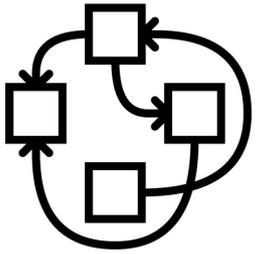


Updates on GNU/Hurd progress:

rump drivers, 64bit, SMP,
software bootstrapping, ...

Samuel Thibault

2026 February 1rd

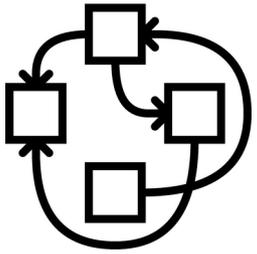


The Hurd is all about freedom #0

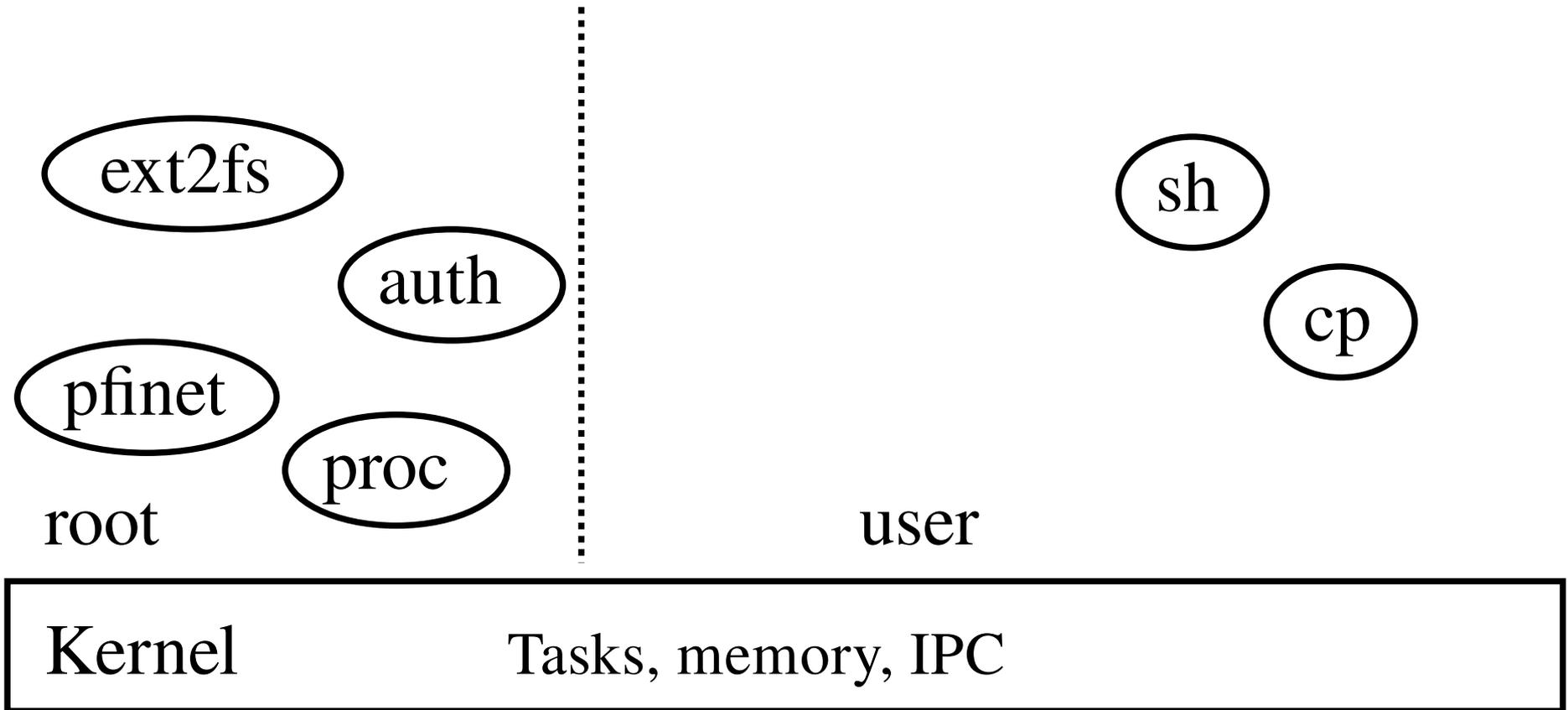
“The freedom to run the program, for any purpose”

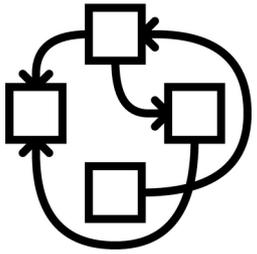
I.e.:

- 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,...
 - Give a PCI card function to a process
- Freedom from misbehaving programs and drivers

