



# AMI Software Utility User Guide

## Aptio 5.x AFU User Guide

**Document Revision 1.01**

**December 3, 2019**



Public Document  
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## Document Information

### Purpose

This document provides information to use the Aptio 5.x AFU for updating system BIOS.

### Audience

Generic BIOS Engineers, OEM Engineers, and Aptio Customers.

### Change History

Date	Revision	Description
2019-10-24	1.00	This is the PUB version, this first draft is based on NDA version 1.26 to generate.
2019-12-03	1.01	Change the text description of RLC: E to “entire BIOS region”.

## Introduction

### Overview

**A** FU (AMI Firmware Update) is a package of utilities used to update the system BIOS under various operating systems. AFU only works for APTIO with SMI FLASH support.

### AFU APTIO Features

This list of features is supported by command line, command prompt, EFI Shell, or BSD/Linux shell.

- Read system ROM image
- Flash ROM image
- Command line operating

### Notifications

- BIOS update may have some potential risks so that AMI suggests closing all programs users are processing and stopping the anti-virus software temporarily!
- Please DO NOT power off or restart the computer device when the system is reading BIOS or updating BIOS!
- To avoid failing in BIOS update, please DO NOT remove the hard disk or USB or any devices. When users update BIOS in any inappropriate way, that incorrect behavior will result in BIOS crash and the computer devices cannot be powered on.

### Requirements

#### Supported Operating System

AFU is supported by the following operating systems:

- Microsoft® Windows® Server 2012 R2
- Microsoft® Windows® 7
- Microsoft® Windows® 8
- Microsoft® Windows® 8.1
- Microsoft® Windows® Server 2016
- Microsoft® Windows® Server 2019
- Microsoft® Windows® 10
- Microsoft® Windows® PE

- EFI Shell Environment
- BSD
- Linux(\*1)
  - ✓ *Ubuntu (18.10)*
  - ✓ *Red Hat*
  - ✓ *Fedora (29)*
  - ✓ *openSUSE*
  - ✓ *Debian (9.6)*
  - ✓ *CentOS (7.3)*

**Note:**

1. Linux notes:

a. On the Linux Xen environment, AFULNX must be executed in host desktop (Domain 0) of the virtual machine.

b. The version of Linux distribution listed which version that AMI testing.

2. Due to System IO access, Windows version requires administrator privileges and executes with "Run as Administrator" option.

3. Due to System IO access, Linux version requires root authority.

4. AFUWIN still can be run while using unsupported Microsoft Windows versions.

## Firmware Requirements

- Compatible with AptioV.
- Please contact AMI for more details.

## AFU Operation

### Overview

The AFU operation mode includes all of the AFU features such as saving current ROM image to file, getting and displaying ROM ID from BIOS ROM file.

An example of AFUEFIX64 that getting and displaying ROM ID from BIOS ROM file command screen are shown below:

```
UEFI Interactive Shell v2.0
EDK II
UEFI v2.40 (American Megatrends, 0x0005000B)
Mapping table
FS0: Alias(s):F6:
    VenHw(58C518B1-76F3-11D4-BCEA-0080C73C8881)/VenHw(0C95A935-A006-11D4-B
CFA-0080C73C8881,00000000)
FS1: Alias(s):F7:
    VenHw(58C518B1-76F3-11D4-BCEA-0080C73C8881)/VenHw(0C95A935-A006-11D4-B
CFA-0080C73C8881,01000000)
BLK0: Alias(s):
    VenHw(58C518B1-76F3-11D4-BCEA-0080C73C8881)/VenHw(0C95A928-A006-11D4-B
CFA-0080C73C8881,00000000)
BLK1: Alias(s):
    VenHw(58C518B1-76F3-11D4-BCEA-0080C73C8881)/VenHw(0C95A92F-A006-11D4-B
CFA-0080C73C8881,01000000)
Press ESC in 5 seconds to skip startup.nsh or any other key to continue.
Shell> fs0:
FS0:\> AFUEFIX64 BIOS.rom /U_
```

### Commands and Options



The following list is to offer you an overview of the commands and options provided by AFU. The content can also be found in help information. A more detailed usage of the commands and options will be explained in the next chapter.

## Usage

*AfuEfix64 <BIOS ROM File Name> [Option 1] [Option 2] ...*

Or

*AfuEfix64 < Input or Output File Name > <Command>*

Or

*AfuEfix64 <Command>*

### **BIOS ROM File Name**

The mandatory field is used to specify path/filename of the BIOS ROM file with extension.

## Commands

The mandatory field is used to select an operation mode.

- /FV                      Copy Secure FV to EFI(\*2)
- /O                        Save current ROM image to file
- /U                        Get and display ROM ID from BIOS ROM file
- /S                        Refer to Option: /S
- /D                        Verification test of given ROM File without flashing BIOS
- /A:                        Refer to Option: /A:
- /OAD                     Refer to Option: /OAD
- /CLNEVNLOG            Clear Event Log

## Options

The optional field is used to supply more information for flashing BIOS ROM. Following lists the supported optional parameters and format:

- /SSB: Send String to BIOS. For example, /SSB:{xxx}(\*3)
- /CMD: Send special command to BIOS. /CMD:{xxx}
- /OEMCMD: Send special value to BIOS. /OEMCMD:xxx
- /DPC Don't Check Aptio 4 and Aptio 5 platform
- /PW: Input password for file
- /MEUL: Program ME Entire Firmware Block, which supports Production.BIN and PreProduction.BIN files
- /Q Silent execution
- /X Do not check ROM ID
- /ATR: Select AMI Twins ROM to flash. For example, /ATR:D or ATR:U(\*3)
- /ATR Select Another Tank ROM to flash. (\*3)
- /S Display current system's ROMID
- /JBC Don't Check AC adapter and battery
- /CLRCFG Program without preserving setup configuration
- /BCPALL Save all question values before flash
- /HOLEOUT: Save specific ROM Hole according to given RomHole GUID
- /SP Preserve Setup setting
- /R Preserve all SMBIOS structures during programming
- /Rn Preserve SMBIOS type N during programming (n=0-255)
- /B Program Boot Block
- /P Program main bios image
- /N Program NVRAM
- /K Program all non-critical blocks
- /Kn Program n'th non-critical block (n=0-15)
- /RLC: To set default option for Rom layout change (E: Entire BIOS region, A: Abort, F: Force)
- /HOLE: Update specific ROM Hole according to RomHole GUID
- /L Program all ROM Holes
- /Ln Program n'th ROM Hole only (n=0-15)

- /ECUF Update EC BIOS when newer version is detected
- /E Program Embedded Controller block
- /ME Program ME Entire Firmware Block
- /A: OEM Activation file
- /OAD Delete OEM Activation Key
- /CLNEVNLOG Clear Event Log
- /CAPSULE Override Secure Flash policy by Capsule
- /RECOVERY Override Secure Flash policy by Recovery
- /RECOVERY:ESP Override Secure Flash policy by ESP Partition Recovery
- /EC Program Embedded Controller Block (Flash Type)
- /REBOOT Reboot after programming
- /SHUTDOWN Shutdown after programming
- /FDR Flash Flash-Descriptor Region (\*1)
- /GBER Flash GBE Region (\*1)
- /MER Flash Entire ME Region (\*1)
- /OPR Flash Operation Region of SPS (\*1)
- /PDR Flash PDR Region (\*1)

**Note:**

\*1: If BIOS ME Module reports these commands, AFU will show this command.

