

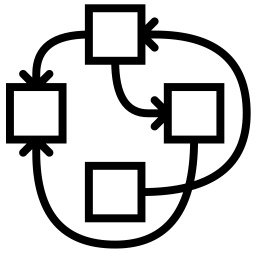
The GNU/Hurd architecture, nifty features, and latest news

Samuel Thibault

2013 February 2nd

Inria



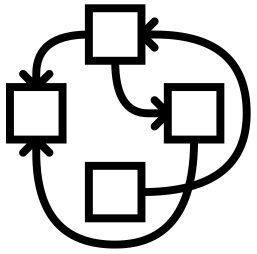


It's all about freedom #0

“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



It's all about freedom #0

From: xxx <xxx@yyy.fr>

Subject: Network expertise

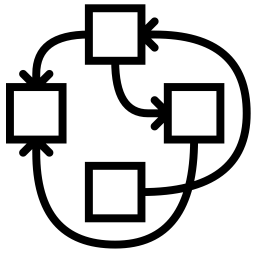
Date: Thu, 31 Jan 2013 12:37:34 +0100

[...] 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!!

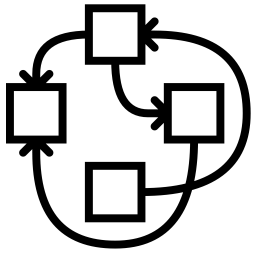
Spoiler: Yes, GNU/Hurd can already do it. Without asking root.



It's all about freedom #0

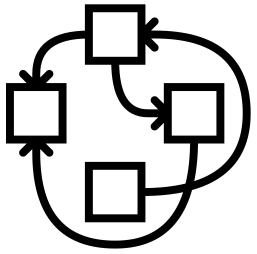
Extensibility for the user

- 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
- ...

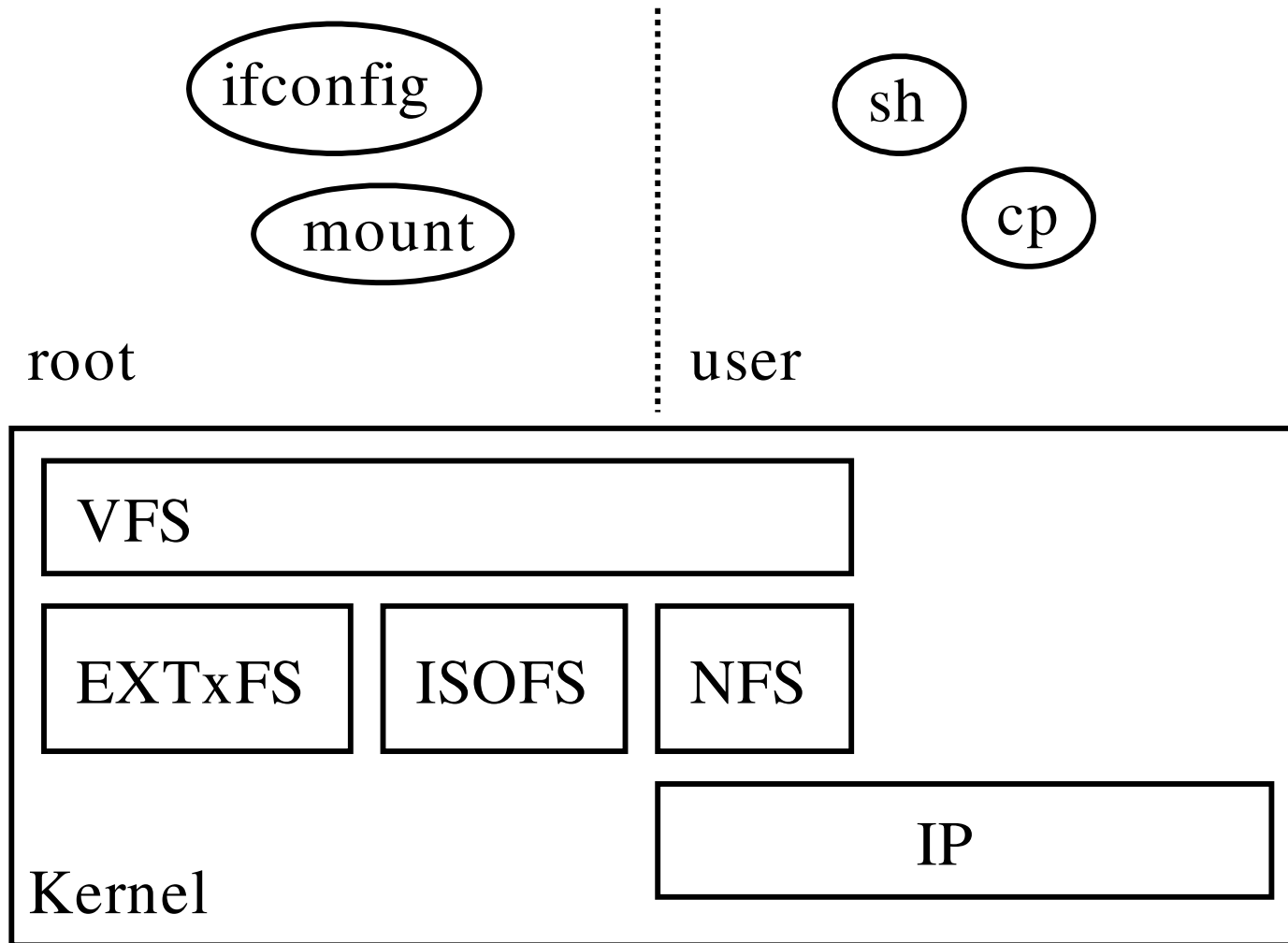


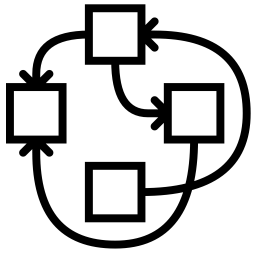
Outline

- Monolithic/Gvfs/FUSE/micro-kernel layering
- Hurd layering
- Hurd nifty features
- Present and future



