

## **Certification Report**

## **NXP JCOP on SN100.C25 Secure Element**

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Report number: NSCIB-CC-195714-CR4

Report version: 1

Project number: 195714\_4

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Date: 20 September 2022

Number of pages: 14

Number of appendices: 0

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The Netherlands



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#### **Foreword**

The Netherlands Scheme for Certification in the Area of IT Security (NSCIB) provides a third-party evaluation and certification service for determining the trustworthiness of Information Technology (IT) security products. Under this NSCIB, TÜV Rheinland Nederland B.V. has the task of issuing certificates for IT security products, as well as for protection profiles and sites.

Part of the procedure is the technical examination (evaluation) of the product, protection profile or site according to the Common Criteria assessment guidelines published by the NSCIB. Evaluations are performed by an IT Security Evaluation Facility (ITSEF) under the oversight of the NSCIB Certification Body, which is operated by TÜV Rheinland Nederland B.V. in cooperation with the Ministry of the Interior and Kingdom Relations.

An ITSEF in the Netherlands is a commercial facility that has been licensed by TÜV Rheinland Nederland B.V. to perform Common Criteria evaluations; a significant requirement for such a licence is accreditation to the requirements of ISO Standard 17025 "General requirements for the accreditation of calibration and testing laboratories".

By awarding a Common Criteria certificate, TÜV Rheinland Nederland B.V. asserts that the product or site complies with the security requirements specified in the associated (site) security target, or that the protection profile (PP) complies with the requirements for PP evaluation specified in the Common Criteria for Information Security Evaluation. A (site) security target is a requirements specification document that defines the scope of the evaluation activities.

The consumer should review the (site) security target or protection profile, in addition to this certification report, to gain an understanding of any assumptions made during the evaluation, the IT product's intended environment, its security requirements, and the level of confidence (i.e., the evaluation assurance level) that the product or site satisfies the security requirements stated in the (site) security target.

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## **Recognition of the Certificate**

The presence of the Common Criteria Recognition Arrangement (CCRA) and the SOG-IS logos on the certificate indicates that this certificate is issued in accordance with the provisions of the CCRA and the SOG-IS Mutual Recognition Agreement (SOG-IS MRA) and will be recognised by the participating nations.

## International recognition

The CCRA was signed by the Netherlands in May 2000 and provides mutual recognition of certificates based on the Common Criteria (CC). Since September 2014 the CCRA has been updated to provide mutual recognition of certificates based on cPPs (exact use) or STs with evaluation assurance components up to and including EAL2+ALC\_FLR.

For details of the current list of signatory nations and approved certification schemes, see <a href="http://www.commoncriteriaportal.org">http://www.commoncriteriaportal.org</a>.

### **European recognition**

The SOG-IS MRA Version 3, effective since April 2010, provides mutual recognition in Europe of Common Criteria and ITSEC certificates at a basic evaluation level for all products. A higher recognition level for evaluation levels beyond EAL4 (respectively E3-basic) is provided for products related to specific technical domains. This agreement was signed initially by Finland, France, Germany, The Netherlands, Norway, Spain, Sweden and the United Kingdom. Italy joined the SOG-IS MRA in December 2010.

For details of the current list of signatory nations, approved certification schemes and the list of technical domains for which the higher recognition applies, see <a href="https://www.sogis.eu">https://www.sogis.eu</a>.



## **Executive Summary**

This Certification Report states the outcome of the Common Criteria security evaluation of the NXP JCOP on SN100.C25 Secure Element. The developer of the NXP JCOP on SN100.C25 Secure Element is NXP Semiconductors NV located in Eindhoven, The Netherlands and they also act as the sponsor of the evaluation and certification. A Certification Report is intended to assist prospective consumers when judging the suitability of the IT security properties of the product for their particular requirements.

The TOE consists of a certified embedded Secure Element (eSE), including an associated Crypto Library and Security Software, and a software stack which is stored and executed on the eSE. The Hardware Secure Element is embedded in a micro-controller which also includes an Integrated NFC controller and a System Mailbox which provides the communication interface for the TOE.

The TOE was evaluated initially by SGS Brightsight B.V. located in Delft and was certified on 13 March 2019. A re-evaluation also took place by Brightsight B.V. and was completed on 09 December 2019 with the approval of the ETR. A second re-evaluation took place by Brightsight B.V. and was completed on 01 October 2020 with the approval of the ETR. This third re-evaluation of the TOE has also been conducted by SGS Brightsight B.V. and was completed on 20 September 2022 with the approval of the ETR. The re-certification procedure has been conducted in accordance with the provisions of the Netherlands Scheme for Certification in the Area of IT Security [NSCIB].

