If this text is too small to read, move closer!

http://groups.google.com/group/scalable

Real World Web: Performance & Scalability

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http://develooper.com/talks/

April 14, 2008 – r17

Hello.

- I'm Ask Bjørn Hansen
  perl.org, ~10 years of mod_perl
  app development, mysql and scalability consulting
  YellowBot
- I hate tutorials!
- Let's do 3 hours of 5 minute° lightning talks!

° Actual number of minutes may vary

Construction Ahead!

- Conflicting advice ahead
- Not everything here is applicable to everything
- Ways to "think scalable" rather than be-all-end-all solutions

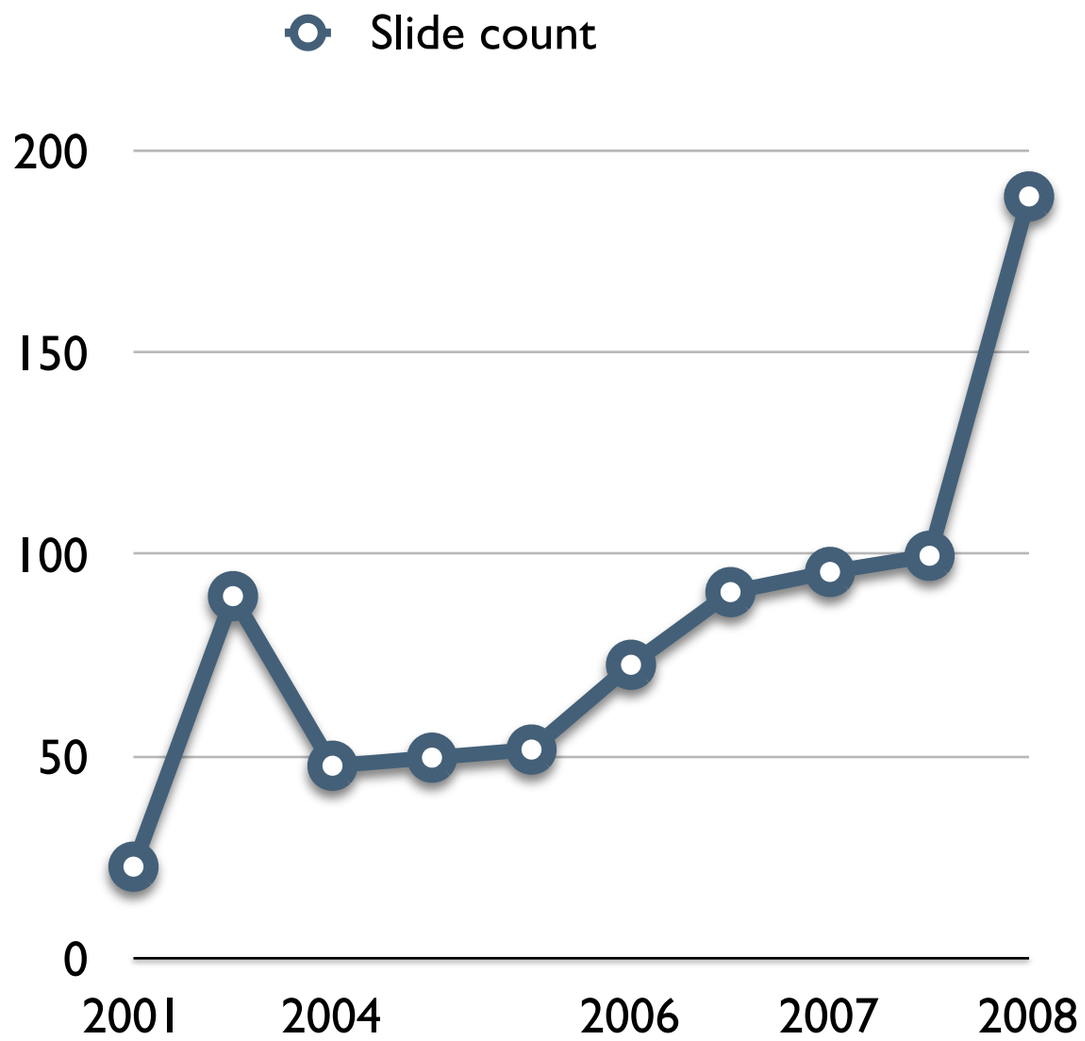
- Don't prematurely optimize!
  (just don't be too stupid with the "we'll fix it later" stuff)

Questions ...

- How many ...
- ... are using PHP? Python? Python? Java? Ruby? C?
- 3.23? 4.0? 4.1? 5.0? 5.1? 6.x?
- MyISAM? InnoDB? Other?
- Are primarily “programmers” vs “DBAs”
- Replication? Cluster? Partitioning?
- Enterprise? Community?
- PostgreSQL? Oracle? SQL Server? Other?

Seen this talk before?

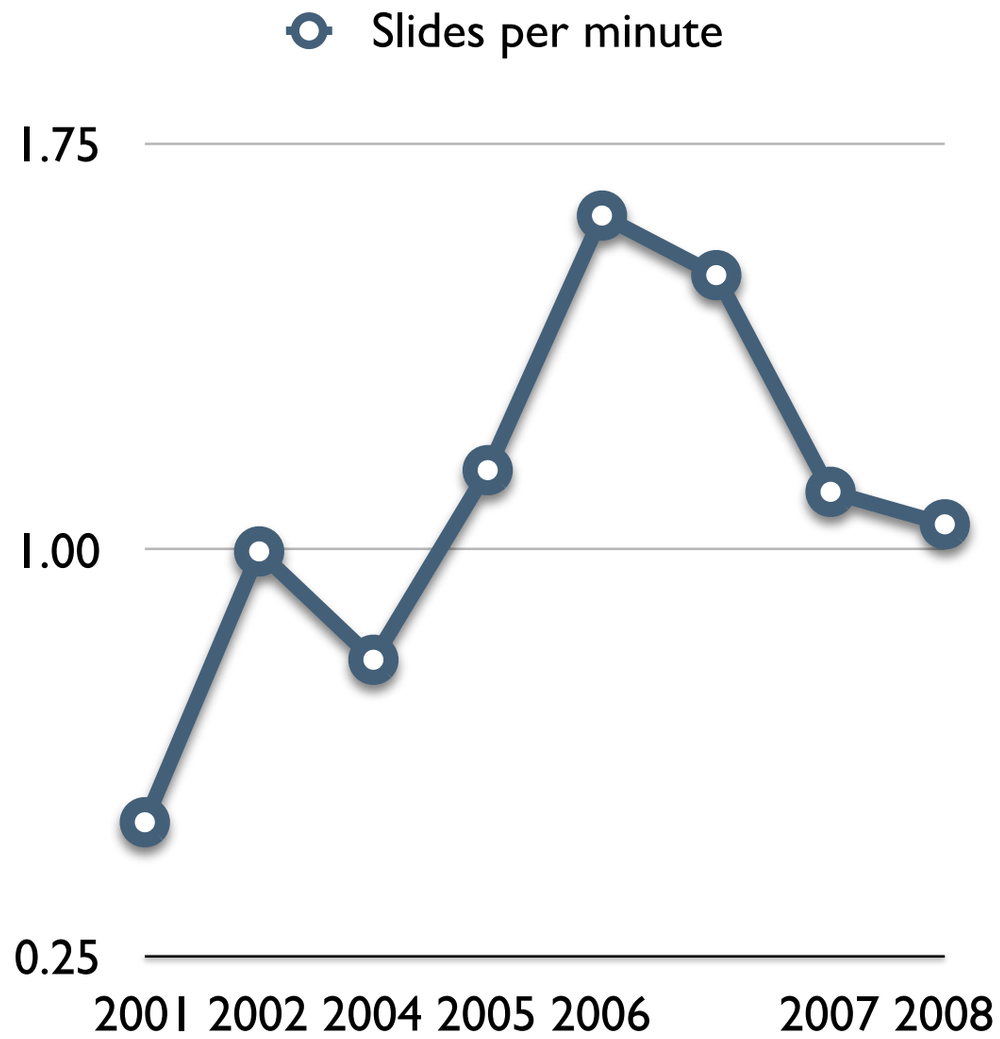
- No, you haven't.
- :-)
- ~266 people * 3 hours
  = half a work year!



Question Policy!

http://groups.google.com/group/**scalable**

- Do we have time for questions?
- Yes! (probably)
- Quick questions anytime
- Long questions after
  - or on the list!
- (answer to anything is likely "it depends" or "let's talk about it after / send me an email")

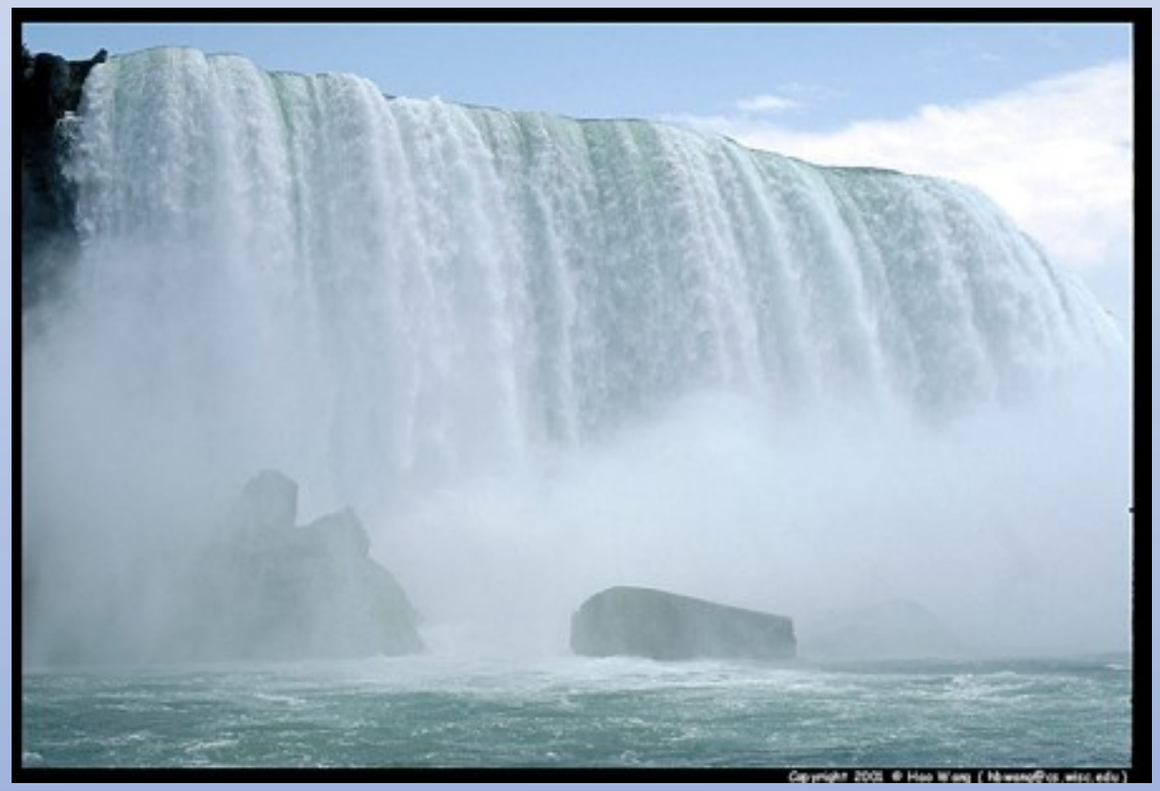


- The first, last and only lesson:

• Think Horizontal!

- Everything in your architecture, not just the front end web servers
- Micro optimizations and other implementation details — Bzzzzt! Boring!

(blah blah blah, we'll get to the cool stuff in a moment!)



Benchmarking techniques

- Scalability isn't the same as processing time
  - Not “how fast” but “how many”
  - Test “force”, not speed. Think amps, not voltage
  - Test *scalability*, not just “performance”
- Use a realistic load
  - Test with "slow clients"
- Testing “how fast” is ok when optimizing implementation details (code snippets, sql queries, server settings)

Vertical scaling

- "Get a bigger server"
- "Use faster CPUs"
- Can only help so much (with bad scale/$ value)
- A server twice as fast is more than twice as expensive
- Super computers are horizontally scaled!

Horizontal scaling

- "Just add another box" (or another thousand or ...)
- Good to great ...
  - **Implementation**, scale your system **a few** times
  - **Architecture**, scale dozens or **hundreds** of times
- Get the big picture right first, do micro optimizations later

Scalable Application Servers

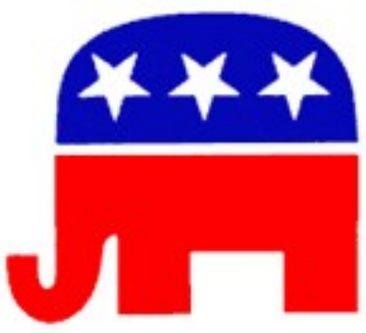
Don't paint yourself into a corner from the start

Run Many of Them

- Avoid having *The Server* for anything
- Everything should (be able to) run on any number of boxes
- Don't replace a server, add a server
- Support boxes with different capacities

Stateless vs Stateful

- "Shared Nothing"
- Don't keep state within the application server
  (or at least be Really Careful)
- Do you use PHP, mod_perl, mod_...
- Anything that's more than one process
- You get that for free! (usually)



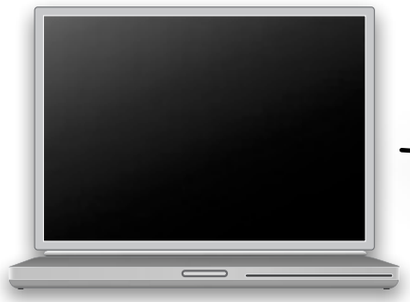
Sessions

"The key to be stateless"
or
"What goes where"

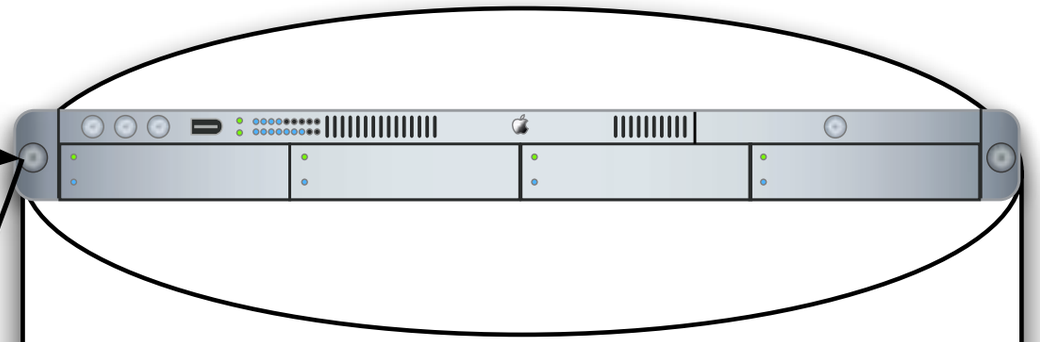
No Local Storage

- Ever! Not even as a quick hack.
- Storing session (or other state information) "on the server" *doesn't work*.
- *"But my load balancer can do 'sticky sessions'"*
  - Uneven scaling – waste of resources
    (and unreliable, too!)
  - The web isn't "session based", it's one short request after another – deal with it

Evil Session



Cookie: session_id=12345



Web/application server
with local
Session store

```
...
12345 => {
    user =>
      { username => 'joe',
        email => 'joe@example.com',
        id => 987,
    },
    shopping_cart => { ... },
    last_viewed_items => { ... },
    background_color => 'blue',
},
12346 => { ... },
....
```

What's wrong with this?

Evil Session

Cookie: session_id=12345

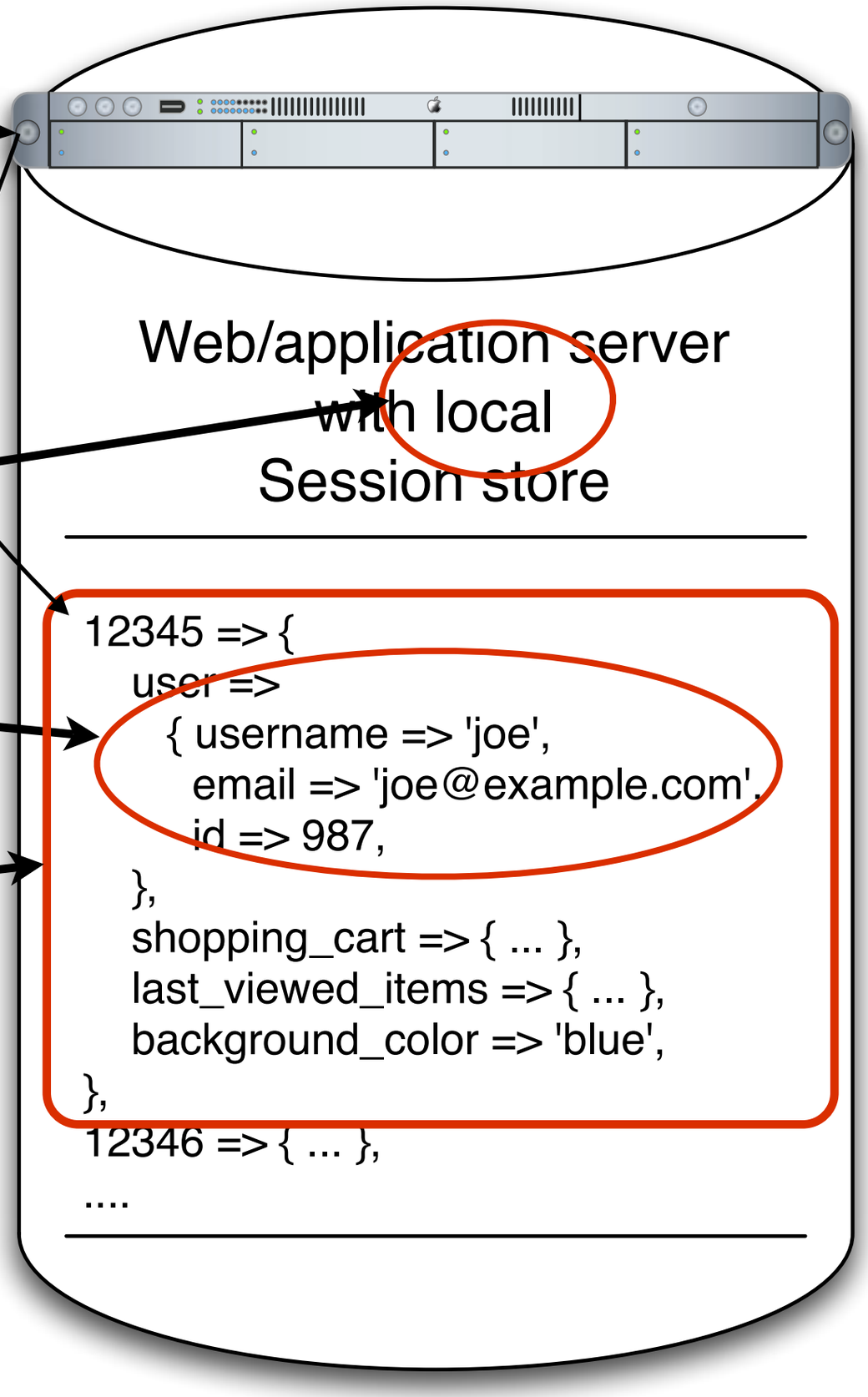
Easy to guess cookie id

Saving state on one server!

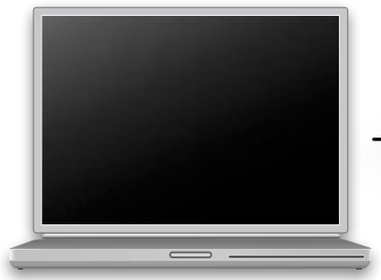
Duplicate data from a DB table

Big blob of junk!

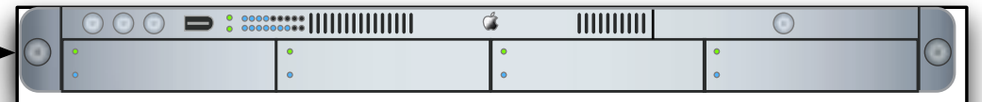
What's wrong with this?



Good Session!



Cookie: sid=seh568fzkj5k09z;
user=987-65abc;
bg_color=blue;
cart=...;



Web/application server

Database(s)

Users
987 =>
{ username => 'joe',
email => 'joe@example.com',
},
...

Shopping Carts
...

- Stateless web server!
- Important data in database
- Individual expiration on session objects
- Small data items in cookies

memcached cache

seh568fzkj5k09z =>
{ last_viewed_items => {...},
... other "junk" ...
},
....

Safe cookies

- Worried about manipulated cookies?
- Use checksums and timestamps to validate
  - `cookie=1/value/1123157440/ABCD1234`
  - `cookie=$cookie_format_version`
    `/$value/$timestamp`
    `/$checksum`
  - function cookie_checksum {
    md5_hex($secret + $time + value);
    }

Safe cookies

- Want fewer cookies? Combine them:
  - `cookie=1/user::987/cart::943/ts::1123.../EFGH9876`
  - `cookie=$cookie_format_version`
    `/$key::$value[/$key::$value]`
    `/ts::$timestamp`
    `/$md5`
- Encrypt cookies if you must (rarely worth the trouble and CPU cycles)

I did *everything* – it's still slow!

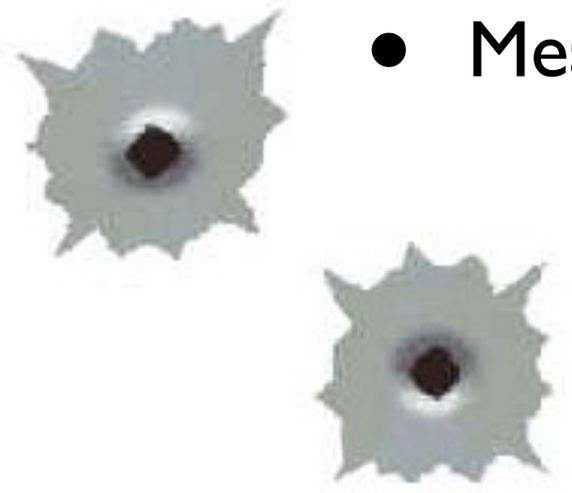
- Optimizations and good micro-practices are necessary, of course
- But don't confuse what is what!
- Know when you are optimizing
- Know when you need to step back and rethink "the big picture"

Caching

How to not do all that work again and again and again...

Cache **hit-ratios**

- Start with things you hit all the time
- Look at web server and database logs
- Don't cache if you'll need more effort writing to the cache than you save
- Do cache if it'll help you when that one single page gets a million hits in a few hours (one out of two hundred thousand pages on the digg frontpage)
- Measure! Don't assume – check!



Generate **Static** Pages

- Ultimate Performance: Make all pages static
- Generate them from templates nightly or when updated
- Doesn't work well if you have millions of pages or page variations
- Temporarily make a page static if the servers are crumbling from one particular page being busy
- Generate your front page as a static file every N minutes

Cache **full** pages

(or responses if it's an API)

- Cache full output **in the application**
- Include cookies etc. in the "cache key"
- Fine tuned application level control
- The most flexible
  - "use cache when this, not when that"
    (anonymous users get cached page, registered users get a generated page)
  - Use regular expressions to insert customized content into the cached page

Cache **full** pages 2

- Front end cache (**Squid**, **Varnish, mod_cache**) stores generated content
  - Set Expires/Cache-Control header to control cache times
- ***or*** Rewrite rule to generate page if the cached file doesn't exist (this is what Rails does or did...) – only scales to one server

```
RewriteCond %{REQUEST_FILENAME} !-s
RewriteCond %{REQUEST_FILENAME}/index.html !-s
RewriteRule (^/.*)  /dynamic_handler/$1 [PT]
```

- Still doesn't work for dynamic content per user *("6 items in your cart")*
- Works for caching "dynamic" images ... on one server

Cache **partial** pages

- Pre-generate static page "snippets"
  (this is what my.yahoo.com does or used to do...)
  - Have the handler just assemble pieces ready to go
  - Cache little page snippets (say the sidebar)
  - Be careful, easy to spend more time managing the cache snippets than you save!
  - "Regexp" dynamic content into an otherwise cached page

Cache **data**

- Cache data that's slow to query, fetch or calculate
- Generate page from the cached data
- Use the same data to generate API responses!
- Moves load to cache servers
  - (For better or worse)
- Good for slow data used across many pages
  ("todays bestsellers in $category")

Caching Tools

Where to put the cache data ...

