GNU/Hurd DDE
userland device drivers

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It's all about freedom #0

"The freedom to run the program, for any purpose"

I.e.:

- Freedom from sysadmin!
  - WTH is fdisk/mke2fs/... hidden in /sbin?
  - I should be able to just work with my disk/network access
- Freedom to innovate
  - Experimental filesystem, personal work-flow, new kind of process combination,...

- Also provide freedom from misbehaving programs and drivers

It's all about freedom #0

From: xxx <xxx@yyy.fr>

Subject: Network expertise

Date: Thu, 31 Jan 2013 12:37:34 +0100

[…] Would it be possible to route to my VPN the traffic of only one application?

Actually, also well-known classical issue of full-VPN: traffic of the VPN itself shouldn't go through the VPN!

And yet, here root capabilities!!

Spoiler: Yes, GNU/Hurd can already do it. Without even asking root.

It's all about freedom #0

Extensibility for the user

- Mount one's own files
  - Access archives content
  - Access remote files
  - Experiment with filesystems
- Access one's own network
  - Access remote networks / VPN
  - Access virtual machine network
- Redirect one's sound
  - Through network
  - Sound effects
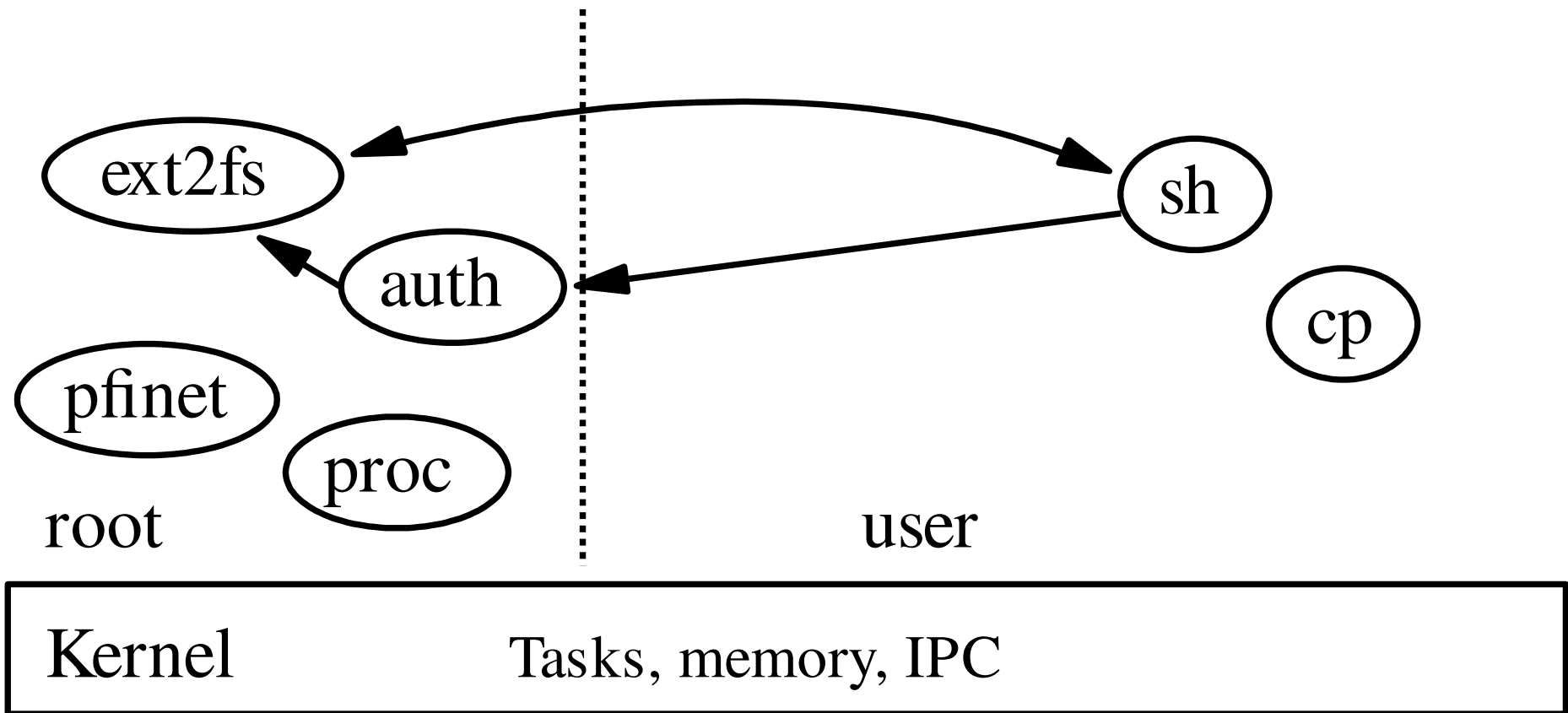 - Recording
- …
- and Flexible hardware support

