# Linux Introduction

In short

# Basics of UNIX

- UNIX is an operating system which was first developed in the 1970s, and has been under constant development ever since.
- It is a *stable, multi-user, multi-tasking* system for servers, desktops and laptops.
- UNIX systems also have a graphical user interface (GUI) similar to Microsoft Windows which provides an easy-to-use environment.
- There are many different versions of UNIX, although they share common similarities.

# The UNIX Distributions / Distros

- AIX by IBM
- BSD/OS (BSDi) by Wind River
- HP-UX by Hewlett-Packard Company
- OpenBSD by OpenBSD Group
- Solaris by Sun Microsystems (Oracle)
- IRIX by Silicon Graphics, Inc.
- Tru64 UNIX
- FreeBSD
- NetBSD
- Mac OS

# Beginning of LINUX

- The history of Linux began in 1991 with the commencement of a personal project by Finnish student **Linus B. Torvalds** to create a new free operating system kernel.
- The initial release of its source code in September 17, 1991, which is still getting improved day by day.
- Linus Torvalds had wanted to call his invention Freax, ("free", "freak", and "x“).
- Linus wrote the program specifically for the hardware he was using and independent of an operating system because he wanted to use the functions of his new PC with an 80386 processor.

# Message from Linus Torvalds

From: torvalds@klaava.Helsinki.FI (Linus Benedict Torvalds)
Newsgroups: comp.os.minix
Subject: What would you like to see most in minix?
Summary: small poll for my new operating system
Message-ID: <1991Aug25.205708.9541@klaava.Helsinki.FI>
Date: 25 Aug 91 20:57:08 GMT
Organization: University of Helsinki

Hello everybody out there using minix -
I'm doing a (free) operating system (just a hobby, won't be big and professional like gnu) for 386(486) AT clones. This has been brewing since april, and is starting to get ready. I'd like any feedback on things people like/dislike in minix, as my OS resembles it somewhat (same physical layout of the file-system (due to practical reasons) among other things). I've currently ported bash(1.08) and gcc(1.40), and things seem to work. This implies that I'll get something practical within a few months, and I'd like to know what features most people would want. Any suggestions are welcome, but I won't promise I'll implement them :-)

Linus (torvalds@kruuna.helsinki.fi)

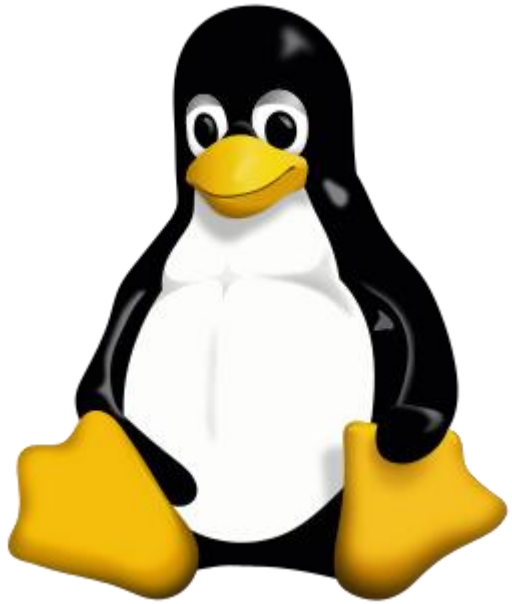
PS. Yes - it's free of any minix code, and it has a multi-threaded fs. It is NOT protable (uses 386 task switching etc), and it probably never will support anything other than AT-hard disks, as that's all I have :-(.

# Why to choose LINUX ?

- Easy to install applications
- Secure
- Easy to change options → Graphical Machines (GUI)
- Community
- Free
- Portable
- Open Source
- Multi-User Hierarchical File System (FHS)

# I AM TUX !!!

- Torvalds announced in 1996 that there would be a mascot for Linux, a **Penguin**.
- This was due to the fact when they were about to select the mascot, Torvalds did mention he was bitten by a little penguin
- It is also known as TUX (Torwalds UniX)



# The Kernel

- All operating systems have kernels.
- The Linux kernel is unique and flexible because it is also modular in nature.
- The kernel of the Window operating system is a solidly connected piece of code, unable to be easily broken up into pieces.
- This modularity is significant to the success of Linux. The ability to scale down (or up) to meet the needs of a specific platform is a big advantage over other operating systems constrained to just a few possible platforms
- Latest stable kernel version is **4.7.3**

# The Shell

- The shell provides you with an interface to the UNIX system.
- It gathers input from you and executes programs based on that input. When a program finishes executing, it displays that program's output.
- A shell is an environment in which we can run our commands, programs, and shell scripts.
- In UNIX there are two major types of shells:
  - The Bourne shell. If you are using a Bourne-type shell, the default prompt is the $ character.
  - The C shell. If you are using a C-type shell, the default prompt is the % character.
- There are again various subcategories for Bourne Shell which are listed as follows −
  - Bourne shell ( sh)
  - Korn shell ( ksh)
  - Bourne Again shell ( bash) – commonly used.