A couple of bad ideas

Don't do this!

- Process memory (`$cache{foo}`)
  - Not shared!
- Shared memory? Local file system?
  - Limited to one machine (likewise for a file system cache)
  - Some implementations are really fast
- MySQL query cache
  - Flushed on each update
  - Nice if it helps; don't depend on it

MySQL cache table

- Write into one or more cache tables
- id is the “cache key”
- type is the “namespace”
- metadata for things like headers for cached http responses
- purge_key to make it easier to delete data from the cache

```
CREATE TABLE `combust_cache` (
  `id` varchar(64) NOT NULL,
  `type` varchar(20) NOT NULL default '',
  `created` timestamp NOT NULL default
    CURRENT_TIMESTAMP on update CURRENT_TIMESTAMP,
  `purge_key` varchar(16) default NULL,
  `data` mediumblob NOT NULL,
  `metadata` mediumblob,
  `serialized` tinyint(1) NOT NULL default '0',
  `expire` datetime NOT NULL default '0000-00-00 00:00:00',
  PRIMARY KEY  (`id`,`type`),
  KEY `expire_idx` (`expire`),
  KEY `purge_idx` (`purge_key`)
) ENGINE=InnoDB
```

MySQL Cache Fails

- Scaling and availability issues
  - How do you load balance?
  - How do you deal with a cache box going away?
- Partition the cache to spread the write load
- Use Spread to *write* to the cache and distribute configuration
  - General theme: Don't write directly to the DB

MySQL Cache Scales

- Persistence
- Most of the usual "scale the database" tricks apply
- Partitioning
- Master-Master replication for availability
- .... more on those things in a moment
- Put metadata in memcached for partitioning and fail-over information

memcached

- LiveJournal's distributed caching system
  (used practically everywhere!)
- Memory based – memory is cheap!
- Linux 2.6 (epoll) or FreeBSD (kqueue)
  - Low overhead for many many connections
- Run it on boxes with free memory
- ... or a dedicated cluster:
  Facebook has *more than five hundred* dedicated memcached servers (a lot of memory!)

more memcached

- No “master” – fully distributed
- Simple lightweight protocol (binary protocol coming)
- Scaling and high-availability is “built-in”
- Servers are dumb – clients calculate which server to use based on the cache key
- Clients in perl, java, php, python, ruby, ...
- New C client library, libmemcached
  `http://tangent.org/552/libmemcached.html`

How to use memcached

- It's a *cache*, not a database
- Store data safely somewhere else
- Pass-through cache (id = session_id or whatever):

Read

```
$data = memcached_fetch( $id );
return $data if $data
$data = db_fetch( $id );
memcached_store( $id, $data );
return $data;
```

Write

```
db_store( $id, $data );
memcached_store( $id, $data );
```

Client Side Replication

- memcached is a cache - the data might "get lost"
- What if a cache miss is Really Expensive?
- Store all writes to several memcached servers
- Client libraries are starting to support this natively

Store complex data

- Most (all?) client libraries support complex data structures
- A bit flag in memcached marks the data as "serialized" (another bit for "gzip")
- All this happens on the client side – memcached just stores a bunch of bytes
- Future: Store data in JSON? Interoperability between languages!

Store complex data 2

- Primary key lookups are probably not worth caching
- Store things that are expensive to figure out!

```
function get_slow_summary_data($id) {
  $data = memcached_fetch( $id );
  return $data if $data
  $data = do_complicated_query( $id );
  memcached_store( $id, $data );
  return $data;
}
```

Cache invalidation

- Writing to the cache on updates is hard!
- Caching is a trade-off
- You trade “fresh” for “fast”
- Decide how “fresh” is required and deal with it!

- Explicit deletes if you can figure out what to delete
- Add a “generation” / timestamp / whatever to the cache key
- select id, unix_timestamp(modified_on) as ts from users where username = ‘ask’;

  memcached_fetch(“user_friend_updates; $id; **$ts**”)

Caching is a trade-off

- Can't live with it?
- Make the primary data-source faster or data-store scale!

Database scaling

How to avoid buying that gazillion dollar Sun box

~$4,000,000
Vertical

~$3,200
*(= **1230** for $4.0M!)*

Be Simple

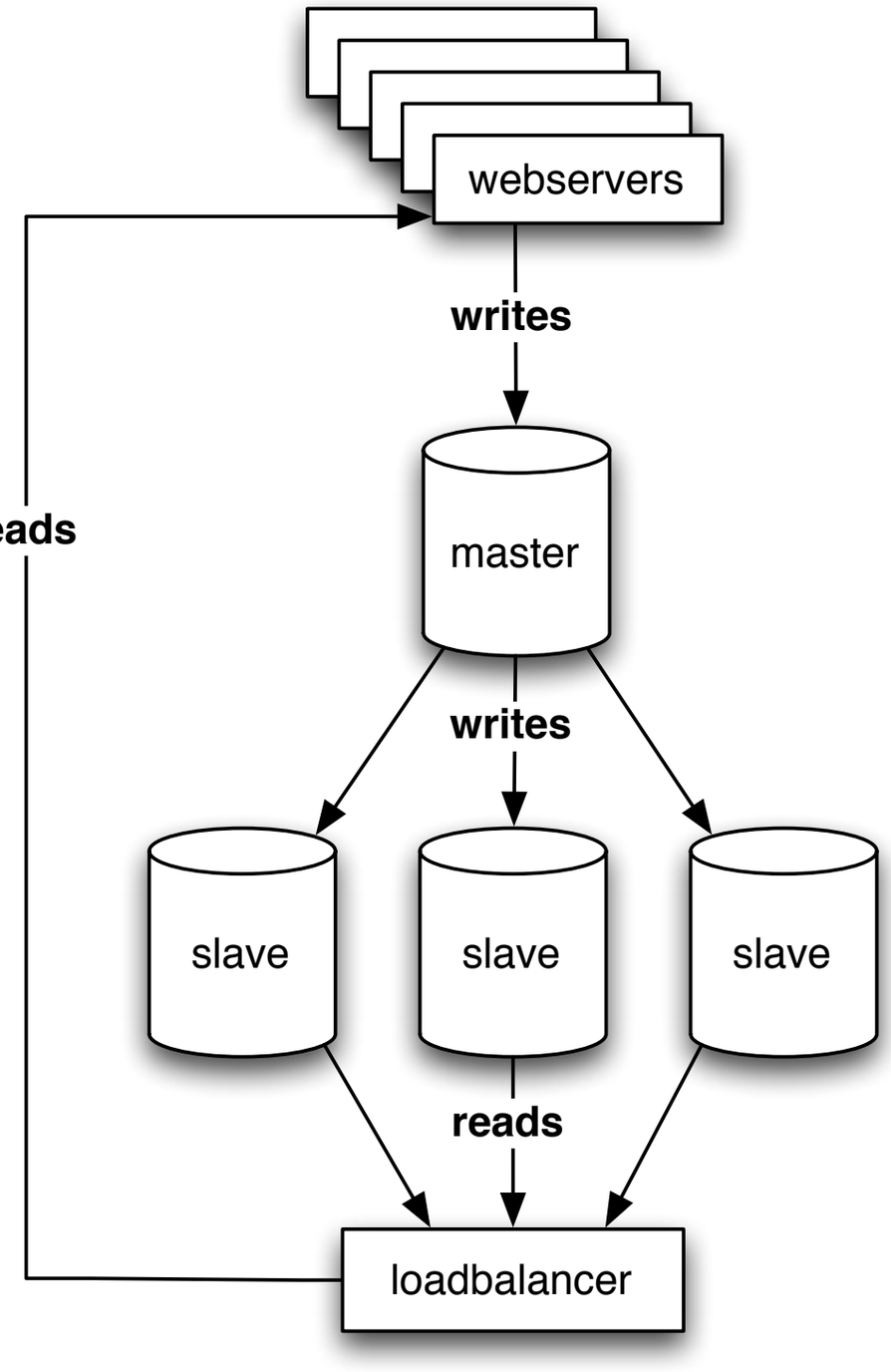
- Use MySQL!
  - It's fast and it's easy to manage and tune
  - Easy to setup development environments
  - Other DBs can be faster at certain complex queries but are harder to tune – and MySQL is catching up!
- Avoid making your schema too complicated
- Ignore some of the upcoming advice until you REALLY need it!
  - (even the part about not scaling your DB "up")
- *PostgreSQL is fast too :-)*

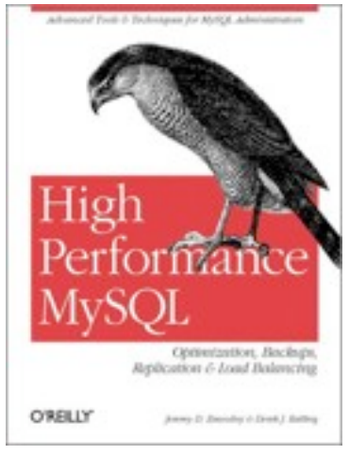
Replication

More data more places!
Share the ~~love~~ load

Basic Replication

- Good Great for read intensive applications
- Write to one master
- Read from many slaves



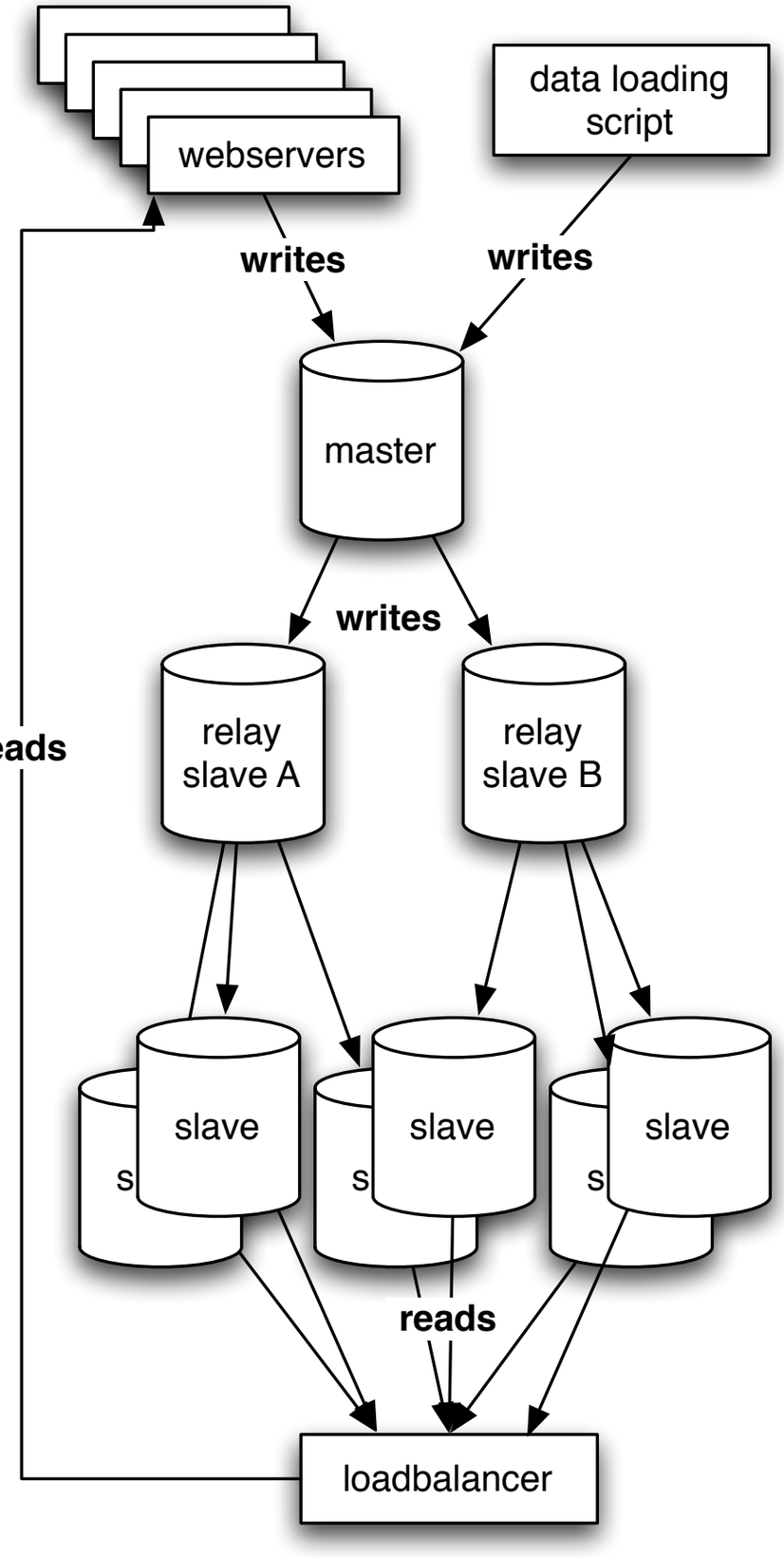


Lots more details in
"High Performance MySQL"

old, but until MySQL 6 the replication concepts are the same

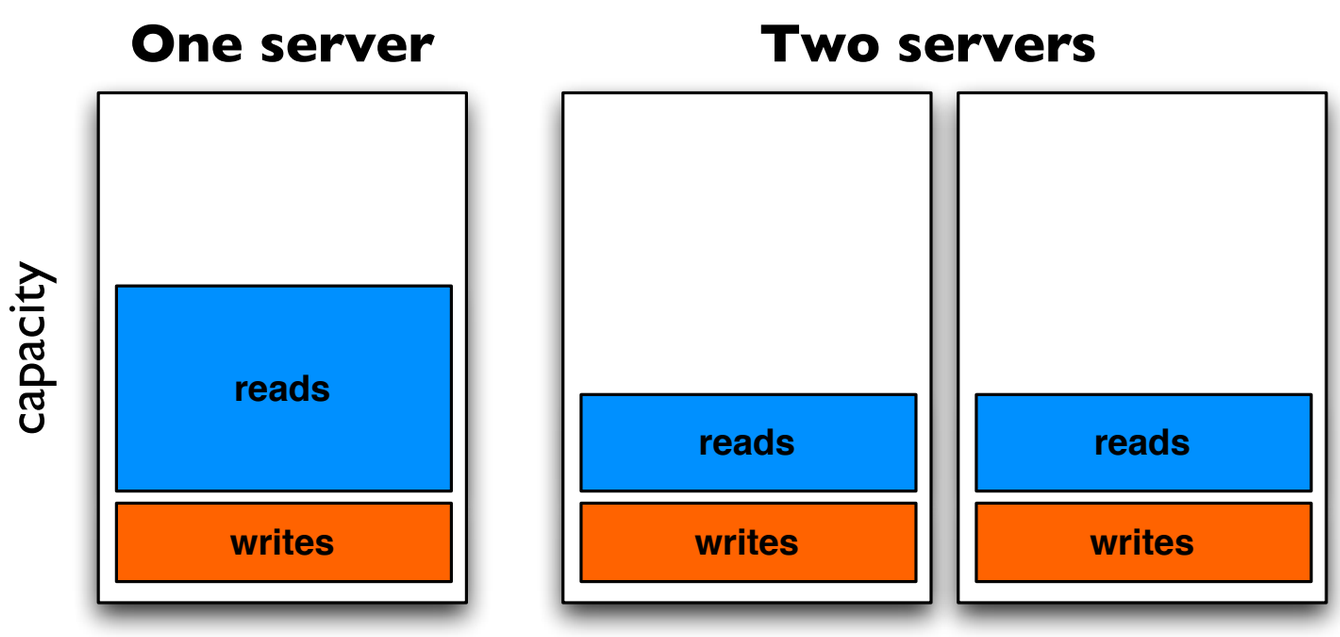
Relay slave replication

- Running out of bandwidth on the master?
- Replicating to multiple data centers?
- A “replication slave” can be master to other slaves
- Almost any possible replication scenario can be setup (circular, star replication, ...)



Replication Scaling – Reads

- Reading scales well with replication
- Great for (mostly) read-only applications

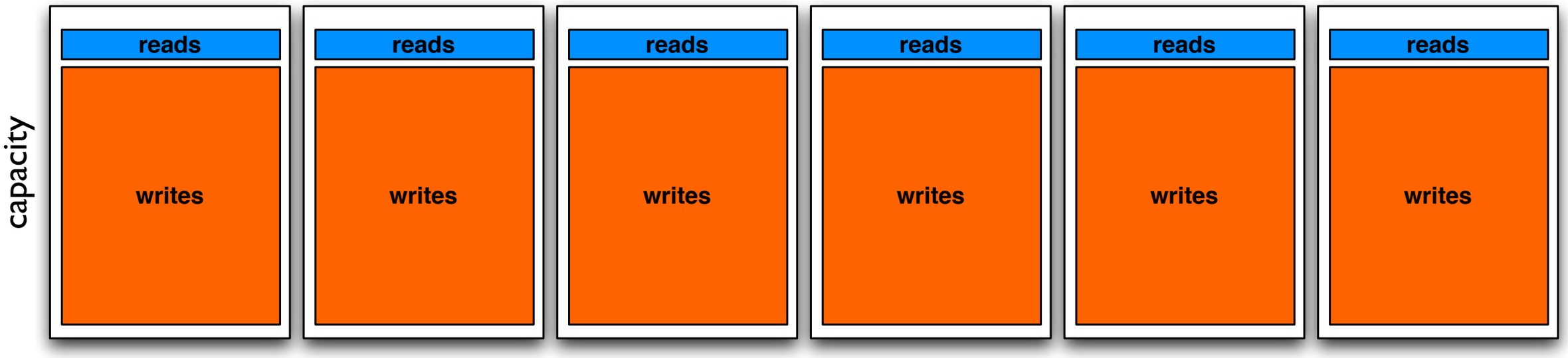


(thanks to Brad Fitzpatrick!)

Replication Scaling – Writes

(aka when replication sucks)

- Writing doesn't scale with replication
- All servers needs to do the same writes



Partition the data

Divide and Conquer!

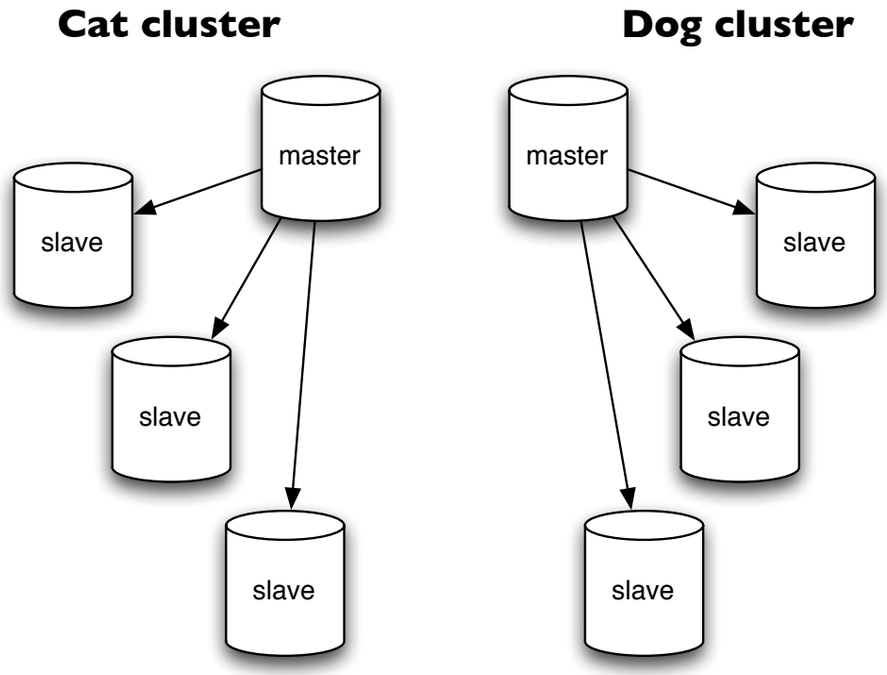
or

Web 2.0 Buzzword Compliant!

Now free with purchase of milk!!

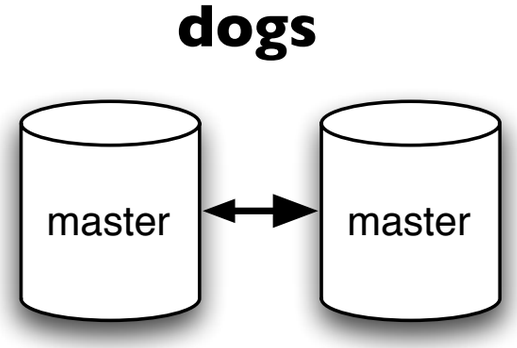
Partition your data

- 96% read application? Skip this step...
- Solution to the too many writes problem: Don't have all data on all servers
- Use a separate cluster for different data sets



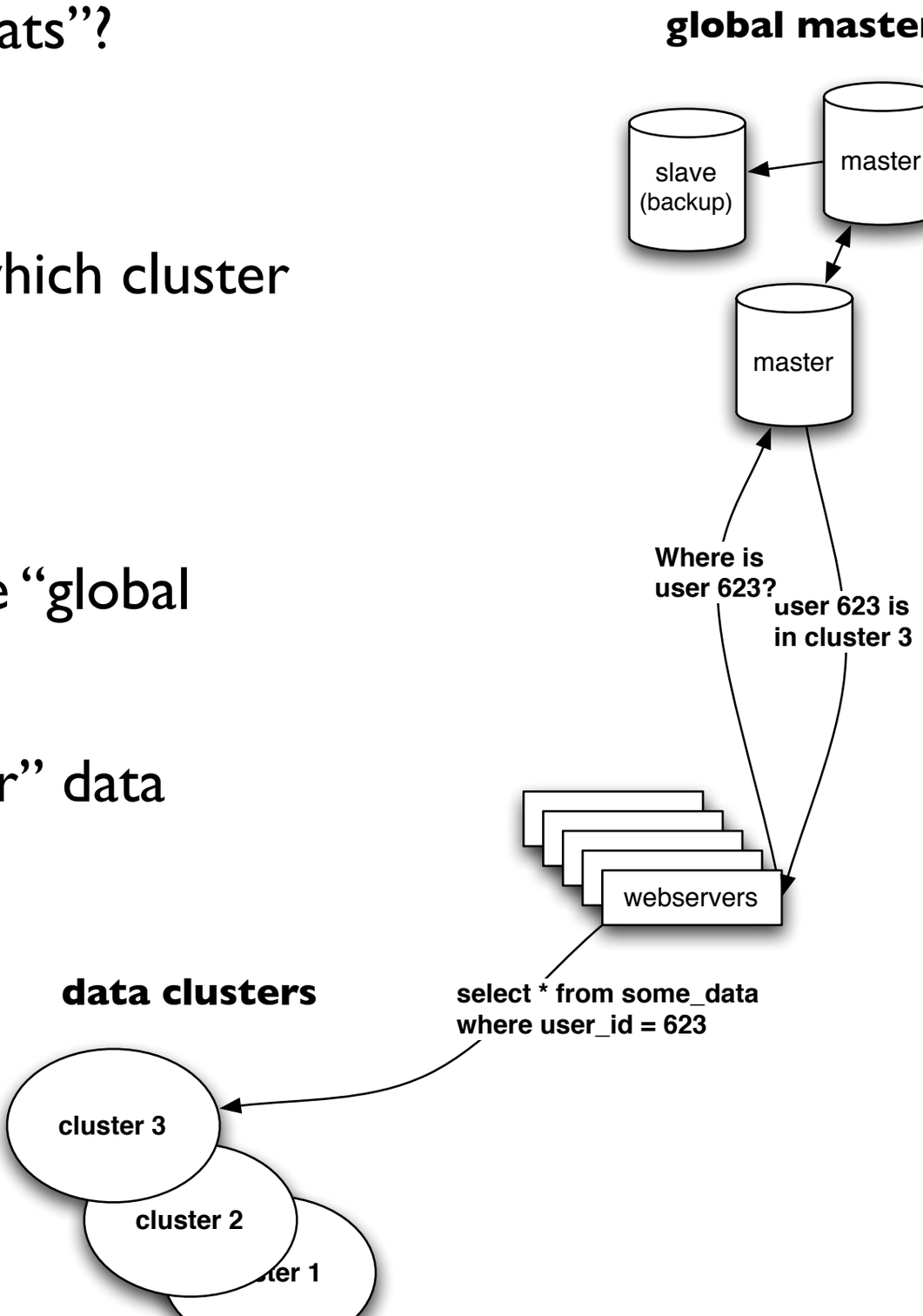
The Write Web!

