



OpenCore

Reference Manual (0.6.~~5~~.6)

[2021.01.12]

Warning: This feature is very dangerous as it passes unprotected data to firmware variable services. Use it only when no hardware NVRAM implementation is provided by the firmware or it is incompatible.

4. LegacyOverwrite

Type: plist boolean

Failsafe: false

Description: Permits overwriting firmware variables from `nvr.plist`.

Note: Only variables accessible from the operating system will be overwritten.

5. LegacySchema

Type: plist dict

Description: Allows setting select NVRAM variables from a map (plist dict) of GUIDs to an array (plist array) of variable names in `plist string` format.

* value can be used to accept all variables for select GUID.

WARNING: Choose variables very carefully, as `nvr.plist` is not vaulted. For instance, do not put `boot-args` or `csr-active-config`, as this can bypass SIP.

6. WriteFlash

Type: plist boolean

Failsafe: false

Description: Enables writing to flash memory for all added variables.

Note: It is recommended to have this value enabled on most types of firmware but it is left configurable for firmware that may have issues with NVRAM variable storage garbage collection or similar.

To read NVRAM variable value from macOS, `nvr` could be used by concatenating GUID and name variables separated by a `:` symbol. For example, `nvr 7C436110-AB2A-4BBB-A880-FE41995C9F82:boot-args`.

A continuously updated variable list can be found in a corresponding document: NVRAM Variables.

9.3 Mandatory Variables

Warning: These variables may be added by PlatformNVRAM or Generic subsections of PlatformInfo section. Using PlatformInfo is the ~~recommend~~recommended way of setting these variables.

The following variables are mandatory for macOS functioning:

- `4D1EDE05-38C7-4A6A-9CC6-4BCCA8B38C14:FirmwareFeatures`
32-bit `FirmwareFeatures`. Present on all Macs to avoid extra parsing of SMBIOS tables.
- `4D1EDE05-38C7-4A6A-9CC6-4BCCA8B38C14:FirmwareFeaturesMask`
32-bit `FirmwareFeaturesMask`. Present on all Macs to avoid extra parsing of SMBIOS tables.
- `4D1EDE05-38C7-4A6A-9CC6-4BCCA8B38C14:MLB`
`BoardSerialNumber`. Present on newer Macs (2013+ at least) to avoid extra parsing of SMBIOS tables, especially in `boot.efi`.
- `4D1EDE05-38C7-4A6A-9CC6-4BCCA8B38C14:ROM`
Primary network adapter MAC address or replacement value. Present on newer Macs (2013+ at least) to avoid accessing special memory region, especially in `boot.efi`.

9.4 Recommended Variables

The following variables are recommended for faster startup or other improvements:

- `7C436110-AB2A-4BBB-A880-FE41995C9F82:csr-active-config`
32-bit System Integrity Protection bitmask. Declared in XNU source code in `csr.h`.
- `4D1EDE05-38C7-4A6A-9CC6-4BCCA8B38C14:ExtendedFirmwareFeatures`
Combined `FirmwareFeatures` and `ExtendedFirmwareFeatures`. Present on newer Macs to avoid extra parsing of SMBIOS tables.
- `4D1EDE05-38C7-4A6A-9CC6-4BCCA8B38C14:ExtendedFirmwareFeaturesMask`
Combined `FirmwareFeaturesMask` and `ExtendedFirmwareFeaturesMask`. Present on newer Macs to avoid extra parsing of SMBIOS tables.

- `FW_FEATURE_SUPPORTS_UEFI_WINDOWS_BOOT` (0x20000000) - Without this bit it is not possible to reboot to Windows installed on a drive with EFI partition being the first partition on the disk.

3. `MaxBIOSVersion`

Type: `plist boolean`

Failsafe: `false`

Description: Sets `BIOSVersion` to `9999.999.999.999.999`, recommended for legacy Macs when using Automatic PlatformInfo to avoid BIOS updates in unofficially supported macOS versions.

4. `SystemMemoryStatus`

Type: `plist string`

Failsafe: `Auto`

Description: Indicates whether system memory is upgradable in `PlatformFeature`. This controls the visibility of the Memory tab in About This Mac.

Valid values:

- `Auto` — use the original `PlatformFeature` value.
- `Upgradable` — explicitly unset `PT_FEATURE_HAS_SOLDERED_SYSTEM_MEMORY` (0x2) in `PlatformFeature`.
- `Soldered` — explicitly set `PT_FEATURE_HAS_SOLDERED_SYSTEM_MEMORY` (0x2) in `PlatformFeature`.