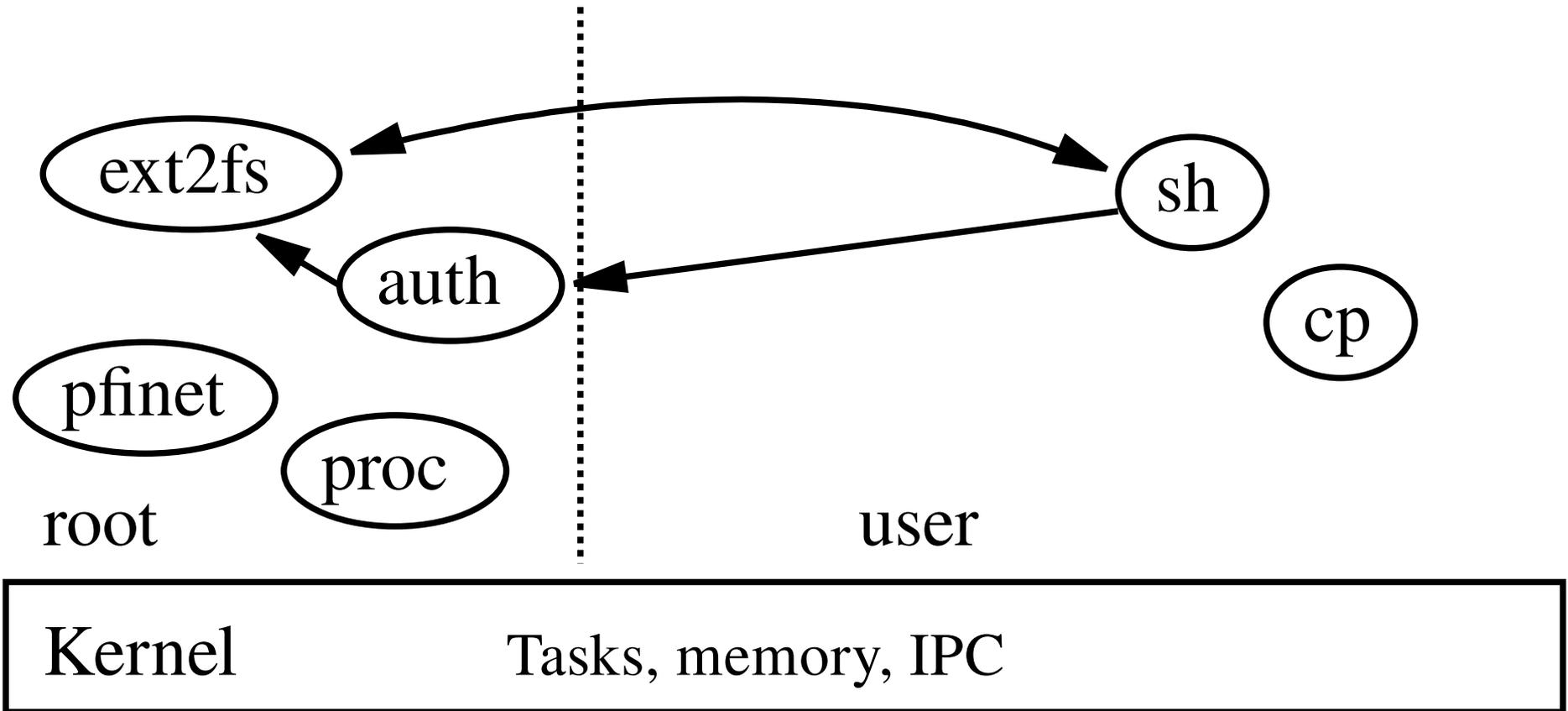


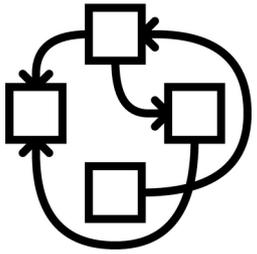
Micro-kernel layering





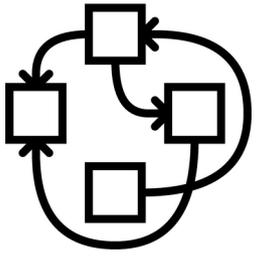
Micro-kernel layering



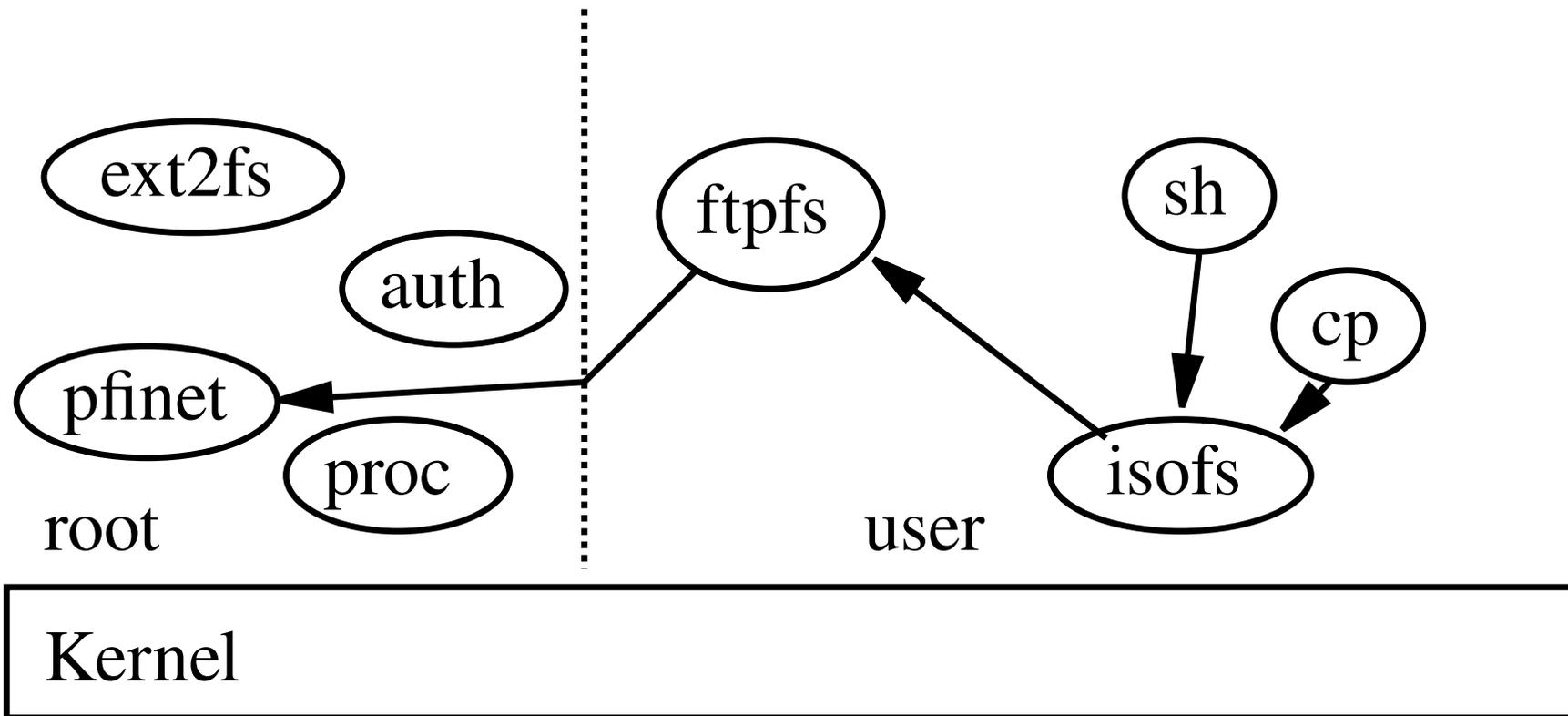


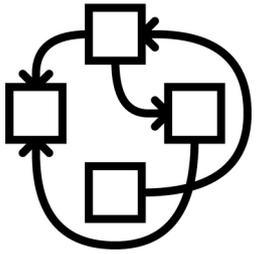
Micro-kernel layering

- 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.
 - And Emojis!
- Kernel only handles Tasks, memory, IPC
- Can virtualize at a very fine grain



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
```

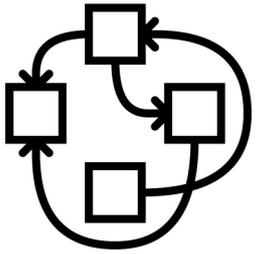
```
€ ls ~/mnt
```

