POWER architecture support on FreeBSD

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Piotr Kubaj

Who am I

- FreeBSD user for the past 13 years (since 8.0-RELEASE),
- Professionally, first Linux sysadmin, then Linux & FreeBSD driver validator, now a FreeBSD driver developer,
- Firm supporter of FOSS, including open-source firmware (on any architecture),
- Always interested in alternative architectures, but wishing both something modern and with open-source firmware,
- Became interested in POWER9 through the coreboot community and got a hardware grant from FreeBSD Foundation and a remote server for development from Raptor Computing Systems (POWER9 boards vendor),
- My other interests are bicycling and Japanese language, movies and literature.

Why POWER?

- Performance-competetive alternative to ARM, AMD and Intel,
- With POWER8 – mostly open-source firmware,
- With POWER9 – full open-source firmware (with select boards),
- Unfortunately, POWER10 requires blobs – rumored to have been caused by COVID due to IBM having been forced to outsource some work due to people working remotely,
- Community hopes that POWER11 will go back to POWER9's level of opensourceness,
- Better performance than any RISC-V board while with much better desktop support and 100% FOSS firmware, which RISC-V lacks,
- Similar to ARM in terms of software support.

What do we run on?

- 32-bit Apple Macs “New World” – on FreeBSD it’s powerpc architecture,
- Freescale evaluation boards – also powerpc, but also some powerpcspe,
- Amiga A1222 – powerpcspe, very rare board,
- Amiga X5000, IBM POWER servers, Playstation 3, Raptor Computing Systems boards, Tyan POWER8 servers, Apple Mac G5 – all can run powerpc64,
- All the machines running POWER8 and newer can also run powerpc64le,
- Pseries platform (virtualized POWER running e.g. on Linux / KVM) also works great.

Is it good enough for desktop?

- On Linux ppc64le (being the platform which most users use):
- Firefox works – however no JIT, JIT is currently WIP,
- Chromium works with unofficial patchset which Google doesn’t want to commit, but it’s anyway in all the major distros,
- Go, Rust, Haskell etc. all work,
- 3D acceleration works with both old radeon driver and the newer amdgpu,
- Open-source games (like 0ad, gzdoom, supertuxkart etc.) work,
- LibreOffice works,
- There is work on Wine with amd64 emulation – arm64 people are also interested,
- Linux amd64 work with Box64,
- KVM virtualization works great,
- Server bits are no issue, as IBM takes care of that.

Has anything happened since the last talk?

- Move to newer ABI on powerpc64,
- Introduction of powerpc64le port,
- Move of all powerpc* to LLVM and subsequent introduction of OpenMP, LLDB and sanitizers,
- Many new drivers: ixl, ice, irdma, mpr, mrsas, wlan, ath, mlx5, aacraid, virtio,
- Ported drm-kmod,
- Radix (new MMU) supported – better performance on POWER9,
- OpenSSL assembly routines added to the base system and upstreamed (about 20x speedup in various benchmarks),
- Many performance optimizations.

What about FreeBSD?

