



Federal Office  
for Information Security

# Certification Report

**BSI-DSZ-CC-0406-2007**

for

**STARCOS 3.2 eGK**  
Version 1.0

from

**Giesecke & Devrient GmbH**

BSI - Bundesamt für Sicherheit in der Informationstechnik, Postfach 20 03 63, D-53133 Bonn  
Phone +49 (0)228 9582-0, Fax +49 (0)228 9582-5477, Infoline +49 (0)228 9582-111



# Deutsches IT-Sicherheitszertifikat

erteilt vom



Bundesamt für Sicherheit in der Informationstechnik

## BSI-DSZ-CC-0406-2007

### STARCOS 3.2 eGK

Version 1.0

from Giesecke & Devrient GmbH

PP Conformance: electronic Health Card (eHC) – elektronische Gesundheitskarte (eGK), Version 2.0, BSI-PP-0020-V2-2007

Functionality: PP conformant plus product specific extensions  
Common Criteria Part 2 extended

Assurance: Common Criteria Part 3 conformant  
EAL 4 augmented by  
ADV\_IMP.2, AVA\_MSU.3 and AVA\_VLA.4



Common Criteria  
Arrangement  
for components  
up to EAL 4



The IT product identified in this certificate has been evaluated at an accredited and licensed/ approved evaluation facility using *the Common Methodology for IT Security Evaluation, Version 2.3 extended by advice of the Certification Body* for components beyond EAL 4 and guidance specific for the technology of the product for conformance to the *Common Criteria for IT Security Evaluation (CC), Version 2.3 (ISO/IEC 15408:2005)*.

This certificate applies only to the specific version and release of the product in its evaluated configuration and in conjunction with the complete Certification Report.

The evaluation has been conducted in accordance with the provisions of the certification scheme of the German Federal Office for Information Security (BSI) and the conclusions of the evaluation facility in the evaluation technical report are consistent with the evidence adduced.

This certificate is not an endorsement of the IT product by the Federal Office for Information Security or any other organisation that recognises or gives effect to this certificate, and no warranty of the IT product by the Federal Office for Information Security or any other organisation that recognises or gives effect to this certificate, is either expressed or implied.

Bonn, 18. December 2007

The President of the Federal Office  
for Information Security



SOGIS - MRA

Dr. Helmbrecht

L.S.

This page is intentionally left blank.

## Preliminary Remarks

Under the BSIG<sup>1</sup> Act, the Federal Office for Information Security (BSI) has the task of issuing certificates for information technology products.

Certification of a product is carried out on the instigation of the vendor or a distributor, hereinafter called the sponsor.

A part of the procedure is the technical examination (evaluation) of the product according to the security criteria published by the BSI or generally recognised security criteria.

The evaluation is normally carried out by an evaluation facility recognised by the BSI or by BSI itself.

The result of the certification procedure is the present Certification Report. This report contains among others the certificate (summarised assessment) and the detailed Certification Results.

The Certification Results contain the technical description of the security functionality of the certified product, the details of the evaluation (strength and weaknesses) and instructions for the user.

---

<sup>1</sup> Act setting up the Federal Office for Information Security (BSI-Errichtungsgesetz, BSIG) of 17 December 1990, Bundesgesetzblatt I p. 2834

## **Contents**

Part A: Certification

Part B: Certification Results

Part C: Excerpts from the Criteria

## A Certification

### 1 Specifications of the Certification Procedure

The certification body conducts the procedure according to the criteria laid down in the following:

- BSIG<sup>2</sup>
- BSI Certification Ordinance<sup>3</sup>
- BSI Schedule of Costs<sup>4</sup>
- Special decrees issued by the Bundesministerium des Innern (Federal Ministry of the Interior)
- DIN EN 45011 standard
- BSI certification: Procedural Description (BSI 7125)
- Common Criteria for IT Security Evaluation (CC), Version 2.3 (ISO/IEC 15408:2005)<sup>5</sup>
- Common Methodology for IT Security Evaluation, Version 2.3
- BSI certification: Application Notes and Interpretation of the Scheme (AIS)
- Advice from the Certification Body on methodology for assurance components above EAL4 (AIS 34)

### 2 Recognition Agreements

In order to avoid multiple certification of the same product in different countries a mutual recognition of IT security certificates - as far as such certificates are based on ITSEC or CC - under certain conditions was agreed.

---

<sup>2</sup> Act setting up the Federal Office for Information Security (BSI-Errichtungsgesetz, BSIG) of 17 December 1990, Bundesgesetzblatt I p. 2834

<sup>3</sup> Ordinance on the Procedure for Issuance of a Certificate by the Federal Office for Information Security (BSI-Zertifizierungsverordnung, BSIZertV) of 07 July 1992, Bundesgesetzblatt I p. 1230

<sup>4</sup> Schedule of Cost for Official Procedures of the Bundesamt für Sicherheit in der Informationstechnik (BSI-Kostenverordnung, BSI-KostV) of 03 March 2005, Bundesgesetzblatt I p. 519

<sup>5</sup> Proclamation of the Bundesministerium des Innern of 10 May 2006 in the Bundesanzeiger dated 19 May 2006, p. 3730

## 2.1 European Recognition of ITSEC/CC - Certificates

The SOGIS-Agreement on the mutual recognition of certificates based on ITSEC became effective on 3 March 1998.

This agreement was signed by the national bodies of Finland, France, Germany, Greece, Italy, The Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom. This agreement on the mutual recognition of IT security certificates was extended to include certificates based on the CC for all evaluation levels (EAL 1 – EAL 7). The German Federal Office for Information Security (BSI) recognises certificates issued by the national certification bodies of France and the United Kingdom within the terms of this Agreement.

The SOGIS-MRA logo printed on the certificate indicates that it is recognised under the terms of this agreement.

## 2.2 International Recognition of CC - Certificates

An arrangement (Common Criteria Arrangement) on the mutual recognition of certificates based on the CC evaluation assurance levels up to and including EAL 4 has been signed in May 2000 (CC-MRA). It includes also the recognition of Protection Profiles based on the CC.

As of February 2007 the arrangement has been signed by the national bodies of: Australia, Austria, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, India, Israel, Italy, Japan, Republic of Korea, The Netherlands, New Zealand, Norway, Republic of Singapore, Spain, Sweden, Turkey, United Kingdom, United States of America. The current list of signatory nations resp. approved certification schemes can be seen on the web site: <http://www.commoncriteriaportal.org>

The Common Criteria Arrangement logo printed on the certificate indicates that this certification is recognised under the terms of this agreement.

