Security Policy for FIPS 140-2 Validation

BitLocker® Windows OS Loader (winload) in Microsoft Windows 8.1 Enterprise Windows Server 2012 R2 Windows Storage Server 2012 R2 Surface Pro 3 Surface Pro 2 Surface Pro Surface 2 Surface Windows RT 8.1 Windows Phone 8.1 Windows Embedded 8.1 Industry Enterprise StorSimple 8000 Series Azure StorSimple Virtual Array Windows Server 2012 R2

DOCUMENT INFORMATION

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CHANGE HISTORY

Date	Version	Updated By	Change
29 OCT 2013	0.1	Tim Myers	First Draft
7 MAY 2014	0.2	Tim Myers	Second Draft; FIPS 186-4 and FIPS 180-4 updates; processor name updates
1 JUL 2014	0.3	Tim Myers	Third Draft; added Security Levels Table and cryptographic algorithm certificate numbers
11 JUL 2014	1.0	Tim Myers	First Release to Validators; includes all algorithm and module certificate numbers
18 JUL 2014	1.1	Tim Myers	Update platforms; consolidate services
12 DEC 2014	1.2	Tim Myers	Address CMVP comments; update platform names
17 DEC 2014	1.3	Tim Myers	Update IG G.5 platforms; update binary versions; add StorSimple
15 JAN 2015	1.4	Tim Myers	Address CMVP comments
29 JAN 2015	1.5	Tim Myers	List AES modes; Update Design Assurance
20 FEB 2015	1.6	Tim Myers	Add StorSimple to Validated Platforms
9 MAR 2015	1.7	Tim Myers	Prepare for publication
17 MAR 2015	1.8	Tim Myers	Reorder StorSimple 8100 OE description
6 APR 2015	1.9	Tim Myers	Specify AES-GCM decryption approved algorithm
14 APR 2015	2.0	Tim Myers	Add Microsoft Surface Pro 3 to Validated Platforms
12 APR 2017	2.1	FIPS Team	Add StorSimple Virtual Array to Validated Platforms

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1 Introduction

The BitLocker ® Windows OS Loader, WINLOAD.EXE, is an operating system loader which loads the Microsoft Windows 8.1 Enterprise, Windows Server 2012 R2, Windows Storage Server 2012 R2, Surface Pro 3, Surface Pro 2, Surface Pro, Surface 2, Surface, Windows RT 8.1, Windows Phone 8.1, Windows Embedded 8.1 Industry Enterprise, StorSimple 8000 Series, and Azure StorSimple Virtual Array Windows Server 2012 R2 (herein referred to as Windows 8.1 OEs) operating system kernel (ntoskrnl.exe) and other boot stage binary image files. Throughout this document, the BitLocker Windows OS Loader may be called the Windows OS Loader for short.

1.1 List of Cryptographic Module Binary Executables

WINLOAD.EXE – Versions 6.3.9600 and 6.3.9600.17031 for Windows 8.1 OEs on systems using conventional BIOS
WINLOAD.EFI – Versions 6.3.9600 and 6.3.9600.17031 for Windows 8.1 OEs on systems using UEFI firmware

Note: both versions of winload exist on all platforms. The firmware determines which is used.

1.2 Brief Module Description

BitLocker Windows OS Loader is the binary executable for loading the Windows operating system.

1.3 Validated Platforms

The BitLocker Windows OS Loader components listed in Section 1.1 were validated using the following machine configurations:

1. Microsoft Windows 8.1 Enterprise (x86) running on a Dell PowerEdge SC440 without AES-NI;
2. Microsoft Windows Embedded 8.1 Industry Enterprise (x86) running on a Dell PowerEdge SC440 without AES-NI;
3. Microsoft Windows 8.1 Enterprise (x86) running on a Dell Dimension E521 without AES-NI;
4. Microsoft Windows Embedded 8.1 Industry Enterprise (x86) running on a Dell Dimension E521 without AES-NI;
5. Microsoft Windows 8.1 Enterprise (x86) running on an Intel Core i7 with AES-NI running on an Intel Maho Bay;
6. Microsoft Windows Embedded 8.1 Industry Enterprise (x86) running on an Intel Core i7 with AES-NI running on an Intel Maho Bay;
7. Microsoft Windows 8.1 Enterprise (x86) running on an HP Compaq Pro 6305 with AES-NI;
8. Microsoft Windows Embedded 8.1 Industry Enterprise (x86) running on an HP Compaq Pro 6305 with AES-NI;
9. Microsoft Windows 8.1 Enterprise (x64) running on a Dell PowerEdge SC440 without AES-NI;
10. Microsoft Windows Embedded 8.1 Industry Enterprise (x64) running on a Dell PowerEdge SC440 without AES-NI;
11. Microsoft Windows Server 2012 R2 (x64) running on a Dell PowerEdge SC440 without AES-NI;
12. Microsoft Windows Storage Server 2012 R2 (x64) running on a Dell PowerEdge SC440 without AES-NI;
13. Microsoft Windows 8.1 Enterprise (x64) running on a Dell Dimension E521 without AES-NI;

