OpenCore

Reference Manual (0.0.2)

[2019.05.08]

1 Introduction

This document provides information on OpenCore user configuration file format used to setup the correct functioning of macOS operating system.

1.1 Known defects

For OpenCore issues please refer to Acidanthera Bugtracker. ~~Currently this file has the following entries not completed:~~

- ~~Not all `NVRAM` variables are properly described (e.g. boot-args).~~

Default value: `false`
Description: Provide reset register and flag in FADT table to enable reboot and shutdown on legacy hardware. Not recommended unless required.

2. `IgnoreForWindows`
   Type: `plist boolean`
   Default value: `false`
   Description: Disable all sorts of ACPI modifications when booting Windows operating system.

   This flag implements a quick workaround for those, who made their ACPI tables incompatible with Windows, but need it right now. Not recommended, as ACPI tables must be compatible with any operating system regardless of the changes.

   Note: This option may be removed in the future.

3. `NormalizeHeaders`
   Type: `plist boolean`
   Default value: `false`
   Description: Cleanup ACPI header fields to workaround macOS ACPI implementation bug causing boot crashes. Reference: Debugging AppleACPIPlatform on 10.13 by Alex James aka theracermaster. The issue is fixed in macOS Mojave (10.14).

4. `RebaseRegions`
   Type: `plist boolean`
   Default value: `false`
   Description: Attempt to heuristically relocate ACPI memory regions. Not recommended.

   ACPI tables are often generated dynamically by underlying firmware implementation. Among the position-independent code, ACPI tables may contain physical addresses of MMIO areas used for device configuration, usually grouped in regions (e.g. `OperationRegion`). Changing firmware settings or hardware configuration, upgrading or patching the firmware inevitably leads to changes in dynamically generated ACPI code, which sometimes lead to the shift of the addresses in aforementioned `OperationRegion` constructions.

   For this reason it is very dangerous to apply any kind of modifications to ACPI tables. The most reasonable approach is to make as few as possible changes to ACPI and try to not replace any tables, especially DSDT. When this is not possible, then at least attempt to ensure that custom DSDT is based on the most recent DSDT or remove writes and reads for the affected areas.

   When nothing else helps this option could be tried to avoid stalls at `PCI Configuration Begin` phase of macOS booting by attempting to fix the ACPI addresses. It does not do magic, and only works with most common cases. Do not use unless absolutely required.

5. `ResetLogoStatus`
   Type: `plist boolean`
   Default value: `false`
   Description: Reset `BGRT` table `Displayed` status field to `false`.

   This works around firmwares that provide `BGRT` table but fail to handle screen updates afterwards.

4. `HideSelf`
   Type: `plist boolean`
   Default value: `false`
   Description: Hides own boot entry from boot picker. This may potentially hide other entries, for instance, when another UEFI OS is installed on the same volume and driver boot is used.

5. `Resolution`
   Type: `plist string`
   Default value: Empty string
   Description: Sets console output screen resolution~~as specified with the~~ .

   - Set to `WxH@Bpp` (e.g. `1920x1080@32`) ~~or~~ `WxH` (e.g. `1920x1080`) formatted string ~~.~~ to request custom resolution from GOP if available.
   - Set to empty string not to change screen resolution.
   - Set to `Max` to try to use largest available screen resolution.

   On HiDPI screens `APPLE_VENDOR_VARIABLE_GUID` `UIScale` NVRAM variable may need to be set to `02` to enable HiDPI scaling in FileVault 2 UEFI password interface and boot screen logo. Refer to Recommended Variables section for more details.

   Note: This will fail when console handle has no GOP protocol. When the firmware does not provide it, it can be added with `ProvideConsoleGop` UEFI quirk set to `true`.

6. `ShowPicker`
   Type: `plist boolean`
   Default value: `false`
   Description: Show simple boot picker to allow boot entry selection.

7. `Timeout`
   Type: `plist integer`, 32 bit
   Default value: `0`
   Description: Timeout in seconds in boot picker before automatic booting of the default boot entry.