This evaluation contains the components ADV\_IMP.2, AVA\_MSU.3 and AVA\_VLA.4 that are not mutually recognised in accordance with the provisions of the CCRA. For mutual recognition the EAL4-components of these assurance families are relevant.

## 3 Performance of Evaluation and Certification

The certification body monitors each individual evaluation to ensure a uniform procedure, a uniform interpretation of the criteria and uniform ratings.

The product STARCOS 3.2 eGK, Version 1.0 has undergone the certification procedure at BSI.

The evaluation of the product STARCOS 3.2 eGK, Version 1.0 was conducted by TÜV Informationstechnik GmbH. The evaluation was completed on 21st



November 2007. The TÜV Informationstechnik GmbH is an evaluation facility (ITSEF)<sup>6</sup> recognised by the certification body of BSI.

For this certification procedure the applicant is: Giesecke & Devrient GmbH.

The product was developed by: Giesecke & Devrient GmbH.

The certification is concluded with the comparability check and the production of this Certification Report. This work was completed by the BSI.

## 4 Validity of the certification result

This Certification Report only applies to the version of the product as indicated. The confirmed assurance package is only valid on the condition that

- all stipulations regarding generation, configuration and operation, as given in the following report, are observed,
- the product is operated in the environment described, where specified in the following report and in the Security Target.

For the meaning of the assurance levels and the confirmed strength of functions, please refer to the excerpts from the criteria at the end of the Certification Report.

The Certificate issued confirms the assurance of the product claimed in the Security Target at the date of certification. As attack methods may evolve over time, the resistance of the certified version of the product against new attack methods can be re-assessed if required and the sponsor applies for the certified product being monitored within the assurance continuity program of the BSI Certification Scheme. It is recommended to perform a re-assessment on a regular basis.

In case of changes to the certified version of the product, the validity can be extended to the new versions and releases, provided the sponsor applies for assurance continuity (i.e. re-certification or maintenance) of the modified product, in accordance with the procedural requirements, and the evaluation does not reveal any security deficiencies.

## 5 Publication

The following Certification Results contain pages B-1 to B-18.

The product STARCOS 3.2 eGK, Version 1.0 has been included in the BSI list of the certified products, which is published regularly (see also Internet: <http://www.bsi.bund.de>). Further information can be obtained from BSI-Infoline +49 228 9582-111.

---

<sup>6</sup> Information Technology Security Evaluation Facility

Further copies of this Certification Report can be requested from the developer<sup>7</sup> of the product. The Certification Report may also be obtained in electronic form at the internet address stated above.

---

<sup>7</sup> Giesecke & Devrient GmbH  
Prinzenregentenstraße 159  
81677 München

## **B Certification Results**

The following results represent a summary of

- the security target of the sponsor for the target of evaluation,
- the relevant evaluation results from the evaluation facility, and
- complementary notes and stipulations of the certification body.

## Contents of the certification results

1	Executive Summary	3
2	Identification of the TOE	4
3	Security Policy	5
4	Assumptions and Clarification of Scope	5
5	Architectural Information	6
6	Documentation	6
7	IT Product Testing	6
8	Evaluated Configuration	8
9	Results of the Evaluation	9
9.1	CC specific results	9
9.2	Results of cryptographic assessment	10
10	Obligations and notes for the usage of the TOE	11
11	Security Target	12
12	Definitions	13
12.1	Acronyms	13
12.2	Glossary	14
13	Bibliography	15

## 1 Executive Summary

The Target of evaluation (TOE) is the STARCOS 3.2 eGK Version 1.0, a contact based smart card with applications for the German health system according to “Gesetz zur Modernisierung der Gesetzlichen Krankenversicherung” (GKV-Modernisierungsgesetz – GMG), the “Sozialgesetzbuch” (SGB) and the privacy legislation (“Datenschutzgesetze des Bundes und der Länder”).

The Security Target [6] is the basis for this certification. It is based on the certified Protection Profile electronic Health Card (eHC) – elektronische Gesundheitskarte (eGK), Version 2.0, BSI-PP-0020-V2-2007 [9].

The TOE security assurance requirements are based entirely on the assurance components defined in part 3 of the Common Criteria (see part C or [1], part 3 for details). The TOE meets the assurance requirements of the Evaluation Assurance Level EAL 4 augmented by ADV\_IMP.2, AVA\_MSU.3 and AVA\_VLA.4.

The TOE Security Functional Requirements (SFR) relevant for the TOE are outlined in the Security Target [6] resp. [7], chapter 6.1. They are selected from Common Criteria Part 2 and some of them are newly defined. Thus the TOE is CC part 2 extended.

The Security Functional Requirements (SFR) relevant for the IT-Environment of the TOE are outlined in the Security Target [6] resp. [7], chapter 6.3. The security target does not describe security functional requirements for the IT Environment.

The TOE Security Functional Requirements are implemented by the following TOE Security Functions:

TOE Security Function	Addressed issue
SF.ACCESS	Access Control
SF.ADMIN	Administration of the TOE
SF.AUTH	Authentication of the Cardholder
SF.CRYPTO	Cryptographic Support
SF.TRUST	Authentication and Trusted Communication
SF.PROTECTION	Protection of TSC
SF.IC_SF	Security Functions of the IC

Table 1: TOE Security Funktionen

For more details please refer to the Security Target [6] resp. [7], chapter 7.1.

The claimed TOE’s strength of functions ‘high’ (SOF-high) for specific functions as indicated in the Security Target [6] resp. [7], chapter 7.1 is confirmed. The rating of the strength of functions does not include the cryptoalgorithms suitable

for encryption and decryption (see BSIG Section 4, Para. 3, Clause 2). For details see chapter 9 of this report.

The assets to be protected by the TOE are defined in the Security Target [6] resp. [7], chapter 3.1.1. Based on these assets the security environment is defined in terms of assumptions, threats and policies. This is outlined in the Security Target [6] resp. [7], chapter 3.2 - 3.4.

This certification covers the following configurations of the TOE: STARCOS 3.2 eGK, Version 1.0. For details please refer to chapter 8.

