

SafeNet Software Cryptographic Library Version 1.0

FIPS 140-2 Level 1 Non-Proprietary Security Policy

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PREFACE

This document deals only with operations and capabilities of the SafeNet Software Cryptographic Library in the technical terms of a FIPS 140-2 cryptographic module security policy. More information is available on SafeNet products from the following sources:

- The SafeNet internet site contains information on the full line of security products at http://www.safenet-inc.com/products/data-protection/.
- For answers to technical or sales related questions please refer to the contacts listed below or on the SafeNet internet site at http://www.safenet-inc.com/company/contact.asp.

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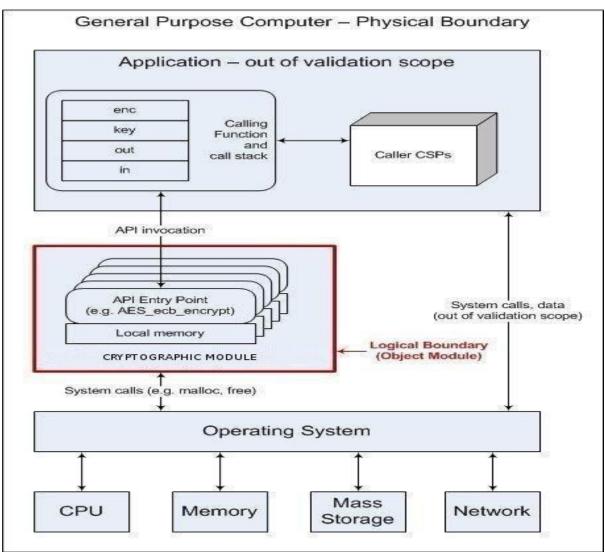


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1 Introduction

This document comprises the non-proprietary FIPS 140-2 Security Policy for the SafeNet Software Cryptographic Library v1.0, hereafter referred to as the Module.



Block Diagram

The Module is a software library providing a C-language application program interface (API) for use by other processes that require cryptographic functionality. The Module is classified by FIPS 140-2 as a software module, multi-chip standalone module embodiment. The physical cryptographic boundary is the general purpose computer on which the module is installed. The logical cryptographic boundary of the Module is the fipscanister object module, a single object module



file named *fipscanister.o*. The Module performs no communications other than with the calling application (the process that invokes the Module services).

The FIPS 140-2 security levels for the Module are as follows:

Security Requirement	Security Level
Cryptographic Module Specification	1
Cryptographic Module Ports and Interfaces	1
Roles, Services, and Authentication	1
Finite State Model	1
Physical Security	NA
Operational Environment	1
Cryptographic Key Management	1
EMI/EMC	1
Self-Tests	1
Design Assurance	3
Mitigation of Other Attacks	NA

Table 1 – Security Level of Security Requirements

The Module's software version for this validation is v1.0.

2 Tested Configurations

Operational Environment		erational Environment Processor		Hardware Device
1	Windows Server 2008R2	Intel Xeon E3-1220v2 (x86)	AES-NI	Dell PowerEdge R210II
2	Windows Server 2008	Intel Xeon E3-1220v2 (x86)	none	Dell PowerEdge R210II
3	Windows 7 (64-bit)	Intel Core i5-2430M (x86)	AES-NI	Acer Aspire AS5750
4	Windows 7 (32-bit)	Intel Core i5-2430M (x86)	none	Acer Aspire AS5750
5	NetBSD 4.0 under	Intel Xeon E3-1220v2 (x86)	AES-NI	Dell PowerEdge



	VMware			R210II
6	Android 4.0	OMAP3 (ARMv7)	NEON	Beagleboard xM
7	RHEL 6.2	Intel Xeon E3-1220v2 (x86)	AES-NI	Dell PowerEdge R210II
8	CentOS 5.6	Intel Xeon 3050 (x86)	none	Dell PowerEdge 860

Table 2 - Supported Platforms

3 Ports and Interfaces

The physical ports of the Module are the same as the computer system on which it is executing. The logical interface is a C-language application program interface (API).

Logical interface type	Description
Control input	API entry point and corresponding stack parameters
Data input	API entry point data input stack parameters
Status output	API entry point return values and status stack parameters
Data output	API entry point data output stack parameters

Table 3 - Logical interfaces

As a software module, control of the physical ports is outside module scope. However, when the module is performing self-tests, or is in an error state, all output on the logical data output interface is inhibited. The module is single-threaded and in error scenarios returns only an error value (no data output is returned).