14. Microsoft Windows Embedded 8.1 Industry Enterprise (x64) running on a Dell Dimension E521 without AES-NI;
15. Microsoft Windows Server 2012 R2 (x64) running on a Dell Dimension E521 without AES-NI;
16. Microsoft Windows Storage Server 2012 R2 (x64) running on a Dell Dimension E521 without AES-NI;
17. Microsoft Windows 8.1 Enterprise (x64) running on an Intel Core i7 with AES-NI running on an Intel Maho Bay;
18. Microsoft Windows Embedded 8.1 Industry Enterprise (x64) running on an Intel Core i7 with AES-NI running on an Intel Maho Bay;
19. Microsoft Windows Server 2012 R2 (x64) running on an Intel Core i7 with AES-NI running on an Intel Maho Bay;
20. Microsoft Windows Storage Server 2012 R2 (x64) running on an Intel Core i7 with AES-NI running on an Intel Maho Bay;
21. Microsoft Windows 8.1 Pro (x64) running on an Intel x64 Processor with AES-NI running on a Microsoft Surface Pro;
22. Microsoft Windows 8.1 Pro (x64) running on an Intel i5 with AES-NI running on a Microsoft Surface Pro 2;
23. Microsoft Windows 8.1 Enterprise (x64) running on an HP Compaq Pro 6305 with AES-NI;
24. Microsoft Windows Embedded 8.1 Industry Enterprise (x64) running on an HP Compaq Pro 6305 with AES-NI;
25. Microsoft Windows Server 2012 R2 (x64) running on an HP Compaq Pro 6305 with AES-NI;
26. Microsoft Windows Storage Server 2012 R2 (x64) running on an HP Compaq Pro 6305 with AES-NI;
27. Microsoft Windows RT 8.1 (ARMv7 Thumb-2) running on an NVIDIA Tegra 3 Tablet;
28. Microsoft Windows RT 8.1 (ARMv7 Thumb-2) running on a Microsoft Surface RT;
29. Microsoft Windows RT 8.1 (ARMv7 Thumb-2) running on a Microsoft Surface 2;
30. Microsoft Windows RT 8.1 (ARMv7 Thumb-2) running on a Qualcomm Tablet;
31. Microsoft Windows Phone 8.1 (ARMv7 Thumb-2) running on a Qualcomm Snapdragon S4 running on a Windows Phone 8.1;
32. Microsoft Windows Phone 8.1 (ARMv7 Thumb-2) running on a Qualcomm Snapdragon 400 running on a Windows Phone 8.1;
33. Microsoft Windows Phone 8.1 (ARMv7 Thumb-2) running on a Qualcomm Snapdragon 800 running on a Windows Phone 8.1;
34. Microsoft Windows 8.1 Enterprise (x64) running on a Dell Inspiron 660s without AES-NI and with PCLMULQDQ and SSSE 3;
35. Microsoft Windows Embedded 8.1 Industry Enterprise (x64) running on a Dell Inspiron 660s without AES-NI and with PCLMULQDQ and SSSE 3;
36. Microsoft Windows Server 2012 R2 (x64) running on a Dell Inspiron 660s without AES-NI and with PCLMULQDQ and SSSE 3;
37. Microsoft Windows Storage Server 2012 R2 (x64) running on a Dell Inspiron 660s without AES-NI and with PCLMULQDQ and SSSE 3;
38. Microsoft Windows 8.1 Enterprise (x64) running on an Intel Core i5 with AES-NI and with PCLMULQDQ and SSSE 3 running on a Microsoft Surface Pro 2;
39. Microsoft Windows Embedded 8.1 Industry Enterprise (x64) running on an Intel Core i7 with AES-NI and with PCLMULQDQ and SSSE 3 running on an Intel Maho Bay;
40. Microsoft Windows Server 2012 R2 (x64) running on an Intel Core i7 with AES-NI and with PCLMULQDQ and SSSE 3 running on an Intel Maho Bay;

