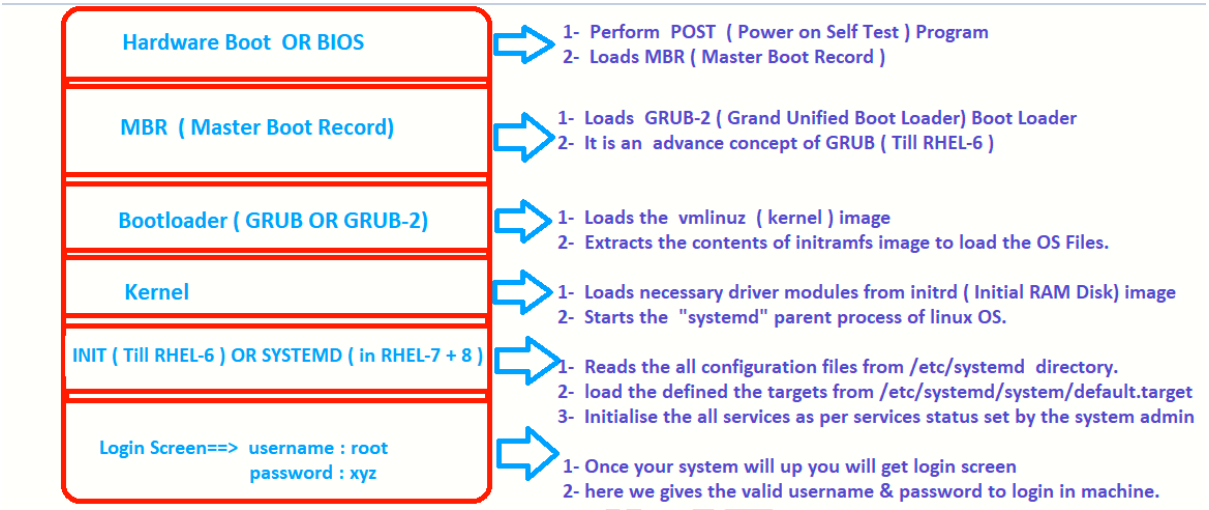
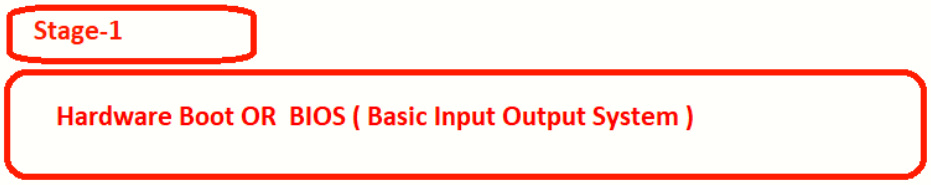
******** Booting Process of Linux OS *********

- Booting Process Basically define step by step process from machine start up END to Till Login Screen.
- Booting process in Linux system is important thing to understand for solve the troubleshoot problem.

Figure below describes basic boot stages and what happens during each boot stage



Now defining it in Brief :-



1- Power on machine
2- After Power on machine SMPS (switched-mode power supply) will supply the power to the all connecting devices with motherboard.
3- Basically It provides the current from AC (alternating current) to DC (direct current).
4- This supplies the computer and its components with the proper amount of voltage and electricity.
5- BIOS initialization => **BIOS** is firmware used to perform hardware **initialization** during the booting process (power-on start-up).
6- It also manages data flow between **the** computer's operating system and attached devices such as **the** hard disk, video adapter, keyboard, mouse and printer.
7- When you start your computer, you may see a message like "Press F2 for setup." This setup is your BIOS configuration interface.
8- 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.
9- The BIOS (Basic Input/Output System), performs the POST (power on self test) to detect, test and initialize system hardware components.
10- This is done by performing a **Power On Self Test** (POST).

Note: If all devices are OK then it gives the healthy Beep otherwise will display the error message as per current machine status.

