

# Lesson Proper for Week 4

## OPEN SOURCE CUSTOM ROUTER FIRMWARE

**Router Firmware**

It is the preinstalled, embedded software that manages the control of routing protocols, administrative features and the router's security mechanism.

**Firmware**

Used to operate the router and works as an operating system by providing an interface, protocol configuration and security settings. It allows the router to be configured and customized according to the network operating environments.

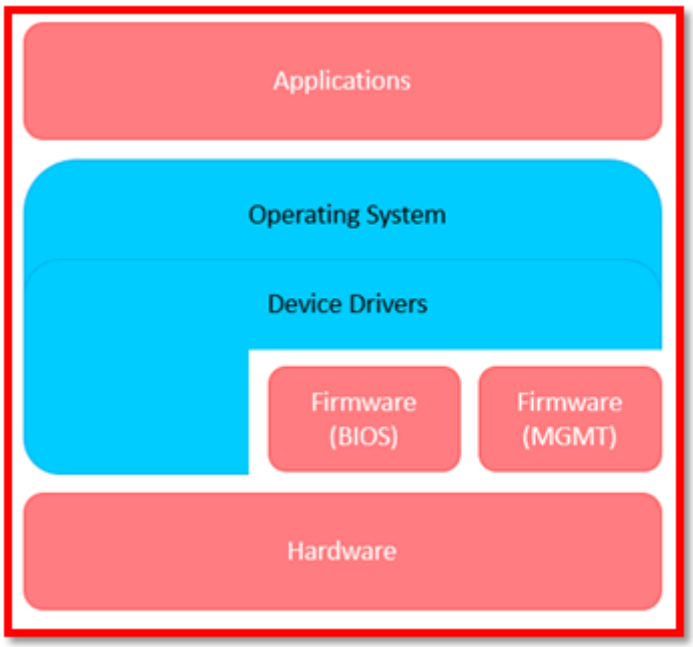
A software program typically stored in the flash ROM (Read-only-Memory) of a hardware device which provides instructions on how the machine should operate.

***Origin of the term***

Ascher Opler coined the term “firmware” in a 1967 Datamation article. Originally, it meant the contents of a writable control store (a small specialized high speed memory), containing microcode that defined and implemented the computer’s instruction set, and that could be reloaded to specialize or modify the instructions that the central processing unit (CPU) could execute.

As originally used, firmware contrasted with hardware (the CPU itself) and software (normal instructions executing on a CPU). It was not composed of CPU machine instructions, but of lower-level microcode involved in the implementation of machine instructions. It existed on the boundary between hardware and software; thus the name “firmware”.

**FIRMWARE, DEVICE DRIVER AND SOFTWARE**




| Firmware | Device Driver | Software |
|---|---|---|
| A type of software program that enables device functionalities without the need for installing additional software | A type of software program that enables the communication between an OS and the hardware | A broad term used to define a set of instructions that enables a device to function in specific ways |
| Types of firmware include BIOS, EFI (Extensible Firmware Interface), etc. | A device driver is hardware-specific. For instance, printer driver, graphics driver, etc. | Types of software include application software, shareware, system software, etc. |
| A firmware gives life to a hardware | A device driver ensures the smooth functioning of a device | A software adds functionality to a device |
| A firmware is not meant for user interaction | A device driver is not meant for user interaction | A software is meant for user interaction |

## EXAMPLES OF FIRMWARE

Examples of devices containing firmware are embedded systems:

§ Traffic lights

§ Consumer appliances

§ Digital watches

§ computers,

§ computer peripherals,

§ mobile phones, and

§ digital cameras

**The firmware contained in these devices provides the control program for the device.*

## TYPES OF FIRMWARE

### 1. BIOS (Basic Input/Output)

After pressing the power button to turn on, the computer will boot into the **BIOS.** It can interact with the hardware and check for any errors, then signal to another program called Bootloader, do the task of waking the sleeping operating system inside the hard drive and sending it. Into temporary data memory (Random Access Memory – RAM).

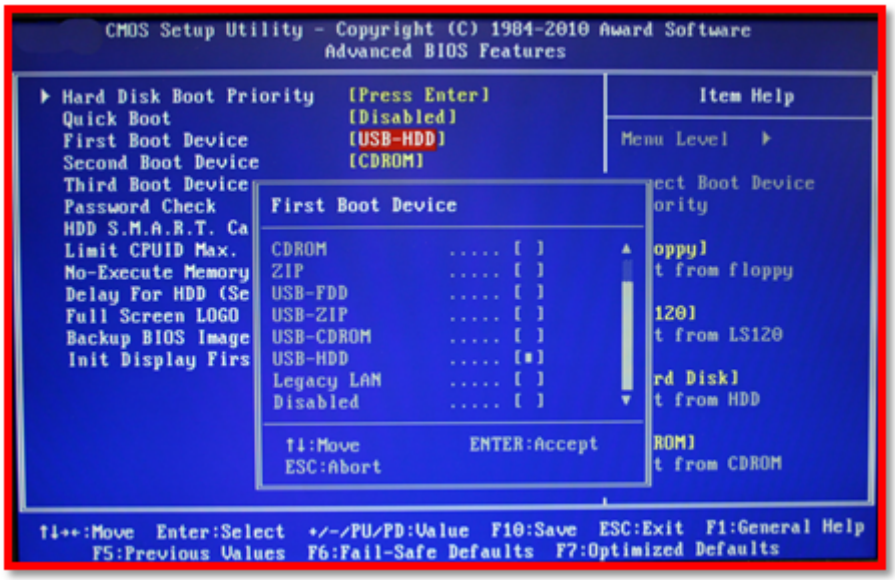
The main task of the **BIOS** is to handle the components of the computer hardware and ensure that these components work properly.

