

A Tale of six motherboards, two BSDs and coreboot



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About me

- a fan of free and open source software and hardware solutions
- I run*BSD systems on coreboot
- I look for other open source hardware
- a sysadmin at datacenter
- maintainer of FreeBSD ports

OpenBSD

- KISS philosophy
- Best manpages seen in UNIX-like world
- Only two RCE vulnerabilities so far
- Very stable, the most stable UNIX-like OS I've seen
- Released twice a year, so it has newer software than your grandma's Debian
- Works great on ThinkPads

OpenBSD

- Security features incubator – many features are later ported to other systems
- Secure by default – security must not be optional, it needs to be enabled by default
- ASLR – the 1st OS to enable it
- W^X
- X11 not running as root

OpenBSD

- Set of programs written by OpenBSD developers, unhappy of the de facto standard software
- OpenNTPd vs ntpd
- LibreSSL vs OpenSSL
- OpenSSH
- OpenSMTPd, OpenOSPFd, OpenBGPd, doas, OpenBSD httpd...
- The list goes on

FreeBSD

- The OS itself has fixed releases, but there is one, rolling release ports tree for all releases – you can have new software on old release
- With ports tree, you can easily make your own repo with changed default versions of software
- E.g. PHP 7.1 (instead of 5.6), MariaDB 10.2 (instead of MySQL 5.6) and LibreSSL (instead of OpenSSL)
- Very high level of customizability – only Gentoo wins in this matter
- Number of ports in the tree is huge – over 25000

FreeBSD

- ZFS:
- Snapshots,
- Compression,
- Deduplication,
- Checksums,
- a combination of file-system and volume manager,
- Supported installation on /

FreeBSD

- Jails
- A method of paravirtualization / containerization
- There's no overhead, you can easily get hundreds of jails on one host
- Great method to separate different services or make standardized containers



