The MINIX3 Service Layer

Recent Past, Current Status, and Near-Term Future

MINIXCon 2016

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Talk outline

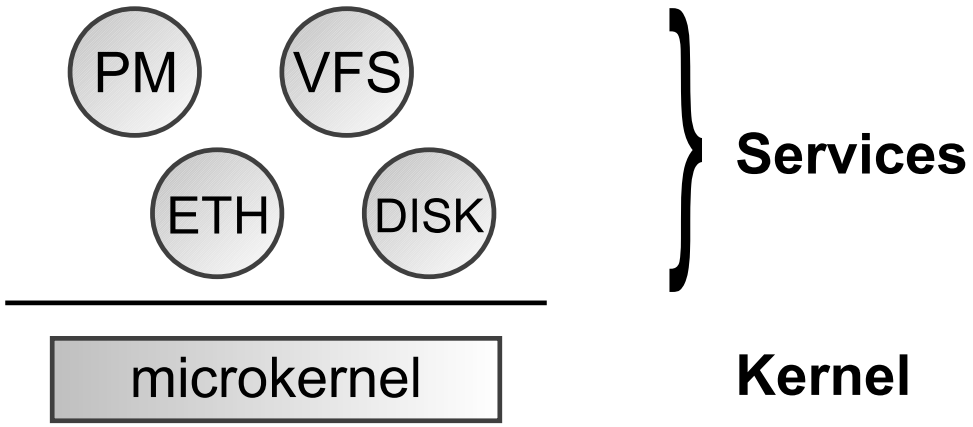
- **Terminology**
- Service layer **evolution**
- Recent and ongoing **projects**
  - A new information service
  - Library-based file systems
  - Network stack redesign
- **Conclusion**
- How to **contribute**

Terminology

microkernel

Kernel

Terminology



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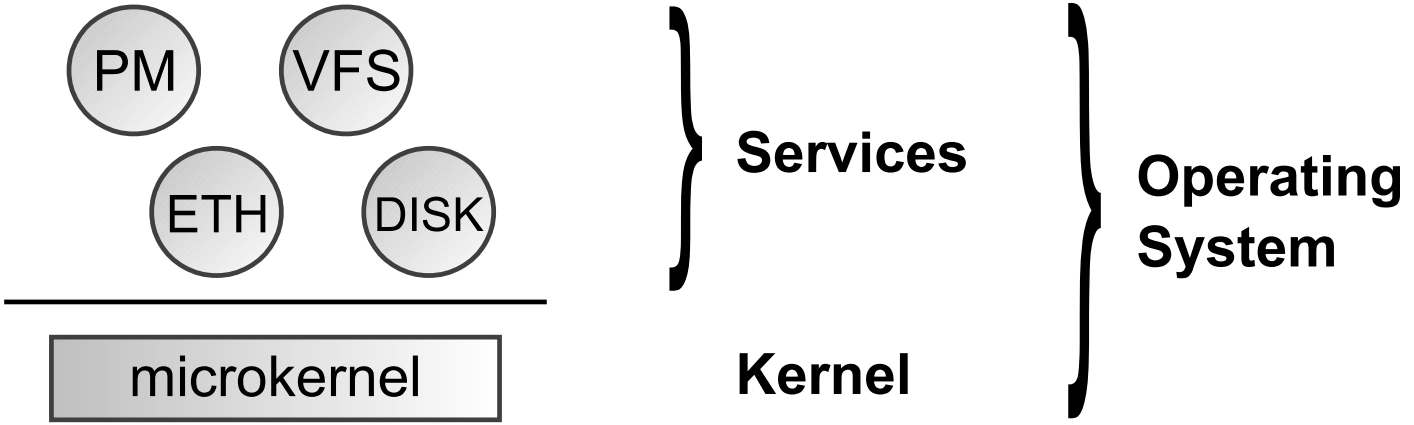

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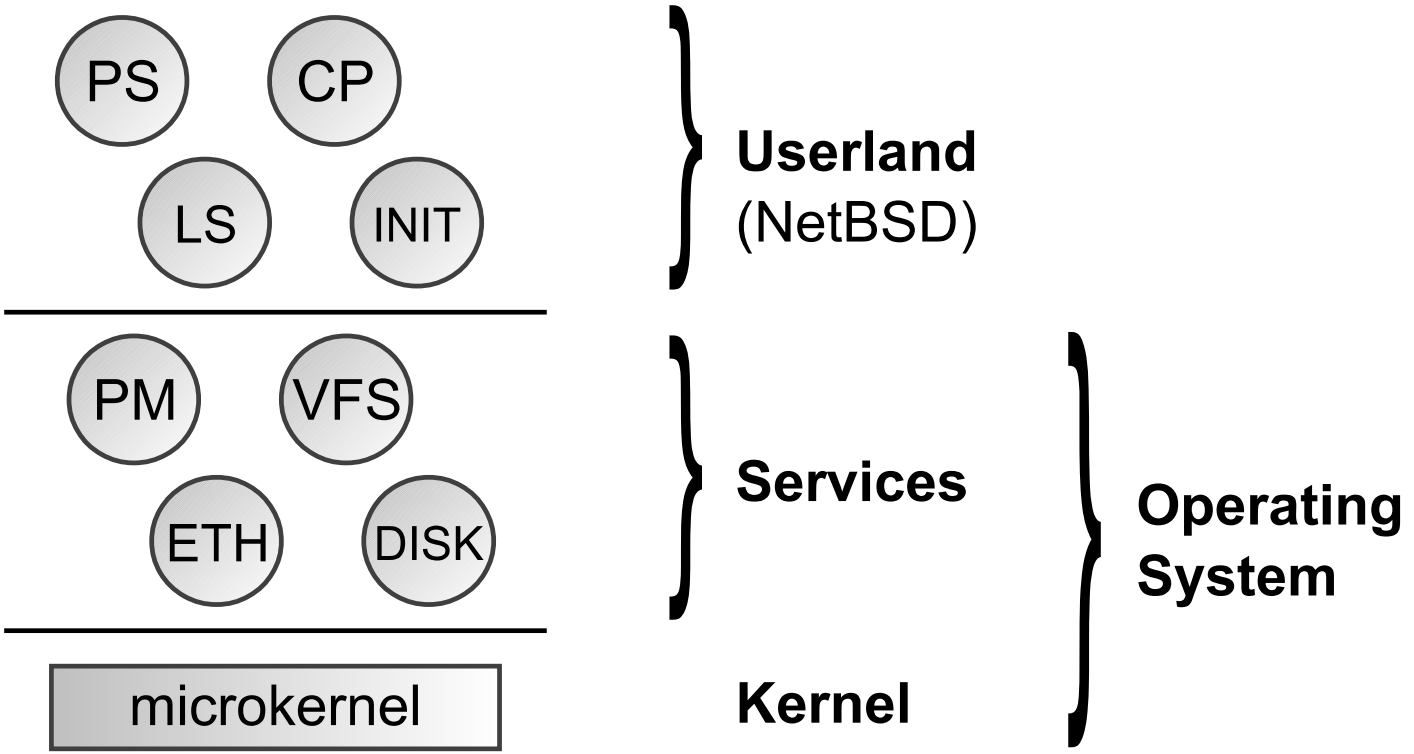

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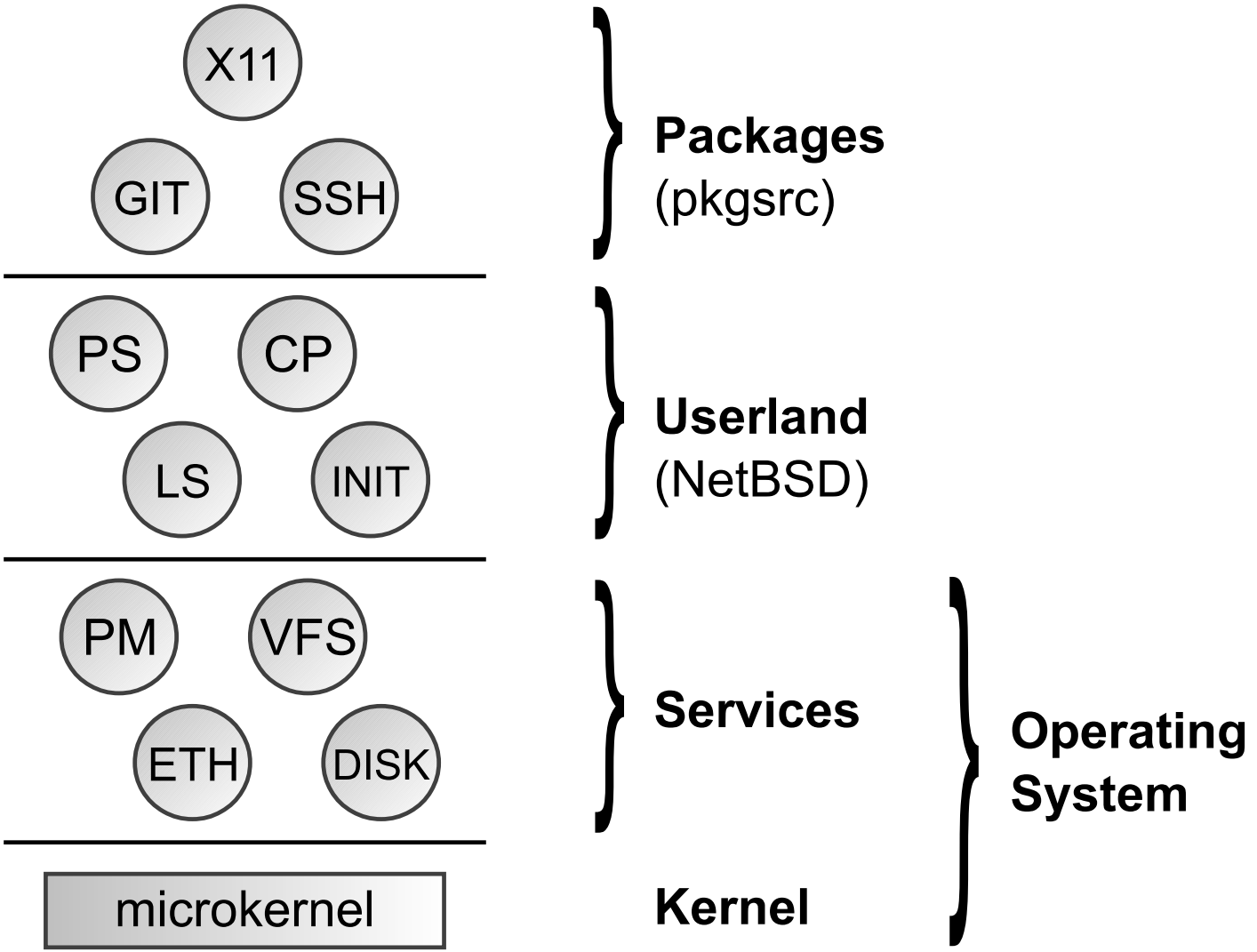

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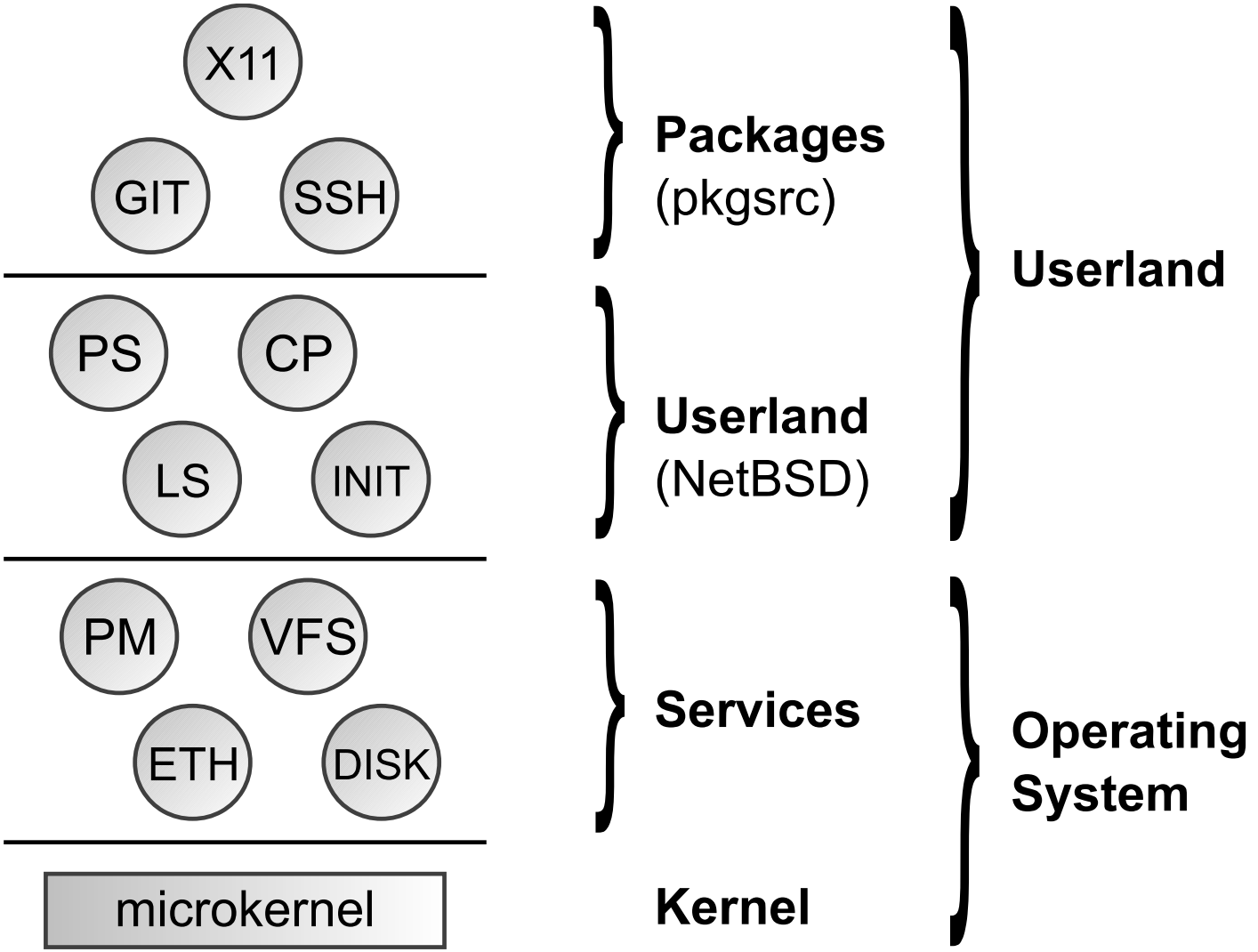