The BIOS's primary function is to handle the system setup process including driver loading and operating system booting.

*The 4 functions of BIOS*

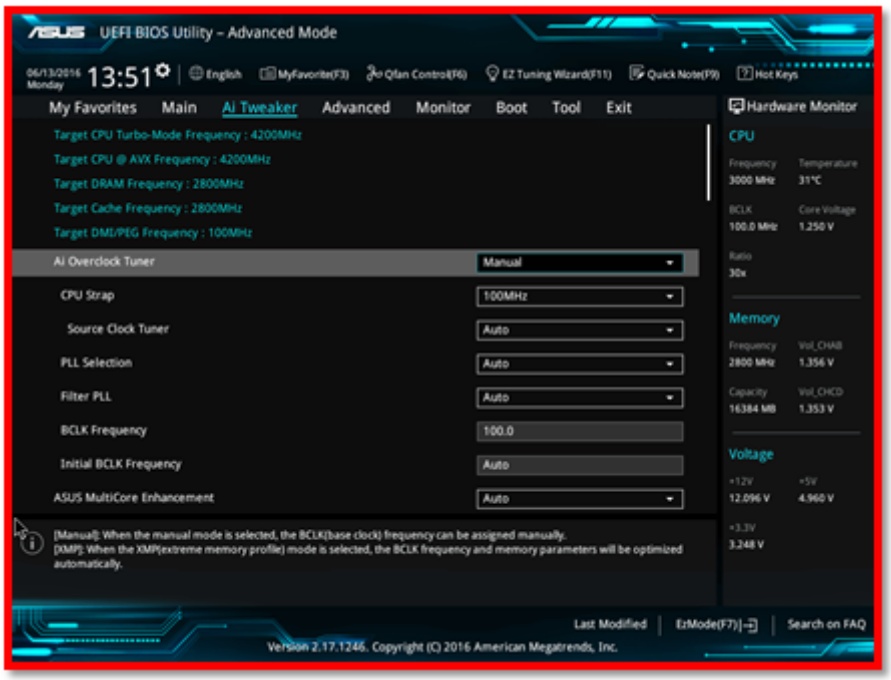
- Power-on self-test (POST). This tests the hardware of the computer before loading the OS.
- Bootstrap loader. This locates the OS.

- Software/drivers. This locates the software and drivers that interface with the OS once running.
- Complementary metal-oxide semiconductor (CMOS) setup.




**2. EFI (Extensible Firmware Interface)**

Is a software protocol specification that is responsible for communicating between the operating system and system firmware, used by the CPU to boot hardware and bypass the Bootloader. Sometimes EFI is also known as UEFI (Stands for Unified Extensible Firmware Interface) and certain advantages over the BIOS.




**ADVANTAGES OF UEFI**

UEFI provides many significant enhancements over BIOS, including the following:

o **Boot mode.** Microsoft Windows users can run 32-bit UEFI or 64-bit UEFI, although experts recommend that the OS bit mode and the firmware bit mode should be the same to avoid communication issues during runtime.

o **Drives.** UEFI supports boot drives of 2.2 TB and higher capacities, including drives with theoretical capacity of 9.4 zettabytes.

o **Drivers.** UEFI supports discrete drivers, whereas BIOS drive support is stored in read-only memory, which necessitates tuning it for compatibility when drives are swapped out or changes are made.

o **Graphical user interface (GUI).** UEFI enables new modules to be added to the GUI more easily, including device drivers for motherboard hardware and attached peripheral devices.

o **Multiple OS support.** Whereas BIOS allows a single boot loader, UEFI lets users install loaders for Debian-based Ubuntu and other Linux variants, along with Windows OS loaders, in the same EFI system partition.

o **Security.** Secure Boot is a UEFI protocol for Windows 8 or later Windows versions. Secure Boot makes a system's firmware the root of trust to verify device and system integrity. The goal is to prevent hackers from installing rootkits in the time between bootup and handoff to the OS. Secure Boot also enables an authorized user to configure networks and troubleshoot issues remotely, something a BIOS administrator must be physically present to do.

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