NetLib® Encryptionizer® DE/FIPS

Version 2010.201.10.0
and 2010.501.10.0

Security Policy

FIPS 140-2 Level 1 Validation

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1 Introduction 3
1.1 Acronyms and Abbreviations 4

2 NetLib® Encryptionizer® 5
2.1 Functional Overview 5
2.2 Module Description 6
2.3 Module Ports and Interfaces 6

3 Security Functions 7

4 FIPS Approved Mode of Operation 9

5 Identification and Authentication 9

6 Cryptographic Keys and CSPs 10

7 Roles and Services 10

8 Access Control 11

9 Self-Tests 12

10 Design Assurance 13

11 Physical Security 13

12 Mitigation of Attacks 13

13 References 13

1 Introduction

This document is the Security Policy for NetLib® Encryptionizer® DE/FIPS 2010.201.10.0 and 2010.501.10.0 cryptographic modules. This Security Policy specifies the security rules under which the module shall operate to meet the requirements of FIPS 140-2 Level 1. It describes how the module functions to meet the FIPS requirements, and the actions that operators must take to maintain the security of the module.

This Security Policy describes the features and design of the Encryptionizer® cryptographic module using the terminology contained in the FIPS 140-2 specification. *FIPS 140-2, Security Requirements for Cryptographic Modules* specifies the security requirements that must be satisfied by a cryptographic module utilized within a security system protecting sensitive but unclassified information. The NIST Cryptographic Module Validation Program (CMVP) validates cryptographic modules to FIPS 140-2 standards. Validated products are accepted by the Federal agencies of both the USA and Canada for the protection of sensitive or designated information.

The FIPS 140-2 standard and information on the CMVP can be found at http://csrc.nist.gov/groups/STM/cmvp. More information describing the Encryptionizer® can be found at http://www.Netlib.com.

In this document, the NetLib® Encryptionizer® DE/FIPS 2010.201.10.0 and NetLib® Encryptionizer® DE/FIPS 2010.501.10.0 is also referred to as the “Encryptionizer®”, “the driver”, the cryptographic module, or “the module”.

This Security Policy contains only non-proprietary information. All other documentation submitted for FIPS 140-2 conformance testing and validation is “NetLib®’ - Proprietary” and is releasable only under appropriate non-disclosure agreements.

The NetLib® Encryptionizer® cryptographic module meets the overall requirements applicable to Level 1 security for FIPS140-2.

Table 1. Cryptographic Module Security Requirements

Security Requirements Section	*Level*
Cryptographic Module Specification	1
Cryptographic Module Ports and Interfaces	1
Roles and Services and Authentication	1
Finite State Machine Model	1
Physical Security	N/A
Operational Environment	1
Cryptographic Key Management	1
EMI/EMC	1
Self-Tests	1
Design Assurance	2
Mitigation of Other Attacks	N/A
Cryptographic Module Security Policy	1

1.1 Acronyms and Abbreviations

AES	Advanced Encryption Standard
Application	Application, such as MS SQL Server or MS Access
CBC	Cipher Block Chaining
CMVP	Cryptographic Module Validation Program
CSE	Communications Security Establishment
CSP	Critical Security Parameter
ECB	Electronic Code Book
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
EK	Encryption Key
FCC	Federal Communication Commission
FIPS	Federal Information Processing Standard
HMAC	Keyed-Hash Message Authentication Code
KAT	Known Answer Test
KMK	Key Management Key
MS	Microsoft
NIST	National Institute of Standards and Technology
PUB	Publication
RAM	Random Access Memory
RFC	Request for Comment
SHA-1	Secure Hash Algorithm
SQL	Structured Query Language
UKMK	User-entered Key Management Key

