System Fundamentals

System and Network Administration

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What is a Server

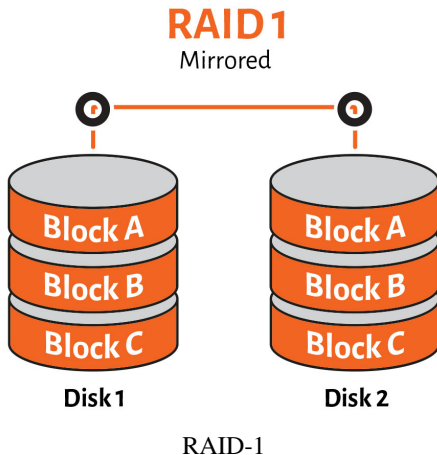*What's the difference between a server and a desktop computer?…*

Rackmount - DL380 gen 10

DL380 gen 10 (w/o cover)

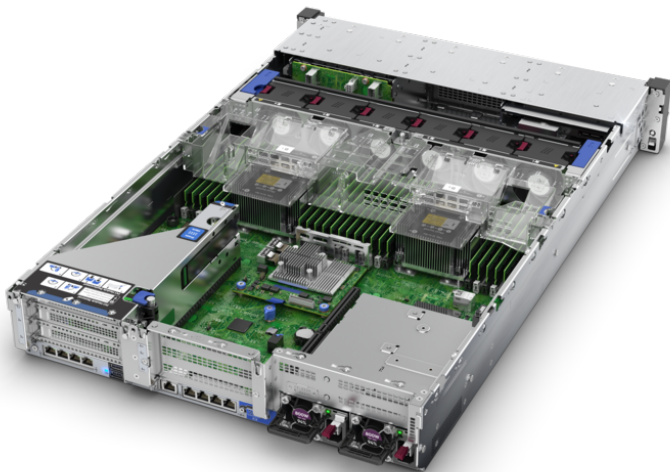# ==> Enterprise-class

avoiding any SPOF a hardware-level

Fault-tolerant storage disks

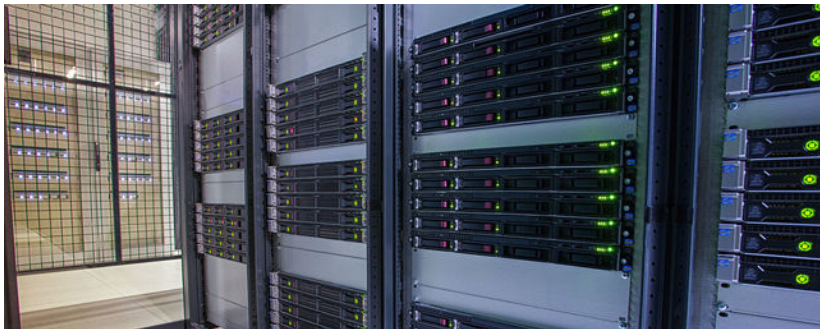RAID controller there is…

RAID-1

DL380 gen 10 top view

Fault-tolerant Power Supply Units (PSU)

DL380 gen 10 rear filled

Racks

More racks

Datacenter cooling

A self-made machine is fine too, as long as it is **dedicated**!

▶ low-cost PC with some AMD Ryzen inside (handle HA system-wise)