OPENSOURCE

**WHAT IS THE WORST THAT CAN
HAPPEN?**

makeameme.org

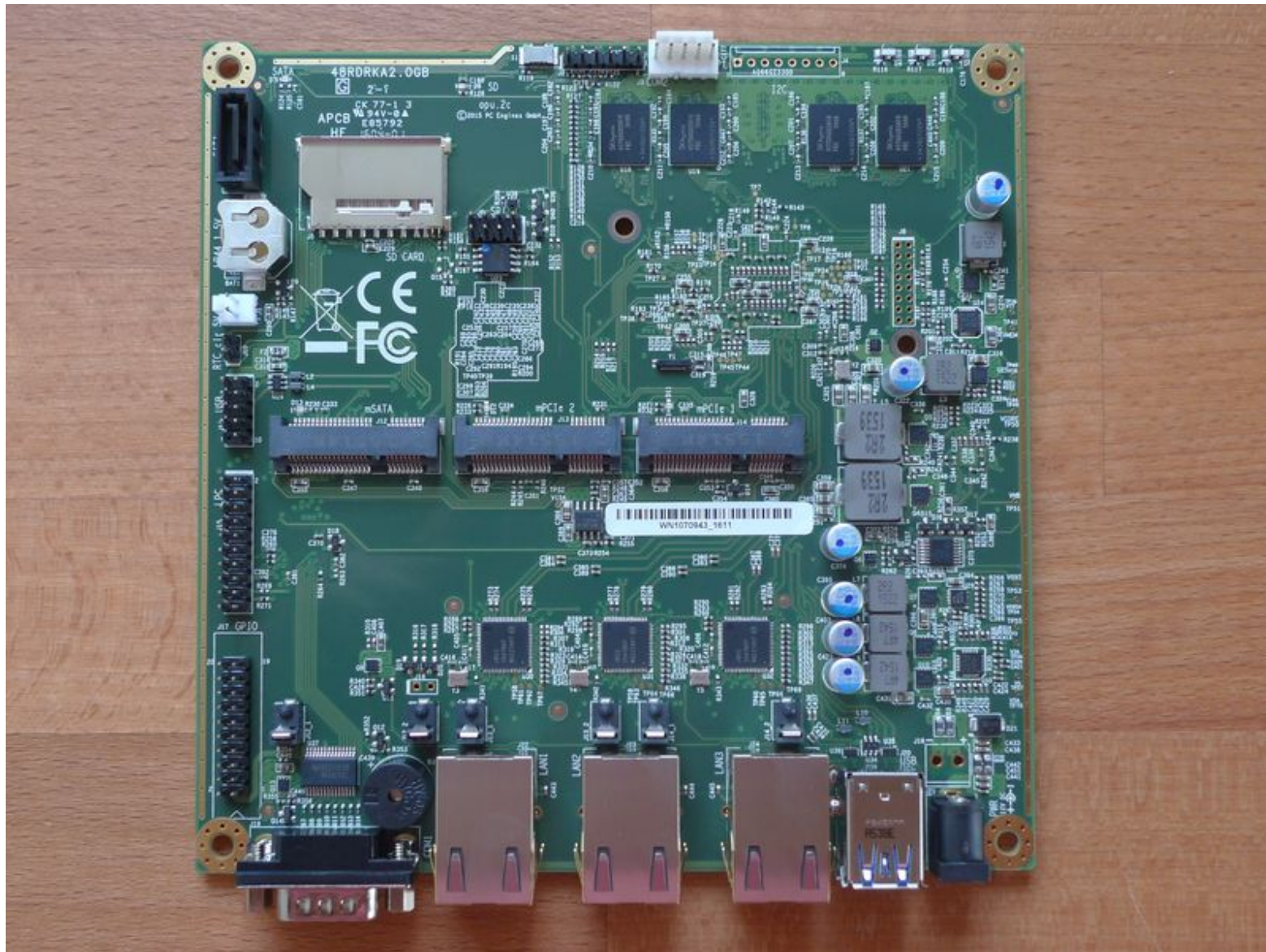
Tested motherboards

- PC-Engines APU2
- ThinkPad X200
- ASRock E350M1
- ASUS KGPE-D16
- ASUS F2A85-M with GT650Ti GPU
- ThinkPad X230

Encountered problems (coreboot-specific)

- FreeBSD doesn't support controlling fans
- There was a work to hardware sensors framework from OpenBSD
- Committed at <https://lists.freebsd.org/pipermail/cvs-src/2007-October/082381.html>
- Reverted a day later due to a complaint from one FreeBSD dev (!)
- Higher TDP on *BSD, which caused additional cooling problem

PC-Engines APU2



PC-Engines APU2

- Actually, not very interesting
- coreboot is installed out-of-the-box, so the vendor had to make sure it works fine with the most popular systems
- So all BSD's work, there are no problems.
- PC-Engines sells SPI recovery boards, so hardware flash in case of bad ROM is not necessary.

