeMapping in SenderRecRecordElementMapping is set. SenderRecArrayTypeMapping in SenderRecRecordElementMapping shall not be set.
977	SenderRecArrayTypeMapping in SenderRecRecordElementMapping is not set. SenderRecArrayTypeMapping in SenderRecRecordElementMapping shall be set.
978	Category in ApplicationArrayElement and Category in ApplicationDataType which TypeTRef in ApplicationArrayElement references is not identical. Category in ApplicationArrayElement and Category in ApplicationDataType which TypeTRef in ApplicationArrayElement references shall be identical.
979	InitValue in NonQueuedReceiverComSpec is empty. InitValue in NonQueuedReceiverComSpec shall be set.
981	InitValue in ParameterDataPrototype is empty. InitValue in ParameterDataPrototype shall be set.
982	InitValue in ParameterProvideComSpec is empty. InitValue in ParameterProvideComSpec shall be set.
985	InitValue in RamBlock is empty. InitValue in RamBlock shall be set.
986	InitValue in RomBlock is empty. InitValue in RomBlock shall be set.
987	InitValue in VariableDataPrototype is empty. InitValue in VariableDataPrototype shall be set.
988	RteExclusiveAreaRef in RteExclusiveAreaImplementation is empty or invalid. RteExclusiveAreaRef in RteExclusiveAreaImplementation shall be set with valid ExclusiveArea path.
989	RteExclusiveAreaImplMechanism in RteExclusiveAreaImplementation is empty or invalid. RteExclusiveAreaImplMechanism in RteExclusiveAreaImplementation shall be set with valid value.
990	RteExclusiveAreaOsResourceRef in RteExclusiveAreaImplementation is empty or invalid. RteExclusiveAreaOsResourceRef in RteExclusiveAreaImplementation shall be set with valid OsResource path.
991	RteBswExclusiveAreaRef in RteBswExclusiveAreaImpl is empty or invalid. RteBswExclusiveAreaRef in RteBswExclusiveAreaImpl shall be set with valid ExclusiveArea path.
992	RteExclusiveAreaImplMechanism in RteBswExclusiveAreaImpl is empty or invalid. RteExclusiveAreaImplMechanism in RteBswExclusiveAreaImpl shall be set with valid value.

993	RteBswExclusiveAreaOsResourceRef in RteBswExclusiveAreaImpl is empty or invalid. RteBswExclusiveAreaOsResourceRef in RteBswExclusiveAreaImpl shall be set with valid OsResource path.
994	There is no RteExclusiveAreaImplementation for the ExclusiveArea. There shall be a RteExclusiveAreaImplementation for the ExclusiveArea.
995	There is no RteBswExclusiveAreaImpl for the ExclusiveArea. There shall be a RteBswExclusiveAreaImpl for the ExclusiveArea.
996	ISignalRef in ISignalGroup is invalid. ISignalRef in ISignalGroup shall be set with valid ISignal Path.
997	HandleOutOfRange values in all ISignals which are referenced by one ISignalGroup are not same. HandleOutOfRange values in all ISignals which are referenced by one ISignalGroup shall be same.
998	HandleOutOfRange in iSignalGroup and HandleOutOfRange in DataElement is not same. HandleOutOfRange in iSignalGroup and HandleOutOfRange in DataElement shall be same.
1000	RteBswReleasedTriggerModInstRef in RteBswRequiredTriggerConnection is empty or invalid. RteBswReleasedTriggerModInstRef in RteBswRequiredTriggerConnection shall be set with RteBswModuleInstance path.
1001	RteBswReleasedTriggerRef in RteBswRequiredTriggerConnection is empty or invalid. RteBswReleasedTriggerRef in RteBswRequiredTriggerConnection shall be set with RteBswModuleInstance path.
1002	RteBswRequiredTriggerRef in RteBswRequiredTriggerConnection is empty or invalid. RteBswRequiredTriggerRef in RteBswRequiredTriggerConnection shall be set with RteBswModuleInstance path.
1003	RteComponentTypeRef in RteSwComponentType is empty or invalid. RteComponentTypeRef in RteSwComponentType shall be set with valid SwComponentType path.
1004	SwcBswMappingRef in BswImplementation is empty or invalid. SwcBswMappingRef in BswImplementation shall be set with valid SwComponentType path.
1005	BehaviorRef in BswImplementation and BehaviorRef in BswImplementation is same. BehaviorRef in BswImplementation and BehaviorRef in BswImplementation shall be different.
1006	SwcBswMappingRef in SwcImplementation is empty or invalid. SwcBswMappingRef in SwcImplementation shall be set with valid SwComponentType path.
1007	SwcBehaviorRef in SwcBswMapping is empty or invalid. SwcBehaviorRef in SwcBswMapping shall be set with valid InternalBehavior path.
1008	BehaviorRef in BswImplementation andSwcBswMappingRef in BswImplementation is mismatching. BehaviorRef in BswImplementation andSwcBswMappingRef in BswImplementation shall be matching.
1009	BehaviorRef in SwcImplementation andSwcBswMappingRef in SwcImplementation is mismatching.

	BehaviorRef in SwcImplementation andSwcBswMappingRef in SwcImplementation shall be matching.
1010	SwcBswMappingRef in BswImplementation and SwcBswMappingRef in BswImplementation is same. SwcBswMappingRef in BswImplementation and SwcBswMappingRef in BswImplementation shall be different.
1011	SwcBswMappingRef in SwcImplementation and SwcBswMappingRef in SwcImplementation is same. SwcBswMappingRef in SwcImplementation and SwcBswMappingRef in SwcImplementation shall be different.
1013	There is no BswImplementation for the BswInternalBehavior. There shall be a BswImplementation for the BswInternalBehavior.
1014	There is no SwcImplementation for the InternalBehavior. There shall be a SwcImplementation for the InternalBehavior.
1015	There is no BswImplementation for the SwcBswMapping. There shall be a BswImplementation for the SwcBswMapping.
1016	There is no SwcImplementation for the SwcBswMapping. There shall be a SwcImplementation for the SwcBswMapping.
1017	SwcBehaviorRef in SwcBswMapping and SwcBehaviorRef in SwcBswMapping is same. SwcBehaviorRef in SwcBswMapping and SwcBehaviorRef in SwcBswMapping shall not be same.
1018	BswBehaviorRef in SwcBswMapping and BswBehaviorRef in SwcBswMapping is same. BswBehaviorRef in SwcBswMapping and BswBehaviorRef in SwcBswMapping shall not be same.
1019	ModeDeclarationGroupPrototypeRef in ManagedModeGroup and ModeDeclarationGroupPrototypeRef in ManagedModeGroup is same. ModeDeclarationGroupPrototypeRef in ManagedModeGroup and ModeDeclarationGroupPrototypeRef in ManagedModeGroup shall not be same.
1020	TriggerRef in BswExternalTriggerOccurredEvent is empty or invalid. TriggerRef in BswExternalTriggerOccurredEvent shall be set with valid RequiredTrigger path.
1021	TriggerRef in IssuedTrigger is empty or invalid. TriggerRef in IssuedTrigger shall be set with valid ReleasedTrigger path.
1022	BswInternalTriggeringPointRef in BswInternalTriggeringPointRefConditional is empty or invalid. BswInternalTriggeringPointRef in BswInternalTriggeringPointRefConditional shall be set with valid BswInternalTriggeringPoint path.
1023	TriggerRef in TriggerRefConditional is empty or invalid. TriggerRef in TriggerRefConditional shall be set.
1024	ModeDeclarationGroupPrototypeRef in ManagedModeGroup is empty or invalid. ModeDeclarationGroupPrototypeRef in ManagedModeGroup shall be set with valid ProvidedModeGroup path.
1025	ModeDeclarationGroupPrototypeRef in ModeDeclarationGroupPrototypeRefConditional is empty or invalid.

	ModeDeclarationGroupPrototypeRef in ModeDeclarationGroupPrototypeRefConditional shall be set.
1026	SwcRunnableRef in SwcBswRunnableMapping is empty or invalid. SwcRunnableRef in SwcBswRunnableMapping shall be set with valid BswEntity path.
1027	Even though BswModuleEntry is referenced by CalledEntry, CallType in called BswModuleEntry is not REGULAR or CALLBACK. If BswModuleEntry is referenced by CalledEntry, CallType in called BswModuleEntry shall be REGULAR or CALLBACK.
1028	Even though BswModuleEntry is referenced by CalledEntry, ExecutionContext in called BswModuleEntry is not identical to ExecutionContext in caller BswModuleEntry. If BswModuleEntry is referenced by CalledEntry, ExecutionContext in called BswModuleEntry shall be identical to ExecutionContext in caller BswModuleEntry.
1029	BswModuleEntryRef in CalledEntry does not refer to an element declared as OutgoingCallback, ProvidedEntry or as RequiredEntry in BswModuleDependency. BswModuleEntryRef in CalledEntry shall refer to an element declared as OutgoingCallback, ProvidedEntry or as RequiredEntry in BswModuleDependency.
1030	HandleOutOfRange in SenderComSpec/ReceiverComSpec is EXTERNAL-REPLACEMENT. HandleOutOfRange in SenderComSpec/ReceiverComSpec shall not be EXTERNAL-REPLACEMENT.
1031	Symbol of RunnableEntity is different with Symbol of BswEntity. Symbol of RunnableEntity shall be same with Symbol of BswEntity.
1032	ModeDeclarationGroupPrototypeRef in AccessedModeGroup is empty or invalid. ModeDeclarationGroupPrototypeRef in AccessedModeGroup shall be set with valid ProvidedModeGroup path.
1033	ModeDeclarationGroupPrototypeRef in AccessedModeGroup and ModeDeclarationGroupPrototypeRef in AccessedModeGroup is same. ModeDeclarationGroupPrototypeRef in AccessedModeGroup and ModeDeclarationGroupPrototypeRef in AccessedModeGroup shall not be same.
1034	RteBswEventRef in RteBswEventToTaskMapping is empty or invalid. RteBswEventRef in RteBswEventToTaskMapping shall be set.
1035	CallType in BswModuleEntry is empty or invalid. CallType in BswModuleEntry shall be set.
1036	PortPrototype and VariableDataPrototype for the RamBlock is connected to SWC Instances of different partitions. PortPrototype and VariableDataPrototype for the RamBlock shall not be connected to SWC Instances of different partitions.
1037	Role in RoleBasedPortAssignment is empty or invalid. Role in RoleBasedPortAssignment shall be set with valid value.
1038	ReadNvData in NvBlockDataMapping is empty. ReadNvData in NvBlockDataMapping shall be exist.

1039	WrittenNvData in NvBlockDataMapping is empty. WrittenNvData in NvBlockDataMapping shall be exist.
1040	Neither RteVariableReadAccessRef nor RteVariableWriteAccessRef in RteImplicitCommunication is exist. RteVariableReadAccessRef or RteVariableWriteAccessRef in RteImplicitCommunication shall be exist.
1041	RteEventRef in RteEventToTaskMapping is empty or invalid. RteEventRef in RteEventToTaskMapping shall be set with valid RteEvent path.
1042	VariableDataPrototype referenced by a SenderReceiverInterface doesn't have a STANDARD or QUEUED SwImplPolicy. VariableDataPrototype referenced by a SenderReceiverInterface shall have a STANDARD or QUEUED SwImplPolicy.
1043	ParameterDataPrototype doesn't have a STANDARD, FIXED or CONST SwImplPolicy. ParameterDataPrototype shall have a STANDARD, FIXED or CONST SwImplPolicy.
1044	HandleOutOfRange in ReceiverComSpec is EXTERNAL-REPLACEMENT. HandleOutOfRange in ReceiverComSpec shall not be EXTERNAL-REPLACEMENT.
1045	There are mismatching function prototypes for the RunnableEntity. Function prototypes for the RunnableEntity shall be consistent. In case only argument name is different, use RunnableEntityArgument Configuration Parameter in RunnableEntity.
1046	There are multiple DataWriteAccesses for the same PortPrototypeRef and TargetDataPrototypeRef. There shall be only one DataWriteAccess for the PortPrototypeRef and TargetDataPrototypeRef.
1047	There are multiple DataSendPoints for the same PortPrototypeRef and TargetDataPrototypeRef. There shall be only one DataSendPoint for the PortPrototypeRef and TargetDataPrototypeRef.
1048	There are multiple DataReadAccesses for the same PortPrototypeRef and TargetDataPrototypeRef. There shall be only one DataReadAccess for the PortPrototypeRef and TargetDataPrototypeRef.
1049	There are multiple DataReceivePointByArguments for the same PortPrototypeRef and TargetDataPrototypeRef. There shall be only one DataReceivePointByArgument for the PortPrototypeRef and TargetDataPrototypeRef.
1050	There are multiple DataReceivePointByValues for the same PortPrototypeRef and TargetDataPrototypeRef. There shall be only one DataReceivePointByValue for the PortPrototypeRef and TargetDataPrototypeRef.
1051	ImplementedEntryRef in BswEntity and ImplementedEntryRef in BswEntity is same. ImplementedEntryRef in BswEntity and ImplementedEntryRef in BswEntity shall be different.
1052	The ComDataInvalidAction in ComSignal/ComSignalGroup and the HandleInvalid in VariableDataPrototype are mismatching. The ComDataInvalidAction in ComSignal/ComSignalGroup and the HandleInvalid in

