Document Title	Specification of Crypto Driver
Document Owner	AUTOSAR
Document Responsibility	AUTOSAR
Document Identification No	807
Document Classification	Standard

Document Status	Final
Part of AUTOSAR Standard	Classic Platform
Part of Standard Release	4.3.0

Document Change History

Date	Release	Changed by	Change Description
2016-11-30	4.3.0	AUTOSAR Release Management	Initial Release

Disclaimer

This specification and the material contained in it, as released by AUTOSAR, is for the purpose of information only. AUTOSAR and the companies that have contributed to it shall not be liable for any use of the specification.

The material contained in this specification is protected by copyright and other types of Intellectual Property Rights. The commercial exploitation of the material contained in this specification requires a license to such Intellectual Property Rights.

This specification may be utilized or reproduced without any modification, in any form or by any means, for informational purposes only. For any other purpose, no part of the specification may be utilized or reproduced, in any form or by any means, without permission in writing from the publisher.

The AUTOSAR specifications have been developed for automotive applications only. They have neither been developed, nor tested for non-automotive applications.

The word AUTOSAR and the AUTOSAR logo are registered trademarks.

Advice for users

AUTOSAR specifications may contain exemplary items (exemplary reference models, "use cases", and/or references to exemplary technical solutions, devices, processes or software).

Any such exemplary items are contained in the specifications for illustration purposes only, and they themselves are not part of the AUTOSAR Standard. Neither their presence in such specifications, nor any later documentation of AUTOSAR conformance of products actually implementing such exemplary items, imply that intellectual property rights covering such exemplary items are licensed under the same rules as applicable to the AUTOSAR Standard.

Table of Contents

1 Introduction and functional overview

This specification specifies the functionality, API and the configuration of the AUTOSAR Basic Software module Crypto Driver.

The Crypto Drivers are located in the Microcontroller Abstraction Layer, which is below the Crypto Hardware Abstraction Layer (Crypto Interface [4]) and the upper service layer (Crypto Service Manager [5]). The Crypto Driver is a driver for a specific device, that is only abstracting the features supported by the hardware.

The Crypto Drivers allow defining of different Crypto Driver Objects (i.e. AES accelerator, SW component, etc), which shall be used for concurrent requests in different buffers. For each hardware object a priority-dependent job processing shall be supported. A crypto software solution (i.e. software-based CDD) can define interfaces identical to the Crypto Drivers for interacting with the upper layers, which shall provide an interface to the applications.

2 Acronyms and abbreviations

Abbreviation / Acronym:	***Description:***
CDD	Complex Device Driver
CSM	Crypto Service Manager
CRYIF	Crypto Interface
CRYPTO	Crypto Driver
DET	Default Error Tracer
HSM	Hardware Security Module
HW	Hardware
SHE	Security Hardware Extension
SW	Software

2.1 Glossary of Terms

<table>
<tr><th><i>Terms:</i></th><th colspan="2"><i>Description:</i></th></tr>
<tr><td>Crypto Driver Object</td><td colspan="2">A Crypto Driver implements one or more Crypto Driver Objects.
The Crypto Driver Object can offer different crypto primitives in hardware or software. The Crypto Driver Objects of one Crypto Driver are independent of each other.
There is only one workspace for each Crypto Driver Object (i.e. only one crypto primitive can be performed at the same time)</td></tr>
<tr><td>Key</td><td colspan="2">A Key can be referenced by a job in the Csm.
In the Crypto Driver, the key references a specific key type.</td></tr>
<tr><td>Key Type</td><td colspan="2">A key type consists of references to key elements.
The key types are typically pre-configured by the vendor of the Crypto Driver.</td></tr>
<tr><td>Key Element</td><td colspan="2">Key elements are used to store data. This data can be e.g. key material or the IV needed for AES encryption.
It can also be used to configure the behaviour oft he key management functions.</td></tr>
<tr><td>Channel</td><td colspan="2">A channel is the path from a Crypto Service Manager queue via the Crypto Interface to a specific Crypto Driver Object.</td></tr>
<tr><td>Job</td><td colspan="2">A job is an instance of a job’s configured cryptographic primitive.</td></tr>
<tr><td>Crypto Primitive</td><td colspan="2">A crypto primitive is an instance of a configured cryptographic algorithm realized in a Crypto Driver Object.</td></tr>
<tr><td rowspan="4">Operation</td><td colspan="2">An operation of a crypto primitive declares what part of the crypto primitive shall be performed. There are three different operation modes:</td></tr>
<tr><td>START</td><td>Operation mode indicates a new request of a crypto primitive, and it shall cancel all previous requests of the same job and primitive.</td></tr>
<tr><td>UPDATE</td><td>Operation mode indicates, that the crypto primitive expect input data.</td></tr>
<tr><td>FINISH</td><td>Operation mode indicates, that after this part all data are fed completely and the crypto primitive can finalize</td></tr>
</table>

		the calculations.
	It is also possible to perform more than one operation at once by concatenating the corresponding bits of the operation mode argument.	
Priority	The priority of a job defines the importance of it. The higher the priority (as well in value), the more immediate the job will be executed. The priority of a cryptographic job is part of the configuration.	

3 Related documentation

3.1 Input documents

[1] AUTOSAR Layered Software Architecture
AUTOSAR_EXP_LayeredSoftwareArchitecture.pdf

[2] AUTOSAR General Requirements on Basic Software Modules
AUTOSAR_SRS_BSWGeneral.pdf

[3] AUTOSAR General Specification for Basic Software Modules
AUTOSAR_SWS_BSWGeneral.pdf

[4] AUTOSAR Specification of Crypto Interface
AUTOSAR_SWS_CryptoInterface.pdf

[5] AUTOSAR Specification of Crypto Service Manager
AUTOSAR_SWS_CryptoServiceManager.pdf

[6] AUTOSAR Requirements on Crypto Modules
AUTOSAR_SRS_CryptoStack.pdf

[7] Glossary
AUTOSAR_TR_Glossary

3.2 Related standards and norms

[8] IEC 7498-1 The Basic Model, IEC Norm, 1994

3.3 Related specification

AUTOSAR provides a General Specification on Basic Software (SWS BSW General) [3] which is also valid for Crypto Driver

Thus, the specification SWS BSW General [3] shall be considered as additional and required specification for Crypto Driver.

4 Constraints and assumptions

4.1 Limitations

n.a.

4.2 Applicability to car domains

The Crypto Driver can be used for all domain applications when security features are to be used.

5 Dependencies to other modules

[SWS_Crypto_00003] ⌈ If an off-chip crypto hardware module (e.g. external HSM) is used, the Crypto Driver shall use services of other MCAL drivers (e.g. SPI).
⌋
Hint: If the Crypto Driver uses services of other MCAL drivers (e.g. SPI), it must be ensured that these drivers are up and running before initializing the Crypto Driver module.

[SWS_Crypto_00116] ⌈The Crypto Driver shall be able to store key material in a non-volatile way if supported by the dedicated crypto hardware..
⌋

Note:
The Crypto Drivers are called by the Crypto Interface (CRYIF), which is implemented according to the cryptographic interface specification [4].

The Crypto Drivers access the underlying hardware and software objects, to calculate results with their cryptographic primitives. The results shall be forwarded to the CRYIF.

5.1 File structure

5.1.1 Code File Structure

The code file structure is not defined within this specification completely.

[SWS_Crypto_00005] ⌈ The code file structure shall contain a source file Crypto.c and a code file Crypto_KeyManagement.c.
⌋()

5.1.2 Header File Structure

[SWS_Crypto_00007] ⌈ The header file structure shall contain an application interface header file Crypto.h, that provides the function prototypes to access the Crypto primitives.
⌋()

[SWS_Crypto_00008] ⌈ The header file structure shall contain a configuration header Crypto_Cfg.h, that provides the configuration parameters for the Crypto Driver.
⌋(SRS_BSW_00345)

[SWS_Crypto_00009] ⌈ The Figure in SWS_Crypto_00010 (Crypto File Structure) shows the include file structure, which shall be as follows:

Crypto.h shall include Csm_Types.h and Crypto_Cfg.h.
Crypto.c shall include Crypto.h and CryIf_Cbk.h.
Crypto_KeyManagement.c shall include Crypto.h, CryIf_Cbk.h and Crypto_KeyManagement.h.
⌋(SRS_BSW_00348)

[SWS_Crypto_00010] ⌈

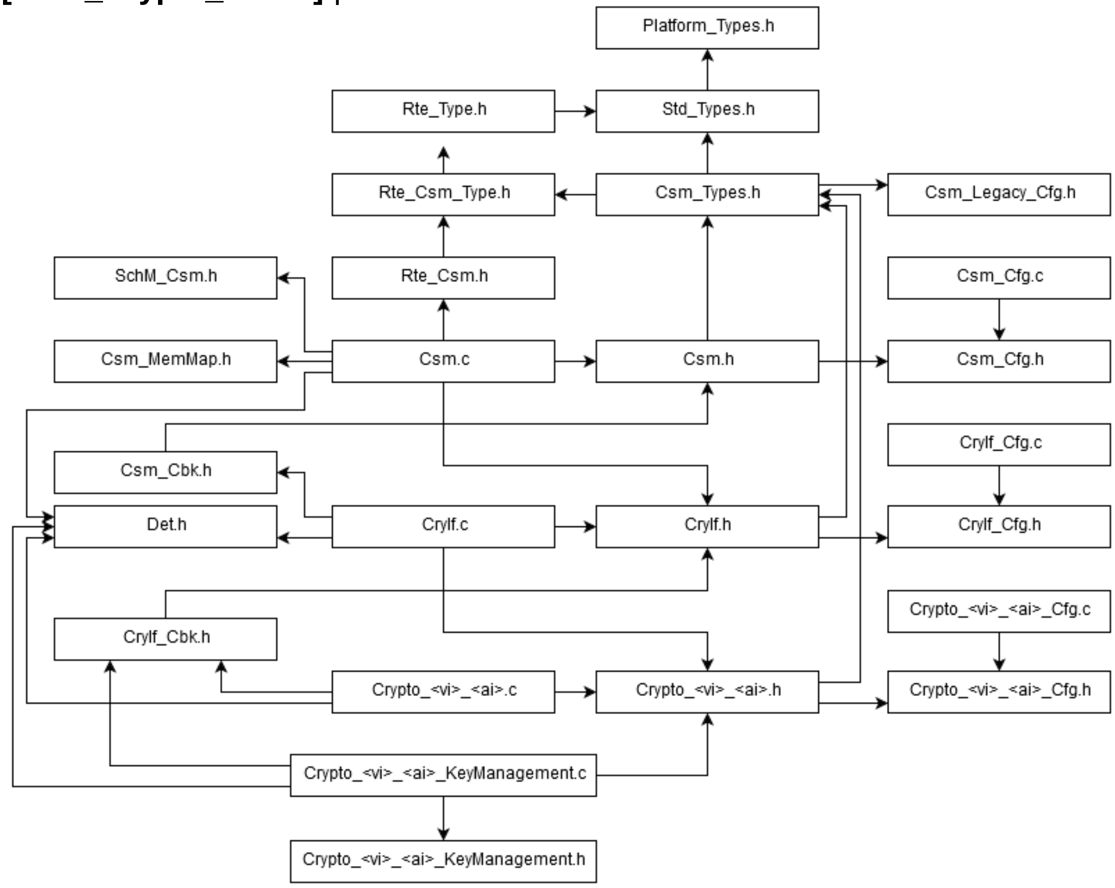


Figure 5.1: Crypto file dependencies

⌋(SRS_BSW_00348)

6 Requirements traceability

Requirement	Description	Satisfied by
SRS_BSW_00101	The Basic Software Module shall be able to initialize variables and hardware in a separate initialization function	SWS_Crypto_91000
SRS_BSW_00345	BSW Modules shall support pre-compile configuration	SWS_Crypto_00008
SRS_BSW_00348	All AUTOSAR standard types and constants shall be placed and organized in a standard type header file	SWS_Crypto_00009, SWS_Crypto_00010
SRS_BSW_00358	The return type of init() functions implemented by AUTOSAR Basic Software Modules shall be void	SWS_Crypto_91000
SRS_BSW_00407	Each BSW module shall provide a function to read out the version information of a dedicated module implementation	SWS_Crypto_91001
SRS_BSW_00414	Init functions shall have a pointer to a configuration structure as single parameter	SWS_Crypto_91000
SRS_CryptoStack_00086	The CSM module shall distinguish between error types	SWS_Crypto_00040
SRS_CryptoStack_00098	The Crypto Driver shall provide access to all cryptographic algorithms supported by the hardware	SWS_Crypto_00013

7 Functional specification

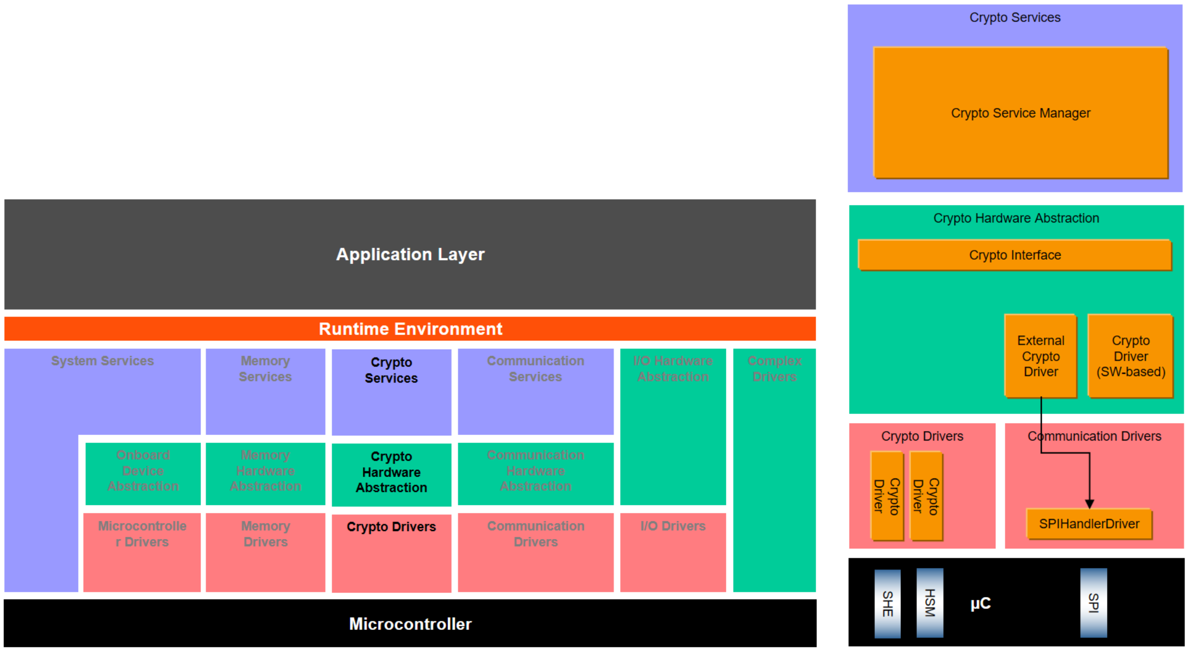


Figure 7.1: AUTOSAR Layered View with Crypto Driver Module

The Crypto Driver module is located in the micro controller abstraction layer and is below the Crypto Interface module and Crypto Service Manager module. It implements a generic interface for synchronous and asynchronous cryptographic primitives. It also supports key storage, key configuration, and key management for cryptographic services.

To provide cryptographic functionalities an ECU needs to integrate one unique Crypto Service Manager module and one Crypto Interface. However, the Crypto Interface can access several Crypto Drivers, each of them is configured according to the underlying Crypto Driver Object.

A Crypto Driver Object represents an instance of independent crypto hardware “device” (e.g. AES accelerator). There could be a channel for fast AES and CMAC calculations on an HSM for jobs with high priority, which ends on a native AES calculation service in the Crypto Driver. But it is also possible, that a Crypto Driver Object is a piece of software, e.g. for RSA calculations where jobs are able to encrypt, decrypt, sign or verify data. The Crypto Driver Object is the endpoint of a crypto channel.

7.1 Pre-Configuration

The vendor of the Crypto Driver has to provide a pre-configuration for the Crypto Driver which represents the capabilities of the Crypto Driver. The pre-configuration shall be delivered with the BSWMD-file of the Crypto Driver.

7.1.1 Cryptographic capabilities

The capabilities of a Crypto Driver can be divided in the two main topics: key storage and supported algorithms. The supported algorithms can be pre-configured by creating a new CryptoPrimitive container (e.g. MacGenerate). In this container the vendor can now specify that the Crypto Driver is for example only capable of doing a CMAC. In this case, an example configuration would be:

```
CryptoPrimitiveAlgorithmFamily  = CRYPTO_ALGOFAM_AES
CryptoPrimitiveAlgorithmMode  = CRYPTO_ALGOMODE_CMAC
CryptoPrimitiveAlgorithmSecondaryFamily =
CRYPTO_ALGOMODE_NOT_SET
CryptoPrimitiveService = MacGenerate
```

The primitive MacGenerate can then be referenced by the Crypto Driver Object to show, that it is capable of doing a CMAC. If no other primitives a pre-configured, the Crypto Driver Object is not able to perform e.g. an AES encryption.

If all primitives are independent from each other, a vendor would pre-configure one Crypto Driver Object for each primitive. Otherwise, there would be one Crypto Driver Object, which would reference all primitives.

7.1.2 Available Keys

The keys, which are provided by the Crypto Driver can also be pre-configured. A CryptoKey container references a specific CryptoKeyType. The CryptoKeyType provides the information which key elements are contained in a CryptoKey referencing this CryptoKeyType.

The vendor also pre-configures the key elements to define:

- read/write access
- the maximum size of the element
- if the element can be read/written with data smaller than the maximum size
- the init value after reset
- if the element is a virtual element

The init value is the value, which is stored into the key element at the initialization of the crypto driver when the key element is empty. It is e.g. used for the key element with the id CRYPTO_KE_<Service>_ALGORITHM. This way, the key management functions can be configured. To provide e.g. different key exchange algorithms in one Crypto Driver, the vendor can pre-configure the following containers and set the init values of the CRYPTO_KE_<Service>_ALGORITHM key element to a vendor specific value:

CryptoKeyElement_KeyExchange_Algorithm_RSA

- ID = 11
- Init value = 0x00
- Size = 1
- Read Access = RA_NONE
- Write Access = WA_NONE

CryptoKeyElement_KeyExchange_Algorithm_Ed25519
- ID = 11
- Init value = 0x01
- Size = 1
- Read Access = RA_NONE
- Write Access = WA_NONE

CryptoKeyType_KeyExchange_RSA
- CryptoKeyElement_KeyExchange_Algorithm_RSA
- CryptoKeyElement_KeyExchange_PartnerPubKey
- CryptoKeyElement_KeyExchange_OwnPubKey
- CryptoKeyElement_KeyExchange_Base
- CryptoKeyElement_KeyExchange_PrivKey
- CryptoKeyElement_KeyExchange_SharedValue

CryptoKeyType_KeyExchange_Ed25519
- CryptoKeyElement_KeyExchange_Algorithm_Ed25519
- CryptoKeyElement_KeyExchange_PartnerPubKey
- CryptoKeyElement_KeyExchange_OwnPubKey
- CryptoKeyElement_KeyExchange_Base
- CryptoKeyElement_KeyExchange_PrivKey
- CryptoKeyElement_KeyExchange_SharedValue

When a key exchange should be performed with a CryptoKey of type CryptoKeyType_KeyExchange_Ed25519, the Crypto Driver knows with the value stored in the key element CRYPTO_KE_KEYEXCHANGE_ALGORITHM that Ed25519 shall be used as underlying cryptographic primitive.