ThinkPad X200



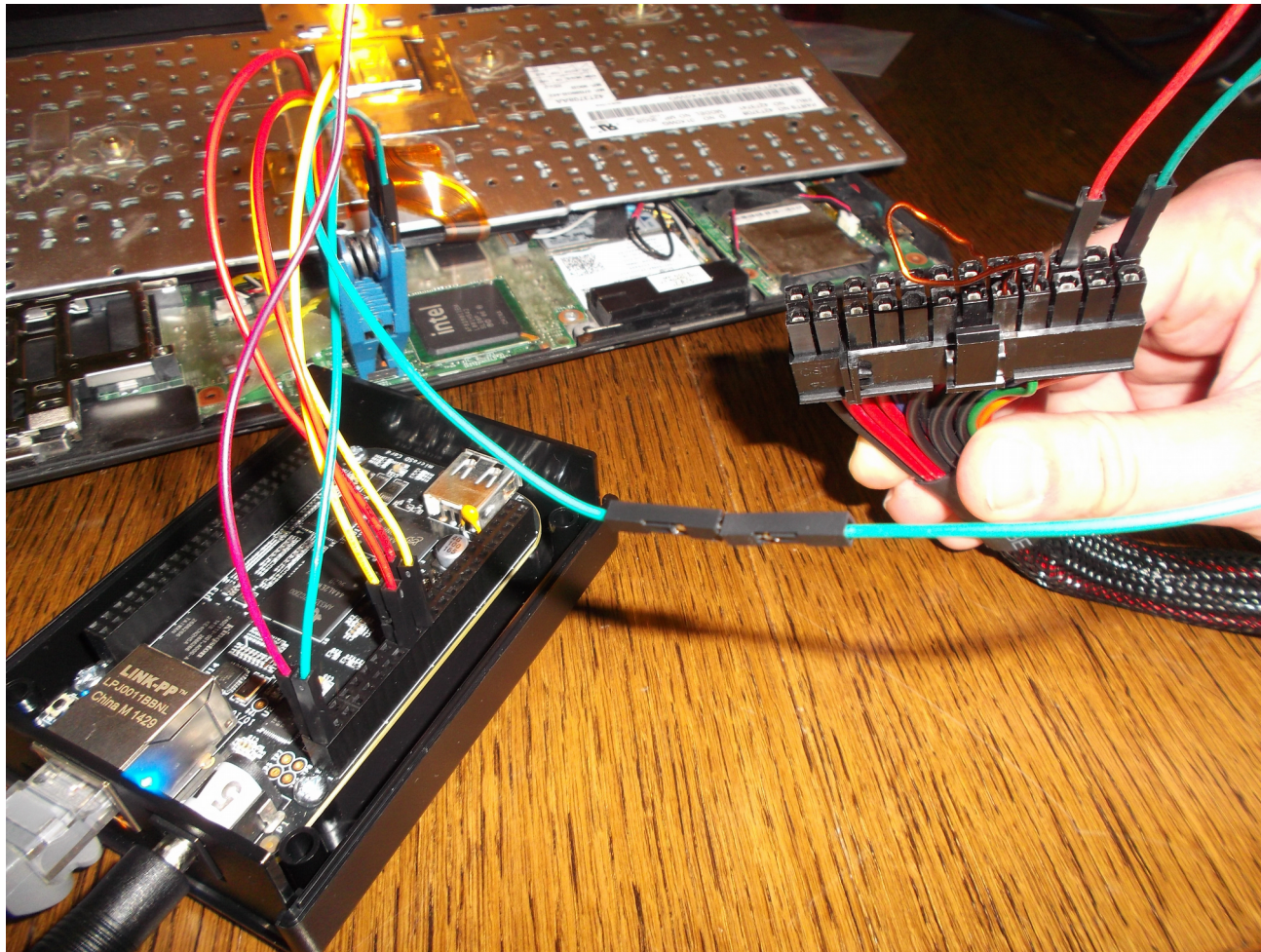
ThinkPad X200

- (Almost) everything works great here
- It's my main PC now that my desktop is broken now
- One issue (not *BSD-specific, also encountered on Linux) with suspend and resume
- FreeBSD doesn't support controlling your fans so X200 ends up either overheated or it's loud

ERRATA: Turns out the dusty fan was a problem here. After cleaning up, the problem is gone. Other problems remain.

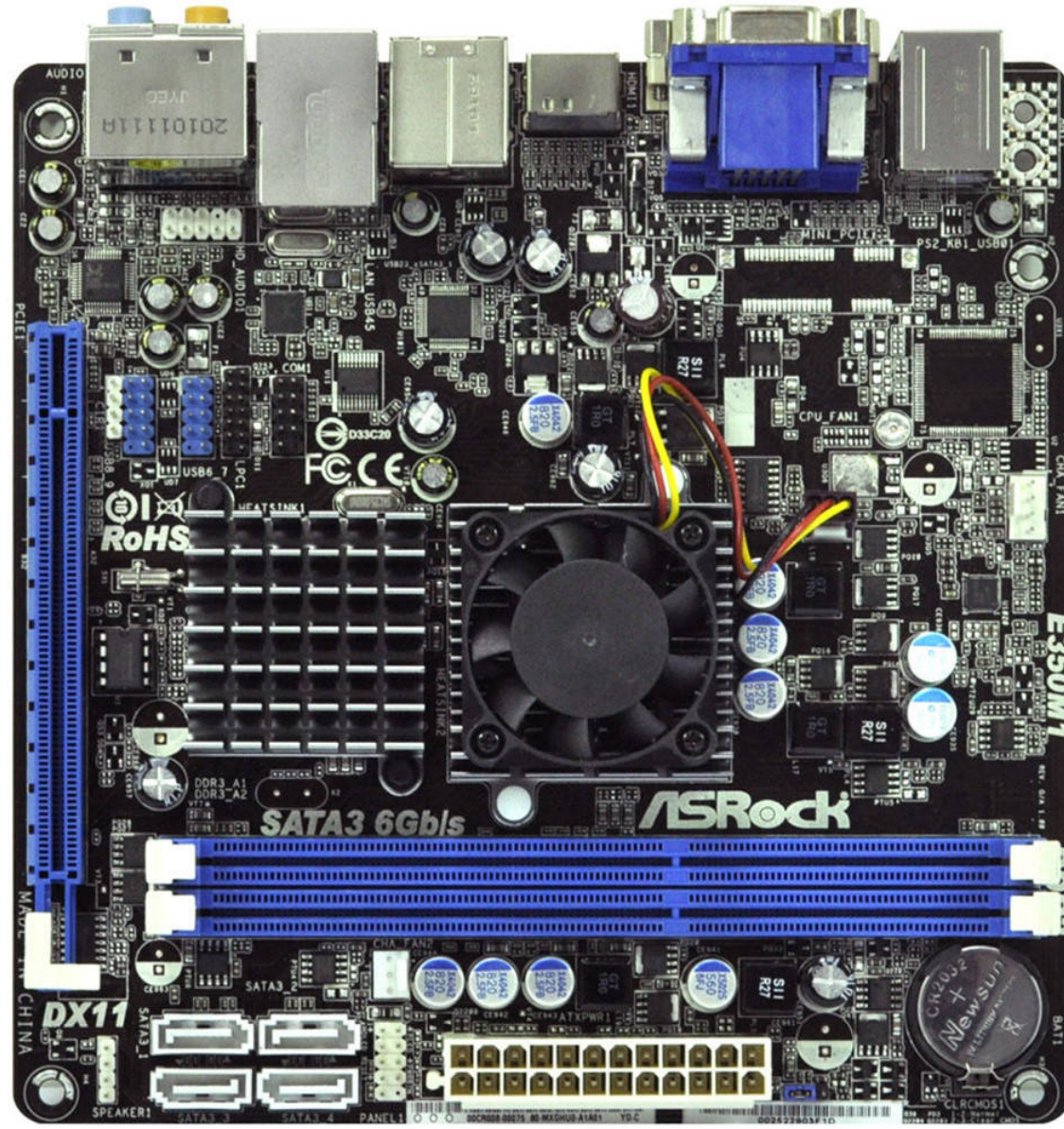
- That's this particular PC I use for our presentation.