\*2: If AFU is running on Linux OS and Windows OS, AFU will show this command.

\*3: If BIOS Module support, AFU will show this command.

To use a command of generic AFU on the Specific platform, please refer the help menu (/?) in generic AFU.

## Rules

- Any parameter enclosed by < > is a mandatory field.
- Any parameter enclosed by [ ] is an optional field.
- <Commands> cannot co-exist with any [Options]. They are /O, /U.
- Main BIOS image is default flashing area if no any options present.
- [/REBOOT], [/X], and [/S] will enable [/P] function automatically.
- If [/B] present alone, there is only the Boot Block area to be updated.
- If [/N] present alone, there is only the NVRAM area to be updated.
- If [/E] present alone, there is only the Embedded Controller block to be updated.
- All options are case-insensitive and no ordering.

## Usage

### Overview

The AFU offers the following basic command and option usages:

- `AfuEfix64 <Input or Output File Name> [Option 1] [Option 2] ...`
- `AfuEfix64 <Input or Output File Name> <Command>`
- `AfuEfix64 <Command>`

Other usages which are not mentioned in help are:

- `AfuEfix64 <ROM Hole File Name> <ROM Hole Option>:<ROM Hole GUID>`
- `AfuEfix64 <BIOS ROM File Name> <Option><Number>`
- `AfuEfix64 <Option /A:> <OEM Activation Key Bin File Name>`

These usages are explained in more detail in this chapter.

### **AfuEfix64 <Input or Output File Name> [Option 1] [Option 2] ...**

The user could put no option or combine multiple options in one command line. Commands cannot be combined in command line like options unless the command is categorized as both a command and an option, such as `/S` and `/A:`.

For option combination case, AFU will check its option priority list and execute the options according to the priority order. Three examples of this usage are provided below.

***AfuEfix64 <Input BIOS ROM File Name>***

Where BIOS ROM File Name, the mandatory field is used to specify path/filename of the BIOS ROM file with extension. This command line would trigger AFU to run the default setting which flashes the system Main Block with the specified BIOS ROM File, so the default behavior will be same as "AfuEfix64 <Input BIOS ROM File Name> /P".

***AfuEfix64 <Input BIOS ROM File Name> /D /S***

Where Output BIOS ROM File Name, the mandatory field is used to specify path/filename of the BIOS ROM file with extension. /D is to verify the current BIOS and the BIOS ROM File, and /S, which is categorized as a command and also an option, gets and displays the current system's ROM ID.

***AfuEfix64 <Input BIOS ROM File Name> /P /B /N /REBOOT***

Where BIOS ROM File Name, the mandatory field is used to specify path/filename of the BIOS ROM file with extension. This command line is to flashing current BIOS by BIOS ROM file. /P /B /N are to specify that the flashing regions are Main Block, Boot Block and NVRAM. /REBOOT is to specify that reboot action will be performed in this execution. AFU would execute the options in the order of /B, /P, /N and then reboot the system at the end. The order of execution is determined by AFU design.

***AfuEfix64 <ME File Name> /ME***

Where ME File Name is used for specifying path/filename of the ME file with extension. This command line programs entire ME block with the specified ME file.

## **AfuEfix64 <Input or Output File Name> <Command>**

AFU can only execute one command at a time and it does not accept combinations of command and option in one command line except those can be both command and option. Three examples of this usage are provided below.

### ***AfuEfix64 <Output BIOS ROM File Name> /O***

Where BIOS ROM File Name, the mandatory field is used to specify path/filename of the BIOS ROM file with extension. This command line saves the current ROM image to a file.

### ***AfuEfix64 <Input BIOS ROM File Name> /U***

Where BIOS ROM File Name is used to specify path/filename of the BIOS ROM file with extension. This command line gets and displays the ROM ID from the specified BIOS ROM file.

## **AfuEfix64 <Command>**

This command usage is for some commands which do not require inputting any file to complete the execution. Usually, this type of commands accesses the current BIOS only. An example of this usage is provided:

### ***AfuEfix64 /S***

This command line gets and displays the ROM ID of the current BIOS in the system.

## **AfuEfix64 <ROM Hole File Name> <ROM Hole Option>:<ROM Hole GUID>**

This command usage is for outputting or flashing a certain ROM hole. For example, the command line for outputting a certain ROM hole whose GUID is 01234567- 89ab- cdef- 0123- 456789abcdef is as following:

***AfuEfix64 <Output ROM Hole File Name> /HOLEOUT:0123456789abcdef0123456789abcdef***

Where Output ROM Hole File Name is used to specify path/filename of the output ROM hole file with extension. The GUID after the option should not contain dashes or spaces in between.

Another example of flashing a certain ROM Hole whose GUID is 01234567- 89ab- cdef- 0123- 456789abcdef is as following:

***AfuEfix64 <ROM Hole File Name> /HOLE:0123456789abcdef0123456789abcdef***

Where ROM Hole File Name is used to specify path/filename of the ROM hole file with extension. Please discard dashes and spaces inside GUID line while typing.

## **AfuEfix64 <BIOS ROM File Name> <Option><Number>**

This command usage is for /Kn and /Ln options where n is indicating the numeric order of a certain non-critical block or ROM hole. For example, to program the 4<sup>th</sup> ROM hole, the command line could be:

***AfuEfix64 <BIOS ROM File Name> /L4***

Where BIOS ROM File Name is used to specify path/filename of the BIOS ROM file with the extension, and 4 is to specify that the 4<sup>th</sup> ROM hole is the one to perform /L operation.

The next chapter has more detail of the numbering rule of non-critical blocks and ROM holes.

