SecureParser®

Version 4.7.0

Security Policy

Revision 1.31

6 August 2009

Revision History

Revision History			
Version	***Date***	***Author***	***Notes***
0.01	01/11/2007	Infogard, Security First Corp.	Documentation Workshop (Infogard template)
0.02	02/26/2007	Security First Corp.	Accumulated changes to date after Documentation Workshop.
0.03	03/20/2007	Security First Corp.	Added key sizes for DSA & RSA keys in Section 3 Modes of Operation
0.04	03/22/2007	Security First Corp.	Added power-on self-test RSA encrypt/decrypt
0.05	04/20/2007	Security First Corp.	Corrected Security Rule 25 to reflect PRNG is based on AES Encrypt, not AES Decrypt
0.06	05/22/2007	Security First Corp.	Clarified that the same HMAC key is used for Data & Share authentication/integrity
0.07	06/07/2007	Security First Corp.	Added Algorithm certificate numbers
0.08	06/12/2007	Security First Corp.	Added entropy assessment details
0.09	07/11/2007	Security First Corp.	Updates after Operational Testing. ECDSA added. Overview updated.
1.00	08/07/2007	Security First Corp.	Final edit before submission
1.01	11/8/2007	Security First Corp. (ISE input)	V4.5.1 revision for submission. Updated API section, removed references to single-threaded requirement, added references for libparser4.sys.

1.02	12/16/2007	Security First Corp. (ISE input)	Title page updated.
1.03	01/07/2008	Security First Corp. (ISE input)	Responses to CMVP Comments. Additional V4.5.1 changes for clarity regarding Multi-threading and Kernel mode.
1.04	01/18/2008	Security First Corp. (ISE input)	Responses to CMVP Comments round 2. All references to MS RSAENH.dll removed. Standard platform services are providing entropy. Security Rule 24:3 corrected.
1.05	01/31/2008	Security First Corp. (ISE input)	Responses to CMVP Comments round 3. Clarification: Key entry/output is always encrypted. PRNG_Seed_Value rationale of strength modified as per CMVP suggestion.
1.1	08/15/2008	Security First Corp. (ISE Input)	V4.6 revision for submission. Updated API, added algorithms, added operating systems.
1.2	02/02/2009	Security First Corp. (ISE input)	V4.7.0 revision for submission. Updated API section, added description of RPU. Removed all operating systems but Ubuntu and the Windows kernel.
1.21	02-17-2009	Security First Corp. (ISE input)	Removed function get_errorlog, it is disabled in FIPS mode.
1.22	02-20-2009	Security First Corp. (ISE input)	Prior Track Changes accepted. Prior comments removed. Table 1: Level of Physical Security NA → 1. Real picture for Figure 2 – Image of the Accelium

1.23	02-20-2009	Security First Corp. (ISE input)	Added real picture of the RPU for Figure 2.
1.24	02-23-2009	Security First Corp. (ISE input)	Updated photos in Figure 2. Adjusted verbiage in the physical RPU section.
1.25	02-26-2009	Security First Corp. (ISE input)	Clarified key wrapping description under Security Rules.
1.26	04-01-2009	Security First Corp. (ISE input)	Final edits before CMVP submission.
1.30	08-06-2009	Security First Corp. (ISE input)	Added Windows Server 2003 references in anticipation of update submission. Responses to CMVP Comments.
1.31	08-06-2009	Security First Corp. (ISE input)	Minor formatting changes.

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1. Module Overview

The SecureParser (HW P/N AC2020-S, Version 1.0; FW Version 1.0; SW Version 4.7.0) encryption module is a Hybrid cryptographic module as defined by FIPS Implementation Guidance for FIPS 140-2: IG 1.9 Definition and Requirements of a Hybrid Cryptographic Module. The SecureParser encryption module is a special type of software cryptographic module that, as part of its operation, utilizes special purpose hardware to accelerate cryptographic operations.

The SecureParser module is a security and data availability architecture delivered in the form of a toolkit that provides cryptographic data splitting (data encryption, random or deterministic distribution to multiple shares including additional fault tolerant bits, key splitting, authentication, integrity, share reassembly, key restoration and decryption) of arbitrary data. The SecureParser accepts any type of digital data and cryptographically splits it into shares so that no discernible plaintext is transmitted across a network or is placed on a single storage device. During the parse process, additional redundant data may be optionally written to each share enabling the capability of restoring the original data when all shares are not available. The shares can be stored in geographically disbursed nodes providing for continuous access to online information.

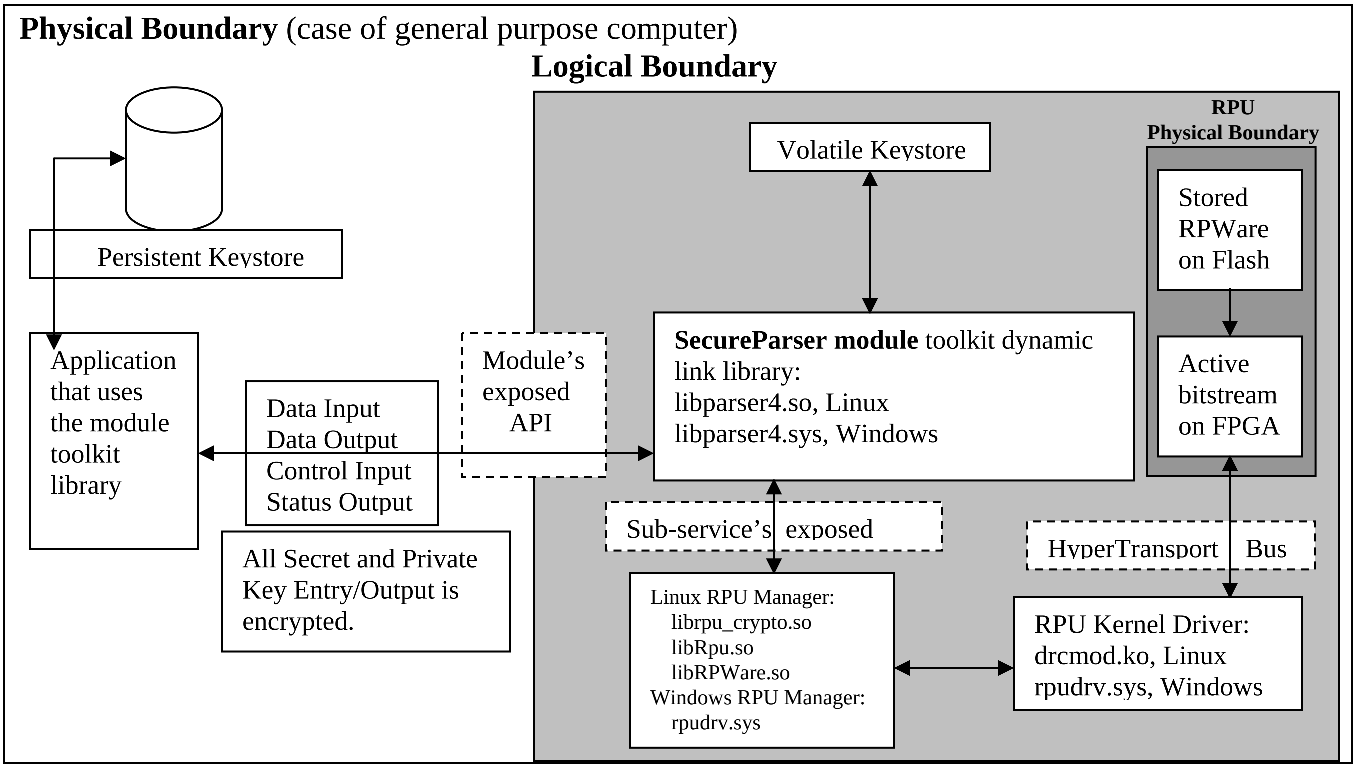
Each share contains a cryptographically strong integrity check that prevents tampering with the stored data and is immediately recognized by the other shares. Any change to the data in a share precludes that share from being used in the data rebuild process. The encryption, integrity and IDA session keys are encrypted with long-term, external workgroup keys, and a per-session key encrypting key that is securely secret shared and stored with the data.