The second issue of the Certification Report was a result of a "recertification with major changes".

The major changes were the inclusion of the JCOP 6.0 variant and associated guidance, and renaming the TOE from "JCOP 5.0 on SN100.C25 Secure Element" to "JCOP on SN100.C25 Secure Element". The underlying hardware platform was recertified to include an additional variant (C58), but the variant used for the TOE (C25) did not change. The impact of the changed guidance for the hardware platform as well as the removal of the claim of SS.Move was analysed and shown to have no impact on this evaluation.

Note that the RNG claim has been changed from DRG.4 to DRG.3.

The security evaluation re-used the evaluation results of previously performed evaluations. A full, up to date vulnerability analysis has been made, as well as renewed testing.

The third issue of the Certification Report was a result of a "recertification with major changes".

The major changes were the inclusion of the JCOP 6.1 variant and associated guidance.

The security evaluation reused the evaluation results of previously performed evaluations. A full, upto-date vulnerability analysis has been made, as well as renewed testing.

This fourth issue of the Certification Report is a result of a "recertification with major changes".

The major changes are the inclusion of the JCOP 6.4 variant with associated guidance and a claim of security to Java Card Protection Profile - Open Configuration Protection Profile version 3.1, [JC PP].

The security evaluation reused the evaluation results of previously performed evaluations. A full, upto-date vulnerability analysis has been made, as well as renewed testing.

The scope of the evaluation is defined by the security target [ST], which identifies assumptions made during the evaluation, the intended environment for the NXP JCOP on SN100.C25 Secure Element, the security requirements, and the level of confidence (evaluation assurance level) at which the product is intended to satisfy the security requirements. Consumers of the NXP JCOP on SN100.C25 Secure Element are advised to verify that their own environment is consistent with the security target, and to give due consideration to the comments, observations and recommendations in this certification report.



The results documented in the evaluation technical report [ETR] <sup>1</sup> for this product provide sufficient evidence that the TOE meets the EAL5 augmented (EAL5+) assurance requirements for the evaluated security functionality. This assurance level is augmented with ALC\_DVS.2 (Sufficiency of security measures) and AVA\_VAN.5 (Advanced methodical vulnerability analysis), ASE\_TSS.2 (TOE summary specification with architectural design summary) and ALC\_FLR.1 (Basic flaw remediation).

The evaluation was conducted using the Common Methodology for Information Technology Security Evaluation, Version 3.1 Revision 5 [CEM] for conformance to the Common Criteria for Information Technology Security Evaluation, Version 3.1 Revision 5 [CC] (Parts I, II and III).

TÜV Rheinland Nederland B.V., as the NSCIB Certification Body, declares that the evaluation meets all the conditions for international recognition of Common Criteria Certificates and that the product will be listed on the NSCIB Certified Products list. Note that the certification results apply only to the specific version of the product as evaluated.

The Evaluation Technical Report contains information proprietary to the developer and/or the evaluator, and is not available for public review.



#### 2 Certification Results

#### 2.1 Identification of Target of Evaluation

The Target of Evaluation (TOE) for this evaluation is the NXP JCOP on SN100.C25 Secure Element from NXP Semiconductors NV located in Eindhoven, The Netherlands.

The TOE is comprised of the following main components:

Delivery item type	Identifier	Version
Hardware (Part of SN100 certificate,	"NXP SN100 Series Secure Element with Crypto Library" SN100_SE B2.1 C25	B2.1 C25
[HW-CR])		
	Factory OS	4.2.0
	Boot OS	4.2.0
Software / Firmware	Flash Driver Software	4.0.8
(Part of	Factory Page	18218
SN100 certificate,	Systems Page Common	18468
[HW-CR])	BootOS Patch	4.2.0 PL3 v4
	Services Software	4.13.3.0
	Crypto Library	1.0.0
	JCOP5.0 OS, native applications and OS Update Component	R1.11.0
Software	JCOP6.0 OS, native applications and OS Update Component	R1.13.0
Joilwale	JCOP6.1 OS, native applications and OS Update Component	R1.04.0
	JCOP6.4 OS, native applications and OS Update Component	R1.06.0

To ensure secure usage a set of guidance documents is provided, together with the NXP JCOP on SN100.C25 Secure Element. For details, see section 2.5 of this report.