▶ low-cost System on a Chip (SoC) ARM boards @ 500 RUB

  ▶ TI Beaglebone Black
  ▶ RPi4
  ▶ …

▶ low-cost GPU processing experimentation

  ▶ Nvidia Jetson Nano Developer Kit

By the way, who's selling more desktop computer CPUs, Intel or AMD?…

==> AMD took over end 2020

Desktop Market Share

Last updated on the 4th of January 2021
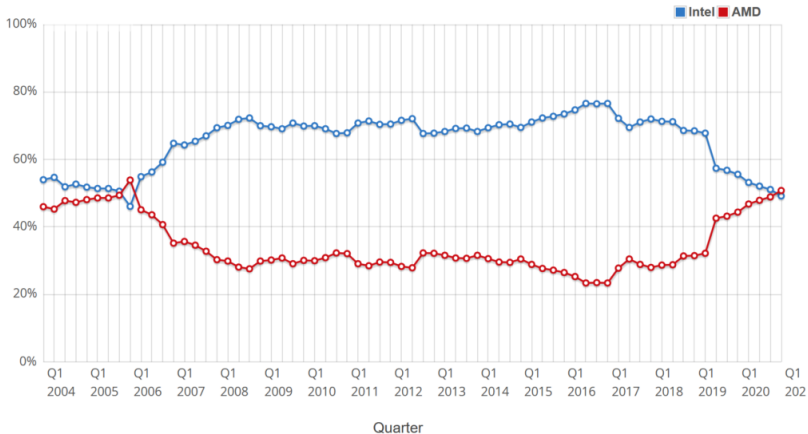
// hardwaretimes.com

Still loosing the laptop market

Laptop Market Share

Last updated on the 4th of January 2021

■ Intel ■ AMD
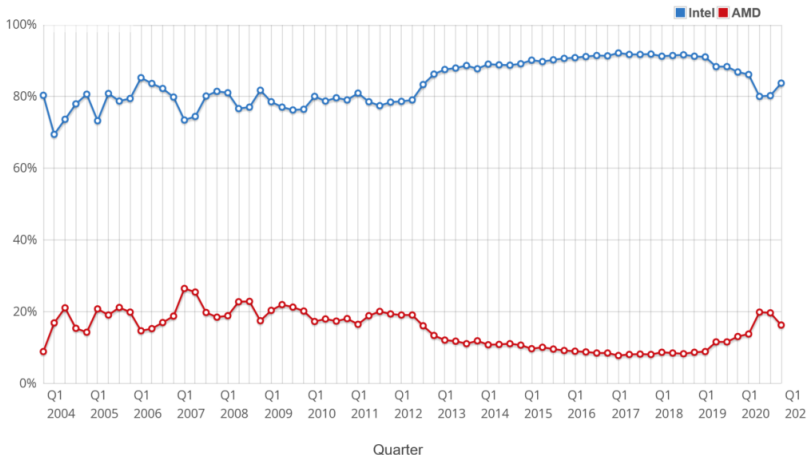
// hardwaretimes.com

Out-of-band management (Lights-out)

aka Lights-Out Management (LOM)

aka Baseboard Management Controller (BMC)

- ▶ THIS IS NOT ABOUT SSH
- ▶ dedicated daughter board
- ▶ –or– hardware integrated in the mobo

BMC capabilities

Low-level power mgmt

- ▶ power on / off
- ▶ power reset (cycle)

Low-level console reachable through

- ▶ Serial console
- ▶ Java
- ▶ HTML5

Remote management engines

HP

- ▶ Management Processor (MP) on HP9000 systems
- ▶ HPE Integrated Lights-Out 2 (iLO2)

IBM

- ▶ Baseboard Management Controller (BMC)
- ▶ e.g. IBM RSAII / IMM

Dell

- ▶ iDRAC

- Sun Microsystems / Oracle – ALOM
- SuperMicro – IPMI BMC
- Fujitsu – iRMC
- Huawei – ?

AST2500

Most used chipset

Tip: you might also find it on some end-consumer mobos…

What differenciates a server in terms of CPU & platforms?…

==>

- ▶ Not necessarily x86
- ▶ High-end motherboards & CPU models

Not necessarily x86

Any non-x86 CPU architecture in mind?…

BTW how are the two x86 ones called?… (32-bit and 64-bit)

A few CPU architectures

▶ ia32 (cisc)
▶ amd64 / em64t (cisc **~ risc** already)
▶ ia64 (Very Long Instruction Word - VLIW)
▶ MIPS (risc)
▶ Alpha (risc)
▶ PA-RISC (risc)
▶ POWER (risc)
▶ SPARC V7,8,9 (risc)
▶ ARM v1-v9 (risc) incl. 32 and 64-bit flavors

Did you hear anything about a new comer in da game?...

