GEOM

Disk handling in FreeBSD 5.x

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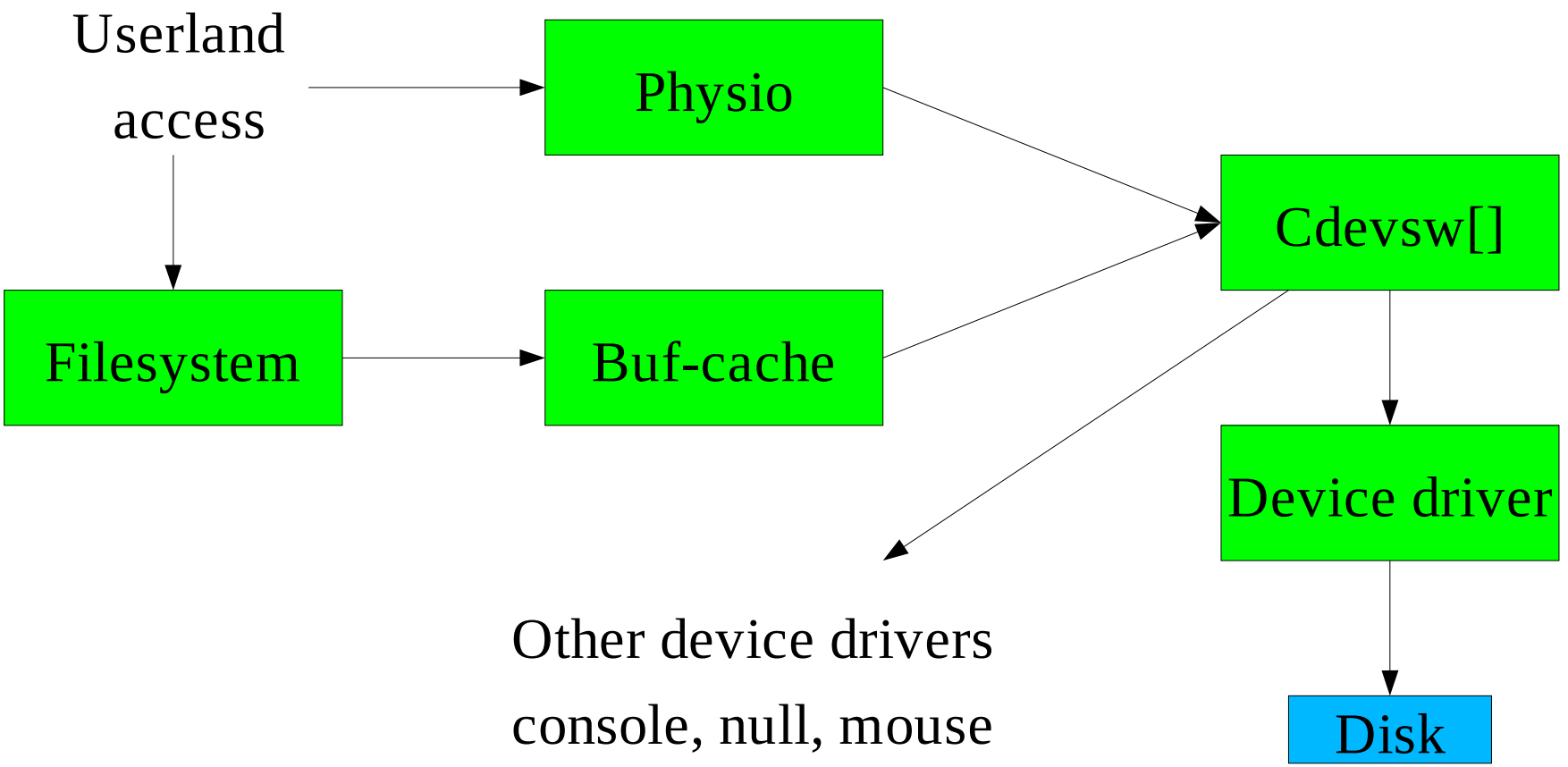
What is “a disk” ?