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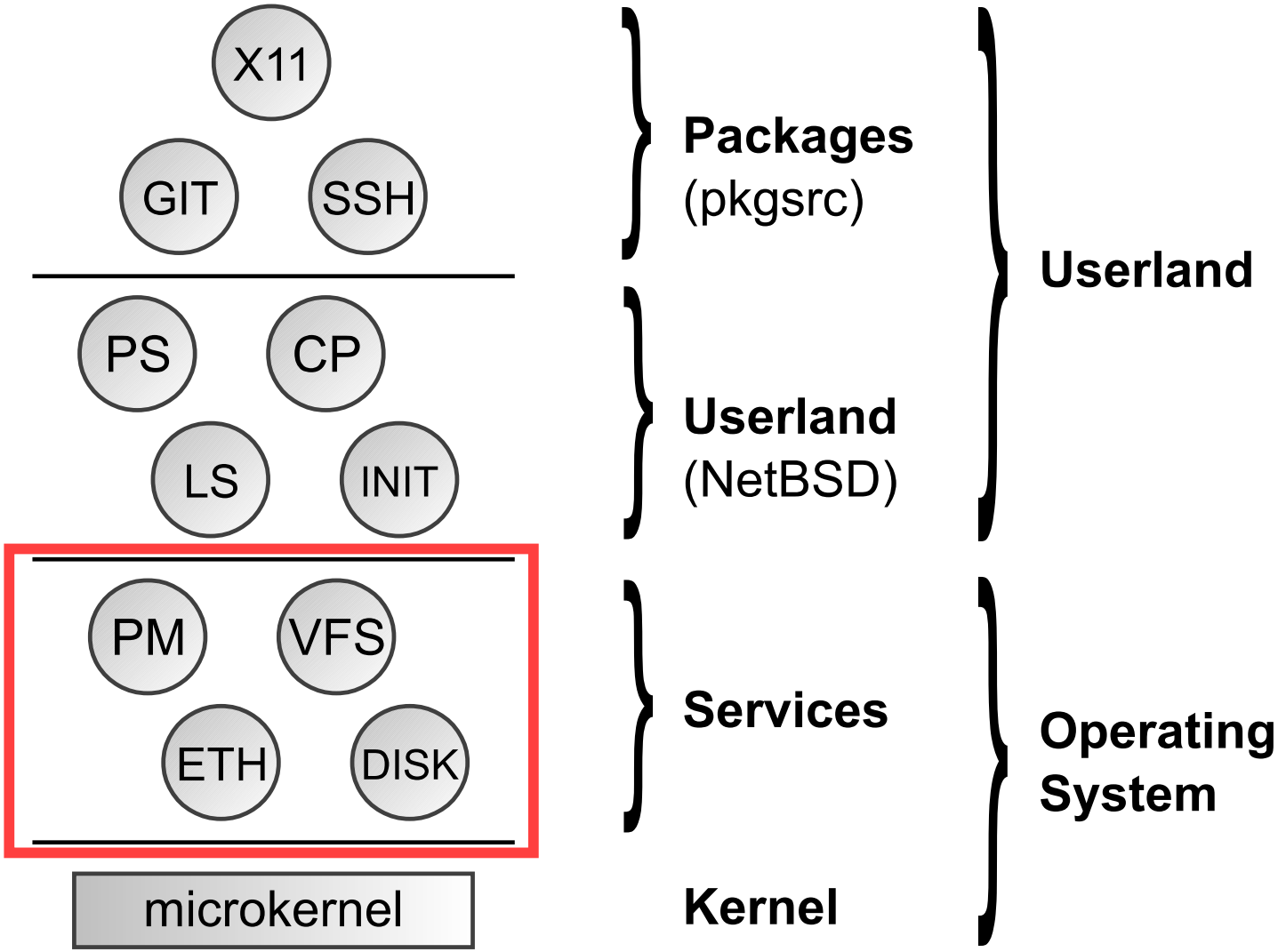
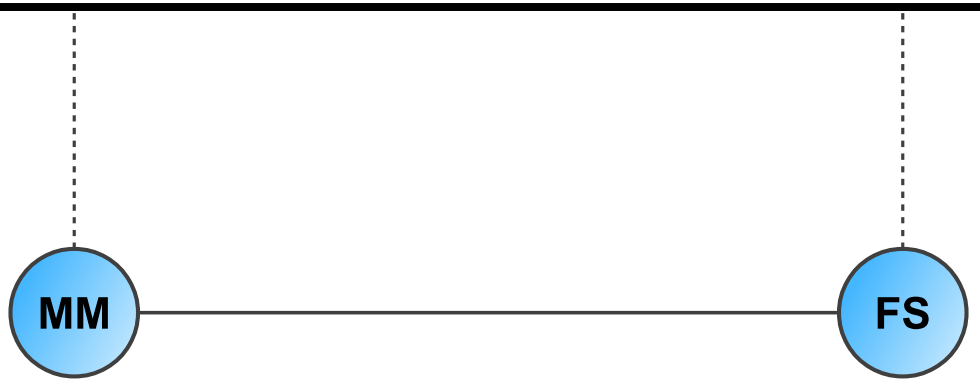


Service layer evolution

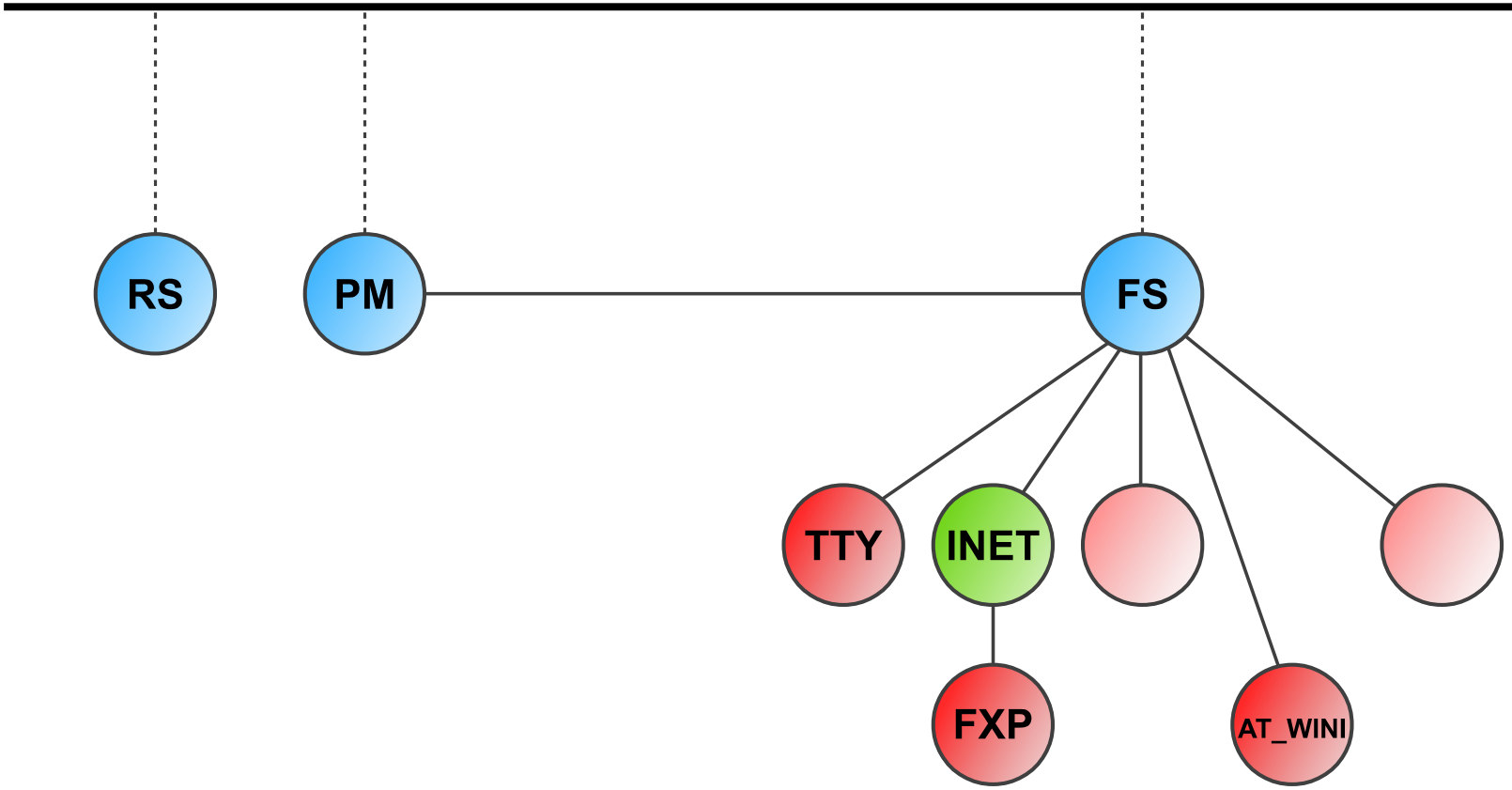


MINIX 1.0.0 (1987)

Service layer evolution

MINIX 2.0.0 (1996)

Service layer evolution



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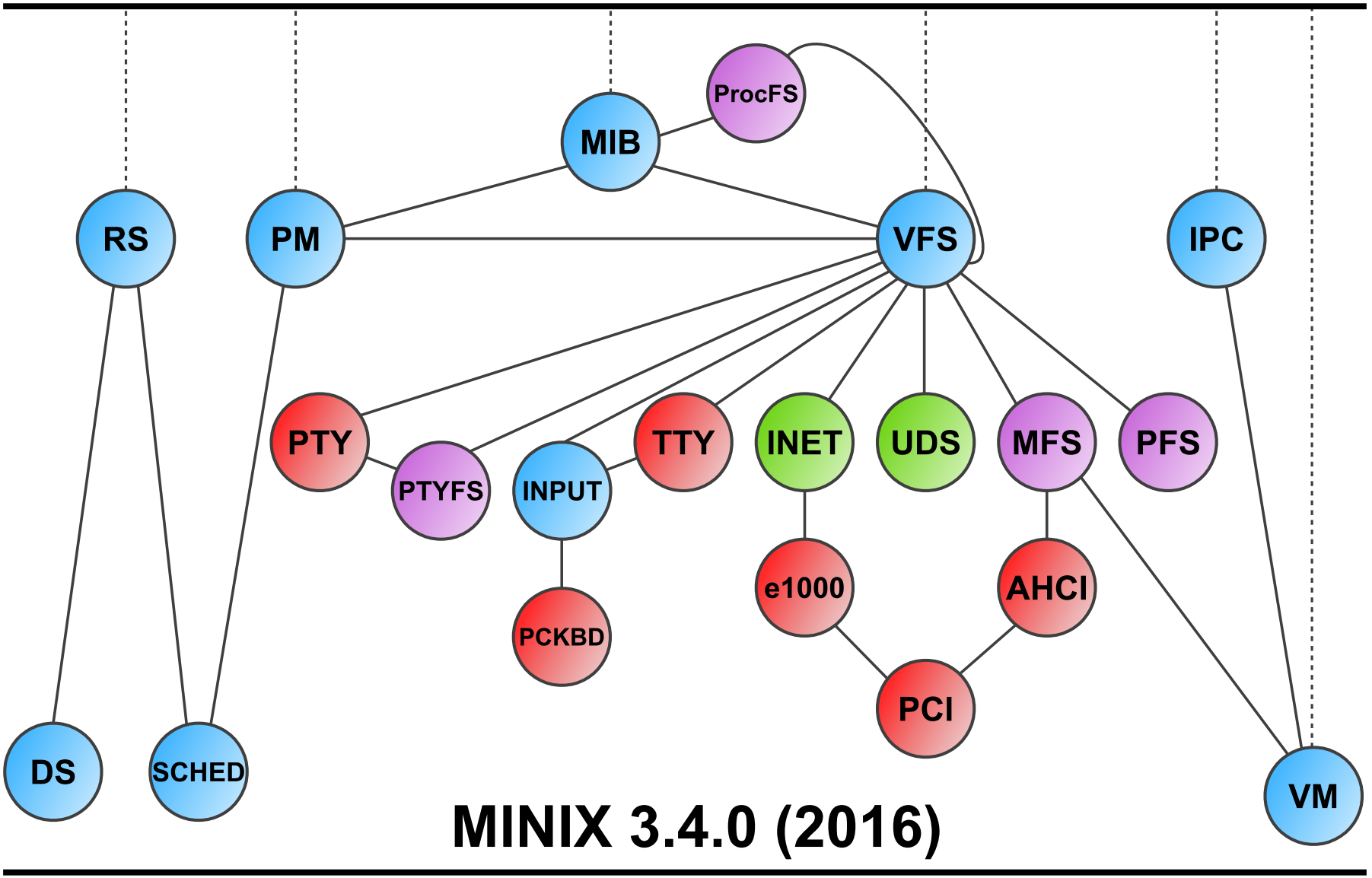

