LINUX BOOT PROCESS

Created & Presented By: Janvi

Linux Boot Process

Press the Power button and after few moments you get to see the login prompt .

Have you ever wondered what goes behind when you press the power button and until the linux login prompt appears?

So , Here is where the Linux Boot Process comes in consideration . There are multiples stages and processes that happens between turning on the Computer and getting the login prompt.
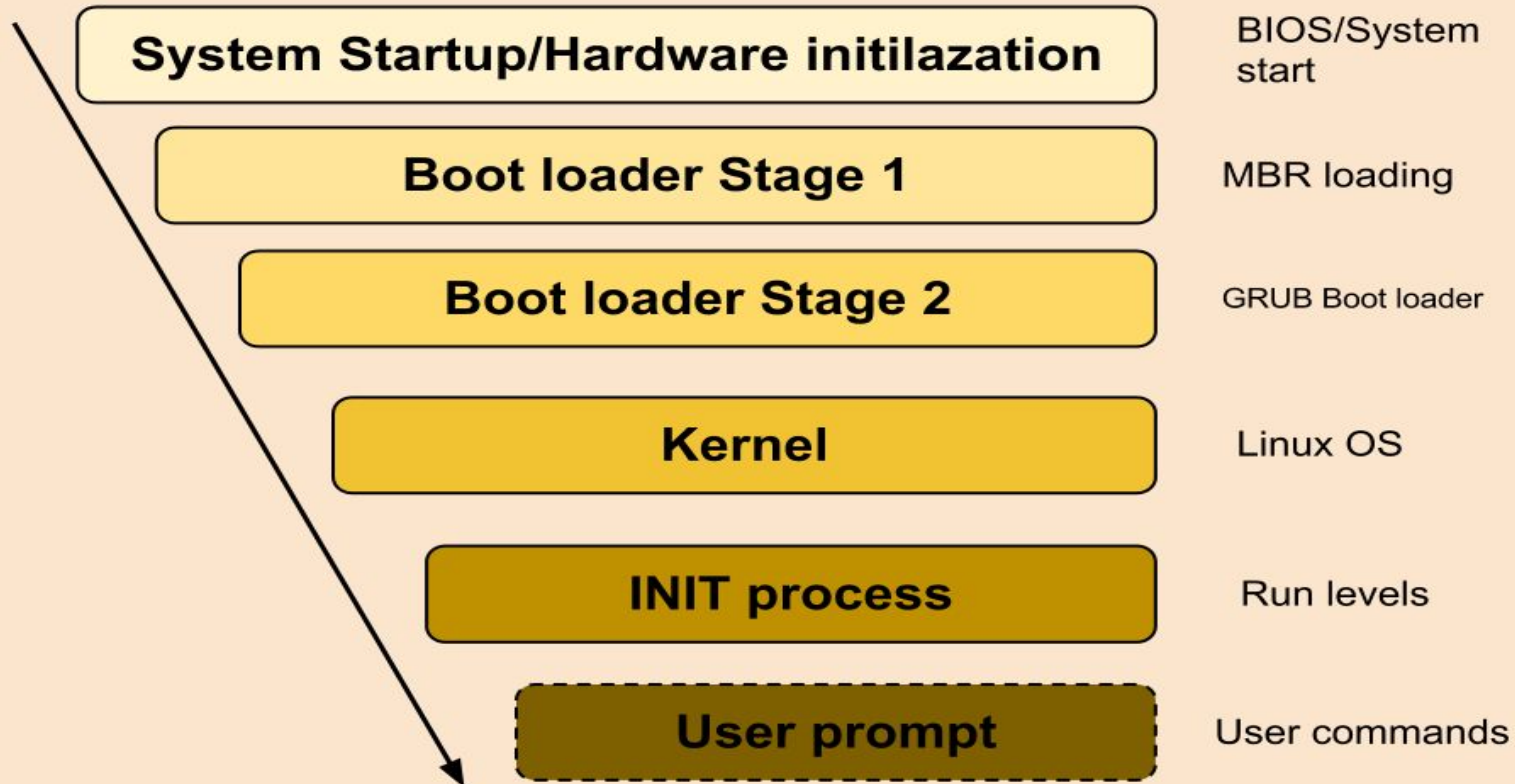
Let's get a deep dive into the same:

Stages of Linux Boot Process

There are these following high level stages of a typical linux boot process.

1. BIOS - (Basic Input /Output System)
2. MBR - (Master Boot Record)
3. GRUB - (Grand Unified Bootloader)
4. Kernel
5. Init
6. Run Level

SMPS

When you press the switch on button on your machine , what happens here is that it switch on power supply . By power supply i mean that it do a SMPS power on which means that the switch mode power supply will be on whenever you switch on your PC.

What SMPS means ?

A switched-mode power supply (SMPS) is an electronic circuit that converts power using switching devices that are turned on and off at high frequencies, and storage components such as inductors or capacitors to supply power when the switching device is in its non-conduction state.

BIOS

From SMPS , It goes to the BIOS.