Outline

- Hurd architecture Overview

- Network flexibility

- DDE stack

- Console support

- Hardware support

- Releases & future

Micro-kernel layering

ext2fs

auth

pfinet

proc

sh

cp

root

user

Kernel   Tasks, memory, IPC
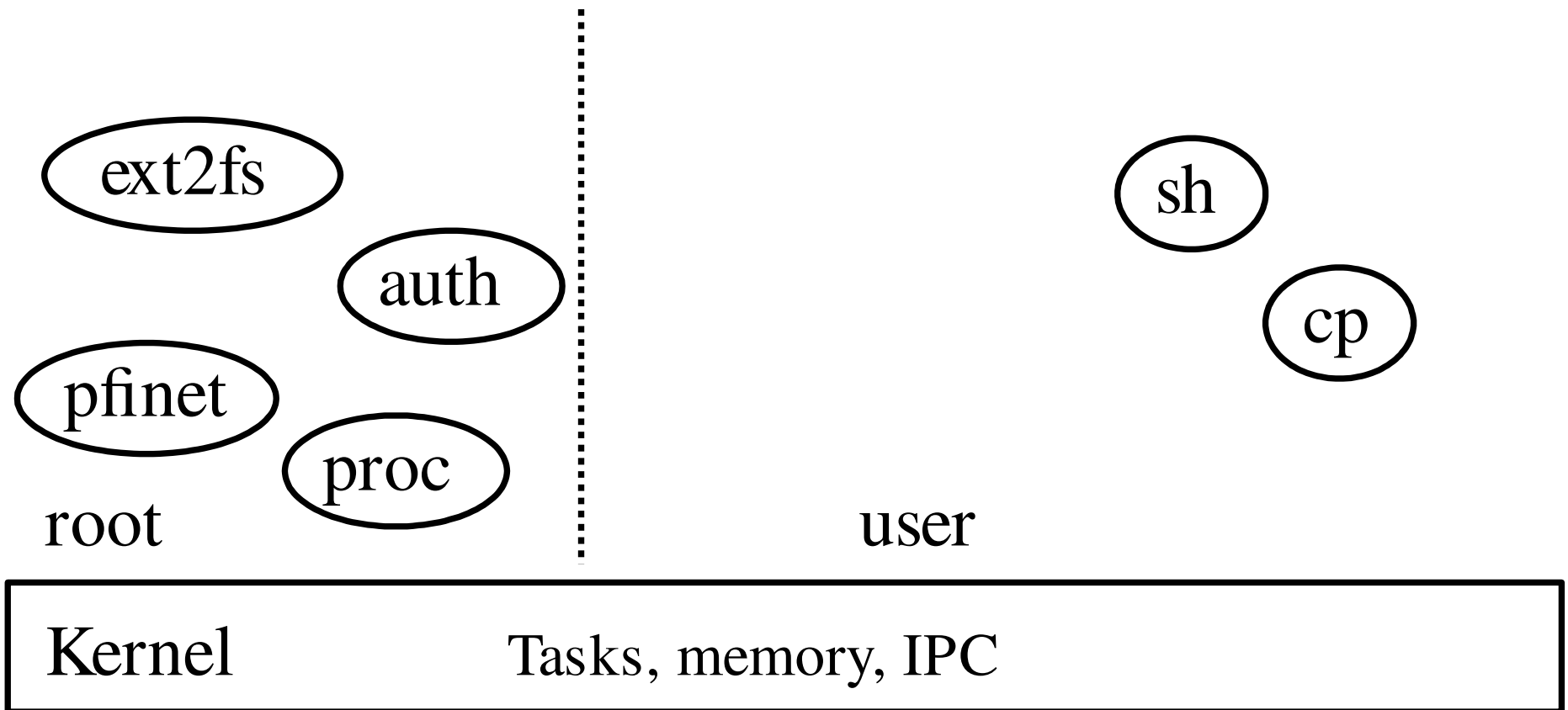
Micro-kernel layering

Micro-kernel layering

- Server crash? Not a problem

  - "Computer bought the farm" is just an error, not something-of-the-death

- Easier to debug/tune

  - Just run gdb, gprof, …

- Can dare crazy things

  - The Hurd console has dynamic font support

    – See chinese support in pseudo-graphical mode (actually pure VGA textmode!) of Debian installer.