41. Microsoft Windows Storage Server 2012 R2 (x64) running on an Intel Core i7 with AES-NI and with PCLMULQDQ and SSSE 3 running on an Intel Maho Bay;
42. Microsoft Windows 8.1 Enterprise (x64) running on an HP Compaq Pro 6305 with AES-NI and with PCLMULQDQ and SSSE 3;
43. Microsoft Windows Embedded 8.1 Industry Enterprise (x64) running on an HP Compaq Pro 6305 with AES-NI and with PCLMULQDQ and SSSE 3;
44. Microsoft Windows Server 2012 R2 (x64) running on an HP Compaq Pro 6305 with AES-NI and with PCLMULQDQ and SSSE 3;
45. Microsoft Windows Storage Server 2012 R2 (x64) running on an HP Compaq Pro 6305 with AES-NI and with PCLMULQDQ and SSSE 3;
46. Windows Server 2012 R2 (x64) running on a Microsoft StorSimple 8100 with an Intel Xeon E5-2648L without AES-NI;
47. Windows Server 2012 R2 (x64) running on a Microsoft StorSimple 8100 with an Intel Xeon E5-2648L with AES-NI;
48. Microsoft Windows 8.1 Pro (x64) running on an Intel Core i7 with AES-NI and with PCLMULQDQ and SSSE 3 running on a Microsoft Surface Pro 3;
49. Azure StorSimple Virtual Array Windows Server 2012 R2 on Hyper-V 6.3 on Windows Server 2012 R2 (x64) running on a Dell Precision Tower 5810 with PAA;
50. Azure StorSimple Virtual Array Windows Server 2012 R2 on VMware Workstation 12.5 on Windows Server 2012 R2 (x64) running on a Dell XPS 8700 with PAA

BitLocker Windows OS Loader maintains FIPS 140-2 validation compliance (according to FIPS 140-2 PUB Implementation Guidance G.5) on the following platforms:

x86 Microsoft Windows 8.1
x86 Microsoft Windows 8.1 Pro

x64 Microsoft Windows 8.1
x64 Microsoft Windows Server 2012 R2 Datacenter

x64-AES-NI Microsoft Windows 8.1
x64-AES-NI Microsoft Windows Server 2012 R2 Datacenter

1.4 Cryptographic Boundary

The software binary that comprises the cryptographic boundary for Windows OS Loader is Winload or Winload.efi depending on the CPU architecture. The Crypto boundary is also defined by the enclosure of the computer system, on which Windows OS Loader is to be executed. The physical configuration of Windows OS Loader, as defined in FIPS-140-2, is multi-chip standalone.