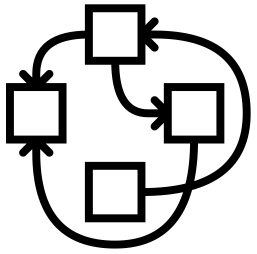
Traditional monolithic layering



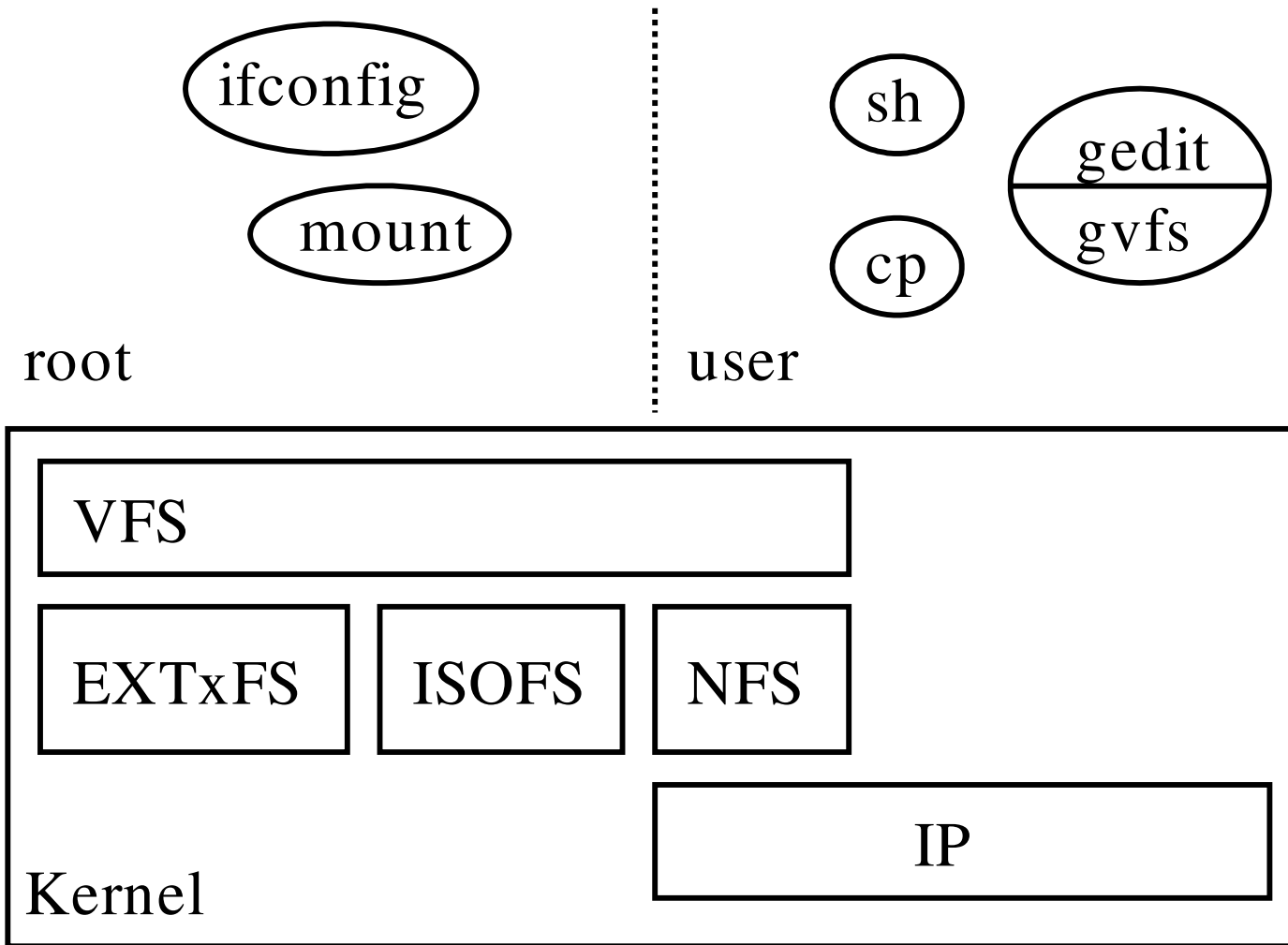


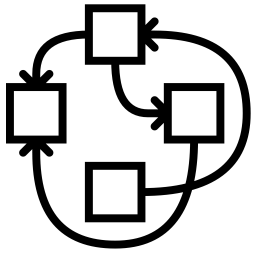
Traditional monolithic layering

- User mounts through “users” option
 - Need to ask root
 - and frowned upon
 - Only kernel-provided filesystems
- User network through tap
 - Need to ask root
 - No personal firewall tuning support



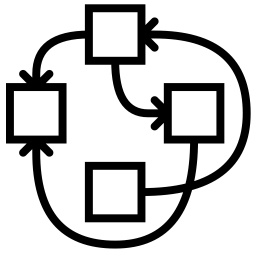
gvfs layering



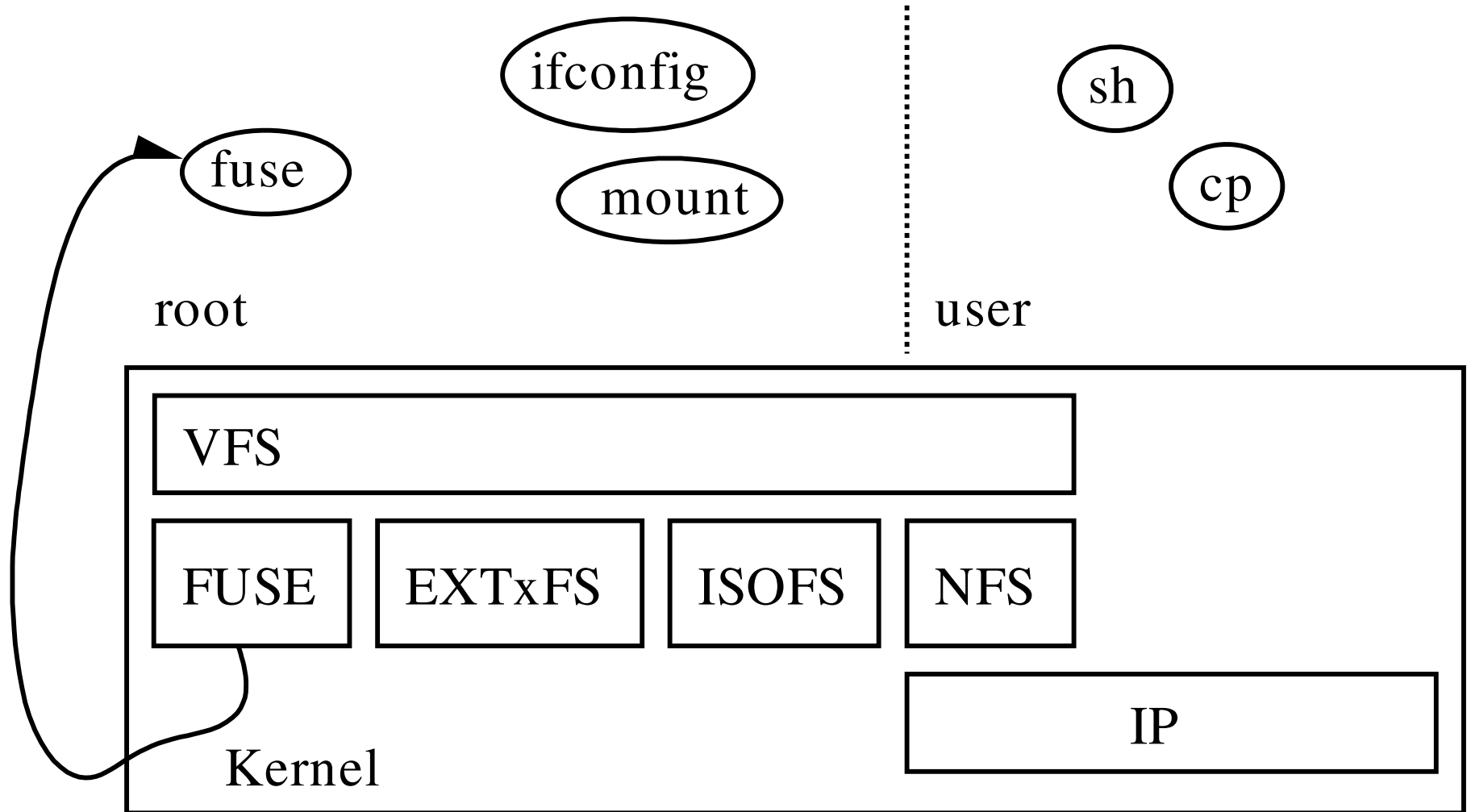


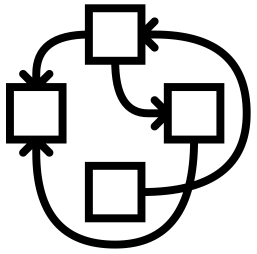
gvfs layering

- Supports a lot of nice features
 - Transparent ftp, webdav, smb, ...
- Only works for gnome applications
 - Not even in gnome-terminal shells
 - Not easily extensible
- i.e., does not compose well.

