THE GEEK STUFF

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6 Stages of Linux Boot Process (Startup Sequence)

by RAMESH NATARAJAN *on* FEBRUARY 7, 2011

Press the power button on your system, and after few moments you see the Linux login prompt.

Have you ever wondered what happens behind the scenes from the time you press the power button until the Linux login prompt appears?

The following are the 6 high level stages of a typical Linux boot process.
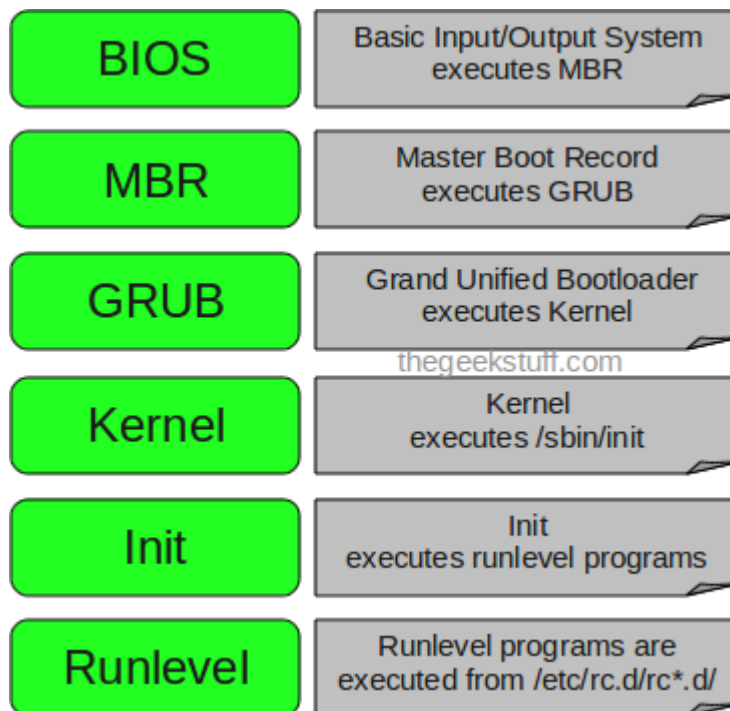
1. BIOS

- BIOS stands for Basic Input/Output System
- Performs some system integrity checks

- Searches, loads, and executes the boot loader program.
- It looks for boot loader in floppy, cd-rom, or hard drive. You can press a key (typically F12 of F2, but it depends on your system) during the BIOS startup to change the boot sequence.
- Once the boot loader program is detected and loaded into the memory, BIOS gives the control to it.
- So, in simple terms BIOS loads and executes the MBR boot loader.

2. MBR

- MBR stands for Master Boot Record.
- 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.
- It contains information about GRUB (or LILO in old systems).
- So, in simple terms MBR loads and executes the GRUB boot loader.

3. GRUB

- GRUB stands for Grand Unified Bootloader.
- 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.

```
#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
```

- As you notice from the above info, it contains kernel and initrd image.
- So, in simple terms GRUB just loads and executes Kernel and initrd images.

4. Kernel

- 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.

5. Init

- Looks at the /etc/inittab file to decide the Linux run level.
- Following are the available run levels
  - 0 – halt
  - 1 – Single user mode
  - 2 – Multiuser, without NFS
  - 3 – Full multiuser mode
  - 4 – unused
  - 5 – X11
  - 6 – reboot
- Init identifies the default initlevel from /etc/inittab and uses that to load all appropriate program.
- Execute 'grep initdefault /etc/inittab' on your system to identify the default run level
- If you want to get into trouble, you can set the default run level to 0 or 6. Since you know what 0 and 6 means, probably you might not do that.
- Typically you would set the default run level to either 3 or 5.

6. Runlevel programs

- When the Linux system is booting up, you might see various services getting started. For example, it might say "starting sendmail …. OK". Those are the runlevel programs, executed from the run level directory as defined by your run level.

- Depending on your default init level setting, the system will execute the programs from one of the following directories.