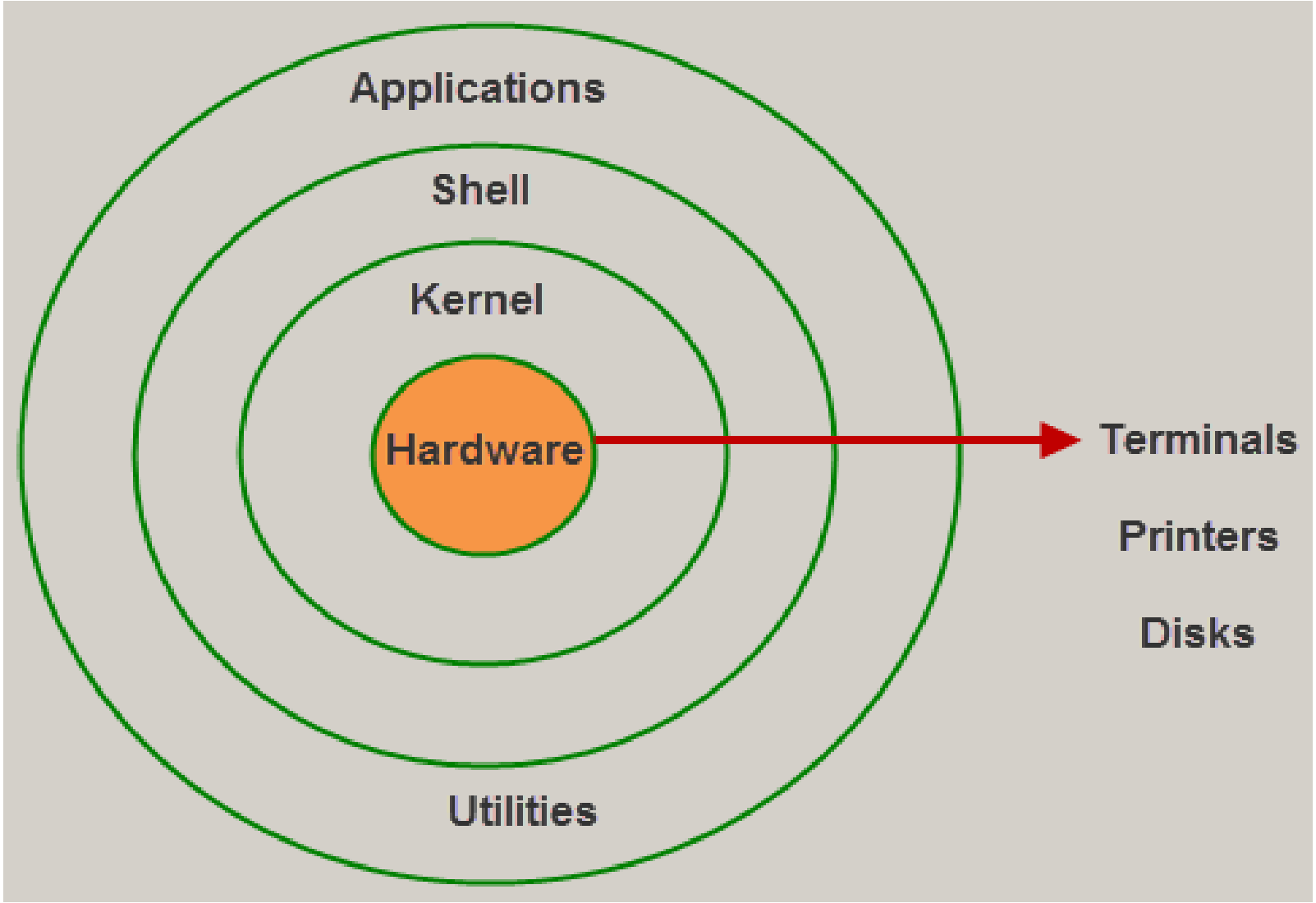
# Linux Environments

- The windows, menus, and dialog boxes known as the **windowing system** and the **desktop environment**.
- These layers provide the human-oriented graphical user interface (GUI).
- In Linux, there a lot of choices for which windowing system and desktop environment can be used, something that Linux allows **users to decide.**
  - **Unity**
  - **GNOME**
  - **KDE**
  - **XFCE**
  - **Cinnamon**
  - **MATE**
  - **LXDE**
  - **XMONAD**