- In UNIX “a disk” is an array of fixed size sectors.
- Sector size is typically 512 bytes.
- Device driver implements two simple operations:
  - read(void *buffer, unsigned sector, unsigned count)
  - write(void *buffer, unsigned sector, unsigned count)

Code structure



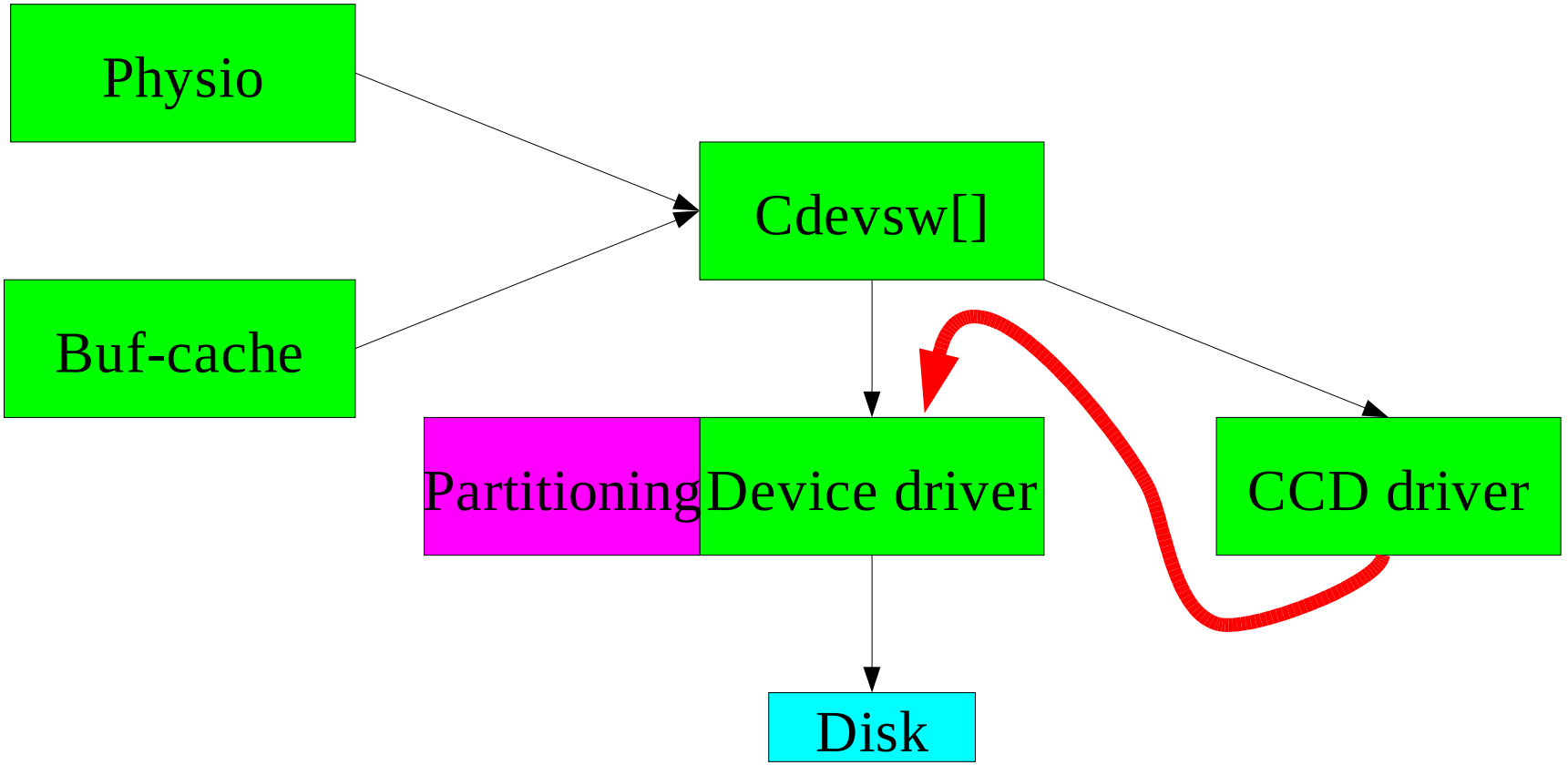
Complications...