  - Run level 0 – /etc/rc.d/rc0.d/
  - Run level 1 – /etc/rc.d/rc1.d/
  - Run level 2 – /etc/rc.d/rc2.d/
  - Run level 3 – /etc/rc.d/rc3.d/
  - Run level 4 – /etc/rc.d/rc4.d/
  - Run level 5 – /etc/rc.d/rc5.d/
  - Run level 6 – /etc/rc.d/rc6.d/

- Please note that there are also symbolic links available for these directory under /etc directly. So, /etc/rc0.d is linked to /etc/rc.d/rc0.d.

- Under the /etc/rc.d/rc*.d/ directories, you would see programs that start with S and K.

- Programs starts with S are used during startup. S for startup.

- Programs starts with K are used during shutdown. K for kill.

- There are numbers right next to S and K in the program names. Those are the sequence number in which the programs should be started or killed.

- For example, S12syslog is to start the syslog deamon, which has the sequence number of 12. S80sendmail is to start the sendmail daemon, which has the sequence number of 80. So, syslog program will be started before sendmail.

There you have it. That is what happens during the Linux boot process.

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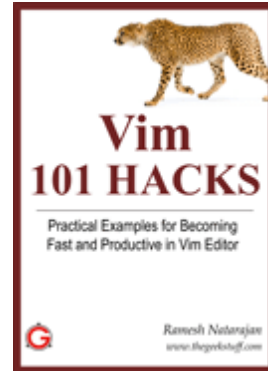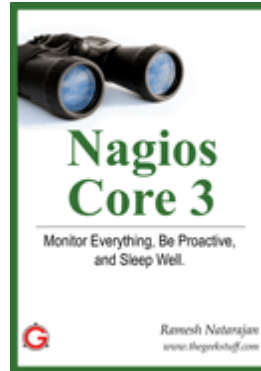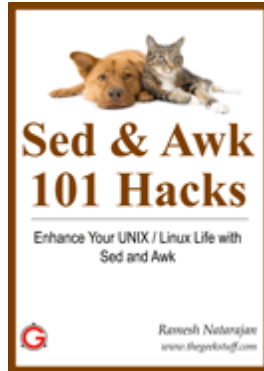
Tagged as: Debian Boot Process, Fedora Boot Process, Linux Kernel Boot Process, Ubuntu Boot Process, UNIX Boot Process

Comments on this entry are closed.

Pushpraj

February 7, 2011, 1:11 am

Excellent……!!! 2011 seems to be rocking for TGS viewers….

∞

BalaC

February 7, 2011, 2:53 am

@Ramesh: This is offtopic discussion. Could you write a article on ack. Thanks

∞

shezars

February 7, 2011, 4:02 am

you are rock,,, lol

nice,

∞

Adam

February 7, 2011, 4:20 am

Great article 😳

You could also write few words about grub2 – configuration files for grub doesn't work in grub2. (Tested in ubuntu)

∞

Edward

February 7, 2011, 4:30 am

very very nice,

tanx

∞

Ajeya

February 7, 2011, 4:58 am

Hello Ramesh,

It would have been better if if you could have explained more on each topic. Probably each high level boot process would need a separate page.

This doc is good for begineers.

Thanks,
Ajeya Krishna K R

∞

Abhijeet

February 7, 2011, 5:02 am

Good Graphics
Great Tutorial

Keep it up

∞

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sagar

February 7, 2011, 5:36 am

nice piece of information
thanks lot

∞

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sandeep

February 7, 2011, 6:38 am

Amazinggggggg good job Guys carry on

∞

---

jameslee

February 7, 2011, 6:56 am

Thank u…

∞

Kuldeep

February 7, 2011, 8:09 am

very well explained !!!!!!!!
Thanx alot…..

plz explain GRUB in detail…….How to use GRUB command prompt at system startup ??

∞

Kyle

February 7, 2011, 11:02 am

These are very helpful. Keep 'em coming please!

∞

Yogesh Upadhyay

February 7, 2011, 1:22 pm

Excellent !!! TGS Rocks…

∞

---

shanil

February 7, 2011, 2:08 pm

thanks alot, just in time to futher clarify things lol..As always, TGS rocks!!!