# Linux Distributions

- Ubuntu
- Linux Mint
- Debian
- Fedora
- OpenSUSE / SUSE Linux Enterprise
- Mandriva
- Puppy Linux
- Slackware Linux
- Arch Linux
- **Red Hat Enterprise Linux** / CentOS
  - CentOS is a community, that uses RedHat code.

# Linux Architecture



# Linux Principle

1. **Everything is a file. ( Including hardware )**
   - The UNIX security model is based around the security of files.
   - By treating everything as a file, a consistency emerges.
   - You can secure access to hardware in the same way as your secure access to a document.

2. **Small, single-purpose programs.**
   - UNIX provides many small utilities that perform one task very well.
   - When new functionality is required, the general philosophy is to create a separate program – rather than to extend an existing utility with new features.

# Linux Principle *(conti.)*

**3. Ability to chain programs together to perform complex tasks.**

- A core design feature of UNIX is that the output of one program can be the input for another.
- This gives the user the flexibility to combine many small programs together to perform a larger, more complex task.

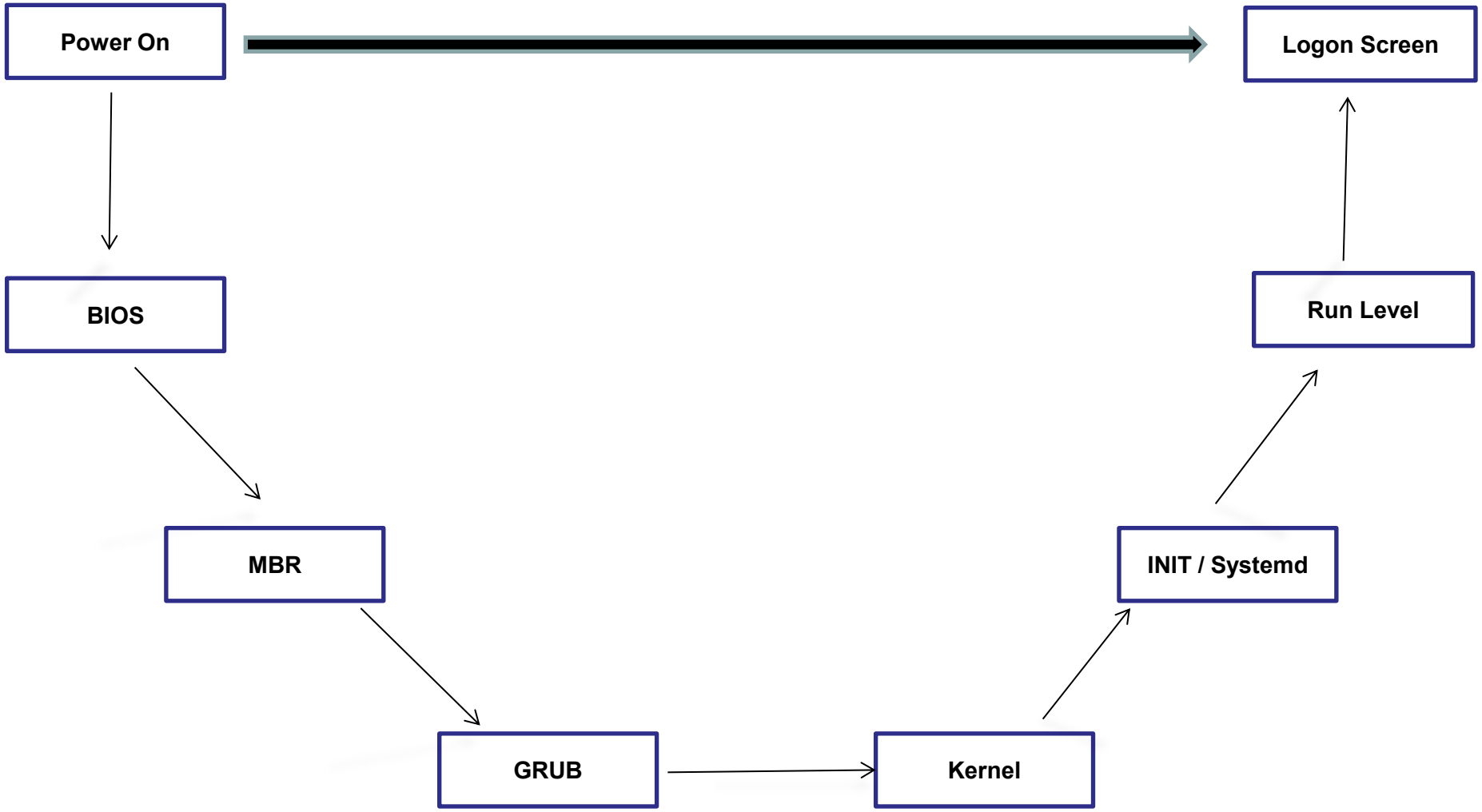
**4. Avoid captive user interfaces.**

- Interactive commands are rare in UNIX.
- Most commands expect their options and arguments to be typed on the command line when the command is launched.

**5. Configuration data stored in text**

- Text is a universal interface, and many UNIX utilities exist to manipulate text.
