What Every Data Programmer Needs to Know about Disks

OSCON Data – July, 2011 - Portland

Ted Dziuba
@dozba
tjdziuba@gmail.com

Who are you and why are you talking?

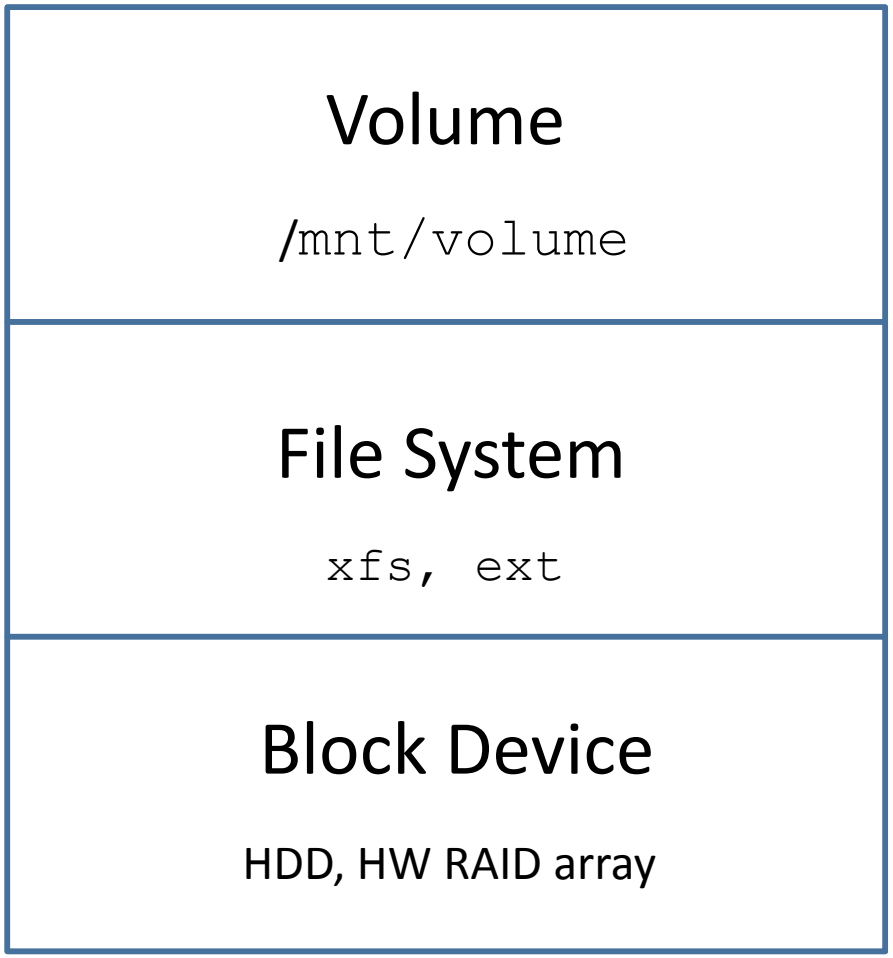
First job: Like college but they pay you to go.

A few years ago: Technical troll for The Register.

Recently: Co-founder of Milo.com, local shopping engine.

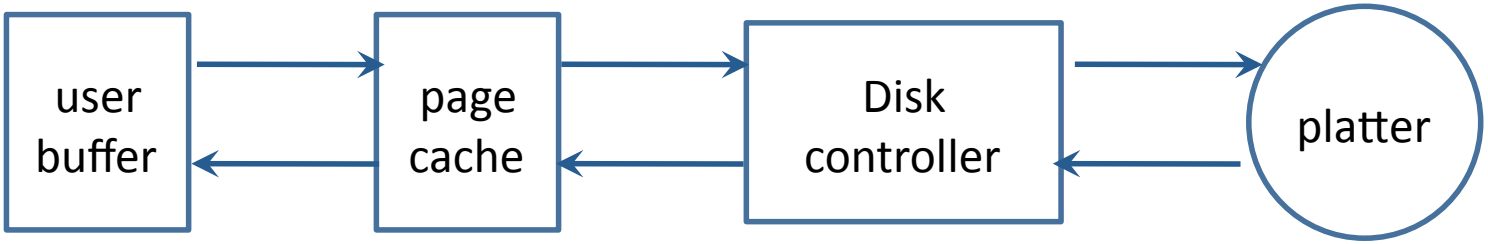
Present: Senior Technical Staff for eBay Local

The Linux Disk Abstraction



What happens when you read from a file?

```
f = open("/home/ted/not_pirated_movie.avi", "rb")
avi_header = f.read(56)
f.close()
```