## **AfuEfix64 <Option /A:> <OEM Activation Key Bin File Name>**

This command usage is for /A command which inserts a specific OEM activation key into the empty key inside current system BIOS. The command line is as follows:

***AfuEfix64 /A: <OEM Activation Key Bin File Name>***

Where OEM Activation Key Bin File Name is used to specify path/filename of the OEM activation key file with extension. Please make sure that the OEM Activation Key region is empty before inserting the key, or please perform /OAD command before insertion.



## Use case

### Overview

This chapter is to describe commands/options which require extra attention and to explain cases which may occur in certain unique scenarios.

### Preserving Setup Setting – /SP

/SP option is designed specifically for “OEM NVRAM/Setup Variable Preserve” module part of OFBD. If /SP is called, AFU would send SMI 0x26 twice to save setup setting before starting updating NVRAM and to restore setup setting after finishing updating NVRAM. Customer can customize their OFBD module to preserve certain NVRAM data when AFU flashes the NVRAM area. For example, there are two methods for preserving Setup Password:

#### Method 1

Enable PRESERVE\_PASSWORDS token – The BIOS will preserve its Setup password when AFU calls the SMIFlash module.

#### Method 2

Control through /SP command – Customer can port PreserveSetupPassword in OFBDSETUPStoreHandle and RestoreSetupPassword in OFBDSETUPRestoreHandle, and use /SP command to keep or not to keep the Setup Password while updating the NVRAM:

AfuEfix64 xxx.ROM /N /SP - keep Setup password

AfuEfix64 xxx.ROM /N - don't keep Setup password.

This feature needs more cooperations from BIOS side. To learn more about preserving setup data, please consult with your BIOS provider.

**Note:**

*/SP is not required when using the **BIOS Configuration Preserve** feature.*

## Preserving SMBIOS – /R and /Rn

If the SMBIOS data is stored in Main Block or Boot Block, AFU /R and /Rn options would take the responsibility to preserve the SMBIOS data. If the SMBIOS data is stored in NVRAM and BIOS project's token SMBIOS\_PRESERVE\_NVRAM = 0, the preservation process would take place at OFBD module. To know more about the detail of preserved data, please consult with your BIOS provider.

/R is used to preserve the whole SMBIOS data. To preserve a certain type of SMBIOS, please use /Rn. For example, to preserve SMBIOS Type 2 and Type 41 during BIOS flashing and the SMBIOS data is located in Boot Block, the command could be:

**AfuEfix64 <BIOS ROM File Name> /B /R2 /R41**

## Programming NVRAM Region – /N

Erasing NVRAM may cause important variables to lose. For the needs to preserve important variables, please check previous "Preserving Setup Setting - /SP" and later "Platform Level Data Model (PLDM)" sections.

## Programming Specific NCB Block – /Kn

/Kn command is designed to program a specific non-critical block or NCB block. AFU would search ROM and identify the first NCB Block found as K0, and the second one as K1, etc. Therefore, command /K2 would program the third NCB Block found by AFU.

## Programming Specific ROM Hole – /Ln

/Ln command is designed to program a specific ROM Hole. Each ROM Hole is identified in the following way: AFU would search for ROM Holes in the order of Boot Block area and Main Block area, and identify each ROM Hole in consecutive integers from 0 to 15. So, for example, /L1 is used to program the second ROM Hole found in ROM.

Scenarios:

- If a ROM contains two ROM Holes in Boot Block area and two in Main Block area, AFU would identify L0 and L1 for the two in Boot Block area and L2 and L3 for the two in Main Block area.
- If a ROM contains 2 ROM Holes in Boot Block area and none in Main Block area, AFU would only find 2 ROM Holes in total and identify them as L0 and L1.
- If a ROM contains no ROM Holes in Boot Block area and three in Main Block area, AFU would find nothing in Boot Block area and identify L0, L1 and L2 for the three ROM Holes in Main Block area.

## Secured Flash Update – /CAPSULE and /RECOVERY

For Secured BIOS, the command rule for programming the current BIOS is different. There are two more modes, Capsule Mode and Recovery Mode, which are different from the regular Runtime Mode mentioned in the previous contents. Unlike Runtime Mode where all the commands/options are supported, Capsule Mode and Recovery Mode only support /P, /B, /N, and /E options, or depending on the BIOS design. The following description explains how to program BIOS under these two modes.

To override Secure Flash policy and program the BIOS image in Capsule Mode, please use the command:

***AfuEfix64 <BIOS ROM File Name> /CAPSULE /P /B /N /E***

And to override Secure Flash policy and program the BIOS image in Recovery Mode, please use this command:

***AfuEfix64 <BIOS ROM File Name> /RECOVERY /P /B /N /E***

Where BIOS ROM File Name is used to specify path/filename of the BIOS ROM file with extension.

For more detail on Secure Flash, please consult with your BIOS provider.

## Send special command to BIOS – /CMD:{xxx}

Send the string between brackets to OFBD OEM CMD Checking Module. The string is corresponding to the string which is defined in BIOS by user.

## **Send special value to BIOS – /OEMCMD:xxx**

Send the value to OFBD OEM CMD Checking Module. The value is corresponding to the value which is defined in BIOS by user.

## **To set default option for ROM Layout Changed – /RLC:**

When AFU detects ROM layout change, AFU will hold the flash step and wait for users to input which command they need:

"/RLC:E" - This option will update entire BIOS region and exit.

"/RLC:A" - This option will be no ROM update.

"/RLC:F" - This option will be forcing to follow the command by user provided.

This command can input a default setting directly.

Normally, AFU will hold 5 seconds to be reconsidered by "continue" or "cancel". However, if users input the command /RLC: (E or A or F) and command /Q, AFU will not hold 5 seconds.

If AFU does not detect ROM layout change but users input this command, it will not be workable.

## **Don't Check AC adapter and battery – /JBC**

By default, AFU will perform power checking (AC adapter and battery checking). Users can use /JBC option to skip power checking. How AFU check power status?

<b>How AFU Check Power Status</b>  (Power: AFU won't know the power is from AC or battery)  (Status: AFU won't know the charge level, only know status)	⇒	a. By checking value stored in Embedded Controller (EC) firmware	⇒	Unable to find value, or No EC	⇒	Continue
			⇒	Value said "Status Normal"	⇒	Continue
			⇒	Value said "Status Abnormal"	⇒	Won't Flash
	⇒	b. Through OFBD module "AC/Battery Checking" module part	⇒	No OFBD, or too old to support	⇒	Continue
			⇒	OFBD returns "Status Normal"	⇒	Continue
			⇒	OFBD returns "Status Abnormal"	⇒	Won't Flash

There are 2 ways AFU check power status:

- By checking value stored in Embedded Controller (EC) firmware:  
By searching EC binary data start from 0xE000 and using "\$ECB" signature to find power status value.
- Through OFBD module "AC/Battery Checking" module part.