Hardware flashing (X200)



There are movies on Youtube with us doing the flashing on Koci Świat ASD channel.

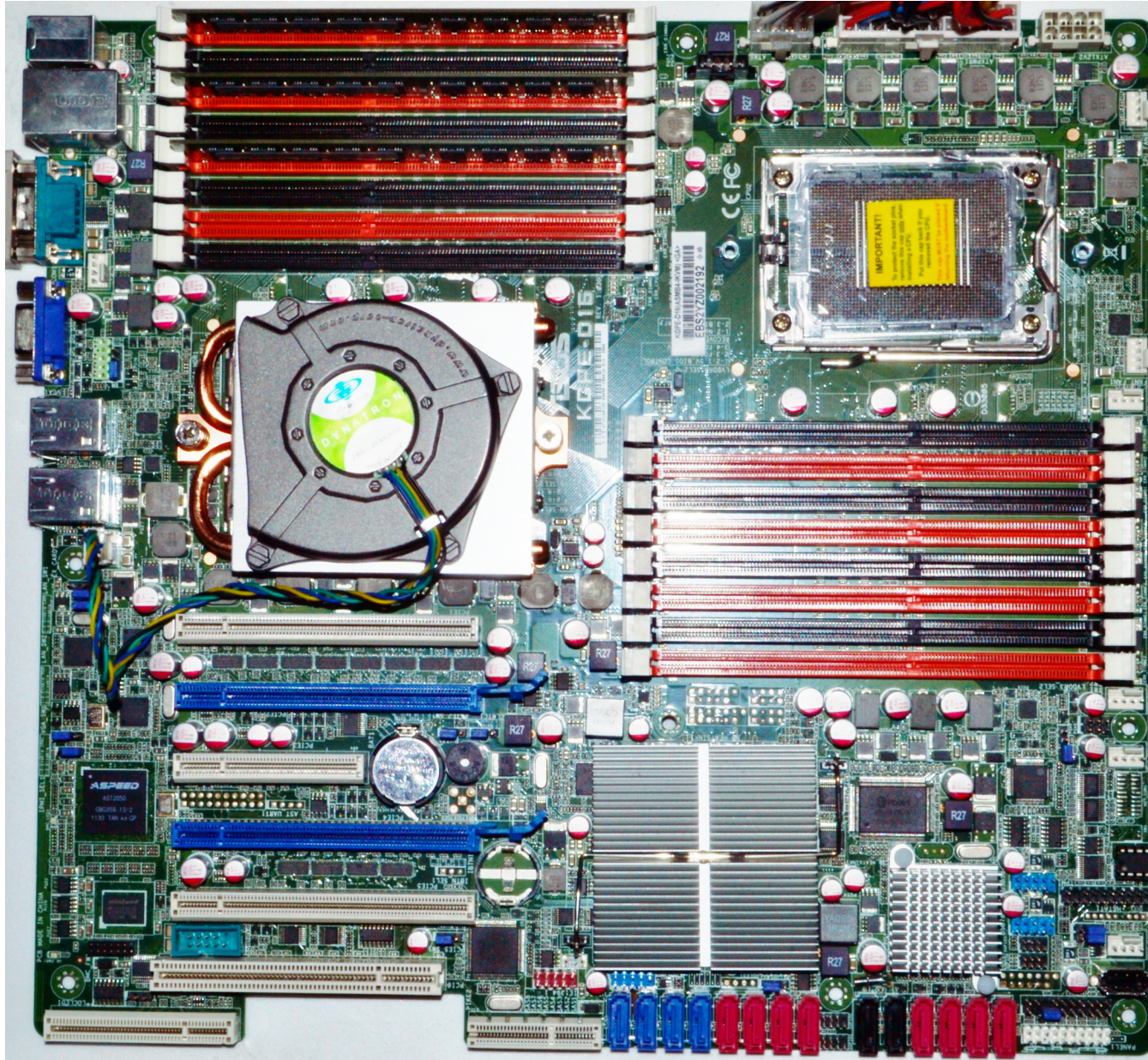
ASRock E350M1



ASRock E350M1

- It's possible to automate fan control at the hardware level with the southbridge – needs a firmware extracted from UEFI ROM file and works only for the CPU fan
- That means it won't have problems with running FreeBSD on it (unless you want to control chassis fans)!
- Turns out FreeBSD and OpenBSD work great!
- Pretty nice board for a small home server or a HTPC