- Storing configuration in text allows an administrator to move a configuration from one machine to another easily.

# Booting process in LINUX



# BIOS (Basic Input Output System)

- Responsible for searching, loading & executing the boot loader program.
- Searches boot loader in HDD, SD card, CD/DVD.
- Once loaded into memory, it gives the control to MBR.
- BIOS loads & executes the MBR

# MBR (Master Boot Record)

- Located in the 1st sector of the HDD.
- Size is equal to 512 byte
  - 446 byte = Primary boot loader info
  - 64 byte = partition table info.
  - 2 byte = MBR validation checks
- It contains info about GRUB
- It loads & executes boot loader.

# GRUB (Grand Unified Boot loader)

- Used for selecting the operating system at the time of boot up.
- Has the knowledge of the file system in “/boot/grub/grub.conf”.
- Grub loads & executes the ‘Kernel’ & INITRD (INITial Ram Disk image).
- INITRD is used by kernel as temp root file system until kernel is booted & real root is mounted.

# Kernel

- Mounts root file system.
- Executes the INIT program located in “/sbin/init”
- INIT becomes the very 1st process which get executes and got PID as 1.
- Loads the file systems & runs the initial (init) program.

# INIT

- It decides the run level.
- System executes the program depending upon Run Level
- Run Level decides which initial program be loaded at startup.
  - INIT 0 = Halt
  - INIT 1 = Single User mode / maintenance
  - INIT 2 = Multiuser, without NFS
  - INIT 3 = Full multiuser mode (CLI)
  - INIT 4 = unused
  - INIT 5 = init 3 + GUI
  - INIT 6 = Reboot

