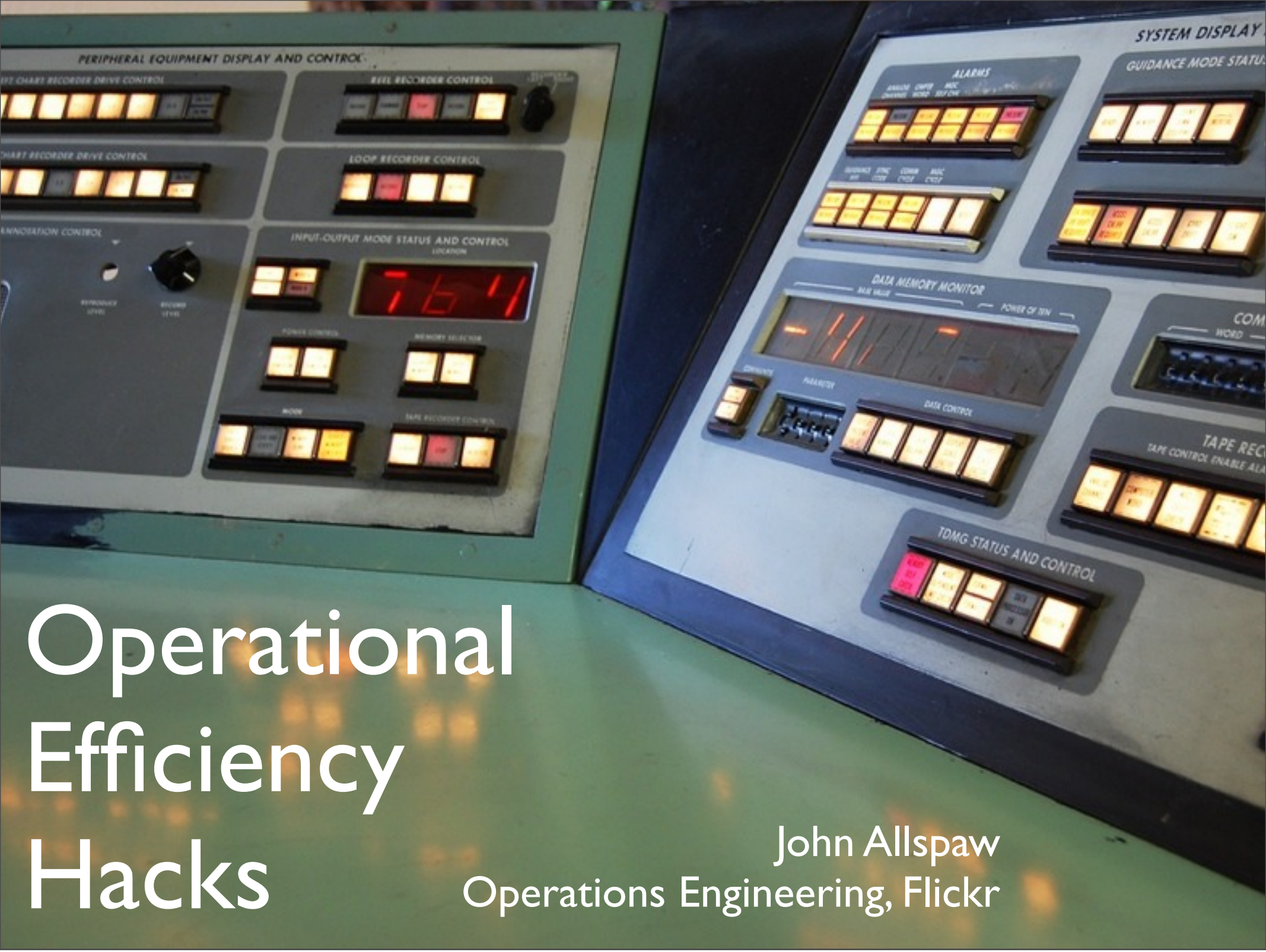


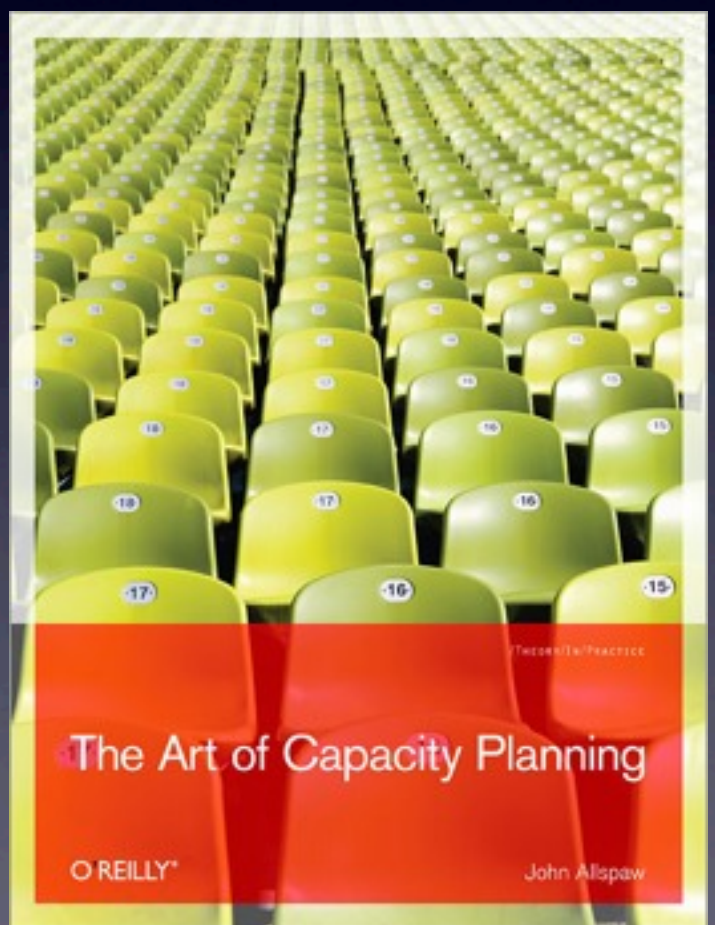
Operational Efficiency Hacks

John Allspaw
Operations Engineering, Flickr

who am I?

Manage the Flickr Operations group

Wrote a geeky book:




“Efficiencies”

“Efficiencies”

Doing more with the robots you’ve got


"Efficiencies"
Doing more with the robots you've got
Doing more with the humans you've got

Some optimization “rules”

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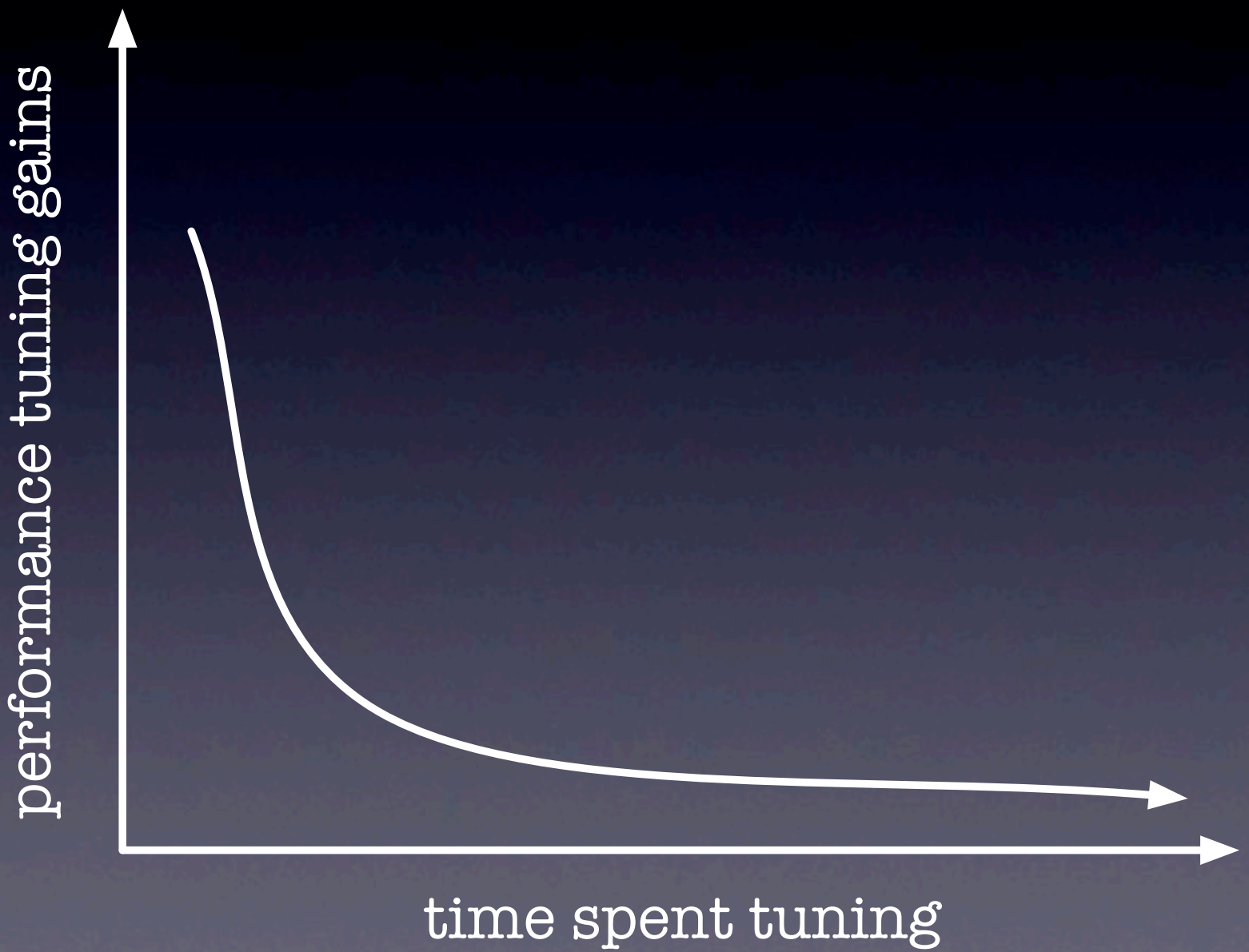
- Don't rely on being able to tweak anything.

Some optimization "rules"

- Don't rely on being able to tweak anything.
- Don't waste too much time tuning when you have no evidence it'll matter.

Optimization "rules"



Optimization "rules"

"We should forget about small efficiencies, say about 97% of the time: premature optimization is the root of all evil."

Knuth, (or Hoare)


however...

Optimization “rules”

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That doesn’t give us an excuse to be lazy and inefficient.

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Optimization “rules”

That doesn’t give us an excuse to be lazy and inefficient.