AFU will only perform (a) (b) for power checking. AFU will stop flash process if (a) or (b) return error. It will also show both error messages from (a) (b) and AFU error code "0x0D - BIOS Report Error."

AFU will keep executing without doing (a) (b) if no EC or no OFBD module "AC/Battery Checking" function.

"Does the tool exit if battery only?"

AFU won't know the power is from AC or battery. AFU will exit only when the return value of (a) or (b) is error. So AFU won't exit if "Battery only and return OK".

"Does it check the level of charge?"

AFU won't know the charge level, only know the power status "OK/Normal or Error/Abnormal" returned by (a) or (b).

## Linux Pre-Requisites

1. Log in Linux as root otherwise use sudo (if permitted).
2. The compiler suite (gcc) must be installed. If these packages are not installed, the driver CANNOT be built.
3. For most of the distributions, AFU will generate driver without any notification, if it doesn't exist you need to install kernel sources. Also if Initmem fails, Please follow point 4.
4. Kernel sources must be installed, \*CONFIGURED\*, and then compiled. Following are steps to do this:

- a. Find Running Kernel's Configuration File:

To configure the sources, simply change to the kernel source directory (typically **/lib/modules/\$(uname -r)/build**). If it doesn't exist, you need to install kernel source.

Typically, the reference configuration for the kernel can be found in the /boot directory with filename **'config'**, **'kernel.config'**, or **'vmlinuz-2.4.18-3.config'**. Type **'uname -a'** and use the configuration filename that best matches the output from **'uname -a'**. Also, check for **/dev/mem** directory existence. If it doesn't exist, you need to install kernel sources.

Normally it comes with the installation unless if the option is deselected.

On some distributions Red Hat, for instance, there is a config directory under **/lib/modules/\$(uname -r)/build**.

Copy this configuration file into the root of the Linux kernel source tree (usually it is **/lib/modules/\$(uname -r)/build**). This file must be renamed to **".config"**(dot config).

- b. Make Your AMI Flash Driver (**amifldr\_v\_mod.o**):

For most distribution, the command to build the driver is:

```
afulnx_32 /MAKEDRV
Or
afulnx_64 /MAKEDRV
```

If your Linux's kernel source tree is under **/lib/modules/\$(uname -r)/build**, instead of being in the default path '**/lib/modules/\$(uname -r)/build**', then add a KERNEL flag:

```
afulnx_32 /MAKEDRV KERNEL=/lib/modules/$(uname -r)/build
Or
afulnx_64 /MAKEDRV KERNEL=/lib/modules/$(uname -r)/build
```

If KERNEL is omitted, the default path is **/lib/modules/\$(uname -r)/build**.  
This should work for MOST distributions.

c. Make Your AMI Flash Driver from driver source files (amifldr\_mod.o):

Using command **/GENDRV**, it will generate driver source files to a specific directory.

```
afulnx_32 /GENDRV [Option 1] [Option 2]
Or
afulnx_64 /GENDRV [Option 1] [Option 2]
```

Where,

[Option 1]: Specific kernel source 'KERNEL=XXXX' same as the **/MAKEDRV**

[Option 2]: Specific output directory 'OUTPUT=XXXX'

Generate files as outlined below:

File Name	Description
amiwrap.c	Driver source code.
amiwrap.h	Driver header.
amifldr.o_shipped	Object file for the driver.
Makefile	Makefile

For most distribution, the command to build the driver is: **make**.

If your Linux's kernel source tree is under **/lib/modules/\$(uname -r)/build**, instead of being in the default path '**/lib/modules/\$(uname -r)/build**', then add a KERNEL flag:

```
make KERNEL=/lib/modules/$(uname -r)/build
```

If KERNEL is omitted, the default is **/lib/modules/\$(uname -r)/build**.  
This should work for MOST distributions.

d. Check Your Build:

Check the version of running Linux kernel with '**uname -r**'.

Check the version of **amifldr\_mod.o** with '**modinfo amifldr\_mod.o**'.

If they mismatch, you will need to select the correct configuration

File (.config), rebuild your kernel and then rebuild your driver as described in steps a, b, c, and d.

5. The Linux driver's case:

	Secure Boot Enabled	Secure Boot Disabled
<b>WSMT is supported</b>	Need Driver	No Need Driver
<b>Can access file path:/dev/mem</b>	Need Driver	No Need Driver
<b>Run Time Memory Hole support</b>	Need Driver	No Need Driver



## Signing Driver and Enrolling Public Key to the System

The following prerequisites are needed on the build system to sign the driver:

1. Login to Linux OS as root otherwise use sudo.
2. The compiler suite (gcc) must be installed. If it's not installed, the AFU driver cannot be built.
3. OpenSSL: Needed to generate cryptographic keys. OpenSSL tool can be downloaded from <https://www.openssl.org>
4. Perl interpreter: Needed to run the signing script. Perl tool can be downloaded from <https://www.perl.org>

Follow the below steps to sign the driver:

1. Boot to Linux OS.
2. Generate a Public and Private key pair using below openssl command: > openssl req -x509 -new -nodes -utf8 -sha256 -days 36500 -batch -config configuration\_file.config -outform DER -out public\_key.der -keyout private\_key.priv

**Note:** The configuration file configuration\_file.config must be created with the required information before running the command. A sample configuration file is shown below. The values in <> must be filled with actual values.

**configuration\_file.config:**

```
[ req ]
default_bits = 4096
distinguished_name = req_distinguished_name
prompt = no
string_mask = utf8only
x509_extensions = myexts

[ req_distinguished_name ]
O = <organization_name>
CN = <organization_name> Signing Key
emailAddress = <email_address>

[ myexts ]
basicConstraints=critical,CA:FALSE
keyUsage=digitalSignature
subjectKeyIdentifier=hash
authorityKeyIdentifier=keyid
```

3. Build AFU driver using below command. The driver will be generated in the current directory with name amifldr\_mod.o.

```
> afu64 /MAKEDRV
```

4. Execute below command to sign driver with the key generated in step 2.

```
> perl /usr/src/kernels/$(uname -r)/scripts/sign-file sha256 private_key.priv  
public_key.der amifldr_mod.o
```