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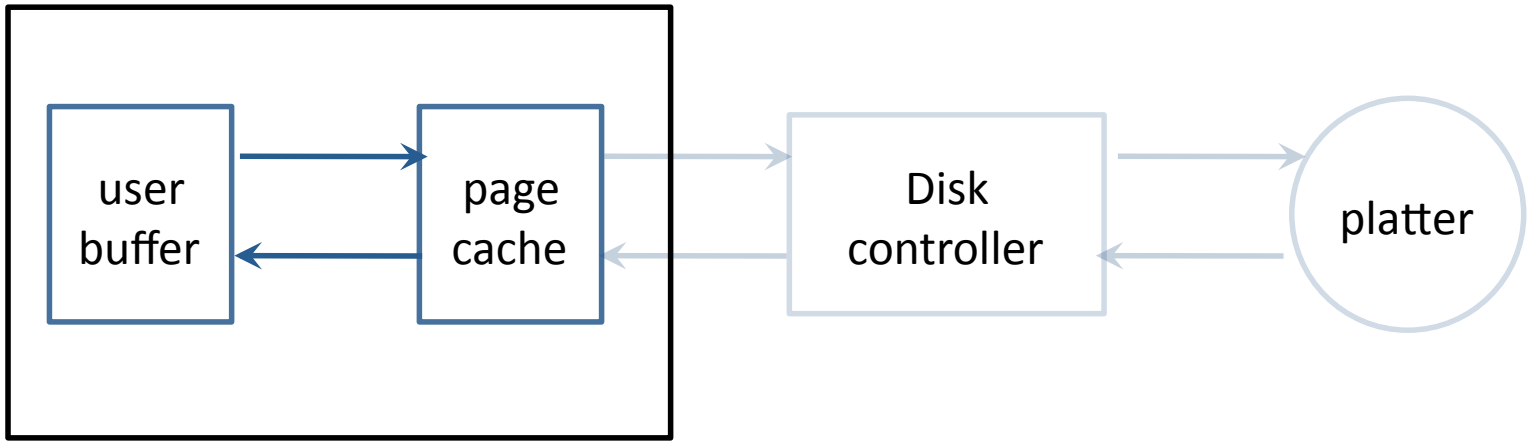
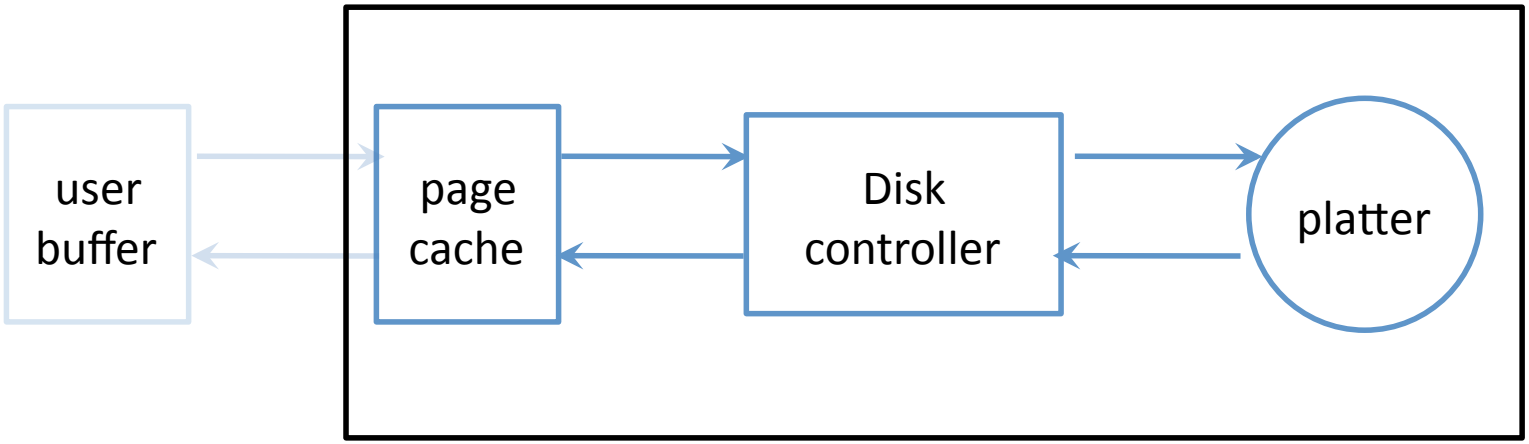


- Main memory lookup
- Latency: 100 nanoseconds
- Throughput: 12GB/sec on good hardware

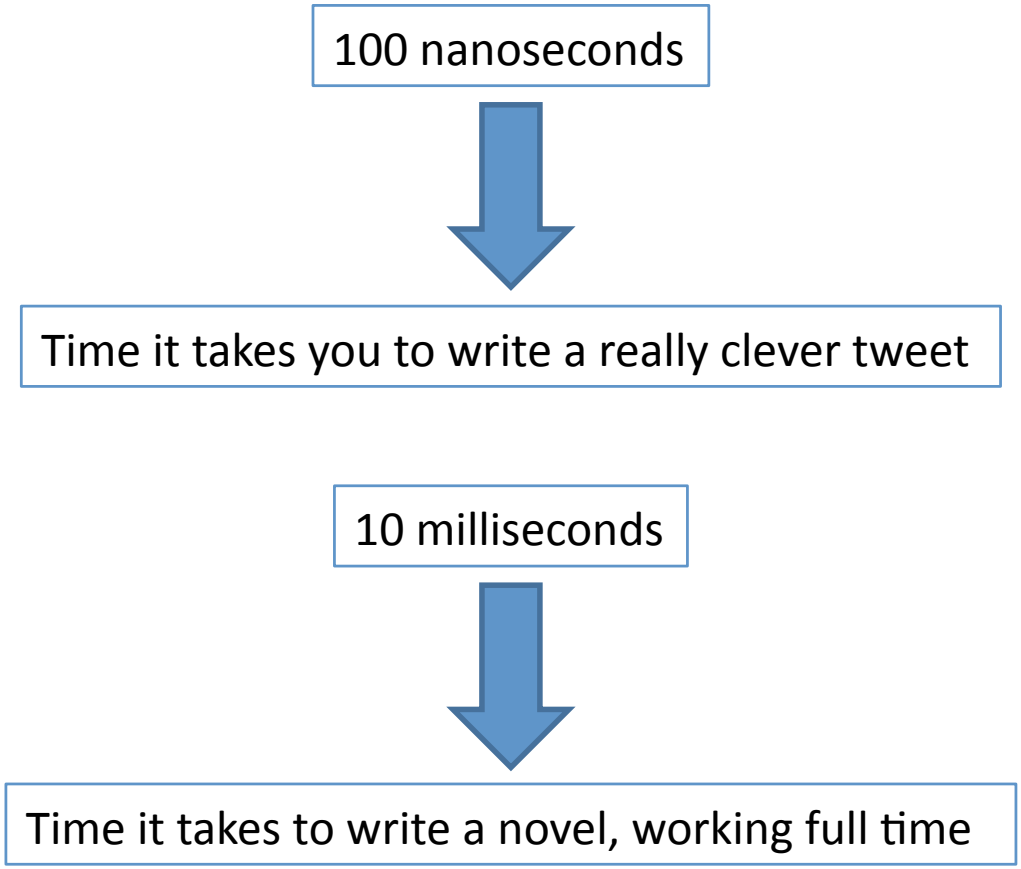
What happens when you read from a file?