- Replication too slow? Don't have replication slaves!
- Use a (fake) **master-master** setup and partition / shard the data!
- Simple redundancy!
- No latency from commit to data being available
- Don't bother with fancy 2 or 3 phase commits
  - (Make each "main object" (user, product, ...) always use the same master – as long as it's available)



Partition with a global master server

- Can't divide data up in "dogs" and "cats"?
- Flexible partitioning!
- The "global" server keeps track of which cluster has the data for user "623"
- Get all PKs from the global master
- Only auto_increment columns in the "global master"
- Aggressively cache the "global master" data (memcached)
  - and/or use MySQL Cluster (ndb)



Master – Master setup

- Setup two replicas of your database copying changes to each-other
- Keep it simple! (all writes to one master)
- Instant fail-over host – no slave changes needed
- Configuration is easy!
  - `set-variable = auto_increment_increment=2`
    `set-variable = auto_increment_offset=1`
  - (offset = 2 on second master)
  - Setup both systems as a slave of the other

Online Schema Changes

The reasons we love master-master!

- Do big schema changes with no downtime!
  - Stop A to B replication
  - Move traffic to B
  - Do changes on A
  - Wait for A to catchup on replication
  - Move traffic to A
  - Re-start A to B replication

Hacks!

Don't be afraid of the data-duplication monster

http://flickr.com/photos/firevixen/7586158 8/

Summary tables!

- Find queries that do things with COUNT(*) and GROUP BY and create tables with the results!
  - Data loading process updates both tables
  - or hourly/daily/... updates
- Variation: Duplicate data in a different "partition"
  - Data affecting both a "user" and a "group" goes in both the "user" and the "group" partition (Flickr does this)

Summary databases!

- Don’t just create summary tables
- Use summary databases!
- Copy the data into special databases optimized for special queries
  - full text searches
  - index with both cats and dogs
  - anything spanning all clusters
- Different databases for different latency requirements (RSS feeds from replicated slave DB)

Make everything repeatable

- Script failed in the middle of the nightly processing job?
  (they will sooner or later, no matter what)
- How do you restart it?
- Build your "summary" and "load" scripts so they always can be run again! (and again and again)
- One "authoritative" copy of a data piece – summaries and copies are (re)created from there

Asynchronous data loading

- Updating counts? Loading logs?
- Don't talk directly to the database, send updates through Spread (or whatever) to a daemon loading data
- Don't update for each request

```
update counts set count=count+1 where id=37
```

- Aggregate 1000 records or 2 minutes data and do fewer database changes

```
update counts set count=count+42 where id=37
```

- Being disconnected from the DB will let the frontend keep running if the DB is down!

“Manual” replication

- Save data to multiple “partitions”
- Application writes two places *or*
- last_updated/modified_on and deleted columns *or*
- Use triggers to add to “replication_queue” table
- Background program to copy data based on the queue table or the last_updated column
- Build summary tables or databases in this process
- Build star/spoke replication system

Preload, -dump and -process

- Let the servers do as much as possible without touching the database directly
  - Data structures in memory – ultimate cache!
  - Dump never changing data structures to JS files for the client to cache
- Dump smaller read-only often accessed data sets to SQLite or BerkeleyDB and rsync to each webserver (or use NFS, but...)
  - Or a MySQL replica on each webserver

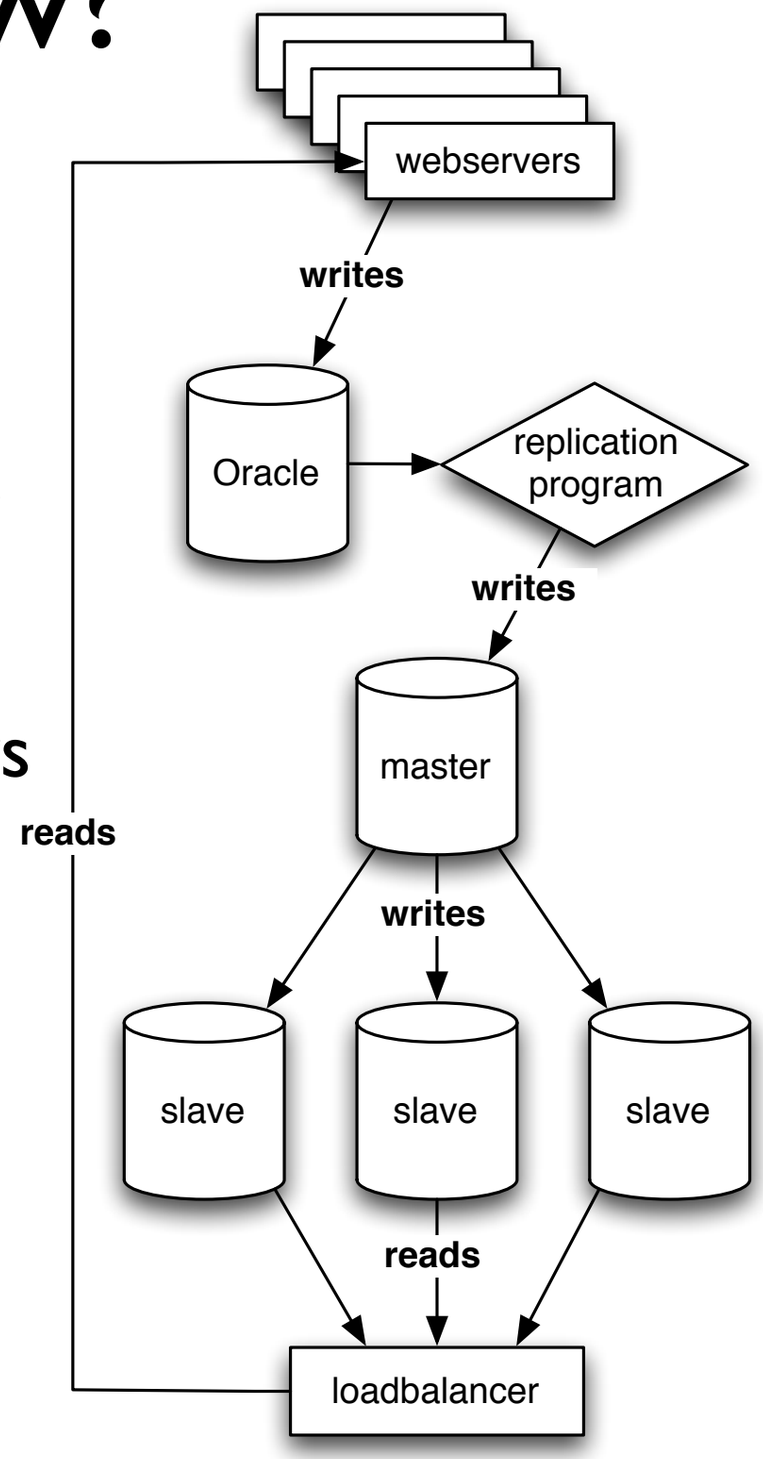
Stored Procedures Dangerous

- Not horizontal
- Bad:
  Work done in the database server (unless it's read-only and replicated)
- Good:
  Work done on one of the scalable web fronts
- Only do stored procedures if they save the database work (network-io work > SP work)

a brief diversion ...

Running Oracle now?

- Move read operations to MySQL!
- Replicate from Oracle to a MySQL cluster with “manual replication”
- Use triggers to keep track of changed rows in Oracle
- Copy them to the MySQL master server with a replication program
- Good way to “sneak” MySQL in ...



Optimize the database

Faster, faster, faster ....

... very briefly

- The whole conference here is about this
- ... so I'll just touch on a few ideas

Memory for MySQL = good

- Put as much memory you can afford in the server
  (Currently 2GB sticks are the best value)
- InnoDB: Let MySQL use ~all memory (don't use more than is available, of course!)
- MyISAM: Leave more memory for OS page caches
- Can you afford to lose data on a crash? Optimize accordingly
- Disk setup: We'll talk about RAID later

What's your app doing?

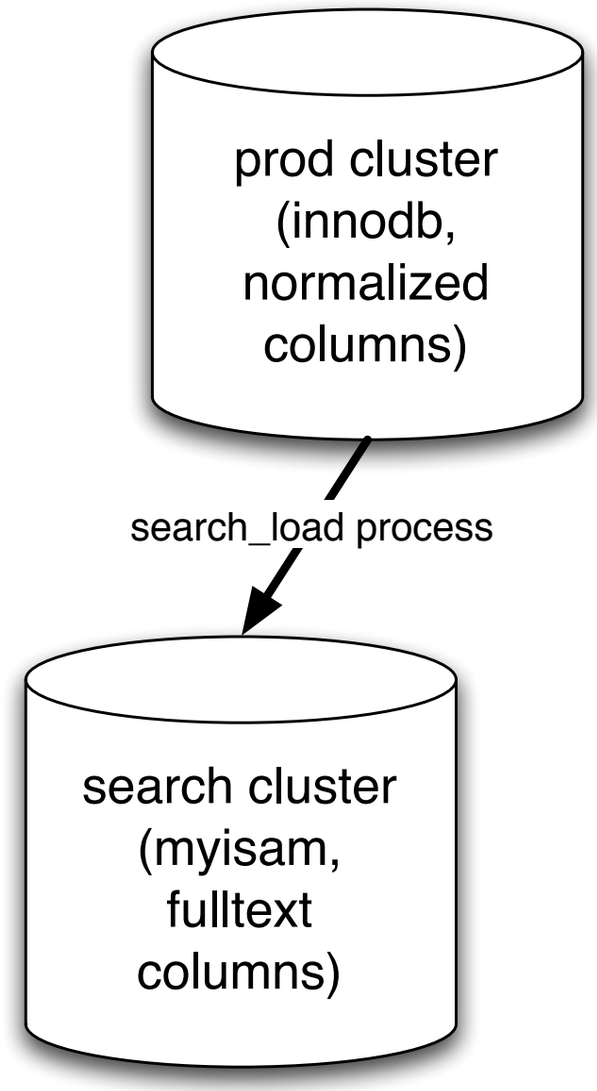
- Enable query logging in your development DB!
- Are all those queries really necessary? Cache candidates?
- (you do have a devel db, right?)
- Just add "`log=/var/lib/mysq/sql.log`" to .cnf
- Slow query logging:
  ```
  log-slow-queries
  log-queries-not-using-indexes
  long_query_time=1
  ```
- `mysqldumpslow` parses the slow log
- 5.1+ does not require a server restart and, can log directly into a CSV table...

Table Choice

- Short version:
  Use InnoDB, it's harder to make them fall over
- Long version:
  Use InnoDB except for
  - Big read-only tables (smaller, less IO)
  - High volume streaming tables (think logging)
    - Locked tables / `INSERT DELAYED`
    - `ARCHIVE` table engine
  - Specialized engines for special needs
  - More engines in the future
  - For now: InnoDB

Multiple MySQL instances

- Run different MySQL instances for different workloads
  - Even when they share the same server anyway!
  - InnoDB vs MyISAM instance
- Move to separate hardware and replication easier
- Optimize MySQL for the particular workload
- Very easy to setup with the instance manager or mysqld_multi
- mysql.com init.d script supports the instance manager (don't use the redhat/fedora script!)



Config tuning helps
Query tuning works

- Configuration tuning helps a little
- The big performance improvements comes from schema and query optimizations – focus on that!
- Design schema based on queries
- Think about what kind of operations will be common on the data; don't go for "perfect schema beauty"
- What results do you need? (now and in the future)

EXPLAIN

- Use the "EXPLAIN SELECT ..." command to check the query
- Baron Schwartz talks about this 2pm on Tuesday!
- Be sure to read
  `http://dev.mysql.com/doc/mysql/en/mysql-indexes.html`
  `http://dev.mysql.com/doc/mysql/en/explain.html`

Use smaller data

- Use Integers
  - Always use integers for join keys
    - And when possible for sorts, group bys, comparisons
- Don’t use bigint when int will do
- Don’t use varchar(255) when varchar(20) will do

Store Large Binary Objects

(aka how to store images)

- Meta-data table (name, size, ...)
- Store images either in the file system
  - meta data says "server '123', filename 'abc'"
    - (If you want this; use mogilefs or Amazon S3 for storage!)
- ***OR*** store images in other tables
  - Split data up so each table don't get bigger than ~4GB
- Include "last modified date" in meta data
  - Include it in your URLs if possible to optimize caching (/images/$timestamp/$id.jpg)

Reconsider Persistent DB Connections

- DB connection = thread = memory
- With partitioning all httpd processes talk to all DBs
- With lots of caching you might not need the main database that often
- MySQL connections are fast
- Always use persistent connections with Oracle!
  - Commercial connection pooling products
- pgsql, sybase, oracle? Need thousands of persistent connections?
  - In Perl the new DBD::Gofer can help with pooling!

InnoDB configuration

- `innodb_file_per_table`
  Splits your innodb data into a file per table instead of one big annoying file
  - Makes `optimize table `table`` clear unused space
  - `innodb_buffer_pool_size=($MEM*0.80)`
  - `innodb_flush_log_at_trx_commit` setting
  - `innodb_log_file_size`
  - `transaction-isolation = READ-COMMITTED`

My favorite MySQL feature

- insert into t (somedate) values (“blah”);
- insert into t (someenum) values (“bad value”);
- Make MySQL picky about bad input!
  - `SET sql_mode = 'STRICT_TRANS_TABLES’;`
  - Make your application do this on connect

Don’t overwork the DB

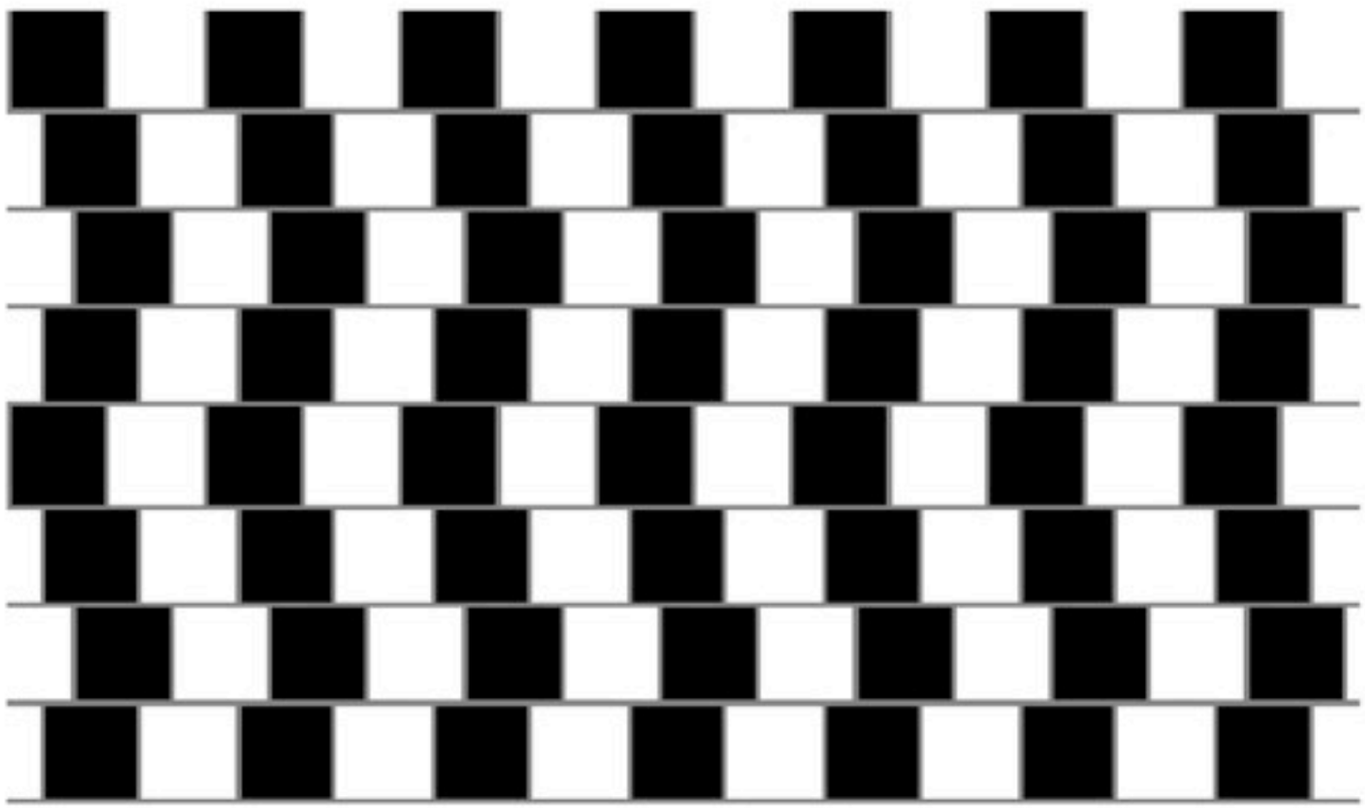
- Databases don’t easily scale
- Don’t make the database do a ton of work
- Referential integrity is good
    - Tons of stored procedures to validate and process data not so much
- Don’t be too afraid of de-normalized data – sometimes it’s worth the tradeoffs (call them summary tables and the DBAs won’t notice)

Use your resources wisely

don't implode when things run warm

Work in parallel

- Split the work into smaller (but reasonable) pieces and run them on different boxes
- Send the sub-requests off as soon as possible, do something else and then retrieve the results



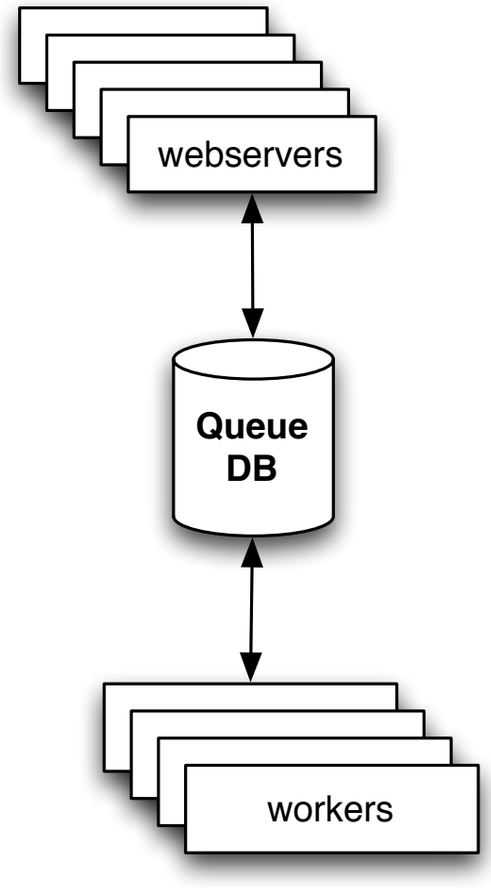
Are the horizontal lines parallel or do they slope?

Job queues

- Processing time too long for the user to wait?
- Can only process N requests / jobs in parallel?
- Use queues (and external worker processes)
- IFRAMEs and AJAX can make this really spiffy (tell the user "the wait time is 20 seconds")

Job queue tools

- Database “queue”
  - Dedicated queue table or just `processed_on` and `grabbed_on` columns
- Webserver submits job
- First available “worker” picks it up and returns the result to the queue
- Webserver polls for status



More Job Queue tools

- beanstalkd - great protocol, *fast*, no persistence (yet)
  `http://xph.us/software/beanstalkd/`
- gearman - for one off out-of-band jobs
  `http://www.danga.com/gearman/`
- starling - from twitter, memcached protocol, disk based persistence
  `http://rubyforge.org/projects/starling/`
- TheSchwartz from SixApart, used in Movable Type
- Spread
- MQ / Java Messaging Service(?) / ...

Log http requests

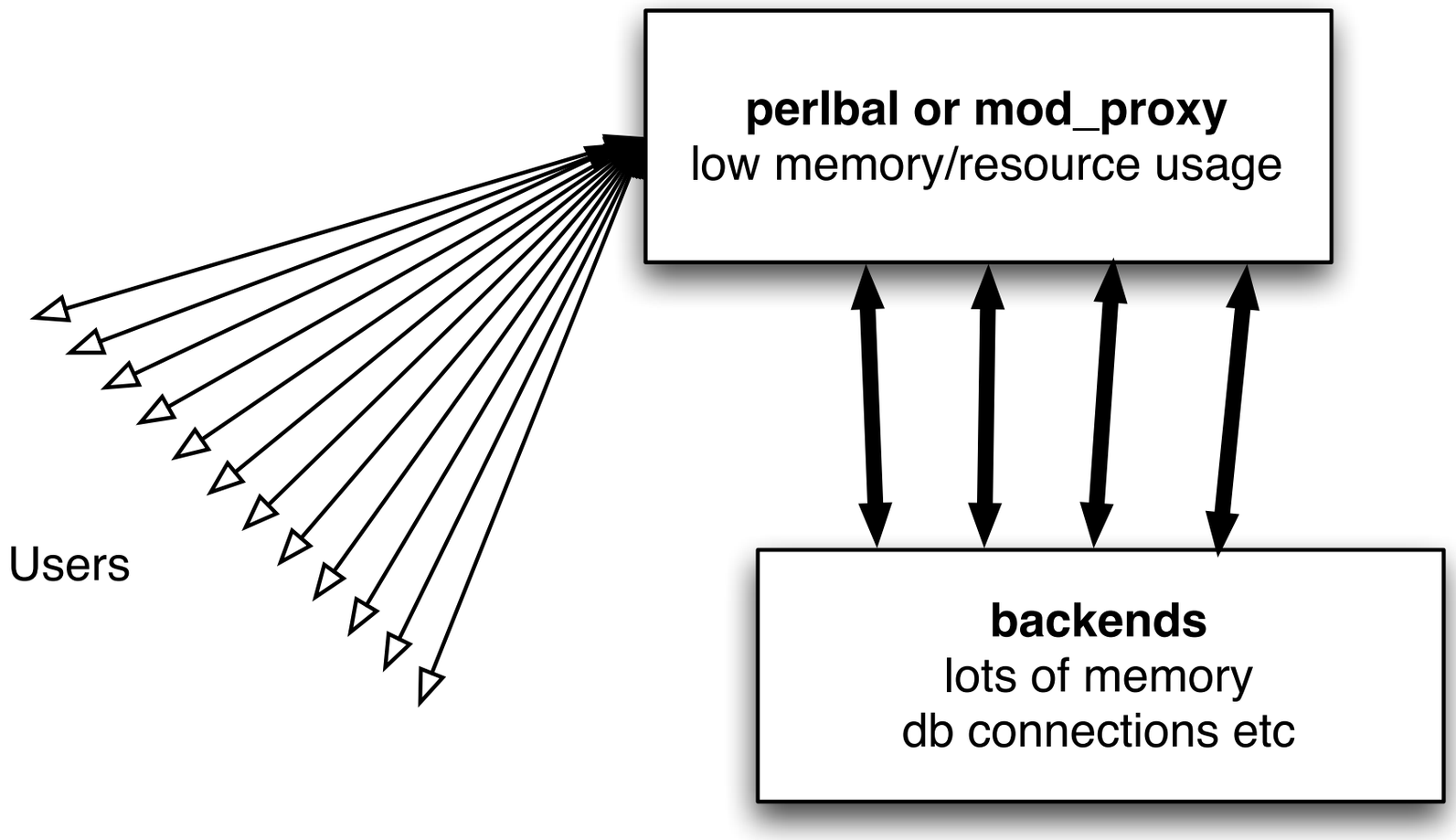
- Log slow http transactions to a database
  time, **response_time**, uri, remote_ip, user_agent, request_args, user, svn_branch_revision, log_reason (a "SET" column), ...
- Log to ARCHIVE tables, rotate hourly / weekly / ...
- Log 2% of all requests!
- Log all 4xx and 5xx requests
- Great for statistical analysis!
  - Which requests are slower
  - Is the site getting faster or slower?
- Time::HiRes in Perl, microseconds from `gettimeofday` system call

Intermission ?

Use light processes for light tasks

- Thin proxies servers or threads for "network buffers"
- Goes between the user and your heavier backend application
- Built-in load-balancing! (for Varnish, perlbal, ...)
- httpd with mod_proxy / mod_backhand
  - perlbal
    – more on that in a bit
  - Varnish, ~~squid~~, ~~pound~~, ...