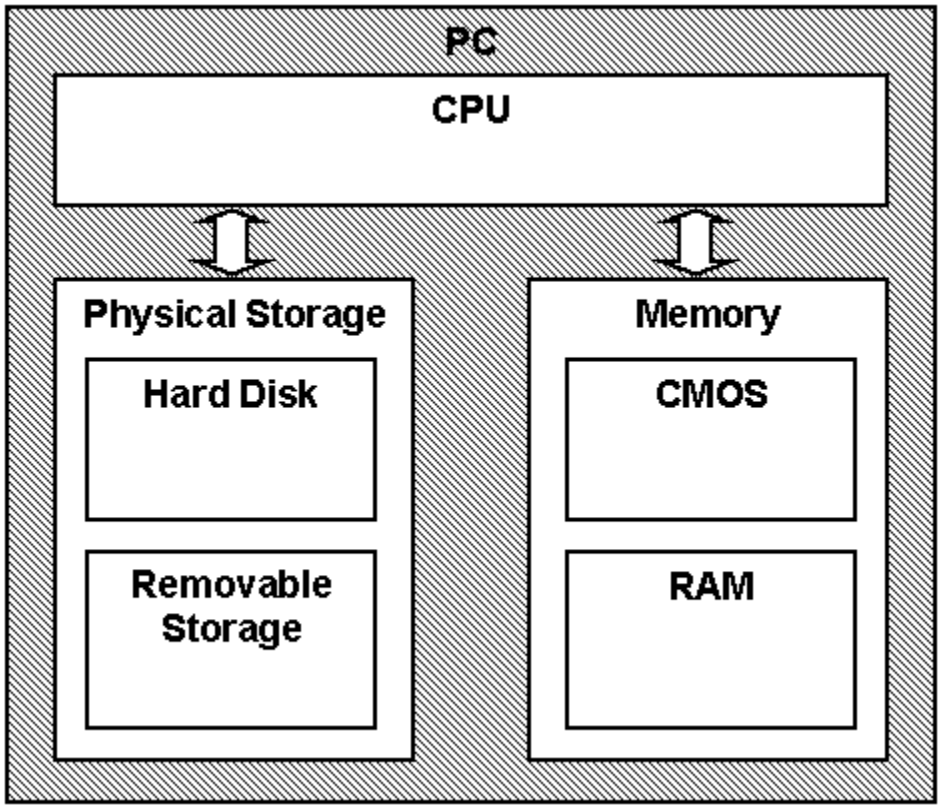
2 Security Policy

Windows OS Loader operates under several rules that encapsulate its security policy.

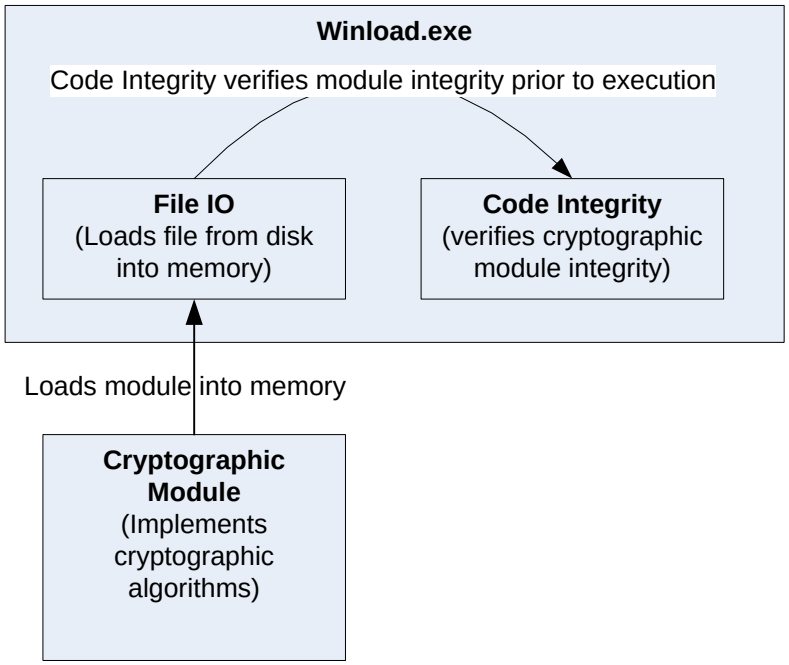
- Windows OS Loader is validated on the platforms listed in Section 1.3.

- Windows OS Loader operates in FIPS mode of operation only when used with the FIPS validated version of Windows 8.1 OEs Boot Manager (bootmgr) validated to FIPS 140-2 under Cert. #2351, respectively, operating in FIPS mode.
- Windows 8.1 OEs are operating systems supporting a “single user” mode where there is only one interactive user during a logon session.
- Windows OS Loader is only in its Approved mode of operation when Windows is booted normally, meaning Debug mode is disabled and Driver Signing enforcement is enabled.
- The Debug mode status and Driver Signing enforcement status can be viewed by using the bcdedit tool.

The following diagram illustrates the master components of the Windows OS Loader module:



The following diagram illustrates Windows OS Loader module interaction with other cryptographic modules:



- Windows OS Loader verifies the integrity of multiple kernel mode crypto modules. This verification relies on RSA 2048-bit signature verification using SHA-256. If the verification fails, the modules are not loaded into memory, and this will prevent Windows from booting. The following binaries are verified in this manner:
  - CI.DLL
  - CNG.SYS
- Windows OS Loader also verifies the integrity of other kernel mode drivers outside of the set of Windows crypto modules. This verification may use other supported RSA modulus sizes (e.g.: 1024 and 3072) and other hash algorithms (e.g.: SHA-1, SHA-384, and SHA-512).