- Needs to actuate a physical device
- Latency: 10 milliseconds
- Throughput: 768 MB/sec on SATA 3
- *(Faster if you have a lot of money)*

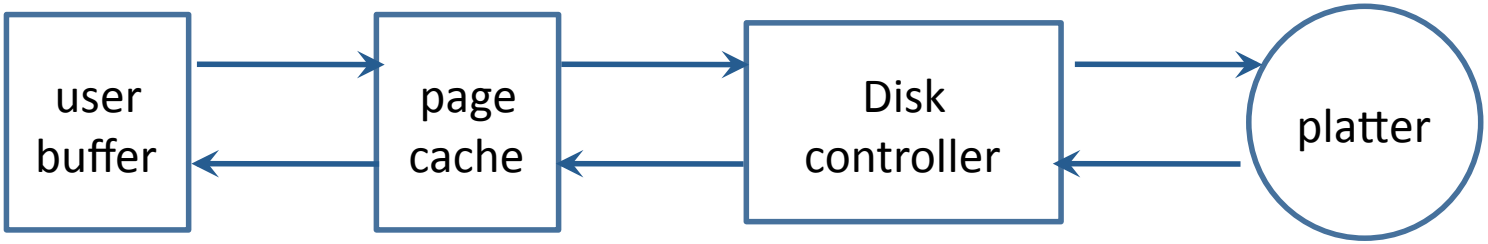
Sidebar: The Horror of a 10ms Seek Latency

A disk read is 100,000 times slower than a memory read.



What happens when you write to a file?

```
f = open("/home/ted/nosql_database.csv", "wb")
f.write(key)
f.write(",")
f.write(value)
f.close()
```



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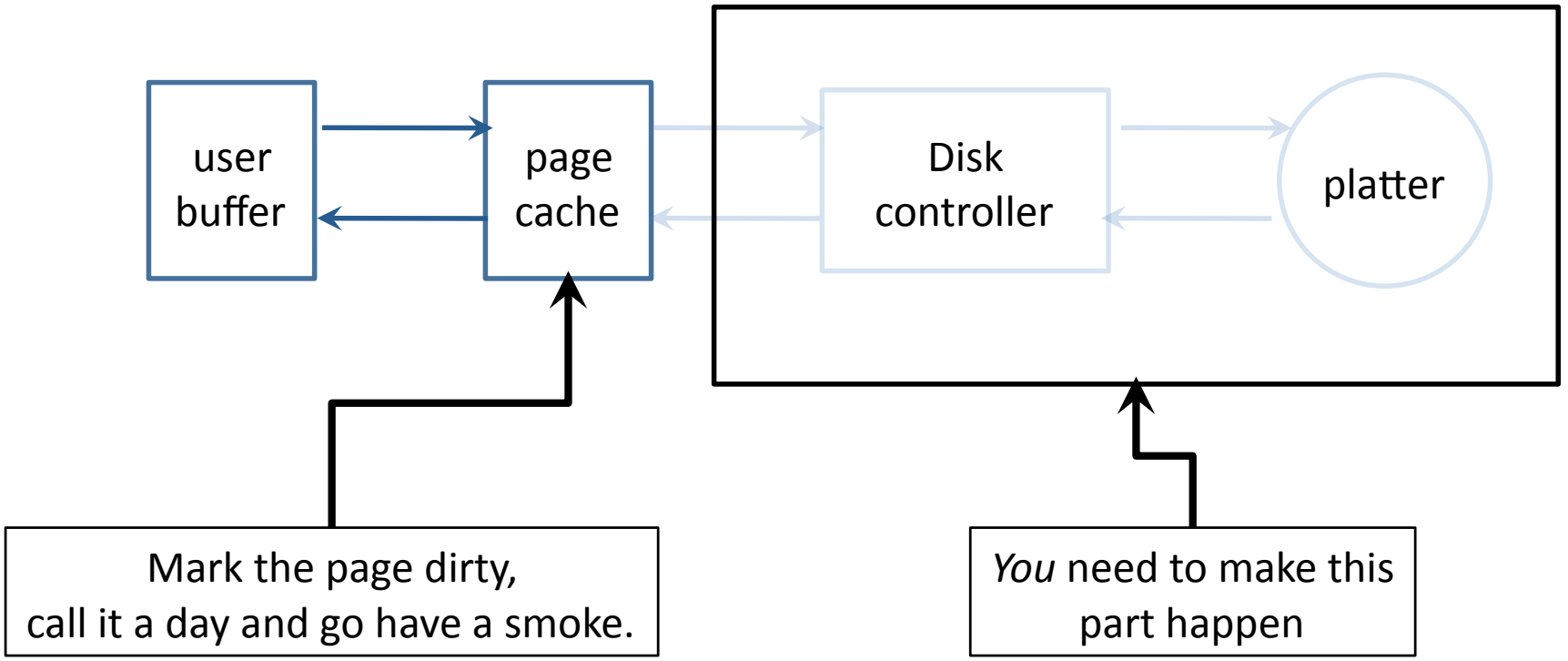