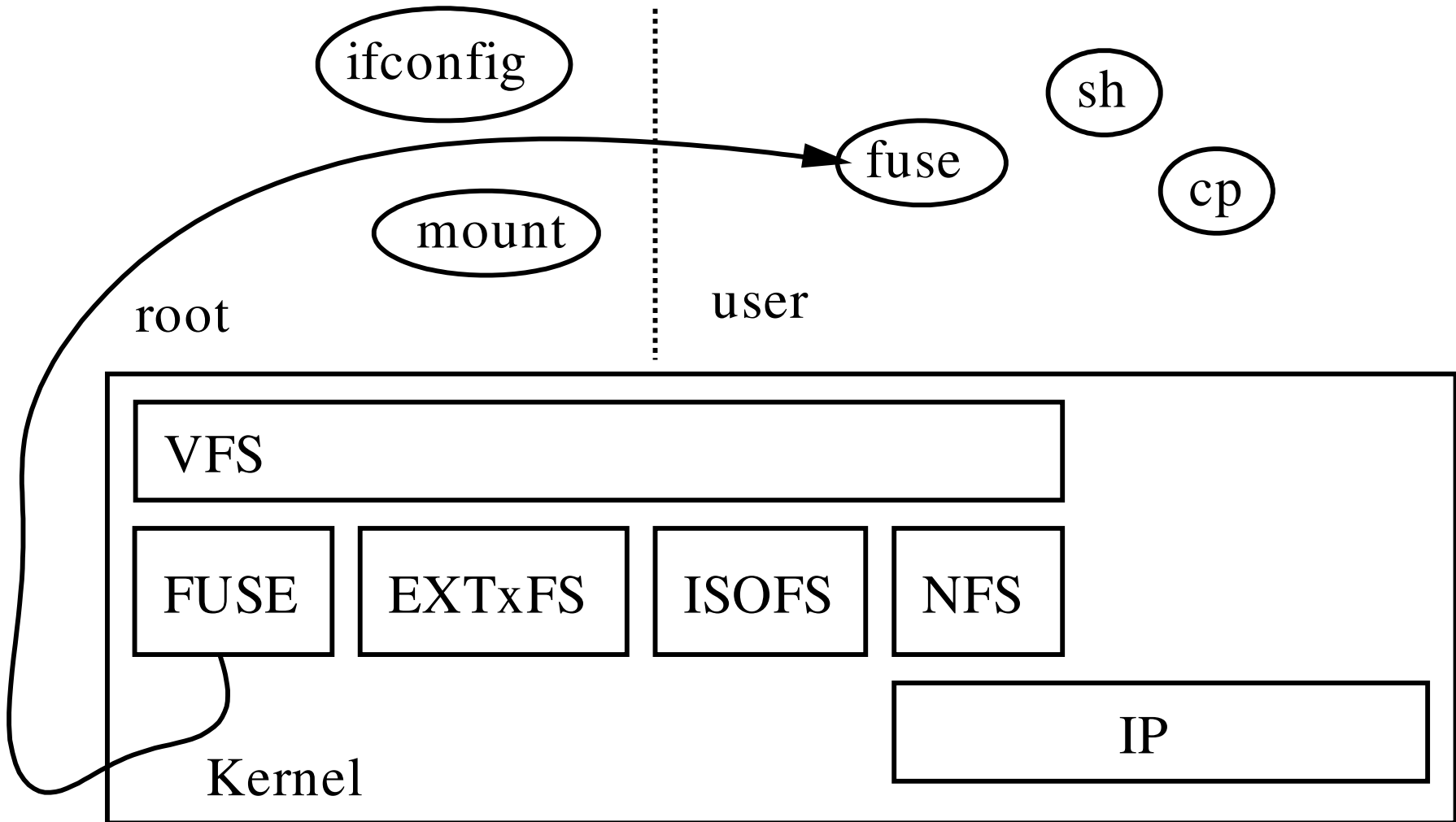


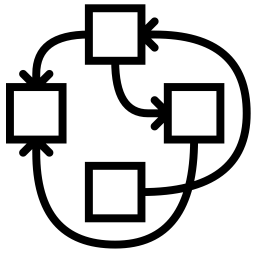
FUSE layering





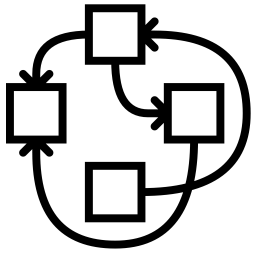
FUSE layering, user



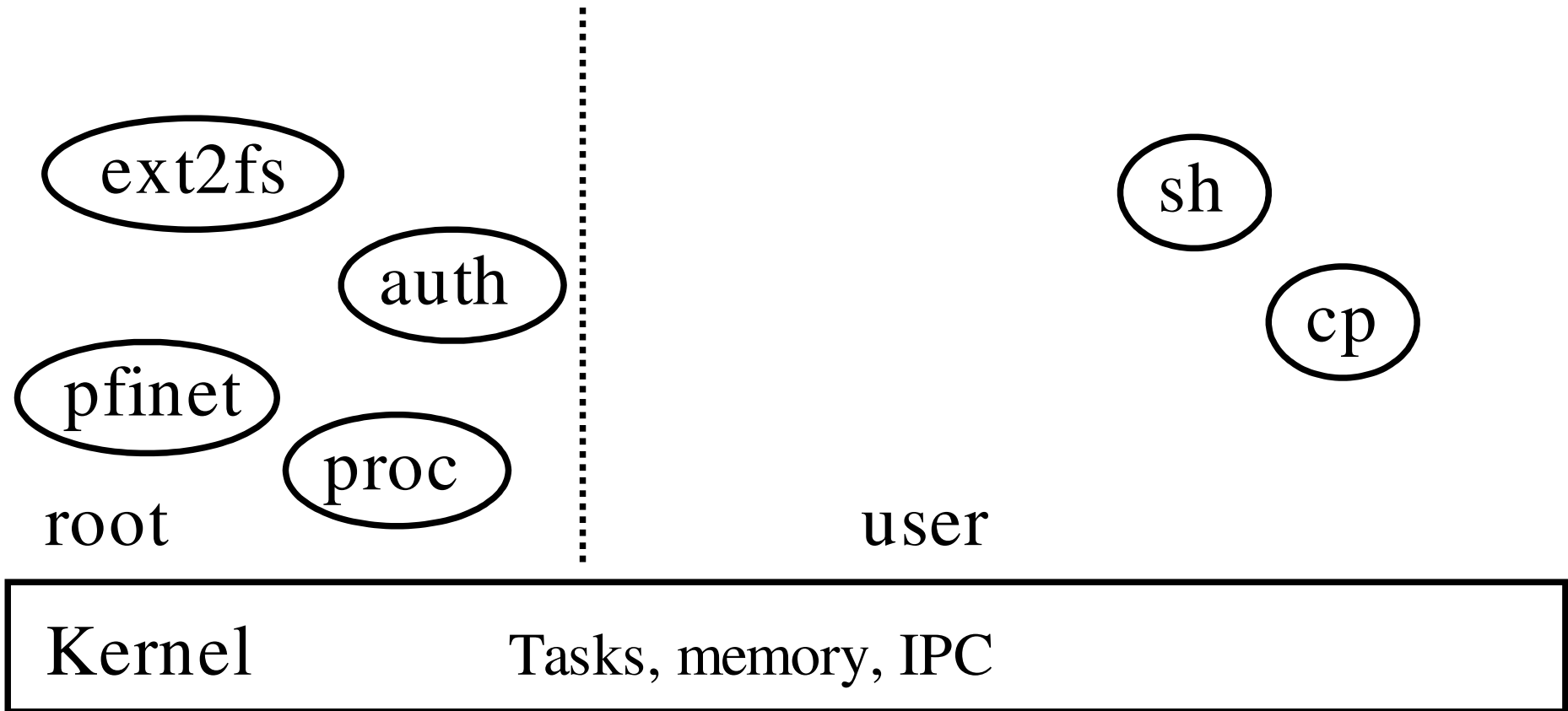


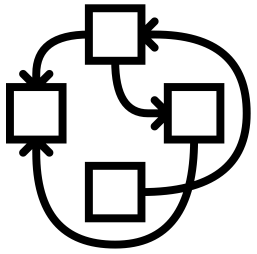
FUSE layering

- Provides a lot of nice features, but
 - Does not combine well by default
 - `cd ~/.avfs/#ftp:ftp.gnu.org/.../coreutils-6.9.tar.bz2#`
 - does not work
 - Does not optimize well by default
 - `fuseiso9660 ~/.avfs/#ftp:ftp.gnu.org/.../foo.iso ~/mnt`
 - downloads it all!
 - Does not provide all root features by default
 - How to deal with partitioned disk image?
 - `e2fsck` what?
- Users are still second-class citizens