ASUS KGPE-D16



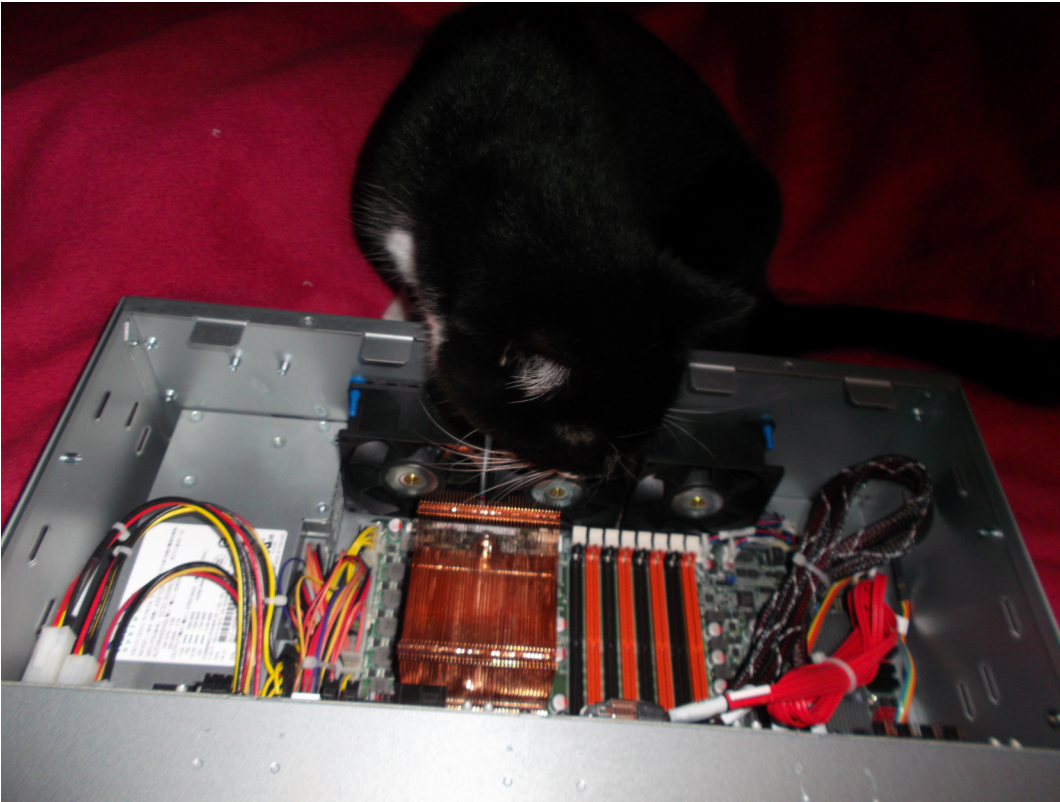
ASUS KGPE-D16

- coreboot causes higher TDP
- Most reports are for Linux, turns out on *BSD it's even higher
- That causes serious overheating, CPUs reach 90C in max. 20 minutes after which the motherboard powers off
- Can be worked around by additional cooling
- Another issue is probably related to C-states
- When CPU starts some work, the system spontaneously reboots
- C-states need to be disabled in the CMOS