Aside: Stick your finger in the Linux Page Cache

Pre-Linux 2.6 used “pdflush”, now per-Backing Device Info (BDI) flush threads

Dirty pages: `grep –i “dirty” /proc/meminfo`

`/proc/sys/vm` Love:

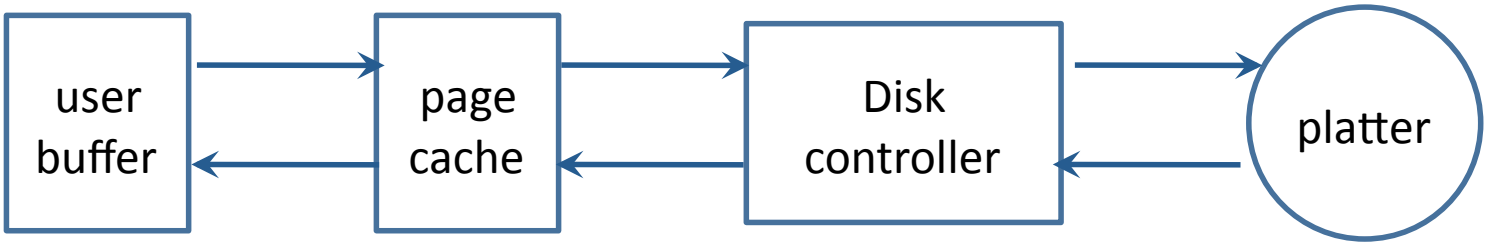
- `dirty_expire_centisecs` : flush old dirty pages
- `dirty_ratio`: flush after some percent of memory is used
- `dirty_writeback_centisecs`: how often to wake up and start flushing

Clear your page cache : `echo 1 > /proc/sys/vm/drop_caches`

Crusty sysadmin’s hail-Mary pass: `sync; sync; sync`

Fsync: force a flush to disk

```
f = open("/home/ted/nosql_database.csv", "wb")
f.write(key)
f.write(",")
f.write(value)
os.fsync(f.fileno())
f.close()
```



Also note, fsync() has a cousin, fdatasync() that does not sync metadata.

Aside: point and laugh at MongoDB

Mongo's "fsync" command:

```
> db.runCommand({fsync:1,async:true});
```

wat.

Also supports "journaling", like a WAL in the SQL world, however…

- It only fsyncs() the journal every 100ms…"for performance".
- It's not enabled by default.

Fsync: bitter lies

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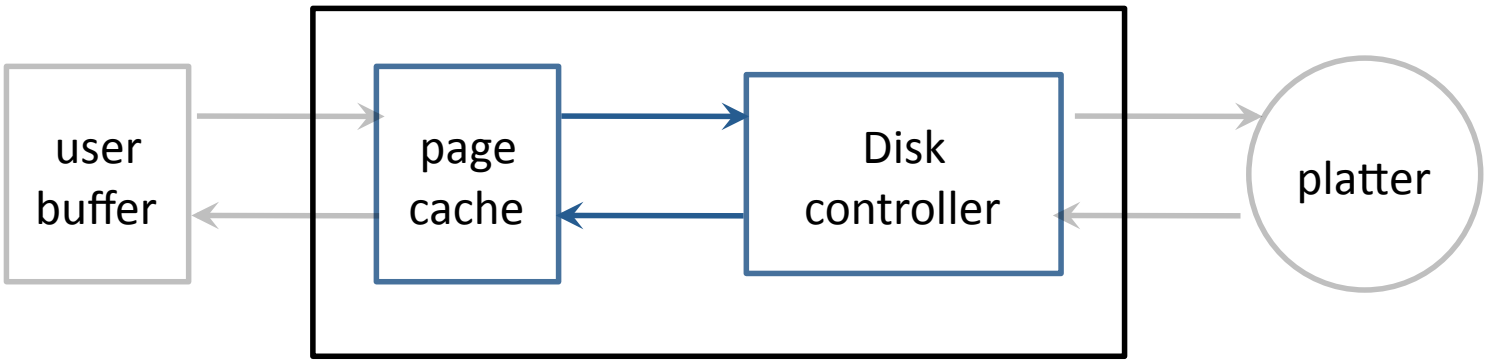
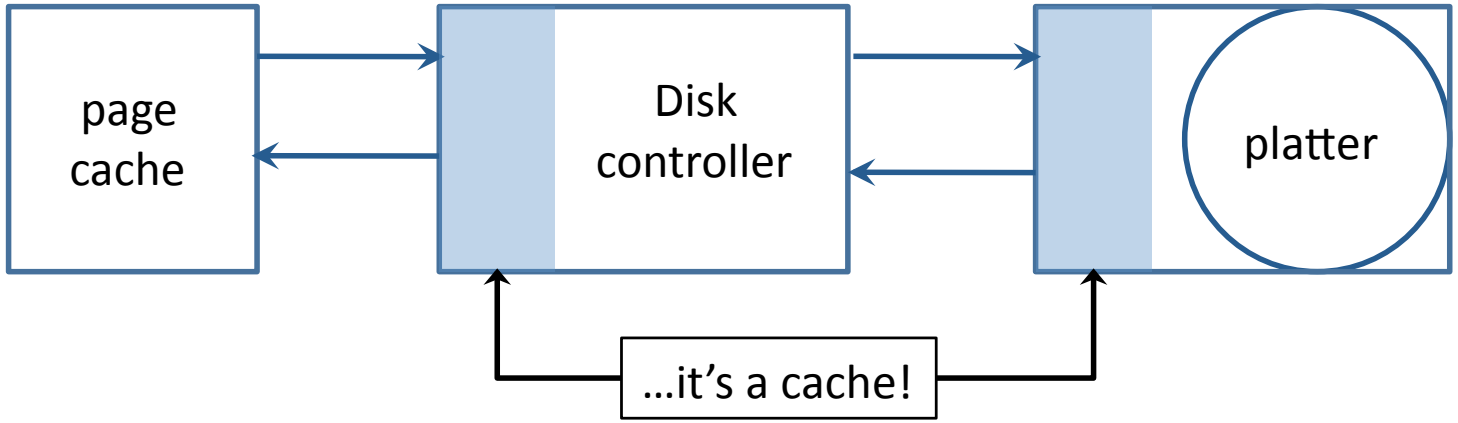