7.4 Debug Properties

1. `DisableWatchDog`
   Type: `plist boolean`
   Default value: `NO`
   Description: Select firmwares may not succeed in quickly booting the operating system, especially in debug mode, which results in watch dog timer aborting the process. This option turns off watch dog timer.

2. `DisplayDelay`
   Type: `plist integer`
   Default value: `0`
   Description: Delay in microseconds performed after every printed line visible onscreen (i.e. console).

3. `DisplayLevel`
   Type: `plist integer`, 64 bit
   Default value: `0`
   Description: EDK II debug level bitmask (sum) showed onscreen. Unless `Target` enables console (onscreen) printing, onscreen debug output will not be visible. The following levels are supported (discover more in DebugLib.h):

   - `0x00000002` — `DEBUG_WARN` in `DEBUG`, `NOOPT`, `RELEASE`.
   - `0x00000040` — `DEBUG_INFO` in `DEBUG`, `NOOPT`.
   - `0x00400000` — `DEBUG_VERBOSE` in custom builds.
   - `0x80000000` — `DEBUG_ERROR` in `DEBUG`, `NOOPT`, `RELEASE`.

4. ~~`ExposeBootPath`~~**Type**~~: plist boolean~~**Default value**~~: false~~**Description**~~: Expose printable booter path to OpenCore.efi or its booter (depending on the load order) as an UEFI variable.~~

   ~~To obtain booter path use the following command in macOS:~~

```
nvram 4D1FDA02-38C7-4A6A-9CC6-4BCCA8B30102:boot-path
```

To use booter path for mounting booter volume use the following command in macOS:

```
u=$(nvram 4D1FDA02-38C7-4A6A-9CC6-4BCCA8B30102:boot-path | sed 's/.*GPT,\([^,]*\),.*/\1/'); \
  if [ "$u" != ""]; then sudo diskutil mount $u ; fi
```

5. `Target`
   Type: `plist integer`
   Default value: `0`
   Description: A bitmask (sum) of enabled logging targets. By default all the logging output is hidden, so this option is required to be set when debugging is necessary.

   The following logging targets are supported:

   - `0x01` — Enable logging, otherwise all log is discarded.
   - `0x02` — Enable basic console (onscreen) logging.
   - `0x04` — Enable logging to Data Hub.
   - `0x08` — Enable serial port logging.
   - `0x10` — Enable UEFI variable logging.
   - `0x20` — Enable non-volatile UEFI variable logging.
   - `0x40` — Enable logging to file.

   Console logging prints less than all the other variants. Depending on the build type (`RELEASE`, `DEBUG`, or `NOOPT`) different amount of logging may be read (from least to most).

   Data Hub log will not log kernel and kext patches. To obtain Data Hub log use the following command in macOS:

```
ioreg -lw0 -p IODeviceTree | grep boot-log | sort | sed 's/.*<\(.*\)>.*/\1/' | xxd -r -p
```

   UEFI variable log does not include some messages and has no performance data. For safety reasons log size is limited to 32 kilobytes. Some firmwares may truncate it much earlier or drop completely if they have no memory. Using non-volatile flag will write the log to NVRAM flash after every printed line. To obtain UEFI variable log use the following command in macOS:

```
nvram 4D1FDA02-38C7-4A6A-9CC6-4BCCA8B30102:boot-log |
  awk '{gsub(/%0d%0a%00/,"");gsub(/%0d%0a/,"\n")}1'
```

   Warning: Some firmwares are reported to have broken NVRAM garbage collection. This means that they may not be able to always free space after variable deletion. Do not use non-volatile NVRAM logging without extra need on such devices.

   While OpenCore boot log already contains basic version information with build type and date, this data may also be found in NVRAM in `opencore-version` variable even with boot log disabled.

```
nvram 4D1FDA02-38C7-4A6A-9CC6-4BCCA8B30102:opencore-version
```

   .

   File logging will create a file named `opencore.log` at EFI volume root with log contents. Please be warned that some file system drivers present in firmwares are not reliable, and may corrupt data when writing files through UEFI. Log is attempted to be written in the safest manner, and thus is very slow. Ensure that `DisableWatchDog` is set to `true` when you use a slow drive.