∞

Júlio Hoffimann Mendes

February 7, 2011, 8:15 pm

I learn to much with your blog. Thank you.

Regards,
Júlio.

∞

Steeven Paul Y

February 7, 2011, 10:04 pm

I know the terms GRUB, KERNEL,INIT, MBR. But i do not know how they work together. Thanks to Ramesh Natarajan, for his blog and useful posts.

∞

Lord

February 8, 2011, 12:42 am

Thank you RAMESH. this was so good...

∞

---

analogtek

February 8, 2011, 1:01 am

The file that most would want is. The menu.list that is in the /boot/grub/ directory on my debian system. I often edit this file for a manual kernel update,time out,boot image change.

∞

Suresh.G

February 8, 2011, 2:33 am

Short and Sweet

∞

Sameer Ambekar

February 8, 2011, 8:03 am

Really nice document for quick reference to Linux boot process!!!

∞

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afujita

February 8, 2011, 8:09 pm

Great article, thank you 🙂

∞

Renjith G

February 10, 2011, 1:45 am

Good one. Thanks.

∞

Mohan

February 11, 2011, 10:25 am

plz explain about how to configure zimbra mail server and how to migrate
sendmail to zimbra

∞

Roberto

February 11, 2011, 6:17 pm

An excelent article, I see another great article here.

∞

Hem Chander

March 1, 2011, 2:57 pm

This is very helpful I was looking for similar one..thanks

∞

Pablo

March 7, 2011, 10:16 am

Great article Ramesh! But is not completely valid for Ubuntu, which use upstart. Nothing on /etc/inittab, for eg.

∞

Sameer

June 7, 2011, 7:07 am

Good doc.
Thanks

∞

Verbila

June 21, 2011, 5:44 pm

Love this site, your explanations are excellent, and I like how you define terms and acronyms. Sometimes a man page can make my head spin – your site is the antidote to that – thanks!!

∞

ethaqer

July 4, 2011, 8:50 pm

the best explanation ever ...

thanks TGS

∞

robin

July 7, 2011, 1:30 am

How many times did i ask myself how to find out order of linuxs' start ?
when this time i saw your blog via TSG, i see thoroughly.

thanks a million

Best Regards
Robin Guo

∞

Senthilkumar

July 29, 2011, 12:38 am

Awesome !! For beginners helped a lot..

∞

D VIjay

August 11, 2011, 5:48 am

Excellent, in detail and simple. Thanks very much

∞

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karthick

September 4, 2011, 2:14 am

Actaully i have failed in my first interview for not answering the above
question,but after reading the above answer.i ensure i will get success.its really
gud explanation,especially beginners lyk me.Thanks a lot

∞

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dulanja

September 19, 2011, 1:11 am

great article! very useful! thanks a lot.

∞

R.YADAV

September 30, 2011, 2:52 am

really…….my total confuse remove after read this article.Thank you………….

∞

Gregory

October 7, 2011, 2:35 am

Are you sure that "Depending on your default init level setting, the system will execute the programs from one of the following directories." ?
For example my system is running on level 3 but executes VERITAS init scripts from rc2.d during the boot as well.

∞

Arun

October 15, 2011, 8:13 am

Very Nice.

∞

rajesh

October 20, 2011, 10:02 pm

Excellent !!!!!!!!!!!!!!!!!!!!!
Enough detail and simple .
Thanks very much

Best regard,
rajesh

∞

ender

October 21, 2011, 1:20 am

good work fine to know how linux boot and the basic's of the init run level's only by ubuntu you have init s (single user) and init u (re run init) as extra

∞

evaa

November 12, 2011, 9:12 pm

wow, your explaination is simple yet full with information

very helpful ! <3

∞

brijesh

November 19, 2011, 2:49 pm

greate usefull

∞

Ketan

November 30, 2011, 1:34 pm

I am flabbergasted.. I have made automation on these parts on S and K .,.. It was too Easy to understand this.. The person who post this.. is really a cool techie.. U rock man..

∞

hossein

January 2, 2012, 12:06 am

That was very useful information.
Thanks.

∞

NARESH

January 17, 2012, 9:45 pm

Excellent. keep it up..