Data availability through redundant shares allows for a return to operations in the face of lost or corrupted shares due to environmental, malicious or accidental catastrophes.

The SecureParser module is designed to be integrated at any point where data is written, retrieved, sent or received.

<u>Boundaries</u>

Figure 1 – Image of the Cryptographic Module



Logical Boundary

When operating on the Linux operating system Ubuntu 8, the SecureParser cryptographic logical boundary is defined as containing several objects: the SecureParser libparser4.so, the RPU Manager files librpu_crypto.so, libRpu.so, and libRPWare.so, the RPU driver drcmod.ko, and the bitstream image. Seed values for the SecureParser's random number generator are imported from standard operating system services within the physical boundary of the general purpose computer.

When operating on Windows Server 2003, the SecureParser module cryptographic logical boundary is defined as containing two executable files, the SecureParser libparser4.sys, the RPU driver/manager rpudrv.sys, and the bitstream image. Seed values for the SecureParser's random number generator will be imported from standard operating system services within the physical boundary of the general purpose computer

The RPU sub-module's logical boundary consists of the RPU Manager, the RPU driver, and the RPU's physical boundary (including the bitstream running therein).

Physical Boundary

The SecureParser cryptographic physical boundary is the case of the General Purpose Computer (GPC) on which the libparser4 executable is instantiated and in which the RPU coprocessor resides. Ports at the physical boundary of the GPC are those typical of a GPC for connecting external devices such as keyboards, monitors, mice, and printers. These devices are outside the physical boundary of the cryptographic module and are excluded from the validation.

Note that all input and output to/from the hardware component of this module (an Accelium™ brand RPU) is directed through the module's software component. The hardware component of the module does have a JTAG port but that port is disabled during manufacturing via compile time options.

Operating Systems & Platforms

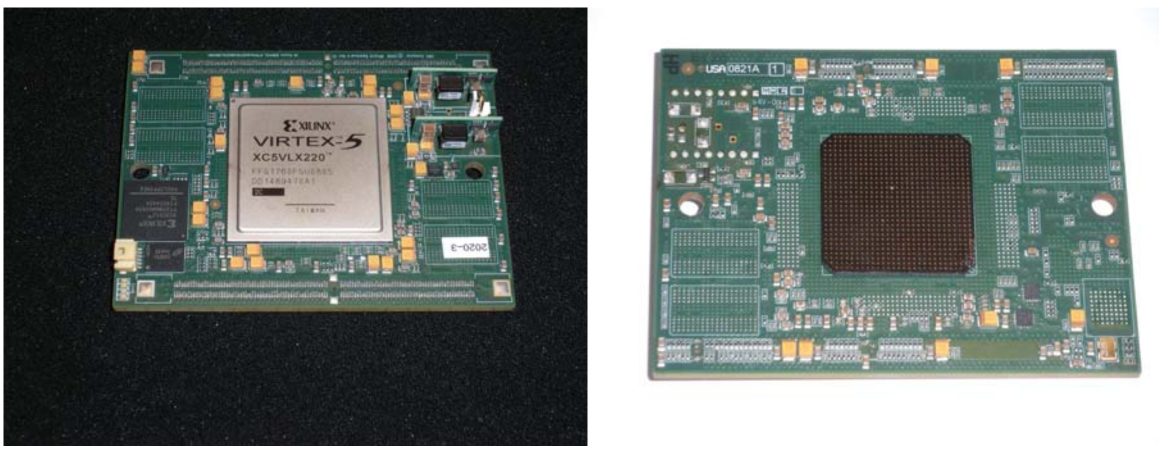
The SecureParser module has been tested on and found to be conformant with the requirements of FIPS 140-2 overall Level 1 on the following GPC operating systems: Ubuntu 8 and Windows Server 2003.

Operational testing was performed on all the above operating systems on a SuperMicro SuperServer with a motherboard model H8DMU+.

Additionally, the module runs without recompilation on other GPC's equipped with x64 compatible processors running kernels compatible with Ubuntu 8 and Windows Server 2003.

The Physical RPU

Figure 2 – Images of the RPU Module



The top of the Accelium™ RPU can be seen on the left of Figure 2. The bottom can be seen on the right.

The Accelium™ brand RPU used by the SecureParser is made by DRC. The RPU module (see Figure 2) is a high-performance computing system for use in data intensive applications. Application images, known as bitstreams, are loaded into the FPGA to configure its operation. These are stored on the RPU in flash memory so that the RPU can be configured immediately at power-on. The bitstream application communicates with the outside world over the industry standard HyperTransport™ bus. Two of the three available HT busses are used for communication with the Opteron™ CPU. The Milano™ Hardware OS connects all these components and provides a simple, well-behaved interface to the RPU Driver running on the CPU.[1] The SecureParser interfaces with the RPU Driver through the RPU Manager to control the RPU.

[1] This paragraph adapted from the DRC Coprocessor System User Guide v3.0.