The Certification Results only apply to the version of the product indicated in the Certificate and on the condition that all the stipulations are kept as detailed in this Certification Report. This certificate is not an endorsement of the IT product by the Federal Office for Information Security (BSI) or any other organisation that recognises or gives effect to this certificate, and no warranty of the IT product by BSI or any other organisation that recognises or gives effect to this certificate, is either expressed or implied.

## 2 Identification of the TOE

The Target of Evaluation (TOE) is called:

### STARCOS 3.2 eGK, Version 1.0

The following table outlines the TOE deliverables:

No	Type	Identifier	Release	Form of Delivery
1	HW/SW	SLE66CX680PE		SmartCard modules, ROM mask of the TOE already implemented
2	SW	Card Operating System STARCOS 3.2 eGK	3.2	Software on the SmartCard
3	DOC	Administrator Guidance STARCOS 3.2 eGK; STARCOS 3.2 QES V1.0 [11]	Version 1.0/Status 13.12.07	Document in paper / electronic form
4	DOC	Benutzerhandbuch für die Deutsche Elektronische Gesundheitskarte eGK [12]	Version 1.0, Datum 20.07.07	Document in paper / electronic form
5	DOC	Spezifikation eGK, Applikation für STARCOS 3.2 [13]	Version 0.51 / Stand 29.08.2007	Document in paper / electronic form
6	DOC	Installation, generation and start up of the STARCOS 3.2 eGK / QES [14]	Version 1.3 / Status 29-Jan-07	Document in paper / electronic form

Table 2: Deliverables of the TOE

The initialisation process is as follows: The administrator guidance [11] is delivered from G&D to the card issuer. The card issuer specifies the initialisation table and sends the specification to G&D. The specification of the

initialisation table can also be done by G&D. Developers at G&D then implement the initialisation table (including the remaining TOE parts for the EEPROM) according to the specification.

The initialisation table is sent to the initialisation site. There, the initialisation table is loaded to each card, starting the initialisation process. At the beginning of the initialisation process, the integrity and authenticity of the initialization table is verified by the card.

To verify the ID of the initialisation table of the TOE (and therefore also the composite TOE), the the card issuer or any other user executes the command GET DATA with Parameters P1='DF' P2='20'. A unique reference number of the initialisation table is specified in the bytes 49 to 60 of the returned protocol data. The numbers of valid initialisation tables are published on the Giesecke&Devrient GmbH website <https://certificates.gi-de.com> for comparison.

### **3 Security Policy**

The TOE is the composition of an IC, IC Dedicated Software and Smart Card Embedded Software and will be used as electronic Health Card (eHC) within the German Health Care System. The security policy is expressed by the set of security functional requirements and implemented by the TOE. It covers the following issues:

- modification and disclosure of IC assets / smart card embedded software / application data
- compromise / forge / misuse of confidential user or TSF data including information leakage
- interception of communication
- abuse of TOE functionality (including its eHC applications)
- malfunction due to environmental stress as well as physical tampering
- physical attacks through the TOE interfaces

### **4 Assumptions and Clarification of Scope**

The assumptions defined in the Security Target and some aspects of threats and organisational security policies are not covered by the TOE itself. These aspects lead to specific security objectives to be fulfilled by the TOE-Environment. The following topics are of relevance:

- Adequate usage of the TOE and IT-Systems in the environment as stated in OE.Users.
- The decision, which data are legally feasible for storage on the TOE or when data need to be deleted has to be made by the persons authorised to deal with the data as mentioned in OE.Legal\_Decisions.

- Sensitive data outside of the TOE (medical data, PINs, cryptographic keys and sensitive personal data) has to be handled confidential and integer as specified in OE.Data\_Protection.
- The Cardholder of the TOE must be informed clearly about secure usage of the product, see OE.User\_Information.
- Data has to be handled secure during personalisation and additional personalisation, see OE.Perso Secure for more details.

Details can be found in the Security Target [6] resp. [7], chapter 3.4.

## 5 Architectural Information

The TOE STARCOS 3.2 eGK, Version 1.0 is composed of the already certified integrated circuit from Infineon SLE66CX680PE [15], the operating system STARCOS 3.2 and the eGK health applications from Giesecke & Devrient, see also figure 1 in [7].

The TOE is composed of the following subsystems:

- Access Control
- Setup
- Commands
- Application Data and Basic Functions
- Crypto Functions
- Secure Messaging
- Hardware

## 6 Documentation

The evaluated documentation as outlined in table 2 is being provided with the product to the customer. This documentation contains the required information for secure usage of the TOE in accordance with the Security Target.

Additional obligations and notes for secure usage of the TOE as outlined in chapter 10 of this report have to be followed.

## 7 IT Product Testing

The tests were performed with the composite smartcard product. The physical format of the test configuration for TOE testing was either

- a card which is usable for all automatic or non-recoverable test cases or
- a simulator which is required for all interactive test cases.

The test targets (TT) were:



- TT1a: Card completed / initialized / personalized with eHC/QES application, (TOE TT), plus test applications loaded onto the TOE by the tests.
- TT1b: Simulator completed / initialized / personalized with eHC/QES application, (Non-TOE TT), plus test applications loaded onto the TOE by the tests.
- TT2a: Uncompleted card + eHC/QES applications in form of an initialization image, (non-TOE TT).
- TT2b: Simulator in uncompleted state + eHC/QES application in form of an initialization image, (non-TOE TT)

These four different test targets were necessary to test the single aspects of the TOE relevant for testing:

- Operating system contained in ROM code and EEPROM patch code
- Applications which were initialized / loaded
- Completion state: card in usage phase or in uncompleted state

## 7.1 Developer Tests according to ATE\_FUN

All TSF as specified in [6] with related sub-functions and subsystems were tested in order to assure complete coverage. The test strategy was that all commands stated in the functional specification were tested to cover the requirements on TSF data, the security functional effects and the most important return codes given there and moreover all interfaces described in the high-level design.

## 7.2 Evaluator Tests

### 7.2.1 Independent Testing according to ATE\_IND

The approach for the evaluator's independent testing was

- Examination of developer's testing amount, depth and coverage analysis and of the developer's test goal and plan for identification of gaps.
- Examination whether the TOE, in its intended environment, is operating as specified using iterations of developer's tests.
- Independent testing was performed by the evaluator in the evaluation facility with the TOE development environment using script based developer test tools with automated comparison of expected and actual test results

During sample testing the evaluator has chosen to repeat all developer functional tests at the Evaluation Body for IT-Security. The evaluator has verified the developer's test results by executing all tests in the developer's test documentation and verifying the test log files of a sample thereof.

