



OpenCore

Reference Manual (~~0.6.9~~0.7.0)

[2021.05.11]

- Enabling XCPM support for an unsupported CPU variant.

Note 1: It may also be the case that the CPU model is supported but there is no power management supported (e.g. virtual machines). In this case, `MinKernel` and `MaxKernel` can be set to restrict CPU virtualisation and dummy power management patches to the particular macOS kernel version.

Note 2: Only the value of `EAX`, which represents the full CPUID, typically needs to be accounted for and remaining bytes should be left as zeroes. The byte order is Little Endian. For example, `C3 06 03 00` stands for CPUID `0x0306C3` (Haswell).

Note 3: For XCPM support it is recommended to use the following combinations.

- Haswell-E (0x0306F2) to Haswell (0x0306C3):
`Cpuid1Data: C3 06 03 00 00 00 00 00 00 00 00 00 00 00 00 00`
`Cpuid1Mask: FF FF FF FF 00 00 00 00 00 00 00 00 00 00 00 00`
- Broadwell-E (0x0406F1) to Broadwell (0x0306D4):
`Cpuid1Data: D4 06 03 00 00 00 00 00 00 00 00 00 00 00 00 00`
`Cpuid1Mask: FF FF FF FF 00 00 00 00 00 00 00 00 00 00 00 00`
- Rocket Lake (0x0A0670) to Comet Lake (0x0906EB):
`Cpuid1Data: EB 06 09 00 00 00 00 00 00 00 00 00 00 00 00 00`
`Cpuid1Mask: FF FF FF FF 00 00 00 00 00 00 00 00 00 00 00 00`
- [Comet Lake U62 \(0x0A0660\) to Comet Lake U42 \(0x0806EC\)](#):
`Cpuid1Data: EC 06 08 00 00 00 00 00 00 00 00 00 00 00 00 00`
`Cpuid1Mask: FF FF FF FF 00 00 00 00 00 00 00 00 00 00 00 00`

Note 4: Be aware that the following configurations are unsupported by XCPM (at least out of the box):

- Consumer Ivy Bridge (0x0306A9) as Apple disabled XCPM for Ivy Bridge and recommends legacy power management for these CPUs. `_xcpm_bootstrap` should manually be patched to enforce XCPM on these CPUs instead of this option.
- Low-end CPUs (e.g. Haswell+ Pentium) as they are not supported properly by macOS. Legacy workarounds for older models can be found in the `Special NOTES` section of [acidanthera/bugtracker#365](#).

2. `Cpuid1Mask`

Type: plist data, 16 bytes

Failsafe: All zero

Description: Bit mask of active bits in `Cpuid1Data`.

When each `Cpuid1Mask` bit is set to 0, the original CPU bit is used, otherwise set bits take the value of `Cpuid1Data`.

3. `DummyPowerManagement`

Type: plist boolean

Failsafe: false

Requirement: 10.4

Description: Disables `AppleIntelCpuPowerManagement`.

Note 1: This option is a preferred alternative to `NullCpuPowerManagement.kext` for CPUs without native power management driver in macOS.

Note 2: While this option is typically needed to disable `AppleIntelCpuPowerManagement` on unsupported platforms, it can also be used to disable this kext in other situations (e.g. with `Cpuid1Data` left blank).

4. `MaxKernel`

Type: plist string

Failsafe: Empty

Description: Emulates CPUID and applies `DummyPowerManagement` on specified macOS version or older.

Note: Refer to the `Add MaxKernel` description for matching logic.

5. `MinKernel`

Type: plist string

Failsafe: Empty

Description: Emulates CPUID and applies `DummyPowerManagement` on specified macOS version or newer.

Note: Refer to the `Add MaxKernel` description for matching logic.