Figure 3 – Data Flow in Accelerated vs. Unaccelerated Applications

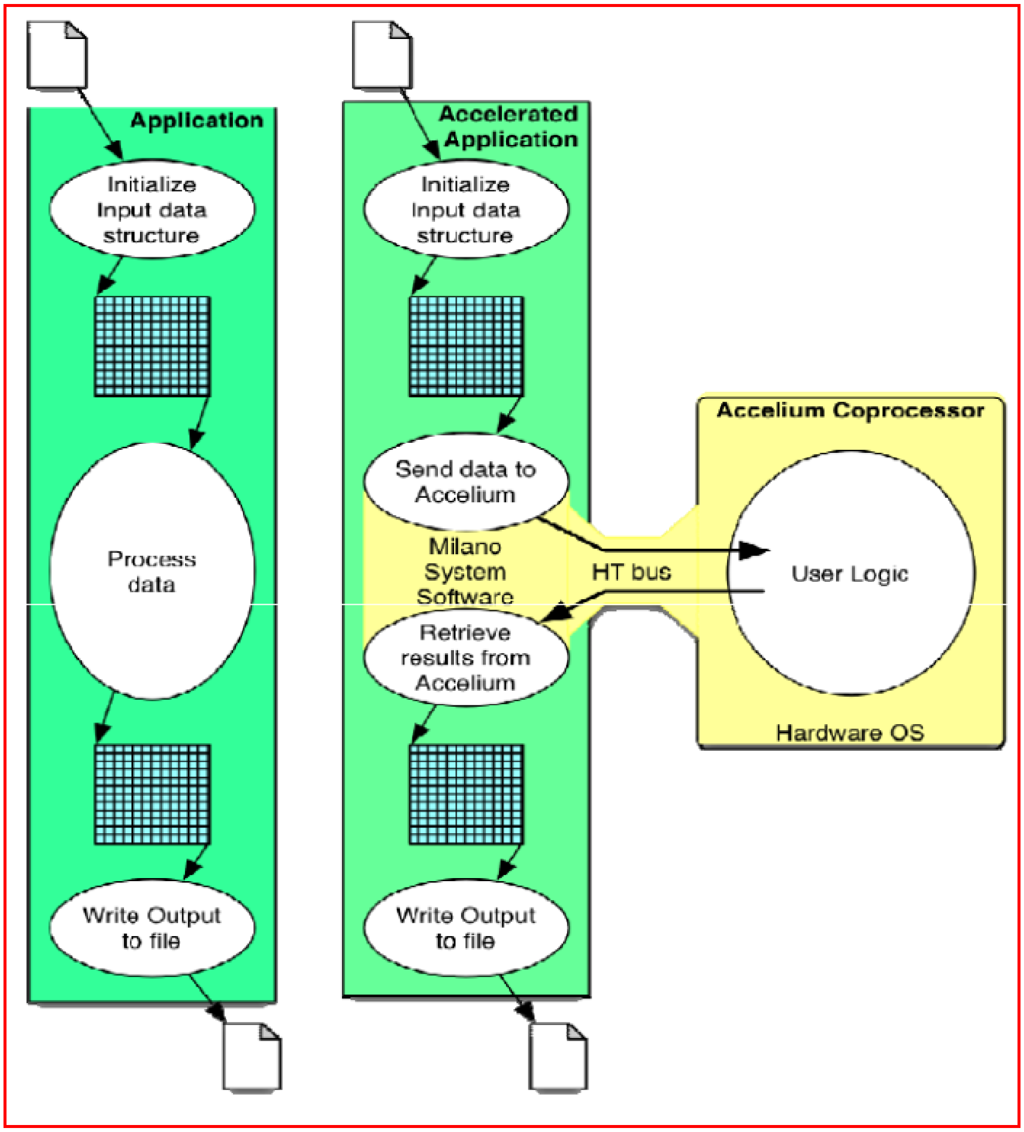


Figure 3 shows two example applications, one in which all code is executed on a CPU and the second whose core functions have been accelerated using the RPU Coprocessor[2].

[2] This paragraph adapted from the DRC Coprocessor System User Guide v3.0.

RPU Versioning Information

As per the Implementation Guidance 1.9 Definition and Requirements of a Hybrid Cryptographic Module, the following is a table of RPU-related part and version numbers:

Item	Part/Version	Description
RPU Coprocessor	AC2030	Socket F daughter board
Windows RPU Manager/Driver	0.91	SecureParser combined RPU Driver and Manager
Ubuntu RPU Manager	0.8	
Ubuntu RPU Driver	3.0 beta 4	SecureParser RPU Driver and support
RPU SecureParser Bitstream	1.0 rev 16	RPU Bitstream – binary consists of Milano Hardware OS, AES, BitSplit and SHA codes
Milano OS	SV1.0	Hardware OS for the DRC RPU
Motherboard of GPC	SuperMicro H8DMU+	

2. Security Level

The cryptographic module meets the overall requirements applicable to Level 1 security of FIPS 140-2.

Table 1 – Module Security Level Specification

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

3. Modes of Operation

Approved Algorithms

In FIPS mode, the SecureParser module supports FIPS Approved algorithms as follows. The certificate #'s sited below have all been obtained by SecureParser module algorithm testing with the CAVP:

Software (CPU) Algorithms:

- AES-CBC/ECB - 128/192/256 bit key Cert. #1027
- AES-CTR - 128/192/256 bit key Cert. #1027
- AES-GCM 128/192/256 bit key Cert. #1028
- HMAC-SHA1, HMAC-SHA256, HMAC-SHA384, HMAC-SHA512 Cert. #576
- SHA-1, SHA-256, SHA-384, SHA-512 hashing Cert. #981
- DSA sign/verify – 1024 bit key Cert. #346
- RSA sign/verify – 1024/2048/4096 bit key Cert. #491
- PRNG Key Generation ANSI X9.31 with AES Cert. #584
- ECDSA sign/verify – 521 bit key Cert. #123

Hardware/Firmware (RPU) Algorithms:

- AES-ECB - 256 bit key (ENC only) Cert. #1017
- AES-CTR - 256 bit key Cert. #1017
- HMAC-SHA256 Cert. #575
- SHA-256 Cert. #980

Key Entry and Output

All Key Entry and Output in FIPS mode must be in encrypted form. Plaintext keys are never entered or output from the module.

NIST Key Wrapping per FIPS 140-2 Annex D using 128/192/256 bit keys. *AES (Cert. #1027, key wrapping; key establishment methodology provides 128, 192 or 256 bits of encryption strength) for NIST Key Wrapping per FIPS 140-2 Annex D)*

RSA Key Wrapping per FIPS 140-2 IG 7.1 Acceptable Key Establishment Protocols, Key Transport using asymmetric keys [key wrapping] using k = 4096. *RSA (key wrapping; key establishment methodology provides 128 bits of encryption strength).*

In FIPS mode the SecureParser module does not support any non-allowed FIPS algorithms.

Configuring the module for FIPS mode

The SecureParser module may be configured for FIPS mode by calling the module's exposed module_initialize( ) API function with the calling parameter "fipsEnabled" set to true. Subsequent SecureParser module API calls that are used to further configure the SecureParser will have their calling parameters checked by the SecureParser based on the value of the "fipsEnabled" calling parameter used in the original module_initialize( ) API function call.

These subsequent checks are used to insure that all FIPS mode configuration values are set properly.

Operators can determine if the cryptographic module is running in FIPS versus non-FIPS mode via execution of the module's module_getStatus( ) API function call, which is used to meet the FIPS area 1 requirements to achieve Level 3. The module_getStatus( ) API function call equates to the FIPS "show status" service and will indicate if a FIPS mode of operation has been selected. The module_getStatus( ) API call returns two items:

- Whether the module is in FIPS mode (value set = 1), or non-FIPS mode (value set = 0)
- The current FSM state of the module (MODULE_STATE enum)

Once a FIPS mode of operation has been selected the module cannot transition into a non-FIPS mode of operation during the lifetime of the module instantiation in executable memory. Similarly once a non-FIPS mode of operation has been selected the module cannot transition into a FIPS mode of operation during the lifetime of the module instantiation in executable memory.

Non-FIPS mode of operation

The SecureParser module can be initialized in to a non-FIPS Approved mode of operation by setting the "fipsEnabled" flag to 0 during the first call to the API function module_initialize( ).

Applications cannot transition their use of the module toolkit library to/from FIPS mode and non-FIPS mode while the module is instantiated. The module must be shut down by the calling application and then restarted to transition to/from FIPS mode and non-FIPS mode. Note that the module does not have any persistent CSPs. All CSPs are zeroed when the module is shut down or transitions between modes.