The independent test results demonstrate that the TOE performs as expected.

### 7.2.2 Penetration Testing according to AVA\_VLA

The approach for the evaluator’s penetration testing was:

- Examination of developer’s vulnerability analysis and of the developer’s rationale based on for why the vulnerabilities are not exploitable in the intended environment of the TOE.
- Examination whether the TOE, in its intended environment, is susceptible to vulnerabilities not considered by the developer by considering current information regarding obvious public domain vulnerabilities.

Penetration testing was performed by the evaluator at the Evaluation Body for IT-Security with the TOE development environment using script based developer test tools with automated comparison of expected and actual test results. All security functions were penetration tested.

During the penetration testing the TOE operated as specified. The vulnerabilities discussed in the vulnerability analysis are not exploitable in the intended environment for the TOE.

## 8 Evaluated Configuration

This certification covers the following configurations of the TOE:

The TOE as an electronic Health Card only features one fixed configuration STARCOS 3.2 eGK, Version 1.0 which cannot be altered by the user. The evaluation is therefore only valid for this configuration of the TOE.

However, to reach this version of the TOE, different initialization tables can be used which differ only in non-security relevant parts (e.g. key length which can range between certain given boundaries or other parameters which can be varied). The requirements for those inzialization tables are listed as generic initialization tables in [13]. The initialization tables listed in Table 3 all fulfil the requirements of [13].

Table Name
01 03 23 E1 E5 DC 60 4A 72 1F B5 C9
01 03 23 E2 0B 55 29 12 7A 63 62 10
01 03 23 E3 E0 A9 BB 1C EB 58 23 B1
01 03 23 E4 9B 64 12 F7 02 1B 3A 7B
01 03 23 E5 C8 CC CA CC 3D ED D0 4D
01 03 23 E6 80 03 CA F1 31 6C 9C 20
01 03 23 E7 93 22 14 80 01 E7 08 18
01 03 23 E8 DC EF 93 03 A4 A9 9C CD
01 03 23 E9 03 46 D8 D8 6E 54 4B 0A
01 03 23 EA 74 2B EF AF 14 7D B5 36

Table 3: List of evaluated initialization tables

The identification of the TOE is described in [12, chapter 5.2]. The relevant identifier for the evaluated initialization table can be found on the dedicated web page: <https://certificates.gi-de.com/>. New initialization tables have to be checked with the evaluated Verifier-Tool before updating the above mentioned web page.

Please note that the usage of the TOE within the scope of this certification is limited in accordance with the validity of the used cryptographic algorithms, see chapter 10.

## 9 Results of the Evaluation

### 9.1 CC specific results

The Evaluation Technical Report (ETR), [8] was provided by the ITSEF according to the Common Criteria [1], the Methodology [2], the requirements of the Scheme [3] and all interpretations and guidelines of the Scheme (AIS) [4] as relevant for the TOE.

The evaluation methodology CEM [2] was used for those components used up to EAL4 extended by advice of the Certification Body for components beyond EAL 4 and guidance specific for the technology of the product [4] (AIS 34).

The following guidance specific for the technology was used:

- (i) *As the evaluation of the TOE was conducted as a composition evaluation, the ETR [8] includes also the evaluation results of the composite evaluation activities in accordance with CC Supporting Document, ETR-lite for Composition: Annex A Composite smart card evaluation [4, AIS 36].*
- (ii) *The ETR [8] builds up on the ETR-lite for Composition documents of the evaluation of the underlying hardware "Infineon Smart Card IC SLE66CX680PE/m1534a13 and SLE66CX360PE/m1536a13 both with RSA 2048 V1.4 and specific IC Dedicated Software" ([15]). The ETR-lite for Composition documents was provided by the ITSEF TÜV Informationstechnik GmbH according to CC Supporting Document, ETR-lite for Composition ([4, AIS 36]) and was validated by a recent re-assessment.*
- (iii) *For smart card specific methodology the scheme interpretations AIS 25 and AIS 26 (see [4]) were used.*

As a result of the evaluation the verdict PASS is confirmed for the following assurance components:

- All components of the class ASE,
- all components of the EAL 4 package as defined in the CC (see also part C of this report),
- the components  
ADV\_IMP.2 - Implementation of the TSF

AVA\_MSU.3 - Analysis and testing for insecure states  
AVA\_VLA.4 - Highly resistant  
augmented for this TOE evaluation.

The evaluation has confirmed:

- for PP Conformance electronic Health Card (eHC) – elektronische Gesundheitskarte (eGK), Version 2.0, BSI-PP-0020-V2-2007 [9]
- for the functionality: PP conformant plus product specific extensions  
Common Criteria Part 2 extended
- for the assurance: Common Criteria Part 3 conformant  
EAL 4 augmented by  
ADV\_IMP.2, AVA\_MSU.3 and AVA\_VLA.4
- The following TOE Security Functions fulfil the claimed Strength of Function high :  
SF.AUTH, SF.CRYPTO and SF.IC  
In order to assess the strength of function the scheme interpretations AIS 20 and 31 (see [4]) were used.

The results of the evaluation are only applicable to the TOE as defined in chapter 2 and the configuration as outlined in chapter 8 above.

## 9.2 Results of cryptographic assessment

The following cryptographic algorithms are used by the TOE to enforce its security policy:

- hash functions:  
SHA-1, SHA-224 bit, SHA-256, SHA-384, SHA-512, RIPEMD-160
- algorithms for the encryption and decryption:  
2TDES, RSA with bitlength between 1024 and 2048 bit, and PKCS #1
- algorithms for signature creation and verification used for card to card authentication:  
RSA signature creation and verification with bitlength between 1024 and 2048 bit that meet ISO/IEC 9796-2 (DS scheme 1)

This holds for the following security functions:

- SF.Crypto (Cryptographic Support)
- SF.Trust (Authentication and Trusted Communication)

The strength of the cryptographic algorithms was not rated in the course of this evaluation (see BSIG Section 4, Para. 3, Clause 2). According to the Technische Richtlinie für die eCard-Projekte der Bundesregierung [16] the algorithms are suitable for the authentication and communication of the TOE and the health insurance infrastructure and the encryption of health data. The

validity period of each algorithm is mentioned in the official catalogue [16] and summarized in chapter 10.