Or

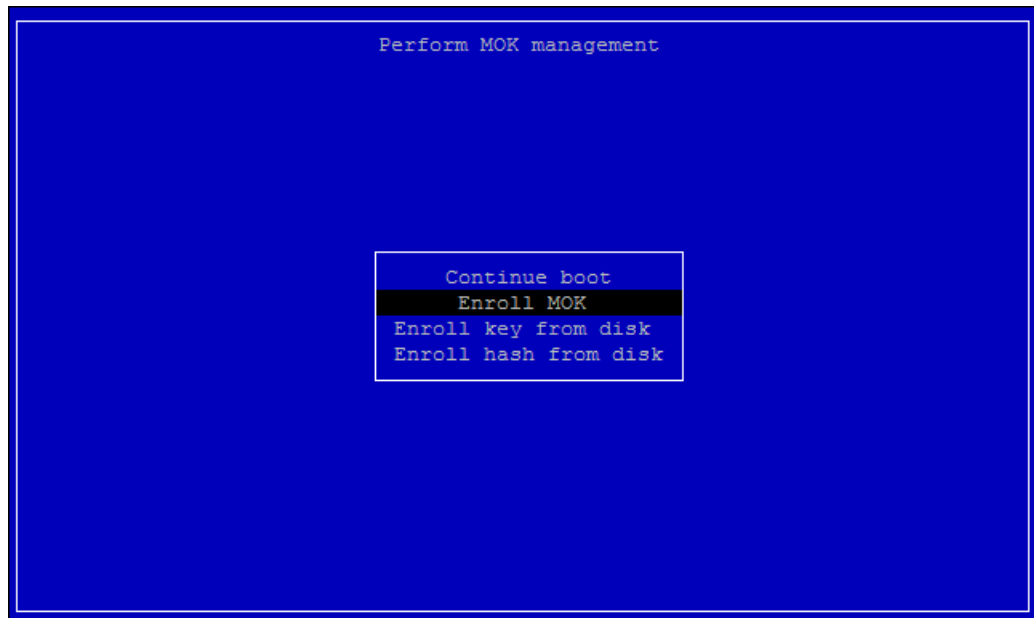
```
> /usr/src/kernels/$(uname -r)/scripts/sign-file sha256 private_key.priv public_key.der  
amifldr_mod.o
```

5. Request addition of a public key to MOK list using mokutil. The command will prompt a password which will be needed during public key enrollment in next step.

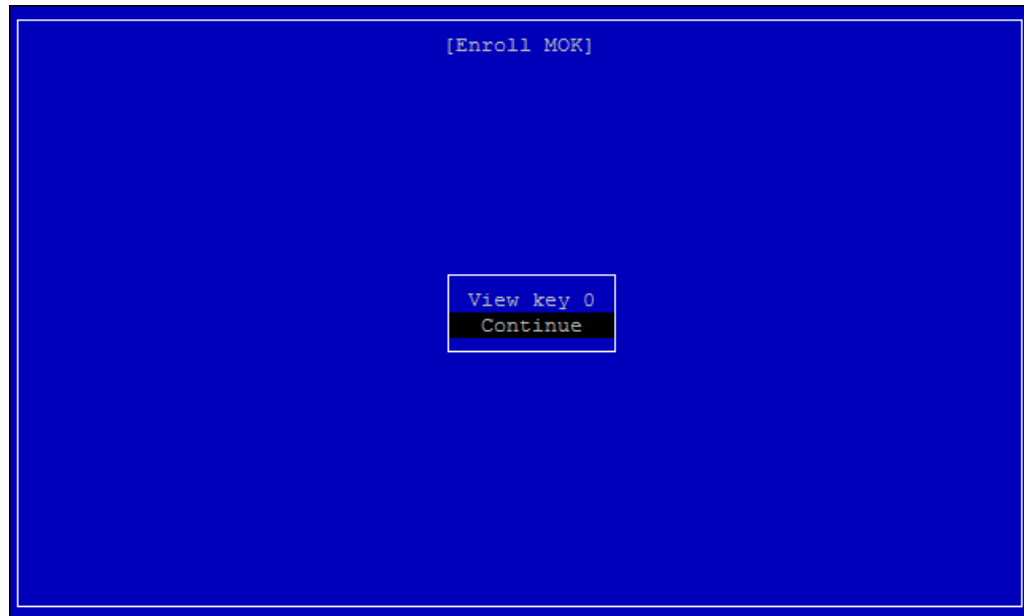
```
> mokutil --import public_key.der
```

6. Reboot the system which will launch MOK manager application to complete public key enrollment.

6-1. Select Enroll MOK.



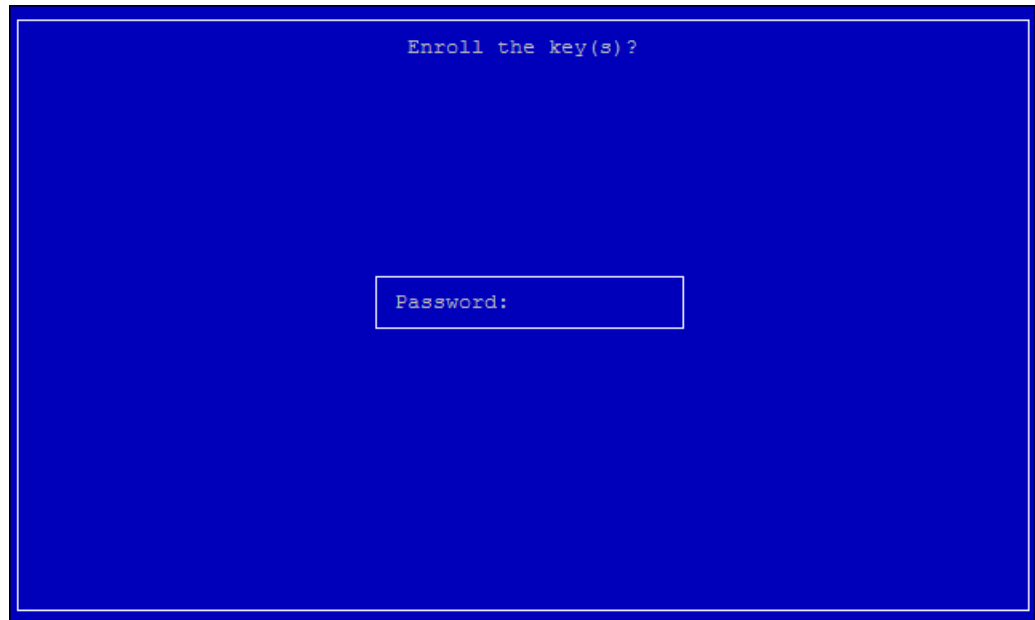
6-2. Select Continue.



6-3. Select Yes.



6-4. Input step 5 password.