For a detailed and precise description of the TOE lifecycle, see the [ST], Chapter 1.3.2.

### 2.2 Security Policy

This TOE is a composite TOE, consisting of a Java Card smart card operating system, an OS updater, an applet migration feature, a restricted mode and an underlying platform, which is composed of a library which provides cryptographic functions and a secure micro controller. The TOE provides Java Card 3.0.4 functionality (and preparation for Java Card 3.0.5 functionality) with post-issuance applet loading, card content management and secure channel features as specified in Global Platform 2.2.1 including SCP03.

It includes also NXP Proprietary Functionality

- Config Applet: JCOP OS includes a Config Applet that can be used for configuration of the TOF
- OS Update Component: Proprietary functionality that can update JCOP OS or UpdaterOS.



- Applet Migration: Keep User Data, Key Data or PIN Data after updating an applet.
- Restricted Mode: In Restricted Mode only very limited functionality of the TOE is available such as, e.g.: reading logging information or resetting the Attack Counter.
- Error Detection Code (EDC) API.

Cryptographic functionality includes 3DES, AES, RSA and RSA CRT; SHA-1, SHA-224, SHA-256, SHA-384, SHA-512 hash algorithms, HMAC, ECC over GF(p), Twisted Edwards Curve 25519 for signature generation and verification (EdDSA), Diffie-Hellman Key Exchange on Montgomery Curve (25519). Furthermore, the TOE provides random number generation according to class DRG.3 of AIS 20.

## 2.3 Assumptions and Clarification of Scope

#### 2.3.1 Assumptions

The assumptions defined in the Security Target are not covered by the TOE itself. These aspects lead to specific Security Objectives to be fulfilled by the TOE-Environment. For detailed information on the security objectives that must be fulfilled by the TOE environment, see section 5.2 of the [ST].

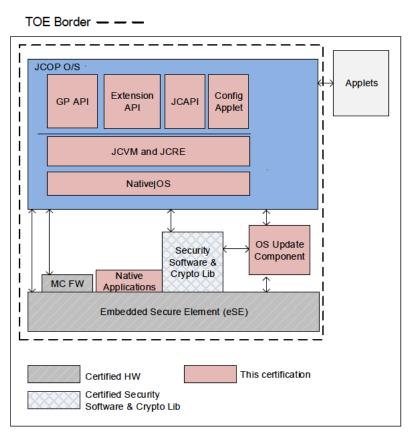
#### 2.3.2 Clarification of scope

The evaluation did not reveal any threats to the TOE that are not countered by the evaluated security functions of the product.

Note that proprietary applications have been included in the TOE, but as there are no security claims on these functionalities, these applications' functionality has not been assessed, only the self-protection of the TSF.

#### 2.4 Architectural Information

The logical architecture, originating from the Security Target [ST], of the TOE can be depicted as follows:





The TOE provides a variety of security features. The hardware of the Micro Controller already protects against physical attacks by applying various sensors to detect manipulations and by processing data in ways which protect against leakage of data by side channel analysis. With the software stack the TOE provides many cryptographic primitives for encryption, decryption, signature generation, signature verification, key generation, secure management of PINs and secure storage of confidential data (e.g. keys, PINs). Also the software stack implements several countermeasures to protect the TOE against attacks.

#### 2.5 Documentation

The following documentation is provided with the product by the developer to the customer: For JCOP 5.0:

Identifier	Version
JCOP 5.0 R1.11.0 (JCOP 5.0 9.3.11) User Guidance Manual	Rev. 1.12, 10 August 2022
JCOP 5.0 R1.11.0 (JCOP 5.0 9.3.11) User Guidance Manual Addendum	Rev. 1.8, 10 April 2018
JCOP 5.0 R1.11.0 (JCOP 5.0 9.3.11) Anomaly Sheet, Rev. 1.12	Rev. 1.12, 14 April 2021

#### For JCOP 6.0:

Identifier	Version
JCOP 6.0 R1.13.0 (JCOP 6.0 11.3.13) User Guidance Manual	Rev. 1.16, 10 August 2022
JCOP 6.0 R1.13.0 (JCOP 6.0 11.3.13) User Guidance Manual Addendum	Rev. 1.13, 16 April 2019
JCOP 6.0 R1.13.0 (JCOP 6.0 11.3.13) Anomaly Sheet, Rev. 1.14	Rev. 1.14, 14 April 2021