4 Modes of Operation and Cryptographic Functionality

The Module supports only a FIPS 140-2 Approved mode. Tables 4a and 4b list the Approved and Non-approved but Allowed algorithms, respectively.



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Function	Algorithm	Options	Cert #
Random Number	[SP 800-90A] DRBG ¹	Hash DRBG	283
Generation;	Prediction resistance	HMAC DRBG, no reseed	
Symmetric key generation	supported for all variations	CTR DRBG (AES), no derivation function	
	[SP 800-67] Triple-DES	3-Key TDES TECB, TCBC, TCFB, TOFB; CMAC generate and verify	1434
Encryption,	[FIPS 197] AES	128/192/256 ECB, CBC, OFB, CFB 1, CFB 8, CFB 128, CTR; CCM; GCM; CMAC generate	2286
Decryption and	[SP 800-38B] CMAC	and verify; 128/256 XTS	
CMAC	[SP 800-38C] CCM		
	[SP 800-38D] GCM		
	[SP 800-38E] XTS		
Message Digests	[FIPS 180-4]	SHA-1, SHA-2 (224, 256, 384, 512)	1967
Keyed Hash	[FIPS 198-1] HMAC	SHA-1, SHA-2 (224, 256, 384, 512)	1402
Digital Signature and	[FIPS 186-2] RSA	GenKey9.31, SigGen9.31, SigGenPKCS1.5,	1176
Asymmetric Key		SigGenPSS (2048/3072/4096)	
Generation		SigVer9.31, SigVerPKCS1.5, SigVerPSS	
		(1024/1536/2048/3072/4096 with all SHA sizes)	
	[FIPS 186-2] DSA ²	PQG Ver, Sig Ver (1024 with SHA-1 only)	714
	[FIPS 186-4] DSA	Key Pair Gen (2048/3072)	
		PQG Gen, Sig Gen (2048/3072 with all SHA-2	
		sizes)	
		PQG Ver, Sig Ver (1024/2048/3072 with all SHA	
		sizes)	
	[FIPS 186-2] ECDSA	PKG: CURVES (P-224 P-256 P-384 P-521 K-233 K-	370
		283 K-409 K-571 B-233 B-283 B-409 B-571)	
		PKV, SigVer: CURVES (P-192 P-224 P-256 P-384	
		P-521 K-163 K-233 K-283 K-409 K-571 B-163 B-	
		233 B-283 B-409 B-571)	

¹ For all DRBGs the "supported security strengths" is just the highest supported security strength per [SP800-90] and [SP800-57].



	[FIPS 186-4] ECDSA	PKG: CURVES (P-224 P-256 P-384 P-521 K-233 K-	
		283 K-409 K-571 B-233 B-283 B-409 B-571)	
		PKV: CURVES (ALL-P ALL-K ALL-B)	
		SigGen: CURVES (P-224: (SHA-1, 224, 256, 384,	
		512) P-256: (SHA-1, 224, 256, 384, 512) P-384:	
		(SHA-1, 224, 256, 384, 512) P-521: (SHA-1, 224,	
		256, 384, 512) K-233: (SHA-1, 224, 256, 384,	
		512) K-283: (SHA-1, 224, 256, 384, 512) K-409:	
		(SHA-1, 224, 256, 384, 512) K-571: (SHA-1, 224,	
		256, 384, 512) B-233: (SHA-1, 224, 256, 384,	
		512) B-283: (SHA-1, 224, 256, 384, 512) B-409:	
		(SHA-1, 224, 256, 384, 512) B-571: (SHA-1, 224,	
		256, 384, 512))	
		SigVer: CURVES(P-192: (SHA-1, 224, 256, 384,	
		512) P-224: (SHA-1, 224, 256, 384, 512) P-256:	
		(SHA-1, 224, 256, 384, 512) P-384: (SHA-1, 224,	
		256, 384, 512) P-521: (SHA-1, 224, 256, 384,	
		512) K-163: (SHA-1, 224, 256, 384, 512) K-233:	
		(SHA-1, 224, 256, 384, 512) K-283: (SHA-1, 224,	
		256, 384, 512) K-409: (SHA-1, 224, 256, 384,	
		512) K-571: (SHA-1, 224, 256, 384, 512 B-163:	
		(SHA-1, 224, 256, 384, 512) B-233: (SHA-1, 224,	
		256, 384, 512) B-283: (SHA-1, 224, 256, 384,	
		512) B-409: (SHA-1, 224, 256, 384, 512) B-571:	
		(SHA-1, 224, 256, 384, 512))	
	[SP 800-56A] (§5.7.1.2)	All NIST defined B, K and P curves except sizes	45
ECC CDH (CVL)		163 and 192	
	•		