Note: On certain Mac models (namely MacBookPro10,x and any MacBookAir), `SPMemoryReporter.spreporter` will ignore `PT_FEATURE_HAS_SOLDERED_SYSTEM_MEMORY` and assume that system memory is non-upgradable.

5. `ProcessorType`

Type: `plist integer`

Failsafe: `0` (Automatic)

Description: Refer to SMBIOS `ProcessorType`.

6. `SystemProductName`

Type: `plist string`

Failsafe: `MacPro6,1`

Description: Refer to SMBIOS `SystemProductName`.

7. `SystemSerialNumber`

Type: `plist string`

Failsafe: `OPENCORE_SN1`

Description: Refer to SMBIOS `SystemSerialNumber`.

8. `SystemUUID`

Type: `plist string, GUID`

Failsafe: `OEM specified`

Description: Refer to SMBIOS `SystemUUID`.

9. `MLB`

Type: `plist string`

Failsafe: `OPENCORE_MLB_SN11`

Description: Refer to SMBIOS `BoardSerialNumber`.

10. `ROM`

Type: `plist data, 6 bytes`

Failsafe: `all zero`

Description: Refer to `4D1EDE05-38C7-4A6A-9CC6-4BCCA8B38C14:ROM`.

10.3 DataHub Properties

1. `PlatformName`

Type: `plist string`

Failsafe: `Not installed`

Description: Sets name in `gEfiMiscSubClassGuid`. Value found on Macs is `platform` in ASCII.

2. `SystemProductName`

Type: `plist string`

Failsafe: `Not installed`

11 UEFI

11.1 Introduction

UEFI (Unified Extensible Firmware Interface) is a specification that defines a software interface between an operating system and platform firmware. This section allows to load additional UEFI modules and/or apply tweaks for the onboard firmware. To inspect firmware contents, apply modifications and perform upgrades UEFITool and supplementary utilities can be used.

11.2 Drivers

Depending on the firmware a different set of drivers may be required. Loading an incompatible driver may lead the system to unbootable state or even cause permanent firmware damage. Some of the known drivers are listed below:

11.3 Tools and Applications

Standalone tools may help to debug firmware and hardware. Some of the known tools are listed below. While some tools can be launched from within OpenCore, see more details in the Tools subsection of the configuration, most should be run separately either directly or from **Shell**.

To boot into OpenShell or any other tool directly save **OpenShell.efi** under the name of **EFI\BOOT\BOOTX64.EFI** on a FAT32 partition. In general it is unimportant whether the partition scheme is GPT or MBR.

While the previous approach works both on Macs and other computers, an alternative Mac-only approach to bless the tool on an HFS+ or APFS volume:

```
sudo bless --verbose --file /Volumes/VOLNAME/DIR/OpenShell.efi \
--folder /Volumes/VOLNAME/DIR/ --setBoot
```

Listing 3: Blessing tool

Note 1: **/System/Library/CoreServices/BridgeVersion.bin** should be copied to **/Volumes/VOLNAME/DIR**.

Note 2: To be able to use **bless** disabling System Integrity Protection is necessary.

Note 3: To be able to boot Secure Boot might be disabled if present.

Some of the known tools are listed below (builtin tools are marked with *):

BootKicker*	Enter Apple BootPicker menu (exclusive for Macs with compatible GPUs).
ChipTune*	Test BeepGen protocol and generate audio signals of different style and length.
CleanNvram*	Reset NVRAM alternative bundled as a standalone tool.
GopStop*	Test GraphicsOutput protocol with a simple scenario.
HdaCodecDump*	Parse and dump High Definition Audio codec information (requires AudioDxe).
KeyTester*	Test keyboard input in SimpleText mode.
MemTest86	Memory testing utility.
OpenControl*	Unlock and lock back NVRAM protection for other tools to be able to get full NVRAM access when launching from OpenCore.
OpenShell*	OpenCore-configured UEFI Shell for compatibility with a broad range of firmware.
PavpProvision	Perform EPID provisioning (requires certificate data configuration).
ResetSystem*	Utility to perform system reset. Takes reset type as an argument: ColdReset , Firmware , Shutdown , WarmReset . Defaults to ColdReset .
RtcRw*	Utility to read and write RTC (CMOS) memory.
VerifyMsrE2*	Check CFG Lock (MSR 0xE2 write protection) consistency across all cores.