2.1 FIPS 140-2 Approved Algorithms

Windows OS Loader implements the following FIPS-140-2 Approved algorithms:

- FIPS 186-4 RSA PKCS#1 (v1.5) digital signature verification (Cert. #1494)
  - RSA signature verification with 1024-bit keys and SHA-1 message digest
  - RSA signature verification with 2048-bit keys and SHA-256 message digest
- FIPS 180-4 SHS (SHA-1, SHA-256, SHA-384, SHA-512) (Cert. #2396)
- FIPS 197 AES-128, AES-192, and AES-256 in ECB, CBC, CFB8, CFB128, and CTR modes (Cert. #2832)
- SP 800-38B and SP 800-38C AES-128, AES-192, and AES-256 in CCM and CMAC modes (Cert #2832)
- SP 800-38D AES-128, AES-192, and AES-256 GCM decryption and GMAC (Cert #2832)

2.2 Non-Approved Algorithms

Windows OS Loader also has a legacy implementation of MD5[1] for backwards compatibility with the verification of the certificate chain of old certificates that might have been used by certificate authorities (CAs) to sign certificates on kernel mode drivers outside of Windows. This legacy implementation of MD5 is not used for checking the integrity of this cryptographic module nor any other Windows cryptographic module. Windows OS Loader has an NDRNG that is a non-Approved, but allowed algorithm.

2.3 Cryptographic Bypass

Cryptographic bypass is not supported by Windows OS Loader.

2.4 Machine Configurations

Windows OS Loader was tested using the machine configurations listed in Section 1.3 - Validated Platforms.

3 Operational Environment

The operational environment for Windows OS Loader is the Windows 8.1 OEs running on the software and hardware configurations listed in Section 1.3 - Validated Platforms.

Windows OS Loader services are only available before the startup of the operating system. This is done inside the Trusted Computing Base (TCB).

4 Integrity Chain of Trust

4.1 Conventional BIOS and UEFI without Secure Boot Enabled

Boot Manager is the start of the chain of trust. It cryptographically checks its own integrity during its startup. It then cryptographically checks the integrity of the Windows OS Loader before starting it. The Windows OS Loader then checks the integrity of the Code Integrity crypto module, the operating system kernel, and other boot stage binary images. An RSA signature with a 2048-bit key and SHA-256 message digest are used.

4.2 UEFI with Secure Boot Enabled

On UEFI systems with Secure Boot enabled, Boot Manager is still the OS binary from which the integrity of all other OS binaries is rooted, and it does cryptographically check its own integrity. However, Boot Manager's integrity is also checked and verified by the UEFI firmware, which is the root of trust on Secure Boot enabled systems. An RSA signature with a 2048-bit key and SHA-256 message digest are used.

[1] MD5 is not allowed for usage in FIPS mode.

5 Ports and Interfaces

5.1 Control Input Interface

The Windows OS Loader Control Input Interface is the set of internal functions responsible for intercepting control input. These functions are:

- BlBdInitialize – Reads the system status to determine if a boot debugger is attached.
- OslMain – This function receives and parses the Boot Application parameters, which are passed to the module when execution is passed from Boot Manager.
- BlInitializeLibrary – Performs the parsing Boot Application parameters.
- BlXmiRead – Reads the operator selection from the Winload user interface.

5.2 Status Output Interface

The Status Output Interface is the BlXmiWrite function that is responsible for displaying the integrity verification errors to the screen. The Status Output Interface is also defined as the BlLogData responsible for writing the name of the corrupt driver to the bootlog.

5.3 Data Output Interface

The Data Output Interface is represented by the OslArchTransferToKernel function and the AhCreateLoadOptionsString function. OslArchTransferToKernel is responsible for transferring the execution from Winload to the initial execution point of the Windows 8.1 OEs kernel. Data exits the module in the form of the initial instruction address of the Windows 8.1 OEs kernel.

Data exits the module from the AhCreateLoadOptionsString function in the form of boot application parameters passed to the Windows 8.1 OEs kernel.