If a key should be used in more than one primitive e.g. KeyExchange and AES-Ecrypt-CBC, the CryptoKeyType could be extended by needed elements:

CryptoKeyType_KeyExchange_Cipher_combined
- CryptoKeyElement_KeyExchange_Algorithm_Ed25519
- CryptoKeyElement_KeyExchange_PartnerPubKey
- CryptoKeyElement_KeyExchange_OwnPubKey
- CryptoKeyElement_KeyExchange_Base
- CryptoKeyElement_KeyExchange_PrivKey
- CryptoKeyElement_KeyExchange_SharedValue
  - ID = 1
- CryptoKeyElement_Cipher_IV

Note that CryptoKeyElement_KeyExchange_SharedValue has the id set to 1. When calling the encrypt service with a key of CryptoKeyType CryptoKeyType_KeyExchange_Cipher_combined, the shared value of the key exchange is automatically used as encryption key.

7.2 General Behavior

The Crypto Driver can have one or more Crypto Driver Objects.

[SWS_Crypto_00012] ⌈ In case several Crypto Driver instances (of same or different vendor) are implemented in one ECU the file names, API names, and published parameters must be distinguished such that no two definitions with the same name are generated.

The name shall be formatted according to **SWS_BSW_00102:** Crypto_<vi>_<ai>, where <vi> is the vendorId and <ai> is the vendorApiInfix.
⌋()

[SWS_Crypto_00013] ⌈ The Crypto Driver may support all crypto primitives that are supported by the underlying hardware object.
⌋(SRS_CryptoStack_00098)

A job, declared in CSM specification [5], is an instance of a configured cryptographic primitive.

[SWS_Crypto_00014] ⌈ A Crypto Driver Object shall only support processing one job at one time.
⌋()

[SWS_Crypto_00117] ⌈ A Crypto Driver with n Crypto Driver Objects shall be able to process n jobs in parallel.
⌋()

Hint: Jobs, that are in the job queue (described in chapter 7.2.3.1), do not count as in processing.

7.2.1 Normal Operation

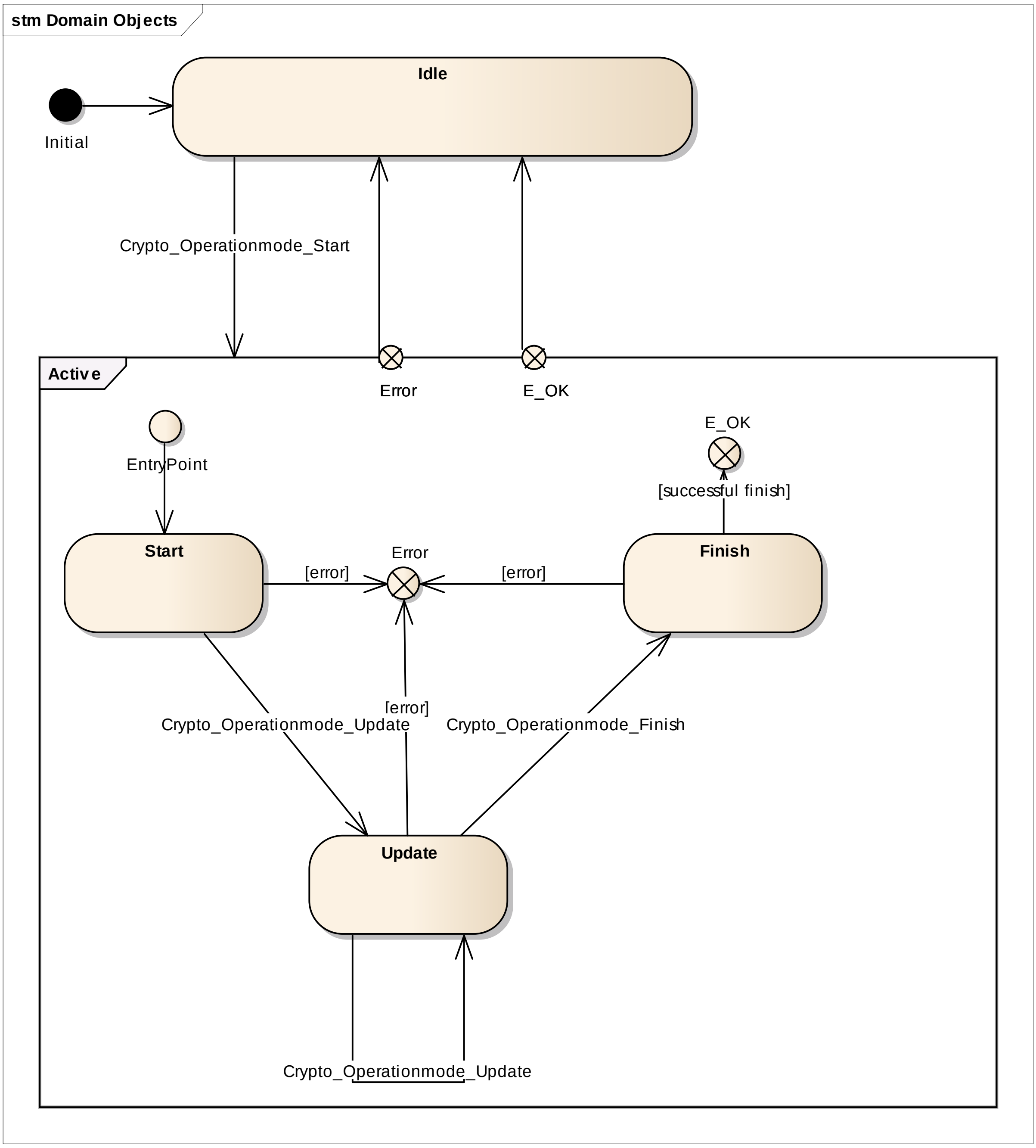
[SWS_Crypto_00017] ⌈
"START" indicates a new request of a crypto primitive, and it shall cancel all previous requests of the same job.
⌋()

Note:
To unite a single call function and a streaming approach for the crypto services, there is one interface Crypto_ProcessJob() with a service operation parameter (embedded in job structure parameter). This service operation is a flag field, that indicates the operation modes "START", "UPDATE" or "FINISH". It declares explicitly which operation will be performed.
If the "UPDATE" flag is set, the crypto primitive expects input data. "FINISH" indicates, that after this function call, all data are fed completely and the crypto primitive can finalize the calculations.
These operations can be combined to execute multiple operations at once. Then, the operations are performed in the order "START", "UPDATE", "FINISH".

The coherent single call approach could improve the performance due to less overhead. Instead of calling the explicit API multiple times, only one call is necessary. This approach is intended to be used with small data input, which demand fast processing.

The diagram in SWS_Crypto_00018 shows the state machine of a job of this design without considering the transitions because of errors.

[SWS_Crypto_00018]
⌈



⌋()

[SWS_Crypto_00019] ⌈ After initialization the crypto driver is in “idle” state.
⌋()

[SWS_Crypto_00020] ⌈ If `Crypto_ProcessJob()` is called while in “Idle” or “Active” state and with the operation mode “`START`”, the previous request shall be

cancelled. That means, that all previously buffered data for this job shall be reset, and the job shall switch to “Active” state and process the new one.
⌋()

[SWS_Crypto_00118] ⌈ If `Crypto_ProcessJob()` is called while the job is in state “Idle” and the “`START`” flag in the operation mode is not set, the function shall return with `E_NOT_OK`.
⌋()

Note:
If `Crypto_ProcessJob()` is called while in “Active” state and with the operation mode “`UPDATE`”, the crypto primitive is fed with input data. In terms of streaming of arbitrary amounts of user data multiple calls with operation mode “`UPDATE`” is used, to feed more input data to the previously ones. In the “Update” state, there are usually also calculations of intermediate results of cryptographic primitives. Actually, in some cases (e.g. AES Encryption in CBC mode) there is also the generation of output data. While operating with the streaming approach (“Start”, “Update”, “Finish”) the Crypto Driver Object is waiting for further input (“Update”) until the “Finish” state has been reached. No other job could be processed meanwhile.

[SWS_Crypto_00023] ⌈ If `Crypto_ProcessJob()` is called while in “Active” state and with the operation mode “`FINISH`”, the cryptographic calculations shall be finalized. Additional data (i.e. the MAC to be tested on a MAC verification service) shall be available at this point to process this job successfully. The results of the calculations shall be stored in the output buffers. At end of the processing the Crypto Driver shall switch to “Idle” state.
⌋()

To process a crypto service with a single call with `Crypto_ProcessJob()` the operation mode ”`CRYPTO_OPERATIONMODE_SINGLECALL`” is a disjunction (bitwise OR) of the 3 modes “`START”, ”UPDATE” and ”FINISH`”.

[SWS_Crypto_00025] ⌈ If a internal error occurs, the corresponding job state shall be set to "Idle" and all input data and intermediate results shall be discarded.
⌋()

[SWS_Crypto_00119] ⌈ If an internal error occurs while processing an asynchronous job, the corresponding job state shall be set to "Idle" and all input data and intermediate results shall be discarded. Further, the callback notification shall be called with an appropriate error code.
⌋()

7.2.2 Functional Requirements

Note: The information whether the job shall be processed synchronously or asynchronously is part of the `Crypto_JobType`.

7.2.2.1 Synchronous Job Processing

[SWS_Crypto_00026] ⌈ When the synchronous job processing is used, the corresponding interface functions shall compute the result synchronously within the context of this function call.
⌋()

7.2.2.2 Asynchronous Job Processing

[SWS_Crypto_00027] ⌈ If the asynchronous job processing is used, the interface functions shall only hand over the necessary information to the primitive. The actual computation may be kicked-off by the main function.
⌋()

[SWS_Crypto_00028] ⌈ For each asynchronous request the Crypto Driver shall notify CRYIF about the completion of the job by calling the CRYIF_CallbackNotification function passing on the job information and the result of cryptographic operation.
⌋()

7.2.3 Design Notes

The Crypto Driver provides two services: (1) the crypto services itself and (2) key management.

7.2.3.1 Priority-dependent Job Queue

[SWS_Crypto_00029] ⌈ Optionally, every Crypto Driver Object shall be able to line up jobs into a queue to process them one after the other.
⌋()

[SWS_Crypto_00179] ⌈ The Crypto Driver Object shall disable queueing when the size of the crypto driver queue is set to 0.
⌋()

[SWS_Crypto_00030] ⌈ The queue shall sort the jobs according to the configured jobs' priority.
⌋()

The higher the job priority value, the higher the job's priority.

[SWS_Crypto_00031] ⌈ If `Crypto_ProcessJob()` is called, when the queue is empty and the Crypto Driver Object is not busy the Job shall switch to the state 'active' and execute the crypto primitive.
⌋()

[SWS_Crypto_00032] ⌈ If `Crypto_ProcessJob()` is called and the queue is full, the function shall return with `CRYPTO_E_QUEUE_FULL`.
⌋()

[SWS_Crypto_00120] ⌈

If the job is synchronous, the function Crypto_ProcessJob() shall wait while the crypto driver object is busy and process the job when the crypto driver object is idle.
⌋()

Note:
It has to be ensured, that the asynchronous jobs are processed fast enough to avoid that the synchronous job has to wait for a long time.
It is also recommended to use CRYPTO_OPERATIONMODE_SINGLECALL for the asynchronous jobs.

Note:
A Crypto Driver Object can handle different jobs with synchronous and asynchronous job processing at the same time. However, synchronous job processing and job-queuing might not be useful. So, if synchronous job processing is chosen, the job queue will not be used, and a job will only be processed, when the Crypto Driver Object is not busy.

[SWS_Crypto_00121] ⌈ If `Crypto_ProcessJob()` is called and the Job is in “ACTIVE” state, the `Crypto_ProcessJob()` shall check if the requested job matches the current job in the Crypto Driver Object and if yes, bypass it from queueing.
⌋()

This implicates that only jobs with operation mode „START“ shall be queued. If a job with operation mode “START” has been finished, the Crypto Driver Object is waiting for input. The callback function indicates the callee that an “UPDATE” or “FINISH” call shall be performed.

[SWS_Crypto_00033] ⌈ If `Crypto_ProcessJob()` is called with asynchronous job processing and the queue is not full, but the Crypto Driver Object is busy and if the job has the operation mode “START”, the Crypto Driver Object shall put the job into the queue and return `CRYPTO_E_OK`.
⌋()

[SWS_Crypto_00034] ⌈ If `Crypto_ProcessJob()` is called with synchronous job processing and the queue is not full, but the Crypto Driver Object is busy, the Crypto Driver Object shall not queue the job and return `CRYPTO_E_BUSY`. No job shall be put in any queue.
⌋()

7.2.4 Key Management

A key consists of one or more key elements.
Examples of key elements are the key material itself, an initialization vector, a seed state for random number generation, or the proof of the SHE standard.

[SWS_Crypto_00037] ⌈ The index of the different key elements from the different crypto services are defined as in imported types table SWS_Crypto_00044.

⌋()

[SWS_Crypto_00038] ⌈ A key has a state which is either “valid” or “invalid”.
⌋()

[SWS_Crypto_00039] ⌈ If a key is in the state “invalid”, crypto services which make use of that key, shall return with `CRYPTO_E_KEY_INVALID`.
⌋()

If a key (or key element) is currently in use by a crypto service, the state of the key has to be “valid”. When the `KeyElementSet()` is called, the key state is set to “invalid”. So, the job which is currently running will probably work with an inconsistent key. It is up to the application to only change key, if currently no primitive works with that key (element).

Note: The mapping of keys and key elements to SHE hardware functionality is possible without being subject to any restrictions. To provide an environment for legacy software the single key used by the hardware can be placed in a key element referenced by several keys. Every key has also a unique reference to a key element containing an identifier. The driver implemented according to this specification can hence wrap existing SHE hard- and software and pass the data from the key elements to the existing SHE driver. In this use case one key element could contain a counter that could be read and written by the driver as well as the application. This counter could be used to detect if the key was overwritten. The loading of a key into the actual hardware key slot could be done immediately before the key is used, which would result in a combined loading and processing of the key, as well as a separate operation following the writing of a key into a key element. This would result in separate operations for loading and processing the key.
If a new driver is to be implemented, it would also be possible to configure keys with completely independent key elements. These independent keys can be stored in RAM and passed to the hardware key slot only when required for an operation. The number of keys stored in the driver can be independent of (and much larger than) the number of hardware key slots. This requires, of course, a handling and storing of keys in software with all potential drawbacks.

A key element can be configured as virtual. This way it behaves like a pointer to data which is stored in another element.

Example is the certificate. The certificate data is stored in one element. Elements like the issuer, public key of the certificate and signature only reference to the data somewhere in the main element with an offset without allocating own memory.

Different key types can have compatible key elements. In this case the keyElementId has the same value. Key elements with the same keyElementId may be regarded as compatible. This way, the same key can be used for different services.
The key material therefore shall always have the keyElementId 1.

Example is the generation of a key with the Key Management Interface and usage of the same key in a primitive like MacGenerate afterwards.

A key element may not be fully written. In some cases, the size of data to be stored in the key element can vary, e.g. certificates. The Crypto Driver shall store the actually written size of data for internal usage and for exporting the element with Crypto_KeyElementGet(). If the key element shall allow to be not fully read or written can be configured with the parameter CryptoKeyElementAllowPartialAccess in the CryptoKeyElement container.

7.3 Error classification

7.3.1 Development Errors

[SWS_Crypto_00040] Development Error Types⌈

Type of error	*Related error code*	*Value [hex]*
API request called before initialization of Crypto Driver.	CRYPTO_E_UNINIT	0x00
Initiation of Crypto Driver failed	CRYPTO_E_INIT_FAILED	0x01
API request called with invalid parameter (Nullpointer).	CRYPTO_E_PARAM_POINTER	0x02
API request called with invalid parameter (out of range).	CRYPTO_E_PARAM_HANDLE	0x04
API request called with invalid parameter (invalid value).	CRYPTO_E_PARAM_VALUE	0x05

⌋(SRS_CryptoStack_00086)

7.3.2 Runtime Errors

There are no runtime errors.

7.3.3 Transient Faults

There are no transient faults.

7.3.4 Production Errors

There are no production errors.

7.3.5 Extended Production Errors

There are no production errors.

8 API specification

8.1 Imported types

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

[SWS_Crypto_00042] Imported Types

Module	*Imported Type*
Csm	Crypto_JobInfoType
	Crypto_JobType
	Crypto_VerifyResultType
Std_Types	Std_ReturnType
	Std_VersionInfoType

⌋()

The Crypto Stack API uses the following extension to Std_ReturnType:
[SWS_Crypto_00043] ⌈

Range:	CRYPTO_E_BUSY	2	The service request failed because the service is still busy.
	CRYPTO_E_SMALL_BUFFER	3	The service request failed because the provided buffer is too small to store the result.
	CRYPTO_E_ENTROPY_EXHAUSTION	4	The service request failed because the entropy of the random number generator is exhausted.
	CRYPTO_E_QUEUE_FULL	5	The service request failed because the queue is full.
	CRYPTO_E_KEY_READ_FAIL	6	The service request failed because read access failed.
	CRYPTO_E_KEY_WRITE_FAIL	7	The service request failed because write access failed.
	CRYPTO_E_KEY_NOT_AVAILABLE	8	The service request failed because the key is not available.
	CRYPTO_E_KEY_NOT_VALID	9	The service request failed because at least one needed key element is invalid.
	CRYPTO_E_KEY_SIZE_MISMATCH	10	The service request failed because the key element is not partially accessible and the provided key element length is too short or too long for that key element.
	CRYPTO_E_COUNTER_OVERFLOW	11	The service request failed because the counter overflowed.
	CRYPTO_E_JOB_CANCELED	12	The service request failed because the Job has been canceled.
Description:	Crypto Stack specific return values for use in Std_ReturnType.		

