🖥️ Everything was (not) better in the past!

Unreliable hardware and half-baked software

Christian ~~Retrowic~~ Stankowic

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$ whoami

- Christian Stankowic
- @stdevel@chaos.social 🐘
- IT consultant and trainer 👨‍🏫
- collects obsolete hardware
- Blogger (cstan.io 📖)
- Podcaster 🎙️🇩🇪
  - Urlaub im Userspace 🐧
  - Faxinformatiker 📠
  - ThinkPad-Museum 💻

Personal collection

- 486er, Celeron and Pentium II/III desktops
- Alpha und SPARC workstations
- **77 different** ThinkPads
- 8 additional notebooks (Medion, Compaq, Toshiba)
- 6 Palm PDAs
- a lot of boxes and manuals

...I can stop at any time! 👆

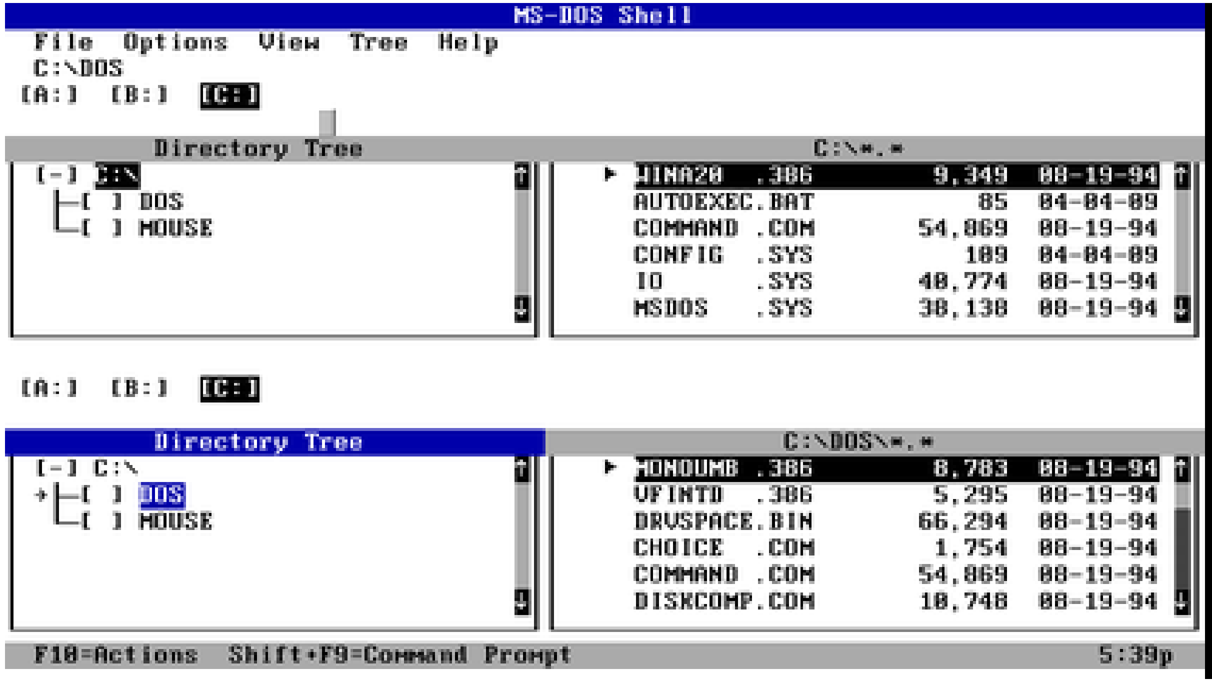
...and you?

Commodore 64 (1982)

Sinclair 48K ZX Spectrum (1982)

[1], [2]

...and you?



MS-DOS 5.0 (1991)

Windows 95 (1995)

[3], [4]

...and you?

Microsoft Windows Me Millennium Edition

Windows ME (2000)

EEE PC (2008) and Windows XP* (2001)

* FCKGW-..., [5], [6],

Agenda

1. Motivation
2. Hardware
3. Software
4. Retrocomputing today

Motivation

- Retro computing/gaming is enjoying great popularity
  - but was everything really better in the past?
- What has been forgotten (for good reasons)?
- Debunking a few myths and highlighting **the worst**
- What is the situation with retro hardware/software today?

Hardware

Mythos

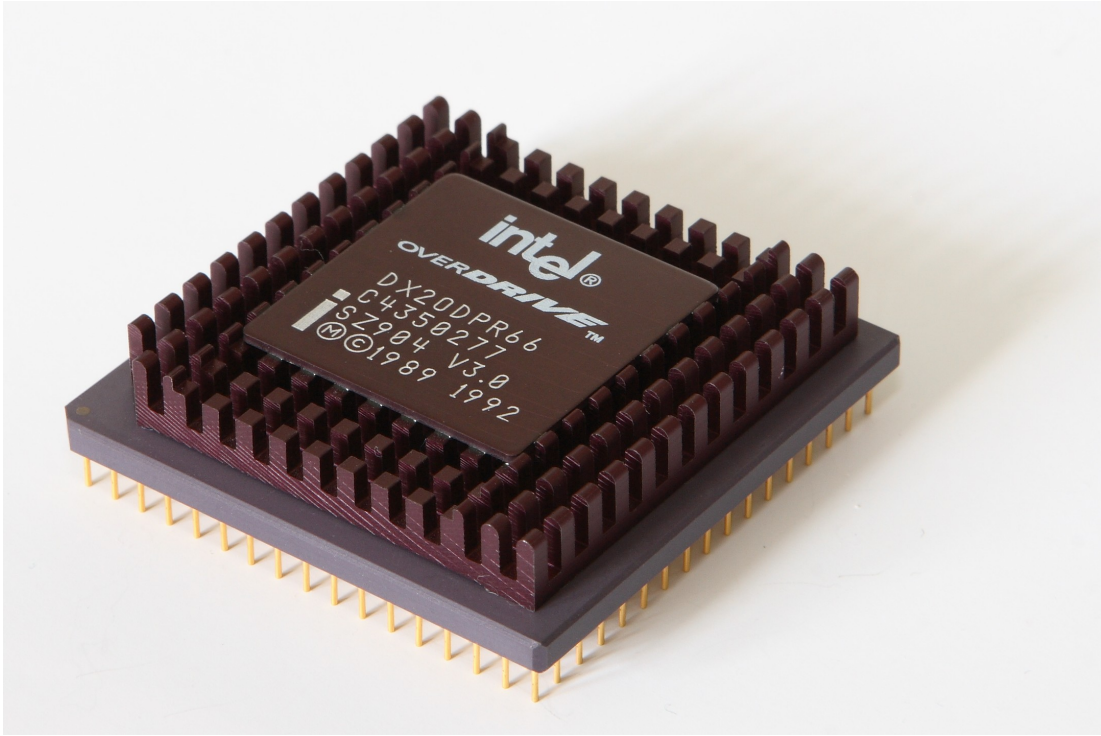
Everything used to be simpler! Today's devices are clocked much too high and get too hot! 🥵

- Earlier CPUs weren't really any better either
  - Until the **i486DX-33**, CPUs didn't need **active fans**
  - With good case ventilation, they didn't even need **passive heat sinks**
  - That changed with **OverDrive** and Pentium
- Fans were generally never turned off, especially in notebooks*
  - Often even **PSUs** had integrated fans

* Even in non-Pentium 4 systems!

Waste heat

Intel 486 SX2 (50 MHz, 1992)



Intel 486 DX2 OverDrive (66 MHz, 1992)

[7], [8]

Waste heat

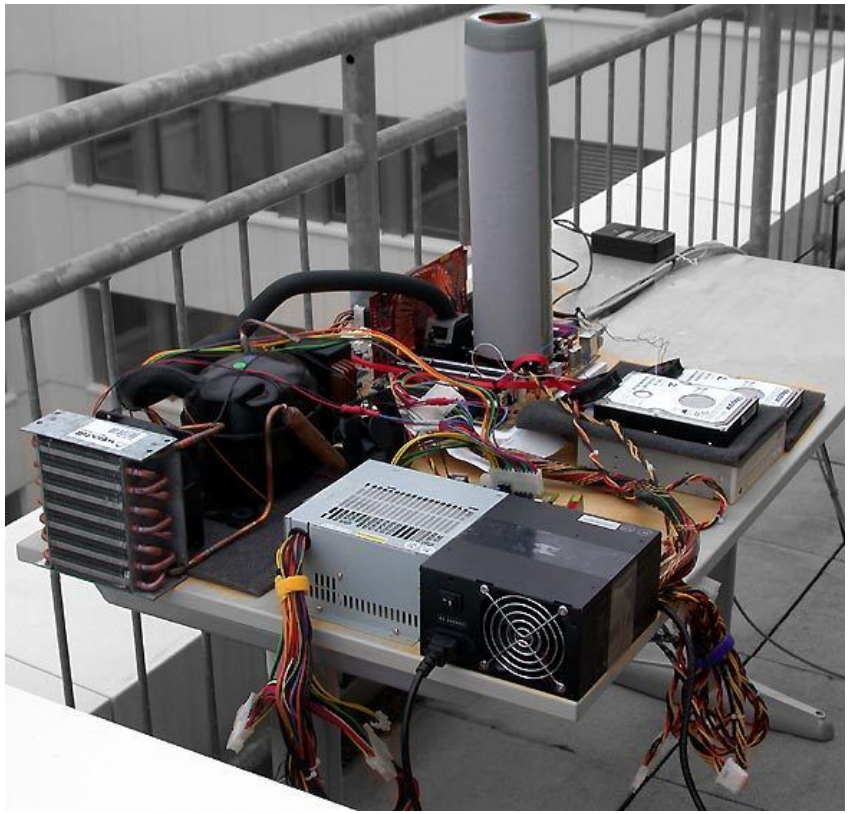
Notebook PSU with fan (2003)

Nitrogen-cooled Pentium 4 (5.25 GHz, 2003)

[9].