Drives will lie to you.

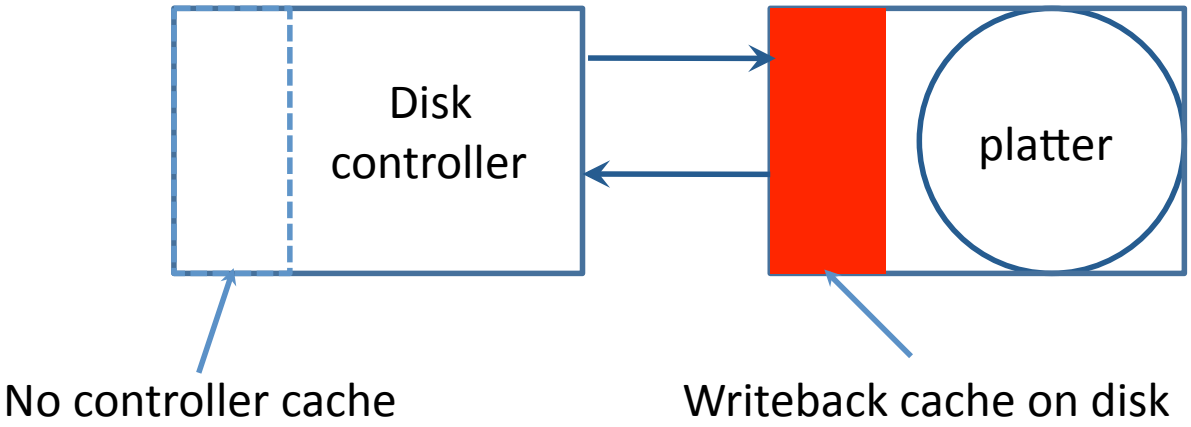
Fsync: bitter lies



- Two types of caches: write*through* and write*back*
- Write*back* is the demon

(Just dropped in) to see what condition your caches are in

A Typical Workstation



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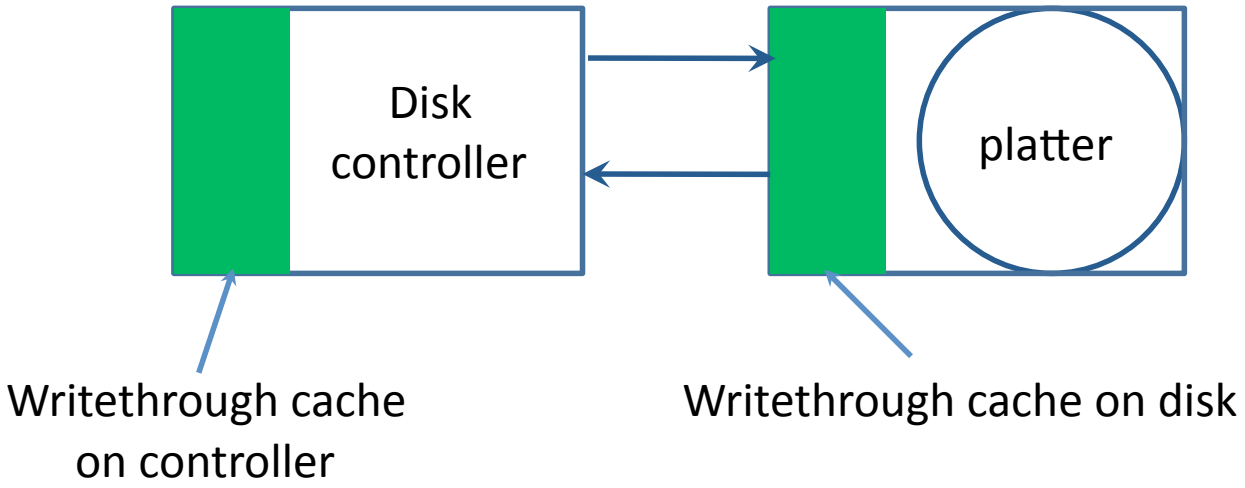
A Good Server



