i.MX8 HSM API Rev 4.2

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1 HSM API

This document is a software referece description of the API provided by the i.MX8 HSM solutions.

2 Revision History

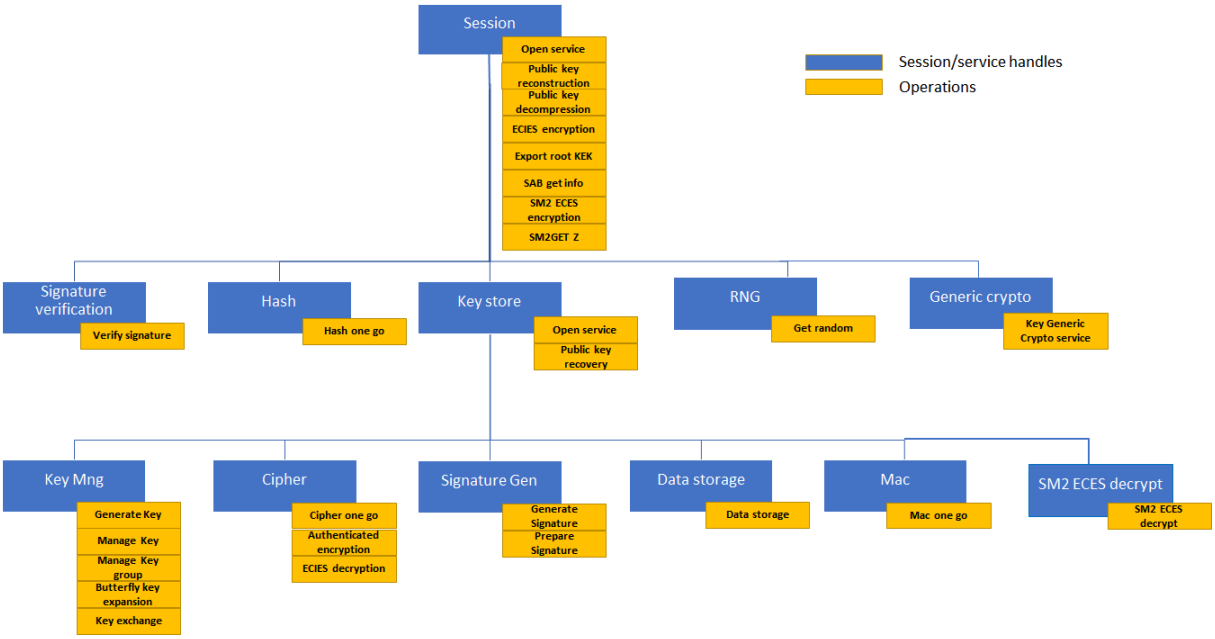
Revision	date	description
0.1	Mar 29 2019	Preliminary draft

Revision	date	description
0.8	May 24 2019	It adds the following API: -signature generation -signature verification -rng -hash -butterfly key expansion -ECIES enc/dec -public key reconstruction -public key decompression
0.9	May 28 2019	Explicit addresses are replaced by pointers.
1.0	May 29 2019	- bug/typos fix. - Change HSM_SVC_KEY_STORE_FLAGS definition
1.1	July 31 2019	- hsm_butterfly_key_expansion argument definition: dest_key_identifier is now a pointer. - add error code definition. - improve argument comments clarity
1.5	Sept 13 2019	- manage key argument: fix padding size - butterfly key expansion: change argument definition - introduce public key recovery API
1.6	Oct 14 2019	- add Key store section in chapter 3 - change key_info and flags definition, substitute key_type_ext with group↩ _id - hsm_generate_key, hsm_manage_key, hsm_butterfly_key_expansion↩ : change argument definition - hsm_manage_key: change argument definition - add hsm_manage_key_group API
1.7	Dec 20 2019	- add generic data storage API - add GCM and CMAC support - add support for AES 192/256 key size for all cipher algorithms - add root KEK export API - add key import functionality - add get info API
2.0	Feb 21 2020	- fix HSM_KEY_INFO_TRANSIENT definition: delete erroneous "not supported" comment - add Key Encryption Key (HSM_KEY_INFO_KEK) support - key store open service API: adding signed message support for key store reprovisionning - naming consistency: remove "hsm_" prefix from hsm_op_ecies_dec_args_t hsm_op_pub_key_rec_args_t hsm_op_pub_key_dec_args_t hsm_op_ecies_enc_args_t hsm_op_pub_key_recovery_args_t hsm_op_get_info_args_t
2.1	Apr 16 2020	- Preliminary version: Add the support of the chinese algorithms and update for i.MX8DXL
2.2	Apr 30 2020	- fix erroneous number of supported key groups (correct number is 1000 while 1024 was indicated) - add missing status code definition - remove hsm_open_key_store_service unused flags: HSM_SVC_KEY↩ _STORE_FLAGS_UPDATE, HSM_SVC_KEY_STORE_FLAGS_DELETE

Revision	date	description
2.3	June 30 2020	- hsm_get_info fips mode definition: now specifying "FIPS mode of operation" and "FIPS certified part" bits. - Update i.MX8QXP specificities section specifying operations disabled when in FIPS approved mode. - Update comments related to cipher_one_go and SM2 ECES APIs for i.↩ MX8DXL
2.4	July 9 2020	- clarify support of hsm_import_public key API.
2.5	July 28 2020	- add section in "i.MX8QXP specificities" chapter indicating the maximum number of keys per group.
2.6	Jul 29 2020	- Key Exchange: add the definition of ECDH_P384 and TLS KDFs - mac_one_go: add definition of HMAC SHA256/384.
2.7	Sep 25 2020	- Key Exchange: additional TLS KDFs support, CMAC KDF replaced by SHA-256 KDF - mac_one_go: add support of HMAC SHA224/523.
2.8	Sep 30 2020	- Key Exchange: add details related to the SM2 key exchange.
2.9	Oct 14 2020	- key_store_open: add STRICT_OPERATION flag. This flag allows to export the key store in the external NVM at the key store creation.
3.0	Nov 16 2020	hsm_open_key_store_service: add min_mac_length argument. hsm_mac_one_go - verification: add HSM_OP_MAC_ONE_GO_↩ FLAGS_MAC_LENGTH_IN_BITS to represent mac_length in bit. hsm_key_exchange: - enforce new costraints on KEK and TLS key generations - add signed message arguments for KEK generation. - rename HSM_KDF_ALG_SHA_256 in HSM_KDF_ONE_STEP_SHA_↩ 256. - rename HSM_OP_KEY_EXCHANGE_FLAGS_USE_EPHEMERAL in HSM_OP_KEY_EXCHANGE_FLAGS_GENERATE_EPHEMERAL
3.1	Nov 20 2020	Enable support of key_exchange and HMAC on QXP
3.2	Dec 1 2020	hsm_generate_key, hsm_manage_key: fix key_group argument wrong description. User must specify the key group for CREATE/UPDATE/DELETE operations.
3.2 Amendement	Feb 3 2021	Clarify Key_exchange and HMAC support on QXP - both are not supported.
3.3	Jan 11 2021	Add hsm_tls_finish API. Update hsm_key_exchange description: - The TLS master_secret is now stored into the key store and accesible by the hsm_tls_finish API - TLS KDF: add support of extended master secret hsm_auth_enc API - GCM encryption (not backward compatible): the IV cannot be fully provided by the user anymore, it must be generated by the HSM instead.
3.4	Jan 13 2021	Add support of per-key min mac length using extension commands for key create and key manage.
3.5	Feb 5 2021	Clarify hsm_tls_finish support on QXP - not supported.
3.6	Feb 12 2021	Key exchange for KEK negotiation supported on QXP, usage of IV flags for auth_enc clarified.
3.7	Mar 19 2021	Add HSM_FATAL_FAILURE error code definition
3.8	April 30 2021	- hsm_open_key_store_service, hsm_generate_key_ext, hsm_manage↩ _key_ext: min_mac_len cannot be set to values $<$ 32 bits when in FIPS approved mode. - Update hsm_key_exchange kdf_input_size argument description in case of TLS Key generation.

Revision	date	description
3.9	May 12 2021	- Butterfly key expansion: add the support of SM2 on DXL - Public key reconstruction: add the support of SM2 on DXL - Introduce standalone Butterfly key expansion API on DXL. - Butterfly key expansion, Public key reconstruction, ECIES enc/dec: remove the support of BR256T1 on DXL. - hsm_prepare_signature: specify max number of stored pre-calculated values. key exchange: add the support of BR256T1 on DXL.
4.0	Aug 05 2021	- Authenticated encryption: add the support of SM4 CCM on DXL. - Add key generic cryptographic service API on DXL.
4.1	Dec 03 2021	- Add exclusive crypto engine flag for hsm cmac one go
4.2	Mar 31 2021	- AES CCM IV handling updated to match AES GCM, to guarantee unique IV's (not backward compatible). - Add the OTP Root KEK flag to the manage Key on DXL B0. - Add the support of HMAC and TLS on DXL B0. - Update the list of unsupported curves on DXL.

3 General concepts related to the API



3.1 Session

The API must be initialized by a potential requestor by opening a session.
The session establishes a route (MU, DomainID...) between the requester and the HSM. When a session is opened, the HSM returns a handle identifying the session to the requester.

3.2 Service flow

For a given category of services, the requestor is expected to open a service flow by invoking the appropriate HSM API.

The session handle, as well as the control data needed for the service flow, are provided as parameters of the call.
Upon reception of the open request, the HSM allocates a context in which the session handle, as well as the provided control parameters are stored and return a handle identifying the service flow.
The context is preserved until the service flow, or the session, are closed by the user and it is used by the HSM to proceed with the sub-sequent operations requested by the user on the service flow.

3.3 Example

```
/* Open a session: create a route between the user and the HSM */
hsm_open_session(&open_session_args, &session_hdl);

/* Open a key store - user is authenticated */
hsm_open_key_store_service(session_hdl, &open_svc_key_store_args, &key_store_hdl);
/* Open hash service - it grants access to hashing operations */
hsm_open_hash_service (session_hdl, &open_svc_hash_args, &hash_hdl);
/* Open cipher service - it grants access to ciphering operations */
hsm_open_cipher_service(key_store_hdl, &open_svc_cipher_args, &cipher_hdl);

/* Perform AES ECB, CCB ... */
hsm_cipher_one_go (cipher_hdl, &op_cipher_one_go_args);
/* Perform authenticate and encryption algos: e.g AES GCM */
hsm_auth_enc (cipher_hdl, &op_auth_enc_args);
/* Perform hashing operations: e.g SHA */
hsm_hash_one_go (hash_hdl, &op_hash_one_go_args);

/* Close the session and all the related services */
hsm_close_session(session_hdl);
```

3.4 Key store

A key store can be created by specifying the CREATE flag in the hsm_open_key_store_service API. Please note that the created key store will be not stored in the NVM till a key is generated/imported specyfing the "STRICT OPERATION" flag.
Only symmetric and private keys are stored into the key store. Public keys can be exported during the key pair generation operation or recalculated through the hsm_pub_key_recovery API.
Secret keys cannot be exported under any circumstances, while they can be imported in encrypted form.

3.4.1 Key management

Keys are divided in groups, keys belonging to the same group are written/read from the NVM as a monolitic block.
Up to 3 key groups can be handled in the HSM local memory (those immediatly available to perform crypto operations), while up to 1000 key groups can be handled in the external NVM and imported in the local memory as needed.
If the local memory is full (3 key groups already reside in the HSM local memory) and a new key group is needed by an incoming user request, the HSM swaps one of the local key group with the one needed by the user request.
The user can control which key group must be kept in the local memory (cached) through the manage_key_group API lock/unlock mechanism.
As general concept, frequently used keys should be kept, when possible, in the same key group and locked in the local memory for performance optimization.

3.4.2 NVM writing

All the APIs creating a key store (open key store API) or modyfing its content (key generation, key_management, key derivation functions) provide a "STRICT OPERATION" flag. If the flag is set, the HSM exports the relevant key store blocks into the external NVM and increments (blows one bit) the OTP monotonic counter used as roll back protection. In case of key generation/derivation/update the "STRICT OPERATION" has effect only on the target key group.
Any update to the key store must be considered as effective only after an operation specifing the flag "STRICT OPERATION" is aknowledged by the HSM. All the operations not specifying the "STRICT OPERATION" flags impact the HSM local memory only and will be lost in case of system reset
Due to the limited monotonic counter size (QXPB0 up to 1620 update available by default), the user should, when possible, perform multiple udates before setting the "STRICT OPERATION" flag (i.e. keys to be updated should be kept in the same key group).
Once the monotonic counter is completely blown a warning is returned on each key store export to the NVM to inform the user that the new updates are not roll-back protected.

3.5 Implementation specificities

HSM API is supported on different versions of the i.MX8 family. The API description below is the same for all of them but some features may not be available on some chips. The details of the supported features per chip can be found here:

- for i.MX8QXP: i.MX8QXP specificities
- for i.MX8DXL: i.MX8DXL specificities

4 Module Index

4.1 Modules

Here is a list of all modules:

5 Module Documentation

5.1 Error codes

Enumerations

- enum hsm_err_t {
  HSM_NO_ERROR = 0x0 ,
  HSM_INVALID_MESSAGE = 0x1 ,
  HSM_INVALID_ADDRESS = 0x2 ,
  HSM_UNKNOWN_ID = 0x3 ,
  HSM_INVALID_PARAM = 0x4 ,
  HSM_NVM_ERROR = 0x5 ,
  HSM_OUT_OF_MEMORY = 0x6 ,
  HSM_UNKNOWN_HANDLE = 0x7 ,
  HSM_UNKNOWN_KEY_STORE = 0x8 ,
  HSM_KEY_STORE_AUTH = 0x9 ,
  HSM_KEY_STORE_ERROR = 0xA ,
  HSM_ID_CONFLICT = 0xB ,
  HSM_RNG_NOT_STARTED = 0xC ,
  HSM_CMD_NOT_SUPPORTED = 0xD ,
  HSM_INVALID_LIFECYCLE = 0xE ,
  HSM_KEY_STORE_CONFLICT = 0xF ,
  HSM_KEY_STORE_COUNTER = 0x10 ,
  HSM_FEATURE_NOT_SUPPORTED = 0x11 ,
  HSM_SELF_TEST_FAILURE = 0x12 ,
  HSM_NOT_READY_RATING = 0x13 ,
  HSM_FEATURE_DISABLED = 0x14 ,
  HSM_FATAL_FAILURE = 0x29 ,
  HSM_GENERAL_ERROR = 0xFF }

5.1.1 Detailed Description

5.1.2 Enumeration Type Documentation

5.1.2.1 hsm_err_t enum hsm_err_t

Error codes returned by HSM functions.

Enumerator

HSM_NO_ERROR	Success.
HSM_INVALID_MESSAGE	The received message is invalid or unknown.
HSM_INVALID_ADDRESS	The provided address is invalid or doesn't respect the API requirements.
HSM_UNKNOWN_ID	The provided identifier is not known.
HSM_INVALID_PARAM	One of the parameter provided in the command is invalid.
HSM_NVM_ERROR	NVM generic issue.
HSM_OUT_OF_MEMORY	There is not enough memory to handle the requested operation.
HSM_UNKNOWN_HANDLE	Unknown session/service handle.
HSM_UNKNOWN_KEY_STORE	The key store identified by the provided "key store Id" doesn't exist and the "create" flag is not set.
HSM_KEY_STORE_AUTH	Key store authentication fails.
HSM_KEY_STORE_ERROR	An error occurred in the key store internal processing.
HSM_ID_CONFLICT	An element (key store, key. . .) with the provided ID already exists.
HSM_RNG_NOT_STARTED	The internal RNG is not started.
HSM_CMD_NOT_SUPPORTED	The functionality is not supported for the current session/service/key store configuration.
HSM_INVALID_LIFECYCLE	Invalid lifecycle for requested operation.
HSM_KEY_STORE_CONFLICT	A key store with the same attributes already exists.
HSM_KEY_STORE_COUNTER	The current key store reaches the max number of monotonic counter updates, updates are still allowed but monotonic counter will not be blown.
HSM_FEATURE_NOT_SUPPORTED	The requested feature is not supported by the firwmare.
HSM_SELF_TEST_FAILURE	Self tests report an issue
HSM_NOT_READY_RATING	The HSM is not ready to handle the current request
HSM_FEATURE_DISABLED	The required service/operation is disabled
HSM_FATAL_FAILURE	A fatal failure occured, the HSM goes in unrecoverable error state not replying to further requests
HSM_GENERAL_ERROR	Error not covered by other codes occured.

5.2 Session

Modules

- i.MX8QXP specificities
- i.MX8DXL specificities

Data Structures

- struct open_session_args_t

Macros

- #define HSM_OPEN_SESSION_PRIORITY_LOW (0x00U)

  Low priority. Should be the default setting on platforms that doesn't support sessions priorities.
- #define HSM_OPEN_SESSION_PRIORITY_HIGH (0x01U)

  High Priority session.
- #define HSM_OPEN_SESSION_FIPS_MODE_MASK (1u << 0)

  Only FIPS certified operations authorized in this session.
- #define HSM_OPEN_SESSION_EXCLUSIVE_MASK (1u << 1)

  No other HSM session will be authorized on the same security enclave.
- #define HSM_OPEN_SESSION_LOW_LATENCY_MASK (1u << 3)

  Use a low latency HSM implementation.
- #define HSM_OPEN_SESSION_NO_KEY_STORE_MASK (1u << 4)

  No key store will be attached to this session. May provide better performances on some operation depending on the implementation. Usage of the session will be restricted to operations that doesn't involve secret keys (e.g. hash, signature verification, random generation).
- #define HSM_OPEN_SESSION_RESERVED_MASK ((1u << 2) | (1u << 5) | (1u << 6) | (1u << 7))

  Bits reserved for future use. Should be set to 0.