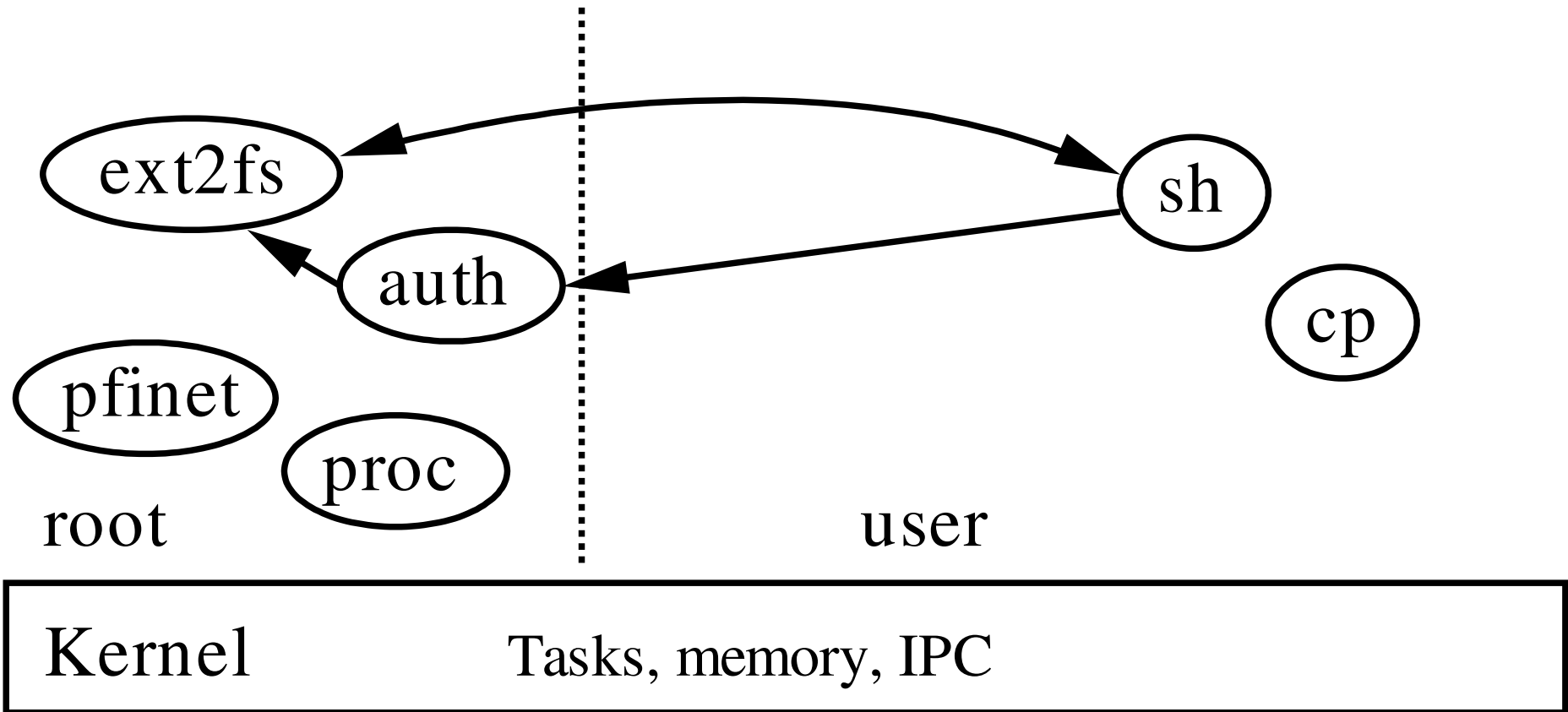


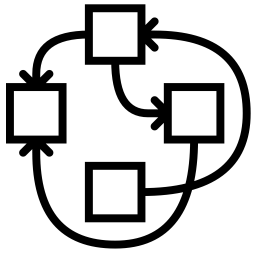
Micro-kernel layering





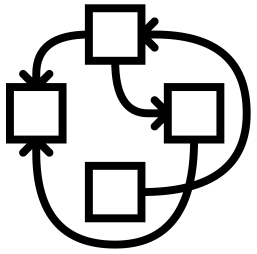
Micro-kernel layering



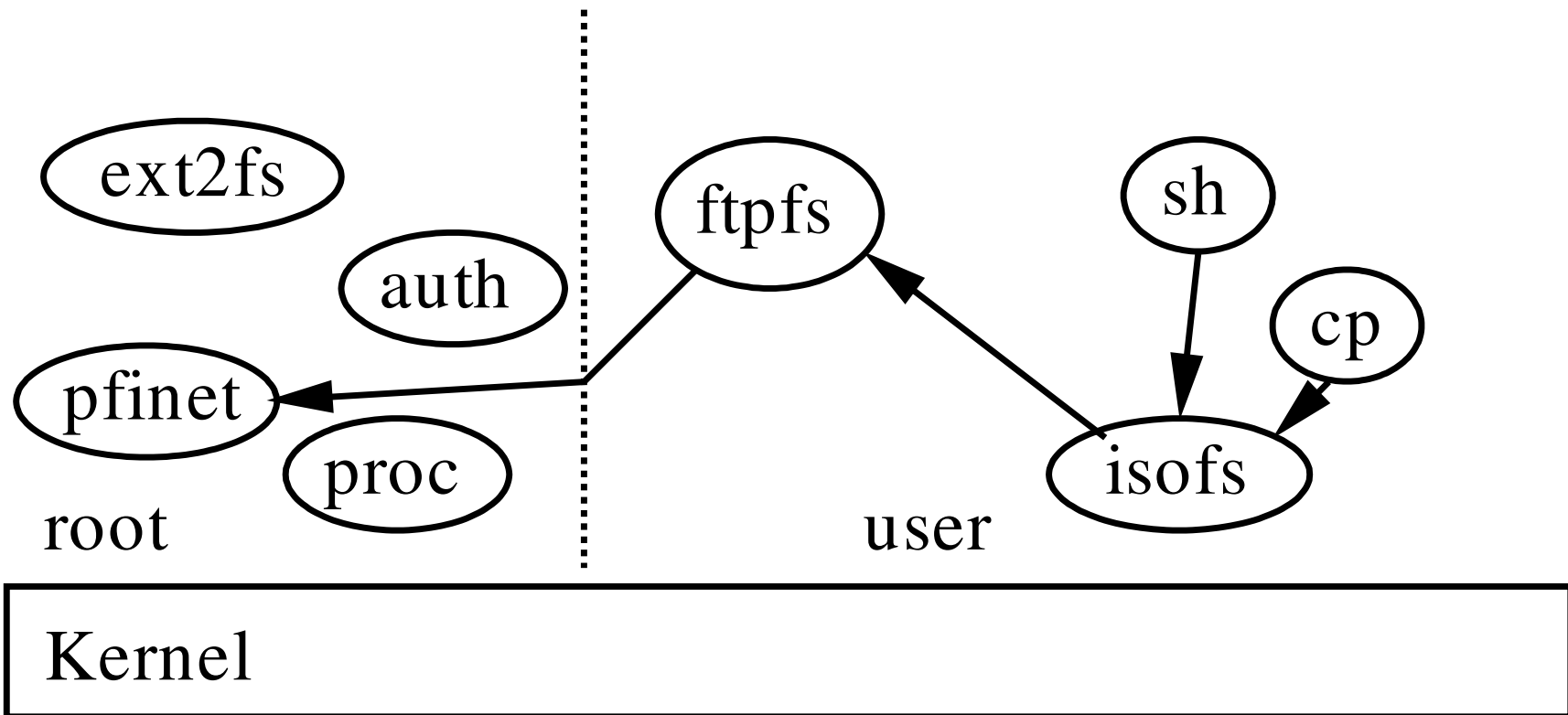


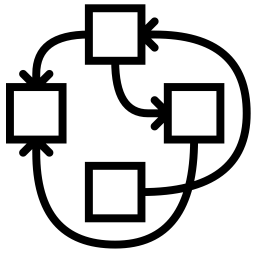
Micro-kernel layering

- 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 ~/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
```

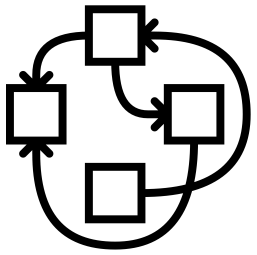
```
€ ls ~/mnt
```

```
README-or-FAIL
```

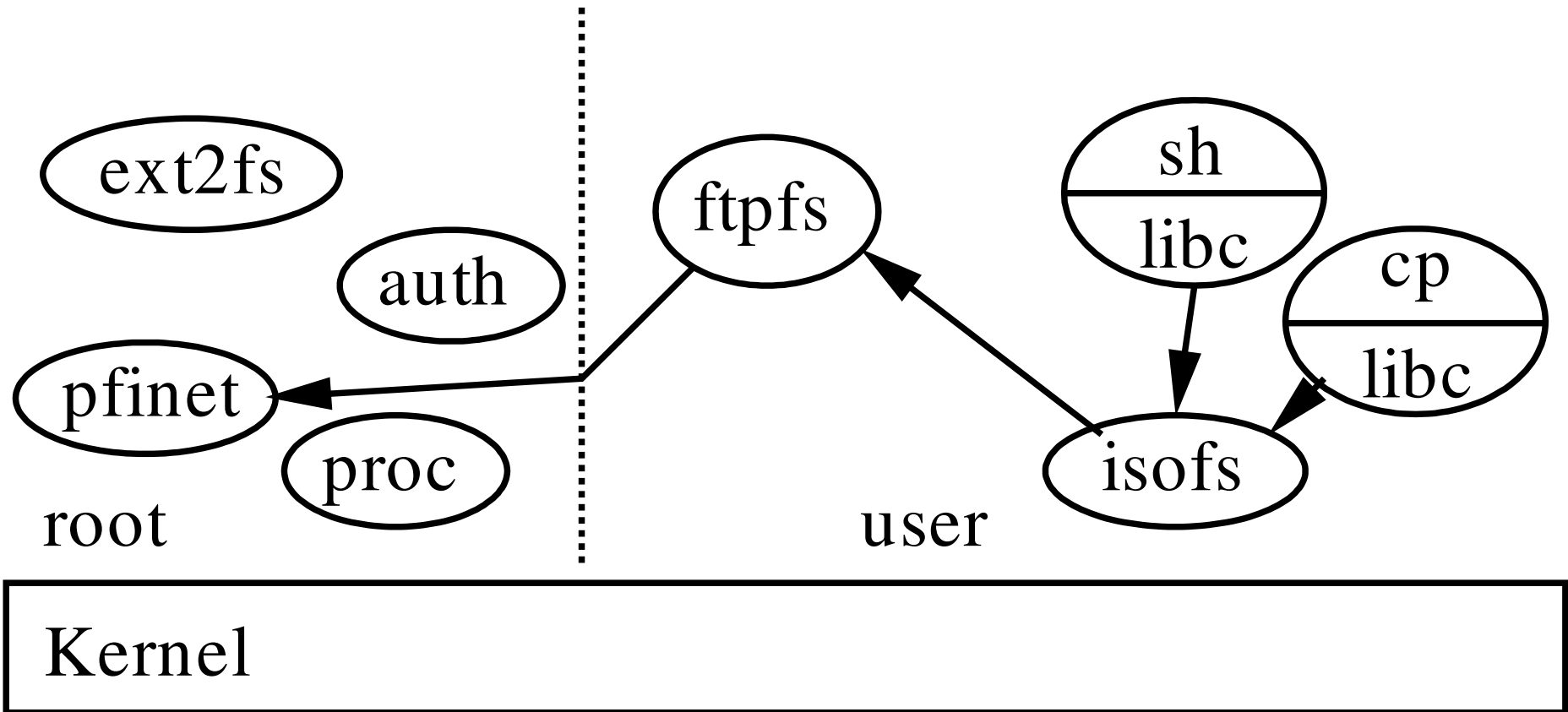
...

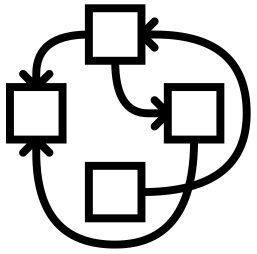
- Only downloads what is needed.
- Can be permanently stored in ext2fs

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



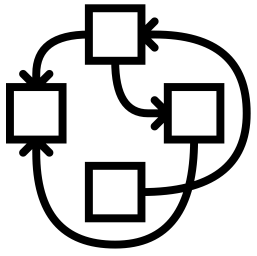
How does it work?





Rationale

- **Everything** is a (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 stackand pile over it



Example: interpose TCP/IP stack

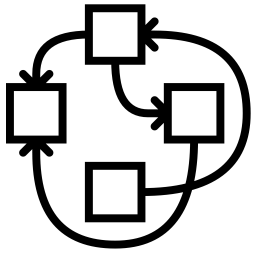
```
€ settrans -ca $HOME/servers/socket/2  
/hurd/pfinet -i $HOME/servers/tun0
```