#### For JCOP 6.1:

Identifier	Version
NXP. JCOP 6.1 R1.04.0 (JCOP 6.1 13.3.04) User Guidance Manual	Rev. 3.5, 10 August 2022
JCOP 6.1 R1.04.0 (JCOP 6.1 13.3.04) User Guidance Manual Addendum	Rev. 3.3, 26 February 2020
NXP. JCOP 6.1 R1.04.0 (JCOP 6.1 13.3.04) Anomaly Sheet	Rev. 3.4, 14 April 2021

#### For JCOP 6.4:

Identifier	Version
JCOP 6.4 R1.06.0 (JCOP 6.4 17.3.06) User Guidance Manual	Rev. 5.9, 10 August 2022
JCOP 6.4 R1.06.0 (JCOP 6.4 17.3.06) User Guidance Manual Addendum	Rev. 5.7, 31 March 2022
JCOP 6.4 R1.06.0 (JCOP 6.4 17.3.06) Anomaly Sheet, Rev. 5.	Rev. 5.7, 31 March 2022

### 2.6 IT Product Testing

Testing (depth, coverage, functional tests, independent testing): The evaluators examined the developer's testing activities documentation and verified that the developer has met their testing responsibilities.



#### 2.6.1 Testing approach and depth

The tests cover all security functions and aspects of the TSF. Testing is performed during development as well as for acceptance/release. The developer used a set of test suites (industry standard and proprietary ones) and tools to test the TOE as well as an emulator, PC Platform and FPGA tool as some tests could only be performed in such environment. The identification was checked based on the SVN number. The developer uses a distributed test environment to allow usage of a vast amount of simultaneously driven testing equipment.

The developer has performed extensive testing on FSP, subsystem, module and module interface level. The tests are performed by NXP through execution of the test scripts using an automated and distributed system. Test tools and scripts are extensively used to verify that the tests return expected values.

Code coverage analysis is used by NXP to verify overall test completeness. Test benches for the various TOE parts are executed using code coverage measurement and analysis tools to determine the code coverage (i.e. lines, branches and/or instructions, depending on tool) of each test bench.

Cases with incomplete coverage were analysed. For each tool, the developer investigated and documented inherent limitations that can lead to coverage being reported as less than 100%. In such cases the developer provided a "gap" analysis with rationales (e.g. attack counter not hit due to redundancy checks).

The underlying hardware and crypto-library test results are extendable to composite evaluations, as the underlying platform is operated according to its guidance and the composite evaluation requirements are met.

For the testing performed by the evaluators, the developer has provided samples and a test environment. The evaluators have reproduced a selection of the developer tests, as well as a small number of test cases designed by the evaluator.

Tests from different test benches that are testing different parts of the functionality of the TOE were selected for witnessing at the developer location. The tests were running at the network of the developer.

Besides the repetition of develop tests, the evaluator defined spot-checks on the calculation of code-coverage as used by the developer to demonstrate their completeness of testing. As developer functional testing is quite rigorous, no other tests were defined by the evaluator.

The TOE exists in four configurations, i.e.: "JCOP 5.0 R1.11.0", "JCOP 6.0 R1.13.0", "JCOP 6.1 R1.04.0" and "JCOP 6.4 R1.06.0". Each configuration exists in a single evaluated configuration.

Since the first, second and third certified configurations, i.e. JCOP 5.0 R1.11.0, JCOP 6.0 R1.13.0 and JCOP 6.1 R1.04.0, have not changed since being certified, the test results (both of the developer and evaluator) for these configurations remain valid. The evaluator then verified that the added configuration, i.e. JCOP 6.4 R1.06.0, was tested and performed his own independent testing sample on this configuration. This means that all tests have been performed on the all configurations of the TOE.

