SXF1800HN/V102B

Security Target Lite

Rev. 1.2 — 06/12/2019 Evaluation Document - Public

Document information

Info	Content
Keywords	Common Criteria, ASE, Security Target, V2X HSM

Revision history

Rev	Date	Description
1.0	14/11/2019	First release
1.1	26/11/2019	Typo correction in augmentation claim and minor clarification in introduction
1.2	06/12/2019	Minor update on references (date, certificate)

Contact information

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1. Introduction

1.1 ST Identification

Table 1. Security Target Identification

ST Title	**SXF1800HN/V102B Security Target Lite**
Authors	NXP Semiconductors
Status	Release
ST Reference	ST-SXF1800HN/V102B
Version	Rev. 1.2
Date	06/12/2019
Common Criteria	CC version 3.1 [1] Part 1: CCMB 2017-04-001 revision 5 [2] Part 2: CCMB 2017-04-002 revision 5 [3] Part 3: CCMB 2017-04-003 revision 5
PP Claim	[4] - Protection Profile — V2X Hardware Security Module

1.2 TOE Identification

The TOE is composed of the software layer (current TOE component) with JavaCard Platform and V2X applets embedded on a hardware platform (underlying TOE component) with the IC and the CryptoLib.

1.2.1 Main version

The current TOE is composed of the software layer (current TOE component) with JavaCard Platform and V2X applets embedded on a hardware platform (underlying TOE component) with the IC and the CryptoLib.

Identification of each components is provided in the table below.

Notes

The Platform ID is composed of following items:

- **J** - constant
- **5** - hardware type (secure element)
- **S** - JCOP version (4.4 Automotive)
- **2M0** - NVM size (2.0 MB)
- **024BB7** - build number in hexadecimal
- **08** - Mask ID (mask 8)
- **00** - patch ID (no patch)

The command GET DATA for platform ID and for applets ID are described in [18] section 3.1.1.

Table 2. TOE Identification

TOE name	**SXF1800HN/V102B**	
TOE Reference	**IC Platform**	
	ID	NCJ38A0 High-performance secure microcontroller for Automotive (short name NCJ38A0)
	Rev	B0.207
	Certificate	*ANSSI-CC-2018/60*
	Assurance	EAL 5+
	Firmware – Crypto Library	
	ID	NCJ38AC High-performance secure microcontroller with Crypto Library for Automotive (short name NCJ38AC)
	Rev	B0.2CB
	Certificate	*ANSSI-CC-2019/23*
	Assurance	EAL 5+
	Software – JCOP JavaCard Platform	
	ID	JCOP SE 4.4
	Rev	R12.1 RC2
	Platform ID	J5S2M0**024BB7**0800
	V2X applet	
	ID	V2X HSM
	Rev	v2.12.3
	Global Storage (GS)	
	ID	GS applet
	Rev	v2.12.1

1.2.2 Delta version

In a specific context, the loading of the TOE on the underlying platform will be performed directly on the field to replace revision R10.3 previous version of the TOE.
To cover such case, this loading on the field is an extension to the “normal” TOE scope. From the previous identification information, only the initial JCOP revision before update will change for R10.3 (Platform ID J5S2M001E0800800).

1.3 Composition information

The current TOE component is the V2X HSM application layer, which includes two applets, V2X HSM and GS, and the underlying JCOP SE 4.4 JavaCard platform (see above section 1.2 for identification details).

This TOE is composed with the certified NXP P73N2M0B0.207 Integrated Circuit and P73N2M0B0.2CB Cryptographic Library.

In this Security Target, the following designation will be used:

- HW Platform will refer to the NXP P73N2M0B0.207 IC and the P73N2M0B0.2CB CryptoLibrary;
- JCOP4 will refer to JCOP SE 4.4 JavaCard platform;
- V2X applets will refer to V2X HSM and GS applets;

- V2X HSM (generic product) or SXF1800 (current product) will refer to the final composed TOE made of all above hardware and software components;
- The name of the composite TOE developer will be referenced as NXP.

According to the Composite Product documentation [8], the different roles considered in the composition activities are associated as follows:

Table 3. Composition Role Allocation

Role	Identity
Underlying platform	
HW Platform Developer	NXP
HW Platform Evaluator	SERMA
HW Platform Certification Body	ANSSI
Current TOE component	
Application Developer	Yagoba
JCOP Developer	NXP
Composite Product Integrator	NXP
Composite Product Evaluation Sponsor	NXP
Composite Product Evaluator	Riscure
Composite Product Certification Body	NSCB

The hardware platform was evaluated to CC EAL 5+ according to [7] (see Security Targets [11] and [14], Integration Circuit certification report [12] and CryptoLibrary certification report [15]).

Integration of the composite product by the IC manufacturer is guided by delivery procedures enforced by NXP during the development phase (see section 0 for life-cycle details).

1.4 TOE Overview

The TOE implements a V2X Hardware Security Module (HSM) to be part of an Intelligent Transport System (ITS) composed of stations (e.g. vehicles, roadside modules) periodically broadcasting information as their position or particular events in their vicinity.

Such communications need to be protected to prevent the spreading of wrong information which could cause from minor issues, as traffic disorganization, to dramatic events, as accident involving people physical integrity.

Also, the privacy of messages preventing the tracking of vehicles/drivers by unauthorized entity is required in several countries' regulations.

NXP implements a solution ensuring the secure broadcast of messages exchanged inside an ITS network, protecting their authenticity, integrity and privacy in compliance with ETSI standards [23], [24], [25], [26], [27].

The whole solution is based on two modules:

- V2X VCS, in charge of messages building and certificate management;
- V2X HSM (SXF1800), in charge of message signatures and private keys protection.

The two components are physically separated and communicate through a secure channel to protect messages exchanged between them.

The current TOE is limited to the V2X HSM module, which in this solution is a smart card implementing the services to be invoked by the V2X VCS.

This TOE is implemented to comply with ETSI standards [23], [24], [25], [26] and [27] for Europe and with IEEE standards [28] and [29] for US. The US configuration has been evaluated against FIPS140-2 referential. Applets can be in FIPS mode or not, both modes are in the scope but FIPS extended functionalities are not.

Note that certificates management is not part of the scope of the TOE; however, the TOE provides all needed functionalities to allow the TOE environment to handle this management in compliance with EU and US requirements.

2. Target of Evaluation

2.1 TOE security functionalities

The TOE implements the following services:

- Device management:
  - Connection to the TOE and reset;
  - Application selection, deselection, logical channel management.
  - Export of non-sensitive TOE information (e.g. components configuration);
  - JCOP firmware including SCP03 implementation;
  - TOE security parameters configuration;
  - TOE monitoring and attack counter management.
- Software management
  - OS update firmware.
  - GlobalPlatform 2.2.1 applet management services.
- V2X applets content management:
  - Generation/Derivation of ECDSA key pairs;
  - Import of ECDSA key pairs;
  - Export of ECDSA public keys.
  - Secure storage of generated/derived/imported private keys.
  - Delete of ECDSA key pair.
- V2X end-usage security services:
  - Access control to services;
  - Import of message to be signed;
  - Generation of ECDSA signature;
  - ECIES encryption and decryption;
  - Random number generation.

2.1.1 Device management

Device management functionalities provide power-up and booting of the device and allows launching either the OS Update firmware (see Software management section) or the JCOP firmware.

The *JCOP firmware* implements JavaCard platform following [47] and [46] specifications. For device management, it first allows selecting a Security Domain or an application to access non-sensitive operations as the reading of information not needing authentication.

Then, it controls the access to sensitive operations by requiring the opening of a secure channel (SCP03) with the targeted Security Domain. Once the secure channel is established, its security level can be modified for adaptation to the sensitivity of exchanged data; typically, the security level is increased for key pair import when generated outside the TOE (see 2.1.3 subsection).

Also, a dedicated *Config Applet* is implemented for the setting of the security parameters of the hardware and software components of the TOE (e.g. clock, SWP, functionalities enabling, etc.).

Device management also include the monitoring of the TOE and handling of secure parameters after issuance; this is done in the dedicated *Restricted Mode* in which only a very limited set of functionalities is available such as reading logging information or resetting the *Attack Counter*.

2.1.2 Software management

When launched instead of JCOP firmware, the *OS Update firmware* allows updating the operating system after a successful authentication by signature verification.

For *applets update and management*, GlobalPlatform services are implemented and used in particular to manage V2X applets life-cycle state e.g. switch from non-operational state to operational state.

No other applet than V2X ones is installed pre-issuance and cannot be install post-issuance by a customer. However, GlobalPlatform commands for applet loading remains functional for V2X applet update unique purpose, available to NXP administrators only.

2.1.3 V2X content management

V2X content management functionalities mainly aim at initializing and maintaining cryptographic keys to be used by V2X end-usage services.

Through those functionalities, all cryptographic material will be either *generated/derived or imported*. Note that private key import service is only available during personalization phase of V2X applets while key generation and derivation remains available in end-usage phase.

In particular, the canonical key pair, named Canonical key pair in C2C related standards, and uniquely identifying a V2X HSM, will first be set; once in use phase, this key pair cannot be replaced.

Then, the Enrolment Credential (EC) key pair and subsequently the Authorization Tickets (AT) key pairs are initialized. Those keys can be replaced in end-usage phase.

At any time, imported or generated private keys are *securely stored* in persistent memory i.e. with confidentiality and integrity protections.

In case a key pair has been generated by the V2X HSM, the *public key export* service allows the environment to retrieve the public key; the V2X VCS will then be able to build the request for certificate creation.

All content management functionalities are accessible under a SCP03 secure channel opened between the V2X VCS and the V2X Security Domain (V2X-SD or SSD-B).

Notes:

- All key management features are compliant with both ETSI ([23], [24], [25], [26], [27]) and IEEE ([28], [29]) standards.
- For performance reasons, a V2X HSM does not handle certificates; the security is the responsibility of the V2X VCS.

2.1.4 V2X end-usage services

When all needed cryptographic material is present in the V2X HSM (see previous 2.1.3 section), the authenticated V2X VCS can therefore invoke the following services:

ECDSA signature creation for TOE authentication when signing EC and AT requests and for data authentication when signing information to be broadcasted to other vehicles in vicinity.

This functionality implements standards [34], [41] and [42].

ECIES encryption/decryption for secure exchange with other ITS entities of session keys used for message encryption when confidentiality is required. The session key is generated by the VCS which then uses ECIES encryption service to encrypt this session key before distribution; in that purpose, an ephemeral key pair is generated based on the recipient public key. Its site, the recipient will invoke ECIES decryption to obtain this session key and be able to decrypt the message.

This functionality implements standards [36] and [43].

Random number generation upon V2X VCS needs.

Such services are accessible under a SCP03 secure channel opened between the V2X VCS and the V2X Security Domain (V2X-SD or SSD-B), only after personalization phase of V2X applets has been ended.

2.2 V2X HSM life-cycle

The V2X life-cycle distinguishes stages for development, production, preparation and operational use. Development and production of the V2X HSM together constitute the development phase of the TOE. The development phase is subject of CC evaluation according to the assurance life-cycle (ALC) class. The development phase ends with the delivery of the TOE to the personalizer (customer).

High level overview of TOE life-cycle is as follows:

- Development Phases
  - Phase 1: Embedded Software Development
  - Phase 2: HW development (covered by the Platform ST)
- Production Phases
  - Phase 3: HW manufacturing (covered by the Platform ST)
  - Phase 4: HW packaging (covered by the Platform ST)
  - Phase 5: Composite product integration (covered by the Platform ST)
- TOE personalization
  - Phase 6: Personalization
- End-user Phase
  - Phase 7: Operational usage

Each life-cycle step is detailed in the following subsections.

2.2.1 Life-cycle phases

2.2.1.1 Design

Software design (phase 1) – NXP

The IC Embedded Software Developer is in charge of

- smartcard embedded software development including the development of Java Card applets;
- specification of IC pre-personalization requirements though the actual data for IC pre-personalization comes from phase 4, 5, or 6.

The Software Developer designs the Integrated Circuit, the IC Dedicated Software and provides the guidance documentation associated with these TOE components.

Hardware platform design (phase 2) – NXP

The IC Developer

- Designs the IC;
- Develops IC Dedicated Software;
- Provides information, software or tools to the IC Embedded Software Developer;
- Receives the embedded software from the developer, through trusted delivery

and verification procedures.

From the IC design, IC Dedicated Software and Smartcard Embedded Software, the IC Developer then constructs the smartcard IC database, necessary for the IC photomask fabrication.

2.2.1.2 Fabrication

Hardware platform manufacturing (phase 3) – NXP

The IC Manufacturer is responsible for

- Producing the IC through three main steps:
  - IC manufacturing,
  - IC testing,
  - IC pre-personalization.

The IC Mask Manufacturer

- Generates the masks for the IC manufacturing based upon an output from the smartcard IC database. Configuration items may be changed/deleted.

Hardware Packaging (phase 4) – NXP

The IC Packaging Manufacturer is responsible for

- IC packaging and testing.

Composite product integration (phase 5) – NXP

The Composite Product Manufacturer is responsible for the smartcard product finishing process.

JCOP platform is integrated and personalized – related SDs (SSD-A and SSD-C) are set to PERSONALIZED before issuance; V2X related applets are loaded and installed – related applications are set to INSTALLED before issuance.

This phase can also include patching (in Flash) if required.

The TOE and the confidential information required to complete this phase are transferred securely between the NXP sites.

After completion, the TOE is self-protected and can be delivered to the customer (delivery point) following ALC_DEL procedures [22].

2.2.1.3 Personalization

Personalization (phase 6) – NXP or 3rd Party Personalization facility

The TOE is first delivered internally from NXP manufacturing area to NXP temporary storage area before being delivered to the customer; this first internal delivery is considered in use phase (AGD); the customer must follow the customer guidance manual [20] for secure acceptance and secure preparation of the TOE.

Main operations for TOE preparation are the import and/or generation of cryptographic material needed for final usage of the TOE. Also, configuration items may be changed/deleted.

2.2.1.4 Operational

End-usage (phase 7) – Where upon card is delivered from customer to end-user

The end-user must follow end-user guidance manual [18] to use securely its product in the ITS context ensuring the authenticity of messages and the privacy of the driver.

NXP administrators and Customer administrator can also perform following operations in this phase:

- OS update triggering (NXP only).
- V2X applets update through Card content management according to

GlobalPlatform and Amendments specifications [46].