2 NetLib® Encryptionizer®

2.1 Functional Overview

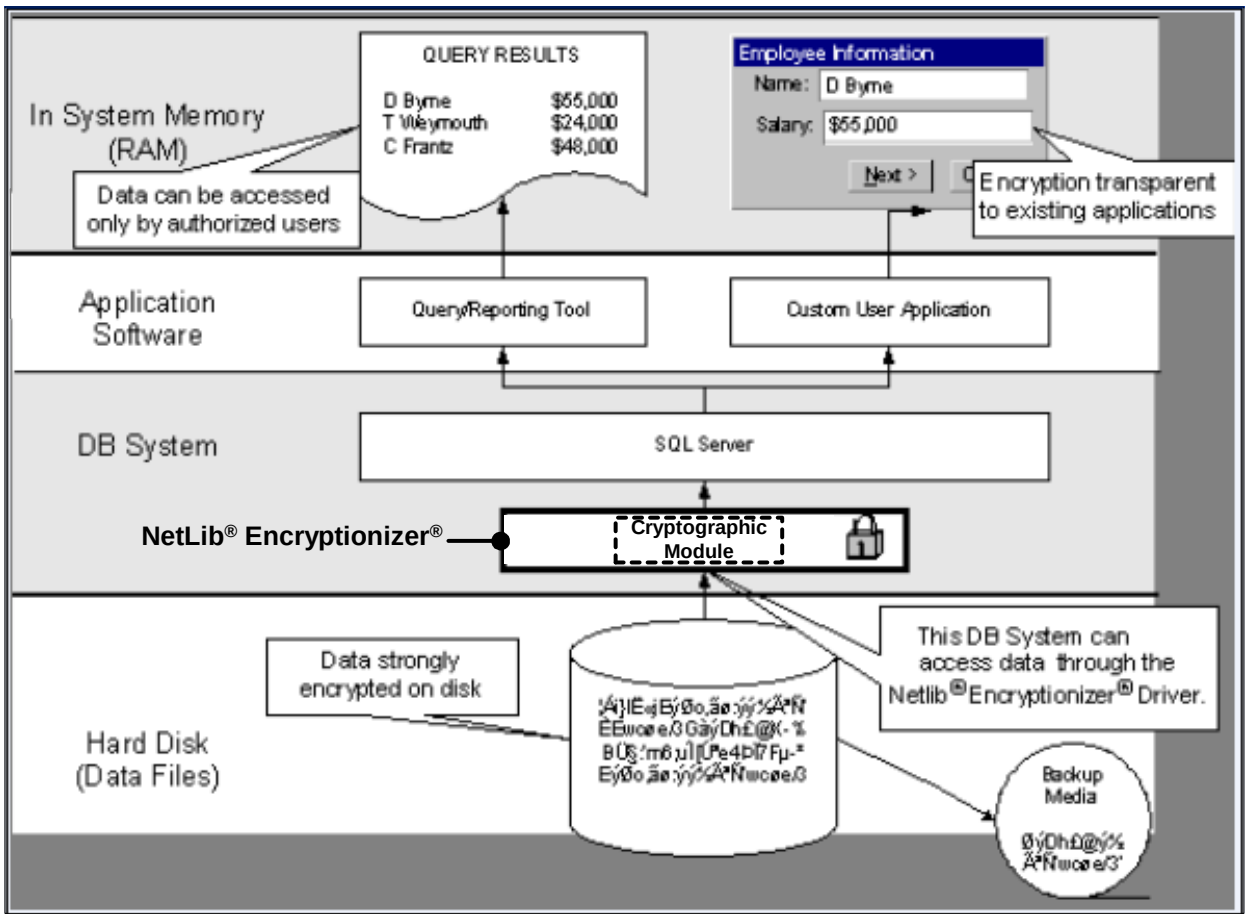
The NetLib® Encryptionizer® DE/FIPS provides encryption of data stored in Application databases and backups. It can be deployed without programming and without adding any administrative overhead. The purpose of whole database encryption is to make a database unusable if it is stolen, copied, downloaded, lost, or otherwise improperly accessed. Data is never decrypted on disk, only in memory as requested by the Application (such as MS SQL Server or MS Access). Access permissions to the decrypted data are controlled by Encryptionizer®'s Administration Wizard. In addition, data is automatically encrypted before being written back to disk.

Features of the software include:

- Strong AES data encryption
- FIPS 140-2 power-on self tests and conditional tests.