7. Once the public key enrollment is done, Boot to OS and execute below command to ensure the newly added key is available in system key ring.

```
> keyctl list %:.system_keyring
```

Or

```
> keyctl list %:.builtin_trusted_keys
```

8. Install signed driver using insmod command.

```
> insmod amifldr_mod.o
```

9. Ensure it is loaded successfully using lsmod command.

Reference: [https://access.redhat.com/documentation/en-US/Red\\_Hat\\_Enterprise\\_Linux/7/html/Kernel\\_Administration\\_Guide/sect-signing-kernel-modules-for-secure-boot.html](https://access.redhat.com/documentation/en-US/Red_Hat_Enterprise_Linux/7/html/Kernel_Administration_Guide/sect-signing-kernel-modules-for-secure-boot.html)

## Intel BIOS Guard Support

AFU capsule and recovery flash update support Intel BIOS Guard which only works for AMI Aptio production.

The input ROM image has to follow BIOS Guard format. The detailed information with regard to Intel BIOS Guard, please contact to AMI.

## Support Table

### Command/Option Support in Each Mode

Command	Runtime Mode	Capsule Mode	Capsule OACU Mode	Recovery Mode
/O	Supported	Not Supported	Not Supported	Not Supported
/U	Supported	Not Supported	Not Supported	Not Supported
/S	Supported	Not Supported	Not Supported	Not Supported
/D	Supported	Not Supported	Not Supported	Not Supported
/A:	Supported	Not Supported	Not Supported	Not Supported
/OAD	Supported	Not Supported	Not Supported	Not Supported
/CLNEVNLOG	Supported	Not Supported	Not Supported	Not Supported

Option	Runtime Mode	Capsule Mode	Capsule OACU Mode	Recovery Mode
/CMD:	Supported	Not Supported	Not Supported	Not Supported
/OEMCMD:	Supported	Not Supported	Not Supported	Not Supported
/DPC	Supported	Not Supported	Not Supported	Not Supported
/PW:	Supported	Not Supported	Not Supported	Not Supported
/MEUL:	Not Supported	Supported	Not Supported	Not Supported
/Q	Supported	Not Supported	Not Supported	Not Supported
/X	Supported	Not Supported	Supported	Not Supported
/S	Supported	Not Supported	Not Supported	Not Supported
/JBC	Supported	Not Supported	Not Supported	Not Supported
/CLRCFG	Supported	Not Supported	Supported	Not Supported
/BCPALL	Supported	Not Supported	Not Supported	Not Supported
/HOLEOUT:	Supported	Not Supported	Not Supported	Not Supported
/SP	Supported	Not Supported	Not Supported	Not Supported
/R	Supported	Supported ( *1 )	Supported ( *1 )	Not Supported
/Rn	Supported	Supported ( *1 )	Supported ( *1 )	Not Supported
/B	Supported	Supported	Supported	Supported
/P	Supported	Supported	Supported	Supported
/N	Supported	Supported	Supported	Supported
/K	Supported	Not Supported	Supported	Not Supported
/Kn	Supported	Not Supported	Supported	Not Supported
/RLC:	Supported	Not Supported	Not Supported	Not Supported
/HOLE:	Supported	Not Supported	Not Supported	Not Supported
/L	Supported	Not Supported	Supported	Not Supported
Option	Runtime Mode	Capsule Mode	Capsule OACU Mode	Recovery Mode

/Ln	Supported	Not Supported	Supported	Not Supported
/ECUF	Supported	Not Supported	Not Supported	Not Supported
/E	Supported	Supported	Supported	Supported
/ME	Supported	Not Supported	Not Supported	Not Supported
/A:	Supported	Not Supported	Not Supported	Not Supported
/OAD	Supported	Not Supported	Not Supported	Not Supported
/CLNEVNLOG	Supported	Not Supported	Not Supported	Not Supported
/CAPSULE	Supported	Supported	Supported	Not Supported
/RECOVERY	Supported	Not Supported	Not Supported	Supported
/EC	Supported	Not Supported	Not Supported	Not Supported
/REBOOT	Supported	Not Supported	Not Supported	Not Supported
/SHUTDOWN	Supported	Not Supported	Not Supported	Not Supported

**Note:**

**\* 1: This option must use with either /P or /B in order to be supported by Capsule Mode.**

## Error Codes

### Error Code Definition

CODE	Definition
0x01	Error: Unknown command.
0x02	Error: BIOS has no flash information available.
0x03	Error: ROM file size does not match existing BIOS size.
0x04	Error: ROM file ROMID is not compatible with existing BIOS ROMID.
0x05	Error: Bootblock error.
0x06	Error: This BIOS version has more Non-Critical blocks than supported.
0x07	Error: BIOS checksum error.
0x08	Error: Invalid option
0x09	Error: Size of ROM file does not match the size of system ROM
0x0A	Error: Unable to update ROM hole
0x0B	Error: ROMHOLE not exist
0x0C	Error: BIOS update canceled by user.
0x0D	Error: BIOS Report Error.
0x0E	Error: Kernel source files cannot be found.
0x0F	Error: Size of PLDM file is more than the FV size.
0x10	Error: Unable to load driver.
0x11	Error: Unable to unload driver.
0x12	Error: No non-critical blocks found in ROM file.
0x13	Error: Requested non-critical block not available in ROM file.
0x14	Error: Non-critical blocks in ROM image file do not match those in the system.
0x15	Error: Secure Flash function is not supported on this platform.
0x16	Error: Unable to get Secure Flash policy from BIOS.
0x17	Error: Unsupported Secure Flash policy.
0x18	Error: Secure Flash Rom Verify fail.
0x19	Error: Failed to erase flash chip (at Runtime Secure Flash).
0x1A	Error: Failed to update flash chip (at Runtime Secure Flash).
0x1B	Error: Failed to read flash chip (at Runtime Secure Flash).
0x1C	Error: Failed to verify flash chip (at Runtime Secure Flash).
0x1D	Error: Failed to load image into memory.
0x1E	Error: Secure Flash function is not supported on this file.
0x1F	Error: Reserved for Secure Flash.
0x20	Error: Unable to initialize memory manager.
0x21	Error: Unable to close memory manager.
0x22	Error: Problem allocating memory.