==> RISC-V

▶ On the way to mainstream for embedded system and anything IoT
▶ There are evaluation boards and FPGAs for that, and even chips already
▶ The amount of hardware-optimized designs will grow

High-end mobos e.g. dual socket Tyan®

more socket plugs and RAM slots

// tyan.com
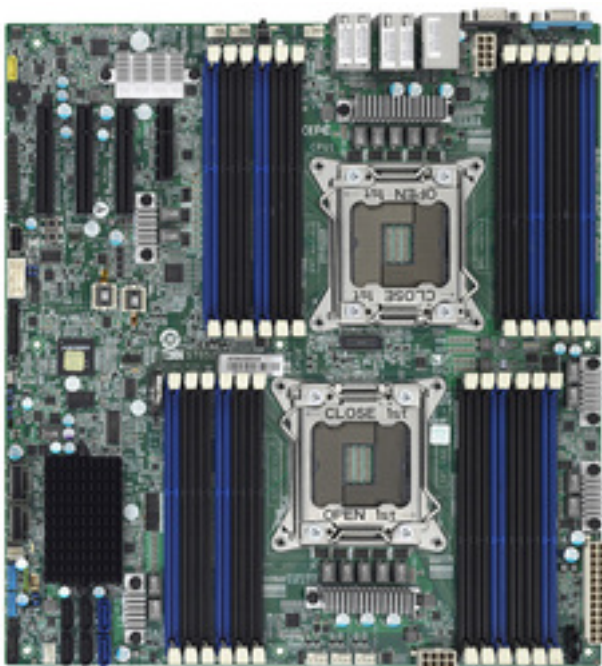
High-end CPUs

more cores, more cache, more features

How are called high-end Intel x86 CPU models?…

How are called high-end AMD x86 CPU models?…

==> Intel Xeon

==> AMD Opteron, AMD EPYC

How can the system take advantage of those many cores?…

==> Symmetric multiprocessing (SMP)

▶ Use all processors at a time
▶ Bus-based **Uniform Memory Access (UMA)**
▶ Shared memory bank

==> –or– Uniform Memory Access (NUMA)

*reach the local-core **RAM** faster*

www.purplewave.com

NUMA insider

- ▶ RAM is split and dedicated to given CPUs
- ▶ Usually one NUMA node per CPU socket
- ▶ Sometimes more e.g. AMD Threadripper has two nodes per socket die

Example with 4 (not 8) CPUs
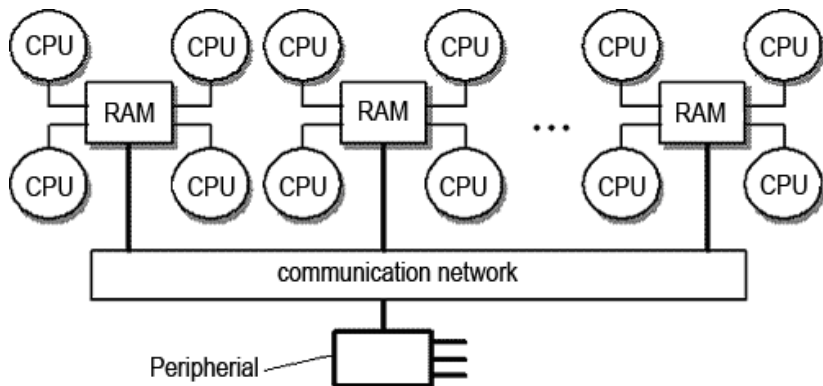
// stackoverflow.com

in terms of operating systems?…

==>

- ▶ Unices
- ▶ Exotic kernels

Market shares

WEB / MAIL / DNS

Top ONE million by W3Cook (Jul 2015)

```
Unices -- 98.1%
Windows -- 1.9%
```

Top TEN million by W3Techs (Feb 2015)

```
Unices -- 67.8%
Windows -- 32.3%
```

(no MacOS)