5.4 Data Input Interface

The Data Input Interface is represented by the BlFileReadEx function and the BlDeviceRead function. BlFileReadEx is responsible for reading the binary data of unverified components from the computer hard drive. In addition the BitLocker Full Volume Encryption Key (FVEK) can also be entered into the module over the module's data input interface. BlDeviceRead is responsible for reading data directly from devices.

6 Specification of Roles

Windows OS Loader supports both User and Cryptographic Officer roles (as defined in FIPS-140-2). Both roles have access to all services implemented in Windows OS Loader. The module does not implement any authentication services. Therefore, roles are assumed implicitly by booting the Windows 8.1 OEs operating systems.

6.1 Maintenance Roles

Maintenance roles are not supported.

6.2 Multiple Concurrent Interactive Operators

There is only one interactive operator in Single User Mode. When run in this configuration, multiple concurrent interactive operators are not supported.

7 Services

Windows OS Loader services are described below. It does not export any cryptographic functions. The only service triggered by the User/Cryptographic Officer is zeroization. Everything else is started by the Boot Manager. The only service for which there is any output to the User/Cryptographic Officer is the Show Status service.

1. **Load the OS** - The main service is to load the Windows 8.1 OEs operating system kernel (ntoskrnl.exe) and other boot stage binary image files, including Code Integrity cryptographic module (ci.dll), after it validates their integrity using its cryptographic algorithm implementations using the FIPS 140-2 approved algorithms mentioned below. After the verified kernel and boot stage binary image files, including Code Integrity, are loaded, Windows OS Loader passes the execution control to the kernel and it terminates its own execution. In addition to this service, Windows OS Loader also provides status and self-test services. The Crypto officer and User have access to all services WINLOAD supports. If the integrity of the kernel or Code Integrity is not verified, Windows OS Loader does not transfer the execution to the kernel.
2. **Show Status –** The module provides a show status service that is automatically executed by the module to provide the status response of the module either via output to the GPC monitor or to log files.
3. **Self-Tests** - The module provides a power-up self-tests service that is automatically executed when the module is loaded into memory.
4. **Zeroization** (see Section 9 Cryptographic Key Management)
5. **Entropy** - Windows OS Loader also implements an entropy source which is used by subsequently-loaded Windows components. This source gathers entropy from the following sources:
    a. The contents of the registry value HKLM\System\RNG\Seed, which is written by the Kernel Mode Cryptographic Primitives Library (cng.sys) during its normal operation.
    b. The contents of the registry value HKLM\System\RNG\ExternalEntropy, which can be populated by system administrators. This value is overwritten after reading, to ensure that it does not get reused.
    c. If a Trusted Platform Module (TPM) is available, the output of a TPM_GetRandom call to the TPM.
    d. The current system time.
    e. The contents of the OEM0 ACPI table in the machine firmware.
    f. If the CPU supports the RDRAND CPU instruction, the output of such an operation.
    g. If booted from UEFI firmware which supports the UEFI entropy protocol, the output of the UEFI random number generator.
    h. The CPU timings.

These inputs are then combined using SHA-512, and the entropy source is conditioned using a non-Approved RNG. From this NDRNG, a block of output bytes is passed to the Windows kernel at boot time. This block of output bytes is used by CNG.SYS as one of its entropy sources.

The Entropy service is considered a "Non-Approved, but Allowed" service. It is only "Allowed" in the context that it is being used by another FIPS 140-2 Approved module, i.e., the Kernel Mode Cryptographic Primitives Library (cng.sys), in order to provide entropy to one of the FIPS-approved DRBGs.

6. **Legacy Certificate Chain Authentication** (non-FIPS Approved service; see Section 2.2 Non-Approved Algorithms)

The following table maps the services to their corresponding algorithms and critical security parameters (CSPs).