RPU sub-module operation

The RPU sub-module, as used by the SecureParser, always operates in a FIPS-Approved mode whether the SecureParser is in FIPS-Approved or non-FIPS Approved mode. It supports strictly FIPS-Approved cryptographic algorithms, and the SecureParser will always zero all keys in the RPU during module destruction. To verify that the RPU has been successfully programmed, the operator can refer to the LED on the RPU that will blink during power-on, then turn on steadily after the RPU is programmed. Additionally, the RPU manager, driver, and bitstream image are digitally signed and verified as part of the module integrity test, and all cryptographic algorithms on the RPU are subject to known-answer-tests during module initialization.

Once the SecureParser has initialized the RPU device, it has exclusive access. No other processes can access the RPU device until the SecureParser releases it. Before releasing the RPU, the SecureParser destroys all CSPs in the RPU by calling rpu_zeroize( ). Since no CSPs natively exist in the RPU, there is no threat of CSP compromise by an untrusted process accessing the RPU before the SecureParser.

4. Identification and Authentication Policy

Assumption of roles

The SecureParser module has two distinct operator roles - governed by a single operator (the operating system): Cryptographic-Officer role; User role. Operators of the cryptographic module implicitly assume roles each time they call into the SecureParser module via exposed SecureParser API function calls. Each API call into the SecureParser module performs a module service. Consistent with FIPS 140-2 area 3 Level 1 requirements, the operators of the SecureParser cryptographic module are not authenticated to the module. Note that the operating systems the module is run on provide functionality to require an operator to be successfully authenticated prior to using any service provided by the module.

Table 2 – Roles and Required Identification and Authentication

Role	Type of Authentication	Authentication Data
Cryptographic-Officer	None	None
User	None	None

Table 3 – Strengths of Authentication Mechanisms

Authentication Mechanism	Strength of Mechanism
None	None

5. Access Control Policy

Roles and Services

Table 4 – Services Authorized for Roles

Role	Authorized Services
Cryptographic-Officer: The Cryptographic-Officer role is assumed when applications call the module's exposed API functions that perform initialization, configuration, and	• **module_initialize**. Initializes the module, sets FIPS mode or non-FIPS mode, performs self tests, and moves the module into an operational state. • **parser_create**. Allocates the memory for a Parser structure. There can be multiple parser instances within the module – they are all either in FIPS mode, or they are all in non-FIPS mode (determined by the **module_initialize** service). • **parser_destroy**. Deallocates the memory of a Parser structure.

Role	Authorized Services
administrative services.	• **parser_generateHeaders.** Configures parser context and generates headers. • **parser_restoreHeaders.** Configures parser context based on headers with optional modifications. • **parser_regenerateHeaders.** Produces headers associated with an already-configured parser context. • **parser_recoverHeaders.** Recovers missing headers and places them in the output buffers that are unused. • **parser_setWorkgroupKeys.** Changes the workgroup keys in an existing parser context. • **keystore_getImportKey.** Provides the RSA public key needed for asymmetric key wrapping for all key entry into the specified keystore of the module (note that each keystore will have its own ephemeral public/private keypair). • **keystore_create.** Allocates memory for a volatile KeyStore structure, and creates a non-persistent RSA public/private encryption keypair to be used for key import (note that each keystore will have its own public/private keypair). • **keystore_destroy.** Deallocates the memory of a volatile KeyStore structure. • **keystore_addKeyFromBuffer.** Imports a key into the specified volatile keystore structure. All imported keys will be RSA key wrapped and will need to be unwrapped by the module. Note: x509 certificates can be in the buffer, their public keys will be imported. • **keystore_removeKey.** Removes a key from the volatile keystore. • **keystore_getKeyType.** Returns the key type for the requested key. • **keystore_getkeylength.** Returns the key length for the requested key. • **keystore_keyexists.** True or False, the requested key exists or does not exist within the specified volatile keystore. • **module_getStatus**: This service provides the current status of the cryptographic module including whether or not a FIPS Approved mode of operation has been selected. • **module_destroy:** Zeroization**,** called by the application prior to (graceful) application termination. Zeroes non-persistent CSPs including the RSA import public/private keypair, and the volatile Keystores. ALL keystores and ALL parsers in memory are zeroed. • **Self tests**: Power cycle

Role	Authorized Services
User: The User role is assumed when applications call the module's exposed API functions that perform general cryptographic services.	• **parser_parseData.** Parses data from the input buffer into the output buffers. • **parser_restoreData.** Restores data from the output buffers into the input buffer. • **parser_parseDataEx.** Parses an array of input buffers into the output buffers. • **parser_recoverData.** Rebuilds all N data shares given only M input shares. • **parser_getFieldOffsets.** Returns an array of {share number, offset, length} tuples necessary to create M of N shares for a given M value and a set of "N of N" parsed shares. • **parser_setFaultTolerance.** Sets a new fault tolerance value (M). Designed for use with parser_getFieldOffsets(). • **parser_getHeaderInfo.** Processes the header and returns information about specific header fields. • **parser_getParsedLength.** Returns the number of bytes needed for each output share when parsing. • **parser_getRestoredLength.** Returns the number of bytes needed for the original share when restoring. • **module_getStatus**: This service provides the current status of the cryptographic module including whether or not a FIPS Approved mode of operation has been selected. • **Self tests**: Power cycle

Table 5 – Specification of Service Inputs & Outputs

Service	Control Input	Data Input	Data Output	Status Output
module_initialize	int fipsEnabled	N/A	N/A	Success or ERROR_TYPE
parser_create	N/A	N/A	Parser **ret	Success or ERROR_TYPE
parser_destroy	Parser *p	N/A	N/A	Success or ERROR_TYPE
parser_ generateHeaders	Parser *p KeyStore *ks int L int M int N IDA_TYPE idaMode ENC_TYPE encMode HASH_TYPE hashMode uint8 *encWgKeyId	N/A	uint8 **outputBuffers uint32 *outputBufferLengths	Success or ERROR_TYPE

Service	Control Input	Data Input	Data Output	Status Output
	uint32 encWgKeyIdMem uint32 encWgKeyIdLength uint8 *macWgKeyId uint32 macWgKeyIdMem uint32 macWgKeyIdLength uint8 *idaWgKeyId uint32 idaWgKeyIdMem uint32 idaWgKeyIdLength AUTH_TYPE postAuthMode HASH_TYPE postHashMode uint8 *postAuthPubKeyId uint32 postAuthPubKeyIdMem uint32 postAuthPubKeyIdLength uint8 *postAuthPrivKeyId uint32 postAuthPrivKeyIdMem uint32 postAuthPrivKeyIdLength uint32 *outputBufferMems int outputBuffersCount			
parser_ restoreHeaders	Parser *p KeyStore *ks HASH_TYPE hashMode uint8 *encWgKeyId uint32 encWgKeyIdMem uint32 encWgKeyIdLength uint8 *macWgKeyId uint32 macWgKeyIdMem uint32 macWgKeyIdLength uint8 *idaWgKeyId uint32 idaWgKeyIdMem uint32 idaWgKeyIdLength AUTH_TYPE postAuthMode HASH_TYPE postHashMode uint8 *postAuthPubKeyId uint32 postAuthPubKeyIdMem uint32 postAuthPubKeyIdLength uint8 *postAuthPrivKeyId uint32 postAuthPrivKeyIdMem uint32 postAuthPrivKeyIdLength uint32 * inputBufferMems uint32 * inputBufferLengths int inputBuffersCount int trustedShareNumber	uint8 **inputBuffers	N/A	Success or ERROR_TYPE
parser_	Parser *p	N/A	uint8 **outputBuffers	Success or