11.4 OpenCanopy

OpenCanopy is a graphical OpenCore user interface that runs in **External PickerMode** and relies on **OpenCorePkg** **OcBootManagementLib** similar to the builtin text interface.

OpenCanopy requires graphical resources located in **Resources** directory to run. Sample resources (fonts and images) can be found in **OcBinaryData** repository. Customised icons can be found over the internet (e.g. [here](#) or [there](#)).

OpenCanopy provides full support for **PickerAttributes** and offers a configurable builtin icon set. The default chosen icon set depends on the **DefaultBackgroundColor** variable value. For **Light Gray Old** icon set will be used, for other colours — the one without a prefix.

Predefined icons are put to **\EFI\OC\Resources\Image** directory. Full list of supported icons (in **.icns** format) is provided below. Missing optional icons will use the closest available icon. External entries will use **Ext**-prefixed icon if available (e.g. **OldExtHardDrive.icns**).

Note: In the following all dimensions are normative for the 1x scaling level and shall be scaled accordingly for other levels.

- **Cursor** — Mouse cursor (mandatory, [up to 144x144](#)).
- **Selected** — Selected item (mandatory, [144x144](#)).
- **Selector** — Selecting item (mandatory, [up to 144x40](#)).
- **Left** — Scrolling left (mandatory, [40x40](#)).
- **Right** — Scrolling right (mandatory, [40x40](#)).

- **HardDrive** — Generic OS (mandatory, [128x128](#)).
- **Background** — Centred background image.
- **Apple** — Apple OS ([128x128](#)).
- **AppleRecv** — Apple Recovery OS ([128x128](#)).
- **AppleTM** — Apple Time Machine ([128x128](#)).
- **Windows** — Windows ([128x128](#)).
- **Other** — Custom entry (see **Entries**, [128x128](#)).
- **ResetNVRAM** — Reset NVRAM system action or tool ([128x128](#)).
- **Shell** — Entry with UEFI Shell name (for e.g. **OpenShell** ([128x128](#))).
- **Tool** — Any other tool ([128x128](#)).

Predefined labels are put to `\EFI\OC\Resources\Label` directory. Each label has `.1b1` or `.12x` suffix to represent the scaling level. Full list of labels is provided below. All labels are mandatory.

- **EFIBoot** — Generic OS.
- **Apple** — Apple OS.
- **AppleRecv** — Apple Recovery OS.
- **AppleTM** — Apple Time Machine.
- **Windows** — Windows.
- **Other** — Custom entry (see **Entries**).
- **ResetNVRAM** — Reset NVRAM system action or tool.
- **Shell** — Entry with UEFI Shell name (e.g. **OpenShell**).
- **Tool** — Any other tool.

Note: All labels must have a height of exactly 12 px. There is no limit for their width.

Label and icon generation can be performed with bundled utilities: **disklabel** and **icnspack**. ~~Please refer to sample data for the details about the dimensions.~~ Font is Helvetica 12 pt times scale factor.

Font format corresponds to AngelCode binary BMF. While there are many utilities to generate font files, currently it is recommended to use **dpFontBaker** to generate bitmap font (using **CoreText** produces best results) and **fonverter** to export it to binary format.

11.5 OpenRuntime

OpenRuntime is an OpenCore plugin implementing `OC_FIRMWARE_RUNTIME` protocol. This protocol implements multiple features required for OpenCore that are otherwise not possible to implement in OpenCore itself as they are needed to work in runtime, i.e. during operating system functioning. Feature highlights:

- NVRAM namespaces, allowing to isolate operating systems from accessing select variables (e.g. **RequestBootVarRouting** or **ProtectSecureBoot**).
- Read-only and write-only NVRAM variables, enhancing the security of OpenCore, Lilu, and Lilu plugins, such as **VirtualSMC**, which implements **AuthRestart** support.
- NVRAM isolation, allowing to protect all variables from being written from an untrusted operating system (e.g. **DisableVariableWrite**).
- UEFI Runtime Services memory protection management to workaround read-only mapping (e.g. **EnableWriteUnprotector**).

11.6 Properties

1. APFS

Type: plist dict

Failsafe: None

Description: Provide APFS support as configured in APFS Properties section below.

2. Audio

Type: plist dict

Failsafe: None

Description: Configure audio backend support described in Audio Properties section below.