Table 4a – FIPS Approved Cryptographic Functions

The Module supports only NIST defined curves for use with ECDSA and ECC CDH.

Category	Algorithm	Description
Key Agreement	EC DH	Non-compliant (untested) DH scheme using elliptic curve, supporting all NIST defined B, K and P curves. Key agreement is a service provided for calling process use, but is not used to establish keys into the Module.
Key Wrapping	RSA	The RSA algorithm may be used by the calling application for wrapping of keys. No claim is made for SP 800-56B compliance, and no CSPs are established into or exported out of the module using these services.

Table 4b – Non-FIPS Approved But Allowed Cryptographic Functions

EC DH Key Agreement provides 80 to 256 bits of security strength. RSA Key Wrapping provides 80 to 256 bits of security strength.



The Module implements the following services which are Non-Approved per the NIST SP 800-131A transitions:

Function	Algorithm	Options	Cert #
Random Number	[ANS X9.31] RNG	AES 128/192/256	1137
Generation;	[SP 800-90A] DRBG	Dual EC DRBG ² : P-256, P-384, P-521	283
Symmetric key generation			
Digital Signature and	[FIPS 186-2] RSA	GenKey9.31, SigGen9.31, SigGenPKCS1.5,	1176
Asymmetric Key		SigGenPSS (1024/1536 with all SHA sizes,	
Generation		2048/3072/4096 with SHA-1)	
	[FIPS 186-2] DSA	PQG Gen, Key Pair Gen, Sig Gen (1024)	714
	[FIPS 186-4] DSA	Key Pair Gen (1024)	714
		PQG Gen (1024 with all SHA sizes)	
		Sig Gen (1024 with all SHA sizes, 2048/3072	
		with SHA-1)	
	[FIPS 186-2] ECDSA	PKG: CURVES (P-192 K-163 B-163)	370
		SigGen: CURVES (P-192 P-224 P-256 P-384	
		P-521 K-163 K-233 K-283 K-409 K-571 B-163	
		B-233 B-283 B-409 B-571)	
	[FIPS 186-4] ECDSA	PKG: CURVES (P-192 K-163 B-163)	370
		SigGen: CURVES (P-192: (SHA-1, 224, 256, 384,	
		512) P-224: (SHA-1) P-256: (SHA-1) P-384: (SHA-	
		1) P-521: (SHA-1) K-163 (SHA-1, 224, 256, 384,	
		512) K-233: (SHA-1) K-283: (SHA-1) K-409: (SHA-	
		1) K-571: (SHA-1) B-163: (SHA-1, 224, 256, 384,	
		512) B-233: (SHA-1) B-283: (SHA-1) B-409: (SHA-	
		1) B-571: (SHA-1))	
ECC CDH (CVL)	[SP 800-56A] (§5.7.1.2)	CURVES: P-192 B-163 K-163	45

Table 4c – FIPS Non-Approved Cryptographic Functions

The Module supports only a FIPS 140-2 Approved mode. These algorithms shall not be used when operating in the FIPS Approved mode of operation.

The Module requires an initialization sequence (see IG 9.5): the calling application invokes FIPS_mode_set()³, which returns a "1" for success and "0" for failure. If FIPS_mode_set() fails then all cryptographic services fail from then on. The application can test to see if FIPS mode has been

³ The function call in the Module is FIPS_module_mode_set() which is typically used by an application via the FIPS_mode_set() wrapper function.



² The Dual EC DRBG will not be available in any of SafeNet's products.

successfully performed.

The Module is a cryptographic engine library, which can be used only in conjunction with additional software. Aside from the use of the NIST defined elliptic curves as trusted third party domain parameters, all other FIPS 186-4 assurances are outside the scope of the Module, and are the responsibility of the calling process.