- Factory Reset.
- Changing *Config Items* through the *Config Applet*:

2.2.2 Life-cycle involved sites

The following table lists all sites involved in the TOE life-cycle:

Table 4. Development and manufacturing sites

Site	Company address	Description	Life-cycle phase
NXP Semiconductors Hamburg	Troplowitzstr. 20, 22529 Hamburg, Germany	Development & Test Center Phase 2 - IC Development	Phase 2 - IC Development
		Trust Provisioning	Phase 3 - IC Manufacturing and Testing
NXP Semiconductors Mougins	E space Park - Bat. C, 45 allee des Ormes, 06250 Mougins, France	Development Center	Phase 2 - IC Development
NXP Semiconductors Eindhoven	HTC-46.3-west Building 46, High Tech Campus, 5656AE Eindhoven, NL	Development Center	Phase 2 - IC Development
NXP Semiconductors Caen	2 Esplanade Anton Phillips, 14000 Caen, France	Development Center	Phase 2 - IC Development
NXP Semiconductors NXP Gratkorn	Mikron-Weg 1, 8101 Gratkorn, Austria	Development Center	Phase 2 - IC Development
		Trust Provisioning	Phase 3 - IC Manufacturing and Testing
NXP Semiconductors Glasgow 2	Pegasus House, Scottish Enterprise Technology Park, Bramah Ave, East Kilbride, Glasgow G75 0RD, Scotland	Development Center	Phase 2 - IC Development
NXP Semiconductors San Jose	411 East Plumeria Drive, San Jose, CA, 95134, USA	Development Center	Phase 2 - IC Development
NXP Semiconductors Bangalore	Nagawara Village, Kasaba Hobli, Bangalore 560 045, India	Development Center	Phase 2 - IC Development
NXP Semiconductors Leuven	Interleuvenlaan 80, 3001 Leuven, Belgium	Development Center	Phase 2 - IC Development
GlobalLogic Wroclaw	Strzegomska 56B Street, 53-611 Wroclaw, Poland	Development Center	Phase 2 - IC Development
SII Gdansk 2	SII Sp. Z.o.o. Olivia Star Building (Floor 17) - Grunwaldzka 472C, 80-309 Gdansk, Poland	Development Center	Phase 2 - IC Development
NXP Semiconductors Kaohsiung (ATKH)	10 Chin 5th Road, N.E.P.Z., 81170 Kaohsiung, Taiwan	Assembly & Test	Phase 3 - IC Manufacturing and Testing Phase 4 - IC Packaging
NXP Semiconductors Nijmegen	Gerstweg 2, 6534 AE Nijmegen, Netherlands	Failure Analysis Lab	Phase 3 - IC Manufacturing and Testing
Advanced Mask Technology Center Gmbh & Co KG (AMTC)	Rähnitzer Allee 9, 01109 Dresden, Germany	Wafer Mask Production	Phase 3 - IC Manufacturing and Testing
Global Foundries Singapore	Pte Ltd. 60 Woodlands Industrial Park D, Street 2, 738406 Singapore	Wafer Production	Phase 3 - IC Manufacturing and Testing

2.3 TOE scope and interfaces

The figure above depicts the current TOE physical and logical scope:

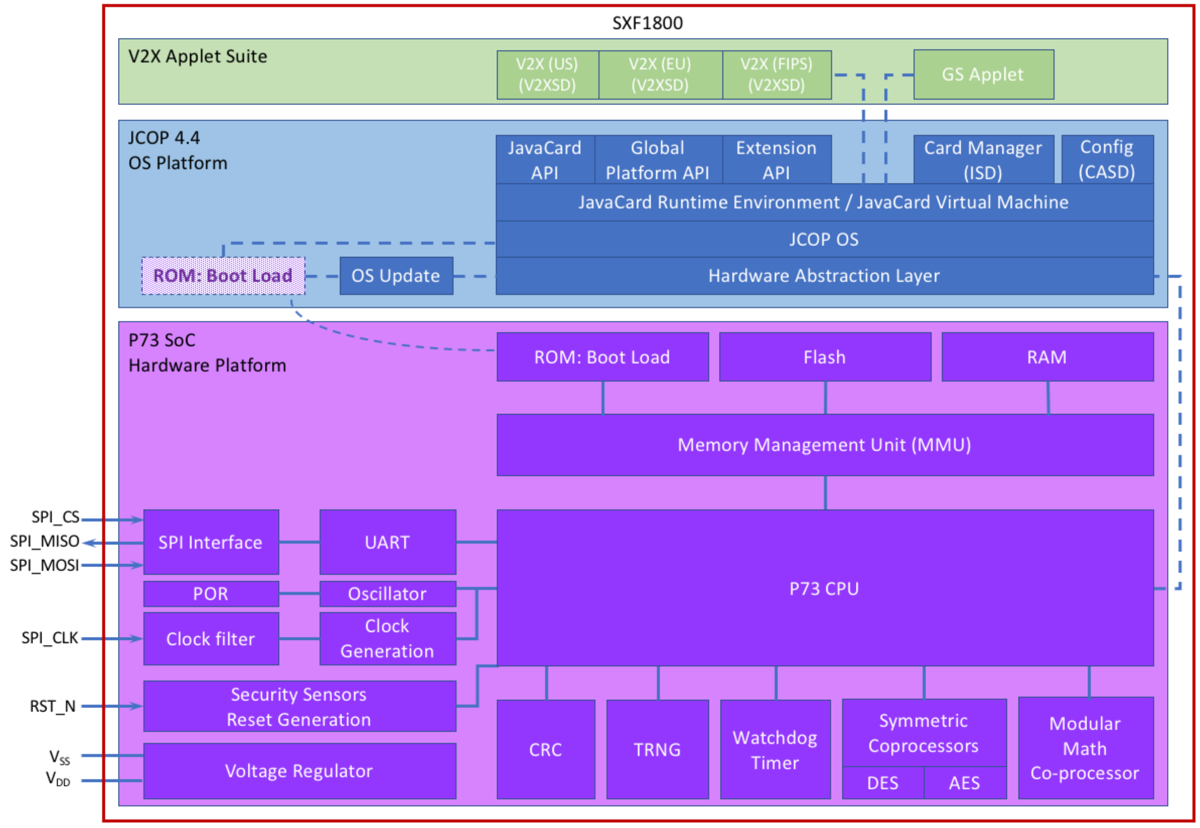


Fig 1. TOE scope

The TOE physical scope is the full integrated circuit hardware.

Physical interfaces are then all included modules, in particular the memories (ROM, RAM and Flash), CPU, internal buses, external buses (SPI) and cryptographic co-processors.

The TOE logical scope is the JCOP platform and the application layer made of two applet packages (V2X and GS).

GlobalPlatform applet loading functionalities remains invokable and related APDUs are therefore TOE external interface; however, their access is restricted to the NXP administrators; JavaCard APIs and bytecodes are not invokable by any customer and are therefore not considered as external interfaces of the TOE.

Logical interfaces are then restricted to APDUs handled by the platform and the V2X applets.

2.4 TOE Form Factor

The TOE will be provided to the Customer in form of HVQFN32 package.

2.5 TOE Guidance

The TOE guidance comprises the following documentation:

Table 5. TOE applicable guidance documents

Title	Date	Version
JCOP4.4 Automotive User Guidance Manual	[21]	1.2
JCOP4.4 Automotive Customer User Guidance Manual	[20]	1.1
SXF1800HN/V102 UGM for preparation phase	[19]	1.1
SXF1800HN/V102 UGM for operational phase	[18]	1.2
SXF1800 - Secure Element for V2X communication ES_SXF1800 - Errata sheet SXF1800	[16] [17]	1.5 1.2

3. Conformance Claims

3.1 CC Conformance claims

The ST claims compliance with the following references:

- Common Criteria Version 3.1 Part 1 [1] revision 5
- Common Criteria Version 3.1 Part 2 [2] revision 5 extended
- Common Criteria Version 3.1 Part 3 [3] revision 5 conformant

Extensions are:

- FCS_RNG.1 – Generation of Random Numbers.
- FCS_CKM.5 – Cryptographic Key Derivation

The assurance level for this ST is EAL 4 augmented with:

- ALC_DVS.2
- ALC_FLR.1
- AVA_VAN.5

3.2 PP Claim

This Security Target claims compliance to the C2C base Protection Profile and its following Packages: Communication Link Extended Protections Package, Private Key Import (online) Package, Software Update Package and Key Derivation Package.

[4]	Protection Profile — V2X Hardware Security Module
Document ID	C2C Protection Profile V2X HSM
Version	1.4.0
Date	13/09/2019
Sponsor	CAR 2 CAR Communication Consortium
Certification Body	-
Registration	-

Additionally, to more closely covers current TOE specific security features – in particular signature generation, key generation and import on a Secure Element – this Security Target adds some SFRs; as it only enhances the security of the TOE, the strict compliance to C2C PP is maintained.

Objectives OT.TOE_CONFIG, OT.ATTACK_COUNTER and OT,RESTRICTED_MODE have been added to cover additional features which could have an impact on the overall product security.

SFRs added are the following:

- FCS_CKM.5/KBKDF iteration has been added to cover the trusted channel key derivation due to the fact the trusted channel method was not defined in the PP.
- FIA_AFL.1: this additional SFR strengthen the set of security requirement about user authentication by limiting the number of authentication attempts.
- FPT_EMS.1.1: this additional SFR strengthen the set of security requirements about TSF protection by requiring the protection against TOE emanation which could lead to sensitive information leakage.
- SFRs on the Configuration Items management and Restricted Mode have been added to cover the additional objectives.

4. Security Problem Definition

4.1 Assets

Cryptographic Keys

Cryptographic keys handled and used by the TSF.

Several types of cryptographic keys are handled:

- (user data) ECDSA key pairs used to perform electronic signature operations,
- (user data) ECC keys used for ECIES encryption,
- (TSF data) AES keys used for trusted channel.
- (TSF data) ECC keys used for software update.

In a V2X context:

- Three types of ECDSA keys will be handled:
    - Canonical key used to sign Enrolment Credentials (ECs) certificate requests.
    - Enrolment Credential keys used to sign Authorization Tickets certificate requests.
    - Authorization Ticket keys used to sign messages containing information to be broadcasted to other vehicles in the vicinity.
- ECIES keys are used to securely exchanged encryption keys with external entities.
- AES keys are used for trusted channel protecting local exchanges of data between the TOE and the V2X VCS which are physically separated.

These assets must be protected in confidentiality and integrity for private ECC and secret keys.

Application Note

For the cryptographic keys the integrity only covers changes controlled by an attacker leading to knowledge of private keys, or modification of public key to value chosen by the attacker. Compromise of the integrity of keys leading to unavailability of the device is not in the scope of this PP.

Secure Services

Secure services provided by the TSF to users (e.g. key generation, signature creation, key encryption/decryption, storage of trusted data, etc.).

In a V2X context, those services are used to ensure security of exchanged information and vehicle/driver privacy.

Services protections: execution consistency (runtime integrity).

VCS data

User data exchanged between the VCS and the TOE.

In a V2X context, messages can be

- Representation of parts of EC/AT requests or ITS information provided to the V2X HSM to be signed;
- Data encryption key generated by the VCS provided to the V2X HSM to be encrypted (ECIES);
- Public key and parameters provided to the V2X HSM for ECIES encryption;
- Public key returned by the TOE corresponding to private key handled by the TOE.

- Random number generated by the TOE.

VCS data protections: integrity and, for data to be encrypted and random data.

HSM Software

Encoded instructions that regulate the behaviour of the TOE.

HSM software protections: integrity.

Software Update Image

Image loaded onto the TOE to replace whole or part of the current one.

HSM software protections: integrity.

This asset is taken from the Software Update Package.

4.2 Users

This Security Target considers the following users and subjects representing users:

Note: all exchanges between users and V2X HSM go through the V2X VCS module in charge of communications.

Table 6. Users & Subjects

Users	Definition
VCS (IT entity)	User of the TOE authorized to invoke non-restricted commands (e.g. for TOE identification) and cryptographic services needed to secure communications in ITS network after successful authentication to the V2X-SD.
NXP Administrator	The NXP Administrator is mainly in charge of the product configuration and OS or applet update operations after issuance. He has an authorized access to the TOE through the intermediate of the V2X VCS and is able to invoke either non-restricted commands (e.g. for TOE identification) or restricted commands (e.g. for TOE administration) after successful authentication to ISD or *Config Applet*.
Customer Administrator	The Customer Administrator is mainly in charge of V2X applets personalization and product configuration after issuance. He has an authorized access to the TOE through the intermediate of the V2X VCS and is able to invoke either non-restricted commands (e.g. for TOE identification) or restricted commands (e.g. for TOE administration) after successful authentication to V2X-SD or *Config Applet*.

4.3 Threats

Threat agents

Two main types of attackers have been identified:

Local attacker	Attacker with physical access to the TOE, either legal owner of the vehicle or not; such attacker does not have an authorized access to the TOE services. Local attacker can run hardware or software attacks through physical or logical TOE interfaces.

Remote attacker	Attacker with access (authorized or not) through the V2X VCS; such attacker has an authorized access to the TOE services by means of V2X VCS. Remote attacker can run hardware or software attacks through logical TOE interfaces only.

Physical attacks on hardware components are typically hardware fault injection, side channel analysis.

Logical attacks on software components are typically exploitation of implementation error leading to illegal reading and/or writing, access control bypass, etc.

Threats

Threats are described in the following where the generic term “attacker” is used to cover both local or remote type of attacker (see previous section); attacks on data can be using existing interfaces or “direct”.

Note that in the V2X context, the applicability of the following threats would result in the possibility for an attacker to:

- Track a victim ITS-S using a known (disclosed or modified) private key;
- Broadcast, from a victim or its own V2X HSM, wrong information by forging authentic signature of messages (information directly or through ATs or ECs requests corruption first), potentially causing safety hazardous situations.

T. KEY_REPLACE	***Replacement of Private Keys***

An attacker is able to directly replace a private key by a key he knows (e.g. generated by him, taking a predictable weak value).

Impact on Cryptographic Keys integrity.

As a consequence, the attacker could use the known private key to decrypt messages sent to a victim of the attack, or to himself create authentic signature of forged messages.

In V2X context, the attacker will then be able to:

- Track the victim vehicle (key known);
- Request a certificate for the corresponding public key and then sign himself (out of TOE) wrong information (on behalf of the victim or of himself).

T. KEY_DISCLOSE	***Information disclosure of Private Keys***

An attacker is able to disclose a private key.

Impact on Cryptographic Keys confidentiality.

As a consequence, the attacker could use the disclosed private key to decrypt messages sent to a V2X HSM victim of the attack or to himself create authentic signature of forged messages.

In V2X context, the attacker will be able to:

- Track the victim vehicle (key known);
- Sign himself (out of TOE) wrong information (on behalf of the victim or himself).

T.VCS_DATA_MODIF	***Modification of received user data***

An attacker is able to modify received VCS Data before signature in such a way that the data does not match the initial data the user intended to sign or encrypt.

Impact on VCS Data integrity.

As a consequence, the attacker could make sign a modified message.

In V2X context, the attacker will then be able to make sign wrong information; if modifications are controlled so the message can be interpreted by receivers, it can provoke an undesired reaction of the vehicle; if modifications are not controlled and cannot be interpreted, this could at least make receivers consume resources unduly or provoke unexpected reactions of receiver devices (e.g. crash).

T.VCS_DATA_DISCLOSE ***Disclosure of received user data***

An attacker is able to disclose received VCS Data requesting confidentiality.

Impact on VCS Data confidentiality.

As a consequence, the attacker could have knowledge of sensitive data.

In V2X context, when data is the data encryption key the attacker will then be able to decrypt data exchanged between VCS and PKI. The exchanged data comprises certificate signing requests, including long term identity of the vehicle, as well as authorization tickets. If this information is disclosed the privacy of the vehicle it compromised.

When data is random number used for key generation by the VCS, the attacker will have information helping for the disclosure of this key.

T.SW_TAMPER ***Tampering with Software***

An attacker is able to directly modify the HSM software without being authorized.

Impact on HSM Software integrity.

As a consequence, the attacker could have a partial control of the TOE behavior, for instance leading to private keys disclosure or modification, signature of forged or modified messages.

In V2X context, various exploitations will be possible depending on the modifications (see impacts in other threats as examples).

T.SW_REPLACE ***Replacement of Software code/data***

An attacker is able to directly replace the HSM software; he then has the full control on TOE behaviour and then on assets.

Impact on HSM Software integrity.

As a consequence, the attacker could have the full control of the TOE behavior, for instance leading to private keys disclosure or modification, signature of forged or modified messages.

In V2X context, all exploitation will be possible (see impacts in other threats as examples).

T.SW_UPDATE ***Illegal Software Update***

An attacker is able to update the HSM software through the software update mechanism; if an older image is installed, the attacker could target unpatched vulnerabilities; if a forged image is installed, he then has control on TOE behaviour,

Impact on HSM Software integrity.

As a consequence, the attacker could have from a partial to a full control of the TOE behavior, for instance leading to private keys disclosure or modification, signature of forged or modified messages.

In V2X context, various exploitations will be possible depending on the modifications (see impacts in other threats as examples).