0x23	Error: Problem freeing memory.
0x24	Error: Problem allocating BIOS buffer.
0x25	Error: Problem freeing BIOS buffer.
0x26	Error: Problem freeing mapping BIOS.
0x27	Error: Problem freeing unmapping BIOS.
0x28	Error: Problem mapping BIOS data.
0x29	Error: Problem unmapping BIOS data.
0x30	Error: Problem opening file for reading.
0x31	Error: Problem reading file.
0x32	Error: Problem opening file to write.
0x33	Error: Problem writing file.
0x34	Error: Using the wrong AFU version, Please use Aptio 4 AFU.
0x35	Error: Using the wrong AFU version, Please use Aptio 5 AFU.
0x36	Error: Fail with the problem of ESP Driver init.
0x37	Error: Fail with the problem of copy ROM file to ESP driver.
0x38	Error: Multi tank ROMs' ROM ID are not allowed the same.
0x39	Error: Multi tank ROMs' ROM ID do not match platform ROM ID.
0x3A	Error: BIOS does not support ACAU Module.
0x3B	Error: AFU does not support this ACAU version.
0x3C	Error: BIOS ACAU reports error.
0x3D	Error: BIOS does not support ACAU-SSB function.
0x3E	Error: BIOS ACAU-SSB reports error.
0x40	Error: BIOS is write-protected.
0x41	Error: Can not close flash interface.
0x42	Error: Problem reading flash.
0x43	Error: Problem erasing flash.
0x44	Error: Problem writing flash.
0x45	Error: Problem verifying flash.
0x46	Error: Problem getting flash information.
0x47	Error: No firmware ID.
0x48	Error: Power cord not connected. Plug in power cord to flash.
0x49	Error: A platform condition has prevented flashing.
0x4A	Error: Platform data is not empty, And data address is not Alignment Block Address.
0x4B	Error: SLP key is not empty at all.
0x4C	Error: Rom file ROM layout is changed.
0x4D	Error: Get block size error.
0x50	Error: This program must be run in MS-DOS mode.
0x51	Error: Size of PLDM file is more than the FV size.
0x52	Error: Preserving setup configuration failed.
0x53	Error: BIOS does not support preserving the setup configuration. Use /CLRCFG option to flash without preserving.
0x54	Error: Initialization failed for preserving setup configuration.
0x55	Error: Error occurred while retrieving HII data.
0x56	Error: Error occurred while creating PLDM Table.
0x57	Error: PLDM table data is empty.
0x58	Error: Capsule command can not be used alone, must be used with the /p /b /n option.

0x59	Error: Recovery command can not be used alone, must be used with the /p /b /n option.
0x5A	Error: EMMC Mode cannot be used runtime flash command, please use capsule or recovery to update BIOS.
0x5B	Error: Capsule and Recovery command cannot be used together.
0x60	Error: Accessing registry.
0x61	Error: Program already running.
0x70	Error: BSD access IO.
0x71	Error: Linux does not support Auto Build Driver when Secure Boot Enable.
0x80	Error: Size of system ROM mismatches size of ROM file.
0x81	Error: ROM ID mismatch.
0x82	Error: Bootblock checksum error.
0x83	Error: Your BIOS policy does not allow ROMID check bypassing.
0x90	Error: Error to shutdown.
0x91	Error: Error to restart.
0x92	Error: Can't open ROM ID file.
0x93	Error: ROM ID file is not a ROM file.
0x94	Error: Invalid MAC address.
0x95	Error: Invalid load current CMOS option.
0x96	Error: Invalid retry count.
0x97	Error: Invalid defined ROM ID length.
0x98	Error: Invalid SMI.
0x99	Error: ROM File ID doesn't exist.
0x9A	Error: System ROM ID doesn't exist.
0x9B	Error: Password Retry count exceeded.
0x9C	Error: BIOS don't support NVRAM/SETUP preserve function.
0x9D	Error: Store SETUP setting error.
0x9E	Error: Restore SETUP setting error.
0x9F	Error: Cannot analyze ROM file. ROM file may be corrupted.
0xA0	Error: Cannot analyze the ME Data. ROM file may be corrupted.
0xA1	Error: BIOS does not support ME Entire Firmware update.
0xA2	Error: BIOS does not support ME Ignition Firmware update.
0xA3	Error: Invalid EC ROM file.
0xA4	Error: EC ROM file checksum error.
0xA5	Error: Can't enter EC flash mode.
0xA6	Error: Erasing EC flash memory fail.
0xA7	Error: Initial EC programming fail.
0xA8	Error: EC flash data transmit error.
0xA9	Error: Writing EC flash memory fail.
0xAA	Error: Exit EC programming mode fail.
0xAB	Error: ROM Chip ID mismatch.
0xAC	Error: Invalid EC Header Table.
0xAD	Error: EC does not permit BIOS update.
0xAE	Error: BIOS doesn't support OEMCMD function.
0xAF	Error: Store DMI Data error.
0xB0	Error: Restore DMI Data error.
0xB1	Error: Invalid Activation Key file.

0xB2	Error: File Size is greater than image activation key length.
0xB3	Error: Image activation key larger than BIOS activation key.
0xB4	Error: Activation Key checksum error.
0xB5	Error: No Support Activation Key error.
0xB6	Error: OA key is available, and OA Key is not the same as BIN file in the system.
0xB7	Error: OA key is empty.
0xB8	Error: OA key region incorrect.
0xB9	Error: BIOS doesn't support Clear event log function.
0xBA	Error: Clear event log error.
0xBB	Error: Rom image layout detected RomHole is redesigned.
0xBC	Error: BIOS have more than one RomHole's GUID is the same.
0xBD	Error: Requested Rom Hole not available in ROM file.
0xBE	Error: RomHoles in ROM image file do not match those in the system.
0xBF	Error: OA key is available, and OA Key is the same as BIN file in the system.
0xC0	Error: BIOS doesn't support process ME information.
0xC1	Error: BIOS return an error, when trying to re-flash ME Firmware data.
0xC2	Error: Region is write-protected.
0xC6	Error: No EC blocks found in system ROM.
0xC7	Error: BIOS doesn't support all ROM flashing function.
0xC8	Error: Invalid ROM image file, ROM image file may be corrupted.
0xD0	Error: OA key data is invalid.
0xD1	Error: BIOS has already updated OA.
0xD2	Error: BIOS does not allow updating OA.
0xD3	Error: BIOS doesn't support updating OA.
0xD4	Error: The DMI data size of the system is greater than File's DMI data length.
0xD5	Error: BIOS doesn't support EC Battery Check function.

## FAQs

### The Error Message Information of ROM

AFU has added the check mechanism of ROM information since AFU 5.09.00.1284. AFU would compare the information between updated ROM and on board ROM. If these ROMs have different information, AFU will show the error of 0x4C.

*AFU 5.09.02.1370 or later added a warning message for informing users to decide whether continue or not when ROM information is different at the beginning.*

WARNING!!