Proxy illustration



Light processes

- Save memory and database connections
- This works spectacularly well. Really!
- Can also serve static files
- Avoid starting your main application as root
- Load balancing
- In particular important if your backend processes are “heavy”

Light processes

- Apache 2 makes it **Really Easy**

- ```
  ProxyPreserveHost On
  <VirtualHost *>
    ServerName combust.c2.askask.com
    ServerAlias *.c2.askask.com
    RewriteEngine on
    RewriteRule (.*) http://localhost:8230$1 [P]
  </VirtualHost>
  ```

- Easy to have different “backend environments” on one IP

- Backend setup (Apache 1.x)
  ```
  Listen 127.0.0.1:8230
  Port 80
  ```

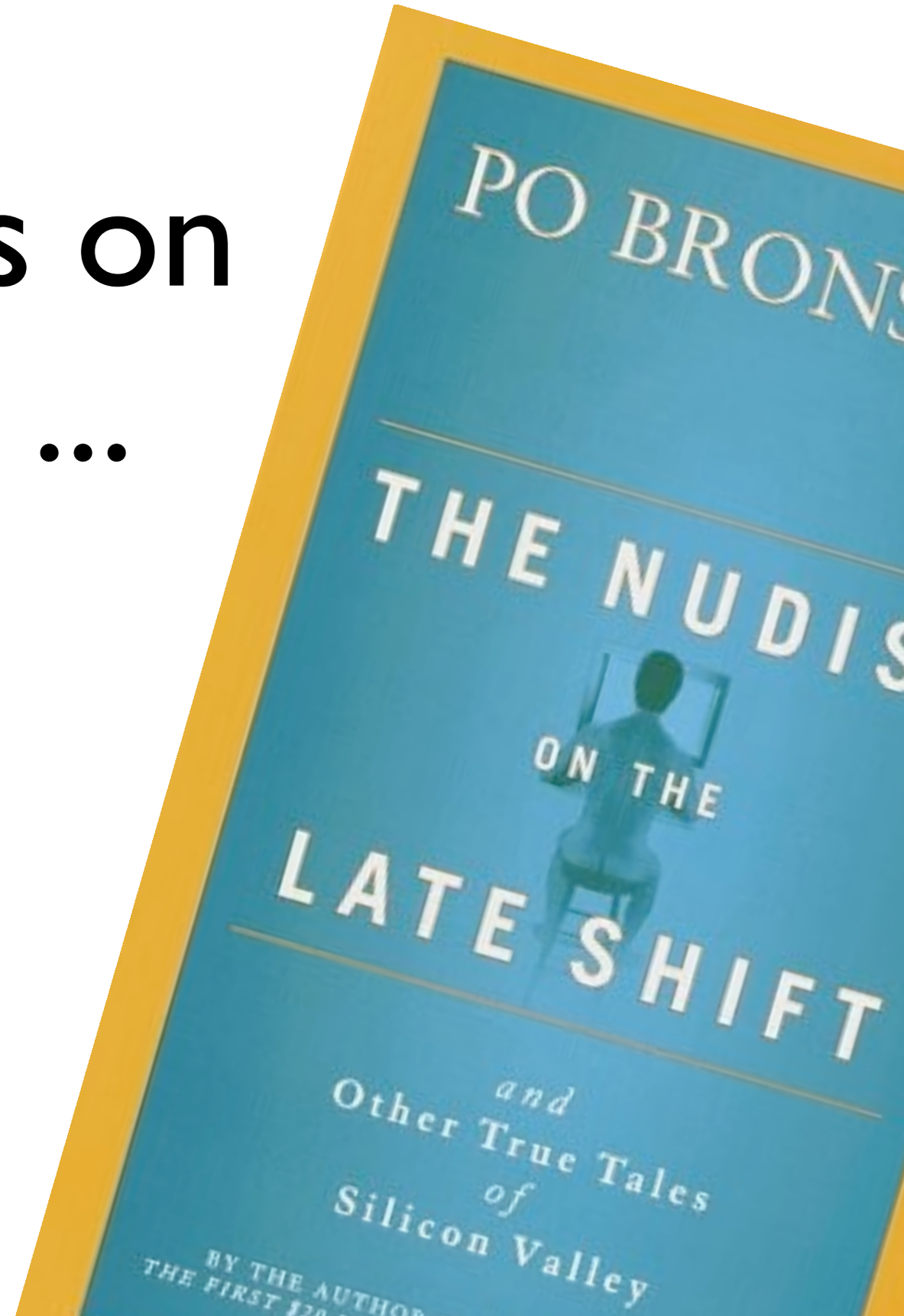

  ```

perlbal configuration

```
CREATE POOL my_apaches
  POOL my_apaches ADD 10.0.0.10:8080
  POOL my_apaches ADD 10.0.0.11:8080
  POOL my_apaches ADD 10.0.0.12
  POOL my_apaches ADD 10.0.0.13:8081

CREATE SERVICE balancer
  SET listen          = 0.0.0.0:80
  SET role            = reverse_proxy
  SET pool            = my_apaches
  SET persist_client  = on
  SET persist_backend = on
  SET verify_backend  = on
ENABLE balancer
```

A few thoughts on development ...



All Unicode All The Time

- The web is international and multilingual, deal with it.
- All Unicode all the time!
  (except when you don't need it – urls, email addresses, ...)
  - Perl: DBD::mysql was fixed last year! PHP 6 will have improved Unicode support. Ruby 2 will someday, too...
  - It will never be easier to convert than now!

Use UTC

Coordinated Universal Time

- It might not seem important now, but some day ...
- It will never be easier to convert than now!
- Store all dates and times as UTC, convert to “local time” on display

Build on APIs

- All APIs All The Time!
- Use “clean APIs” Internally in your application architecture
- Loosely coupled APIs are easier to scale
  - Add versioning to APIs (“&api_version=123”)
- Easier to scale development
- Easier to scale deployment
- Easier to open up to partners and users!

Why APIs?

- Natural place for “business logic”
  - Controller = “Speak HTTP”
  - Model = “Speak SQL”
  - View = “Format HTML / ...”
  - **API** = “**Do Stuff**”
- Aggregate just the right amount of data
  - Awesome place for optimizations that matter!
  - The data layer knows too little

More development philosophy

- Do the Simplest Thing That Can Possibly Work
- ... but do it really well!
- Balance the complexity, err on the side of simple
- This is hard!

Pay your technical debt

- Don’t incur technical debt
  - “We can’t change that - last we tried the site went down”
  - “Just add a comment with ‘TODO’”
    - “Oops. Where are the backups? What do you mean ‘no’?”
    - “Who has the email with that bug?”
- Interest on technical debt will kill you
- *Pay it back as soon as you can!*

Coding guidelines

- Keep your formatting consistent!
  - perl: perltidy, perl best practices, Perl::Critic
- Keep your APIs and module conventions consistent
- Refactor APIs mercilessly (in particular while they are not public)

qmail lessons

- Lessons from 10 years of qmail
- Research paper from Dan Bernstein
  `http://cr.yp.to/qmail/qmailsec-20071101.pdf`
- Eliminate bugs
  - Test coverage
  - Keep data flow explicit
- (continued)

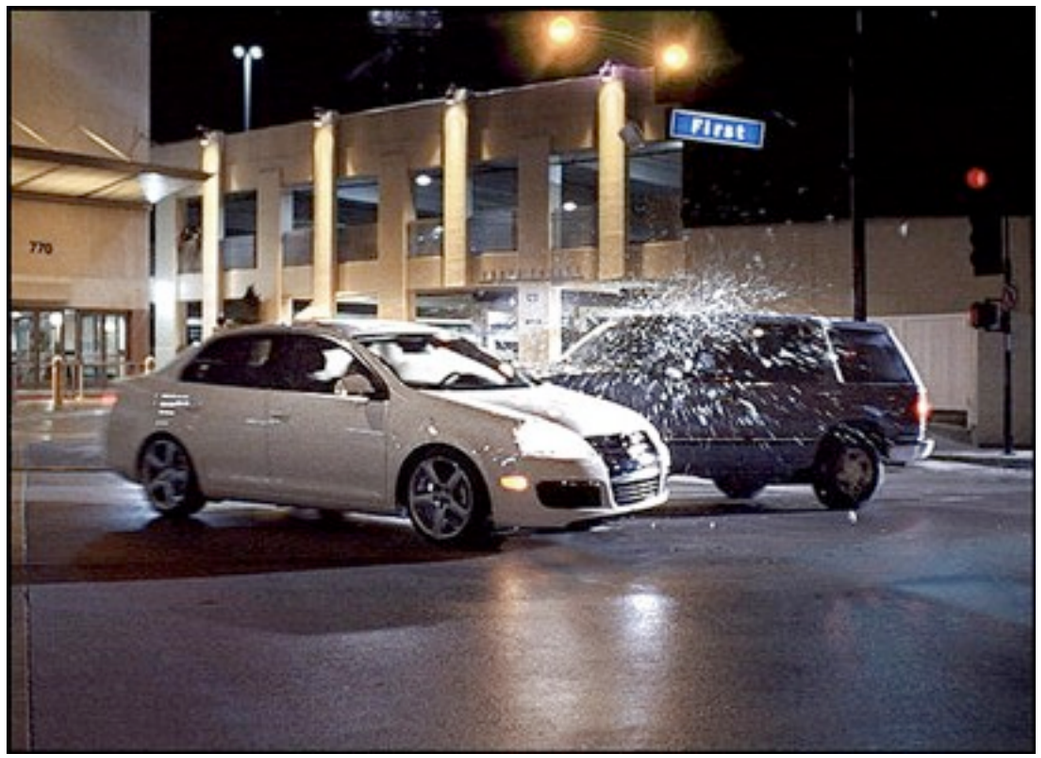
qmail lessons (2)

- Eliminate code – less code = less bugs!
  - Refactor common code
  - Reuse code (Unix tools / libs, CPAN, PEAR, Ruby Gems, ...)
  - Reuse access control
- Eliminate trusted code – what needs access?
  - Treat transformation code as completely untrusted

Joint Strike Fighter

- ~Superset of the "Motor Industry Software Reliability Association Guidelines For The Use Of The C Language In Vehicle Based Software"
- Really Very Detailed!
- No recursion! (Ok, ignore this one :-))
- Do make guide lines – know when to break them
- Have code reviews - make sure every commit email gets read (and have automatic commit emails in the first place!)

High Availability



and Load Balancing
and Disaster Recovery

High Availability

- Automatically handle failures! (bad disks, failing fans, "oops, unplugged the wrong box", ...)
- For your app servers the load balancing system should take out "bad servers" (most do)
  - perlbal or Varnish can do this for http servers
- Easy-ish for things that can just "run on lots of boxes"

Make that service always work!

- Sometimes you need a service to always run, but on specific IP addresses
  - Load balancers (level 3 or level 7: perlbal/varnish/squid)
  - Routers
  - DNS servers
  - NFS servers
  - Anything that has failover or an alternate server – the IP needs to move (much faster than changing DNS)

Load balancing

- Key to horizontal scaling (duh)
- 1) All requests goes to the load balancer
  2) Load balancer picks a "real server"
- Hardware (lots of vendors)
  Coyote Point have relatively cheaper ones
  - Look for older models for cheap on eBay!
- Linux Virtual Server
- Open/FreeBSD firewall rules (pf firewall pools)
  (no automatic failover, have to do that on the "real servers")

Load balancing 2

- Use a “level 3” (tcp connections only) tool to send traffic to your proxies
- Through the proxies do “level 7” (http) load balancing
- perlbal has some really good features for this!

perlbal

- Event based for HTTP load balancing, web serving, and a mix of the two (see below).
- Practical fancy features like "multiplexing" keep-alive connections to both users and back-ends
- Everything can be configured or reconfigured on the fly
- If you configure your backends to only allow as many connections as they can handle (you should anyway!) perlbal with automatically balance the load "perfectly"
- Can actually give Perlbal a list of URLs to try. Perlbal will find one that's alive. Instant failover!
- `http://www.danga.com/perlbal/`

Varnish

- Modern high performance http accelerator
- Optimized as a “reverse cache”
- Whenever you would have used squid, give this a look
- Recently got “Vary” support
- Super efficient (except it really wants to “take over” a box)
- Written by Poul-Henning Kamp, famed FreeBSD contributor
- BSD licensed, work is being paid by a norwegian newspaper
- `http://www.varnish-cache.org/`

Fail-over tools

"move that IP"


© 2004 Photography by: Nicholas Griffin
www.roundstone.ie
2004-09-04 13:01:48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www.roundstone.ie
2004-09-04 13:01:57

Buy a “hardware load balancer”

- Generally *Quite Expensive*
  - (Except on eBay - used network equipment is often great)
- Not appropriate (cost-wise) until you have MANY servers
- If the feature list fits it “Just Works”
- ... but when we are starting out, what do we use?

wackamole

- Simple, just moves the IP(s)
- Can embed Perl so you can run Perl functions when IPs come and go
- Easy configuration format
- Setup “groups of IPs”
- Supports Linux, FreeBSD and Solaris
- Spread toolkit for communication
- Easy to troubleshoot (after you get Spread working...)
- http://www.backhand.org/wackamole/

Heartbeat

- Monitors and moves services (an IP address is "just a service")
- v1 has simple but goofy configuration format
- v2 supports all sorts of groupings, larger clusters (up to 16 servers)
- Uses /etc/init.d type scripts for running services
- Maybe more complicated than you want your HA tools
- http://www.linux-ha.org/

Carp + pfsync

- Patent-free version of Ciscos “VRRP” (Virtual Router Redundancy Protocol)
- FreeBSD and OpenBSD only
- Carp (moves IPs) and pfsync (synchronizes firewall state)
- (awesome for routers and NAT boxes)
- Doesn’t do any service checks, just moves IPs around

mysql master master replication manager

- mysql-master-master tool can do automatic failover!
- No shared disk
- Define potential “readers” and “writers”
- List of “application access” IPs
- Reconfigures replication
- Moves IPs
- `http://code.google.com/p/mysql-master-master/`
  `http://groups.google.com/group/mmm-devel/`

Suggested Configuration

- Open/FreeBSD routers with Carp+pfsync for firewalls
- A set of boxes with perlbal + wackamole on static "always up" HTTP enabled IPs
  - Trick on Linux: Allow the perlbal processes to bind to all IPs (no port number tricks or service reconfiguration or restarts!)

```
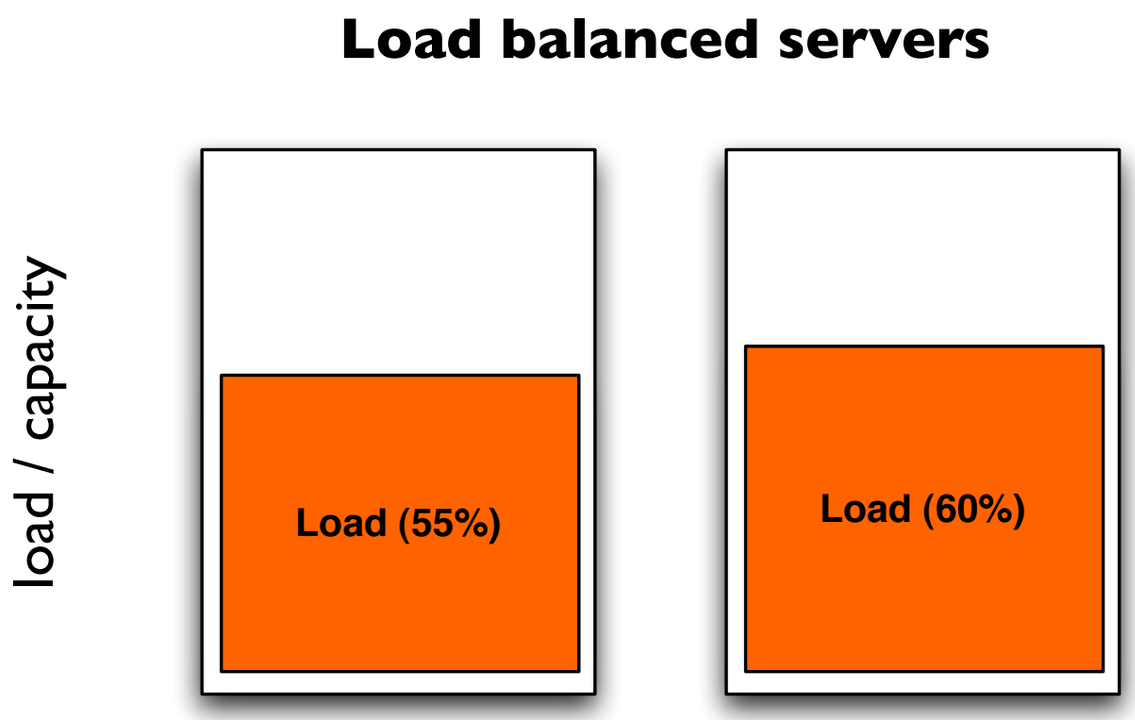
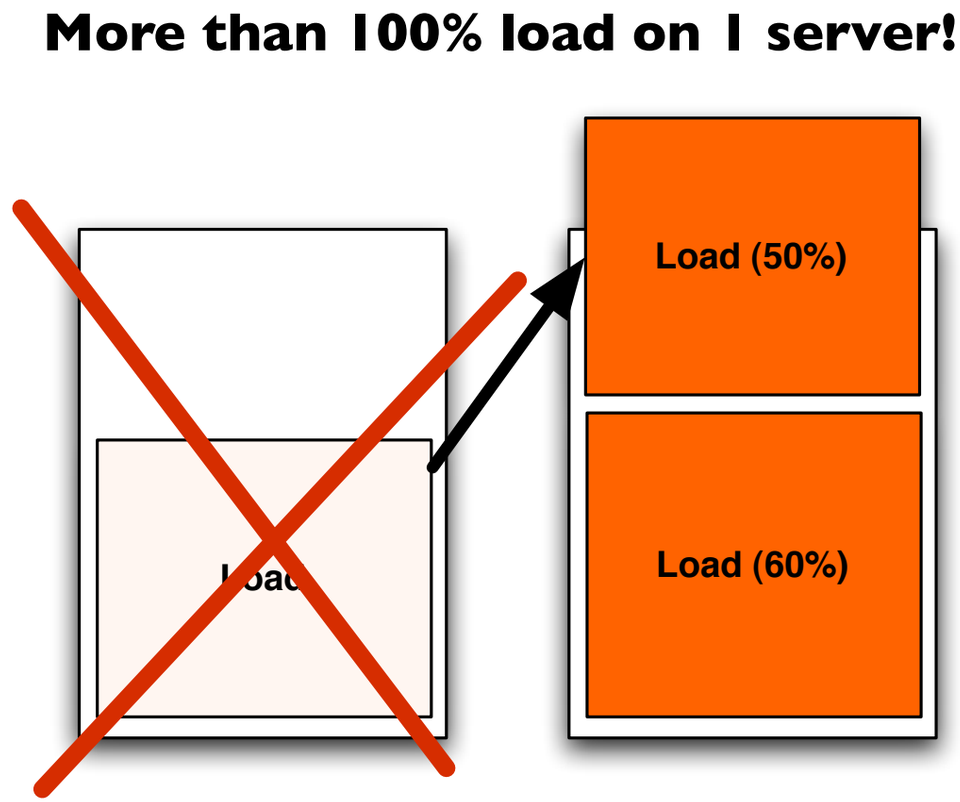
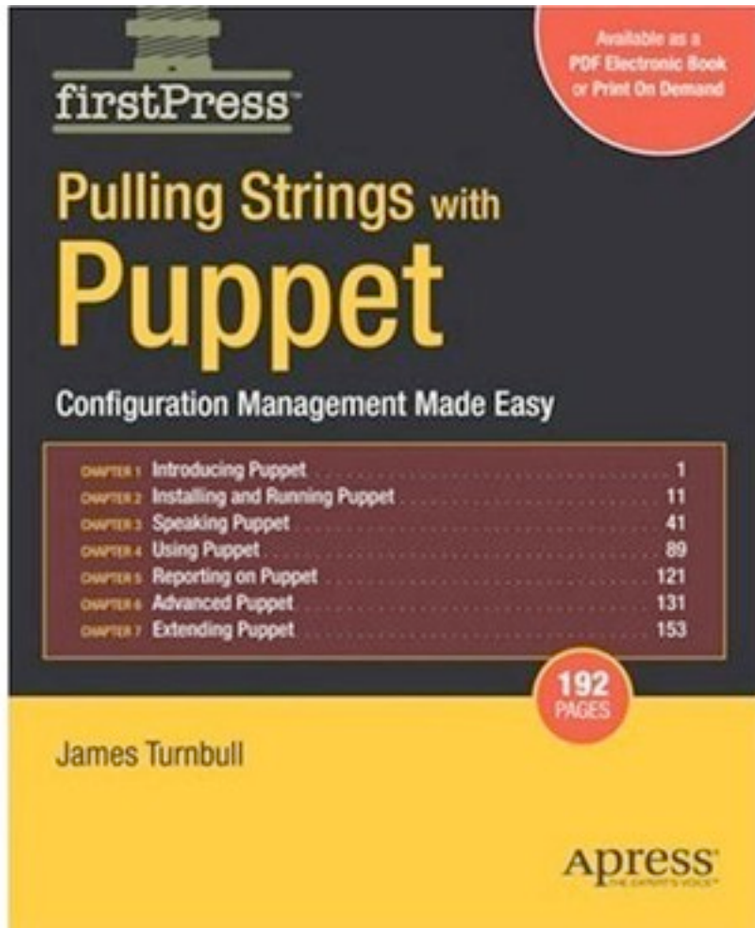
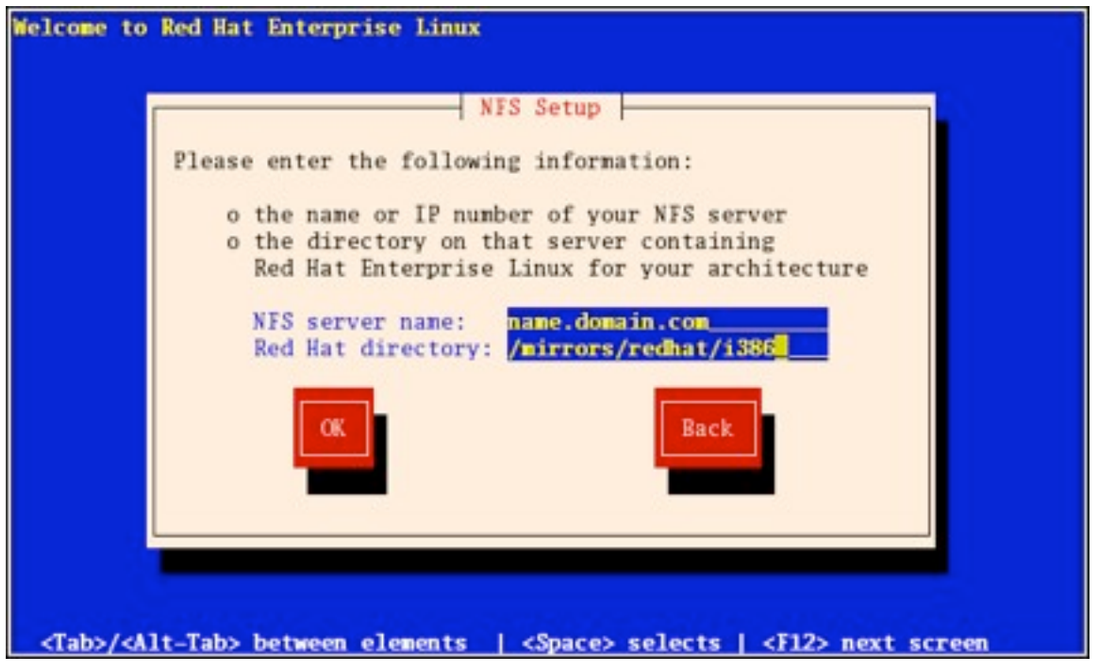
echo 1 > /proc/sys/net/ipv4/ip_nonlocal_bind
or
sysctl -w net.ipv4.ip_nonlocal_bind=1
or
echo net.ipv4.ip_nonlocal_bind = 1 >> /etc/sysctl.conf
```

- Dumb regular http servers "behind" the perlbal ones
- wackamole for other services like DNS
- mmm for mysql fail-over

Redundancy fallacy!

- Don’t confuse load-balancing with redundancy
- What happens when one of these two fail?



Oops – no redundancy!

- Always have "n+1" capacity
- Consider have a "passive spare" (active/passive with two servers)
- Careful load monitoring!
  - Munin `http://munin.projects.linpro.no/`
  - MySQL Network
  - (ganglia, cacti, ...)



High availability
Shared storage

- NFS servers (for diskless servers, ...)
- Failover for database servers
- Traditionally either via fiber or SCSI connected to both servers
- Or NetApp filer boxes
- All expensive and smells like “the one big server”

Cheap high availability storage with DRBD

- Synchronizes a block device between two servers!
- "Network RAID1"
- Typically used in Active/Primary-Standby/Secondary setup
- If the active server goes down the secondary server will switch to primary, run fsck, mount the device and start the service (MySQL / NFS server / ...)
- v0.8 can do writes on both servers at once – "shared disk semantics" (you need a filesystem on top that supports that, OCFS, GFS, ... – probably not worth it, but neat)

Disaster Recovery

- Separate from "fail-over"
  (no disaster if we failed-over...)
  - "The rescue truck fell in the water"
  - "All the 'redundant' network cables melted"
  - "The datacenter got flooded"
  - "The grumpy sysadmin sabotaged everything before he left"

Disaster Recovery Planning

- You won't be back up in 2 hours, but plan so you quickly will have an idea how long it will be
- Have a status update site / weblog
- Plans for getting hardware replacements
- Plans for getting running temporarily on rented "dedicated servers" (ev1servers, rackspace, ...)
- And ....

Backup your databse!

- Binary logs!
  - Keep track of “changes since the last snapshot”
- Use replication to Another Site
  (doesn’t help on “for $table = @tables { truncate $table }”)
- On small databases use `mysqldump`
  (or whatever similar tool your database comes with)
- Zmanda MySQL Backup
  packages the different tools and options

Backup Big Databases

- Use `mylvmbackup` to snapshot and archive
  - Requires data on an LVM device (just do it)
  - InnoDB:
    Automatic recovery! (ooh, magic)
  - MyISAM:
    Read Lock your database for a few seconds before making the snapshot
    (on MySQL do a "FLUSH TABLES" first (which might be slow) and then a "FLUSH TABLES WITH READ LOCK" right after)
  - Sync the LVM snapshot elsewhere
  - And then remove the snapshot!
- Bonus Optimization:
  Run the backup from a replication slave!

Backup on replication slave

- Or just run the backup from a replication slave ...
- Keep an extra replica of your master
  - shutdown mysqld and archive the data
  - Small-ish databases:
    `mysqldump --single-transaction`

All Automation All The Time

or

How to manage 200 servers in your spare-time

System Management

Keep software deployments easy

- Make upgrading the software a simple process
- Script database schema changes
- Keep configuration minimal
  - Servername (“www.example.com”)
  - Database names (“userdb = host=db1;db=users”;...”
  - If there’s a reasonable default, put the default in the code (for example)
  - “deployment_mode = devel / test / prod” lets you put reasonable defaults in code

Easy software deployment 2

- How do you distribute your code to all the app servers?
- Use your source code repository (Subversion etc)! (tell your script to svn up to http://svn/branches/prod revision 123 and restart)
- .tar.gz to be unpacked on each server
- .rpm or .deb package
- NFS mount and symlinks
- No matter what: Make your test environment use the same mechanism as production and:
  Have it scripted!

actually,

*have **everything** scripted!*

http://flickr.com/photos/karlequin/84829873/

Configuration management

Rule Number One

- Configuration in SVN (or similar)
- "infrastructure/" repository
- SVN rather than rcs to automatically have a backup in the Subversion server – which you are carefully backing up anyway
- Keep notes! Accessible when the wiki is down; easy to grep
- Don't worry about perfect layout; just keep it updated

Configuration management

Rule Two

- Repeatable configuration!
- Can you reinstall any server Right Now?
- Use tools to keep system configuration in sync
- Upcoming configuration management (and more) tools!
  - csync2 (librsync and sqlite based sync tool)
  - puppet (central server, rule system, ruby!)

puppet



- Automating sysadmin tasks!
- 1) Client provides “facter” to server
  2) Server makes configuration
  3) Client implements configuration