7.5 Security Properties

1. `ExposeSensitiveData`
   Type: `plist integer`
   Default value: 2
   Description: Sensitive data exposure bitmask (sum) to operating system.

- `0x01` — Expose printable booter path as an UEFI variable.
- `0x02` — Expose OpenCore version as an UEFI variable.

Exposed booter path points to OpenCore.efi or its booter depending on the load order. To obtain booter path use the following command in macOS:

```
nvram 4D1FDA02-38C7-4A6A-9CC6-4BCCA8B30102:boot-path
```

To use booter path for mounting booter volume use the following command in macOS:

```
u=$(nvram 4D1FDA02-38C7-4A6A-9CC6-4BCCA8B30102:boot-path | sed 's/.*GPT,\([^,]*\),.*/\1/'); \
  if [ "$u" != ""]; then sudo diskutil mount $u ; fi
```

To obtain OpenCore version use the following command in macOS:

```
nvram 4D1FDA02-38C7-4A6A-9CC6-4BCCA8B30102:opencore-version
```

2. `HaltLevel`
   Type: `plist integer`, 64 bit
   Default value: `0x80000000` (`DEBUG_ERROR`)
   Description: EDK II debug level bitmask (sum) causing CPU to halt (stop execution) after obtaining a message of `HaltLevel`. Possible values match `DisplayLevel` values.

3. `RequireSignature`
   Type: `plist boolean`
   Default value: `true`
   Description: Require `vault.sig` signature file for `vault.plist` in `OC` directory.

   This file should contain a raw 256 byte RSA-2048 signature from SHA-256 hash of `vault.plist`. The signature is verified against the public key embedded into `OpenCore.efi`.

   To embed the public key you should do either of the following:

   - Provide public key during the `OpenCore.efi` compilation in `OpenCoreVault.c` file.
   - Binary patch `OpenCore.efi` replacing zeroes with the public key between `=BEGIN OC VAULT=` and `==END OC VAULT==` ASCII markers.

   RSA public key 520 byte format description can be found in Chromium OS documentation. To convert public key from X.509 certificate or from PEM file use RsaTool.

   Note: `vault.sig` is used regardless of this option when public key is embedded into `OpenCore.efi`. Setting it to `true` will only ensure configuration sanity, and abort the boot process when public key is not set but was supposed to be used for verification.

4. `RequireVault`
   Type: `plist boolean`
   Default value: `true`
   Description: Require `vault.plist` file present in `OC` directory.

   This file should contain SHA-256 hashes for all files used by OpenCore. Presence of this file is highly recommended to ensure that unintentional file modifications (including filesystem corruption) do not happen unnoticed. To create this file automatically use `create_vault.sh` script.

   Regardless of the underlying filesystem, path name and case must match between `config.plist` and `vault.plist`.

   Note: `vault.plist` is tried to be read regardless of the value of this option, but setting it to `true` will ensure configuration sanity, and abort the boot process.

   The complete set of commands to:

   - Create `vault.plist`.
   - Create a new RSA key (always do this to avoid loading old configuration).
   - Embed RSA key into `OpenCore.efi`.
   - Create `vault.sig`.

8.4 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.
- `4D1EDE05-38C7-4A6A-9CC6-4BCCA8B38C14:HW_BID`
  Hardware `BoardProduct` (e.g. `Mac-35C1E88140C3E6CF`). Not present on real Macs, but used to avoid extra parsing of SMBIOS tables, especially in boot.efi.
- `4D1EDE05-38C7-4A6A-9CC6-4BCCA8B38C14:HW_MLB`
  Hardware `BoardSerialNumber`. Override for MLB. Present on newer Macs (2013+ at least).
- `4D1EDE05-38C7-4A6A-9CC6-4BCCA8B38C14:HW_ROM`
  Hardware ROM. Override for ROM. Present on newer Macs (2013+ at least).
- `7C436110-AB2A-4BBB-A880-FE41995C9F82:prev-lang:kbd`
  ASCII string defining default keyboard layout. Format is `lang-COUNTRY:keyboard`, e.g. `ru-RU:19456` for Mac keyboard. Also accepts short forms: `ru:19456` or `ru:0`. Full decoded list of keyboards in `AppleKeyboardLayouts-L.dat` can be found on AppleLife.
- `7C436110-AB2A-4BBB-A880-FE41995C9F82:security-mode`
  ASCII string defining FireWire security mode. Legacy, can be found in IOFireWireFamily source code in IOFireWireController.cpp. It is recommended not to set this variable, which may speedup system startup. Setting to `full` is equivalent to not setting the variable and `none` disables FireWire security.
- `4D1EDE05-38C7-4A6A-9CC6-4BCCA8B38C14:UIScale`
  8-bit integer defining boot.efi user interface scaling. Should be 1 for normal screens and 2 for HDPI screens.