- Kernel only handles Tasks, memory, IPC

Hurd possibilities
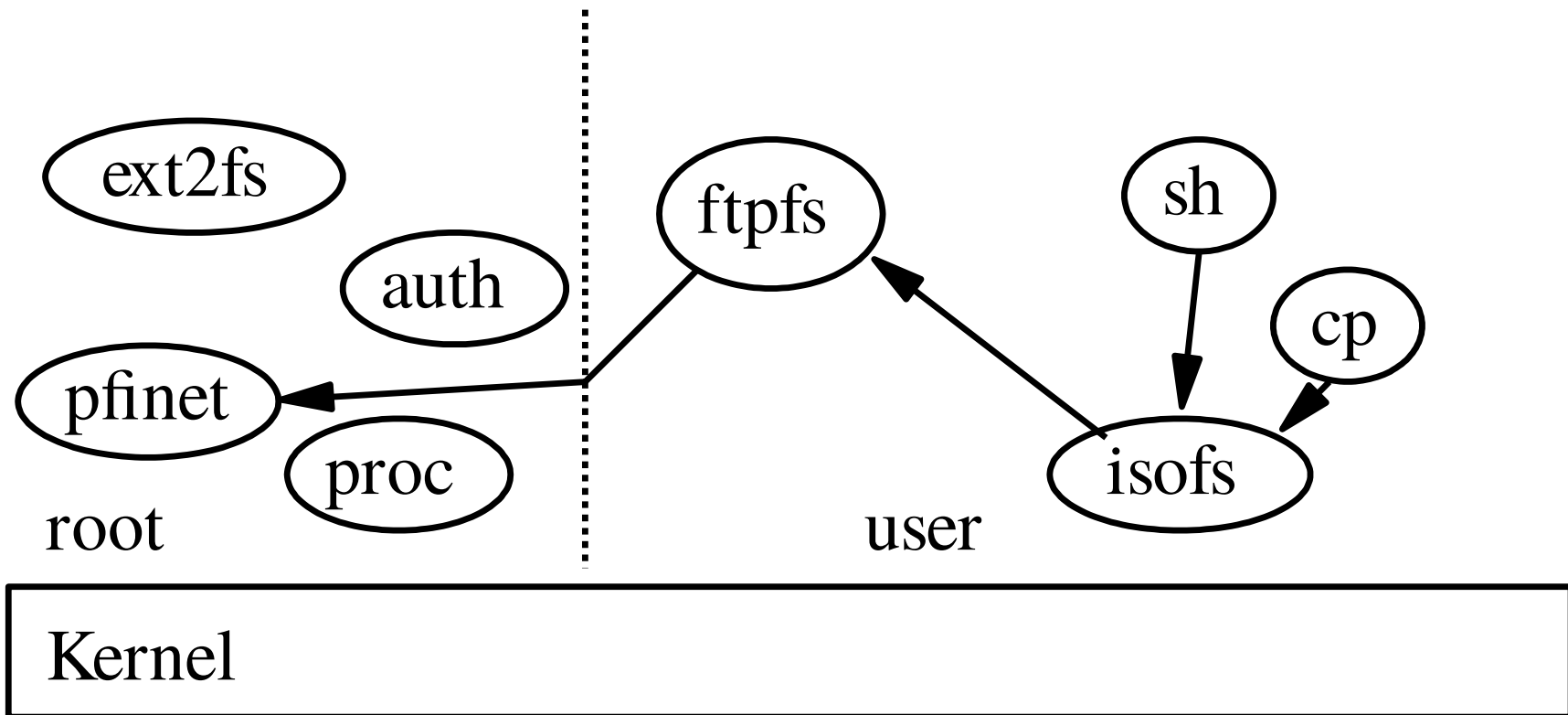
Hurd possibilities

```
€ settrans -c ~/ftp: /hurd/hostmux /hurd/ftpfs /

(just once for good)

€ settrans -a ~/mnt /hurd/iso9660fs
~/ftp://ftp.gnu.org/old-gnu/gnu-f2/hurd-F2-main.iso

€ ls ~/mnt

README-or-FAIL

…
```
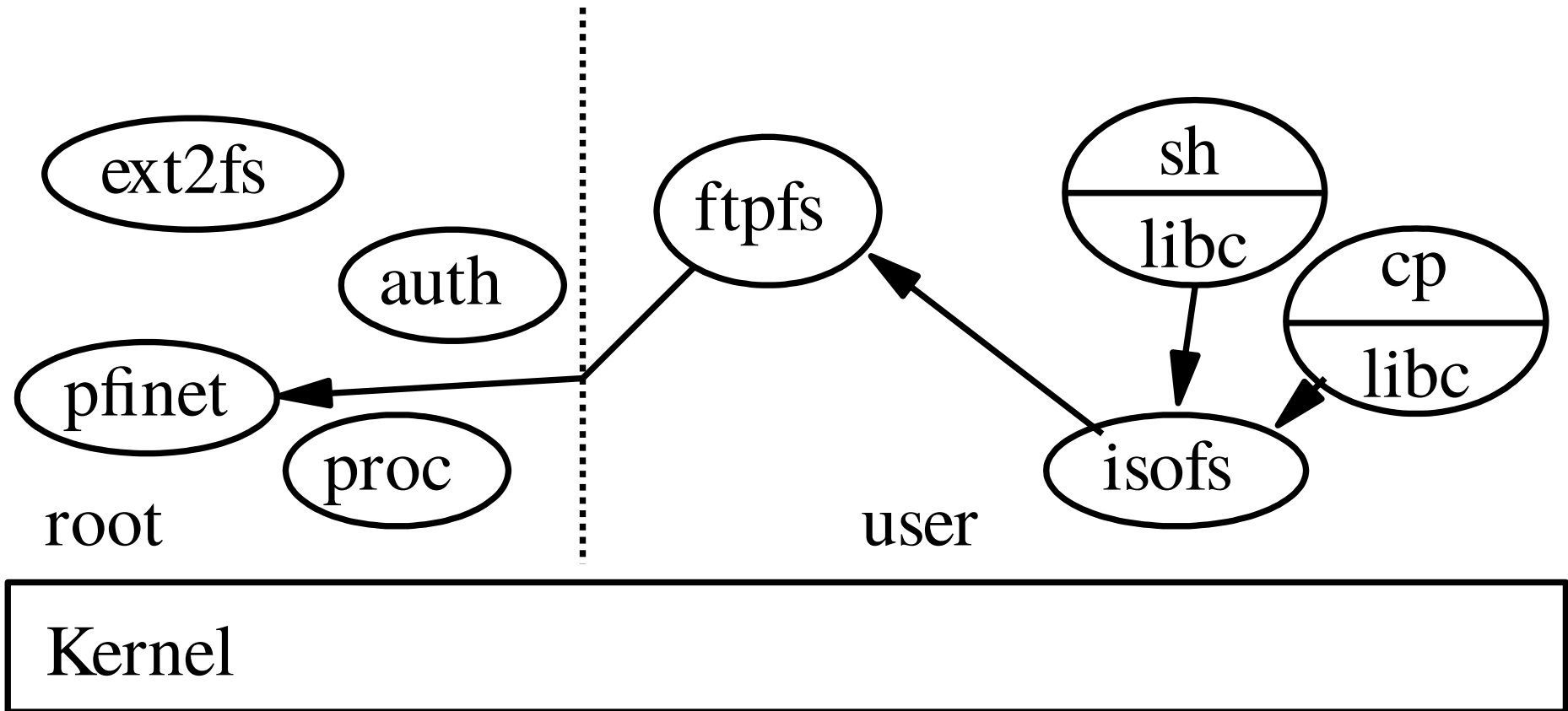
- Only downloads what is needed.
- Can be permanently stored in ext2fs

```
€ settrans ~/.signature /hurd/run /usr/games/fortune
```

How does it work?