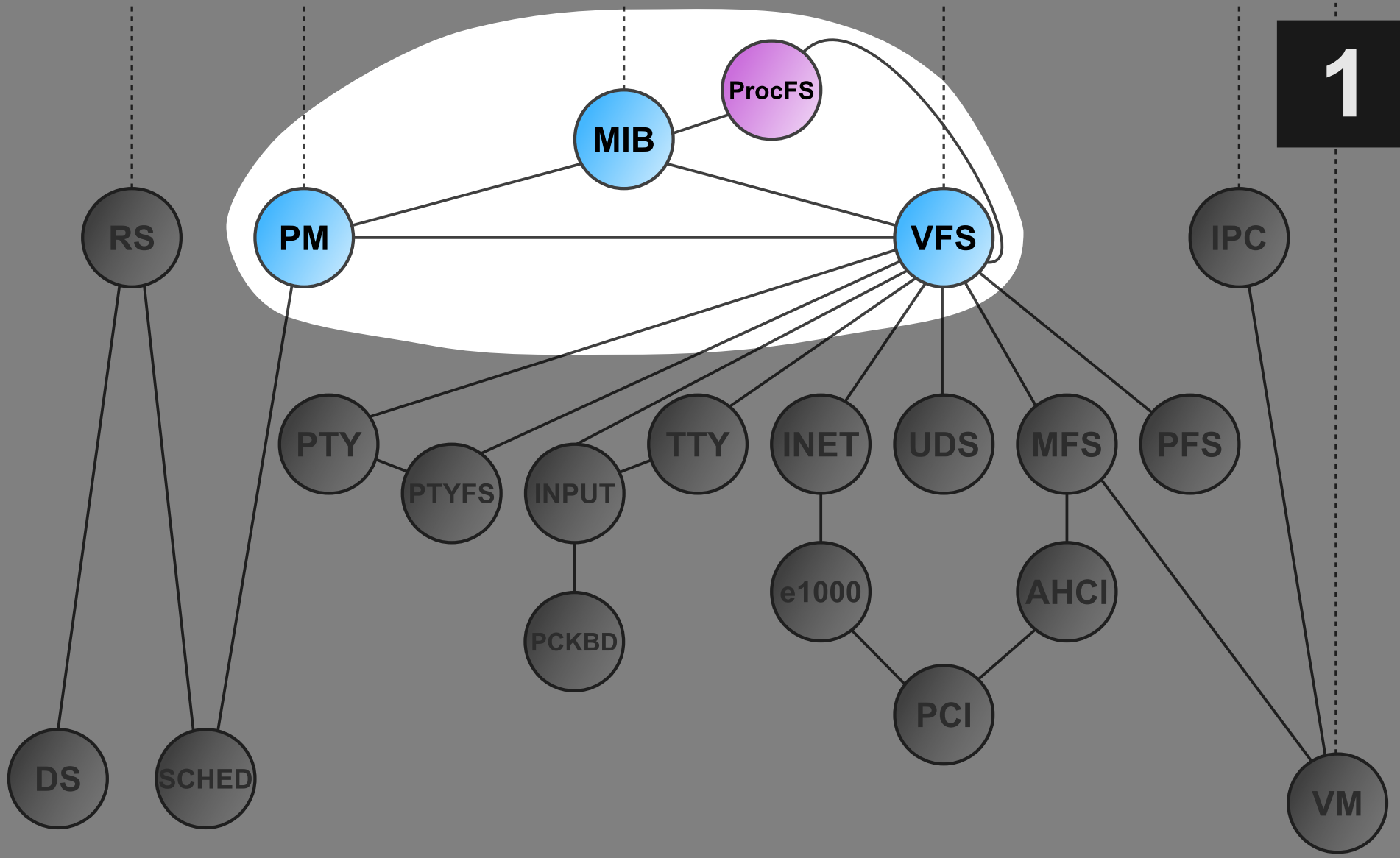

A new information service

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- In MINIX, ps needs info from *process tables*
  - Distributed across PM, VFS, and the kernel
- Traditional ps: get tables directly from services
  - Every system change requires ps recompilation

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  - Google Summer of Code 2009 project
  - Loosely based on Linux procfs, sysfs

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- That is, until we wanted to import **NetBSD ps**...