The ROM file information does not match with the system BIOS!

If forcedly update BIOS, it may destroy the System BIOS!

We strongly do not suggest to flash the BIOS!

Press "E"- This option will update entire BIOS region and exit.

Press "A"- This option will be no ROM update.

Press "F"- This option will be forcing to follow the command by user provided.

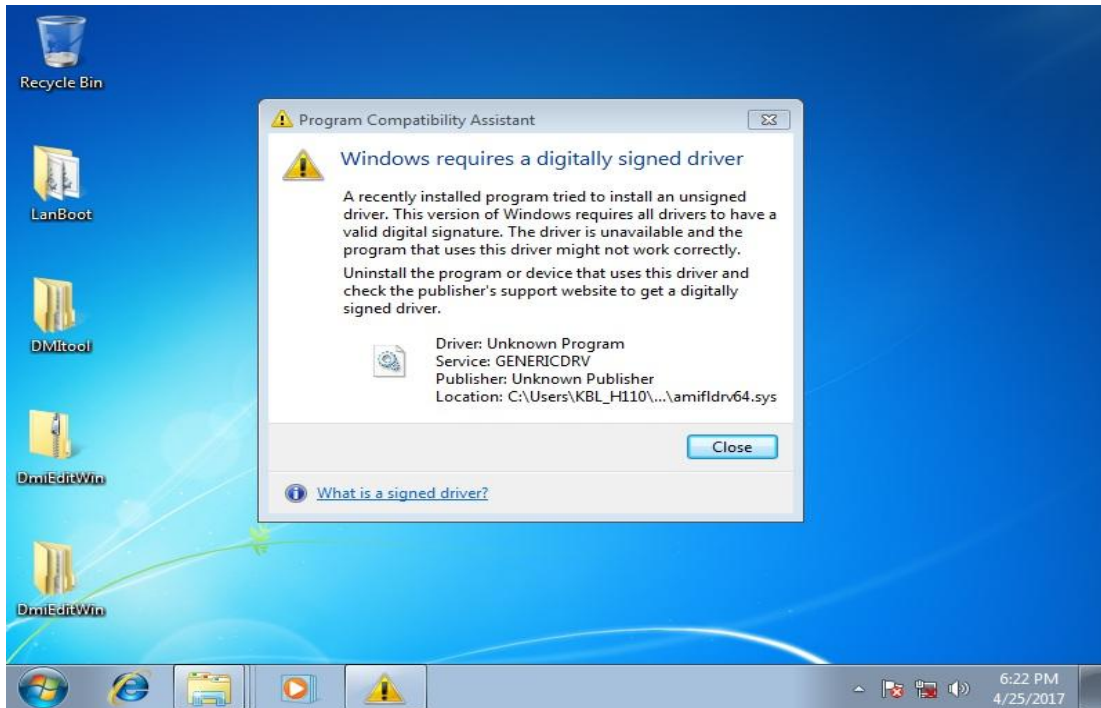
- Please select one of the options:

AMI extremely suggest users to stop choosing "Continue to update" (Add "E" and "F" options in v5.10.00.1615 ) if users do not comprehend ROM structure very much. The system will be crashed after BIOS update because of ROM information difference.

Option "E" will flash entire blocks of BIOS region data as a new BIOS, this option also will not preserve any data.

Option "F" will keep executing the command from user input. For example, if users input command /p /b and decide to select option "F", AFU will only flash Boot block and Main block. The definition of this block will be the same as the previous Block definition.

## Windows requires a digitally signed driver



*This issue is resolved by a security fix provided by [MS. KB3033929](#) resolves this issue. The certificate used to sign the driver is higher security and older versions of Win7 don't support it.*

## Windows version with new driver for WSMT support has to install 2 hot fixes

1. If OS is Win 7 SP1, need to install Windows hot fix, [KB3033929](#).

This issue is resolved by a security fix provided by MS. KB3033929 resolves this issue. The certificate used to sign the driver is higher security and older versions of Win7 don't support it.

2. If OS is Win 10 build 10240 (version 1507), need to install Windows hot fix, [KB3081436](#).

<https://docs.microsoft.com/en-us/windows-hardware/drivers/install/driver-signing>

## AMI AFULNX supports XEN

AFULNX v2.35 or later has supported XEN, but BIOS must add the "RuntimeMemoryHole" Module.

However, if BIOS supports WSMT feature, no need to add the module.

## Segmentation Fault when AFULNX is kernel 3.14.40 with XEN

### 4.2.4

Please follow steps below to operate the configuration, and try again.

1. Check if the system runs under X11, a.k.a GUI mode. If so, switch to console mode with the following command.

```
# systemctl set-default multi-user.target
```

Remember to restart system after configured.

2. Check if Dom0 has enough free memory.

```
# xl info
```

Check the item "free\_memory", make sure it is larger than 1024. If the number is lower than 1024, use the command

```
# xm mem-set Domain-0 1024
```

You don't need to restart the system after this step.

3. Set virtual CPU number to 1 of Domain-0 in XEN.

```
# xm vcpu-set Domain-0 1
```

4. AFULNX updates BIOS.

## "AFUxxx has stopped working" or "Segmentation Fault" error

Common reason which caused the error is that: AFU access to invalid/prohibit memory area.

Since AFU uses/needs driver file to access memory, most cases we met which caused the error are:

- (1) Don't use administrator/root privilege to execute tool.
- (2) Use unmatched version between driver file and AFU tool.
- (3) BIOS has enabled "Secure Boot" but don't sign driver file for it.
- (4) Use some newer/older AFU version which is not compatible with some motherboard.

For (1), if users are using:

- AFU WIN: Please open a command line with administrator privilege, then execute tool in it.
- AFU LNX: Please use "sudo" command to execute tool.

For (2), if users are using:

- AFU WIN:
  - Driver file (amifldrXX.sys) can be found in AFU deliverables (Bundled with tool).
  - Please don't use other source of .sys file from other AFU version or other AMI tools.
- AFU LNX:
  - Driver file (amifldr\_mod.o) will be auto built by tool while executing AFU.
  - Driver file will be generated at the same folder of AFU tool.
  - Recommended to create an empty folder and put tool in it before executing, so AFU will generate the pure/clean driver file in folder.

For (3), please check "Signing Driver and Enrolling Public Key to the System" section to sign driver file.

For (4), if checked (1) (2) (3) but still see error:

- Firstly, please try the latest AFU version.
- Secondary, please try the older AFU version (Which can run well in that motherboard previously):
  - If older version also fails, please check BIOS code.
  - If order version runs well, and also latest AFU still fails, please kindly contact AMI.