Figure 1 shows how Encryptionizer® operates within the Database Access Layers. Data at rest (on disk) is encrypted. If stolen and moved to another machine, it cannot be read. Only authorized human users can freely access data with encryption being totally transparent to applications. The cryptographic module consists of only those libraries within the application that perform key management and encrypt and decrypt data.

Figure 1. High Level Functional View of the Cryptographic Module Function



2.2 Module Description

The Encryptionizer® cryptographic module is a FIPS level 1 multi-chip standalone cryptographic module consisting of application software that executes on a general-purpose computer configured in single-user mode. Only the administrator account is enabled. All other user and guest accounts are disabled. Only a single user (e.g., MS Access or MS SQL Server) may access the module at any point in time. Multiple concurrent users (e.g., multiple SQL Server or Access processes) are not supported. The Application provides a Process ID Hash with each command that the module uses to restrict access to the single Application.

The module supports the following operational environments:

- Windows 2003 Server x86. (Single-user mode)
- Windows 2003 Server x64. (Single-user mode)
- Windows 7 x86. (Single-user mode)
- Windows 7 x64. (Single-user mode)
- Windows 2008 Server x86. (Single-user mode)
- Windows 2008 Server x64 (Single-user mode)

The module provides data encryption and decryption services, key management services, software integrity services, a power up self-test and a conditional test assuring operators of a valid firmware state within the module.

The module consists of the following files:

Version 2010.201.10.0 of the module consists of the following files for Windows x86 Operating Systems:

File	***Version***
C:\Program Files\NetLib\SecDE.FIPS\nlrun1402.exe	2010.201.10.0
C:\Windows\System32\nlbld1402.dll	2010.201.10.0
C:\Windows\System32\nlem1402.dll	2010.201.10.0
C:\Windows\System32\drivers\nlem1402.sys	2010.201.10.0

Version 2010.501.10.0 of the module consists of the following files for Windows x64 Operating Systems:

File	***Version***
C:\Program Files\NetLib\SecDE.FIPS\nlrun1402.exe	2010.201.10.0
C:\Windows\SysWow64\nlbld1402.dll	2010.201.10.0
C:\Windows\SysWow64\nlem1402.dll	2010.201.10.0
C:\Windows\System32\drivers\nlem1402.sys	2010.501.10.0
C:\Windows\System32\nlbld1402.dll	2010.501.10.0
C:\Windows\System32\nlem1402.dll	2010.501.10.0

2.3 Module Ports and Interfaces

The cryptographic module has four physical interfaces and four FIPS 140-2 logical interfaces. The physical ports have the functions described in Table 2. Where distinct logical interfaces share the same physical port, the system timing, software and hardware protocols, software APIs, and other controls logically separate and isolate these distinct categories of data from one another. The internal system bus acts as the physical path for clocking data into and out of the module. System synchronization and timing controls, and the protocol of the data ensure that logically distinct categories of data do not occupy the data path at the same time

Table 2. Physical Interfaces and Logical 140-2 Interfaces

Physical Interface	*FIPS 140-2 Logical Interface*
PC USB ports, PC network port, keyboard interface, mouse port, hard drive, floppy drive, CDROM drive, internal I/O ports.	Data input interface
PC USB ports, PC network port, hard drive, floppy drive, CDROM drive, internal I/O ports.	Data output interface
PC keyboard port, mouse port, network port, PC power button, internal I/O ports.	Control input interface
PC monitor.	Status output interface

The physical interfaces map to logical interfaces as described in Table 3.

Table 3. FIPS 140-2 Logical Interfaces

Logical Interface	*Description*
Data input	The data input is: • All plaintext data entering the Encryptionizer® for the purpose of being encrypted and stored in the database. The Application provides these logical interfaces. • All ciphertext data entering the Encryptionizer® from the database for the purpose of being decrypted and output. The database API provides these logical interfaces.
Data output	The data output is: • All ciphertext data exiting the Encryptionizer® to the database. The database API provides these logical interfaces. • All plaintext data exiting the Encryptionizer® for use by the Application. The Application database API provides these logical interfaces.
Control input	The Encryptionizer® accepts control input from the following sources: • Commands passed from the Encryptionizer® user interface. • Parameters provided by the profile. • Parameters provided from the database header.
Status output	The status output consists of all messages either logged by or returned from the module and status messages returned to the Encryptionizer® user interface for viewing by the operator.