#### 2.6.2 Independent penetration testing

The methodical analysis performed was conducted along the following steps:

- When evaluating the evidence in the classes ADV and AGD potential vulnerabilities were identified from generating questions to the type of TOE and the specified behaviour. From the ASE class, no potential vulnerabilities were identified.
- For ADV\_IMP a thorough implementation representation review was performed on the TOE. During this attack oriented analysis the protection against the attack scenarios was analysed using the knowledge gained from all previous evaluation classes. This resulted in the identification of additional potential vulnerabilities. This analysis was performed according to the attack list in [JIL-AP]. An important source for assurance against attacks in this step was the [ETRfC-HW] of the underlying platform; no additional potential vulnerabilities were concluded from this.
- All potential vulnerabilities were analysed using the knowledge gained from all evaluation classes and the public domain. A judgment was made on how to assure that these potential vulnerabilities



are not exploitable. For most of the potential vulnerabilities a penetration test was defined. Several potential vulnerabilities were found to be not exploitable due to an impractical attack path.

On the original certification, in total 11 test cases were described. The test effort is a fulltime occupation during to the test period as described in the test descriptions. It results in an overall effort of 21 weeks.

In the first re-certification, 3 perturbation tests, 3 side channel analysis tests, and 2 logical tests were performed.

In the second re-certification, 1 perturbation test and 1 logical test were performed to supplement previous tests (which have been shown to be still valid on this configuration in the vulnerability analysis phase).

For this third re-certification, the total test effort expended by the evaluators was 5.5 weeks. During that test campaign, 23% of the total time was spent on Perturbation attacks, 54% on side-channel testing, and 23% on logical tests.

See details in [ETRfC].

#### 2.6.3 Test configuration

The TOE was tested to provide assurance for all configurations i.e. "JCOP 5.0 R1.11.0", "JCOP 6.0 R1.13.0" "JCOP 6.1 R1.04.0" and "JCOP 6.4 R1.06.0".

Note that for some tests intermediate and related versions that share the same code base were used. The used TOE versions provide assurance for the TOE configurations as the code base and security concepts are shared. The following versions were used for some tests: "JCOP 5.1 R1.00.1", JCOP 5.2 R1.01.1", "JCOP 6.0 R1.11.0", "JCOP 6.3 R2.04.0" and "JCOP 6.0 R2.02.0". The difference in these versions have been analysed and all test are applicable to the actual version of the TOE in all of its configurations.

#### 2.7 Reused Evaluation Results

This is a re-certification. Documentary evaluation results of the earlier version of the TOE have been reused, but vulnerability analysis and penetration testing has been renewed.

There has been extensive reuse of the ALC aspects for the sites involved in the development and production of the TOE, by use of seven (7) Site Technical Audit Reports. Sites involved in the development and production of the hardware platform were reused by composition.

No sites have been visited as part of this evaluation.

#### 2.8 Evaluated Configuration

The TOE is defined uniquely by its name and version number NXP JCOP on SN100.C25 Secure Element (with configurations "JCOP 5.0 R1.11.0". "JCOP 6.0 R1.13.0". "JCOP 6.1 R1.04.0" and "JCOP 6.4 R1.06.0").

#### 2.9 Evaluation Results

The evaluation lab documented their evaluation results in the [ETR], which references an ASE Intermediate Report and other evaluator documents. To support composite evaluations according to [COMP] a derived document [ETRfC] was provided and approved. This document provides details of the TOE evaluation that must be considered when this TOE is used as platform in a composite evaluation.

The verdict of each claimed assurance requirement is "Pass".

Based on the above evaluation results the evaluation lab concluded the NXP JCOP on SN100.C25 Secure Element, to be CC Part 2 extended, CC Part 3 conformant, and to meet the requirements of EAL 5 augmented with ALC DVS.2, AVA VAN.5, ASE TSS.2 and ALC FLR.1. This implies that the product satisfies the security requirements specified in Security Target [ST].

The Security Target claims demonstrable conformance to the Protection Profile [JC PP].



#### 2.10 Comments/Recommendations

The user guidance as outlined in section 2.5 contains necessary information about the usage of the TOE. Certain aspects of the TOE's security functionality, in particular the countermeasures against attacks, depend on accurate conformance to the user guidance of both the software and the hardware part of the TOE. There are no particular obligations or recommendations for the user apart from following the user guidance. Please note that the documents contain relevant details concerning the resistance against certain attacks

In addition, all aspects of assumptions, threats and policies as outlined in the Security Target not covered by the TOE itself must be fulfilled by the operational environment of the TOE.

The customer or user of the product shall consider the results of the certification within his system risk management process. For the evolution of attack methods and techniques to be covered, the customer should define the period of time until a re-assessment for the TOE is required and thus requested from the sponsor of the certificate.

For users of the previous certification results: note that the RNG claim has been changed from DRG.4 to DRG.3 at the first recertification.