```
€ hexdump $HOME/servers/tun0 &
```

```
€ ~/remap/remap.sh /servers/socket/2  
$HOME/servers/socket/2
```

```
€ wget www.gnu.org
```

- My own translator
- Can now plug my own VPN software
- Only wget accesses it (well, the shell too :))



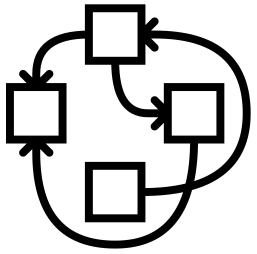
But also

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

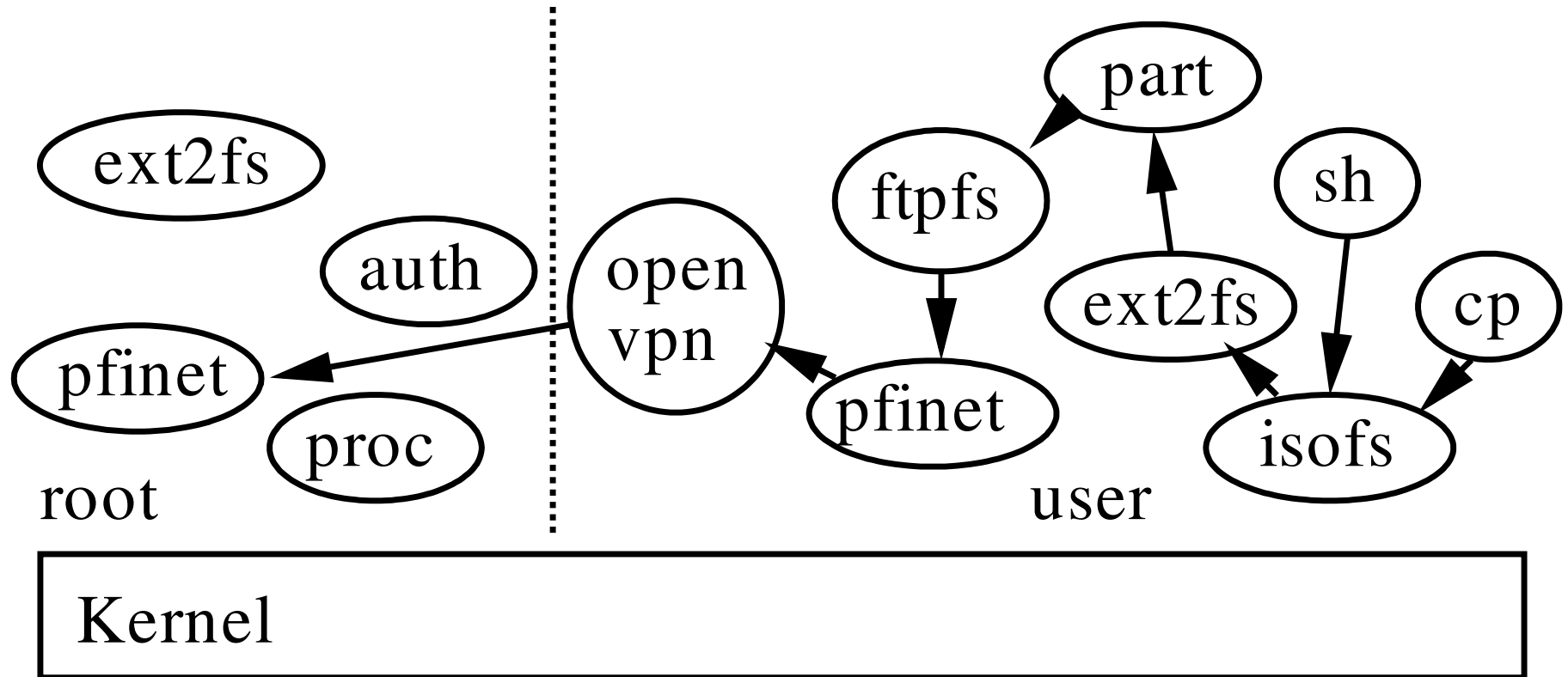
```
€ ~/remap/remap.sh /bin $HOME/unionbin
```

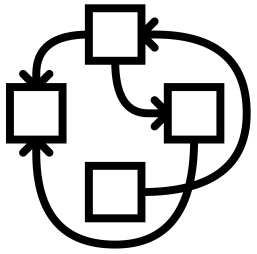
...

- Check out Guix!

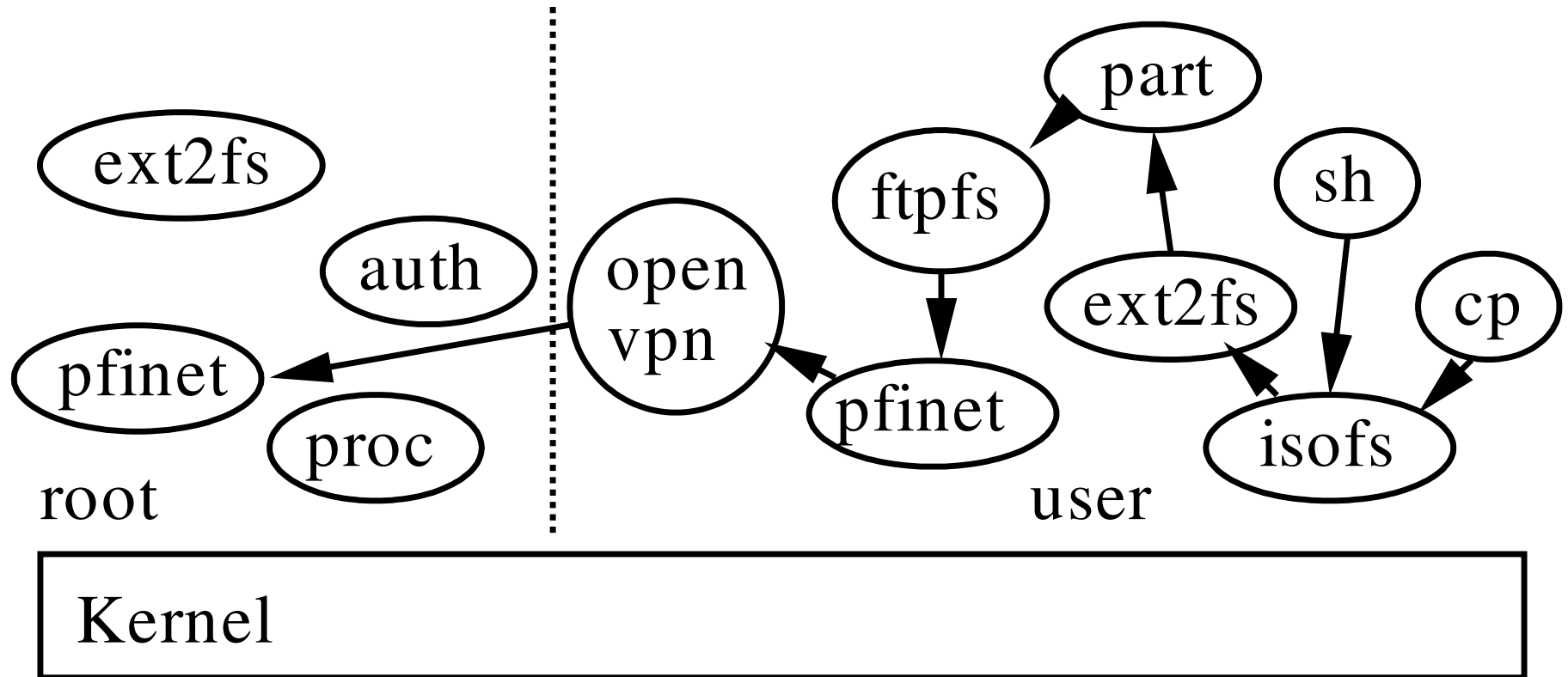


Hurd possibilities (cont'ed)

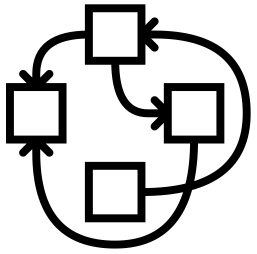




Hurd possibilities (cont'ed)

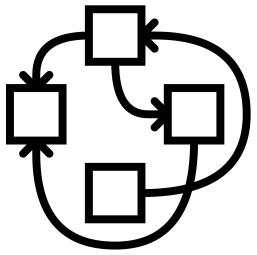


i.e. ISO image inside a partitioned disk image
on ftp over a VPN

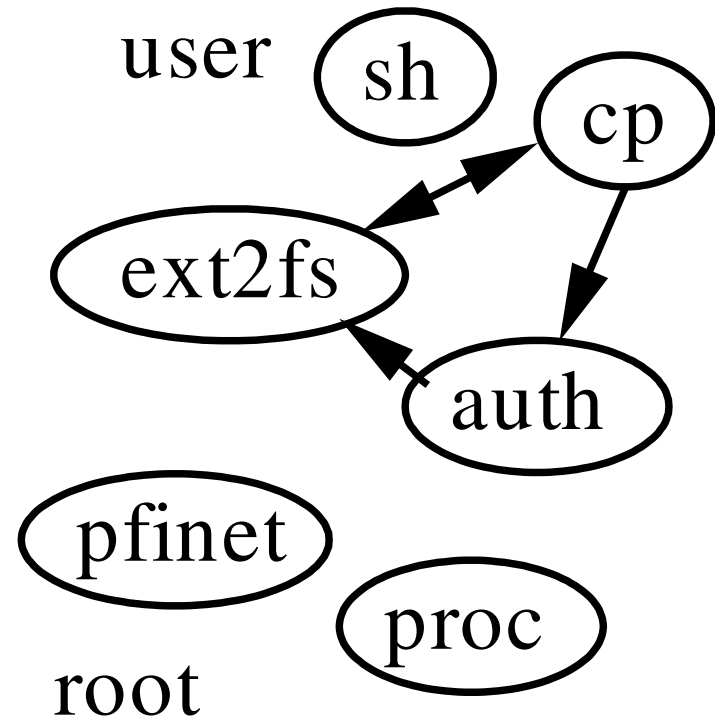
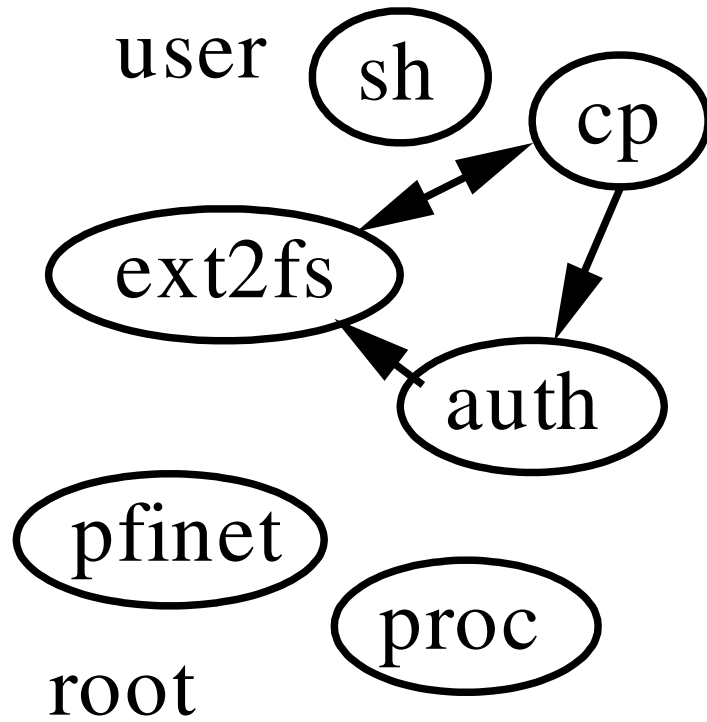


Hurd possibilities (cont'ed)

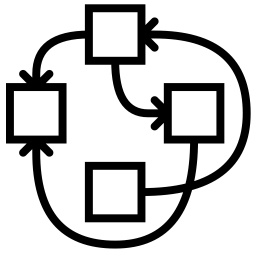
- VPN running as user
- Parted running as user
- Chroot running as user
- Tarfs, Xmlfs, cvsfs, httpfs, gopherfs, ...
- ...
- No less power than root
 - Since root uses the same mechanism anyway!
 - Except direct hardware access, of course
 - And still, can `chmod o+rw /dev/eth0`
 - And still, could be interfaced safely thanks to I/O MMU
- More power for everybody (root and non-root)