This threat is taken from the Software Update Package.

T.SRV_MALFUNCTION V2X services behavior disturbance

An attacker is able to provoke and/or take advantage of a malfunction of the Secure Services.

Impact on Secure Services execution consistency.

In V2X context, various exploitations will be possible depending on the modifications (see impacts in other threats as examples).

4.4 Organizational Security Policy

The TOE shall comply with the following Organizational Security Policies (OSP) as security rules, procedures, practices, or guidelines imposed by an organization upon its operations.

P.KEY_GENERATION ***Key Generation***

The TOE shall be able to generate ECC asymmetric key pairs for ECDSA features in compliance with FIPS 186-4 [34], RFC 5639 [41] and ECC private keys following [42].

The TOE shall be able to generate ECC asymmetric key pairs for ECIES features in compliance with FIPS 186-4 [34], RFC 5639 [41] and derive symmetric keys and MAC keys following X9.63-KDF [36].

All security requirements related to mention standards must be respected.

P.KEY_DERIVE ***Key Derivation***

The TOE shall implement the ECC key derivation feature following [29] standard.

This policy is taken from the Key Derivation Package; it completes the policy P.SECURE_COMMUNICATION policy from the base PP.

P.PRIVKEY_IMPORT_TC ***Private Key Import***

The TOE shall be able to import ECC private keys generated externally.

This policy is taken from the Private Key Import (online) Package.

P.SIGNATURE_GENERATION ***Signature Generation***

The TOE shall be able to generate ECDSA digital signatures in compliance with FIPS 186-4 [34], RFC 5639 [41] in respect with related security requirements.

P.ECIES ***Key Encryption/Decryption***

The TOE shall be able to encrypt and decrypt user data according to IEEE Std 1363a [43] in respect with related security requirements.

P.RNG ***Random Numbers Generation***

The TOE shall be able to generate random numbers that meet specified quality metric, for use by other applications. These random numbers shall be suitable for use as keys, authentication/authorisation data or seed data for another random number generator.

P.SW_UPDATE ***Software Update***

The TOE shall be securely update-able following related TOE security guidance.

This threat is taken from the Software Update Package.

P.SECURE_COMMUNICATION	***Secure Communication***

The TOE environment must implement protection for integrity and confidentiality (if required) of VCS data when exchanged between the TOE and the VCS,

P.ACCESS_CONTROL	***Access Control***

The TOE shall implement protections to restrict the access to secure services to the VCS only.

This policy is taken from the Communication Link Extended Protections Package; it replaces the policy P.SRV_ACCESS policy from the base PP.

P.TRUSTED_CHANNEL	***Trusted Channel***

The TOE and the V2X VCS shall be able to establish a trusted channel.

This policy is taken from the Communication Link Extended Protections Package; it completes the policy P.SECURE_COMMUNICATION policy from the base PP.

4.5 Assumptions

The assumptions describe the security aspects of the environment in which the TOE will be used or is intended to be used:

A.KEY_EXT_MNGT	***Secure Key Pair management by Customer***

It is assumed that when a key pair is generated outside the TOE, the entity generating it uses only a trustworthy key pair generation device and ensures that this device can be used by authorized user only.

It is ensured that:

- Generation is provided to authorized users only;
- Generation is performed in accordance with [34], [36], [41] and [42] and related security guidance;
- Confidentiality of private key is ensured while outside the TOE.

This policy is taken from the Private Key Import (online) Package.

A.INTEGRATION	***Secure TOE integration to ITS system***

It is assumed that appropriate technical and/or organisational security measures in the phase of the integration of the TOE and the V2X VCS in the TOE life cycle model guarantee for the confidentiality, integrity and authenticity of the assets of the TOE.

5. Security Objectives

This chapter describes the security objectives for the TOE and the security objectives for the TOE environment addressing the aspects of identified threats to be countered by the TOE and organizational security policies to be met by the TOE.

5.1 Security Objectives for the TOE

5.1.1 V2X services security

The following security objectives for the TOE are related to the V2X HSM final usage.

OT.KEY_MANAGEMENT ***Secure Key Management***

The TOE shall implement ECC key creation, by either internal generation/derivation following [34], [36], [41], [42]; once created, private keys must be protected against illegal access, modification or disclosure.

OT.KEY_DERIVE ***Key Derivation***

The TOE shall implement the ECC key derivation feature following [29] standard.

This objective for the TOE is taken from the Key Derivation Package; it completes the policy P.SECURE_COMMUNICATION policy from the base PP.

OT.PRIVKEY_IMPORT_TC ***Private Key Import***

The TOE shall implement the import of ECC private keys generated externally.

This objective is taken from the Private Key Import (online) Package.

OT.SIGNATURE_GENERATION ***Authorized Signature Creation***

The TOE shall implements ECDSA digital signatures generation in compliance with FIPS 186-4 [34], RFC 5639 [41] upon authorized user request.

OT.ECIES ***Authorized Encryption/Decryption***

The TOE shall implement ECIES encryption and decryption according to [43] upon authorized user request.

OT.RNG ***Authorized Encryption/Decryption***

The TOE shall implement a robust generation of Random Numbers for internal use for key generation and for external service.

OT.VCS_DATA ***Protection of received User Data***

The TOE shall implement security measures to prevent any alteration, and disclosure when confidentiality is requested, of received user data.

OT. AUTHENTICATION ***VCS authentication***

The TOE shall verify that communication links are established with the expected VCS.

This objective is taken from the Communication Link Extended Protections Package.

OT. PRIVKEY_ACCESS ***Private Key confidentiality***

he TOE shall ensure that private keys can only be used through V2X services and cannot be retrieved out of the TOE.

OT.ACCESS_CONTROL ***Access control to Secure Services***

The TOE shall provide and enforce the functionality of access right control. The access right control shall cover the functionality provided by the TOE (including management) and the objects stored in or processed by the TOE.

The TOE shall enforce that only authenticated entities with sufficient access control rights can access restricted objects and services.

This objective is taken from the Communication Link Extended Protections Package; it replaces the objective OE.SRV_ACCESS of the Base-PP.

OT.TRUSTED_CHANNEL ***Secure Communications***

The TOE shall be able to establish and maintain secure and authenticated communications based on strong cryptographic means with authorized users; level of security must be set depending on content sensitivity: in case of private key import, integrity and confidentiality must be ensured.

This objective for the TOE is taken from the Communication Link Extended Protections Package and covers the one from Private Key Import (online) Package.

Application Note

For this objective, the integrity only covers changes controlled by an attacker leading to knowledge of private keys, or modification of public key to value chosen by the attacker. Compromise of the integrity of keys leading to unavailability of the device is not in the scope of this PP.

5.1.2 OS Update security

The following security objective for the TOE is related to the OS Update functionality and covers threats on software code and data (*T.Sw_**).

OT.SW_UPDATE **Secure *Software Update* process**

The TOE shall be able to update whole or part of its software with an authorized image i.e. authenticity and integrity verifications are performed on loaded image before installation process.

This objective for the TOE is taken from the Software Update Package.

5.1.3 TOE configuration security

The following security objectives for the TOE are related to the OS configuration data update functionality and covers threats on software code and data (T.Sw_*).

OT.TOE_CONFIG ***Secure access to TOE Configuration Items***

The TOE shall ensure that the customer can only configure customer configuration items and that NXP can configure customer and NXP configuration items. Additionally, the customer can only disable the customer configuration and NXP can disable customer and NXP configuration.

5.1.4 TOE restricted mode

The following security objectives for the TOE are related to the Restricted Mode functionality.

OT.ATTACK_COUNTER ***Secure Access to Attack Counter reset***

The TOE shall ensure that only the ISD can reset the Attack Counter.

OT.RESTRICTED_MODE **Access Control in Restricted Mode**

The TOE shall ensure that in Restricted Mode all operations return an error except for the limited set of commands that are allowed by the TOE when in Restricted Mode.

5.1.5 TOE overall security bases

The following security objectives for the TOE are related to the overall security of the TSF.

OT.TOE_SELF_PROTECTION ***Self-protection***

The TOE shall be able to protect itself and its assets from manipulation including physical and software tampering and physical emanation.

5.2 Security Objectives for the Operational Environment

This section describes the security objectives for the environment addressing the aspects of identified threats to be countered by the environment and the organizational security policies to be met by the environment.

OE.TRUSTED_CHANNEL ***V2X* VCS *conformance and security***

The V2X VCS must comply with the TOE security guidance and be able to initialize and maintain a secure communication channel towards the TOE i.e. ensuring authentication of end entities and protection of data exchange in respect with their security need.

This objective for the TOE Environment is taken from the Communication Link Extended Protections Package and covers the one from Private Key Import (online) Package; it replaces the objective on the environment OE.SECURE_COMMUNICATION of the base PP.

OE.KEY_MANAGEMENT ***Authorized Key Pair Generation***

In any phase of the life-cycle, any key manipulated outside the TOE must be protected,

In particular, in case a key pair is generated outside the TOE to be then imported, the environment shall ensure that key pair are securely managed:

- Key generation service shall be provided to authorized users only;
- Key generation shall be performed in accordance with standards [34] and related security guidance;
- Confidentiality of private key shall be ensured while outside the TOE.

This objective for the TOE Environment is taken from the Private Key Import (online) Package.

OE.INTEGRATION ***Secure TOE Integration***

Appropriate technical and/or organisational security measures shall be in place in the phase of the integration of the TOE in its environment in the TOE life-cycle model such that confidentiality, integrity and authenticity of the assets of the TOE are guaranteed. Security Objectives Rationale

All the security objectives described in the ST are traced back to items described in the TOE security environment and any items in the TOE security environment are covered by those security objectives appropriately.

5.2.1 Security Objectives Coverage

The table below summarizes the coverage of Assumptions, OSPs and Threats by the Security Objectives for the TOE.

Table 7. Security Problem Definition coverage by Security Objectives for the TOE

Security Objectives for the TOE **Security Problem Definition**	OT.KEY MANAGEMENT	OT.KEY DERIVE	OT.PRIVKEY IMPORT TC	OT.SIGNATURE GENERATION	OT.ECIES	OT.RNG	OT.VCS DATA	OT.AUTENTICATION	OT.PRIVKEY ACCESS	OT.ACCESS CONTROL	OT.TRUSTED CHANNEL	OT.SW UPDATE	OT.TOE CONFIG	OT.TOE ATTACK COUNTER	OT.RESTRICTED MODE	OT.TOE SELF PROTECTION
T.KEY_REPLACE	X								X	X	X					X
T.KEY_DISCLOSE	X								X	X	X					X
T.VCS_DATA_MODIF							X				X					X
T.VCS_DATA_DISCLOSE							X				X					X
T.SW_TAMPER													X	X	X	X
T.SW_REPLACE																X
T.SW_UPDATE												X				
T.SRV_MALFUNCTION																X
P.KEY_GENERATION	X					X										
P.KEY_DERIVE											X					
P.PRIVKEY_IMPORT_TC			X								X					
P.SIGNATURE_GENERATION				X		X										
P.ECIES					X	X										
P.RNG						X										
P.SW_UPDATE												X				
P.SECURE_COMMUNICATION																
P. ACCESS_CONTROL								X		X						
P.TRUSTED_CHANNEL											X					
A.KEY_EXT_MNGT																
A.INTEGRATION																

The table below summarizes the coverage of Assumptions, OSPs and Threats by the Security Objectives for the environment.

Table 8. Security Problem Definition coverage by Security Objectives for the Environment

Security objectives for the environment Security Problem Definition	OE.TRUSTED_CHANNEL	OE.KEY_MANAGEMENT	OE.INTEGRATION
T. KEY_REPLACE	X		
T.KEY_DISCLOSE	X	X	
TVCS_DATA_MODIF	X		
T.VCS_DATA_DISCLOSE	X		
T.SW_TAMPER			
T.SW_REPLACE			
T.SW_ UPDATE			
T.SRV_MALFUNCTION			
P.KEY_GENERATION			
P.PRIVKEY_IMPORT_TC	X		
P.SIGNATURE_GENERATION			
P.ECIES			
P.RNG			
P.SW_UPDATE			
P.SECURE_COMMUNICATION	X		
P.ACCESS_CONTROL			
P.TRUSTED_CHANNEL	X		
A.KEY_EXT_MNGT		X	
A.INTEGRATION			X

5.2.2 Security Objectives sufficiency

5.2.2.1 Threats and Security Objective Sufficiency

T.KEY_REPLACE deals with the attacks aiming at replacing/modifying private keys; this threat is addressed by:

- OT.KEY_MANAGEMENT which ensure private keys are securely stored once generated or imported.
- OT.PRIVKEY_ACCESS and OT.ACCESS_CONTROL which ensures private key access is only possible through secure services to which access are restricted to authorized users only.
- OT.TRUSTED_CHANNEL and OE.TRUSTED_CHANNEL which ensure than when key is generated outside from the TOE it can be securely imported through a trusted channel and cannot be replaced.
- OT.TOE_SELF_PROTECTION which requires the detection and resistance of the TOE to tampering attacks.

T.KEY_DISCLOSE addresses the threat against the legal validity of signature due to storage and copying of private key outside the TOE. This threat is addressed by:

- OT. KEY_MANAGEMENT which requires the confidentiality of the private key during use by the TOE for signature creation.
- OT.PRIVKEY_ACCESS and OT.ACCESS_CONTROL which ensures private key access is only possible through secure services to which access are restricted to authorized users only.
- OT. TRUSTED_CHANNEL and OE.TRUSTED_CHANNEL which ensure that during import of a private key, its confidentiality is protected.
- OE.KEY_MANAGEMENT which requires the private keys is kept confidential and securely stored in the environment once exported to the TOE.
- TOE_SELF_PROTECTION which requires the detection and resistance of the TOE to tampering attacks.

T.VCS_DATA_MODIF addresses the threat arising from modifications of the data sent as input to the TOE's secure service that does not represent the information as presented by the V2X VCS; this threat is addressed by:

- OT.VCS_DATA which requires the TOE prevents alteration of received user data inside the TOE so only expected data are signed.
- OT.TRUSTED_CHANNEL and OE. TRUSTED_CHANNEL which requires the protections of communications between the V2X VCS and the TOE.
- OT.TOE_SELF_PROTECTION which requires the detection and resistance of the TOE to tampering attacks.

T.VCS_DATA_DISCLOSE addresses the threat arising from modifications of the data sent as input to the TOE's secure service that does not represent the information as presented by the V2X VCS; this threat is addressed by:

- OT.VCS_DATA which requires the TOE prevents disclosure of received user data requesting confidentiality.
- OT.TRUSTED_CHANNEL and OE. TRUSTED_CHANNEL which requires the protections of communications between the V2X VCS and the TOE.
- OT.TOE_SELF_PROTECTION which requires the detection and resistance of the TOE to tampering attacks.

T.SW_TAMPER deals with the attacks aiming at modifying the V2X HSM software; this threat is addressed by:

- OT.TOE_CONFIG, OT.ATTACK_COUNTER and OT.RESTRICTED_MODE require that TOE provides in particular security measures to protect configuration items and attack counter accessible in Restricted Mode.
- OT.TOE_SELF_PROTECTION which requires the detection and resistance of the TOE to tampering attacks.

T.SW_REPLACE deals with the attacks aiming at replacing the V2X HSM software; this threat is countered by:

- OT.TOE_SELF_PROTECTION which requires the detection and resistance of the TOE to tampering attacks.

T.SW_UPDATE deals with the attacks aiming at replacing the V2X HSM software; this threat is countered by:

- OT.SW_UPDATE which requires the software update functionality is accessible to authorized user only and integrity of code is checked before loading.

T.SRV_MALFUNCTION deals with the attacks exploiting a weakness in the implementation of services:

- OT.TOE_SELF_PROTECTION which requires the detection software and hardware tampering attack against the TOE as for instance through invocation of services.