⌋()

The Crypto Stack API uses the key element index definition from the CSM module.
Type definitions
N/A.

8.2 Function definitions

This is a list of functions provided for upper layer modules.

8.2.1 General API

8.2.1.1 Crypto_Init

[SWS_Crypto_91000] ⌈

Service name:	Crypto_Init	

Syntax:	`void Crypto_Init(`
	`    void`
	`)`	

Service ID[hex]:	0x00	
Sync/Async:	Synchronous	
Reentrancy:	Reentrant	
Parameters (in):	None	
Parameters (inout):	None	
Parameters (out):	None	
Return value:	void	--
Description:	Initializes the Crypto Driver.	

⌋ (SRS_BSW_00101, SRS_BSW_00358, SRS_BSW_00414)

[SWS_Crypto_00045] ⌈ If the initialization of the Crypto Driver fails, the Crypto shall report `CRYPTO_E_INIT_FAILED` to the DET.
⌋()

8.2.1.2 Crypto_GetVersionInfo

[SWS_Crypto_91001] ⌈

Service name:	Crypto_GetVersionInfo	

Syntax:	`void Crypto_GetVersionInfo(`
	`    Std_VersionInfoType* versioninfo`
	`)`	

Service ID[hex]:	0x01	
Sync/Async:	Synchronous	
Reentrancy:	Reentrant	
Parameters (in):	versioninfo	Pointer to where to store the version information of this module.
Parameters (inout):	None	
Parameters (out):	None	
Return value:	void	--
Description:	Returns the version information of this module.	

⌋ (SRS_BSW_00407)

[SWS_Crypto_00047] ⌈ If the parameter `versioninfo` is a null pointer and if default error detection for the Crypto Driver is enabled, the function `Crypto_GetVersionInfo` shall report `CRYPTO_E_PARAM_POINTER` to the DET.
⌋()

8.2.2 Job Processing Interface

8.2.2.1 Crypto_ProcessJob

[SWS_Crypto_91003] ⌈

Service name:	Crypto_ProcessJob	

Syntax:	`Std_ReturnType Crypto_ProcessJob(`
	`    uint32 objectId,`
	`    Crypto_JobType* job`
	`)`	

Service ID[hex]:	0x03	
Sync/Async:	Sync or Async, depends on the job configuration	
Reentrancy:	Reentrant	
Parameters (in):	objectId	Holds the identifier of the Crypto Driver Object.
Parameters (inout):	job	Pointer to the configuration of the job. Contains structures with job and primitive relevant information but also pointer to result buffers.
Parameters (out):	None	
Return value:	Std_ReturnType	E_OK: Request successful E_NOT_OK: Request Failed CRYPTO_E_BUSY: Request Failed, Crypro Driver Object is Busy CRYPTO_E_KEY_NOT_VALID, Request failed, the key is not valid CRYPTO_E_KEY_SIZE_MISMATCH, Request failed, a key element has the wrong size. CRYPTO_E_QUEUE_FULL: Request failed, the queue is full CRYPTO_E_ENTROPY_EXHAUSTION: Request failed, the entropy is exhausted CRYPTO_E_SMALL_BUFFER: The provided buffer is too small to store the result CRYPTO_E_COUNTER_OVERFLOW: The counter is overflowed. CRYPTO_E_JOB_CANCELED: The service request failed because the synchronous Job has been canceled.
Description:	Performs the crypto primitive, that is configured in the job parameter.	

⌋ ()

This Interface has a different behavior depending on the content of the `job` parameter (i.e. the type of crypto service).
Depending on this configuration, other input parameters within the `job` need to be set, in order to call this function successfully. I.e. the MAC Generate crypto primitive requires a key, a plaintext to be used, and a buffer for the generated MAC.

[SWS_Crypto_00057] ⌈ If the module is not initialized and if default error detection for the Crypto Driver is enabled, the function `Crypto_ProcessJob` shall report `CRYPTO_E_UNINIT` to the DET and return `E_NOT_OK`.
⌋()

[SWS_Crypto_00058] ⌈ If the parameter objectId is out of range and if default error detection for the Crypto Driver is enabled, the function Crypto_ProcessJob shall report CRYPTO_E_PARAM_HANDLE to the DET and return E_NOT_OK.
⌋()

[SWS_Crypto_00059] ⌈ **I**f the parameter job is a null pointer and if default error detection for the Crypto Driver is enabled, the function Crypto_ProcessJob shall report CRYPTO_E_PARAM_POINTER to the DET and return E_NOT_OK.
⌋()

[SWS_Crypto_00064] ⌈ If the parameter job->jobPrimitiveInfo->primitiveInfo->service is not supported by the Crypto Driver Object and if default error detection for the Crypto Driver is enabled, the function Crypto_ProcessJob shall report CRYPTO_E_PARAM_HANDLE to the DET and return E_NOT_OK
⌋()

[SWS_Crypto_00065] ⌈ If job->jobPrimitiveInfo->primitiveInfo->service is set to CRYPTO_HASH or CRYPTO_MACGENERATE, the parameter job->jobPrimitiveInfo->primitiveInfo->resultLength is required.
If the configured result length of the job is smaller than the result length of the chosen algorithm, the most significant bits of the result shall be truncated to the configured result length.
⌋()

[SWS_Crypto_00067] ⌈
If the parameter job->jobPrimitiveInfo->primitiveInfo->algorithm (with its variation in family, keyLength and mode) is not supported by the Crypto Driver Object and if default error detection for the Crypto Driver is enabled, the function Crypto_ProcessJob shall report CRYPTO_E_PARAM_HANDLE to the DET and return E_NOT_OK.
⌋()

Depending of the crypto service configured in job->jobPrimitiveInfo->primitiveInfo->service, different parameters of job->jobPrimitiveInput are required to be set with valid values. The table in SWS_Crypto_00071 specifies which parameters are required or optional for a service in different modes. The following requirements specify the behavior if a required member is a null pointer.

[SWS_Crypto_00070] ⌈
If a pointer is required as an argument, but it is a null pointer, the Crypto_ProcessJob() function shall report CRYPTO_E_PARAM_POINTER. If the value, which is pointed by a length pointer, is zero, and if default error detection for the Crypto Driver is enabled, the Crypto_ProcessJob() function report CRYPTO_E_PARAM_VALUE to the DET and return E_NOT_OK.
⌋()

[SWS_Crypto_00142] ⌈

If a length pointer is required as an argument, but the value, which is pointed by the length pointer is zero, and if default error detection for the Crypto Driver is enabled, the `Crypto_ProcessJob()` function report `CRYPTO_E_PARAM_VALUE` to the DET and return `E_NOT_OK`.
⌋()

[SWS_Crypto_00071] ⌈

Member / Service*	inputPtr	inputLengthPtr	secondaryInputPtr	secondaryInputLengthPtr	tertiaryInputPtr	tertiaryInputLengthPtr	outputPtr	outputLengthPtr	secondaryOutputPtr	secondaryOutputLengthPtr	verifyPtr	output64Ptr	mode
HASH	UG	UG					F	F					SUF
MACGENERATE	UG	UG					F	F					SUF
MACVERIFY	UG	UG	F	F							F		SUF
ENCRYPT	UG	UG					UF	UF					SUF
DECRYPT	UG	UG					UF	UF					SUF
AEADENCRYPT	UG	UG	F	F			UF	UF	F	F			SUF
AEADDECRYPT	UG	UG	F	F	F	F	UF	UF			F		SUF
SIGNATUREGENERATE	UG	UG					F	F					SUF
SIGNATUREVERIFY	UG	UG	F	F							F		SUF
SECCOUNTERINCREMENT													
SECCOUNTERREAD												F	
RANDOMGENERATE							F	F					

***:** Service names are derived from `Crypto_ServiceInfoType` (part of job struct)
S: member required in Start mode.
U: member required in Update mode.
F: member required in Finish mode.
G: member optional in Finish mode.
⌋()

[SWS_Crypto_00072] ⌈ All crypto services listed in `Crypto_ServiceInfoType` except of `CRYPTO_HASH, CRYPTO_SECCOUNTERINCREMENT, CRYPTO_SECCOUNTERREAD` and `CRYPTO_RANDOMGENERATE` require a key represented as a key identifier.
⌋()

[SWS_Crypto_00073] ⌈ In the following table the content of the different input and output buffers of `job.jobPrimitiveInputOutputType` are specified:

Parameter / Service*	Input	Secondary Input	Tertiary Input	Output	Secondary Output
HASH	plaintext			generated hash	
MACGENERATE	plaintext			generated MAC	
MACVERIFY	plaintext	MAC to be			

		verified			
ENCRYPT	plaintext			encrypted ciphertext	
DECRYPT	ciphertext			decrypted plaintext	
AEADENCRYPT	plaintext	associated Data		encrypted ciphertext	generated Tag
AEADDECRYPT	ciphertext	associated Data	Tag to be verified	decrypted Plaintext	
SIGNATUREGENERATE	plaintext			generated signature	
SIGNATUREVERIFY	plaintext	signature to be verified			
RANDOMGENERATE				random number	

***:** Service names are derived from `Crypto_ServiceInfoType`.
⌋()

If no errors are detected by the Crypto Driver, the Crypto Driver processes the crypto service, configured in `job`, with the underlying hardware or software solutions.

[SWS_Crypto_00134] ⌈ If the crypto primitive requires input data, its memory location is referred by the pointer `job->jobPrimitiveInput.inputPtr.`
On calling `Crypto_ProcessJob`, the length of this data is stored in `job->jobPrimitiveInput.inputLength`.

This applies analogously to `job->jobPrimitiveInput.secondaryInputPtr` and `job->jobPrimitiveInput.secondaryInputLength` respectively `job->jobPrimitiveInput.tertiaryinputPtr` and `job->jobPrimitiveInput.tertiaryInputLength`, if they shall be used for the chosen crypto primitive.
⌋()

[SWS_Crypto_00135] ⌈
If the crypto primitive requires a buffer for the result, its memory location is referred by the pointer `job->jobPrimitiveInput.outputPtr.` On calling this function, `job->jobPrimitiveInput. outputLengthPtr` shall contain the size of the associated buffer. When the request has finished, the actual length of the returned value shall be stored.

This applies analogously to `job->jobPrimitiveInput.secondaryOutputPtr` and `job->jobPrimitiveInput.secondaryOutputLengthPtr`, if they shall be used for the chosen crypto primitive .
⌋()

[SWS_Crypto_00136] ⌈ If the buffer `job->jobPrimitiveInput.outputPtr` or `job->jobPrimitiveInput.secondaryOutputPtr` is too small to store the result of the request, `CRYPTO_E_SMALL_BUFFER` shall be returned and if default error detection is enabled, `CRYPTO_E_RE_SMALL_BUFFER` shall be reported to the DET.
⌋()

[SWS_Crypto_00137] ⌈ If the increment secure counter service is chosen and the corresponding counter is overflowed and default error detection for the Crypto Driver is enabled, the function `Crypto_ProcessJob` shall report `CRYPTO_E_PARAM_HANDLE` to the DET and return `CRYPTO_E_COUNTER_OVERFLOW`.
⌋()

[SWS_Crypto_00141] ⌈ If the random generator service is chosen and the corresponding entropy, the function shall return `CRYPTO_E_ENTROPY_EXHAUSTED`. If the default error detection for the Crypto Driver is enabled, the function `Crypto_ProcessJob` shall additionally report `CRYPTO_E_RE_ENTROPY_EXHAUSTED` to the DET.
⌋()

8.2.3 Job Cancellation Interface

8.2.3.1 Crypto_CancelJob

[SWS_Crypto_00122] ⌈

Service name:	Crypto_CancelJob	

Syntax:	`Std_ReturnType Crypto_CancelJob(`
	`    uint32 objectId,`
	`    Crypto_JobInfoType* job`
	`)`	

Service ID[hex]:	0x0e	
Sync/Async:	Synchronous	
Reentrancy:	Reentrant, but not for same Crypto Driver Object	
Parameters (in):	objectId	Holds the identifier of the Crypto Driver Object.
Parameters (inout):	job	Pointer to the configuration of the job. Contains structures with job and primitive relevant information.
Parameters (out):	None	
Return value:	Std_ReturnType	E_OK: Request successful, job has been removed E_NOT_OK: Request Failed, job couldn't be removed
Description:	This interface removes the provided job from the queue and cancels the processing of the job if possible.	

⌋ ()

[SWS_Crypto_00123] ⌈ If default error detection for the Crypto Driver is enabled: The function `Crypto_CancelJob` shall raise the error `CRYPTO_E_UNINIT` and return `E_NOT_OK` if the module is not yet initialized.
⌋ ( )

[SWS_Crypto_00124] ⌈ If default error detection for the Crypto Driver is enabled: The function `Crypto_CancelJob` shall raise the error `CRYPTO_E_PARAM_HANDLE` and return `E_NOT_OK` if the parameter `objectId` is out or range.
⌋ ( )

[SWS_Crypto_00125] ⌈ If default error detection for the Crypto Driver is enabled: The function `Crypto_CancelJob` shall raise the error

CRYPTO_E_PARAM_POINTER and return E_NOT_OK if the parameter job is a null pointer.
⌋ ( )

[SWS_Crypto_00143] ⌈ If no errors are detected by Crypto Driver, the service Crypto_CancelJob() shall remove the job from the queue. If the job is currently processed it shall be cancelled. When cancellation of current processing is not possible due to limitations, the result shall be discarded and the callback notification shall be suppressed.
⌋()

[SWS_Crypto_00144] ⌈ If a job is canceled, it shall return CRYPTO_E_JOB_CANCELED either with the callback, when the job is an asynchronous job or as the return value of the function Crypto_CancelJob(), in case the job is synchronous.
⌋()

8.2.4 Key Management Interface

Note: If the actual key element to be modified is directly mapped to flash memory, there could be a bigger delay when calling the key management functions (synchronous operation)

[SWS_Crypto_00145] ⌈ If the underlying crypto hardware does not allow execution of key management functions at the same time as processing a job, the key management functions shall wait while the current job is executed and start the processing of the key management function afterwards.
⌋()

Note:
It has to be ensured, that the jobs are processed fast enough to avoid that the key management function has to wait for a long time.
It is also recommended to use CRYPTO_OPERATIONMODE_SINGLECALL for the jobs.

8.2.4.1 Key Setting Interface

8.2.4.1.1 Crypto_KeyElementSet

[SWS_Crypto_91004] ⌈

Service name:	Crypto_KeyElementSet	

Syntax:	`Std_ReturnType Crypto_KeyElementSet(`
	`    uint32 cryptoKeyId,`
	`    uint32 keyElementId,`
	`    const uint8* keyPtr,`
	`    uint32 keyLength`
	`)`	

Service ID[hex]:	0x04	
Sync/Async:	Synchronous	
Reentrancy:	Non Reentrant	
Parameters (in):	cryptoKeyId	Holds the identifier of the key whose key element shall be set.
	keyElementId	Holds the identifier of the key element which shall be set.

	keyPtr	Holds the pointer to the key data which shall be set as key element.
	keyLength	Contains the length of the key element in bytes.
Parameters (inout):	None	
Parameters (out):	None	
Return value:	Std_ReturnType	E_OK: Request successful E_NOT_OK: Request Failed CRYPTO_E_BUSY: Request Failed, Crypto Driver Object is Busy CRYPTO_E_KEY_WRITE_FAIL:Request failed because write access was denied CRYPTO_E_KEY_NOT_AVAILABLE: Request failed because the key is not available. CRYPTO_E_KEY_SIZE_MISMATCH: Request failed, key element size does not match size of provided data.
Description:	Sets the given key element bytes to the key identified by cryptoKeyId.	

⌋ ()

Note: This service works synchronously. However, it is possible that the underlying key material is resident in the flash memory. Hence it may take some time to execute this function.

[SWS_Crypto_00075] ⌈ If the Crypto Driver is not yet initialized and if default error detection for the Crypto Driver is enabled, the function `Crypto_KeyElementSet` shall report `CRYPTO_E_UNINIT` to the DET and return `E_NOT_OK`.
⌋()

[SWS_Crypto_00076] ⌈ If `cryptoKeyId` is out of range and if default error detection for the Crypto Driver is enabled, the function `Crypto_KeyElementSet` shall report `CRYPTO_E_PARAM_HANDLE` to the DET and return `E_NOT_OK`.
⌋()

[SWS_Crypto_00077] ⌈ If parameter `keyElementId` is out of range and if default error detection for the Crypto Driver is enabled, the function `Crypto_KeyElementSet` shall report `CRYPTO_E_PARAM_HANDLE` to the DET and return `E_NOT_OK`.
⌋()

[SWS_Crypto_00078] ⌈ If the parameter `keyPtr` is a null pointer and if default error detection for the Crypto Driver is enabled, the function `Crypto_KeyElementSet` shall report `CRYPTO_E_PARAM_POINTER` to the DET and return `E_NOT_OK`.
⌋()

[SWS_Crypto_00079] ⌈ If `keyLength` is zero and if default error detection for the Crypto Driver is enabled, the function `Crypto_KeyElementSet` shall report `CRYPTO_E_PARAM_VALUE` to the DET and return `E_NOT_OK`.
⌋()

[SWS_Crypto_00146] ⌈ If `keyLength` is smaller than the size of the key element, and the key element is not configured to allow partial access, the function `Crypto_KeyElementSet` shall return `CRYPTO_E_KEY_SIZE_MISMATCH`.

⌋()

8.2.4.1.2 Crypto_KeyValidSet

[SWS_Crypto_91005] ⌈

Service name:	Crypto_KeyValidSet	

Syntax:	`Std_ReturnType Crypto_KeyValidSet(`
	`    uint32 cryptoKeyId`
	`)`	

Service ID[hex]:	0x05	
Sync/Async:	Synchronous	
Reentrancy:	Non Reentrant	
Parameters (in):	cryptoKeyId	Holds the identifier of the key which shall be set to valid.
Parameters (inout):	None	
Parameters (out):	None	
Return value:	Std_ReturnType	E_OK: Request successful E_NOT_OK: Request Failed CRYPTO_E_BUSY: Request Failed, Crypro Driver Object is Busy
Description:	Sets the key state of the key identified by cryptoKeyId to valid.	

⌋ ()

[SWS_Crypto_00082] ⌈ If the module is not yet initialized and default error detection for the Crypto Driver is enabled, the function `Crypto_KeyValidSet` shall report `CRYPTO_E_UNINIT` to the DET and return `E_NOT_OK`.
⌋()

[SWS_Crypto_00083] ⌈ If parameter `cryptoKeyId` is out of range and if default error detection for the Crypto Driver is enabled, the function `Crypto_KeyValidSet` shall report `CRYPTO_E_PARAM_HANDLE` to the DET and return `E_NOT_OK`.
⌋()

If no errors are detected by Crypto Driver, the service `Crypto_KeyValidSet()` sets the key `cryptoKeyId` to “valid”.