	VariableDataPrototype shall be matching.
1053	The ComSignalDataInvalidValue in ComSignal is empty even though the ComDataInvalidAction in ComSignal is set as NOTIFY or REPLACE. The ComSignalDataInvalidValue in ComSignal shall be set if the ComDataInvalidAction in ComSignal is set as NOTIFY or REPLACE.
1054	ComSignalGroup is mapped to dynamic length of array datatype. Dynamic length of array data type shall be mapped to ComSignal.
1055	The ComSignalDataInvalidValue in ComGroupSignal is empty even though the ComDataInvalidAction in ComSignalGroup is set as NOTIFY or REPLACE. The ComSignalDataInvalidValue in ComGroupSignal shall be set if the ComDataInvalidAction in ComSignalGroup is set as NOTIFY or REPLACE.
1056	ComSignalDataInvalidValue in ComGroupSignal and InvalidValue in DataType is mismatching. ComSignalDataInvalidValue in ComGroupSignal and InvalidValue in DataType shall be matching.
1057	ComSignalDataInvalidValue in ComSignal and InvalidValue in DataType is mismatching. ComSignalDataInvalidValue in ComSignal and InvalidValue in DataType shall be matching.
1058	Osloc container in the OS Ecud Arxml File exists. Osloc container in the OS Ecud Arxml File shall not exist. Rte creates the Osloc contatiner automatically if necessary.
1059	RTE Generator cannot find OS Ecud Arxml File. Please check whether RTE Generator has OS Ecud Arxml file as an argument.
1060	RTE Generator cannot find DefinitionRef in OS Configuration. Please check whether OS Ecud Arxml File has a DefinitionRef in OS Configuration.
1061	RteUsedOsAlarmRef in RteEventToTaskMapping is empty or invalid. RteUsedOsAlarmRef in RteEventToTaskMapping shall be set with valid OsAlarm Path.
1062	RteComponentTypeRef in RteSwComponentType and RteComponentTypeRef in RteSwComponentType is same. RteComponentTypeRef in RteSwComponentType and RteComponentTypeRef in RteSwComponentType shall be different.
1063	ShortName of OsTask is duplicated. ShortName of OsTask shall be unique.
1064	RteActivationOsAlarmRef in RteUsedOsActivation and RteActivationOsAlarmRef in RteUsedOsActivation is same. RteActivationOsAlarmRef in RteUsedOsActivation and RteActivationOsAlarmRef in RteUsedOsActivation shall be different.
1065	RteActivationOsSchTblRef in RteUsedOsActivation and RteActivationOsSchTblRef in RteUsedOsActivation is same. RteActivationOsSchTblRef in RteUsedOsActivation and RteActivationOsSchTblRef in RteUsedOsActivation shall be different.
1066	Both RteActivationOsAlarmRef and RteActivationOsSchTblRef in RteUsedOsActivation is empty. One of RteActivationOsAlarmRef or RteActivationOsSchTblRef in RteUsedOsActivation shall be

	set.
1067	Both RteActivationOsAlarmRef and RteActivationOsSchTblRef in RteUsedOsActivation is set. Only one of RteActivationOsAlarmRef or RteActivationOsSchTblRef in RteUsedOsActivation shall be set.
1068	RteActivationOsAlarmRef in RteUsedOsActivation is empty or invalid. RteActivationOsAlarmRef in RteUsedOsActivation shall be set with valid OsAlarm Path.
1069	RteActivationOsSchTblRef in RteUsedOsActivation is empty or invalid. RteActivationOsSchTblRef in RteUsedOsActivation shall be set with valid OsAlarm Path.
1070	Both RteBswUsedOsAlarmRef and RteBswUsedOsSchTblExpiryPointRef in RteBswEventToTaskMapping exist. Only one of RteBswUsedOsAlarmRef or RteBswUsedOsSchTblExpiryPointRef in RteBswEventToTaskMapping shall exist.
1071	Neither RteBswUsedOsAlarmRef nor RteBswUsedOsSchTblExpiryPointRef in RteBswEventToTaskMapping exists. One of RteBswUsedOsAlarmRef or RteBswUsedOsSchTblExpiryPointRef in RteBswEventToTaskMapping shall exist.
1072	RteBswUsedOsAlarmRef in RteBswEventToTaskMapping is empty or invalid. RteBswUsedOsAlarmRef in RteBswEventToTaskMapping shall be set with valid OsAlarm Path.
1073	RteBswUsedOsEventRef in RteBswEventToTaskMapping is empty or invalid. RteBswUsedOsEventRef in RteBswEventToTaskMapping shall be set with valid OsAlarm Path.
1074	OsTask of RteBswUsedOsEventRef in RteBswEventToTaskMapping is not activated by OsAlarm of RteBswUsedOsAlarmRef in RteBswEventToTaskMapping. OsTask of RteBswUsedOsEventRef in RteBswEventToTaskMapping shall be activated by OsAlarm of RteBswUsedOsAlarmRef in RteBswEventToTaskMapping.
1075	OsTask of RteBswMappedToTaskRef in RteBswEventToTaskMapping is not activated by OsAlarm of RteBswUsedOsAlarmRef in RteBswEventToTaskMapping. OsTask of RteBswMappedToTaskRef in RteBswEventToTaskMapping shall be activated by OsAlarm of RteBswUsedOsAlarmRef in RteBswEventToTaskMapping.
1076	OsTask of RteBswMappedToTaskRef in RteBswEventToTaskMapping does not have OsEvent of RteBswUsedOsEventRef in RteBswEventToTaskMapping. OsTask of RteBswMappedToTaskRef in RteBswEventToTaskMapping shall have OsEvent of RteBswUsedOsEventRef in RteBswEventToTaskMapping.
1077	RteExpectedTickDuration in RteUsedOsActivation is not multiples of OsSecondsPerTick in OsCounter. RteExpectedTickDuration in RteUsedOsActivation shall be multiples of OsSecondsPerTick in OsCounter.
1078	RteExpectedTickDuration in RteUsedOsActivation is not within a range of 0 and OsSecondsPerTick * OsCounterMaxAllowedValue in OsCounter. RteExpectedTickDuration in RteUsedOsActivation shall be within a range of 0 and OsSecondsPerTick * OsCounterMaxAllowedValue in OsCounter.
1079	RteEvents/RteBswEvent except BackgroundEvent and BswBackgroundEvent is mapped to Background OsTask

	RteEvent/RteBswEvent except BackgroundEvent and BswBackgroundEvent shall not be mapped to Background OsTask
1080	The priority of background OsTask is higher than or equal to the priority of nonbackground OsTask. The priority of background OsTask shall be lower than the priority of nonbackground OsTask.
1081	RteUsedOsSchTblExpiryPointRef in RteEventToTaskMapping is empty or invalid RteUsedOsSchTblExpiryPointRef in RteEventToTaskMapping shall be set with valid OsScheduleTableExpiryPoint Path.
1082	RteUsedOsAlarmRef in RteEventToTaskMapping is empty. RteUsedOsAlarmRef in RteEventToTaskMapping shall be set with valid OsAlarm Path.
1083	RteUsedOsSchTblExpiryPointRef in RteEventToTaskMapping is set. RteUsedOsSchTblExpiryPointRef in RteEventToTaskMapping shall not be set.
1084	RteUsedOsEventRef in RteEventToTaskMapping is empty or invalid. RteUsedOsEventRef in RteEventToTaskMapping shall be set with valid OsEvent Path.
1085	RteBswUsedOsEventRef in RteBswEventToTaskMappingis empty or invalid. RteBswUsedOsEventRef in RteBswEventToTaskMapping shall be set with valid OsEvent Path.
1086	RteBswUsedOsSchTblExpiryPointRef in RteBswEventToTaskMapping is set. RteBswUsedOsSchTblExpiryPointRef in RteBswEventToTaskMapping shall not be set.
1087	RteBswProvidedModeGroupRef in RteBswRequiredModeGroupConnection is empty or invalid. RteBswProvidedModeGroupRef in RteBswRequiredModeGroupConnection shall be set with valid ProvidedModeGroup Path.
1088	RteBswRequiredModeGroupRef in RteBswRequiredModeGroupConnection is empty or invalid. RteBswRequiredModeGroupRef in RteBswRequiredModeGroupConnection shall be set with valid RequiredModeGroup Path.
1089	RteBswProvidedModeGrpModInstRef in RteBswRequiredModeGroupConnection is empty or invalid. RteBswProvidedModeGrpModInstRef in RteBswRequiredModeGroupConnection shall be set with valid ProvidedModeGroup Path.
1090	There are multiple SenderRecElementMappings which have same SystemSignalRef in a SenderReceiverToSignalGroupMapping. There shall not be multiple SenderRecElementMappings which have same SystemSignalRef in a SenderReceiverToSignalGroupMapping.
1091	There is no SenderRecElementMapping which have SystemSignalRef in a SenderReceiverToSignalGroupMapping. There shall be a SenderRecElementMapping which have SystemSignalRef in a SenderReceiverToSignalGroupMapping.
1092	OsApplicationCoreAssignment in OsApplication is bigger than or equal to OsNumberOfCores in OsOs. OsApplicationCoreAssignment in OsApplication shall be less than OsNumberOfCores in OsOs.
1093	RteBswUsedOsSchTblExpiryPointRef in RteBswEventToTaskMapping is empty or invalid.

	RteBswUsedOsSchTblExpiryPointRef in RteBswEventToTaskMapping shall be set with valid OsScheduleTableExpiryPoint Path.
1094	Some VariableDataPrototypes that are connected to the same sender, or connected to the same receiver, have different init values All VariableDataPrototype that are connected to the same sender, or connected to the same receiver, must have identical init values
1095	Some VariableDataPrototypes that are mapped to the same ComSignal/ComSignalGroup, have different init values All VariableDataPrototype that are mapped to the same ComSignal/ComSignalGroup, must have identical init values.
1096	Some NonQueuedReceiverComSpec's TimeoutSubstitutuionValues of VariableDataPrototypes that are mapped to the same ComSignal/ComSignalGroup, have different ComTimeoutSubstitutuionValues. All NonQueuedReceiverComSpec's TimeoutSubstitutuionValue of VariableDataPrototype that are mapped to the same ComSignal/ComSignalGroup, must have identical ComTimeoutSubstitutuionValues.
1097	Even though HandleTimeoutType is REPLACE-BY-TIMEOUT-SUBSTITUTION-VALUE, TimeoutSubstitutionValue is not set. If HandleTimeoutType is REPLACE-BY-TIMEOUT-SUBSTITUTION-VALUE, TimeoutSubstitutionValue shall be set.
1099	TransmissionAcknowledge is used even though multiple sender is mapped to same ComSignal/ComSignalGroup. TransmissionAcknowledge shall not be used if multiple sender is mapped to same ComSignal/ComSignalGroup
1100	There are multiple RunnableEntities which have VariableAccesses to same PortPrototype and VariableDataPrototype if TransmissionAcknowledge is set. There shall be only one RunnableEntity which have VariableAccesses to the same PortPrototype and VariableDataPrototype if TransmissionAcknowledge is set.
1113	There are multiple ProvidedEntries which have the same BswModuleEntryRef in BswModuleDescription There shall not be multiple ProvidedEntries which have same BswModuleEntryRef in BswModuleDescription
1114	Module which BswModuleDependency refers to and whose Id is does not exist. Module which BswModuleDependency refers to and whose Id is shall exist.
2000	The attribute category of EndToEndDescription can have the following values: NONE, PROFILE_01, PROFILE_02. Check wheter the attribute category of EndToEndDescription is configured and is either NONE, PROFILE_01, or PROFILE_02.
2001	In PROFILE_01, the applicable range of values for counterOffset is [0 .. 65535]. For the value of this attribute the constraint value mod 4 = 0 applies. Check wheter the attribute counterOffset of EndToEndDescription is configured, is [0 .. 65535], and mod 4 = 0.
2002	In PROFILE_01, the applicable range of values for crcOffset is [0 .. 65535]. For the value of this attribute the constraint value mod 8 = 0 applies.

	Check wheter the attribute crcOffset of EndToEndDescription is configured, is [0 .. 65535], and mod 8 = 0.
2003	In PROFILE_01, the applicable range of values for dataIdMode is [0 .. 2]. Check wheter the attribute dataIdMode of EndToEndDescription is configured and is [0 .. 2].
2004	In PROFILE_01, there shall be only one element in the set of dataIds and in PROFILE_02, there shall be exactly ordered 16 elements in the set of dataIds. Check wheter the attribute dataIds of EndToEndDescription is configured and the number of elements is correct.
2005	In PROFILE_01, the applicable range of values for the element of dataIds is [0 .. 65535] and in PROFILE_02, the applicable range of values for each element of dataIds is [0 .. 255]. Check wheter the value for each element of dataIds is configured and the range is correct.
2006	In PROFILE_01, the applicable range of values for dataLength is [0 .. 240] and in PROFILE_02, the applicable range of values for dataLength is [0 .. 65535]. For the value of this attribute the constraint value mod 8 = 0 applies Check wheter the value for dataLength is configured and the range is correct.
2007	In PROFILE_01, the applicable range of values for maxDeltaCounterInit is [0 .. 14] and in PROFILE_02, the applicable range of values for maxDeltaCounterInit is [0 .. 15]. Check wheter the range of the value for maxDeltaCounterInit is correct.
2008	The ISignalGroupRef of EndToEndProtectionISignalIPdu is not configured or invalid. Check whether the ISignalGroupRef of EndToEndProtectionISignalIPdu is configured or the referenced value is correct.
2009	The ISignalIPduRef of EndToEndProtectionISignalIPdu is not configured or invalid. Check whether the ISignalIPduRef of EndToEndProtectionISignalIPdu is configured or the referenced value is correct.
2011	If the E2E Library is invoked at the level of Data Elements, then a Data Element shall either map to a local intra-ECU communication (without COM involvement) or shall map to a COM I-PDU, but shall not map to both at the same time. Remove either intra-ECU or inter-ECU connections.
2012	If the E2E Library is invoked at the level of Data Elements (e.g. from SW-Cs or from E2E Protection Wrapper), then the communication shall be an explicit sender-receiver communication, in 1:1 and 1:N multiplicities. Remove either N:1 connction or turn off end-to-end protection feature.
2013	A given I-PDU , shall not be at the same protected by means of COM E2E callouts (through association with ISignalIPdu) and by means of E2E Protection Wrapper (through association with E2E Protection Wrapper. Remove either EndToEndProtectionISignalIPdu or EndToEndProtectionVariablePrototype.
2014	The ContextComponentRef in VariableDataPrototypeInSystemInstanceRef is not configured or invalid. Check whether the ContextComponentRef in VariableDataPrototypeInSystemInstanceRef is configured or the referenced value is correct.
2015	The ContextPortRef in VariableDataPrototypeInSystemInstanceRef is not configured or invalid. Check whether the ContextPortRef in VariableDataPrototypeInSystemInstanceRef is configured or the referenced value is correct.

2016	The TargetDataPrototypeRef in VariableDataPrototypeInSystemInstanceRef is not configured or invalid. Check whether the TargetDataPrototypeRef in VariableDataPrototypeInSystemInstanceRef is configured or the referenced value is correct.
9018	Inter Ecu Communication through Inter Partition is not supported.
9019	DataReadAccess/DataWriteAccess is set in a RunnableEntity activated by a direct function call.
9020	Rte does not support that RteEvents/BswEvents except for TimingEvent in an ExtendedTask reference the same OsEvent.