Rationale

- **Everything** is an (interposable) RPC

- Translators exposed in the FS

- The user gets to decide what/how to interpose

  - Without need for costly ptrace or fragile libc symbols interposition.

  - **Native** fakeroot/chroot

  - Fully virtualized and fine-grained interface

- Just need to use what's provided by the admin, e.g.

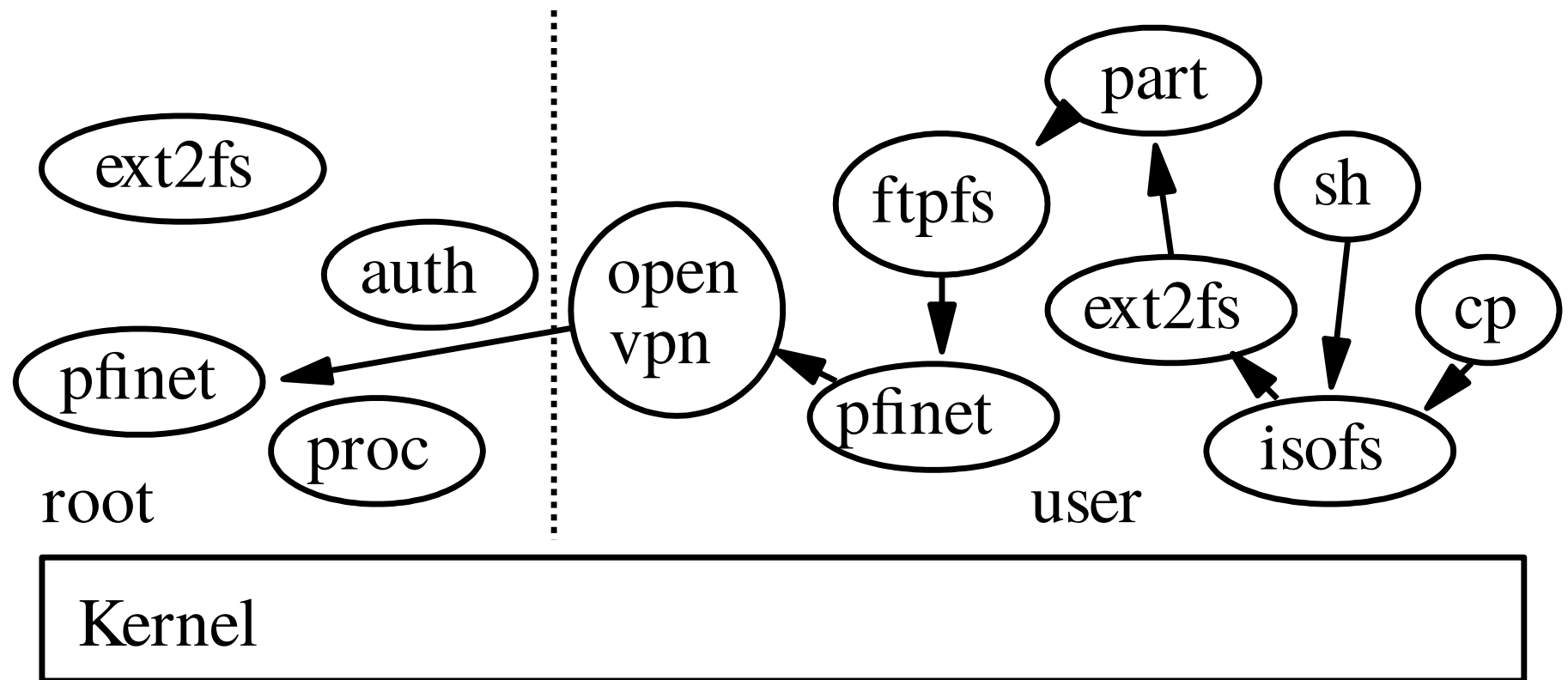 - $HOME/

  - TCP/IP stack

  and pile over it

But also

€ `~/remap/remap.sh /bin/sh $HOME/bin/sh`

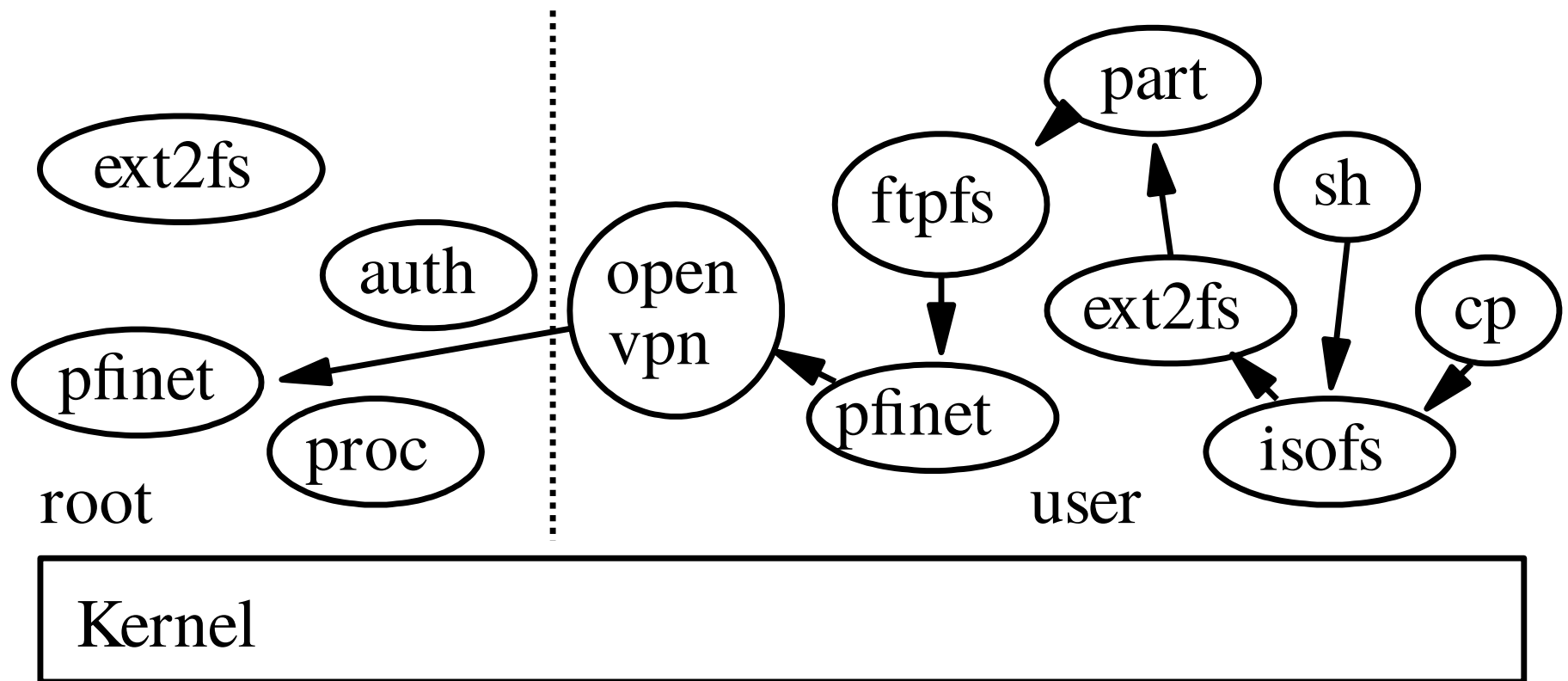€ `~/remap/remap.sh /bin $HOME/unionbin`

…

- Check out Stow/Nix/Guix!
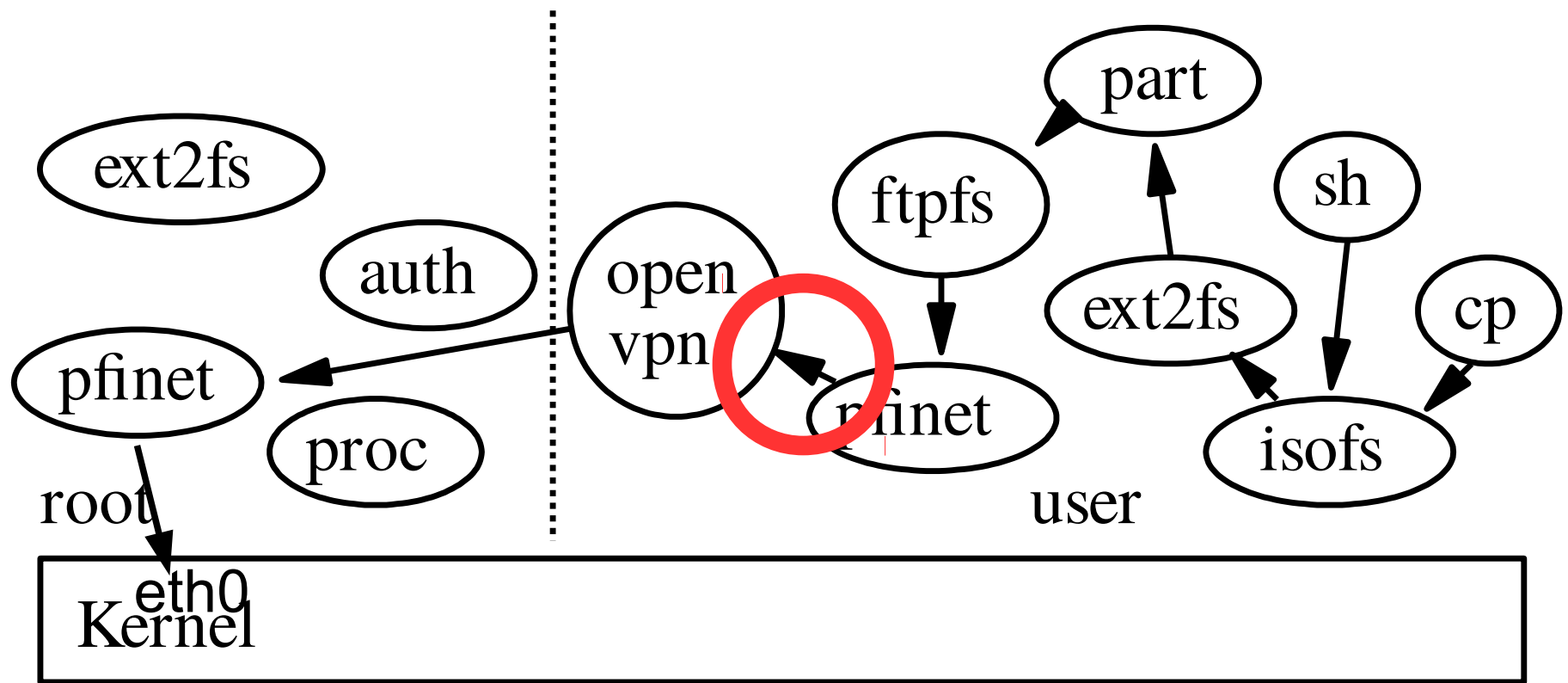
Hurd possibilities (cont'ed)