5.2.2.2 Organizational Security Policies and Security Objective Sufficiency

P.KEY_GENERATION provides that the TOE should be employed to handles keys involved in ITS communications.

The requirement of invocation of the TOE required services is addressed by:

- OT.KEY_MANAGEMENT which requests that the TOE implements key import and key generation functions following determined standards and related security requirements.
- O.RNG which ensures the quality of random used in key generation.

P.KEY_DERIVE provides that the TOE must implement the Butterfly key derivation mechanism. This is addressed by:

- OT.KEY_DERIVE which requires the implementation of the requested key derivation mechanism.

P.PRIVKEY_IMPORT_TC provides that the TOE should implements key import. This is addressed by:

- OT.PRIVKEY_IMPORT_TC which requires that the TOE implement the private key import functionality.
- OT.TRUSTED_CHANNEL and OE.TRUSTED_CHANNEL which ensure the proper protections of private key during import.

P.SIGNATURE_GENERATION provides that the TOE should be employed to sign messages as a proof of their authenticity and that generated signatures follow the ETSI standard [27] and are secured. This is addressed by:

- OT.SIGNATURE_GENERATION which requires that the TOE implements ECSDA signature implementation following determined standards and related security requirements.
- O.RNG which ensures the quality of random used in signature generation.

P.ECIES provides that the TOE should be employed to encrypt session keys following the ECIES standards.

- OT.ECIES which requires that the TOE implements encryption and decryption functionalities following determined standards and related security requirements.
- O.RNG which ensures the quality of random used in ECIES scheme.

P.SW_UPDATE provides that in the TOE should be updatable:

- OT.SW_UPDATE which requires that the TOE implements secure software update mechanism.

P.RNG provides that in the TOE should implement random number generator as an external service and for internal purposes:

- OT.RNG which requires that the TOE implements a random number generator for external services and internal purposes.

P.SECURE_COMMUNICATION provides that the TOE environment must implement protections for integrity and confidentiality of exchanged data when required. This is addressed by:

- OE.TRUSTED_CHANNEL which requires the implementation of trusted channel handling by both the VCS (TOE environment),

P.ACCESS_CONTROL provides that the TOE must implement protections to restrict the access to secure services. This is addressed by:

- OT.AUTHENTICATION which requires the user authentication on which the access control will be based.

- OT.ACCESS_CONTROL which ensures private key access is only possible through secure services to which access is restricted to authorized users only.

P.TRUSTED_CHANNEL provides that the TOE and the V2X VCS must be able to establish a trusted channel. This is addressed by:

- OT.TRUSTED_CHANNEL and OE. TRUSTED_CHANNEL which requires the implementation of trusted channel handling by both the V2X VCS and the TOE.

5.2.2.3 Assumptions and Security Objective sufficiency

A.KEY_EXT_MNGT establishes several security aspects concerning handling of private key and public key by the environment; this is addressed by:

- OE.KEY_MANAGEMENT which requires the external key pair generation device can only be used by authorized users, follows determined standards and related security guidance and provides confidentiality protections.

A.INTEGRATION establishes the use of appropriate technical and/or organizational security measures in the phase of integration of the TOE in its environment. This is directly addressed by OE.INTEGRATION.

6. Extended Components Definition

This ST contains the following extended component defined as extension to CC part 2 in referred PPs [4], [5] and [6]:

- SFR FCS_RNG.1 'Generation of Random Numbers' (PP [4])
- SFR FPT_EMS.1 'TOE emanation' (PPs [5] and [6])
- SFR FCS_CKM.5 'Cryptographic Key derivation' (PP [4])

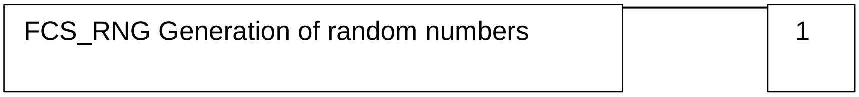
6.1 FCS_RNG (Generation of Random Numbers)

To define the IT security functional requirements of the TOE an additional family (FCS_RNG) of the Class FCS (Cryptographic Support) is defined here. This extended family FCS_RNG describes an SFR for random number generation used for cryptographic purposes.

Family Behaviour

This family defines quality requirements for the generation of random numbers, which are intended to be used for cryptographic purposes.

Component Levelling



FCS_RNG.1 Generation of random numbers requires that the random number generator implements defined security capabilities and the random numbers meet a defined quality metric.

Management

FCS_RNG.1 There are no management activities foreseen.

Audit

FCS_RNG.1 There are no actions defined to be auditable.

FCS_RNG.1 Random number generation

Hierarchical to: No other components.

Dependencies: No dependencies.

FCS_RNG.1.1 The TSF shall provide a [selection: physical, non-physical true, deterministic, hybrid physical, hybrid deterministic] random number generator that implements: [assignment: list of security capabilities].

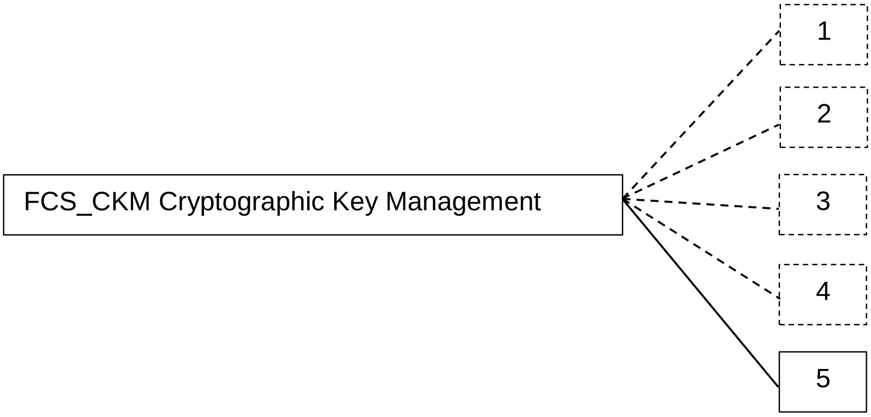
FCS_RNG.1.2 The TSF shall provide random numbers that meet [assignment: *a defined quality metric*].

6.2 FCS_CKM.5 (Cryptographic Key derivation)

This chapter describes a component of the family Cryptographic key management (FCS_CKM) for key derivation as process by which one or more keys are calculated from either a pre-shared key or a shared secret and other information. Key derivation is the deterministic repeatable process by which one or more keys are calculated from both a pre-shared key or shared secret, and other information, while key generation required by FCS_CKM.1 uses internal random numbers.

The component FCS_CKM.5 is on the same level as the other components of the family FCS_CKM.

Component Levelling



FCS_CKM.5 Cryptographic key derivation requires the TOE to provide key derivation which can be based on an assigned standard.

Management: FCS_CKM.5

There are no management activities foreseen

Audit: FCS_CKM.5

The following actions should be auditable if FAU_GEN Security audit data generation is included in the PP/ST:

a) Minimal: Success and failure of the activity.

b) Basic: The object attribute(s), and object value(s) excluding any sensitive information (e.g. secret or private keys).

FCS_CKM.5 Cryptographic key derivation

Hierarchical to: No other components.

Dependencies: [FCS_CKM.2 Cryptographic key distribution, or FCS_COP.1 Cryptographic operation]

FCS_CKM.4 Cryptographic key destruction

FCS_CKM.5.1 The TSF shall derive cryptographic keys [assignment: key type] from [assignment: *input parameters*] in accordance with a specified cryptographic key derivation algorithm [assignment: *cryptographic key derivation algorithm*] and specified cryptographic key sizes [assignment: *cryptographic key sizes*] that meet the following: [assignment: *list of standards*].

6.3 FPT_EMS (TOE Emanation)

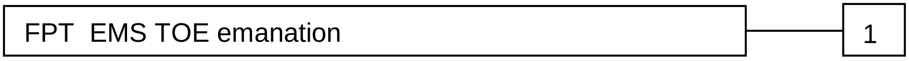
The additional family FPT_EMS (TOE Emanation) of the Class FPT (Protection of the TSF) is defined here to describe the IT security functional requirements of the TOE. The TOE shall prevent attacks against the SCD and other secret data where the attack is based on external observable physical phenomena of the TOE. Examples of such attacks are evaluation of TOE’s electromagnetic radiation, simple power analysis (SPA), differential power analysis (DPA), timing attacks, radio emanation etc. This family describes the functional requirements for the limitation of intelligible emanations. The family FPT_EMS belongs to the Class FPT because it is the class for TSF protection. Other families within the Class FPT do not cover the TOE emanation.

FPT_EMS TOE Emanation

Family behaviour

This family defines requirements to mitigate intelligible emanations.

Component leveling



FPT_EMS.1 TOE Emanation has two constituents:

- FPT_EMS.1.1 Limit of Emissions requires to not emit intelligible emissions enabling access to TSF data or user data.
- FPT_EMS.1.2 Interface Emanation requires to not emit interface emanation enabling access to TSF data or user data.

Management:

FPT_EMS.1 There are no management activities foreseen.

Audit:

FPT_EMS.1 There are no actions identified that shall be auditable if FAU_GEN Security audit data generation is included in a PP or ST using FPT_EMS.1.

FPT_EMS.1 TOE Emanation

Hierarchical to: No other components.

Dependencies: No dependencies.

FPT_EMS.1.1 The TOE shall not emit [assignment: *types of emissions*] in excess of [assignment: *specified limits*] enabling access to [assignment: *list of types of TSF data*] and [assignment: *list of types of user data*].

FPT_EMS.1.2 The TSF shall ensure [assignment: *type of users*] are unable to use the following interface [assignment: *type of connection*] to gain access to [assignment: *list of types of TSF data*] and [assignment: *list of types of user data*].

7. Security Requirements

This chapter gives the security functional requirements and the security assurance requirements for the TOE.

Security functional requirements components given in section 7.1, except FCS_RNG.1 and FPT_EMS.1 which are explicitly stated, are drawn from Common Criteria part 2 v3.1.

Some security functional requirements represent extensions to [2]. Operations for assignment, selection and refinement have been made and are designated by an *italic underline*; addition to the Protection Profile requirements, base and packages, are additionally in ***Bold***

The TOE security assurance requirements statement given in section is drawn from the security assurance components from Common Criteria part 3 [3].

7.1 Definitions

The following table provides list of subjects, objects and related security attributes involved in SFRs descriptions:

Table 9. TOE subjects and object with their related Security Attributes

Subject / Object / Information	Security attributes	Values	Remarks
S.User	Role	R.VCS	Set after SCP03 authentication to V2X-SSD (for access to V2X functionalities)
		R.Customer	Set after SCP03 authentication to V2X-SSD (for access to V2X functionalities) or to Config-SSD (for access to configuration items) *This role covers the S.ImportComponent defined in the Private Key Import Package.*
		R.NXP	Set after SCP03 authentication to ISD (for access to administration)
O.PrivateKey	-	-	-
O.VCSData	-	-	External data loaded to be signed or encrypted. In V2X context, could be requests, messages to be broadcasted, encryption session keys to be ECIES encrypted/decrypted.
S.SWU	Current version	Var	Dynamically increased
O.ImgUpdt	New version	Var	-
	Image Type	Upgrade	-
		Downgrade	
		Reset	

Subject / Object / Information	Security attributes	Values	Remarks
S.Config	Customer Configuration Token	Var	-
	NXP Configuration Token	Var	-
	NXP Configuration Access	Enable	-
		Disable	
	Customer Configuration Access	Enable	-
		Disable	
I.ConfigItem	Access Privilege	-	-
S.Applet	Life-cycle	Installed	Set before delivery
		Selectable	Set after personalization completion
	O.AttackCounter	Var	-

The following table defines operations which will be used in security functional requirements.

Table 10. TOE operations

Operations	Descriptions
OP.KeyPair_Create	ECC key pair generation/derivation
OP.Key_Derive	
OP.Import	ECC private key import
OP.Signature	ECDSA signature
OP.EncDec	ECIES encryption and decryption
OP.RNG	Random number generation
OP.SWU	Software code update
OP.ConfigItem_Update	TOE configuration items update
OP.AttackCounter_Reset	TOE attack counter reset in restricted mode

7.1.1 Security Functional Policies

The following sections defines security functional policies which will be used in security functional requirements.

7.1.1.1 V2X Services access control SFP

The TOE enforces this SFP to forbid the direct access to ECC private keys. The access to ECC private keys is allowed only via the Secure Services.

This SFP is taken from the Communication Link Extended Protections Package; it replaces the Private Key Access Control SFP defined in the base PP.

7.1.1.2 Private Key Import TC SFP

The TOE enforces this SFP to securely manage O.PrivateKey object during OP.Import operation.

This SFP is taken from the Private Key Import (online) Package.

7.1.1.3 Software Update access control SFP

The TOE enforces this SFP to securely manage O.ImgUpdt object during OP.SWU operation.
This SFP is taken from the Software Update Package.

7.1.1.4 Configuration Item information flow control SFP

The TOE enforces this SFP to securely manage O.ConfigItem information during OP.ConfigItem_Update operation.

7.1.1.5 Restricted Mode access control SFP

The TOE enforces this SFP to securely manage O.AttackCounter object during OP.AttackCounter_Reset operation.

7.2 General Security Functional Requirements

General SFRs are based security requirements used by several functionalities as for instance V2X features or OS update process.

7.2.1 Cryptographic support (FCS)

7.2.1.1 Cryptographic key generation (FCS_CKM.1)

ECDSA Signature keys

FCS_CKM.1.1 The TSF shall generate cryptographic keys for *signature generation* in accordance with a specified cryptographic key generation algorithm *ECC, NIST P-256, Brainpool P256r1, NIST P-384, Brainpool P384r1* and specified cryptographic key sizes *256 bits, 384 bits* that meet the following: *FIPS 186-4 [34]*.

7.2.1.2 Cryptographic key destruction (FCS_CKM.4)

FCS_CKM.4.1 The TSF shall destroy cryptographic keys in accordance with a specified cryptographic key destruction method *zeroization* that meets the following: *FIPS 140-2 (Level 1) [33]*.

7.2.1.3 Cryptographic key derivation (FCS_CKM.5)

This SFR is taken from the Key Derivation Package.

ECDSA Runtime keys

FCS_CKM.5.1/ ECC The TSF shall derive cryptographic keys *ECC private key* from *an initial ECC private key* in accordance with a specified cryptographic key derivation algorithm *ECQV* and specified cryptographic key sizes *256 bits* that meet the following: *ECQV [42]*.

Application note

From the ECQV specification, an additional parameter is to be used in order to cover the use of butterfly key mechanism which has been specifically designed for V2X communications in [45]; as a result, the ECQV derivation function s_i := *Hash * a* + p_i *is replaced by* s_i = Hash * (a + f_i) + p_i. *Note also that the Hash is generated from outside.*

SCP03 Session keys

This SFR is added to the Protection Profile existing SFRs.

FCS_CKM.5.1/ KBKDF — The TSF shall derive cryptographic *AES keys* from *SCP03 AES master keys* in accordance with a specified cryptographic key derivation algorithm *KBKDF* and specified cryptographic key sizes 128 bits, 192 bits, 256 bits that meet the following: *NIST SP800-108 [38]*.

7.2.1.4 Cryptographic operation (FCS_COP.1)

FCS_COP.1.1/(Id) — The TSF shall perform *the operations according to Table 11* in accordance with a specified cryptographic algorithm *defined in Table 11* and cryptographic key sizes *defined in Table 11* that meet the following: *standards defined in Table 11*.

Application note

The hashing part of ECDSA algorithm can be performed outside of TOE.

Application note

Usage of ECIES is limited by choices described in [28] 5.3.5.