- After a successful test with the help of POST , **BIOS checks the MBR** (Master Boot Record) in the hard disk to check if it refers to the location of the boot loader using DISK priority .
- CMOS initialization ➔ If the computer passes POST Operation, then it goes for CMOS initialization. This chip is kept alive by the CMOS battery even when the computer is turned off. This chip contains information such as the system time and date and information about all the hardware installed in your computer.
- Finally, the POST sends signals to the computer floppy, optical, and hard drive to test these drives. If all drives pass the test, the POST is complete and instruct the computer to start the process of loading the operating system.
- So, in simple terms BIOS loads and executes the MBR boot loader and give control to MBR.

Note: What is the difference between BIOS and CMOS?

- The terms BIOS and CMOS both refer to essential parts of your computer's motherboard. They work together and they're both important, but they are not the same thing.
- The BIOS's primary function is to handle the system setup process including driver loading and operating system booting.
- The CMOS's primary function is to handle and store the BIOS configuration settings.
- The BIOS is a ROM chip on the motherboard which contains code that tells the CPU how to interact and control the other components in the computer. The CMOS is also a chip on the motherboard but is a RAM chip with volatile memory which stores information about the computer components and their settings
- the **BIOS** is copied from **ROM** to **RAM** each time the computer is booted.
- CMOS holds a small amount of data, usually 256 bytes. The information on the CMOS chip includes types of disk drives are installed, the current date and time of your system clock, and your computer's boot sequence

Stage-2

MBR (Master Boot Record)

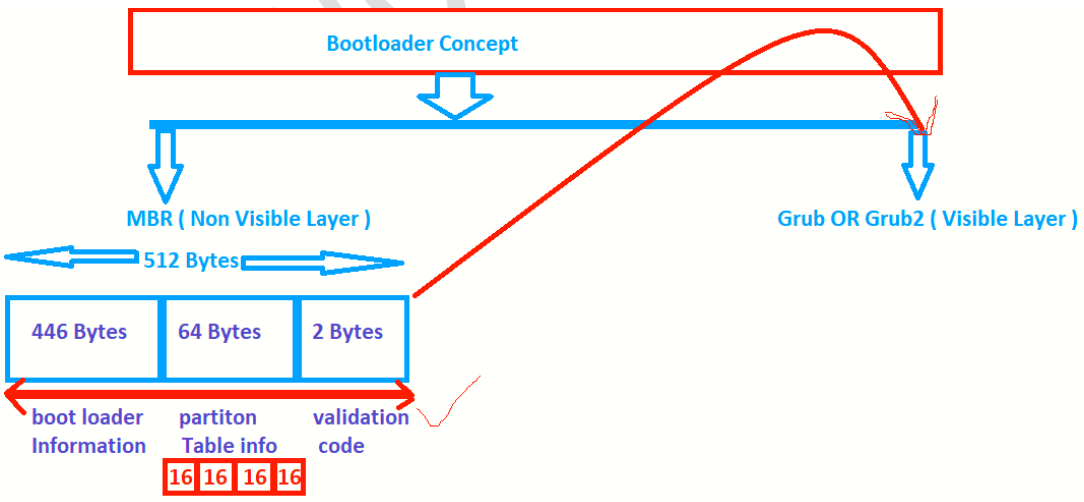
1- The Master Boot Record (MBR) is the information in the first sector of any hard disk or diskette that identifies how and where an operating system is located so that it can be boot (loaded) into the computer's main storage or random access memory.
2- Master Boot Record (MBR) is the first sector of disk. It's at first 512 bytes of the boot drive that is read into memory by the BIOS.
3- Also in Every Hard drive the MBR is a starting point which contains information about the number of partitions and their types
4- MRB contains 512 bytes which divides in three parts

Part-1 ➔ 446 bytes for information about boot loader

Part-2 ➔ 64 bytes for information about partition table

Part-3 ➔ 2 bytes for validation code or magic number which is use for error detection in sector.