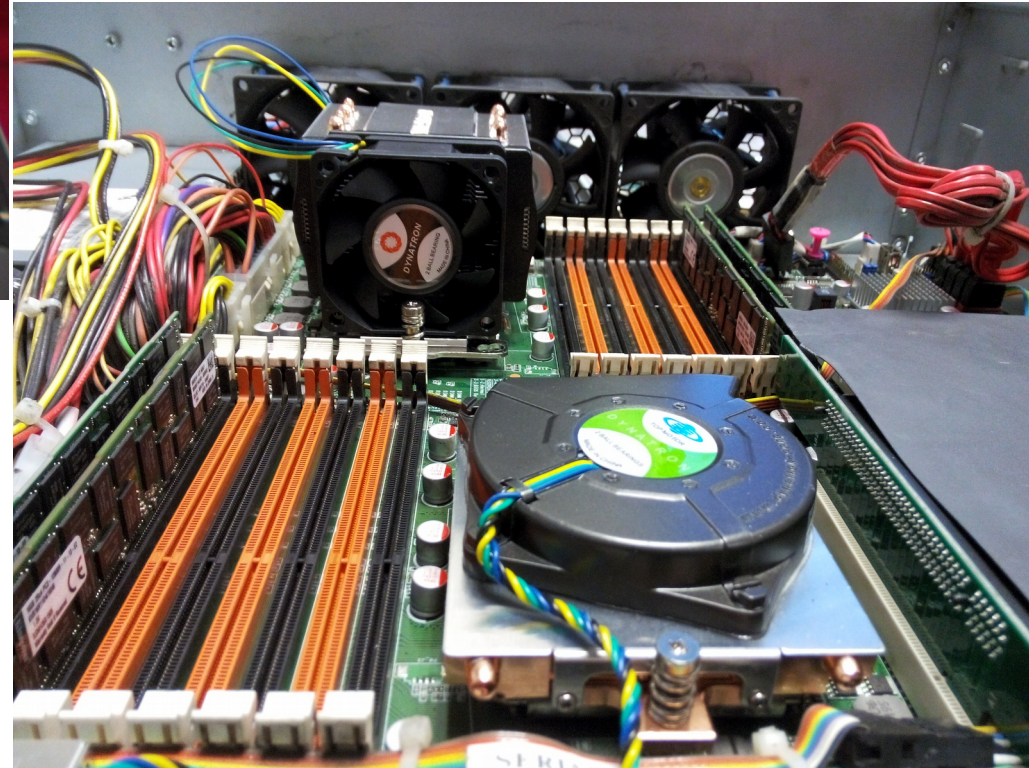
ASUS KGPE-D16

- After that, FreeBSD and OpenBSD work fine, we couldn't test NetBSD
- coreboot sets fans at boot-time to 100%, so temperatures with FreeBSD are fine
- Recent development by @tpearson and Raptor of OpenBMC stack for KGPE-D16 make BMC and controlling fans available, making this motherboard ready for serious remote usage

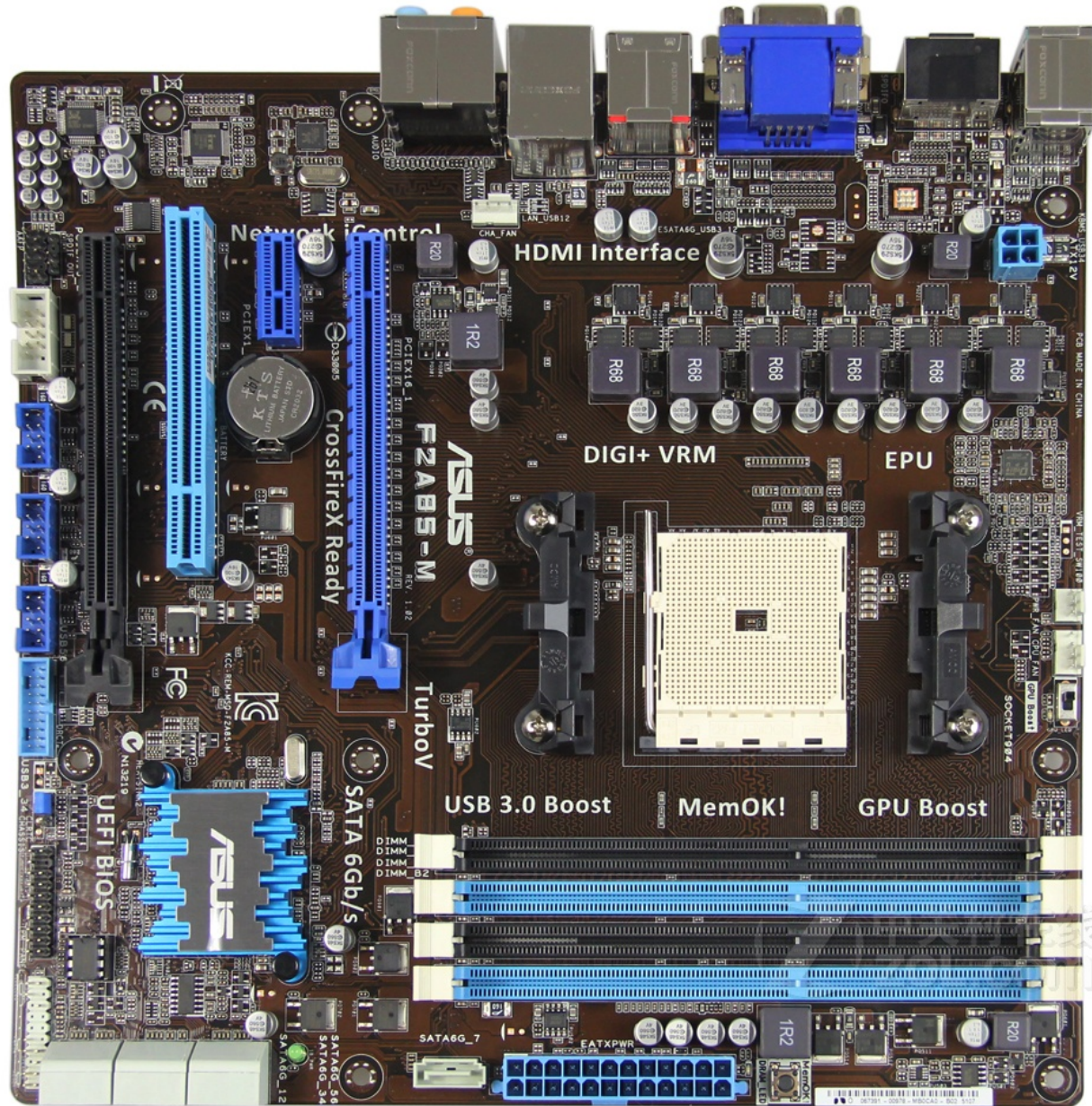
Old and new cooling



Yeah, the cat wasn't enough.