Typedefs

- typedef uint32_t **hsm_hdl_t**

Functions

- hsm_err_t hsm_open_session (open_session_args_t *args, hsm_hdl_t *session_hdl)
- hsm_err_t hsm_close_session (hsm_hdl_t session_hdl)

5.2.1 Detailed Description

The API must be initialized by a potential requestor by opening a session.
Once a session is closed all the associated service flows are closed by the HSM.

5.2.2 Data Structure Documentation

Data Fields

uint8_t	session_priority	Priority of the operations performed in this session. */.
uint8_t	operating_mode	Options for the session to be opened (bitfield). */.
uint16_t	reserved	

5.2.2.1 struct open_session_args_t

5.2.3 Function Documentation

5.2.3.1 hsm_open_session() hsm_err_t hsm_open_session (open_session_args_t * *args*, hsm_hdl_t * *session_hdl*)

Parameters

args	pointer to the structure containing the function arguments.
session_hdl	pointer to where the session handle must be written.

Returns

error_code error code.

5.2.3.2 hsm_close_session() hsm_err_t hsm_close_session (hsm_hdl_t *session_hdl*)

Terminate a previously opened session. All the services opened under this session are closed as well

Parameters

session_hdl	pointer to the handle identifying the session to be closed.

Returns

error_code error code.

5.3 Key store

Data Structures

- struct open_svc_key_store_args_t

Macros

- #define HSM_SVC_KEY_STORE_FLAGS_CREATE ((hsm_svc_key_store_flags_t)(1u << 0))

  It must be specified to create a new key store. The key store will be stored in the NVM only if the STRICT OPERATION flag is set.
- #define HSM_SVC_KEY_STORE_FLAGS_SET_MAC_LEN ((hsm_svc_key_store_flags_t)(1u << 3))

  If set, minimum mac length specified in min_mac_length field will be stored in the key store when creating the key store. Must only be set at key store creation.
- #define HSM_SVC_KEY_STORE_FLAGS_EXCLUSIVE_CMAC_CRYPTO_ENGINE ((hsm_svc_key_↩ store_flags_t)(1u << 4))

  If set, cmac on this hsm keystore will be perfomed by an exclusive crypto engine.
- #define HSM_SVC_KEY_STORE_FLAGS_STRICT_OPERATION ((hsm_svc_key_store_flags_t)(1u << 7))

  The request is completed only when the new key store has been written in the NVM. This applicable for CREATE operations only.

Typedefs

- typedef uint8_t **hsm_svc_key_store_flags_t**

Functions

- hsm_err_t hsm_open_key_store_service (hsm_hdl_t session_hdl, open_svc_key_store_args_t *args, hsm_hdl_t *key_store_hdl)
- hsm_err_t hsm_close_key_store_service (hsm_hdl_t key_store_hdl)

5.3.1 Detailed Description

User must open a key store service flow in order to perform the following operations:

- create a new key store
- perform operations involving keys stored in the key store (ciphering, signature generation...)
- perform a key store reprovisioning using a signed message. A key store re-provisioning results in erasing all the key stores handled by the HSM.

To grant access to the key store, the caller is authenticated against the domain ID (DID) and Messaging Unit used at the keystore creation, additionally an authentication nonce can be provided.

5.3.2 Data Structure Documentation

Data Fields

uint32_t	key_store_identifier	user defined id identifying the key store. Only one key store service can be opened on a given key_store_identifier.
uint32_t	authentication_nonce	user defined nonce used as authentication proof for accesing the key store.
uint16_t	max_updates_number	maximum number of updates authorized for the key store. Valid only for create operation. This parameter has the goal to limit the occupation of the monotonic counter used as anti-rollback protection. If the maximum number of updates is reached, HSM still allows key store updates but without updating the monotonic counter giving the opportunity for rollback attacks.
hsm_svc_key_store_flags_t	flags	bitmap specifying the services properties.
uint8_t	min_mac_length	it corresponds to the minimum mac length (in bits) accepted by the HSM to perform MAC verification operations. Only used upon key store creation when HSM_SVC_KEY_STORE_FLAGS_SET_MAC_LEN bit is set. It is effective only for MAC verification operations with the mac length expressed in bits. It can be used to replace the default value (32 bits). It impacts all MAC algorithms and all key lengths. It must be different from 0.
		When in FIPS approved mode values < 32 bits are not allowed.

Data Fields

uint8_t *	signed_message	pointer to signed_message to be sent only in case of key store re-provisioning
uint16_t	signed_msg_size	size of the signed_message to be sent only in case of key store re-provisioning
uint8_t	reserved_1[2]	

5.3.2.1 struct open_svc_key_store_args_t

5.3.3 Function Documentation

5.3.3.1 hsm_open_key_store_service()

```
hsm_err_t hsm_open_key_store_service (
        hsm_hdl_t session_hdl,
        open_svc_key_store_args_t * args,
        hsm_hdl_t * key_store_hdl )
```

Open a service flow on the specified key store. Only one key store service can be opened on a given key store.

Parameters

session_hdl	pointer to the handle identifying the current session.
args	pointer to the structure containing the function arguments.
key_store_hdl	pointer to where the key store service flow handle must be written.

Returns

error_code error code.

5.3.3.2 hsm_close_key_store_service()

```
hsm_err_t hsm_close_key_store_service (
        hsm_hdl_t key_store_hdl )
```

Close a previously opened key store service flow. The key store is deleted from the HSM local memory, any update not written in the NVM is lost

Parameters

handle	identifying the key store service flow to be closed.

Returns

error_code error code.

5.4 Key management

Modules

- i.MX8QXP specificities
- i.MX8DXL specificities

Data Structures

- struct open_svc_key_management_args_t
- struct op_generate_key_args_t
- struct op_generate_key_ext_args_t
- struct op_manage_key_args_t
- struct op_manage_key_ext_args_t
- struct op_manage_key_group_args_t
- struct op_butt_key_exp_args_t

Macros

- #define **HSM_KEY_TYPE_ECDSA_NIST_P256** ((hsm_key_type_t)0x02u)
- #define **HSM_KEY_TYPE_ECDSA_NIST_P384** ((hsm_key_type_t)0x03u)
- #define **HSM_KEY_TYPE_ECDSA_NIST_P521** ((hsm_key_type_t)0x04u)
- #define **HSM_KEY_TYPE_ECDSA_BRAINPOOL_R1_256** ((hsm_key_type_t)0x13u)
- #define **HSM_KEY_TYPE_ECDSA_BRAINPOOL_R1_320** ((hsm_key_type_t)0x14u)
- #define **HSM_KEY_TYPE_ECDSA_BRAINPOOL_R1_384** ((hsm_key_type_t)0x15u)
- #define **HSM_KEY_TYPE_ECDSA_BRAINPOOL_R1_512** ((hsm_key_type_t)0x16u)
- #define **HSM_KEY_TYPE_ECDSA_BRAINPOOL_T1_256** ((hsm_key_type_t)0x23u)
- #define **HSM_KEY_TYPE_ECDSA_BRAINPOOL_T1_320** ((hsm_key_type_t)0x24u)
- #define **HSM_KEY_TYPE_ECDSA_BRAINPOOL_T1_384** ((hsm_key_type_t)0x25u)
- #define **HSM_KEY_TYPE_ECDSA_BRAINPOOL_T1_512** ((hsm_key_type_t)0x26u)
- #define **HSM_KEY_TYPE_AES_128** ((hsm_key_type_t)0x30u)
- #define **HSM_KEY_TYPE_AES_192** ((hsm_key_type_t)0x31u)
- #define **HSM_KEY_TYPE_AES_256** ((hsm_key_type_t)0x32u)
- #define **HSM_KEY_TYPE_DSA_SM2_FP_256** ((hsm_key_type_t)0x42u)
- #define **HSM_KEY_TYPE_SM4_128** ((hsm_key_type_t)0x50u)
- #define **HSM_KEY_TYPE_HMAC_224** ((hsm_key_type_t)0x60u)
- #define **HSM_KEY_TYPE_HMAC_256** ((hsm_key_type_t)0x61u)
- #define **HSM_KEY_TYPE_HMAC_384** ((hsm_key_type_t)0x62u)
- #define **HSM_KEY_TYPE_HMAC_512** ((hsm_key_type_t)0x63u)
- #define HSM_OP_KEY_GENERATION_FLAGS_UPDATE ((hsm_op_key_gen_flags_t)(1u << 0))

  User can replace an existing key only by generating a key with the same type of the original one.
- #define HSM_OP_KEY_GENERATION_FLAGS_CREATE ((hsm_op_key_gen_flags_t)(1u << 1))

  Create a new key.
- #define HSM_OP_KEY_GENERATION_FLAGS_STRICT_OPERATION ((hsm_op_key_gen_flags_t)(1u << 7))

  The request is completed only when the new key has been written in the NVM. This applicable for persistent key only.
- #define HSM_KEY_INFO_PERSISTENT ((hsm_key_info_t)(0u << 1))

  Persistent keys are stored in the external NVM. The entire key group is written in the NVM at the next STRICT operation.
- #define HSM_KEY_INFO_PERMANENT ((hsm_key_info_t)(1u << 0))

When set, the key is permanent (write locked). Once created, it will not be possible to update or delete the key anymore. Transient keys will be anyway deleted after a PoR or when the corresponding key store service flow is closed. This bit can never be reset.

- #define HSM_KEY_INFO_TRANSIENT ((hsm_key_info_t)(1u << 1))

  Transient keys are deleted when the corresponding key store service flow is closed or after a PoR. Transient keys cannot be in the same key group than persistent keys.
- #define HSM_KEY_INFO_MASTER ((hsm_key_info_t)(1u << 2))

  When set, the key is considered as a master key. Only master keys can be used as input of key derivation functions (i.e butterfly key expansion).
- #define HSM_KEY_INFO_KEK ((hsm_key_info_t)(1u << 3))

  When set, the key is considered as a key encryption key. KEK keys can only be used to wrap and import other keys into the key store, all other operation are not allowed. Only keys imported in the key store through the hsm_mange↩ _key API can get this attribute.
- #define HSM_OP_MANAGE_KEY_FLAGS_IMPORT_UPDATE ((hsm_op_manage_key_flags_t)(1u << 0))

  User can replace an existing key only by importing a key with the same type of the original one.
- #define HSM_OP_MANAGE_KEY_FLAGS_IMPORT_CREATE ((hsm_op_manage_key_flags_t)(1u << 1))

  Import a key and create a new identifier.
- #define HSM_OP_MANAGE_KEY_FLAGS_DELETE ((hsm_op_manage_key_flags_t)(1u << 2))

  Delete an existing key.
- #define HSM_OP_MANAGE_KEY_FLAGS_PART_UNIQUE_ROOT_KEK ((hsm_op_manage_key_flags_↩ t)(1u << 3))

  The key to be imported is encrypted using the part-unique root kek.
- #define HSM_OP_MANAGE_KEY_FLAGS_COMMON_ROOT_KEK ((hsm_op_manage_key_flags_t)(1u << 4))

  The key to be imported is encrypted using the common root kek.
- #define HSM_OP_MANAGE_KEY_FLAGS_OTP_ROOT_KEK ((hsm_op_manage_key_flags_t)(1u << 5))

  The key to be imported is encrypted using the otp root kek.
- #define HSM_OP_MANAGE_KEY_FLAGS_STRICT_OPERATION ((hsm_op_manage_key_flags_t)(1u << 7))

  The request is completed only when the new key has been written in the NVM. This is only applicable for persistent key.
- #define HSM_OP_MANAGE_KEY_GROUP_FLAGS_CACHE_LOCKDOWN ((hsm_op_manage_key_↩ group_flags_t)(1u << 0))

  The entire key group will be cached in the HSM local memory.
- #define HSM_OP_MANAGE_KEY_GROUP_FLAGS_CACHE_UNLOCK ((hsm_op_manage_key_group_↩ flags_t)(1u << 1))

  HSM may export the key group in the external NVM to free up the local memory. HSM will copy the key group in the local memory again in case of key group usage/update.
- #define HSM_OP_MANAGE_KEY_GROUP_FLAGS_DELETE ((hsm_op_manage_key_group_flags_t)(1u << 2))

  Delete an existing key group.
- #define HSM_OP_MANAGE_KEY_GROUP_FLAGS_STRICT_OPERATION ((hsm_op_manage_key_↩ group_flags_t)(1u << 7))

  The request is completed only when the update has been written in the NVM. Not applicable for cache lock-down/unlock.
- #define HSM_OP_BUTTERFLY_KEY_FLAGS_UPDATE ((hsm_op_but_key_exp_flags_t)(1u << 0))

  User can replace an existing key only by generating a key with the same type of the original one.
- #define HSM_OP_BUTTERFLY_KEY_FLAGS_CREATE ((hsm_op_but_key_exp_flags_t)(1u << 1))

  Create a new key.
- #define HSM_OP_BUTTERFLY_KEY_FLAGS_IMPLICIT_CERTIF ((hsm_op_but_key_exp_flags_t)(0u << 2))

  butterfly key expansion using implicit certificate.
- #define HSM_OP_BUTTERFLY_KEY_FLAGS_EXPLICIT_CERTIF ((hsm_op_but_key_exp_flags_t)(1u << 2))

butterfly key expansion using explicit certificate.

- #define HSM_OP_BUTTERFLY_KEY_FLAGS_STRICT_OPERATION ((hsm_op_but_key_exp_flags_t)(1u << 7))

  The request is completed only when the new key has been written in the NVM.

Typedefs

- typedef uint8_t **hsm_svc_key_management_flags_t**
- typedef uint8_t **hsm_op_key_gen_flags_t**
- typedef uint8_t **hsm_key_type_t**
- typedef uint16_t **hsm_key_info_t**
- typedef uint16_t **hsm_key_group_t**
- typedef uint8_t **hsm_op_key_gen_ext_flags_t**
- typedef uint8_t **hsm_op_manage_key_flags_t**
- typedef uint8_t **hsm_op_manage_key_ext_flags_t**
- typedef uint8_t **hsm_op_manage_key_group_flags_t**
- typedef uint8_t **hsm_op_but_key_exp_flags_t**

Functions

- hsm_err_t hsm_open_key_management_service (hsm_hdl_t key_store_hdl, open_svc_key_management_args_t *args, hsm_hdl_t *key_management_hdl)
- hsm_err_t hsm_generate_key (hsm_hdl_t key_management_hdl, op_generate_key_args_t *args)
- hsm_err_t hsm_generate_key_ext (hsm_hdl_t key_management_hdl, op_generate_key_ext_args_t *args)
- hsm_err_t hsm_manage_key (hsm_hdl_t key_management_hdl, op_manage_key_args_t *args)
- hsm_err_t hsm_manage_key_ext (hsm_hdl_t key_management_hdl, op_manage_key_ext_args_t *args)
- hsm_err_t hsm_manage_key_group (hsm_hdl_t key_management_hdl, op_manage_key_group_args_t *args)
- hsm_err_t hsm_butterfly_key_expansion (hsm_hdl_t key_management_hdl, op_butt_key_exp_args_t *args)
- hsm_err_t hsm_close_key_management_service (hsm_hdl_t key_management_hdl)

5.4.1 Detailed Description

5.4.2 Data Structure Documentation

Data Fields

hsm_svc_key_management_flags_t	flags	bitmap specifying the services properties.
uint8_t	reserved[3]	

5.4.2.1 struct open_svc_key_management_args_t

Data Fields

uint32_t *	key_identifier	pointer to the identifier of the key to be used for the operation. In case of create operation the new key identifier will be stored in this location.
uint16_t	out_size	length in bytes of the generated key. It must be 0 in case of symmetric keys.

Data Fields

hsm_op_key_gen_flags_t	flags	bitmap specifying the operation properties.
hsm_key_type_t	key_type	indicates which type of key must be generated.
hsm_key_group_t	key_group	Key group of the generated key. It must be a value in the range 0-1023. Keys belonging to the same group can be cached in the HSM local memory through the hsm_manage_key_group API.
hsm_key_info_t	key_info	bitmap specifying the properties of the key.
uint8_t *	out_key	pointer to the output area where the generated public key must be written.

5.4.2.2 struct op_generate_key_args_t

Data Fields

uint32_t *	key_identifier	pointer to the identifier of the key to be used for the operation. In case of create operation the new key identifier will be stored in this location.
uint16_t	out_size	length in bytes of the generated key. It must be 0 in case of symmetric keys.
hsm_op_key_gen_flags_t	flags	bitmap specifying the operation properties.
hsm_key_type_t	key_type	indicates which type of key must be generated.
hsm_key_group_t	key_group	Key group of the generated key. It must be a value in the range 0-1023. Keys belonging to the same group can be cached in the HSM local memory through the hsm_manage_key_group API.
hsm_key_info_t	key_info	bitmap specifying the properties of the key.
uint8_t *	out_key	pointer to the output area where the generated public key must be written.
uint8_t	min_mac_len	min mac length in bits to be set for this key, value 0 indicates use default (see op_mac_one_go_args_t for more details). Only accepted for keys that can be used for mac operations, must not be larger than maximum mac size that can be performed with the key. When in FIPS approved mode values $<$ 32 bits are not allowed.
uint8_t	reserved[3]	It must be 0.

5.4.2.3 struct op_generate_key_ext_args_t

Data Fields

uint32_t *	key_identifier	pointer to the identifier of the key to be used for the operation. In case of create operation the new key identifier will be stored in this location.
uint32_t	kek_identifier	identifier of the key to be used to decrypt the key to be imported (Key Encryption Key), only AES-256 key can be used as KEK. It must be 0 if the HSM_OP_MANAGE_KEY↩ _FLAGS_PART_UNIQUE_ROOT_KEK or HSM_OP_MANAGE_KEY_FLAGS_COMMON_ROOT_KEK or HSM_OP_MANAGE_KEY_FLAGS_OTP_ROOT_KEK flags are set.