Table 1

Service	Algorithms	CSPs	Invocation
Load the OS	FIPS 186-4 RSA PKCS#1 (v1.5) verify with public key FIPS 180-4 SHS: SHA-256 hash SHA-512 hash AES CBC 128 and 256 bits AES CCM 256 bits	Asymmetric Public keys (to verify digital signatures of OS components) Full Volume Encryption Key (FVEK) (to load the BitLocker encrypted data containing the OS)	This service is fully automatic. The User / Cryptographic Officer does not take any actions to start this service.
Show Status	None	None	This service is fully automatic. The User / Cryptographic Officer does not take any actions to start this service.
Self-Tests	FIPS 186-4 RSA PKCS#1 (v1.5) verify with public key KAT and signature verification KAT FIPS 180-4 SHS: SHA-1 KAT SHA-256 KAT SHA-512 KAT AES CBC KAT AES CCM KAT	None	This service is fully automatic. The User / Cryptographic Officer does not take any actions to start this service.
Zeroization	None	None	See section 9.
Entropy	SHA-512	None	This service is fully automatic. The User / Cryptographic Officer

			does not take any actions to start this service.
Legacy certificate chain authentication (non-FIPS Approved service)	MD5 (non-FIPS Approved algorithm)	Asymmetric Public keys	This service is fully automatic. The User / Cryptographic Officer does not take any actions to start this service.

7.1 Show Status Services

The User and Cryptographic Officer roles have the same Show Status functionality, which is, for each function, the status information is returned to the caller as the return value from the function.

7.2 Self-Test Services

The User and Cryptographic Officer roles have the same Self-Test functionality, which is described in Section 10 Self-Tests.

7.3 Service Inputs / Outputs

The User and Cryptographic Officer roles have service inputs and outputs as specified in Section 5 Ports and Interfaces.

8 Authentication

The Windows OS Loader does not implement any authentication services. The User and Cryptographic Officer roles are assumed implicitly by booting the Windows operating system.

9 Cryptographic Key Management

Windows OS Loader does not store any secret or private cryptographic keys across power-cycles. However, it does use two AES keys in support of the BitLocker feature. These keys are:

- Full Volume Encryption Key (FVEK) - 128 or 256-bit AES key that is used to decrypt data on disk sectors of the hard drive.

This key is stored in memory and is zeroized by power-cycling the OS.

The key enters the module via machine memory; a pointer to this memory is provided to Winload by Boot Manager after it verifies the integrity of Winload.

Windows OS Loader also uses the Microsoft root CA public key certificate stored on the computer hard disk to verify digital signatures using its implementation of RSA PKCS#1 (v1.5) verify. This public key is available to both roles.

9.1 Access Control Policy

All the keys (mentioned above) are accessed only by the Windows OS Loader service that loads the operating system kernel (ntoskrnl.exe) and other boot stage binary image files, including Code Integrity. This service only has execute access to the keys mentioned above. For this reason, an access control policy table is not included in this document.

10 Self-Tests

10.1 Power-On Self-Tests

Windows OS Loader performs the following power-on (startup) self-tests:

- SHS (SHA-1) Known Answer Test
- SHS (SHA-256) Known Answer Test
- SHS (SHA-512) Known Answer Test
- RSA PKCS#1 (v1.5) verify with public key
  - RSA signature with 1024-bit key and SHA-1 message digest
  - RSA signature with 2048-bit key and SHA-256 message digest
- AES-CBC Encrypt/Decrypt Known Answer Tests
- AES-CCM Encrypt/Decrypt Known Answer Tests

If the self-test fails, the module will not load and status will be returned. If the status is not STATUS_SUCCESS, then that is the indicator a self-test failed.

10.2 Conditional Self-Tests

Windows OS Loader performs the following conditional self-test:

- Non-Approved RNG CRNGT (entropy pool)

11 Design Assurance

The secure installation, generation, and startup procedures of this cryptographic module are part of the overall operating system secure installation, configuration, and startup procedures for the Windows 8.1 OEs. The various methods of delivery and installation for each product are listed in the following table.

Product	Delivery and Installation Method
Windows 8.1	• DVD • Pre-installed on the computer by OEM • Download that updates Windows 8
Windows Server 2012 R2	• DVD • Pre-installed on the computer by OEM • Download that updates Windows Server 2012

Windows Storage Server 2012 R2	• Pre-installed by the OEM (Third party)
Surface Pro 3, Surface Pro 2, Surface Pro, Surface 2, Surface	• Pre-installed by the OEM (Microsoft)
Windows RT 8.1	• Pre-installed on the device by OEM • Download that updates Windows RT
Windows Phone 8.1	• Pre-installed on the device by OEM or mobile network operator • Download that updates Windows 8
Windows Embedded 8.1 Industry Enterprise	• Pre-installed by the OEM (Third party)
StorSimple 8000 Series	• Pre-installed by the OEM (Third party)
Azure StorSimple Virtual Array Windows Server 2012 R2	• Pre-installed by Azure

After the operating system has been installed, it must be configured by enabling the "System cryptography: Use FIPS compliant algorithms for encryption, hashing, and signing" policy setting followed by restarting the system. This procedure is all the crypto officer and user behavior necessary for the secure operation of this cryptographic module.