Hurd possibilities (cont'ed)

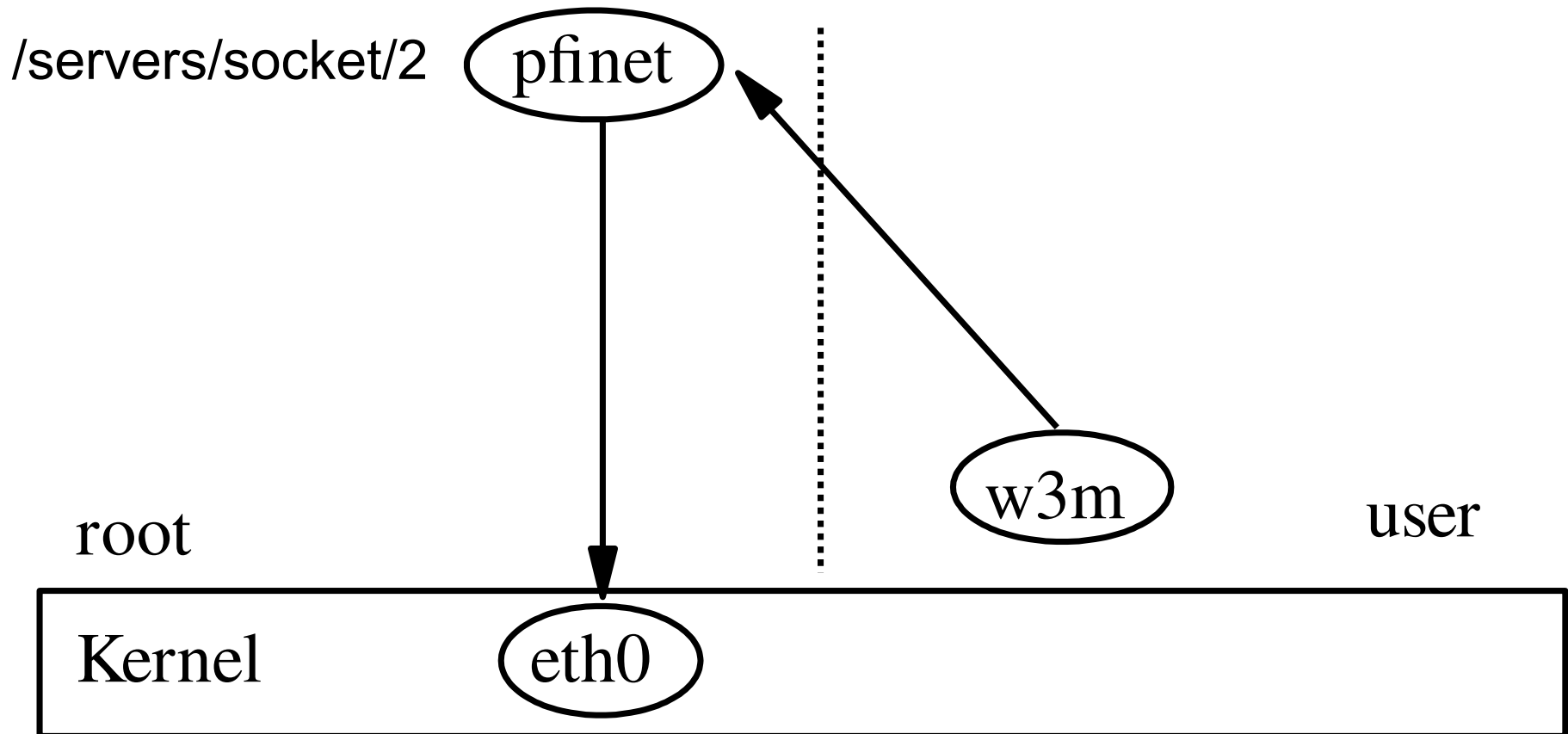i.e. ISO image inside a partitioned disk image
on ftp over a VPN

Hurd possibilities (cont'ed)

i.e. ISO image inside a partitioned disk image
on ftp over a VPN

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Hurd userland network support