Data Fields

uint16_t	input_size	length in bytes of the input key area. It must be eqaul to the length of the IV (12 bytes) + ciphertext + Tag (16 bytes). It must be 0 in case of delete operation.
hsm_op_manage_key_flags_t	flags	bitmap specifying the operation properties.
hsm_key_type_t	key_type	indicates the type of the key to be managed.
hsm_key_group_t	key_group	key group of the imported key. It must be a value in the range 0-1023. Keys belonging to the same group can be cached in the HSM local memory through the hsm_manage_key_group API.
hsm_key_info_t	key_info	bitmap specifying the properties of the key, in case of update operation it will replace the existing value. It must be 0 in case of delete operation.
uint8_t *	input_data	pointer to the input buffer. The input buffer is the concatenation of the IV, the encrypted key to be imported and the tag. It must be 0 in case of delete operation.

5.4.2.4 struct op_manage_key_args_t

Data Fields

uint32_t *	key_identifier	pointer to the identifier of the key to be used for the operation. In case of create operation the new key identifier will be stored in this location.
uint32_t	kek_identifier	identifier of the key to be used to decrypt the key to be imported (Key Encryption Key), only AES-256 key can be used as KEK. It must be 0 if the HSM_OP_MANAGE_KEY↩ _FLAGS_PART_UNIQUE_ROOT_KEK or HSM_OP_MANAGE_KEY_FLAGS_COMMON_ROOT_KEK or HSM_OP_MANAGE_KEY_FLAGS_OTP_ROOT_KEK flags are set.
uint16_t	input_size	length in bytes of the input key area. It must be eqaul to the length of the IV (12 bytes) + ciphertext + Tag (16 bytes). It must be 0 in case of delete operation.
hsm_op_manage_key_flags_t	flags	bitmap specifying the operation properties.
hsm_key_type_t	key_type	indicates the type of the key to be managed.
hsm_key_group_t	key_group	key group of the imported key. It must be a value in the range 0-1023. Keys belonging to the same group can be cached in the HSM local memory through the hsm_manage_key_group API.
hsm_key_info_t	key_info	bitmap specifying the properties of the key, in case of update operation it will replace the existing value. It must be 0 in case of delete operation.
uint8_t *	input_data	pointer to the input buffer. The input buffer is the concatenation of the IV, the encrypted key to be imported and the tag. It must be 0 in case of delete operation.
uint8_t	min_mac_len	min mac length in bits to be set for this key, value 0 indicates use default (see op_mac_one_go_args_t for more details). Only accepted for keys that can be used for mac operations, must not be larger than maximum mac size that can be performed with the key. When in FIPS approved mode values $<$ 32 bits are not allowed.

Data Fields

uint8_t	reserved[3]	It must be 0.

5.4.2.5 struct op_manage_key_ext_args_t

Data Fields

hsm_key_group_t	key_group	it must be a value in the range 0-1023. Keys belonging to the same group can be cached in the HSM local memory through the hsm_manage_key_group API.
hsm_op_manage_key_group_flags_t	flags	bitmap specifying the operation properties.
uint8_t	reserved	

5.4.2.6 struct op_manage_key_group_args_t

Data Fields

uint32_t	key_identifier	identifier of the key to be expanded.
uint8_t *	expansion_function_value	pointer to the expansion function value input
uint8_t *	hash_value	pointer to the hash value input. In case of explicit certificate, the hash value address must be set to 0.
uint8_t *	pr_reconstruction_value	pointer to the private reconstruction value input. In case of explicit certificate, the pr_reconstruction_value address must be set to 0.
uint8_t	expansion_function_value_size	length in bytes of the expansion function input
uint8_t	hash_value_size	length in bytes of the hash value input. In case of explicit certificate, the hash_value_size parameter must be set to 0.
uint8_t	pr_reconstruction_value_size	length in bytes of the private reconstruction value input. In case of explicit certificate, the pr_reconstruction_value_size parameter must be set to 0.
hsm_op_but_key_exp_flags_t	flags	bitmap specifying the operation properties
uint32_t *	dest_key_identifier	pointer to identifier of the derived key to be used for the operation. In case of create operation the new destination key identifier will be stored in this location.
uint8_t *	output	pointer to the output area where the public key must be written.
uint16_t	output_size	length in bytes of the generated key, if the size is 0, no key is copied in the output.
hsm_key_type_t	key_type	indicates the type of the key to be derived.

Data Fields

uint8_t	reserved	
hsm_key_group_t	key_group	it must be a value in the range 0-1023. Keys belonging to the same group can be cached in the HSM local memory through the hsm_manage_key_group API
hsm_key_info_t	key_info	bitmap specifying the properties of the derived key.

5.4.2.7 struct op_butt_key_exp_args_t

5.4.3 Function Documentation

5.4.3.1 hsm_open_key_management_service()

```
hsm_err_t hsm_open_key_management_service (
        hsm_hdl_t key_store_hdl,
        open_svc_key_management_args_t * args,
        hsm_hdl_t * key_management_hdl )
```

Open a key management service flow
User must open this service flow in order to perform operation on the key store keys (generate, update, delete)

Parameters

key_store_hdl	handle identifying the key store service flow.
args	pointer to the structure containing the function arguments.
key_management_hdl	pointer to where the key management service flow handle must be written.

Returns

error_code error code.

5.4.3.2 hsm_generate_key()

```
hsm_err_t hsm_generate_key (
        hsm_hdl_t key_management_hdl,
        op_generate_key_args_t * args )
```

Generate a key or a key pair. Only the confidential keys (symmetric and private keys) are stored in the internal key store, while the non-confidential keys (public key) are exported.
The generated key can be stored using a new or existing key identifier with the restriction that an existing key can be replaced only by a key of the same type.
The hsm_generate_key_ext function (described separately) allows additional settings. When using the hsm_↩ generate_key function, all additional settings are set to their default values.
User can call this function only after having opened a key management service flow.

Parameters

key_management_hdl	handle identifying the key management service flow.
args	pointer to the structure containing the function arguments.

Returns

error code

5.4.3.3 hsm_generate_key_ext()

```
hsm_err_t hsm_generate_key_ext (
        hsm_hdl_t key_management_hdl,
        op_generate_key_ext_args_t * args )
```

Generate a key or a key pair with extended settings. Basic operation is identical to hsm_generate_key, but accepts additional settings. Currently the min_mac_len is the only additional setting accepted.

Parameters

key_management_hdl	handle identifying the key management service flow.
args	pointer to the structure containing the function arguments.

Returns

error code

5.4.3.4 hsm_manage_key()

```
hsm_err_t hsm_manage_key (
        hsm_hdl_t key_management_hdl,
        op_manage_key_args_t * args )
```

This command is designed to perform the following operations:

- import a key creating a new key identifier (import and create)
- import a key using an existing key identifier (import and update)
- delete an existing key

The key encryption key (KEK) can be previously pre-shared or stored in the key store.

The key to be imported must be encrypted by using the KEK as following:

- Algorithm: AES GCM
- Key: root KEK
- AAD = 0

- IV = 12 bytes. When encrypting with a given key, the same IV MUST NOT be repeated. Refer to SP 800-38D for recommendations.
- Tag = 16 bytes
- Plaintext: key to be imported

In case the HSM_OP_MANAGE_KEY_FLAGS_OTP_ROOT_KEK is set, the OTP Root KEK is fetched from the OTP Space and used to derive a dedicated KEK per security enclave. The derivation scheme used is approved by NIST SP 800-108 "Recommendation for Key Derivation Using Pseudorandom Functions" and defined as following:

- key derivation scheme: CMAC based KDF in counter mode
- Number of Iterations: 2 iterations (256 bits generated)
- Label : "SECO HSM" or "V2X HSM" depending on the session priority and the operating mode used at the open session level
- Context : "NXP IMX8 DXL B0 OTP ROOT KEK" The OTP Root KEK is different from OEM open to OEM closed Lifecycle;
- OEM Open Lifecyle: this facsimile must be used "693f25bd6a299107cf7220b9ab504111fd3003bfe9aa38294262c3abab372790".
- OEM Closed Lifecyle: the OTP Root KEK generated as a valid AES-256 key and seculry provisoned by the OEM is used. In case the OTP Root KEK has not been provisoned, the HSM_OP_MANAGE_KEY_FLAGS↩ _OTP_ROOT_KEK can't be used.

The hsm_manage_key_ext function (described separately) allows additional settings when importing keys. When using the hsm_manage_key function to import a key, all additional settings are set to their default values

User can call this function only after having opened a key management service flow

Parameters

key_management_hdl	handle identifying the key management service flow.
args	pointer to the structure containing the function arguments.

Returns

error code

5.4.3.5 hsm_manage_key_ext()

```
hsm_err_t hsm_manage_key_ext (
        hsm_hdl_t key_management_hdl,
        op_manage_key_ext_args_t * args )
```

Manage a key or a key pair with extended settings. Basic operation is identical to hsm_manage_key, but accepts additional settings. Currently the min_mac_len is the only additional setting accepted.

Parameters

key_management_hdl	handle identifying the key management service flow.
args	pointer to the structure containing the function arguments.

Returns

error code

5.4.3.6 hsm_manage_key_group() `hsm_err_t hsm_manage_key_group (`

```
hsm_hdl_t key_management_hdl,
op_manage_key_group_args_t * args )
```

This command is designed to perform the following operations:

- lock/unlock down a key group in the HSM local memory so that the keys are available to the HSM without additional latency
- un-lock a key group. HSM may export the key group into the external NVM to free up local memory as needed
- delete an existing key group

User can call this function only after having opened a key management service flow.

Parameters

key_management_hdl	handle identifying the key management service flow.
args	pointer to the structure containing the function arguments.

Returns

error code

5.4.3.7 hsm_butterfly_key_expansion() `hsm_err_t hsm_butterfly_key_expansion (`

```
hsm_hdl_t key_management_hdl,
op_butt_key_exp_args_t * args )
```

This command is designed to perform the butterfly key expansion operation on an ECC private key in case of implicit and explicit certificates. Optionally the resulting public key is exported.
The result of the key expansion function f_k is calculated outside the HSM and passed as input. The expansion function is defined as f_k = f_k_int mod l , where l is the order of the group of points on the curve.
User can call this function only after having opened a key management service flow.

Explicit certificates:

- f_k = expansion function value

out_key = Key + f_k

Implicit certificates:

- f_k = expansion function value,
- hash = hash value used in the derivation of the pseudonym ECC key,
- pr_v = private reconstruction value

out_key = (Key + f_k)∗hash + pr_v

Parameters

key_management_hdl	handle identifying the key store management service flow.
args	pointer to the structure containing the function arguments.

Returns

error code

5.4.3.8 hsm_close_key_management_service() `hsm_err_t hsm_close_key_management_service ( hsm_hdl_t key_management_hdl )`

Terminate a previously opened key management service flow

Parameters

key_management_hdl	handle identifying the key management service flow.

Returns

error code

5.5 Ciphering

Modules

- i.MX8QXP specificities
- i.MX8DXL specificities

Data Structures

- struct open_svc_cipher_args_t
- struct op_cipher_one_go_args_t
- struct op_auth_enc_args_t
- struct op_ecies_dec_args_t

Macros

- #define **HSM_CIPHER_ONE_GO_ALGO_AES_ECB** ((hsm_op_cipher_one_go_algo_t)(0x00u))
- #define **HSM_CIPHER_ONE_GO_ALGO_AES_CBC** ((hsm_op_cipher_one_go_algo_t)(0x01u))
- #define HSM_CIPHER_ONE_GO_ALGO_AES_CCM ((hsm_op_cipher_one_go_algo_t)(0x04u))

  Perform AES CCM with following constraints: AES CCM where Adata = 0, Tlen = 16 bytes, nonce size depends on IV option.
- #define **HSM_CIPHER_ONE_GO_ALGO_SM4_ECB** ((hsm_op_cipher_one_go_algo_t)(0x10u))
- #define **HSM_CIPHER_ONE_GO_ALGO_SM4_CBC** ((hsm_op_cipher_one_go_algo_t)(0x11u))
- #define **HSM_CIPHER_ONE_GO_FLAGS_DECRYPT** ((hsm_op_cipher_one_go_flags_t)(0u << 0))

- #define **HSM_CIPHER_ONE_GO_FLAGS_ENCRYPT** ((hsm_op_cipher_one_go_flags_t)(1u << 0))
- #define HSM_CIPHER_ONE_GO_FLAGS_GENERATE_FULL_IV ((hsm_op_auth_enc_flags_t)(1u << 1))

  Full IV is internally generated (only relevant for CCM encryption)
- #define HSM_CIPHER_ONE_GO_FLAGS_GENERATE_COUNTER_IV ((hsm_op_auth_enc_flags_t)(1u << 2))

  User supplies 4 bytes of the IV (fixed part), the other bytes are internally generated (only relevant for CCM encryption)
- #define HSM_AUTH_ENC_ALGO_AES_GCM ((hsm_op_auth_enc_algo_t)(0x00u))

  Perform AES GCM with following constraints: AES GCM where AAD supported, Tag len = 16 bytes, IV len depends on IV option.
- #define HSM_AUTH_ENC_ALGO_SM4_CCM ((hsm_op_auth_enc_algo_t)(0x10u))

  Perform SM4 CCM with following constraints: SM4 CCM where AAD supported, Tag len = 16 bytes, IV len = 12 bytes.
- #define **HSM_AUTH_ENC_FLAGS_DECRYPT** ((hsm_op_auth_enc_flags_t)(0u << 0))
- #define **HSM_AUTH_ENC_FLAGS_ENCRYPT** ((hsm_op_auth_enc_flags_t)(1u << 0))
- #define HSM_AUTH_ENC_FLAGS_GENERATE_FULL_IV ((hsm_op_auth_enc_flags_t)(1u << 1))

  Full IV is internally generated (only relevant for encryption)
- #define HSM_AUTH_ENC_FLAGS_GENERATE_COUNTER_IV ((hsm_op_auth_enc_flags_t)(1u << 2))

  User supplies 4 bytes of the IV (fixed part), the other bytes are internally generated (only relevant for encryption)

Typedefs

- typedef uint8_t **hsm_svc_cipher_flags_t**
- typedef uint8_t **hsm_op_cipher_one_go_algo_t**
- typedef uint8_t **hsm_op_cipher_one_go_flags_t**
- typedef uint8_t **hsm_op_auth_enc_algo_t**
- typedef uint8_t **hsm_op_auth_enc_flags_t**
- typedef uint8_t **hsm_op_ecies_dec_flags_t**

Functions

- hsm_err_t hsm_open_cipher_service (hsm_hdl_t key_store_hdl, open_svc_cipher_args_t *args, hsm_hdl_t *cipher_hdl)
- hsm_err_t hsm_cipher_one_go (hsm_hdl_t cipher_hdl, op_cipher_one_go_args_t *args)
- hsm_err_t hsm_auth_enc (hsm_hdl_t cipher_hdl, op_auth_enc_args_t *args)
- hsm_err_t hsm_ecies_decryption (hsm_hdl_t cipher_hdl, op_ecies_dec_args_t *args)
- hsm_err_t hsm_close_cipher_service (hsm_hdl_t cipher_hdl)

5.5.1 Detailed Description

5.5.2 Data Structure Documentation

Data Fields

hsm_svc_cipher_flags_t	flags	bitmap specifying the services properties.
uint8_t	reserved[3]	

5.5.2.1 struct open_svc_cipher_args_t

Data Fields

uint32_t	key_identifier	identifier of the key to be used for the operation
uint8_t *	iv	pointer to the initialization vector (user supplied part of nonce in case of AES CCM)
uint16_t	iv_size	length in bytes of the initialization vector it must be 0 for algorithms not using the initialization vector. It must be 0 or 4 for AES in CCM mode depending on IV option
hsm_op_cipher_one_go_algo_t	cipher_algo	algorithm to be used for the operation
hsm_op_cipher_one_go_flags_t	flags	bitmap specifying the operation attributes
uint8_t *	input	pointer to the input area plaintext for encryption ciphertext for decryption (in case of CCM is the purported ciphertext)
uint8_t *	output	pointer to the output area ciphertext for encryption (in case of CCM is the output of the generation-encryption process + full IV) plaintext for decryption
uint32_t	input_size	length in bytes of the input. In case of CBC and ECB, the input size should be multiple of a block cipher size (16 bytes).
uint32_t	output_size	length in bytes of the output

5.5.2.2 struct op_cipher_one_go_args_t

Data Fields

uint32_t	key_identifier	identifier of the key to be used for the operation
uint8_t *	iv	pointer to the user supplied part of initialization vector or nonce, when applicable, otherwise 0
uint16_t	iv_size	length in bytes of the fixed part of the initialization vector for encryption (0 or 4 bytes), length in bytes of the full IV for decryption (12 bytes)
uint8_t *	aad	pointer to the additional authentication data
uint16_t	aad_size	length in bytes of the additional authentication data
hsm_op_auth_enc_algo_t	ae_algo	algorithm to be used for the operation
hsm_op_auth_enc_flags_t	flags	bitmap specifying the operation attributes
uint8_t *	input	pointer to the input area plaintext for encryption Ciphertext + Tag (16 bytes) for decryption
uint8_t *	output	pointer to the output area Ciphertext + Tag (16 bytes) + IV for encryption plaintext for decryption if the Tag is verified
uint32_t	input_size	length in bytes of the input
uint32_t	output_size	length in bytes of the output

5.5.2.3 struct op_auth_enc_args_t

Data Fields

uint32_t	key_identifier	identifier of the private key to be used for the operation
uint8_t *	input	pointer to the VCT input
uint8_t *	p1	pointer to the KDF P1 input parameter
uint8_t *	p2	pointer to the MAC P2 input parameter should be NULL
uint8_t *	output	pointer to the output area where the plaintext must be written
uint32_t	input_size	length in bytes of the input VCT should be equal to 96 bytes
uint32_t	output_size	length in bytes of the output plaintext should be equal to 16 bytes
uint16_t	p1_size	length in bytes of the KDF P1 parameter should be equal to 32 bytes
uint16_t	p2_size	length in bytes of the MAC P2 parameter should be zero reserved for generic use cases
uint16_t	mac_size	length in bytes of the requested message authentication code should be equal to 16 bytes
hsm_key_type_t	key_type	indicates the type of the used key
hsm_op_ecies_dec_flags_t	flags	bitmap specifying the operation attributes.