- OCAE — OcAppleEventLib
- OCAK — OcAppleKernelLib
- OCAU — OcAudioLib
- OCA — OcAcpiLib
- OCBP — OcAppleBootPolicyLib
- OCB — OcBootManagementLib
- [OCLBT — OcBlitLib](#)
- OCCL — OcAppleChunkListLib
- OCCPU — OcCpuLib
- OCC — OcConsoleLib
- OCDC — OcDriverConnectionLib
- OCDH — OcDataHubLib
- OCDI — OcAppleDiskImageLib
- OCDM — OcDeviceMiscLib
- OCFS — OcFileLib
- OCFV — OcFirmwareVolumeLib
- OCHS — OcHashServicesLib
- OCIA4 — OcAppleImg4Lib
- OCIC — OcImageConversionLib
- OCII — OcInputLib
- OCJS — OcApfsLib
- OCKM — OcAppleKeyMapLib
- OCL — OcDebugLogLib
- OCM — OcMiscLib
- OCMCO — OcMachoLib
- OCME — OcHeciLib
- OCMM — OcMemoryLib
- OCPE — OcPeCoffLib, OcPeCoffExtLib
- OCPI — OcFileLib, partition info
- OCPNG — OcPngLib
- OCRAM — OcAppleRamDiskLib
- OCRTC — OcRtcLib
- OCSB — OcAppleSecureBootLib
- OCSMB — OcSmbiosLib
- OCSMC — OcSmcLib
- OCST — OcStorageLib
- OCS — OcSerializedLib
- OCTPL — OcTemplateLib
- OCUC — OcUnicodeCollationLib
- OCUT — OcAppleUserInterfaceThemeLib
- OCXML — OcXmlLib

8.5 Security Properties

1. AllowNvramReset

Type: plist boolean

Failsafe: false

Description: Allow CMD+OPT+P+R handling and enable showing NVRAM **Reset** entry in OpenCore picker.

Note 1: It is known that some Lenovo laptops have a firmware bug, which makes them unbootable after performing NVRAM reset. Refer to [acidanthera/bugtracker#995](#) for details.

Note 2: Resetting NVRAM will also erase any boot options not backed up using the bless command. For example, Linux installations to custom locations not specified in BlessOverride

2. AllowSetDefault

Type: plist boolean

Failsafe: false

Description: Allow CTRL+Enter and CTRL+Index handling to set the default boot option in the OpenCore

- `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).
- `4D1EDE05-38C7-4A6A-9CC6-4BCCA8B38C14:SSN`
Serial number. 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:252` for Russian locale and ABC keyboard. Also accepts short forms: `ru:252` or `ru:0` (U.S. keyboard, compatible with 10.9). Full decoded keyboard list from `AppleKeyboardLayouts-L.dat` can be found [here](#). Using non-latin keyboard on 10.14 will not enable ABC keyboard, unlike previous and subsequent macOS versions, and is thus not recommended in case 10.14 is needed.
- `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`
One-byte data defining `boot.efi` user interface scaling. Should be `01` for normal screens and `02` for HiDPI screens.
- [`7C436110-AB2A-4BBB-A880-FE41995C9F82:ForceDisplayRotationInEFI` 32-bit integer defining display rotation. Can be 0 for no rotation or any of 90, 180, 270 for matching rotation in degrees.](#)
- `4D1EDE05-38C7-4A6A-9CC6-4BCCA8B38C14:DefaultBackgroundColor`
Four-byte BGRA data defining `boot.efi` user interface background colour. Standard colours include `BF BF BF 00` (Light Gray) and `00 00 00 00` (Syrah Black). Other colours may be set at user's preference.

9.5 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:
 - `acpi_layer=0xFFFFFFFF`
 - `acpi_level=0xFFFF5F` (implies `ACPI_ALL_COMPONENTS`)
 - `arch=i386` (force kernel architecture to `i386`, see `KernelArch`)
 - `batman=VALUE` (`AppleSmartBatteryManager` debug mask)
 - `batman-nosmc=1` (disable `AppleSmartBatteryManager` SMC interface)
 - `cpus=VALUE` (maximum number of CPUs used)
 - `debug=VALUE` (debug mask)
 - `io=VALUE` (`IOKit` debug mask)
 - `ioaccel_debug=VALUE` (`IOAccelerator` debug mask)
 - `keepsyms=1` (show panic log debug symbols)
 - `kextlog=VALUE` (kernel extension loading debug mask)
 - `nvram-log=1` (enables `AppleEFINVRAM` logs)
 - `nv_disable=1` (disables NVIDIA GPU acceleration)
 - `nvda_drv=1` (legacy way to enable NVIDIA web driver, removed in 10.12)
 - `npcci=0x2000` (legacy, disables `kIOPCIConfiguratorPFM64`)