## 10 Obligations and notes for the usage of the TOE

The operational documents as outlined in table 2 contain necessary information about the usage of the TOE and all security hints therein have to be considered. In particular, the user and administrator guidance makes the following constraints for TOE use:

- The ChipPWD shall be kept confidential ([11, chapter 4.1.4])
- The Initialiser must perform the self tests of the TOE ([11, chapters 6.2, 6.3, 6.15])
- The chosen User PIN has to be random. It should not be possible to guess it (12, chapter 2.3.1)

In addition, the following aspects need to be fulfilled when using the TOE:

- The identification of the TOE is described in [12, chapter 5.2]. The relevant identifier for the evaluated initialization table can be found on the dedicated web page: <https://certificates.gi-de.com/>.
- The card issuer is responsible for choosing only values which are permitted by [13].
- When Giesecke & Devrient modifies the non-TOE part of the initialization table (e.g. when Giesecke & Devrient implements the initialisation table with the values of the card issuer), that initialization table has to be checked before updating the above mentioned web page.
- Giesecke & Devrient is supported in this task with an automatic verification tool that checks the consistency to [13], e.g. FCPs for MF/DFs or the access rules for MF/DFs.
- CV-certificates have to be generated immediately after generation of the authentication keys stored on the card. This must be done in a way that an attacker is not able to modify any content of the certificates, in particular the ICCSN [11, 4.2.3.1].

As outlined in chapter 9.2 of this report and in the Security Target, the TOE uses the hash functions SHA-1, SHA-224, SHA-256, SHA-384, SHA-512 and RIPEMD-160. For encryption and decryption the TOE uses 2TDES or RSA with bitlength between 1024 and 2048 bits and PKCS#1. For asymmetric authentication the TOE uses RSA signature creation and verification with bitlength between 1024 and 2048 bits that meet ISO/IEC 9796-1 (DS scheme 1).

The following table describes the validity period of hash functions according to the Technische Richtlinie für die eCard-Projekte der Bundesregierung [16]:

Hash function	Valid until end of
SHA-1	2007
RIPEMD-160	2009
SHA-224, SHA-256, SHA-384, SHA-512	2013

Table 4: Validity period of hash functions

As the STARCOS 3.2 eGK implements certain cryptographic algorithms for encryption, decryption, authentication and communication, the following table summarizes the validity period of these algorithms as published in [16].

Algorithm with bitlength	Valid until end of
2TDES	2009
RSA 1024	2007
RSA 1280	2008
RSA 1536	2009
RSA 1728	2010
RSA 1976	2013
PKCS #1 v2.1	Valid
ISO-9796-2 (DS scheme 1)	2013

Table 5: Validity period of cryptographic algorithms

A bitlength of 2048 bits for RSA is recommended for an acceptable long term security level.

For the expiry of the cryptographic algorithms please refer to the relevant and applicable national directives. The usage of the TOE within the scope of this certification is limited in accordance with the validity of the used cryptographic algorithms.

The automatic verification tool cannot check the validity of the used cryptographic algorithms, hence by-and-by less of the initialisation tables on the above mentioned web site will fall under this certificate. If a valid CC certificate is required, the card issuer is responsible for only using initialisation tables where the used cryptoalgorithms are valid according to the then effective Technische Richtlinie für die eCard-Projekte der Bundesregierung [16].

## 11 Security Target

For the purpose of publishing, the security target [7] of the target of evaluation (TOE) is provided within a separate document. It is a sanitised version of the complete security target [6] used for the evaluation performed. Sanitisation was performed according to the rules as outlined in the relevant CCRA policy (see AIS 35 [4]).

## 12 Definitions

### 12.1 Acronyms

<b>2TDES</b>	Two-key Triple DES
<b>ATE</b>	Assurance class Test Activity
<b>ATE_IND</b>	Independant testing
<b>AVA</b>	Assurance class Vulnerability Assessment Activity
<b>AVA_VLA</b>	Vulnerability analysis
<b>BSI</b>	Bundesamt für Sicherheit in der Informationstechnik / Federal Office for Information Security, Bonn, Germany
<b>BSIG</b>	Act setting up the Federal Office for Information Security (BSI-Errichtungsgesetz, BSIG) of 17 December 1990, Bundesgesetzblatt I p. 2834
<b>CCRA</b>	Common Criteria Recognition Arrangement
<b>CC</b>	Common Criteria for IT Security Evaluation
<b>DES</b>	Data Encryption Standard
<b>DOC</b>	Documentation / documents
<b>EAL</b>	Evaluation Assurance Level
<b>EEPROM</b>	Electronically Erasable Programmable Read Only Memory
<b>eGK</b>	elektronische Gesundheitskarte (eHC)
<b>eHC</b>	Electronic Health Card
<b>IT</b>	Information Technology
<b>ETR</b>	Evaluation Technical Report
<b>G&amp;D</b>	Giesecke&Devrient
<b>HW</b>	Hardware
<b>IC</b>	Integrated Circuit
<b>ID</b>	Identification number
<b>IT</b>	Information technology
<b>IMP</b>	Implementation Representation
<b>ITSEF</b>	Information Technology Security Evaluation Facility
<b>MAC</b>	Message Authentication Code
<b>OE</b>	Operational Environment
<b>PKCS</b>	Public Key Cryptography Standards
<b>PIN</b>	Personal Identification Number

<b>PP</b>	Protection Profile
<b>PW</b>	Password
<b>QES</b>	qualifizierte elektronische Signatur, qualified electronic signature
<b>RIPEMD</b>	RACE Integrity Primitives Evaluation Message Digest, Hash algorithm
<b>ROM</b>	Read Only Memory
<b>RSA</b>	Rivest-Shamir-Adleman Algorithm
<b>SF</b>	Security Function
<b>SFP</b>	Security Function Policy
<b>SFR</b>	Security Functional Requirements
<b>SHA</b>	Secure Hash Algorithm
<b>SOF</b>	Strength of Function
<b>ST</b>	Security Target
<b>STARCOS</b>	SmarT cARd Chip Operating System
<b>SW</b>	Software
<b>TDES</b>	Triple DES
<b>TOE</b>	Target of Evaluation
<b>TSC</b>	TSF Scope of Control
<b>TSF</b>	TOE Security Functions
<b>TSP</b>	TOE Security Policy
<b>TT</b>	Test Target

## 12.2 Glossary

**Augmentation** - The addition of one or more assurance component(s) from CC Part 3 to an EAL or assurance package.

**Extension** - The addition to an ST or PP of functional requirements not contained in part 2 and/or assurance requirements not contained in part 3 of the CC.