5.5.2.4 struct op_ecies_dec_args_t

5.5.3 Function Documentation

5.5.3.1 hsm_open_cipher_service()

```
hsm_err_t hsm_open_cipher_service (
        hsm_hdl_t key_store_hdl,
        open_svc_cipher_args_t * args,
        hsm_hdl_t * cipher_hdl )
```

Open a cipher service flow
User can call this function only after having opened a key store service flow.
User must open this service in order to perform cipher operation

Parameters

key_store_hdl	handle identifying the key store service flow.
args	pointer to the structure containing the function arguments.
cipher_hdl	pointer to where the cipher service flow handle must be written.

Returns

error code

5.5.3.2 hsm_cipher_one_go()

```
hsm_err_t hsm_cipher_one_go (
        hsm_hdl_t cipher_hdl,
        op_cipher_one_go_args_t * args )
```

Perform ciphering operation
User can call this function only after having opened a cipher service flow

For CCM encryption operations, either HSM_CIPHER_ONE_GO_FLAGS_GENERATE_FULL_IV or HSM_↩ CIPHER_ONE_GO_FLAGS_GENERATE_COUNTER_IV must be set when calling this function:

- When HSM_CIPHER_ONE_GO_FLAGS_GENERATE_FULL_IV is set, the full IV is internally generated, iv and iv_size must be set to 0
- When HSM_CIPHER_ONE_GO_FLAGS_GENERATE_COUNTER_IV is set, the user supplies a 4 byte fixed part of the IV. The other IV bytes are internally generated

Parameters

cipher_hdl	handle identifying the cipher service flow.
args	pointer to the structure containing the function arguments.

Returns

error code

5.5.3.3 hsm_auth_enc()

```
hsm_err_t hsm_auth_enc (
        hsm_hdl_t cipher_hdl,
        op_auth_enc_args_t * args )
```

Perform authenticated encryption operation
User can call this function only after having opened a cipher service flow

For decryption operations, the full IV is supplied by the caller via the iv and iv_size parameters. HSM_AUTH_ENC↩ _FLAGS_GENERATE_FULL_IV and HSM_AUTH_ENC_FLAGS_GENERATE_COUNTER_IV flags are ignored.
For encryption operations, either HSM_AUTH_ENC_FLAGS_GENERATE_FULL_IV or HSM_AUTH_ENC_↩ FLAGS_GENERATE_COUNTER_IV must be set when calling this function:

- When HSM_AUTH_ENC_FLAGS_GENERATE_FULL_IV is set, the full IV is internally generated, iv and iv↩ _size must be set to 0
- When HSM_AUTH_ENC_FLAGS_GENERATE_COUNTER_IV is set, the user supplies a 4 byte fixed part of the IV. The other IV bytes are internally generated

Parameters

cipher_hdl	handle identifying the cipher service flow.
args	pointer to the structure containing the function arguments.

Returns

error code

5.5.3.4 hsm_ecies_decryption() `hsm_err_t hsm_ecies_decryption (`

```
hsm_hdl_t cipher_hdl,
op_ecies_dec_args_t * args )
```

Decrypt data usign ECIES
User can call this function only after having opened a cipher store service flow.
ECIES is supported with the constraints specified in 1609.2-2016.

Parameters

session_hdl	handle identifying the current session.
args	pointer to the structure containing the function arguments.

Returns

error code

5.5.3.5 hsm_close_cipher_service() `hsm_err_t hsm_close_cipher_service (`

```
hsm_hdl_t cipher_hdl )
```

Terminate a previously opened cipher service flow

Parameters

cipher_hdl	pointer to handle identifying the cipher service flow to be closed.

Returns

error code

5.6 Signature generation

Modules

- i.MX8QXP specificities
- i.MX8DXL specificities

Data Structures

- struct open_svc_sign_gen_args_t
- struct op_generate_sign_args_t
- struct op_prepare_sign_args_t

Macros

- #define **HSM_SIGNATURE_SCHEME_ECDSA_NIST_P256_SHA_256** ((hsm_signature_scheme_id_↩ t)0x02u)
- #define **HSM_SIGNATURE_SCHEME_ECDSA_NIST_P384_SHA_384** ((hsm_signature_scheme_id_↩ t)0x03u)
- #define **HSM_SIGNATURE_SCHEME_ECDSA_NIST_P521_SHA_512** ((hsm_signature_scheme_id_↩ t)0x04u)
- #define **HSM_SIGNATURE_SCHEME_ECDSA_BRAINPOOL_R1_256_SHA_256** ((hsm_signature_↩ scheme_id_t)0x13u)
- #define **HSM_SIGNATURE_SCHEME_ECDSA_BRAINPOOL_R1_320_SHA_384** ((hsm_signature_↩ scheme_id_t)0x14u)
- #define **HSM_SIGNATURE_SCHEME_ECDSA_BRAINPOOL_R1_384_SHA_384** ((hsm_signature_↩ scheme_id_t)0x15u)
- #define **HSM_SIGNATURE_SCHEME_ECDSA_BRAINPOOL_R1_512_SHA_512** ((hsm_signature_↩ scheme_id_t)0x16u)
- #define **HSM_SIGNATURE_SCHEME_ECDSA_BRAINPOOL_T1_256_SHA_256** ((hsm_signature_↩ scheme_id_t)0x23u)
- #define **HSM_SIGNATURE_SCHEME_ECDSA_BRAINPOOL_T1_320_SHA_384** ((hsm_signature_↩ scheme_id_t)0x24u)
- #define **HSM_SIGNATURE_SCHEME_ECDSA_BRAINPOOL_T1_384_SHA_384** ((hsm_signature_↩ scheme_id_t)0x25u)
- #define **HSM_SIGNATURE_SCHEME_ECDSA_BRAINPOOL_T1_512_SHA_512** ((hsm_signature_↩ scheme_id_t)0x26u)
- #define **HSM_SIGNATURE_SCHEME_DSA_SM2_FP_256_SM3** ((hsm_signature_scheme_id_t)0x43u)
- #define **HSM_OP_GENERATE_SIGN_FLAGS_INPUT_DIGEST** ((hsm_op_generate_sign_flags_t)(0u << 0))
- #define **HSM_OP_GENERATE_SIGN_FLAGS_INPUT_MESSAGE** ((hsm_op_generate_sign_flags_t)(1u << 0))
- #define **HSM_OP_GENERATE_SIGN_FLAGS_COMPRESSED_POINT** ((hsm_op_generate_sign_flags_↩ t)(1u << 1))
- #define **HSM_OP_GENERATE_SIGN_FLAGS_LOW_LATENCY_SIGNATURE** ((hsm_op_generate_sign↩ _flags_t)(1u << 2))
- #define **HSM_OP_PREPARE_SIGN_INPUT_DIGEST** ((hsm_op_prepare_signature_flags_t)(0u << 0))
- #define **HSM_OP_PREPARE_SIGN_INPUT_MESSAGE** ((hsm_op_prepare_signature_flags_t)(1u << 0))
- #define **HSM_OP_PREPARE_SIGN_COMPRESSED_POINT** ((hsm_op_prepare_signature_flags_t)(1u << 1))

Typedefs

- typedef uint8_t **hsm_svc_signature_generation_flags_t**
- typedef uint8_t **hsm_signature_scheme_id_t**
- typedef uint8_t **hsm_op_generate_sign_flags_t**
- typedef uint8_t **hsm_op_prepare_signature_flags_t**

Functions

- hsm_err_t hsm_open_signature_generation_service (hsm_hdl_t key_store_hdl, open_svc_sign_gen_args_t *args, hsm_hdl_t *signature_gen_hdl)
- hsm_err_t hsm_close_signature_generation_service (hsm_hdl_t signature_gen_hdl)
- hsm_err_t hsm_generate_signature (hsm_hdl_t signature_gen_hdl, op_generate_sign_args_t *args)
- hsm_err_t hsm_prepare_signature (hsm_hdl_t signature_gen_hdl, op_prepare_sign_args_t *args)

5.6.1 Detailed Description

5.6.2 Data Structure Documentation

Data Fields

hsm_svc_signature_generation_flags_t	flags	bitmap specifying the services properties.
uint8_t	reserved[3]	

5.6.2.1 struct open_svc_sign_gen_args_t

Data Fields

uint32_t	key_identifier	identifier of the key to be used for the operation
uint8_t *	message	pointer to the input (message or message digest) to be signed
uint8_t *	signature	pointer to the output area where the signature must be stored. The signature S=(r,s) is stored in format r||s||Ry where Ry is an additional byte containing the lsb of y. Ry has to be considered valid only if the HSM_OP_↩ GENERATE_SIGN_FLAGS_COMPRESSED_POINT is set.
uint32_t	message_size	length in bytes of the input
uint16_t	signature_size	length in bytes of the output
hsm_signature_scheme_id_t	scheme_id	identifier of the digital signature scheme to be used for the operation
hsm_op_generate_sign_flags_t	flags	bitmap specifying the operation attributes

5.6.2.2 struct op_generate_sign_args_t

Data Fields

hsm_signature_scheme_id_t	scheme_id	identifier of the digital signature scheme to be used for the operation
hsm_op_prepare_signature_flags_t	flags	bitmap specifying the operation attributes
uint16_t	reserved	

5.6.2.3 struct op_prepare_sign_args_t

5.6.3 Function Documentation

5.6.3.1 hsm_open_signature_generation_service()

```
hsm_err_t hsm_open_signature_generation_service
(
        hsm_hdl_t key_store_hdl,
        open_svc_sign_gen_args_t * args,
        hsm_hdl_t * signature_gen_hdl )
```

Open a signature generation service flow
User can call this function only after having opened a key store service flow.
User must open this service in order to perform signature generation operations.

Parameters

key_store_hdl	handle identifying the key store service flow.
args	pointer to the structure containing the function arguments.
signature_gen_hdl	pointer to where the signature generation service flow handle must be written.

Returns

error code

5.6.3.2 hsm_close_signature_generation_service()

```
hsm_err_t hsm_close_signature_generation_service (
            hsm_hdl_t signature_gen_hdl )
```

Terminate a previously opened signature generation service flow

Parameters

signature_gen_hdl	handle identifying the signature generation service flow to be closed.

Returns

error code

5.6.3.3 hsm_generate_signature()

```
hsm_err_t hsm_generate_signature (
            hsm_hdl_t signature_gen_hdl,
            op_generate_sign_args_t * args )
```

Generate a digital signature according to the signature scheme
User can call this function only after having opened a signature generation service flow
The signature S=(r,s) is stored in the format r||s||Ry where Ry is an additional byte containing the lsb of y. Ry has to be considered valid only if the HSM_OP_GENERATE_SIGN_FLAGS_COMPRESSED_POINT is set.

In case of HSM_SIGNATURE_SCHEME_DSA_SM2_FP_256_SM3, message of op_generate_sign_args_t should be (as specified in GB/T 32918):

- equal to Z||M in case of HSM_OP_GENERATE_SIGN_FLAGS_INPUT_MESSAGE
- equal to SM3(Z||M) in case of HSM_OP_GENERATE_SIGN_FLAGS_INPUT_DIGEST

Parameters

signature_gen_hdl	handle identifying the signature generation service flow.
args	pointer to the structure containing the function arguments.

Returns

error code

5.6.3.4 hsm_prepare_signature()

```
hsm_err_t hsm_prepare_signature (
        hsm_hdl_t signature_gen_hdl,
        op_prepare_sign_args_t * args )
```

Prepare the creation of a signature by pre-calculating the operations having not dependencies on the input message.
The pre-calculated value will be stored internally and used once call hsm_generate_signature. Up to 20 pre-calculated values can be stored, additional preparation operations will have no effects.
User can call this function only after having opened a signature generation service flow
The signature S=(r,s) is stored in the format r||s||Ry where Ry is an additional byte containing the lsb of y, Ry has to be considered valid only if the HSM_OP_PREPARE_SIGN_COMPRESSED_POINT is set.

Parameters

signature_gen_hdl	handle identifying the signature generation service flow
args	pointer to the structure containing the function arguments.

Returns

error code

5.7 Signature verification

Modules

- i.MX8QXP specificities
- i.MX8DXL specificities

Data Structures

- struct open_svc_sign_ver_args_t
- struct op_verify_sign_args_t
- struct op_import_public_key_args_t

Macros

- #define **HSM_OP_VERIFY_SIGN_FLAGS_INPUT_DIGEST** ((hsm_op_verify_sign_flags_t)(0u << 0))
- #define **HSM_OP_VERIFY_SIGN_FLAGS_INPUT_MESSAGE** ((hsm_op_verify_sign_flags_t)(1u << 0))
- #define **HSM_OP_VERIFY_SIGN_FLAGS_COMPRESSED_POINT** ((hsm_op_verify_sign_flags_t)(1u << 1))
- #define HSM_OP_VERIFY_SIGN_FLAGS_KEY_INTERNAL ((hsm_op_verify_sign_flags_t)(1u << 2))

  when set the value passed by the key argument is considered as the internal reference of a key imported through the hsm_import_pub_key API.
- #define **HSM_VERIFICATION_STATUS_SUCCESS** ((hsm_verification_status_t)(0x5A3CC3A5u))

Typedefs

- typedef uint8_t **hsm_svc_signature_verification_flags_t**
- typedef uint8_t **hsm_op_verify_sign_flags_t**
- typedef uint32_t **hsm_verification_status_t**
- typedef uint8_t **hsm_op_import_public_key_flags_t**

Functions

- hsm_err_t hsm_open_signature_verification_service (hsm_hdl_t session_hdl, open_svc_sign_ver_args_t *args, hsm_hdl_t *signature_ver_hdl)
- hsm_err_t hsm_verify_signature (hsm_hdl_t signature_ver_hdl, op_verify_sign_args_t *args, hsm_↩ verification_status_t *status)
- hsm_err_t hsm_import_public_key (hsm_hdl_t signature_ver_hdl, op_import_public_key_args_t *args, uint32_t *key_ref)
- hsm_err_t hsm_close_signature_verification_service (hsm_hdl_t signature_ver_hdl)

5.7.1 Detailed Description

5.7.2 Data Structure Documentation

Data Fields

hsm_svc_signature_verification_flags_t	flags	bitmap indicating the service flow properties
uint8_t	reserved[3]	

5.7.2.1 struct open_svc_sign_ver_args_t

Data Fields

uint8_t *	key	pointer to the public key to be used for the verification. If the HSM_OP_VERIFY_SIGN_FLAGS_KEY_INTERNAL is set, it must point to the key reference returned by the hsm_import_public_key API.
uint8_t *	message	pointer to the input (message or message digest)
uint8_t *	signature	pointer to the input signature. The signature S=(r,s) is expected to be in the format r||s||Ry where Ry is an additional byte containing the lsb of y. Ry will be considered as valid only if the HSM_OP_VERIFY_SIGN_FLAGS_COMPRESSED_POINT is set.
uint16_t	key_size	length in bytes of the input key
uint16_t	signature_size	length in bytes of the output - it must contain one additional byte where to store the Ry.
uint32_t	message_size	length in bytes of the input message
hsm_signature_scheme_id_t	scheme_id	identifier of the digital signature scheme to be used for the operation
hsm_op_verify_sign_flags_t	flags	bitmap specifying the operation attributes
uint16_t	reserved	

5.7.2.2 struct op_verify_sign_args_t

Data Fields

uint8_t *	key	pointer to the public key to be imported
uint16_t	key_size	length in bytes of the input key
hsm_key_type_t	key_type	indicates the type of the key to be imported.
hsm_op_import_public_key_flags_t	flags	bitmap specifying the operation attributes

5.7.2.3 struct op_import_public_key_args_t

5.7.3 Function Documentation

5.7.3.1 hsm_open_signature_verification_service()

```
hsm_err_t hsm_open_signature_verification_service (
            hsm_hdl_t session_hdl,
            open_svc_sign_ver_args_t * args,
            hsm_hdl_t * signature_ver_hdl )
```

User must open this service in order to perform signature verification operations.
User can call this function only after having opened a session.

Parameters

session_hdl	handle identifying the current session.
args	pointer to the structure containing the function arguments.
signature_ver_hdl	pointer to where the signature verification service flow handle must be written.

Returns

error code

5.7.3.2 hsm_verify_signature()

```
hsm_err_t hsm_verify_signature (
            hsm_hdl_t signature_ver_hdl,
            op_verify_sign_args_t * args,
            hsm_verification_status_t * status )
```

Verify a digital signature according to the signature scheme
User can call this function only after having opened a signature verification service flow
The signature S=(r,s) is expected to be in format r||s||Ry where Ry is an additional byte containing the lsb of y. Ry will be considered as valid only if the HSM_OP_VERIFY_SIGN_FLAGS_COMPRESSED_POINT is set.
Only not-compressed keys (x,y) can be used by this command. Compressed keys can be decompressed by using the dedicated API.

In case of HSM_SIGNATURE_SCHEME_DSA_SM2_FP_256_SM3, message of op_verify_sign_args_t should be (as specified in GB/T 32918):

- equal to Z||M in case of HSM_OP_VERIFY_SIGN_FLAGS_INPUT_MESSAGE
- equal to SM3(Z||M) in case of HSM_OP_VERIFY_SIGN_FLAGS_INPUT_DIGEST

Parameters

signature_ver_hdl	handle identifying the signature verification service flow.
args	pointer to the structure containing the function arguments.
status	pointer to where the verification status must be stored if the verification suceed the value HSM_VERIFICATION_STATUS_SUCCESS is returned.

Returns

error code

5.7.3.3 hsm_import_public_key()

```
hsm_err_t hsm_import_public_key (
        hsm_hdl_t signature_ver_hdl,
        op_import_public_key_args_t * args,
        uint32_t * key_ref )
```

Import a public key to be used for several verification operations, a reference to the imported key is returned.
User can use the returned reference in the hsm_verify_signature API by setting the HSM_OP_VERIFY_SIGN_↩ FLAGS_KEY_INTERNAL flag
Only not-compressed keys (x,y) can be imported by this command. Compressed keys can be decompressed by using the dedicated API. User can call this function only after having opened a signature verification service flow.