The FreeBSD Project — Mozilla Firefox

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FreeBSD-SA-23:03.openssl

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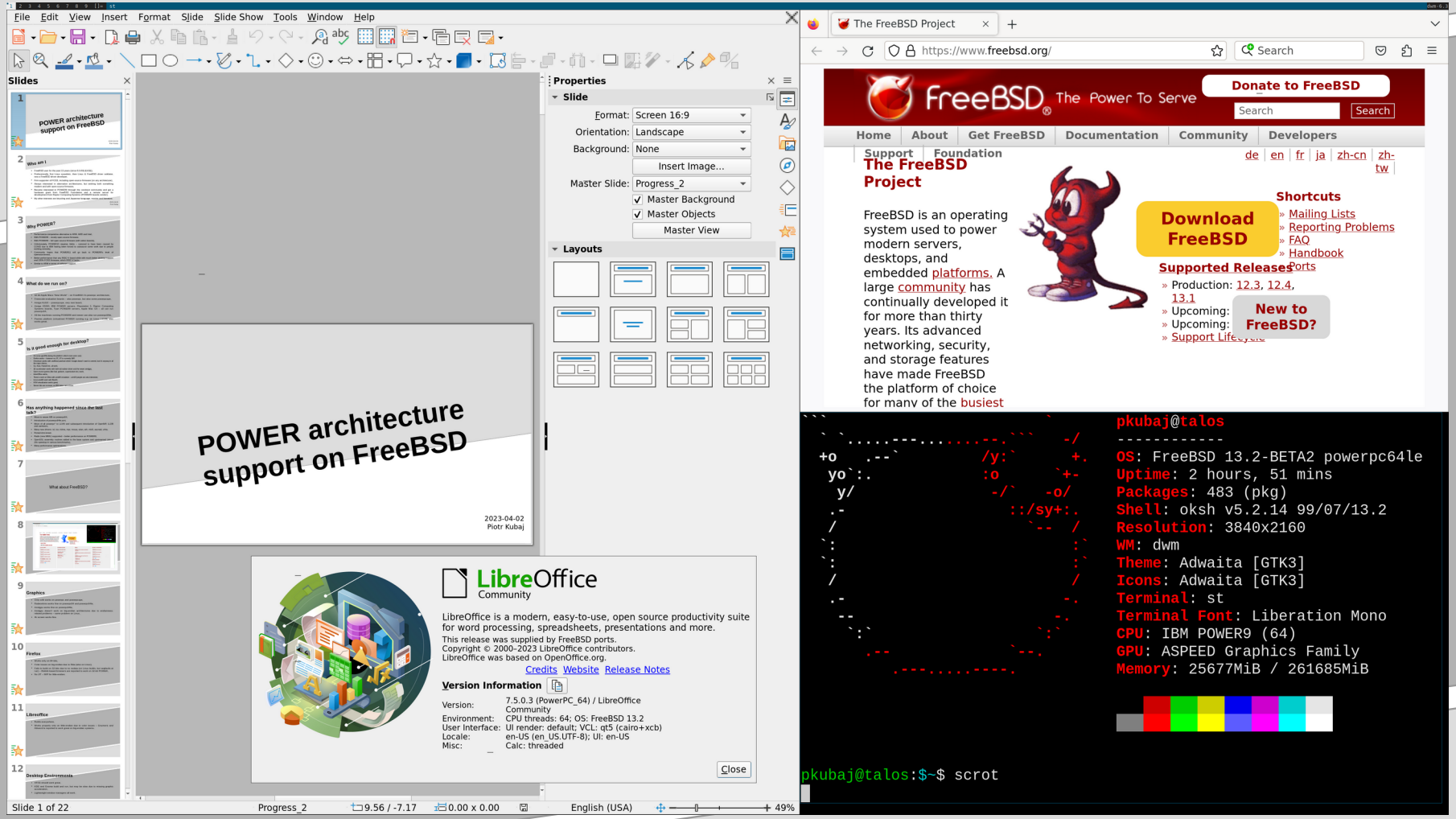
```
pkubaj@talos:$~$ neofetch
                                    pkubaj@talos
  ` `.....---.....--.```   -/       ------------
 +o   .--`         /y:`      +.     OS: FreeBSD 13.2-RC1 powerpc64
 yo`:.            :o      `+-     Uptime: 8 hours, 26 mins
  y/               -/`   -o/      Packages: 662 (pkg)
 .-                  ::/sy+:.     Shell: oksh v5.2.14 99/07/13.2
 /                     `--  /     Resolution: 3840x2160
 `:                          :`   WM: dwm
 `:                          :`   Theme: Adwaita [GTK3]
 /                           /    Icons: Adwaita [GTK3]
 .-                         -.    Terminal: tmux
  --                        -.    CPU: IBM POWER9 (64)
   `:`                    `:`     GPU: ASPEED Graphics Family
     .--                `--.      Memory: 24381MiB / 261685MiB
        .---.....----.
pkubaj@talos:$~$
[1] 1:oksh*                                  "talos" 19:06 16-Mar-23
```


File Edit View Insert Format Slide Slide Show Tools Window Help
Slides
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Properties
Slide
Format: Screen 16:9
Orientation: Landscape
Background: None
Insert Image...
Master Slide: Progress_2
Master Background
Master Objects
Master View
Layouts
LibreOffice
Community
LibreOffice is a modern, easy-to-use, open source productivity suite for word processing, spreadsheets, presentations and more.
This release was supplied by FreeBSD ports.
Copyright © 2000-2023 LibreOffice contributors.
LibreOffice was based on OpenOffice.org.
Credits Website Release Notes
Version Information
Version: 7.5.0.3 (PowerPC_64) / LibreOffice Community
Environment: CPU threads: 64; OS: FreeBSD 13.2
User Interface: UI render: default; VCL: qt5 (cairo+xcb)
Locale: en-US (en_US.UTF-8); UI: en-US
Misc: Calc: threaded
Close
Slide 1 of 22
Progress_2
9.56 / -7.17
0.00 x 0.00
English (USA)
49%
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New to FreeBSD?
pkubaj@talos
OS: FreeBSD 13.2-BETA2 powerpc64le
Uptime: 2 hours, 51 mins
Packages: 483 (pkg)
Shell: oksh v5.2.14 99/07/13.2
Resolution: 3840x2160
WM: dwm
Theme: Adwaita [GTK3]
Icons: Adwaita [GTK3]
Terminal: st
Terminal Font: Liberation Mono
CPU: IBM POWER9 (64)
GPU: ASPEED Graphics Family
Memory: 25677MiB / 261685MiB
pkubaj@talos:$~$ scrot