Table 11. Cryptographic operations (FCS_COP.1)

Id	Algorithm	Key length	Standard
ECDSA Signature			
ECDSA (Digital signature generation)	ECDSA with curves NIST P-256, Brainpool P256r1 ECDSA with curves NIST P-384, Brainpool P384r1	256 bits 384 bits	[34] - FIPS 186-4, SEC1 [41] - RFC 5639
ECIES Encryption/Decryption			
ECIES_ENC (Data encryption and decryption)	ECDSA with curves NIST P-256 and Brainpool P256r1	256 bits	[43] - IEEE Std 1363a. [34] - FIPS 186-4, SEC1 [41] - RFC 5639
ECIES_DEC (Data encryption and decryption)	ECDSA with curves NIST P-256 and Brainpool P256r1	256 bits	[43] - IEEE Std 1363a. [34] - FIPS 186-4, SEC1 [41] - RFC 5639
SCP03 secure channel			
AES (Data encryption and decryption)	AES-128, AES-192, AES-256 in CBC mode	128 bits 192 bits 256 bits	[31] - FIPS SP 800-38A [32] - FIPS PUB 197
AES_MAC (MAC generation and verification)	AES-CMAC	128 bits 192 bits 256 bits	[30] - FIPS SP 800-38B
Software Update			

Id	Algorithm	Key length	Standard
SWU_ECDSA (ECDSA signature verification)	ECDSA with NIST P-256, Brainpool P256r1	256 bits	[34] - FIPS 186-4, [41] - RFC 5639
SWU_ECC (ECC key agreement)	ECC with NIST P-256, Brainpool P256r1	256 bits	[34] - FIPS 186-4 [41] - RFC 5639
SWU_AES (AES decryption)	AES-128 in CBC mode	128 bits	[31] - FIPS SP 800-38A [32] - FIPS PUB 197

7.2.1.5 Random number generation – FCS_RNG.1

FCS_RNG.1.1 The TSF shall provide a *deterministic* random number generator that implements:

1. *(DRG.3.1) If initialized with a random seed using a PTRNG of class PTG.2 (as defined in [44]) as random source, the internal state of the RNG shall have at least 256 bits of entropy.*
2. *(DRG.3.2) The RNG provides forward secrecy (as defined in [44]).*
3. *(DRG.3.3) The RNG provides enhanced backward secrecy even if the current internal state is known (as defined in [44]),*

FCS_RNG.1.2 The TSF shall provide *random numbers* that meet:

1. *(DRG.3.4) The RNG, initialized with a random seed using a PTRNG of class PTG.2 (as defined in [44]) as random source, generates output for which 248 strings of bit length 128 are mutually different with probability at least 1-2^{-24}.*
2. *(DRG.3.5) Statistical test suites cannot practically distinguish the random numbers from output sequences of an ideal RNG. The random numbers must pass test procedure A (as defined in [44]),*

Application note

This functionality is provided by the certified Security Software (FCS_RNG.1/HYB-DET), see [12] and [15].

7.2.2 Identification and Authentication (FIA)

7.2.2.1 Timing of identification (FIA_UID.1)

This SFR is taken from the Communication Link Extended Protections Package.

FIA_UID.1.1 The TSF shall allow

1. *Self-protection features,*
2. *Establishment of a trusted channel between authorized, entities and the TOE.*
3. *Operating system selection (OS Updater or JCOP)*

on behalf of the user to be performed before the user is identified.

FIA_UID.1.2 The TSF shall require each user to be successfully identified before allowing any other TSF-mediated actions on behalf of that user.

7.2.2.2 Timing of authentication (FIA_UAU.1)

This SFR is taken from the Communication Link Extended Protections Package.

FIA_UAU.1.1 The TSF shall allow

1. *Self-protection features,*
2. *Identification of users by means of TSF required by FIA_UID.1.*
3. *Establishment of a trusted channel between authorized entities and the TOE.*
4. *Operating system selection (OS Updater or JCOP)*

on behalf of the user to be performed before the user is authenticated.

FIA_UAU.1.2 The TSF shall require each user to be successfully authenticated before allowing any other TSF-mediated actions on behalf of that user.

7.2.2.3 Authentication failure handling (FIA_AFL.1)

This SFR is added to the Protection Profile existing SFRs.

FIA_AFL.1.1 The TSF shall detect when 5 unsuccessful authentication attempts occur related to consecutive failed authentication attempts.

FIA_AFL.1.2 When the defined number of unsuccessful authentication attempts has been *met* the TSF shall:

- *block the possibility to authenticate as R.VCS or R.Customer;*
- *impose 30 second delay to authenticate as R.NXP.*

Application note

For R.NXP authentication to the ISD, after 15 unsuccessful authentication attempts, the attack counter is additionally incremented, and a software reset is initiated.

7.2.3 User Data Protection (FDP)

7.2.3.1 Stored data integrity monitoring and action (FDP_SDI.2)

FDP_SDI.2.1 The TSF shall monitor user data stored in containers controlled by the TSF for *integrity error* on all objects, based on the following attributes:

1. *secure container CRC32 integrity verification status for persistent data.*
2. *parity bitwise verification status for transient data.*

FDP_SDI.2.2 Upon detection of a data integrity error, the TSF shall:

3. *prohibit the use of the altered data,*
4. *inform S.User about integrity error.*

Application note

User data integrity protected by this SFRs are the Cryptographic keys, VCS data and Software Update Images.

7.2.3.2 Subset residual information protection (FDP_RIP.1)

FDP_RIP.1.1 The TSF shall ensure that any previous information content of a resource is made unavailable upon the *de-allocation of the resource from* the following objects: *O.PrivateKey*.

7.2.4 Security Management (FMT)

7.2.4.1 Security roles (FMT_SMR.1)

This SFR is taken from the Communication Link Extended Protections Package.

FMT_SMR.1.1 The TSF shall maintain the roles *R.VCS, R.Customer, R.NXP*.

FMT_SMR.1.2 The TSF shall be able to associate users with roles.

7.2.4.2 Management of TSF data (FMT_MTD.1)

This SFR is taken from the Communication Link Extended Protections Package.

FMT_MTD.1.1 The TSF shall restrict the ability to *create and modify* the *SCP03 keys* to *the related SSD owner (R.NXP or R.Customer)*.

7.2.4.3 Trusted Path/Channels (FTP)Inter-TSF trusted channel (FTP_ITC.1)

Secure Services

This SFR is taken from the Communication Link Extended Protections Package

.FTP_ITC.1.1 The TSF shall provide a communication channel between itself and another trusted IT product that is logically distinct from other communication channels and provides assured identification of its end points and protection of the channel data from modification or disclosure.

FTP_ITC.1.2 The TSF shall permit *another trusted IT device* to initiate communication via the trusted channel.

FTP_ITC.1.3 The TSF shall initiate communication via the trusted channel for:

1. *Transfer of VCS data*
2. *Administration services (Software Update, Restricted Mode)*

Application note

"Another trusted IT product" is in the V2X context the VCS.

Private Key Import

This SFR is taken from the Private Key Import (online) Package.

FTP_ITC.1.1/Import_TC The TSF shall provide a communication channel between itself and another trusted IT product that is logically distinct from other communication channels and provides assured identification of its end points and protection of the channel data from modification or disclosure.

FTP_ITC.1.2/Import_TC The TSF shall permit *another trusted IT device* to initiate communication via the trusted channel.

FTP_ITC.1.3/Import_TC The TSF shall initiate communication via the trusted channel for:

1. *Private Key Import*

7.2.5 Protection of the TSF (FPT)

7.2.5.1 TOE Emanation (FPT_EMS.1)

This SFR is added to the Protection Profile existing SFRs.

FPT_EMS.1.1 The TOE shall not emit information of IC Power consumption in excess of state-of-the-art values enabling access to *O.PrivateKey*.

FPT_EMS.1.2 The TSF shall ensure *any user* is unable to use the following interface *physical chip contacts and contactless I/O* to gain access to *O.PrivateKey*.

Application note

This SFR has been added to the set of SFRs taken from [4] to fit with the secure element secure hardware aspects; these strengthened the PP SFRs.

The TOE shall prevent attacks against the private keys and other secret data where the attack is based on external observable physical phenomena of the TOE. Such attacks may be observable at the interfaces of the TOE or may origin from internal operation of the TOE or may origin by an attacker that varies the physical environment under which the TOE operates. The set of measurable physical phenomena is influenced by the technology employed to implement the TOE. Examples of measurable phenomena are variations in the power consumption, the timing of transitions of internal states, electromagnetic radiation due to internal operation, radio emission.
Due to the heterogeneous nature of the technologies that may cause such emanations, evaluation against state-of-the-art attacks applicable to the technologies employed by the TOE is assumed. Examples of such attacks are, but are not limited to, evaluation of TOE's electromagnetic radiation, simple power analysis (SPA), differential power analysis (DPA), timing attacks, etc

7.2.5.2 Failure with preservation of secure state (FPT_FLS.1)

FPT_FLS.1.1 The TSF shall preserve a secure state when the following types of failures occur:

1. *failure from self-test under FPT_TST,*
2. *physical tampering according to FPT_PHP.3.*

7.2.5.3 Resistance to physical attack (FPT_PHP.3)

FPT_PHP.3.1 The TSF shall resist *physical tampering* to *the TOE components implementing the TSF* by responding automatically such that the SFRs are always enforced.

7.2.5.4 TSF testing (FPT_TST.1)

FPT_TST.1.1 The TSF shall run a suite of self-tests *during initial start-up or before running a secure operation* to demonstrate the correct operation of *the TSF*.

FPT_TST.1.2 The TSF shall provide authorized users with the capability to verify the integrity of *TSF data*.

FPT_TST.1.3 The TSF shall provide authorized users with the capability to verify the integrity of *HSM software*.

7.3 V2X services Security Functional Requirements

7.3.1 User Data Protection (FDP)

The security attributes for the user, TOE components and related status are defined in Table 9.

7.3.1.1 Subset access control (FDP_ACC.1)

Secure Services

FDP_ACC.1.1 The TSF shall enforce the *V2X Services access control SFP* on

1. *subject: S.User, **S.Applet**;*
2. *objects: O.PrivateKey, **O.VCSData**.*
3. *operations: OP.KeyPair_Create, OP.Signature, OP.EncDec, **OP.RNG**.*

Private Key Import

This SFR is taken from the Private Key Import (online) Package.

FDP_ACC.1.1/Import_TC The TSF shall enforce the *Private Key Import TC SFP* on

1. subject: S.User, **S.Applet**;
2. object: O.PrivateKey;
3. operation: OP.Import.

7.3.1.2 Security attribute based access control (FDP_ACF.1)

Secure Services

This SFR is taken from the Communication Link Extended Package.

FDP_ACF.1.1 The TSF shall enforce the *V2X Services access control SFP* to objects based on the following:

1. *S.User is associated with the security attribute "Role";*
2. *O.PrivateKey, **O.VCSData**,*
3. ***S.Applet is associated with the security attributes "Life-cycle",***

FDP_ACF.1.2 The TSF shall enforce the following rules to determine if an operation among controlled subjects and controlled objects is allowed:

1. *S.User is allowed to perform*
   a. *OP.KeyPair_Create to create O.PrivateKey* ***following FCS_CKM.1****,*
   b. *OP.Signature on O.GData with O.PrivateKey* ***following FCS_COP.1/ECDSA,***
   c. *OP.EncDec* ***on O.GDdata*** *with O.PrivateKey* ***following FCS_COP.1/ECIES_ENC for encryption and FCS_COP.1/ECIES_DEC for decryption***
   d. ***OP.RNG following FCS_RNG.1****.*

   *if its security attribute “Role” is set to “VCS****”****.*

FDP_ACF.1.3 The TSF shall explicitly authorize access of subjects to objects based on the following additional rules:

1. *R.VCS is allowed to perform same operations as mentioned above if S.Applet security Attributes “Life-cycle” is set to ”Selectable”.*

FDP_ACF.1.4 The TSF shall explicitly deny access of subjects to objects based on the rule:

1. *No one shall be able to retrieve O.PrivateKey unencrypted from the TOE.*

Private Key Import

FDP_ACF.1.1/Import_TC The TSF shall enforce the *Private Key Import TC access control SFP* to objects based on the following:

1. *S.User is associated with the security attribute “Role”;*
2. ***S.Applet is associated with the security attributes “Life-cycle”;***
3. *O.PrivateKey;*

FDP_ACF.1.2/Import_TC The TSF shall enforce the following rules to determine if an operation among controlled subjects and controlled objects is allowed:

1. *S.User is allowed to import a private key to be stored in O.PrivateKey according to FDP_ITC.1 under FDP_UIT.1/Import)TC and FDP_UCT.1/Import_TC if its security attribute “Role” is set to “Customer”****.***

FDP_ACF.1.3/Import_TC The TSF shall explicitly authorize access of subjects to objects based on the following additional rules:

1. *R.Customer is allowed to perform same operations as mentioned above if S.Applet security Attributes “Life-cycle” is set to ”Installed”.*

FDP_ACF.1.4/Import_TC The TSF shall explicitly deny access of subjects to objects based on the rule: *none*.

7.3.1.3 Basic data exchange integrity (FDP_UIT.1)

Secure Services

This SFRs is taken from Communication Link Extended Protections Package.

FDP_UIT.1.1 The TSF shall enforce the *V2X Services access control* to *receive* **VCS data** ~~userdata~~ in a manner protected from *modification and insertion* errors.

FDP_UIT.1.2 The TSF shall enforce the *V2X Services access control SFP* to be able to determine on receipt of user data, whether *modification and insertion* has occurred.

Application Note

The integrity only covers changes controlled by an attacker leading to knowledge of private keys, or modification of public key to value chosen by the attacker. Compromise of the integrity of keys leading to unavailability of the device is not in the scope of this PP.

The ECDSA signatures are protected by their nature, as such protection for transmit is not needed for OP.Signature operation.

Private Key Import

This SFRs is taken from Private Key Import (online) Package.

FDP_UIT.1.1/Import_TC The TSF shall enforce the *Private Key Import TC SFP* to *receive* **private key** ~~userdata~~ in a manner protected from *modification and insertion* errors.

FDP_UIT.1.2/Import_TC The TSF shall enforce the *Private Key Import TC SFP* to be able to determine on receipt of user data, whether *modification and insertion* has occurred.

7.3.1.4 Import of user data without security attributes (FDP_ITC.1)

Secure Services

This SFRs is taken from Communication Link Extended Protections Package.

FDP_ITC.1.1 The TSF shall enforce the *V2X Services access control SFP* when importing **VCS data** ~~userdata~~, controlled under the SFP, from outside of the TOE.

FDP_ITC.1.2 The TSF shall ignore any security attributes associated with the **VCS data** ~~userdata~~ when imported from outside the TOE.

FDP_ITC.1.3 The TSF shall enforce the following rules when importing **VCS data** ~~user data~~ controlled under the SFP from outside the TOE: none.

Private Key Import

This SFRs is taken from Private Key Import (online) Package.

FDP_ITC.1.1/Import_TC The TSF shall enforce the *Private Key Import TC SFP* when importing **private key** ~~userdata~~, controlled under the SFP, from outside of the TOE.

FDP_ITC.1.2/Import_TC The TSF shall ignore any security attributes associated with the **private key** ~~userdata~~ when imported from outside the TOE.

FDP_ITC.1.3/Import_TC The TSF shall enforce the following rules when importing **private key** ~~user data~~ controlled under the SFP from outside the TOE*: none.*

7.3.1.5 Basic data exchange confidentiality (FDP_UCT.1)

Secure Services

This SFRs is taken from Communication Link Extended Protections Package.

FDP_UCT.1.1 The TSF shall enforce the *V2X Services access control SFP* to *transmit and receive* **confidential VCS Data**~~userdata~~ in a manner protected from unauthorized disclosure.

Application Note

Confidential VCS Data covers all and only the VCS Data defined in the assets list as confidential.