The use of `System` protocols is more complicated. Typically, the preferred setting is `SystemGraphics` or `SystemText`. Enabling `ProvideConsoleGop`, setting `Resolution` to `Max`, enabling `ReplaceTabWithSpace` is useful on almost all platforms. `SanitiseClearScreen`, `IgnoreTextInGraphics`, and `ClearScreenOnModeSwitch` are more specific, and their use depends on the firmware.

Note: Some Macs, such as the `MacPro5,1`, may have incompatible console output when using modern GPUs, and thus only `BuiltinGraphics` may work for them in such cases. NVIDIA GPUs may require additional firmware upgrades.

2. `ConsoleMode`

Type: `plist string`

Failsafe: Empty (Maintain current console mode)

Description: Sets console output mode as specified with the `WxH` (e.g. `80x24`) formatted string.

Set to `Max` to attempt using the largest available console mode. This option is currently ignored as the `Builtin` text renderer only supports one console mode.

Note: This field is best left empty on most types of firmware.

3. `Resolution`

Type: `plist string`

Failsafe: Empty (Maintain current screen resolution)

Description: Sets console output screen resolution.

- 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 `Max` to attempt using the 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 `Builtin` text renderer, FileVault 2 UEFI password interface, and boot screen logo. Refer to the Recommended Variables section for 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` set to `true`.

4. `ForceResolution`

Type: `plist boolean`

Failsafe: `false`

Description: Forces `Resolution` to be set in cases where the desired resolution is not available by default, such as on legacy Intel GMA and first generation Intel HD Graphics (Ironlake/Arrandale). Setting `Resolution` to `Max` will try to pull the largest available resolution from the connected display's EDID.

Note: This option depends on the `OC_FORCE_RESOLUTION_PROTOCOL` protocol being present. This protocol is currently only supported by `OpenDuetPkg`. The `OpenDuetPkg` implementation currently only supports Intel iGPUs.

5. `ClearScreenOnModeSwitch`

Type: `plist boolean`

Failsafe: `false`

Description: Some types of firmware only clear part of the screen when switching from graphics to text mode, leaving a fragment of previously drawn images visible. This option fills the entire graphics screen with black colour before switching to text mode.

Note: This option only applies to `System` renderer.

6. `DirectGopRendering`

Type: `plist boolean`

Failsafe: `false`

Description: Use builtin graphics output protocol renderer for console.

On certain firmware, such as on the `MacPro5,1`, this may provide better performance or fix rendering issues. However, this option is not recommended unless there is an obvious benefit as it may result in issues such as slower scrolling.

This renderer fully supports `AppleEg2Info` protocol and will provide screen rotation for all EFI applications. In order to provide seamless rotation compatibility with `EfiBoot`, builtin `AppleFramebufferInfo` should also be used, i.e. it may need to be overridden on Mac EFI.

7. `GopPassThrough`

Type: plist boolean

Failsafe: false

Description: Provide GOP protocol instances on top of UGA protocol instances.

This option provides the GOP protocol via a UGA-based proxy for firmware that do not implement the protocol.

Note: This option requires `ProvideConsoleGop` to be enabled.

8. `IgnoreTextInGraphics`

Type: plist boolean

Failsafe: false

Description: Some types of firmware output text onscreen in both graphics and text mode. This is typically unexpected as random text may appear over graphical images and cause UI corruption. Setting this option to `true` will discard all text output when console control is in a different mode from `Text`.

Note: This option only applies to the `System` renderer.

9. `ReplaceTabWithSpace`

Type: plist boolean

Failsafe: false

Description: Some types of firmware do not print tab characters or everything that follows them, causing difficulties in using the UEFI Shell's builtin text editor to edit property lists and other documents. This option makes the console output spaces instead of tabs.