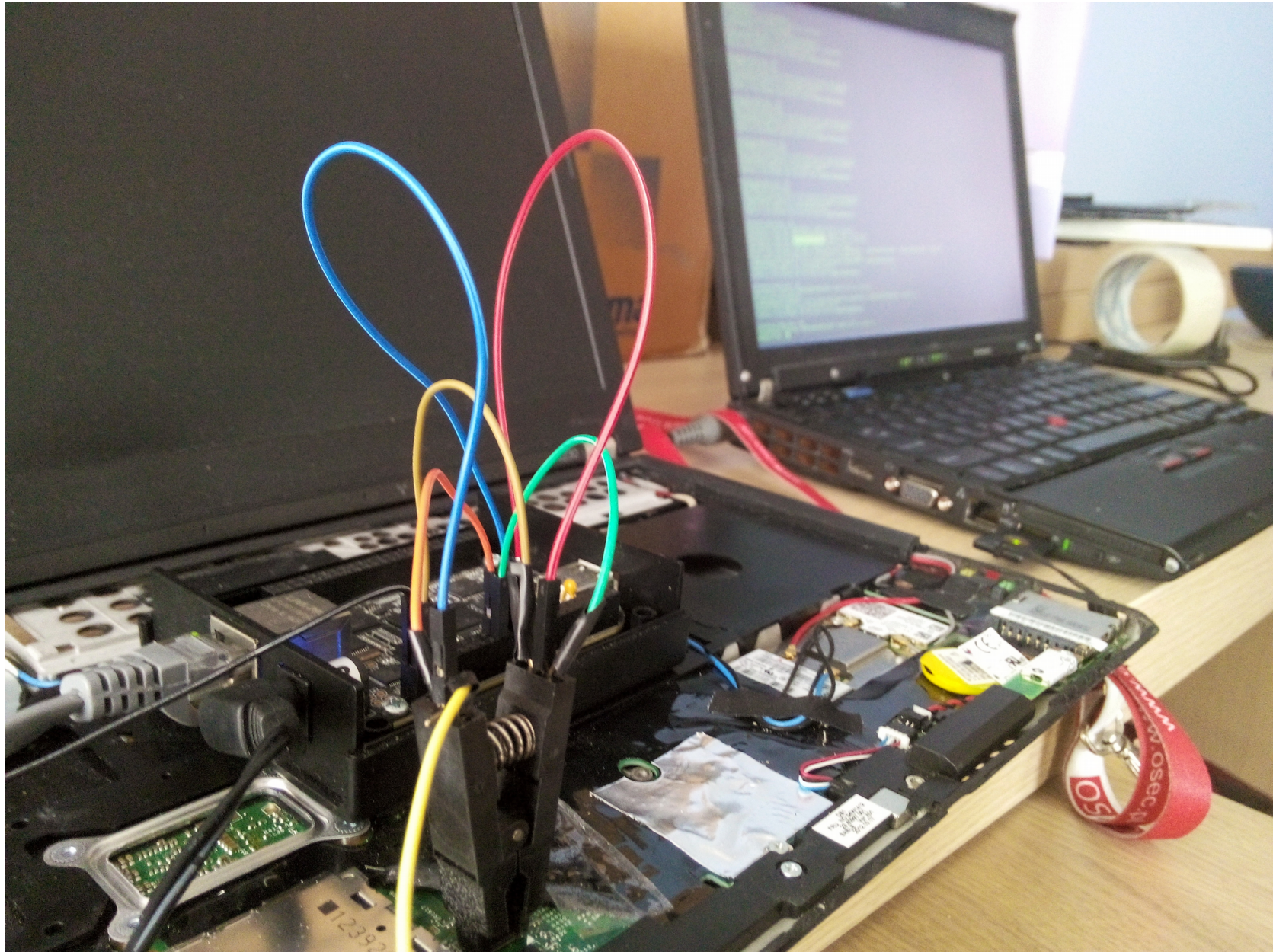
ASUS F2A85-M



ASUS F2A85-M

- OpenBSD just works^(TM)!
- FreeBSD has a serious cooling problem
- Since you can't control the fans on FreeBSD, the system shuts down when doing some work
- Additionally, after booting the system, there's no video console output, only serial works
- Starting X11 works and you can use the system (until you start e.g. compilation)

