GNU Linux

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History

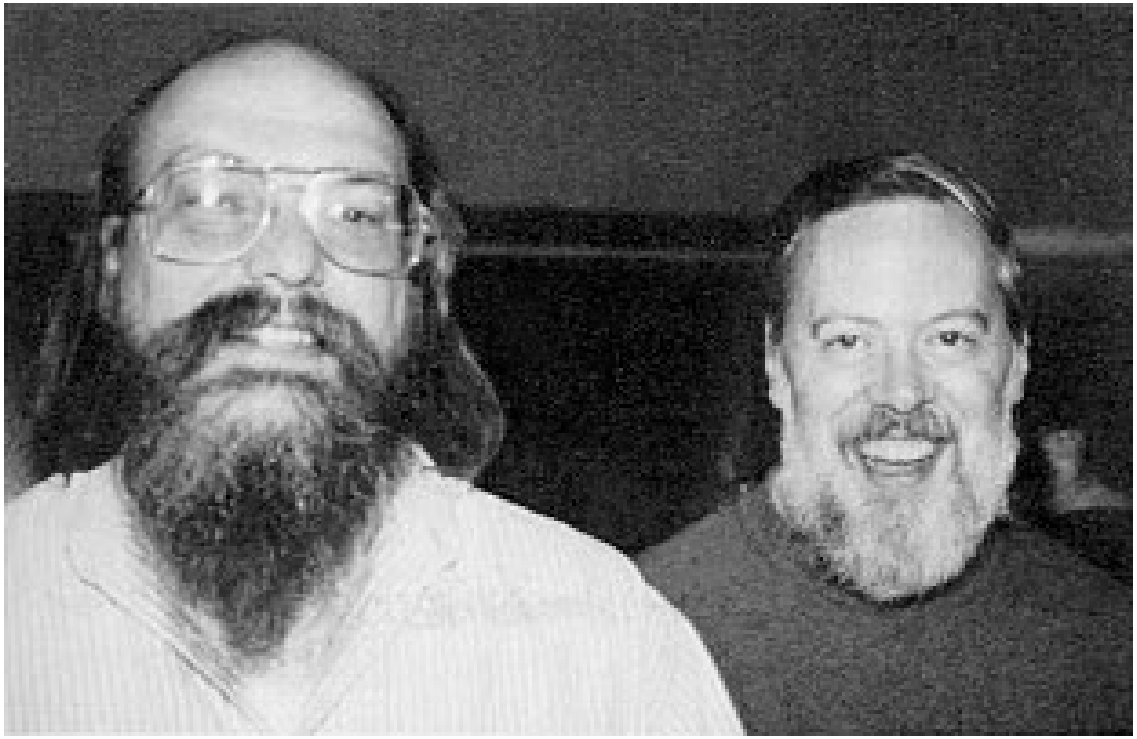


Figure: Ken Thompson and Dennis Ritchie †2011 Turing Award in 1983

GNU Linux

- created by Linus Torvalds
- Linux runs on:
  - all android phones, tablets, watches and TV (2 Billion)
  - all supercomputers of the top 500
  - 96.5 % webservers of the top 1 million domains
  - 92 % of all amacon ec2 instances in their cloud
- around 25 million lines of code (C)

Advantages and Disadvantages

- pro:
  - very stable
  - almost never reboots
  - code written for Linux can be ported to all Unixoid operatings systems
  - does not demand many hardware resources
  - one system can be used by multiple users
  - no known virus existing
  - security can be enhanced with selinux (developed by the NSA)
- contra:
  - graphical desktop support is just ok
  - steep learning curve
  - almost no games
  - no support for crazy hardware (special measurement devices . . .)