- ```
  service { "sshd":
     enable => true,
     ensure => running
  }
  ```
- ```
  package { "vim-enhanced": ensure => installed }
  package { "emacs": ensure => installed }
  ```

puppet example

```
node db-server inherits standard {
  include mysql_server
  include solfo_hw
}

node db2, db3, db4 inherits db-server { }

node trillian inherits db-server {
  include ypbot_devel_dependencies
}

# ----------------------------
```

```
class mysql_client {
   package { "MySQL-client-standard": ensure => installed }
   package { "MySQL-shared-compat": ensure => installed }
}

class mysql_server {
  file { "/mysql":
           ensure => directory,
       }
  package { "MySQL-server-standard": ensure => installed }

  include mysql_client
}
```

puppet mount example

- Ensure an NFS mount exists, except on the NFS servers




```
class nfs_client_pkg {

  file { "/pkg":
            ensure => directory,
         }

 $mount = $hostname ? {
    "nfs-a" => absent,
    "nfs-b" => absent,
    default => mounted
  }

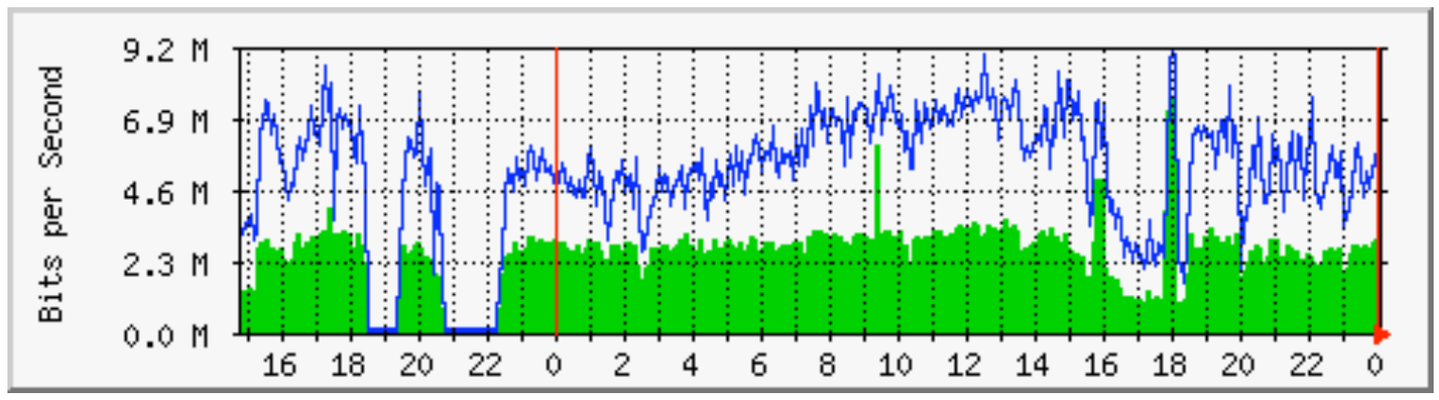
   mount {
      "/pkg":
         atboot => true,
         device => 'nfs.la.sol:/pkg',
         ensure => $mount,
         fstype => 'nfs4',
         options => 'ro,intr,noatime',
         require => File["/pkg"],
   }
}
```

More puppet features

- In addition to services, packages and mounts...
  - Manage users
  - Manage crontabs
  - Copy configuration files (with templates)
  - … and much more
- Recipes, reference documentation and more at
  `http://reductivelabs.com/`

Backups!

- Backup everything you can
  - Check/test the backups routinely
- Super easy deployment: **rsnapshot**
  - Uses rsync and hardlinks to efficiently store many backup generations
  - Server initiated – just needs ssh and rsync on client
  - Simple restore – files
- Other tools
  - Amanda (Zmanda)
  - Bacula

Backup is cheap!

- Extra disk in a box somewhere? That can do!
- Disks are cheap – get more!
- Disk backup server in your office:
  Enclosure + PSU: $275
  CPU + Board + RAM: $400
  3ware raid (optional): $575
  6x1TB disks: $1700 (~4TB in raid 6)
  = $3000 for 4TB backup space, easily expandable
  (or less than *$5000 for 9TB* space with raid 6 and hot standby)
- Ability to get back your data = **Priceless!**

somewhat tangentially ...

RAID Levels

RAID-I (1989) consisted of a Sun 4/280 workstation with 128 MB of DRAM, four dual-string SCSI controllers, 28 5.25-inch SCSI disks and specialized disk striping software.

`http://www.cs.berkeley.edu/~pattrsn/Arch/prototypes2.html`

Basic RAID levels

- RAID 0
  Stripe all disks (capacity = N*S
  Fail: Any disk

- RAID 1
  Mirror all disks (capacity = S)
  Fail: All disks

- RAID 10
  Combine RAID 1 and 0 (capacity = N*S / 2)

- RAID 5
  RAID 0 with parity (capacity = N*S - S)
  Fail: 2 disks

- RAID 6
  Two parity disks (capacity = N*S - S*2)
  Fail: 3 disks!

RAID 1

- Mirror all disks to all disks
- Simple - easiest to recover!
- Use for system disks and small backup devices

RAID 0

- Use for redundant database mirrors or scratch data that you can quickly rebuild
- Absolutely never for anything you care about
- Failure = system failure
- Great performance; no safety
- Capacity = 100%
- Disk IO = every IO available is “useful”

RAID 10

- Stripe of mirrored devices
- IO performance and capacity of half your disks - not bad!
- Relatively good redundancy, lose one disk from each of the “sub-mirrors”
- Quick rebuild: Just rebuild one mirror
- More disks = more failures! If you have more than X disks, keep a hot spare.

RAID 5

- Terrible database performance
- A partial block write = read *all* disks!
- When degraded a RAID 5 is a RAID 0 in redundancy!
- Rebuilding a RAID 5 is a great way to find more latent errors
- Don’t use RAID 5 – just not worth it

RAID 6

- Like RAID 5 but doesn't fail as easily
- Can survive two disks failing
- Don't make your arrays too big
  - 12 disks = 12x failure rate of one disk!
  - Always keep a hot-spare if you can

Hardware or software RAID?

- Hardware RAID: Worth it for the Battery Backup Unit!
  - Battery allows the controller to – safely – fake "Sure mister, it's safely on disk" responses
- No Battery? Use Software RAID
  - Low or no CPU use
  - Easier and faster to recover from failures!
    - Write-intent bitmap
  - More flexible layout options
    - RAID 1 partition for system + RAID 10 for data on each disk

Nagios

http://app1.la.sol/nagios/

Inquisitor

Nagios®

General
- Home
- Documentation

Monitoring
- Tactical Overview
- Service Detail
- Host Detail
- Hostgroup Overview
- Hostgroup Summary
- Hostgroup Grid
- Servicegroup Overview
- Servicegroup Summary
- Servicegroup Grid
- Status Map
- 3-D Status Map
- Service Problems
- Host Problems
- Network Outages

Show Host:

- Comments
- Downtime
- Process Info
- Performance Info
- Scheduling Queue

Reporting
- Trends
- Availability
- Alert Histogram
- Alert History
- Alert Summary
- Notifications
- Event Log

Configuration
- View Config

Current Network Status
Last Updated: Sun Mar 23 21:18:46 PDT 2008
Updated every 60 seconds
Nagios® - www.nagios.org
Logged in as *ask*

View History For all hosts
View Notifications For All Hosts
View Host Status Detail For All Hosts

Host Status Totals

Up	Down	Unreachable	Pending
19	3	0	0

All Problems	All Types
3	22

Service Status Totals

Ok	Warning	Unknown	Critical	Pending
78	0	3	13	0

All Problems	All Types
16	94

Service Status Details For All Hosts

Host	Service	Status	Last Check	Duration	Attempt	Status Information
app1	Root Partition	OK	2008-03-23 21:15:42	5d 19h 45m 13s	1/4	DISK OK - free space: / 243 MB (22% inode=94%):
	df	OK	2008-03-23 21:15:59	518d 14h 26m 46s	1/4	/dev/mapper/vg0/vgvar: 80 /dev/md0: 31 /dev/mapper/vg0/vgroot: 78 /dev/mapper/vg0/vgusr: 54 /dev/mapper/vgmirror/local: 1 /dev/mapper/vgmirror/xen: 4 /dev/mapper/vg0/vgtmp: 2
	dns auth internal	OK	2008-03-23 21:15:45	573d 16h 35m 22s	1/4	DNS OK: 0.016 seconds response time. dnstest.la.sol returns 127.0.0.2
	dns cache	OK	2008-03-23 21:17:18	573d 16h 35m 22s	1/4	DNS OK: 0.006 seconds response time. dnstest.la.sol returns 127.0.0.2
	ldap	OK	2008-03-23 21:17:55	0d 16h 28m 52s	1/4	LDAP OK - 0.002 seconds response time
	ntpd	OK	2008-03-23 21:15:50	420d 14h 59m 24s	1/4	NTP OK: Offset -5.125999451e-06 secs
	smtp	OK	2008-03-23 21:17:15	33d 5h 51m 9s	1/4	SMTP OK - 0.023 sec. response time
	ssh	OK	2008-03-23 21:17:18	7d 18h 41m 38s	1/4	SSH OK - OpenSSH_4.3 (protocol 2.0)
	ups1	OK	2008-03-23 21:15:43	6d 9h 0m 1s	1/4	UPS OK - Status=Online Utility=115.0V Batt=100.0% Load=55.0% Temp=27.0C
	ups2	CRITICAL	2008-03-23 21:17:18	186d 8h 10m 44s	4/4	CRITICAL - no such ups 'ups2' on that host
app2	df	OK	2008-03-23 21:15:59	8d 20h 55m 55s	1/4	/dev/md0: 30 /dev/mapper/vg0/tmp: 4 /dev/mapper/vg0/usr: 34 /dev/mapper/vg0/var: 23 /dev/mapper/vg0/root: 47 /dev/sda7: 35 /dev/mapper/vgmirror/xen: 45 /dev/sdb7: 11
	ntpd	OK	2008-03-23 21:16:27	8d 20h 53m 45s	1/4	NTP OK: Offset -0.4193743467 secs
	ssh	OK	2008-03-23 21:17:23	8d 20h 54m 51s	1/4	SSH OK - OpenSSH_4.7 (protocol 2.0)
app3	df	OK	2008-03-23 21:17:23	0d 8h 52m 30s	1/4	/dev/mapper/vg0/var: 70 /dev/mapper/vg0/usr: 43 /dev/mapper/vg0/tmp: 4 /dev/md0: 30 /dev/mapper/vg0/root: 56 /dev/mapper/vgmirror/local: 52 /dev/sda7: 11 /dev/mapper/vgmirror/xen: 23 /dev/sdb7: 34
	memcached	OK	2008-03-23 21:17:55	0d 8h 51m 35s	1/4	OK
	ntpd	OK	2008-03-23 21:15:35	0d 8h 50m 55s	1/4	NTP OK: Offset -0.4405990839 secs
	ssh	OK	2008-03-23 21:15:45	0d 8h 51m 0s	1/4	SSH OK - OpenSSH_4.7 (protocol 2.0)
	ypbot app	OK	2008-03-23 21:16:22	0d 4h 13m 26s	1/4	HTTP OK HTTP/1.1 200 OK - 25897 bytes in 0.116 seconds
con1	ssh	OK	2008-03-23 21:16:40	0d 5h 50m 10s	1/4	SSH OK - OpenSSH_4.4 (protocol 1.99)

nagios

df	OK	2008-03-23 22:36:59	518d 15h 45m 23s	1/4	/dev/mapper/vg0/vgvar: 80 /dev/md0: 31 /dev/mapper/vg0/vgroot: 78 /dev/mapper/vg0/vgusr: 54 /dev/mapper/vgmirror/local: 1 /dev/mapper/vgmirror/xen: 4 /dev/mapper/vg0/vgtmp: 2
dns auth internal	OK	2008-03-23 22:36:45	573d 17h 53m 59s	1/4	DNS OK: 0.009 seconds response time. dnstest.la.sol returns 127.0.0.2
dns cache	OK	2008-03-23 22:35:21	573d 17h 53m 59s	1/4	DNS OK: 0.078 seconds response time. dnstest.la.sol returns 127.0.0.2
ldap	OK	2008-03-23 22:35:55	0d 17h 47m 29s	1/4	LDAP OK - 0.002 seconds response time
ntpd	OK	2008-03-23 22:36:50	420d 16h 18m 1s	1/4	NTP OK: Offset -3.468990326e-05 secs
smtp	OK	2008-03-23 22:35:15	33d 7h 9m 46s	1/4	SMTP OK - 0.021 sec. response time
ssh	OK	2008-03-23 22:35:21	7d 20h 0m 15s	1/4	SSH OK - OpenSSH_4.3 (protocol 2.0)
ups1	OK	2008-03-23 22:36:43	6d 10h 18m 38s	1/4	UPS OK - Status=Online Utility=117.0V Batt=100.0% Load=55.0% Temp=27.0C

- Monitoring “is the website up” is easy
- Monitoring dozens or hundreds of sub-systems is hard
- Monitor everything!
- Disk usage, system daemons, applications daemons, databases, data states, ...

nagios configuration tricks

- nagios configuration is famously painful
- Somewhat undeserved!

examples of simple configuration
- templates
- groups

nagios best practices

- All alerts must be “important” – if some alerts are ignored, all other alerts easily are, too.
- Don’t get 1000 alerts if a DB server is down
- Don’t get paged if 1 of 50 webservers crashed
- Why do you as a non-sysadmin care?
  - Use nagios to help the sysadmins fix the application
  - Get information to improve reliability

Resource management

- If possible, only run one service per server (makes monitoring/ managing your capacity much easier)
- Balance how you use the hardware
  - Use memory to save CPU or IO
  - Balance your resource use (CPU vs RAM vs IO)
  - Extra memory on the app server? Run memcached!
  - Extra CPU + memory? Run an application server in a Xen box!
- Don't swap memory to disk. Ever.

Netboot your application servers!

- Definitely netboot the installation (you'll never buy another server with a tedious CD/DVD drive)
  - RHEL / Fedora: Kickstart + puppet = from box to all running in ~10 minutes
- Netboot application servers
- FreeBSD has awesome support for this
- Debian is supposed to
- Fedora Core ~~7~~ ~~8~~ ?? looks like it will (RHEL5uX too?)

No shooting in foot!

- Ooops? Did that leak memory again? Development server went kaboom?
- Edit /etc/security/limits.conf
- ```
  @users     soft rss    250000
  @users     hard rss    250000
  @users     hard as     500000
  ```
- Use to set higher open files limits for mysqld etc, too!
  ```

noatime mounts

- Mount ~all your filesystems "noatime"
- By default the filesystem will do a **write** *every time it accesses/reads a file*!
- That's clearly **insane**
  - Stop the madness, mount noatime

```
/dev/vg0/lvhome   /home   ext3   defaults   1 2
/dev/vg0/lvhome   /home   ext3   noatime    1 2
```

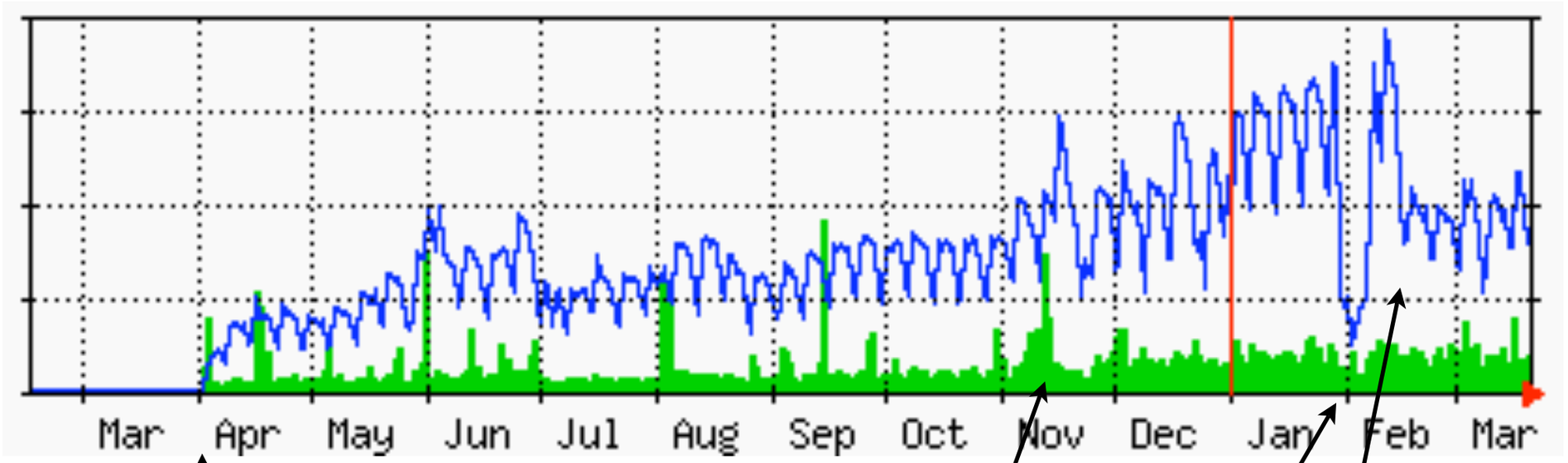
graph everything!



- mrtg
  The Multi Router Traffic Grapher
- rrdtool
  round-robin-database tool
  - Fixed size database handling time series data
  - Lots of tools built on rrdtool
- ganglia
  cluster/grid monitoring system

Historical perspective

basic bandwidth graph



Launch

Steady growth

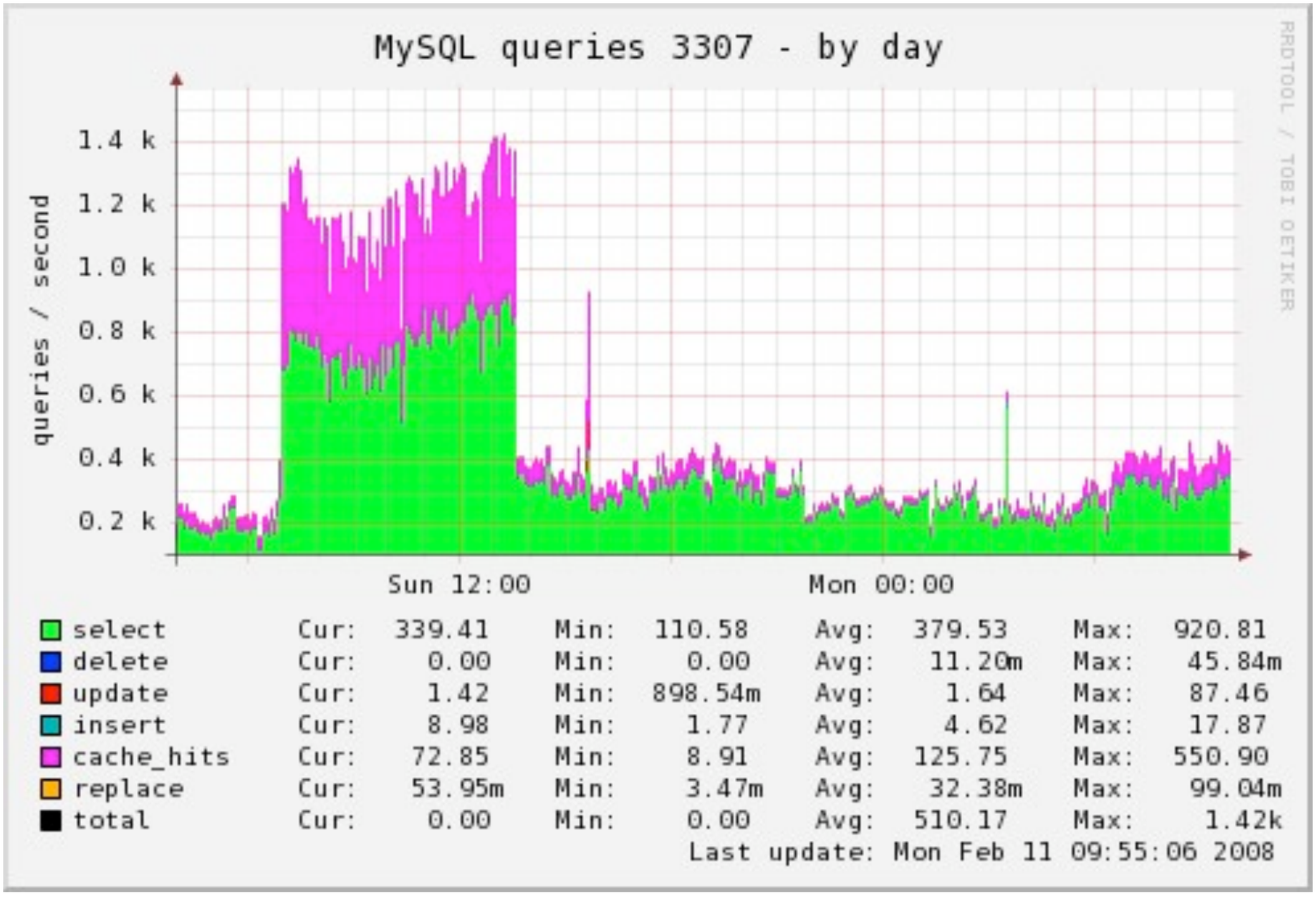
Try CDN

Enable compression
for all browsers

munin

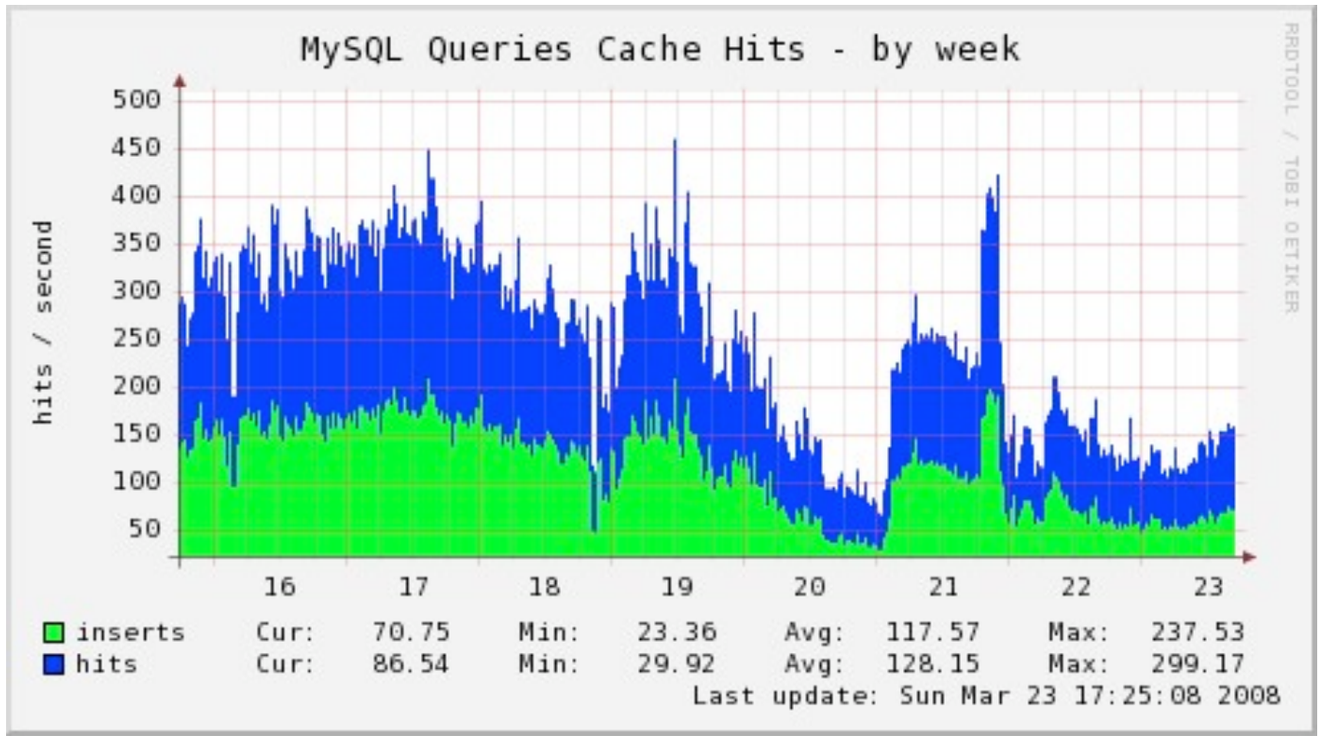
- *"Hugin and Munin are the ravens of the Norse god king Odin. They flew all over Midgard for him, seeing and remembering, and later telling him."*
- Munin is also AWESOME!
- Shows trends for system statistics
- Easy to extend