3 Security Functions

The Encryptionizer® cryptographic module implements the security functions described in Table 4:

Table 4. Module Approved Security Functions.

Approved Security Function	*Certificate*
Symmetric Key Encryption/Decryption	
AES-CTR (128/256)**, AES-CBC**(128/256 e/d)**, AES-ECB** (128/256 e/d)	1502, 1528
Hashing	

Approved Security Function	*Certificate*
SHA-1 byte-oriented hashing used with HMAC. (FIPS PUB 180-2)	1376, 1377
Keyed Hash Message Authentication Code (HMAC)	
HMAC (FIPS Pub 198)	905, 906

The module provides the following cryptographic functions:

- AES symmetric key encryption / decryption of data and symmetric key encryption / decryption of encryption keys stored in the profile, and the key management key.
- SHA-1 hashing for use with HMAC for the software integrity test.
- HMAC/SHA-1 for the power-on self-test software integrity test.

4 FIPS Approved Mode of Operation

The Encryptionizer® has only a FIPS Approved mode of operation that is restricted to performing only FIPS-approved cryptographic algorithms and security functions. The module does not have a non-approved mode.

The approved mode becomes active after the module has powered up and has passed the power-on self-test. The approved mode lets the user read and write data from and to an Application database. If the module is operational (meaning it has passed the power-on self-test), the module is operating in FIPS approved mode. The status message "FIPS Mode" is displayed on any Encryptionizer® wizard splash screen.

The module must run on one of the platforms described in section 2.1. The system is configured in single-user mode by configuring the OS to provide only an Administrator (Windows) account. Disable any other administrative, guest, and user accounts during setup of the server.

When the module is installed on a 32-bit operating system, confirm the Encryptionizer® has the correct version number by clicking "**About"** on any Encryptionizer® wizard splash screen and checking that the version is 2010.201.10.0.

When the module is installed on a 64-bit operating system, confirm the Encryptionizer® has the correct version number by clicking "**About"** on any Encryptionizer® wizard splash screen and checking that the version is 2010.501.10.0.

5 Identification and Authentication

The module supports two roles, as follows.

- crypto officer role
- user role

The crypto officer role is implicitly assumed by the operator installing the module and configuring it for use. Crypto officer operations consist of running the installation program to install NetLib® Encryptionizer® application software, setting up the initial user account, entering encryption keys, and uninstalling the software. Crypto officers must authenticate to the Windows operating system to install and configure the module for use.

The user role is implicitly assumed by the software Application. User operations consist of read and write operations from and to the database. Human users authenticate to the Application that is outside the boundary of the cryptographic module.

Multiple concurrent users are not supported. Only a single user may access the cryptographic module at any given point in time.

The module does not require any physical maintenance.

The module does not support authentication or identification for the Crypto-Officer or User role.

6 Cryptographic Keys and CSPs

The following table identifies the cryptographic keys employed within the module.

Table 5. Cryptographic Keys and CSPs.