Parameters

signature_ver_hdl	handle identifying the signature verification service flow.
args	pointer to the structure containing the function arguments.
key_ref	pointer to where the 4 bytes key reference to be used as key in the hsm_verify_signature will be stored

Returns

error code

5.7.3.4 hsm_close_signature_verification_service()

```
hsm_err_t hsm_close_signature_verification_↩
service (
        hsm_hdl_t signature_ver_hdl )
```

Terminate a previously opened signature verification service flow

Parameters

signature_ver_hdl	handle identifying the signature verification service flow to be closed.

Returns

error code

5.8 Random number generation

Data Structures

- struct open_svc_rng_args_t
- struct op_get_random_args_t

Typedefs

- typedef uint8_t **hsm_svc_rng_flags_t**

Functions

- hsm_err_t hsm_open_rng_service (hsm_hdl_t session_hdl, open_svc_rng_args_t *args, hsm_hdl_t *rng_hdl)
- hsm_err_t hsm_close_rng_service (hsm_hdl_t rng_hdl)
- hsm_err_t hsm_get_random (hsm_hdl_t rng_hdl, op_get_random_args_t *args)

5.8.1 Detailed Description

5.8.2 Data Structure Documentation

Data Fields

hsm_svc_rng_flags_t	flags	bitmap indicating the service flow properties
uint8_t	reserved[3]	

5.8.2.1 struct open_svc_rng_args_t

Data Fields

uint8_t *	output	pointer to the output area where the random number must be written
uint32_t	random_size	length in bytes of the random number to be provided.

5.8.2.2 struct op_get_random_args_t

5.8.3 Function Documentation

5.8.3.1 hsm_open_rng_service() hsm_err_t hsm_open_rng_service (

```
hsm_hdl_t session_hdl,
open_svc_rng_args_t * args,
hsm_hdl_t * rng_hdl )
```

Open a random number generation service flow
User can call this function only after having opened a session.
User must open this service in order to perform rng operations.

Parameters

session_hdl	handle identifying the current session.
args	pointer to the structure containing the function arguments.
rng_hdl	pointer to where the rng service flow handle must be written.

Returns

error code

5.8.3.2 hsm_close_rng_service() hsm_err_t hsm_close_rng_service (

```
hsm_hdl_t rng_hdl )
```

Terminate a previously opened rng service flow

Parameters

rng_hdl	handle identifying the rng service flow to be closed.

Returns

error code

5.8.3.3 hsm_get_random() hsm_err_t hsm_get_random (

```
hsm_hdl_t rng_hdl,
op_get_random_args_t * args )
```

Get a freshly generated random number
User can call this function only after having opened a rng service flow

Parameters

rng_hdl	handle identifying the rng service flow.
args	pointer to the structure containing the function arguments.

Returns

error code

5.9 Hashing

Modules

- i.MX8QXP specificities

Data Structures

- struct open_svc_hash_args_t
- struct op_hash_one_go_args_t

Macros

- #define **HSM_HASH_ALGO_SHA_224** ((hsm_hash_algo_t)(0x0u))
- #define **HSM_HASH_ALGO_SHA_256** ((hsm_hash_algo_t)(0x1u))
- #define **HSM_HASH_ALGO_SHA_384** ((hsm_hash_algo_t)(0x2u))
- #define **HSM_HASH_ALGO_SHA_512** ((hsm_hash_algo_t)(0x3u))
- #define **HSM_HASH_ALGO_SM3_256** ((hsm_hash_algo_t)(0x11u))

Typedefs

- typedef uint8_t **hsm_svc_hash_flags_t**
- typedef uint8_t **hsm_hash_algo_t**
- typedef uint8_t **hsm_op_hash_one_go_flags_t**

Functions

- hsm_err_t hsm_open_hash_service (hsm_hdl_t session_hdl, open_svc_hash_args_t *args, hsm_hdl_t *hash_hdl)
- hsm_err_t hsm_close_hash_service (hsm_hdl_t hash_hdl)
- hsm_err_t hsm_hash_one_go (hsm_hdl_t hash_hdl, op_hash_one_go_args_t *args)

5.9.1 Detailed Description

5.9.2 Data Structure Documentation

Data Fields

hsm_svc_hash_flags_t	flags	bitmap indicating the service flow properties
uint8_t	reserved[3]	

5.9.2.1 struct open_svc_hash_args_t

Data Fields

uint8_t *	input	pointer to the input data to be hashed
uint8_t *	output	pointer to the output area where the resulting digest must be written
uint32_t	input_size	length in bytes of the input
uint32_t	output_size	length in bytes of the output
hsm_hash_algo_t	algo	hash algorithm to be used for the operation
hsm_op_hash_one_go_flags_t	flags	flags bitmap specifying the operation attributes.
uint16_t	reserved	

5.9.2.2 struct op_hash_one_go_args_t

5.9.3 Function Documentation

5.9.3.1 hsm_open_hash_service()

```
hsm_err_t hsm_open_hash_service (
        hsm_hdl_t session_hdl,
        open_svc_hash_args_t * args,
        hsm_hdl_t * hash_hdl )
```

Open an hash service flow
User can call this function only after having opened a session.
User must open this service in order to perform hash operations.

Parameters

session_hdl	handle identifying the current session.
args	pointer to the structure containing the function arguments.
hash_hdl	pointer to where the hash service flow handle must be written.

Returns

error code

5.9.3.2 hsm_close_hash_service() hsm_err_t hsm_close_hash_service (hsm_hdl_t *hash_hdl*)

Terminate a previously opened hash service flow

Parameters

hash_hdl	handle identifying the hash service flow to be closed.

Returns

error code

5.9.3.3 hsm_hash_one_go()

```
hsm_err_t hsm_hash_one_go (
        hsm_hdl_t hash_hdl,
        op_hash_one_go_args_t * args )
```

Perform the hash operation on a given input
User can call this function only after having opened a hash service flow

Parameters

hash_hdl	handle identifying the hash service flow.
args	pointer to the structure containing the function arguments.

Returns

error code

5.10 Public key reconstruction

Modules

- i.MX8QXP specificities
- i.MX8DXL specificities

Data Structures

- struct op_pub_key_rec_args_t

Typedefs

- typedef uint8_t **hsm_op_pub_key_rec_flags_t**

Functions

- hsm_err_t hsm_pub_key_reconstruction (hsm_hdl_t session_hdl, op_pub_key_rec_args_t *args)

5.10.1 Detailed Description

5.10.2 Data Structure Documentation

Data Fields

uint8_t *	pub_rec	pointer to the public reconstruction value extracted from the implicit certificate.
uint8_t *	hash	pointer to the input hash value. In the butterfly scheme it corresponds to the hash value calculated over PCA certificate and, concatenated, the implicit certificat.
uint8_t *	ca_key	pointer to the CA public key
uint8_t *	out_key	pointer to the output area where the reconstructed public key must be written.
uint16_t	pub_rec_size	length in bytes of the public reconstruction value
uint16_t	hash_size	length in bytes of the input hash
uint16_t	ca_key_size	length in bytes of the input CA public key
uint16_t	out_key_size	length in bytes of the output key
hsm_key_type_t	key_type	indicates the type of the managed key.
hsm_op_pub_key_rec_flags_t	flags	flags bitmap specifying the operation attributes.
uint16_t	reserved	

5.10.2.1 struct op_pub_key_rec_args_t

5.10.3 Function Documentation

5.10.3.1 hsm_pub_key_reconstruction()

```
hsm_err_t hsm_pub_key_reconstruction (
        hsm_hdl_t session_hdl,
        op_pub_key_rec_args_t * args )
```

Reconstruct an ECC public key provided by an implicit certificate
User can call this function only after having opened a session
This API implements the followign formula:
out_key = (pub_rec * hash) + ca_key

Parameters

session_hdl	handle identifying the current session.
args	pointer to the structure containing the function arguments.

Returns

error code

5.11 Public key decompression

Modules

- i.MX8QXP specificities

Data Structures

- struct op_pub_key_dec_args_t

Typedefs

- typedef uint8_t **hsm_op_pub_key_dec_flags_t**

Functions

- hsm_err_t hsm_pub_key_decompression (hsm_hdl_t session_hdl, op_pub_key_dec_args_t *args)

5.11.1 Detailed Description

5.11.2 Data Structure Documentation

Data Fields

uint8_t *	key	pointer to the compressed ECC public key. The expected key format is x||lsb_y where lsb_y is 1 byte having value 1 if the least-significant bit of the original (uncompressed) y coordinate is set, and 0 otherwise.
uint8_t *	out_key	pointer to the output area where the decompressed public key must be written.
uint16_t	key_size	length in bytes of the input compressed public key
uint16_t	out_key_size	length in bytes of the resulting public key
hsm_key_type_t	key_type	indicates the type of the manged keys.
hsm_op_pub_key_dec_flags_t	flags	bitmap specifying the operation attributes.
uint16_t	reserved	

5.11.2.1 struct op_pub_key_dec_args_t

5.11.3 Function Documentation

5.11.3.1 hsm_pub_key_decompression()

```
hsm_err_t hsm_pub_key_decompression (
        hsm_hdl_t session_hdl,
        op_pub_key_dec_args_t * args )
```

Decompress an ECC public key
The expected key format is x||lsb_y where lsb_y is 1 byte having value 1 if the least-significant bit of the original (uncompressed) y coordinate is set, and 0 otherwise.
User can call this function only after having opened a session

Parameters

session_hdl	handle identifying the current session.
args	pointer to the structure containing the function arguments.

Returns

error code

5.12 ECIES encryption

Modules

- i.MX8QXP specificities
- i.MX8DXL specificities

Data Structures

- struct op_ecies_enc_args_t

Typedefs

- typedef uint8_t **hsm_op_ecies_enc_flags_t**

Functions

- hsm_err_t hsm_ecies_encryption (hsm_hdl_t session_hdl, op_ecies_enc_args_t *args)

5.12.1 Detailed Description

5.12.2 Data Structure Documentation

Data Fields

uint8_t *	input	pointer to the input plaintext
uint8_t *	pub_key	pointer to the input recipient public key
uint8_t *	p1	pointer to the KDF P1 input parameter
uint8_t *	p2	pointer to the MAC P2 input parameter should be NULL
uint8_t *	output	pointer to the output area where the VCT must be written
uint32_t	input_size	length in bytes of the input plaintext should be equal to 16 bytes
uint16_t	p1_size	length in bytes of the KDF P1 parameter should be equal to 32 bytes
uint16_t	p2_size	length in bytes of the MAC P2 parameter should be zero reserved for generic use cases
uint16_t	pub_key_size	length in bytes of the recipient public key should be equal to 64 bytes
uint16_t	mac_size	length in bytes of the requested message authentication code should be equal to 16 bytes
uint32_t	out_size	length in bytes of the output VCT should be equal to 96 bytes
hsm_key_type_t	key_type	indicates the type of the recipient public key
hsm_op_ecies_enc_flags_t	flags	bitmap specifying the operation attributes.
uint16_t	reserved	

5.12.2.1 struct op_ecies_enc_args_t

5.12.3 Function Documentation

5.12.3.1 hsm_ecies_encryption()

```
hsm_err_t hsm_ecies_encryption (
        hsm_hdl_t session_hdl,
        op_ecies_enc_args_t * args )
```

Encrypt data usign ECIES
User can call this function only after having opened a session.
ECIES is supported with the constraints specified in 1609.2-2016.

Parameters

session_hdl	handle identifying the current session.
args	pointer to the structure containing the function arguments.

Returns

error code

5.13 Public key recovery

Data Structures

- struct op_pub_key_recovery_args_t

Typedefs

- typedef uint8_t **hsm_op_pub_key_recovery_flags_t**

Functions

- hsm_err_t hsm_pub_key_recovery (hsm_hdl_t key_store_hdl, op_pub_key_recovery_args_t *args)

5.13.1 Detailed Description

5.13.2 Data Structure Documentation

Data Fields

uint32_t	key_identifier	pointer to the identifier of the key to be used for the operation
uint8_t *	out_key	pointer to the output area where the generated public key must be written
uint16_t	out_key_size	length in bytes of the output key
hsm_key_type_t	key_type	indicates the type of the key to be recovered
hsm_op_pub_key_recovery_flags_t	flags	bitmap specifying the operation attributes.

5.13.2.1 struct op_pub_key_recovery_args_t

5.13.3 Function Documentation

5.13.3.1 hsm_pub_key_recovery()

```
hsm_err_t hsm_pub_key_recovery (
        hsm_hdl_t key_store_hdl,
        op_pub_key_recovery_args_t * args )
```

Recover Public key from private key present in key store
User can call this function only after having opened a key store.

Parameters

key_store_hdl	handle identifying the current key store.
args	pointer to the structure containing the function arguments.

Returns

error code

5.14 Data storage

Data Structures

- struct open_svc_data_storage_args_t
- struct op_data_storage_args_t

Macros

- #define HSM_OP_DATA_STORAGE_FLAGS_STORE ((hsm_op_data_storage_flags_t)(1u << 0))
  Store data.
- #define HSM_OP_DATA_STORAGE_FLAGS_RETRIEVE ((hsm_op_data_storage_flags_t)(0u << 0))
  Retrieve data.

Typedefs

- typedef uint8_t **hsm_svc_data_storage_flags_t**
- typedef uint8_t **hsm_op_data_storage_flags_t**

Functions

- hsm_err_t hsm_open_data_storage_service (hsm_hdl_t key_store_hdl, open_svc_data_storage_args_t *args, hsm_hdl_t *data_storage_hdl)
- hsm_err_t hsm_data_storage (hsm_hdl_t data_storage_hdl, op_data_storage_args_t *args)
- hsm_err_t hsm_close_data_storage_service (hsm_hdl_t data_storage_hdl)

5.14.1 Detailed Description

5.14.2 Data Structure Documentation

Data Fields

hsm_svc_data_storage_flags_t	flags	bitmap specifying the services properties.
uint8_t	reserved[3]	

5.14.2.1 struct open_svc_data_storage_args_t

Data Fields

uint8_t *	data	pointer to the data. In case of store request, it will be the input data to store. In case of retrieve, it will be the the pointer where to load data.
uint32_t	data_size	length in bytes of the data
uint16_t	data_id	id of the data
hsm_op_data_storage_flags_t	flags	flags bitmap specifying the operation attributes.
uint8_t	reserved	

5.14.2.2 struct op_data_storage_args_t

5.14.3 Function Documentation

5.14.3.1 hsm_open_data_storage_service()

```
hsm_err_t hsm_open_data_storage_service (
        hsm_hdl_t key_store_hdl,
        open_svc_data_storage_args_t * args,
        hsm_hdl_t * data_storage_hdl )
```

Open a data storage service flow
User must open this service flow in order to store/retreive generic data in/from the HSM.

Parameters

key_store_hdl	handle identifying the key store service flow.
args	pointer to the structure containing the function arguments.
data_storage_hdl	pointer to where the data storage service flow handle must be written.

Returns

error_code error code.

5.14.3.2 hsm_data_storage()

```
hsm_err_t hsm_data_storage (
        hsm_hdl_t data_storage_hdl,
        op_data_storage_args_t * args )
```

Store or retrieve generic data identified by a data_id.

Parameters

data_storage_hdl	handle identifying the data storage service flow.
args	pointer to the structure containing the function arguments.

Returns

error code

5.14.3.3 hsm_close_data_storage_service() `hsm_err_t hsm_close_data_storage_service ( hsm_hdl_t data_storage_hdl )`

Terminate a previously opened data storage service flow

Parameters

data_storage_hdl	handle identifying the data storage service flow.

Returns

error code

5.15 Root KEK export

Data Structures

- struct op_export_root_kek_args_t

Macros

- #define **HSM_OP_EXPORT_ROOT_KEK_FLAGS_COMMON_KEK** ((hsm_op_export_root_kek_flags_t)(1u << 0))
- #define **HSM_OP_EXPORT_ROOT_KEK_FLAGS_UNIQUE_KEK** ((hsm_op_export_root_kek_flags_t)(0u << 0))

Typedefs

- typedef uint8_t **hsm_op_export_root_kek_flags_t**

Functions

- hsm_err_t hsm_export_root_key_encryption_key (hsm_hdl_t session_hdl, op_export_root_kek_args_t *args)

5.15.1 Detailed Description

5.15.2 Data Structure Documentation

Data Fields

uint8_t *	signed_message	pointer to signed_message authorizing the operation
uint8_t *	out_root_kek	pointer to the output area where the derived root kek (key encryption key) must be written
uint16_t	signed_msg_size	size of the signed_message authorizing the operation
uint8_t	root_kek_size	length in bytes of the root kek. Must be 32 bytes.
hsm_op_export_root_kek_flags_t	flags	flags bitmap specifying the operation attributes.
uint8_t	reserved[2]	

5.15.2.1 struct op_export_root_kek_args_t

5.15.3 Function Documentation

5.15.3.1 hsm_export_root_key_encryption_key()

```
hsm_err_t hsm_export_root_key_encryption_key (
    hsm_hdl_t session_hdl,
    op_export_root_kek_args_t * args )
```

Export the root key encryption key. This key is derived on chip. It can be common or chip unique. This key will be used to import key in the key store through the manage key API.

Parameters

session_hdl	handle identifying the current session.
args	pointer to the structure containing the function arguments.