8.2.4.2 Key Extraction Interface

8.2.4.2.1 Crypto_KeyElementGet

[SWS_Crypto_91006] ⌈

Service name:	Crypto_KeyElementGet	

Syntax:	`Std_ReturnType Crypto_KeyElementGet(`
	`    uint32 cryptoKeyId,`
	`    uint32 keyElementId,`
	`    uint8* resultPtr,`
	`    uint32* resultLengthPtr`
	`)`	

Service ID[hex]:	0x06	
Sync/Async:	Synchronous	
Reentrancy:	Reentrant	
Parameters (in):	cryptoKeyId	Holds the identifier of the key whose key element shall be returned.
	keyElementId	Holds the identifier of the key element which shall be returned.

Parameters (inout):	resultLengthPtr	Holds a pointer to a memory location in which the length information is stored. On calling this function this parameter shall contain the size of the buffer provided by resultPtr. If the key element is configured to allow partial access, this parameter contains the amount of data which should be read from the key element. The size may not be equal to the size of the provided buffer anymore. When the request has finished, the amount of data that has been stored shall be stored.
Parameters (out):	resultPtr	Holds the pointer of the buffer for the returned key element
Return value:	Std_ReturnType	E_OK: Request successful E_NOT_OK: Request Failed CRYPTO_E_BUSY: Request Failed, Crypto Driver Object is Busy CRYPTO_E_KEY_NOT_AVAILABLE: Request failed, the requested key element is not available CRYPTO_E_KEY_READ_FAIL: Request failed because read access was denied CRYPTO_E_SMALL_BUFFER: The provided buffer is too small to store the result
Description:	This interface shall be used to get a key element of the key identified by the cryptoKeyId and store the key element in the memory location pointed by the result pointer. Note: If the actual key element is directly mapped to flash memory, there could be a bigger delay when calling this function (synchronous operation).	

⌋ ()

[SWS_Crypto_00140] ⌈ If the function Crypto_KeyElementGet returns CRYPTO_E_KEY_NOT_AVAILABLE and default error detection is enabled, the function shall additionally report CRYPTO_E_RE_KEY_NOT_AVAILABLE to the DET.
⌋()

[SWS_Crypto_00139] ⌈ If the function Crypto_KeyElementGet returns CRYPTO_E_KEY_EXTRACT_DENIED and default error detection is enabled, the function shall additionally report CRYPTO_E_RE_KEY_EXTRACT_DENIED to the DET.
⌋()

[SWS_Crypto_00085] ⌈ If the module is not yet initialized and if default error detection for the Crypto Driver is enabled, the function Crypto_KeyElementGet shall report CRYPTO_E_UNINIT to the DET and return E_NOT_OK.
⌋()

[SWS_Crypto_00086] ⌈ If the parameter cryptoKeyId is out of range and if default error detection for the Crypto Driver is enabled, the function Crypto_KeyElementGet shall report CRYPTO_E_PARAM_HANDLE to the DET and return E_NOT_OK.
⌋()

[SWS_Crypto_00087] ⌈ If the parameter keyElementId is out of range and if default error detection for the Crypto Driver is enabled, the function Crypto_KeyElementGet shall report CRYPTO_E_PARAM_HANDLE to the DET and return E_NOT_OK.
⌋()

[SWS_Crypto_00088] ⌈ If the parameter resultPtr is a null pointer and if default error detection for the Crypto Driver is enabled, the function Crypto_KeyElementGet shall report CRYPTO_E_PARAM_POINTER the DET and return E_NOT_OK.
⌋()

[SWS_Crypto_00089] ⌈ If the parameter resultLengthPtr is a null pointer and if default error detection for the Crypto Driver is enabled, the function Crypto_KeyElementGet shall report CRYPTO_E_PARAM_POINTER to the DET and return E_NOT_OK.
⌋()

[SWS_Crypto_00090] ⌈ If the value, which is pointed by resultLengthPtr is zero and if default error detection for the Crypto Driver is enabled, the function Crypto_KeyElementGet shall report CRYPTO_E_PARAM_VALUE to the DET and return E_NOT_OK.
⌋()

If no errors are detected by Crypto Driver, the service Crypto_KeyElementGet() retrieves the value of the key element and store it in the buffer, which is pointed by the resultPtr.

[SWS_Crypto_00092] ⌈ The pointer resultPtr holds the memory location, where the data of the key element shall be stored. On calling this function, resultLengthPtr shall contain the size of the buffer provided by resultPtr. When the request has finished, the actual length of the returned value shall be stored.
⌋()

[SWS_Crypto_00093] ⌈ If the buffer resultPtr is too small to store the result of the request, CRYPTO_E_SMALL_BUFFER shall be returned and if default error detection is enabled, CRYPTO_E_SMALL_BUFFER shall be reported to the DET.
⌋()

[SWS_Crypto_00147] ⌈ If the value, which is pointed by resultLengthPtr is smaller than the size of the key element, and the key element is not configured to allow partial access, the function Crypto_KeyElementGet shall return CRYPTO_E_KEY_SIZE_MISMATCH.
⌋()

8.2.4.3 Key Copying Interface

8.2.4.3.1 Crypto_KeyElementCopy

[SWS_Crypto_00148] ⌈

Service name:	Crypto_KeyElementCopy

Syntax:	`Std_ReturnType Crypto_KeyElementCopy(`
	`    uint32 cryptoKeyId,`

	`uint32 keyElementId,`
	`uint32 targetCryptoKeyId,`
	`uint32 targetKeyElementId`
	`)`	

Service ID[hex]:	0x0f	
Sync/Async:	Synchronous	
Reentrancy:	Reentrant, but not for the same cryptoKeyId	
Parameters (in):	cryptoKeyId	Holds the identifier of the key whose key element shall be the source element.
	keyElementId	Holds the identifier of the key element which shall be the source for the copy operation.
	targetCryptoKeyId	Holds the identifier of the key whose key element shall be the destination element.
	targetKeyElementId	Holds the identifier of the key element which shall be the destination for the copy operation.
Parameters (inout):	None	
Parameters (out):	None	
Return value:	Std_ReturnType	E_OK: Request successful E_NOT_OK: Request Failed E_BUSY: Request Failed, Crypto Driver Object is Busy CRYPTO_E_KEY_NOT_AVAILABLE: Request failed, the requested key element is not available CRYPTO_E_KEY_READ_FAIL: Request failed, not allowed to extract key element CRYPTO_E_KEY_WRITE_FAIL: Request failed, not allowed to write key element. CRYPTO_E_KEY_SIZE_MISMATCH: Request failed, key element sizes are not compatible.
Description:	Copies a key element to another key element in the same crypto driver. Note: If the actual key element is directly mapped to flash memory, there could be a bigger delay when calling this function (synchronous operation)	

⌋ ()

[SWS_Crypto_00149] ⌈ If the Crypto Driver is not yet initialized and if default error detection for the Crypto Driver is enabled, the function `Crypto_KeyElementCopy` shall report `CRYPTO_E_UNINIT` to the DET and return `E_NOT_OK`.
⌋()

[SWS_Crypto_00150] ⌈ If `cryptoKeyId` is out of range and if default error detection for the Crypto Driver is enabled, the function `Crypto_KeyElementCopy` shall report `CRYPTO_E_PARAM_HANDLE` to the DET and return `E_NOT_OK`.
⌋()

[SWS_Crypto_00151] ⌈ If `targetCryptoKeyId` is out of range and if default error detection for the Crypto Driver is enabled, the function `Crypto_KeyElementCopy` shall report `CRYPTO_E_PARAM_HANDLE` to the DET and return `E_NOT_OK`.
⌋()

[SWS_Crypto_00152] ⌈ If parameter `keyElementId` is out of range and if default error detection for the Crypto Driver is enabled, the function

Crypto_KeyElementCopy shall report CRYPTO_E_PARAM_HANDLE to the DET and return E_NOT_OK.
⌋()

[SWS_Crypto_00153] ⌈ If parameter targetKeyElementId is out of range and if default error detection for the Crypto Driver is enabled, the function Crypto_KeyElementCopy shall report CRYPTO_E_PARAM_HANDLE to the DET and return E_NOT_OK.
⌋()

[SWS_Crypto_00154] If no errors are detected by the Crypto Driver, the function shall copy the key element referenced by keyElementId in the key referenced by cryptoKeyId to the key element referenced by targetKeyElementId in the key referenced by targetCryptoKeyId.

8.2.4.3.2 Crypto_KeyCopy

[SWS_Crypto_00155] ⌈

Service name:	Crypto_KeyCopy	

Syntax:	`Std_ReturnType Crypto_KeyCopy(`
	`    uint32 cryptoKeyId,`
	`    uint32 targetCryptoKeyId`
	`)`	

Service ID[hex]:	0x10	
Sync/Async:	Synchronous	
Reentrancy:	Reentrant, but not for the same cryptoKeyId	
Parameters (in):	cryptoKeyId	Holds the identifier of the key whose key element shall be the source element.
	targetCryptoKeyId	Holds the identifier of the key whose key element shall be the destination element.
Parameters (inout):	None	
Parameters (out):	None	
Return value:	Std_ReturnType	E_OK: Request successful E_NOT_OK: Request Failed E_BUSY: Request Failed, Crypto Driver Object is Busy CRYPTO_E_KEY_NOT_AVAILABLE: Request failed, the requested key element is not available CRYPTO_E_KEY_READ_FAIL: Request failed, not allowed to extract key element CRYPTO_E_KEY_WRITE_FAIL: Request failed, not allowed to write key element. CRYPTO_E_KEY_SIZE_MISMATCH: Request failed, key element sizes are not compatible.
Description:	Copies a key with all its elements to another key in the same crypto driver. Note: If the actual key element is directly mapped to flash memory, there could be a bigger delay when calling this function (synchronous operation)	

⌋ ()

[SWS_Crypto_00156] ⌈ If the Crypto Driver is not yet initialized and if default error detection for the Crypto Driver is enabled, the function Crypto_KeyCopy shall report CRYPTO_E_UNINIT to the DET and return E_NOT_OK.
⌋()

[SWS_Crypto_00157] ⌈ If `cryptoKeyId` is out of range and if default error detection for the Crypto Driver is enabled, the function `Crypto_KeyCopy` shall report `CRYPTO_E_PARAM_HANDLE` to the DET and return `E_NOT_OK`.
⌋()

[SWS_Crypto_00158] ⌈ If `targetCryptoKeyId` is out of range and if default error detection for the Crypto Driver is enabled, the function `Crypto_KeyCopy` shall report `CRYPTO_E_PARAM_HANDLE` to the DET and return `E_NOT_OK`.
⌋()

[SWS_Crypto_00159] If no errors are detected by the Crypto Driver, the function shall copy all key elements in the key referenced by `cryptoKeyId` to the key the key referenced by `targetCryptoKeyId`.
⌋()

8.2.4.3.3 Crypto_KeyElementIdsGet

[SWS_Crypto_00160] ⌈

Service name:	Crypto_KeyElementIdsGet	

Syntax:	`Std_ReturnType Crypto_KeyElementIdsGet(`
	`    uint32 cryptoKeyId,`
	`    uint32* keyElementIdsPtr,`
	`    uint32* keyElementIdsLengthPtr`
	`)`	

Service ID[hex]:	0x11	
Sync/Async:	Synchronous	
Reentrancy:	Reentrant, but not for the same cryptoKeyId	
Parameters (in):	cryptoKeyId	Holds the identifier of the key whose available element ids shall be exported.
	keyElementIdsLengthPtr	Holds a pointer to the memory location in which the number of key elements in the given key is stored. On calling this function, this parameter shall contain the size of the buffer provided by keyElementIdsPtr. When the request has finished, the actual number of key elements shall be stored.
Parameters (inout):	None	
Parameters (out):	keyElementIdsPtr	Contains the pointer to the array where the ids of the key elements shall be stored.
Return value:	Std_ReturnType	E_OK: Request successful E_NOT_OK: Request Failed E_BUSY: Request Failed, Crypto Driver Object is Busy CRYPTO_E_SMALL_BUFFER: The provided buffer is too small to store the result
Description:	Used to retrieve information which key elements are available in a given key.	

⌋ ()

[SWS_Crypto_00161] ⌈ If the Crypto Driver is not yet initialized and if default error detection for the Crypto Driver is enabled, the function `Crypto_KeyElementIdsGet` shall report `CRYPTO_E_UNINIT` to the DET and return `E_NOT_OK`.
⌋()

[SWS_Crypto_00162] ⌈ If `cryptoKeyId` is out of range and if default error detection for the Crypto Driver is enabled, the function `Crypto_KeyElementIdsGet` shall report `CRYPTO_E_PARAM_HANDLE` to the DET and return `E_NOT_OK`.
⌋()

[SWS_Crypto_00163] ⌈ If the value, which is pointed by `keyElementIdsLengthPtr` is smaller than the number of key elements in the key and if default error detection for the Crypto Driver is enabled, the function `Crypto_KeyElementIdsGet` shall report `CRYPTO_E_PARAM_HANDLE` to the DET and return `E_NOT_OK`.
⌋()

[SWS_Crypto_00164] ⌈ If the buffer `keyElementIdsPtr` is too small to store the result of the request, `CRYPTO_E_SMALL_BUFFER` shall be returned and if default error detection is enabled, `CRYPTO_E_SMALL_BUFFER` shall be reported to the DET.
⌋()

If no errors are detected by the Crypto Driver, the function stores all ids of the key elements available in the key identified by `cryptoKeyId` to an array provided by `keyElementIdsPtr`. It also stores the number of elements to the value, which is pointed by `keyElementIdsLengthPtr`.

Note: This function is needed by the CRYIF when a whole key should be copied from one Crypto Driver to another Crypto Driver by the CRYIF.

8.2.4.4 Key Generation Interface

8.2.4.4.1 Crypto_RandomSeed

[SWS_Crypto_91013] ⌈

Service name:	Crypto_RandomSeed	

Syntax:	`Std_ReturnType Crypto_RandomSeed(`
	`    uint32 cryptoKeyId,`
	`    const uint8* entropyPtr,`
	`    uint32 entropyLength`
	`)`	

Service ID[hex]:	0x0d	
Sync/Async:	Synchronous	
Reentrancy:	Reentrant, but not for the same cryptoKeyId	
Parameters (in):	cryptoKeyId	Holds the identifier of the key for which a new seed shall be generated.
	entropyPtr	Holds a pointer to the memory location which contains the data to feed the entropy
	entropyLength	Contains the length of the entropy in bytes
Parameters (inout):	None	
Parameters (out):	None	
Return value:	Std_ReturnType	E_OK: Request successful E_NOT_OK: Request Failed
Description:	This function generates the internal seed state using the provided entropy source. Furthermore, this function can be used to update the seed state with new entropy	

⌋ ()

[SWS_Crypto_00128] ⌈ If the module is not yet initialized and if default error detection for the Crypto Driver is enabled, the function `Crypto_RandomSeed` shall report `CRYPTO_E_UNINIT` to the DET and return `E_NOT_OK`.
⌋()

[SWS_Crypto_00129] ⌈ If the parameter `cryptoKeyId` is out of range and if default error detection for the Crypto Driver is enabled, the function `Crypto_RandomSeed` shall report `CRYPTO_E_PARAM_HANDLE` to the DET and return `E_NOT_OK`.
⌋()

[SWS_Crypto_00130] ⌈ If the parameter `seedPtr` is a null pointer and if default error detection for the Crypto Driver is enabled, the function `Crypto_RandomSeed` shall report `CRYPTO_E_PARAM_POINTER` to the DET and return `E_NOT_OK`.
⌋()

[SWS_Crypto_00131] ⌈ If `seedLength` is zero and if default error detection for the Crypto Driver is enabled, the function `Crypto_RandomSeed` shall report `CRYPTO_E_PARAM_VALUE` to the DET and return `E_NOT_OK`.
⌋()

If no errors are detected by Crypto Driver, the service `Crypto_RandomSeed()` feeds the given key with a seed state derived from the entropy source. The internal state of the random generator is stored in the key element `CRYPTO_KE_RANDOM_SEED`.

8.2.4.4.2 Crypto_KeyGenerate

[SWS_Crypto_91007] ⌈

Service name:	Crypto_KeyGenerate	

Syntax:	`Std_ReturnType Crypto_KeyGenerate(`
	`    uint32 cryptoKeyId`
	`)`	

Service ID[hex]:	0x07	
Sync/Async:	Synchronous	
Reentrancy:	Reentrant, but not for the same cryptoKeyId	
Parameters (in):	cryptoKeyId	Holds the identifier of the key which is to be updated with the generated value.
Parameters (inout):	None	
Parameters (out):	None	
Return value:	Std_ReturnType	E_OK: Request successful E_NOT_OK: Request Failed E_BUSY: Request Failed, Crypto Driver Object is Busy
Description:	Generates new key material store it in the key identified by cryptoKeyId.	

⌋ ()

[SWS_Crypto_00094] ⌈ If the module is not yet initialized and if default error detection for the Crypto Driver is enabled, the function `Crypto_KeyGenerate` shall report `CRYPTO_E_UNINIT` to the DET and return `E_NOT_OK`.
⌋()

[SWS_Crypto_00095] ⌈ If the parameter `cryptoKeyId` is out of range and if default error detection for the Crypto Driver is enabled, the function `Crypto_KeyGenerate` shall report `CRYPTO_E_PARAM_HANDLE` to the DET and return `E_NOT_OK`.
⌋()

[SWS_Crypto_00165] ⌈ If no errors are detected by Crypto Driver, the service `Crypto_KeyGenerate()` generates the corresponding key.
⌋()

8.2.4.5 Key Derivation Interface

8.2.4.5.1 Crypto_KeyDerive

[SWS_Crypto_91008] ⌈

Service name:	Crypto_KeyDerive	

Syntax:	`Std_ReturnType Crypto_KeyDerive(`
	`    uint32 cryptoKeyId,`
	`    uint32 targetCryptoKeyId`
	`)`	

Service ID[hex]:	0x08	
Sync/Async:	Synchronous	
Reentrancy:	Reentrant, but not for the same cryptoKeyId	
Parameters (in):	cryptoKeyId	Holds the identifier of the key which is used for key derivation.
	targetCryptoKeyId	Holds the identifier of the key which is used to store the derived key.
Parameters (inout):	None	
Parameters (out):	None	
Return value:	Std_ReturnType	E_OK: Request successful E_NOT_OK: Request Failed E_BUSY: Request Failed, Crypto Driver Object is Busy
Description:	Derives a new key by using the key elements in the given key identified by the cryptoKeyId. The given key contains the key elements for the password, salt. The derived key is stored in the key element with the id 1 of the key identified by targetCryptoKeyId. The number of iterations is given in the key element CRYPTO_KE_KEYDERIVATION_ITERATIONS.	