/servers/socket/2 pfinet

root

user

Kernel eth0

w3m

Hurd userland network support

pfinet

DDE layer
Linux 2.6.32 drivers
/dev/eth0

root

eth0

w3m

user

Kernel

Hurd userland network support

Hurd userland network support

/servers/socket/2   pfinet   openvpn   ~/servers/tun0

eth-filter   pfinet   ~/servers/socket/2

eth0   w3m

root   user

Kernel
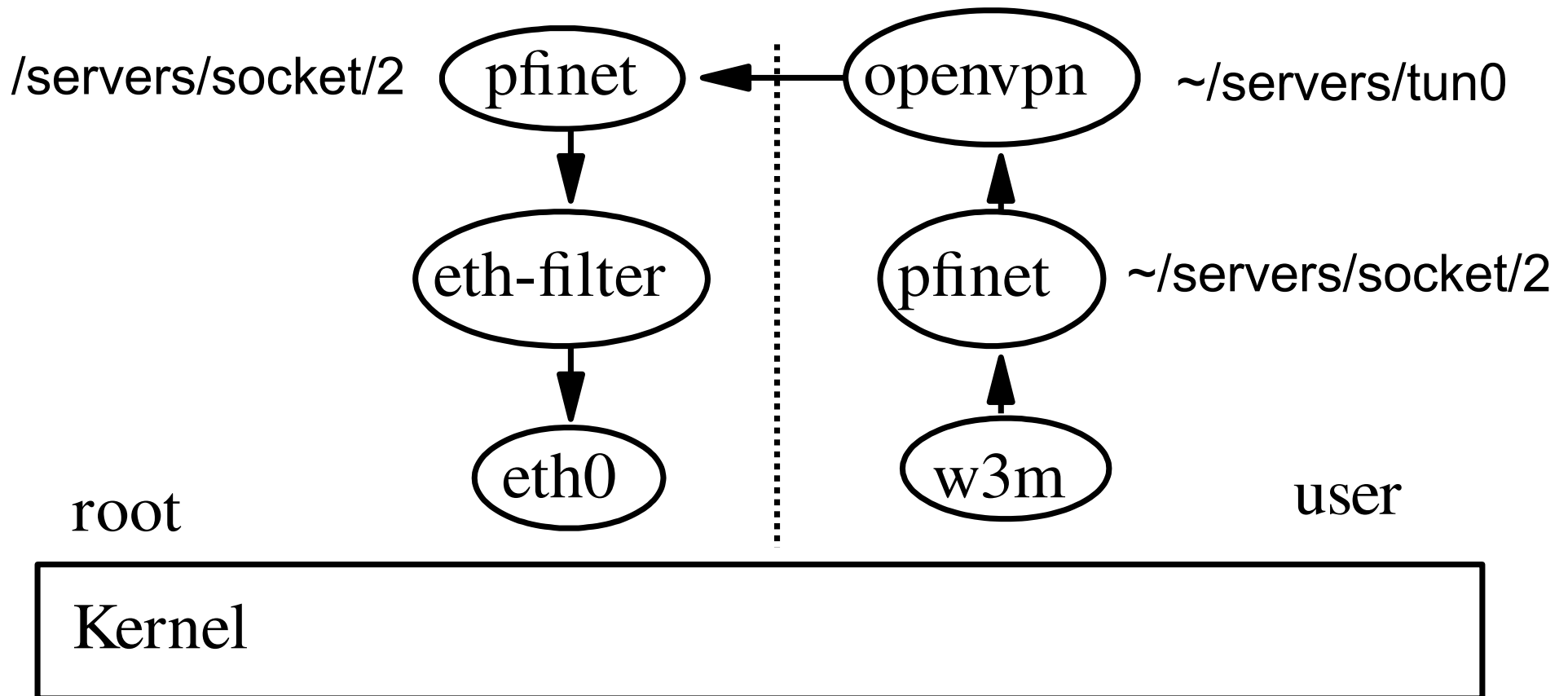
Hurd userland network support

```
€ settrans -ca ~/servers/socket/2              \
      ~/bin/pfinet -i ~/servers/tun0          \
      -a 80.67.176.254 -p 80.67.179.1
€ vpn.sh &
€ ~/remap/remap.sh                              \
      /servers/socket/2 ~/servers/socket/2    \
      /etc/resolv.conf ~/resolv.conf
€€€ wget www.gnu.org
```

- My own translators
- Only wget accesses my pfinet (well, the shell too :))

DDE stack

Based on TU-Dresden's DDE stack

- Zheng Da's GSOC
- Ported to Mach kernel
- Ported to Mach device interface
- Updated libdde_linux26 for long-term-supported linux 2.6.32
    - Most drivers (and mostly the really useful ones) just work without patches
    - We should cooperate on upgrading that part
- Used by default by Debian GNU/Hurd