Returns

error code

5.16 Get info

Data Structures

- struct op_get_info_args_t

Functions

- hsm_err_t hsm_get_info (hsm_hdl_t session_hdl, op_get_info_args_t *args)

5.16.1 Detailed Description

5.16.2 Data Structure Documentation

Data Fields

uint32_t *	user_sab_id	pointer to the output area where the user identifier (32bits) must be written
uint8_t *	chip_unique_id	pointer to the output area where the chip unique identifier (64bits) must be written
uint16_t *	chip_monotonic_counter	pointer to the output are where the chip monotonic counter value (16bits) must be written
uint16_t *	chip_life_cycle	pointer to the output area where the chip current life cycle bitfield (16bits) must be written
uint32_t *	version	pointer to the output area where the module version (32bits) must be written
uint32_t *	version_ext	pointer to the output area where module extended version (32bits) must be written
uint8_t *	fips_mode	pointer to the output area where the FIPS mode bitfield (8bits) must be written. Bitmask definition: bit0 - FIPS mode of operation: - value 0 - part is running in FIPS non-approved mode. - value 1 - part is running in FIPS approved mode. bit1 - FIPS certified part: - value 0 - part is not FIPS certified. - value 1 - part is FIPS certified. bit2-7: reserved - 0 value.

5.16.2.1 struct op_get_info_args_t

5.16.3 Function Documentation

5.16.3.1 hsm_get_info()

```
hsm_err_t hsm_get_info (
        hsm_hdl_t session_hdl,
        op_get_info_args_t * args )
```

Parameters

session_hdl	handle identifying the current session.
args	pointer to the structure containing the function arguments.

Returns

error code

5.17 Mac

Modules

- i.MX8QXP specificities
- i.MX8DXL specificities

Data Structures

- struct open_svc_mac_args_t
- struct op_mac_one_go_args_t

Macros

- #define **HSM_OP_MAC_ONE_GO_FLAGS_MAC_VERIFICATION** ((hsm_op_mac_one_go_flags_t)(0u << 0))
- #define **HSM_OP_MAC_ONE_GO_FLAGS_MAC_GENERATION** ((hsm_op_mac_one_go_flags_t)(1u << 0))
- #define **HSM_OP_MAC_ONE_GO_FLAGS_MAC_LENGTH_IN_BITS** ((hsm_op_mac_one_go_flags_t)(1u << 1))
- #define **HSM_OP_MAC_ONE_GO_FLAGS_EXCLUSIVE_CMAC_CRYPTO_ENGINE** ((hsm_op_mac_↩ one_go_flags_t)(1u << 2))
- #define **HSM_OP_MAC_ONE_GO_ALGO_AES_CMAC** ((hsm_op_mac_one_go_algo_t)(0x01u))
- #define **HSM_OP_MAC_ONE_GO_ALGO_HMAC_SHA_224** ((hsm_op_mac_one_go_algo_t)(0x05u))
- #define **HSM_OP_MAC_ONE_GO_ALGO_HMAC_SHA_256** ((hsm_op_mac_one_go_algo_t)(0x06u))
- #define **HSM_OP_MAC_ONE_GO_ALGO_HMAC_SHA_384** ((hsm_op_mac_one_go_algo_t)(0x07u))
- #define **HSM_OP_MAC_ONE_GO_ALGO_HMAC_SHA_512** ((hsm_op_mac_one_go_algo_t)(0x08u))
- #define **HSM_MAC_VERIFICATION_STATUS_SUCCESS** ((hsm_mac_verification_status_t)(0x6C1AA1↩ C6u))

Typedefs

- typedef uint8_t **hsm_svc_mac_flags_t**
- typedef uint8_t **hsm_op_mac_one_go_algo_t**
- typedef uint8_t **hsm_op_mac_one_go_flags_t**
- typedef uint32_t **hsm_mac_verification_status_t**

Functions

- hsm_err_t hsm_open_mac_service (hsm_hdl_t key_store_hdl, open_svc_mac_args_t *args, hsm_hdl_↩ t *mac_hdl)
- hsm_err_t hsm_mac_one_go (hsm_hdl_t mac_hdl, op_mac_one_go_args_t *args, hsm_mac_verification↩ _status_t *status)
- hsm_err_t hsm_close_mac_service (hsm_hdl_t mac_hdl)

5.17.1 Detailed Description

5.17.2 Data Structure Documentation

Data Fields

hsm_svc_mac_flags_t	flags	bitmap specifying the services properties.
uint8_t	reserved[3]	

5.17.2.1 struct open_svc_mac_args_t

Data Fields

uint32_t	key_identifier	identifier of the key to be used for the operation
hsm_op_mac_one_go_algo_t	algorithm	algorithm to be used for the operation
hsm_op_mac_one_go_flags_t	flags	bitmap specifying the operation attributes
uint8_t *	payload	pointer to the payload area
uint8_t *	mac	pointer to the tag area
uint16_t	payload_size	length in bytes of the payload
uint16_t	mac_size	length of the tag. Specified in bytes if HSM_OP_MAC_↩ ONE_GO_FLAGS_MAC_LENGTH_IN_BITS is clear, specified in bits when HSM_OP_MAC_ONE_GO_FLAGS↩ _MAC_LENGTH_IN_BITS is set. When specified in bytes the mac size cannot be less than 4 bytes. When specified in bits the mac size cannot be less than: - the key specific min_mac_len setting if specified for this key when generated/injected or - the min_mac_length value if specified at the key store provisioning (if a key specific setting was not specified at key generation/injection) or - the default value (32 bit) if a minimum has not been specified using one of the above 2 methods.

5.17.2.2 struct op_mac_one_go_args_t

5.17.3 Function Documentation

5.17.3.1 hsm_open_mac_service()

```
hsm_err_t hsm_open_mac_service (
        hsm_hdl_t key_store_hdl,
        open_svc_mac_args_t * args,
        hsm_hdl_t * mac_hdl )
```

Open a mac service flow
User can call this function only after having opened a key store service flow.
User must open this service in order to perform mac operation

Parameters

key_store_hdl	handle identifying the key store service flow.
args	pointer to the structure containing the function arguments.
mac_hdl	pointer to where the mac service flow handle must be written.

Returns

error code

5.17.3.2 hsm_mac_one_go() hsm_err_t hsm_mac_one_go (

```
hsm_hdl_t mac_hdl,
op_mac_one_go_args_t * args,
hsm_mac_verification_status_t * status )
```

Perform mac operation
User can call this function only after having opened a mac service flow
For CMAC algorithm, a key of type HSM_KEY_TYPE_AES_XXX must be used
For HMAC algorithm, a key of type HSM_KEY_TYPE_HMAC_XXX must be used
For mac verification operations, the verified mac length can be specified in bits by setting the HSM_OP_MAC_↩ ONE_GO_FLAGS_MAC_LENGTH_IN_BITS flag, if this flag is clear then the mac_length is specified in bytes. For mac generation operations, the mac length must be set in bytes and the HSM_OP_MAC_ONE_GO_FLAGS_↩ MAC_LENGTH_IN_BITS flag must be 0

Parameters

mac_hdl	handle identifying the mac service flow.
args	pointer to the structure containing the function arguments.

Returns

error code

5.17.3.3 hsm_close_mac_service() hsm_err_t hsm_close_mac_service (

```
hsm_hdl_t mac_hdl )
```

Terminate a previously opened mac service flow

Parameters

mac_hdl	pointer to handle identifying the mac service flow to be closed.

Returns

error code

5.18 SM2 Get Z

Modules

- i.MX8QXP specificities

Data Structures

- struct op_sm2_get_z_args_t

Typedefs

- typedef uint8_t **hsm_op_sm2_get_z_flags_t**

Functions

- hsm_err_t hsm_sm2_get_z (hsm_hdl_t session_hdl, op_sm2_get_z_args_t *args)

5.18.1 Detailed Description

5.18.2 Data Structure Documentation

Data Fields

uint8_t *	public_key	pointer to the sender public key
uint8_t *	identifier	pointer to the sender identifier
uint8_t *	z_value	pointer to the output area where the Z value must be written
uint16_t	public_key_size	length in bytes of the sender public key should be equal to 64 bytes
uint8_t	id_size	length in bytes of the identifier
uint8_t	z_size	length in bytes of Z should be at least 32 bytes
hsm_key_type_t	key_type	indicates the type of the sender public key. Only HSM_KEY_TYPE_DSA_SM2_FP_256 is supported.
hsm_op_sm2_get_z_flags_t	flags	bitmap specifying the operation attributes.
uint8_t	reserved[2]	

5.18.2.1 struct op_sm2_get_z_args_t

5.18.3 Function Documentation

5.18.3.1 hsm_sm2_get_z()

```
hsm_err_t hsm_sm2_get_z (
    hsm_hdl_t session_hdl,
    op_sm2_get_z_args_t * args )
```

This command is designed to compute Z = SM3(Entl || ID || a || b || xG || yG || xpubk || ypubk)

- ID, Entl: user distinguishing identifier and length,
- a, b, xG and yG : curve parameters,
- xpubk , ypubk : public key

  This value is used for SM2 public key cryptography algorithms, as specified in GB/T 32918. User can call this function only after having opened a session.

Parameters

session_hdl	handle identifying the current session.
args	pointer to the structure containing the function arguments.

Returns

error code

5.19 SM2 ECES decryption

Modules

- i.MX8QXP specificities
- i.MX8DXL specificities

Data Structures

- struct open_svc_sm2_eces_args_t
- struct op_sm2_eces_dec_args_t

Typedefs

- typedef uint8_t **hsm_svc_sm2_eces_flags_t**
- typedef uint8_t **hsm_op_sm2_eces_dec_flags_t**

Functions

- hsm_err_t hsm_open_sm2_eces_service (hsm_hdl_t key_store_hdl, open_svc_sm2_eces_args_t *args, hsm_hdl_t *sm2_eces_hdl)
- hsm_err_t hsm_close_sm2_eces_service (hsm_hdl_t sm2_eces_hdl)
- hsm_err_t hsm_sm2_eces_decryption (hsm_hdl_t sm2_eces_hdl, op_sm2_eces_dec_args_t *args)

5.19.1 Detailed Description

5.19.2 Data Structure Documentation

Data Fields

hsm_svc_sm2_eces_flags_t	flags	bitmap indicating the service flow properties
uint8_t	reserved[3]	

5.19.2.1 struct open_svc_sm2_eces_args_t

Data Fields

uint32_t	key_identifier	identifier of the private key to be used for the operation
uint8_t *	input	pointer to the input ciphertext
uint8_t *	output	pointer to the output area where the plaintext must be written
uint32_t	input_size	length in bytes of the input ciphertext.
uint32_t	output_size	length in bytes of the output plaintext
hsm_key_type_t	key_type	indicates the type of the used key. Only HSM_KEY_TYPE_DSA_SM2_FP_256 is supported.
hsm_op_sm2_eces_dec_flags_t	flags	bitmap specifying the operation attributes.
uint16_t	reserved	

5.19.2.2 struct op_sm2_eces_dec_args_t

5.19.3 Function Documentation

5.19.3.1 hsm_open_sm2_eces_service()

```
hsm_err_t hsm_open_sm2_eces_service (
        hsm_hdl_t key_store_hdl,
        open_svc_sm2_eces_args_t * args,
        hsm_hdl_t * sm2_eces_hdl )
```

Open a SM2 ECES decryption service flow
User can call this function only after having opened a key store.
User must open this service in order to perform SM2 decryption.

Parameters

session_hdl	handle identifying the current session.
args	pointer to the structure containing the function arguments.
sm2_eces_hdl	pointer to where the sm2 eces service flow handle must be written.

Returns

error code

5.19.3.2 hsm_close_sm2_eces_service()

```
hsm_err_t hsm_close_sm2_eces_service (
        hsm_hdl_t sm2_eces_hdl )
```

Terminate a previously opened SM2 ECES service flow

Parameters

sm2_eces_hdl	handle identifying the SM2 ECES service flow to be closed.

Returns

error code

5.19.3.3 hsm_sm2_eces_decryption()

```
hsm_err_t hsm_sm2_eces_decryption (
        hsm_hdl_t sm2_eces_hdl,
        op_sm2_eces_dec_args_t * args )
```

Decrypt data usign SM2 ECES
User can call this function only after having opened a SM2 ECES service flow.
SM2 ECES is supported with the requirements specified in the GB/T 32918.4.

Parameters

sm2_eces_hdl	handle identifying the SM2 ECES
args	pointer to the structure containing the function arguments.

Returns

error code

5.20 SM2 ECES encryption

Modules

- i.MX8QXP specificities
- i.MX8DXL specificities

Data Structures

- struct op_sm2_eces_enc_args_t

Typedefs

- typedef uint8_t **hsm_op_sm2_eces_enc_flags_t**

Functions

- hsm_err_t hsm_sm2_eces_encryption (hsm_hdl_t session_hdl, op_sm2_eces_enc_args_t *args)

5.20.1 Detailed Description

5.20.2 Data Structure Documentation

Data Fields

uint8_t *	input	pointer to the input plaintext
uint8_t *	output	pointer to the output area where the ciphertext must be written
uint8_t *	pub_key	pointer to the input recipient public key
uint32_t	input_size	length in bytes of the input plaintext
uint32_t	output_size	length in bytes of the output ciphertext. It should be at least input_size + 97 bytes (overhead related to C1 and C3 - as specifed below) + size alignment constraints specific to a given implementation (see related chapter).
uint16_t	pub_key_size	length in bytes of the recipient public key should be equal to 64 bytes
hsm_key_type_t	key_type	indicates the type of the recipient public key. Only HSM_KEY_TYPE_DSA_SM2_FP_256 is supported.
hsm_op_sm2_eces_enc_flags_t	flags	bitmap specifying the operation attributes.

5.20.2.1 struct op_sm2_eces_enc_args_t

5.20.3 Function Documentation

5.20.3.1 hsm_sm2_eces_encryption()

```
hsm_err_t hsm_sm2_eces_encryption (
        hsm_hdl_t session_hdl,
        op_sm2_eces_enc_args_t * args )
```

Encrypt data usign SM2 ECES
User can call this function only after having opened a session.
SM2 ECES is supported with the requirements specified in the GB/T 32918.4.
The output (i.e. ciphertext) is stored in the format C= C1||C2||C3 :
C1 = PC||x1||y1 where PC=04 and (x1,y1) are the coordinates of a an elliptic curve point
C2 = M xor t where t=KDF(x2||y2, input_size) and (x2,y2) are the coordinates of a an elliptic curve point
C3 = SM3 (x2||M||y2)

Parameters

session_hdl	handle identifying the current session.
args	pointer to the structure containing the function arguments.

Returns

error code

5.21 Key exchange

Modules

- i.MX8QXP specificities
- i.MX8DXL specificities

Data Structures

- struct op_key_exchange_args_t
- struct op_tls_finish_args_t

Macros

- #define **HSM_KDF_ALG_FOR_SM2** ((hsm_kdf_algo_id_t)0x10u)
- #define HSM_KDF_HMAC_SHA_256_TLS_0_16_4 ((hsm_kdf_algo_id_t)0x20u)

  TLS PRF based on HMAC with SHA-256, the resulting mac_key_length is 0 bytes, enc_key_length is 16 bytes and fixed_iv_length is 4 bytes.
- #define HSM_KDF_HMAC_SHA_384_TLS_0_32_4 ((hsm_kdf_algo_id_t)0x21u)

  TLS PRF based on HMAC with SHA-384, the resulting mac_key_length is 0 bytes, enc_key_length is 32 bytes and fixed_iv_length is 4 bytes.
- #define HSM_KDF_HMAC_SHA_256_TLS_0_32_4 ((hsm_kdf_algo_id_t)0x22u)

  TLS PRF based on HMAC with SHA-256, the resulting mac_key_length is 0 bytes, enc_key_length is 32 bytes and fixed_iv_length is 4 bytes.
- #define HSM_KDF_HMAC_SHA_256_TLS_32_16_4 ((hsm_kdf_algo_id_t)0x23u)

  TLS PRF based on HMAC with SHA-256, the resulting mac_key_length is 32 bytes, enc_key_length is 16 bytes and fixed_iv_length is 4 bytes.
- #define HSM_KDF_HMAC_SHA_384_TLS_48_32_4 ((hsm_kdf_algo_id_t)0x24u)

  TLS PRF based on HMAC with SHA-384, the resulting mac_key_length is 48 bytes, enc_key_length is 32 bytes and fixed_iv_length is 4 bytes.
- #define HSM_KDF_ONE_STEP_SHA_256 ((hsm_kdf_algo_id_t)0x31u)

  One-Step Key Derivation using SHA256 as per NIST SP80056C. It can only be used, together with a signed message, to generate KEKs (key encryption keys) for key injection (hsm_manage_key API).
- #define **HSM_KE_SCHEME_ECDH_NIST_P256** ((hsm_key_exchange_scheme_id_t)0x02u)
- #define **HSM_KE_SCHEME_ECDH_NIST_P384** ((hsm_key_exchange_scheme_id_t)0x03u)
- #define **HSM_KE_SCHEME_ECDH_BRAINPOOL_R1_256** ((hsm_key_exchange_scheme_id_t)0x13u)
- #define **HSM_KE_SCHEME_ECDH_BRAINPOOL_R1_384** ((hsm_key_exchange_scheme_id_t)0x15u)
- #define **HSM_KE_SCHEME_ECDH_BRAINPOOL_T1_256** ((hsm_key_exchange_scheme_id_t)0x23u)
- #define **HSM_KE_SCHEME_SM2_FP_256** ((hsm_key_exchange_scheme_id_t)0x42u)
- #define HSM_OP_KEY_EXCHANGE_FLAGS_UPDATE ((hsm_op_key_exchange_flags_t)(1u << 0))

  User can replace an existing key only by the derived key which should have the same type of the original one.
- #define HSM_OP_KEY_EXCHANGE_FLAGS_CREATE ((hsm_op_key_exchange_flags_t)(1u << 1))

  Create a new key.
- #define HSM_OP_KEY_EXCHANGE_FLAGS_GENERATE_EPHEMERAL ((hsm_op_key_exchange_↩ flags_t)(1u << 2))

  Use an ephemeral key (freshly generated key)
- #define HSM_OP_KEY_EXCHANGE_FLAGS_KEY_CONF_EN ((hsm_op_key_exchange_flags_t)(1u << 3))

  Enable key confirmation (valid only in case of HSM_KE_SCHEME_SM2_FP_256)
- #define HSM_OP_KEY_EXCHANGE_FLAGS_USE_TLS_EMS ((hsm_op_key_exchange_flags_t)(1u << 4))

  Use extended master secret for TLS KDFs.
- #define HSM_OP_KEY_EXCHANGE_FLAGS_STRICT_OPERATION ((hsm_op_key_exchange_flags_t)(1u << 7))

  The request is completed only when the new key has been written in the NVM. This applicable for persistent key only.
- #define **HSM_OP_TLS_FINISH_HASH_ALGO_SHA256** (0x06)
- #define **HSM_OP_TLS_FINISH_HASH_ALGO_SHA384** (0x07)
- #define HSM_OP_TLS_FINISH_FLAGS_CLIENT (1 << 0)

  Use "client finished" label for PRF.
- #define HSM_OP_TLS_FINISH_FLAGS_SERVER (1 << 1)

  Use "server finished" label for PRF.