Total Bytes ➔ 446 + 64 + 2 =====➔ 512 Bytes



- The boot loader will be installed if an operating system is installed on the system.
- MBR discovers the bootable device and loads the GRUB2 boot loader into memory and transfers control over to it.
- So, in simple terms MBR loads and executes the GRUB OR GRUB-2 boot loader.
- Now finally Grub2 will take the handover from MBR to load the Bootloader.

Stage-3

Bootloader (GRUB OR GRUB-2)

1- A boot loader, also called a boot manager, is a small program that places the operating system (OS) of a computer into memory.
2- A bootloader is the first program which executes before the main program whenever a system is initialized. On a PC, it is used to boot the OS.
3- A **boot loader** is also known as a **boot** manager or **bootstrap loader.**
4- The boot loader will present the user with a list of menu entries, each of which corresponds to different operating system
5- GRUB2 , GRUB stands for Grand Unified Bootloader.
6- GRUB2 is default boot loader program in CentOS/RHEL7/RHEL-8.
7- In machine All OS Booting files store in /boot directory.
8- So it read the grub2 configuration file from /boot/grub2/grub.cfg to load the booting files step by step.
9- Now GRUB2 will load the Kernel & Initramfs or (initrd) image file from /boot directory.
10- GRUB2 loads the vmlinuz kernel image file into memory and extracts the contents of the initramfs image file into a temporary, memory-based file system (tmpfs).

- Is detects what all device drivers are needed to load the actual file system and it loads them from a temporary file system. After that, other partition like LVM, RAID etc is mounted then initrd is unmounted.

- We can see kernel and initramfs file in /boot directory.

- The initrd is used by the Linux kernel as a temporary filesystem in the memory
- It contains tools and kernel modules which will continue the boot process including **mounting a virtual root file system** temporarily.
- Instead of using initrd, some Linux filesystem will also use **initramfs**.
- So, in simple terms GRUB just loads and executes Kernel and initrd images.

1- Virtual root File system
2- Real root File System =➔ it will mount in next stage using kernel.

- Successor of initrd (initial ram disk) is Initramfs (initial ram disk file system)
- Initramfs is used by 2.6 kernels whereas initrd was used by older 2.4 (and earlier) kernels.

Stage-4

Kernel

1. In this kernel stage , it will mount real root " / " file system.
2. After it Kernel will executes the "init" or "systemd" program.
3. We Can check with command # pidof systemd
4. Till RHEL-6 we was using init but in rhel-7 and rhel-8 we are using system concept.
5. Since init or system was the 1st program to be executed by Linux Kernel, it has the process id (PID) of 1.

Stage-5

init or systemd

1. Systemd is the controller program of all processes on a system.

2. "Init" OR " systemd" known as the parent process and responsible for starting all the other process.

3. Systemd is the advance concept of "init" program.
4. Systemd reads the file /etc/systemd/system/default.target to determine the default system target (equivalent to run level) .
5. Note: configuration file of runlevel is /etc/inittab .

   - multi-user.target: analogous to runlevel 3
   - graphical.target: analogous to runlevel 5

6. After defined the target it will check about the all services status and will take the actions.
7. It will also check the /etc/rc.local file if any command or scripts defined by the system admin it will run all things before giving the login screen.

Systemd brings the system to the state defined by the system target, performing system initialization tasks such as:

1. Setting the host name

2. Initializing the network

3. Initializing SELinux based on its configuration

4. Printing a welcome banner

5. Initializing the system hardware based on kernel boot arguments

6. Mounting the file systems, including virtual file systems such as the /proc file system

7. Cleaning up directories in /var

8. Starting swapping

- Once all required services and script are executed user gets login prompt

Stage-6

Login Screen

Once system will up , it will give you the login screen where you can give the username and password.

Here It will verify the all information :

- /etc/passwd
- /etc/group
- /etc/shadow
- Password policy
- All bash profiles files of user.
- Then you will get command prompt as per defined Shell.
- If all things are ok then you will command a command prompt as per user types.

[root @ localhost ~] #

[krishna @ localhost ~] $

*********KR Network Cloud**********