The *sysctl* interface


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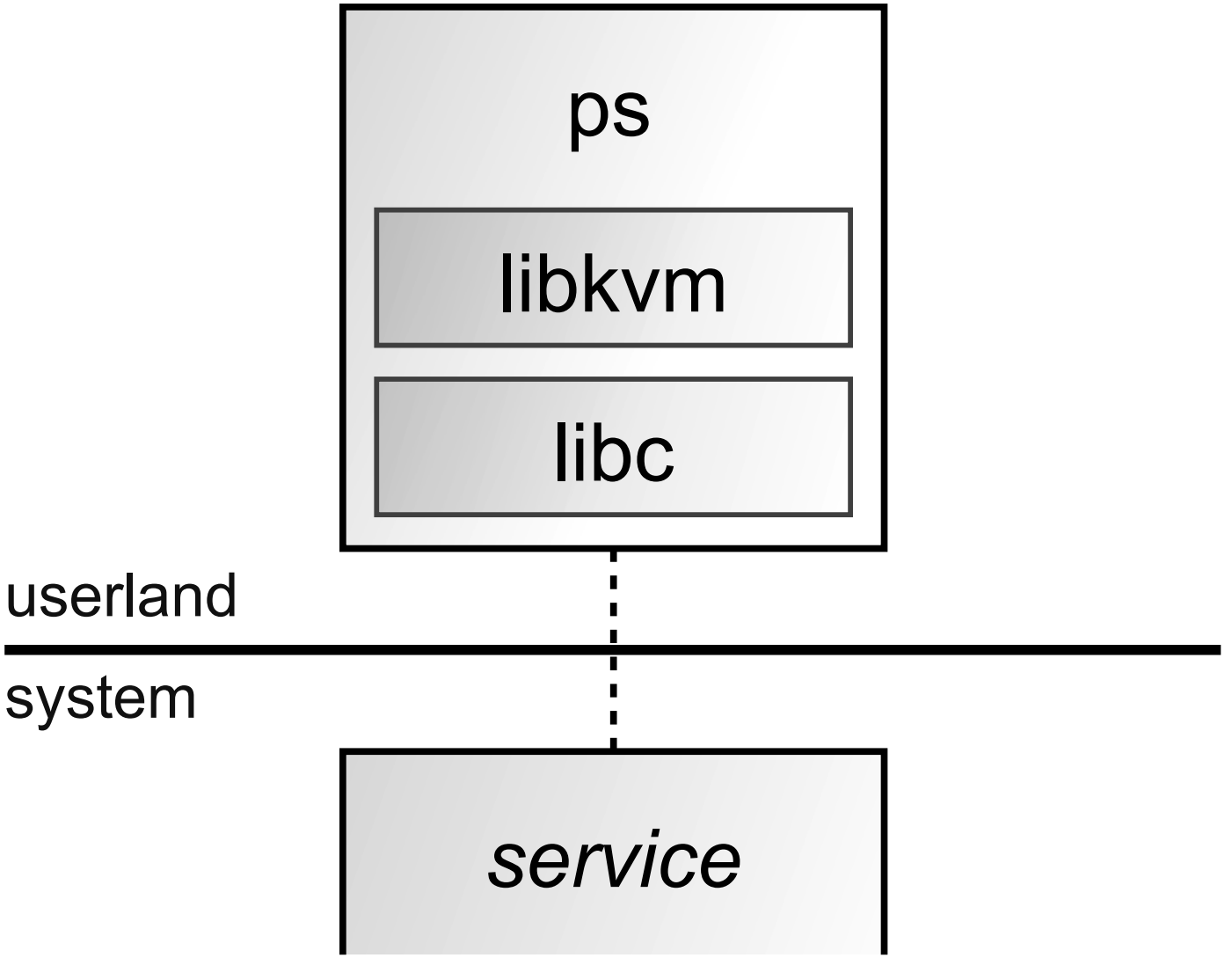
```

- Access to a hierarchical **key-value store**
- **Key**: an array of numbers, one per tree level
  - *Management Information Base* style
  - For example: 1.4.2.13.5
  - Symbolic names: “kern.hostname” instead of “1.10”
- **Value**: integer, string, or structure
- Not persistent; most keys managed by system

Importing NetBSD ps

1



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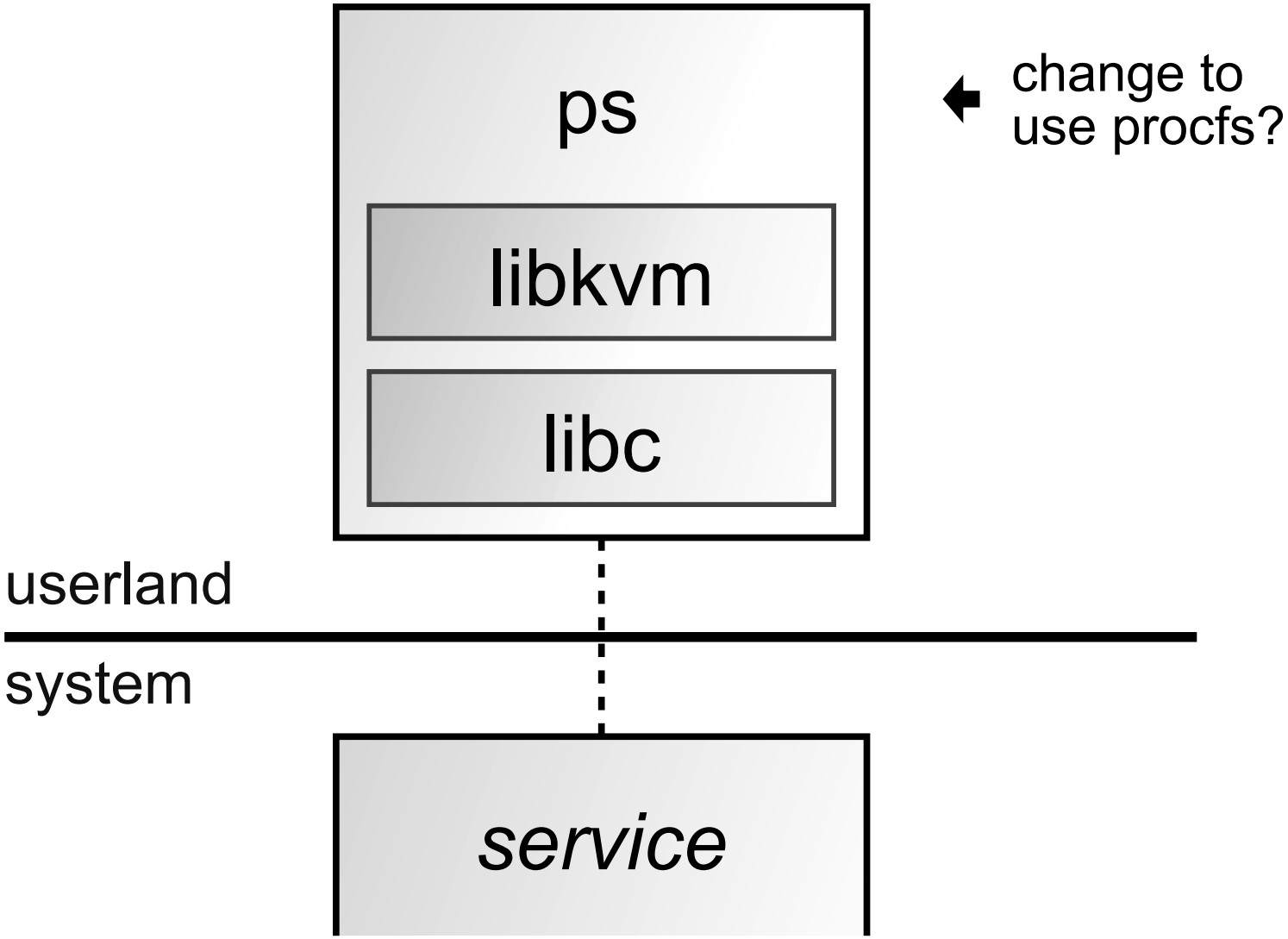

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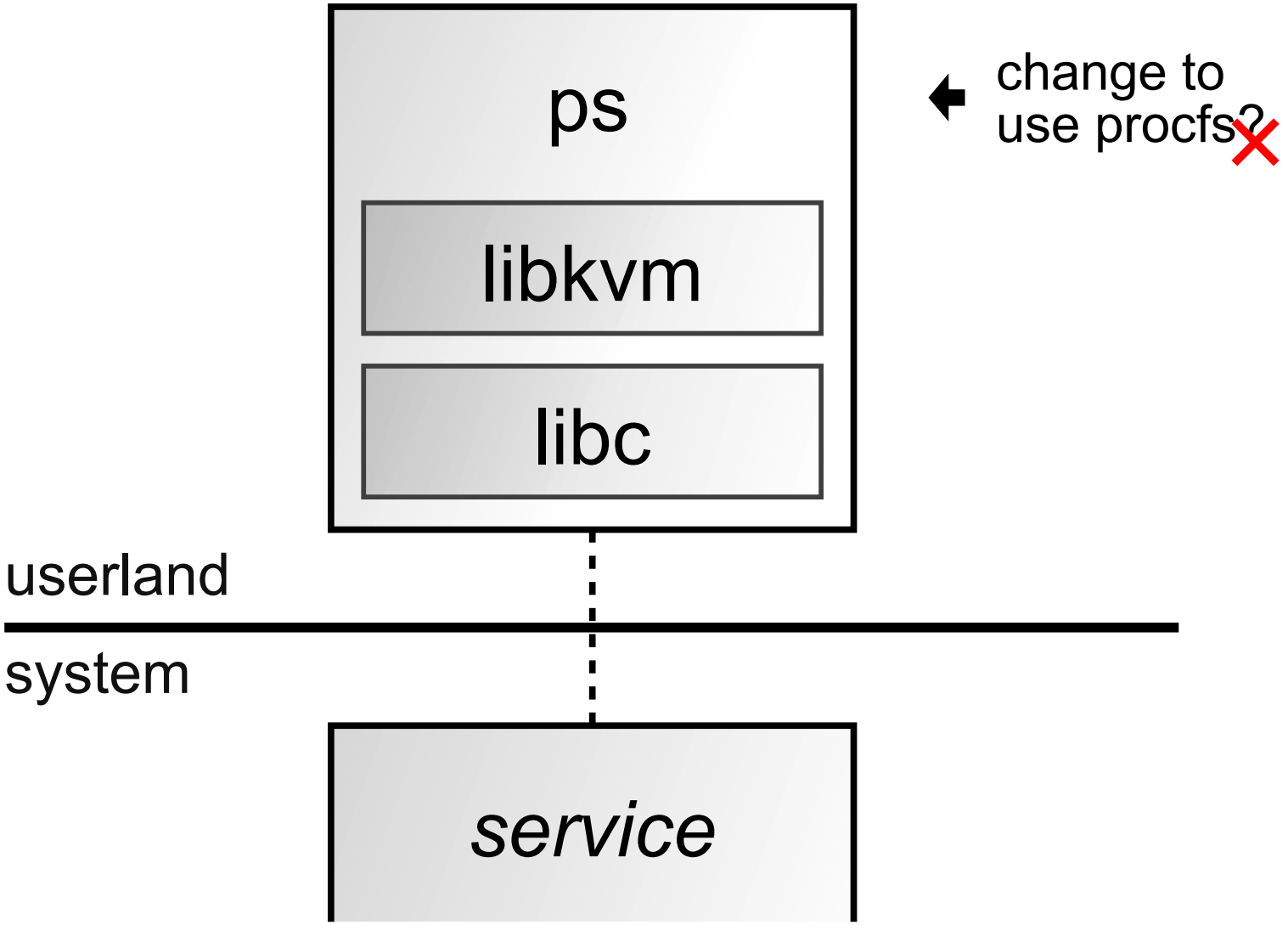