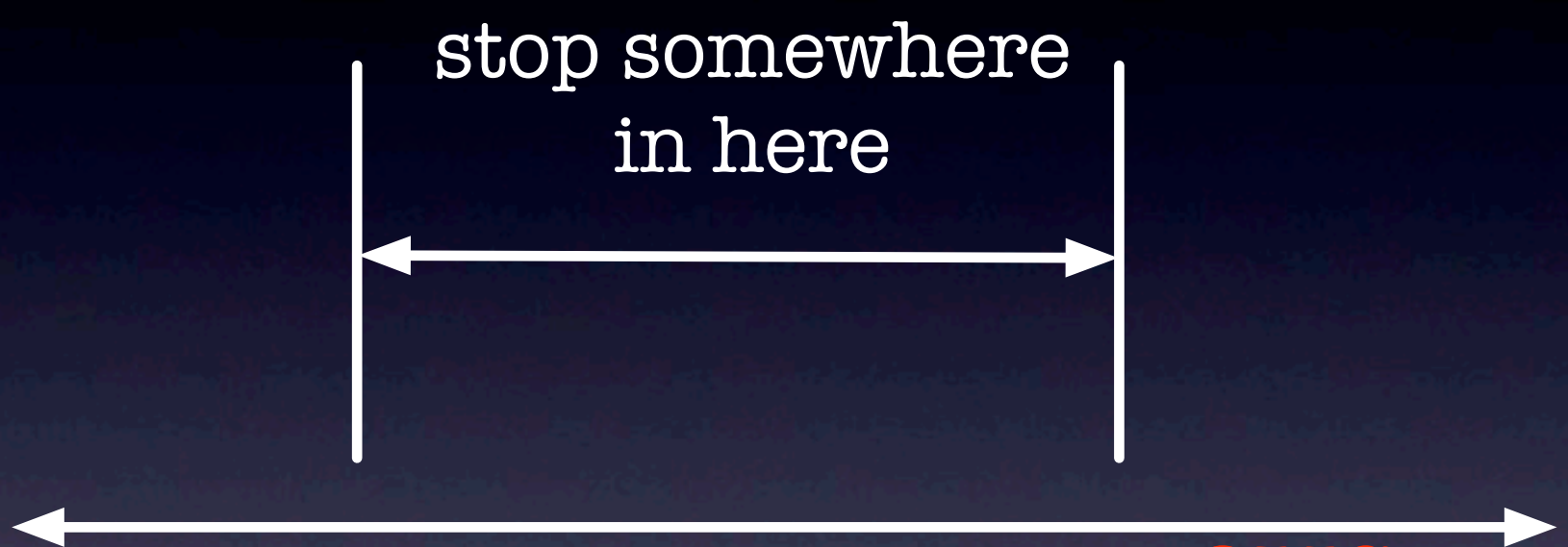
We lean on the experience of people in the community for evidence that tuning(s) might be a worthwhile thing to do.

Optimization "rules"

"Yet we should not pass up our opportunities in that critical 3 percent."

Knuth, (or Hoare)

So...


stop somewhere
in here
obvious
tuning
wins
OMG
I'm wasting
!@#$ time
for no reason

Our Context

Our Context

- 24 TB of MySQL data

Our Context

- 24 TB of MySQL data
- 32k/sec of MySQL writes

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- 24 TB of MySQL data
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- 120k/sec of MySQL reads

Our Context

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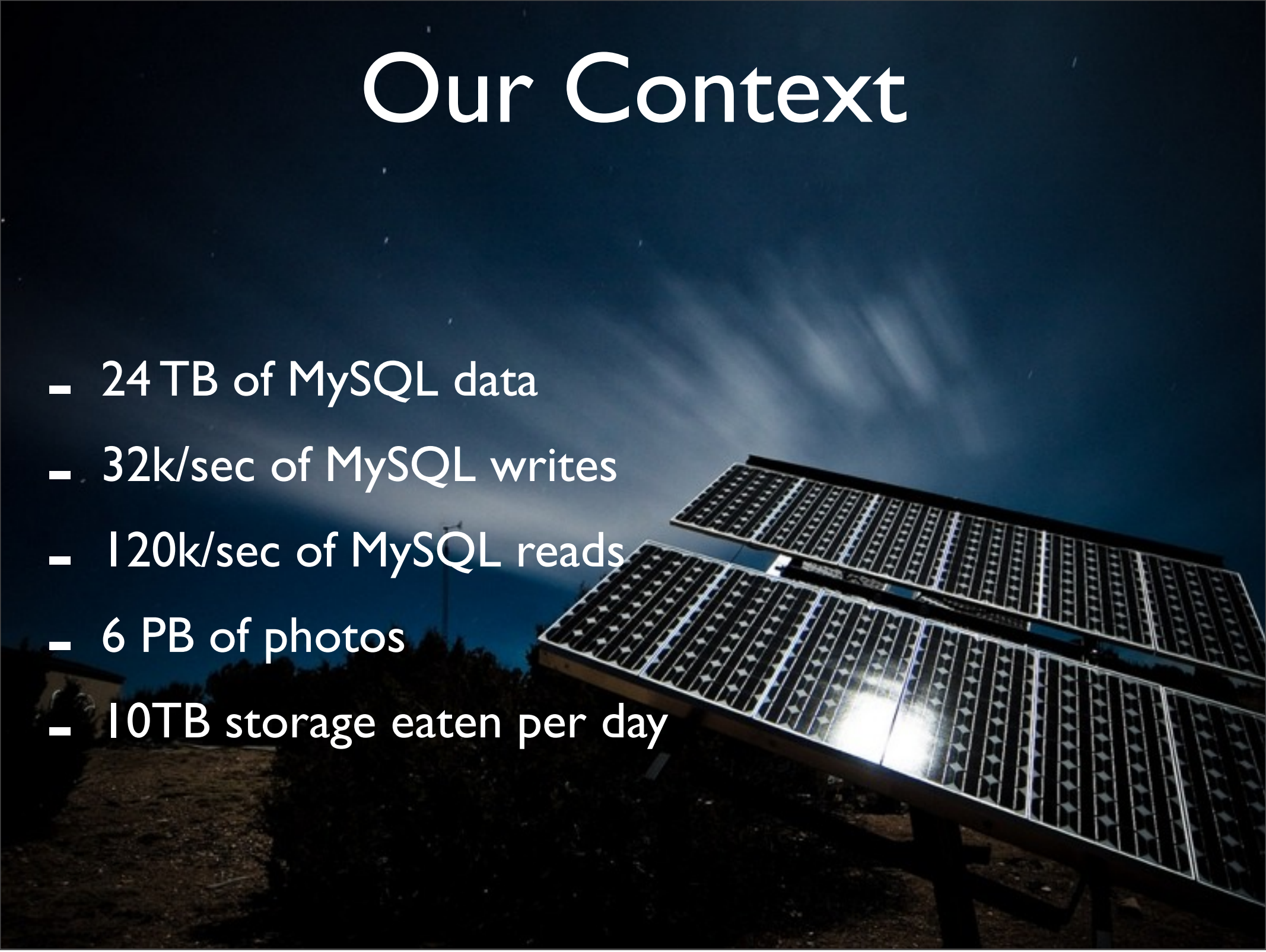
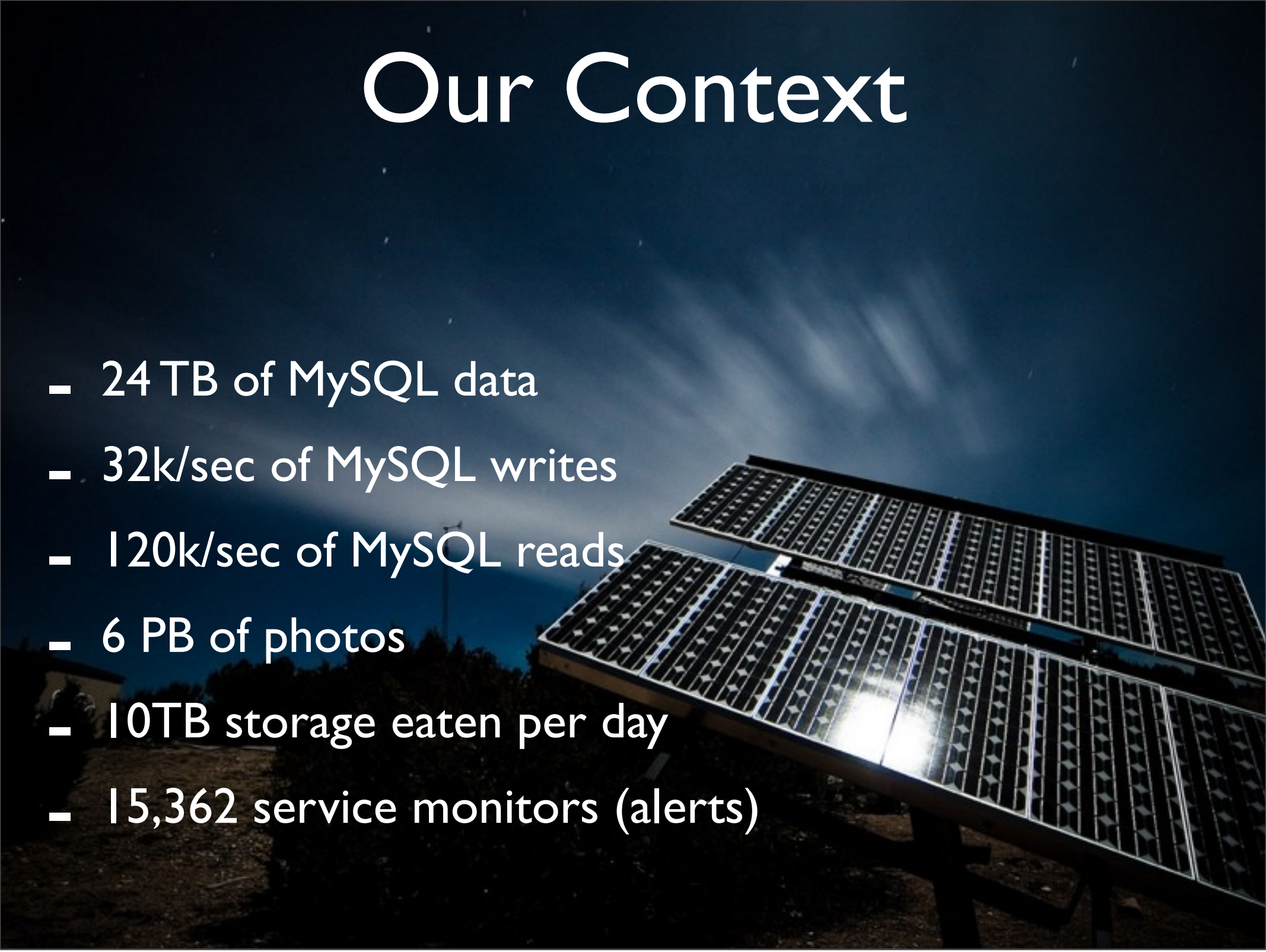
- 32k/sec of MySQL writes
- 120k/sec of MySQL reads
- 6 PB of photos

Our Context



- 24 TB of MySQL data
- 32k/sec of MySQL writes
- 120k/sec of MySQL reads
- 6 PB of photos
- 10TB storage eaten per day

Our Context



- 24 TB of MySQL data
- 32k/sec of MySQL writes
- 120k/sec of MySQL reads
- 6 PB of photos
- 10TB storage eaten per day
- 15,362 service monitors (alerts)

Infrastructure Hacks

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- Examples of what changing software can do

  (plain old-fashioned performance tuning)