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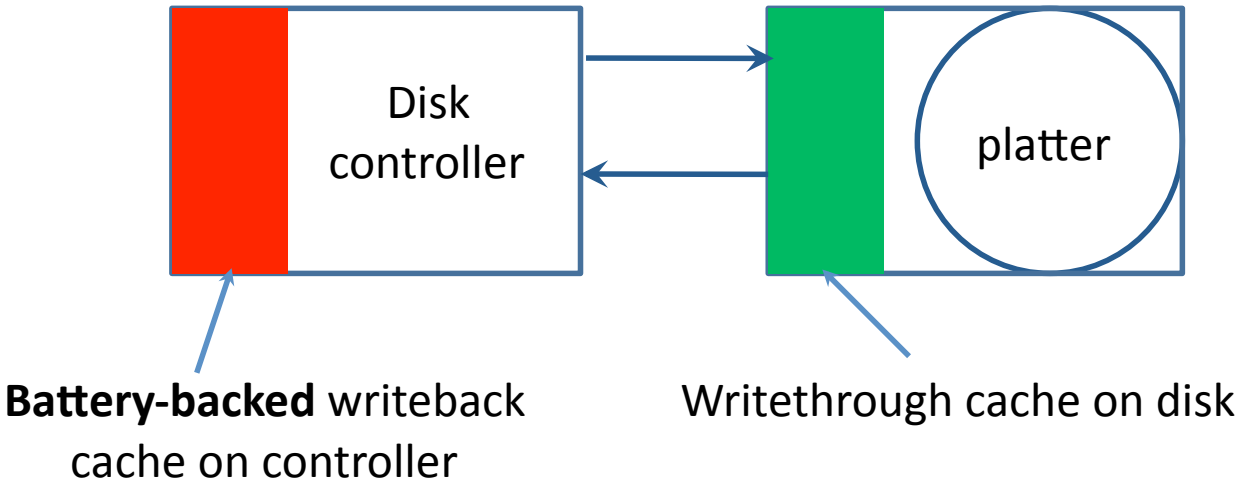
An Even Better Server



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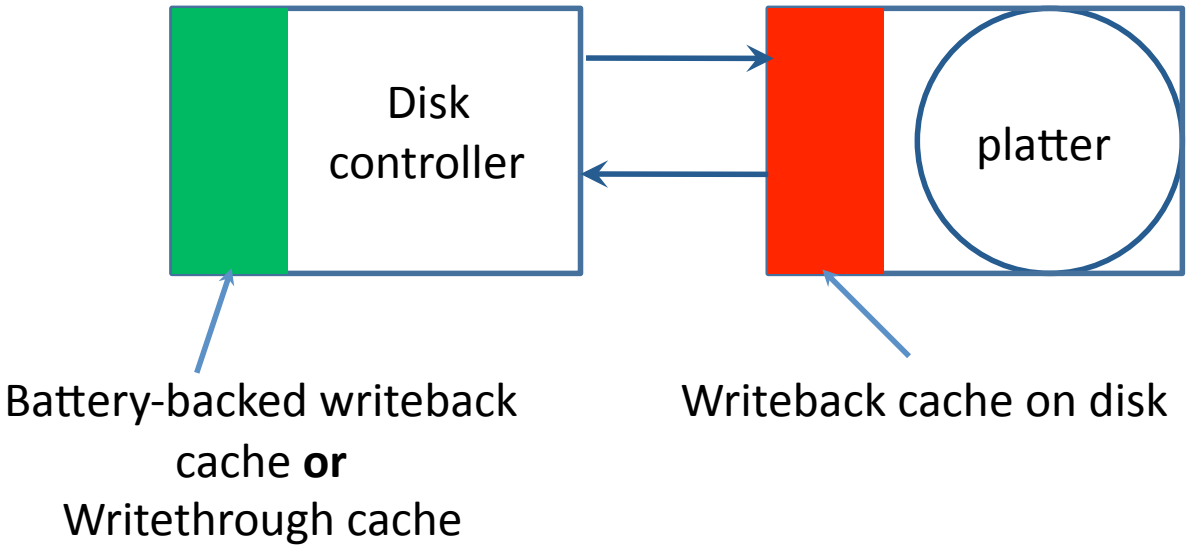
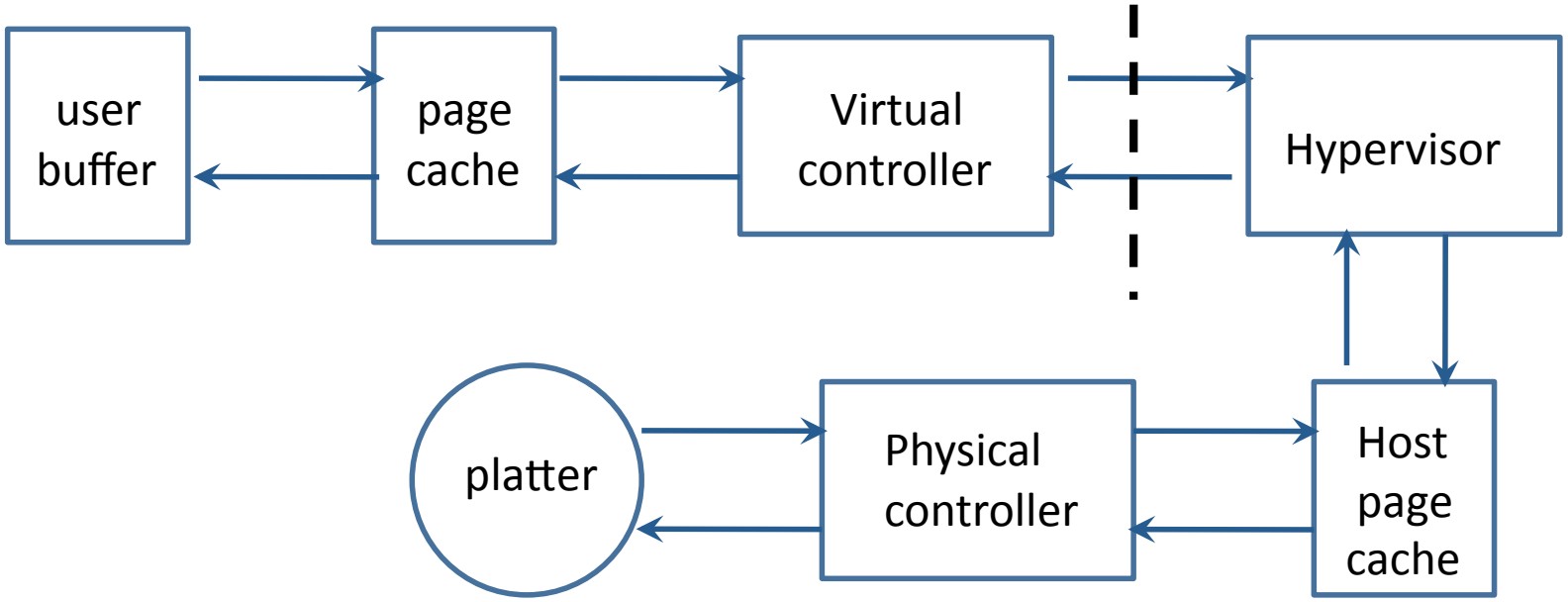
The Demon Setup



