



OpenCore

Reference Manual (0.5.~~2~~.3)

[2019.11.01]

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 Properties

1. ConnectDrivers

Type: plist boolean

Failsafe: false

Description: Perform UEFI controller connection after driver loading. This option is useful for loading filesystem drivers, which usually follow UEFI driver model, and may not start by themselves. While effective, this option is not necessary with e.g. APFS loader driver, and may slightly slowdown the boot.

2. Drivers

Type: plist array

Failsafe: None

Description: Load selected drivers from `OC/Drivers` directory.

Designed to be filled with string filenames meant to be loaded as UEFI drivers. Depending on the firmware a different set of drivers may be required. Loading an incompatible driver may lead your system to unbootable state or even cause permanent firmware damage. Some of the known drivers include:

- **ApfsDriverLoader** — APFS file system bootstrap driver adding the support of embedded APFS drivers in bootable APFS containers in UEFI firmwares.
- **FwRuntimeServices** — `OC_FIRMWARE_RUNTIME` protocol implementation that increases the security of OpenCore and Lilu by supporting read-only and write-only NVRAM variables. Some quirks, like **RequestBootVarRouting**, require this driver for proper function. Due to the nature of being a runtime driver, i.e. functioning in parallel with the target operating system, it cannot be implemented within OpenCore itself.
- **EnhancedFatDxe** — FAT filesystem driver from **FatPkg**. This driver is embedded in all UEFI firmwares, and cannot be used from OpenCore. It is known that multiple firmwares have a bug in their FAT support implementation, which leads to corrupted filesystems on write attempt. Embedding this driver within the firmware may be required in case writing to EFI partition is needed during the boot process.
- **NvmExpressDxe** — NVMe support driver from **MdeModulePkg**. This driver is included in most firmwares starting with Broadwell generation. For Haswell and earlier embedding it within the firmware may be more favourable in case a NVMe SSD drive is installed.
- **UsbKbDxe** — USB keyboard driver adding the support of **AppleKeyMapAggregator** protocols on top of a custom USB keyboard driver implementation. This is an alternative to builtin **KeySupportKeySupport**, which may work better or worse depending on the firmware.
- **VirtualSmc** — UEFI SMC driver, required for proper FileVault 2 functionality and potentially other macOS specifics. An alternative, named **SMCHelper**, is not compatible with **VirtualSmc** and OpenCore, which is unaware of its specific interfaces. In case **FakeSMC** kernel extension is used, manual NVRAM variable addition may be needed and **VirtualSmc** driver should still be used.
- **VBoxHfs** — HFS file system driver with bless support. This driver is an alternative to a closed source **HFSPlus** driver commonly found in Apple firmwares. While it is feature complete, it is approximately 3 times slower and is yet to undergo a security audit.
- **XhciDxe** — XHCI USB controller support driver from **MdeModulePkg**. This driver is included in most firmwares starting with Sandy Bridge generation. For earlier firmwares or legacy systems it may be used to support external USB 3.0 PCI cards.

To compile the drivers from UDK (EDK II) use the same command you do normally use for OpenCore compilation, but choose a corresponding package:

```
git clone https://github.com/acidanthera/audk UDK
cd UDK
source edksetup.sh
```

- Logging is enabled (1) and shown onscreen (2): Misc → Debug → Target = 3.
- Logged messages from at least DEBUG_ERROR (0x80000000), DEBUG_WARN (0x00000002), and DEBUG_INFO (0x00000040) levels are visible onscreen: Misc → Debug → DisplayLevel = 0x80000042.
- Critical error messages, like DEBUG_ERROR, stop booting: Misc → Security → HaltLevel = 0x80000000.
- Watch Dog is disabled to prevent automatic reboot: Misc → Debug → DisableWatchDog = true.
- Boot Picker (entry selector) is enabled: Misc → Boot → ShowPicker = true.

If there is no obvious error, check the available hacks in Quirks sections one by one. For early boot troubleshooting, for instance, when OpenCore menu does not appear, using UEFI Shell may help to see early debug messages.

2. How to customise boot entries?

OpenCore follows standard Apple Bless model and extracts the entry name from `.contentDetails` and `.disk_label.contentDetails` files in the booter directory if present. These files contain an ASCII string with an entry title, which may then be customised by the user.

3. How to choose the default boot entry?

OpenCore uses the primary UEFI boot option to select the default entry. This choice can be altered from UEFI Setup, with the macOS Startup Disk preference, or the Windows Boot Camp Control Panel. Since choosing OpenCore's `BOOTx64.EFI` as a primary boot option limits this functionality in addition to several firmwares deleting incompatible boot options, potentially including those created by macOS, you are strongly encouraged to use the `RequestBootVarRouting` quirk, which will preserve your selection made in the operating system within the OpenCore variable space. Note, that `RequestBootVarRouting` requires a separate driver for functioning.

4. What is the simplest way to install macOS?

Copy online recovery image (`*.dmg` and `*.chunklist` files) to `com.apple.recovery.boot` directory on a FAT32 partition with OpenCore. Load OpenCore Boot Picker and choose the entry, it will have a `(dmg)` suffix. Custom name may be created by providing `.contentDetails` file.

To download recovery online you may use `macrecovery.py` tool from `MacInfoPkg`.

For offline installation refer to How to create a bootable installer for macOS article.

5. Why do online recovery images (*.dmg) fail to load?

This may be caused by missing HFS+ driver, as all presently known recovery volumes have HFS+ filesystem. Another cause may be buggy firmware allocator, which can be worked around with `AvoidHighAlloc` UEFI quirk.

6. Can I use this on Apple hardware or virtual machines?

Sure, most relatively modern Mac models including `MacPro5,1` and virtual machines are fully supported. Even though there are little to none specific details relevant to Mac hardware, some ongoing instructions can be found in `acidanthera/bugtracker#377`.

7. Why do Find&Replace patches must equal in length?

For machine code (x86 code) it is not possible to do ~~such~~ differently sized replacements due to relative addressing. For ACPI code this is risky, and is technically equivalent to ACPI table replacement, thus not implemented. More detailed explanation can be found on `AppleLife.ru`.

8. How can I migrate from AptioMemoryFix?

Behaviour similar to that of `AptioMemoryFix` can be obtained by installing `FwRuntimeServices` driver and enabling the quirks listed below. Please note, that most of these are not necessary to be enabled. Refer to their individual descriptions in this document for more details.

- `ProvideConsoleGop` (UEFI quirk)
- `AvoidRuntimeDefrag`
- `DiscardHibernateMap`
- `EnableSafeModeSlide`
- `EnableWriteUnprotector`
- `ForceExitBootServices`
- `ProtectCsmRegion`
- `ProvideCustomSlide`