```
README-or-FAIL
```

...

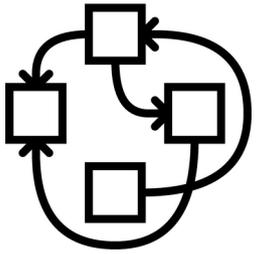
- Only downloads what is needed.
- Can be permanently stored in ext2fs

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



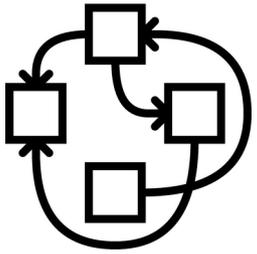
Current state

- Rather stable
 - Have not reinstalled boxes for a decade
 - Debian buildbots keep building packages
- ~75% of Debian archive builds out of tree
 - XFCE, gnome, KDE, ...
- Support merged upstream
 - gcc, glibc, llvm, rust, ...
- Debian distribution
- Guix/Hurd released!



Hardware support

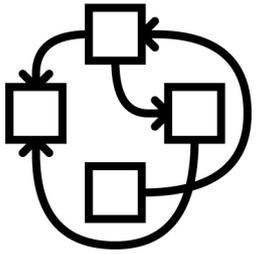
- PAE on 32b
 - Required for memory-hungry builds (webkit2gtk)
- APIC, HPET (Damien Zammit)
 - HPET required nowadays: software expects sub-tick time precision
- ACPI (Damien Zammit)
 - Running libacpica in userland, and tell kernel
- PCI arbiter (Joan Lledó)
 - Runs I/O port-accessing libpciaccess in userland



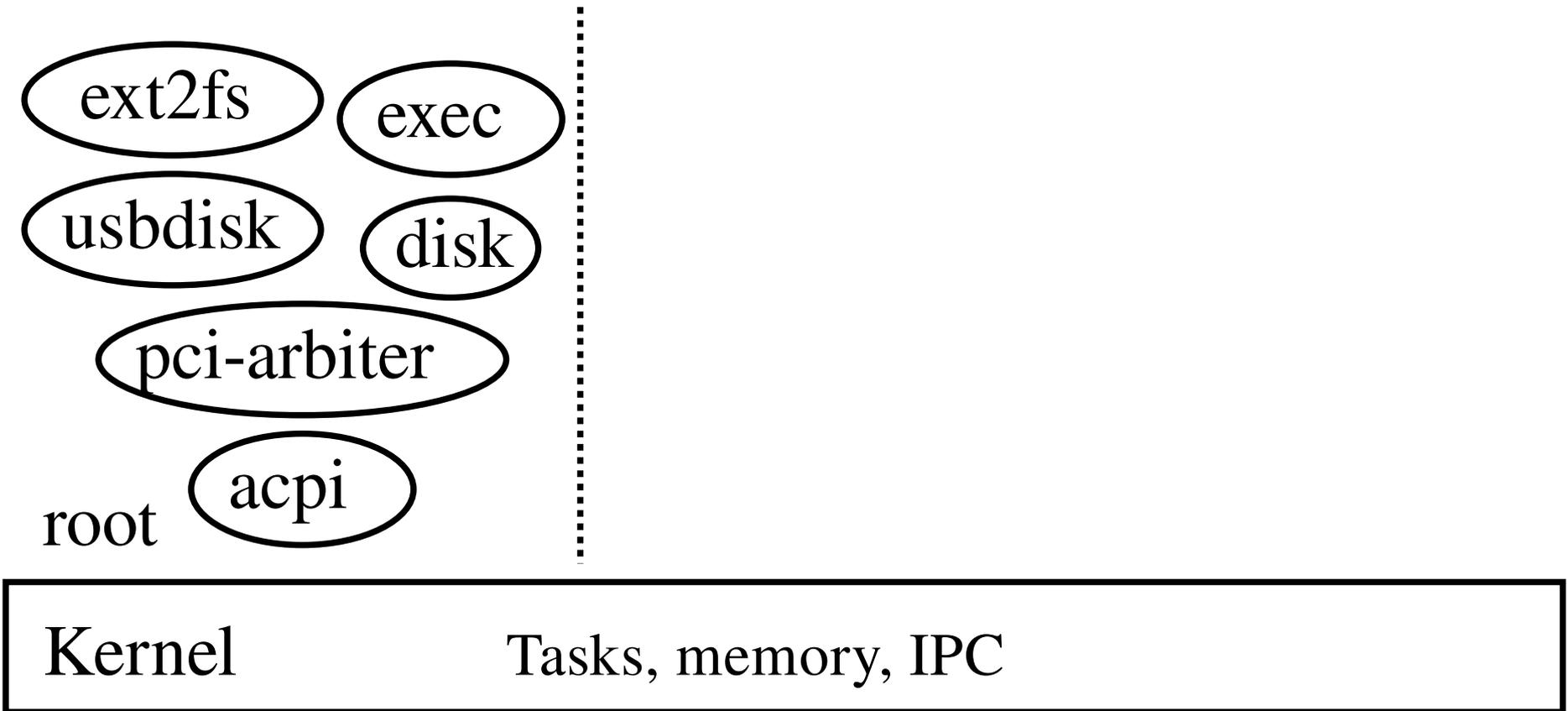
Hardware support (cont')

- USB disk/CD support (Damien Zammit)
 - rumpusbdisk userland translator
 - separate from rumpdisk (for SATA/IDE)
 - integrates USB stack for now
 - plans to split with ugen layer in between
- Network devices support (Damien Zammit)
 - rumpnet userland translator
 - to replace the old netdde linux 2.6.32 translator
 - (was based on unmaintained DDE)

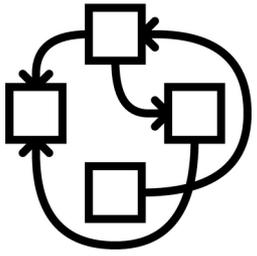