Infrastructure Hacks

- Examples of what changing software can do

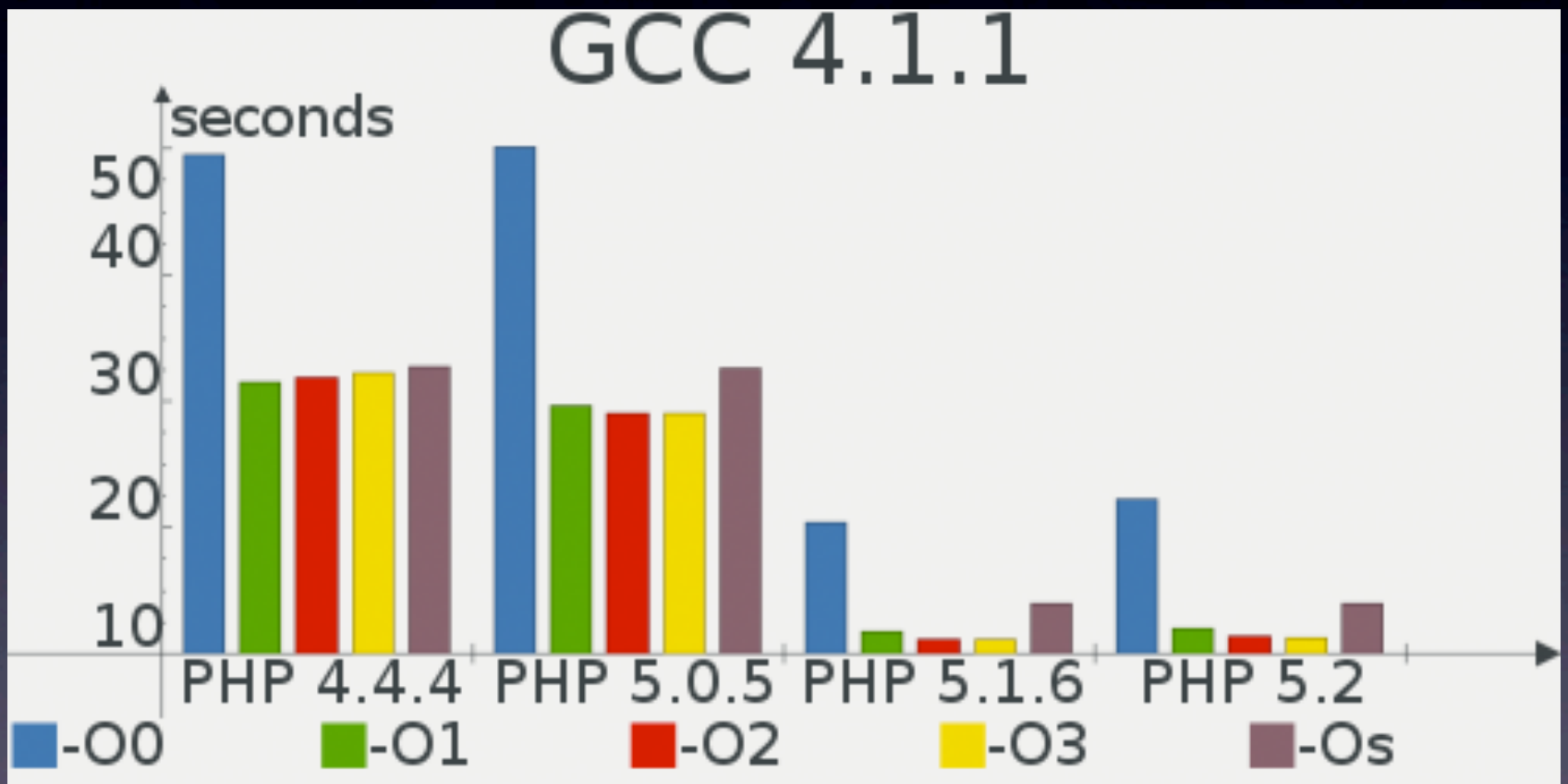
(plain old-fashioned performance tuning)

- Examples of what changing hardware can do

(yay for Mr. Moore!)

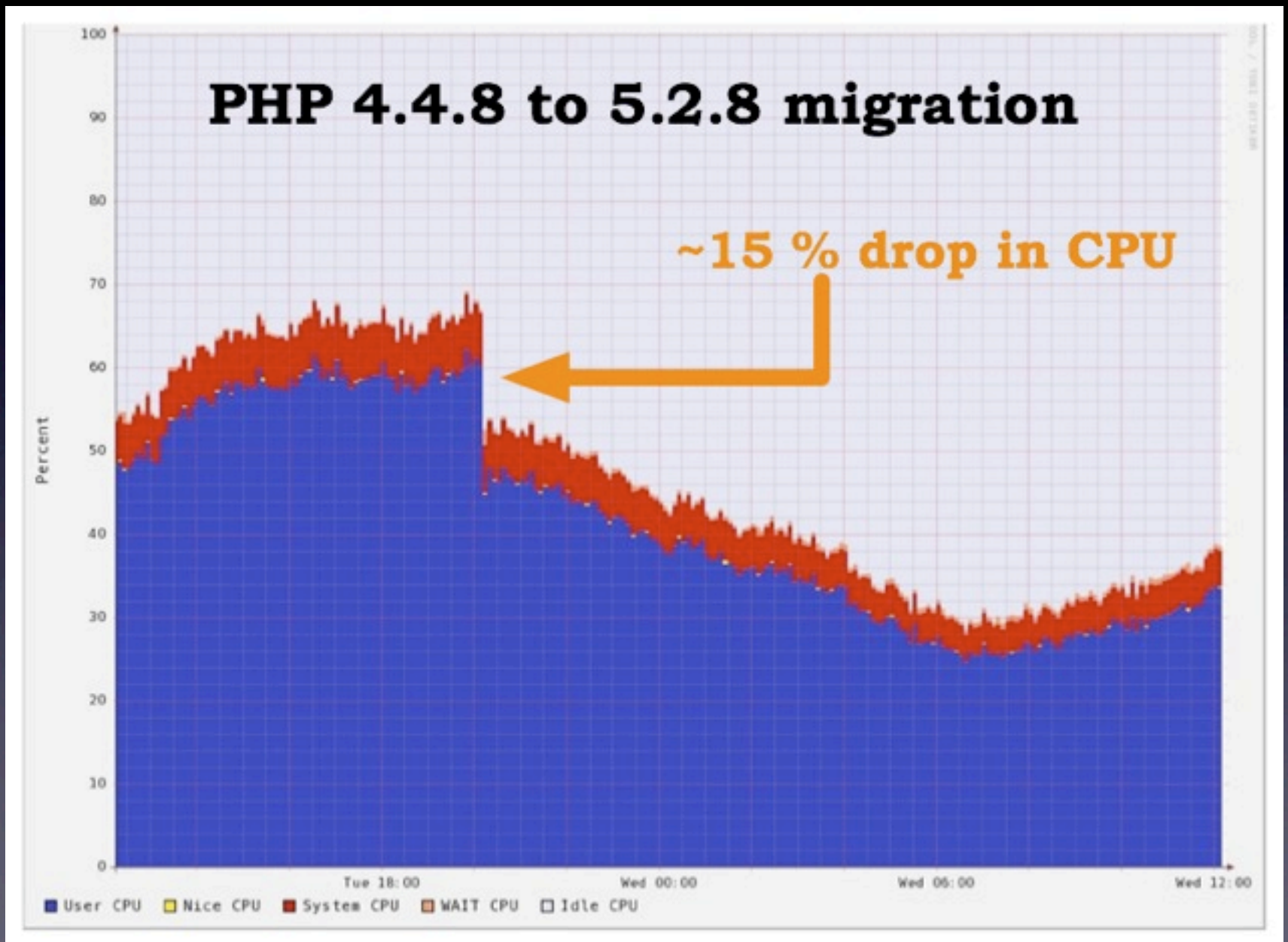
Leaning on compilers

(synthetic PHP benchmarks, not real-world)

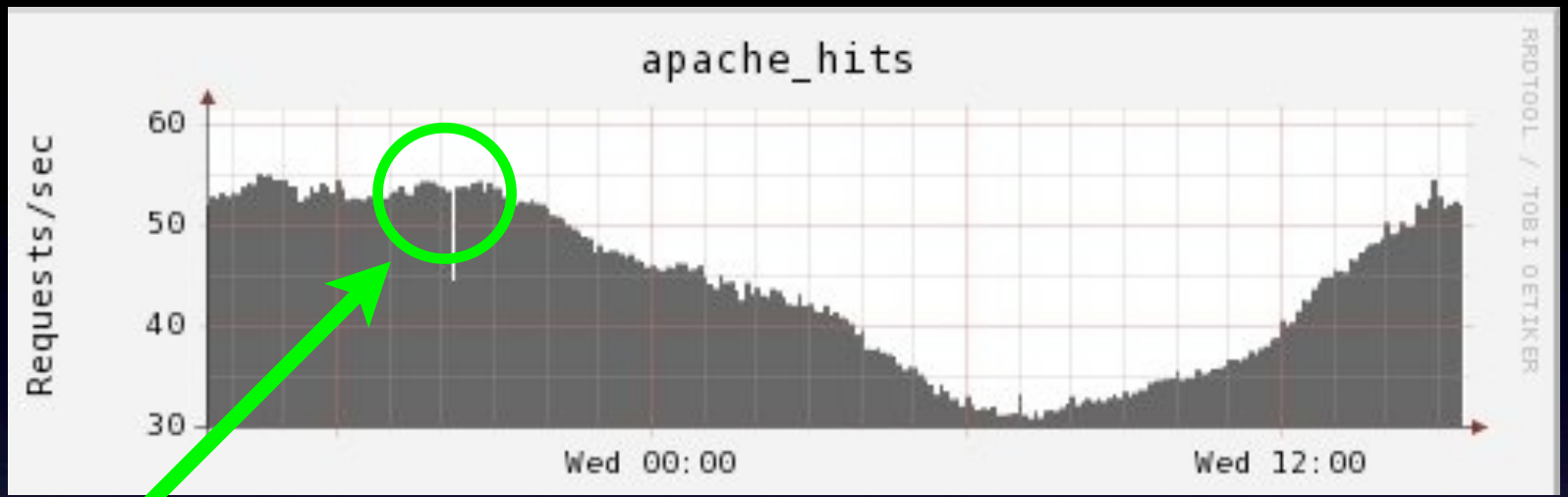


(http://sebastian-bergmann.de/archives/634-PHP-GCC-ICC-Benchmark.html)

PHP *(real-world)*



Can now handle more with less



same taste, less filling

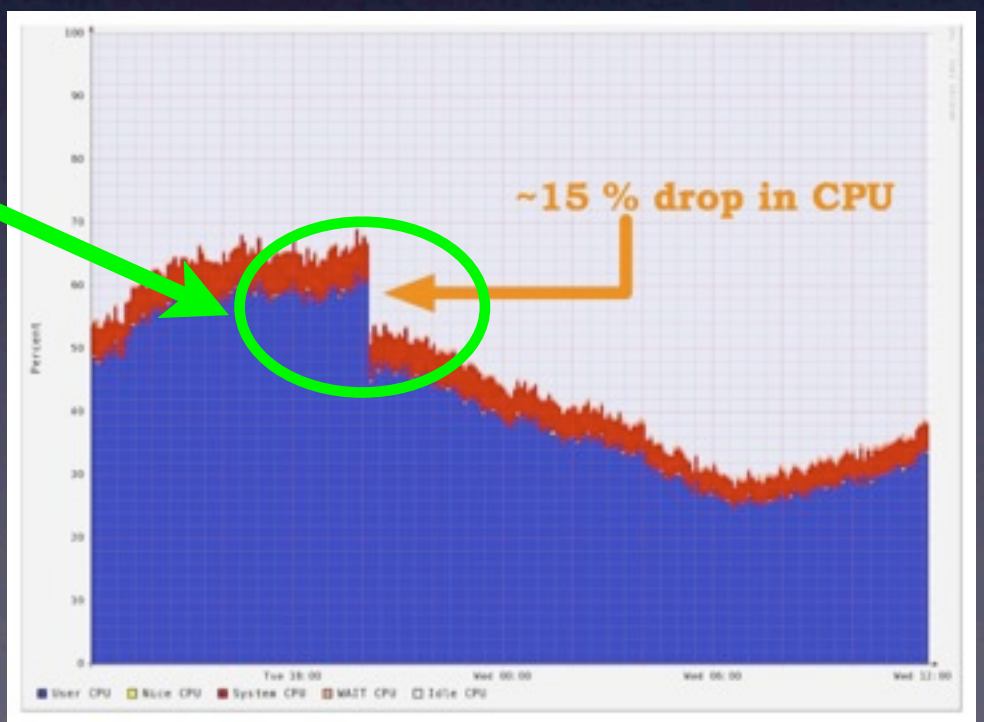


Image Processing

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- Changed to GraphicsMagick, about 15% faster at the time *(version 1.1.5)*
- Only need a subset of ImageMagick features anyway for our purposes