- Multiple operating systems on a disk.
- Multiple filesystems on a disk.
- Solution: “Disk partitioning”
  - “lets just hack it into the disk driver”
  - Disk driver pretends to be multiple disks
  - No change in the rest of the kernel.

More complications...

- Striping, Mirror & RAID
- “I guess we'll make it a pseudo device driver...”
  - Pseudo device driver implements a disk device.
  - Requests are “fixed up” and sent to the “real” disk.

Code structure



Erhmm...

- Multiple disklabel formats
  - BSD, MBR, GPT, SUN, PC98, MAC (...)
- Reading “alien disks”
  - MAC format on a PC ?
  - PC98 format on a Sun ?
- Increasingly complex for each new architecture we add.

eehhhhh...

- Disk encryption
- Volume managers
  - RaidFrame, vinum etc.
- Volume labels
- ... and a lot of other really neat ideas.

The final straw...

- Disks which come and go.
  - It used to be that the disk you had at boot would stick around, and no new disks would appear.
- FibreChannel, SAN, RAID devices
  - “disks” are really software abstractions.
- USB, Firewire
  - Cameras, iPods, dongles, flash keys &c &c

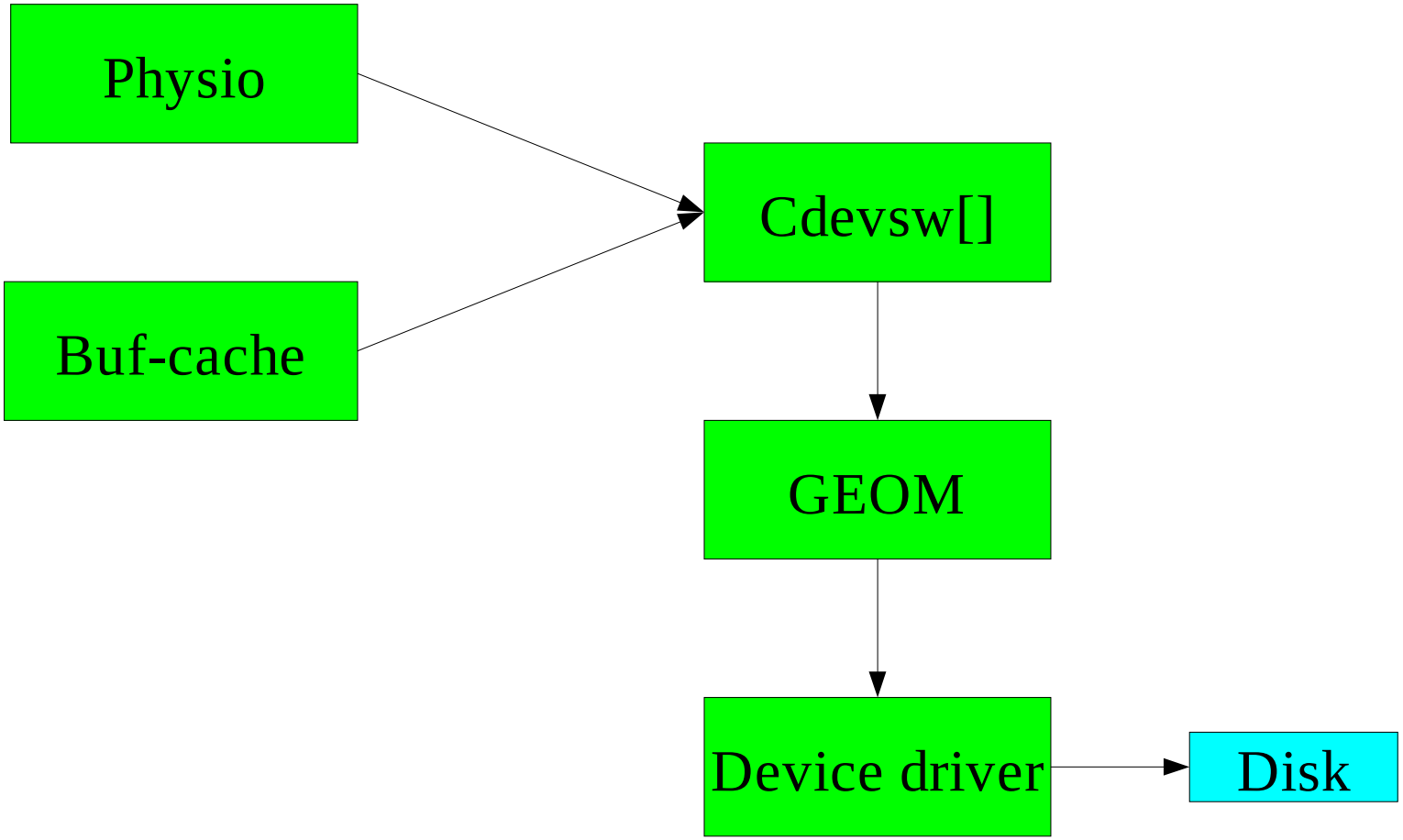
GEOM

- GEOM is a framework for classes which perform transformations on disk I/O.
- Extensible:
  - New classes can be loaded on the fly
- Apolitical:
  - Classes can stack in whatever order they want
- General:
  - Any sort of tranformation is legal.

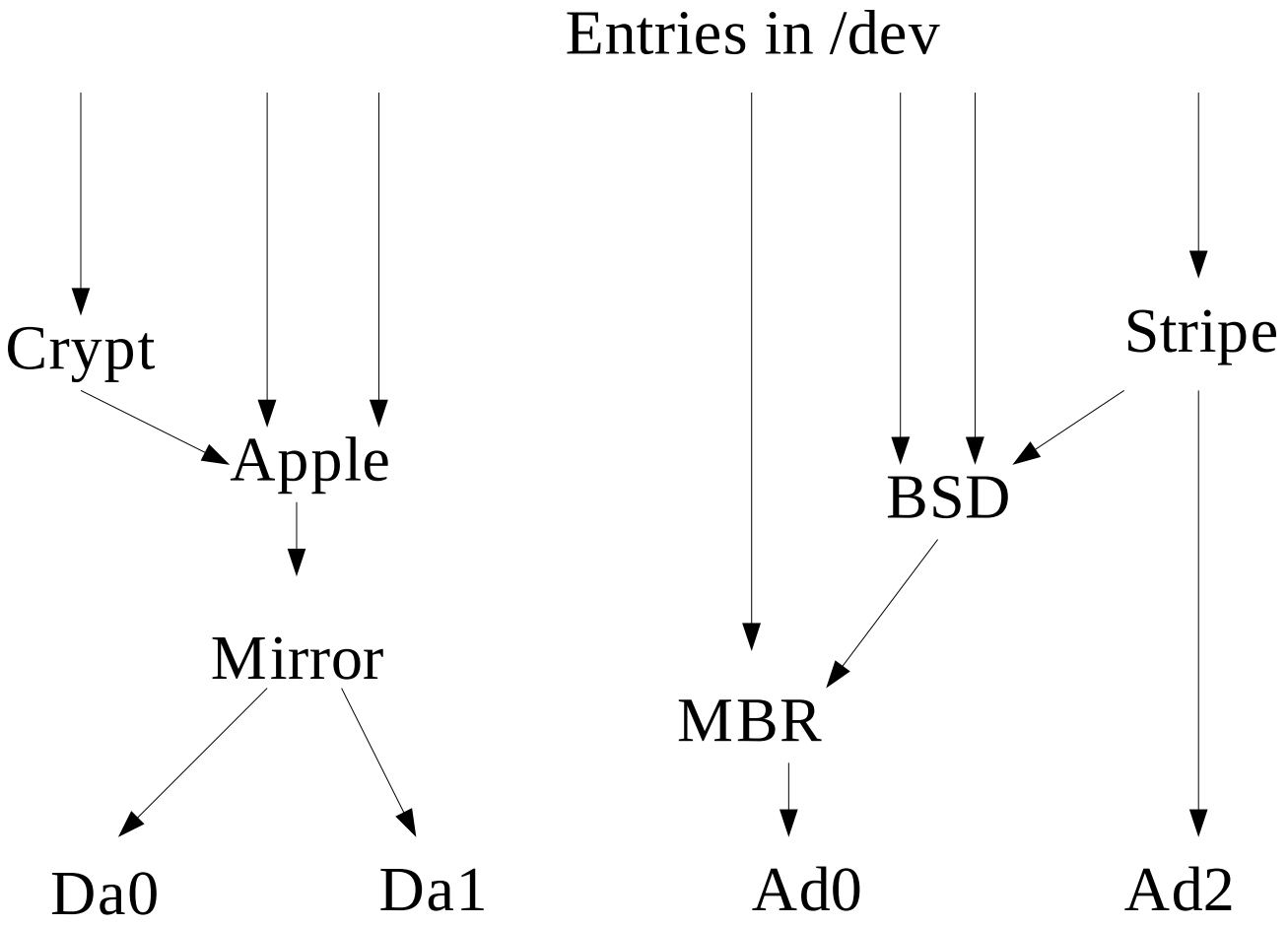
Geom is also...