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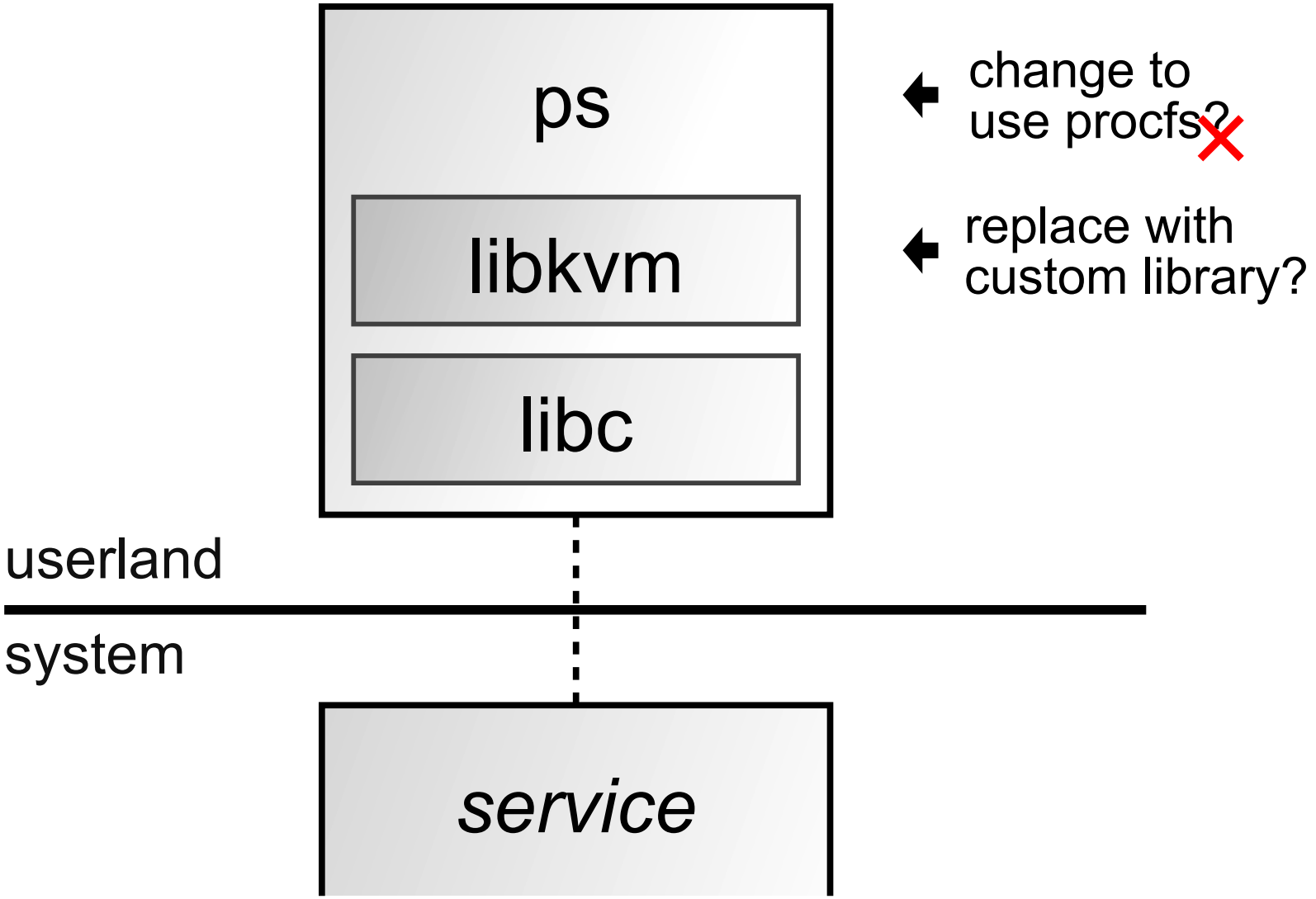

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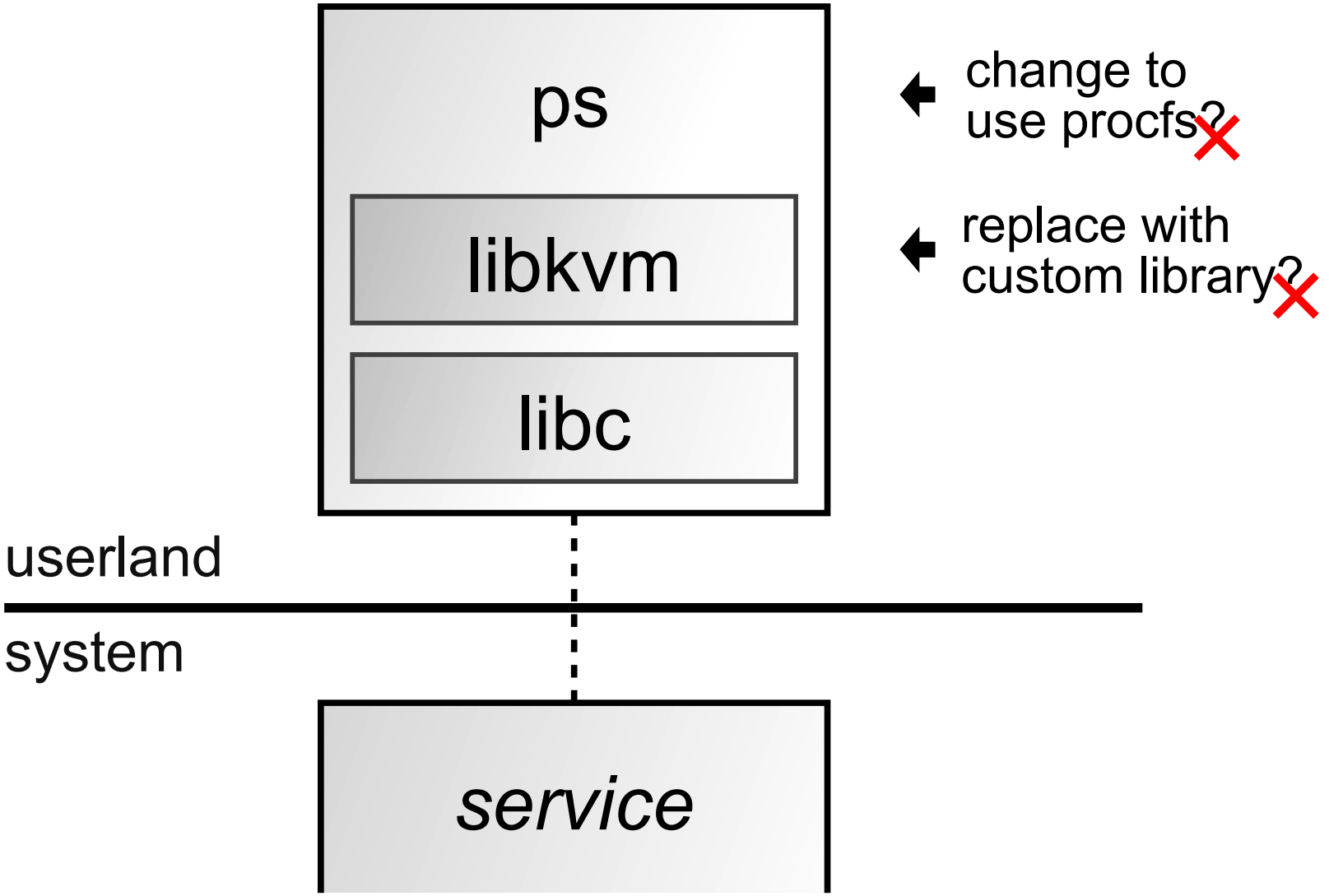

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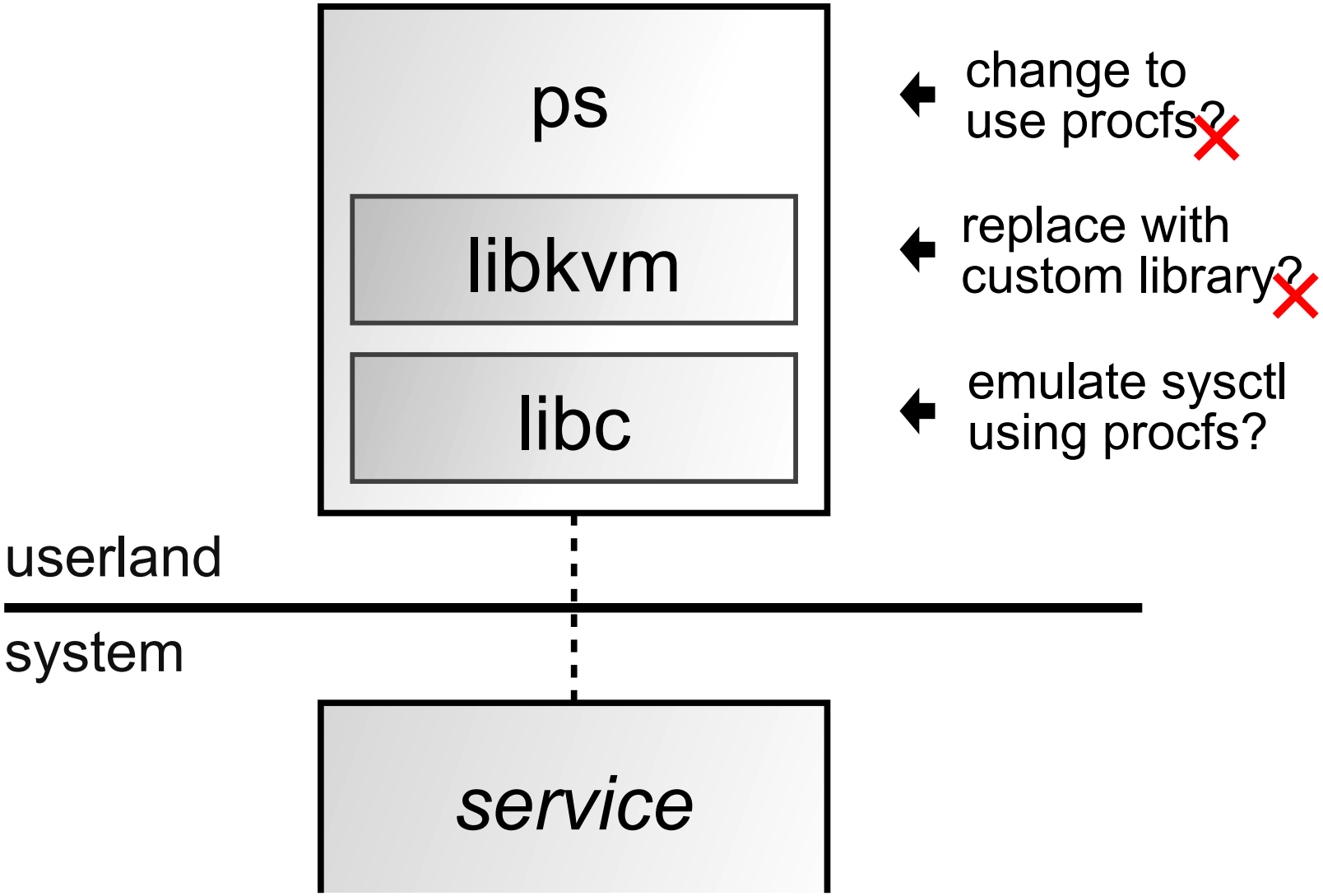

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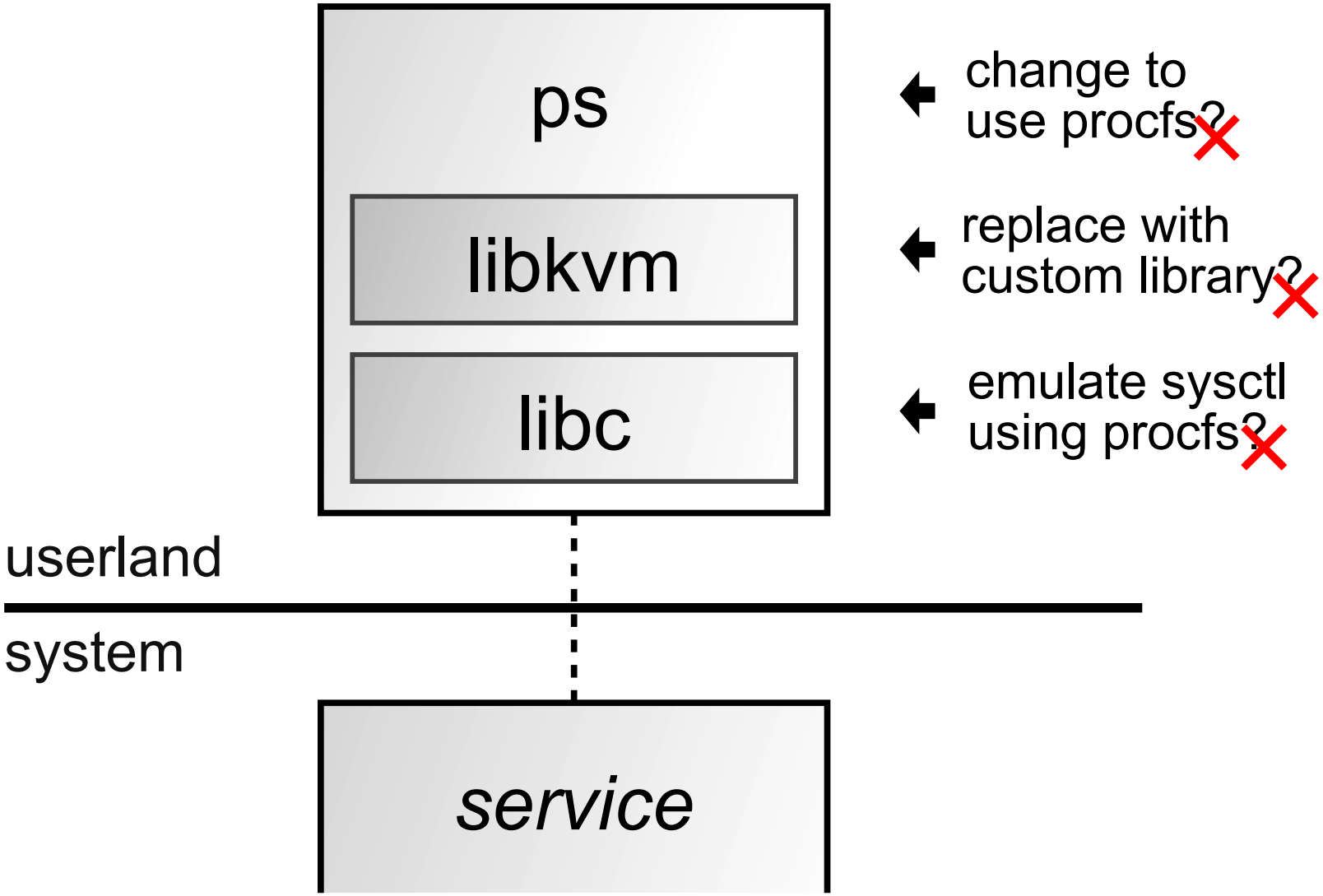

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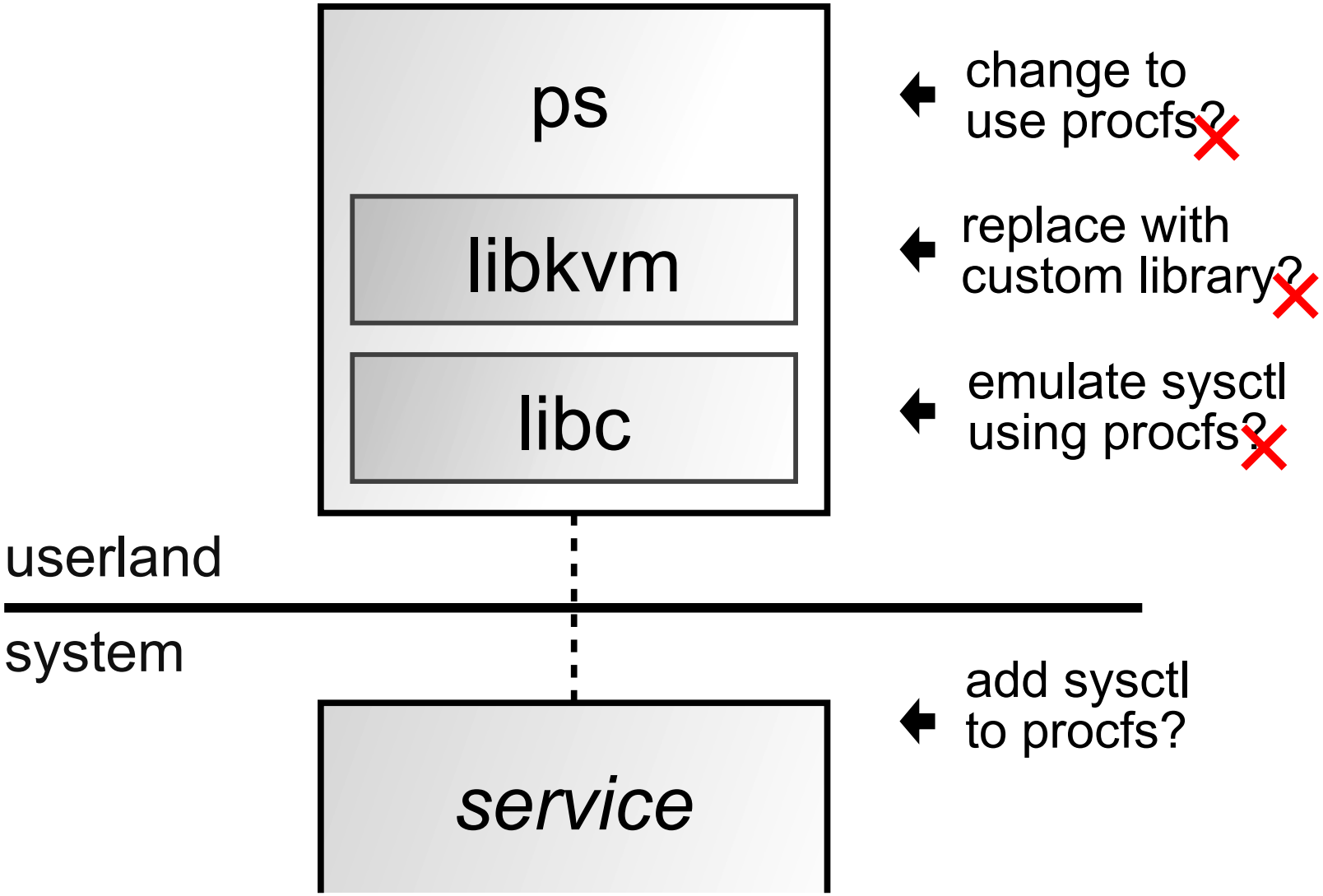

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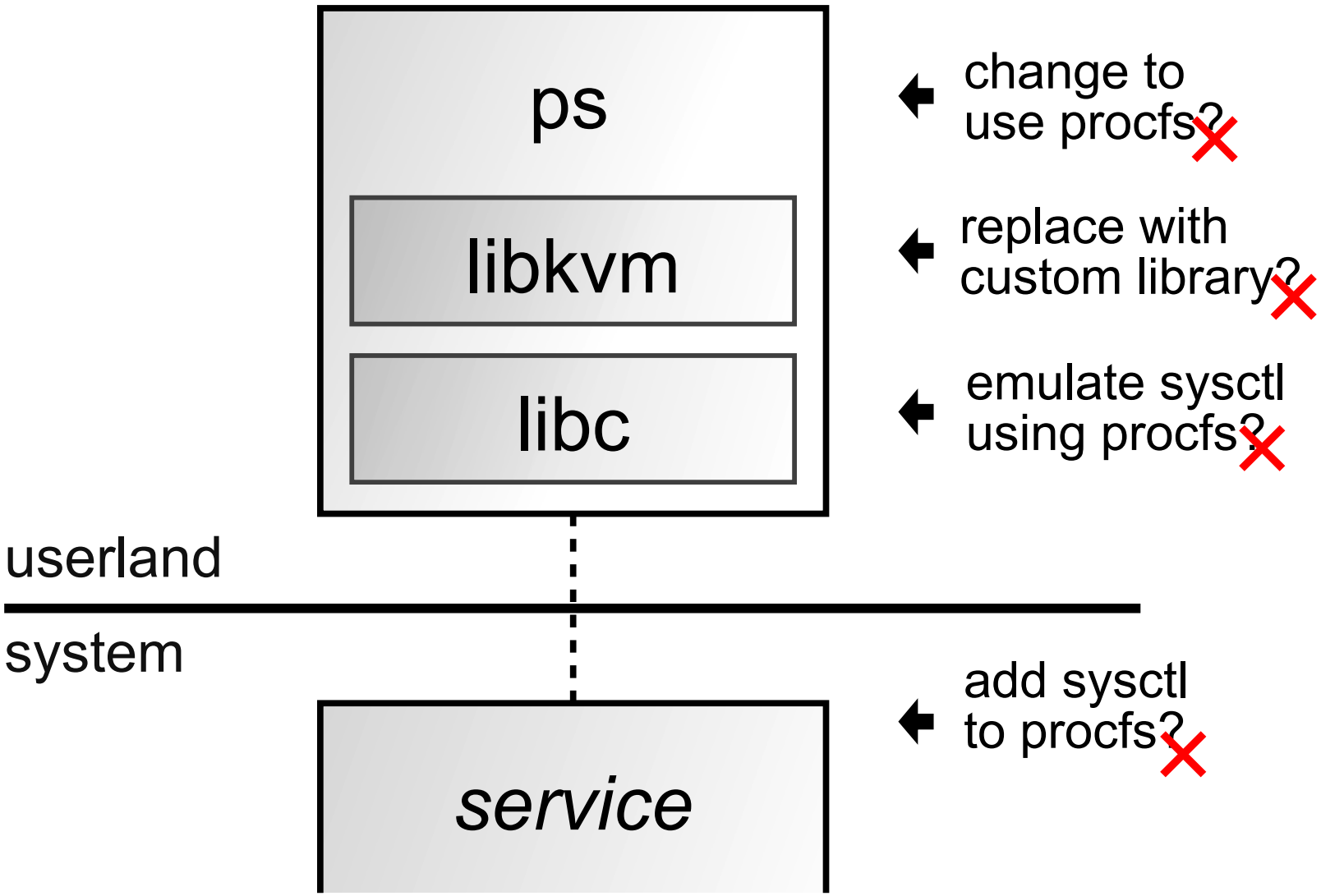