Note: These assume maintenance of rump



Hurd boot, userland disk



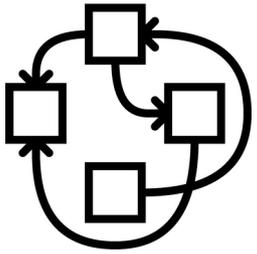
Really a library-based OS!



64b support

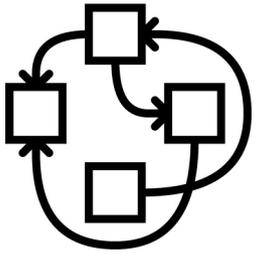
x86_64 support running well!

- Kernel x86 boot (Luca Dariz)
- mig RPCs (Flávio Cruz, Luca Dariz)
 - Teach it 64 bitness, fix translations
 - Then all RPCs work fine (“system calls” etc.)
- gcc/gdb (Flávio Cruz)
 - Mostly plumbing x86_64
- hurd: 64 bitness fixes (Sergey Bugaev)
 - also fixing future 64b archs



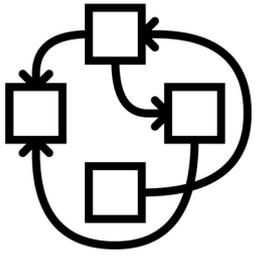
64b support (cont')

- bootstrap of Debian hurd-amd64
 - Cross-buildability of software, essential!
 - First ./configure-etc. shell scripts with --target/--host to fix early support (Flávio Cruz)
 - Then Helmut Grohne's rebootstrap script
 - cross-builds all necessary packages for builddds
 - Then unleash builddds!
- Made it to debian'25
- Preliminary work for arm64 (Sergey Bugaev)



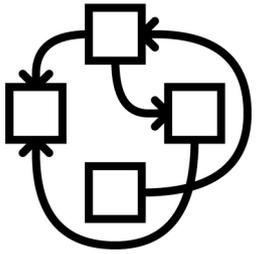
SMP support

- Mach originally had SMP support
 - Kernel framework already there: locks, sched, ...
- Initial code (Almudena Garcia): cpu detection, enumeration, cpus startup
- Then a lot of fixes, and 64b (Damien Zammit)
- Userland translators on CPU0 for now
 - To avoid SMP-concurrency issues for now
 - Will migrate to other cpus progressively