Excursus: The 5 GHz Project

- Crazy project by Tom's Hardware (2003) 📽
- Pentium 4 HT cooled with **liquid nitrogen** via compressor
  - 3.2 GHz, 512 KB cache, 82 watts TDP
- Highly customised Xeon cooler
  - Solid copper and high precision
  - Had to withstand **-196 °C***



* Nitrogen freezes at **-210 °C**, [9]

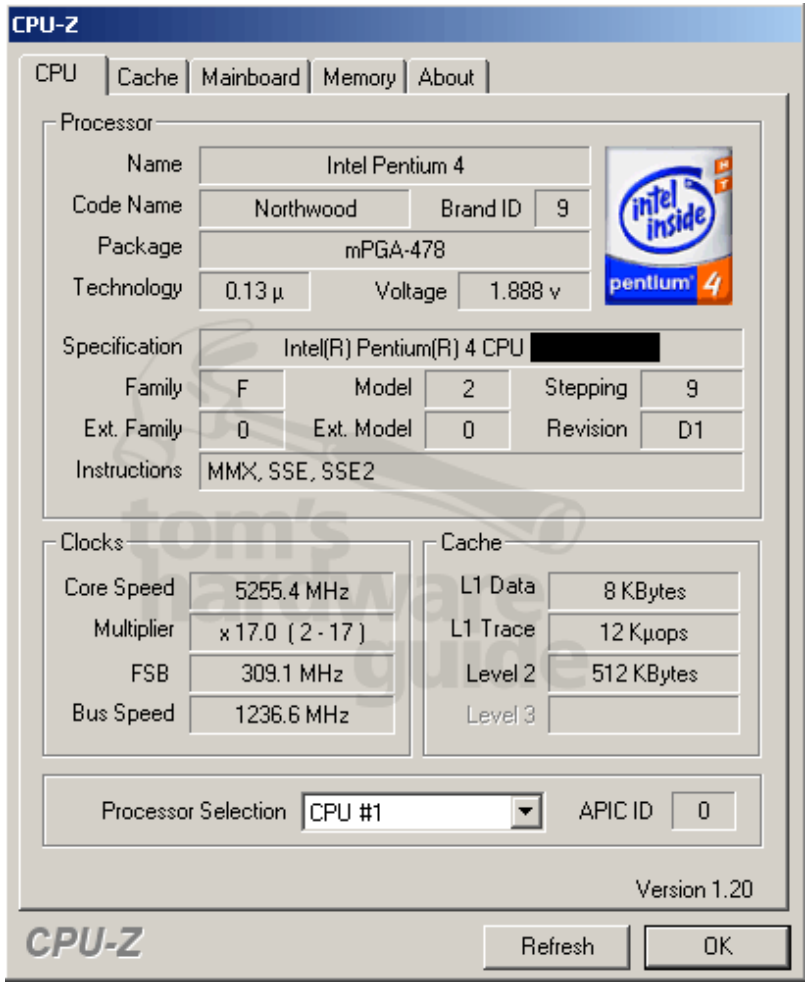
Excursus: The 5 GHz Project

- Modified Asus P4C800-E motherboard
  - Voltage regulator replaced (**96 amps**)
  - Previously designed for "only" 90 amps
- Gradual experimentation with clock speeds and bus speeds
- TDP increased to **180 watts**
  - comparable to an **Intel Itanium 2** and **AMD Threadripper**

Normal cooling behaviour

💡 The power supply in single-family homes is usually designed for 80 amps

Excursus: The 5 GHz Project



[9].

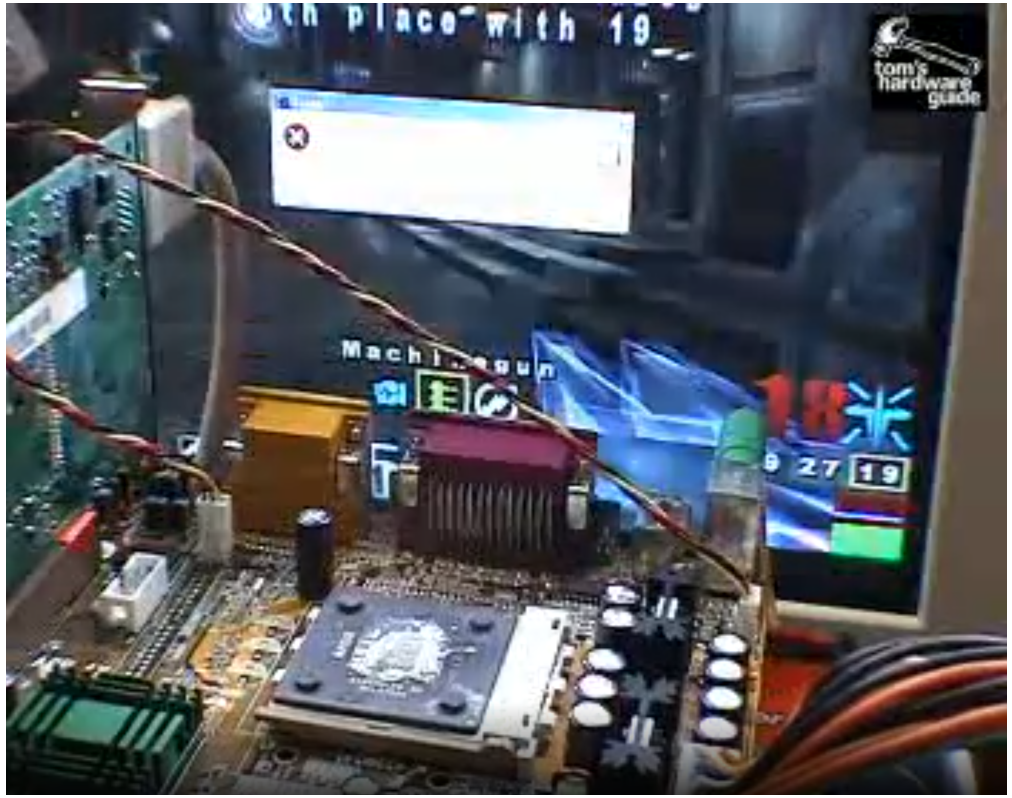
Waste heat: Emergency shutdown

- **Emergency shutdown** was not a matter of course!
  - Usually shut down when CPU temperatures exceeded 100–125 °C
- What happens when the cooler is removed? 🤔
  - Up to Pentium 3* **freeze** OS/application usually **one**
  - Pentium 4+ offer extended heat protection (**thermal throttling**)
    - Cycles are suspended without reducing the clock speed
- OS/application run slower, but do not freeze
- Earlier AMD Athlon CPUs lacked an emergency shutdown feature
- Mainboard and CPU were **damaged** after a short time
- **Conclusion**: Today's CPUs are more efficient and less sensitive

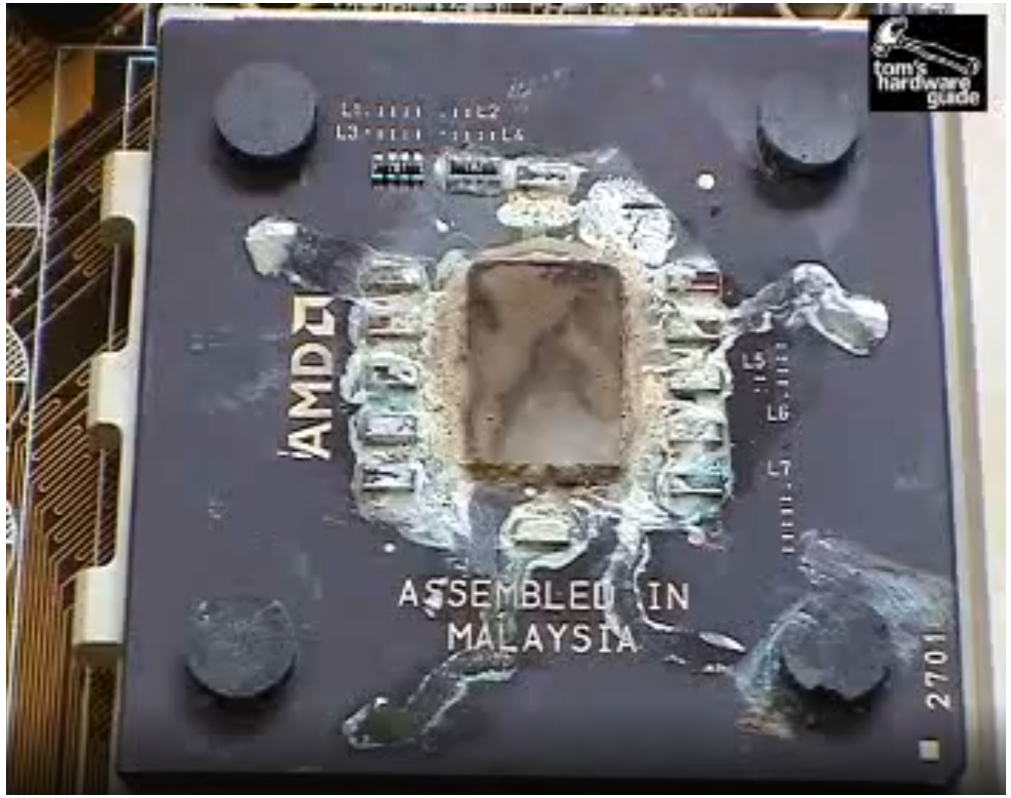
* Mobile Pentium III was already able to downclock (**SpeedStep**)

Waste heat: Emergency shutdown

Tom's Hardware answered the cooler question in 2001 in a test 📽



Crashed application



Die charred at **370 °C** ☠

[10]

Mythos

Today's CPUs are far too complex, there are always breaches! 🐛

- Yes, but there were errors in the past too – e.g. **Pentium FDIV bug**
  - **Hardware error** published in Oct 1994 by mathematician Prof. Nicely
  - Affects some floating point commands of the new **FPU**, such as `FDIV`
  - Unpredictable inaccuracy in complex calculations
- Standard software often did not use the FPU at that time
- Intel tried to sit out the problem and avoid replacing CPUs
- **Conclusion:** Microcode updates are **good**

Proprietary CMOS batteries

- CMOS* batteries used to be part of the **real-time clock**
- these modules were often **soldered**
  - usually replaced after **~10 years**
- later socketed, now usually out of stock
  - replicas and conversion instructions available
- CMOS batteries used to be soldered, too
  - Common modules: BR2335, CR2023,...
- **Conclusion:** Replaceable batteries are good?

Dallas DS12B887

* **C**omplementary **m**etal-**o**xide-**s**emiconductor, [11]

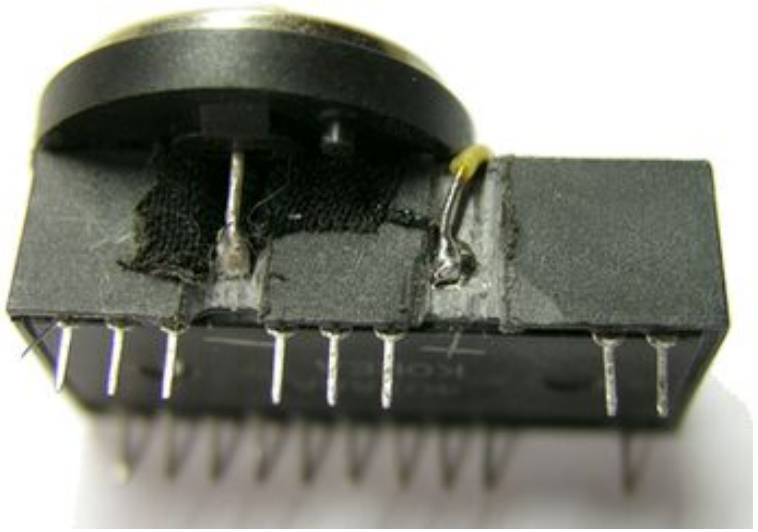
BIOS battery or ticking bomb?