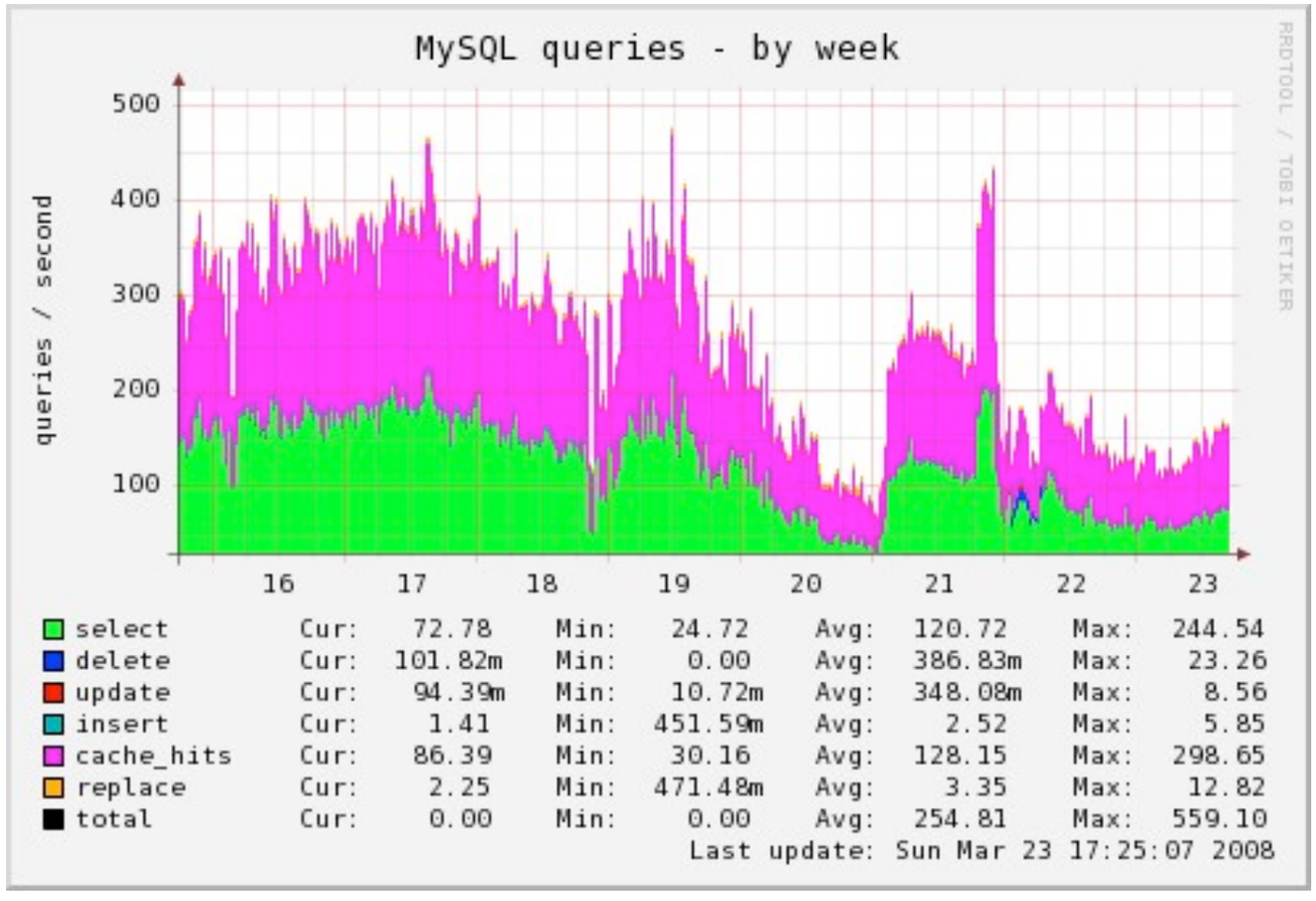
mysql query stats



Query cache useful?

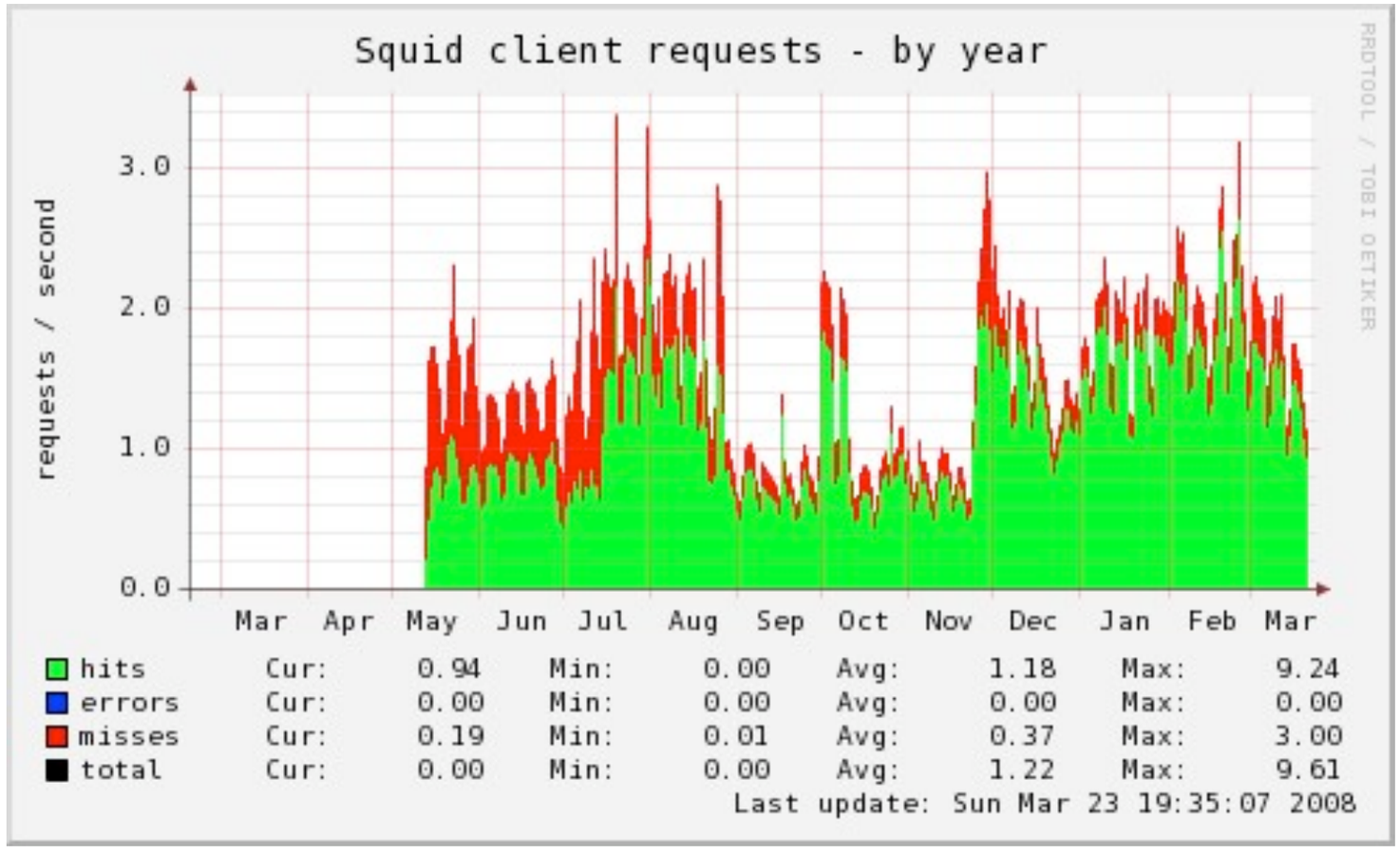
- Is the MySQL query cache useful for your application?
- Make a graph!
- In this particular installation it answers half of the selects





squid cache hitratio?

- Red:
  Cache Miss
- Green:
  Cache Hit
- Increased cache size to get better hit ratio
- Huh? When?

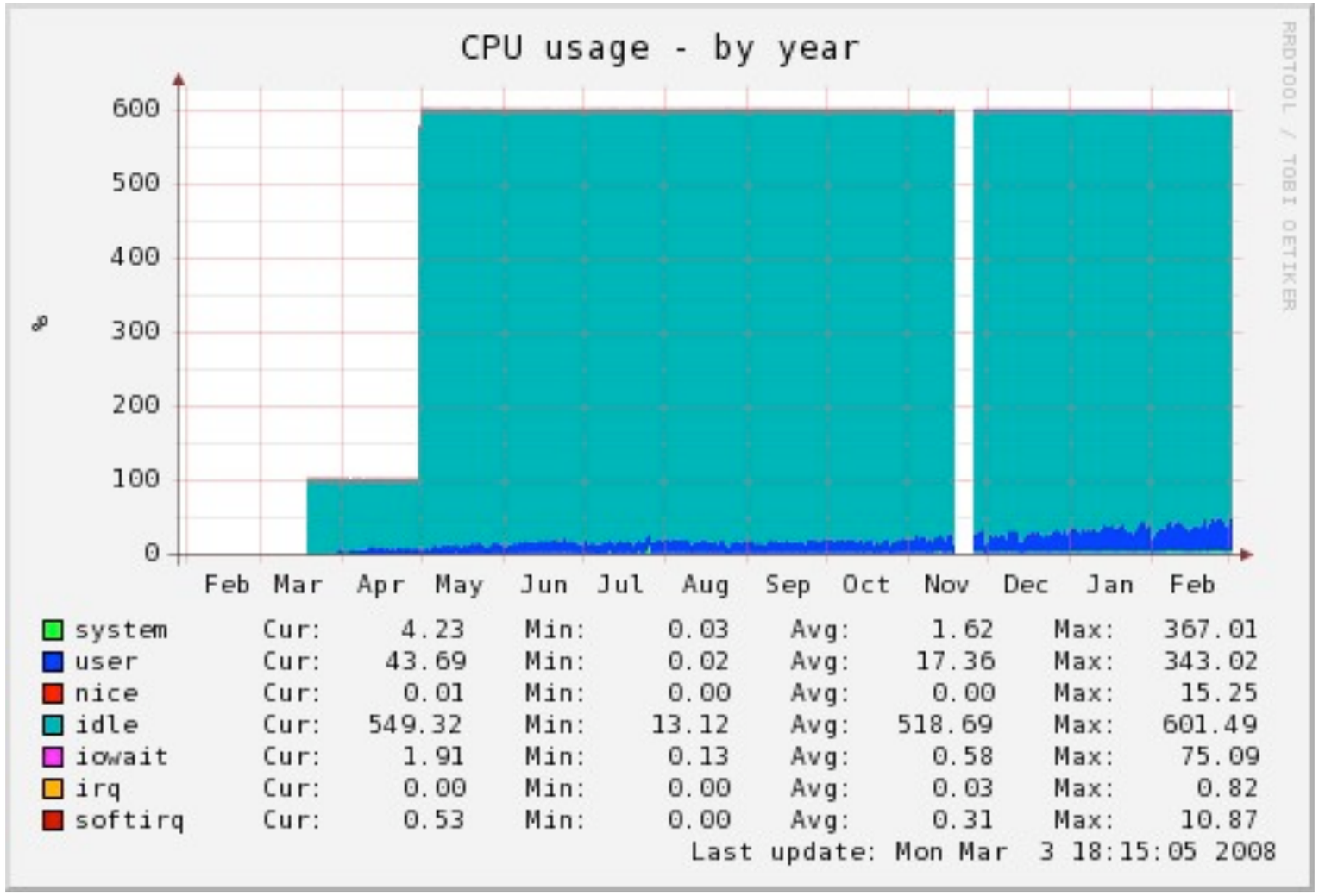


Don't confuse graphs with "hard data"

Keep the real numbers, too!

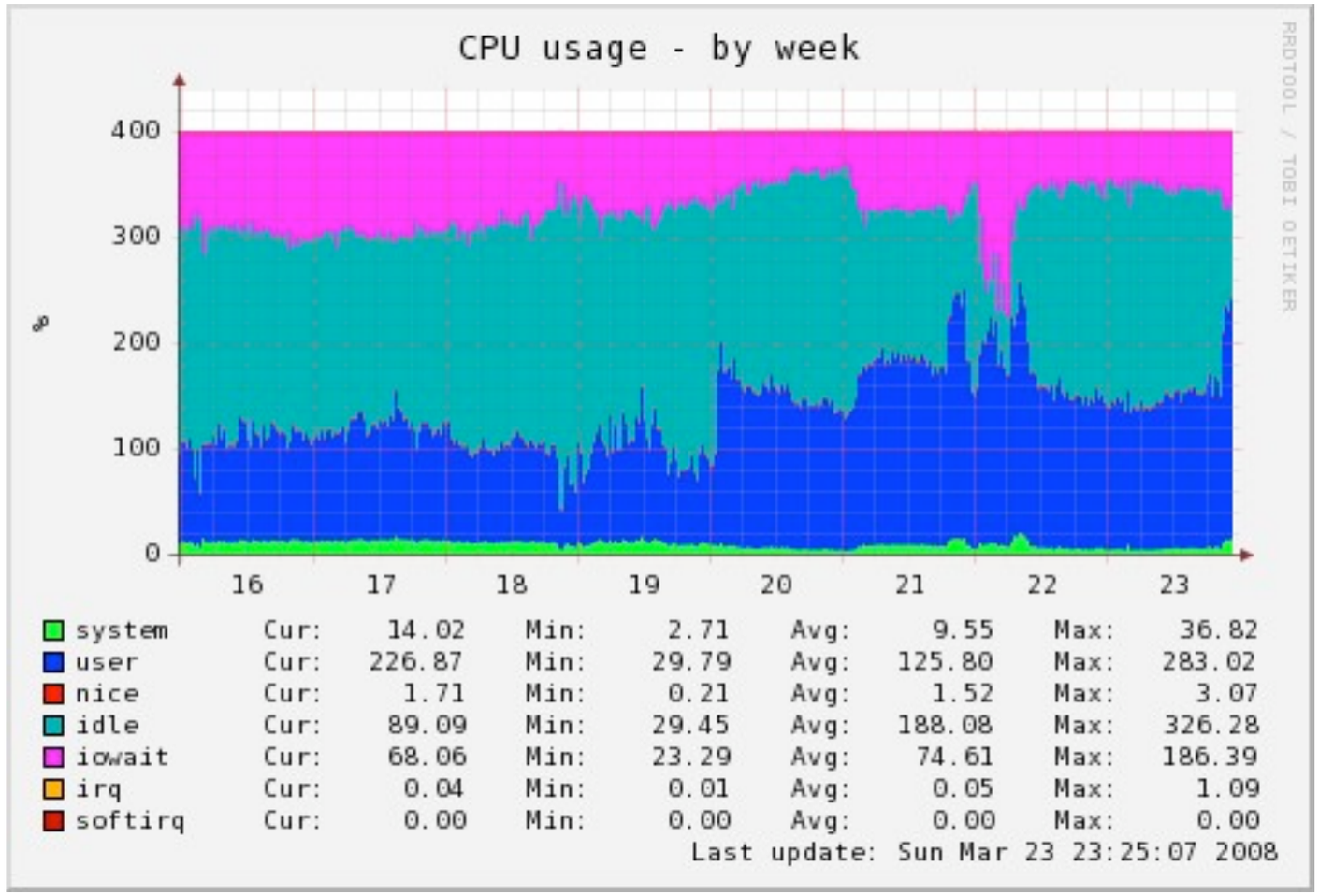
munin: capacity planning, cpu

- xen system
  6 cpus
- plenty to spare



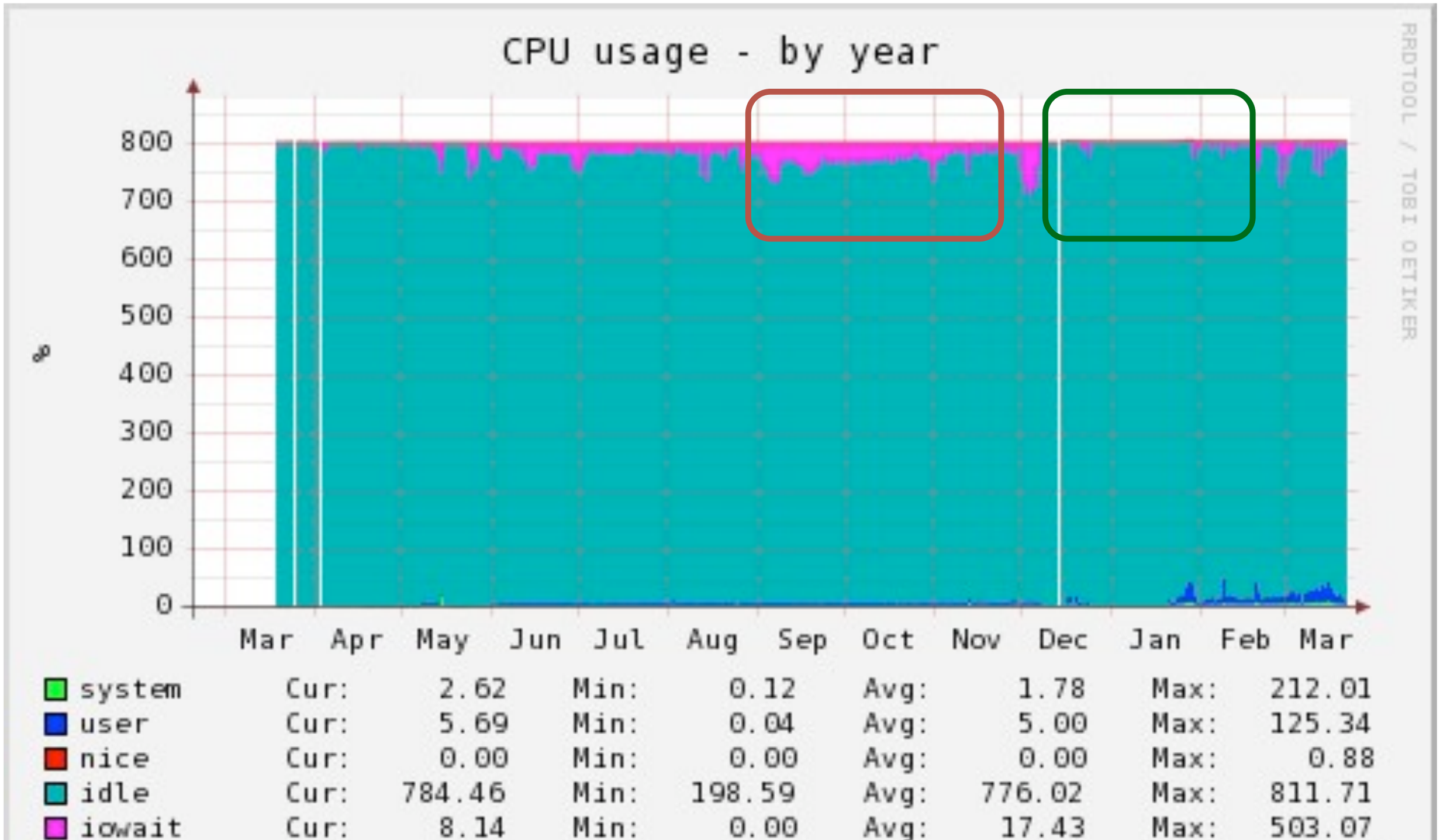
Blocking on disk I/O?

- Pink:
  iowait
- This box needs more memory or faster disks!