An inspection of authenticity of the physical medium can be made by following the guidance at this Microsoft web site: http://www.microsoft.com/en-us/howtotell/default.aspx

The installed version of Windows 8.1 OEs must be verified to match the version that was validated. See Appendix A for details on how to do this.

For Windows Updates, the client only accepts binaries signed by Microsoft certificates. The Windows Update client only accepts content whose SHA-2 hash matches the SHA-2 hash specified in the metadata. All metadata communication is done over a Secure Sockets Layer (SSL) port. Using SSL ensures that the client is communicating with the real server and so prevents a spoof server from sending the client harmful requests. The version and digital signature of new cryptographic module releases must be verified to match the version that was validated. See Appendix A for details on how to do this.

12 Mitigation of Other Attacks

The following table lists the mitigations of other attacks for this cryptographic module:

Algorithm	Protected Against	Mitigation	Comments
SHA1	Timing Analysis Attack	Constant Time Implementation	
	Cache Attack	Memory Access pattern is independent of any confidential data	
SHA2	Timing Analysis Attack	Constant Time Implementation	
	Cache Attack	Memory Access pattern is independent of any confidential data	
AES	Timing Analysis Attack	Constant Time Implementation	
	Cache Attack	Memory Access pattern is independent of any confidential data	Protected Against Cache attacks only when used with AES NI

13 Security Levels

The security level for each FIPS 140-2 security requirement is given in the following table.

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	2
Mitigation of Other Attacks	1

14 Additional Details

For the latest information on Microsoft Windows, check out the Microsoft web site at:

http://windows.microsoft.com

For more information about FIPS 140 evaluations of Microsoft products, please see:

http://technet.microsoft.com/en-us/library/cc750357.aspx

15 Appendix A – How to Verify Windows Versions and Digital Signatures

15.1 How to Verify Windows Versions

The installed version of Windows 8.1 OEs must be verified to match the version that was validated using one of the following methods:

1. The ver command
   a. From Start, open the Search charm.
   b. In the search field type "cmd" and press the Enter key.
   c. The command window will open with a "C:\>" prompt.
   d. At the prompt, type "ver" and press the Enter key.
   e. You should see the answer "`Microsoft Windows [Version 6.3.9600]`".
2. The systeminfo command
   a. From Start, open the Search charm.
   b. In the search field type "cmd" and press the Enter key.
   c. The command window will open with a "C:\>" prompt.
   d. At the prompt, type "systeminfo" and press the Enter key.
   e. Wait for the information to be loaded by the tool.
   f. Near the top of the output, you should see:

```
OS Name:                   Microsoft Windows 8.1 Enterprise
OS Version:                6.3.9600 N/A Build 9600
OS Manufacturer:           Microsoft Corporation
```

If the version number reported by the utility matches the expected output, then the installed version has been validated to be correct.

15.2 How to Verify Windows Digital Signatures

After performing a Windows Update that includes changes to a cryptographic module, the digital signature and file version of the binary executable file must be verified. This is done like so:

1. Open a new window in Windows Explorer.
2. Type “C:\Windows\” in the file path field at the top of the window.
3. Type the cryptographic module binary executable file name (for example, “CNG.SYS”) in the search field at the top right of the window, then press the Enter key.
4. The file will appear in the window.
5. Right click on the file’s icon.
6. Select Properties from the menu and the Properties window opens.
7. Select the Details tab.
8. Note the File version Property and its value, which has a number in this format: x.x.xxxx.xxxxx.
9. If the file version number matches one of the version numbers that appear at the start of this security policy document, then the version number has been verified.
10. Select the Digital Signatures tab.
11. In the Signature list, select the Microsoft Windows signer.
12. Click the Details button.
13. Under the Digital Signature Information, you should see: “This digital signature is OK.” If that condition is true then the digital signature has been verified.