Linux Distributions

- Linux distributions consists of:
  - Linux Kernel (OS)
  - software packages
  - package manager
- famous distributions are:
  - Ubuntu (user friendly)
  - Debian (stable server)
  - CentOS (free) / RHEL (commercial) (cluster)
  - Arch Linux (advanced users)

Boot Process

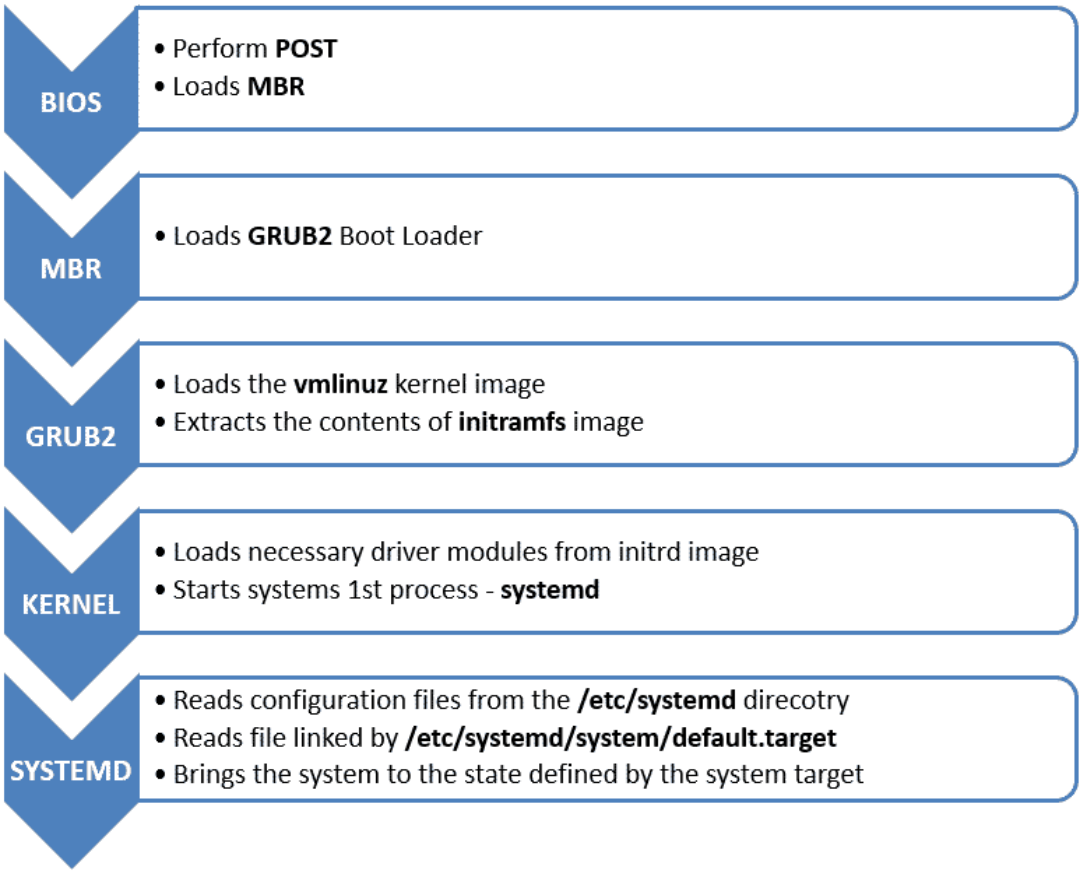


Figure: Caption

TTY

Multi-user OS

- interact with the machine via:
  - keyboard and screen (tty)
  - serial cable
  - ssh from another machine
- share expensive hardware
- share expensive licenses (if they are machine bound)

The Shell

- interacts with the Kernel via the tty
- can be graphical or console based
- available shells:
  - sh
  - bash
  - zsh
  - tcsh
- is a full programming language
- is used to:
  - run programms
  - interact with the filesystem via these programms
  - handels background tasks

Bash

- the shell sh was written by Stephen R. Bourne in 1977
- 1987 it was rewritten and named bourne again shell (bash)
- compatible with the sh
- features:
  - history
  - variables
  - math functions
  - globbing
  - input output redirection
  - pipe operations

Filesystem

- follows the POSIX standard
- everything is mounted under / (called: filesystem root)
- everything is a file in a tree of paths
  - harddisks: /dev/sda /dev/nvmen0
  - partitions: on harddisks /dev/sda1
  - leds: /dev/led0
- storage is mounted to paths in the tree (mount point)
- remote storage can be mounted via sshfs to a local path