⌋ ()

[SWS_Crypto_00097] ⌈ If the module is not yet initialized and if default error detection for the Crypto Driver is enabled, the function `Crypto_KeyDerive` shall report `CRYPTO_E_UNINIT` to the DET and return `E_NOT_OK`.
⌋()

[SWS_Crypto_00098] ⌈ If the parameter `cryptoKeyId` is out of range and if default error detection for the Crypto Driver is enabled, the function `Crypto_KeyDerive` shall report `CRYPTO_E_PARAM_HANDLE` to the DET and return `E_NOT_OK`.
⌋()

[SWS_Crypto_00166] ⌈ If no errors are detected by Crypto Driver, the service `Crypto_KeyDerive()` derives a key element with the aid of a salt and a password.
⌋()

The key derivation service needs a salt and password to derivate a new key. The salt and the password therefore are stored as key elements in the key referred by `cryptoKeyId`.

8.2.4.6 Key Exchange Interface

8.2.4.6.1 Crypto_KeyExchangeCalcPubVal

[SWS_Crypto_91009] ⌈

Service name:	Crypto_KeyExchangeCalcPubVal	

Syntax:	`Std_ReturnType Crypto_KeyExchangeCalcPubVal(`
	`    uint32 cryptoKeyId,`
	`    uint8* publicValuePtr,`
	`    uint32* publicValueLengthPtr`
	`)`	

Service ID[hex]:	0x09	
Sync/Async:	Synchronous	
Reentrancy:	Reentrant, but not for the same cryptoKeyId	
Parameters (in):	cryptoKeyId	Holds the identifier of the key which shall be used for the key exchange protocol.
Parameters (inout):	publicValueLengthPtr	Holds a pointer to the memory location in which the public value length information is stored. On calling this function, this parameter shall contain the size of the buffer provided by publicValuePtr. When the request has finished, the actual length of the returned value shall be stored.
Parameters (out):	publicValuePtr	Contains the pointer to the data where the public value shall be stored.
Return value:	Std_ReturnType	E_OK: Request successful E_NOT_OK: Request Failed E_BUSY: Request Failed, Crypto Driver Object is Busy CRYPTO_E_SMALL_BUFFER: The provided buffer is too small to store the result
Description:	Calculates the public value for the key exchange and stores the public key in the memory location pointed by the public value pointer.	

⌋ ()

[SWS_Crypto_00103] ⌈ If the module is not yet initialized and if default error detection for the Crypto Driver is enabled: The function `Crypto_KeyExchangeCalcPubVal` shall report `CRYPTO_E_UNINIT` to the DET and return `E_NOT_OK`.
⌋()

[SWS_Crypto_00104] ⌈ If the parameter `cryptoKeyId` is out of range and if default error detection for the Crypto Driver is enabled, the function `Crypto_KeyExchangeCalcPubVal` shall report `CRYPTO_E_PARAM_HANDLE` to the DET and return `E_NOT_OK`.
⌋()

[SWS_Crypto_00105] ⌈ If the parameter `publicValuePtr` is a null pointer and if default error detection for the Crypto Driver is enabled, the function

Crypto_KeyExchangeCalcPubVal shall report CRYPTO_E_PARAM_POINTER to the DET and return E_NOT_OK.
⌋()

[SWS_Crypto_00106] ⌈ If the parameter pubValueLengthPtr is a null pointer and if default error detection for the Crypto Driver is enabled, the function Crypto_KeyExchangeCalcPubVal shall report CRYPTO_E_PARAM_POINTER to the DET and return E_NOT_OK.
⌋()

[SWS_Crypto_00107] ⌈ If the value, which is pointed by pubValueLengthPtr is zero and if default error detection for the Crypto Driver is enabled, the function Crypto_KeyExchangeCalcPubVal shall report CRYPTO_E_PARAM_VALUE to the DET and return E_NOT_OK.
⌋()

[SWS_Crypto_00167] ⌈ If no errors are detected by Crypto Driver, the service Crypto_KeyExchangeCalcPubVal() calculates the public value of the current job for the key exchange.
⌋()

[SWS_Crypto_00109] ⌈ The pointer publicValuePtr holds the memory location, where the data of the public value shall be stored. On calling this function, publicValueLengthPtr shall contain the size of the buffer provided by publicValuePtr. When the request has finished, the actual length of the returned value shall be stored.
⌋()

[SWS_Crypto_00110] ⌈ If the buffer publicValuePtr is too small to store the result of the request, CRYPTO_E_SMALL_BUFFER shall be returned and if default error detection is enabled, CRYPTO_E_RE_SMALL_BUFFER shall be reported to the DET.
⌋()

8.2.4.6.2 Crypto_KeyExchangeCalcSecret

[SWS_Crypto_91010] ⌈

Service name:	Crypto_KeyExchangeCalcSecret	
Syntax:	Std_ReturnType Crypto_KeyExchangeCalcSecret(uint32 cryptoKeyId, const uint8* partnerPublicValuePtr, uint32 partnerPublicValueLength)	
Service ID[hex]:	0x0a	
Sync/Async:	Synchronous	
Reentrancy:	Reentrant, but not for the same cryptoKeyId	
Parameters (in):	cryptoKeyId	Holds the identifier of the key which shall be used for the key exchange protocol.
	partnerPublicValuePtr	Holds the pointer to the memory location which contains the partner's public value.
	partnerPublicValueLength	Contains the length of the partner's public value in bytes.

Parameters (inout):	None	
Parameters (out):	None	
Return value:	Std_ReturnType	E_OK: Request successful E_NOT_OK: Request Failed E_BUSY: Request Failed, Crypto Driver Object is Busy CRYPTO_E_SMALL_BUFFER: The provided buffer is too small to store the result
Description:	Calculates the shared secret key for the key exchange with the key material of the key identified by the cryptoKeyId and the partner public key. The shared secret key is stored as a key element in the same key.	

⌋ ()

[SWS_Crypto_00111] ⌈ If the module is not yet initialized and if default error detection for the Crypto Driver is enabled, the function `Crypto_KeyExchangeCalcSecret` shall report `CRYPTO_E_UNINIT` to the DET and return `E_NOT_OK`.
⌋()

[SWS_Crypto_00112] ⌈ If the parameter `cryptoKeyId` is out of range and if default error detection for the Crypto Driver is enabled, the function `Crypto_KeyExchangeCalcSecret` shall report `CRYPTO_E_PARAM_HANDLE` to the DET and return `E_NOT_OK`
⌋()

[SWS_Crypto_00113] ⌈ If the parameter `partnerPublicValuePtr` is a null pointer and if default error detection for the Crypto Driver is enabled, the function `Crypto_KeyExchangeCalcSecret` shall report `CRYPTO_E_PARAM_POINTER` to the DET and return `E_NOT_OK`.
⌋()

[SWS_Crypto_00115] ⌈ If `partnerPubValueLength` is zero and if default error detection for the Crypto Driver is enabled, the function `Crypto_KeyExchangeCalcSecret` shall report `CRYPTO_E_PARAM_VALUE` to the DET and return `E_NOT_OK`.
⌋()

If no errors are detected by Crypto, the service `Crypto_KeyExchangeCalcSecret()` calculated the shared secret key for the key exchange and store it as key element in `cryptoKeyId`.

8.2.4.7 Certificate Interface

8.2.4.7.1 Crypto_CertificateParse

[SWS_Crypto_91011] ⌈

Service name:	Crypto_CertificateParse

Syntax:	`Std_ReturnType Crypto_CertificateParse(`
	`    uint32 cryptoKeyId`
	`)`

Service ID[hex]:	0x0b
Sync/Async:	Synchronous

Reentrancy:	Reentrant, but not for the same cryptoKeyId	
Parameters (in):	cryptoKeyId	Holds the identifier of the key which shall be parsed.
Parameters (inout):	None	
Parameters (out):	None	
Return value:	Std_ReturnType	E_OK: Request successful E_NOT_OK: Request Failed E_BUSY: Request Failed, Crypto Driver Object is Busy
Description:	Parses the certificate data stored in the key element CRYPTO_KE_CERT_DATA and fills the key elements CRYPTO_KE_CERT_SIGNEDDATA, CRYPTO_KE_CERT_PARSEDPUBLICKEY and CRYPTO_KE_CERT_SIGNATURE.	

⌋ ()

[SWS_Crypto_00168] ⌈ If the module is not yet initialized and if default error detection for the Crypto Driver is enabled, the function `Crypto_CertificateParse` shall report `CRYPTO_E_UNINIT` to the DET and return `E_NOT_OK`.
⌋()

[SWS_Crypto_00169] ⌈ If the parameter `cryptoKeyId` is out of range and if default error detection for the Crypto Driver is enabled, the function `Crypto_CertificateParse` shall report `CRYPTO_E_PARAM_HANDLE` to the DET and return `E_NOT_OK`.
⌋()

[SWS_Crypto_00170] ⌈ If no errors are detected by Crypto Driver, the service `Crypto_CertificateParse()` parses the certificate which is stored in the certificate data element and fills at least the key elements `CRYPTO_KE_CERT_SIGNEDDATA, CRYPTO_KE_CERT_PARSEDPUBLICKEY` and `CRYPTO_KE_CERT_SIGNATURE` with the corresponding data.
⌋()

Note: These key elements may be virtual and point with an offset to the certificate data, which is stored in the key element `CRYPTO_KE_CERT_DATA`, in order to save memory. The offset can not be read or written by the CRYIF.

8.2.4.7.2 Crypto_CertificateVerify

[SWS_Crypto_00171] ⌈

Service name:	Crypto_CertificateVerify	

Syntax:	`Std_ReturnType Crypto_CertificateVerify(`
	`    uint32 cryptoKeyId,`
	`    uint32 verifyCryptoKeyId,`
	`    Crypto_VerifyResultType* verifyPtr`
	`)`	

Service ID[hex]:	0x12	
Sync/Async:	Synchronous	
Reentrancy:	Reentrant, but not for the same cryptoKeyId	
Parameters (in):	cryptoKeyId	Holds the identifier of the key which shall be used to validate the certificate.

	verifyCryptoKeyId	Holds the identifier of the key contain
Parameters (inout):	None	
Parameters (out):	verifyPtr	Holds a pointer to the memory location which will contain the result of the certificate verification.
Return value:	Std_ReturnType	E_OK: Request successful E_NOT_OK: Request Failed E_BUSY: Request Failed, Crypto Driver Object is Busy
Description:	Verifies the certificate stored in the key referenced by cryptoValidateKeyId with the certificate stored in the key referenced by cryptoKeyId.	

⌋ ()

[SWS_Crypto_00172] ⌈ If the module is not yet initialized and if default error detection for the Crypto Driver is enabled, the function `Crypto_CertificateVerify` shall report `CRYPTO_E_UNINIT` to the DET and return `E_NOT_OK`.
⌋()

[SWS_Crypto_00173] ⌈ If the parameter `cryptoKeyId` is out of range and if default error detection for the Crypto Driver is enabled, the function `Crypto_CertificateVerify` shall report `CRYPTO_E_PARAM_HANDLE` to the DET and return `E_NOT_OK`.
⌋()

[SWS_Crypto_00174] ⌈ If the parameter `validateCryptoKeyId` is out of range and if default error detection for the Crypto Driver is enabled, the function `Crypto_CertificateVerify` shall report `CRYPTO_E_PARAM_HANDLE` to the DET and return `E_NOT_OK`.
⌋()

[SWS_Crypto_00175] ⌈ If the parameter `verifyPtr` is a null pointer and if default error detection for the Crypto Driver is enabled, the function `Crypto_CertificateVerify` shall report `CRYPTO_E_PARAM_POINTER` to the DET and return `E_NOT_OK`.
⌋()

[SWS_Crypto_00176] ⌈ If the key element `CRYPTO_KE_CERTIFICATE_CURRENT_TIME` is used during verification and the format of this timestamp does not match with the format of the timestamp of the certificate, the function `Crypto_CertificateVerify` shall report `CRYPTO_E_PARAM_HANDLE` to the DET and return `E_NOT_OK`.
⌋()

[SWS_Crypto_00177] ⌈ If no errors are detected by Crypto Driver, the service `Crypto_CertificateVerify()` uses the key element `CRYPTO_KE_CERT_PARSEDPUBLICKEY` of the key referenced by `cryptoKeyId` to do a signature verification. The data contained in the key element `CRYPTO_KE_CERT_SIGNEDDATA` and the signature contained in the key element `CRYPTO_KE_CERT_SIGNATURE` shall be available in the key referenced by `verifyCryptoKeyId`.
⌋()

[SWS_Crypto_00178] ⌈ If certificate identified by `verifyCryptoKeyId` is verified successfully, the key identified by `validateCryptoKeyId` shall be set to valid.
⌋()

Note: The Function may also do further certificate validation by checking if the current time is in the validity period of the certificate and if the issuer of the key referenced by `validateCryptoKeyId` is the same as the subject in the key referenced by `cryptoKeyId`.

8.3 Scheduled functions

8.3.1.1 Crypto_MainFunction

The `Crypto_MainFunction()` is necessary for asynchronous job processing.

[SWS_Crypto_91012] ⌈

Service name:	Crypto_MainFunction

Syntax:	`void Crypto_MainFunction(`
	`    void`
	`)`

Service ID[hex]:	0x0c
Description:	If asynchronous job processing is configured and there are job queues, the function is called cyclically to process queued jobs.

⌋ ()

8.4 Expected Interfaces

In this section, all interfaces required from other modules are listed.

8.4.1 Interfaces to Standard Software Modules

[SWS_Crypto_00126] ⌈ The Crypto Driver shall use an AUTOSAR DET module for development error notification.
⌋()

8.4.2 Mandatory Interfaces

API function	***Description***

8.4.3 Optional Interfaces

9

API function	Description

10 Sequence diagrams

n/a

11 Configuration specification

Chapter 10.1 specifies the structure (containers) and the parameters of the module Crypto.

Chapter 10.2 specifies additionally published information of the module Crypto.

11.1 Containers and configuration parameters

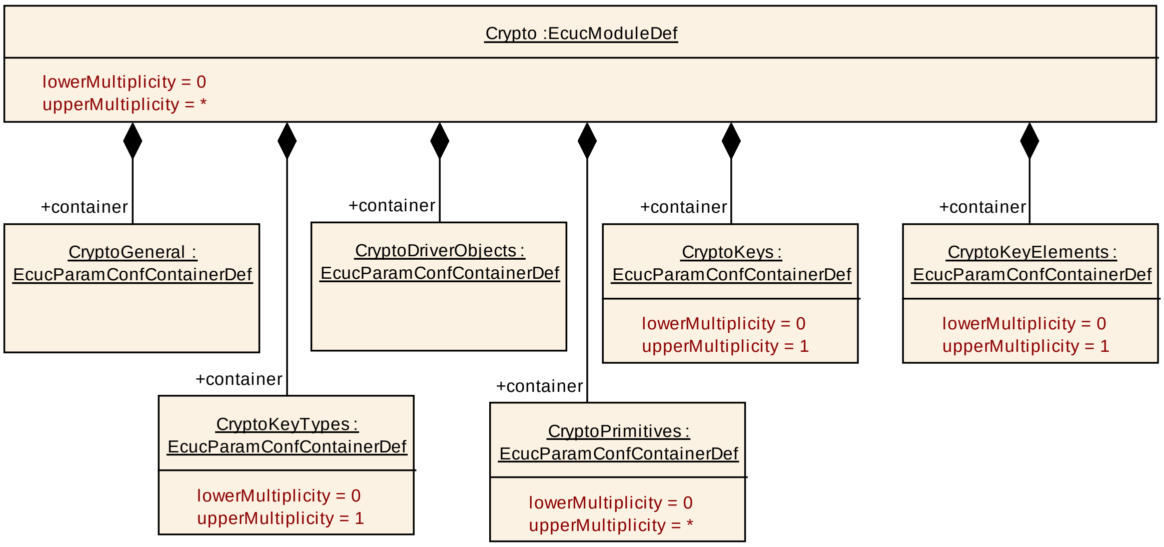
The following chapters summarize all configuration parameters. The detailed meanings of the parameters describe Chapters 7 and Chapter 8.

Note: The Ids in the configuration containers shall be consecutive, gapless and shall start from zero.