**Formal** - Expressed in a restricted syntax language with defined semantics based on well-established mathematical concepts.

**Informal** - Expressed in natural language.

**Object** - An entity within the TSC that contains or receives information and upon which subjects perform operations.

**Protection Profile** - An implementation-independent set of security requirements for a category of TOEs that meet specific consumer needs.



**Security Function** - A part or parts of the TOE that have to be relied upon for enforcing a closely related subset of the rules from the TSP.

**Security Target** - A set of security requirements and specifications to be used as the basis for evaluation of an identified TOE.

**Semiformal** - Expressed in a restricted syntax language with defined semantics.

**Strength of Function** - A qualification of a TOE security function expressing the minimum efforts assumed necessary to defeat its expected security behaviour by directly attacking its underlying security mechanisms.

**SOF-basic** - A level of the TOE strength of function where analysis shows that the function provides adequate protection against casual breach of TOE security by attackers possessing a low attack potential.

**SOF-medium** - A level of the TOE strength of function where analysis shows that the function provides adequate protection against straightforward or intentional breach of TOE security by attackers possessing a moderate attack potential.

**SOF-high** - A level of the TOE strength of function where analysis shows that the function provides adequate protection against deliberately planned or organised breach of TOE security by attackers possessing a high attack potential.

**Subject** - An entity within the TSC that causes operations to be performed.

**Target of Evaluation** - An IT product or system and its associated administrator and user guidance documentation that is the subject of an evaluation.

**TOE Security Functions** - A set consisting of all hardware, software, and firmware of the TOE that must be relied upon for the correct enforcement of the TSP.

**TOE Security Policy** - A set of rules that regulate how assets are managed, protected and distributed within a TOE.

**TSF Scope of Control** - The set of interactions that can occur with or within a TOE and are subject to the rules of the TSP.

## 13 Bibliography

- [1] Common Criteria for Information Technology Security Evaluation, Version 2.3, August 2005
- [2] Common Methodology for Information Technology Security Evaluation (CEM), Evaluation Methodology, Version 2.3, August 2005
- [3] BSI certification: Procedural Description (BSI 7125)
- [4] Application Notes and Interpretations of the Scheme (AIS) as relevant for the TOE. specifically:

- AIS 25, Version 3, 6 August 2007 for: CC Supporting Document, - The Application of CC to Integrated Circuits, Version 2.0, CCDB-2006-04-003, April 2006
  - AIS 26, Version 3, 6 August 2007 for: CC Supporting Document, - Application of Attack Potential to Smartcards, Version 2.3, CCDB-2007-04-001, April 2007
  - AIS 31, Version 1, 25 Sept. 2001 for: Functionality classes and evaluation methodology of physical random number generators
  - AIS 32, Version 1, 02 July 2001, Übernahme international abgestimmter CC-Interpretationen ins deutsche Zertifizierungsschema.
  - AIS 34, Version 1.00, 1 June 2004, Evaluation Methodology for CC Assurance Classes for EAL5+
  - AIS 35 ST-lite
  - AIS 36, Version 1, 29 July 2002 for: CC Supporting Document, ETR-lite for Composition, Version 1.1, July 2002 and CC Supporting Document, ETR-lite for Composition: Annex A Composite smartcard evaluation, Version 1.2 March 2002
  - AIS 38, Version 2.0, 28 September 2007, Reuse of evaluation results
- [5] German IT Security Certificates (BSI 7148, BSI 7149), periodically updated list published also on the BSI Web-site
- [6] Security Target of STARCOS 3.2 eGK, BSI-DSZ-0406-2007, Version 1.4, 20.11.2007, Giesecke&Devrient (confidential document)
- [7] Security Target Lite of STARCOS 3.2 eGK, BSI-DSZ-0406-2007, Version 1.1, 20.11.2007, Giesecke&Devrient (sanitised public document)
- [8] Evaluation Technical Report for STARCOS 3.2 eGK, BSI-DSZ-0406-2007, Version 7, 13.12.2007, Evaluation Body for IT-Security of TÜV Informationstechnik GmbH (confidential document)
- [9] Common Criteria Protection Profile electronic Health Card (eHC) – elektronische Gesundheitskarte (eGK), Version 2.0, BSI-PP-0020-V2-2007, 29.1.2007, Bundesamt für Sicherheit in der Informationstechnik
- [10] Configuration list for the TOE, Version 1.7, 13.12.2007, Configuration List STARCOS 3.2 eGK, Giesecke&Devrient (confidential document)
- [11] Administrator Guidance STARCOS 3.2 eGK; STARCOS 3.2 QES V1.0, Version 1.0/Status 13.12.07, Giesecke&Devrient
- [12] Benutzerhandbuch für die Deutsche Elektronische Gesundheitskarte eGK, Version 1.0, Datum 20.07.07, Giesecke&Devrient
- [13] Spezifikation eGK, Applikation für STARCOS 3.2, Version 0.51 / Stand 29.08.2007, Giesecke&Devrient

- [14] Installation, generation and start up of the STARCOS 3.2 eGK / QES, Version 1.3 / Status 29-Jan-07, Giesecke&Devrient
- [15] Certification Report BSI-DSZ-CC-0322-2005 for Infineon Smart Card IC (Security Controller) SLE66CX680PE/m1534a13 and SLE66CX360PE/m1536a13 both with RSA 2048 V1.4 and specific IC Dedicated Software, 14. September 2005, BSI
- [16] Technische Richtlinie für die eCard-Projekte der Bundesregierung, Version 1.0, 23.03.2007, BSI

This page is intentionally left blank.

## C Excerpts from the Criteria

CC Part1:

### Conformance results (chapter 7.4)

„The conformance result indicates the source of the collection of requirements that is met by a TOE or PP that passes its evaluation. This conformance result is presented with respect to CC Part 2 (functional requirements), CC Part 3 (assurance requirements) and, if applicable, to a pre-defined set of requirements (e.g., EAL, Protection Profile).