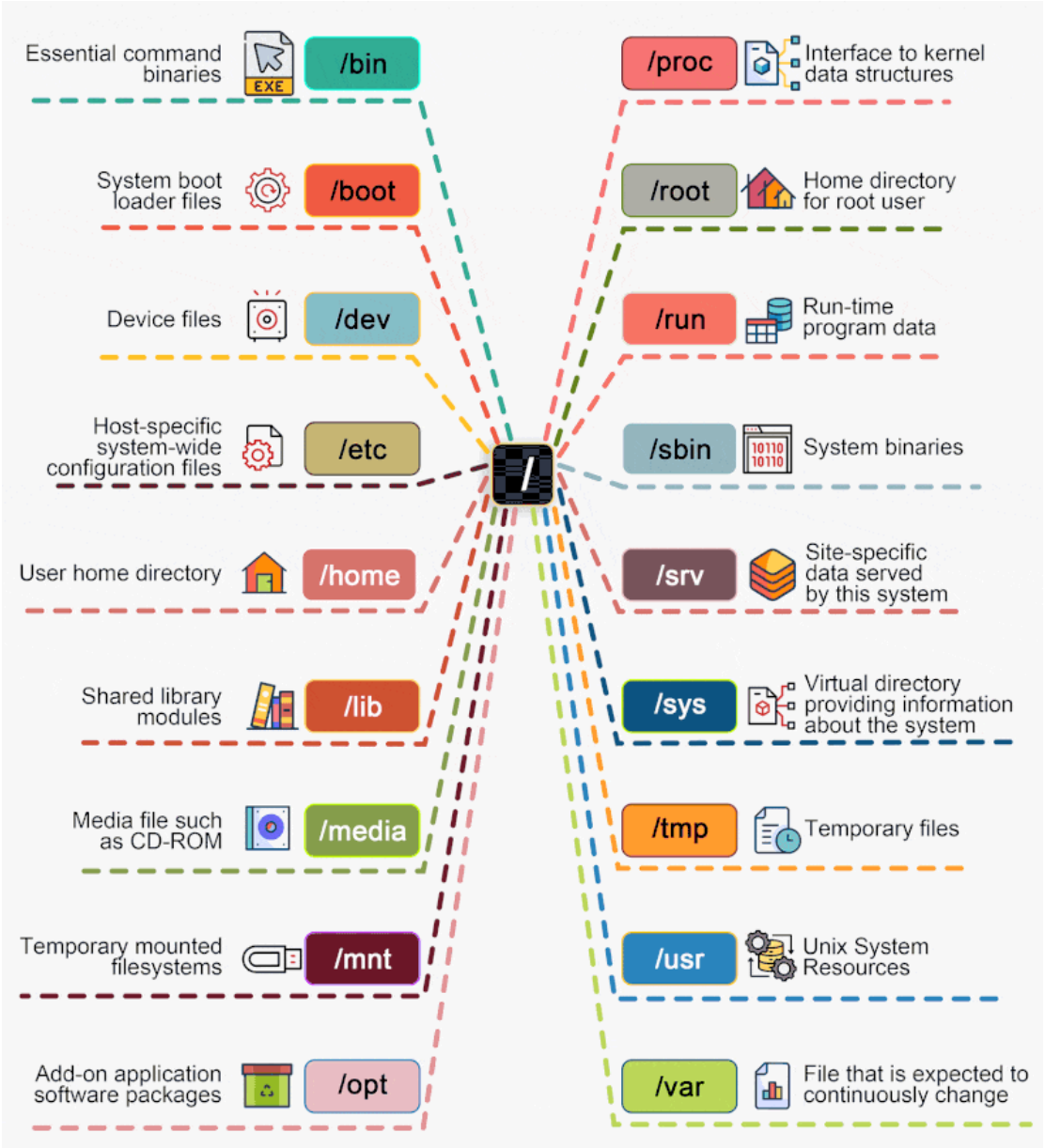
# INIT

| Runlevel | Description |
|---|---|
| **0** | System halt i.e., the system can be safely powered off with no activity. |
| **1** | Single user mode. |
| **2** | Multiple user mode with no NFS (network file system). |
| **3** | Multiple user modes under the **command line interface** and not under the graphical user interface. |
| **4** | User-definable. |
| **5** | Multiple user mode under GUI (**graphical user interface**) and this is the standard runlevel for most of the LINUX-based systems. |
| **6** | Reboot which is used to restart the system. |
| | |

# RUN LEVEL EQUIVALENTS

| Old runlevel | RedHat 7 `systemd` unit |
|---|---|
| init0 | poweroff.target |
| init1 | rescue.target |
| init2 | multi-user.target |
| init3 | multi-user.target |
| init4 | multi-user.target |
| init5 | graphical.target |
| init6 | reboot.target |