Data Item	*Description*
Encryption Key (EK)	The EK (AES) is entered manually into the cryptographic module. Key length depends on the options chosen by the crypto officer when entering the key. Key lengths are 128 and 256-bits. A crypto officer must enter the key twice to confirm the correct key is used. This key is used to encrypt and decrypt data written to or read from the database. A copy of this EK is stored in encrypted form (under the KMK) within the module profile that is outside the cryptographic module boundary. In subsequent uses, this key is passed automatically from the profile to the module for use. The EK is deleted from memory after use. Zeroize this key according to IG 7.9 described in Note 1 below.
Key Management Key (KMK)	The KMK is an AES 256-bit key that is hard coded by the manufacturer. By default, the Encryptionizer® uses the KMK to encrypt and decrypt the module profile (the encryption key store). If the crypto officer enters a User-Entered Key Management Key (UKMK), the KMK encrypts the UKMK that is stored in the registry. In this case the KMK is not used to encrypt and decrypt the module profile. The KMK is deleted from memory immediately after use. Zeroize this key according to IG 7.9 described in Note 1 below. Note that this is not a FIPS key and only provides obfuscation of the EK that it encrypts. In order to claim true FIPS encryption of the profile and EK, user must assign a UKMK (see below).
User-Entered Key Management Key (UKMK)	The UKMK is a 128-bit or 256-bit AES key that may be entered by a crypto officer. A crypto officer must enter the key twice to confirm the correct key is used. The UKMK is used only to encrypt and decrypt the module profile (the encryption key store). The UKMK is stored in the registry encrypted under the KMK. The UKMK is deleted from memory immediately after use. Zeroize this key according to IG 7.9 described in Note 1 below.
HMAC Key	20 byte HMAC key used for the Software Integrity Test. The key is is hard coded by the manufacturer. Zeroize this key according to IG 7.9 described in Note 1 below.

Note 1: Perform zeroization by uninstalling the cryptographic module, and reformatting the platform's hard drive and overwriting the platform's hard drive, at least once.

7 Roles and Services

The module supports services that are available to crypto officers and users (the user is the Application accessing the module). All of the services are described in detail in the module's user documentation.

The crypto officer role is established by the operational rules of the module. The crypto officer role is assumed implicitly.

The crypto officer may install, configure (enter keys), and uninstall the module. The crypto officer may also view version information, run the power-up self-test (by starting the Encryptionizer®), and view status information (event logs).

The user role is also established by the operational rules of the module. The user role is implicitly assumed by the Application (sending read and write commands) when the module is running.

Table 6 shows the services available to the various roles. Encrypt and decrypt services delete the encryption key from memory (RAM) when the operation completes without modifying, disclosing, or substituting the key in any manner.

Table 6. Roles and Services

Service	*Crypto Officer*	*User*
Install the module	●	
Uninstall the module, reformat and overwrite at least once, the hard drive.	●	
Configure the module (Optionally enter a UKMK and / or set a policy rule)	●	
Enter UKMK from outside the module	●	
Create a new file	●	
Enter EK from outside the module	●	
Encrypt data being written to the database		●
Decrypt data being read from the database		●
View version information	●	
Run Self-Test	●	
Show Status	●	

8 Access Control

Table 7 shows services that use or affect cryptographic keys or CSPs. For each service, the key or CSP is indicated along with the type of access.

R - The item is **read** or referenced by the service.
W - The item is **written** or updated by the service.
E - The item is **executed** by the service. (The item is used as part of a cryptographic service.)
D - The item is **deleted** by the service.
Z - The item is **zeroized** by the service.

Table 7. Access Control

Authentication Data (Key or CSP)	Service	Role[1]	Access Control
Encryption Key (EK)	Encrypt data being written to the database	U	R,E,D
	Decrypt data being read from the database	U	R,E,D
	Enter EK from outside the module	CO	W
	Uninstall the module, format and overwrite at least once, the hard drive.	CO	Z
Key Management Key (KMK) [2]	Create a new file	CO	R,E,D
	Modify encryption policy rule	CO	R,E,D
	Create a profile	CO	R,E,D
	Encrypt data being written to the database	U	R,E,D
	Decrypt data being read from the database	U	R,E,D
	Encrypt/decrypt UKMK [2]	CO	R,E,D
	Uninstall the module, format and overwrite at least once, the hard drive.	CO	Z
User-Entered Key Management Key (UKMK) [3]	Enter KMK from outside the module	CO	W
	Create a new file	CO	R,E,D
	Modify encryption policy rule	CO	R,E,D
	Create a profile	CO	R,E,D
	Encrypt data being written to the database	CO	R,E,D
	Decrypt data being read from the database	CO	R,E,D
	Uninstall the module, format and overwrite at least once, the hard drive.	CO	Z
HMAC Key	Run the power-on self-test	CO	R,E,D
	Uninstall the module, format and overwrite at least once, the hard drive.	CO	Z

[1] U indicates the service is available to a user role. CO indicates the service is available to a crypto officer role.
[2] If a UKMK is used the KMK is used only to encrypt or decrypt the UKMK that is stored in the registry. The access control for these encryption and decryption operations is R,E.D.
[3] These associated services are available only if the crypto officer uses the UKMK.