※ Regarding Error 45

Parameter name	Container
Symbol	RunnableEntity
Native Declaration	SwBaseType
Period	BswTimingEvent
Behaviour Ref	BswImplementation
ImplEntryRef	BSW SchedulabelEntity
BswEveRef	BswEventToTaskMapping
BswImplRef	BswModuleInstance
Period	Timing Event
EventRef	EventToTaskMapping
OsAlarmCntrRef	OsAlarm
OsAlarmActivationTaskRef	OsAlarmActivateTask
OsAlarmSetEventTaskRef	OsAlarmEvent
OsAlarmSetEventRef	OsAlarmEvent
OsSecPerTick	OsCounter

8. Apendix

이 Chapter 에서는, RTE 를 이용한 Application 설계 시, 고려사항에 대하여 설명하고 있으며, 설계 시 활용 가능한 팁을 포함하고 있다.

단, 아래의 내용 중, 현재 RTE Module 배포 버전에 대한 Limitation 및 Deviation 에서 사용에 제한이 있음을 언급하고 있는 경우에는, 관련 내용 (4.5 내용) 이 이 Chapter 에서 언급하고 있는 사항 보다 우선 시 된다.

8.1 Interrupt Decoupling Guide

8.1.1 General Description

8.1.1.1 Scope

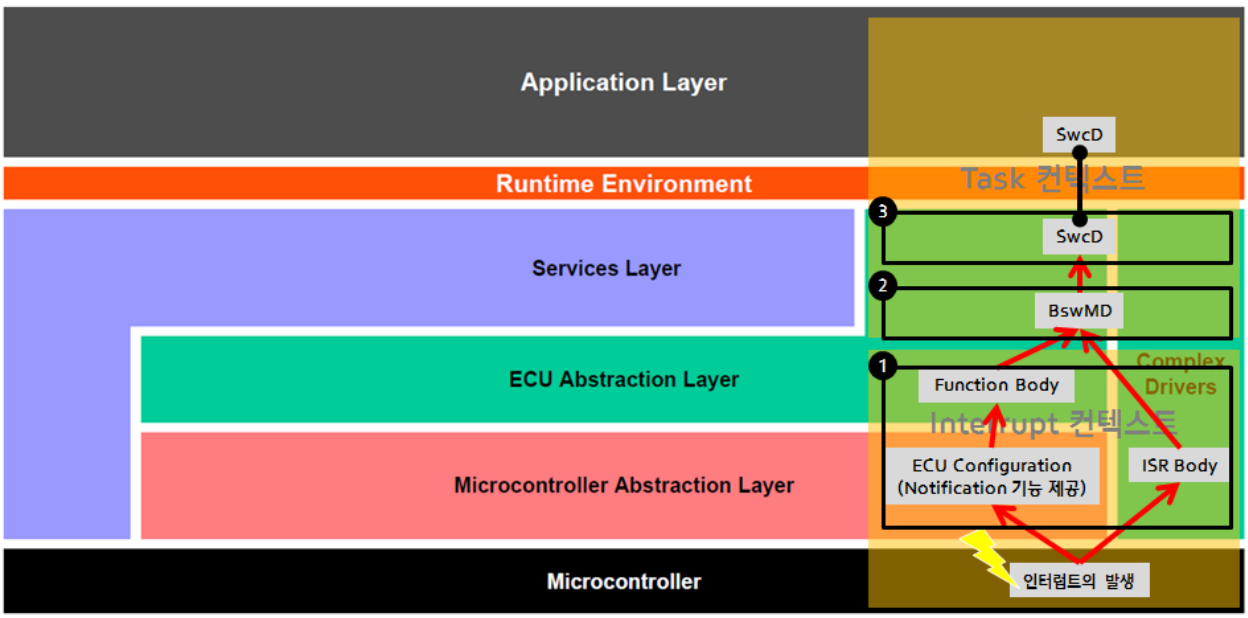
플랫폼에서 제공하는 Interrupt 의 Decoupling 방법에 대해 설명한다.

8.1.1.2 Overall Description

일반적으로 Interrupt 발생 시 Interrupt Service Routine (ISR)이 실행된다. ISR 은 MicroController Abstraction Layer (MCAL)에 의해 Notification Function 으로 제공되거나 직접 구현할 수 있다. 이 때, ISR 의 동작은 시스템 전체에 영향을 줄 수 있으므로, 최소한의 역할을 수행하고 나머지 동작은 Decoupling 을 통해 수행되도록 설계하여야 한다.

Interrupt 의 처리 방법은 다음과 같이 구분할 수 있으며, 자세한 내용은 각 Chapter 에서 기술한다.

1. Interrupt Service Routine: Interrupt 컨텍스트에서 모든 동작을 수행하는 경우로 MCAL 에 의해 제공되는 Notification Function 을 수행하는 것을 포함한다. (8.1.1.2.1)
2. Decoupling on BSW level: Interrupt 가 Decoupling 되어 BSW(CDD 를 포함) 내에서 수행되는 경우이다. (8.1.1.2.2)
3. Communication with ASW: Interrupt 가 Decoupling 되어 BSW 내에서 수행 중 Rte 를 통해 ASW 와의 통신이 필요한 경우이다. (8.1.1.2.3)



8.1.1.2.1 Interrupt Service Routine

Interrupt 컨텍스트에서 모든 동작을 수행하는 경우, Rte 를 통한 동작이 없으므로 별도의 Software Component Description 또는 Basic Software Module Description 은 필요하지 않다.
코드를 통해 ISR 을 직접 구현하거나 MCAL 의 Notification Function 을 설정하여 해당 Function 을 구현할 수 있다.

관련 내용은 MCAL 의 각 모듈 또는 Os 매뉴얼을 참조한다.

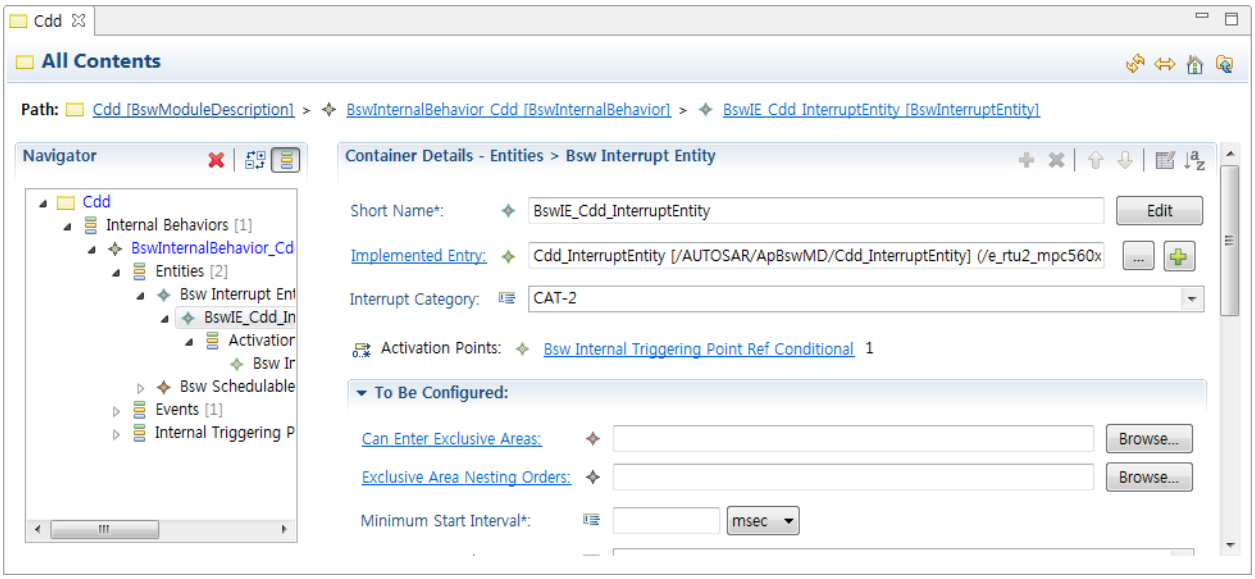
8.1.1.2.2 Decoupling on BSW level

Interrupt 는 BSW level 에서 Decoupling 함을 기본으로 한다.
Interrupt 를 BSW level 에서 Decoupling 하기 위해서는 각 BSW 모듈 (CDD 포함)에서 Basic Software Module Description (BswMD)을 통해 설계한다.
Basic Software Module Description 내에 Interrupt Entity 로 부터 Schedulable Entity 로의 Internal Trigger 를 통해 Decoupling 할 수 있다.

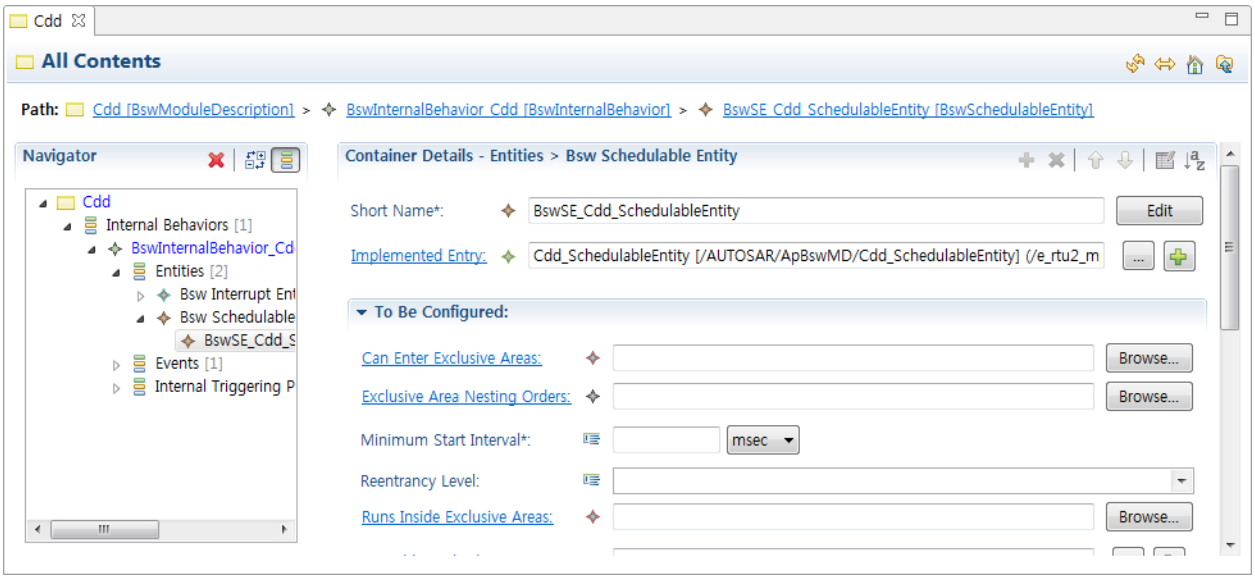
그 방법과 절차는 다음과 같다.

1. Basic Software Module Description

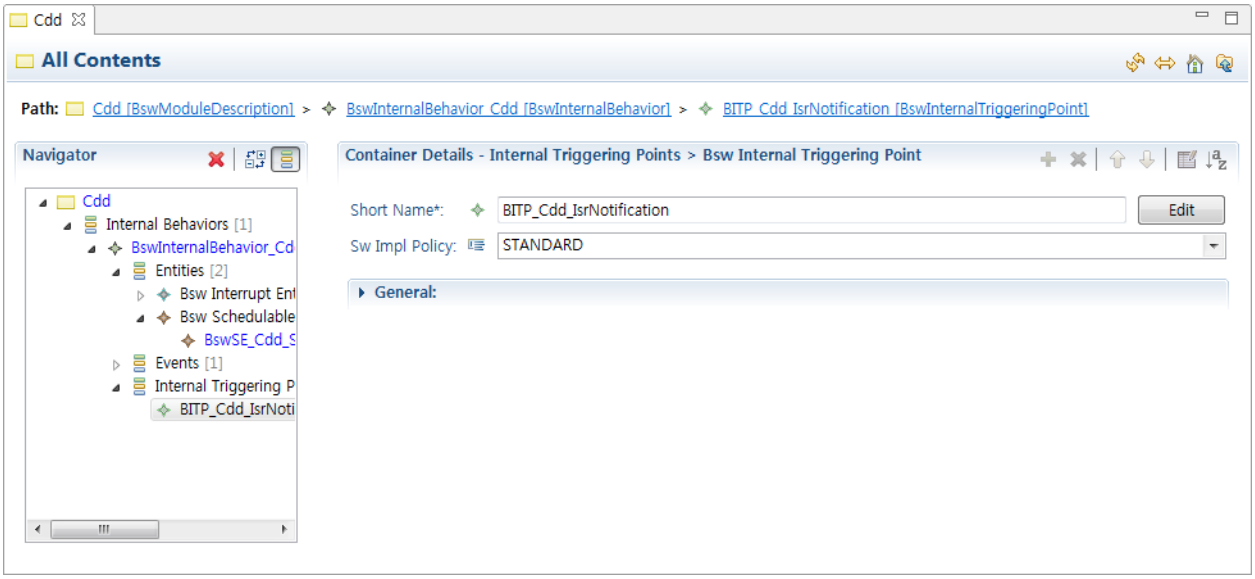
   A. Bsw Interrupt Entity 추가: BswModuleDescription 내에 MCAL 에 등록한 Notification function 또는 직접 구현한 ISR 에 대해 Interrupt Entity 를 생성한다.