- **Ni-Cd*** batteries, which were particularly common in the past, can be dangerous
  - **Toxic** heavy metal, complex recycling
  - Sensitive to overcharging
  - Prone to crystal formation (**short circuit!**)
  - Banned throughout the EU in 2004
- **Check** and replace batteries regularly!
- Even new batteries can swell

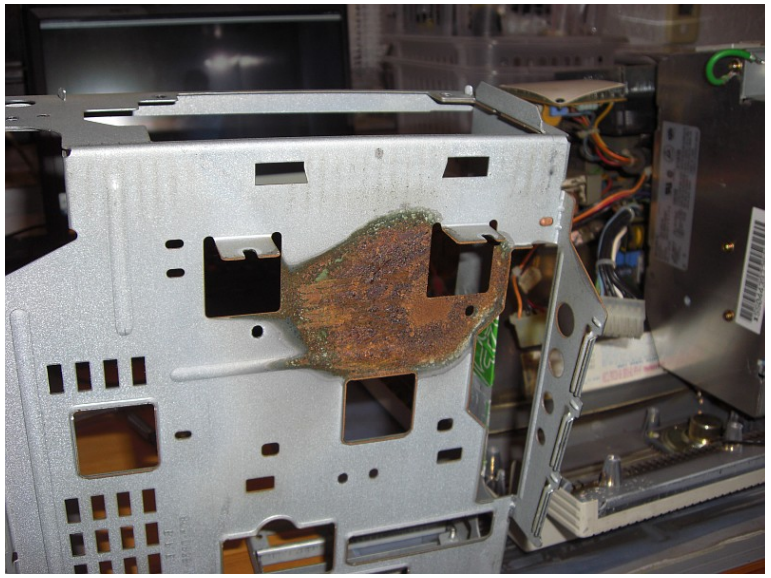
Leaked ER3S battery

* Nickel-Cadmium

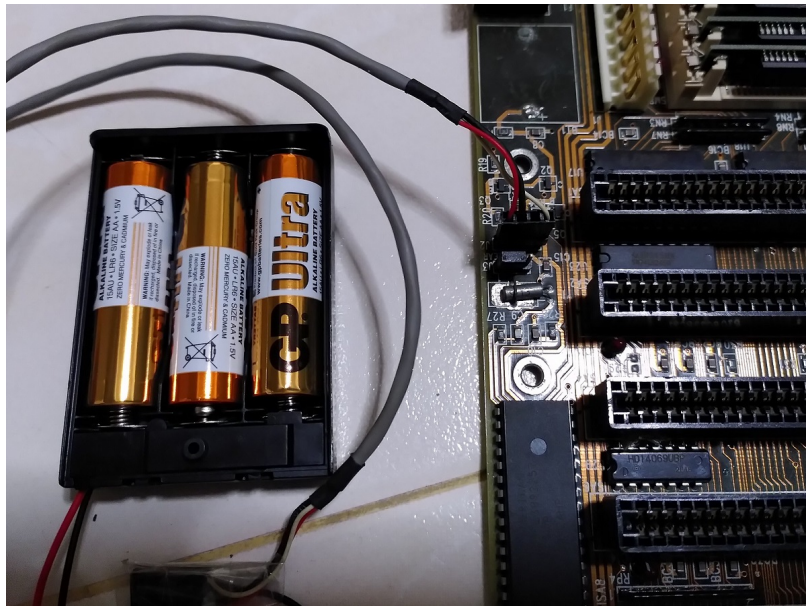
BIOS battery or ticking bomb?



Dallas RTC with extended button cell



Housing damaged by leaking battery



AA batteries as battery replacements

[12], [13]

Mythos

There used to be many more connection standards!!11

- Yes, but **disruption** joins modernisation
- Disadvantages of some standards: **Firewire**
- Collaboration between **Apple** and Sony, among others
  - Previously better for A/V, faster than USB
- Firewire offered 800 Mbit/s
- However, high licence fees*

* Initially a flat rate of USD 7,500, later USD 1 per connection [sic!]

Adapters, adapters everywhere!

[14].

Obsolete standards

- Computers have long since become **mainstream**
- Devices are becoming smaller and lighter, eliminating the need for many ports
- Since **USB** came along, many things have become easier and more elegant
- e.g. PS/2, RS232, LPT, gameport
- thanks to **DisplayPort Alt Mode**, audio and video too
  - Adapters for almost everything (*except perhaps Gardena and three-phase current*)
- **Conclusion**: Standards are not always bad

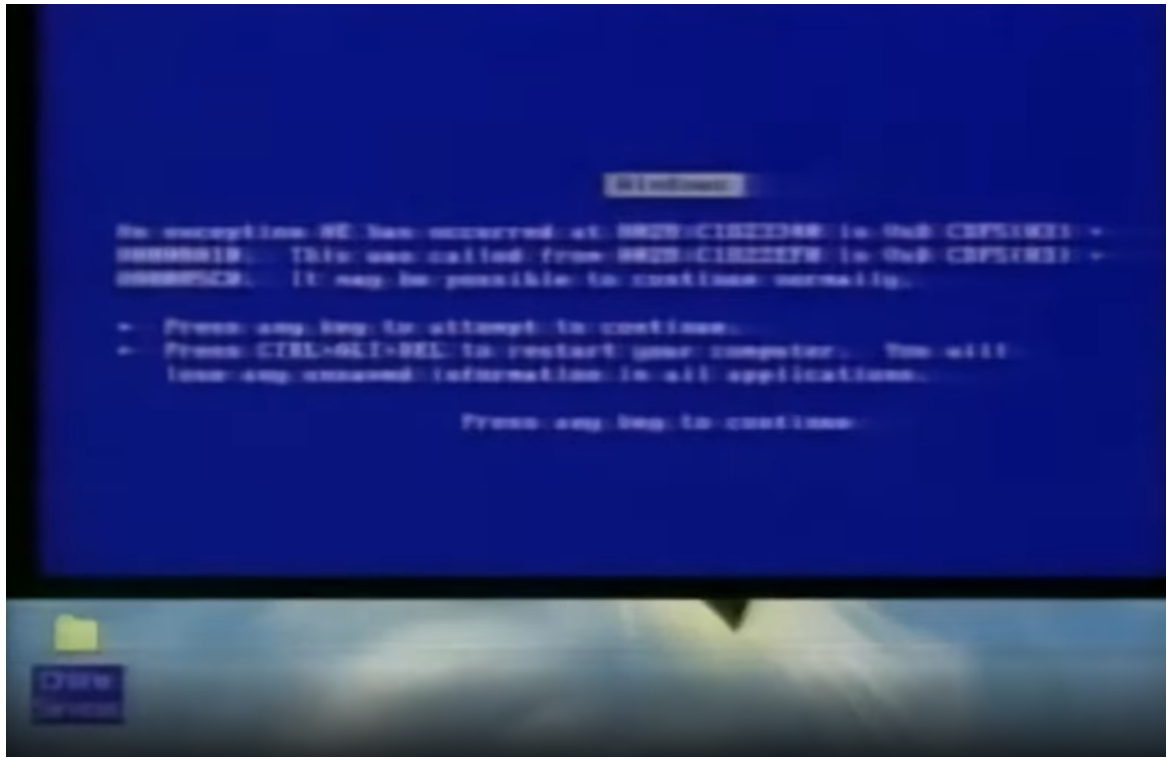
💡 DisplayPort is **licence-free**, while HDMI usually costs **10,000 USD** per year

Excursus: USB - One to rule them all?

- Idea originated in 1992 in the **plug and play** sphere surrounding Intel, IBM, etc.
- The first chip was developed in 1995
- First specifications and first chipsets in 1996
- Numerous **port formats** over the years
  - A, B, Mini, Micro,..
- Initially poor OS support
  - Legendary **BSOD** during COMDEX 1998
  - Lack of keyboard support in BIOS 🙄
  - Lack of boot support

[15]

Excursus: USB - One to rule them all?



COMDEX 1998 - Windows 98 📽

[16]

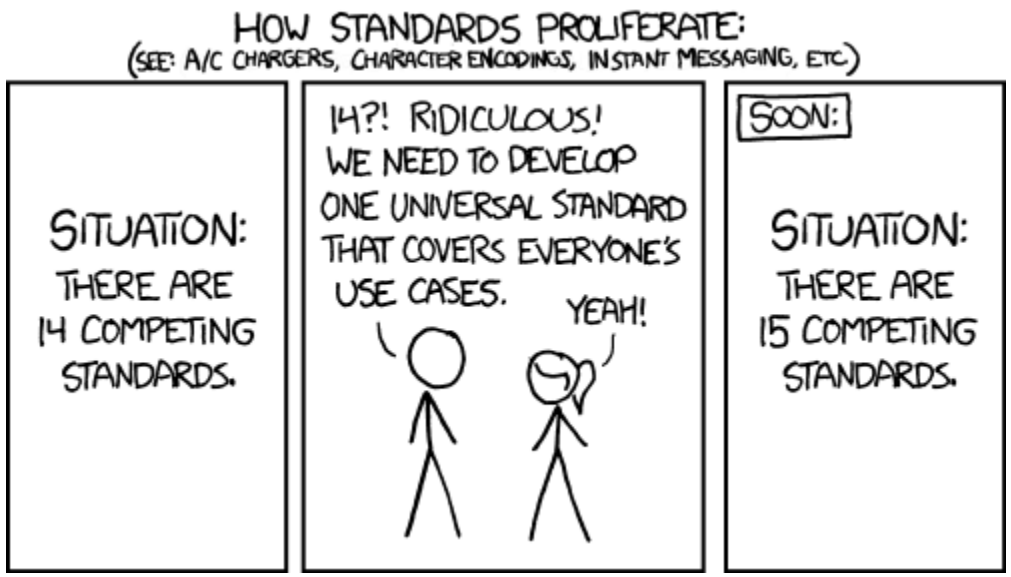
Excursus: USB - One to rule them all?