User Management

- every user on the system has an account
- every account is member of groups
- every file and directory has permissions for:
  - the user who owns the file
  - the group the file is associated to
  - all others which are not the user or part of that group

Permission System

```
[kemnitzs@frontend /]$ ls -lh
total 333M
lrwxrwxrwx    1 root root    7 Mar 16  2016 bin -> usr/bin
dr-xr-xr-x.   4 root root 4.0K Mar 16  2016 boot
drwxr-xr-x   20 root root 3.4K Feb  6 10:04 dev
drwxr-xr-x. 128 root root  12K Feb 19 14:56 etc
drwxr-xr-x  125 root root  123 Jan 21 14:43 home
lrwxrwxrwx.   1 root root    7 Aug 25  2015 lib -> usr/lib
lrwxrwxrwx.   1 root root    9 Aug 25  2015 lib64 -> usr/lib64
drwx------.   2 root root  16K Aug 25  2015 lost+found
drwxr-xr-x.   2 root root 4.0K Jun 10  2014 media
drwxr-xr-x.   3 root root 4.0K Feb 20 10:56 mnt
drwxr-xr-x.  96 root root 4.0K Feb 13 11:14 opt
dr-xr-xr-x  597 root root    0 Jan 16  2018 proc
dr-xr-x---.  31 root root 4.0K Feb 20 10:56 root
drwxr-xr-x   34 root root 1.2K Feb 19 15:24 run
lrwxrwxrwx.   1 root root    8 Aug 25  2015 sbin -> usr/sbin
drwxr-xr-x.   4 root root 4.0K Aug 25  2015 srv
dr-xr-xr-x   13 root root    0 Jan 16  2018 sys
drwxr-xr-x    2 root root 4.0K Aug 25  2015 sysinst
drwxrwxrwt.  79 root root 764K Feb 20 12:14 tmp
drwxr-xr-x.  13 root root 4.0K Jan 14  2016 usr
drwxr-xr-x.  21 root root 4.0K Jan 16  2018 var
```