WEB ONLY

Top TEN million by W3Techs (Jul 2019)

```
Unices -- 70.5%
Windows -- 29.5%
```

■	Linux
■	Ubuntu
■	CentOS
■	Debian
■	Windows
■	FreeBSD
■	Fedora
■	אחר

41.1%

20.6%

19.7%

14%
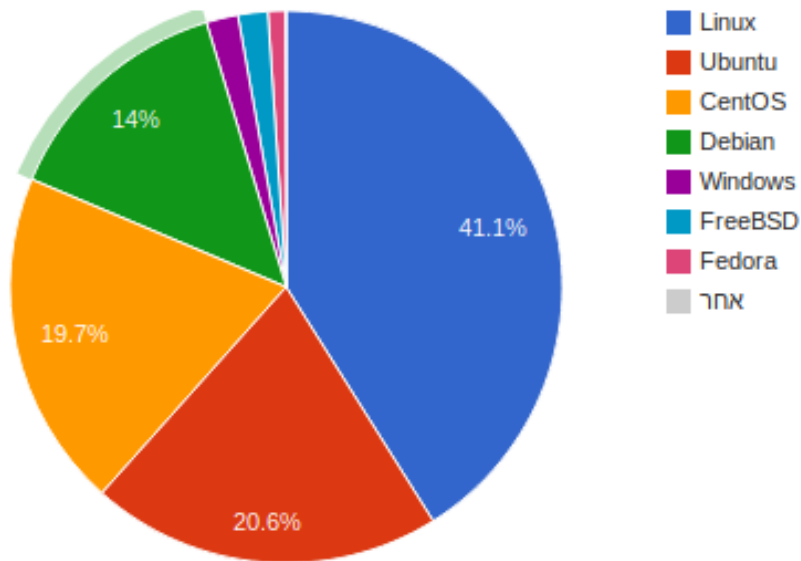
W3COOK web survey (Aug 2015)

- ▶ If you really need Windows… then there is Windows Server
- ▶ Disabling Telemetry on Windows 10 is too much pain

==> Unices

- ▶ GNU/Linux
- ▶ BSD systems
- ▶ Proprietary Unices
- ▶ *MacOS X / Darwin*

Why `GNU/Linux` *and not simply* `Linux` *?…*

==> Kernel vs. user-land / user-space

- ▶ All Linux distributions share the kernel
- ▶ Check out `kernel.org` (upstream)
- ▶ Somehow tweaked sometimes (heavy patchset e.g. from RHEL)

BSD systems

Base system (kernel + user-land) vs. packages

Some nice exceptions

- Debian GNU/kFreeBSD/NetBSD
- Gentoo/FreeBSD/NetBSD/OpenBSD
- Mastodon Linux (libc 5 and BSD userland)
- Stali Linux (suckless's userland) – *go check <https://suckless.org/philosophy/>*

Proprietary Unices

▶ Oracle Solaris - bought from SUN for 7.4 billion dollars (Jan 2010)
▶ IBM AIX
▶ HP/UX

Are those still alive?...

==> (mostly) dead

- Solaris –> DEAD
- resurgence of OpenSolaris
  - SmartOS
  - illumos
  - OmniOS
- AIX –> alive but quite rare (extreme high-end CPUs)
- HP/UX –> alive but quite rare (extreme high-end HBAs)
- *Karl Marx was right – who owns the means of production?*

MacOS X / Darwin

▶ XNU kernel based on FreeBSD & MACH (Carnegie Mellon)
▶ open-sourced as PureDarwin
▶ Gentoo/MacOSX

Some are not Windows nor Unices.

Something un-orthodox in mind?…

==> Exotic kernels

- ▶ VMS / OpenVMS
- ▶ OS/2
- ▶ BeOS
- ▶ MS-DOS / FreeDOS / DR-DOS
- ▶ GNU/Hurd
- ▶ Minix 3
- ▶ PureDarwin & GNU-Darwin
- ▶ Genode (branched sanboxen)
- ▶ KolibriOS (written in assembly)
- ▶ Phantom OS / EROS / Singularity (managed code)
- ▶ AtheOS / Syllable Server (Amiga style)

in terms of UI/UX?…

==> NO GUI (console mode)

We will see how to switch terminals in the lab tutorial – UNIX tips & tricks Week 1.

// Questions on what is a server?