Since then, countless other standards have appeared*

Standard	Year	Mode name	Marketing name	Data rate
USB 1.0/1.1	1995	USB 1.0/1.1	Low-Speed	1,5 Mbit/s
USB 1.0/1.1	1995	USB 1.0/1.1	Full-Speed	12 Mbit/s
USB 2.0	2000	USB 2.0	Hi-Speed	480 Mbit/s
USB 3.0	2008	USB 3.2 **Gen 1x1**	SuperSpeed	5 Gbit/s
USB 3.1	2013	USB 3.2 **Gen 2x1**	SuperSpeed+	10 Gbit/s
USB 3.2	2017	USB 3.2 **Gen 2x2**	USB 20Gbps	20 Gbit/s
USB 4	2019	USB 4 **Gen 3x2**	USB 40Gbps	40 Gbit/s
USB 4v2	2022	USB 4 **Gen 4x2**	USB 80Gbps	80 Gbit/s

[16]

Excursus: USB - One to rule them all?



[XKCD 927: Standards]

[17]

Standards that never made it: MCA

- **M**icro **C**hannel **A**rchitecture
- Proprietary standard for IBM PS/2, RS/6000 and AS/400
- Introduced in 1987, replaced by **PCI** in 1993

- was primarily intended to solve the **problems** of the **ISA** bus*
  - wider bus (*32-bit instead of 16-bit*), higher throughput (*66 instead of 5.33 MB/s*)
  - shared interrupts
  - automatic card detection (*video, sound card, etc.*)
- But it also aimed to regulate the market for IBM PC clones and expansion cards 🤡

* **I**ndustry **S**tandard **A**rchitecture, aka **IBM AT**

Standards that never made it: MCA

- Could not establish itself
  - Only a few and very **expensive** expansion cards
  - Excessive **licence costs** from hardware manufacturers
- Compaq founded the **Gang of Nine**, development of the **EISA** bus
  - **E**xtended **I**ndustry **S**tandard **A**rchitecture, 32-bit instead of 16-bit
  - **Backward compatible** thanks to additional contacts
  - Higher throughput (*20 instead of 5.33 MB/s*)
  - Still no automatic configuration
- **Conclusion**: Vendor lock-in only works if your product is good

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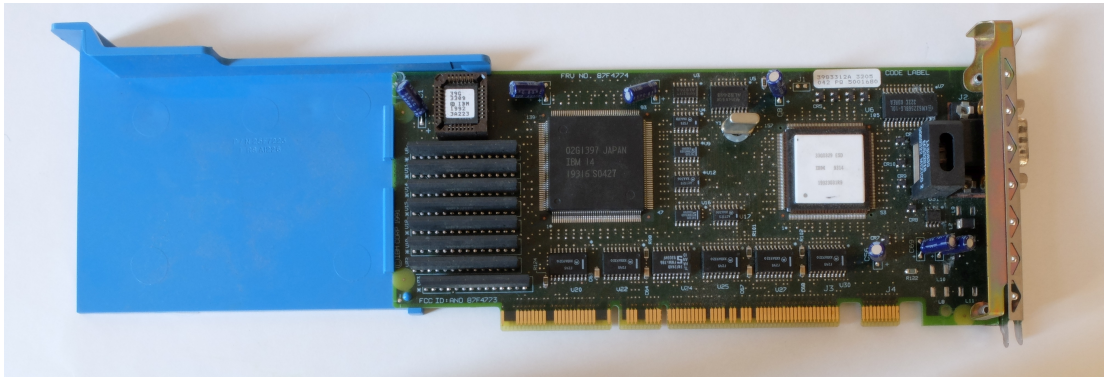
💡 Compaq's first product (**Compaq Portable**) was the first portable computer – **before IBM**.

Standards that never made it: MCA



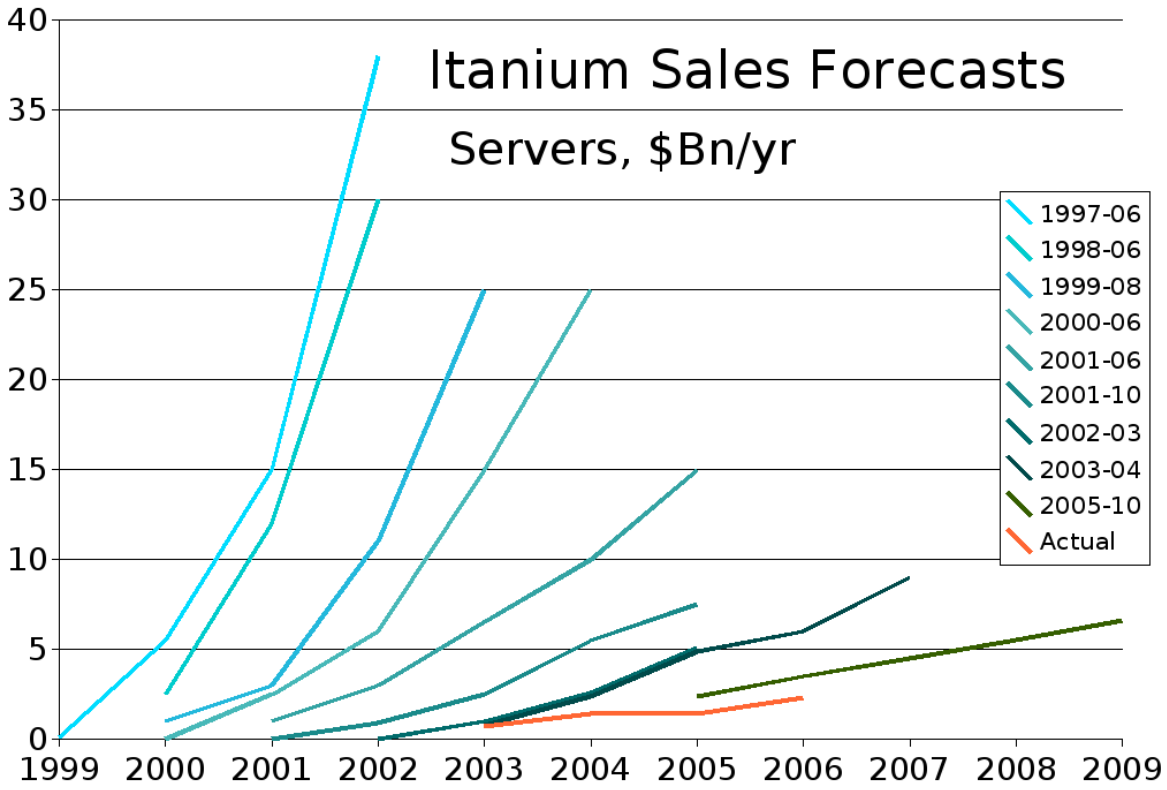
IBM MicroChannel XGA GPU

XT, ISA and EISA (from top to bottom)

[18], [19]

Standards that never made it: Intel Itanium (2)

Old Intel Itanium logo



Forecast and actual sales

[20], [21]

Standards that never made it: Intel Itanium (2)

- Failed **64-bit** processor architecture
- Produced by Intel and **HP** between 2001 and 2020
  - Development began in 1994 with basic research
- Was intended to be a high-performance "post-RISC" design
- Considered one of the most expensive computer projects in history

- The **EPIC*** architecture used should
  - execute instructions in pairs
  - be able to implement parallelisation at the CPU command level (**VLIW***)

---

* **E**xplicitly **P**arallel **I**nstruction **C**omputing, **V**ery **L**ong **I**nstruction **W**ord

Standards that never made it: Intel Itanium (2)

- **Theoretical** advantage has not been proven
  - **No** dynamic scheduling of calls (**branch prediction**)
  - Static scheduling, relies on compiler results
  - Optimisation via test runs and profiling necessary
    - Application only fast with optimal development
- Expectations were **not met**
  - Barely faster than an x86 CPU, partly due to slow cache
  - Software was ported slowly or not at all
  - No support for 32-bit code, had to be **emulated** at great expense
    - Speed then dropped to **1/8**

Standards that never made it: Intel Itanium (2)

- x86 CPUs developed faster than expected in 1994
- Intel and AMD competed in the **1 GHz race**
  - 06.03.00: AMD Athlon Thunderbird, 08.03.2000: Intel P3 Coppermine
- **x86_64 CPUs** from 2003 (*Opteron K8*) or 2004 (*Xeon NetBurst*)
- Applications ran faster thanks to techniques such as **prefetching** and **speculative execution**
  - The advantages of the EPIC/VLIW concept evaporated 😿
- Legal dispute between Oracle and HP over discontinued support
- Long adherence to the concept earned it the name **Itanic**
- **Conclusion**: Please recognise when you've taken a wrong turn