- Other processes can go fine on other cpus



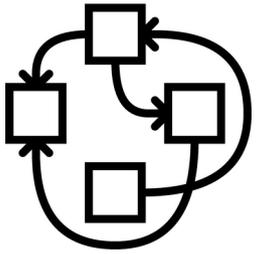
OS support

- Security fixes (Sergey Bugaev)
 - Tricks with ports, make sure not to leak access!
- Memory fixes / stress tests (Michael Kelly)
 - stress-ng really nice to trigger some bugs
- pfinet TCP/IP stack still using linux 2.2 stack
 - Costly to follow Linux' net layer
- being replaced by lwip as userland TCP/IP stack (Joan Lledó)



OS support (cont'd)

- Translator records in /dev and /servers
 - Used to be a Hurd-specific ext2 extensions
 - Now using xattrs by default
 - Can now cross-install completely from Linux
- FS JBD2 journaling support (Milos Nikic)
 - In progress
- Console xkb keyboard layout (Etienne Brateau)

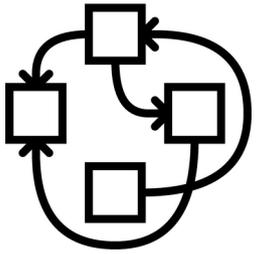


Quality

CI

- gnumach: make check (Luca Dariz)
 - Small userland programs to check kernel RPCs
 - Really nice for progressive 64b port
 - Now running as CI
- debian salsa-gitlab pipelines
 - gitlab runner thanks to gccgo port
- exim and postgresql buildfarm animals

Ideally, integrate with as many upstreams as poss



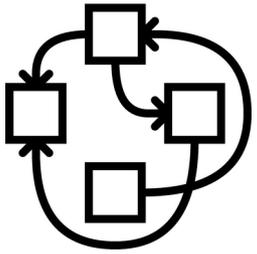
Quality

Warnings (Diego Nieto Cid)

- You want to avoid them
- Permanent uphill battle with newer gcc versions

pthread-in-libc (Guy Fleury)

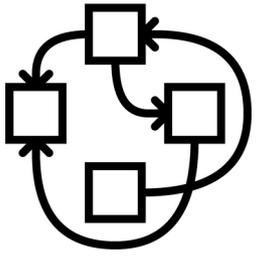
- Was done by glibc on Linux