∞

Arun

January 24, 2012, 9:52 pm

Nice. Very useful

∞

Omkar

January 27, 2012, 9:32 am

short and sweet and precise explanation

∞

Anonymous

February 3, 2012, 3:53 am

very good material and easy to understand ...great work

∞

54nju1

February 19, 2012, 1:59 pm

Thanks dude, that was so helpful..

∞

subhash

March 13, 2012, 8:27 am

it's very nice material.....i like it........superb ....

∞

sandeep samale

March 21, 2012, 9:37 pm

HI this is very very useful information as interview point of view as well as for study how Linux boots. Great info Thank you very much Ramesh

∞

Anuj

April 12, 2012, 9:28 am

Great and brief doc for Linux boot process. I truly liked it!!!

∞

Ravi

May 4, 2012, 11:05 pm

Thanx

∞

Deepika

May 9, 2012, 11:03 pm

Superb article with detailed information.

∞

Deepak

May 14, 2012, 11:11 am

It is very nice article 🙄

∞

divya

May 21, 2012, 5:19 am

how to create kickstart server in rhel 6.0

∞

---

sasidharan

May 25, 2012, 4:54 am

Excellent stuff from TGS!!!

∞

Anand

June 3, 2012, 1:41 pm

gr8 article , got a lot of other info while reading this awesome stuff, thx alot

∞

Sumen

June 22, 2012, 5:09 am

Great...very well explained...

∞

VIKAS

June 26, 2012, 5:15 am

Very nice, very neatly explained.

∞

Saravana Kumar

July 12, 2012, 2:18 am

Keep on the work going

∞

Kuldeep Kulkarni

July 14, 2012, 1:58 pm

Nice Stuff !!

Thanks a lot !!

∞

Rakesh yadav jaipur

July 19, 2012, 10:20 pm

really…….my total confuse remove after read this article.Thank you………….

∞

Sudhakar

July 26, 2012, 1:14 am

Good One, will be helpfull for new leaners!!!

∞

rajendra

July 31, 2012, 8:22 am

excellent

∞

Naveen

August 8, 2012, 12:17 am

Its very Good article and helpful for linux beginers

∞

Ranjit Rajput

September 10, 2012, 12:57 am

Excellent …

∞

Hughe

September 10, 2012, 5:21 am

You can bypass the first three stage using kexec program for fast boot. This saves time when you have to reboot a lot for tuning system or handling init script.

Debian provides it as kexec-tools package.

Find the kernel options:
$ cat /proc/cmdline
BOOT_IMAGE=/vmlinuz-3.4.0-10.dmz.1-liquorix-amd64 root=UUID=07cf8c3a-d5a5-4b41-833f-16a9afebf70c ro quiet

Add a kernel image:
vmlinuz is the kernel image file I uses. If the kernel image uses initrd file, add –initrd option. Without it kernel will panic next boot.

$ sudo kexec -l /vmlinuz –append="root=UUID=07cf8c3a-d5a5-4b41-833f-16a9afebf70c
ro quiet" –initrd=/initrd.img

Or

In my Linux box, boot partition is /dev/sda1
$ sudo kexec -l /vmlinux –append="root=/dev/sda1 ro quiet" –initrd=/initrd.img

Start warm boot:
$ sudo kexec -e

Linux will boot up without going through BIOS, MBR, and Grub.

∞

---

manoj sharma

September 18, 2012, 9:14 am

thanks

∞

Guru Reddy

September 24, 2012, 8:04 am

Excellent.., and thank you a lot..,

∞

---

karunakar

September 27, 2012, 2:22 pm

Excellent and simple explanation and a great deal for beginners !! Thank you.

∞

Rajeev

September 28, 2012, 3:23 am

very nice

∞

Mithun Shrivastav

October 11, 2012, 3:01 am

Hi its excellent. Thanks.

∞

Amaresh Samal

November 13, 2012, 12:34 pm

thanks friend…….

∞

krish

November 14, 2012, 2:11 pm

what is 1st stage boot loader and what is 2nd stage boot loader ? kindly clear this point also.

∞

Rajgopal H.G.