Typedefs

- typedef uint8_t **hsm_kdf_algo_id_t**
- typedef uint8_t **hsm_key_exchange_scheme_id_t**
- typedef uint8_t **hsm_op_key_exchange_flags_t**
- typedef uint8_t **hsm_op_tls_finish_algo_id_t**
- typedef uint8_t **hsm_op_tls_finish_flags_t**

Functions

- hsm_err_t hsm_key_exchange (hsm_hdl_t key_management_hdl, op_key_exchange_args_t *args)
- hsm_err_t hsm_tls_finish (hsm_hdl_t key_management_hdl, op_tls_finish_args_t *args)

5.21.1 Detailed Description

5.21.2 Data Structure Documentation

Data Fields

uint32_t	key_identifier	identifier of the key used for derivation. It must be zero, if HSM_OP_KEY_EXCHANGE_↩ FLAGS_GENERATE_↩ EPHEMERAL is set.
uint8_t *	shared_key_identifier_array	pointer to the identifiers of the derived keys. In case of create operation the new destination key identifiers will be stored in this location. In case of update operation the destination key identifiers to update are provided by the caller in this location.
uint8_t *	ke_input	pointer to the initiator input data related to the key exchange function.
uint8_t *	ke_output	pointer to the output area where the data related to the key exchange function must be written. It corresponds to the receiver public data.
uint8_t *	kdf_input	pointer to the input data of the KDF.
uint8_t *	kdf_output	pointer to the output area where the non sensitive output data related to the KDF are written.
hsm_key_group_t	shared_key_group	It specifies the group where the derived keys will be stored. It must be a value in the range 0-1023. Keys belonging to the same group can be cached in the HSM local memory through the hsm_manage_key_group API.

Data Fields

hsm_key_info_t	shared_key_info	bitmap specifying the properties of the derived keys, it will be applied to all the derived keys.
hsm_key_type_t	shared_key_type	indicates the type of the derived key.
hsm_key_type_t	initiator_public_data_type	indicates the public data type specified by the initiator, e.g. public key type.
hsm_key_exchange_scheme_id_t	key_exchange_scheme	indicates the key exchange scheme
hsm_kdf_algo_id_t	kdf_algorithm	indicates the KDF algorithm
uint16_t	ke_input_size	length in bytes of the input data of the key exchange function.
uint16_t	ke_output_size	length in bytes of the output data of the key exchange function
uint8_t	shared_key_identifier_array_size	length in byte of the area containing the shared key identifiers
uint8_t	kdf_input_size	length in bytes of the input data of the KDF.
uint8_t	kdf_output_size	length in bytes of the non sensitive output data related to the KDF.
hsm_op_key_exchange_flags_t	flags	bitmap specifying the operation properties
uint8_t *	signed_message	pointer to the signed_message authorizing the operation.
uint16_t	signed_msg_size	size of the signed_message authorizing the operation.
uint8_t	reserved[2]	It must be 0.

5.21.2.1 struct op_key_exchange_args_t

Data Fields

uint32_t	key_identifier	identifier of the master_secret key used for the PRF.
uint8_t *	handshake_hash_input	pointer to the input area containing the hash of the handshake messages.
uint8_t *	verify_data_output	pointer to the output area where the verify_data contents will be written.
uint16_t	handshake_hash_input_size	size of the hash of the handshake messages
uint16_t	verify_data_output_size	size of the required verify_data output
hsm_op_tls_finish_flags_t	flags	bitmap specifying the operation properties
hsm_op_tls_finish_algo_id_t	hash_algorithm	hash algorithm to be used for the PRF
uint8_t	reserved[2]	It must be 0.

5.21.2.2 struct op_tls_finish_args_t

5.21.3 Function Documentation

5.21.3.1 hsm_key_exchange()

```
hsm_err_t hsm_key_exchange (
        hsm_hdl_t key_management_hdl,
        op_key_exchange_args_t * args )
```

This command is designed to compute secret keys through a key exchange protocol and the use of a key derivation function. The resulting secret keys are stored into the key store as new keys or as an update of existing keys.
A freshly generated key or an existing key can be used as input of the shared secret calculation.
User can call this function only after having opened a key management service flow.

This API support three use cases:

- Key Encryption Key generation:
  - shared_key_identifier_array: it must corresponds to the KEK key id.
  - The kdf_input must be 0
  - The kdf_output must be 0
  - The shared_key_info must have the HSM_KEY_INFO_KEK bit set (only Key Encryption Keys can be generated).
  - The shared_key_type must be HSM_KEY_TYPE_AES_256
  - The initiator_public_data_type must be HSM_KEY_TYPE_ECDSA_NIST_P256 or HSM_KEY_TYPE_ECDSA_BRAINPOOL_R1_256 or HSM_KEY_TYPE_ECDSA_BRAINPOOL_T1_256.
  - The key_exchange_scheme must be HSM_KE_SCHEME_ECDH_NIST_P256 or HSM_KE_SCHEME_ECDH_BRAINPOOL_R1_256 or HSM_KE_SCHEME_ECDH_BRAINPOOL_T1_256.
  - The kdf_algorithm must be HSM_KDF_ONE_STEP_SHA_256. As per as per SP800-56C rev2, the KEK is generated using the formula SHA_256(counter || Z || FixedInput), where:
    - counter is the value 1 expressed in 32 bit and in big endian format
    - Z is the shared secret generated by the DH key-establishment scheme
    - FixedInput is the literal 'NXP HSM USER KEY DERIVATION' (27 bytes, no null termination).
  - The kdf_input_size must be 0.
  - The kdf_output_size must be 0.
  - Flags: the use of the HSM_OP_KEY_EXCHANGE_FLAGS_GENERATE_EPHEMERAL flag is mandatory (only freshly generated keys can be used as input of the Z derivation)
  - signed_message: mandatory in OEM CLOSED life cycle.
- TLS Key generation:
  - Only an ephemeral key pair is supported as input of the TLS key_exchange negotiation. This can be:
    - either a TRANSIENT private key already stored into the key store indicated by its key identifier. To prevent any misuse non-transient key will be rejected, additionally the private key will be deleted from the key store as part of this command handling.
    - either a key pair freshly generated by the use of HSM_OP_KEY_EXCHANGE_FLAGS_GENERATE_EPHEMERAL flag.
  - shared_key_identifier_array: it must correspond to the concatenation of client_write_MAC_key id (4 bytes, if any), server_write_MAC_key id (4 bytes, if any), client_write_key id (4 bytes), the server_write_key id (4 bytes), and the master_secret key id (4 bytes).
  - The kdf_input format depends on the HSM_OP_KEY_EXCHANGE_FLAGS_USE_TLS_EMS flag:

    - for HSM_OP_KEY_EXCHANGE_FLAGS_USE_TLS_EMS not set, the kdf_input must correspond to the concatenation of clientHello_random (32 bytes), serverHello_random (32 bytes), server_↩ random (32 bytes) and client_random (32 bytes).
    - for HSM_OP_KEY_EXCHANGE_FLAGS_USE_TLS_EMS set, the kdf_input must correspond to the concatentation of message_hash, server_random (32 bytes) and client_random (32 bytes). The length of the message_hash must be 32 bytes for SHA256 based KDFs or 48 bytes for SHA384 based KDFs.
  - kdf_output: the concatenation of client_write_iv (4 bytes) and server_write_iv (4 bytes) will be stored at this address.
  - The shared_key_info must have the HSM_KEY_INFO_TRANSIENT bit set (only transient keys can be generated), the HSM_KEY_INFO_KEK bit is not allowed.
  - The shared_key_type is not applicable and must be left to 0.
  - The initiator_public_data_type must be HSM_KEY_TYPE_ECDSA_NIST_P256/384 or HSM_KEY_↩ TYPE_ECDSA_BRAINPOOL_R1_256/384.
  - The key_exchange_scheme must be HSM_KE_SCHEME_ECDH_NIST_P256/384 or HSM_KE_↩ SCHEME_ECDH_BRAINPOOL_R1_256/384.
  - The kdf_algorithm must be HSM_KDF_HMAC_SHA_xxx_TLS_xxx. The generated MAC keys will have type ALG_HMAC_XXX, where XXX corresponds to the key length in bit of generated MAC key. The generated encryption keys will have type HSM_KEY_TYPE_AES_XXX, where XXX corresponds to the key length in bit of the generated AES key. The master_secret key can only be used for the hsm_tls_↩ finish function or be deleted using the hsm_manage_key function.
  - kdf_input_size:
    - for HSM_OP_KEY_EXCHANGE_FLAGS_USE_TLS_EMS not set, it must be 128 bytes.
    - for HSM_OP_KEY_EXCHANGE_FLAGS_USE_TLS_EMS set, it must be 96 (SHA256) or 112 (SHA384) bytes.
  - kdf_output_size: It must be 8 bytes
  - signed_message: it must be NULL

- SM2 key generation (as specified in GB/T 32918):
  - Only the receiver role is supported.
  - ke_input = (x||y) || (xephemeral||yephemeral) of the 2 public keys of initiator
  - ke_out = (x||y)|| (xephemeral||yephemeral) of the 2 public keys the receiver
  - kdf_input = (Zinitiator||Zinitiator||V1) if HSM_OP_KEY_EXCHANGE_FLAGS_KEY_CONF_EN enabled,
    where V1 is the verification value calculated on the initiator side
  - kdf_output = (VA||VB) if HSM_OP_KEY_EXCHANGE_FLAGS_KEY_CONF_EN enabled, 0 otherwise.
  - shared_key_info: the HSM_KEY_INFO_KEK bit is not allowed.
  - The shared_key_type must be HSM_KEY_TYPE_SM4_128 or HSM_KEY_TYPE_DSA_SM2_FP_256
  - The initiator_public_data_type must be HSM_KEY_TYPE_DSA_SM2_FP_256
  - The key_exchange_scheme must be HSM_KE_SCHEME_SM2_FP_256.
  - The kdf_algorithm must be HSM_KDF_ALG_FOR_SM2.
  - Flags: the HSM_OP_KEY_EXCHANGE_FLAGS_GENERATE_EPHEMERAL flag is not supported
  - signed_message: it must be NULL

Parameters

key_management_hdl	handle identifying the key store management service flow.
args	pointer to the structure containing the function arguments.

Returns

error code

5.21.3.2 hsm_tls_finish()

```
hsm_err_t hsm_tls_finish (
        hsm_hdl_t key_management_hdl,
        op_tls_finish_args_t * args )
```

This command is designed to compute the verify_data block required for the Finished message in the TLS handshake.
The input key must be a master_secret key generated by a previous hsm_key_exchange call using a TLS KDF.
User can call this function only after having opened a key management service flow.

Parameters

key_management_hdl	handle identifying the key store management service flow.
args	pointer to the structure containing the function arguments.

Returns

error code

5.22 Standalone butterfly key expansion

Modules

- i.MX8QXP specificities
- i.MX8DXL specificities

Data Structures

- struct op_st_butt_key_exp_args_t

Macros

- #define HSM_OP_ST_BUTTERFLY_KEY_FLAGS_UPDATE ((hsm_op_st_but_key_exp_flags_t)(1u << 0))

  User can replace an existing key only by generating a key with the same type of the original one.
- #define HSM_OP_ST_BUTTERFLY_KEY_FLAGS_CREATE ((hsm_op_st_but_key_exp_flags_t)(1u << 1))

  Create a new key.
- #define HSM_OP_ST_BUTTERFLY_KEY_FLAGS_IMPLICIT_CERTIF ((hsm_op_st_but_key_exp_flags_t)(0u << 2))

  standalone butterfly key expansion using implicit certificate.
- #define HSM_OP_ST_BUTTERFLY_KEY_FLAGS_EXPLICIT_CERTIF ((hsm_op_st_but_key_exp_flags_t)(1u << 2))

  standalone butterfly key expansion using explicit certificate.
- #define HSM_OP_ST_BUTTERFLY_KEY_FLAGS_STRICT_OPERATION ((hsm_op_st_but_key_exp_flags_t)(1u << 7))

  The request is completed only when the new key has been written in the NVM.

Typedefs

- typedef uint8_t **hsm_op_st_but_key_exp_flags_t**

Functions

- hsm_err_t hsm_standalone_butterfly_key_expansion (hsm_hdl_t key_management_hdl, op_st_butt_key_exp_args_t *args)

5.22.1 Detailed Description

5.22.2 Data Structure Documentation

Data Fields

uint32_t	key_identifier	identifier of the key to be expanded.
uint32_t	expansion_fct_key_identifier	identifier of the key to be use for the expansion function computation
uint8_t *	expansion_fct_input	pointer to the input used to compute the expansion function
uint8_t *	hash_value	pointer to the hash value input. In case of explicit certificate, the hash value address must be set to 0.
uint8_t *	pr_reconstruction_value	pointer to the private reconstruction value input. In case of explicit certificate, the pr_reconstruction_value address must be set to 0.
uint8_t	expansion_fct_input_size	length in bytes of the expansion function input. It msut be 16 bytes.
uint8_t	hash_value_size	length in bytes of the hash value input. In case of explicit certificate, the hash_value_size parameter must be set to 0.
uint8_t	pr_reconstruction_value_size	length in bytes of the private reconstruction value input. In case of explicit certificate, the pr_reconstruction_value_size parameter must be set to 0.
hsm_op_st_but_key_exp_flags_t	flags	bitmap specifying the operation properties
uint32_t *	dest_key_identifier	pointer to identifier of the derived key to be used for the operation. In case of create operation the new destination key identifier will be stored in this location.
uint8_t *	output	pointer to the output area where the public key must be written.
uint16_t	output_size	length in bytes of the generated key, if the size is 0, no key is copied in the output.
hsm_key_type_t	key_type	indicates the type of the key to be derived.
uint8_t	expansion_fct_algo	cipher algorithm to be used for the expansion function computation

Data Fields

hsm_key_group_t	key_group	it must be a value in the range 0-1023. Keys belonging to the same group can be cached in the HSM local memory through the hsm_manage_key_group API
hsm_key_info_t	key_info	bitmap specifying the properties of the derived key.

5.22.2.1 struct op_st_butt_key_exp_args_t

5.22.3 Function Documentation

5.22.3.1 hsm_standalone_butterfly_key_expansion()

```
hsm_err_t hsm_standalone_butterfly_key_↩
expansion (
            hsm_hdl_t key_management_hdl,
            op_st_butt_key_exp_args_t * args )
```

This command is designed to perform a standalone butterfly key expansion operation on an ECC private key in case of implicit and explicit certificates. Optionally the resulting public key is exported.
The standalone butterfly key expansion computes the expansion function in addition to the butterfly key expansion The expansion function is defined as: f_k = (cipher(k, x+1) xor (x+1)) || (cipher(k, x+2) xor (x+2)) || (cipher(k, x+3) xor (x+3)) mod l

- Cipher = AES 128 ECB or SM4 128 ECB
- K: the expansion function key
- X: is expansion function the input
- l: the order of the group of points on the curve.
  User can call this function only after having opened a key management service flow.

  Explicit certificates:

f_k = expansion function value

out_key = Key + f_k

Implicit certificates:

- f_k = expansion function value,
- hash = hash value used in the derivation of the pseudonym ECC key,
- pr_v = private reconstruction value

out_key = (Key + f_k)∗hash + pr_v

Parameters

key_management_hdl	handle identifying the key store management service flow.
args	pointer to the structure containing the function arguments.

Returns

error code

5.23 Key generic crypto service

Modules

- i.MX8QXP specificities

Data Structures

- struct open_svc_key_generic_crypto_args_t
- struct op_key_generic_crypto_args_t

Macros

- #define HSM_KEY_GENERIC_ALGO_SM4_CCM ((hsm_op_key_generic_crypto_algo_t)(0x10u))

  Perform SM4 CCM with following characteristics: SM4 CCM where AAD supported, Tag len = {4, 6, 8, 10, 12, 14, 16} bytes, IV len = {7, 8, 9, 10, 11, 12, 13} bytes.
- #define **HSM_KEY_GENERIC_FLAGS_DECRYPT** ((hsm_op_key_generic_crypto_flags_t)(0u << 0))
- #define **HSM_KEY_GENERIC_FLAGS_ENCRYPT** ((hsm_op_key_generic_crypto_flags_t)(1u << 0))

Typedefs

- typedef uint8_t **hsm_svc_key_generic_crypto_flags_t**
- typedef uint8_t **hsm_op_key_generic_crypto_algo_t**
- typedef uint8_t **hsm_op_key_generic_crypto_flags_t**

Functions

- hsm_err_t hsm_open_key_generic_crypto_service (hsm_hdl_t session_hdl, open_svc_key_generic_crypto_args_t *args, hsm_hdl_t *key_generic_crypto_hdl)
- hsm_err_t hsm_close_key_generic_crypto_service (hsm_hdl_t key_generic_crypto_hdl)
- hsm_err_t hsm_key_generic_crypto (hsm_hdl_t key_generic_crypto_hdl, op_key_generic_crypto_args_t *args)

5.23.1 Detailed Description

5.23.2 Data Structure Documentation

Data Fields

hsm_svc_key_generic_crypto_flags_t	flags	bitmap indicating the service flow properties
uint8_t	reserved[3]	

5.23.2.1 struct open_svc_key_generic_crypto_args_t

Data Fields

uint8_t *	key	pointer to the key to be used for the cryptographic operation
uint8_t	key_size	length in bytes of the key
uint8_t *	iv	pointer to the initialization vector
uint16_t	iv_size	length in bytes of the initialization vector
uint8_t *	aad	pointer to the additional authentication data
uint16_t	aad_size	length in bytes of the additional authentication data
uint8_t	tag_size	length in bytes of the tag
hsm_op_key_generic_crypto_algo_t	crypto_algo	algorithm to be used for the cryptographic operation
hsm_op_key_generic_crypto_flags_t	flags	bitmap specifying the cryptographic operation attributes
uint8_t *	input	pointer to the input area plaintext for encryption ciphertext + tag for decryption
uint8_t *	output	pointer to the output area ciphertext + tag for encryption plaintext for decryption if the tag is verified
uint32_t	input_size	length in bytes of the input
uint32_t	output_size	length in bytes of the output
uint32_t	reserved	

5.23.2.2 struct op_key_generic_crypto_args_t

5.23.3 Function Documentation

5.23.3.1 hsm_open_key_generic_crypto_service()

```
hsm_err_t hsm_open_key_generic_crypto_service (
    hsm_hdl_t session_hdl,
    open_svc_key_generic_crypto_args_t * args,
    hsm_hdl_t * key_generic_crypto_hdl )
```

Open a generic crypto service flow.
User can call this function only after having opened a session.
User must open this service in order to perform key generic cryptographic operations.