BIOS stands for Basic Input /Output System . It performs System Integrity Checks and execute the MBR i.e Master Boot Record.

- When the machine is powered on **BIOS** is the first one to be called to verify if the hardware is present in the machine and if it is functioning. It does some System Integrity Checks. This is done by performing a **Power On Self Test** (POST).
- After Successful completion , It searches for the bootloader program from the boot devices such as HDD , FDD or CD Drive.
- Once the boot loader program is found on the boot device , it transfer the control to it.

MBR

MBR stands for Master Boot Record , and is responsible for Loading and executing the GRUB boot loader.

- It is located in the 1st sector of the bootable disk. Typically /dev/hda, or /dev/sda.
- MBR is less than 512 bytes in size. This has three components 1) primary boot loader info in 1st 446 bytes 2) partition table info in next 64 bytes 3) mbr validation check in last 2 bytes.
- MBR has the information about the Boot Loader program.

GRUB

GRUB stands for Grand Unified Bootloader . It just loads and executes Kernel and initrd images.

- If you have multiple kernel images installed on your system, you can choose which one to be
- executed.
- GRUB displays a splash screen, waits for few seconds, if you don't enter anything, it loads the default kernel image as specified in the grub configuration file.
- GRUB has the knowledge of the filesystem (the older Linux loader LILO didn't understand filesystem).
- Grub configuration file is /boot/grub/grub.conf (/etc/grub.conf is a link to this). The following is sample grub.conf of CentOS. It contains kernel and initrd image

```
#boot=/dev/sda
default=0
timeout=5
splashimage=(hd0,0)/boot/grub/splash.xpm.gz
hiddenmenu
title CentOS (2.6.18-194.el5PAE)
        root (hd0,0)
        kernel /boot/vmlinuz-2.6.18-194.el5PAE ro root=LABEL=/
        initrd /boot/initrd-2.6.18-194.el5PAE.img
```

Kernel Stage

A linux kernel is responsible for handling Process management, Memory Management, Users, Inter process communication etc.

- Mounts the root file system as specified in the "root=" in grub.conf
- Kernel executes the /sbin/init program
- Since init was the 1st program to be executed by Linux Kernel, it has the process id (PID) of 1. Do a 'ps -ef | grep init' and check the pid.
- initrd stands for Initial RAM Disk.
- initrd is used by kernel as temporary root file system until kernel is booted and the real root file system is mounted. It also contains necessary drivers compiled inside, which helps it to access the hard drive partitions, and other hardware.

Init

- Now as soon as the kernel executes the init process, it will look at the /etc/inittab configuration file to see the default run level.
- It reads the initab file to decide which runlevel to be enter during booting.
- It starts the program appropriate to the run level.
- It executes the /etc/rc.d/rc.sysinit in sub shell to set the hostname , networking to the system.
- Also executes the /etc/init.d/functions to set unmask, run the dmesg and mount the filesystems that are mentioned in the /etc/fstab .
- Then it executes the /etc/rc.d/rc.*d/ programs . This is called run level Programs .

Different Run Levels in Linux

Run-Level	Usage
0	System Halt/Shut Down
1	Single User Mode
2	Multiuser Mode Without Networking
3	Full Multiuser Mode
4	Unused
5	GUI/X11
6	Reboot

Run level Programs

Once the run level is identified , then run level specific programs are started by the kernel.

If you see the files inside these run level specific folders, they either begin with **S** or they begin with **K**. The files are also numbered. Now files with an S at starting will be executed during the startup process, and files that begins with **K**, will be killed during shutdown process.

The number after either S or K is the sequence with which these will be executed.

```
root@vm1-VirtualBox:/etc/rc3.d# ls
K01speech-dispatcher    S01cups-browsed    S01pulseaudio-enable-autospawn
S01acpid                S01dbus            S01rsync
S01anacron              S01gdm3            S01rsyslog
S01apport               S01grub-common     S01saned
S01avahi-daemon         S01irqbalance      S01spice-vdagent
S01bluetooth            S01kerneloops      S01ubuntu-fan
S01console-setup.sh     S01open-vm-tools   S01unattended-upgrades
S01cron                 S01openvpn         S01uuidd
S01cups                 S01plymouth        S01whoopsie
```

RUN LEVEL PROGRAMS

```
drwxr-xr-x    2 root root     4096 Mar 16 09:06 rc0.d
drwxr-xr-x    2 root root     4096 Mar 16 09:06 rc1.d
drwxr-xr-x    2 root root     4096 Mar 16 09:06 rc2.d
drwxr-xr-x    2 root root     4096 Mar 16 09:06 rc3.d
drwxr-xr-x    2 root root     4096 Mar 16 09:06 rc4.d
drwxr-xr-x    2 root root     4096 Mar 16 09:06 rc5.d
drwxr-xr-x    2 root root     4096 Mar 16 09:06 rc6.d
```

Once the kernel has started all programs in your desired run level directory. You will get a login screen to log inside your booted system. Hope this article was helpful and easy to understand. Please let us know in case anybody finds a mistake in this article, so that we can correct it.

Thank You