Private Key Import

This SFRs is taken from Private Key Import (online) Package.

FDP_UCT.1.1/Import_TC The TSF shall enforce the *Private Key Import TC SFP* to *transmit and receive* **private keys**~~userdata~~ in a manner protected from unauthorized disclosure.

7.3.2 Security Management (FMT)

7.3.2.1 Security Management (FMT_SMF.1)

FMT_SMF.1.1 The TSF shall be capable of performing the following security management functions:

1. *Management of key objects by means of commands*;
2. *V2X Applet Life-Cycle management*;
3. *Management of V2X services related security attributes (FMT_MSA.1 FMT_MSA.3).*

7.3.2.2 Management of security attributes (FMT_MSA.1)

This SFR is taken from the Communication Link Extended Protections Package.

FMT_MSA.1.1 The TSF shall enforce the *V2X Services access control SFP* to restrict the ability to:

1. *query the security attribute “V2X Applet Life-Cycle” to R.Customer (for Key Import) and R.* VCS *(for V2X Services);*
2. *modify the security attribute “V2X Applet Life-Cycle” to R.Customer.*

7.3.2.3 Static attribute initialisation (FMT_MSA.3)

FMT_MSA.3.1 The TSF shall enforce the *V2X Services access control SFP* to provide *restrictive* default values for security attributes that are used to enforce the SFPs.

FMT_MSA.3.2 The TSF shall allow *none* to specify alternative initial values to override the default values when an object or information is created.

7.4 Software Update Security Functional Requirements

The following SFRs are taken from the Software Update (online) Package.

7.4.1 User Data Protection (FDP)

7.4.1.1 Complete access control (FDP_ACC.1[SWU])

FDP_ACC.1.1/SWU The TSF shall enforce the *Software Update access control SFP* to objects based on the following:

1. *Suject: S.SWU*
2. *Object: O.ImgUdpt*
3. *Operation: OP.SWU*

7.4.1.2 Access control functions (FDP_ACF.1[SWU])

FDP_ACF.1.1/SWU The TSF shall enforce the *Software Update access control SFP* based on the following types of subject and information security attributes:

1. *S.SWU: “Current Version*
2. *O.ImgUpdt: “New Version”*

FDP_ACF.1.2/SWU The TSF shall enforce the following rules to determine if an operation among controlled subjects and controlled objects is allowed:

1. *S.SWU is allowed to import O.ImgUpdt according to FDP_ITC.2/SWU.*
2. *O.ImgUpdt authenticity is successfully verified according to FCS_COP.1/SWU_ECDSA and FCS_COP.1/SWU_ECC.*
3. *New Version” of O.ImgUpdt is equal or higher than “Current Version” of S.SWU.*
4. ***O.ImgUpdt has been successfully decrypted according to FCS_COP.1/SWU_AES“***
5. ***S.SWU is allowed to delete the current version of the Software after authentication of the command according to FCS_COP.1/SWU_ECDSA and FCS_COP.1/SWU_ECC.***

FDP_ACF.1.3/SWU The TSF shall explicitly authorize access of subjects to objects based on the following additional rules: *none*.

FDP_ACF.1.4/SWU The TSF shall explicitly deny access of subjects to objects based on the following additional rules: *none*

7.4.1.3 Import of user data with security attributes – FDP_ITC.2 [SWU]

FDP_ITC.2.1/SWU The TSF shall enforce the *Software Update access control SFP* when importing user data, controlled under the SFP, from outside of the TOE.

FDP_ITC.2.2/SWU The TSF shall use the security attributes associated with the imported user data.

FDP_ITC.2.3/SWU The TSF shall ensure that interpretation of the security attributes of the imported user data is as intended by the source of the user data.

FDP_ITC.2.4/SWU The TSF shall ensure that interpretation of the security attributes of the imported user data is as intended by the source of the user data.

FDP_ITC.2.5/SWU The TSF shall enforce the following rules when importing user data controlled under the SFP from outside the TOE:

1. *Execution of O.ImgUpdt only after successful verification of authenticity according to FCS_COP.1/SWU_ECDSA*

7.4.1.4 Inter-TSF basic TSF data consistency – FPT_TDC.1 [SWU]

FPT_TDC.1.1/SWU The TSF shall provide the capability to consistently interpret security attribute *"New Version"* when shared between the TSF and another trusted IT product.

FPT_TDC.1.2/SWU The TSF shall use the following rules:

1. *the "New Version" must be identified*

when interpreting the TSF data from another trusted IT product.

7.4.2 Security Management (FMT)

7.4.2.1 Specification of Management Functions (FMT_SMF.1[SWU])

FMT_SMF.1.1/SWU The TSF shall be capable of performing the following management functions:

1. *Perform Software Update*
2. *Management of security attributes (FMT_MSA.1, FMT_MSA.3.*

7.4.2.2 Management of security attributes (FMT_MSA.1[SWU])

FMT_MSA.1.1/SWU The TSF shall enforce the *Software Update access control SFP* to restrict the ability to *modify* the security attributes *"Current Version"* to *S.SWU*.

7.4.2.3 Static attribute initialization (FMT_MSA.3[SWU])

FMT_MSA.3.1/SWU The TSF shall enforce the *Software Update access control SFP* to provide *restrictive* default values for security attributes that are used to enforce the SFP.

FMT_MSA.3.2/SWU The TSF shall allow the *S.SWU* specify alternative initial values to override the default values when an object or information is created.

7.5 TOE Configuration Security Functional Requirements

7.5.1 User Data protection

7.5.1.1 Complete information flow control (FDP_IFC.2[CFG])

FDP_IFC.2.1/CFG The TSF shall enforce the *Configuration information flow control SFP* on *R.Customer, R.NXP, S.Config, and I.ConfigItem* and all operations that cause that information to flow to and from subjects covered by the SFP.

FDP_IFC.2.2/CFG The TSF shall ensure that all operations that cause any information in the TOE to flow to and from any subject in the TOE are covered by an information flow control SFP.

7.5.1.2 Simple security attributes (FDP_IFF.1[CFG])

FDP_IFF.1.1/CFG The TSF shall enforce the *Configuration information flow control SFP* based on the following types of subject and information security attributes:

1. *S.Config: "Customer Configuration Token",*
2. *"NXP Configuration Token", "NXP Configuration Access", "Customer Configuration Access";*
3. *I.ConfigItem: "Access Privilege".*

FDP_IFF.1.2/CFG The TSF shall permit an information flow between a controlled subject and controlled information via a controlled operation if the following rules hold:

1. *Read and write operations of I.ConfigItem between S.Config and S.User shall only be possible when R.NXP is authenticated with its "NXP Configuration Token".*
2. *Read and write operations of I.ConfigItem between S.Config and S.User shall only be possible when R.Customer is authenticated with its "Customer Configuration Token" and if "Access Privilege" allows it.*
3. *Enabling or disabling of "NXP Configuration Access" between S.Config and S.User shall only be possible when R.NXP is authenticated with its "NXP Configuration Token".*

FDP_IFF.1.3/CFG The TSF shall enforce the additional information flow control SFP rules [assignment: *none*.

FDP_IFF.1.4/CFG The TSF shall explicitly authorize an information flow based on the following rules: *none*.

FDP_IFF.1.5/CFG The TSF shall explicitly deny an information flow based on the following rules:

1. *If "NXP Configuration Access" is set to "Disable" then nobody can read or write I.ConfigItem.*
2. *If "Customer Configuration Access" is set to "Disable" then R.Customer cannot read or write I.ConfigItem.*

Application note

GlobalPlatform Framework authentication mechanism is used to authenticate the tokens.

7.5.2 Security Management (FMT)

7.5.2.1 Specification of Management Functions (FMT_SMF.1[CFG])

FMT_SMF.1.1/CFG The TSF shall be capable of performing the following management functions:

1. *Read/Write I.ConfigItem;*
2. *Enable/Disable "NXP Configuration Access";*
3. *Enable/Disable "Customer Configuration Access".*

7.5.2.2 Management of security attributes (FMT_MSA.1[CFG])

FMT_MSA.1.1/CFG The TSF shall enforce the *Configuration information flow control SFP* to restrict the ability to *modify* the security attribute *"NXP Configuration Access" and ''Customer Configuration Access''* to *R.NXP and R.Customer respectively*.

7.5.2.3 Static attribute initialization (FMT_MSA.3[CFG])

FMT_MSA.3.1/CFG The TSF shall enforce the *Configuration information flow control SFP* to provide *restrictive* default values for security attributes that are used to enforce the SFP.

FMT_MSA.3.2/CFG The TSF shall allow the *nobody* to specify alternative initial values to override the default values when an object or information is created.

7.6 Restricted Mode Security Functional Requirements

7.6.1 User Data Protection (FDP)

7.6.1.1 Complete access control (FDP_ACC.2[RM])

FDP_ACC.2.1/RM The TSF shall enforce the *Restricted Mode access control SFP* on *S.Applet* and all operations among subjects and objects covered by the SFP.

FDP_ACC.2.2/RM The TSF shall ensure that all operations between any subject controlled by the TSF and any object controlled by the TSF are covered by an access control SFP.

7.6.1.2 Security attribute based access control (FDP_ACF.1[RM])

FDP_ACF.1.1/RM The TSF shall enforce the *Restricted Mode access control SFP* to objects based on the following:

1. *S.Applet;*
2. *O.AttackCounter.*

FDP_ACF.1.2/RM The TSF shall enforce the following rules to determine if an operation among controlled subjects and controlled objects is allowed:

1. *O.AttackCounter can be reset by R.NXP.*

FDP_ACF.1.3/RM The TSF shall explicitly authorize access of subjects to objects based on the following additional rules: *none*.

FDP_ACF.1.4/RM The TSF shall explicitly deny access of subjects to objects based on the following additional rules:

Deny all operations on all objects if the O.AttackCounter has reached its limit (restricted mode), except for operations listed in FMT_SMF.1/RM.

7.6.2 Security Management (FMT)

7.6.2.1 Specification of management functions (FMT_SMF.1[RM])

FMT_SMF.1.1/RM The TSF shall be capable of performing the following management functions:

1. *Select ISD;*
2. *Authentication against the ISD;*
3. *Initialize a secure channel with the card;*
4. *Query the Serial Number (Unique ID for chip);*
5. *Read Platform Identifier;*
6. *Query the logging information;*
7. *Read Secure Channel Sequence Counter;*
8. *Read Current Sequence Number;*
9. *Reset O.AttackCounter.*

7.6.2.2 Management of security attributes (FMT_MSA.1[RM])

FMT_MSA.1.1/RM The TSF shall enforce the *Restricted Mode access control SFP* to restrict the ability to *modify* the security attributes *O.AttackCounter* to *R.NXP*.

7.6.2.3 Static attribute initialization (FMT_MSA.3[RM])

FMT_MSA.3.1/RM The TSF shall enforce the *Restricted Mode access control SFP* to provide *restrictive* default values for security attributes that are used to enforce the SFP.

FMT_MSA.3.2/RM The TSF shall allow the *nobody* to specify alternative initial values to override the default values when an object or information is created.

7.7 TOE Security Assurance Requirements

7.7.1 SARs measures

The table below lists the selected Security Assurance Requirements, corresponding to EAL4 augmented with components ALC_DVS.2, ALC_FLR.1 and AVA_VAN.5 (marked in bold):

Table 12. Assurance Requirements: EAL4 augmented

Assurance Class	Component	Description
ADV: Development	ADV_ARC.1	Security architecture description
	ADV_FSP.4	Complete functional specification
	ADV_IMP.1	Implementation representation of the TSF
	ADV_TDS.3	Basic modular design
AGD: Guidance documents	AGD_OPE.1	Operational user guidance
	AGD_PRE.1	Preparative procedures
ALC: Lifecycle support	ALC_CMC.4	Production support, acceptance procedures and automation
	ALC_CMS.4	Problem of Tracking CM coverage
	ALC_DEL.1	Delivery procedures
	ALC_DVS.2	Sufficiency of security measures
	ALC_FLR.1	Basic flaw remediation
	ALC_LCD.1	Developer defined life-cycle model
	ALC_TAT.1	Well defined development tools
ASE: Security Target evaluation	ASE_CCL.1	Conformance claims
	ASE_ECD.1	Extended components definition
	ASE_INT.1	ST introduction
	ASE_OBJ.2	Security objectives
	ASE_REQ.2	Derived security requirements
	ASE_SPD.1	Security problem definition
	ASE_TSS.1	TOE summary specification
ATE: Test	ATE_COV.2	Analysis of coverage
	ATE_DPT.1	Testing: basic design
	ATE_FUN.1	Functional testing
	ATE_IND.2	Independent testing - sample
AVA: Vulnerability assessment	AVA_VAN.5	Advanced methodical vulnerability analysis

7.7.2 SARs Rationale

The EAL4+ was chosen to permit the developer to gain maximum assurance from positive security engineering based on good commercial development practices. EAL4 is the level at which it is likely to be economically feasible to retrofit to an existing product line. EAL4 is applicable in those circumstances where developers or users require a moderate to high level of independently assured security in conventional commodity TOEs and are prepared to incur sensitive security specific engineering costs.

Augmentation results from the selection of:

1. **ALC_DVS.2 - Life-cycle support- Sufficiency of security measures**
The selection of the component ALC_DVS.2 provides a higher assurance of the security of the TOE development and manufacturing especially for the secure handling of the TOE material.
The component ALC_DVS.2 has no dependencies.
2. **ALC_FLR.1 - Basic flaw remediation**
The selection of the component ALC_FLR.1 provides a higher assurance of the maintenance of the TOE with the handling of security flaw.
The component ALC_FLR.1 has no dependencies.
3. **AVA_VAN.5** - **Vulnerability Assessment - Advanced methodical vulnerability analysis**
The selection of the component AVA_VAN.5 provides a higher assurance of the security by vulnerability analysis to assess the resistance to penetration attacks performed by an attacker possessing a high attack potential. This vulnerability analysis is necessary to fulfil the TOE security objectives.
The component AVA_VAN.5 has the following dependencies:

   a. ADV_ARC.1 Security architecture description
   b. ADV_FSP.4 Complete functional specification
   c. ADV_TDS.3 Basic modular design
   d. ADV_IMP.1 Implementation representation
   e. AGD_OPE.1 Operational user guidance
   f. AGD_PRE.1 Preparative procedures
   g. ATE_DPT.1 Testing: basic design

All of these are met or exceeded in the EAL4 assurance package.

7.8 Security Requirements Rationale

7.8.1 Security Requirement Coverage

The table below summarizes the coverage of Security Objectives of the TOE by the Security Functional Requirements. Some requirements correspond to the security objectives of the TOE in combination with other objectives.

Table 13. Security Objectives for the TOE coverage by Security Functional Requirements

Cross in bold are added regarding the claimed Protection Profile and Packages; however, this is only a matter of interpretation and fit to the specificity of the product but do not lower down the security coverage.