Parameters

session_hdl	handle identifying the current session.
args	pointer to the structure containing the function arguments.
key_generic_crypto_hdl	pointer to where the key generic cryto service flow handle must be written.

Returns

error code

5.23.3.2 hsm_close_key_generic_crypto_service() hsm_err_t hsm_close_key_generic_crypto_service (

```
hsm_hdl_t key_generic_crypto_hdl )
```

Terminate a previously opened key generic service flow.

Parameters

key_generic_crypto_hdl	handle identifying the key generic service flow to be closed.

Returns

error code

5.23.3.3 hsm_key_generic_crypto() hsm_err_t hsm_key_generic_crypto (

```
hsm_hdl_t key_generic_crypto_hdl,
op_key_generic_crypto_args_t * args )
```

Perform key generic crypto service operations
User can call this function only after having opened a key generic crypto service flow

Parameters

key_generic_crypto_hdl	handle identifying the key generic cryto service flow.
args	pointer to the structure containing the function arguments.

Returns

error code

5.24 Run FIPS selftests

Modules

- i.MX8QXP specificities
- i.MX8DXL specificities

Data Structures

- struct op_run_fips_selftests_args_t

Functions

- hsm_err_t hsm_run_fips_selftests (hsm_hdl_t session_hdl, op_run_fips_selftests_args_t *args)

5.24.1 Detailed Description

5.24.2 Data Structure Documentation

Data Fields

uint32_t	selftest_bitmap	Bitmap of selftests to run, refer to FIPS specific documentation for definitions.

5.24.2.1 struct op_run_fips_selftests_args_t

5.24.3 Function Documentation

5.24.3.1 hsm_run_fips_selftests()

```
hsm_err_t hsm_run_fips_selftests (
    hsm_hdl_t session_hdl,
    op_run_fips_selftests_args_t * args )
```

Perform selected FIPS selftests if device is running in FIPS approved mode. Any selftest failure will cause device to abort (locked state requiring reboot).

Parameters

session_hdl	handle identifying the current session.
args	pointer to the structure containing the function arguments.

Returns

error code

5.25 i.MX8QXP specificities

Session

i.MX8QXP HSM is implemented only on SECO core which doesn't offer priority management neither low latencies.

- HSM_OPEN_SESSION_FIPS_MODE_MASK not supported and ignored
- HSM_OPEN_SESSION_EXCLUSIVE_MASK not supported and ignored
- session_priority field of open_session_args_t is ignored.
- HSM_OPEN_SESSION_LOW_LATENCY_MASK not supported and ignored.

Key management

- HSM_OP_MANAGE_KEY_GROUP_FLAGS_DELETE is not supported.
- HSM_KEY_TYPE_ECDSA_NIST_P521 is not supported.
- HSM_KEY_TYPE_ECDSA_BRAINPOOL_R1_320 is not supported.
- HSM_KEY_TYPE_ECDSA_BRAINPOOL_R1_512 is not supported.
- HSM_KEY_TYPE_ECDSA_BRAINPOOL_T1_256 is not supported.
- HSM_KEY_TYPE_ECDSA_BRAINPOOL_T1_320 is not supported.
- HSM_KEY_TYPE_ECDSA_BRAINPOOL_T1_384 is not supported.
- HSM_KEY_TYPE_ECDSA_BRAINPOOL_T1_512 is not supported.
- HSM_KEY_TYPE_DSA_SM2_FP_256 is not supported.
- HSM_KEY_TYPE_SM4_128 is not supported.
- HSM_KEY_TYPE_HMAC_224 is not supported.
- HSM_KEY_TYPE_HMAC_256 is not supported.
- HSM_KEY_TYPE_HMAC_384 is not supported.
- HSM_KEY_TYPE_HMAC_512 is not supported.
- hsm_butterfly_key_expansion: This feature is disabled when part is running in FIPS approved mode. Any call to this API will results in a HSM_FEATURE_DISABLED error.
- hsm_key_type_t of op_butt_key_exp_args_t: Only HSM_KEY_TYPE_ECDSA_NIST_P256 and HSM_KEY↩ _TYPE_ECDSA_BRAINPOOL_R1_256 are supported.
- HSM_OP_MANAGE_KEY_FLAGS_OTP_ROOT_KEK is not supported.

Ciphering

- HSM_CIPHER_ONE_GO_ALGO_SM4_ECB is not supported.
- HSM_CIPHER_ONE_GO_ALGO_SM4_CBC is not supported.
- HSM_AUTH_ENC_ALGO_SM4_CCM is not supported.
- hsm_ecies_decryption: This feature is disabled when part is running in FIPS approved mode. Any call to this API will results in a HSM_FEATURE_DISABLED error.
- hsm_key_type_t of op_ecies_dec_args_t: Only HSM_KEY_TYPE_ECDSA_NIST_P256 and HSM_KEY_↩ TYPE_ECDSA_BRAINPOOL_R1_256 are supported.

Signature generation

- HSM_SIGNATURE_SCHEME_ECDSA_NIST_P521_SHA_512 is not supported.
- HSM_SIGNATURE_SCHEME_ECDSA_BRAINPOOL_R1_320_SHA_384 is not supported.
- HSM_SIGNATURE_SCHEME_ECDSA_BRAINPOOL_R1_512_SHA_512 is not supported.
- HSM_SIGNATURE_SCHEME_ECDSA_BRAINPOOL_T1_256_SHA_256 is not supported.
- HSM_SIGNATURE_SCHEME_ECDSA_BRAINPOOL_T1_320_SHA_384 is not supported.

- HSM_SIGNATURE_SCHEME_ECDSA_BRAINPOOL_T1_384_SHA_384 is not supported.
- HSM_SIGNATURE_SCHEME_ECDSA_BRAINPOOL_T1_512_SHA_512 is not supported.
- HSM_SIGNATURE_SCHEME_DSA_SM2_FP_256_SM3 is not supported.

Signature verification

- HSM_SIGNATURE_SCHEME_ECDSA_NIST_P521_SHA_512 is not supported.
- HSM_SIGNATURE_SCHEME_ECDSA_BRAINPOOL_R1_320_SHA_384 is not supported.
- HSM_SIGNATURE_SCHEME_ECDSA_BRAINPOOL_R1_512_SHA_512 is not supported.
- HSM_SIGNATURE_SCHEME_ECDSA_BRAINPOOL_T1_256_SHA_256 is not supported.
- HSM_SIGNATURE_SCHEME_ECDSA_BRAINPOOL_T1_320_SHA_384 is not supported.
- HSM_SIGNATURE_SCHEME_ECDSA_BRAINPOOL_T1_384_SHA_384 is not supported.
- HSM_SIGNATURE_SCHEME_ECDSA_BRAINPOOL_T1_512_SHA_512 is not supported.
- HSM_SIGNATURE_SCHEME_DSA_SM2_FP_256_SM3 is not supported.
- HSM_OP_VERIFY_SIGN_FLAGS_KEY_INTERNAL is not supported
- hsm_import_public_key: This API is not supported

Hashing

- HSM_HASH_ALGO_SM3_256 is not supported.

Public key reconstruction

- This feature is disabled when part is running in FIPS approved mode. Any call to this API will results in a HSM_FEATURE_DISABLED error.
- hsm_key_type_t of op_pub_key_rec_args_t: Only HSM_KEY_TYPE_ECDSA_NIST_P256 and HSM_KEY↩_TYPE_ECDSA_BRAINPOOL_R1_256 are supported.

Public key decompression

- This feature is disabled when part is running in FIPS approved mode. Any call to this API will results in a HSM_FEATURE_DISABLED error.

ECIES encryption

- hsm_ecies_encryption: This feature is disabled when part is running in FIPS approved mode. Any call to this API will results in a HSM_FEATURE_DISABLED error.
- hsm_key_type_t of op_ecies_enc_args_t: Only HSM_KEY_TYPE_ECDSA_NIST_P256 and HSM_KEY_↩TYPE_ECDSA_BRAINPOOL_R1_256 are supported.

Mac

- HSM_OP_MAC_ONE_GO_ALGO_HMAC_SHA_224 is not supported.
- HSM_OP_MAC_ONE_GO_ALGO_HMAC_SHA_256 is not supported.
- HSM_OP_MAC_ONE_GO_ALGO_HMAC_SHA_384 is not supported.
- HSM_OP_MAC_ONE_GO_ALGO_HMAC_SHA_512 is not supported.

SM2 Get Z

- This API is not supported.

SM2 ECES decryption

- All the APIs related the SM2 ECES decryption are not supported.

SM2 ECES encryption

- This API is not supported.

Key exchange

- HSM_KDF_HMAC_SHA_256_TLS_0_16_4 is not supported.
- HSM_KDF_HMAC_SHA_384_TLS_0_32_4 is not supported.
- HSM_KDF_HMAC_SHA_256_TLS_0_32_4 is not supported.
- HSM_KDF_HMAC_SHA_256_TLS_32_16_4 is not supported.
- HSM_KDF_HMAC_SHA_384_TLS_48_32_4 is not supported.
- hsm_tls_finish API is not supported.
- HSM_OP_TLS_FINISH_HASH_ALGO_SHA256 is not supported.
- HSM_OP_TLS_FINISH_HASH_ALGO_SHA384 is not supported.
- HSM_OP_TLS_FINISH_FLAGS_CLIENT is not supported.
- HSM_OP_TLS_FINISH_FLAGS_SERVER is not supported.
- HSM_KE_SCHEME_ECDH_BRAINPOOL_T1_256 is not supported.

Standalone butterfly key expansion

- This API is not supported.

Key generic crypto service

- This API is not supported.

Run FIPS selftests

- This API is not supported.

Key store

The table below summarizes the maximum number of keys per group in the QXP implementation:

Key size (bits)	Number of keys per group
128	169
192	126
224	101
256	101
384	72
512	56

5.26 i.MX8DXL specificities

Session

i.MX8DXL has 2 separate implementations of HSM on SECO and on V2X cores.

- HSM_OPEN_SESSION_FIPS_MODE_MASK not supported and ignored
- HSM_OPEN_SESSION_EXCLUSIVE_MASK not supported and ignored
- If HSM_OPEN_SESSION_LOW_LATENCY_MASK is unset then SECO implementation will be used. In this case session_priority field of open_session_args_t is ignored.
- If HSM_OPEN_SESSION_LOW_LATENCY_MASK is set then V2X implementation is used. session_priority field of open_session_args_t and HSM_OPEN_SESSION_NO_KEY_STORE_MASK are considered.

Key management

- HSM_OP_MANAGE_KEY_GROUP_FLAGS_DELETE is not supported.
- HSM_KEY_TYPE_ECDSA_BRAINPOOL_R1_320 is not supported.
- HSM_KEY_TYPE_ECDSA_BRAINPOOL_R1_512 is not supported.
- HSM_KEY_TYPE_ECDSA_BRAINPOOL_T1_320 is not supported.
- HSM_KEY_TYPE_ECDSA_BRAINPOOL_T1_512 is not supported.
- HSM_KEY_TYPE_HMAC_224 is only supported on the B0 revision of DXL.
- HSM_KEY_TYPE_HMAC_256 is only supported on the B0 revision of DXL.
- HSM_KEY_TYPE_HMAC_384 is only supported on the B0 revision of DXL.
- HSM_KEY_TYPE_HMAC_512 is only supported on the B0 revision of DXL.
- hsm_key_type_t of op_butt_key_exp_args_t: Only HSM_KEY_TYPE_ECDSA_NIST_P256, HSM_KEY_↩ TYPE_ECDSA_BRAINPOOL_R1_256 and HSM_KEY_TYPE_DSA_SM2_FP_256 are supported.
- HSM_OP_MANAGE_KEY_FLAGS_OTP_ROOT_KEK is only supported on the B0 revision of DXL.

Ciphering

- hsm_key_type_t of op_ecies_dec_args_t: Only HSM_KEY_TYPE_ECDSA_NIST_P256 and HSM_KEY_↩ TYPE_ECDSA_BRAINPOOL_R1_256 are supported.

Signature generation

- HSM_SIGNATURE_SCHEME_ECDSA_BRAINPOOL_R1_320_SHA_384 is not supported.
- HSM_SIGNATURE_SCHEME_ECDSA_BRAINPOOL_R1_512_SHA_512 is not supported.
- HSM_SIGNATURE_SCHEME_ECDSA_BRAINPOOL_T1_320_SHA_384 is not supported.
- HSM_SIGNATURE_SCHEME_ECDSA_BRAINPOOL_T1_512_SHA_512 is not supported.
- HSM_OP_GENERATE_SIGN_FLAGS_COMPRESSED_POINT is not supported, in case of HSM_↩ SIGNATURE_SCHEME_DSA_SM2_FP_256_SM3.

Signature verification

HSM_SIGNATURE_SCHEME_ECDSA_BRAINPOOL_R1_320_SHA_384 is not supported.

- HSM_SIGNATURE_SCHEME_ECDSA_BRAINPOOL_R1_512_SHA_512 is not supported.
- HSM_SIGNATURE_SCHEME_ECDSA_BRAINPOOL_T1_320_SHA_384 is not supported.
- HSM_SIGNATURE_SCHEME_ECDSA_BRAINPOOL_T1_512_SHA_512 is not supported.
- HSM_OP_VERIFY_SIGN_FLAGS_COMPRESSED_POINT is not supported, in case of HSM_↩ SIGNATURE_SCHEME_DSA_SM2_FP_256_SM3.
- HSM_OP_VERIFY_SIGN_FLAGS_KEY_INTERNAL is not supported
- hsm_import_public_key: This API is a preliminary version

Public key reconstruction

- hsm_key_type_t of op_pub_key_rec_args_t: Only HSM_KEY_TYPE_ECDSA_NIST_P256, HSM_KEY_↩ TYPE_ECDSA_BRAINPOOL_R1_256 and HSM_KEY_TYPE_DSA_SM2_FP_256 are supported.

ECIES encryption

- hsm_key_type_t of op_ecies_enc_args_t: Only HSM_KEY_TYPE_ECDSA_NIST_P256 and HSM_KEY_↩ TYPE_ECDSA_BRAINPOOL_R1_256 are supported.

Mac

- HSM_OP_MAC_ONE_GO_ALGO_HMAC_SHA_224 is only supported on the B0 revision of DXL.
- HSM_OP_MAC_ONE_GO_ALGO_HMAC_SHA_256 is only supported on the B0 revision of DXL.
- HSM_OP_MAC_ONE_GO_ALGO_HMAC_SHA_384 is only supported on the B0 revision of DXL.
- HSM_OP_MAC_ONE_GO_ALGO_HMAC_SHA_512 is only supported on the B0 revision of DXL.

SM2 ECES decryption

- The output_size should be a multiple of 4 bytes.

SM2 ECES encryption

- The output_size should be a multiple of 4 bytes.

Key exchange

- HSM_KDF_HMAC_SHA_256_TLS_0_16_4 is only supported on the B0 revision of DXL.
- HSM_KDF_HMAC_SHA_384_TLS_0_32_4 is only supported on the B0 revision of DXL.
- HSM_KDF_HMAC_SHA_256_TLS_0_32_4 is only supported on the B0 revision of DXL.
- HSM_KDF_HMAC_SHA_256_TLS_32_16_4 is only supported on the B0 revision of DXL.
- HSM_KDF_HMAC_SHA_384_TLS_48_32_4 is only supported on the B0 revision of DXL.
- hsm_tls_finish API is only supported on the B0 revision of DXL.
- HSM_OP_TLS_FINISH_HASH_ALGO_SHA256 is only supported on the B0 revision of DXL.
- HSM_OP_TLS_FINISH_HASH_ALGO_SHA384 is only supported on the B0 revision of DXL.
- HSM_OP_TLS_FINISH_FLAGS_CLIENT is only supported on the B0 revision of DXL.
- HSM_OP_TLS_FINISH_FLAGS_SERVER is only supported on the B0 revision of DXL.

Standalone butterfly key expansion

hsm_key_type_t of op_butt_key_exp_args_t: Only HSM_KEY_TYPE_ECDSA_NIST_P256, HSM_KEY_TYPE_↩ECDSA_BRAINPOOL_R1_256 and HSM_KEY_TYPE_DSA_SM2_FP_256 are supported.

Run FIPS selftests

This API only supported on DXL B0 device.

Key store

The table below summarizes the maximum number of keys per group in the DXL implementation:

sessions using V2X implementation (HSM_OPEN_SESSION_LOW_LATENCY_MASK) :

Key size (bits)	Number of keys per group
128	166
192	125
224	111
256	100
384	71
512	52

session using SECO implementation : same number as QXP applies

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