- Thus nowadays software forgets `-lpthread`
- Had to do it as well



Languages

rust

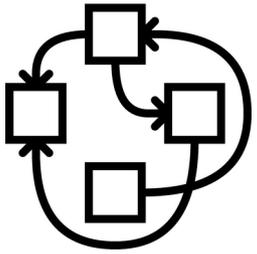
- Ported through cross-build, but tedious (thanks Vedant Tewari!)
 - Has to teach it **all** ABI details
 - bindgen didn't help that much, had to review it all
 - **very** moving target
 - fast commit pace, release every 40 days
 - and n+1 builds with $\geq n$ only!
 - `#cfg(target_os="foo")` hell in a lot of crates
 - two "errno" crates...
- Now fully native build and up to date



Languages (cont')

gccgo (Svante Signell)

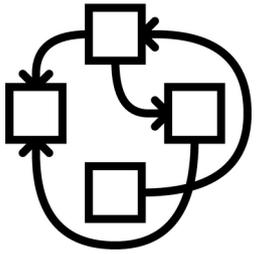
- Could just reuse a lot of BSD code
- Some tweaking
- Needed to fix split stack
- Still not enough for quite a few packages
 - Would need golang port, contribution welcome!



Languages (cont' 2)

java openjdk

- Previous work by Emilio Pozuelo Montfort
 - Hurd support for siginfo, \$ORIGIN, ...
- Previous work by Jeremy Koenig
 - Port openjdk6
- We also have gcj from gcc-6
- Damien Zammit taking on openjdk
 - Tedious: $n+1$ builds with $\geq n$... starting from openjdk7!



Dissemination

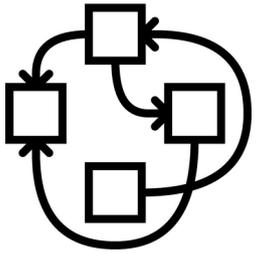
News coverage

- Quarter of the Hurd (QotH) (Joshua Branson)

Guix/hurd (Manolis Ragkousis, Janneke Nieuwenhuizen, Yelninei)

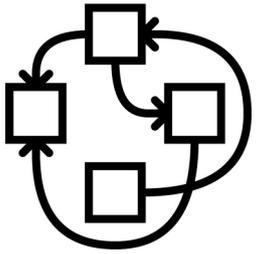
- <https://guix.gnu.org/en/blog/2024/hurd-on-thinkpad/>