ThinkPad X230





OOPS

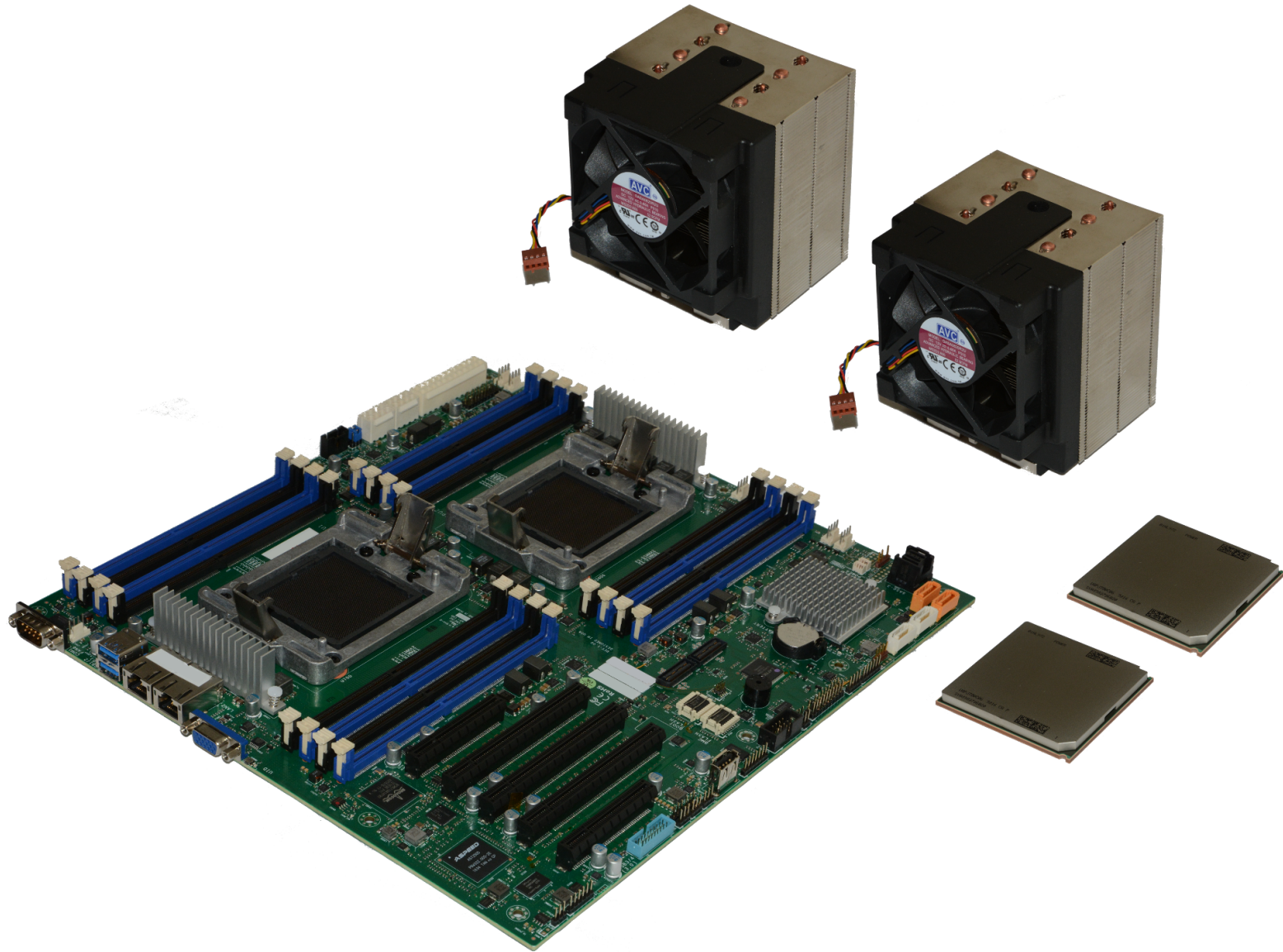
Why it burned

- After our experiences with X200, we decided to make our own, small 3.3V PSU
- I couldn't get a proper ROM image
- Some guy on the IRC suggested using the Lenovo PSU
- Don't trust the random guys on the Internet
- The board was fried, but the seller was kind to accept it for the warranty replacement, thank you!
- I was afraid to make another try.

Alternatives

- Novena – fully open ARM board
- Turris Omnia – open source ARM router
- You can try other coreboot motherboards, although x86 is a dead end

TALOS II



TALOS II

- Uses IBM POWER9 CPUs
- Fully open down to microcode and BMC stack
- Cheap for the specs - \$2850 for the dual CPU + board bundle
- Max. 2 CPUs with max. 24 cores each (each core running 4 threads, giving a total of 192 simultaneous threads)
- Max. 2TB RAM
- I know at least two FreeBSD developers buying this motherboard with the intention of porting FreeBSD on it
- Can make a powerful workstation, a server or a enterprise router

Questions



Thank you!