 - Combine translators, invent new ones without kernel programming, ...



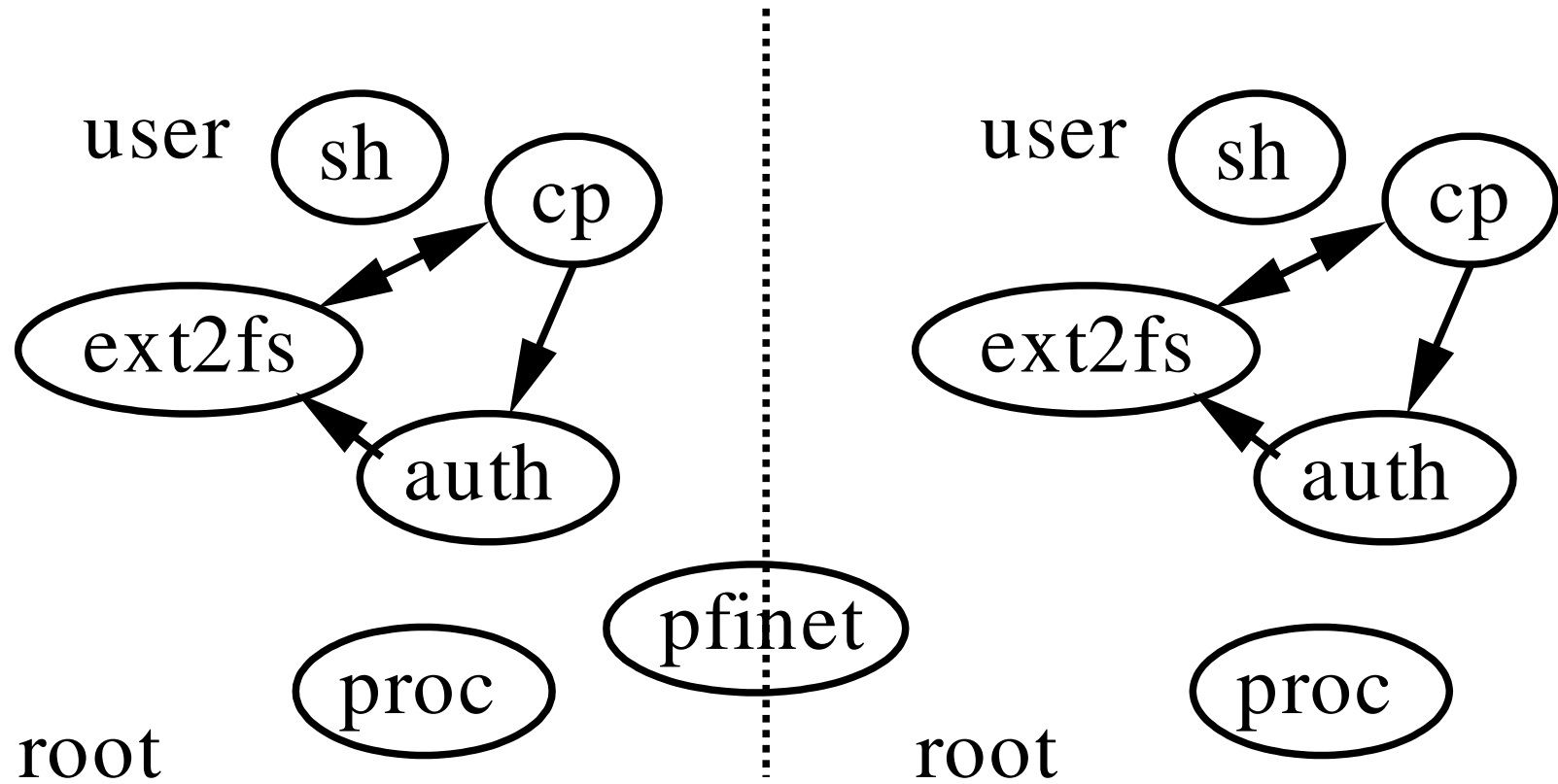
Neighbour Hurds



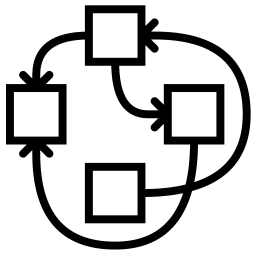
Kernel



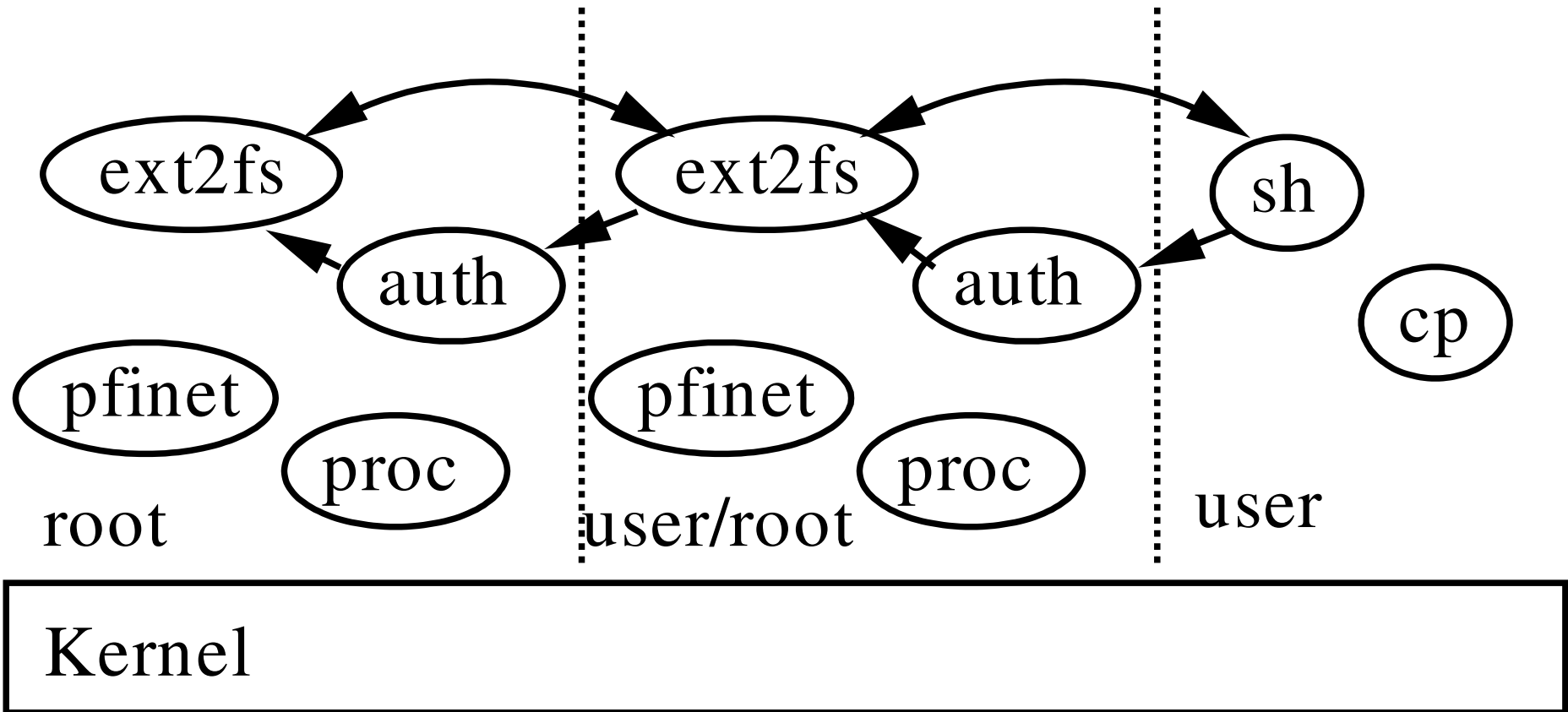
Neighbour Hurds

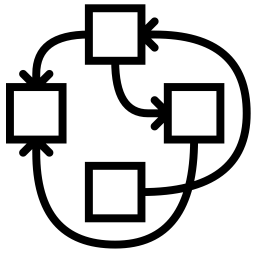


Kernel



Sub-Hurd

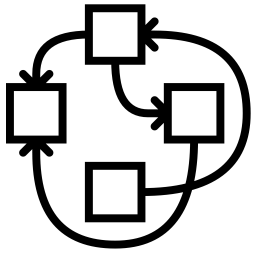




Neighbour/Sub-Hurd

Looks like Linux containers

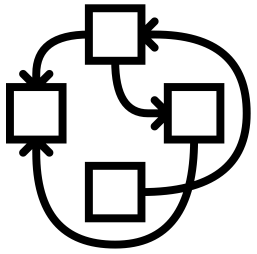
- Except they can be combined in many ways, including recursive
 - Simply the standard features in the Hurd
 - Safer, because ext2fs, pfinet, etc. are not shared
- And complete
 - Since that's how a normal Hurd system is structured already.
 - Linux containers have a hard time being completely contained, e.g. sound?



Current State

Hardware support

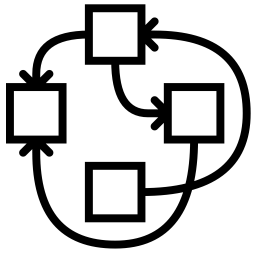
- i686
- DDE Linux 2.6.32 drivers layer for network boards
 - In userland netdde translator!
- IDE, SCSI, PCMCIA, Xorg, ...
- Xen PV domU
- No USB, no sound, no SATA.



Current State

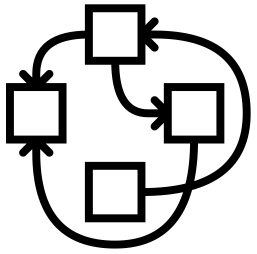
Software support

- Quite stable
 - I don't remember when I last reinstalled by system, several years ago at least. Used only for development, though.
 - Debian buildbots keep building packages, usually hang after some weeks, out of some remaining memory leak.