11.1.1 Crypto

SWS Item	**ECUC_Crypto_00001 :**
Module Name	*Crypto*
Module Description	Configuration of the Crypto (CryptoDriver) module
Post-Build Variant Support	false
Supported Config Variants	VARIANT-PRE-COMPILE

Included Containers		
Container Name	***Multiplicity***	***Scope / Dependency***
CryptoDriverObjects	1	Container for CRYPTO Objects
CryptoGeneral	1	Container for common configuration options
CryptoKeyElements	0..1	Container for Crypto key elements
CryptoKeyTypes	0..1	Container for CRYPTO key types
CryptoKeys	0..1	Container for CRYPTO keys
CryptoPrimitives	0..*	Container for CRYPTO primitives



11.1.2 CryptoGeneral

SWS Item	**ECUC_Crypto_00002 :**		
Container Name	CryptoGeneral		
Description	Container for common configuration options		
Post-Build Variant Multiplicity	false		
Multiplicity Configuration Class	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Configuration Parameters			

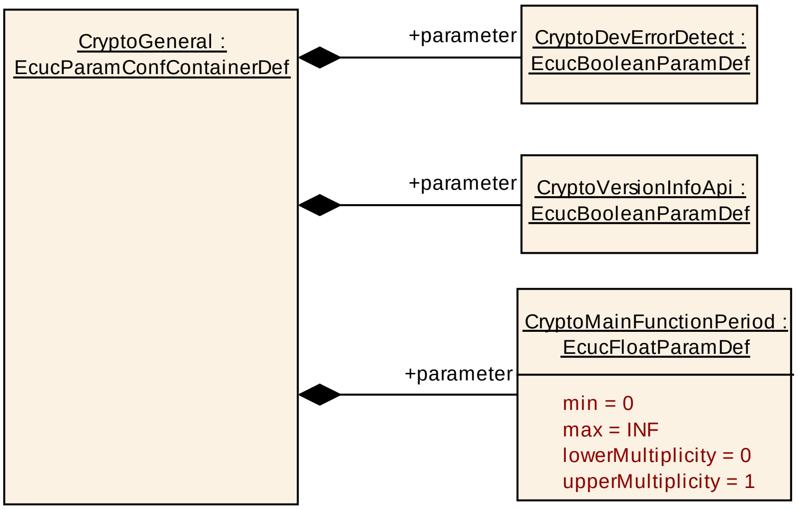
SWS Item	**ECUC_Crypto_00006 :**		
Name	CryptoDevErrorDetect		
Description	Switches the development error detection and notification on or off. true: detection and notification is enabled. false: detection and notification is disabled		
Multiplicity	1		
Type	EcucBooleanParamDef		
Default value	--		
Multiplicity Configuration Class	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Value Configuration Class	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: local		

SWS Item	**ECUC_Crypto_00038 :**		
Name	CryptoMainFunctionPeriod		
Description	Specifies the period of main function Crypto_MainFunction in seconds.		
Multiplicity	0..1		
Type	EcucFloatParamDef		
Range	]0 .. INF[		
Default value	--		
Multiplicity Configuration Class	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Value Configuration Class	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: local		

SWS Item	**ECUC_Crypto_00007 :**		
Name	CryptoVersionInfoApi		
Description	Pre-processor switch to enable and disable availability of the API Crypto_GetVersionInfo(). True: API Crypto_GetVersionInfo() is available False: API Cryptosm_GetVersionInfo() is not available.		
Multiplicity	1		
Type	EcucBooleanParamDef		
Default value	--		
Multiplicity Configuration Class	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Value Configuration Class	***Pre-compile time***	X	All Variants

	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: local		

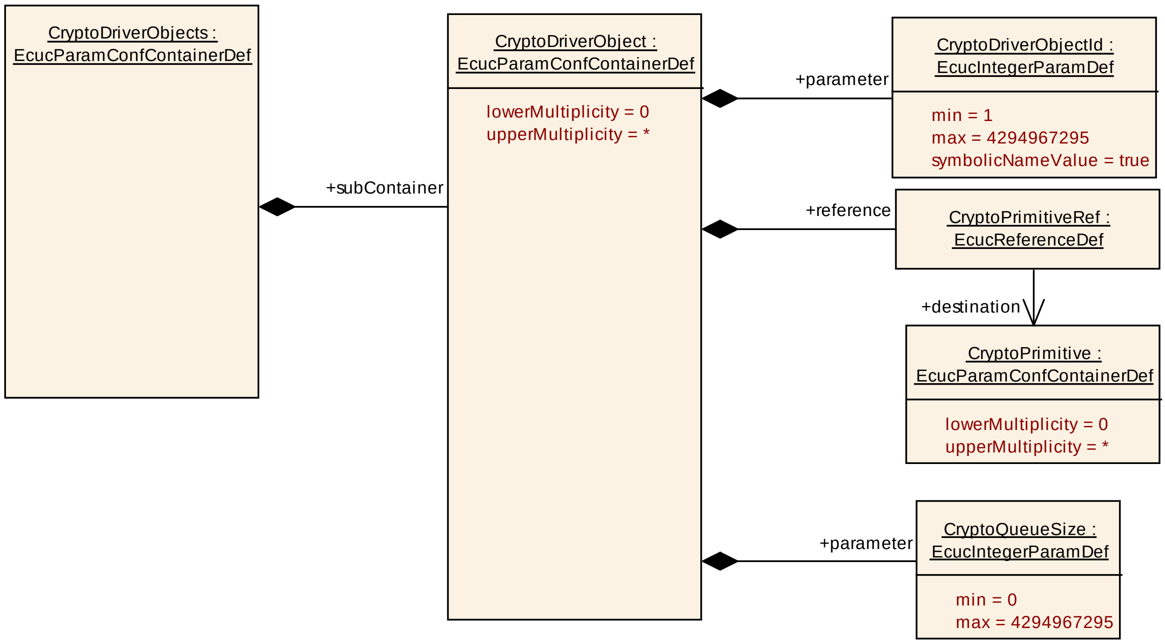
No Included Containers



11.1.3 CryptoDriverObjects

SWS Item	**ECUC_Crypto_00003 :**		
Container Name	CryptoDriverObjects		
Description	Container for CRYPTO Objects		
Post-Build Variant Multiplicity	false		
Multiplicity Configuration Class	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Configuration Parameters			

Included Containers		
Container Name	***Multiplicity***	***Scope / Dependency***
CryptoDriverObject	0..*	Configuration of a CryptoDriverObject


CryptoDriverObjects : EcucParamConfContainerDef
+subContainer
CryptoDriverObject : EcucParamConfContainerDef
lowerMultiplicity = 0
upperMultiplicity = *
+parameter
CryptoDriverObjectId : EcucIntegerParamDef
min = 1
max = 4294967295
symbolicNameValue = true
+reference
CryptoPrimitiveRef : EcucReferenceDef
+destination
CryptoPrimitive : EcucParamConfContainerDef
lowerMultiplicity = 0
upperMultiplicity = *
+parameter
CryptoQueueSize : EcucIntegerParamDef
min = 0
max = 4294967295

11.1.4 CryptoDriverObject

SWS Item	**ECUC_Crypto_00008 :**
Container Name	CryptoDriverObject
Description	Configuration of a CryptoDriverObject
Configuration Parameters	

SWS Item	**ECUC_Crypto_00009 :**		
Name	CryptoDriverObjectId		
Description	Identifier of the Crypto Driver Object. The Crypto Driver Object offers different crypto primitives.		
Multiplicity	1		
Type	EcucIntegerParamDef (Symbolic Name generated for this parameter)		
Range	1 .. 4294967295		
Default value	--		
Post-Build Variant Multiplicity	false		
Post-Build Variant Value	false		
Multiplicity Configuration Class	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Value Configuration Class	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: local		

SWS Item	**ECUC_Crypto_00019 :**
Name	CryptoQueueSize
Description	Size of the queue in the Crypto Driver. Defines the maximum number of jobs in the Crypto Driver Object queue. If it is set to 0, queueing is disabled in the Crypto Driver Object.
Multiplicity	1
Type	EcucIntegerParamDef

Range	0 .. 4294967295		
Default value	--		
Multiplicity Configuration Class	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Value Configuration Class	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: local		

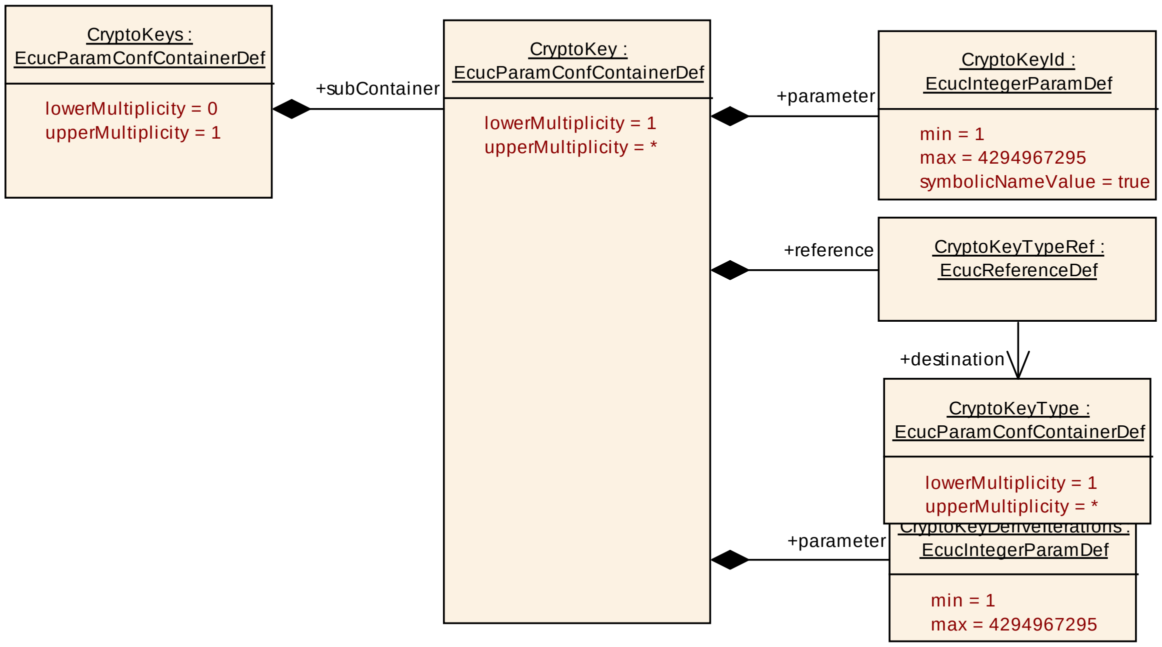
SWS Item	**ECUC_Crypto_00018 :**		
Name	CryptoPrimitiveRef		
Description	Refers to primitive in the CRYPTO. The CryptoPrimitive is a pre-configured container of the crypto service that shall be used.		
Multiplicity	1		
Type	Reference to [CryptoPrimitive]		
Post-Build Variant Multiplicity	false		
Post-Build Variant Value	false		
Multiplicity Configuration Class	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Value Configuration Class	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: local		

No Included Containers

11.1.5 CryptoKeys

SWS Item	**ECUC_Crypto_00004 :**
Container Name	CryptoKeys
Description	Container for CRYPTO keys
Configuration Parameters	

Included Containers		
Container Name	***Multiplicity***	***Scope / Dependency***
CryptoKey	1..*	Configuration of a CryptoKey



11.1.6 CryptoKey

SWS Item	**ECUC_Crypto_00011 :**		
Container Name	CryptoKey		
Description	Configuration of a CryptoKey		
Post-Build Variant Multiplicity	false		
Multiplicity Configuration Class	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Configuration Parameters			

SWS Item	**ECUC_Crypto_00015 :**		
Name	CryptoKeyDeriveIterations		
Description	Holds the number of iterations to be performed by the key derivation primitive		
Multiplicity	1		
Type	EcucIntegerParamDef		
Range	1 .. 4294967295		
Default value	--		
Post-Build Variant Multiplicity	false		
Post-Build Variant Value	false		
Multiplicity Configuration Class	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Value Configuration Class	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: local		

SWS Item	**ECUC_Crypto_00012 :**		
Name	CryptoKeyId		
Description	Identifier of the CRYPTO Key		
Multiplicity	1		
Type	EcucIntegerParamDef (Symbolic Name generated for this parameter)		
Range	1 .. 4294967295		
Default value	--		
Post-Build Variant Multiplicity	false		
Post-Build Variant Value	false		
Multiplicity Configuration Class	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Value Configuration Class	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: local		

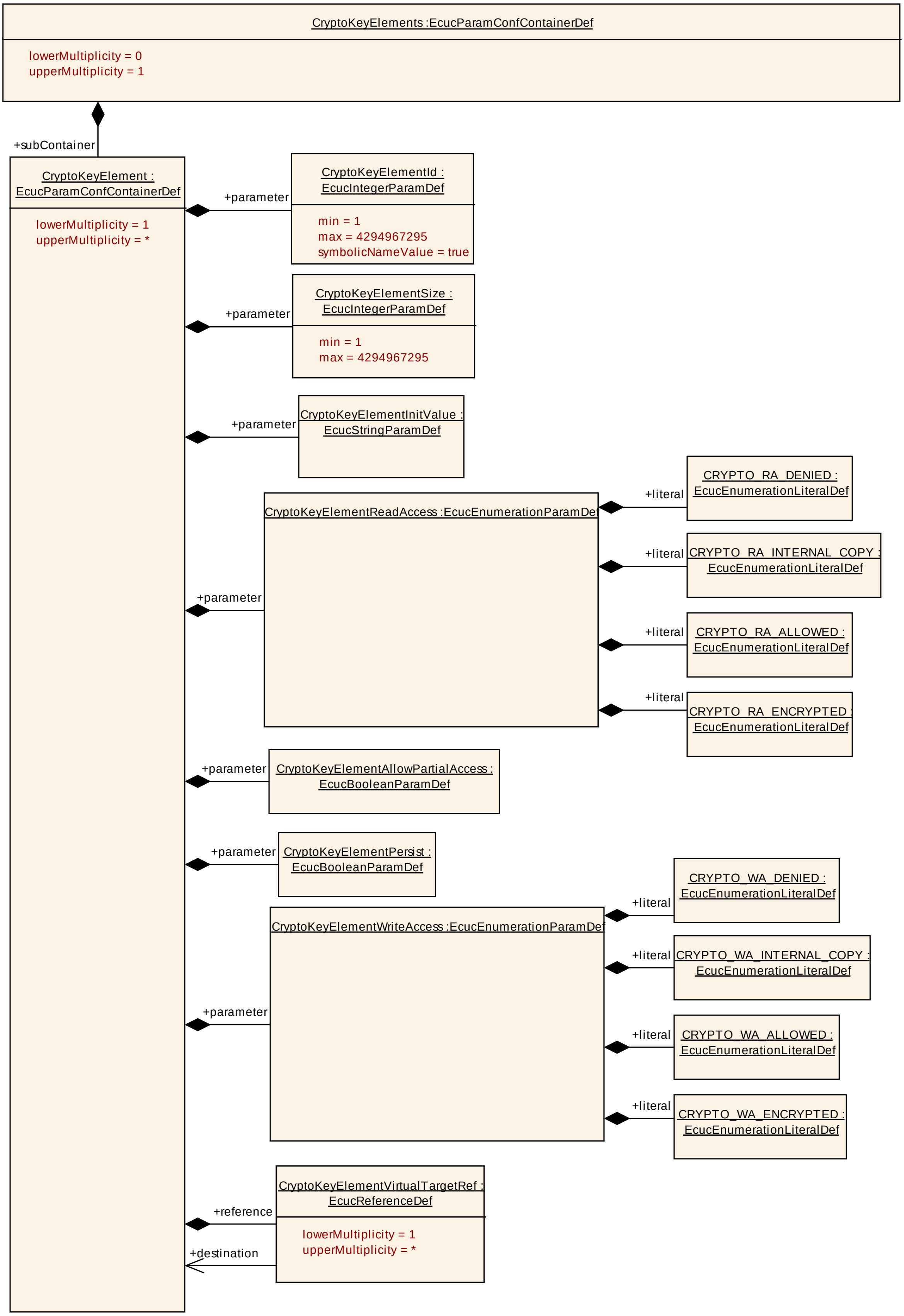
SWS Item	**ECUC_Crypto_00020 :**		
Name	CryptoKeyTypeRef		
Description	Refers to a pointer in the CRYPTOto a CryptoKeyType. The CryptoKeyType provides the information which key elements are contained in a CryptoKey.		
Multiplicity	1		
Type	Reference to [CryptoKeyType]		
Post-Build Variant Multiplicity	false		
Post-Build Variant Value	false		
Multiplicity Configuration Class	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Value Configuration Class	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: local		

No Included Containers

11.1.7 CryptoKeyElements

SWS Item	**ECUC_Crypto_00005 :**
Container Name	CryptoKeyElements
Description	Container for Crypto key elements
Configuration Parameters	

Included Containers		
Container Name	***Multiplicity***	***Scope / Dependency***
CryptoKeyElement	1..*	Configuration of a CryptoKeyElement


CryptoKeyElements :EcucParamConfContainerDef
lowerMultiplicity = 0
upperMultiplicity = 1
+subContainer
CryptoKeyElement : EcucParamConfContainerDef
lowerMultiplicity = 1
upperMultiplicity = *
+parameter
CryptoKeyElementId : EcucIntegerParamDef
min = 1
max = 4294967295
symbolicNameValue = true
+parameter
CryptoKeyElementSize : EcucIntegerParamDef
min = 1
max = 4294967295
+parameter
CryptoKeyElementInitValue : EcucStringParamDef
+parameter
CryptoKeyElementReadAccess :EcucEnumerationParamDef
+literal
CRYPTO_RA_DENIED : EcucEnumerationLiteralDef
+literal
CRYPTO_RA_INTERNAL_COPY : EcucEnumerationLiteralDef
+literal
CRYPTO_RA_ALLOWED : EcucEnumerationLiteralDef
+literal
CRYPTO_RA_ENCRYPTED : EcucEnumerationLiteralDef
+parameter
CryptoKeyElementAllowPartialAccess : EcucBooleanParamDef
+parameter
CryptoKeyElementPersist : EcucBooleanParamDef
+parameter
CryptoKeyElementWriteAccess :EcucEnumerationParamDef
+literal
CRYPTO_WA_DENIED : EcucEnumerationLiteralDef
+literal
CRYPTO_WA_INTERNAL_COPY : EcucEnumerationLiteralDef
+literal
CRYPTO_WA_ALLOWED : EcucEnumerationLiteralDef
+literal
CRYPTO_WA_ENCRYPTED : EcucEnumerationLiteralDef
+reference
CryptoKeyElementVirtualTargetRef : EcucReferenceDef
lowerMultiplicity = 1
upperMultiplicity = *
+destination

11.1.8 CryptoKeyElement

SWS Item	ECUC_Crypto_00014 :
Container Name	CryptoKeyElement
Description	Configuration of a CryptoKeyElement
Configuration Parameters	

SWS Item	ECUC_Crypto_00025 :		
Name	CryptoKeyElementAllowPartialAccess		
Description	Enable or disable writing and reading the key element with data smaller than the size of the element. True: enable partial access of the key element False: disable partial access of the key element		
Multiplicity	1		
Type	EcucBooleanParamDef		
Default value	--		
Multiplicity Configuration Class	Pre-compile time	X	All Variants
	Link time	--	
	Post-build time	--	
Value Configuration Class	Pre-compile time	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: local		

SWS Item	ECUC_Crypto_00021 :		
Name	CryptoKeyElementId		
Description	Identifier of the CRYPTO key element		
Multiplicity	1		
Type	EcucIntegerParamDef (Symbolic Name generated for this parameter)		
Range	1 .. 4294967295		
Default value	--		
Post-Build Variant Multiplicity	false		
Post-Build Variant Value	false		
Multiplicity Configuration Class	Pre-compile time	X	All Variants
	Link time	--	
	Post-build time	--	
Value Configuration Class	Pre-compile time	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: local		

SWS Item	ECUC_Crypto_00023 :		
Name	CryptoKeyElementInitValue		
Description	Value which will be used to fill the element during initialisation, when the element is not already initialized.		
Multiplicity	1		
Type	EcucStringParamDef		
Default value	--		
maxLength	--		
minLength	--		
regularExpression	--		
Multiplicity Configuration Class	Pre-compile time	X	All Variants
	Link time	--	
	Post-build time	--	
Value Configuration Class	Pre-compile time	X	All Variants

	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: local		

SWS Item	**ECUC_Crypto_00026 :**		
Name	CryptoKeyElementPersist		
Description	Enable or disable persisting of the key element in non-volatile storage. True: enable persisting of the key element. False: disable persisting of the key element.		
Multiplicity	1		
Type	EcucBooleanParamDef		
Default value	--		
Multiplicity Configuration Class	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Value Configuration Class	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: local		