B. Bsw Schedulable Entity 추가: BswModuleDescription 내에 Interrupt 가 Decoupling 되어 실행될 SchedulableEntity 를 생성한다.

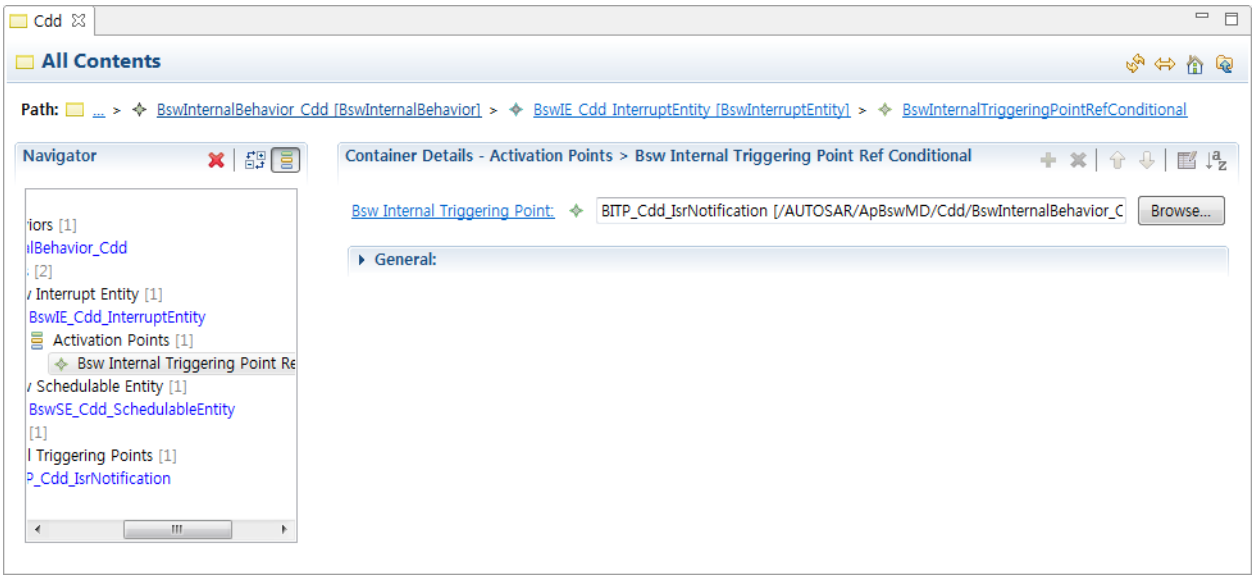


C. Internal Triggering Point 추가: BswModuleDescription 내에 Interrupt Decoupling 을 실행하기 위한 Internal Triggering Point 를 생성한다.

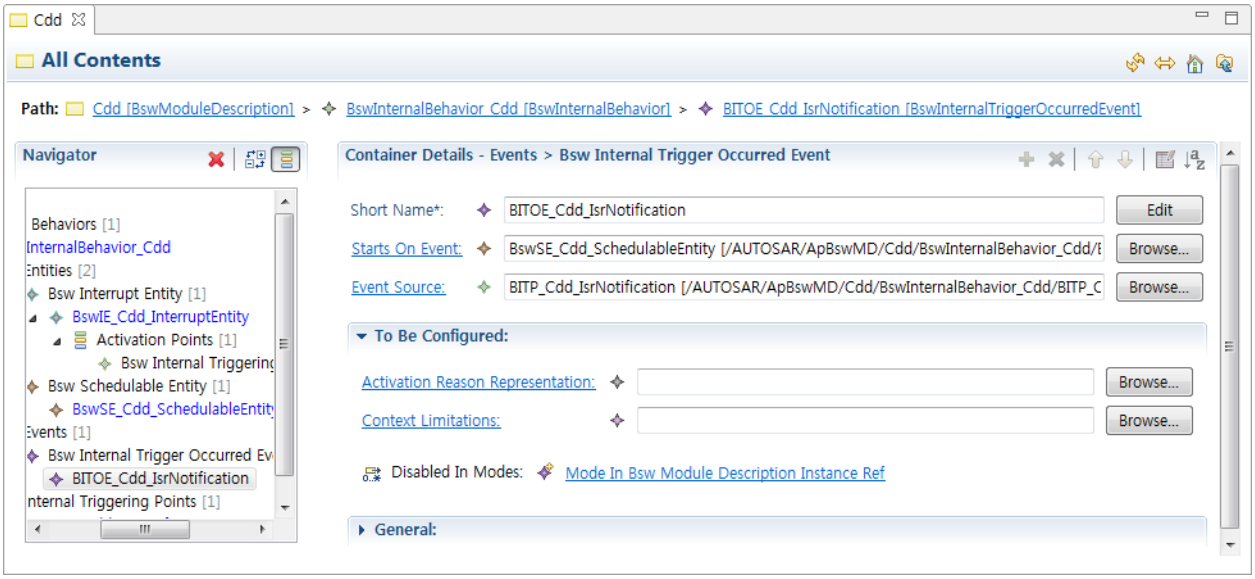


D. Bsw Interrupt Entity 내 Activation Point (Bsw Internal Triggering Point Ref Conditional) 추

가: Interrupt 내에서 Decoupling 을 시작하기 위한 Activation Point (Bsw Internal Triggering Point Ref Conditional)을 생성한다.

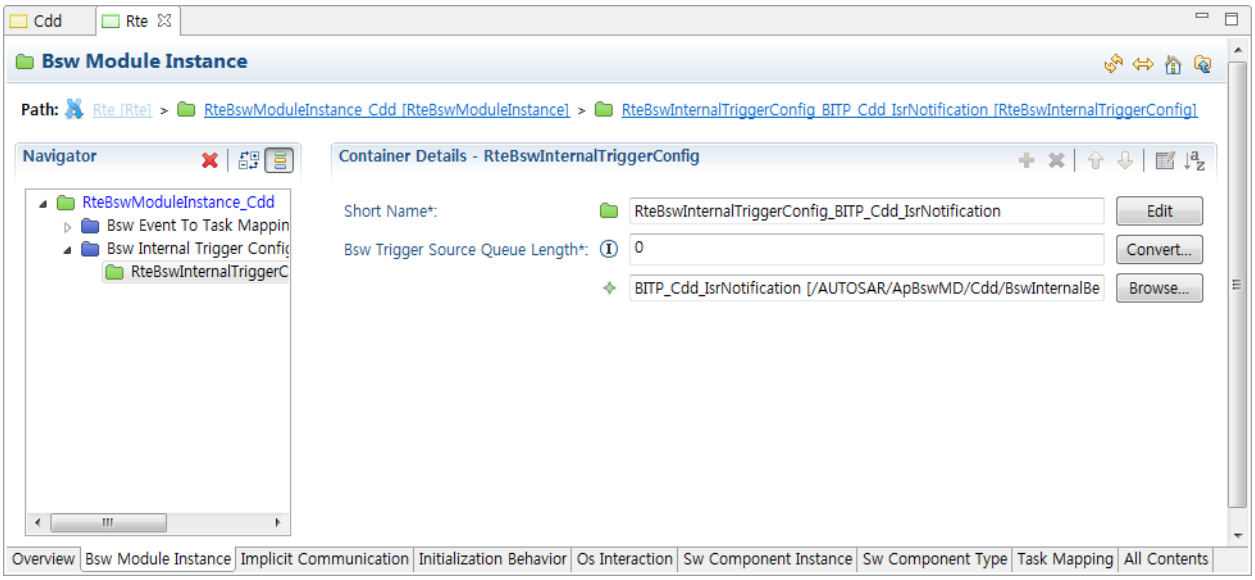


E. Bsw Internal Trigger Occurred Event 추가: Decoupling 을 위해 Internal Trigger 가 실행되었을 때 Schedulable Entity 를 호출하기 위해 Bsw Internal Trigger Occurred Event 를 생성한다.

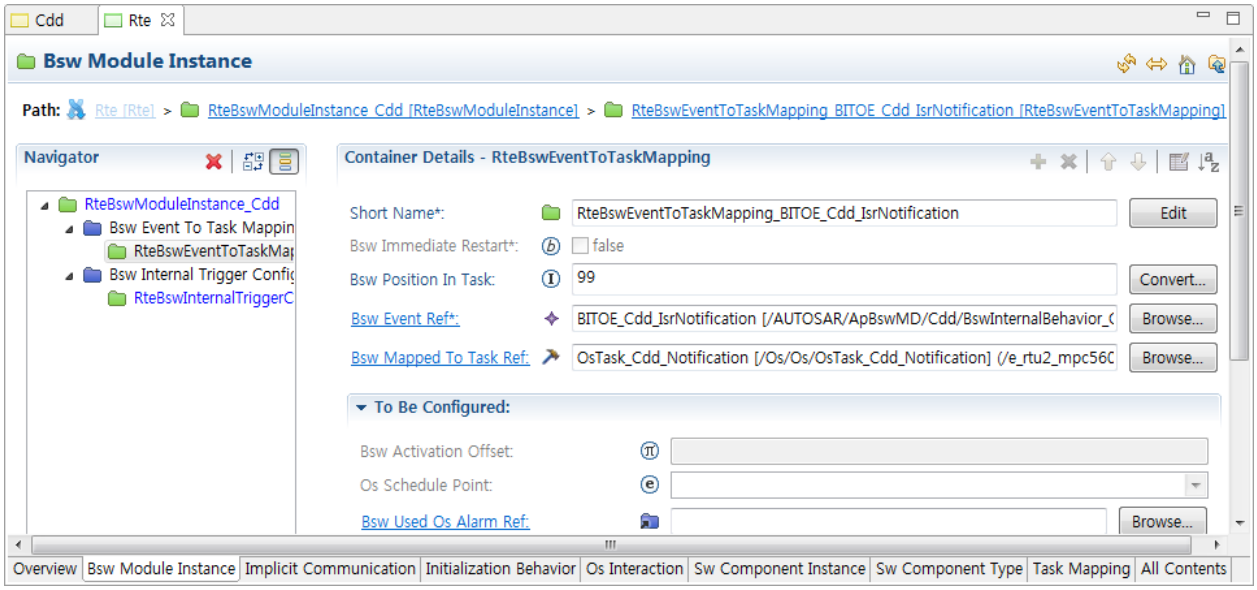


2. Ecu Configuration (Rte)

A. RteBswInternalTriggerConfig 추가: 1.C 에서 생성한 Internal Triggering Point 에 대해 Ecu Configuration (Rte) 내에 해당 BSW 모듈(CDD 포함)의 RteBswModuleInstance 내에 RteBswInternalTriggerConfig 를 생성한다.



B. RteBswEventToTaskMapping 추가: 1.E 에서 생성한 BswInternalTriggerOccuredEvent 에 대해 RteEventToTaskMapping 을 생성한다.



3. Code

A. InterruptEntity: Notification function 또는 ISR 내에 Decoupling 을 시작하기 위해

SchM_ActMainFunction API (상세 설명은 6.3.3.9 참조)를 호출한다.

```
#include "SchM_Cdd.h"

void Cdd_Isr (void)
{
  ...
  SchM_ActMainFunction_Cdd_BITP_Cdd_IsrNotification();
  ...
}
```

8.1.1.2.3 Communication with ASW

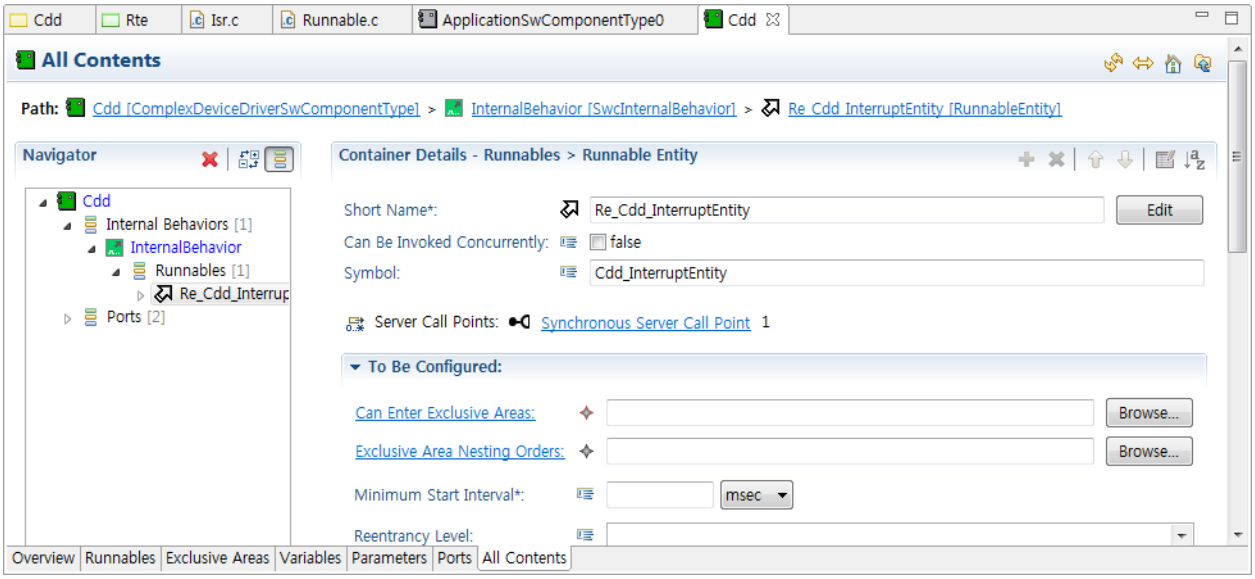
Rte 의 ASW 와 BSW 모듈(CDD 포함)간의 통신은 BSW 모듈에 대한 Software Component Description 을 통해 가능하다.

8.1.1.2.2 를 통해 Interrupt 를 Decoupling 하는 Basic Software Module 에 대한 Software Component 를 설계하고, 해당 Software Component 와 ASW 의 Software Component 간의 통신을 설계한다.