# File system Hierarchy Standard (FHS)



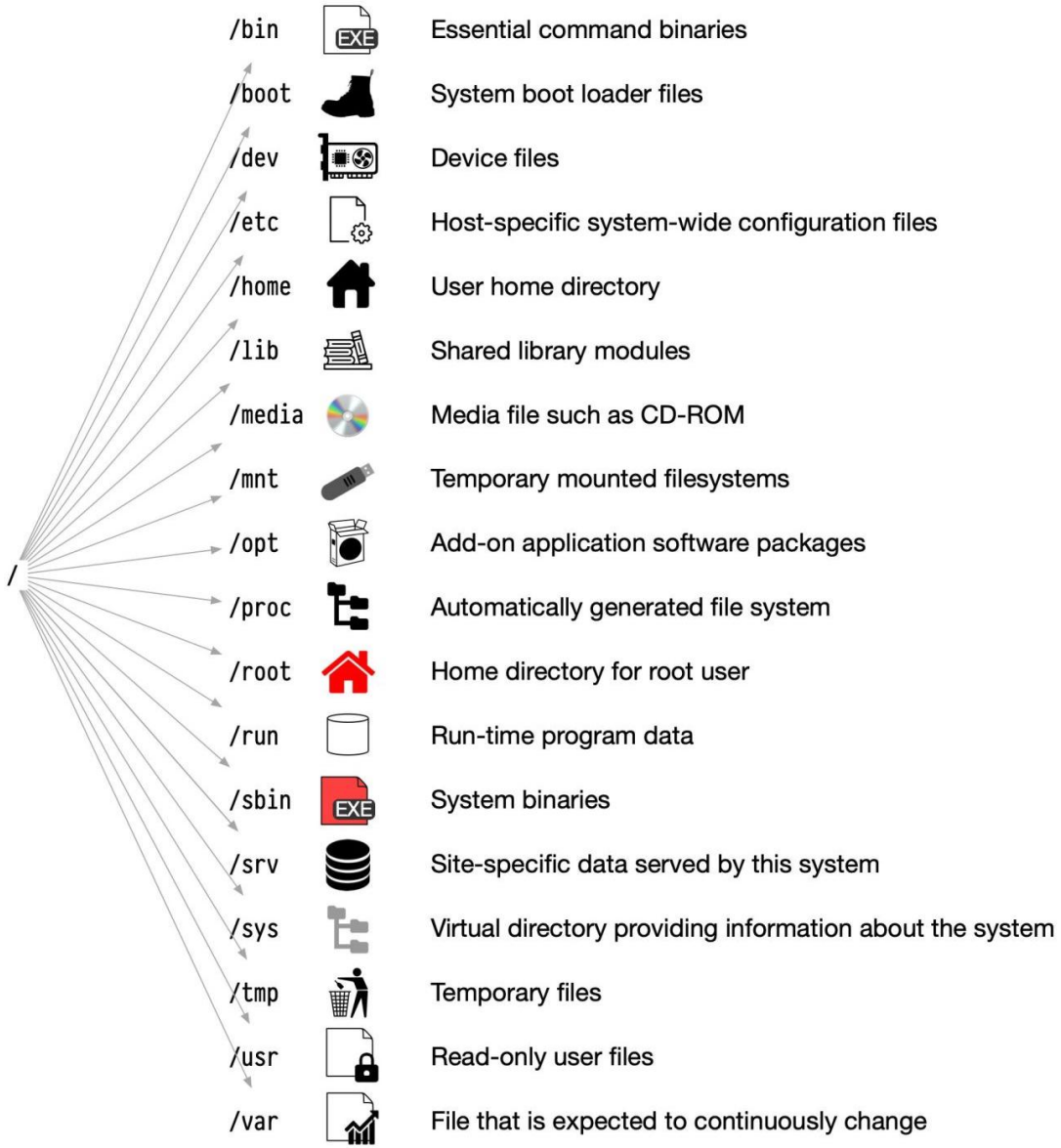
# File system Hierarchy Standard (FHS)

| Directory | Usage |
|---|---|
| /bin | Essential command binaries |
| /boot | System boot loader files |
| /dev | device files |
| /etc | system wide config files |
| /home | user home directory |
| /lib | shared library modules |
| /media | media files (CD ROM) |
| /mnt | temporary mounted file system (Pen drive) |
| /opt | add on application software packages |

# File system Hierarchy Standard (FHS)

| Directory | Usage |
|---|---|
| /proc | interface to kernel data structure |
| /root | home directory for root user |
| /run | run time program data |
| /sbin | system binaries |
| /srv | site specific data |
| /sys | virtual directory providing info about the system. |
| /tmp | temporary files |
| /usr | UNIX system Resources |
| /var | file that is expected to continuously change |