- Backwards compatible.
  - To the extent possible & sensible.
- Intuitively obvious to the casual user
  - He doesn't have to do or know anything.
- Confusing the heck out of the old guard
  - It lacks old quirks and desupports hacks.

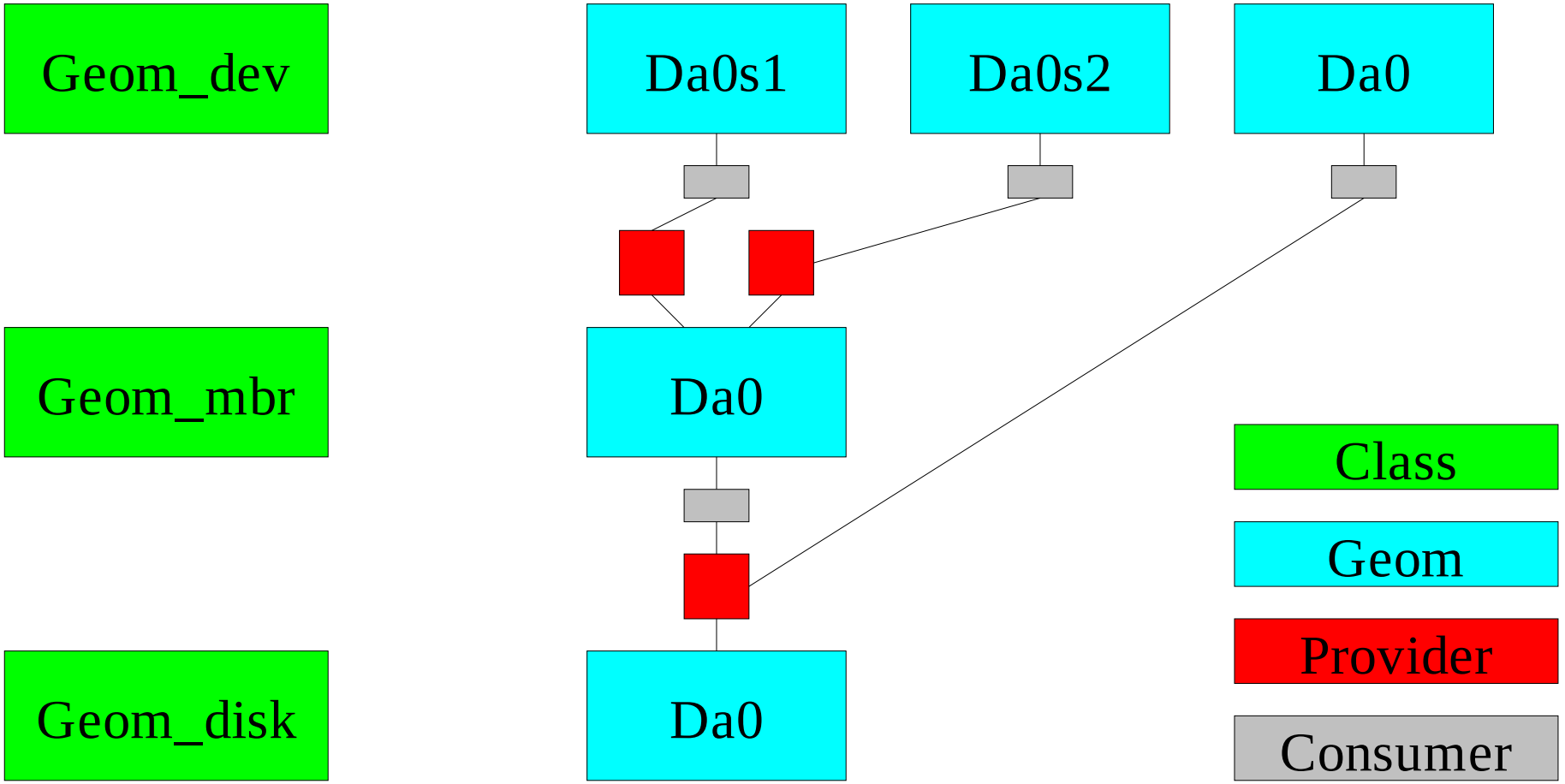
Code structure



Plug and play...



In a picture...


Geom_dev
Geom_mbr
Geom_disk
Da0s1
Da0s2
Da0
Da0
Da0
Class
Geom
Provider
Consumer

Data structures in GEOM

- A “CLASS” implements a transformation
  - BSD labels, Mirroring, Encryption, RAID-5
- A “GEOM” is an instance of a class
  - “the BSD label on disk da0”
- A “PROVIDER” is a “disk” offered by a GEOM
- A “CONSUMER” attaches geom to a provider.