Image Processing

- OpenMP support

  (http://en.wikipedia.org/wiki/Openmp)

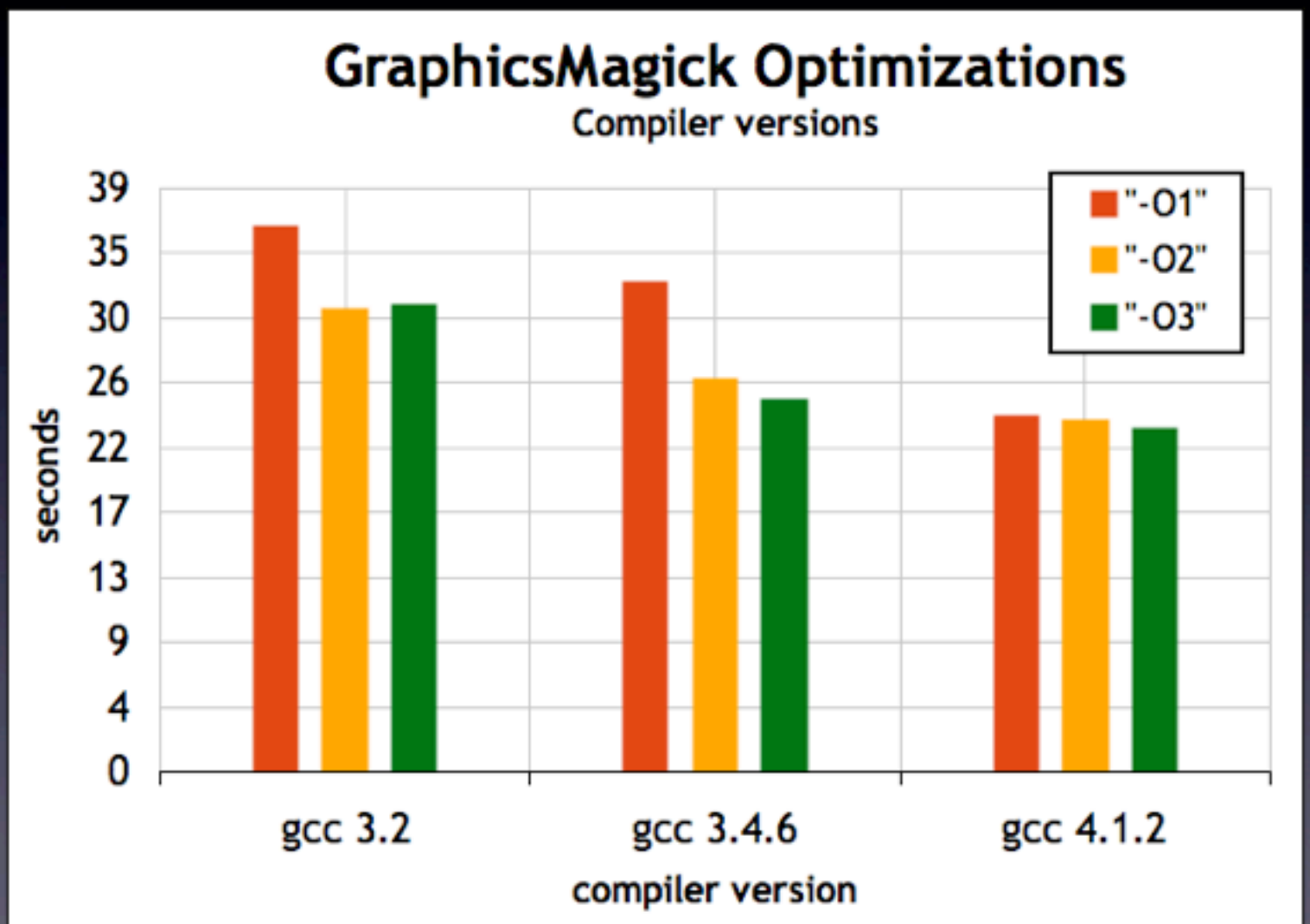
  - Allows parallelization of processing jobs, using multiple cores working on the same image
  - Some algorithms have more parallelization than others

Image Processing

- Test script
  - 7 large-ish DSLR photos
  - Cascade resizing each to 6 smaller sizes, semi-typical for Flickr's workload
  - Each resize processed serially

Image Processing

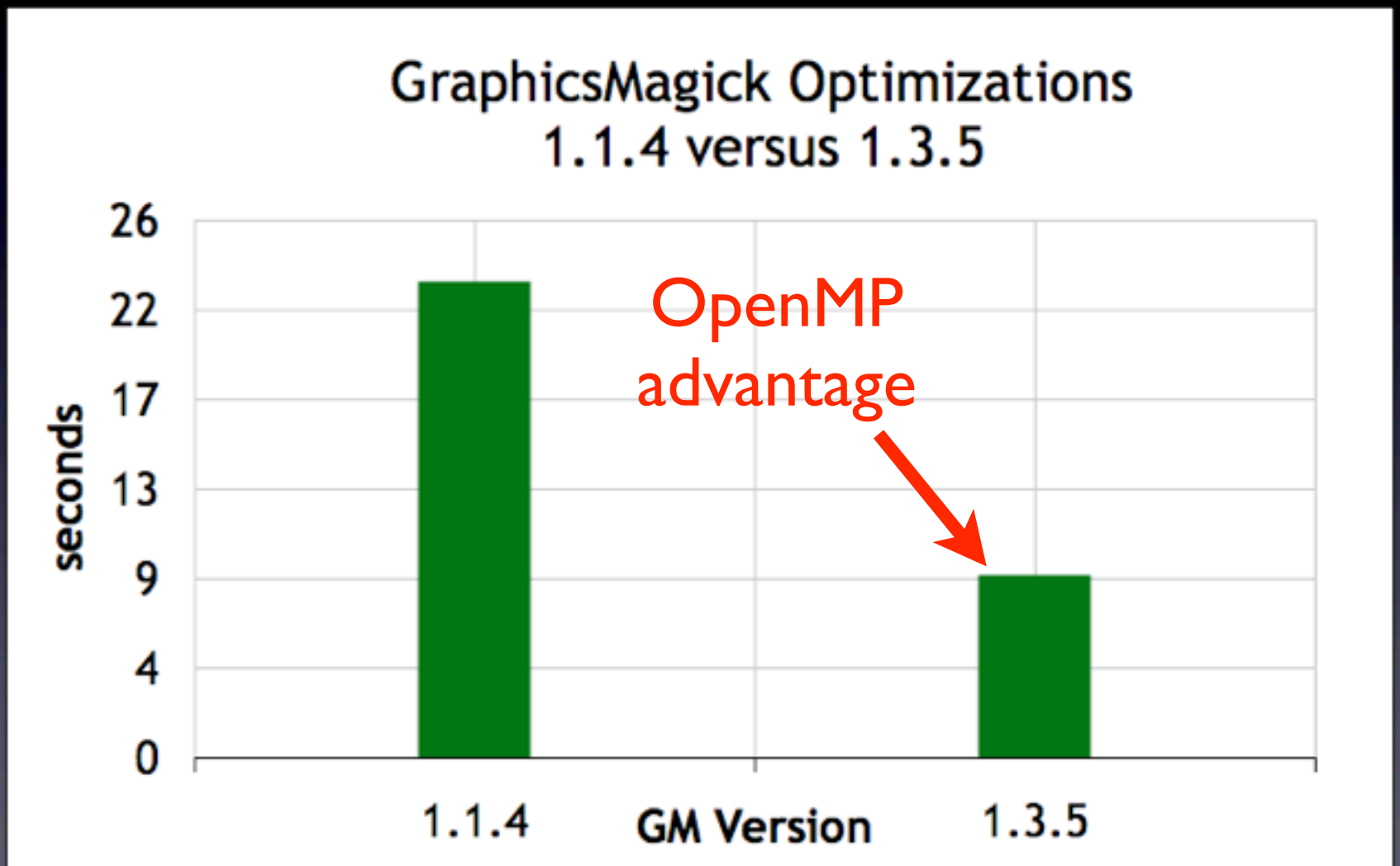
compiler differences



(GM version 1.1.14, non-OpenMP)

Image Processing

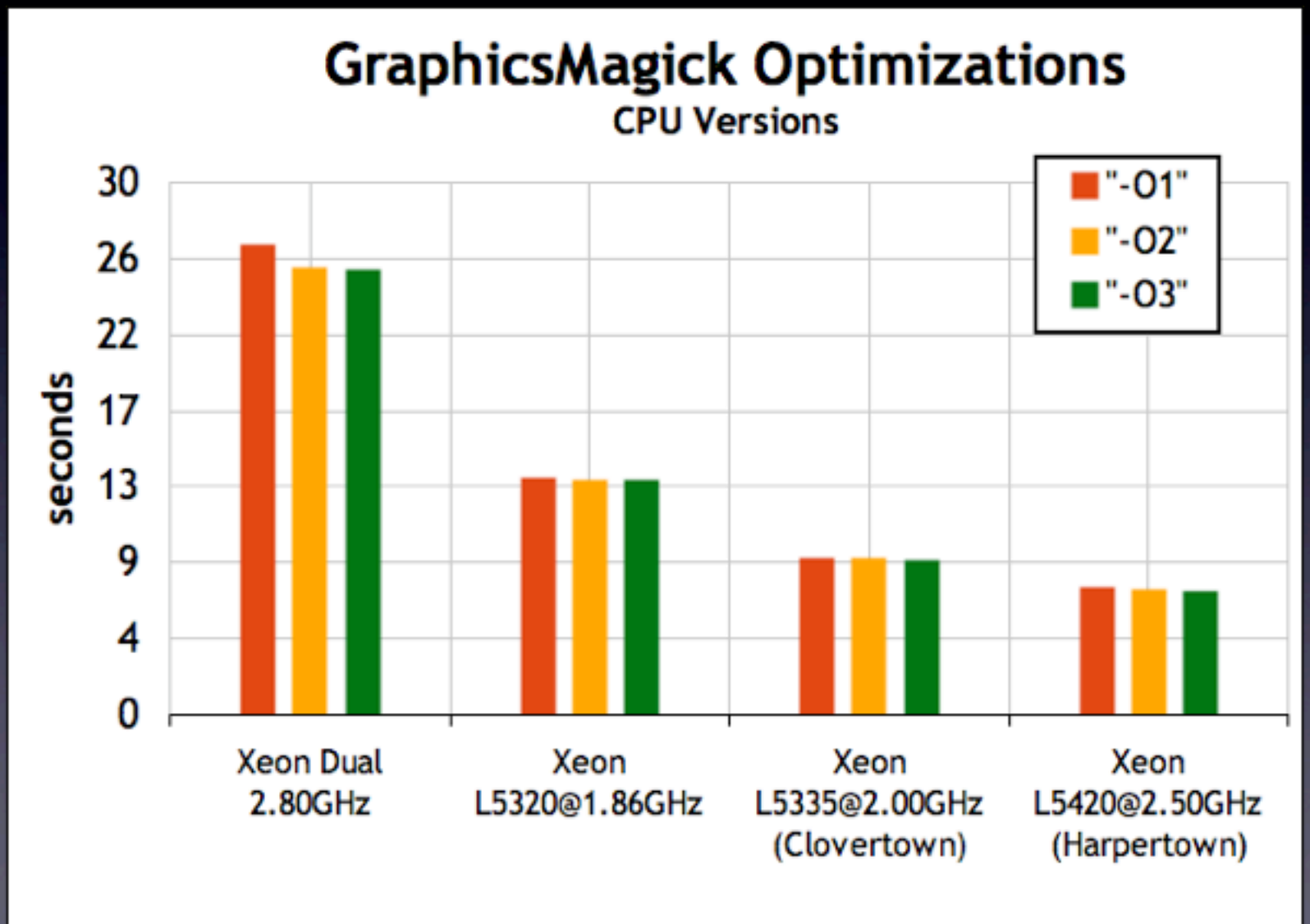
OpenMP differences



(gcc 4.1.2, on quad core Xeon L5335 @ 2.00GHz)