Service	Control Input	Data Input	Data Output	Status Output
regenerateHeaders	uint32 *outputBufferMems int outputBuffersCount		uint32 *outputBufferLengths	ERROR_TYPE
parser_ recoverHeaders	KeyStore *ks HASH_TYPE hashMode char *workgroupKeyId uint32 workgroupKeyIdMem uint32 workgroupKeyIdSize, AUTH_TYPE postAuthMode char *postAuthKeyId uint32 postAuthKeyIdMem uint32 postAuthKeyIdSize uint32 *outputBufferMems uint32 *outputBufferLengths	uint8 **outputBuffers	uint8 **outputBuffers uint32 *outputBufferLengths	Success or ERROR_TYPE
parser_ setWorkgroupKey s	Parser * p char * encWgKeyId uint32 encWgKeyIdMem uint32 encWgKeyIdLength char * macWgKeyId uint32 macWgKeyIdMem uint32 macWgKeyIdLength char * idaWgKeyId uint32 idaWgKeyIdMem uint32 idaWgKeyIdLength	N/A	N/A	Success or ERROR_TYPE
keystore_ getImportKey	KeyStore *ks uint32 bufferMem	N/A	uint8 *buffer uint32 *bufferLength	Success or ERROR_TYPE
keystore_create	int minimumKeyCount	N/A	KeyStore **ret	Success or ERROR_TYPE
keystore_destroy	KeyStore *ks	N/A	N/A	Success or ERROR_TYPE
keystore_ addKeyFromBuffe r	KeyStore *ks uint32 bufferMem uint32 bufferLength char *id uint32 idMem uint32 idLength char *passphrase uint32 passphraseMem uint32 passphraseLength IMPORT_TYPE importType	uint8* buffer char *id	N/A	Success or ERROR_TYPE
keystore_ removeKey	KeyStore *ks char *id uint32 idMem uint32 idLength	N/A	N/A	Success or ERROR_TYPE
keystore_ getKeyType	KeyStore *ks char *id uint32 idMem uint32 idLength	N/A	KEY_TYPE *keyType	Success or ERROR_TYPE
keystore_ getKeyLength	KeyStore *ks char *id uint32 idMem	N/A	uint32 *keyLength	Success or ERROR_TYPE

Service	**Control Input**	**Data Input**	**Data Output**	**Status Output**
	uint32 idLength			
keystore_keyExists	KeyStore *ks char *id uint32 idMem uint32 idLength	N/A	int *keyExists	Success or ERROR_TYPE
parser_parseData	Parser *p uint32 inputBufferLength uint32 inputBufferMem uint32 *outputBufferMems int outputBuffersCount	uint8 *inputBuffer	uint8**outputBuffers uint32 *outputBufferLengths	Success or ERROR_TYPE
parser_parseDataEx	Parser * p uint32 * inputBufferMems uint32 * inputBufferLengths uint32 inputBuffersCount uint32 * outputBufferMems uint32 outputBuffersCount	uint8 ** inputBuffers	uint8**outputBuffers uint32 *outputBufferLengths	Success or ERROR_TYPE
parser_restoreData	Parser *p uint32 outputBufferMem uint32 *inputBufferLengths uint32 *inputBufferMems int inputBuffersCount int trustedShareNumber	uint8 **inputBuffers	uint8 *outputBuffer uint32 *outputBufferLength	Success or ERROR_TYPE
parser_recoverData	Parser *p uint32 *outputBufferLengths uint32 *outputBufferMems int outputBuffersCount int trustedShareNumber	uint8 *outputBuffers	uint8**outputBuffers uint32 *outputBufferLengths	Success or ERROR_TYPE
parser_ getHeaderInfo	uint32 headerMem uint32 headerLength uint32 retMem	DATAFIELD_TYPE t uint8 *header	void *ret uint32 *retLength	Success or ERROR_TYPE
parser_ getParsedLength	Parser *p	uint32 inputLength	uint32 *ret	Success or ERROR_TYPE
parser_ getRestoredLength	Parser *p	uint32 inputLength	uint32 *ret	Success or ERROR_TYPE
parser_ getFieldOffsets	Parser * p uint32 plaintextLength int intendedM	N/A	FieldOffsets * o	Success or ERROR_TYPE
parser_ setFaultTolerance	Parser *p int newM	N/A	N/A	Success or ERROR_TYPE
module_getStatus	N/A	N/A	int *fipsEnabled MODULE_STATE *state	Success or ERROR_TYPE
module_destroy (Zeroization)	N/A	N/A	N/A	Success or ERROR_TYPE
Self-Tests (Power cycle)	N/A	N/A	N/A	

Table 5.1 – Specification of Accelerator Subservice Inputs & Outputs

Service	Control Input	Data Input	Data Output	Status Output
rpu_parse_init	bool useRpu rpu_enc_t encMode rpu_ida_t idaMode rpu_macIV_t macIVMode	N/A	size_t * shareStrideRpu DHANDLE *pHndlRpuIF	Success or Error
rpu_parse_cleanup	DHANDLE hndlRpuIF	N/A	N/A	Success or Error
rpu_parseData	bool useRpu DHANDLE hndlRpuIF int numShares size_t bufferLen size_t shareStride unsigned char *encKey size_t encKeyLen unsigned char *encIV size_t encIVLen unsigned char *idaKey size_t idaKeyLen rpu_mac_t macMode unsigned char *macKey size_t macKeyLen	unsigned char **aInBuffer unsigned char *inBuffer	unsigned char **aOutBuffer unsigned char *outBuffer unsigned char **aDigest size_t digestLen	Success or Error
rpu_restoreData	bool useRpu DHANDLE hndlRpuIF int numShares size_t bufferLen size_t shareStride unsigned char *encKey size_t encKeyLen unsigned char *encIV size_t encIVLen unsigned char *idaKey size_t idaKeyLen rpu_mac_t macMode unsigned char *macKey size_t macKeyLen	unsigned char **aInBuffer unsigned char *inBuffer	unsigned char **aOutBuffer unsigned char *outBuffer uint32_t *aMacVerified	Success or Error
rpu_getStatus	N/A	N/A	uint32 * rpuInitialized	Success or ERROR_TYPE
rpu_zeroize	N/A	N/A	N/A	Success or ERROR_TYPE

Definition of Critical Security Parameters (CSPs)

The following are CSPs contained within the module:

- **Private_Import_Key_RSA_Unwrap**: Used by the SecureParser module to unwrap encrypted keys sent to it by applications. All keys sent to the SecureParser will be RSA key wrapped by applications with CSP **Public_Import_Key_RSA_Wrap**. Note that each SecureParser keystore will have its own associated RSA public/private import keypair.
- **Workgroup_Key_Enc:** Used to NIST key wrap internally generated encryption session key (Session_Key_Enc), also used to unwrap encryption session key when headers are being restored.
- **Workgroup_Key_Mac:** Used to NIST key wrap internally generated integrity session key (Session_Key_Mac), also used to unwrap integrity session key when headers are being restored.
- **Workgroup_Key_Ida:** Used to NIST key wrap internally generated IDA session key (Session_Key_Ida), also used to unwrap IDA session key when headers are being restored.
- **Session_Key_Enc**: Used to encrypt all plaintext data prior to data splitting. Encrypted by Workgroup_Key_Enc using the NIST Key wrap and then placed into share headers.
- **Session_Key_Mac**: HMAC-SHA1, SHA256, SHA384, or SHA512 key used for ciphertext data integrity once splitting is complete. Encrypted by Workgroup_Key_Mac using the NIST Key wrap and then placed into share headers.
- **Session_Key_Ida**: Random seed used as input to IDAs for adding randomness. Encrypted by Workgroup_Key_Mac using the NIST Key wrap and then placed into share headers.
- **Share_Integrity_Key_HMAC:** Optional HMAC-SHA1, HMAC-SHA256, HMAC-SHA384, or HMAC-SHA512 key used for additional ciphertext share data integrity after data splitting. Never output.
- **Share_Integrity_Key_ DSA_Sign:** Optional DSA Private Key (PEM or ANSI) used to sign ciphertext share data after the data splitting process. Never output.
- **Share_Integrity_Key_ RSA_Sign:** Optional RSA Private Key used to sign ciphertext share data after the data splitting process. Never output.
- **Share_Integrity_Key_ ECDSA_Sign:** Optional ECDSA Private Key (PEM or ANSI) used to sign ciphertext share data after the data splitting process. Never output.
- **PRNG_Seed_Key**: Imported from standard operating system services within the physical boundary of the general purpose computer. Used to seed the module's own FIPS ANSI X9.31 pseudo random number generator. **Rationale of strength** follows PRNG_Seed_Value description.
- **PRNG_Seed_Value**: Imported from standard operating system services within the physical boundary of the general purpose computer. Used to seed the module's own FIPS ANSI X9.31 pseudo random number generator. Must not be identical to PRNG_Seed_Key. **Since the PRNG seed comes from the operating system, which is outside the logical boundary of the module, for the purposes of FIPS 140-2, the entropy of this seed may be assumed to be equal to the length of the seed. The seed length is 128 bits.**

- **SecureParser PRNG_State**: Internal state of the SecureParser's PRNG (Cert. #584).

Definition of Public Keys

The following are the public keys contained in the module:

- **Public_Import_Key_RSA_Wrap**: Used by applications to wrap keys they are sending to the SecureParser module. All keys sent to the SecureParser must be RSA wrapped. Note that each SecureParser keystore will have its own public/private key pair.
- **SW_Integrity_Key_DSA_Verify**: Used for verification of the signed module executable during power-on self-tests. Hard coded in the module.
- **Share_Integrity_Key_DSA_Verify**: Optional DSA Public Key (PEM or ANSI) used to verify ciphertext share data during the restoration process. Can be imported into the module from an X509 certificate.
- **Share_Integrity_Key_RSA_Verify**: Optional RSA Public Key used to verify ciphertext share data during the restoration process. Can be imported into the module from an X509 certificate.
- **Share_Integrity_Key_ECDSA_Verify**: Optional ECDSA Public Key (PEM or ANSI) used to verify ciphertext share data during the restoration process. Can be imported into the module from an X509 certificate.

Definition of CSPs Modes of Access

Table 6 defines the relationship between access to CSPs and the different module services. The modes of access shown in the table are defined as follows:

- G = Generate CSP
- R = Read CSP
- W = Write CSP
- Z = Zero CSP
- W_R = Write CSP to RPU[3]
- Z_R = Zero CSP on RPU

Table 6 – CSP Access Rights within Roles & Services
Ref. SecureParser Specification: 4.4 Critical Security Parameters

Role		Service	Cryptographic Keys and CSPs Access Operation
C.O.	**User**		
X		**module_initialize**	PRNG_Seed_Key, **G-Z** PRNG_Seed_Value, **G-Z** PRNG_State, **W**
X		**parser_create**	N/A

[3] The RPU provides no interface to read back CSPs after they are written.

Role		Service	Cryptographic Keys and CSPs Access Operation
C.O.	**User**		
X		**parser_destroy**	Session_Key_Enc, **Z** Session_Key_Mac, **Z** Session_Key_Ida, **Z**
X		**parser_generateHeaders**	Session_Key_Enc, **G-R-W** Session_Key_Mac, **G-R-W** Session_Key_Ida, **G-R-W** Workgroup_Key_Enc, **R** Workgroup_Key_Mac, **R** Workgroup_Key_Ida, **R** Share_Integrity_Key_HMAC, **R** Share_Integrity_Key_DSA_Sign, **R** Share_Integrity_Key_RSA_Sign, **R** Share_Integrity_Key_ECDSA_Sign, **R** PRNG_State, **R-W**
X		**parser_restoreHeaders**	Session_Key_Enc, **R-W** Session_Key_Mac, **R-W** Session_Key_Ida, **R-W** Workgroup_Key_Enc, **R** Workgroup_Key_Mac, **R** Workgroup_Key_Ida, **R** Share_Integrity_Key_HMAC, **R**
X		**parser_regenerateHeaders**	Session_Key_Enc, **R** Session_Key_Mac, **R** Session_Key_Ida, **R** Workgroup_Key_Enc, **R** Workgroup_Key_Mac, **R** Workgroup_Key_Ida, **R** Share_Integrity_Key_HMAC, **R** Share_Integrity_Key_DSA_Sign, **R** Share_Integrity_Key_RSA_Sign, **R** Share_Integrity_Key_ECDSA_Sign, **R**
X		**parser_recoverHeaders**	Session_Key_Enc, **R** Session_Key_Mac, **R** Session_Key_Ida, **R** Workgroup_Key_Enc, **R** Workgroup_Key_Mac, **R** Workgroup_Key_Ida, **R** Share_Integrity_Key_HMAC, **R** Share_Integrity_Key_DSA_Sign, **R** Share_Integrity_Key_RSA_Sign, **R** Share_Integrity_Key_ECDSA_Sign, **R**