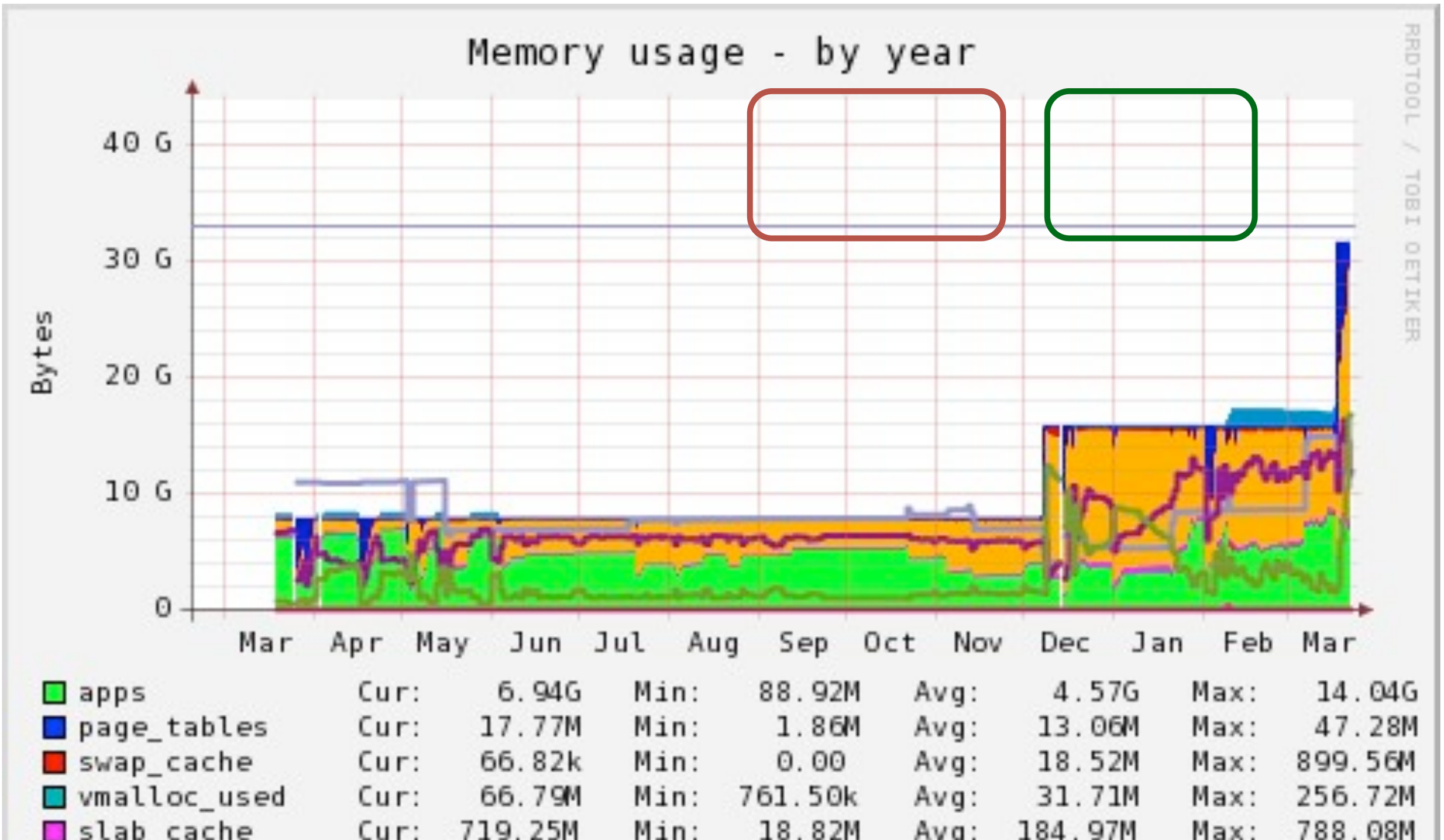
More IO Wait fun

- 8 CPU box - harder to see the details
- High IO Wait



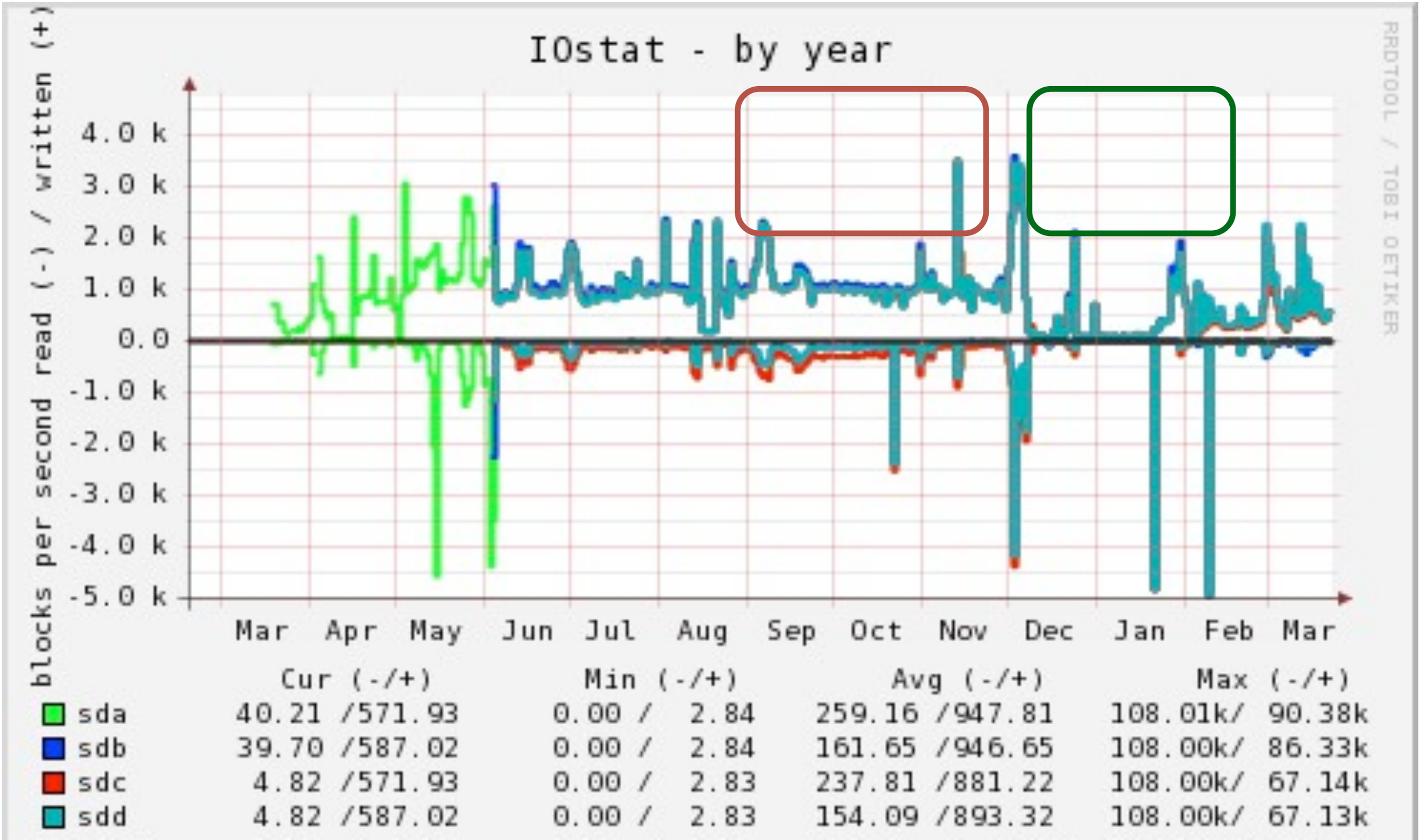
More IO Wait fun

- Upgraded memory, iowait dropped!



IO Statistics

- per disk IO statistics
- more memory, less disk IO

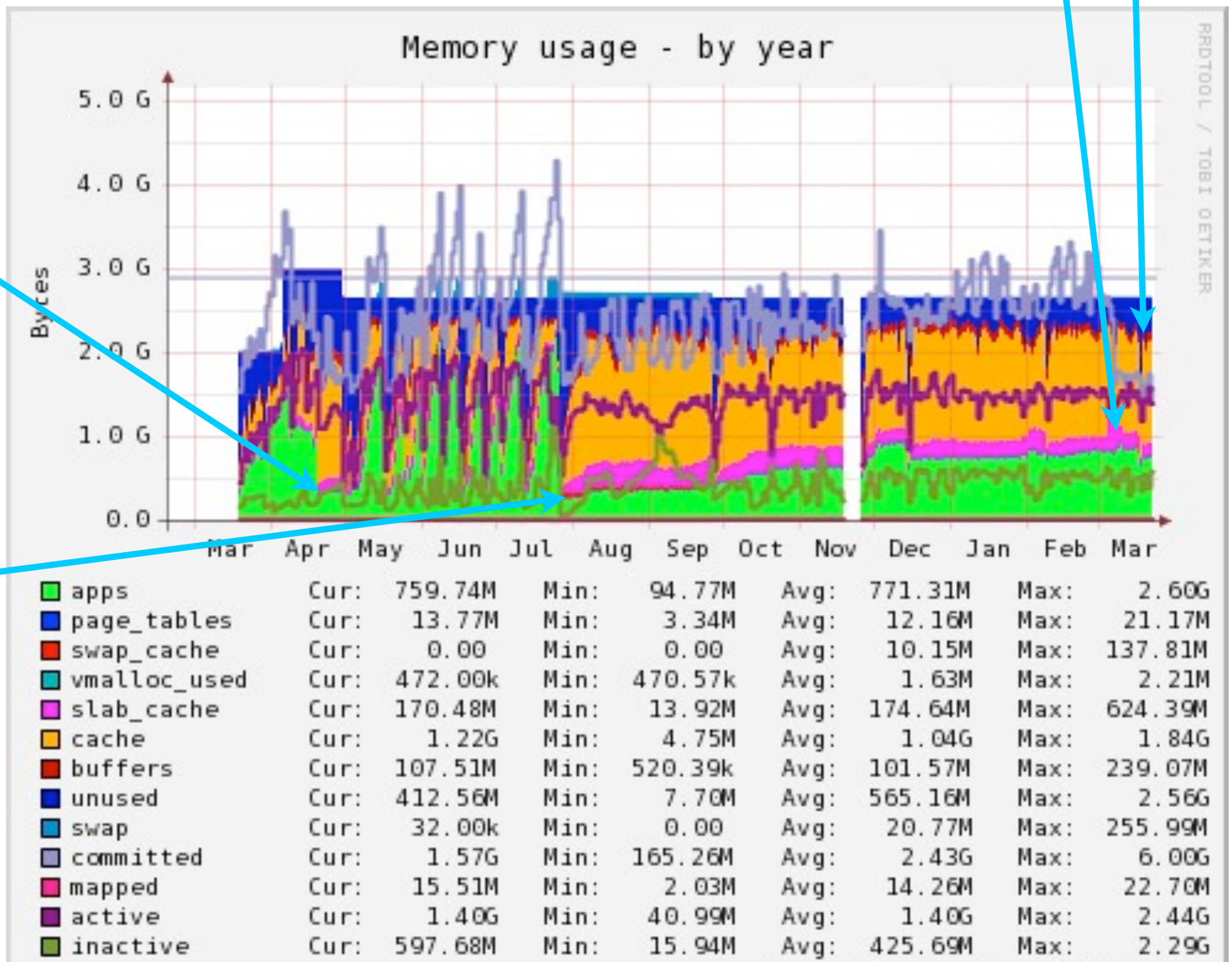


more memory stats

plenty memory free

fix app config

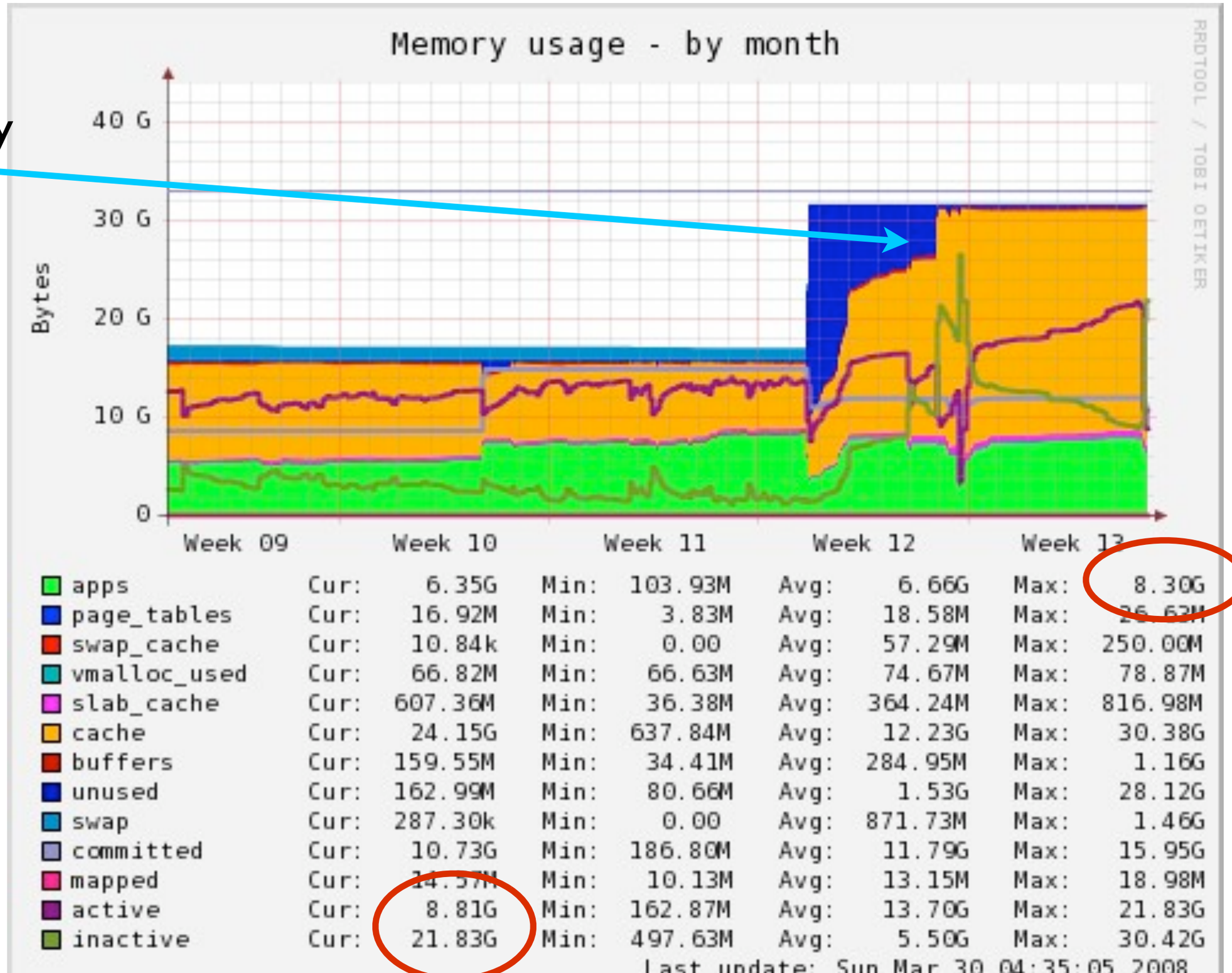
fix perlbal leak



room for memcached?

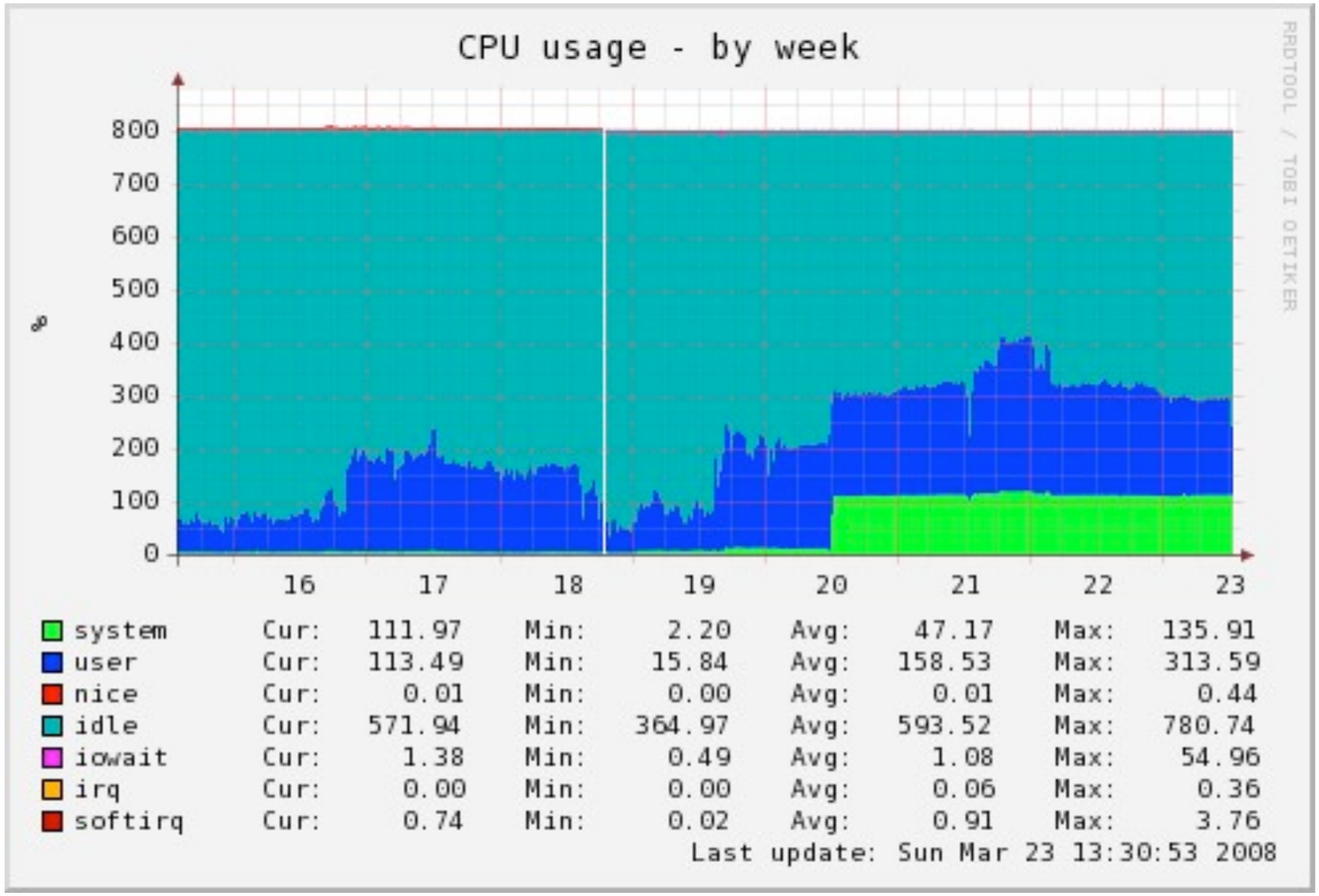
took a week to use new memory for caching

plenty memory to run memcached here!



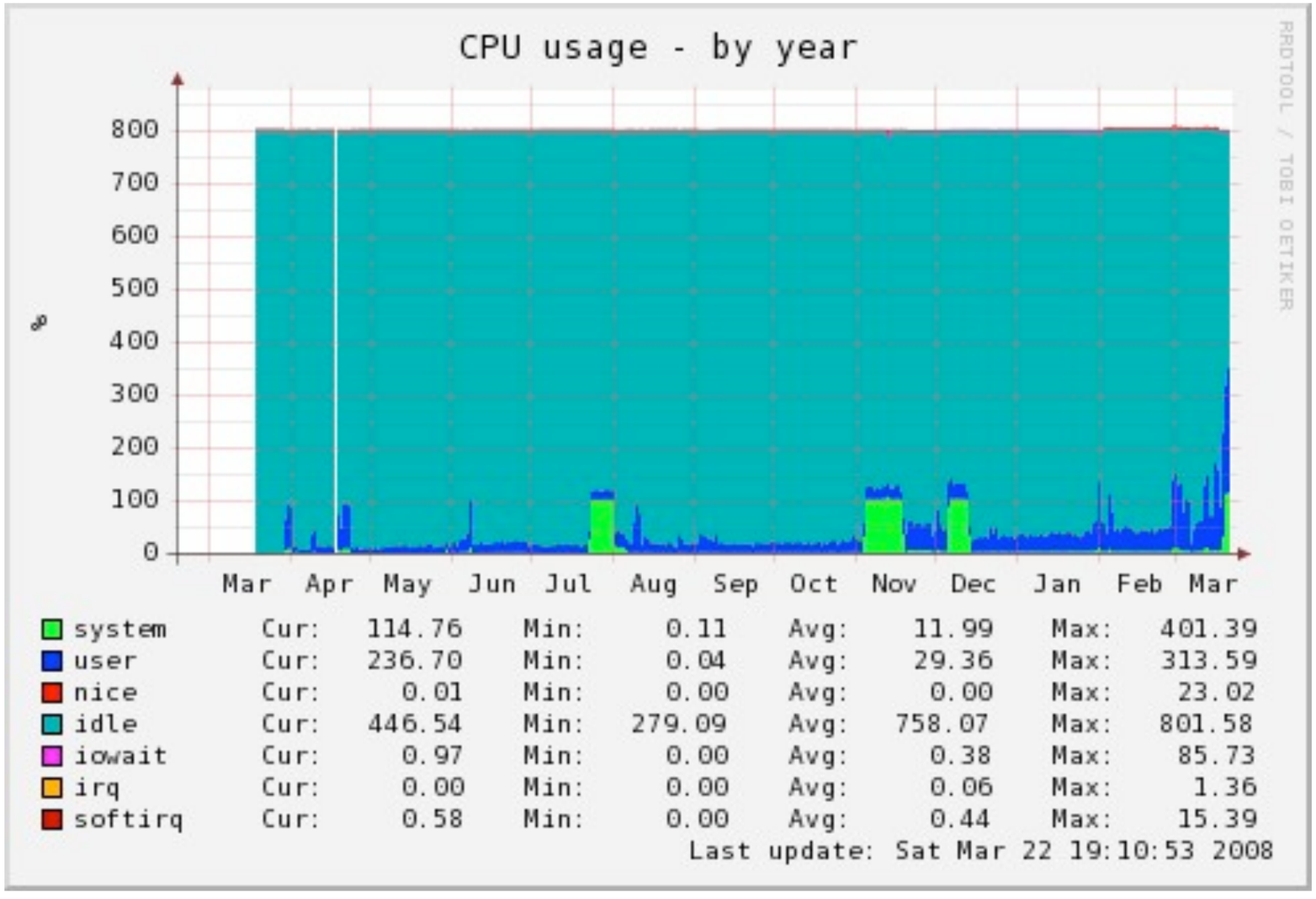
munin: spot a problem?

- 1 CPU 100% busy on “system”?
- Started a few days ago



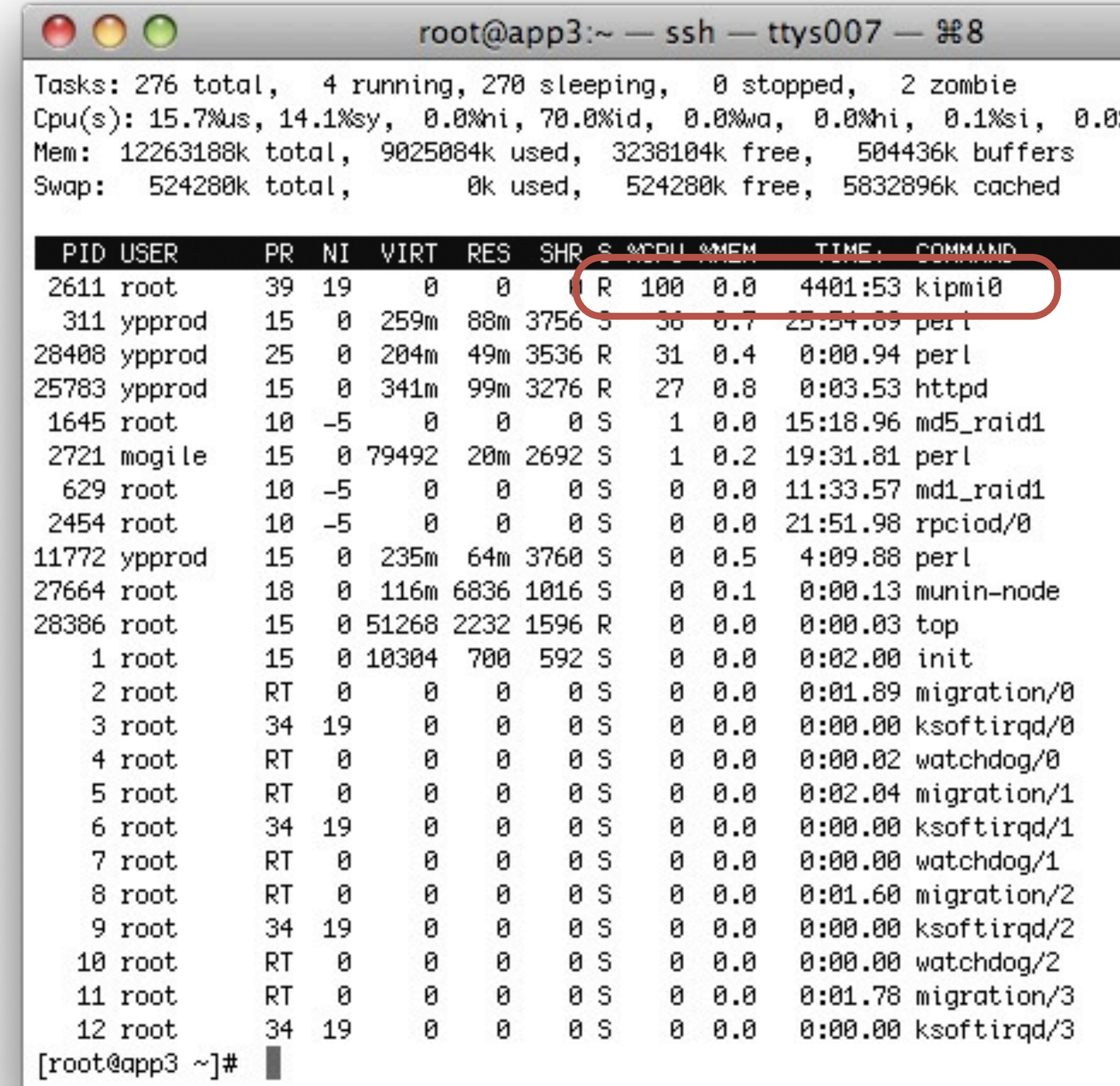
munin: spot a problem?