DDE stack
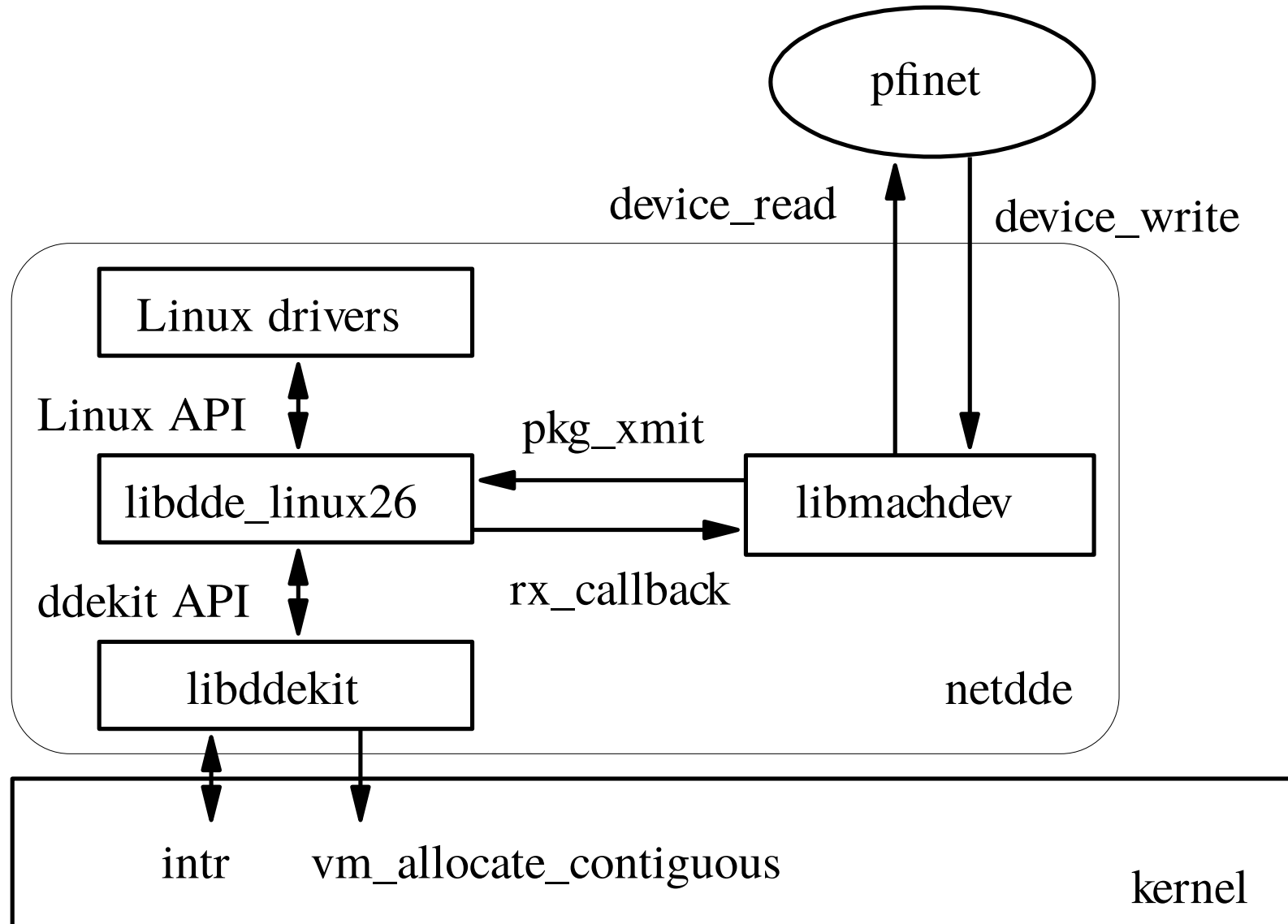
DDE stack

- Only two additions to the kernel
  - Interrupt delivery and masking
  - Physically-contiguous memory allocation
  - (Direct I/O access was already available)
- Performance similar to in-kernel driver
- Driver in a separate process
  - Can just crash and be happy with it...
  - Can easily debug and profile them
  - Stack smashing protection ;)
  - Could benefit from I/O MMU for better isolation.
    - For now drivers can just access all RAM...

More DDE?

- Disk DDE is supposed to be working
  - Should be not very complex
    - device_read / device_write
  - Zheng Da said he didn't manage to make it work
- USB/sound DDE was mentioned as experimental
  - I don't know the status?
  - We would definitely love to have that
- Rather use Rump kernels?

Hurd userland console support

Modular design similar to screen

- Server running virtual ttys and gettys on them
- Client with drivers
  - Keyboard + mouse + VGA,
  - or ncurses,
  - or whatever

Hurd userland console support

Keyboard driver

- Gets keyboard/mouse events from kernel

- Translation done through xkb

  - No need to maintain our own keymaps any more

Hurd userland console support

VGA driver

- Directly drives VGA board in VGA text mode
- 256/512 dynamic glyphs support
  - 32-126 static ASCII characters for compatibility
  - Other glyphs dynamically allocated from BFD font
  - GNU greets user!
- Double-width glyph support
  - Can print kanjis in text mode!

Recent software support

- GCJ, GNAT

- Gcc go: ongoing GSOC, issues with its own thread implementation

- Fixed lots of testsuite failures (perl, python, ...)

  - POSIX corners

  - Around the 99% figure now

- Languages for translators

  - Now using libpthread → python, perl, whatever...

Current State

Hardware support

- i686

- start of 64bit support

  - Kernel boots completely, now missing RPC 32/64bit translation

- DDE Linux 2.6.32 drivers layer for network boards

  - In userland netdde translator!

- IDE, Xorg, …

- AHCI driver for SATA (up to 2TiB disk support btw)

  - Needs more testing, perhaps bug fixing (no trouble on qemu)

- Xen PV domU

  - Required GNU Mach changes only

- No USB, no sound yet

Current State

Software support

- Quite stable
  - Have not reinstalled boxes for years.
  - Debian buildds keep building packages, usually hang after some weeks, out of some remaining memory leak.
- ~79% of Debian archive builds out of tree
  - XFCE, almost gnome, almost KDE
  - Firefox (aka iceweasel), gnumeric, …
- Standard *native* Debian Installer

Releases

- Nice 0.401 release on April 2011.

- Arch Hurd LiveCD release on August 2011.

- Released Debian-unofficial wheezy/sid snapshot CDs on May 2013 \o/

- Hurd 0.5 released on 2013 Sept 27th \O/

  - Just in time for GNU's 30th birthday!

Future work

- Xen PVH support, X86_64 support

- Language bindings for translators

- Read-ahead

- {hdd,sound,usb}dde?

- GNU system: Guix/Hurd?

- Debian GNU/Hurd Jessie?

- Your own pet project?

Thanks!

- http://hurd.gnu.org/

- http://www.debian.org/ports/hurd/

- http://people.debian.org/~mbanck/debian-hurd.pdf

- The increasing irrelevance of IPC performance for microkernel-based Operating Systems

  http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.37.9653&rep=rep1&type=pdf