Image Processing

CPU differences



Diagonal Scaling

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- Vertically scaling your *already* horizontally-scaled nodes

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- *a.k.a. "tech refresh"*

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- *a.k.a. "Moore's Law Surfing"*

Diagonal Scaling

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We replaced 67 “old” webservers with 18 “new” :

Diagonal Scaling

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servers	CPUs per server	RAM per server	drives per server	total power (W) @60% peak
67	2	4GB	1x80GB	8763.6
18	8	4GB	1x146GB	2332.8

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~70% LESS power

49U LESS rack space

Diagonal Scaling

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~75% FASTER

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65% LESS power

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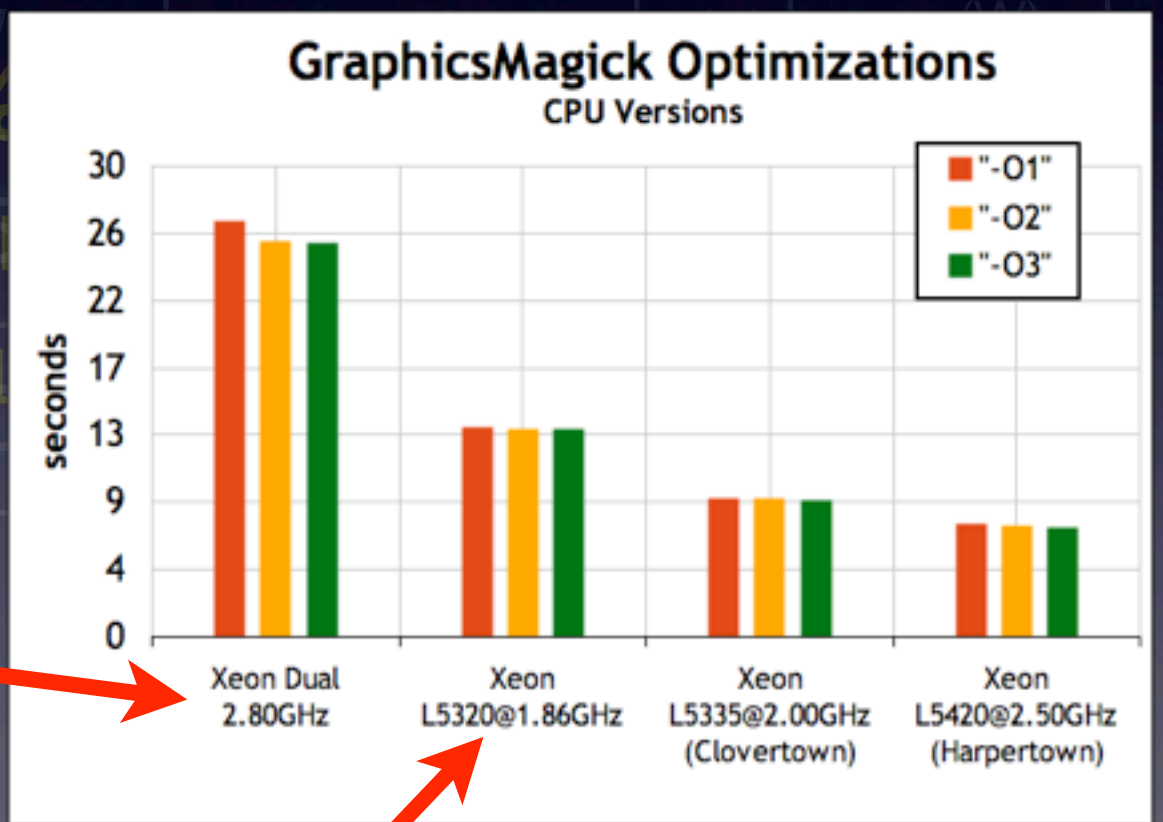
server	photos/
23	150
8	65%



from this

to this

What do you do with old/slow machines?

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- Liquidate

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- “offline” tasks

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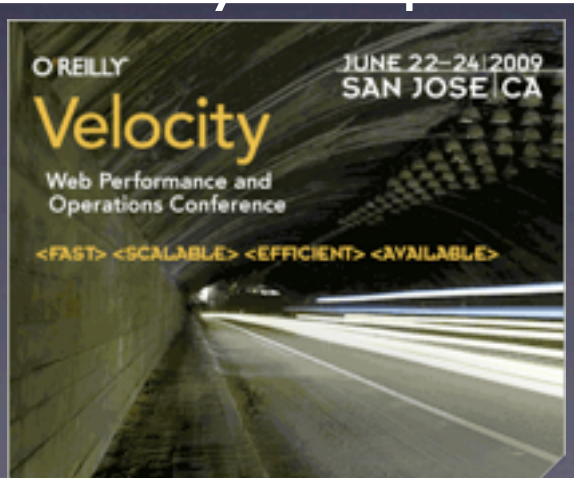

Runbook Hacks

"WTF HAPPENED LAST NIGHT?!"

Why?

Why?

As infrastructure grows, try to keep the Humans:Machines ratio from getting out of hand

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Some of the How:

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As infrastructure grows, try to keep the Humans:Machines ratio from getting out of hand

Some of the How:

- teach machines to build themselves

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Why?

As infrastructure grows, try to keep the Humans:Machines ratio from getting out of hand

Some of the How:

- teach machines to build themselves
- teach machines to watch themselves
- teach machines to fix themselves
- reduce MTTR by streamlining

Automated Infrastructure

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- If there is only ***one*** thing you do, automatic configuration and deployment management should be it.

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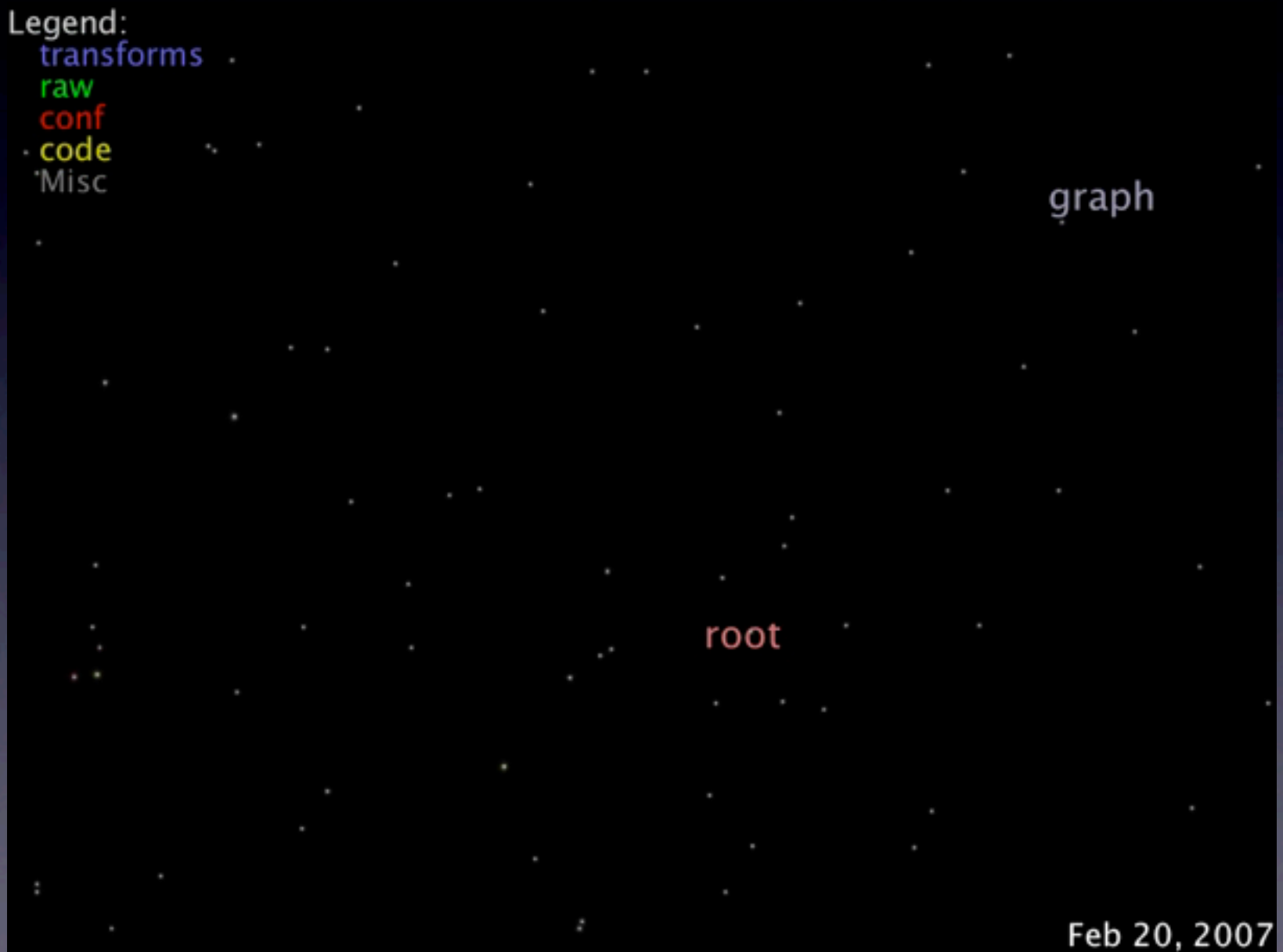
- See:
  - Opscode/Chef *(http://opscode.com/)*
  - Puppet *(http://reductivelabs.com/products/puppet/)*
  - System Imager/Configurator *(http://wiki.systemimager.org)*