Security Objectives for the TOE Security Functional Requirements	OT.KEY_MANAGEMENT	OT.KEY_DERIVE	OT.PRIVKEY_IMPORT_TC	OT.SIGNATURE_GENERATION	OT.ECIES	OT.RNG	OT.VCS_DATA	OT.AUTHENTICATION	OT.PRIVKEY_ACCESS	OT.ACCESS_CONTROL	OT.TRUSTED_CHANNEL	OT.SW_UPDATE	OT.TOE_CONFIG	OT.ATTACK_COUNTER	OT.RESTRICTED_MODE	OT.TOE_SELF_PROTECTION
FCS_CKM.1	X				X											
FCS_CKM.4	X															
FCS_CKM.5/ECC		X														
FCS_CKM.5/KBKDF											X					
FCS_COP.1/ECDSA				X												
FCS_COP.1/ECIES_ENC					X											
FCS_COP.1/ECIES_DEC					X											
FCS_COP.1/AES											X					
FCS_COP.1/AES_MAC											X					
FCS_COP.1/SWU_ECDSA												X				
FCS_COP.1/SWU_ECC												X				
FCS_COP.1/SWU_AES												X				
FCS_RNG.1	X				X	X										
FIA_UID.1								X					X			
FIA_UAU.1								X								
FIA_AFL.1								X								
FDP_SDI.2	X						X					X				
FDP_RIP.1	X			X	X											
FMT_SMR.1								**X**		X				X		
FMT_MTD.1											X					
FTP_ITC.1							**X**				X					
FTP_ITC.1/Import_TC											X					
FPT_EMS.1	**X**	**X**	**X**													X
FPT_FLS.1	**X**	**X**	**X**	**X**	**X**	**X**										X
FPT_PHP.3	**X**	**X**	**X**	**X**	**X**	**X**	X									X
FPT_TST.1	**X**	**X**	**X**	**X**	**X**	**X**										X
FDP_ACC.1									X	X	**X**					
FDP_ACC.1Import_TC									**X**	**X**	X					
FDP_ACF.1									X	X	**X**					
FDP_ACF.1/Import_TC									**X**	**X**	X					

Security Objectives for the TOE Security Functional Requirements	OT.KEY_MANAGEMENT	OT.KEY_DERIVE	OT.PRIVKEY_IMPORT_TC	OT.SIGNATURE_GENERATION	OT.ECIES	OT.RNG	OT.VCS_DATA	OT.AUTHENTICATION	OT.PRIVKEY_ACCESS	OT.ACCESS_CONTROL	OT.TRUSTED_CHANNEL	OT.SW_UPDATE	OT.TOE_CONFIG	OT.ATTACK_COUNTER	OT.RESTRICTED_MODE	OT.TOE_SELF_PROTECTION
FDP_UIT.1						**X**	**X**				X					
FDP_UIT.1/Import_TC											X					
FDP_ITC.1						**X**	**X**				X					
FDP_ITC.1/Import_TC			X								**X**					
FDP_UCT.1						**X**	**X**				X					
FDP_UCT.1/Import_TC											X					
FMT_SMF.1									X	**X**						
FMT_MSA.1									**X**	X						
FMT_MSA.3									X	**X**						
FDP_ACC.1/SWU												X				
FDP_ACF.1/SWU												X				
FDP_ITC.2/SWU												X				
FPT_TDC.1/SWU												X				
FMT_SMF.1/SWU												X				
FMT_MSA.1/SWU												X				
FMT_MSA.3/SWU												X				
FDP_IFC.2/CFG													X			
FDP_IFF.1/ CFG													X			
FMT_SMF.1/CFG													X			
FMT_MSA.1/CFG													X			
FMT_MSA.3/CFG													X			
FDP_ACC.2/RM															X	
FDP_ACF.1/RM															X	
FMT_SMF.1/RM															X	
FMT_MSA.1/RM														X		
FMT_MSA.3/RM														X		

7.8.2 Security Requirements Sufficiency

OT.KEY_MANAGEMENT requires key creation via internal generation is implemented following standards; subsequently to their creation, private and secret keys must be protected over their lifetime. This is covered as follows:

- Expected key generation implementation is addressed by FCS_CKM.1 which implements secure cryptographic algorithms ensuring the cryptographic quality of key pairs and that the confidentiality of the private key cannot be disclosed from the public key.; such generation uses random number generator respecting FCS_RNG requirements.
- FDP_SDI.2 requires that the integrity of private key cannot be altered while stored.
- FCS_CKM.4 and FDP_RIP.1 require the private key is destroyed after being used for signature creation or upon user request and that this destruction leaves no residual information.

- Key creation services execution protection is addressed by FPT_TST.1 which tests the working conditions of the TOE and FPT_FLS.1 which guarantees a secure state when integrity is violated; this ensures that the specified security functions are operational and that data have not been altered.
- FPT_EMS.1 and FPT_PHP.3 require additional security features of the TOE to ensure the confidentiality of the private key.

OT.KEY_DERIVE requires key derivation is implemented following standards. This is covered as follows:

- Expected key derivation implementation is addressed by FCS_CKM.5/ECC and FCS_CKM.5/KBKDF use random number generator respecting FCS_RNG requirements.
- FPT_TST.1 which tests the working conditions of the TOE and FPT_FLS.1 guarantees a secure state when integrity is violated (e.g. after fault injection for DFA); this ensures that the specified security functions are operational and that data have not been altered.
- FPT_EMS.1 and FPT_PHP.3 require additional security features of the TOE to ensure the confidentiality of the private key.

Remark: further management of derived keys is covered by the objective OT.KEY_MANAGEMENT.

OT.PRIVKEY_IMPORT_TC requires key import is implemented following standards. This is covered as follows:

- Expected key import functionality implementation is addressed by FDP_ITC.1/Import_TC.
- FPT_TST.1 which tests the working conditions of the TOE and FPT_FLS.1 guarantees a secure state when integrity is violated (e.g. after fault injection for DFA); this ensures that the specified security functions are operational and that data have not been altered.
- FPT_EMS.1 and FPT_PHP.3 require additional security features of the TOE to ensure the confidentiality of the private key.

Remark: trusted channel establishment and protections are covered by the objective OT.TRUSTED_CHANNEL; then, further management of imported keys is covered by the objective OT.KEY_MANAGEMENT.

OT.SIGNATURE_GENERATION requires that signature generation functionality is implemented following standards; this is covered as follows:

- FDP_RIP.1 prevents misuse of any resources containing the private key after de-allocation (e.g. after the signature process).
- Expected implementation of the signature operation is addressed by FCS_COP.1/ECDSA.
- Signature service execution protection is addressed by FPT_TST.1 which tests the working conditions of the TOE and FPT_FLS.1 which guarantees a secure state when integrity is violated; this ensures that the specified security functions are operational and that data have not been altered.
- Private key integrity and confidentiality protection is addressed by FPT_PHP.3 which requires physical protections against tampering.

OT.ECIES requires that the ECIES encryption/decryption of data received from the V2X VCS is implemented following:

- FDP_RIP.1 prevents misuse of any resources containing private and secret keys after de-allocation (e.g. after the encryption process).
- Expected implementation of ECIES is addressed by FCS_CKM.1 for ephemeral keys generation, by FCS_COP.1/ECIES_ENC and FCS_COP.1/ECIES_DEC for

encryption/decryption and FCS_RNG.1 for use of random number generator.

- ECIES service execution protection is addressed by FPT_TST.1 which tests the working conditions of the TOE and FPT_FLS.1 which guarantees a secure state when integrity is violated; this ensures that the specified security functions are operational and that data have not been altered.
- Private and secret keys integrity and confidentiality protection is addressed by FPT_PHP.3 which requires physical protections against tampering.

OT.RNG requires implementation of random numbers generation following standards for internal purposes (key generation) or external:

- Expected implementation of RNG is addressed by FCS_RNG.1.
- FTP_ITC.1 with FDP_UIT.1 and FDP_UCT.1 requires the integrity, and confidentiality when needed, of the message exchanged between the TOE and an authorized entity is verified.
- Random number service execution protection is addressed by FPT_TST.1 which tests the working conditions of the TOE and FPT_FLS.1 which guarantees a secure state when integrity is violated; this ensures that the specified security functions are operational and that data have not been altered.
- Random number integrity and confidentiality protection is addressed by FPT_PHP.3 which requires physical protections against tampering and then ensures the integrity and the confidentiality of the generated random number.

OT.VCS_DATA requires protection of messages to be signed against any alteration; this is covered as follows:

- FDP_SDI.2 requires the verification that the message has not been altered after reception by the TOE and during temporary storage before signature operation.
- FTP_ITC.1 with FDP_UIT.1 and FDP_UCT.1 requires the integrity, and confidentiality when needed, of the message exchanged between the TOE and an authorized entity is verified.
- FPT_PHP.3 which requires physical protections against tampering and then ensures the integrity and the confidentiality of the generated random number.

OT.AUTHENTICATION requires that the user is authenticated before accessing defined security features; this is covered as follows:

- Users identification and authentication addressed by FIA_UID.1 and FIA_UAU.1, completed by FIA_AFL.1 which requires the limitation of the number of authentication tries then protecting against attacks, such as cryptographic extraction of residual information, or brute force attacks.
- FMT_SMR.1 for handling of roles set by user authentication.

OT.PRIVKEY_ACCESS requires that private keys are only accessible to expected services and that none implement export of those keys; this is covered as follows:

- FDP_ACC.1 and FDP_ACF.1 based on current role directly requires the access to private key by secure services only and reject any export possibility.
- FMT_SMF.1, FMT_MSA.1 and FMT_MSA.3 require that security attributes involved in access control are securely handled and that security attributes of created private keys are securely initiated.

OT.ACCESS_CONTROL requires that access control is performed based on authentication verification to grant access to secure services; this is covered as follows:

- FMT_SMR.1 handles role setting based on user authentication process (see OT.AUTHENTICATION).
- FDP_ACC.1/* and FDP_ACF.1/* implement access control based on current role set previously.
- FMT_SMF.1, FMT_MSA.1 and FMT_MSA.3 require that security attributes

involved in access control are securely handled and that security attributes of created private keys are securely initiated.

OT.TRUSTED_CHANNEL requires the protections of communication interface with the VCS; this is covered as follows:

- FTP_ITC.1/* with FDP_UIT.1/* and FDP_UCT.1/* require that a trusted channel is used to authenticate its end points and exchange data securely.
- FDP_ITC.1/* requires the data import itself without security attributes.
- FDP_ACC.1/*, FDP_ACF.1/* handles the authentication requirements on which the trusted channel will be based.
- FCS_CKM.5/KBKDF requires the generation of the symmetric key used for a trusted channel session;
- FCS_COP.1/AES and FCS_COP.1/AES_MAC implement the trusted channel MAC and/or encryption requested to protect communications between the V2X VCS and the TOE.
- FMT_MTD.1 requires that the trusted channel key is created and modified by the related security domain owner only.

OT.SW_UPDATE requires software update is implemented ensuring the authenticity and integrity of the image to be installed; this is covered as follows:

- Image loading along with its signature and version is addressed by FDP_ITC.2/SWU.
- FDP_ACC.1/SWU and FDP_ACF.1/SWU require the authenticity and integrity verification of the image before installation.
- FPT_TDC.1 requires that the signature of the update package authenticity can be checked and that only after the package is stored.
- Cryptographic operations for signature verification is addressed by FCS_COP.1/SWU_ECC and FCS_COP.1/SWU_ECDSA.
- FMT_MSA.3/SWU requires that restrictive default values are used for the attributes of the OS Update information flow control SFP.

This objective also requires the version verification of the image to be installed; this is addressed by:

- FDP_ACC.1/SWU and FDP_ACF.1/SWU require the verification of version correctness.
- FPT_TDC.1 requires that the version hold by the update package is correctly interpreted.
- FMT_MSA.1/SWU requires the secure handling of the internal current version of the software (Current Sequence Number).

The update process is protected as follows:

- Software update service execution protection is addressed by FPT_TST.1 which tests the working conditions of the TOE and FPT_FLS.1 which guarantees a secure state when integrity is violated; this ensures that the specified security functions are operational and that data have not been altered.
- Image integrity protection is addressed by FDP_SDI.2 which requires the integrity protection of storage of sensitive data FPT_PHP.3 which requires physical protections against tampering.

This objective also requires the identification of additional code and its protection; this is addressed by:

- FMT_SMF.1/SWU which requires the ability to query the identification data (Current Sequence Number, Reference Sequence Number, Final Sequence Number) of the TOE.
- Identification data protection is addressed by FDP_SDI.2 which requires the

integrity protection of storage of sensitive data

OT.TOE_CONFIG requires each configuration item can be modified and enabled/disabled by its associated authorized users. This objective is addressed by:

- FIA_UID.1 requires the identification of the user before configuration applet can be selected.
- FDP_IFC.2/CFG and FDP_IFF.1/CFG define the rules to determine if the user is authorized to access a targeted configuration item.
- FMT_SMR.1/CFG defines the security roles allowed to access configuration items (R.NXP and R.Customer).
- FMT_SMF.1/CFG defines management functions on configuration items related security attributes.
- FMT_MSA.1/CFG and FMT_MSA.3/CFG defines the restriction on ability to modify configuration items.

OT.ATTACK_COUNTER requires that only NXP can reset the Attack Counter; this is covered as follows:

- FIA_UAU.1 and FIA_UID.1 require identification and authentication before resetting the Attack Counter.
- FMT_SMR.1 defines the security role R.NXP.
- FMT_MSA.1/RM restricts the ability to modify the Attack Counter to R.NXP.
- FMT_MSA.3/RM restricts the initial value of the Attack Counter and allows nobody to change the initial value.

OT.RESTRICTED_MODE requires that in Restricted Mode the TOE only accept a limited set of commands; this is covered as follows:

- FIA_UAU.1 requires authentication before resetting the Attack Counter.
- FDP_ACC.2/RM defines the subject of the Restricted Mode access control SFP.
- FDP_ACF.1/RM requires the control of access to objects for all operations.
- FMT_SMR.1 defines the security role R.NXP.
- FMT_SMF.1/RM defines the management functions of the restricted mode.

OT.TOE_SELF_PROTECTION requires that the TOE implements counter-measures resist to tampering attack and physical emanation analysis; this is covered as follows:

- FPT_EMS.1 provides measures against emanation analysis.
- FPT_FLS.1 requires a secure state is maintain over operations of the TOE.
- FPT_PHP.3 requires the resistance to physical attacks.
- FPT_TST.1 provides failure detection over operations of the TOE.

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8. TOE Summary Specification

8.1 SF.Crypto

This security function provides key creation, key management, key deletion and cryptographic functionality and protection against state-of-the-art attacks of key material during those processes.

SF.Crypto fulfills the following SFRs:

- FCS_CKM.1, FCS_CKM.5, FCS_CKM.4 and FCS_COP.1 by handling the required cryptographic standards based on the invocation of Security Software certified with the TOE hardware.
- FCS_COP.1 by handling the required cryptographic standards based on the invocation of Security Software of certified IC.

SF.Crypto supports:

- SF.Authentication and SF.Secure_Messaging for SCP03 cryptographic algorithms it is based on;
- SF.Storage by providing AES implementation used to encrypt stored data.

8.2 SF.RNG

This SFR provides secure random generation.

SF.RNG fulfills the following SFRs:

- FCS_RNG.1 by handling the generation of random numbers according to the Java Card API Specification [34] and based on the Security Software certified with the TOE hardware.

SF.RNG supports:

- FCS_Crypto by providing random number generation when needed during key generation.

8.3 SF.Authentication

This Security Function manages the identification and authentication of users and enforces role separation between V2X services access in end-usage (S.V2X), V2X services access in personalization (R.Customer), Configuration management access (R.Customer and R.NXP) and card administration (R.NXP).

SF.Authentication fulfills the following SFRs:

- FIA_UID.1 and FIA_UAU.1 by implementing the GlobalPlatform SCP03 specification [46] which requires the mutual authentication of its end-points by the means of cryptographic functions.
- FIA_AFL.1 by implementing the verification of try authentication limit following the GlobalPlatform Specification [46].
  FMT_SMR.1 by setting the role following SCP03 mutual authentication result i.e. based on the current secure channel session specified by GlobalPlatform [46].

SF.Authentication supports:

- SF.Access_Control by setting the current role information on which the access control is partly based.

8.4 SF.Access_Control

This Security Function checks that for each operation initiated by a user, the conditions for user authorization and data communication required are satisfied. As non-TSF commands are originally present in the product, this Security Function will allow to grant or disable access to certain commands according to security attributes defined in the initial file system. Those security attributes are set as part of the configuration of the file system performed during the product's initialization (pre-issuance) phase.