Role		**Service**	**Cryptographic Keys and CSPs Access Operation**
C.O.	**User**		
X		**parser_setWorkgroupKeys**	Session_Key_Enc, **R** Session_Key_Mac, **R** Session_Key_Ida, **R** Workgroup_Key_Enc, **W** Workgroup_Key_Mac, **W** Workgroup_Key_Ida, **W**
X		**keystore_create**	Private_Import_Key_RSA_Unwrap, **G** Public_Import_Key_RSA_Wrap, **G**
X		**keystore_destroy**	All CSPs in the keystore, **Z**
X		**keystore_addKeyFromBuffer**	All keys that are imported, **R-W** Private_Import_Key_RSA_ Unwrap, **R**
X		**keystore_removeKey**	Specified key in volatile keystore structure **Z**
X		**keystore_getKeyType**	Specified key in volatile keystore structure **R**
X		**keystore_getKeyLength**	Specified key in volatile keystore structure **R**
X		**keystore_keyExists**	Specified key in volatile keystore structure **R**
X		**keystore_getImportKey**	Public_Import_Key_RSA_Wrap, **R**
	X	**parser_parseDataEx**	Session_Key_Enc, **R,** $\mathbf{W_R}$ Session_Key_Mac, **R,** $\mathbf{W_R}$ Session_Key_Ida, **R,** $\mathbf{W_R}$ Share_Integrity_Key_HMAC, **R** Share_Integrity_Key_DSA_Sign, **R** Share_Integrity_Key_RSA_Sign, **R** Share_Integrity_Key_ECDSA_Sign, **R** PRNG_State, **R-W**
	X	**parser_parseData**	Session_Key_Enc, **R,** $\mathbf{W_R}$ Session_Key_Mac, **R,** $\mathbf{W_R}$ Session_Key_Ida, **R,** $\mathbf{W_R}$ Share_Integrity_Key_HMAC, **R** Share_Integrity_Key_DSA_Sign, **R** Share_Integrity_Key_RSA_Sign, **R** Share_Integrity_Key_ECDSA_Sign, **R** PRNG_State, **R-W**
	X	**parser_restoreData**	Session_Key_Enc, **R,** $\mathbf{W_R}$ Session_Key_Mac, **R,** $\mathbf{W_R}$ Session_Key_Ida, **R,** $\mathbf{W_R}$ Share_Integrity_Key_HMAC, **R**
	X	**parser_recoverData**	Session_Key_Mac, **R**

Role		Service	Cryptographic Keys and CSPs Access Operation
C.O.	**User**		
			Session_Key_Ida, **R** Share_Integrity_Key_HMAC, **R** Share_Integrity_Key_DSA_Sign, **R** Share_Integrity_Key_RSA_Sign, **R** Share_Integrity_Key_ECDSA_Sign, **R**
	X	**parser_getHeaderInfo**	N/A
	X	**parser_getFieldOffsets**	N/A
	X	**parser_setFaultTolerance**	N/A
	X	**parser_getParsedLength**	N/A
	X	**parser_getRestoredLength**	N/A
X	X	**module_getstatus**	N/A
X		**Zeroization:** **module_destroy**	All CSPs (includes imported public keys and everything in the volatile keystore). Also zeroes all keys in the RPU sub-module by calling rpu_zeroize, **Z, Z_R**
		Self tests (power cycle)	SW Integrity: Digital signature using Security First Corp. public DSA key SW_Integrity_Key_ DSA_Verify, **R**

For each service listed in Table 6 above, the following identifies all CSPs that are entered into and output from the module during execution of each service.

- module_initialize:
  - Entry: N/A.
  - Output: N/A.
- parser_create:
  - Entry: N/A.
  - Output: N/A.
- parser_destroy:
  - Entry: N/A.
  - Output: N/A.
- parser_generateHeaders:
  - Entry: N/A.
  - Output:
    - Session_Key_Enc (encrypted with Workgroup_Key_Enc).
    - Session_Key_Mac (encrypted with Workgroup_Key_Mac).
    - Session_Key_Ida (encrypted with Workgroup_Key_Ida).
- parser_restoreHeaders:
  - Entry:
    - Session_Key_Enc (encrypted with Workgroup_Key_Enc).
    - Session_Key_Mac (encrypted with Workgroup_Key_Mac).

        - Session_Key_Ida (encrypted with Workgroup_Key_Ida).
    - Output: N/A.
- parser_regenerateHeaders:
    - Entry: N/A.
    - Output:
        - Session_Key_Enc (encrypted with Workgroup_Key_Enc).
        - Session_Key_Mac (encrypted with Workgroup_Key_Mac).
        - Session_Key_Ida (encrypted with Workgroup_Key_Ida).
- parser_recoverHeaders:
    - Entry:
        - Session_Key_Enc (encrypted with Workgroup_Key_Enc).
        - Session_Key_Mac (encrypted with Workgroup_Key_Mac).
        - Session_Key_Ida (encrypted with Workgroup_Key_Ida).
    - Output:
        - Session_Key_Enc (encrypted with Workgroup_Key_Enc).
        - Session_Key_Mac (encrypted with Workgroup_Key_Mac).
        - Session_Key_Ida (encrypted with Workgroup_Key_Ida).
- parser_setWorkgroupKeys:
    - Entry: N/A.
    - Output: N/A.
- keystore_create:
    - Entry: N/A.
    - Output: N/A.
- keystore_destroy:
    - Entry: N/A.
    - Output: N/A.
- keystore_addKeyFromBuffer:
    - Entry:
        - Workgroup_Key_Enc (encrypted with Public_Import_Key_RSA_Wrap).
        - Workgroup_Key_Mac (encrypted with Public_Import_Key_RSA_Wrap).
        - Workgroup_Key_Ida (encrypted with Public_Import_Key_RSA_Wrap).
        - Share_Integrity_Key_HMAC (encrypted with Public_Import_Key_RSA_Wrap).
        - Share_Integrity_Key_DSA_Sign (encrypted with Public_Import_Key_RSA_Wrap).
        - Share_Integrity_Key_RSA_Sign (encrypted with Public_Import_Key_RSA_Wrap).
        - Share_Integrity_Key_ECDSA_Sign (encrypted with Public_Import_Key_RSA_Wrap).
    - Output: N/A.
- keystore_removeKey:
    - Entry: N/A.
    - Output: N/A.
- keystore_getKeyType:
    - Entry: N/A.

    - Output: N/A.
- keystore_getKeyLength:
    - Entry: N/A.
    - Output: N/A.
- keystore_keyExists:
    - Entry: N/A.
    - Output: N/A.
- keystore_getImportKey:
    - Entry: N/A.
    - Output: Public_Import_Key_RSA_Wrap (plaintext).
- parser_parseDataEx:
    - Entry: N/A.
    - Output: N/A.
- parser_parseData:
    - Entry: N/A.
    - Output: N/A.
- parser_restoreData:
    - Entry: N/A.
    - Output: N/A.
- parser_recoverData:
    - Entry: N/A.
    - Output: N/A.
- parser_getHeaderInfo:
    - Entry: N/A.
    - Output: N/A.
- parser_getFieldOffsets:
    - Entry: N/A.
    - Output: N/A.
- parser_setFaultTolerance:
    - Entry: N/A.
    - Output: N/A.
- parser_getParsedLength:
    - Entry: N/A.
    - Output: N/A.
- parser_getRestoredLength:
    - No key Entry or Output.
- module_getstatus:
    - Entry: N/A.
    - Output: N/A.
- Zeroization: module_destroy:
    - Entry: N/A.
    - Output: N/A.
- Self tests (power cycle):
    - Entry: N/A.
    - Output: N/A.

6. Operational Environment

The FIPS 140-2 Area 6 Operational Environment requirements are applicable because the SecureParser module operates in a modifiable operational environment on a general purpose computer. See the description of the operational environment in Section 1, Module Overview, above.

7. Security Rules

The SecureParser cryptographic module's design corresponds to the module's security rules. This section documents the security rules enforced by the cryptographic module to implement the security requirements of this FIPS 140-2 Level 1 hybrid module.