Conguration Management Codeswarm



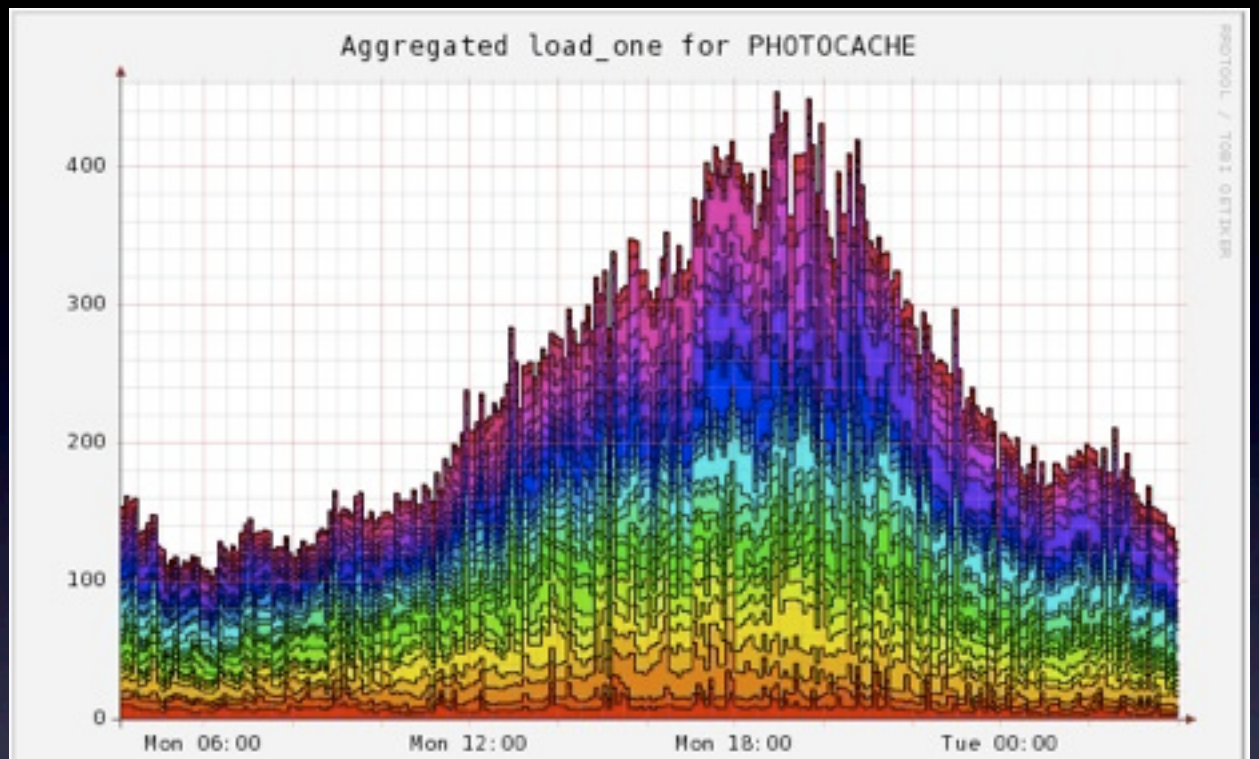
Time

Machine time is cheaper than human time.

If a failure results in some commands being run to ‘fix’ it, make the machines do it.

(i.e., don’t wake people up for stupid things!)

Aggregate Monitoring



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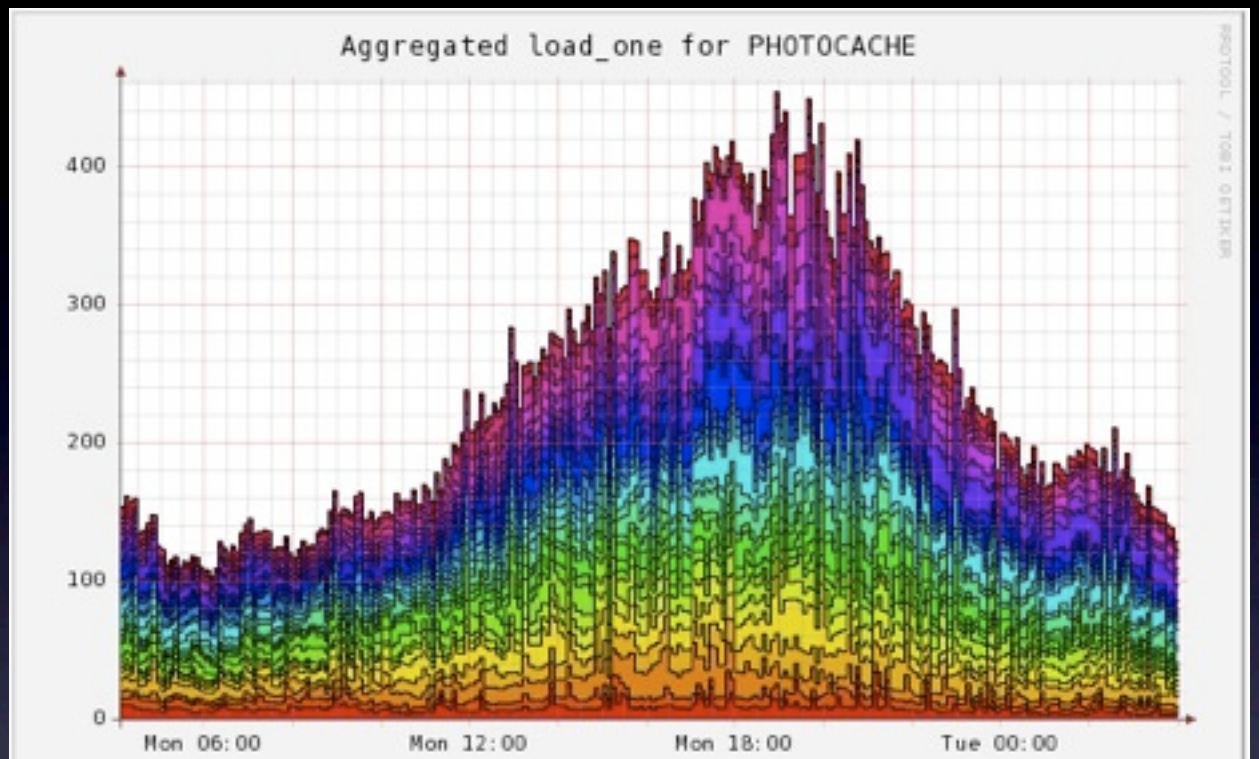

Don't care about single nodes, only care about delta change of metrics/faults

- Warn (email) on X % change
- Page (wake up) on Y % change

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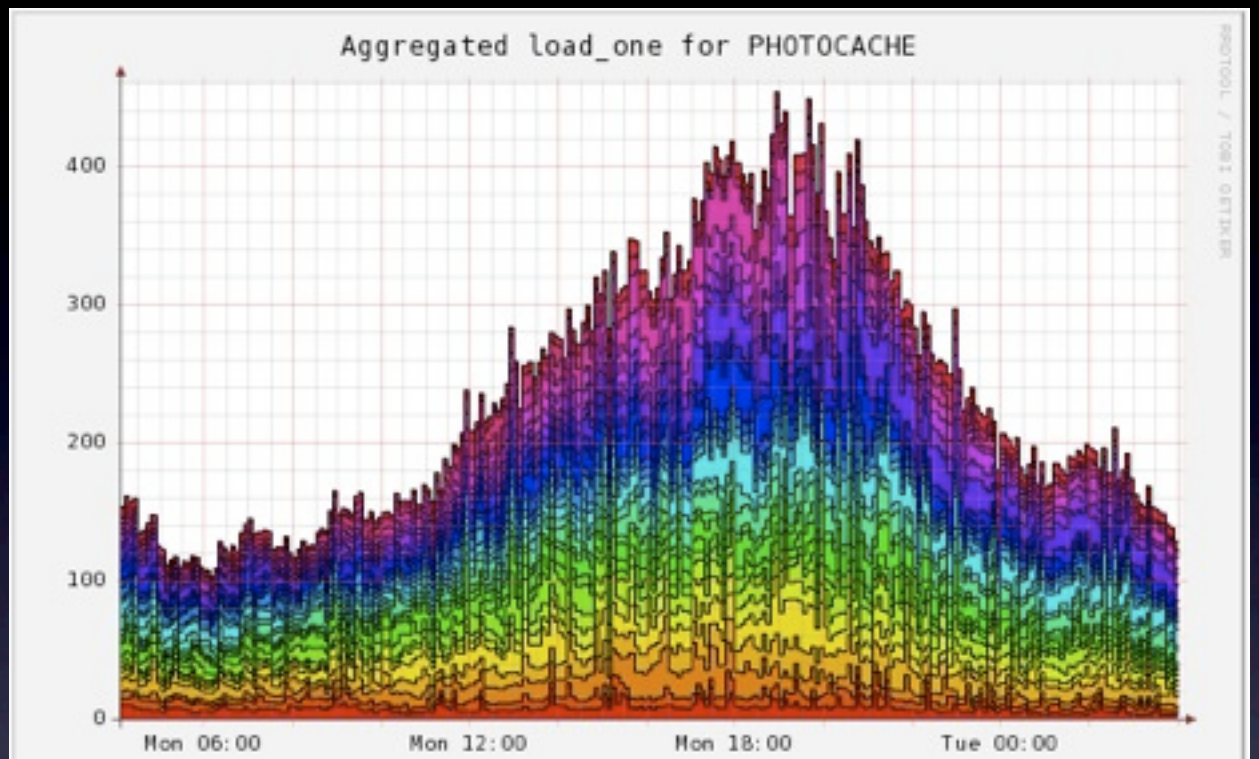

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High *and* low water marks for some metrics

Self-Healing

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Make service monitoring fix common failure scenarios, notify us later about it.

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Basic Apache Example

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1. Webserver not running?

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2. Under certain conditions, try to start it, and email that this happened. *(I'll read it tomorrow)*

Basic Apache Example

1. Webserver not running?
2. Under certain conditions, try to start it, and email that this happened. *(I'll read it tomorrow)*
3. Won't start? Assume something's really wrong, so don't keep trying *(email that, too)*

MySQL Self-Healing

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Some MySQL Issues "fixed" by the machines

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MySQL Self-Healing

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- Kill long-running SELECT queries (marked *safe* to kill)
- Queries not safe to kill are marked by the application as "*NO KILL*" in comments
- Run EXPLAIN on killed queries, and report the results
- Keep track of the query types and databases that need the most killing, produce a "DBs that Suck" report

MySQL Self-Healing

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Some MySQL Replication issues “fixed” by the machines, by error

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    - 1205 (ER_LOCK_WAIT_TIMEOUT)
    - 1213 (ER_LOCK_DEADLOCK)

Troubleshooting

Code and Config
Deploy Logs

Code and Config Deploy Logs

1. ESSENTIAL

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2. MANDATORY

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  - Broadcasts all to all contacts
  - Logged, and injected into IRC
  - IM Status = who is in primary/secondary on-call