November 19, 2012, 12:58 am

I am working on Linux since decade. Some times I am unable explain the basic stuff like this. Thanks for explaining Ramesh Natarajan. Today onwards, I am the member of your fan club.

∞

saurabh

December 5, 2012, 2:41 am

Thanks for this excellent article………… 🙄

∞

Purna

December 18, 2012, 3:26 pm

Hello,

Description is good and very easy to understand, thanks for this.
If possible please explain in detail about each and every config file or script, how is jumping from on script/config-file to another

Anyways I am happy for this post.
Thank you once more....

∞

Rajshekhar

December 28, 2012, 11:49 am

Excellent material. So simple to understand it. Doing a great job!!!!!

∞

niky

December 28, 2012, 1:08 pm

The Article is good And explained Simple ...
tnx 4 this

∞

C subhash

January 1, 2013, 6:36 am

Thanks for this excellent article......

∞

Amit Bhandari

January 18, 2013, 12:31 am

its a superb article..........and simple and superb explanation.

∞

Rajaswaminathan

January 24, 2013, 8:33 am

This is really nice article. Appreciate your excellent work.

∞

karthi prasanth

February 16, 2013, 7:12 am

sir now i am using windows7 and linux in one computer.i dont want to use linux that have 250gb harddisk then how to boot(delete) a linux and how to plaace 250gb in windows7? Pls hlp me.

∞

Aswathy

February 25, 2013, 11:33 am

Thanks Mr.Linux natarajan

∞

lakshman

March 1, 2013, 4:59 am

it was simply good.

∞

prathamesh

March 1, 2013, 11:43 am

thanks dude

∞

chrly chacko

March 1, 2013, 11:15 pm

good keep itup

∞

Kapil

March 20, 2013, 3:46 am

Very Good Explanation.

Thank you very much .

∞

Lily

April 4, 2013, 12:36 pm

Hey,you explained all,excellent.Thanks

∞

Ranjith

April 6, 2013, 1:34 am

Thanks Friend

∞

shipra

April 13, 2013, 11:51 pm

thnkss ..very useful fo me..;) 😊

∞

Magesh

April 16, 2013, 5:29 am

Great Man.....

∞

laks

April 19, 2013, 3:13 am

its really useful.

∞

googler

April 22, 2013, 2:25 pm

Oh yes .. this is what i am seeking for .. something simple and effective ..
i don't know why most people who talk about boot process and FHS love to make it
very difficult…
but you my friend .. u r brilliant .. this really easy and useful explanation ..
thanks as enormous as the sky

∞

shruti

April 27, 2013, 1:18 am

good explanation & easy to understand!!!

∞

Anonymous

May 4, 2013, 12:36 pm

excellent, very well explained

∞

sudhakar

May 21, 2013, 11:24 pm

Good article ….

∞

sreejith ks

May 26, 2013, 6:01 pm

awesome man, what a simply way to explain such a difficult process.,, thanks a lot,,keep going,,

∞

Mitesh

May 30, 2013, 3:22 am

Really Nice Article…. learn much from this…
Thanks

∞

Ashokraj R

May 30, 2013, 5:45 am

Thank you

∞

Akshay

June 23, 2013, 12:05 pm

Perfect article on Great topic.

∞

Shams

July 20, 2013, 1:19 pm

Ramesh,

Thanks a ton for your efforts to provide such a excellent information by keeping it simple.

You rock man ...... Keep it up...

∞

karthik

July 25, 2013, 1:32 am

nice job.any one can understand this . good explantion

∞

Suraj

August 2, 2013, 1:12 am

Superb Article !!! Excellent explanation.

Keep it on.

∞

Kaali Dasu

August 9, 2013, 1:50 am

I got confused by studying the process in another sites however this one is very easy to understand and remember.

∞

hariharasudhans

August 28, 2013, 10:01 am

i have littile bit confusion in bootprocessor .nw i clrd & esay to understand...
good article of boot processor

∞

Arun

September 6, 2013, 12:26 am

Thank you for simple, compact and clear explanation . . . 😊

∞

Pradeep

September 14, 2013, 7:47 am

Good,Easy to understand and very useful for starters........:)

∞

yang

September 23, 2013, 7:33 pm

good! the article is easy to understand,

∞

Ramesh

October 22, 2013, 10:42 am

very nice , thanks

∞

Akshay Kalra

October 24, 2013, 11:37 pm

Thanks for such a nice explanation.....
This article has cleared my all doubts.