4.1 Critical Security Parameters and Public Keys

All CSPs used by the Module are described in this section. All access to these CSPs by Module services are described in Section 4. The CSP names are generic, corresponding to API parameter data structures.

CSP Name	Description	
RSA SGK	RSA (1024 to 16384 bits) signature generation key	
RSA KDK	RSA (1024 to 16384 bits) key decryption (private key transport) key	
DSA SGK	[FIPS 186-4] DSA (1024/2048/3072) signature generation key or [FIPS 186-2] DSA	
	(1024) signature generation key	
ECDSA SGK	ECDSA (All NIST defined B, K, and P curves) signature generation key	
EC DH Private	EC DH (All NIST defined B, K, and P curves) private key agreement key.	
AES EDK	AES (128/192/256) encrypt / decrypt key	
AES CMAC	AES (128/192/256) CMAC generate / verify key	
AES XTS	AES (256/512) XTS cipher key	
TDES EDK	TDES (3-Key) encrypt / decrypt key	
TDES CMAC	TDES (3-Key) CMAC generate / verify key	
HMAC Key	Keyed hash key (160/224/256/384/512)	
RNG CSPs	Seed (128 bit), AES 128/192/256 seed key and associated state variables for ANSI	
	X9.31 AES based RNG ⁴	
Hash_DRBG CSPs	V (440/880 bits) and C (440/880 bits), entropy input (length dependent on security	
	strength)	
HMAC_DRBG CSPs	V (160/224/256/384/512 bits) and Key (160/224/256/384/512 bits), entropy input	
	(length dependent on security strength)	
CTR_DRBG CSPs	V (128 bits) and Key (AES 128/192/256), entropy input (length dependent on security	
	strength)	
Dual_EC_DRBG CSPs	S (P-256, P-384, P-521), entropy input (length dependent on security strength)	

Table 4.1a – Critical Security Parameters

The module does not output intermediate key generation values.

⁴ There is an explicit test for equality of the seed and seed key inputs



CSP Name	Description			
RSA SVK	RSA (1024 to 16384 bits) signature verification public key			
RSA KEK	RSA (1024 to 16384 bits) key encryption (public key transport) key			
DSA SVK	[FIPS 186-4] DSA (1024/2048/3072) signature verification key or [FIPS 186-2] DSA (1024) signature verification key			
ECDSA SVK	CDSA SVK ECDSA (All NIST defined B, K and P curves) signature verification key			
EC DH Public	EC DH (All NIST defined B, K and P curves) public key agreement key.			

Table 4.1b – Public Keys

For all CSPs and Public Keys:

Storage: RAM, associated to entities by memory location. The Module stores RNG and DRBG state values for the lifetime of the RNG or DRBG instance. The module uses CSPs passed in by the calling application on the stack. The Module does not store any CSP persistently (beyond the lifetime of an API call), with the exception of RNG and DRBG state values used for the Modules' default key generation service.

Generation: The Module implements ANSI X9.31 compliant RNG and SP 800-90 compliant DRBG services for creation of symmetric keys, and for generation of DSA, elliptic curve, and RSA keys as shown in Table 4a. The calling application is responsible for storage of generated keys returned by the module.

Entry: All CSPs enter the Module's logical boundary in plaintext as API parameters, associated by memory location. However, none cross the physical boundary.

Output: The Module does not output CSPs, other than as explicit results of key generation services. However, none cross the physical boundary.

Destruction: Zeroization of sensitive data is performed automatically by API function calls for temporarily stored CSPs. In addition, the module provides functions to explicitly destroy CSPs related to random number generation services. The calling application is responsible for parameters passed in and out of the module.

Private and secret keys as well as seeds and entropy input are provided to the Module by the calling application, and are destroyed when released by the appropriate API function calls. Keys residing in internally allocated data structures (during the lifetime of an API call) can only be accessed using the Module defined API. The operating system protects memory and process space from unauthorized access. Only the calling application that creates or imports keys can use or export such keys. All API functions are executed by the invoking calling application in a non-overlapping sequence such that no two API functions will execute concurrently. An authorized application as user (Crypto-Officer and User) has access to all key data generated during the operation of the Module.



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In the event Module power is lost and restored the calling application must ensure that any AES GCM keys used for encryption or decryption are re-distributed.