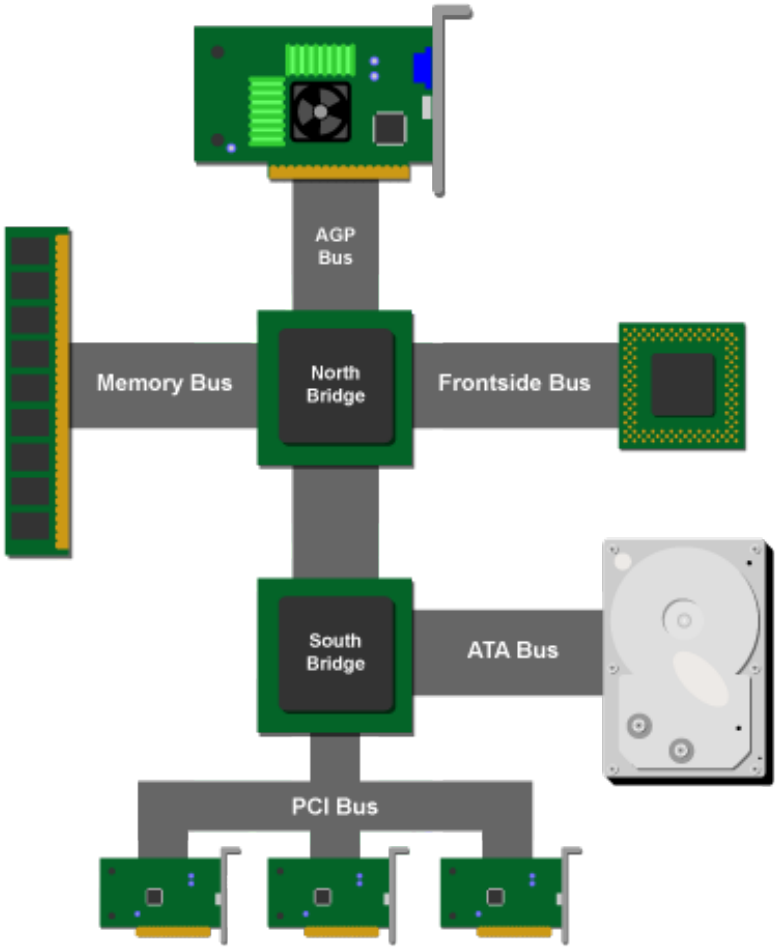
Disks in a virtual environment

The Trail of Tears to the Platter



Disks in a virtual environment

Why EC2 I/O is Slow and Unpredictable

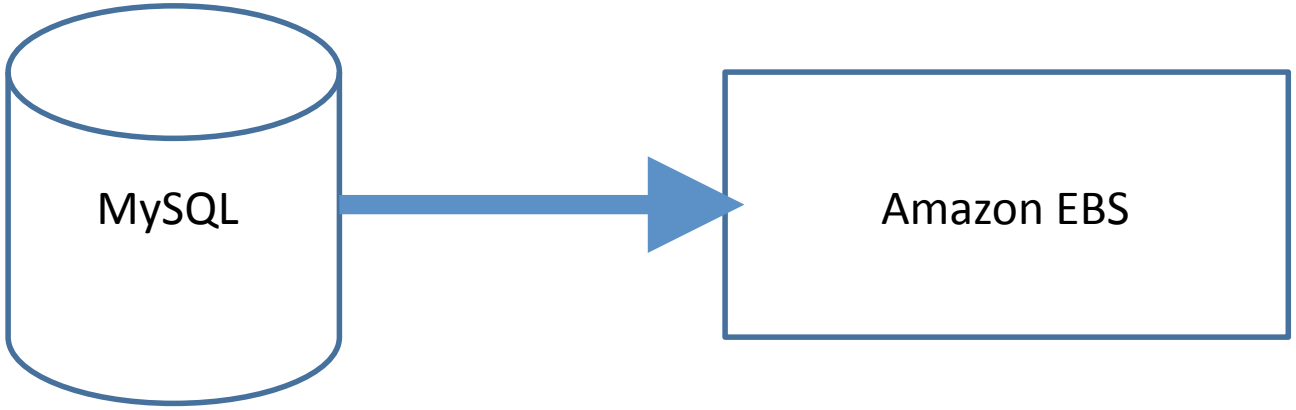


Shared Hardware
- Physical Disk
- Ethernet Controllers
- Southbridge

- How are the caches configured?
- How big are the caches?
- How many controllers?
- How many disks?
- RAID?

Image Credit: Ars Technica

Aside: Amazon EBS



Please stop doing this.

What's Killing That Box?

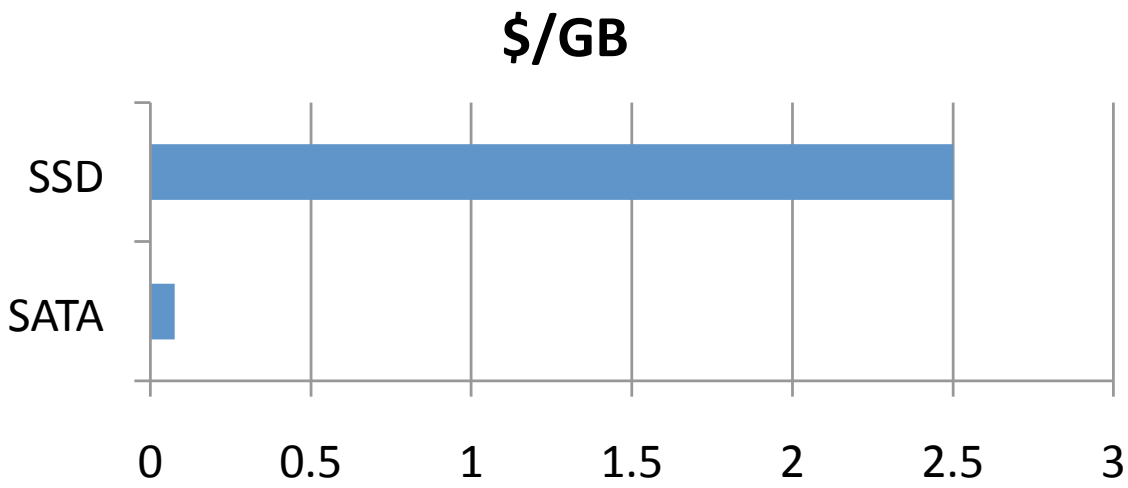
```
ted@u235:~$ iostat -x
Linux 2.6.32-24-generic (u235)  07/25/2011      _x86_64_        (8 CPU)

avg-cpu:  %user   %nice %system %iowait  %steal   %idle
           0.15    0.14    0.05    0.00    0.00   99.66

Device:         rrqm/s   wrqm/s     r/s     w/s   rsec/s   wsec/s avgrq-sz   %util