SWS Item	**ECUC_Crypto_00024 :**		
Name	CryptoKeyElementReadAccess		
Description	Define the reading access rights of the key element. CRYPTO_RA_DENIED = key element cannot be read from outside the Crypto Driver CRYPTO_RA INTERNAL_COPY = key element can be copied to another key element in the same crypto driver. CRYPTO_RA_ALLOWED = key element can be read as plaintext CRYPTO_RA_ENCRYPTED = key element can be read encrypted. E.g. SHE Ram-Key export.		
Multiplicity	1		
Type	EcucEnumerationParamDef		
Range	CRYPTO_RA_ALLOWED	0x03	
	CRYPTO_RA_DENIED	0x01	
	CRYPTO_RA_ENCRYPTED	0x04	
	CRYPTO_RA_INTERNAL_COPY	0x02	
Multiplicity Configuration Class	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Value Configuration Class	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: local		

SWS Item	**ECUC_Crypto_00022 :**		
Name	CryptoKeyElementSize		
Description	Maximum Size size of a CRYPTO key element in bytes		
Multiplicity	1		
Type	EcucIntegerParamDef		
Range	1 .. 4294967295		
Default value	--		
Post-Build Variant Multiplicity	false		
Post-Build Variant Value	false		
Multiplicity Configuration	***Pre-compile time***	X	All Variants

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

SWS Item	**ECUC_Crypto_00027 :**		
Name	CryptoKeyElementWriteAccess		
Description	Define the writing access rights of the key element CRYPTO_WA_DENIED = key element can not be written from outside the Crypto Driver CRYPTO_WA INTERNAL_COPY = key element can be filled with another key element in the same crypto driver. CRYPTO_WA_ALLOWED = key element can be rwritten as plaintext CRYPTO_WA_ENCRYPTED = key element can be written encrypted. E.g. SHE load key.		
Multiplicity	1		
Type	EcucEnumerationParamDef		
Range	CRYPTO_WA_ALLOWED	0x03	
	CRYPTO_WA_DENIED	0x01	
	CRYPTO_WA_ENCRYPTED	0x04	
	CRYPTO_WA_INTERNAL_COPY	0x02	
Multiplicity Configuration Class	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Value Configuration Class	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: local		

SWS Item	**ECUC_Crypto_00028 :**		
Name	CryptoKeyElementVirtualTargetRef		
Description	Refers to a key element which will contain the actual data. If the Reference is configured, the key element will be a virtual key element.		
Multiplicity	1..*		
Type	Reference to [CryptoKeyElement]		
Post-Build Variant Value	true		
Multiplicity Configuration Class	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Value Configuration Class	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: local		

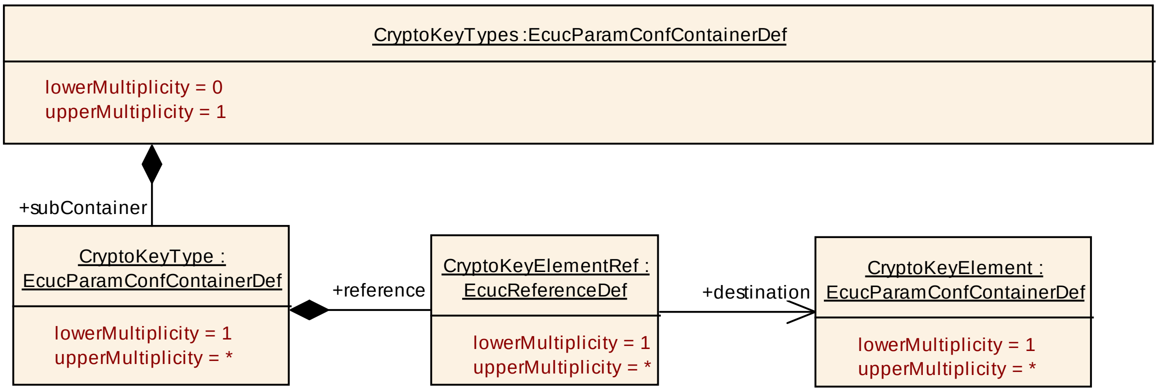
No Included Containers

11.1.9 CryptoKeyTypes

SWS Item	**ECUC_Crypto_00017 :**
Container Name	CryptoKeyTypes

Description	Container for CRYPTO key types		
Post-Build Variant Multiplicity	false		
Multiplicity Configuration Class	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Configuration Parameters			

Included Containers		
Container Name	***Multiplicity***	***Scope / Dependency***
CryptoKeyType	1..*	Configuration of a CryptoKeyType



11.1.10 CryptoKeyType

SWS Item	**ECUC_Crypto_00030 :**
Container Name	CryptoKeyType
Description	Configuration of a CryptoKeyType
Configuration Parameters	

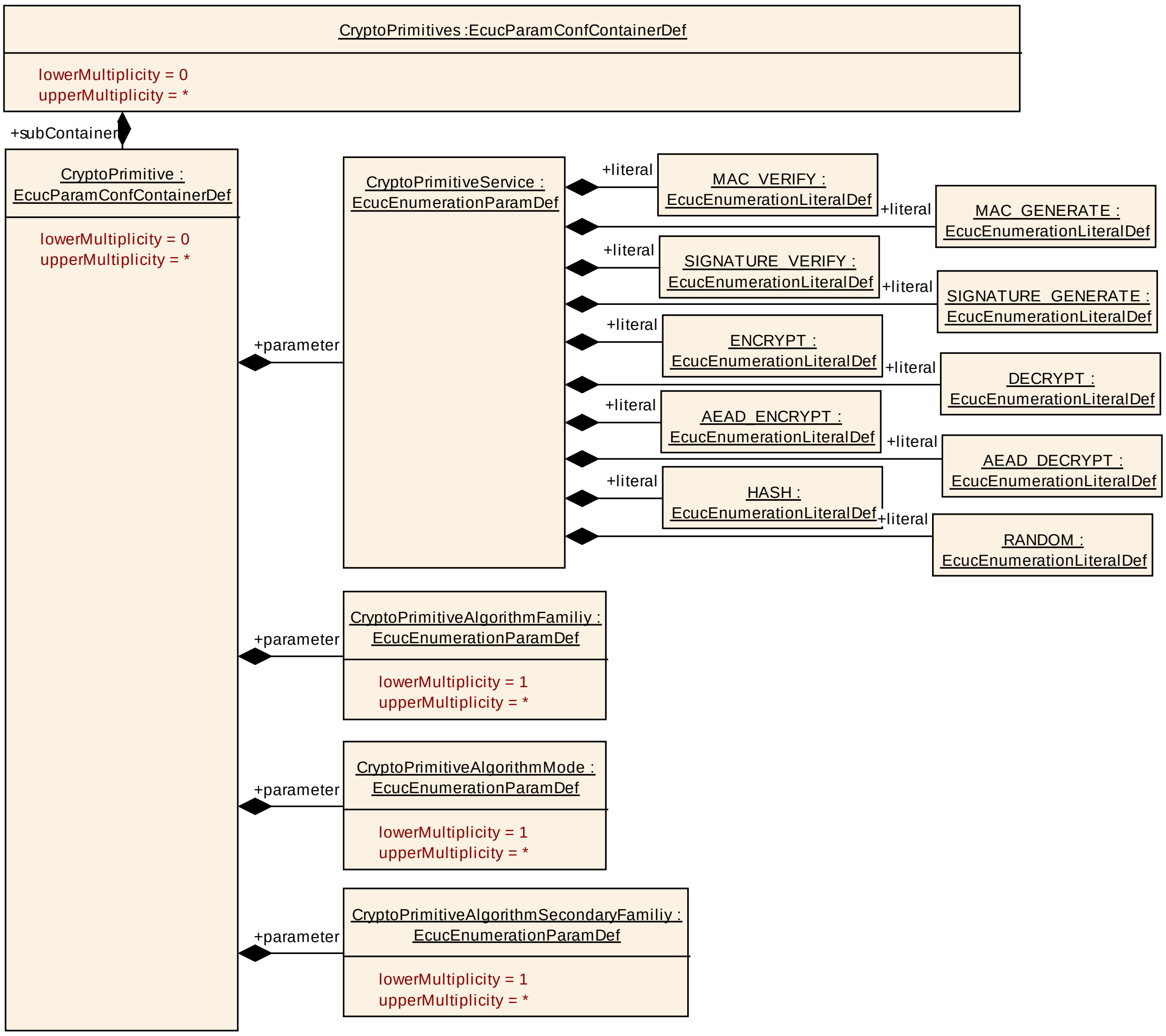
SWS Item	**ECUC_Crypto_00031 :**		
Name	CryptoKeyElementRef		
Description	Refers to a pointer in the CRYPTOCrypto Key Element, which holds the data of the crypto key element.		
Multiplicity	1..*		
Type	Reference to [CryptoKeyElement]		
Multiplicity Configuration Class	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Value Configuration Class	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: local		

No Included Containers

11.1.11 CryptoPrimitives

SWS Item	**ECUC_Crypto_00032 :**		
Container Name	CryptoPrimitives		
Description	Container for CRYPTO primitives		
Multiplicity Configuration Class	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Configuration Parameters			

Included Containers		
Container Name	***Multiplicity***	***Scope / Dependency***
CryptoPrimitive	0..*	Configuration of a CryptoPrimitive


CryptoPrimitives :EcucParamConfContainerDef
lowerMultiplicity = 0
upperMultiplicity = *
+subContainer
CryptoPrimitive : EcucParamConfContainerDef
lowerMultiplicity = 0
upperMultiplicity = *
+parameter
CryptoPrimitiveService : EcucEnumerationParamDef
+literal
MAC_VERIFY : EcucEnumerationLiteralDef
+literal
MAC_GENERATE : EcucEnumerationLiteralDef
+literal
SIGNATURE_VERIFY : EcucEnumerationLiteralDef
+literal
SIGNATURE_GENERATE : EcucEnumerationLiteralDef
+literal
ENCRYPT : EcucEnumerationLiteralDef
+literal
DECRYPT : EcucEnumerationLiteralDef
+literal
AEAD_ENCRYPT : EcucEnumerationLiteralDef
+literal
AEAD_DECRYPT : EcucEnumerationLiteralDef
+literal
HASH : EcucEnumerationLiteralDef
+literal
RANDOM : EcucEnumerationLiteralDef
+parameter
CryptoPrimitiveAlgorithmFamiliy : EcucEnumerationParamDef
lowerMultiplicity = 1
upperMultiplicity = *
+parameter
CryptoPrimitiveAlgorithmMode : EcucEnumerationParamDef
lowerMultiplicity = 1
upperMultiplicity = *
+parameter
CryptoPrimitiveAlgorithmSecondaryFamiliy : EcucEnumerationParamDef
lowerMultiplicity = 1
upperMultiplicity = *

11.1.12 CryptoPrimitive

SWS Item	**ECUC_Crypto_00033 :**
Container Name	CryptoPrimitive
Description	Configuration of a CryptoPrimitive

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

SWS Item	**ECUC_Crypto_00035 :**		
Name	CryptoPrimitiveAlgorithmFamiliy		
Description	Determines the algorithm family used for the crypto service		
Multiplicity	1..*		
Type	EcucEnumerationParamDef		
Range	CRYPTO_ALGOFAM_3DES	0x13	
	CRYPTO_ALGOFAM_AES	0x14	
	CRYPTO_ALGOFAM_BLAKE_1_256	0x0F	
	CRYPTO_ALGOFAM_BLAKE_1_512	0x10	
	CRYPTO_ALGOFAM_BLAKE_2s_256	0x11	
	CRYPTO_ALGOFAM_BLAKE_2s_512	0x12	
	CRYPTO_ALGOFAM_BRAINPOOL	0x18	
	CRYPTO_ALGOFAM_CHACHA	0x15	
	CRYPTO_ALGOFAM_CUSTOM	0xFF	
	CRYPTO_ALGOFAM_ECCNIST	0x19	
	CRYPTO_ALGOFAM_ECIES	0x1D	
	CRYPTO_ALGOFAM_ED25519	0x17	
	CRYPTO_ALGOFAM_NOT_SET	0x00	
	CRYPTO_ALGOFAM_RIPEMD160	0x0E	
	CRYPTO_ALGOFAM_RNG	0x1B	
	CRYPTO_ALGOFAM_RSA	0x16	
	CRYPTO_ALGOFAM_SECURECOUNTER	0x1A	
	CRYPTO_ALGOFAM_SHA1	0x01	
	CRYPTO_ALGOFAM_SHA2_224	0x02	
	CRYPTO_ALGOFAM_SHA2_256	0x03	
	CRYPTO_ALGOFAM_SHA2_384	0x04	
	CRYPTO_ALGOFAM_SHA2_512	0x05	
	CRYPTO_ALGOFAM_SHA2_512_224	0x06	
	CRYPTO_ALGOFAM_SHA2_512_256	0x07	
	CRYPTO_ALGOFAM_SHA3_224	0x08	
	CRYPTO_ALGOFAM_SHA3_256	0x09	
	CRYPTO_ALGOFAM_SHA3_384	0x0A	
	CRYPTO_ALGOFAM_SHA3_512	0x0B	
	CRYPTO_ALGOFAM_SHAKE128	0x0C	
	CRYPTO_ALGOFAM_SHAKE256	0x0D	
	CRYPTO_ALGOFAM_SIPHASH	0x1C	
Post-Build Variant Value	false		
Multiplicity Configuration Class	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Value Configuration Class	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: local		

SWS Item	**ECUC_Crypto_00036 :**
Name	CryptoPrimitiveAlgorithmMode
Description	Determines the algorithm mode used for the crypto service
Multiplicity	1..*

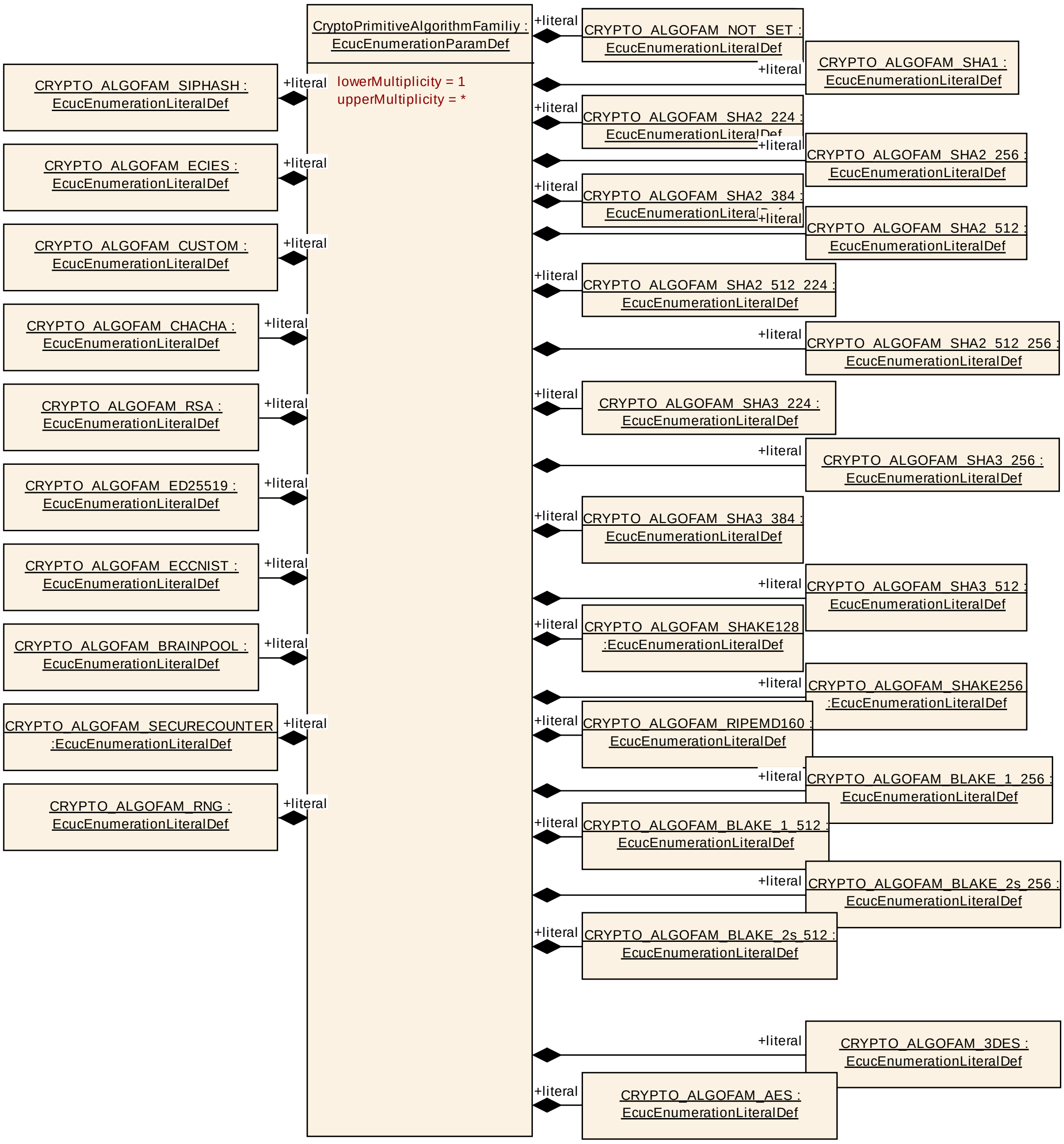
Type	EcucEnumerationParamDef		
Range	CRYPTO_ALGOMODE_12ROUNDS	0x0D	
	CRYPTO_ALGOMODE_20ROUNDS	0x0E	
	CRYPTO_ALGOMODE_8ROUNDS	0x0C	
	CRYPTO_ALGOMODE_CBC	0x02	
	CRYPTO_ALGOMODE_CFB	0x03	
	CRYPTO_ALGOMODE_CMAC	0x10	
	CRYPTO_ALGOMODE_CTR	0x05	
	CRYPTO_ALGOMODE_CTRDRBG	0x12	
	CRYPTO_ALGOMODE_CUSTOM	0xFF	
	CRYPTO_ALGOMODE_ECB	0x01	
	CRYPTO_ALGOMODE_GCM	0x06	
	CRYPTO_ALGOMODE_GMAC	0x11	
	CRYPTO_ALGOMODE_HMAC	0x0F	
	CRYPTO_ALGOMODE_NOT_SET	0x00	
	CRYPTO_ALGOMODE_OFB	0x04	
	CRYPTO_ALGOMODE_RSAES_OAEP	0x08	
	CRYPTO_ALGOMODE_RSAES_PKCS1_v1_5	0x09	
	CRYPTO_ALGOMODE_RSASSA_PKCS1_v1_5	0x0B	
	CRYPTO_ALGOMODE_RSASSA_PSS	0x0A	
	CRYPTO_ALGOMODE_XTS	0x07	
Post-Build Variant Value	false		
Multiplicity Configuration Class	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Value Configuration Class	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: local		