The conformance result consists of one of the following:

- **CC Part 2 conformant** - A PP or TOE is CC Part 2 conformant if the functional requirements are based only upon functional components in CC Part 2.
- **CC Part 2 extended** - A PP or TOE is CC Part 2 extended if the functional requirements include functional components not in CC Part 2.

plus one of the following:

- **CC Part 3 conformant** - A PP or TOE is CC Part 3 conformant if the assurance requirements are based only upon assurance components in CC Part 3.
- **CC Part 3 extended** - A PP or TOE is CC Part 3 extended if the assurance requirements include assurance requirements not in CC Part 3.

Additionally, the conformance result may include a statement made with respect to sets of defined requirements, in which case it consists of one of the following:

- **Package name Conformant** - A PP or TOE is conformant to a pre-defined named functional and/or assurance package (e.g. EAL) if the requirements (functions or assurance) include all components in the packages listed as part of the conformance result.
- **Package name Augmented** - A PP or TOE is an augmentation of a pre-defined named functional and/or assurance package (e.g. EAL) if the requirements (functions or assurance) are a proper superset of all components in the packages listed as part of the conformance result.

Finally, the conformance result may also include a statement made with respect to Protection Profiles, in which case it includes the following:

- **PP Conformant** - A TOE meets specific PP(s), which are listed as part of the conformance result.“

CC Part 3:

**Protection Profile criteria overview** (chapter 8.2)

“The goal of a PP evaluation is to demonstrate that the PP is complete, consistent, technically sound, and hence suitable for use as a statement of requirements for one or more evaluatable TOEs. Such a PP may be eligible for inclusion within a PP registry.”

“Assurance Class	Assurance Family
Class APE: Protection Profile evaluation	TOE description (APE_DES)
	Security environment (APE_ENV)
	PP introduction (APE_INT)
	Security objectives (APE_OBJ)
	IT security requirements (APE_REQ)
	Explicitly stated IT security requirements (APE_SRE)

Table 3 - Protection Profile families - CC extended requirements ”

**Security Target criteria overview** (Chapter 8.3)

“The goal of an ST evaluation is to demonstrate that the ST is complete, consistent, technically sound, and hence suitable for use as the basis for the corresponding TOE evaluation.”

“Assurance Class	Assurance Family
Class ASE: Security Target evaluation	TOE description (ASE_DES)
	Security environment (ASE_ENV)
	ST introduction (ASE_INT)
	Security objectives (ASE_OBJ)
	PP claims (ASE_PPC)
	IT security requirements (ASE_REQ)
	Explicitly stated IT security requirements (ASE_SRE)
	TOE summary specification (ASE_TSS)

Table 5 - Security Target families - CC extended requirements ”

**Assurance categorisation** (chapter 7.5)

“The assurance classes, families, and the abbreviation for each family are shown in Table 1.

Assurance Class	Assurance Family
ACM: Configuration management	CM automation (ACM_AUT)
	CM capabilities (ACM_CAP)
	CM scope (ACM_SCP)
ADO: Delivery and operation	Delivery (ADO_DEL)
	Installation, generation and start-up (ADO_IGS)
ADV: Development	Functional specification (ADV_FSP)
	High-level design (ADV_HLD)
	Implementation representation (ADV_IMP)
	TSF internals (ADV_INT)
	Low-level design (ADV_LLD)
	Representation correspondence (ADV_RCR)
	Security policy modeling (ADV_SPM)
AGD: Guidance documents	Administrator guidance (AGD_ADM)
	User guidance (AGD_USR)
ALC: Life cycle support	Development security (ALC_DVS)
	Flaw remediation (ALC_FLR)
	Life cycle definition (ALC_LCD)
	Tools and techniques (ALC_TAT)
ATE: Tests	Coverage (ATE_COV)
	Depth (ATE_DPT)
	Functional tests (ATE_FUN)
	Independent testing (ATE_IND)
AVA: Vulnerability assessment	Covert channel analysis (AVA_CCA)
	Misuse (AVA_MSU)
	Strength of TOE security functions (AVA_SOF)
	Vulnerability analysis (AVA_VLA)

Table 1: Assurance family breakdown and mapping”

## **Evaluation assurance levels** (chapter 11)

“The Evaluation Assurance Levels (EALs) provide an increasing scale that balances the level of assurance obtained with the cost and feasibility of acquiring that degree of assurance. The CC approach identifies the separate concepts of assurance in a TOE at the end of the evaluation, and of maintenance of that assurance during the operational use of the TOE.

It is important to note that not all families and components from CC Part 3 are included in the EALs. This is not to say that these do not provide meaningful and desirable assurances. Instead, it is expected that these families and components will be considered for augmentation of an EAL in those PPs and STs for which they provide utility.”

### **Evaluation assurance level (EAL) overview** (chapter 11.1)

“Table 6 represents a summary of the EALs. The columns represent a hierarchically ordered set of EALs, while the rows represent assurance families. Each number in the resulting matrix identifies a specific assurance component where applicable.

As outlined in the next section, seven hierarchically ordered evaluation assurance levels are defined in the CC for the rating of a TOE's assurance. They are hierarchically ordered inasmuch as each EAL represents more assurance than all lower EALs. The increase in assurance from EAL to EAL is accomplished by substitution of a hierarchically higher assurance component from the same assurance family (i.e. increasing rigour, scope, and/or depth) and from the addition of assurance components from other assurance families (i.e. adding new requirements).

These EALs consist of an appropriate combination of assurance components as described in chapter 7 of this Part 3. More precisely, each EAL includes no more than one component of each assurance family and all assurance dependencies of every component are addressed.

While the EALs are defined in the CC, it is possible to represent other combinations of assurance. Specifically, the notion of “augmentation” allows the addition of assurance components (from assurance families not already included in the EAL) or the substitution of assurance components (with another hierarchically higher assurance component in the same assurance family) to an EAL. Of the assurance constructs defined in the CC, only EALs may be augmented. The notion of an “EAL minus a constituent assurance component” is not recognised by the standard as a valid claim. Augmentation carries with it the obligation on the part of the claimant to justify the utility and added value of the added assurance component to the EAL. An EAL may also be extended with explicitly stated assurance requirements.