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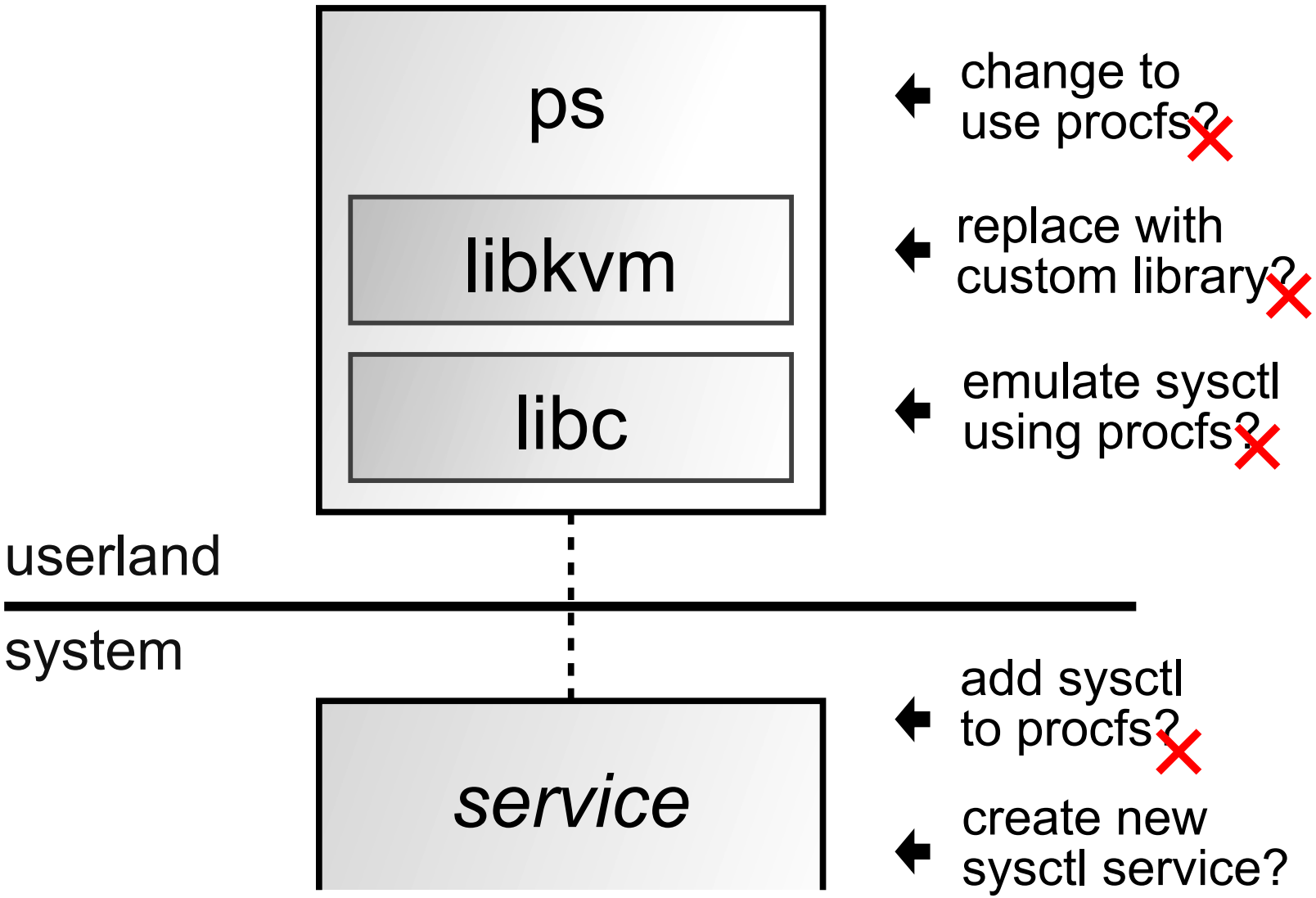

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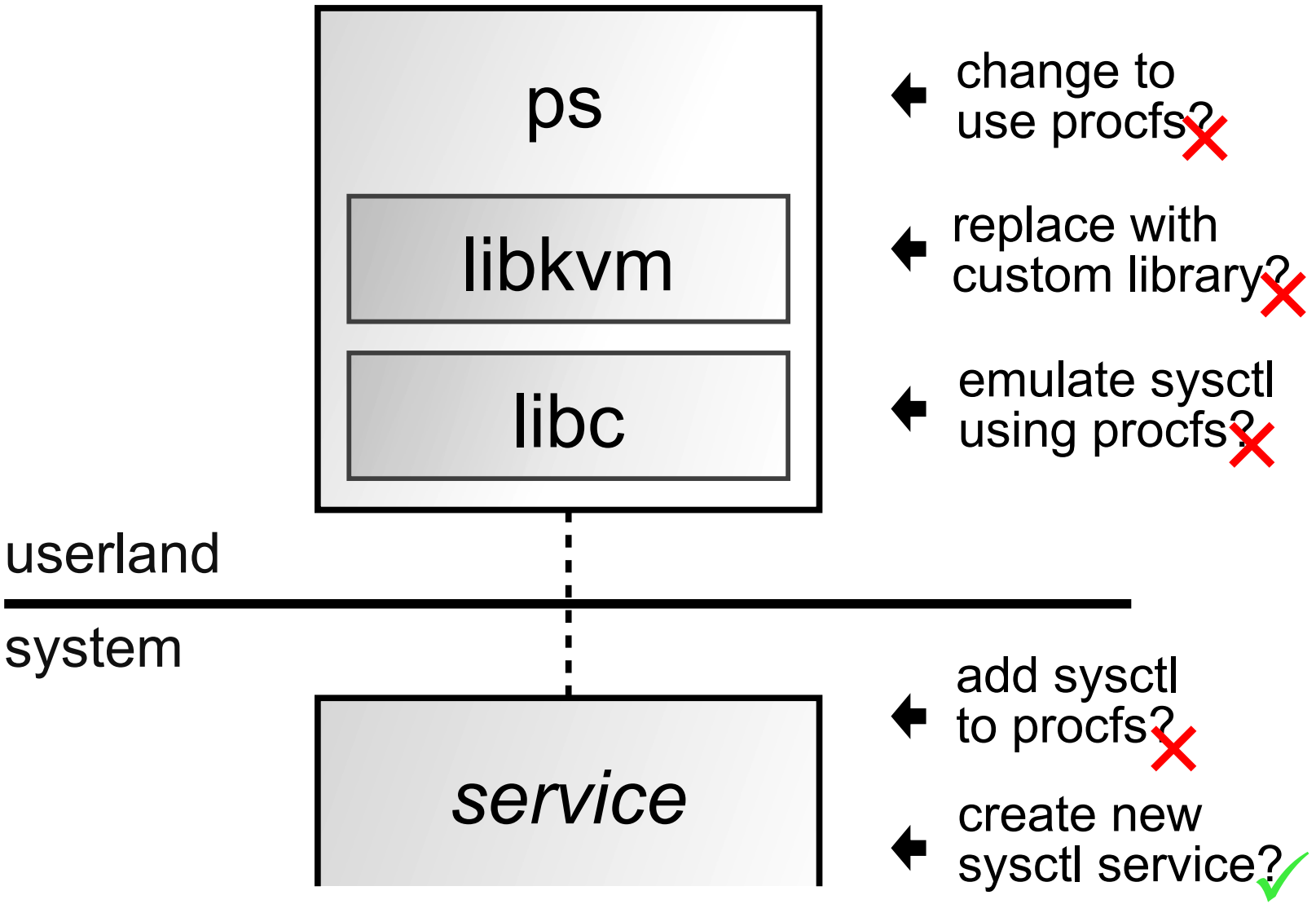

Current status and future

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- Management Information Base (MIB) service
  - **Merged**, available in 3.4.0!
  - About **85** of NetBSD's ~800 **keys** implemented
  - **4,146 LoC** (Lines of Code)
  - ProcFS now calls into the MIB service
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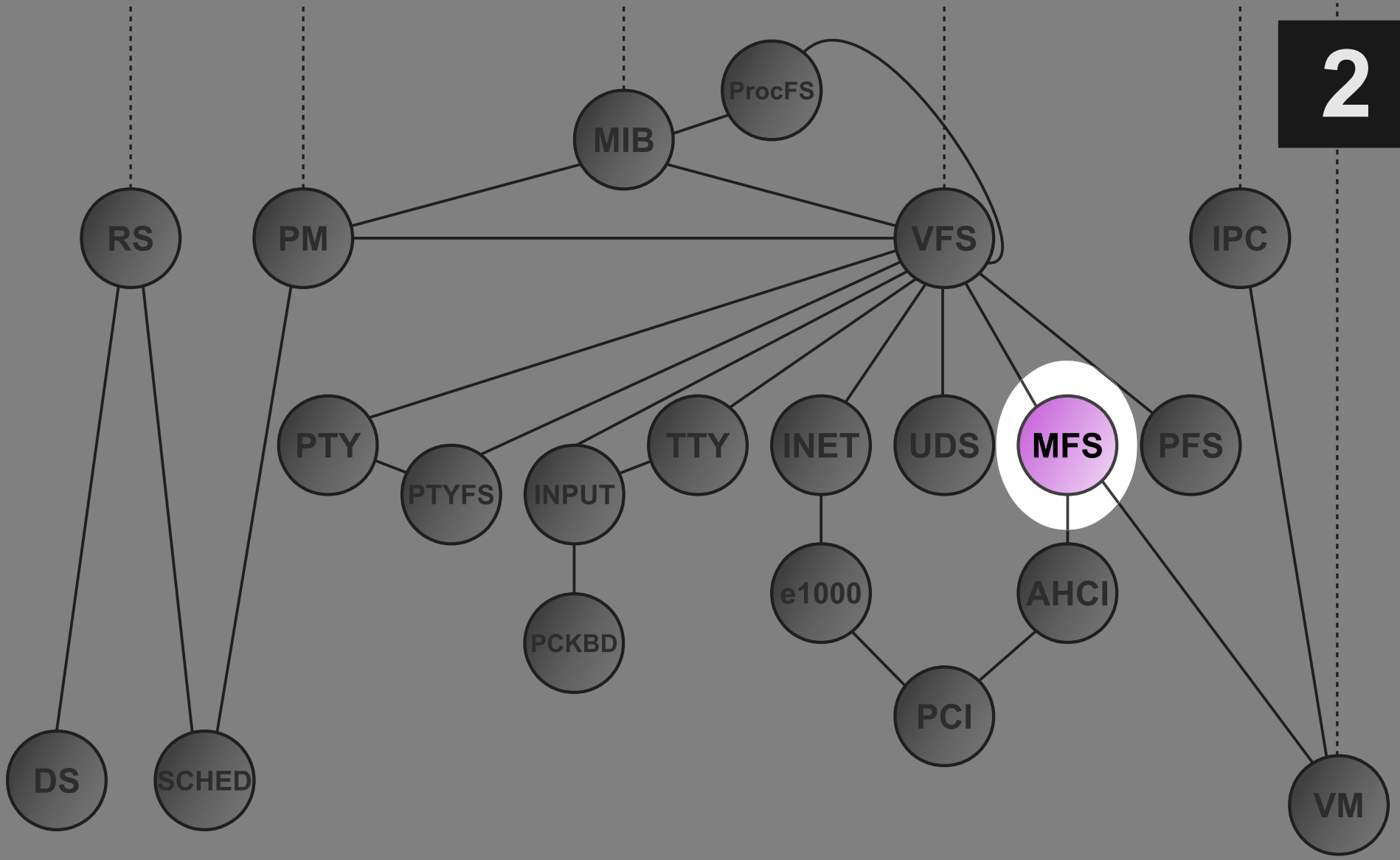
- A path forward for importing other NetBSD tools

Try it: *sysctl -a*

1