Module users (the calling applications) shall use entropy sources that meet the security strength required for the random number generation mechanism: 128 bits for the [ANS X9.31] RNG mechanism, and as shown in [SP 800-90] Table 2 (Hash_DRBG, HMAC_DRBG), Table 3 (CTR_DRBG) and Table 4 (Dual_EC_DRBG). This entropy is supplied by means of callback functions. Those functions must return an error if the minimum entropy strength cannot be met.

5 Roles, Authentication and Services

The Module meets all FIPS 140-2 level 1 requirements for Roles and Services, implementing both Crypto-User and Crypto-Officer roles. As allowed by FIPS 140-2, the Module does not support user authentication for those roles. Only one role may be active at a time and the Module does not allow concurrent operators.

The User and Crypto Officer roles are implicitly assumed by the entity accessing services implemented by the Module. The Crypto Officer can install and initialize the Module. The Crypto Officer role is implicitly entered when installing the Module or performing system administration functions on the host operating system.

• User Role: Loading the Module and calling any of the API functions. This role has access to all of the services provided by the Module.

• Crypto-Officer Role: Installation of the Module on the host computer system. This role is assumed implicitly when the system administrator installs the Module library file.

All services implemented by the Module are listed below, along with a description of service CSP access. If the module is not initialized as per Section 4 of the Security Policy, non-conformant versions of the services in Table 5 are made available to the calling application.

Service	Role	Description
Initialize	User, CO	Module initialization, inclusive of all POST tests (FIPS_module_mode_set). Does not access CSPs.
Self-test	User, CO	Perform all POST tests (FIPS_selftest). Does not access CSPs.
Show status	User, CO	 Functions that provide module status information: Version (as unsigned long or const char *) FIPS Mode (Boolean) Does not access CSPs.
Zeroize	User, CO	Functions that destroy CSPs:fips_rand_prng_reset: destroys RNG CSPs.



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 fips_drbg_uninstantiate: for a given DRBG context, over (Hash_DRBG CSPs, HMAC_DRBG CSPs, CTR_DRBG CSPs, Dua All other services automatically overwrite CSPs stored in alloca cleanup is the responsibility of the calling application. Used for random number and symmetric key generation. Seed or reseed an RNG or DRBG instance Determine security strength of an RNG or DRBG instance Obtain random data Uses and updates RNG CSPs, Hash_DRBG CSPs, HMAC_DRBG CSPs, Dual_EC_DRBG CSPs. 	I_EC_DRBG CSPs.) Ited memory. Stack
Random number generationUser, COSeed or reseed an RNG or DRBG instance• Determine security strength of an RNG or DRBG instance • Detain random data Uses and updates RNG CSPs, Hash_DRBG CSPs, HMAC_DRBG CSP	
	Ps, CTR_DRBG
Asymmetric key generation User, CO User, CO User, CO User, CO User, CO Used to generate DSA, ECDSA and RSA keys: RSA SGK, RSA SVK; DSA SGK, DSA SVK; ECDSA SGK, ECDSA SVK There is one supported entropy strength for each mechanism a the maximum specified in SP800-90	and algorithm type,
Symmetric encrypt/decrypt User, CO Used to encrypt or decrypt data. Executes using AES EDK, TDES EDK (passed in by the calling processing and the calling processing action) Executes using AES EDK, TDES EDK (passed in by the calling processing action)	ess).
Symmetric digestUser, COUsed to generate or verify data integrity with CMAC. Executes using AES CMAC, TDES, CMAC (passed in by the calling	process).
Message digest User, CO Used to generate a SHA-1 or SHA-2 message digest. Does not access CSPs.	
Keyed HashUser, COUsed to generate or verify data integrity with HMAC. Executes using HMAC Key (passed in by the calling process).	
Key transport5User, COUsed to encrypt or decrypt a key value on behalf of the calling establish keys into the module). Executes using RSA KDK, RSA KEK (passed in by the calling process)	
Key agreementUser, COUsed to perform key agreement primitives on behalf of the cannot establish keys into the module). Executes using EC DH Private, EC DH Public (passed in by the call	
Digital signatureUser, COUsed to generate or verify RSA, DSA or ECDSA digital signatures. Executes using RSA SGK, RSA SVK; DSA SGK, DSA SVK; ECDS (passed in by the calling process).	A SGK, ECDSA SVK
Utility User, CO Miscellaneous helper functions. Does not access CSPs.	