8.5 Other Variables

The following variables may be useful for certain configurations or troubleshooting:

- `7C436110-AB2A-4BBB-A880-FE41995C9F82:boot-args`
  Kernel arguments, used to pass configuration to Apple kernel and drivers. There are many arguments, which may be found by looking for the use of `PE_parse_boot_argn` function in the kernel or driver code. Some of the known boot arguments include:
  - ~~FIXME: document several known values! debug, keepsyms, slide, -v, -s, -x, cpus=x, io=x, kextlog=x, -nehalem_error_disable -no_compat_check nvda_drv=1, etc?~~ acpi_layer=0xFFFFFFFF
  - acpi_level=0xFFFF5F (implies ACPI_ALL_COMPONENTS)
  - cpus=VALUE
  - debug=VALUE
  - io=VALUE
  - keepsyms=1
  - kextlog=VALUE
  - nvda_drv=1
  - slide=VALUE
  - -nehalem_error_disable
  - -no_compat_check
  - -s
  - -v
  - -x
- `7C436110-AB2A-4BBB-A880-FE41995C9F82:bootercfg`
  Booter arguments, similar to `boot-args` but for boot.efi. Accepts a set of arguments, which are hexadecimal 64-bit values with or without 0x prefix primarily for logging control:
  - `log=VALUE`
    * `1` — AppleLoggingConOutOrErrSet/AppleLoggingConOutOrErrPrint (classical ConOut/StdErr)
    * `2` — AppleLoggingStdErrSet/AppleLoggingStdErrPrint (StdErr or serial?)

patching AppleSmbios.kext and AppleACPIPlatform.kext to read from another GUID: "EB9D2D31" -> "EB9D2D35" (in ASCII).

6. Generic
   Type: plist dictonary
   Optional: When Automatic is false
   Description: Update all fields. This section is read only when Automatic is active.

7. DataHub
   Type: plist dictonary
   Optional: When Automatic is true
   Description: Update Data Hub fields. This section is read only when Automatic is not active.

8. PlatformNVRAM
   Type: plist dictonary
   Optional: When Automatic is true
   Description: Update platform NVRAM fields. This section is read only when Automatic is not active.

9. SMBIOS
   Type: plist dictonary
   Optional: When Automatic is true
   Description: Update SMBIOS fields. This section is read only when Automatic is not active.

9.2 Generic Properties

1. SpoofVendor
   Type: plist boolean
   Default value: false
   Description: Sets SMBIOS vendor fields to Acidanthera.

   It is dangerous to use Apple in SMBIOS vendor fields for reasons given in SystemManufacturer description. However, certain firmwares may not provide valid values otherwise, which could break some software.

2. SystemProductName
   Type: plist string
   Default value: MacPro6,1
   Description: Refer to SMBIOS SystemProductName.

3. SystemSerialNumber
   Type: plist string
   Default value: OPENCORE_SN1
   Description: Refer to SMBIOS SystemSerialNumber.

4. SystemUUID
   Type: plist string, GUID
   Default value: OEM specified
   Description: Refer to SMBIOS SystemUUID.

5. MLB
   Type: plist string
   Default value: OPENCORE_MLB_SN11
   Description: Refer to SMBIOS BoardSerialNumber.

6. ROM
   Type: plist data, 6 bytes
   Default value: all zero
   Description: Refer to 4D1EDE05-38C7-4A6A-9CC6-4BCCA8B38C14:ROM.

9.3 DataHub Properties

1. PlatformName
   Type: plist string