Permission System ctd

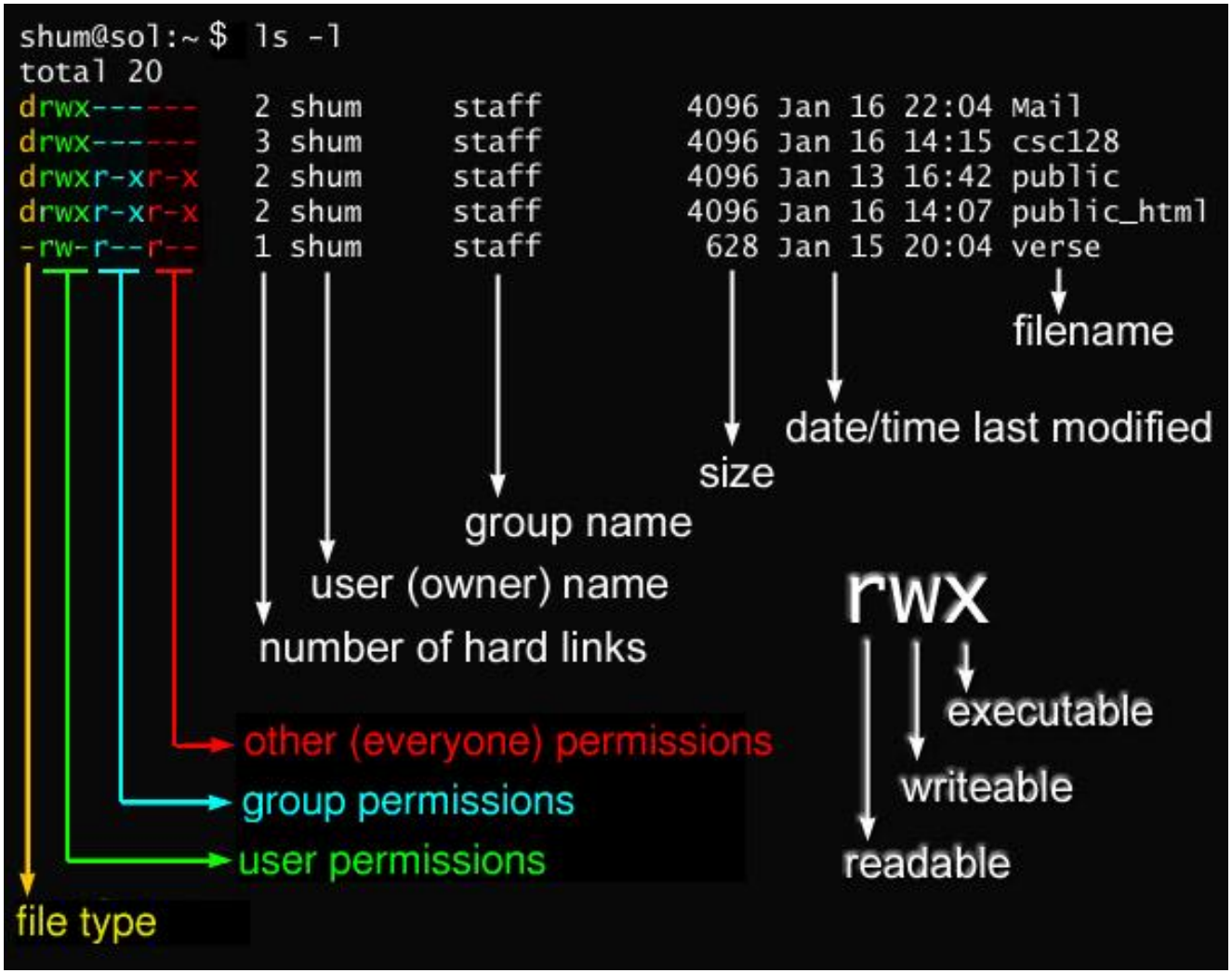
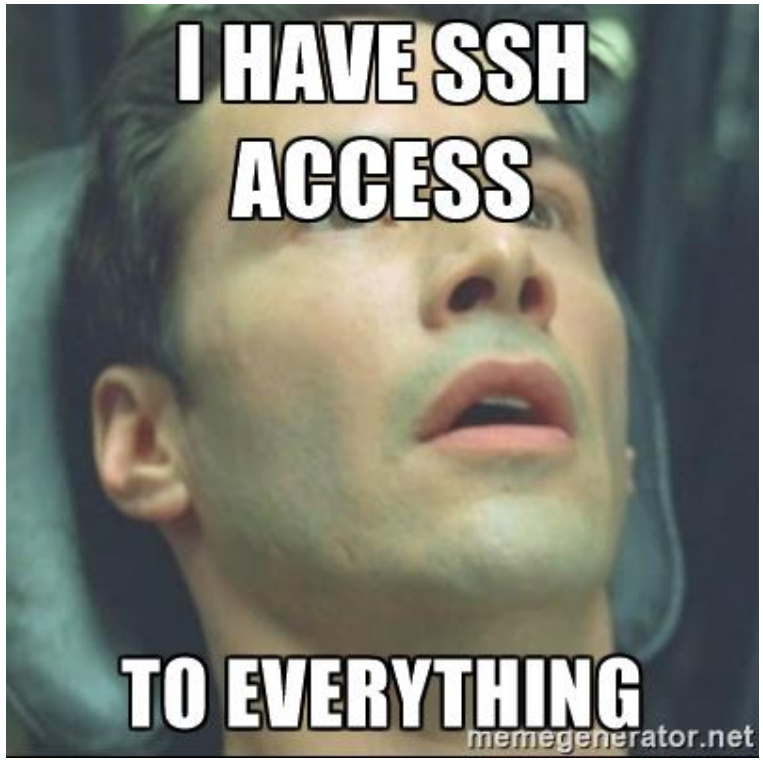


Figure: Permissions

Secure Shell Protocol

- get a shell on a remote system
- copy data
- tunnel network traffic
- forward browser traffic via socks proxy
- mount a remote filesystem to your local machine



Secure Shell Protocol

- client side:
  - from windows:
    - putty
    - OpenSSH beta client
  - on all distributions installed
- server side:
  - windows: left open for the interested reader
  - linux: you can make yourself an ssh server in 30s