Past bus systems: IDE

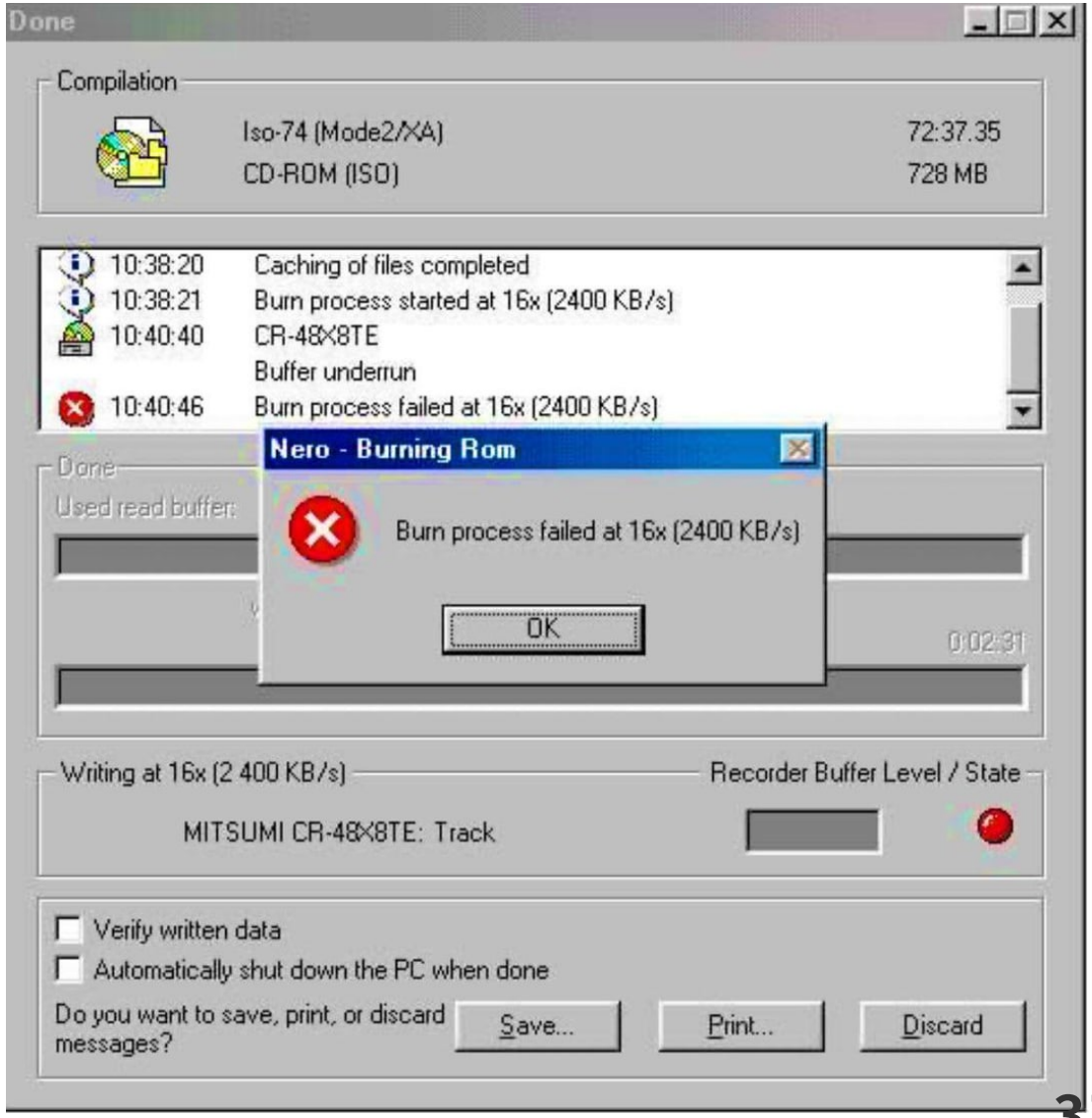
- Renamed **PATA** after the introduction of SATA (2003)
- Originally developed by Western Digital, later standardised
- 34- or 40-pin connector for hard drives and floppy drives
- 9 development stages, maximum transfer rate of **133 MB/s**

- 2 channels, each with two drives (master, slave*) per controller
  - 2 additional channels for floppy drives
- With **Cable Select**, the cable determines the order
- **ATAPI** allowed IDE to encapsulate **SCSI** packets
  - this also enabled support for optical drives and tape drives

* actually Device 0 and Device 1

Past bus systems: IDE

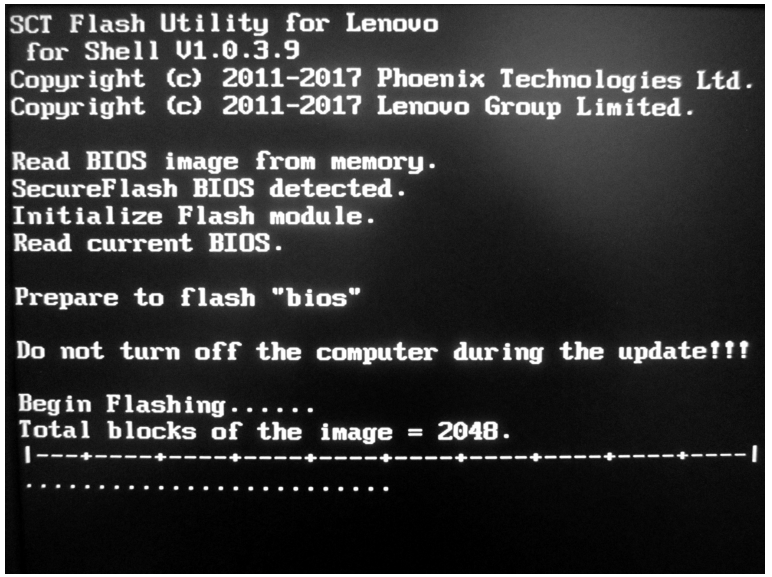
- Correct device distribution across the buses was **essential**
- Hard drives and CD burners were **not** allowed to be connected to the same bus
- The primary and usually faster drive was generally the **master**
- This improved later with more modern controllers and standards



[22].

BIOS updates from hell

- BIOS updates used to be possible only under DOS.
  - Linux users had to use **dual boot** or live media
- Some BIOS updates still require this **today**
- **Backup ROMs** did not yet exist in case of failed updates
  - Some manufacturers still manage to brick devices during updates today 🤡



- `fwupd` has made many things so much easier 🎉
  - Over 50 manufacturers, 2,500 devices and **13k updates**
  - Requires UEFI
  - Manufacturers can upload their firmware via LVFS
  - Nevertheless, there is still room for improvement

What could go wrong?

Software

Drivers

- Driver search without original packaging and accessories in the pre-Internet era 😮‍💨
- Driver search before Windows 7
- Missing **SATA drivers** in Windows XP
- Creating a driver **diskette** on a second computer

- Compiling NVIDIA drivers under Linux
- Third-party drivers before DKMS
- ndiswrapper - Windows WLAN drivers under Linux 🤯

[23]

Windows Millennium Edition

- Succeeded Windows 98 in 06/2000 (after 1y)
- Emergency product; Windows 2000 was supposed to merge the two product lines
- Last operating system in the Win 9x series
  - DOS 7.0 is hidden, but still exists
- Significantly more unstable than Win 98 SE
  - Attempted to combine 9x userland with Windows 2000 features
  - Applications could still crash the entire system

ME in its usual habitat

actually pronounced *me*

IBM OS/2 (formerly known as BS/2)

- PC operating system developed between 1987 and 2002
  - intended to **replace DOS**, developed briefly in collaboration with Microsoft
- Partnership ended in 1991
  - Microsoft wanted to offer OS/2 for many PCs, IBM only for PS/2
  - A lot of **bureaucracy** and delays
  - First version without GUI, but high **system requirements**

[24].

IBM OS/2 (formerly known as BS/2)

- Windows 3.0 sold significantly **better** than OS/2
  - OS/2 was significantly **more expensive** than DOS and Windows
  - 3 million vs. 300,000 copies in one year
- Was sold and further developed by third parties
  - 2001-2015 as **eComStation**
  - since 2015 as **ArcaOS**
- Niche OS, but still in use
  - supports UEFI, USB 3.0, NVMe and yum

[24]

Mythos

There used to be more exciting experiments with operating systems! Nobody dares to do anything anymore! 🤡

- The UNIX system landscape has thinned out
  - BSD family, IBM AIX, macOS (and still a little Solaris)
- There are over 600 Linux distributions
  - Some of them even have alternative init systems 😜
- There are numerous niche operating systems
  - Haiku, SerenityOS, Redox, 9Front, RISC-OS, ReactOS, ZealOS, Hurd,...

Operating system landscape

XFree86 vs. X.Org

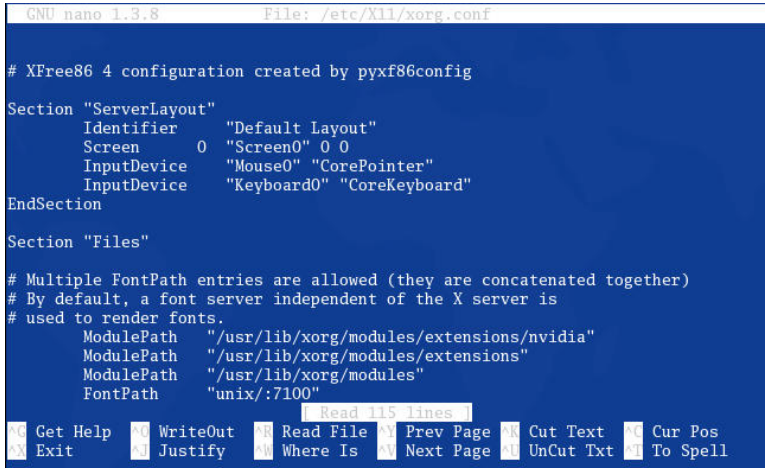
- **XFree86** was released in 1991 as a free X11 implementation
- for UNIX, BSD, Linux, and others
- was forked in 2004 as **X.Org**
- disputes over new licence from 4.4 onwards
  - XFree86 Project License, GPL-incompatible
  - More modular design
- Different driver support depending on implementation
  - XFree86 bypasses the kernel for the GPU

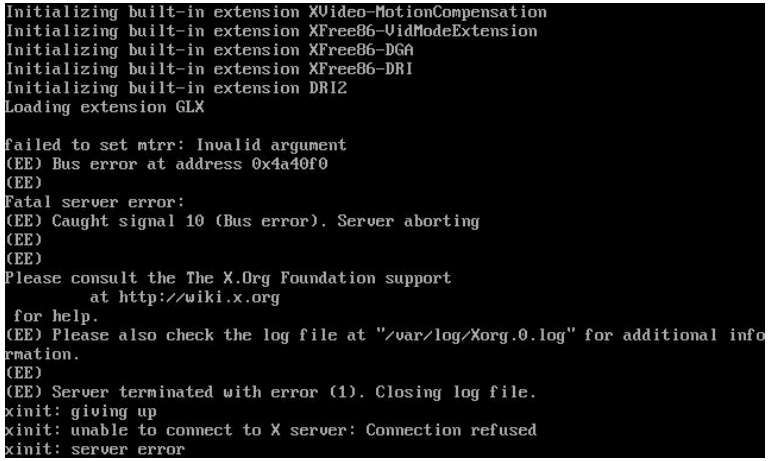
X.Org logo

[25]

XFree86 vs. X.Org

- At times, **both** X servers were delivered
  - This confused new users in particular
- Configuration was generally **too complex**
  - No good default configurations
  - Difficult to use
  - Troubleshooting
- Before 2000, CRT modelines sometimes had to be entered manually
  - Frequencies and clock rates
  - Incorrect entries could **damage** CRTs





XFree86 vs. X.Org

- X.Org has architectural disadvantages
  - Applications can read each other's inputs
  - Numerous CVEs in recent years
  - Development has **stagnated**
- Wayland was introduced in 2008 as an **alternative**
  - Easier to maintain protocol
  - Less vulnerable design
  - Now standard in most distributions