```
minix$ sysctl -a
kern.ostype = Minix
kern.osrelease = 3.4.0
kern.osrevision = 304000000
kern.version = Minix 3.4.0 (GENERIC)
kern.maxvnodes = 1024
kern.maxproc = 256
kern.maxfiles = 1024
kern.argmax = 262144
kern.securelevel = -1
kern.hostname = minix
kern.hostid = 0
kern.clockrate: tick = 16666, tickadj = 16666, hz = 60, profhz = 60, stathz = 60
kern.posix1version = 200112
...
vm.loadavg: 0.00 0.00 0.00
vm.maxslp = 20
vm.uspace = 0
hw.machine = i386
hw.ncpu = 1
hw.byteorder = 1234
hw.physmem = 1073213440
hw.usermem = 1069870560
hw.pagesize = 4096
:_
```



Library-based file systems

Disk-backed file systems

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  - 2006: “FS” service split into VFS and MFS
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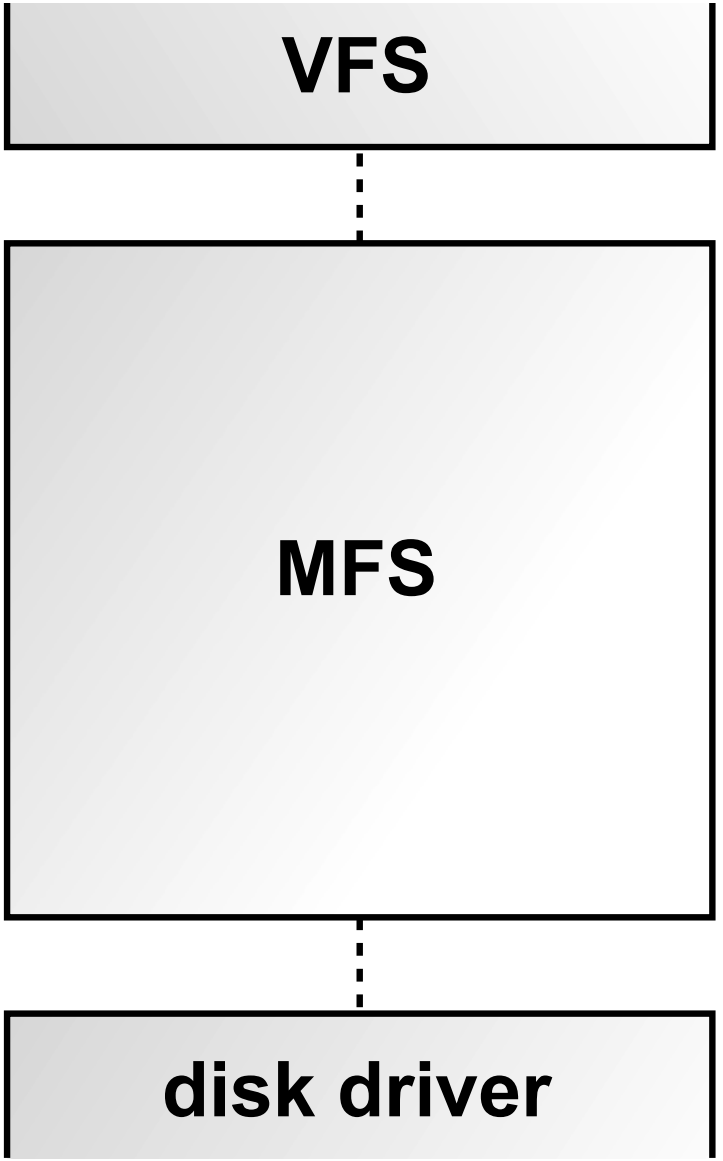
- What can we do to improve on this?

Some first steps



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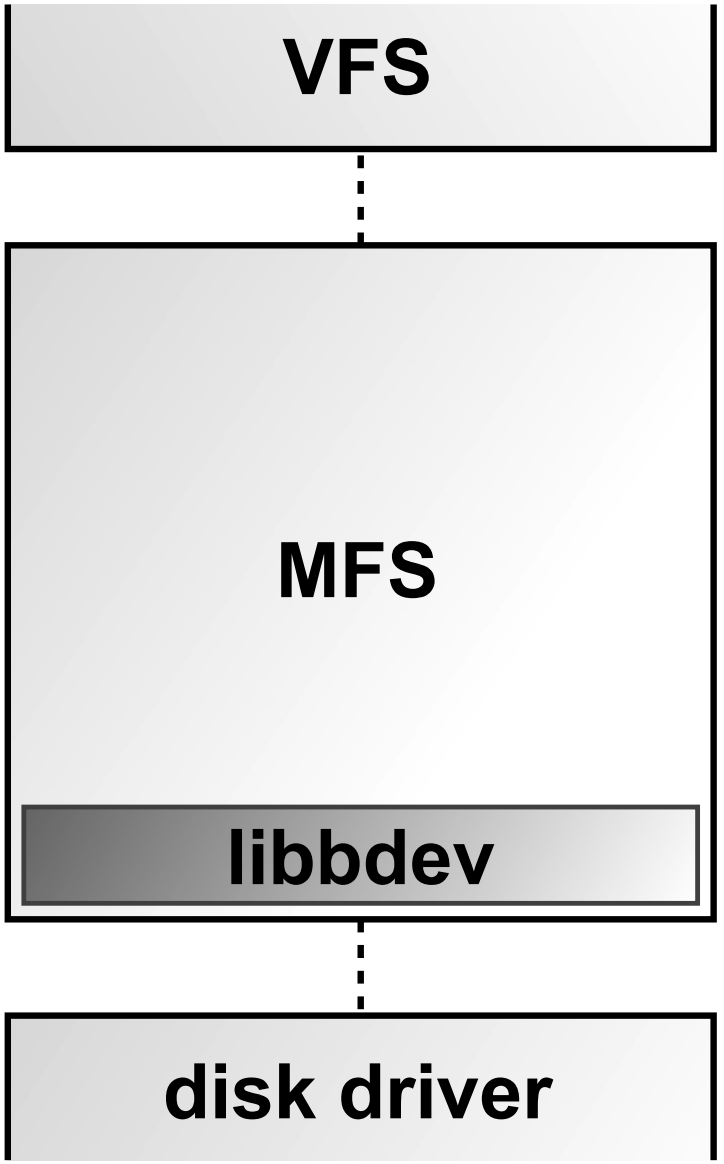

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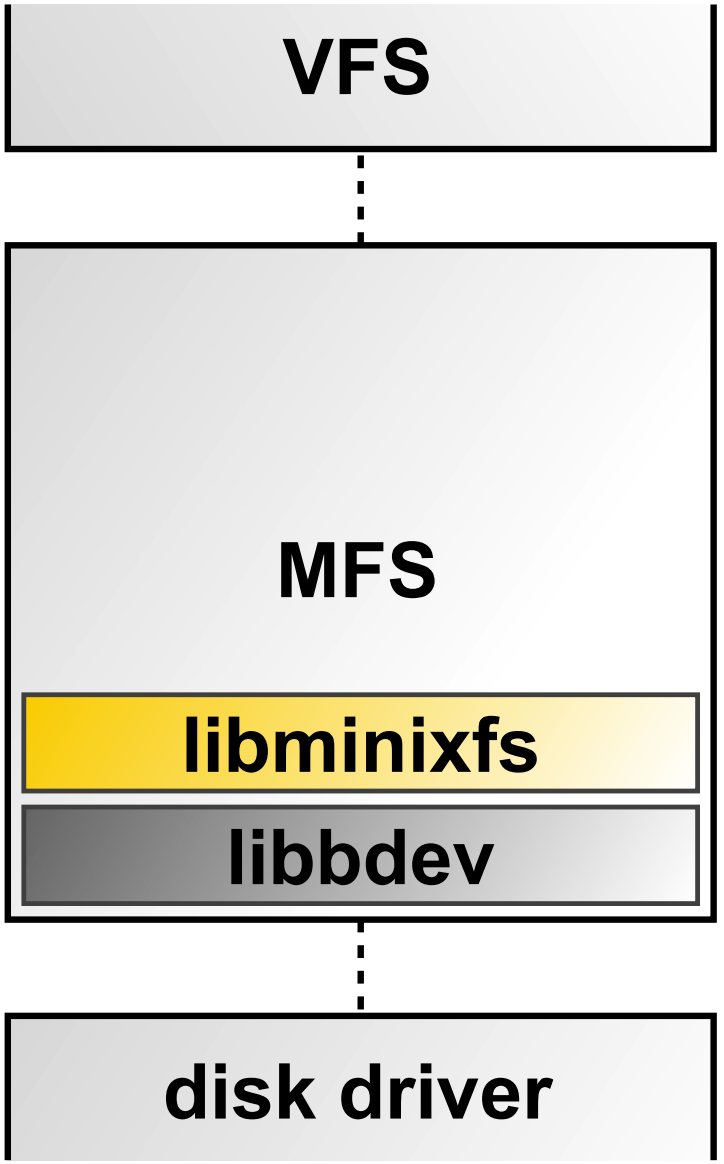

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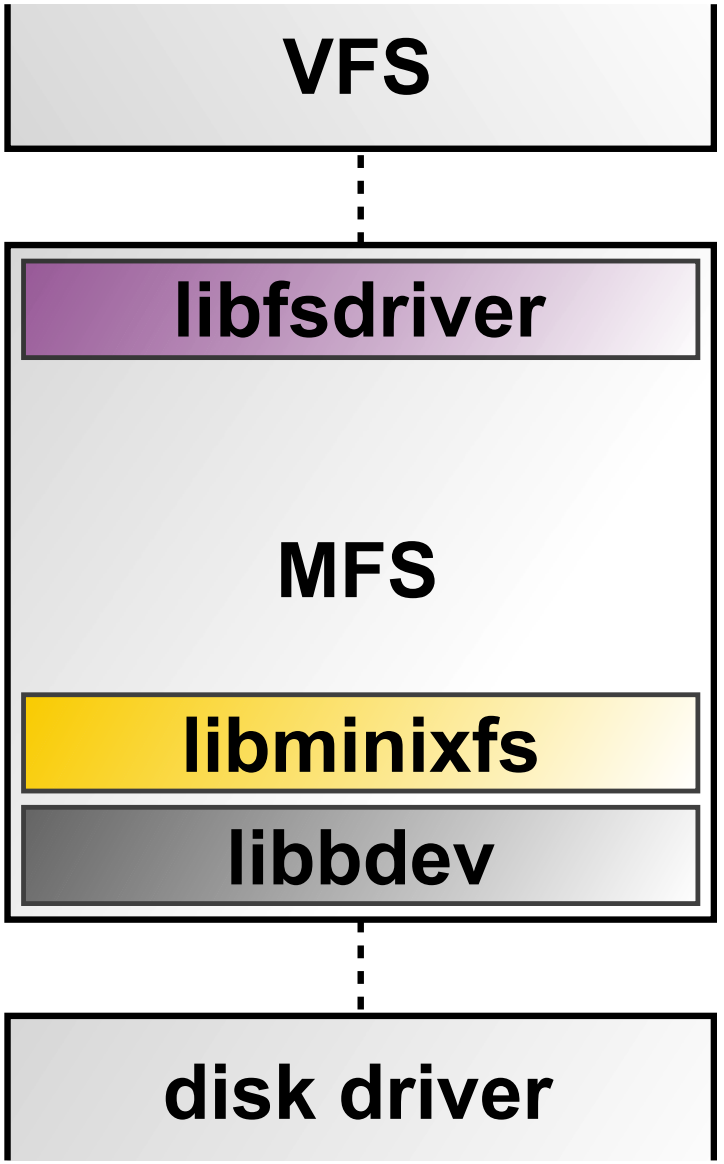

Towards decomposition

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- To **create** a file, one needs to..
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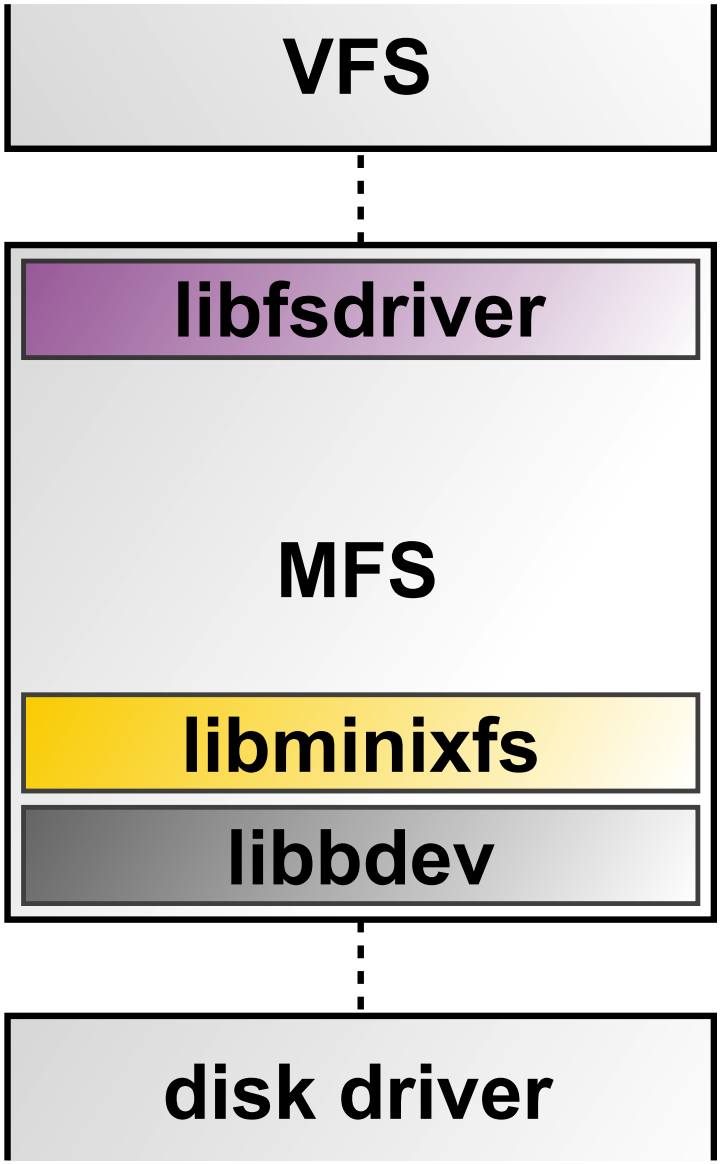
- This **graph-level logic** is (mostly) generic!
  - That means we can **reuse** that part

Splitting up the file system 2



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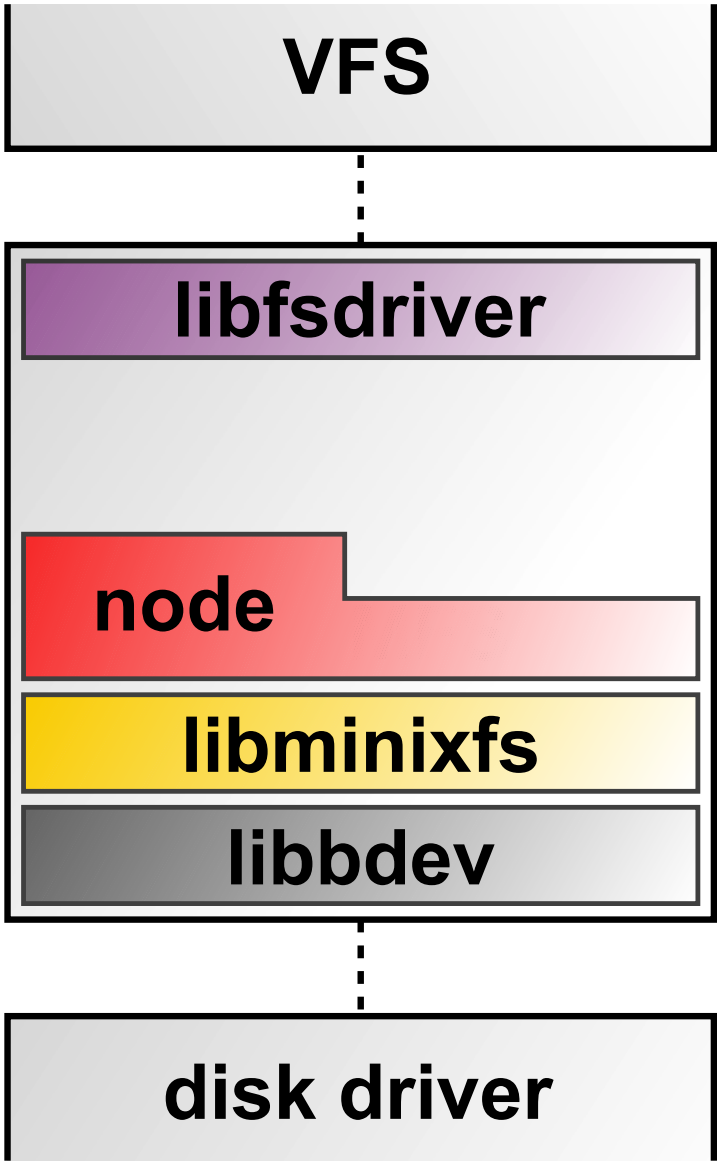

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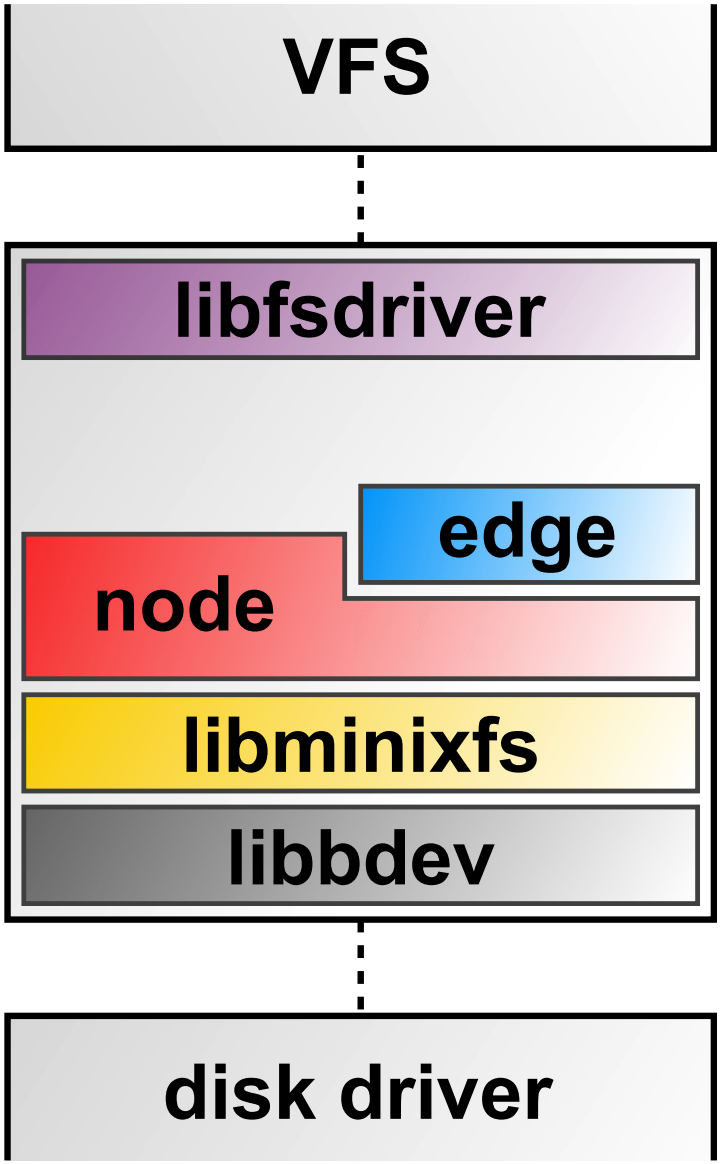

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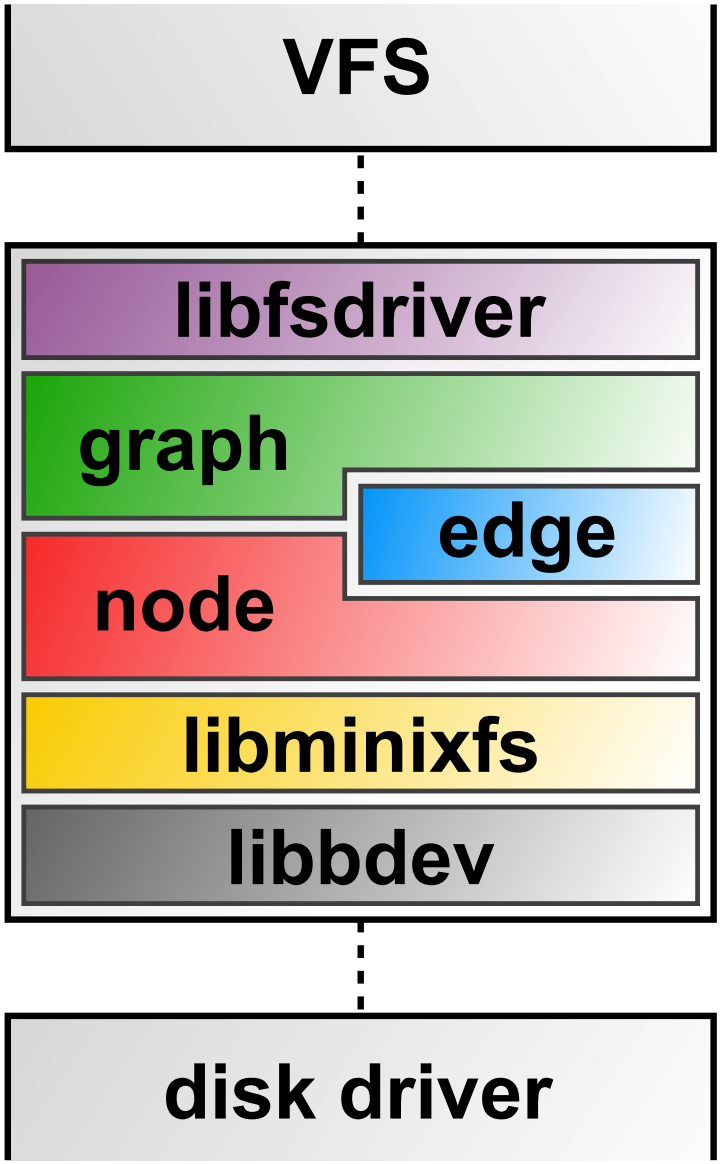

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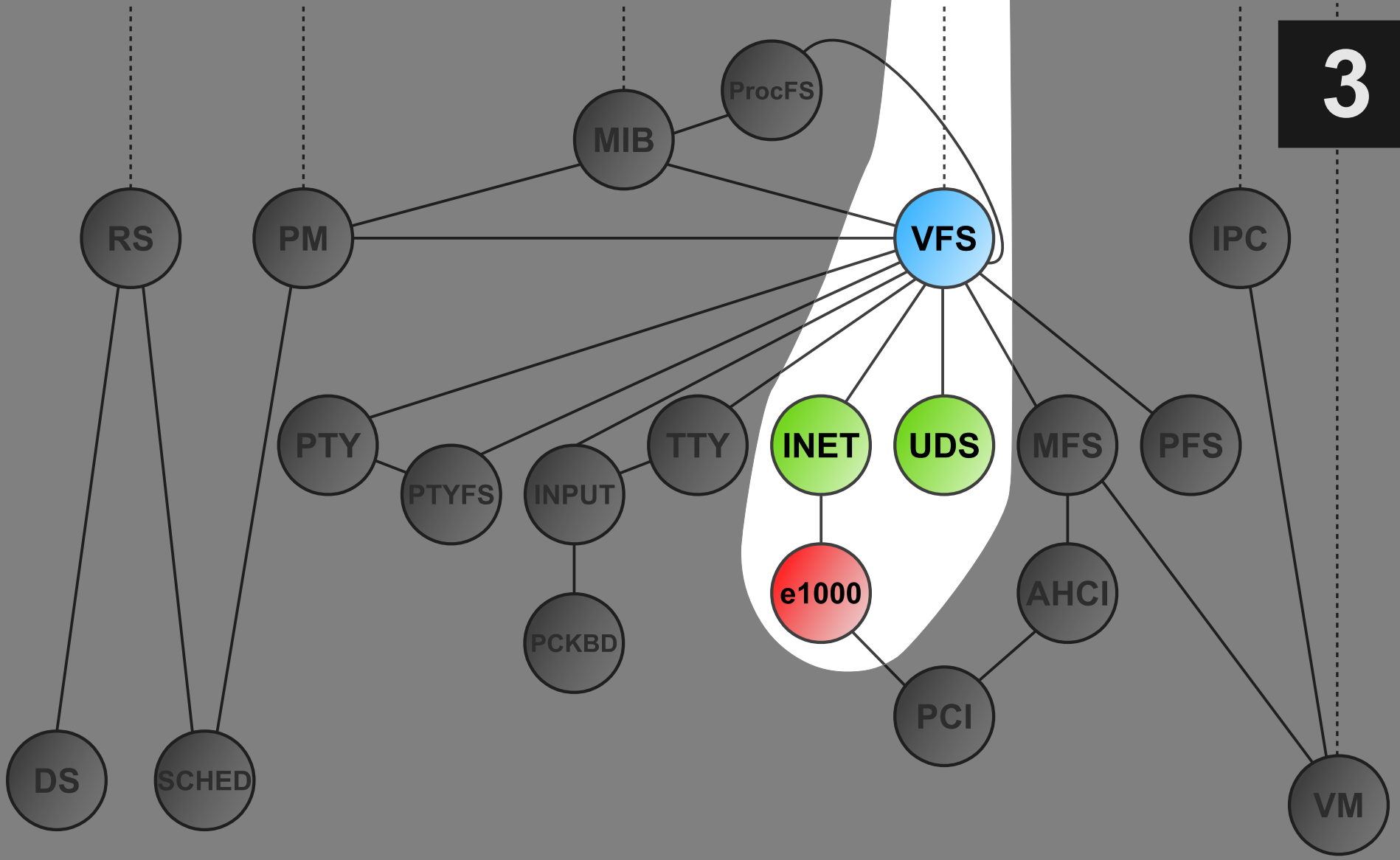