Alpine (Sergey Bugaev)

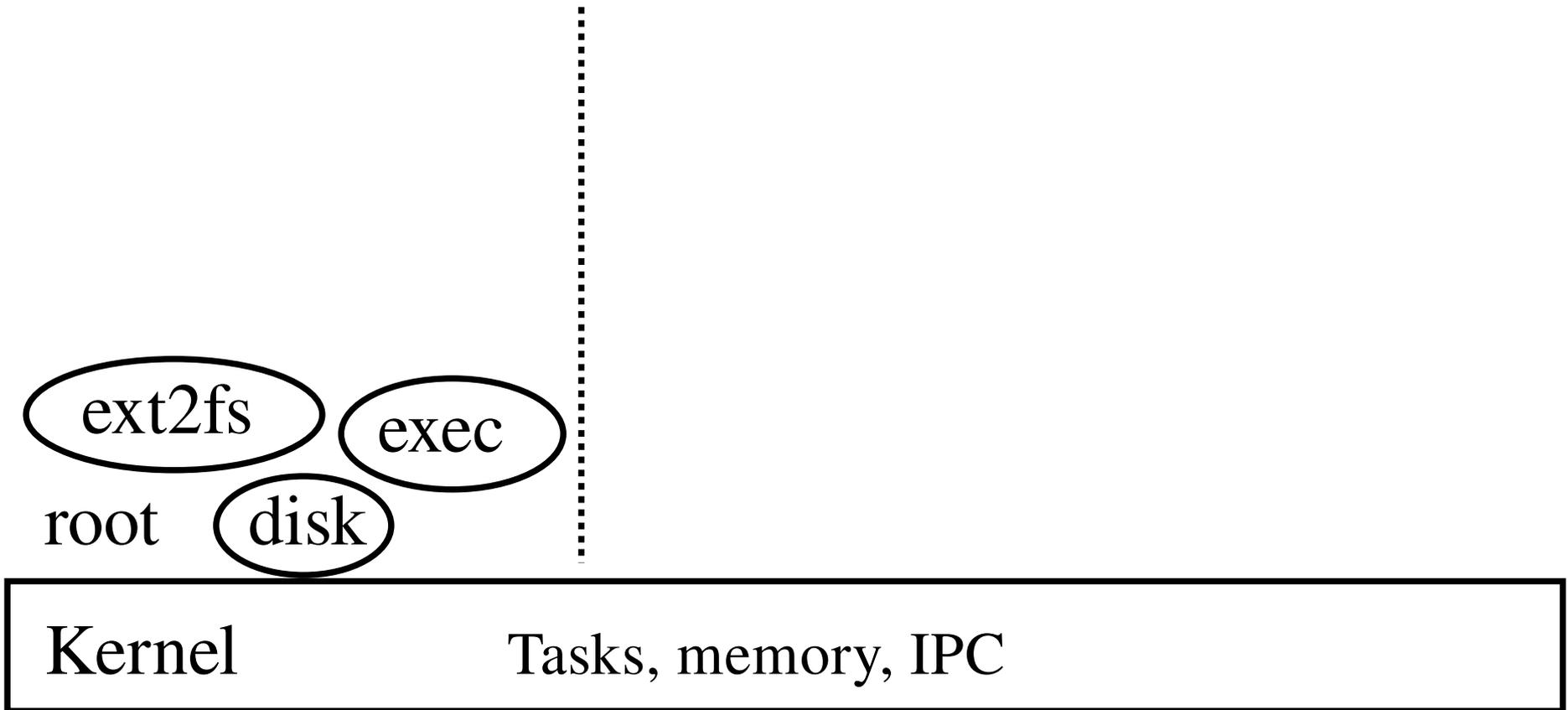


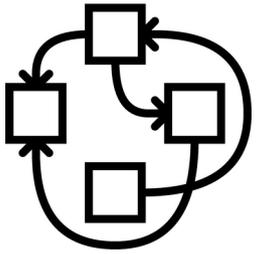
So, what do we have?

- x86_64, SMP
- SATA/USB disks/cd, all in userland
- network driver & TCP/IP all in userland
- kernel only manages tasks, memory, IPC
- go, rust, ocaml, ghc, some java, ...
- Debian (~75% packages)
- Guix
- some Arch, some Alpine

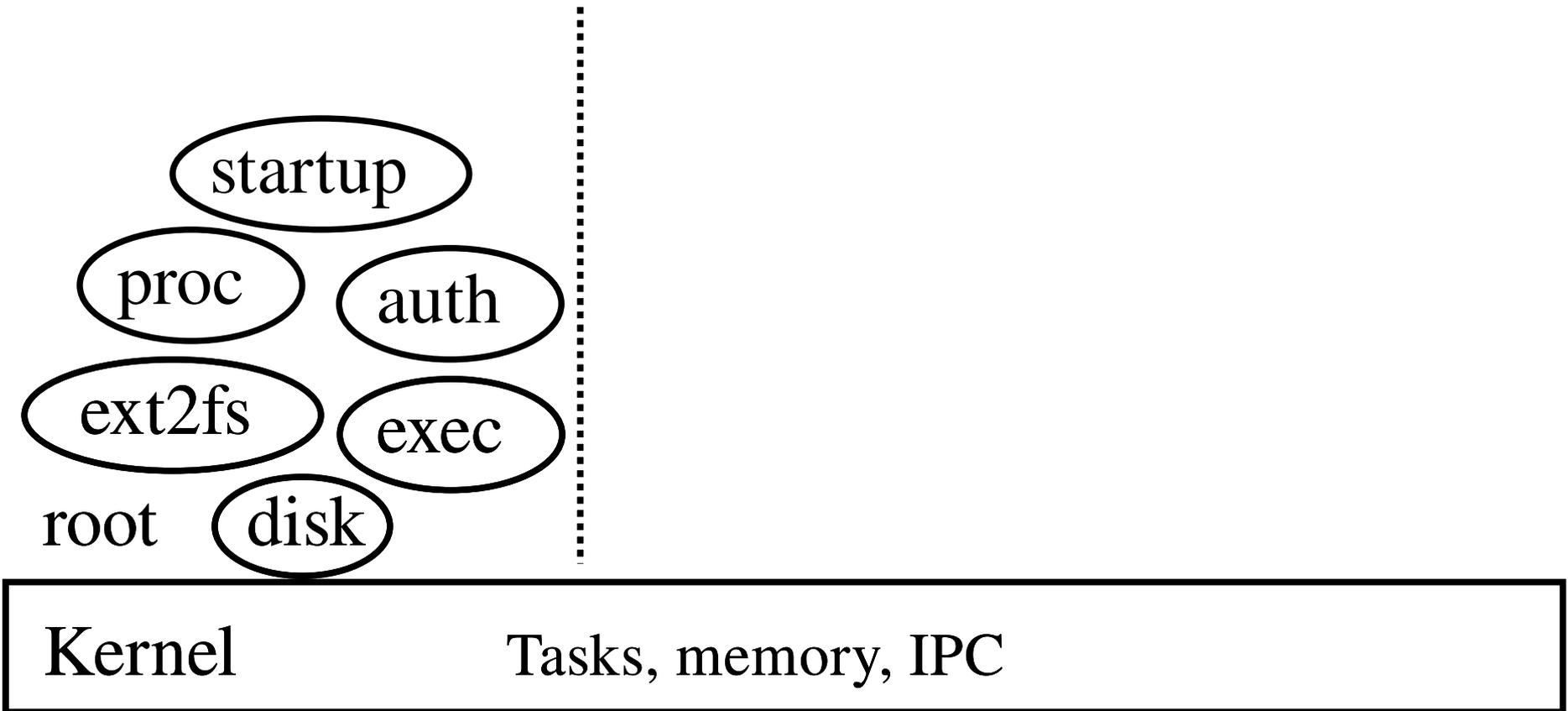


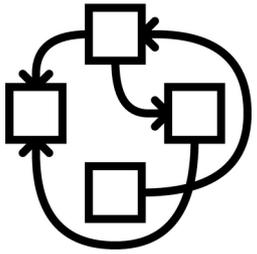
Hurd boot, userland disk



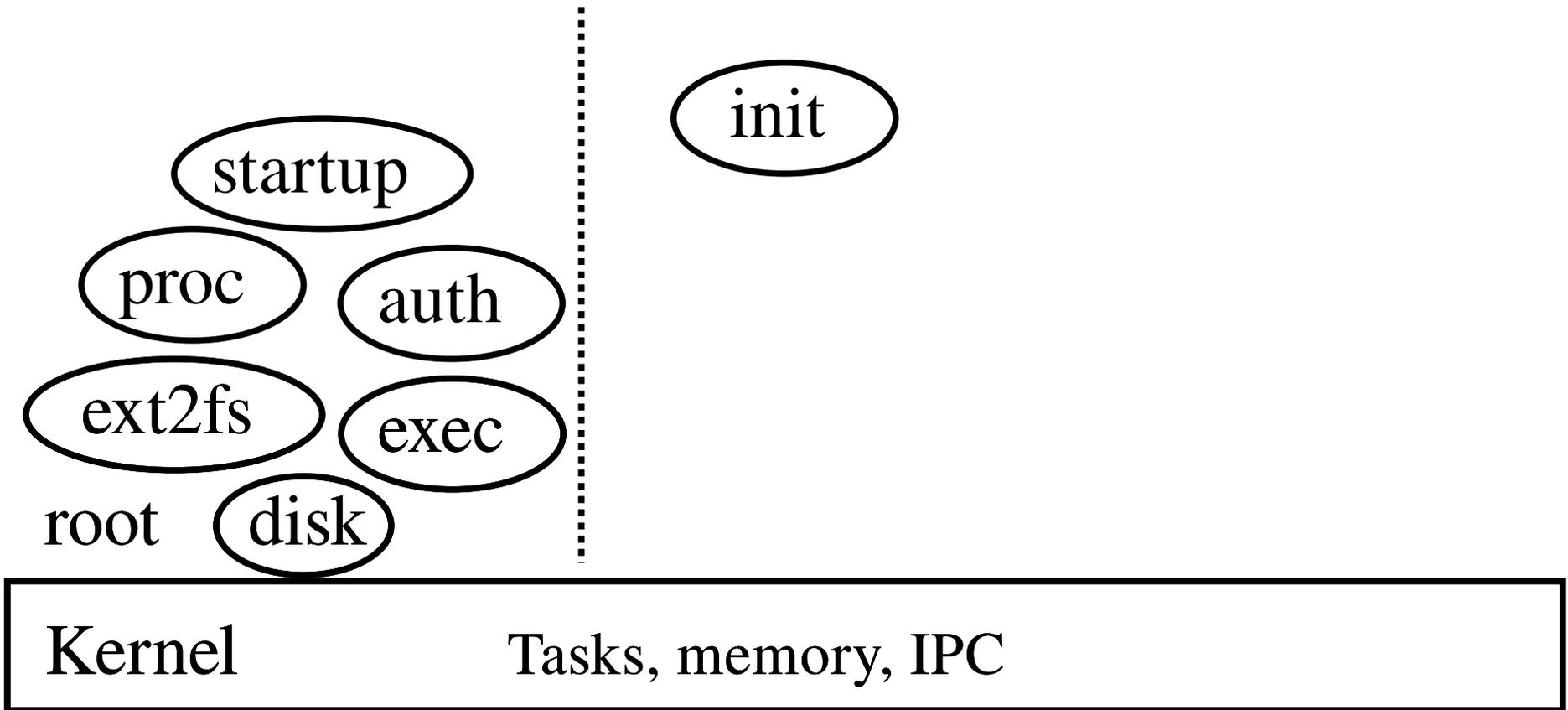


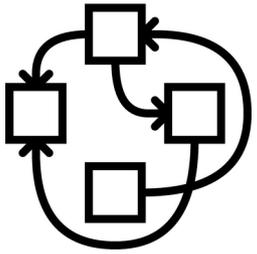
Hurd boot, userland disk



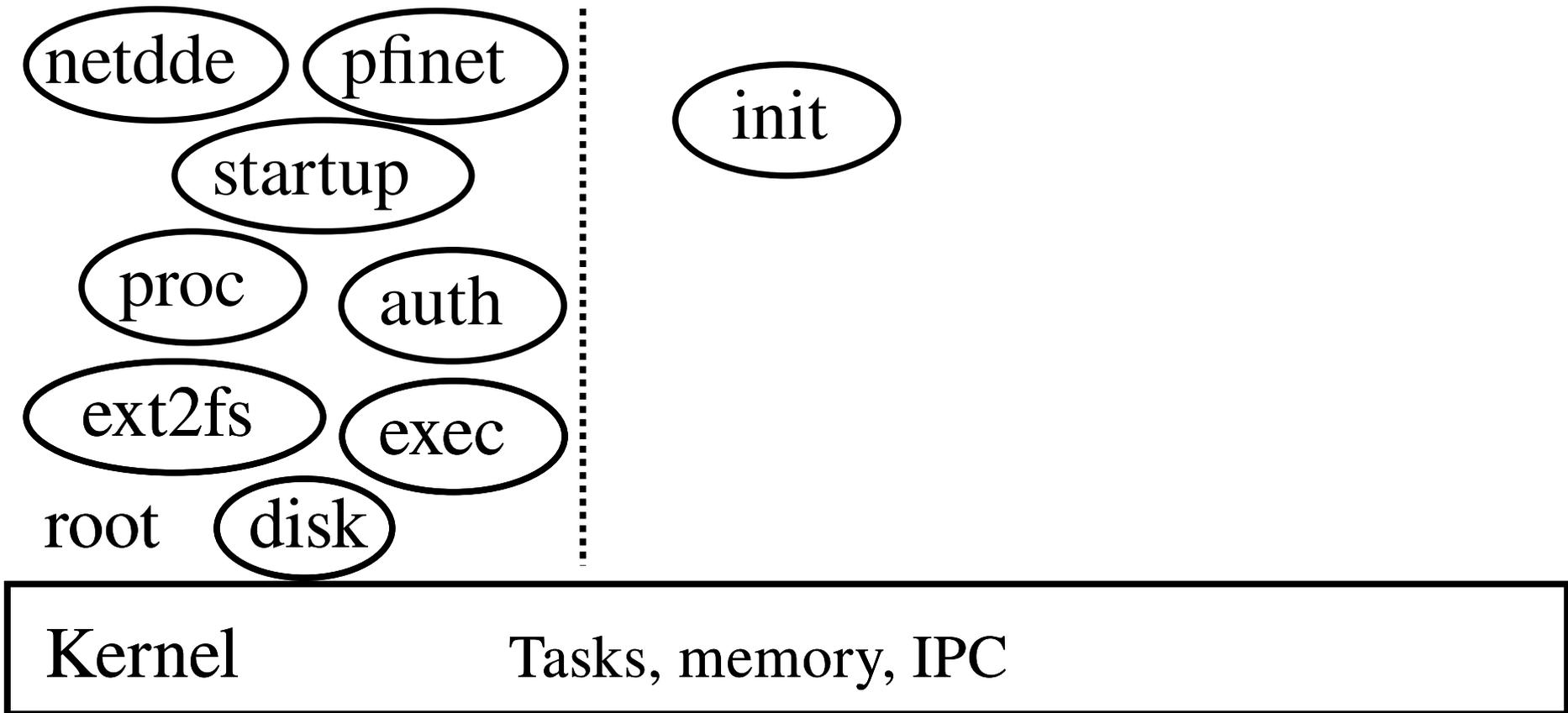


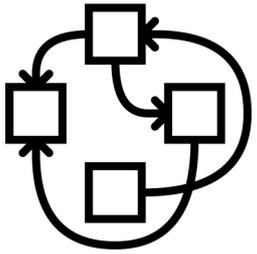
Hurd boot, userland disk





Hurd boot, userland disk

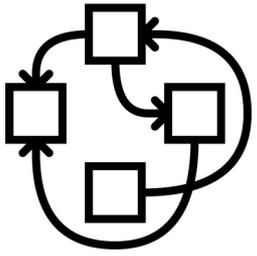




Conclusion

- x86_64, SMP
- SATA/USB disks/cd, all in userland
- network driver & TCP/IP all in userland
- kernel only manages tasks, memory, IPC
- go, rust, ocaml, ghc, some java, ...

- A lot of nice things to achieve in GNU/Hurd
 - <https://www.gnu.org/software/hurd/contributing.html>
- GNU/Hurd is almost there with Debian/Guix/Arch/Alpine
 - Just needs your help :)



Thanks!

- For listening
- And to the people working on all this
- <http://hurd.gnu.org/>
- <http://www.debian.org/ports/hurd/>
- 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>