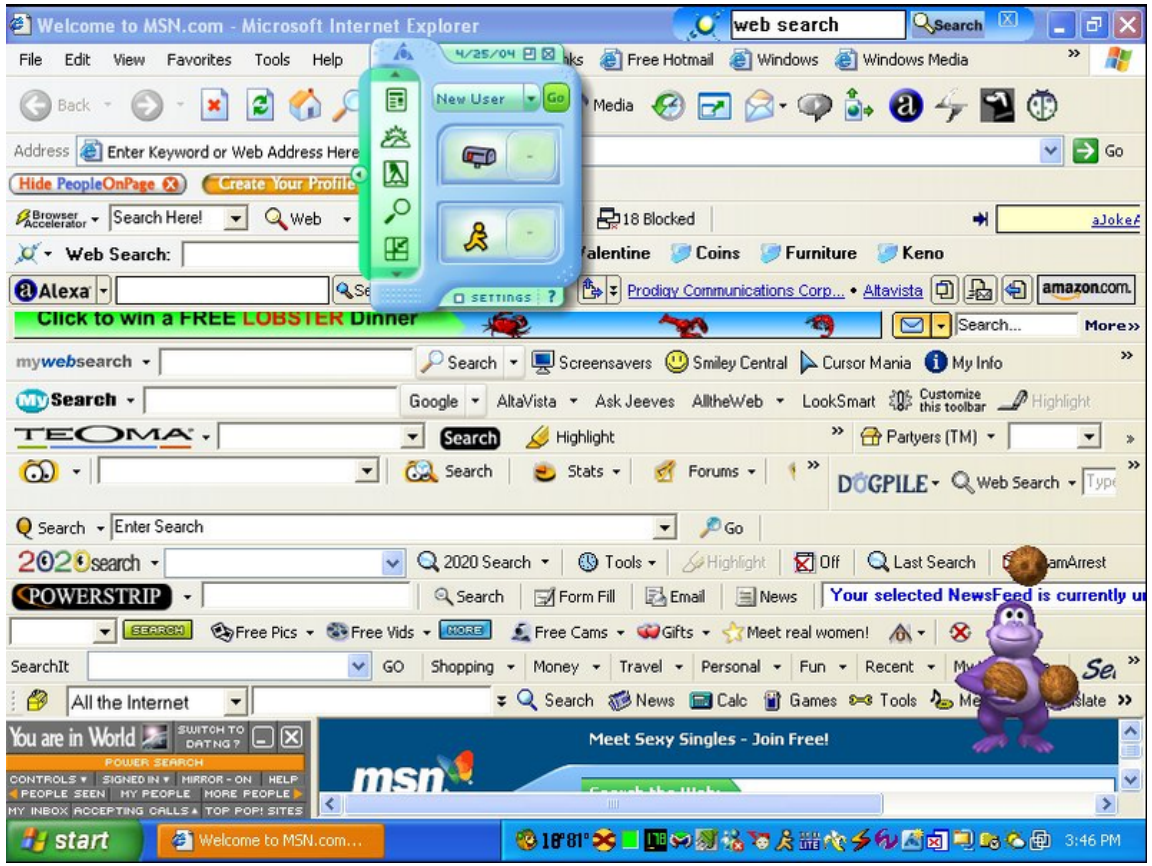
[26]

Mythos

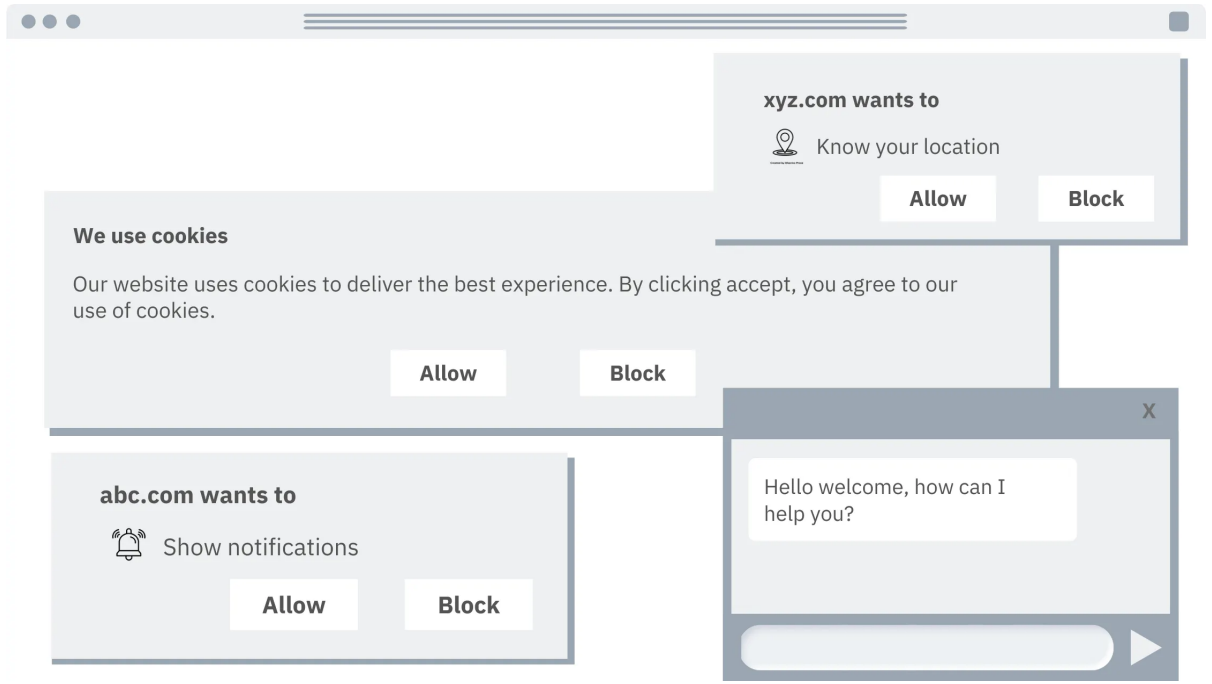
The internet used to be less polluted with advertising! 🚀

- **Toolbars** for web browsers
- Systray pop-ups
- Messengers with integrated advertising (ICQ ProSieben Edition)
- Branded shareware, registerware software
- Cookie banners are a real **nuisance**
  - Use Consent-O-Matic
- **Conclusion**: Advertising has always been intrusive

The internet



Internet Explorer with toolbars



Typical contemporary website

[27], [28]

The internet

- Persistent trend: **web apps** instead of native applications
- **Runtime** approach
  - Simplifies development
  - Strong dependence on the framework used
  - Vendor lock-in likely
- Firefox support is getting worse
- Can we please undo this? 👉👈
  🙄

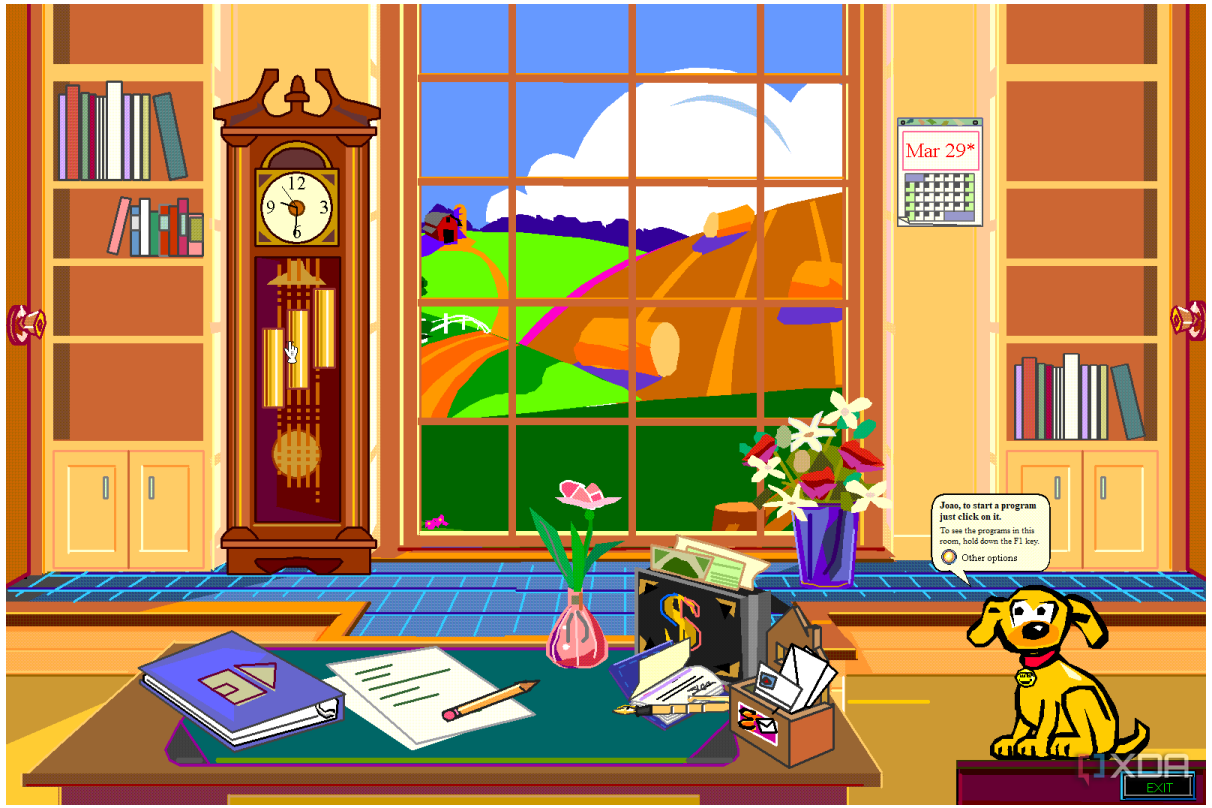
Mythos

The previous design language was clearer and more appealing! 😭

- Yes and no
- There have always been design failures and changes
- Minimalism has been omnipresent (again) for several years now