∞

---

montana

November 13, 2013, 12:01 am

Simple and Powerful.
Thanks.

∞

Mehbub

November 19, 2013, 5:16 am

Thanx a lot for ur great explanations buddy.........................suprm performance
nw i hv nt any confusn

∞

Pradeep

December 13, 2013, 5:14 am

Good work, Thanks

∞

---

mohammed tousif

December 13, 2013, 7:40 am

excellent

∞

Ravi singh

December 14, 2013, 2:17 pm

Thanks bro ... It is realy excellent and easy to understand

∞

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nisha

December 27, 2013, 11:34 pm

Thanks for sharing ...good article to understand linux boot up

process....................

∞

Narender

January 14, 2014, 11:43 pm

that is why lappy takes so much time for startup, actually this guy is busy in doing this or that, offcourse useful.

∞

Srikanth

January 30, 2014, 4:49 am

Thanks a lot. very nice....

∞

---

viji

February 3, 2014, 4:32 am

Thanks much

∞

Satheesh Kumar G

February 17, 2014, 12:17 am

Hi Ramesh,

This is the best explanation i've seen so far.

ThnQ very much,…

∞

Choperro

February 28, 2014, 12:11 am

The role of initrd is not clear at all.
What does it contain?
Where does it come from?
When and how is it used?

Also the possibilities and methods to configure each step and its pieces are not clear at all. We can change boot device (interactively or not), we can change the kernel (interactively or not), we can change the boot menu and give orders to grub….. can we change initrd? how? what for? and the init proces? inittab seems to be deprecated in Debian…..

∞

Choperro

February 28, 2014, 1:43 am

"Programs starts with S are used during startup. S for startup.
Programs starts with K are used during shutdown. K for kill."

or

The S set are the programs that are started when we enter in that runlevel and K is the set of programs that are killed when we enter in that runlevel?

∞

Harshit Shrivastava

March 12, 2014, 3:56 am

Awesome Tutorial. Linux Boot Process Cleared Very Well.

∞

Gurpreet Singh

March 14, 2014, 6:15 am

Excellent Tutorial

∞

Spatik

March 26, 2014, 10:18 pm

Nice and well explained, thank you so much.

∞

Syam

April 11, 2014, 12:16 am

good one 🙄 great

∞

Damodhar Taklakar

April 18, 2014, 6:34 am

Very well explained....! 🙄

∞

venkateswara reddy

June 23, 2014, 1:58 am

i'm learning linux admin so any sugences pls give me and any learning text books and any meteriles

∞

priya

July 2, 2014, 1:59 am

excellent... very well explained

∞

Rod Nussbaumer

July 3, 2014, 9:41 am

The information here all seems correct, however I think you do a disservice to the reader not to mention that this is just one of many different ways to load Linux on a PC architecture. Other architectures use other methods, and there are other methods available on a PC architecture, and the version and configuration of the Linux kernel itself affects the boot process.

∞

Hal

August 5, 2014, 3:08 pm

Thank you for a very clear presentation. I have one small comment, I went looking for the meaning of "MBR" and "initrd" before reading on to find you gave them later. May I suggest an expansion of the acronym in brackets immediately after the acronym. Thank you again very well done.

∞

Ancklesh

August 30, 2014, 9:16 pm

thanks soo much 😳

∞

Joyneel

September 9, 2014, 11:21 am

The best consize and apt explanation i have read so far

∞

Suresh

October 7, 2014, 12:29 pm

Very well explained. But latest Ubuntu version 14.04 has some changes with respect to above explanation.

∞

ashish yadav

October 16, 2014, 5:48 am

very nice …... so helpful.

∞

Ashutosh

October 31, 2014, 4:11 pm

you are awesome!