UNIX History

▶ 1969 Unix™ invention at Bell Labs

  ▶ Written in assembly for PDP-7 then PDP-11
  ▶ by Kenneth, Lane Thompson (still alive)
  ▶ and Dennis, MacAlistair Ritchie (died recently)

▶ 1976 John Lions, *Lions' Commentary on UNIX 6th Edition, with Source Code*

▶ 1977 Berkeley Software Distribution

▶ 1978 K&R (The C Programming Language) book

  ▶ Written by Brian **K**ernighan (still alive) & Dennis **R**itchie

▶ 1982 Microsystems SunOS (incl. Bill Joy from Berkeley)
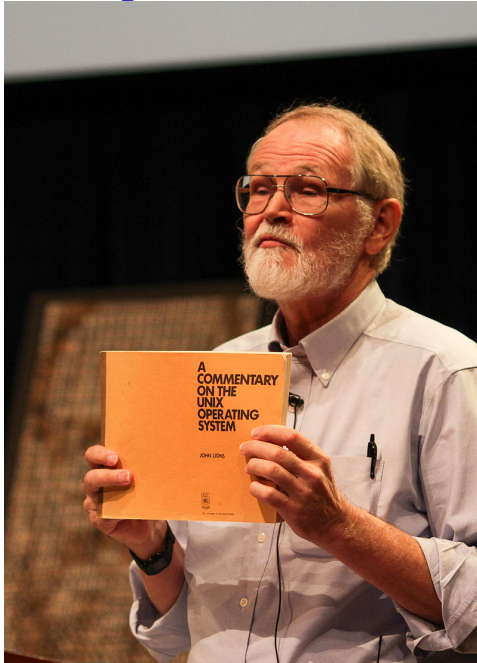
▶ 1983 UNIX System V Release Version 4 (SVR4)

PDP-7

- John Lions, *Lions' Commentary on UNIX 6th Edition, with Source Code*
- AT&T academic/research license
- v6 license allowed for classrooms
- Books are not forbidden
- Resulting binary running on PDP-11/40
- Possible lab mega bonus, or midterm project?
- Run v6 or v7 into SIMH emulator

Brian Kernigan with Lions Book

Andrew S. Tanenbaum (Linus' teacher)

When AT&T released Version 7, it began to realize that UNIX was a valuable commercial product, so it issued Version 7 with a license that prohibited the source code from being studied in courses, in order to avoid endangering its status as a trade secret. Many universities complied by simply dropping the study of UNIX, and teaching only theory.

Linux History

- 1992 Linux kernel
  - microkernels vs. monolithic kernels (Tanenbaum vs. Torvalds)
  - (Minix v3 & HURD)
- EXT file-system based on Minix
- 1993 EXT2 + Berkeley FFS ideas
- 1994 Slackware vs SLS…
- 1995 ported to Alpha

// Questions on UNIX history?

Server Distributions

- desktop vs. server?
- what init system?
- what release model?
- what libc?
- what packaging system?
- *some bonuses – PAM or no PAM?*

first servers, then desktops

Init systems

boring average

- ▶ System D

some alternatives

- ▶ BSD-style **rc.d** (Slackware)
- ▶ OpenRC (Gentoo)
- ▶ Runit (Sabotage, Void)

Casual release cycles

Overview of NetBSD release branches
<https://www.netbsd.org/releases/release-map.html>

NetBSD 9.0 release process has started <https://mail-index.netbsd.org/netbsd-announce/2019/07/31/msg000301.html>

Idem for RHEL major release vs. minor releases

```
RHEL 7.0 7.1 etc. upgrades without issue
```

Rolling release distros

always get the latest packages

- ▶ Arch Linux
- ▶ Gentoo
- ▶ Debian testing
- ▶ Fedora Rawhide (development)
- ▶ Void Linux
- ▶ (openSUSE Tumbleweed)

Commercial distros

▶ Red Hat Enterprise Linux (RHEL) – VERY AGGRESSIVE EULA: FORCED subscription every year