Assurance Class	Assurance Family	Assurance Evaluation Assurance Level Components by						
		EAL1	EAL2	EAL3	EAL4	EAL5	EAL6	EAL7
Configuration management	ACM_AUT				1	1	2	2
	ACM_CAP	1	2	3	4	4	5	5
	ACM_SCP			1	2	3	3	3
Delivery and operation	ADO_DEL		1	1	2	2	2	3
	ADO_IGS	1	1	1	1	1	1	1
Development	ADV_FSP	1	1	1	2	3	3	4
	ADV_HLD		1	2	2	3	4	5
	ADV_IMP				1	2	3	3
	ADV_INT					1	2	3
	ADV_LLD				1	1	2	2
	ADV_RCR	1	1	1	1	2	2	3
	ADV_SPM				1	3	3	3
Guidance documents	AGD_ADM	1	1	1	1	1	1	1
	AGD_USR	1	1	1	1	1	1	1
Life cycle support	ALC_DVS			1	1	1	2	2
	ALC_FLR							
	ALC_LCD				1	2	2	3
	ALC_TAT				1	2	3	3
Tests	ATE_COV		1	2	2	2	3	3
	ATE_DPT			1	1	2	2	3
	ATE_FUN		1	1	1	1	2	2
	ATE_IND	1	2	2	2	2	2	3
Vulnerability assessment	AVA_CCA					1	2	2
	AVA_MSU			1	2	2	3	3
	AVA_SOF		1	1	1	1	1	1
	AVA_VLA		1	1	2	3	4	4

Table 6: Evaluation assurance level summary"

**Evaluation assurance level 1 (EAL1) - functionally tested** (chapter 11.3)

## “Objectives

EAL1 is applicable where some confidence in correct operation is required, but the threats to security are not viewed as serious. It will be of value where independent assurance is required to support the contention that due care has been exercised with respect to the protection of personal or similar information.

EAL1 provides an evaluation of the TOE as made available to the customer, including independent testing against a specification, and an examination of the guidance documentation provided. It is intended that an EAL1 evaluation could be successfully conducted without assistance from the developer of the TOE, and for minimal outlay.

An evaluation at this level should provide evidence that the TOE functions in a manner consistent with its documentation, and that it provides useful protection against identified threats.”

**Evaluation assurance level 2 (EAL2) - structurally tested** (chapter 11.4)

## “Objectives

EAL2 requires the co-operation of the developer in terms of the delivery of design information and test results, but should not demand more effort on the part of the developer than is consistent with good commercial practice. As such it should not require a substantially increased investment of cost or time.

EAL2 is therefore applicable in those circumstances where developers or users require a low to moderate level of independently assured security in the absence of ready availability of the complete development record. Such a situation may arise when securing legacy systems, or where access to the developer may be limited.”

**Evaluation assurance level 3 (EAL3) - methodically tested and checked** (chapter 11.5)

## “Objectives

EAL3 permits a conscientious developer to gain maximum assurance from positive security engineering at the design stage without substantial alteration of existing sound development practices.

EAL3 is applicable in those circumstances where developers or users require a moderate level of independently assured security, and require a thorough investigation of the TOE and its development without substantial re-engineering.”

**Evaluation assurance level 4 (EAL4) - methodically designed, tested, and reviewed** (chapter 11.6)

## “Objectives

EAL4 permits a developer to gain maximum assurance from positive security engineering based on good commercial development practices which, though rigorous, do not require substantial specialist knowledge, skills, and other resources. EAL4 is the highest level at which it is likely to be economically feasible to retrofit to an existing product line.

EAL4 is therefore 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 additional security-specific engineering costs.”

**Evaluation assurance level 5 (EAL5) - semiformally designed and tested** (chapter 11.7)

## “Objectives

EAL5 permits a developer to gain maximum assurance from security engineering based upon rigorous commercial development practices supported by moderate application of specialist security engineering techniques. Such a TOE will probably be designed and developed with the intent of achieving EAL5 assurance. It is likely that the additional costs attributable to the EAL5 requirements, relative to rigorous development without the application of specialised techniques, will not be large.

EAL5 is therefore applicable in those circumstances where developers or users require a high level of independently assured security in a planned development and require a rigorous development approach without incurring unreasonable costs attributable to specialist security engineering techniques.”

**Evaluation assurance level 6 (EAL6) - semiformally verified design and tested** (chapter 11.8)

## “Objectives

EAL6 permits developers to gain high assurance from application of security engineering techniques to a rigorous development environment in order to produce a premium TOE for protecting high value assets against significant risks.

EAL6 is therefore applicable to the development of security TOEs for application in high risk situations where the value of the protected assets justifies the additional costs.”

**Evaluation assurance level 7 (EAL7) - formally verified design and tested**  
(chapter 11.9)**“Objectives**

EAL7 is applicable to the development of security TOEs for application in extremely high risk situations and/or where the high value of the assets justifies the higher costs. Practical application of EAL7 is currently limited to TOEs with tightly focused security functionality that is amenable to extensive formal analysis.“

**Strength of TOE security functions (AVA\_SOF)** (chapter 19.3)**“Objectives**

Even if a TOE security function cannot be bypassed, deactivated, or corrupted, it may still be possible to defeat it because there is a vulnerability in the concept of its underlying security mechanisms. For those functions a qualification of their security behaviour can be made using the results of a quantitative or statistical analysis of the security behaviour of these mechanisms and the effort required to overcome them. The qualification is made in the form of a strength of TOE security function claim.”

**Vulnerability analysis (AVA\_VLA)** (chapter 19.4)**"Objectives**

Vulnerability analysis is an assessment to determine whether vulnerabilities identified, during the evaluation of the construction and anticipated operation of the TOE or by other methods (e.g. by flaw hypotheses), could allow users to violate the TSP.

Vulnerability analysis deals with the threats that a user will be able to discover flaws that will allow unauthorised access to resources (e.g. data), allow the ability to interfere with or alter the TSF, or interfere with the authorised capabilities of other users.”

**"Application notes**

A vulnerability analysis is performed by the developer in order to ascertain the presence of security vulnerabilities, and should consider at least the contents of all the TOE deliverables including the ST for the targeted evaluation assurance level. The developer is required to document the disposition of identified vulnerabilities to allow the evaluator to make use of that information if it is found useful as a support for the evaluator's independent vulnerability analysis.”

“Independent vulnerability analysis goes beyond the vulnerabilities identified by the developer. The main intent of the evaluator analysis is to determine that the TOE is resistant to penetration attacks performed by an attacker possessing a low (for AVA\_VLA.2 Independent vulnerability analysis), moderate (for AVA\_VLA.3 Moderately resistant) or high (for AVA\_VLA.4 Highly resistant) attack potential.”