∞

dxman

November 7, 2014, 2:51 am

Excellent Article Admin – you simplify the words
TFS

∞

Alexlee joana

December 8, 2014, 12:42 am

Thanks your good article.

But linux Os (like Cent Os 7) dosen't have grub.conf.

Please explaing the reason.

Sorry. I am beginner of Linux!

Thanks your favor!

Help me!

∞

jitendra khasdev

January 29, 2015, 12:52 pm

MBR is a bootloader ?

∞

nidhi sardeshpande

February 4, 2015, 5:33 am

wow!i got too much information which was actually new for me. thank you sooo much.

∞

rohini rathod

February 4, 2015, 5:35 am

nice experience, nice information, thank you so much.

∞

Raj Somwanshi

May 24, 2015, 1:03 am

Good one ......Thanks

∞

Harsha Hulikere

July 14, 2015, 6:53 pm

Nice and well explained, thanks a lot ..:)

∞

---

fayaz

July 17, 2015, 3:15 am

great one. it has given a simple procedure and best among all..

∞

---

mike r

July 30, 2015, 8:03 am

good explanation, also some newer linux kernels dont use init, only systemd

∞

Prashanth

August 4, 2015, 10:09 am

Thankyou Ramesh. That was so simply explained 😋 !

∞

Vinay

September 13, 2015, 11:24 pm

How to change the runlevel if it is set to 0 or 6.

∞

Anusha

November 20, 2015, 12:23 am

Good one… Thanks

∞

Rajasekhat

December 9, 2015, 2:17 am

Really good article on Linux boot process.

∞

Sunil

January 11, 2016, 2:38 pm

Excellent explaination……

∞

Parvathy

January 27, 2016, 7:29 am

Nice,Thanks !

∞

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ankit

February 19, 2016, 2:24 pm

Ultimate…thanks for sharing the transparency, simplicity and purity of Linux with such a simple Techincal Laguage

∞

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nagamani

March 15, 2016, 2:54 am

Good One Usefull…. Thank you

∞

Nisha

March 29, 2016, 4:32 am

Hai It was awesome to read this. Thanks for your article.

∞

Anonymous

April 12, 2016, 12:16 am

It is really very useful
Thank you
Mahesh

∞

nithya

May 9, 2016, 4:22 am

Superb article.. its very useful to me…. thank u so much

∞

Ravi

May 15, 2016, 6:47 am

Great article

∞

Malcolm Daniel

May 30, 2016, 2:37 pm

doing great bro keep it up

∞

Suraj

May 31, 2016, 11:36 pm

Great article with vast information in short

∞

sachin

December 22, 2016, 3:14 am

Thanx

∞

vilas Bhumare

December 23, 2016, 1:06 am

Nice piece of information

Thanks a lot

∞

Saurabh Aditya

December 28, 2016, 3:12 pm

Thanks Bro,
Easy to understand amazingly explained.

∞

Jide

January 8, 2017, 5:57 am

Thanks for sharing

Appreciate it ✌️ .

∞

Pal

January 11, 2017, 9:28 pm

Micro article.

∞

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gopi krishna

January 17, 2017, 6:16 am

its good Excellent explaination .

∞

Anonymous

January 18, 2017, 12:20 am

Good Article...

∞

Anonymous

April 20, 2017, 12:04 am

well explained . nice article. 🙄

∞

Anonymous

April 24, 2017, 6:19 am

great

∞

Dang Tan Hoa

May 4, 2017, 4:03 am

Great article.
Thank you!

∞

Jay

June 27, 2017, 7:44 am

Awesome article with easy to understand explanation.'

A bit outdated though; would be good if you would keep the article updated.

Great historical reference, nevertheless.

∞

Rehana B

March 13, 2019, 12:54 am

very helpful !!!! Thanks alot 🙄

∞

Sriravali Vallem

March 25, 2019, 7:58 am

Well explanation..thank you so much

∞

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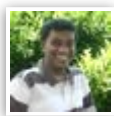
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My name is **Ramesh Natarajan**. I will be posting instruction guides, how-to, troubleshooting tips and tricks on Linux, database, hardware, security and web. My focus is to write articles that will either teach you or help you resolve a problem. Read

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