UI/UX: Designs from hell

Windows 3.1 Hot Dog Stand

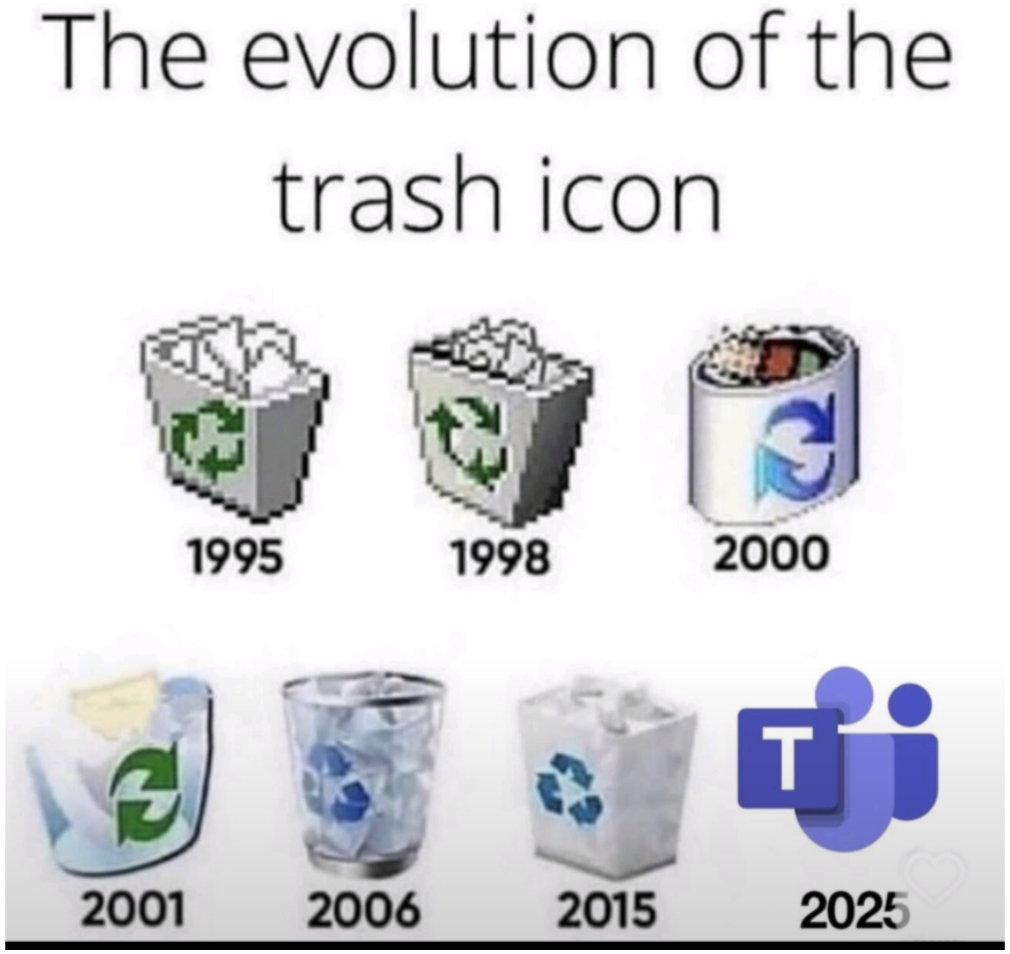


Microsoft Bob

[29].

UI/UX: Changes over time

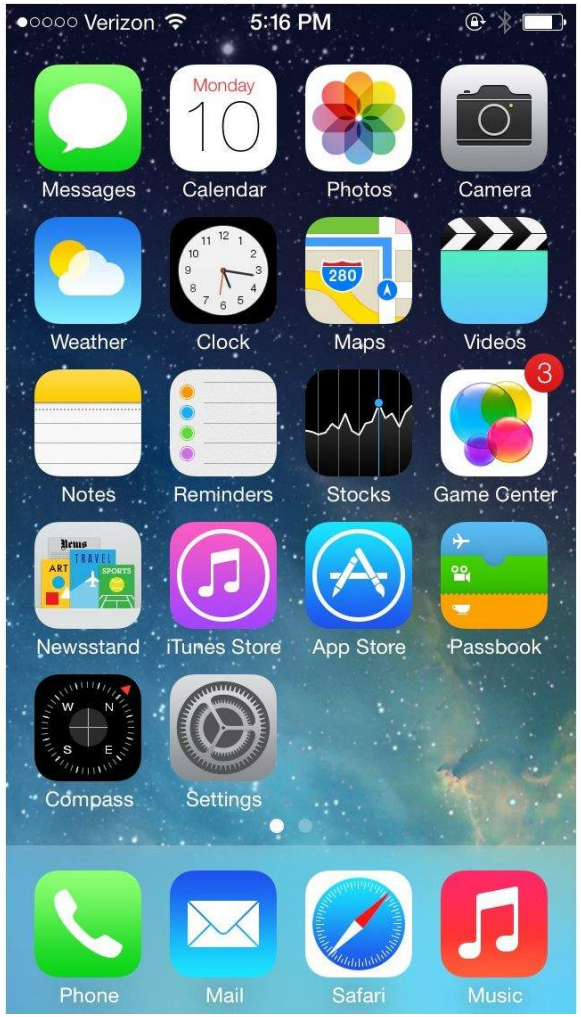
- Skeuomorphism has been almost completely disappeared
  - An approach in which the design is modelled on familiar **everyday objects**
- Since the 2010s, **flat design** in particular has been back in vogue
  - Windows Phone 7 (2010)
  - Apple iOS 7 (2013)
  - Google Material Design (from 2014)

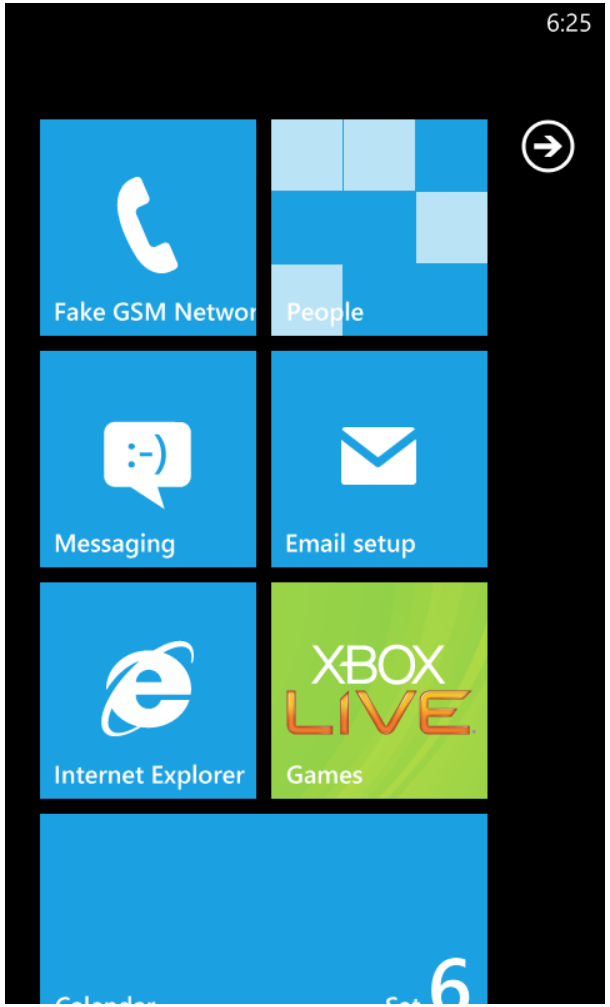


Icon changes

[30]

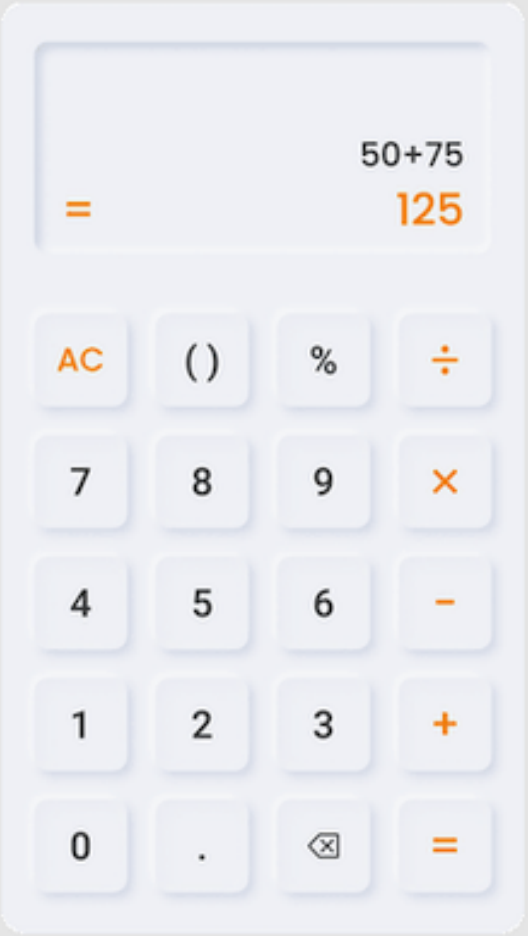
UI/UX: iOS 6/7 and Windows Phone 7





[31], [32]

UI/UX: Skeuomorphism, Flat Design, Neomorphism



[33]

UI/UX: Is less really more?

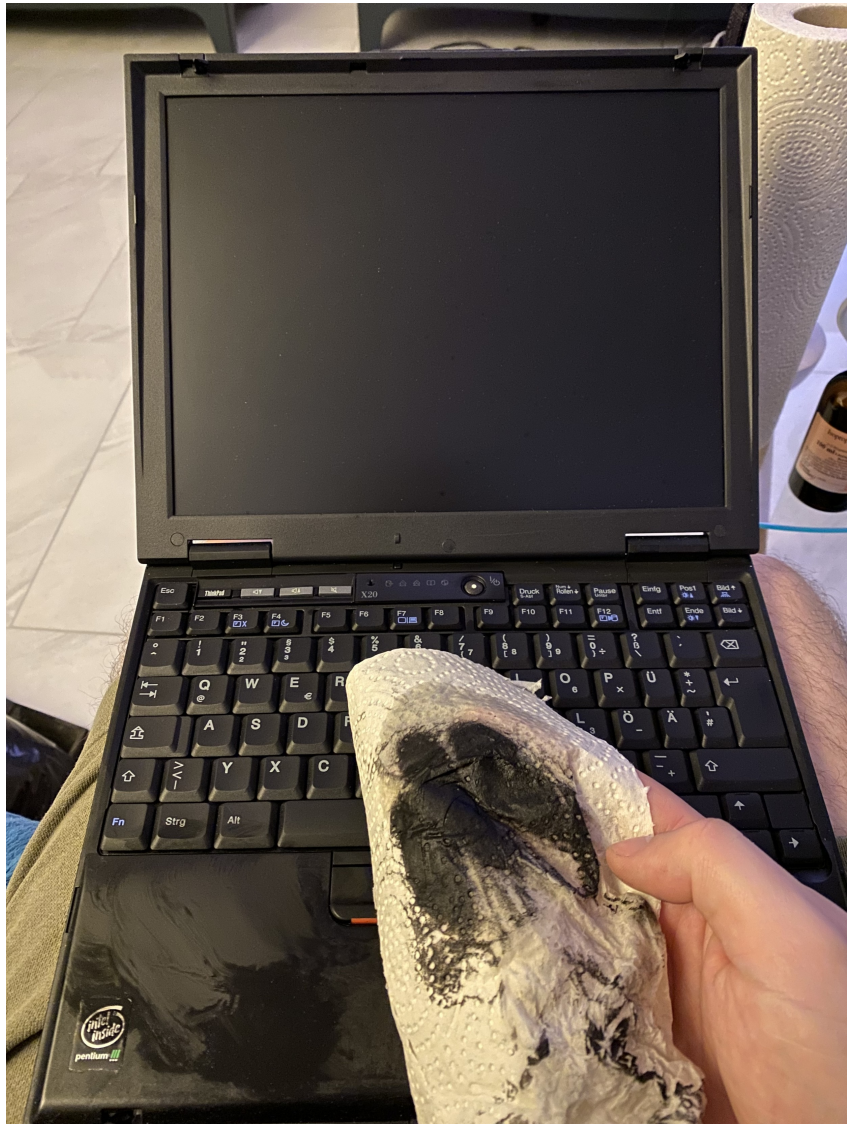
- The trend is towards flat designs
- Reduction to the essentials
- High similarity between many icons