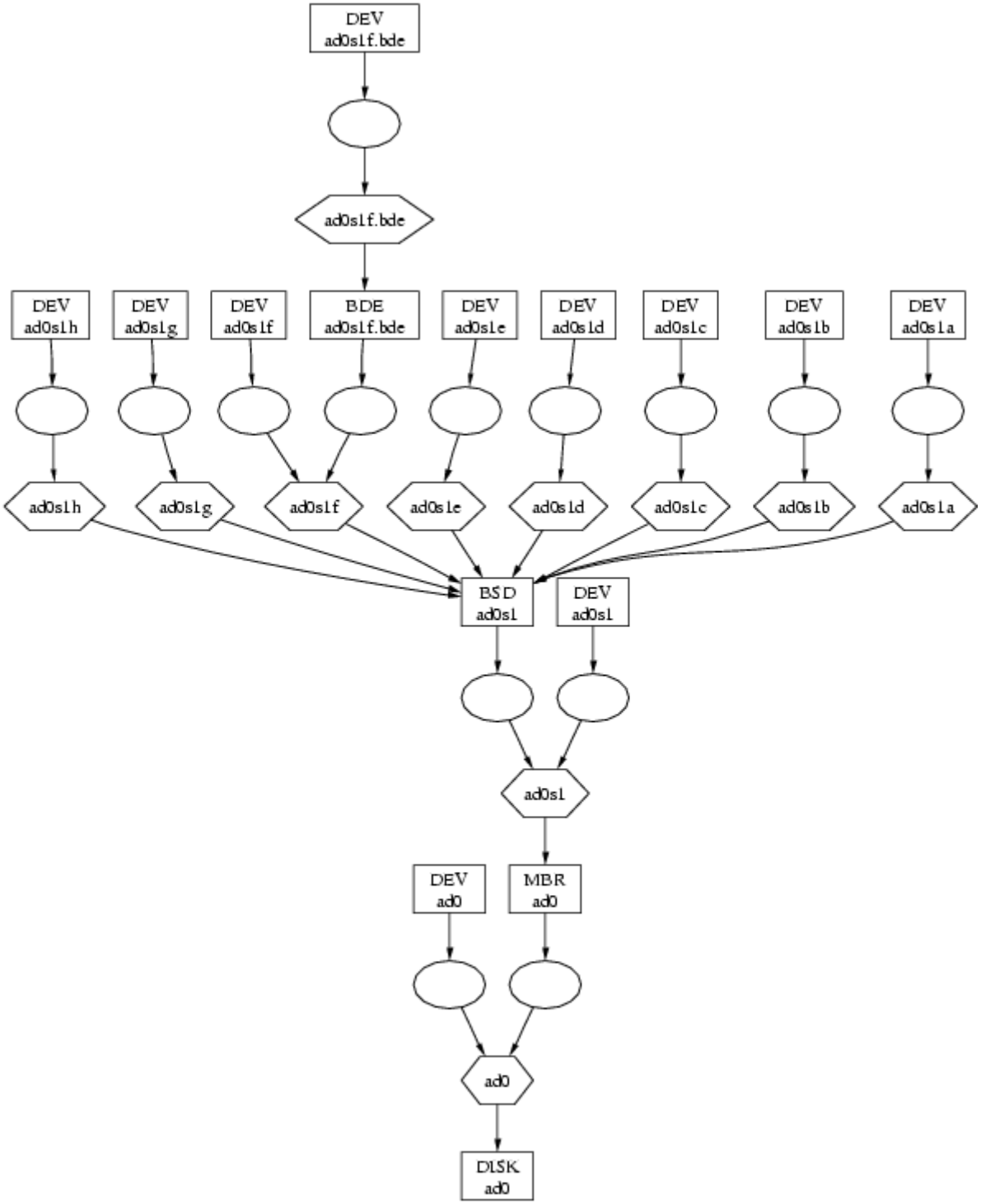
GEOM on my laptop

box: geom

oval: consumer

hexagonal: provider

Note that “DEV” attaches to all providers so that all “disks” are available from /dev/mumble.



How is GEOM configured ?

- Autoconfiguration through “taste” mechanism
  - When a provider is created, all classes are polled.
  - The class can probe the provider for magic bits.
- Configuration from userland
  - “Stripe these two providers”
  - “Start encryption on this provider”
  - Generic API (“OaM”) for issuing requests.