Note: This option only applies to `System` renderer.

10. `ProvideConsoleGop`

Type: plist boolean

Failsafe: false

Description: Ensure GOP (Graphics Output Protocol) on console handle.

macOS bootloader requires GOP or UGA (for 10.4 `EfiBoot`) to be present on console handle, yet the exact location of the graphics protocol is not covered by the UEFI specification. This option will ensure GOP and UGA, if present, are available on the console handle.

Note: This option will also replace incompatible implementations of GOP on the console handle, as may be the case on the `MacPro5,1` when using modern GPUs.

11. `ReconnectOnResChange`

Type: plist boolean

Failsafe: false

Description: Reconnect console controllers after changing screen resolution.

On certain firmware, the controllers that produce the console protocols (simple text out) must be reconnected when the screen resolution is changed via GOP. Otherwise, they will not produce text based on the new resolution.

Note: On several boards this logic may result in black screen when launching OpenCore from Shell and thus it is optional. In versions prior to 0.5.2 this option was mandatory and not configurable. Please do not use this unless required.

12. `SanitiseClearScreen`

Type: plist boolean

Failsafe: false

Description: Some types of firmware reset screen resolutions to a failsafe value (such as 1024x768) on the attempts to clear screen contents when large display (e.g. 2K or 4K) is used. This option attempts to apply a workaround.

Note: This option only applies to the `System` renderer. On all known affected systems, `ConsoleMode` must be set to an empty string for this option to work.

13. UgaPassThrough

Type: plist boolean

Failsafe: false

Description: Provide UGA protocol instances on top of GOP protocol instances.

Some types of firmware do not implement the legacy UGA protocol but this may be required for screen output by older EFI applications such as EfiBoot from 10.4.

11.12 ProtocolOverrides Properties

1. AppleAudio

Type: plist boolean

Failsafe: false

Description: Replaces Apple audio protocols with builtin versions.

Apple audio protocols allow OpenCore and the macOS bootloader to play sounds and signals for screen reading or audible error reporting. Supported protocols are beep generation and VoiceOver. The VoiceOver protocol is specific to Gibraltar machines (T2) and is not supported before macOS High Sierra (10.13). Older macOS versions use the AppleHDA protocol (which is not currently implemented) instead.

Only one set of audio protocols can be available at a time, so this setting should be enabled in order to enable audio playback in the OpenCore user interface on Mac systems implementing some of these protocols.

Note: The backend audio driver needs to be configured in **UEFI Audio** section for these protocols to be able to stream audio.

2. AppleBootPolicy

Type: plist boolean

Failsafe: false

Description: Replaces the Apple Boot Policy protocol with a builtin version. This may be used to ensure APFS compatibility on VMs and legacy Macs.

Note: This option is advisable on certain Macs, such as the **MacPro5,1**, that are APFS compatible but on which the Apple Boot Policy protocol has recovery detection issues.

3. AppleDebugLog

Type: plist boolean

Failsafe: false

Description: Replaces the Apple Debug Log protocol with a builtin version.

4. [AppleEg2Info](#)

[**Type:** plist boolean](#)

[**Failsafe:** false](#)

[**Description:** Replaces the Apple EFI Graphics 2 protocol with a builtin version.](#)

[*Note:* This protocol allows newer EfiBoot versions \(at least 10.15\) to expose screen rotation to macOS. Refer to ForceDisplayRotationInEFI variable description on how to set screen rotation angle.](#)

5. AppleFramebufferInfo

Type: plist boolean

Failsafe: false

Description: Replaces the Apple Framebuffer Info protocol with a builtin version. This may be used to override framebuffer information on VMs and legacy Macs to improve compatibility with legacy EfiBoot such as the one in macOS 10.4.

Note: The current implementation of this property results in it only being active when GOP is available (it is always equivalent to **false** otherwise).

6. AppleImageConversion

Type: plist boolean

Failsafe: false

Description: Replaces the Apple Image Conversion protocol with a builtin version.