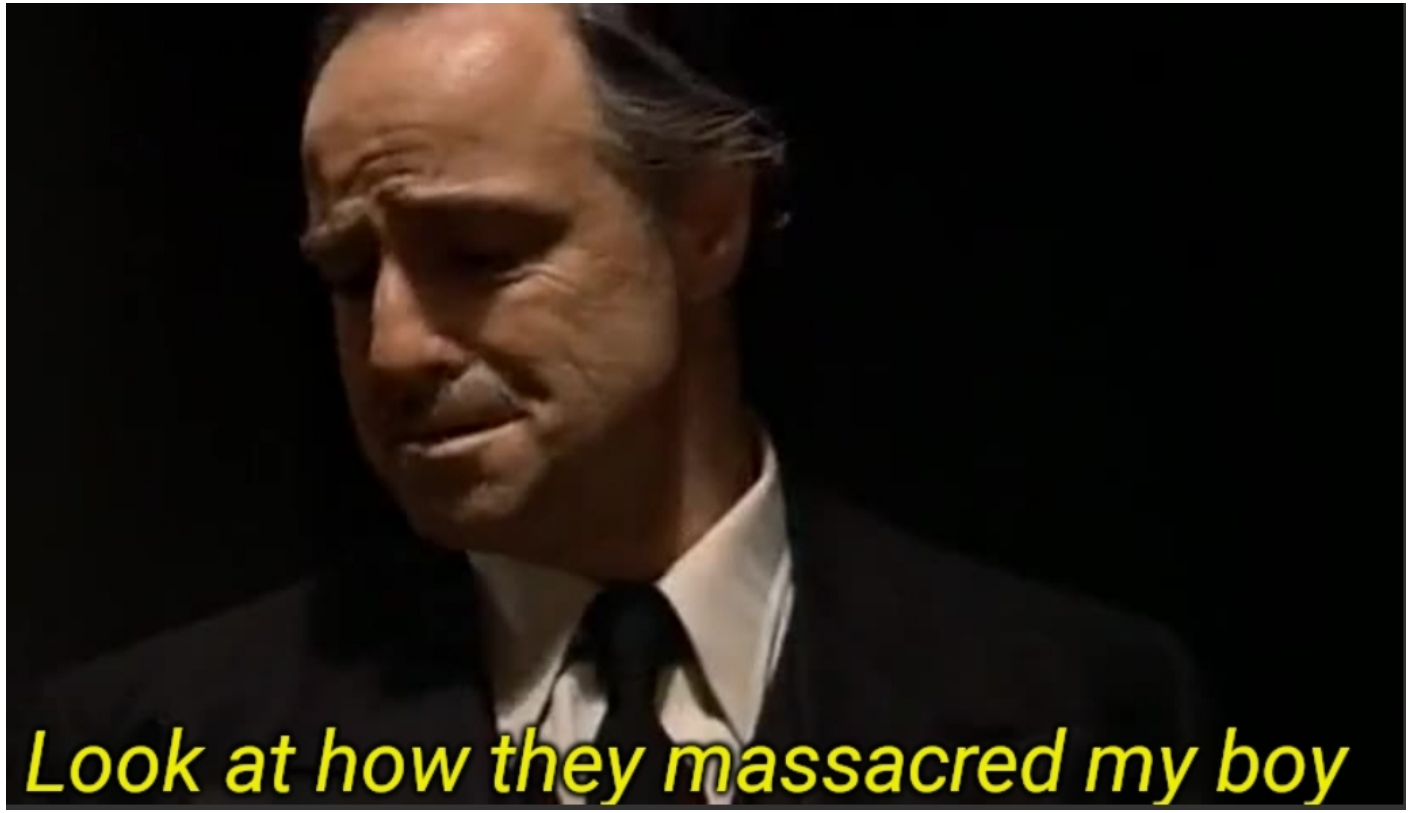
Retrocomputing today

Retrocomputing today

- How useful is it (still) to use old hardware today?
  - It depends...
- Hardware is not improving
  - Previously lacking power management, poor performance/watts
  - Cases break, paint peels, rubber coatings deteriorate
  - Proper storage is essential
  - **Dispose** of old (Ni-Cd) batteries properly
- Retro computing has long since **ceased** to be a **niche hobby**
  - Plenty of content available, often at inflated prices

Retrocomputing today





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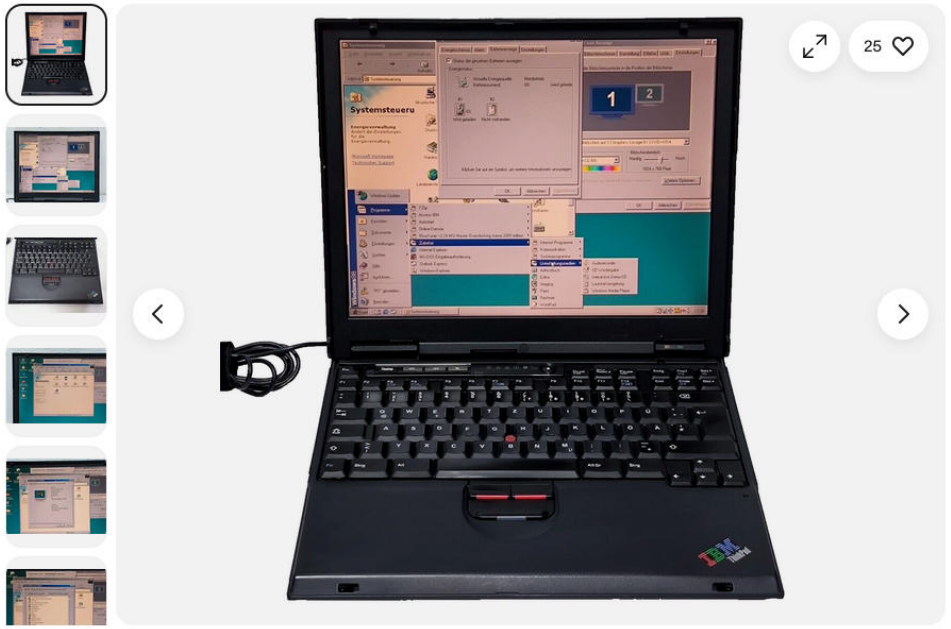

IBM T23 Super Retro 14,1" Windows 98! Notebook Laptop 384Mb 10Gb CDROM COM LPT

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Artikelzustand: **Gebraucht**

"von Händler - mit 12 Monaten Gewährleistung und Ink. MwSt"

Weitere Details

Auf die Beobachtungsliste

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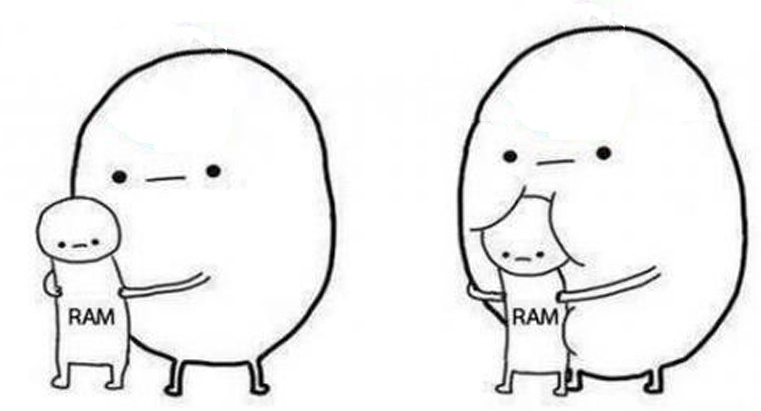
[34].

Retrocomputing today

- It's still fun to use old hardware/software
- It grounds you immensely: things were **not** better in the past
- There is a lot to learn
  - e.g. how to achieve a lot with few resources
- There are many **impressive projects**
  - DOStodon (*DOS Mastodon client*)
  - jSH (*JavaScript for DOS*)
  - heffalump (*PalmOS Mastodon client*)



Retrocomputing today: Recommended sources

- Nachlese 📖
  - Pentium bug history 🇩🇪
  - SFT12 - Pentium 🎙️🇩🇪
- Webseiten 🌍
  - WinWorld PC (Abandonware)
  - Abort Retry Fail (Blog)
- Fediverse 🕸️
  - Regionales Retro-RZ 🇩🇪
  - OpenPA
  - in ♥ with PDA
- YouTube 📽️
  - LGR
  - This Does Not Compute
  - Userlandia
  - The Serial Port
  - RetroBytes
  - Laptop Retrospective
- Podcasts 🎙️
  - DOS Game Club
  - Stay Forever 🇩🇪

ThinkPad-Museum Podcast

- Published every **~4 weeks**
- Focuses on history and the present day
- News, models, techniques and personalities
- **Interactive** format, guests welcome!
- Available wherever podcasts are available™
  - Feed, fyyd, Apple Podcasts, Spotify

Image sources

- C64
- ZX Sepctrum 48K
- DOS-Shell
- Windows 95
- Windows ME
- EEE PC
- Intel 486 SX2
- Intel 486 DX2 OverDrive
- 5 GHz Project
- AMD DIE
- Dallas DS12B887
- Dallas Rework
- 486er Battery
- Gardena to USB
- USB Logo
- COMDEX 1998 - Windows 98
- XKCD 927 - Standards
- MCA
- XT, ISA, EISA
- Itanium logo
- Itanium forecasts
- Nero screenshot
- Torvalds/NVIDIA
- OS/2
- X.Org logo
- Wayland logo
- IE Toolbars
- Web Fail
- Windows 3.1 Hotdog Stand theme
- Trash icon
- iOS 6 vs 7
- Windows Phone 7
- Skeuomorphism
- Spicy Battery

Thank you for your attention