The strength of the cryptographic algorithms and protocols was not rated in the course of this evaluation. This specifically applies to the following proprietary or non-standard algorithms, protocols and implementations: None.

Not all key sizes specified in the [ST] have sufficient cryptographic strength to satisfy the AVA VAN.5 "high attack potential". To be protected against attackers with a "high attack potential", appropriate cryptographic algorithms with sufficiently large cryptographic key sizes shall be used (references can be found in national and international documents and standards).

The NXP JCOP on SN100.C25 Secure Element Security Target, Rev. 4.3, 22 August 2022 [ST] is included here by reference.

Please note that, to satisfy the need for publication, a public version [ST-lite] has been created and verified according to [ST-SAN].

#### 3 **Definitions**

This list of acronyms and definitions contains elements that are not already defined by the CC or CEM:

		_	
ACI	Access	Control	liot'
AUJ	ACCESS	COULTO	1 151

**AES** Advanced Encryption Standard

CBC Cipher Block Chaining (a block cipher mode of operation)

**CBC-MAC** Cipher Block Chaining Message Authentication Code

**DES Data Encryption Standard DFA** Differential Fault Analysis

**ECB** Electronic Code Book (a block cipher mode of operation)

**ECC** Elliptic Curve Cryptography

**ECDH** Elliptic Curve Diffie-Hellman algorithm **ECDSA** Elliptic Curve Digital Signature Algorithm

**EMA** Electromagnetic Analysis

IC Integrated Circuit

IT Information Technology

**ITSEF** IT Security Evaluation Facility



JIL Joint Interpretation Library

MAC Message Authentication Code

NSCIB Netherlands scheme for certification in the area of IT security

PKI Public Key Infrastructure

PP Protection Profile

RNG Random Number Generator
RMI Remote Method Invocation

RSA Rivest-Shamir-Adleman Algorithm

SHA Secure Hash Algorithm

SPA/DPA Simple/Differential Power Analysis

TOE Target of Evaluation

TRNG True Random Number Generator





## 4 Bibliography

[CC]

This section lists all referenced documentation used as source material in the compilation of this report.

Common Criteria for Information Technology Security Evaluation, Parts I, II and

[00]	III, Version 3.1 Revision 5, April 2017
[CEM]	Common Methodology for Information Technology Security Evaluation, Version 3.1 Revision 5, April 2017
[COMP]	Joint Interpretation Library, Composite product evaluation for Smart Cards and similar devices, Version 1.5.1, May 2018 Must be retained for all composite smartcard TOEs
[ETR]	Evaluation Technical Report "NXP JCOP on SN100.C25 Secure Element" – EAL5+, 19-RPT-948, Version 6.0, 19 September 2022
[ETRfC]	Evaluation Technical Report for Composition "NXP JCOP on SN100.C25 Secure Element" – EAL5+, 19-RPT-949, Version 7.0, 19 September 2022
[HW-CR]	SN100 Series – Secure Element with Crypto Library SN100_SE B2.1 C25/C48/C58, NSCIB-CC-174263-CR5, version 1, 12 July 2021 (Certificate number CC-21-174263/2)
[HW-ETRfC]	Evaluation Technical Report for Composition SN100 Series – Secure Element with Crypto Library SN100_SE B2.1 C25, C48 and C58 Product Update F EAL6+, 21-RPT-670, Version 3.0, 08 July 2021
[HW-ST]	SN100 Series – Secure Element with Crypto Library Security Target, Version 3.5, 21 April 2021

[JIL-AM] Attack Methods for Smartcards and Similar Devices, Version 2.4, January 2020 (sensitive with controlled distribution)
 [NSCIB] Netherlands Scheme for Certification in the Area of IT Security, Version 2.5, 28 March 2019

[JC PP] Java Card System – Open Configuration Protection Profile Version 3.1, April 2020, registered under the reference BSI-CC-PP-0099-V2-2020, 06 May 2020

2020, registered dilider the reference BSI-CC-FF-0099-V2-2020, 00 May 202

JIL Application of Attack Potential to Smartcards, Version 3.1, June 2020

[ST] NXP JCOP on SN100.C25 Secure Element Security Target, Rev. 4.3, 22

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[ST-lite] NXP JCOP on SN100.C25 Secure Element Security Target Lite, Rev. 4.3, 22

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[JIL-AAPS]