Table 5 - Services and CSP Access

^{5 &}quot;Key transport" can refer to a) moving keys in and out of the module or b) the use of keys by an external application. The latter definition is the one that applies to this Module.



6 Self-test

The Module performs the self-tests listed below on invocation of Initialize or Self-test.

Algorithm	Туре	Test Attributes
Software integrity	KAT	HMAC-SHA1
HMAC	KAT	One KAT per SHA1, SHA224, SHA256, SHA384 and SHA512 Per IG 9.3, this testing covers SHA POST requirements.
AES	KAT	Separate encrypt and decrypt, ECB mode, 128 bit key length
AES CCM	KAT	Separate encrypt and decrypt, 192 key length
AES GCM	KAT	Separate encrypt and decrypt, 256 key length
XTS-AES	KAT	128, 256 bit key sizes to support either the 256-bit key size (for XTS-AES-128) or the 512-bit key size (for XTS-AES-256)
AES CMAC	KAT	Sign and verify CBC mode, 128, 192, 256 key lengths
TDES	KAT	Separate encrypt and decrypt, ECB mode, 3-Key
TDES CMAC	KAT	CMAC generate and verify, CBC mode, 3-Key
RSA	KAT	Sign and verify using 2048 bit key, SHA-256, PKCS#1
DSA	PCT	Sign and verify using 2048 bit key, SHA-384
DRBG	KAT	CTR_DRBG: AES, 256 bit with and without derivation function HASH_DRBG: SHA256 HMAC_DRBG: SHA256 Dual_EC_DRBG: P-256 and SHA256
ECDSA	РСТ	Keygen, sign, verify using P-224, K-233 and SHA512. The K-233 self-test is not performed for operational environments that support prime curve only (see Table 2).
ECC CDH	KAT	Shared secret calculation per SP 800-56A §5.7.1.2, IG 9.6
X9.31 RNG	KAT	128, 192, 256 bit AES keys

Table 6a - Power On Self Tests (KAT = Known answer test; PCT = Pairwise consistency test)

The FIPS_mode_set()⁶ function performs all power-up self-tests listed above with no operator intervention required, returning a "1" if all power-up self-tests succeed, and a "0" otherwise. If any component of the power-up self-test fails an internal flag is set to prevent subsequent invocation of any cryptographic function calls. The module will only enter the FIPS Approved mode if the module is reloaded and the call to FIPS_mode_set() succeeds.

⁶ FIPS_mode_set() calls Module function FIPS_module_mode_set()



The power-up self-tests may also be performed on-demand by calling FIPS_selftest(), which returns a "1" for success and "0" for failure. Interpretation of this return code is the responsibility of the calling application.

The Module also implements the following conditional tests:

Algorithm	n Test	
DRBG	Tested as required by [SP800-90] Section 11	
DRBG	FIPS 140-2 continuous test for stuck fault	
DSA	Pairwise consistency test on each generation of a key pair	
ECDSA	Pairwise consistency test on each generation of a key pair	
RSA	Pairwise consistency test on each generation of a key pair	
ANSI X9.31 RNG	Continuous test for stuck fault	

Table 6b - Conditional Tests

In the event of a DRBG self-test failure the calling application must uninstantiate and re-instantiate the DRBG per the requirements of [SP 800-90]; this is not something the Module can do itself.

Pairwise consistency tests are performed for both possible modes of use, e.g. Sign/Verify and Encrypt/Decrypt.

7 Operational Environment

The tested operating systems segregate user processes into separate process spaces. Each process space is logically separated from all other processes by the operating system software and hardware. The Module functions entirely within the process space of the calling application, and implicitly satisfies the FIPS 140-2 requirement for a single user mode of operation.

8 Design Assurance

8.1 Configuration Management

SafeNet uses a configuration management system called Agile that controls versioning control for documents within the company and a software configuration management tool called Github for managing software.

8.2 Delivery and Operation

The SafeNet Software Cryptographic Library is never released outside of SafeNet as a source code distribution. It is contained within our source code management repository that can be accessed by engineering to download a copy of the code. It is not possible to make changes to the code and



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replace it within this repository. When a developer downloads code for integration into a SafeNet product, the code gets integrated into the configuration management structure for that product. The module code is then linked as part of an application build process that is configured to operate in FIPS Approved Mode.

9 Mitigation of other attacks

The Module does not claim any attack mitigation beyond FIPS 140-2 Level 1 requirements.