sda               0.00     3.27    0.01    2.38     0.58    45.23    19.21    0.24
```

Cool Hardware Tricks

Beginner Hardware Trick: SSD Drives



- $2.50/GB vs 7.5c/GB
- Negligible seek time vs 10ms seek time
- Not a lot of space

Cool Hardware Tricks

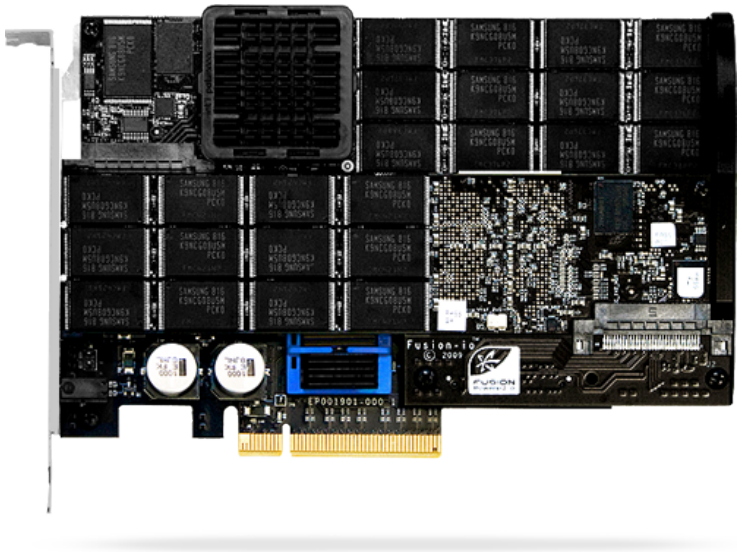
Intermediate Hardware Trick: RAID Controllers

- Standard RAID Controller
- SSD as writeback cache
- Battery-backed
- Adaptec “MaxIQ”
- $1,200

Image Credit: Tom’s Hardware

Cool Hardware Tricks

Advanced Hardware Trick: FusionIO



- SSD Storage on the Northbridge (PCIe)
- 6.0 GB/sec throughput. Giga***bytes***.
- 30 microsecond latency (30k ns)
- Roughly $20/GB
- Top-line card > $100,000 for around 5TB

Questions & Heckling

Thank You

http://teddziuba.com/

@dozba