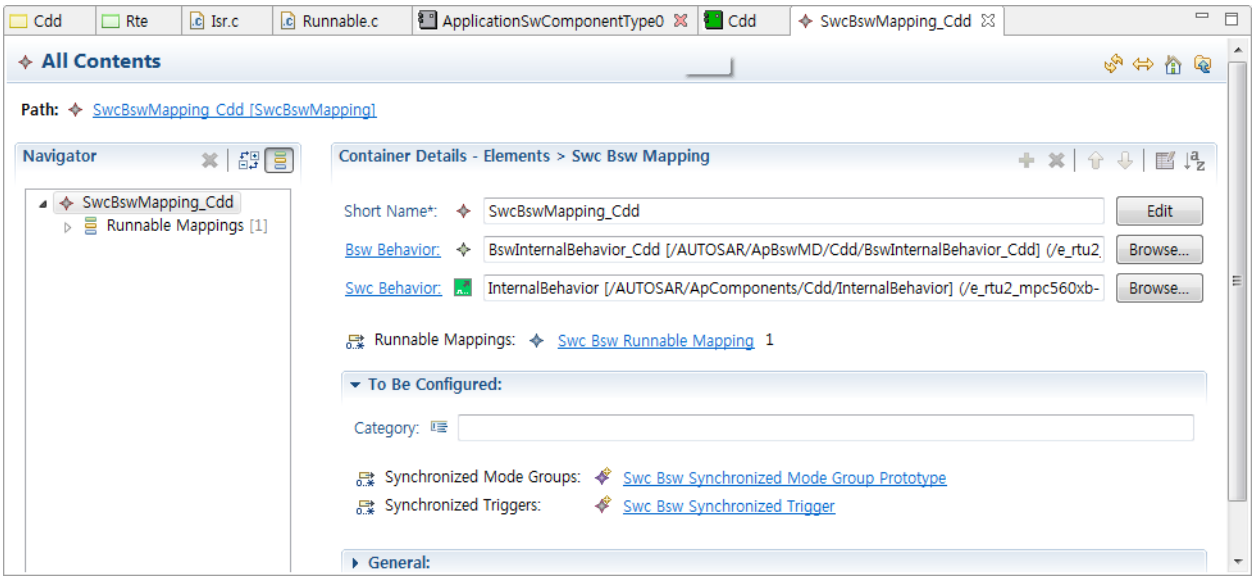
Basic Software Module 에 대한 Software Component 는 SwcBswMapping 을 통해 지정할 수 있다.

그 방법과 절차는 다음과 같다.

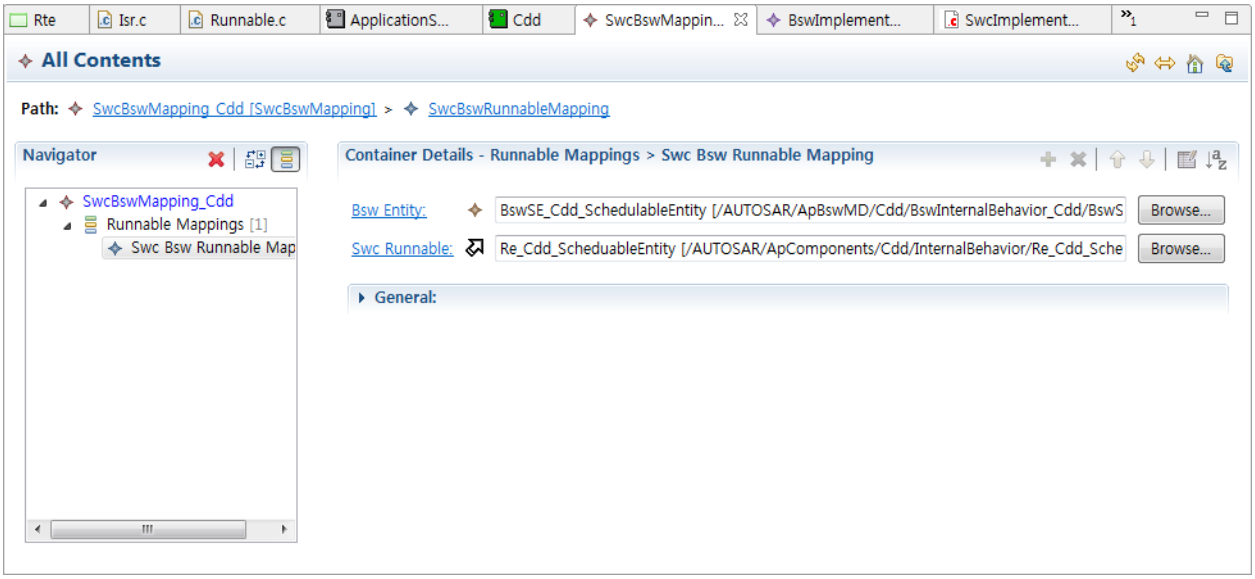
1. 8.1.1.2.2 의 BSW 모듈 (CDD 포함)에 대한 SW-C 내에 Interrupt 가 Decoupling 되어 실행되는 SchedulableEntity 에 대해 동일한 이름의 RunnableEntity 를 생성한다.



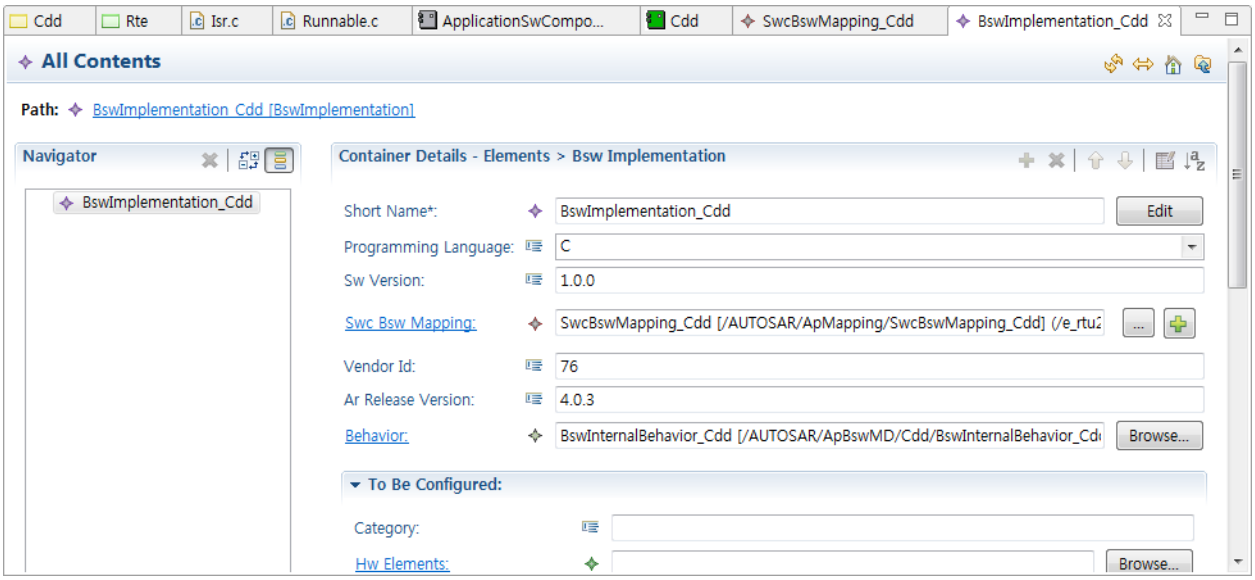
2. ARPackage 내에 SwcBswMapping 을 생성한다.

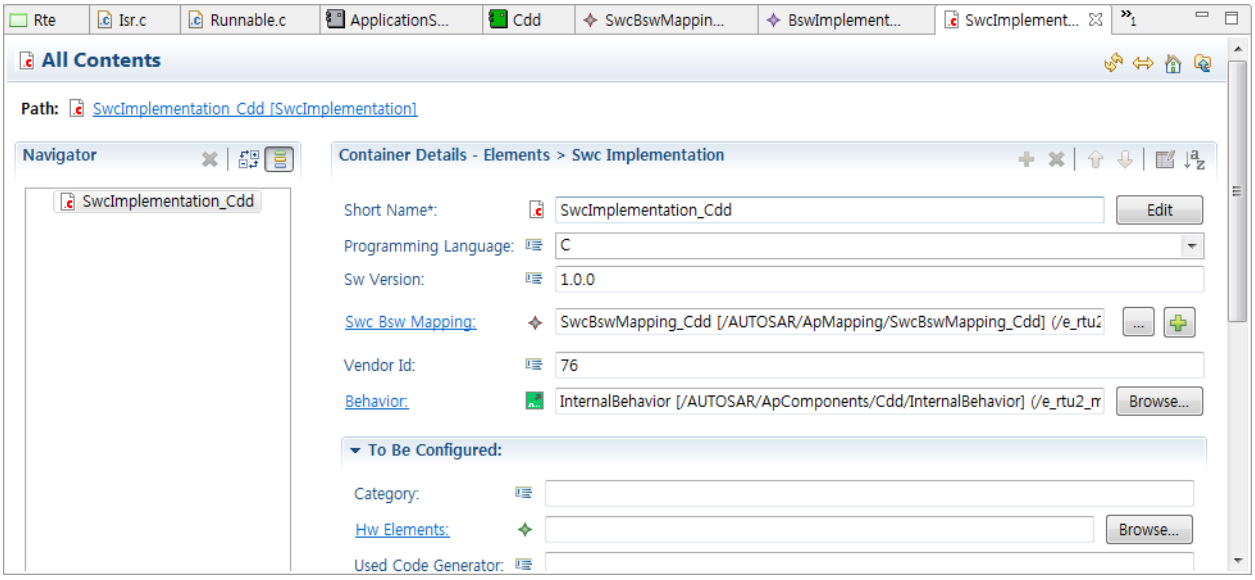


3. SwcBswMapping 내에 SwcBswRunnableMapping 을 생성한다.



4. BswImplementation 과 SwcImplementation 에 SwcBswMappingRef 를 추가한다.





5. Code: BSW 모듈(CDD 포함)에 대한 Software Component Description 에서 통신 설정 (Sender-Receiver 통신 등)을 한 후, Schedulable Entity (Runnable Entity)의 코드에 Rte API 를 사용하여 ASW 와 통신하는 코드를 작성한다.

```
#include "Rte_Cdd.h"

void Cdd_ScheduableEntity (void)
{
  …
  Rte_Send_…(…);
  …
}
```

8.1.2 Specific Description depending on MCU

8.1.2.1 Scope

이 Section 에서는, General Description (Chapter 8.1.1) 외, Target MCU 에 특성에 따른 특이 사항에 대하여 기술 한다.

8.1.2.2 Bolero Family (MPC560x)

Bolero MCU 기반의 ECU 를 개발 하는 경우, 제공되는 AUTOSAR OS 는 Task 의 Multiple Activation 을 지원하지 않는다. (I.e. 단일 OsTask 의 중복 Activation 기능이 제공되지 않음 (Task 의 Ready Queue = 1) 을 의미). 따라서, Multiple Activation Error 가 발생할 수 있으며, 이에 따른 Error Hook 함수가 호출될 수 있다.

8.2 Execution of Runnable mapped in Non-Periodic OsTask

8.2.1 General Description

8.2.1.1 Scope

이 Section 에서는, AUTOSAR 기반 SW 설계 시, 적용될 수 있는 비주기 OS Task 기반 Runnable 을 통한 설계 시 고려사항에 대하여 설명한다..

8.2.1.2 Non Periodic OsTask and Runnable

AUTOSAR 에서는, 비주기 RTE Event 기반의 시스템 설계가 가능하다. 예를 들어, Rte_Trigger Interface 를 통하여, 특정 SWC 에서 타 SWC 의 Runnable (i.e. SINK Runnable) 수행을 요청할 수 있다. 이때 RTE 에서는, 해당 Runnable 이 mapping 되어 있는 OsTask 를 Activate 시키고, 관련 Runnable 이 수행될 수 있도록 코드를 생성 한다.

8.2.1.2.1 Basic principles

비주기 RTE Event 는 Basic / Extended OsTask 기반으로 구현이 가능하며, 이는 RTE 설정에 의해서 결정된다.

8.2.1.2.2 Non Periodic OsTask in Basic and Extended OsTask

기본적으로, RTE Event 수행의 경우, Basic / Extended OsTask 설정에 따른 Runnable 수행에 대한 차이점은 없으며, RTE 의 경우, 해당 Runnable 수행을 위하여, OS 에서 제공하는 API 를 사용하며, 이를 통해 필요한 OsTask 를 Ready 상태로 변경 시킨 후, 해당 OsTask 에서 필요한 Runnable 을 수행 되도록 하고 있다.

하지만, Basic OsTask 와 Extended OsTask 기반의 Runnable 수행을 위한 OS 내부 동작 메커니즘에서는 차이가 있다.

Basic OsTask 기반의 Runnable 처리 방식

1) RTE 는 ActivateTask 를 통해, OS 에게 특정 OsTask 수행을 요청 (Event A)한다.
2) 이 때, 해당 OsTask 가 수행 될 수 있는 상태이면 해당 Task 가 수행되지만, 그렇지 않은 경우 자신의 수행 순서를 기다리게 된다.
3) 만일 이때, 다른 OsTask 에서 1)에서 수행 요청한 OsTask 에 대하여 추가 수행을 요구 (Event B) 하는 경우, 이 OsTask 에 대한 Queue 설정에 따라, Multiple Activation Error 가 발생할 수 있다.
4) 3)의 상황에서 (설정 상, 해당 OsTask 의 Queue > 2 로 설정이 되어 있어, Multiple Activation Error 가 발생하지 않은 상황), 실제 자신의 수행 시점에 도달한 경우, 현재 이 OsTask 는 두번 Activate

되게 된다. 이때 첫번째 OsTask 수행 시점에서 Event A 및 Event B 가 순차적으로 수행 (depends on PositionInTask) 되게 되며, 두번째 OsTask 수행 시점에서는 이미 두개의 Event 가 수행 완료된 상태이므로 특정 Event 에 의한 Runnable 수행 없이 OsTask 는 동작 후 Terminate 되게 된다.

Extended OsTask 기반의 Runnable 처리 방식

1) RTE 는 SetEvent 를 통해, OS 에게 특정 OsTask 수행을 요청 (Event A)한다.
2) 이 때, 해당 OsTask 가 수행 될 수 있는 상태이면 해당 Task 는 Wating 상태에서 깨어나게 되지만, 그렇지 않은 경우 자신의 수행 순서를 기다리게 된다.
3) 만일 이때, 다른 OsTask 에서 1)에서 수행 요청한 OsTask 에 대하여 추가 수행을 요구 (Event B) 하는 경우, 2)와 같은 동작을 취한다.
4) 요청된 OsTask 가 수행 시점에 도달한 경우, 해당 OsTask 는 Waiting 상태에서 Run 상태로 천이한 후, 요청된 OsEvent 를 참조하여 연결된 Event A 및 Event B 를 순차적으로 수행하게 된다.
   이때, Basic OsTask 기반의 Runnable 처리 방식과는 다르게, 해당 OsTask 를 두번 Activate 시킨 것이 아니므로, Task 는 한번만 수행하고 Terminate 되게 된다.