SF.Access_Control fulfills the following SFRs:

- FDP_ACC.1/*, FDP_ACF.1/* and FMT_MSA.1 by transmitting all received restricted commands to an access control function in charge of checking the current role handled by the platform.

8.5 SF.Secure_Messaging

The Secure Messaging is used between the V2X VCS and the TOE to protect communication of sensitive user data.

SF.Secure_MessagingM fulfills the following SFRs:

- FTP_ITC.1/* by implementing SCP03 protocol following GlobalPlatform specifications [46] which provides a secure communication channel, logically distinct from each other and from other communication channel, between legitimate end-points by the means of cryptographic functions (fulfilled by SF.Crypto).
- FDP_UIT.1/* by the calculation of cryptographic checksum (MAC) (supported by SF.Crypto – FCS_COP.1/AES_MAC).
- FDP_UCT.1/* by encryption of communication data by AES symmetric cryptography (supported by SF.Crypto – FCS_COP.1/AES).
- FDP_MTD.1 by restricting the ability to create or modify the SCP03 key to the SD owner.
- FDP_ITC.1/* by implementing GlobalPlatform specification [46] including in particular the highest secure channel security level MAC+ENC.

8.6 SF.Storage

SF.Storage provides a secure data storage for confidential data to fulfill the following SFRs:

- FDP_SDI.2 by
  - protecting all data stored with CRC32 check on the Flash memory; additionally, data as private key stored in a secure container are AES encrypted and integrity protected by CRC32 (both on plain and encrypted data).
  - protecting RAM memory with parity bitwise check.

SF.Storage supports:

- SF.Crypto by securely storing cryptographic keys.

8.7 SF.OS

SF.OS implements the JCOP4.4 OS invoked by V2X applets.

SF.OS fulfills the following SFRs:

- FMT_SMR.1 by implementing the current secure channel session on which role handling is based and application separation following GlobalPlatform and JavaCard specifications ([46], [47]).
- FMT_SMF.1 FMT_MSA.3 and FDP_ITC.1 by initializing and assigning itself all values for security attributes.
- FDP_RIP.1 by

  - providing garbage collection according to the Java Card Runtime Environment specification [34].
  - granting access to and erasing of CLEAR_ON_RESET and CLEAR_ON_DESELECT transient arrays and by clearing the bArray during application installation.
  - halting the system in case of object creation in aborted transactions.
- FCS_CKM.4 and FDP_RIP.1 by deleting authentication resources (secret and private keys) when relevant memory is de-allocated.
- FPT_FLS.1 by throwing Java Exception Exceptions according to JavaCard specifications [47] and handling catched exceptions such that a secure state is maintained (e.g. reset preventing persistent corruption).
- FPT_EMS.1 by handling the electromagnetic detection feature.
- FPT_TST.1 by integrity check added in critical code parts as redundancy (e.g. for reading, writing, if statement), flow control, etc

SF.OS supports:

- SF.Crypto by providing security exception handling and secure key destruction features;
- SF.Authentication by implementing GlobalPlatform specification including the current secure channel session on which role handling is based and JavaCard specification ensuring application separation.
- SF.Access_Control by providing the current role information and current Security Domain life-cycle security attribute for access control checkings.

8.8 SF.HW

This Security Function provides security measures based on underlying hardware features to ensure the protection of the TSF.

SF.HW fulfills the following SFRs:

- FPT_TST.1 by
  - performing self-tests of the TOE at each power-up;
  - memory content integrity checks are performed based on several mechanism as error detection codes.
  - control of security sensors integrity.
  - control of CPU operations including code fetching control, code signature, register monitoring, etc.
- FDP_SDI.2 by validating the integrity of all stored data at memory reading/writing.
- FPT_FLS.1, FPT_PHP.3 by preserving secure state after sensitive processing failure (RNG, EEPROM handling) or potential physical tampering or intrusion detection.
- FPT_EMS.1 by detecting abnormal electric conditions.

SF.HW supports all security function by providing flaws detection mechanism allowing protecting the whole implementation execution.

8.9 SF.SWU

The on-card S.SWU subject interacts with the off-card Update Image Creator via dedicated commands. The O.ImgUpdt is split up into smaller chunks and transmitted as payload within the dedicated commands to the TOE.

Decrypting the O.ImgUpdt with the Package Decryption Key prevents the authorization of the O.ImgUpdt for the update process on a not certified system. The Package Decryption Key is only available on a certified TOE.

This Security Function provides secure functionality to update the JCOP4.4 OS or UpdaterOS itself with an image created by a trusted off-card entity (FMT_SMR.1, FMT_SMF.1/SWU).

SF.SWU allows authenticated commands to securely upload an image, i.e. ensuring integrity and confidentiality, and to update the current operating system (FDP_ACC.1/SWU, FDP_ACF.1/SWU).

Image authenticity and integrity is based on the verification of commands signature to fulfill FDP_ACC.1/SWU and FDP_ACF.1/SWU. Integrity protection of the commands uses ECDSA, SHA-256 and CRC verifications to fulfill FDP_ACF.1/SWU.

Image confidentiality is and additional security ensured by ECDH and AES encryption to fulfill FDP_ACF.1/SWU.

FDP_ITC.1/SWU and FPT_TDC.1/SWU are covered by the management of a mechanism of sequence number and an OS plan for authorized versions.

SF.SWU ensures that the system stays in a secure state in case of invalid or aborted update procedures to fulfill FPT_FLS.1 and that the information identifying the currently running OS is modified and the updated code is activated only after successful OS Update procedure (FMT_MSA.3/SWU, FMT_MSA.1/SWU).

Note that the update of V2X applets is possible only under the control of NXP; same protections for integrity and authenticity of image to be installed by implementing the GP Amendment H standard.

8.10 SF.Config

This Security Function provides means to store Initialization Data and Pre-personalization Data before TOE delivery and to change configurations of the card after delivery.

Some configurations can be changed by the customer and some can only be changed by NXP (FDP_IFC.2/CFG, FDP_IFF.1/CFG, FMT_MSA.3/CFG, FMT_MSA.1/CFG, FMT_SMR.1, FMT_SMF.1/CFG, FIA_UID.1).

SF.Config supports FCS_COP.1 by configuring the behavior of cryptographic operations.

Additionally, SF.Config provides proprietary commands to select (FIA_UID.1) the OS update mechanism and to reset the OS to an initial state (FPT_FLS.1).

8.11 SF.RM

This Security Function provides a restricted mode that is entered when the Attack Counter reaches its limit. In restricted mode only limited functionality is available. Only the issuer is able to reset the Attack Counter to leave the restricted mode. This supports FDP_ACC.2/RM, FDP_ACF.1/RM, FMT_MSA.3/RM, FMT_MSA.1/RM, and FMT_SMF.1/RM. SF.RM only allows a limited set of operations to not identified and not authenticated users when in restricted mode. All other operations require identification and authentication (FIA_UID.1, FIA_UAU.1).

8.12 TOE Summary Specifications Rationale

Table 14. Security Functions coverage by Security Functional Requirements

Security Functions Security Functionality Requirements	SF.Crypto	SF.RNG	SF.Authentication	SF.Access_Control	SF.Secure_Messaging	SF.Storage	SF.OS	SF.HW	SF.SWU	SF.Applet_Update	SF.Config	SF.RM
FCS_CKM.1	X											
FCS_CKM.4							X					
FCS_CKM.5/ECC	X											
FCS_CKM.5/KBKDF	X											
FCS_COP.1/ECDSA	X											
FCS_COP.1/ECIES_ENC	X											
FCS_COP.1/ECIES_DEC	X											
FCS_COP.1/AES	X											
FCS_COP.1/AES_MAC	X											
FCS_COP.1/SWU_ECDSA	X											
FCS_COP.1/SWU_ECC	X											
FCS_COP.1/SWU_AES	X											
FCS_RNG.1		X										
FIA_UID.1			X						X	X	X	X
FIA_UAU.1			X						X	X	X	X
FIA_AFL.1			X									
FDP_SDI.2						X		X				
FDP_RIP.1							X					
FMT_SMR.1			X						X	X	X	
FMT_MTD.1					X							
FTP_ITC.1/*					X							
FPT_EMS.1							X	X				
FPT_FLS.1							X	X	X			
FPT_PHP.3								X				
FPT_TST.1								X				
FDP_ACC.1				X								
FDP_ACC.1/Import_TC				X								
FDP_ACF.1				X								
FDP_ACF.1/Import_TC				X								
FDP_UIT.1/*					X							
FDP_ITC.1/*					X							
FDP_UCT.1/*					X							
FMT_SMF.1							X					
FMT_MSA.1				X								
FMT_MSA.3							X					
FDP_ACC.1/SWU									X			
FDP_ACF.1/SWU									X			
FDP_ITC.2/SWU									X			
FPT_TDC.1/SWU									X			
FMT_SMF.1/SWU									X			
FMT_MSA.1/SWU									X			
FMT_MSA.3/SWU									X			
FDP_IFC.2/CFG											X	

Security Functions Security Functionality Requirements	SF.Crypto	SF.RNG	SF.Authentication	SF.Access_Control	SF.Secure_Messaging	SF.Storage	SF.OS	SF.HW	SF.SWU	SF.Applet_Update	SF.Config	SF.RM
FDP_IFF.1/ CFG											X	
FMT_SMF.1/CFG											X	
FMT_MSA.1/CFG											X	
FMT_MSA.3/CFG											X	
FDP_ACC2/RM												X
FDP_ACF.1/RM												X
FMT_SMF.1/RM												X
FMT_MSA.1/RM												X
FMT_MSA.3/RM												X

9. Additional Rationale

9.1 Dependencies Rationale

9.1.1 SAR Dependencies

The functional and assurance requirements dependencies for the TOE are completely fulfilled.

Table 15. SAR Dependencies

Requirement	Dependencies
ADV_ARC.1	ADV_FSP.5, ADV_TDS.4
ADV_FSP.4	ADV_TDS.1
ADV_IMP.1	ADV_TDS.3, ALC_TAT.2
ADV_TDS.3	ADV_FSP.4
AGD_OPE.1	ADV_FSP.4
AGD_PRE.1	No dependencies
ALC_CMC.4	ALC_CMS.4, ALC_DVS.2, ALC_LCD.1
ALC_CMS.4	No dependencies
ALC_DEL.1	No dependencies
ALC_DVS.2	No dependencies
ALC_FLR.1	No dependencies
ALC_LCD.1	No dependencies
ALC_TAT.2	ADV_IMP.1
ASE_CCL.1	ASE_ECD.1, ASE_INT.1, ASE_REQ.2
ASE_ECD.1	No dependencies
ASE_INT.1	No dependencies
ASE_OBJ.2	ASE_SPD.1
ASE_REQ.2	ASE_ECD.1, ASE_OBJ.2
ASE_SPD.1	No dependencies
ASE_TSS.1	ADV_FSP.4, ASE_INT.1, ASE_REQ.2
ATE_COV.2	ADV_FSP.4, ATE_FUN.1
ATE_DPT.1	ADV_ARC.1, ADV_TDS.4, ATE_FUN.1
ATE_FUN.1	ATE_COV.2
ATE_IND.2	ADV_FSP.4, AGD_OPE.1, AGD_PRE.1, ATE_COV.2, ATE_FUN.1
AVA_VAN.5	ADV_ARC.1, ADV_FSP.4, ADV_TDS.3, ADV_IMP.1, AGD_OPE.1, AGD_PRE.1

Justification of Unsupported Dependencies

All dependencies are supported.

9.1.2 SFR Dependencies

Table 16. SFR Dependencies

Requirement	Dependencies
FCS_CKM.1	FCS_COP.1/ECDSA, FCS_CKM.4
FCS_CKM.4.1	FCS_CKM.1 FCS_CKM.5/ECC, FCS_CKM.5/KBKDF
FCS_CKM.5/ECC	FCS_COP.1/ECDSA, FCS_CKM.4
FCS_CKM.5/KBKDF	FCS_COP.1/AES, FCS_CKM.4
FCS_ COP.1/ECDSA	FCS_CKM.4
FCS_ COP.1/ECIES_ENC	FCS_CKM.4
FCS_ COP.1/ECIES_DEC	FCS_CKM.4
FCS_COP.1/AES	FCS_CKM.4
FCS_COP.1/AES_MAC	FCS_CKM.4
FCS_COP.1/SWU_ECDSA	FCS_CKM.4
FCS_COP.1/SWU_ECC	FCS_CKM.4
FCS_COP.1/SWU_AES	FCS_CKM.4
FCS_RNG.1	No dependencies
FIA_UID.1	No dependencies
FIA_UAU.1	FIA_UID.1
FIA_AFL.1	FIA_UAU.1
FDP_SDI.2	No dependencies
FDP_RIP.1	No dependencies
FMT_SMR.1	FIA_UID.1
FTP_ITC.1	No dependencies
FPT_EMS.1	No dependencies
FPT_FLS.1	No dependencies
FPT_PHP.3	No dependencies
FPT_TST.1	No dependencies
FDP_ACC.1/V2X	FDP_ACF.1/V2X
FDP_ACC.1/KI	FDP_ACF.1/KI
FDP_ACF.1/V2X	FDP_ACC.1/V2X FMT_MSA.3
FDP_ACF.1/KI	FDP_ACC.1/KI FMT_MSA.3
FDP_UIT.1	FTP_ITC.1, FDP_ACC.1/Signature_Generation
FDP_ITC.1	FDP_ACC.1/PrivateKey_Import, FMT_MSA.3
FDP_UCT.1	FTP_ITC.1, FDP_ACC.1/PrivateKey_Import
FMT_SMF.1	No dependencies
FMT_MSA.1	FDP_ACC.1/PrivateKey_Import, FMT_SMR.1, FMT_SMF.1
FMT_MSA.3	FMT_MSA.1, FMT_SMR.1
FDP_IFC.2/SWU	FDP_IFF.1/OSU
FDP_IFF.1/SWU	FDP_IFC.2/OSU, FMT_MSA.3/OSU
FMT_SMR.1/SWU	FIA_UID.1/OSU
FMT_SMF.1/SWU	No dependencies

FMT_MSA.1/SWU	FDP_IFC.2/OSU, FMT_SMR.1/OSU, FMT_SMF.1/OSU
FMT_MSA.3/SWU	FMT_MSA.1/OSU, FMT_SMR.1/OSU
FDP_IFC.2/CFG	FDP_IFF.1/CFG
FDP_IFF.1/ CFG	FDP_IFC.2/CFG, FMT_MSA.3/CFG
FMT_SMR.1/CFG	FIA_UID.1/CFG
FMT_SMF.1/CFG	No dependencies
FMT_MSA.1/CFG	FDP_IFC.2/CFG, FMT_SMR.1/CFG, FMT_SMF.1/CFG
FMT_MSA.3/CFG	FMT_MSA.1/CFG, FMT_SMR.1/CFG
FDP_ACC2/RM	FDP_ACF.1/RM
FDP_ACF.1/RM	FDP_ACC.2/RM, FMT_MSA.3/RM
FMT_SMF.1/RM	No dependencies
FMT_MSA.1/RM	FDP_ACC.2/RM, FMT_SMR.1, FMT_SMF.1/RM
FMT_MSA.3/RM	FMT_MSA.1/RM, FMT_SMR.1

9.2 Rationale for Extensions

Extensions are based on the Protection Profiles PPs [4], [5], [6] and [9]:

- SFR FCS_RNG.1 'Generation of Random Numbers' (PP [4])
- SFR FCS_CKM.5 'Cryptographic Key Derivation" (PP [9])
- SFR FPT_EMS.1 'TOE emanation' (PPs [5] and [6])

9.3 PP Claim Rationale

This ST does not claim any PP; however, it is based on PPs [4]..

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[25]	ETSI TS 102 940 - ITS Security - ITS Communications Security Architecture and Security Management, v1.3.1, 2018-04
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