- A way forward to *simplify* writing FS services



Network stack redesign

A tale of scope creep

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- **Now**: three subprojects
  - Native BSD socket API
  - Replacing the TCP/IP stack
  - Revisiting the packet level

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- **Solution**: turn BSD socket calls into syscalls
  - Turn INET and UDS into “socket drivers”
  - VFS forwards socket calls to right socket drivers
- **Current status**
  - All infrastructure complete (but untested)
  - Almost done converting UDS to socket driver

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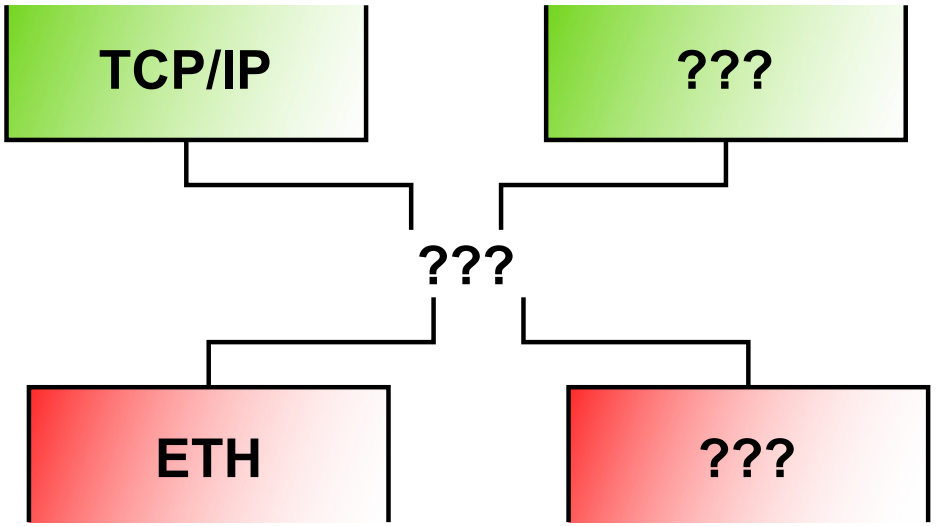
- Leaning heavily towards option **2**

Revisiting the packet level

- Preparing for the **future**
  - Support for other protocol families?
  - Support for non-ethernet devices?
  - Support for a firewall?



Conclusion

- The service layer is evolving rapidly
  - MINIX is growing up and catching up
- That calls for proper software engineering
  - Not just **adding** functionality
  - But also **restructuring** what is already there
  - And **reducing** redundancy
- The main concern is **maintenance**!

How to contribute (1)

- **We could use your help!**
- Code development...
  - Porting more of NetBSD userland
  - Writing a device driver
  - Filling in missing functionality
- ...and other activities
  - Documentation
  - PR work
  - Testing

How to contribute (2)

- **Information and wishlists**
  - Wiki: http://wiki.minix3.org
- **Source code, bug reports, submitting code**
  - GitHub: https://github.com/Stichting-MINIX-Research-Foundation/minix
- **Getting support**
  - Newsgroup: http://groups.google.com/group/minix3
  - IRC: FreeNode #minix-dev

End of talk

david@minix3.org