- ~78% of Debian archive builds out of tree
 - XFCE, almost gnome, almost KDE
 - Firefox (aka iceweasel), gnumeric, ...
- Standard Debian Installation CD
- Will release some unofficial Debian Wheezy CDs
- Nix-based distribution



Future work

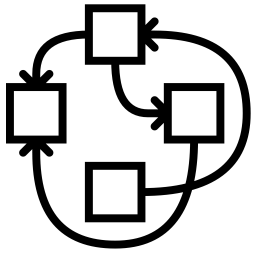
- Make an unofficial Debian GNU/Hurd Wheezy release !!
- Xen PVH support
- SATA driver
- X86_64 support
- Language bindings for translators
- Read-ahead
- {hdd,sound,usb}dde?
- Official Debian GNU/Hurd Jessie?
- Your own pet project?



Hardware support

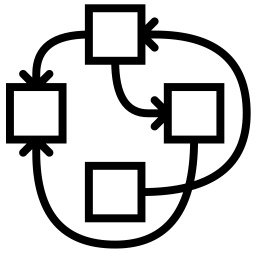
Æternam issue of all our nice micro-kernel projects

- KVM / Xen support
 - Leverage existing system
 - Not satisfactory, even if very good performance: users want to run on real hardware of course!
- DDE layer
 - Leverage Linux drivers
 - Still has to be maintained
 - Shared maintenance?



People at work nowadays

- Emilio Pozuelo Monfort : gnome
- Jeremie Koenig : glibc, openjdk
- Olaf Buddenhagen : community, mentor
- Pino Toscano : KDE
- Samuel Thibault : debian installer, autobuilders
- Thomas Schwinge : GNU gdb, gcc
- And various porters : Gabriele Giaccone, Svante Signell, ...
- You're welcome!



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>