▶ No much competition there, really – although there is Novell SLES

Red alarms in the hat…

▶ Jul 2019 - IBM acquires Red Hat for $34 billion dollars

▶ Dec 2020 - No more CentOS == RHEL releases (goes CentOS Stream)

Is RHEL Free Software or not?…

==> Yes, the code is still free – as in freedom – and open-source

Companies are however paying for

- ▶ Qualified and responsive support
- ▶ (Responsibility, in case something goes wrong with the software)

and possibly with additional IT service on top of that

- ▶ Design study / architecture with docs
- ▶ Specifications with docs
- ▶ Initial setup/deployment (w/ or w/o docs - but always with an acceptance phase)
- ▶ Operations docs & training

Hardcore distros & zombieland underground

Binary packages there is

- ▶ Slackware Linux (RC scripts, LLVM-capable)
- ▶ Void Linux (possibly musl, runit, LibreSSL)
- ▶ CRUX (RC scripts)

Learn with Slackware Linux Current

▶ Release 14.2 is too old (Jul 2016)
▶ Get the latest Slackware64 daily snapshot
▶ Burn it to an USB key memstick

Base system + packages from source

- ▶ Gentoo Linux (OpenRC, LLVM-capable)
- ▶ GNU Guix
- ▶ Trisquel GNU/Linux
- ▶ SourceMage / Sorcery
- ▶ Gobolinux (no `/bin` nor `/usr/bin`)

Musl libc powered distros

- OpenWRT – note there's a x86 port
- Alpine Linux
- Sabotage (runit, netbsd curses, only `/bin`)
- Adelie Linux
- Gentoo musl

The *ultimate* distro

▶ Linux From Scratch (LFS)

Specific use-case distros

- CoreOS (containers)
- Redhat Atomic (containers)
- SmartOS (Solaris + ZFS + LX zones + KVM zones)
- Replicant (Android fork/clone)
- Lindows / FreeSpire (GNU/Linux + WineHQ = Windows)
- ReactOS (idem)

BSD systems

And if you're really angry on how a system should run…

▶ NetBSD
▶ OpenBSD
▶ FreeBSD
▶ DragonFlyBSD

==> ideal for networking purposes

The forgotten duckling

MirOS BSD (*not* discontinued) has nice features

- ▶ MKSH
- ▶ binary updates (like `syspatch`?)
- ▶ wtf tool – database of acronyms

// Questions on UNIX-like server distros?

Desktop Distributions

various kinds of graphical environments

Display servers

- X11
- Wayland
- *KMS console all-the-way*

Desktop Environments (DE)

- Unity / Gnome 3
- Cinnamon vs. **MATE**
- Budgie vs. Deepin
- KDE is back with v5 and Neon
- XCFE / LXDE / Enlightment / …

Window Managers (WM)

▶ Tab Window Manager (TWN)
▶ Motif Window Manager (MWM)
▶ FVWM2 / Blackbox / IceWM / …
▶ Tiling VMs: Awesome / Ion / Ratpoison
▶ *No WM at all?*

Tiling WM families

- i3 (X11) / Sway (Wayland)
- **DWM** (X11) / DWL (Wayland)

UNIX-style graphical env

▶ Focus on mouse-over (w/o click)
▶ Workspaces and keyboard shortcuts
▶ Tile w/ `Alt` and arrow keys
▶ Resize windows w/ `Alt` and right-click

and something from the windows world

▶ Terminator copy/pasting ala Putty (instead of middle-click)

Popular & desktop-oriented distros

What GNU/Linux distro do you use?…

==> Usually

▶ Debian & Ubuntu (and many other Debian-based distros)
  ▶ Linux Mint
  ▶ Deepin
▶ Arch Linux
▶ Fedora

What GNU/Linux flavors are usually proprietary packages available for?…

==> Recommended (although not by RMS)

- Debian & Ubuntu (DEB)
- Fedora (RPM)

but still there are a few exotic desktop-oriented distros out there

▶ Slackware 15+ (KDE 5) vs. Neon
▶ Hyperbola (FSF, Xenocara, LibreSSL)
▶ TrueOS (PC-BSD, LibreSSL)

// Questions on UNIX-like desktop distros?

This is the end