9 Self-Tests

The module performs a power-on self-test (POST) to verify the integrity and correct operational functioning of the cryptographic module. If the system fails a POST, it reports status indicating which failure occurred and transitions to an error state. The module does not contain any user data before or during the POST so it is impossible for the module to output user data in this state or a subsequent error state that halts module operation. The module outputs its status to the log file in the event of a passed or failed power on self-test. Operators can run the POST on demand by stopping and restarting the containing application.

Table 8 summarizes the system self-tests.

Table 8. Self-Tests.

Self Test	Description
Mandatory power-up tests performed at power-up and on demand:	
Cryptographic Algorithm Known Answer Tests	The AES and SHA-1 cryptographic algorithms are tested using a “known answer” test to verify the operation of the function. The AES and SHA-1 known answer tests perform both encryption and decryption. HMAC is tested using the Software Integrity Test.

Self Test	Description
Software Integrity Test	The module verifies the integrity of the software by generating an HMAC/SHA-1 message authentication code for the Encryptionizer® and comparing the code against the expected values stored in the registry.
Conditional tests	
Manual Key Entry Test	Manually entered keys are entered twice and are compared to ensure the correct key is entered.

Known answer tests for encryption/decryption or hashing, function by encrypting (or hashing) a string for which the calculated output is known and stored within the cryptographic module. An encryption or hashing test passes when the freshly calculated output matches the expected (stored) value. A test fails when the calculated output does not match the expected value. The test then decrypts the ciphertext string. A decryption test passes when the freshly calculated output matches the plaintext value. A test fails when the calculated output does not match the plaintext value. Success and failure messages are written to the log file.

The software integrity test performs an HMAC/SHA1 calculation over each file comprising the cryptographic module. If the freshly calculated values match the pre-calculated stored values, the test passes. The module writes the success message to the log file and the module startup continues. If any freshly calculated value does not match the associated pre-calculated stored value, the test fails and the module startup exits. The module writes the failure message to the log file.

The manual key entry test compares key values that must be entered twice. If the values match, the key value is accepted. If the values do not match, the key value is rejected and the key must again be entered twice. Success and failure messages are written to the log file.

10 Design Assurance

Configuration Management – Source code and associated documentation and files are managed using a configuration management system. Each modification requires using a unique version identifier.

Delivery and Operation – Delivery and first time operation are controlled. Organizations purchasing the product must register to receive a unique authorization key to use the product.

Development – The module design follows a High Level Design specification that functionally defines the module, ports and interfaces and the purpose of each. Guidance is provided in the Security Policy and User Guide.

11 Physical Security

The FIPS 140-2 Physical Security requirements are not applicable to this module because the Netlib® Encryptionizer® DE/FIPS is a software only module.

The module is software that is intended to run on a GPC that conforms to the EMI/EMC requirements specified by 47 Code of Federal Regulations, Part 15, Subpart B, Unintentional Radiators, Digital devices, Class A. The module was tested on a GPC having a FCC DoC (Declaration of Conformity) meeting these requirements.

12 Mitigation of Attacks

The cryptographic module is not designed to mitigate specific attacks such as differential power analysis or timing attacks.

13 References

The following references are available at URL: http://csrc.nist.gov/groups/STM/index.html.

- *FIPS PUB 140-2: Security Requirements for Cryptographic Modules*

- *FIPS 140-2 Annex A: Approved Security Functions*
- *Derived Test Requirements (DTR) for FIPS PUB 140-2, Security Requirements for Cryptographic Modules*
- *Secure Hash Standard (SHS)*, *Federal Information Processing Standards Publication 180-1*
- *Advanced Encryption Standard (AES)*. *FIPS 197*
- *Keyed-Hash Message Authentication Code (HMAC*) *FIPS 198*