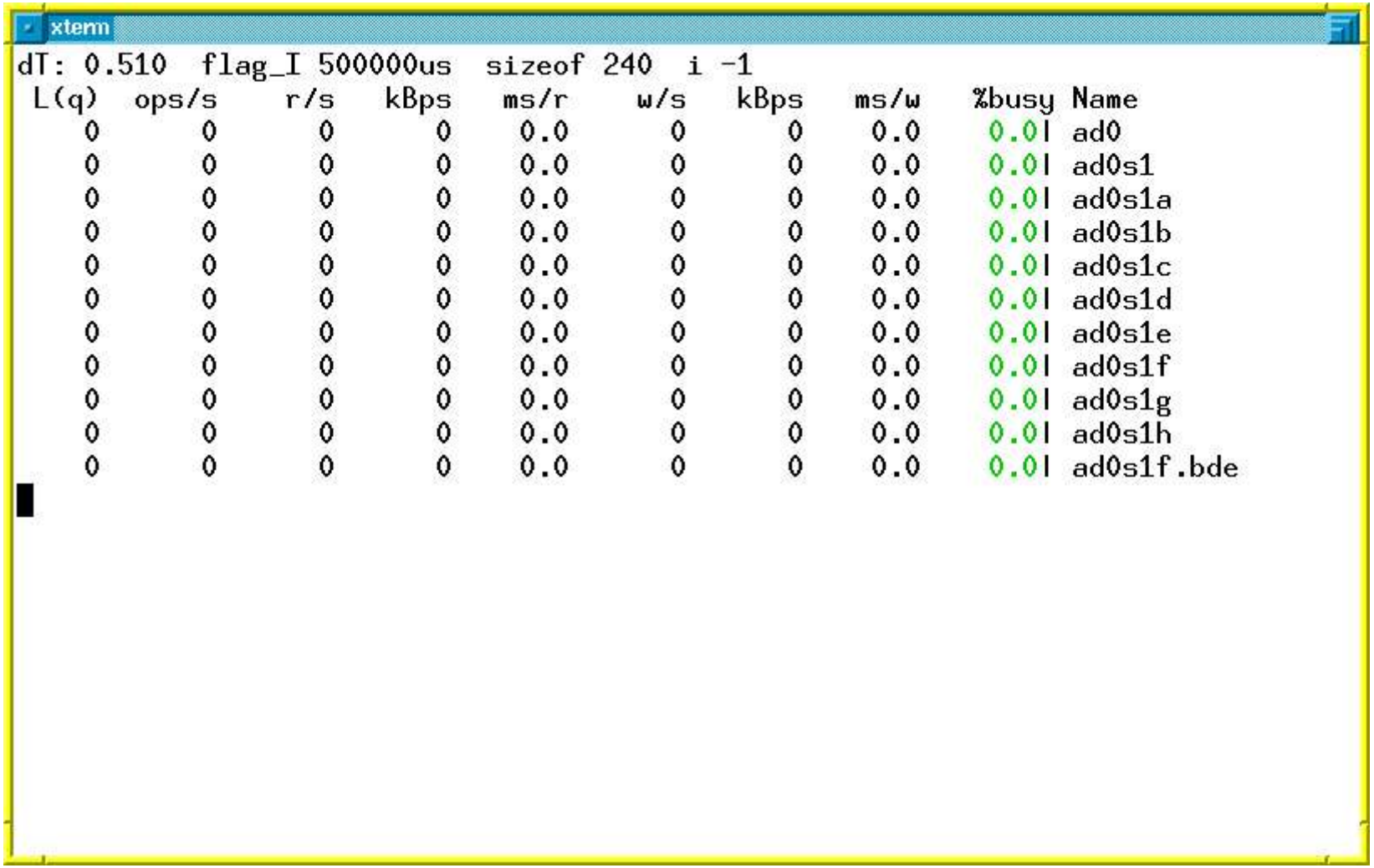
Reporting state from GEOM

- Configuration/status exported in XML
  - Standard
  - General
  - Lots of tools
  - Extensible
    - Important that new classes can be implemented without requiring recompilation of existing code.

Statistics from GEOM

- Exported in shared memory
  - Fast, Low overhead
- Uses improved devstat API:
  - Transactions per action (Read/Write/Delete)
  - Bytes per action (Read/Write/Delete)
  - Queue length, busy time, service time
  - Collected for all providers and consumers

Gstat(8) utility



Old tricks

- Geom can:
  - Interpret MBR partitioning,
  - Interpret BSD partitioning.
  - CCD striping/mirroring
  - MD ram/swap disks.
- What's missing:
  - Vinum
  - A few strange ways to shoot your own feet.

New tricks

- Interpret new architectures disk-slicing:
  - GPT format for Itanic/IA64
  - Apple format for Macintosh
  - Solaris labels for sparc64
  - PC98 labels now actually works.
- These works on all architectures.
  - Plug your Solaris disk into your sparc64
  - Filesystems needs to learn about LE/BE.

Vol_FFS

- Put a label on your filesystem:
  - tunefs -L home /dev/ad0s1e
- Mount it by name:
  - mount /dev/vol/home /home
- Also works when you move your disk.
- FAT labels and ISO9660 labels underway.

GeomGate

- Allows you to implement a disk device in userland.
- Sample application implements network disk.
  - Serious alternative to NFS
- Many other cool uses.
  - iSCSI prototype anyone ?
- Owner: pawel@

Geom/Vinum

- Lukas is working on this.
- I belive he is currently reimplementing rather than porting.
- Not sure what current status is.

RAID3

- RAID3
  - Faster than RAID5
  - Larger sectorsize.
  - Restricted to 2^n data disks (1, 2, 4, 8 ...)
  - Unrestricted number of ECC disks.
  - 8+3 gives 4K sectorsize.

Other stuff

- geom_stripe
- geom_concat
- Demo classes:
  - AES
  - MIRROR
  - FOX (multipath)

People & Politics

- Mailing list:
  - Geom@
- I defend the infrastructure from hacks.
  - You will have to show that you cannot possibly do what you want before you get a change past me.
- You can do anything you want in the classes you write.