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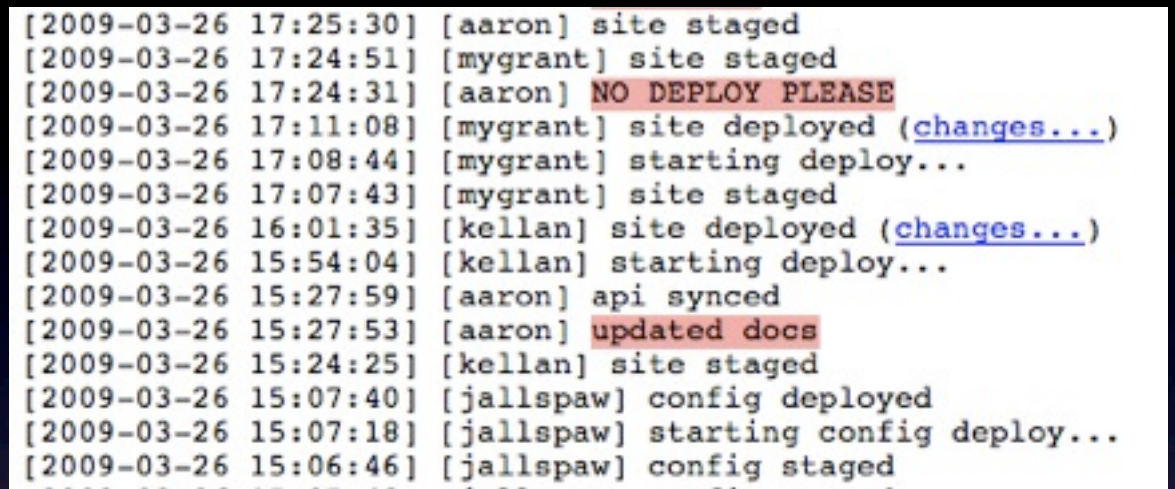
  - Logged, and injected into IRC
  - IM Status = who is in primary/secondary on-call
- All of IRC and IM Bot slurped into a search index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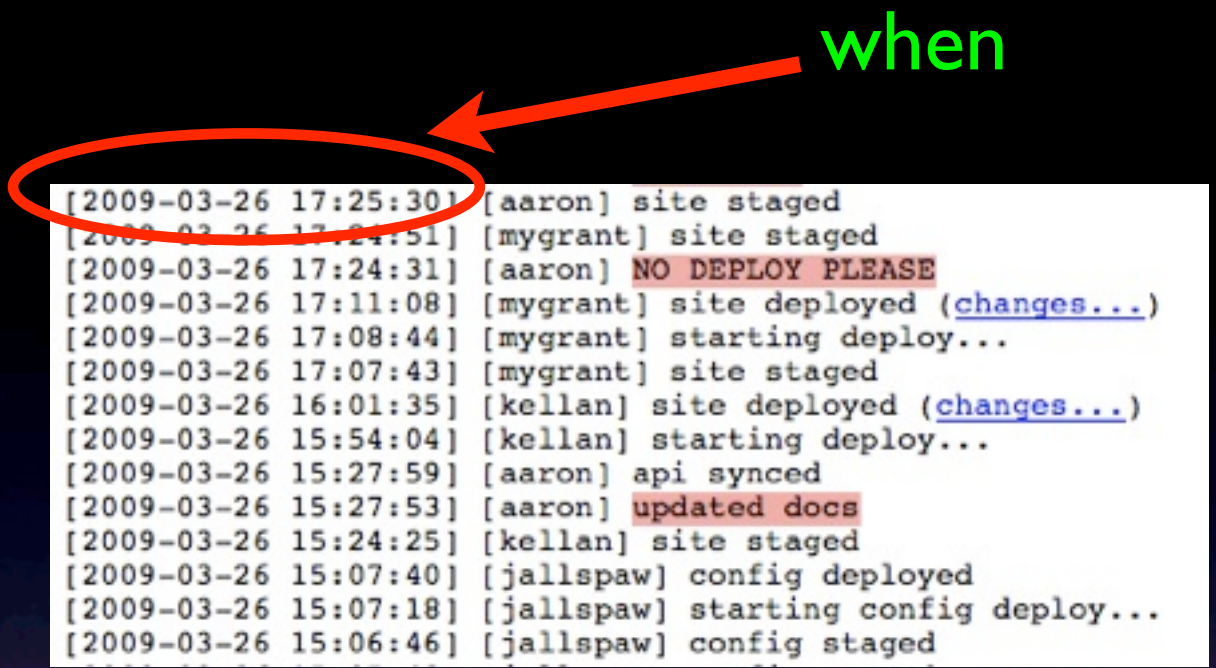
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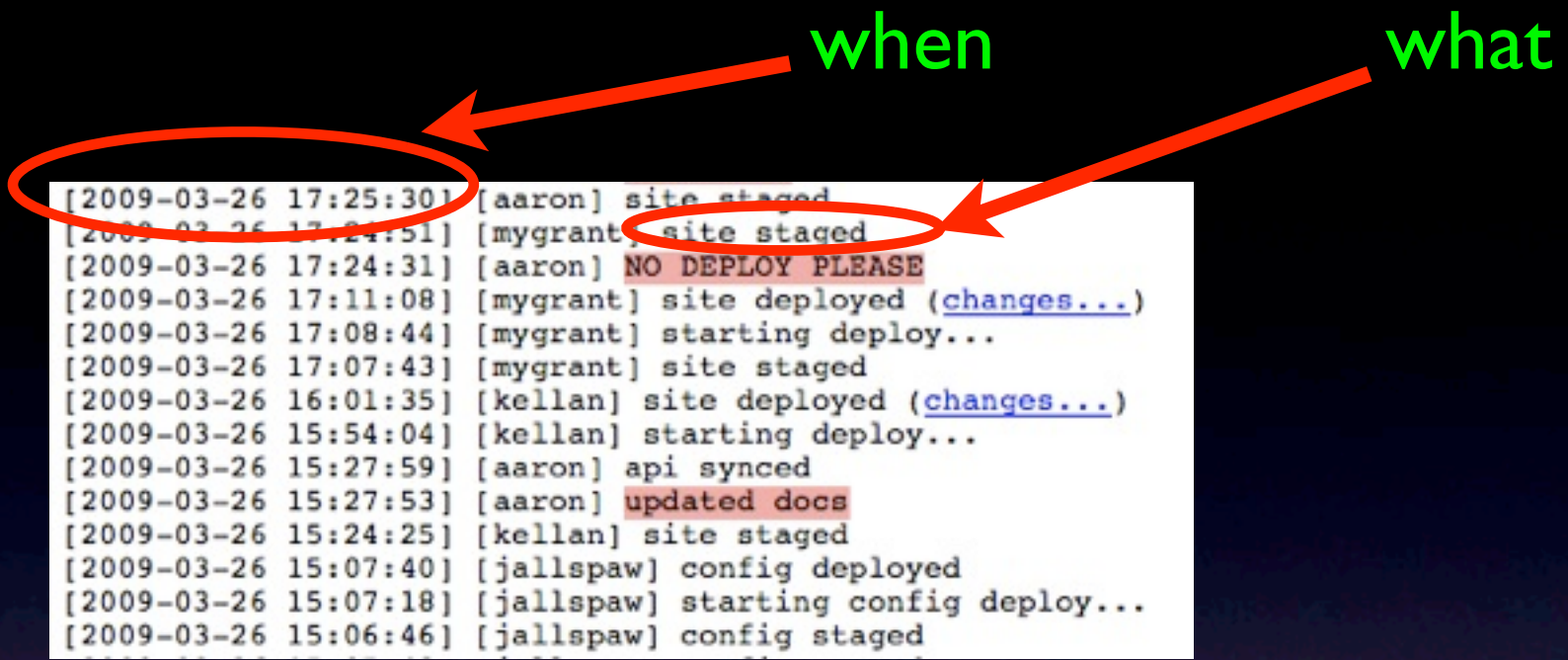
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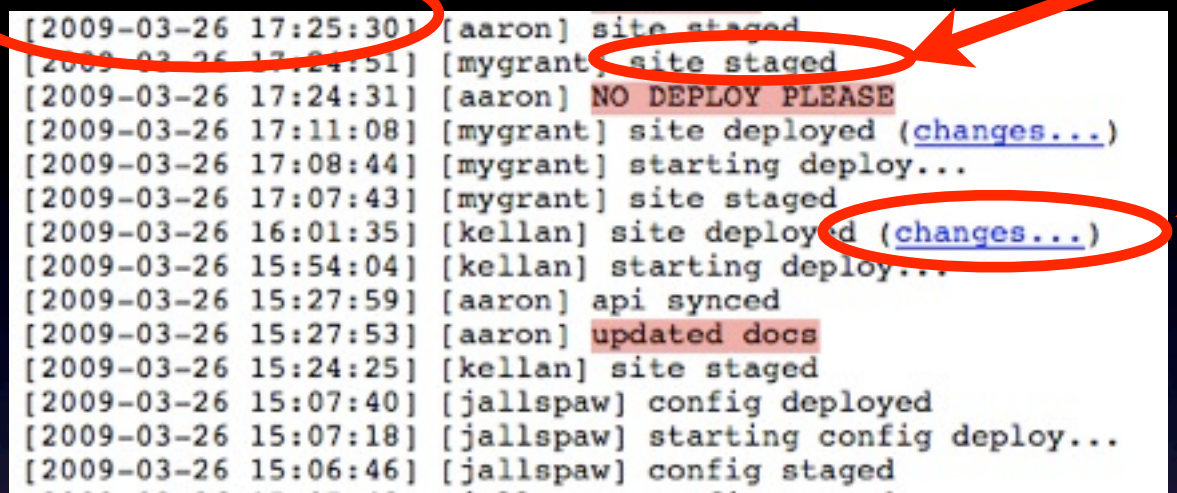
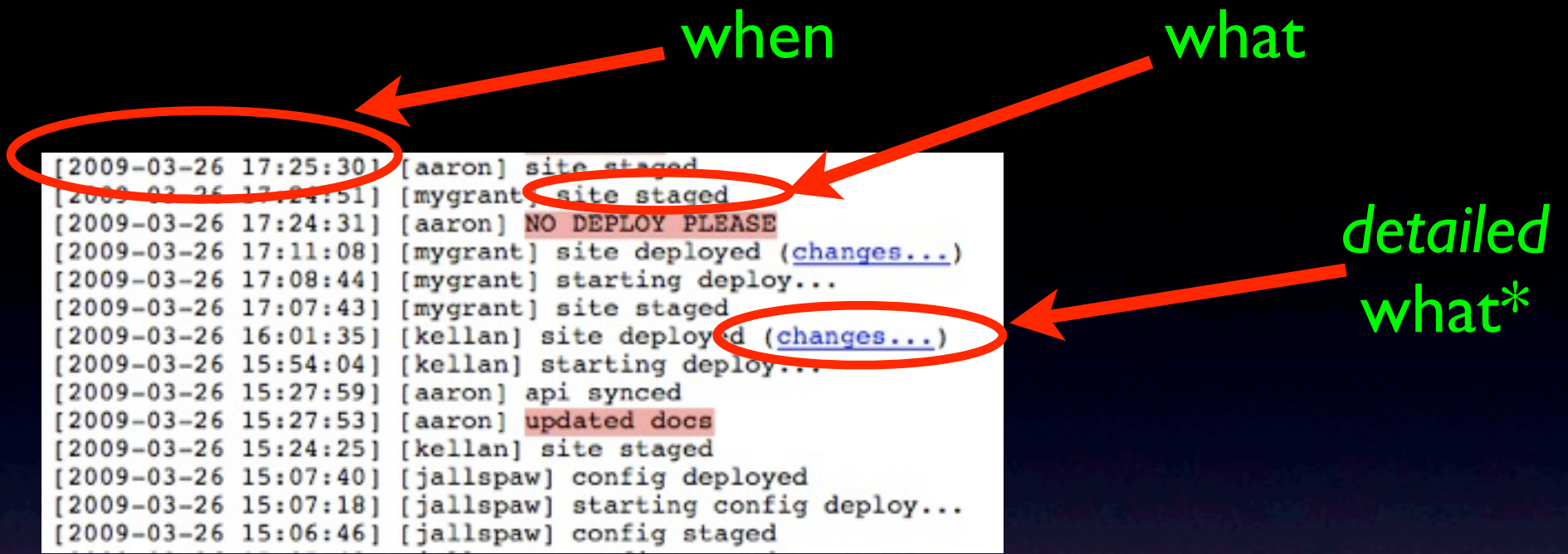
[2009-03-26 15:54:04] [kellan] starting deploy...
[2009-03-26 15:27:59] [aaron] api synced
[2009-03-26 15:27:53] [aaron] updated docs
[2009-03-26 15:24:25] [kellan] site staged
[2009-03-26 15:07:40] [jallspaw] config deployed
[2009-03-26 15:07:18] [jallspaw] starting config deploy...
[2009-03-26 15:06:46] [jallspaw] config staged