8.2.2 Specific Description depending on MCU

8.2.2.1 Scope

이 Section 에서는, General Description (Chapter 8.2.1) 외, Target MCU 에 특성에 따른 특이 사항에 대하여 기술 한다.

8.2.2.2 Bolero Family (MPC560x)

Bolero MCU 기반의 ECU 를 개발 하는 경우, 제공되는 AUTOSAR OS 는 Task 의 Multiple Activation 을 지원하지 않는다. (I.e. 단일 OsTask 의 중복 Activation 기능이 제공되지 않음 (Task 의 Ready Queue = 1) 을 의미).

8.3 Configuration Guide for Client-Server Communication

8.3.1 General Description

클라이언트-서버 통신은 클라이언트의 요청(Request)에 의해 서버가 서비스를 수행하고 그 결과를 클라이언트에서 응답(Response)하는 동작으로 이루어진 통신 방식이다.

8.3.1.1 Scope

이 Section 에서는, 클라이언트-서버 통신의 동작 및 관련 Ecu Configuration 설정 방법을 설명한다.

8.3.1.2 Synchronous Client-Server Communication

동기식(Synchronous) 클라이언트-서버 통신은 요청(Request)과 응답(Response)이 Rte_Call() API 내에서 동시에 동작하는 방식이다.

애플리케이션에서 Rte_Call() API 를 호출하면,

1. Rte_Call() API 내에서 서버 Runnable 수행을 요청하고, 서버의 응답 결과를 기다린다.
2. 서버는 클라이언트로부터 요청을 받으면 서비스를 수행한다.
3. 서버의 수행이 완료되면, 대기하던 Rte_Call() API 는 결과를 받아 애플리케이션에 전달한다.

동기식 클라이언트-서버 통신은 Direct Function Call 방식과 TASK 방식이 있다.
(Rte 의 이벤트는 RteEventToTaskMapping 을 통해 TASK 에 매핑되는 것이 기본이며, 클라이언트-서버 통신을 위한 OperationInvokedEvent 도 TASK 방식을 기본으로 하지만, 동시 실행이 가능한 경우 (CanBeInvokedConcurrently 가 true) TASK 에 매핑하지 않고 Direct Function Call 방식을 사용할 수 있다.)

8.3.1.2.1 Direct Function Call

서버가 별도의 TASK 에서 실행되지 않고, 클라이언트의 Rte_Call() API 에서 서버 Runnable 을 직접 Function Call 하는 형태로 수행된다.

일반적으로

1. 서버에 해당하는 Runnable 은 CanBeInvokedConcurrently 를 true 로 설정하고,
2. 위 Runnable 을 실행하는 OperationInvokedEvent 에 대해 RteEventToTaskMapping 에서

RteMappedToTaskRef 를 설정하지 않으면
Direct Function Call 형태로 코드를 생성한다.

위의 "요청-서비스 수행-응답" 세 단계에서 응답을 위해 Rte_Call() API 는 대기를 필요로 한다. Direct Function Call 방식은 Rte_Call() API 내에서 서버의 Runnable 을 직접 Function Call 로 실행하기 때문에 콜스택에에 의해 서버 Runnable 의 실행이 완료될 때까지 대기하다 서버 Runnable 이 리턴하면 나머지 동작을 수행 후 결과를 애플리케이션에 전달한다.

서버의 Runnable 이 클라이언트의 Task Context 에서 실행되며, 따라서 동시에 여러 Context 에서 실행 가능하다. 그리고 큐, 타임아웃 등의 기능을 사용할 수 없다.

8.3.1.2.2 Task Activation

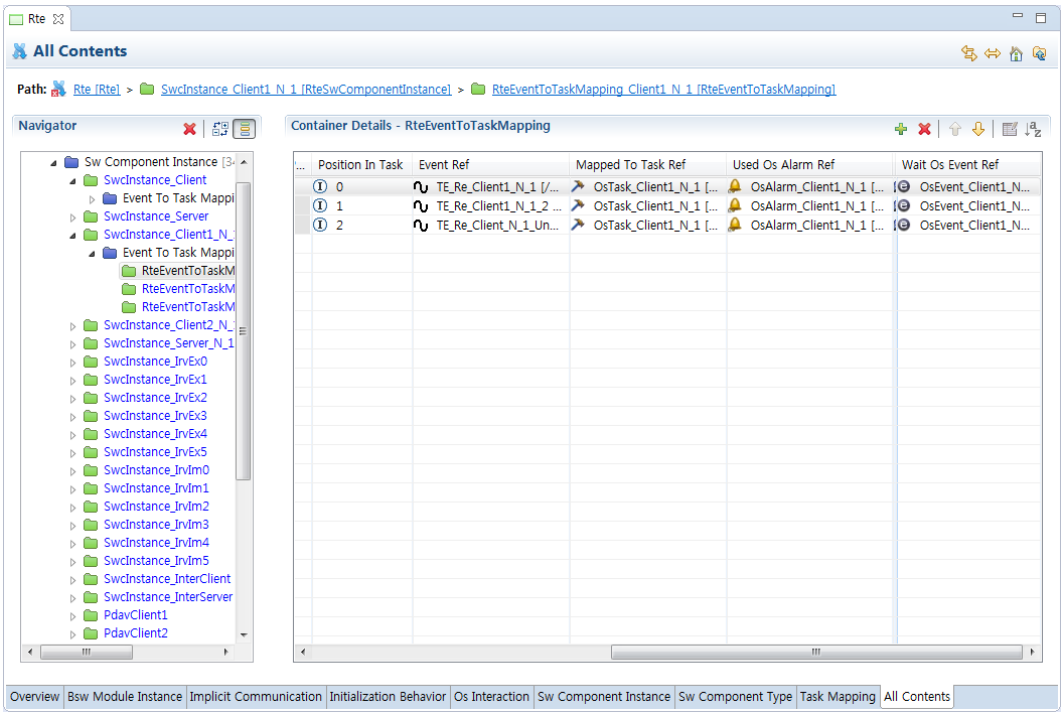
서버가 별도의 TASK 에서 실행되는 형태이다. Direct Function Call 과 마찬가지로 요청-서비스 수행-응답이라는 세 단계로 실행한다.

Direct Function Call 방식과 달리 Task Activation 방식은 Rte_Call() API 내에서 서버의 Runnable 을 실행하기 위해 서버 Runnable 이 속한 Task 를 Activation 하는 형태로 서비스 수행을 요청한다. 이를 통해 서버의 Runnable 은 동시 실행이 불가능하며, 다수의 요청이 있는 경우 큐를 사용한다.

단, 클라이언트(Rte_Call() API)와 서버(서버 Runnable)이 별도의 Task Context 에서 수행되기 때문에 우선 순위에 따라 Rte_Call()이 서버 Task 의 수행에 앞서 리턴할 수도 있다. 따라서 Rte_Call() API 가 서버에 서비스 수행을 요청 후 서버의 수행 완료를 대기 하기 위한 설정(우선 순위 및 Wait Point 설정)이 필요하다.

1. Wait Point
   서버의 응답을 대기하기 위해 Rte_Call() API 내에 Wait Point 를 정의한다. Wait Point 는 Os 의 EVENT 를 사용한다. 서버에게 서비스 수행 요청 (ActivateTask() / SetEvent()) 후, WaitEvent() API 를 통해 서버의 EVENT 발생을 기다린다.
   서버는 서비스 수행을 완료한 후, 요청한 클라이언트에 대한 EVENT 를 발생(SetEvent() API) 시켜 서버 종료 후 결과를 올바른 클라이언트에게 전달할 수 있도록 한다.
   따라서 클라이언트에서 사용할 EVENT 를 설정해야 한다. 이 때, 동기식 클라이언트-서버 통신에서는 Rte_Call() API 에서 모든 동작이 수행되기 때문에 Wait Point 의 위치를 별도로 지정할 필요는 없다. (Wait Point 의 위치는 Synchronous Server Call Point 가 되므로) **단 클라이언트 Task 에서 사용하는 OsEvent 를 RteWaitOsEventRef 를 통해 지정해야 한다.** (RteWaitOsEventRef 는

RteEventToTaskMapping 에 있으며, SynchronousServerCallPoint 가 정의된 RunnableEntity (클라이언트 Runnable)을 실행하는 이벤트(예: Timing Event 등)에 대한 RteEventToTaskMapping 에서 설정한다. 동일한 TASK 에 대해 동일한 OsEvent 를 지정하는 것으로 충분하다. 그림 참조: 세 개의 Rte 이벤트가 같은 태스크에서 동작할 때 RteWaitOsEventRef 는 모두 같은 것으로 지정한다. (아래 그림은 단순 참조용이며, 프로젝트에 단순 적용해서는 안 된다.)



2. 우선 순위

위와 같이 Wait Point 를 사용하여 동작하기 때문에, **클라이언트가 속한 TASK 의 우선 순위를 서버가 속한 TASK 의 우선순위 보다 높게 설정**하는 것을 기본으로 한다.

3. 예외

1, 2 의 조건을 만족할 수 없는 경우(SC1 의 지원 등)를 위해, 아래 세 조건을 모두 만족 시키는 설정을 허용한다. (동기식)

A. 파티션 내(Intra-Partition)의 통신

B. 클라이언트의 우선순위 보다 서버의 우선 순위를 높게 설정

C. RteWaitOsEventRef 를 설정하지 않음

8.3.1.3 Asynchronous Client-Server Communication

비동기식(Asynchronous) 클라이언트-서버 통신은 요청과 응답이 분리되어 Rte_Call() API 에서 서비스 수행 요청을 하고 Rte_Result()API 에서 수행 결과를 받는다.

애플리케이션에서

1. Rte_Call() API 를 호출하면 Rte_Call() API 내에서 서버 Runnable 수행을 요청하고,
2. 서버는 Runnable 코드 실행을 통해 서비스를 수행 후
3. Rte_Result()는 응답 결과를 애플리케이션에 알려준다.

이 때 애플리케이션은 Rte_Call() API 를 호출 후, 다른 동작을 수행하다가 원하는 시점에 Rte_Result() API 를 호출하여 응답을 받을 수 있다.

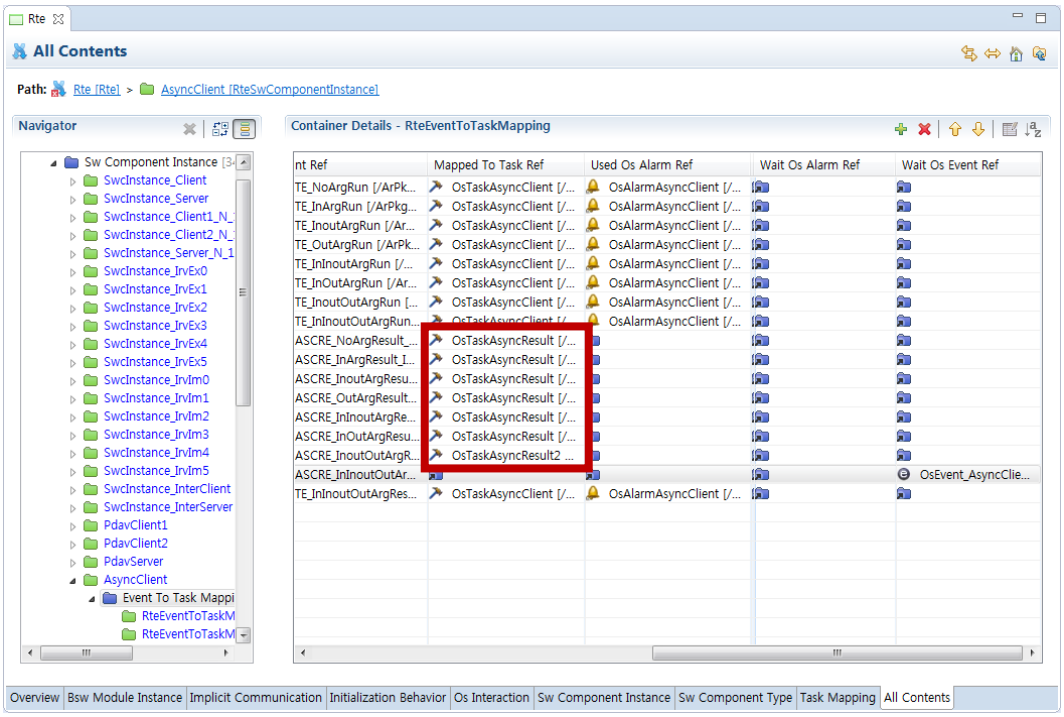
비동기식의 경우 서버의 수행이 완료되었음을 아래(Activation of Runnable Entity)와 같은 방식으로 클라이언트에게 전달한다.

8.3.1.3.1 Activation of Runnable Entity

서버가 서비스 수행을 완료하면 지정된 Runnable 을 Activation 하는 방식이다. Runnable 이 Activation 된 후에는 Rte_Result() API 를 통해 응답 결과를 얻을 수 있다. AsynchronousServerCallReturnsEvent 에 StartOnEventRef 를 지정하여 이 방식으로 동작시킬 수 있다.

1. Asynchronous Server Call Returns Event

   이 방식에서는 AsynchronousServerCallReturnsEvent 가 Runnable 을 시작하므로 AsynchronousServerCallReturnEvent 에 대한 **RteEventToTaskMapping 에 RteMappedToTaskRef 를 지정**하여 Runnable 이 실행할 TASK 를 설정한다. 그림 참조 (아래 그림은 단순 참조용이며, 프로젝트에 단순 적용해서는 안 된다.)



2. 우선 순위

Rte_Call() API 가 동작하는 Runnable 이 속한 TASK 의 우선 순위 >
Rte_Result() API 가 동작하는 Runnable 이 속한 TASK 의 우선 순위 >
서버 Runnable 이 속한 TASK 의 우선 순위를 기본으로 한다.

8.3.1.4 Inter-Partition Communication

8.3.1.4.1 OsEvent

Client-Server Communication 을 파티션 간 사용하려면 Sync/Async 모두 RteWaitOsEventRef 를 반드시 설정해야 한다. 이 때, RteWaitOsEventRef 로 설정한 OsEvent 에 대해 OsEvent 의 ShortName 에 PartitionTerminated 라는 Postfix 가 붙은 OsEvent 를 추가해야 한다.