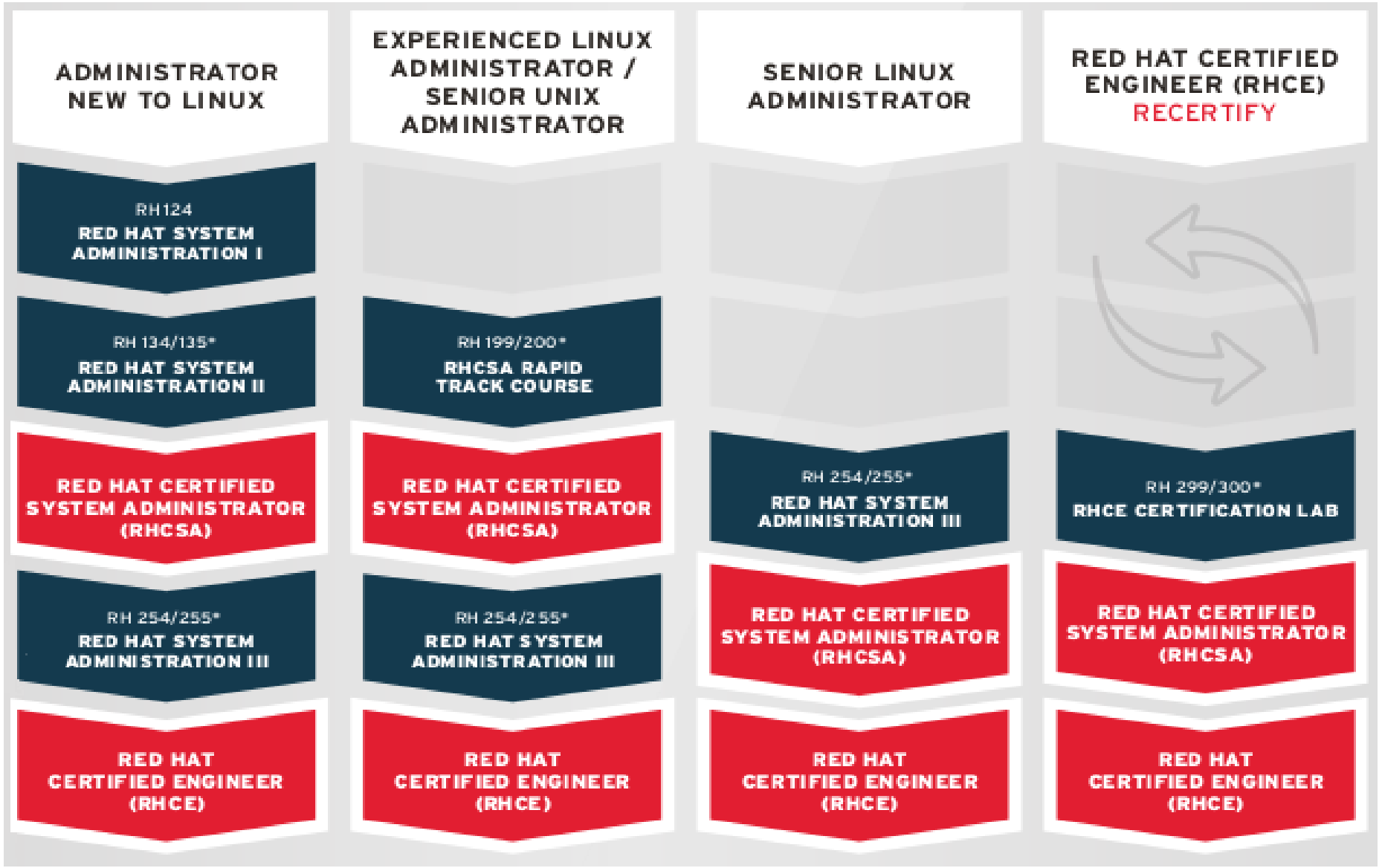
# File system Hierarchy Standard (FHS)



# Difference between different file systems

| | Ext2 | Ext3 | Ext4 | XFS |
|---|---|---|---|---|
| Full form | 2nd extended file system | 3rd extended file system | 4th extended file system | extent file system |
| Introduced in | 1993 | 2001 | 2008 | 1994 with IRIX 5.3 |
| Journaling feature | No | Yes - dedicated area | yes - but can be turned off | Yes |
| Individusal File size | 16 GB to 2 TB | 16 GB to 2 TB | 16 GB to 16 TB | 16 TB to 16 Exabyte |
| Overall File size | 2 TB to 32 TB | 2 TB to 32 TB | 1 ExaByte to 1 PetaByte | 16 TB to 18 Exabyte |

# What's new in RHEL 7

- No 32 Bit ISO Image
- New Ruby and Python Versions
- OpenJDK7 Made Default
- More Powerful Network Manager
- Support for 40 Gigabit NICs
- Implementation of tmpfs file system
- Minimum Disk Space for Installation of RHEL7
  - At least 1 GB of disk space, but 5 GB is recommended for all architecture.

# Red Hat Certification Path