Graphics

- Only scfb works on powerpc and powerpcspe,
- Radeonkms works fine on powerpc64 and powerpc64le,
- Amdgpu works fine on powerpc64le,
- Amdgpu doesn’t work on big-endian architectures due to endianness-related problems – same problem on Linux,
- 4k screen works fine.

Firefox

- Works only on 64-bits,
- Color issues on big-endian due to Skia (also on Linux),
- Fails to build on 32-bits due to no nodejs (on Linux builds, but segfaults at run) – Webkit-based browsers are reported to work on 32-bit POWER,
- No JIT – WIP for little-endian.

Libreoffice

- Builds everywhere,
- Works properly only on little-endian due to color issues – Gnumeric and Abiword is reported to work great on big-endian systems.

Desktop Environments

- XFCE should work great,
- KDE and Gnome build and run, but may be slow due to missing graphic acceleration,
- Lightweight window managers all work.

OpenJDK

- OpenJDK 8, 11, 17, 18 and 19 in the ports tree,
- Bootstraps available for 8, 11 and 17, which are the current LTS versions,
- Uses JIT code on 64-bits,
- Not yet available on FreeBSD / powerpc, but on 32-bits only the portable zero backend is available on 32-bit POWER anyway, which is slow.

Rust

- Works fine on all except for powerpcspe,
- On powerpcspe a gcc package would be necessary because of libatomic dependency, but gcc removed support for SPE and gcc 8 (the last supported) doesn’t build,
- On powerpc gcc also needs to be used for libatomic linking,
- Many ports use ring crate, which doesn’t work on powerpc* at all (also on Linux) – upstream is not responsive about this issue,
- On powerpc, many ports use old libc crate, but FreeBSD / powerpc support has only been introduced in 0.2.102, thus they need to be patched.

Package support

- The package builders we had previously broke in April 2021,
- Although new package builders were available, apparently no one knew how to set them up and there were various hardware issues,
- New package builders using Talos II boards have been set up in December 2022,
- There are two machines – one for big-endian (powerpc and powerpc64) and one for little-endian (powerpc64le),
- Packages are currently being built for powerpc, powerpc64 and powerpc64le on 13.1-RELEASE for quarterly branch and 14.0-CURRENT for main branch – meaning 6 package sets in total,

What’s missing?

Go

- WIP branch on Github,
- Can’t be upstreamed, because it’s not bootstrappable – built go binaries can’t compile themselves because of weird errors,
- No one knows how to fix it.

Graphics acceleration

- No graphics acceleration on 32-bits with scfb,
- No graphics acceleration on 64-bits with radeonkms on powerpc64 due to test error while loading the driver and on powerpc64le the acceleration needs to be manually disabled to not cause checkstop error.
- No graphics acceleration on 64-bits with amdgpu – using the acceleration causes checkstop errors,
- fpu_kern(9) is necessary.

No DRM on powerpc64

```
<6>[drm] radeon: irq initialized.
[drm ERROR :cik_ring_test] radeon: ring 0 test failed
(scratch(0x3010C)=0xCAFEDEAD)
drmn0: disabling GPU acceleration
```

fpu_kern(9)

- Needed to enable using SIMD in the kernel,
- Would probably allow using graphics acceleration,
- Would also improve ZFS performance, which currently needs SIMD disabled,
- Would also allow to easily port ossl(4).

Loader for PowerNV

- Currently on PowerNV (POWER8 and POWER9 bare-metal) kernel is loaded directly from Petitboot,
- Ignores /boot/loader.conf,
- ZFS needs to be builtin in the kernel to allow root on ZFS,
- Same for GELI.

What is it currently good for?

- Headless server – provided it’s not a VM host (KVM guest is fine though), but the system itself is very stable,
- Development system – GCC, GDB, LLDB, Clang with OpenMP (on 64-bits) all work,
- For desktop – only alpha level – proof of concept,
- Basically the OS is stable for wide range of use, but its performance is quite low in comparison to Linux.

Thank you!