예를 들어

1. OsTask: OsTaskInterClient 가 Client 가 동작하는 OsTask 라고 하고,
2. **OsEvent:** OsEventInterClient 가 RteWaitOsEventRef 로 설정된 OsEvent 라고 하면, (OsTaskInterClient 의 OsEventRef 역시 OsEventInterClient 를 참조하고 있어야 한다.)

   ☞ 이 때, Os 설정에서 OsEventInterClient**PartitionTerminated** 라는 OsEvent 를 추가해야 한다. (이 OsEventInterClient**PartitionTerminated** 라는 OsEvent 또한 OsTaskInterClient 의 OsEventRef 에서 참조하고 있어야 한다.)

이는 Server 의 파티션이 Terminate 될 경우, Client 의 무한 대기를 막기 위해 AUTOSAR 사양에서 요구하는 조건(Server 의 파티션이 Terminate 될 경우, Client 에게 즉시 알려 주어야 한다.)을 만족하는 기능에서 필요한 설정이다. (PartitionTerminated 가 붙은 OsEvent 를 통해 Client 에게 Server 파티션이 Terminate 되었음을 알림)

8.3.1.4.2 Scalability Class

Client-Server Communication 을 파티션 간 사용하려면 Sync/Async 모두 Scalability Class 를 SC3 또는 SC4 로 설정해야 한다. 파티션 간 클라이언트-서버 통신 시, Rte_Call/Rte_Result API 는 AUTOSAR 사양에 의해 Os 의 CheckTaskMemoryAccess() API 를 사용해야 하는데, CheckTaskMemoryAccess() API 는 SC3/4 에서만 제공되기 때문이다.

8.3.1.5 Clients on Interrupt Level or Invoked by Direct Function Call

Rte_Call API 를 실행하는 RunnableEntity(클라이언트)가 인터럽트 Level 이거나 Direct Function Call 로 실행되는 경우, Rte Generator 는 우선 순위 비교에 의한 Error 메시지를 출력하지 않고, Warning 메시지(WRN0087) 출력 후, 코드를 생성한다. 따라서 Warning 메시지가 출력되는 경우, 설정을 직접 확인하여 정상적인 클라이언트-서버 통신을 위한 확인 및 조치를 취한다.

예를 들면,

1. 인터럽트에서의 클라이언트 실행하는 경우 (인터럽트를 애플리케이션에 Notification 하는 경우)
   Trigger 등을 이용하여 BSW 내에서 인터럽트 Decoupling 후에 Decoupling 된 RunnableEntity (Task Level)에서 클라이언트-서버 통신을 사용하거나, 인터럽트에서 Rte_Call 을 직접 사용 시, Operation 의 Argument 를 제거하고, RteWaitOsEventRef 를 설정하지 않도록 하여, 단순히 서버(애플리케이션)의 RunnableEntity 를 동작하는 용도로만 사용한다.
2. 클라이언트가 Direct Function Call 로 실행하는 경우
   클라이언트가 실제 동작하는 Task 들을 찾아 각각의 Task 와 서버 Task 간의 우선 순위를 비교하여 8.3.1.2 와 8.3.1.3 에서의 우선 순위 조건에 맞게 설정되었는 지 확인한다.

8.3.1.6 Conclusion

	동기식 (Synchronous)		비동기식 (Asynchronous)	
	Direct Function Call	TASK[1)]	Activation of Runnable Entity	Wake Up of Wait Point
RteWaitOsEventRef	미설정	클라이언트 Runnable[2)]	미설정	ASCRE[3)]
우선 순위	해당 없음	클라이언트 > 서버	Rte_Call > Rte_Result > 서버 [4)]	

1) 동기식 TASK 방식에 대해 파티션 내 통신(Intra-Partition Communication)에 대해 RteWaitOsEventRef 를 설정하지 않고, 우선 순위를 클라이언트 < 서버로 설정하는 것을 허용한다.
2) Rte_Call 이 동작하는 Runnable 을 실행하는 Rte 이벤트에 대한 RteEventToTaskMapping 에 설정
3) Asynchronous Server Call Returns Event 에 대한 RteEventToTaskMapping 에 설정
4) Rte_Call, Rte_Result 란 Rte_Call, Rte_Result 가 동작하는 TASK 를 의미

8.3.2 Specific Description depending on MCU

8.3.2.1 Scope

이 Section 에서는, General Description (Chapter 8.3.1) 외, Target MCU 에 특성에 따른 특이 사항에 대하여 기술 한다.

8.3.2.2 Bolero Family (MPC560x)

Bolero MCU 기반의 ECU 를 개발 하는 경우, 제공되는 AUTOSAR OS 는 Task 의 Multiple Activation 을 지원하지 않는다. (I.e. 단일 OsTask 의 중복 Activation 기능이 제공되지 않음 (Task 의 Ready Queue = 1) 을 의미).

8.4 Mode Instance Initialization on inter partition mode switching

8.4.1 General Description

8.4.1.1 Scope

이 Section 에서는, 파티션간 모드 변경 기능 사용 시, 각 파티션의 초기화 과정에서 모드 Instance 에 대한 동기화 및 초기화 내용을 설명한다.

8.4.1.2 Initialization of Mode Instance in inter partition

멀티 파티션간 모드 변경 기능 사용 시, Mode Manager 가 위치한 파티션에서는, Mode Instance 에 대한 초기화를 진행한다. Mode User 가 위치한 파티션에서는 아래의 두 가지 상태에 따라 Mode Instance 에 대한 초기화가 다르게 수행 된다.

- **Mode Manager 파티션이 Starting 상태에 있는 경우**
  Mode Manager 에서 초기화된 Mode Instance 정보를 참조 한다.
- **Mode Manager 파티션이 Stopping 또는 Restarting 상태에 있는 경우**
  Mode Instance 에 대한 초기화 설정 (from Configuration)을 기반으로 자체적으로 초기화를 수행한다.

초기 모드(Initial Mode)에 OnEntry Event 의 Runnable 실행은 Mode User 가 위치한 파티션이 start 되는 시점 (Mode Instance 에 대한 초기화 완료 이후 SchM_Init 또는 Rte_Start 내) 에서 자체적으로 수행되며, 이때 참조하는 Mode Instance 는 위에서 설명한 두가지 상태에 따른 Instance 초기화 정보를 따른다.

8.4.1.2.1 Basic principles

멀티 파티션 기반, 모드 변경 기능 사용 시, 각 파티션 (특히, Multi Core 기반의 Multi Partition 시스템 설계 시)의 초기화 시점이 달라질 수 있다. BswM (또는 EcuM) 에 의하여 각 파티션의 초기화 시점 및 파티션 간 초기화 순서가 관리 되는 경우, (i.e. 현대오토에버에서 제공하는 Mode Stack (EcuM, BswM) 및 Init Policy 사용 시, 파티션 간 초기화 순서가 고정 됨) Mode Manager / User 간 파티션 초기화 순서에 따른 각 파티션에서의 Mode Instance 처리에 대한 사항을 고려하여 설계하도록 한다.

8.4.2 Specific Description depending on MCU

8.4.2.1 Scope

이 사항은, 모든 MCU 에 공통으로 적용된다.

8.5 Precautions on Rte API Usage

8.5.1 General Description

8.5.1.1 Scope

이 Section 에서는, RTE 에서 제공하는 API 기반으로 SW 설계 시, 유의해야 할 사항을 포함하고 있다.

8.5.1.2 Rte API in Runnable

RTE 에서 제공하는 API 는 사용하고자 하는 Runnable 내에서만 유효하다. 즉, SW 설계 시 특정 Runnable 에서 사용하고자 하는 Rte API 는 반드시 시스템 내에 해당 설정 (SWC arxml 파일 內) 이 반영되어야 한다.
RTE 에서는 시스템 내 특정 Runnable 에서 사용하겠다고 설정된 내용을 기반으로 연관되는 Rte API 를 생성하며, 이 API 는 반드시 해당 Runnable 내에서만 사용되어야 한다. 해당 Runnable 외에 Rte API 가 사용되는 경우 런타임 시, 원치 않는 오류를 발생 할 수 있다.

8.5.2 Specific Description depending on MCU

8.5.2.1 Scope

이 사항은, 모든 MCU 에 공통으로 적용된다.

8.6 Synchronized Offset

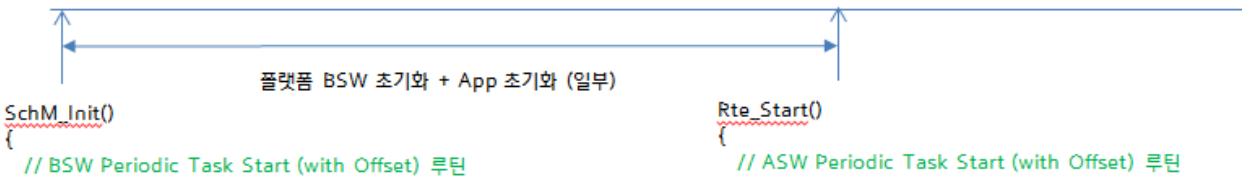
8.6.1 General Description

8.6.1.1 Scope

이 Section 에서는, Synchronized Offset 기반으로 BSW, ASW 간 Task 수행에 대한 Offset 설정 시 필요한 설정, 내용 및 주의사항에 대하여 설명한다.

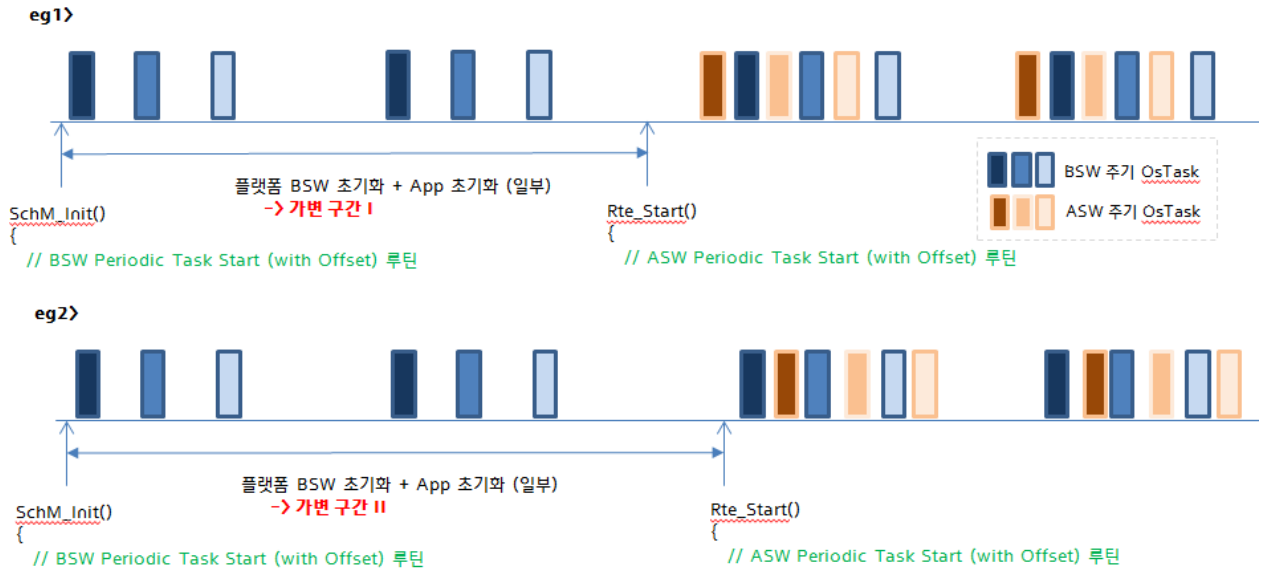
8.6.1.2 Description of Synchronized Offset Feature

특정 OS Counter 기반의 OsAlarm 을 이용하여 동작하는 Timing Event 의 Offset 의 동기화가 필요한 경우, 이 기능을 사용할 수 있다. 이 기능은 AUTOSAR 표준에서 제시하고 있는 기능은 아니며 현대오토에버에서 BSW 와 ASW 에서 사용하는 OsTask 의 효율적인 수행시간 분배가 가능하게 하고자 추가한 기능이다.
기본적으로 AUTOSAR 에서는 BSW 에서 사용되는 주기 OsTask 와 ASW 에서 사용하는 주기 OsTask Start 시점은 각각 SchM_Init / Rte_Start 함수 내에서 분리되어 수행되어 BSW/ASW 의 주기 OsTask 간 Offset 설정의 동기화를 보장하지 않는다. 즉 ASW Task 간 Offset, BSW Task 간 Offset 설정은 상호 OsTask 들간 (i.e. ASW 주기 OsTask 간, BSW 주기 OsTask 간) 에서만 유효하게 동작하게 된다.



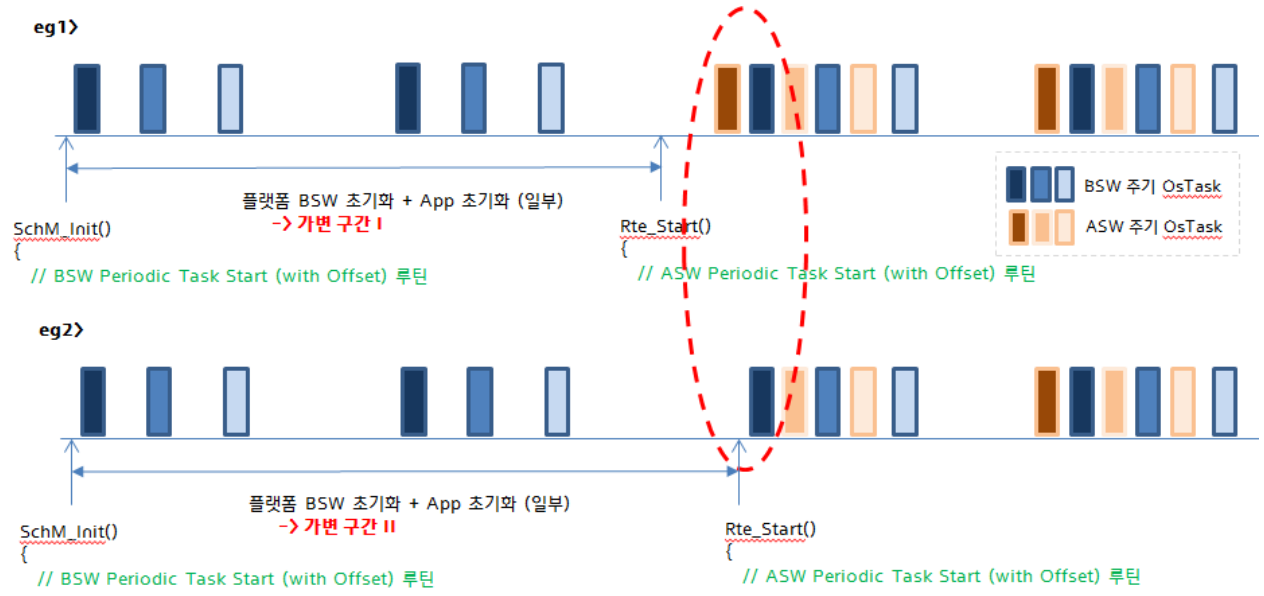
결국 ASW 주기 OsTask 들과 BSW 주기 OsTask 들간의 Offset 설정을 상호 연동하여 동작하게 하기 위해서는, Synchronized Offset 기능을 사용하여야 하며, 이를 통해 BSW, ASW OsTask 구분 없이 모든 OsTask (단 동일한 하나의 OsCounter 에 연동되어 있는 OsAlarm 을 통해 Activation 되는 OsTask) 에 유효한 Offset 기반으로 OsTask 수행 시간을 분배 할 수 있다.
※ Synchronized Offset 기능은 결국 BSW 와 ASW 에서 설정된 Timing Event 에 대한 Offset 정보는 상호간 동기화 되지 않기 때문에, 동기화 된 Offset 기반으로 효율적인 주기 Timing Event 수행 리소스를 분배하고자 하는 경우, 사용이 권장된다.