when

what

detailed what*

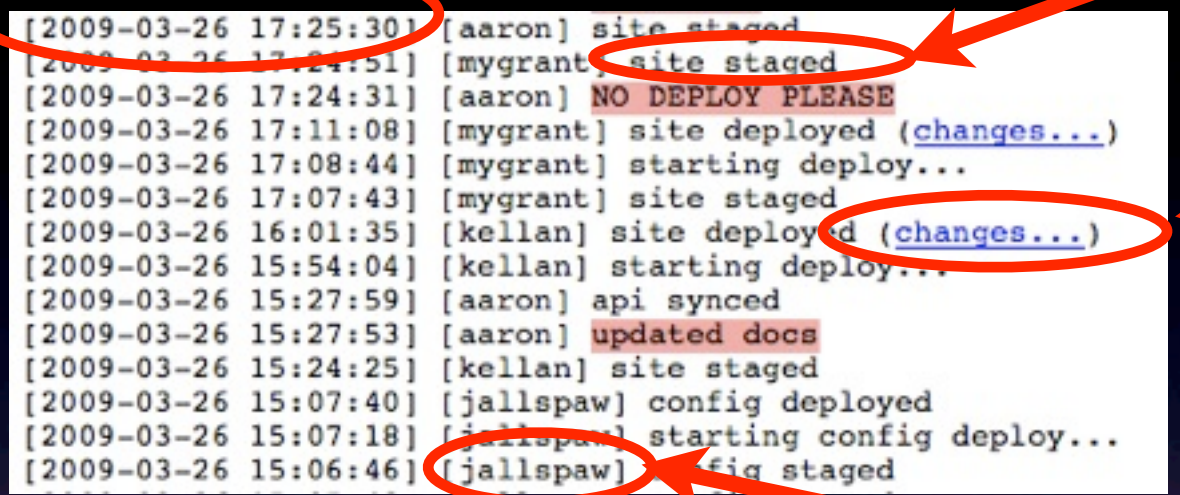




*also points to what commands should be used to back out the changes

when

what



detailed
what*

who

**also points to what commands should be used to back out the changes*

when

what

detailed what*

who

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[2009-03-26 17:25:30] [aaron] site staged
[2009-03-26 17:24:51] [mygrant] site staged
[2009-03-26 17:24:31] [aaron] NO DEPLOY PLEASE
[2009-03-26 17:11:08] [mygrant] site deployed (changes...)
[2009-03-26 17:08:44] [mygrant] starting deploy...
[2009-03-26 17:07:43] [mygrant] site staged
[2009-03-26 16:01:35] [kellan] site deployed (changes...)
[2009-03-26 15:54:04] [kellan] starting deploy...
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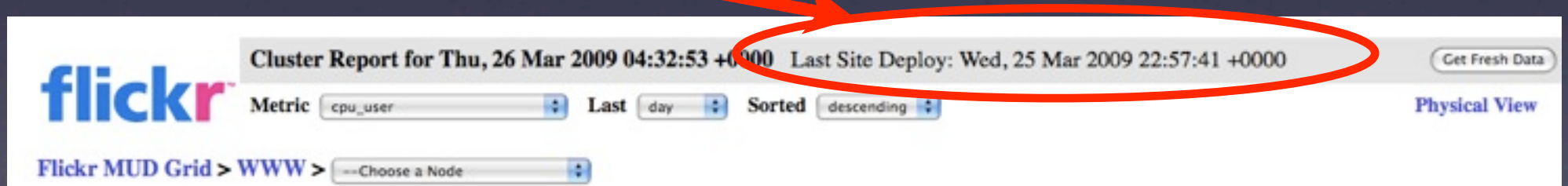
time of last deploy at top of ganglia



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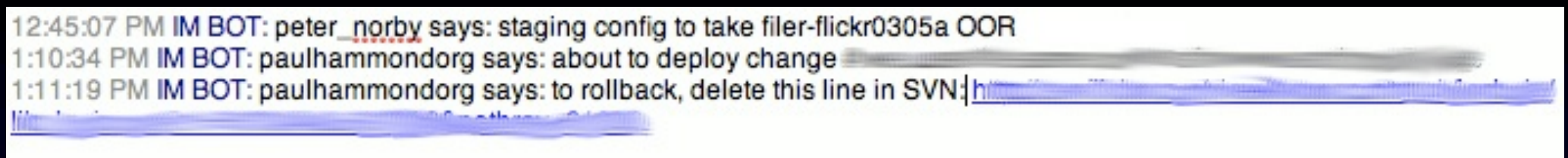
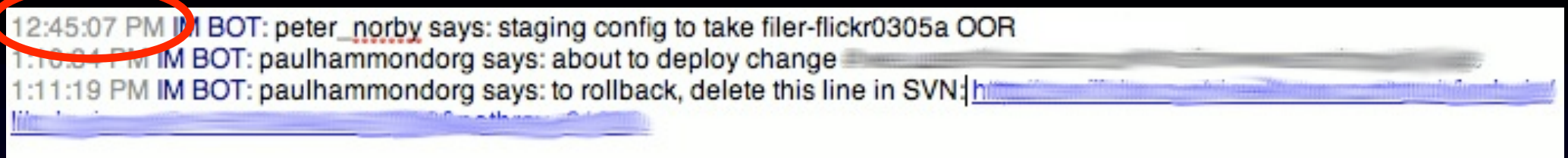

12:45:07 PM IM BOT: peter_norby says: staging config to take filer-flickr0305a OOR
1:10:34 PM IM BOT: paulhammondorg says: about to deploy change
1:11:19 PM IM BOT: paulhammondorg says: to rollback, delete this line in SVN:

IM Bot (timestamps help correlation)



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filer-flickr0305a Find!

who: anyone relevancy sort 3 lines scope

after YYYY-MM-DD: 1969-12-31 before YYYY-MM-DD: 2046-12-31

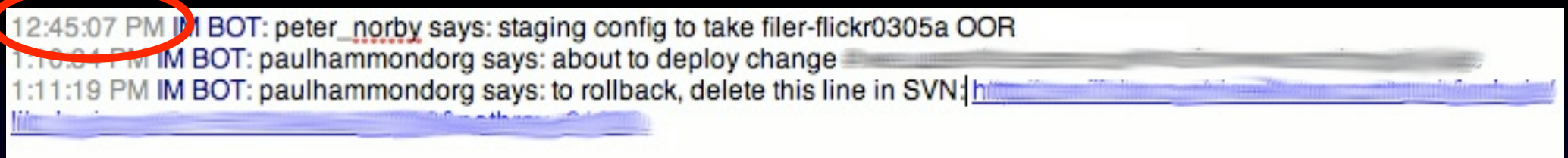
kevbob (1) peter_norby (1)

TOTAL HITS: 2

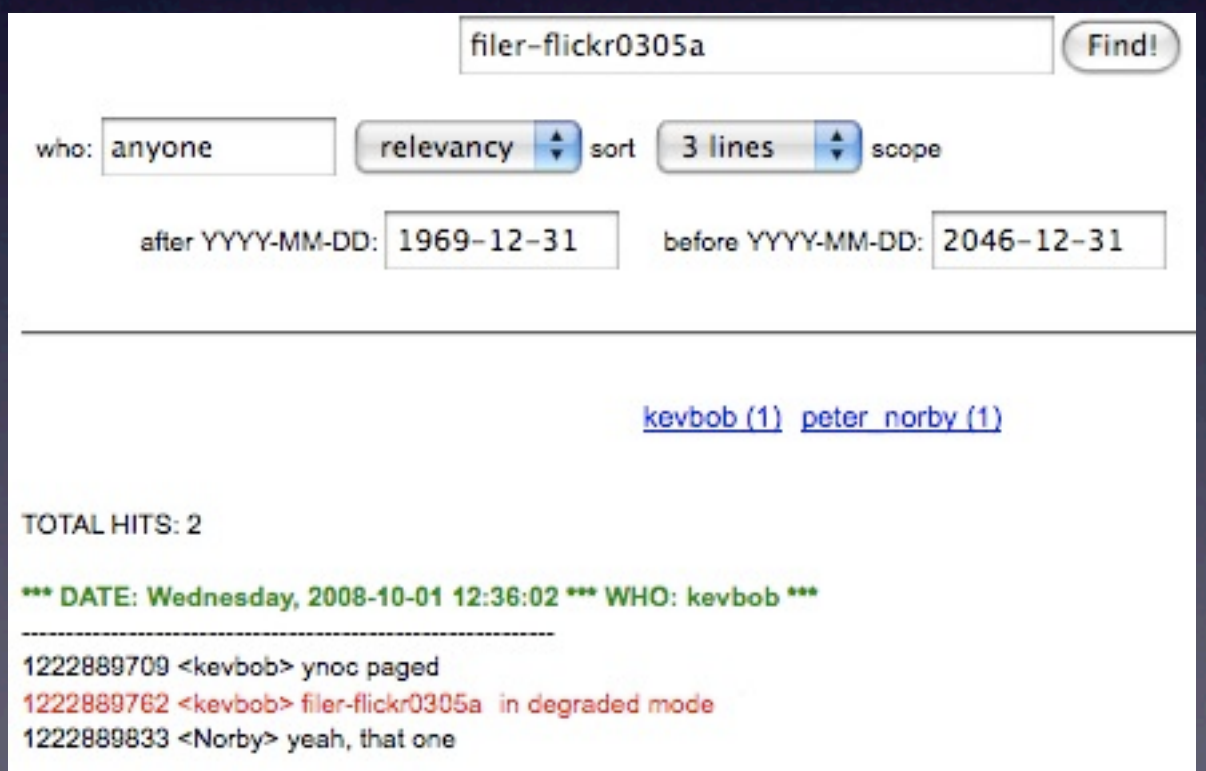
*** DATE: Wednesday, 2008-10-01 12:36:02 *** WHO: kevbob ***

1222889709 <kevbob> ynoc paged
1222889762 <kevbob> filer-flickr0305a in degraded mode
1222889833 <Norby> yeah, that one

IM Bot (timestamps help correlation)



all IRC, IM bot into searchable history



Morals of Our Stories

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- Weigh time spent optimizing against expected gains
- Lean on others for how much "expected gains" mean for different scenarios
- Plain old-fashioned intuition

Some Wisdom Nuggets

Jon Prall's 85 WebOps Rules:

http://jprall.vox.com/library/post/85-operations-rules-to-live-by.html

Questions?

http://www.flickr.com/photos/ebarney/3348965637/
http://www.flickr.com/photos/dgmiller/1606071911/
http://www.flickr.com/photos/dannyboyster/60371673/
http://www.flickr.com/photos/bright/189338394/
http://www.flickr.com/photos/nickwheeleroz/2475011402/
http://www.flickr.com/photos/dramaqueennorma/191063346/
http://www.flickr.com/photos/telstar/2861103147/
http://www.flickr.com/photos/norby/2309046043/
http://www.flickr.com/photos/allysonk/201008992/