1. The SecureParser module interfaces shall be logically distinct from each other as defined by the SecureParser API for the following interfaces: Data Input; Data Output; Control Input; Status Output.
2. Status information shall not contain CSPs or sensitive data that if misused could lead to a compromise of the module.
3. Data output shall be inhibited during self-tests, and while in error states.
4. Data output shall be disconnected from the module processes that perform key generation, and plaintext CSP zeroing (the module will not support manual key entry).
5. All input and output to/from the RPU sub-module must be directed through the SecureParser's interface.
6. Two independent internal actions will be required to output data via the output interface through which sensitive restored plaintext share data is output.
7. Plaintext secret/private key output is not supported. No SecureParser API calls will permit secret/private key output.
8. The SecureParser module shall provide two distinct operator roles. These are the User role, and the Cryptographic-Officer role.
9. The SecureParser module shall not support concurrent operators.
10. The SecureParser module shall not support a maintenance role.
11. The SecureParser module shall not support a bypass capability.
12. The SecureParser module does not provide any operator authentication.
13. Explicit service API calls into the SecureParser module shall allow the implicit assumption of operator roles.
14. The SecureParser module includes the following operational and error states: Power on/off state; Crypto officer state; User state; Self-test state; Error state; Key/CSP Entry state.
15. Recovery from error states shall be possible by power cycling the module.
16. Secret keys, private keys, and CSPs shall be protected within the cryptographic module from unauthorized disclosure, modification, and substitution.
17. Public keys shall be protected within the cryptographic module against unauthorized modification and substitution.
18. An Approved RNG (ANSIX9.31 with AES) shall be used for the generation of AES

cryptographic keys within the module.

19. An Approved RNG (ANSIX9.31 with AES) shall be used for the generation of RSA cryptographic key pairs within the module.
20. The PRNG seed and seed key shall not have the same value.
21. Compromising the security of the key generation method (e.g., guessing the seed value to initialize the deterministic RNG) shall require as least as many operations as determining the value of the generated key.
22. The SecureParser module shall associate all cryptographic keys (secret, private, or public) stored within the module with the correct entity (KeyID) to which the key is assigned.
23. The SecureParser module shall provide a method to zero all plaintext secret and private cryptographic keys and CSPs within the module (including the RPU sub-module) in a time that is not sufficient to compromise the plaintext secret and private keys and CSPs (service: module_destroy).
24. Power-on Self-tests will not require operator intervention, they will be performed automatically when the module is initialized.
25. The cryptographic module shall perform the following self-tests:
    a. Power up Self-Tests:
        i. Software cryptographic algorithm tests:
            1. PRNG KAT, covers AES Encrypt
            2. AES Decrypt KAT (ECB mode with 256-bit key)
            3. AES Encrypt and Decrypt KAT (GCM mode with 128,192, and 256-bit keys)
            4. HMAC KATS using SHA-256, SHA-384, SHA-512, covers SHA-256, SHA-384, and SHA-512 hashing
            5. DSA sign/verify using SHA-1, covers SHA-1 hashing
            6. RSA-PSS sign/verify
            7. RSA encrypt/decrypt
            8. ECDSA sign/verify
        ii. RPU cryptographic algorithm tests:
            1. AES256-CTR KAT, covers ECB Encrypt
            2. HMAC KAT using SHA-256
            3. SHA-256 KAT
        iii. Software/Firmware Integrity Test – DSA public key verification of a private key signature. Covers all module executables listed in **Figure 1 - Image of the Cryptographic Module**.
    b. Conditional Self-Tests:
        i. Continuous Random Number Generator (PRNG) test – performed on each sample from the PRNG (each sample will be 128 AES bits).
        ii. Pairwise consistency test – performed each time an RSA “import” key pair is generated inside the module.
26. If the SecureParser module fails a self-test, the module shall enter an error state and output an error indicator via the status output interface.
27. The SecureParser module, including the RPU sub-module, shall not perform any cryptographic operations while in an error state.
28. The SecureParser module and the RPU sub-module shall have a shared error state.

29. When the power-up tests are completed, the results (i.e. indications of success or failure) shall be output via the “status output” interface.
30. The operator shall be capable of commanding the module to perform the power-up self-tests at any time by power cycling the cryptographic module.
31. None of the mentioned hardware, software, or firmware components will be excluded from the module.

This section documents the security rules imposed by the vendor:

1. An approved encryption mode and an approved integrity mechanism must be requested by calling applications to run the SecureParser module in FIPS Approved mode.
2. Workgroup keys shall be mandatory for the SecureParser module to run in a FIPS Approved mode.
3. Workgroup keys shall not be placed in data shares.
4. The SecureParser module shall encrypt all share data using AES session keys.
5. The SecureParser module shall provide for the integrity of encrypted data shares using HMAC-SHA1, HMAC-SHA256, HMAC-SHA384, HMAC-SHA512, or GCM. In addition an optional configurable second layer of integrity will be provided using either HMAC-SHA1, HMAC-SHA256, HMAC-SHA384, HMAC-SHA512, DSA, ECDSA, or RSA.
6. All Secret and Private Keys entered via the module's keystore_addKeyFromBuffer( ) service are encrypted using RSA key wrapping. All Secret and Private Keys entered/output via the module's parser_parseData( ) and parser_restoreData( ) services are encrypted using NIST Key Wrapping.
7. There is a procedural control prohibiting the use of the JTAG debugging port on the physical RPU.

8. Physical Security

FIPS 140-2 Area 5 Physical Security requirements are applicable because the SecureParser is a hybrid module. The SecureParser is intended to operate on a general purpose computer, which is defined as a Multi-Chip Standalone device. The general purpose computer shall be comprised of production grade components and a production grade enclosure. The DRC RPU hardware component of the hybrid module also consists of production-grade components that include standard passivation techniques to protect against environmental or other physical damage. The Secure Delivery Document for SecureParser by Security First Corp. defines the procedures for maintaining security while distributing the module to operators.

9. Mitigation of Other Attacks Policy

The SecureParser module has not been designed to mitigate any specific attacks.

10. References

OpenSSL: This product includes software developed by the OpenSSL Project for use in the OpenSSL Toolkit. (http://www.openssl.org)

Portions of this document were based upon the DRC Coprocessor System User Guide v3.0 (© 2009 DRC Computer Corporation).

11. Definitions and Acronyms

Share

A partition of data created after the SecureParser is enacted to parse data.

Mandatory Share

A mandatory share is a share that must be present for the proper recovery of data. In other words, all mandatory shares must be available. The number of mandatory shares is denoted by L.

Non-mandatory Share

The SecureParser allows for the reconstruction of data with a subset of non-mandatory shares. The number of non-mandatory shares is denoted by N and the number of non-mandatory shares that must be available to restore is denoted by M.

M of N

In this document, we refer to M of N shares which is intended to mean M of N non-mandatory shares and L mandatory shares. For example, "without M of N shares..." means without at least M non-mandatory shares and L mandatory shares.

Trusted

Something that is trusted is known to meet its security assumptions. For example, a trusted share is known to be valid, untampered with, and otherwise uncompromised by any adversaries.

Workgroup key

This can be any encryption key that can be used to encrypt or decrypt data. Often it is a shared key between users of the application working together.

Integrity Authentication key:

This can be any key used for generating or verifying a MAC or signature of data.

Information Dispersal Algorithm (IDA):

An algorithm, possibly keyed, that divides information into multiple components. An IDA may add redundancy to allow the information to be recovered if some of the components are unavailable. Each IDA has an inverse algorithm that, when given some or all of the aforementioned components, produces the original information.