- Has it happened before?
- Yup - occasionally!



munin: spot a problem?

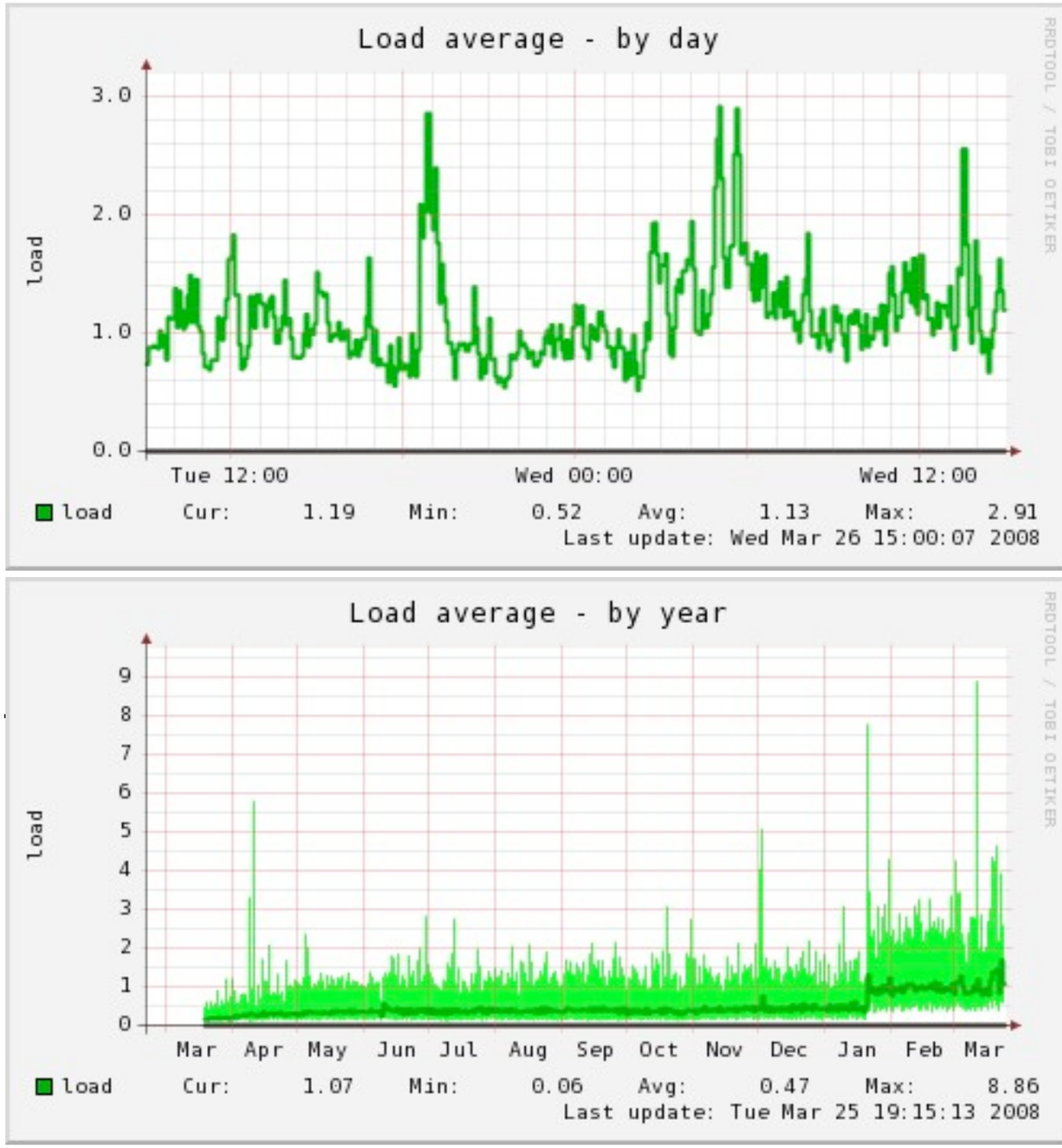
- IPMI driver went kaboom!



Make your own Munin plugin

- Any executable with the right output

```
# ./load config
graph_title Load average
graph_args --base 1000 -l 0
graph_vlabel load
...
load.label load
load.info Average load for
...

# ./load fetch
load.value 1.67
```



Munin as a nagios agent

- Use a Nagios plugin to talk to munin!
- Munin is already setup to monitor important metrics
- Nagios plugin talks to munin as if the collector agent

```
define service {
        use                     local-service
        hostgroup_name          xen-servers,db-servers,app-ser
        service_description df
        check_command           check_munin!df!88!94
}
```

A little on hardware

- Hardware is a commodity!
- Configuring it isn't *(yet – Google AppEngine!)*
- Managed services - *cthought.com, RackSpace, SoftLayer ...*
- Managing hardware != Managing systems
- Rent A Server
  (crummy support, easy on hardware replacements, easy on cashflow)
- Amazon EC2 *(just announced persistent storage!)*
- Use standard configurations and automatic deployment
- Now you can buy or rent servers from anywhere!

Use a CDN

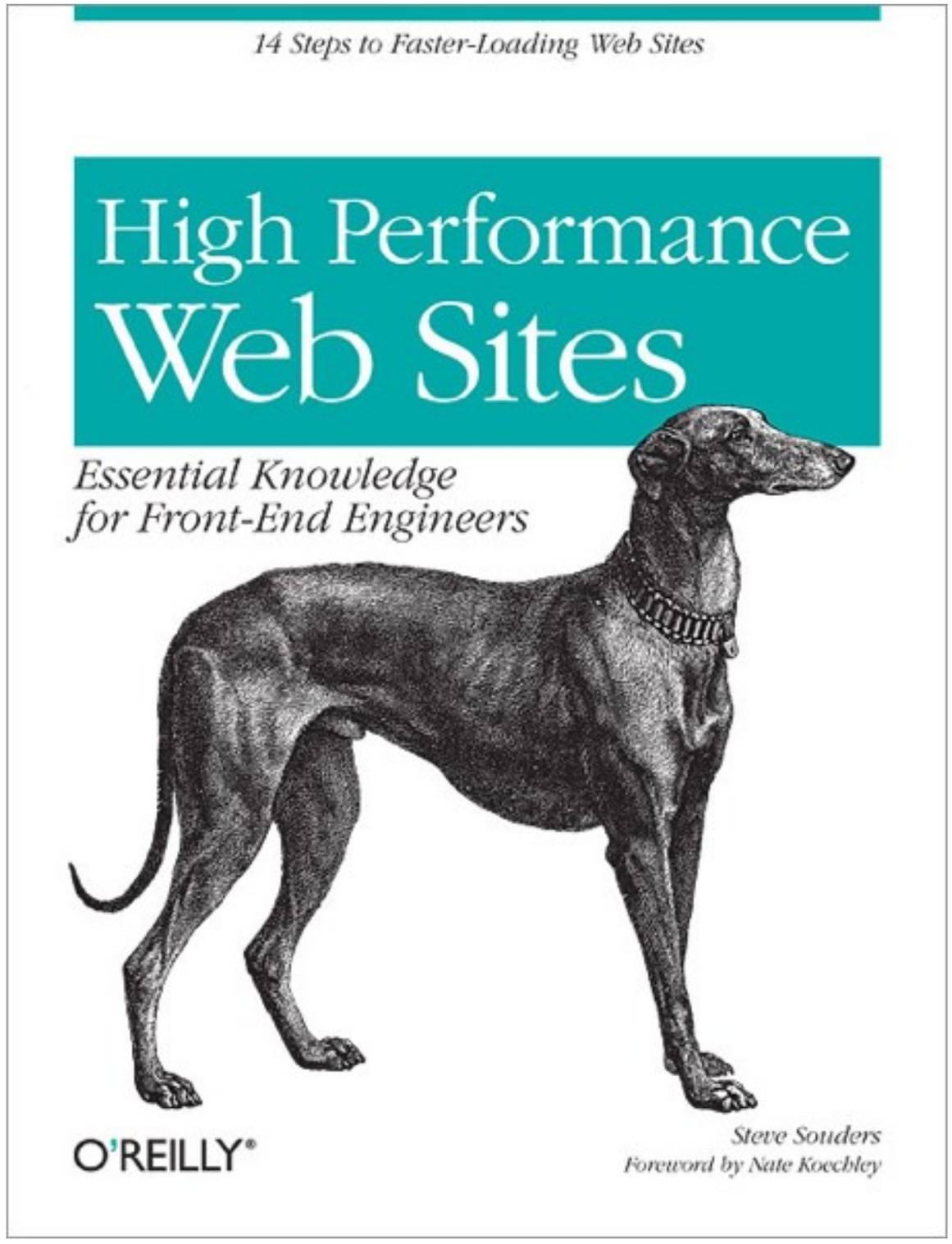
- If you serve more than a few TB static files a month...
- Consider a Content Delivery Network
- Fast for users, easier on your network
- Pass-through proxy cache - easy deployment
- Akamai, LimeLight, PantherExpress, CacheFly, ...
  (only Akamai supports compressed files (??))

Client Performance

"Best Practices for Speeding Up Your Web Site"

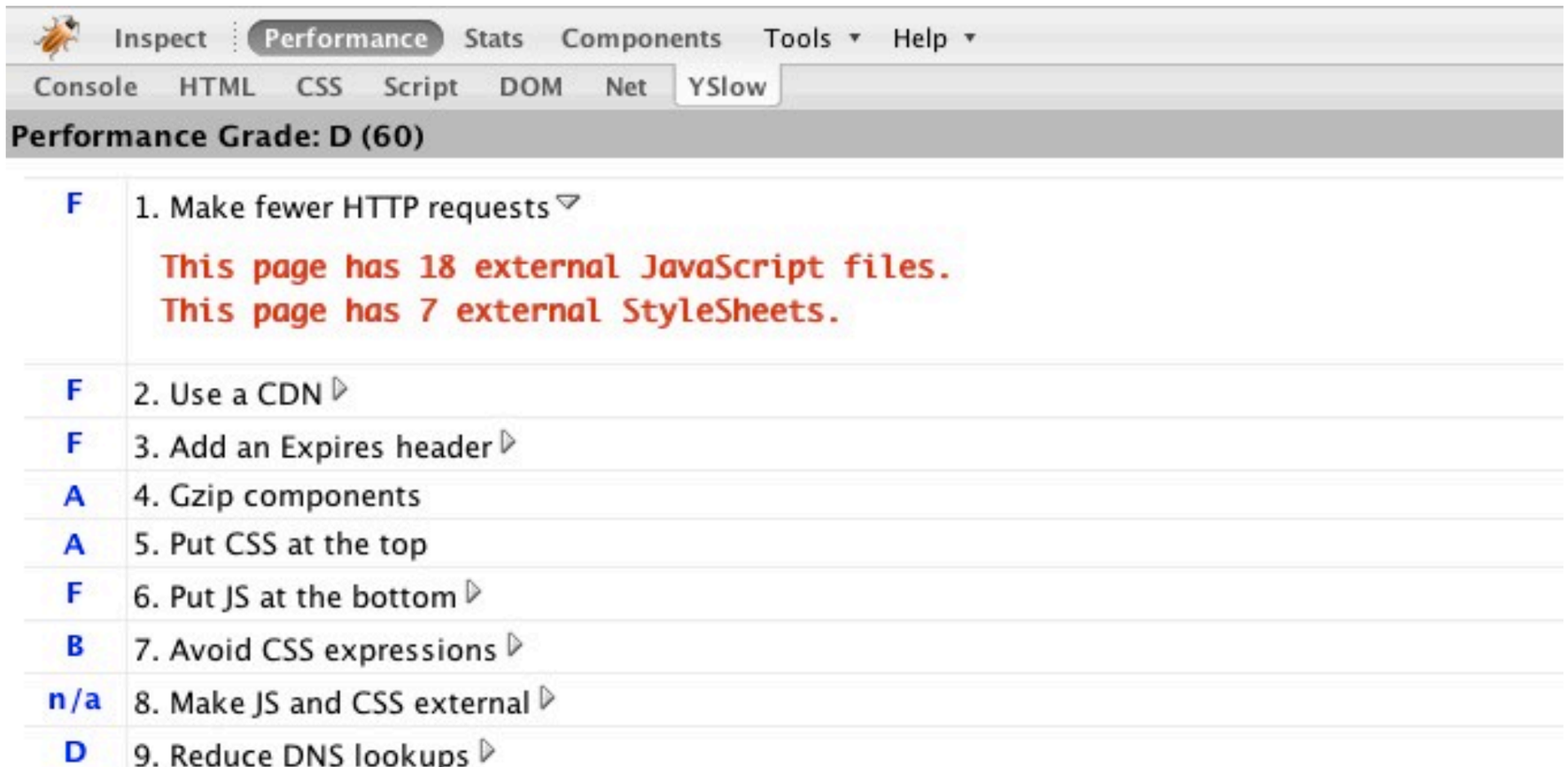
Recommended Reading

- "High Performance Web Sites" book by Steve Souders
- http://developer.yahoo.com/performance/



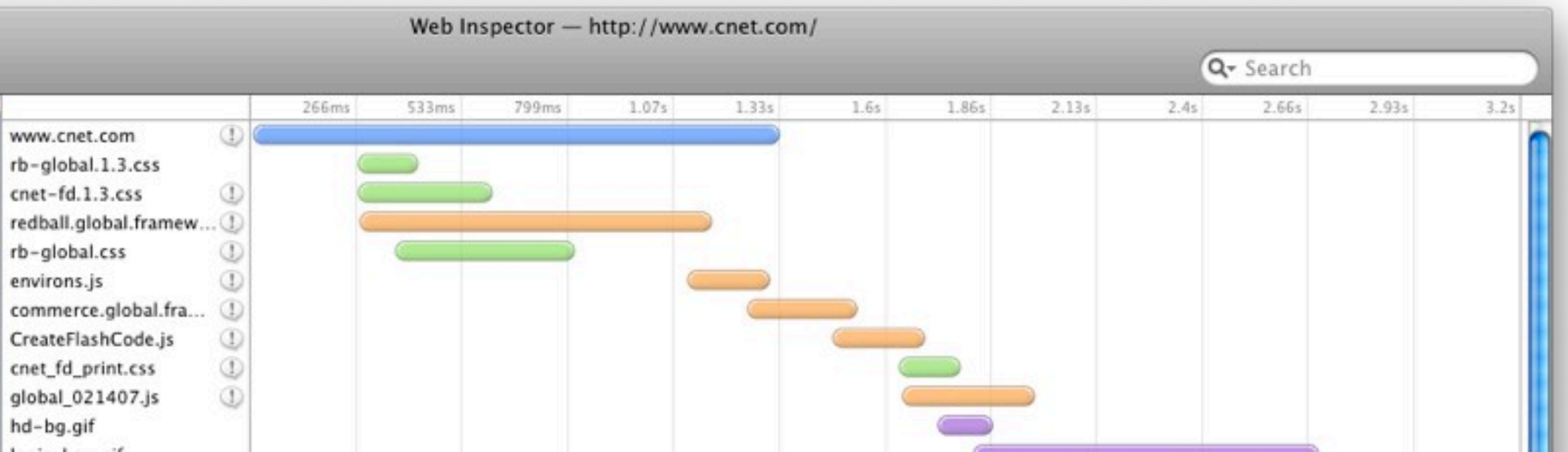
Use YSlow

- Firefox extension made by Yahoo!
- `http://developer.yahoo.com/yslow/`
- Quickly checks your site for the Yahoo Performance Guidelines
- I'll quickly go over a few server / infrastructure related rules ...



Minimize HTTP Requests

- Generate and download the main html in 0.3 seconds
- Making connections and downloading 38 small dependencies (CSS, JS, PNG, …) – more than 0.3s!
- Combine small JS and CSS files into fewer larger files
  - Make it part of your release process!
    - In development use many small files, in production group them
- CSS sprites to minimize image requests



Add an “Expires” header

http://www.flickr.com/photos/leecullivan/

- Avoid unnecessary “yup, that hasn’t changed” requests
- Tell the browser to cache objects
- HTTP headers
  - `Expires: Mon, Jan 28 2019 23:45:00 GMT`
    `Cache-Control: max-age=315360000`
- Must change the URL when the file changes!

Ultimate Cache Control

- Have all your static resources be truly static
- Change the URL when the resource changes
- Version number – from Subversion, git, …
  `/js/foo.v1.js`
  `/js/foo.v2.js`
  `...`
- Modified timestamp – good for development
  `/js/foo.v1206878853.js`
- (partial) MD5 of file contents – safe for cache poisoning
  `/js/foo.v861ad7064c17.js`
- Build a "file to version" mapping in your build process and load in the application

Serve “versioned” files

- Crazy easy with Apache rewrite rules
- “`/js/foo.js`” is served normally
- “`/js/foo.vX.js`” is served with extra cache headers

```
RewriteEngine on
# remove version number, set environment variable
RewriteRule ^/(.*\.)v[0-9a-f.]+\.(css|js|gif|png|jpg|ico)$ \
    /$1$2 [E=VERSIONED_FILE:1]

# Set headers when “VERSIONED_FILE” environment is set
Header add "Expires" "Fri, Nov 10 2017 23:45:00 GMT" \
  env=VERSIONED_FILE
Header add "Cache-Control" "max-age=315360001" \
  env=VERSIONED_FILE
```

Minimize CSS, JS and PNG

- Minimize JS and CSS files (remove whitespace, shorten JS, …)
- `http://developer.yahoo.com/yui/compressor/`
- Add to your "version map" if you have a "`-min`" version of the file to be used in production
- Losslessly recompress PNG files with OptiPNG `http://optipng.sourceforge.net/`

Pre-minimized JS

```
function EventsFunctions() {
  this.get_data = function(loc_id) {
    if (this.TIMEOUT) {
      window.clearTimeout(this.TIMEOUT);
      this.TIMEOUT = null;
    }
    var parameters = 'auth_token=' + escape(global_auth_token) + ';total=5;location='+loc_id;
    var request = YAHOO.util.Connect.asyncRequest('POST', '/api/events/location_events',
    {
      success:function(o) {
        var response =  eval( '(' + o.responseText + ')' );
        if (response.system_error) {
          // alert(response.system_error);
        }
        else if (response.length) {
          var eventshtml='';
          for (var i=0; i<response.length; i++) {
            eventshtml+='<br /><a href="http://example.com/event/'+response[i].id+'/">'+
              response[i].name+'</a> - '+response[i].start_date;
          if (response[i].start_time) eventshtml+=' '+response[i].start_time;
          if (response[i].description) eventshtml+='<br />'+response[i].description;
          eventshtml+='<br /><br />';
        }
        var le = document.createElement("DIV");
        le.id='location_events';
        le.innerHTML=eventshtml;
        document.body.appendChild(le);
        tab_lookups['events_tab'] = new YAHOO.widget.Tab({
                        label: 'Events',
                        contentEl: document.getElementById('location_events')
                });
        profileTabs.addTab(tab_lookups['events_tab']);
      }
      try{ pageTracker._trackPageview('/api/events/location_events') } catch(err) {}
    },
    failure:function(o) {
      // error contacting server
    }
```

Minimized JS

~1600 to ~1100 bytes
~30% saved!

```
function EventsFunctions(){this.get_data=function(loc_id){if(this.TIMEOUT)
{window.clearTimeout(this.TIMEOUT);
this.TIMEOUT=null;}var parameters="auth_token="+escape(global_auth_token)
+";total=5;location="+loc_id;
var request=YAHOO.util.Connect.asyncRequest("POST","/api/events/location_events",
{success:function(o){var response=eval("("+o.responseText+")");
if(response.system_error){}else{if(response.length){var eventshtml="";for(var
i=0;i<response.length;i++){eventshtml+='<br /><a href="http://example.com/
event/'+response[i].id+'/">'+response[i].name+"</a> - "+response[i].start_date;
if(response[i].start_time){eventshtml+="
"+response[i].start_time;}if(response[i].description){eventshtml+="<br /
>"+response[i].description;
}eventshtml+="<br /><br />";}var
le=document.createElement("DIV");le.id="location_events";le.innerHTML=eventshtml;
document.body.appendChild(le);tab_lookups.events_tab=new
YAHOO.widget.Tab({label:"Events",contentEl:document.getElementById("location_events")});
profileTabs.addTab(tab_lookups.events_tab);}}try{pageTracker._trackPageview("/api/events/
location_events");
```

Gzip components

- Don't make the users download *several times more data than necessary.*
- Browser:
  `Accept-Encoding: gzip, deflate`
- Server:
  `Content-Encoding: gzip`
- Dynamic content (Apache 2.x)
  `LoadModule mod_deflate …`

  ```
  AddOutputFilterByType DEFLATE text/html
     text/plain text/javascript text/xml
  ```

Gzip static objects

- Pre-compress .js and .css files in the build process
  `foo.js` > `foo.js.gzip`
- `AddEncoding gzip .gzip`

```
# If the user accepts gzip data
RewriteCond %{HTTP:Accept-Encoding} gzip

# … and we have a .gzip version of the file
RewriteCond %{DOCUMENT_ROOT}/%{REQUEST_FILENAME}.gzip -f

# then serve that instead of the original file
RewriteRule ^(.*)$ $1.gzip [L]
```

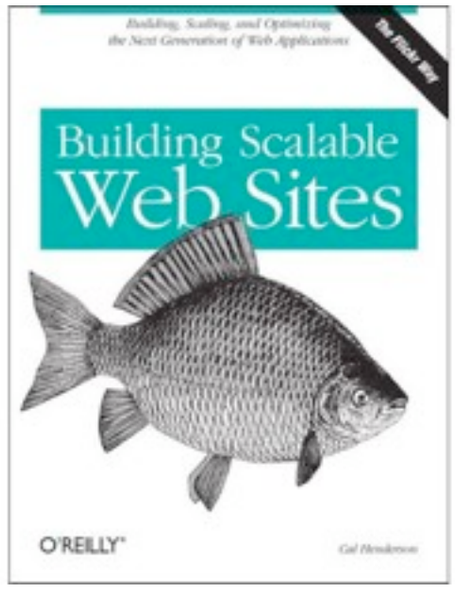
remember

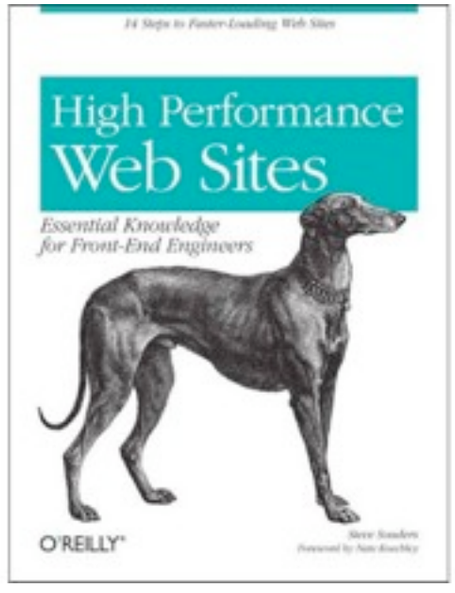
Think Horizontal!

(and go build something neat!)

Books!

- "Building Scalable Web Sites" by Cal Henderson of Flickr fame
  - Only $26 on Amazon! (But it's worth the $40 from your local bookstore too)
- "Scalable Internet Architectures" by Theo Schlossnagle
  Teaching concepts with lots of examples
- "High Performance Web Sites" by Steve Souders
  Front end performance





Thanks!

- Direct and indirect help from ...
- Cal Henderson, ~~Flickr~~ Yahoo!
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- Vani Raja Hansen
- Jay Pipes
- Joshua Schachter
- Ticketmaster
- Shopzilla
- .. and many more

– The End –

Questions?

Thank you!

More questions? Comments? Need consulting?

ask@develooper.com

`http://develooper.com/talks/`

`http://groups.google.com/group/scalable`