Synchronized Offset 기능을 사용하지 않은 경우, 아래 그림과 같이 가변구간 (i.e. 그림 내 가변구간 I, II) 에 따라 ASW, BSW 주기 OsTask 간 Offset 반영이 달라질 수 있다.



Synchronized Offset 기능을 사용하는 경우는, 아래 그림과 같이 가변구간 (i.e.그림 내 가변구간 I, II) 이 상황에 따라 변경될 수 있음에도 불구하고 ASW, BSW 주기 OsTask 간 Offset 이 상호 동기화되어 일정한 Offset 을 기반으로 OsTask 수행 될 수 있다.

단, 최초 ASW, BSW 주기 OsTask 간 Task 수행은 상황에 따라 달라질 수 있다. (아래 그림 붉은색 원 부분 참조)



8.6.1.3 How to Use this Feature

Synchronized Offset 기능을 사용하기 위해서는 하나의 OsCounter 에 연동되는 OsAlarm 의 정보가 필요하며, 각각의 OsAlarm 수행 순서 정의 (관련 파라미터 RteExpectedActivationPosition) 가 필요하다.

8.6.1.4 Cautions regarding Task Activation Design based on Synchronized Offset Feature

Synchronized Offset 기능 사용에 대하여 아래의 주의사항에 대하여 반드시 숙지 후, ASW 를 디자인 하여야 한다.

① OsAlarm 의 첫 실행 순서는 SchM_Init 및 Rte_Start 가 호출되는 시점에 따라 변경되기 때문에, 위의 Offset 기능이 OsAlarm 의 첫 실행 순서를 보장하지 않는다. (8.6.1.2 내 그림 (붉은색 타원 부분) 참조)

② 첫 실행 이후에 OsAlarm 은 주기에 맞추어 발생하지만 OsTask 의 실행 순서는 OsAlarm 발생 직후 Activation 시점의 Os 상황 (예를 들어 OsTask 우선순위, Task 수행시간 등) 에 따라 변경될 수 있으므로, 위의 Offset 기능이 OsTask 의 실행 순서를 보장하지 않는다.

③ SchM_Init ~ Rte_Start 사이에 OsCounter 의 Tick 값이 MaxAllowedValue 값을 넘어가지 (Wrap around) 않도록 MaxAllowedValue 는 OsCounter 가 사용하고 있는 HW Counter 에서 지원하는 가장 큰 값으로 설정해야 한다. (Wrap around 발생 이후에는 Offset 동기화를 보장하지 않는다.)

④ OsAlarm 의 Offset 또는 주기가 OsCounter 의 (MaxAllowedValue - 1) 값을 초과하면 안 된다.

⑤ OS Counter 타입에 따른 설계 시 제약사항 존재 하며, 경우에 따라서는 Offset 동기화에 대한 Timing 오차가 발생할 수 있으므로 반드시 사전 검토 후 사용하도록 함

카운터 종류	조건	SW 동작 영향 상세	조치 사항
SW 카운터	NR	Offset 오차 발생하지 않음. 단 DI~EI[1] 기간 내에서 Counter 값이 증가되지 않아서 해당 시간 만큼 전체적인 Timer 지연 발생 가능함	NR
HW 카운터	Counter 1 Tick 값 > Rte_DisableInterrupt ~ Rte_EnableInterrupt 구간의 수행시간	Counter 1 Tick 에 해당하는 시간 만큼 Offset 동기화 시 오차 발생 가능함. (예를 들어 1 Tick 이 1ms 이고 Rte_DisableInterrupt ~ Rte_EnableInterrupt 수행구간이 50us 이라면, 1ms Offset 오차가 발생할 수 있음)	반드시 **"조건에 따른 예상 Offset 오차 범위 * 2"** 를 감안하여 Task 분배를 위한 Offset 설계를 하도록 함. 즉, Offset 예상 오차가 50us 가 예상된다면, Task 간 분배는 최소 100us 이상의 마진을 가지고 설계되어야 함.[2]
	Counter 1 Tick 값 < Rte_DisableInterrupt ~ Rte_EnableInterrupt 구간의 수행시간	Rte_DisableInterrupt ~ Rte_EnableInterrupt 구간 수행 시간 만큼의 Offset 동기화 시 오차 발생 가능함. (예를 들어 1tick 이 1us 이고 Rte_DisableInterrupt ~ Rte_EnableInterrupt 구간 수행 시간이 50us 이라면, 50us 의 Offset 오차가 발생할 수 있음)	

* 1) Rte_DisableInterrupt ~ Rte_EnableInterrupt 구간 수행 시간: Rte_Start / SchM_Init 함수 내 해당 루틴에 대한 수행 시간 측정 후, 긴 시간을 기준으로 함.

Rte_DisableInterrupt ~ Rte_EnableInterrupt 구간 수행 시간 측정 방법은 아래와 같다.

※ 수행 시간 측정 방법

① Rte_Start 함수 Rte_DisableInterrupt ~ Rte_EnableInterrupt 구간 수행 시간 측정 방법: Rte_Start 함수 (Rte.c 파일 내 위치) 내에서 Rte_DisableInterrupt(); 직전부터 Rte_EnableInterrupt(); 직후까지의 수행 시간을 측정한다.

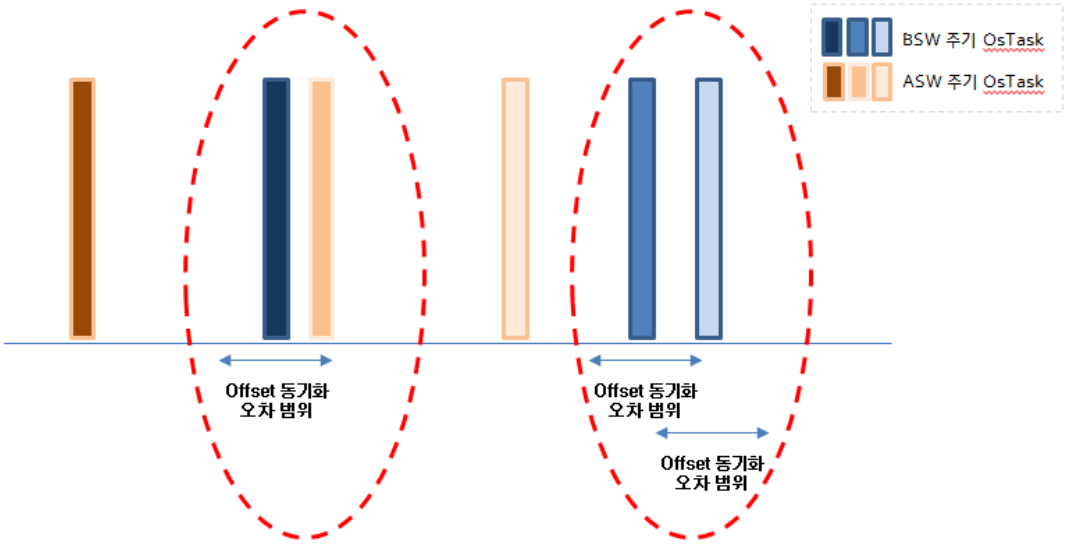
② SchM_Init 함수 Rte_DisableInterrupt ~ Rte_EnableInterrupt 구간 수행 시간 측정 방법: SchM_Init 함수 (Rte.c 파일 내 위치) 내에서 Rte_DisableInterrupt(); 직전부터 Rte_EnableInterrupt(); 직후까지의 수행 시간을 측정한다.

③ Rte_DisableInterrupt ~ Rte_EnableInterrupt 구간에 대한 최종 오차: ①, ② 측정결과 중 큰 값을 Rte_DisableInterrupt ~ Rte_EnableInterrupt 구간에 대한 최종 오차로 함.

(추후 반드시 실제 측정한 값을 기반으로 오토에버와 테크니컬 리뷰 시 같이 검토하여야 한다. 만일 MCU Clock 이 변경되는 경우, 수행시간이 변경될 수 있으므로 반드시 재 측정 후 Offset 의 유효성 여부를 확인해야 한다.)

** 2) 오차 범위를 고려한 Task 간 분배의 의미: 아래 그림에서 붉은색 점선의 타원의 경우와 같이 Offset 동기 오차 범위 내에서 OsTask 의 Offset 이 설정되어서는 안 된다.

※ Synchronized Offset 은 BSW <-> ASW 간 Sync 를 위한 기능이므로 ASW <-> ASW, BSW <-> BSW 간 offset 오차 범위에 대해서는 고려할 필요 없음.



8.6.2 Specific Description depending on MCU

8.6.2.1 Scope

이 사항은, 모든 MCU 에 공통으로 적용된다.

8.7 Guide for RteEvent

8.7.1 General Description

8.7.1.1 Scope

이 Section 에서는, RteEvent 에 의해 실행되는 Runnable Entity 들의 Task Mapping 과 Direct Function Call 에 대한 설정 및 주의사항에 대하여 설명한다.

8.7.1.2 Task Mapping

RteEvent 에 의해 실행되는 Runnable Entity 들은 일반적으로 Task Mapping 을 통해 수행된다. 이 경우 Runnable Entity 는 Mapping 된 Task 내에서 실행된다.

8.7.1.3 Direct Function Call

몇몇 RteEvent 는 각 통신에서 특정 조건을 만족하면 Direct Function Call 로 수행 될 수 있다.

8.7.1.3.1 RTE and Basic Software Scheduler and BswExecutionContext

RTE 와 Basic Software Scheduler 는 특별한 경우에 한하여 triggered ExecutableEntity 호출을 Direct function call 을 통해 수행하는 것을 지원한다. 그럼에도 불구하고 특정 실행 Context 의 ExecutableEntity 가 더 많은 권한을 지닌 execution context 을 요구하는 Triggered ExecutableEntity 호출하는 것을 방지한다. 아래의 표는 지원되는 조합을 나타낸다.

호출자의 BswExecutionContext	피호출자의 BswExecutionContext				
	task	**interruptCat2**	**interruptCat1**	**hook**	**unspecified**
task	지원	지원	지원		지원
interruptCat2		지원	지원		지원
interruptCat1			지원		지원
hook					
unspecified	지원				지원

예를 들어(4 번째 열), 호출자의 BswExecutionContext 가 task, interruptCat2 또는 interruptCat1 이라면 BswModuleEntiry interruptCat1 BswExecutionContext 의 ExecutableEntity 호출은 Direct Function Call 로 구현이 가능하다.

SchM_Trigger, SchM_ActMain 또는 Rte_Trigger API 에 의한 triggered ExecutableEntity 의 호출이나 SchM_Switch 또는 Rte_Switch 에 의한 OnEntry ExecutableEntity, OnTransition ExecutableEntity, OnExit ExecutableEntity 또는 mode switch acknowledge ExecutableEntity 에 적용된다.

참고로 RunnableEntity 의 execution context 는 task 로 간주된다.

8.7.1.3.2 Client-Server Communication

클라이언트-서버 통신에서 적어도 아래의 조건을 만족한 경우 RTE 제너레이터가 Direct Function Call 을 지원한다

- 서버 Runnable 의 canBeInvokedConcurrently 속성이 TRUE 로 지정
- 클라이언트와 서버가 같은 파티션에서 수행된다. 즉 intra-Partition 클라이언트 서버 통신
- ServerCallPoint 는 Synchronous(동기식)
- OperationInvokedEvent 가 OsTask 에 맵핑되어 있지 않음

8.7.1.3.3 Modes

Modes 에서 OnEntry ExecutionEntitys, OnTransition ExecutableEntitys, OnExitExecutableEntitys 그리고 mode switch acknowledge ExecutableEntity 의 호출은 아래의 조건을 모두 만족할 경우 RTE 제너레이터는 Direct Function Call 을 지원한다.

- Asynchronous mode switch behaviour 설정
- OnEntry ExecutableEntitys, OnTransition ExecutableEntitys, OnExit ExecutableEntitys 그리고 mode switch acknowledge ExecutableEntity 에 minimum start distance 미설정
- Mode manager 와 Mode user 는 같은 파티션
- 8.7.1.3.1 의 조합 만족

8.7.1.3.4 Trigger Sink

RTE Generator 는 Triggered ExecutableEntitys 의 Direct Function Call 은 아래의 조건을 모두 만족할 경우 Direct function Call 을 통한 호출을 지원한다.

- Triggered ExecutableEntitys 들의 'minimum start distance' 미정의
- Trigger Sink 와 Trigger Source 는 같은 파티션
- BswTriggerDirectImplementation 미정의
- 8.7.1.3.1 의 조합 만족
- Queue 가 아닌 Trigger Source 설정

8.7.2 Specific Description depending on MCU

8.7.2.1 Scope

이 사항은, 모든 MCU 에 공통으로 적용된다.