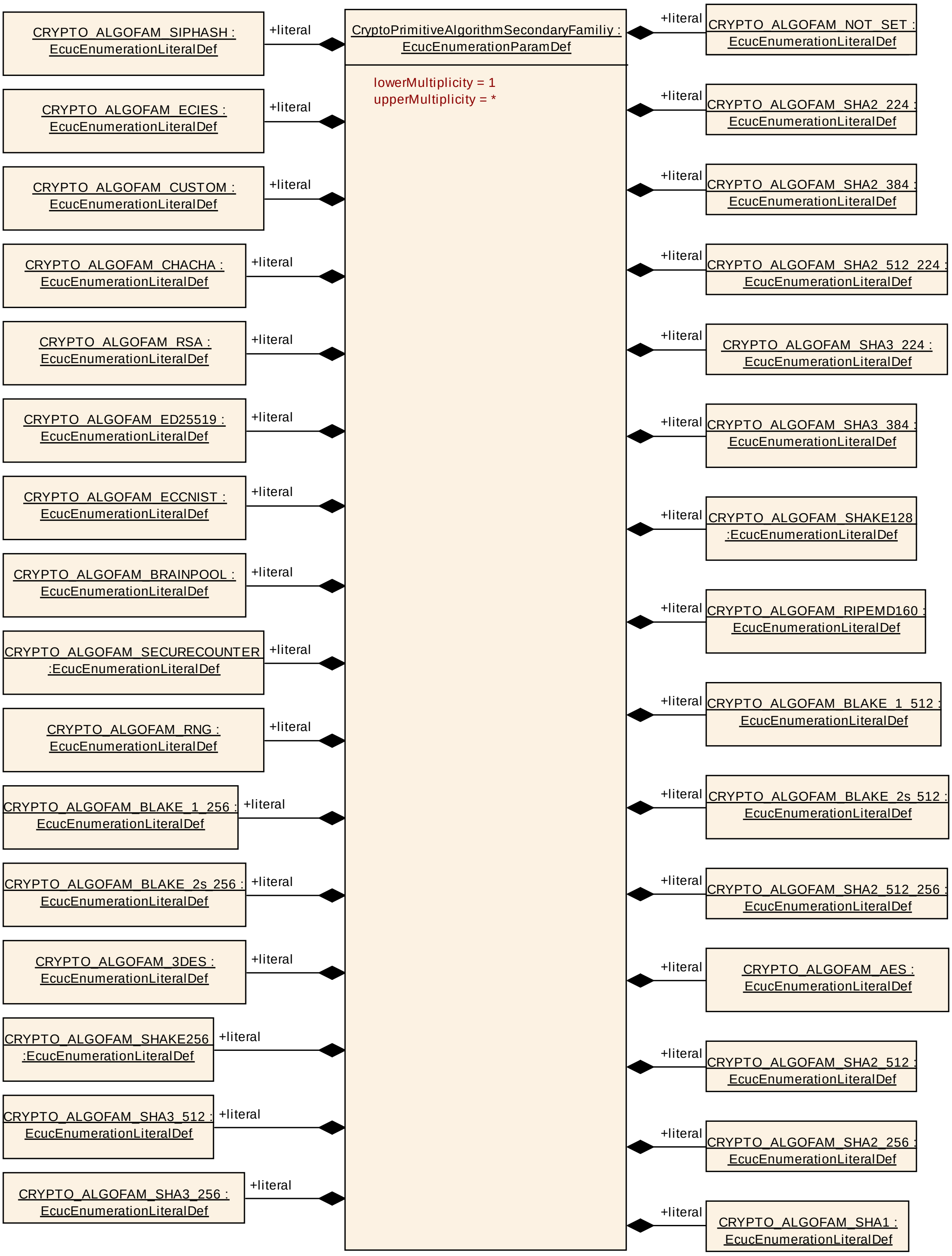
SWS Item	**ECUC_Crypto_00037 :**	
Name	CryptoPrimitiveAlgorithmSecondaryFamiliy	
Description	Determines the algorithm secondary family used for the crypto service	
Multiplicity	1..*	
Type	EcucEnumerationParamDef	
Range	CRYPTO_ALGOFAM_3DES	0x13
	CRYPTO_ALGOFAM_AES	0x14
	CRYPTO_ALGOFAM_BLAKE_1_256	0x0F
	CRYPTO_ALGOFAM_BLAKE_1_512	0x10
	CRYPTO_ALGOFAM_BLAKE_2s_256	0x11
	CRYPTO_ALGOFAM_BLAKE_2s_512	0x12
	CRYPTO_ALGOFAM_BRAINPOOL	0x18
	CRYPTO_ALGOFAM_CHACHA	0x15
	CRYPTO_ALGOFAM_CUSTOM	0xFF
	CRYPTO_ALGOFAM_ECCNIST	0x19
	CRYPTO_ALGOFAM_ECIES	0x1D
	CRYPTO_ALGOFAM_ED25519	0x17
	CRYPTO_ALGOFAM_NOT_SET	0x00
	CRYPTO_ALGOFAM_RIPEMD160	0x0E
	CRYPTO_ALGOFAM_RNG	0x1B
	CRYPTO_ALGOFAM_RSA	0x16
	CRYPTO_ALGOFAM_SECURECOUNTER	0x1A
	CRYPTO_ALGOFAM_SHA1	0x01
	CRYPTO_ALGOFAM_SHA2_224	0x02

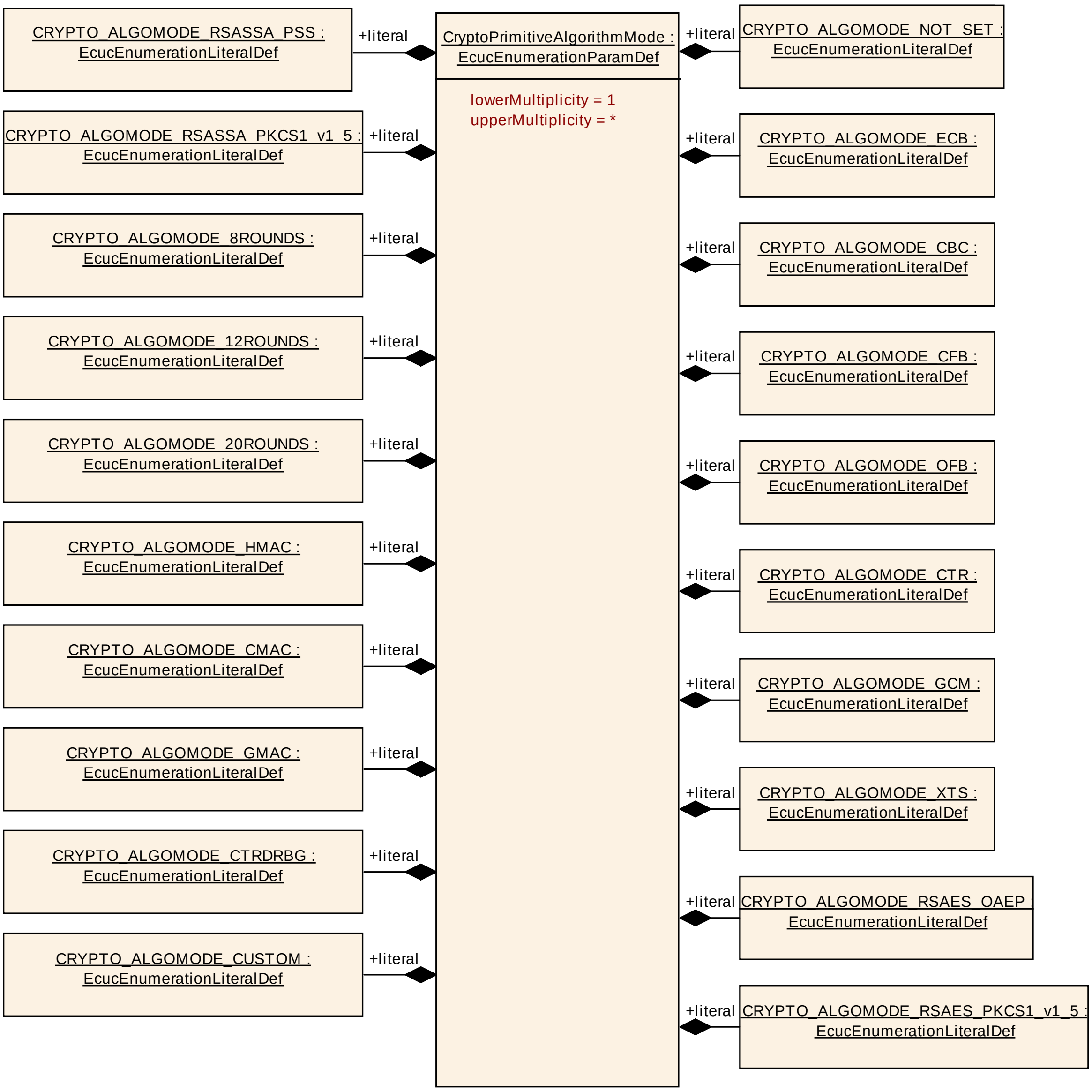
	CRYPTO_ALGOFAM_SHA2_256	0x03	
	CRYPTO_ALGOFAM_SHA2_384	0x04	
	CRYPTO_ALGOFAM_SHA2_512	0x05	
	CRYPTO_ALGOFAM_SHA2_512_224	0x06	
	CRYPTO_ALGOFAM_SHA2_512_256	0x07	
	CRYPTO_ALGOFAM_SHA3_224	0x08	
	CRYPTO_ALGOFAM_SHA3_256	0x09	
	CRYPTO_ALGOFAM_SHA3_384	0x0A	
	CRYPTO_ALGOFAM_SHA3_512	0x0B	
	CRYPTO_ALGOFAM_SHAKE128	0x0C	
	CRYPTO_ALGOFAM_SHAKE256	0x0D	
	CRYPTO_ALGOFAM_SIPHASH	0x1C	
Post-Build Variant Value	false		
Multiplicity Configuration Class	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Value Configuration Class	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: local		

SWS Item	**ECUC_Crypto_00034 :**		
Name	CryptoPrimitiveService		
Description	Determines the crypto service used for defining the capabilities		
Multiplicity	1		
Type	EcucEnumerationParamDef		
Range	AEAD_DECRYPT	0x8	
	AEAD_ENCRYPT	0x7	
	DECRYPT	0x6	
	ENCRYPT	0x5	
	HASH	0x9	
	MAC_GENERATE	0x2	
	MAC_VERIFY	0x1	
	RANDOM	0xA	
	SIGNATURE_GENERATE	0x4	
	SIGNATURE_VERIFY	0x3	
Multiplicity Configuration Class	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Value Configuration Class	***Pre-compile time***	X	All Variants
	Link time	--	
	Post-build time	--	
Scope / Dependency	scope: local		

No Included Containers


CryptoPrimitiveAlgorithmFamiliy : EcucEnumerationParamDef
lowerMultiplicity = 1
upperMultiplicity = *
+literal
CRYPTO_ALGOFAM_SIPHASH : EcucEnumerationLiteralDef
CRYPTO_ALGOFAM_ECIES : EcucEnumerationLiteralDef
CRYPTO_ALGOFAM_CUSTOM : EcucEnumerationLiteralDef
CRYPTO_ALGOFAM_CHACHA : EcucEnumerationLiteralDef
CRYPTO_ALGOFAM_RSA : EcucEnumerationLiteralDef
CRYPTO_ALGOFAM_ED25519 : EcucEnumerationLiteralDef
CRYPTO_ALGOFAM_ECCNIST : EcucEnumerationLiteralDef
CRYPTO_ALGOFAM_BRAINPOOL : EcucEnumerationLiteralDef
CRYPTO_ALGOFAM_SECURECOUNTER :EcucEnumerationLiteralDef
CRYPTO_ALGOFAM_RNG : EcucEnumerationLiteralDef
CRYPTO_ALGOFAM_NOT_SET : EcucEnumerationLiteralDef
CRYPTO_ALGOFAM_SHA1 : EcucEnumerationLiteralDef
CRYPTO_ALGOFAM_SHA2_224 : EcucEnumerationLiteralDef
CRYPTO_ALGOFAM_SHA2_256 : EcucEnumerationLiteralDef
CRYPTO_ALGOFAM_SHA2_384 : EcucEnumerationLiteralDef
CRYPTO_ALGOFAM_SHA2_512 : EcucEnumerationLiteralDef
CRYPTO_ALGOFAM_SHA2_512_224 : EcucEnumerationLiteralDef
CRYPTO_ALGOFAM_SHA2_512_256 : EcucEnumerationLiteralDef
CRYPTO_ALGOFAM_SHA3_224 : EcucEnumerationLiteralDef
CRYPTO_ALGOFAM_SHA3_256 : EcucEnumerationLiteralDef
CRYPTO_ALGOFAM_SHA3_384 : EcucEnumerationLiteralDef
CRYPTO_ALGOFAM_SHA3_512 : EcucEnumerationLiteralDef
CRYPTO_ALGOFAM_SHAKE128 :EcucEnumerationLiteralDef
CRYPTO_ALGOFAM_SHAKE256 :EcucEnumerationLiteralDef
CRYPTO_ALGOFAM_RIPEMD160 : EcucEnumerationLiteralDef
CRYPTO_ALGOFAM_BLAKE_1_256 : EcucEnumerationLiteralDef
CRYPTO_ALGOFAM_BLAKE_1_512 : EcucEnumerationLiteralDef
CRYPTO_ALGOFAM_BLAKE_2s_256 : EcucEnumerationLiteralDef
CRYPTO_ALGOFAM_BLAKE_2s_512 : EcucEnumerationLiteralDef
CRYPTO_ALGOFAM_3DES : EcucEnumerationLiteralDef
CRYPTO_ALGOFAM_AES : EcucEnumerationLiteralDef


CryptoPrimitiveAlgorithmSecondaryFamiliy : EcucEnumerationParamDef
lowerMultiplicity = 1
upperMultiplicity = *
CRYPTO_ALGOFAM_SIPHASH : EcucEnumerationLiteralDef
CRYPTO_ALGOFAM_ECIES : EcucEnumerationLiteralDef
CRYPTO_ALGOFAM_CUSTOM : EcucEnumerationLiteralDef
CRYPTO_ALGOFAM_CHACHA : EcucEnumerationLiteralDef
CRYPTO_ALGOFAM_RSA : EcucEnumerationLiteralDef
CRYPTO_ALGOFAM_ED25519 : EcucEnumerationLiteralDef
CRYPTO_ALGOFAM_ECCNIST : EcucEnumerationLiteralDef
CRYPTO_ALGOFAM_BRAINPOOL : EcucEnumerationLiteralDef
CRYPTO_ALGOFAM_SECURECOUNTER :EcucEnumerationLiteralDef
CRYPTO_ALGOFAM_RNG : EcucEnumerationLiteralDef
CRYPTO_ALGOFAM_BLAKE_1_256 : EcucEnumerationLiteralDef
CRYPTO_ALGOFAM_BLAKE_2s_256 : EcucEnumerationLiteralDef
CRYPTO_ALGOFAM_3DES : EcucEnumerationLiteralDef
CRYPTO_ALGOFAM_SHAKE256 :EcucEnumerationLiteralDef
CRYPTO_ALGOFAM_SHA3_512 : EcucEnumerationLiteralDef
CRYPTO_ALGOFAM_SHA3_256 : EcucEnumerationLiteralDef
CRYPTO_ALGOFAM_NOT_SET : EcucEnumerationLiteralDef
CRYPTO_ALGOFAM_SHA2_224 : EcucEnumerationLiteralDef
CRYPTO_ALGOFAM_SHA2_384 : EcucEnumerationLiteralDef
CRYPTO_ALGOFAM_SHA2_512_224 : EcucEnumerationLiteralDef
CRYPTO_ALGOFAM_SHA3_224 : EcucEnumerationLiteralDef
CRYPTO_ALGOFAM_SHA3_384 : EcucEnumerationLiteralDef
CRYPTO_ALGOFAM_SHAKE128 :EcucEnumerationLiteralDef
CRYPTO_ALGOFAM_RIPEMD160 : EcucEnumerationLiteralDef
CRYPTO_ALGOFAM_BLAKE_1_512 : EcucEnumerationLiteralDef
CRYPTO_ALGOFAM_BLAKE_2s_512 : EcucEnumerationLiteralDef
CRYPTO_ALGOFAM_SHA2_512_256 : EcucEnumerationLiteralDef
CRYPTO_ALGOFAM_AES : EcucEnumerationLiteralDef
CRYPTO_ALGOFAM_SHA2_512 : EcucEnumerationLiteralDef
CRYPTO_ALGOFAM_SHA2_256 : EcucEnumerationLiteralDef
CRYPTO_ALGOFAM_SHA1 : EcucEnumerationLiteralDef
+literal


CryptoPrimitiveAlgorithmMode : EcucEnumerationParamDef
lowerMultiplicity = 1
upperMultiplicity = *
CRYPTO_ALGOMODE_RSASSA_PSS : EcucEnumerationLiteralDef
CRYPTO_ALGOMODE_RSASSA_PKCS1_v1_5 : EcucEnumerationLiteralDef
CRYPTO_ALGOMODE_8ROUNDS : EcucEnumerationLiteralDef
CRYPTO_ALGOMODE_12ROUNDS : EcucEnumerationLiteralDef
CRYPTO_ALGOMODE_20ROUNDS : EcucEnumerationLiteralDef
CRYPTO_ALGOMODE_HMAC : EcucEnumerationLiteralDef
CRYPTO_ALGOMODE_CMAC : EcucEnumerationLiteralDef
CRYPTO_ALGOMODE_GMAC : EcucEnumerationLiteralDef
CRYPTO_ALGOMODE_CTRDRBG : EcucEnumerationLiteralDef
CRYPTO_ALGOMODE_CUSTOM : EcucEnumerationLiteralDef
CRYPTO_ALGOMODE_NOT_SET : EcucEnumerationLiteralDef
CRYPTO_ALGOMODE_ECB : EcucEnumerationLiteralDef
CRYPTO_ALGOMODE_CBC : EcucEnumerationLiteralDef
CRYPTO_ALGOMODE_CFB : EcucEnumerationLiteralDef
CRYPTO_ALGOMODE_OFB : EcucEnumerationLiteralDef
CRYPTO_ALGOMODE_CTR : EcucEnumerationLiteralDef
CRYPTO_ALGOMODE_GCM : EcucEnumerationLiteralDef
CRYPTO_ALGOMODE_XTS : EcucEnumerationLiteralDef
CRYPTO_ALGOMODE_RSAES_OAEP : EcucEnumerationLiteralDef
CRYPTO_ALGOMODE_RSAES_PKCS1_v1_5 : EcucEnumerationLiteralDef
+literal

11.2 Published Information

Published information contains data defined by the implementer of the SW module that does not change when the module is adapted (i.e. configured) to the actual HW/SW environment. It thus contains version and manufacturer information.

Additional module-specific published parameters are listed below if applicable.