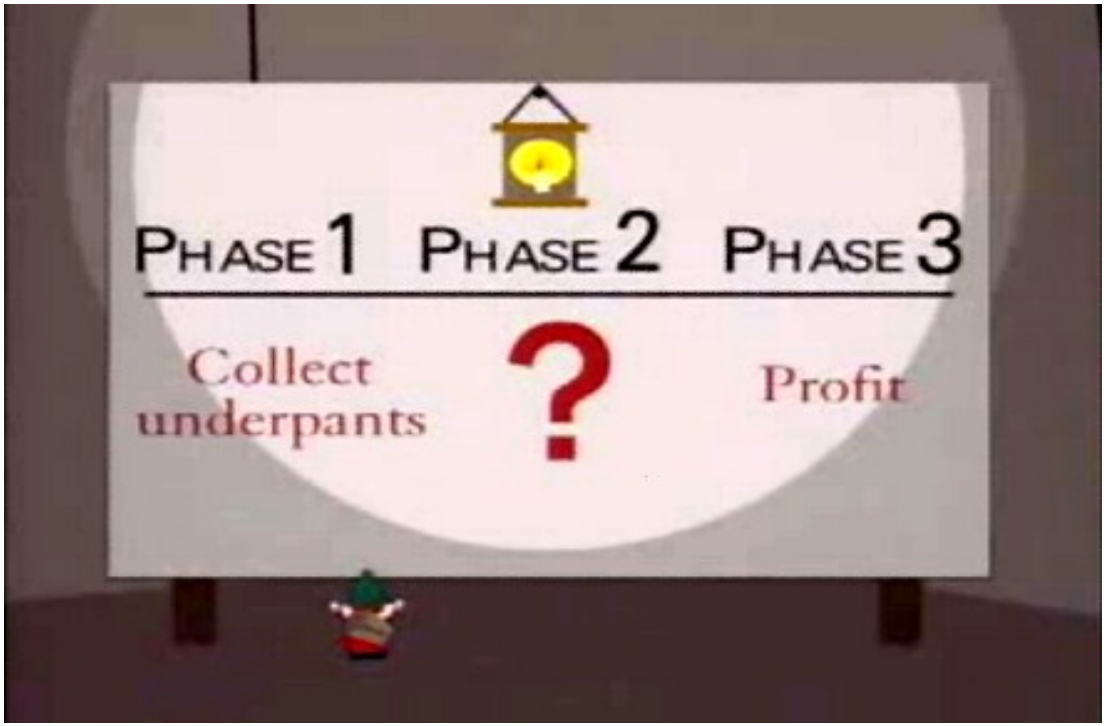
Re-architecting for the 'green' cloud and lower costs ***Justin Cormack***

1. build a cloud from lots of ~~underpants~~ mobile phone CPUs

2. ?

3. Profit



What would change the status quo?

Slower processors more power efficient

But require many more of them

Much more parallelism, hard

Some numbers

	RAM	power	cost	SHA1 speed
dual core 1GHz ARM	1 GB	4 W	$50	120 MB/s
dual core Pentium	8 GB	40 W	$500	720 MB/s
12 core Xeon	64 GB	400 W	$5000	3000 MB/s

Almost linear performance, not compelling. Amdahl's Law.

RAM based world

The applications we are building are very RAM hungry.

RAM based data storage: Memcache, Redis, Membase, VoltDB, Gigaspaces, TimesTen ...

EC2 offers 68GB high memory instances. Intel releasing machines that can take 1TB RAM.

ARM servers are 32 bit. 4GB is enough for anybody?

Why are we so RAM obsessed?

Reads per second

L1 cache reference	2,000,000,000
Branch mispredict	200,000,000
L2 cache reference	140,000,000
Mutex lock/unlock	10,000,000
RAM reference	10,000,000
datacentre round trip	2000
hard drive seek	100
Intercontinental round trip	10

Hold on, something happened...

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SLC flash SSD, PCIe	180,000
MLC flash SSD, SATA	35,000
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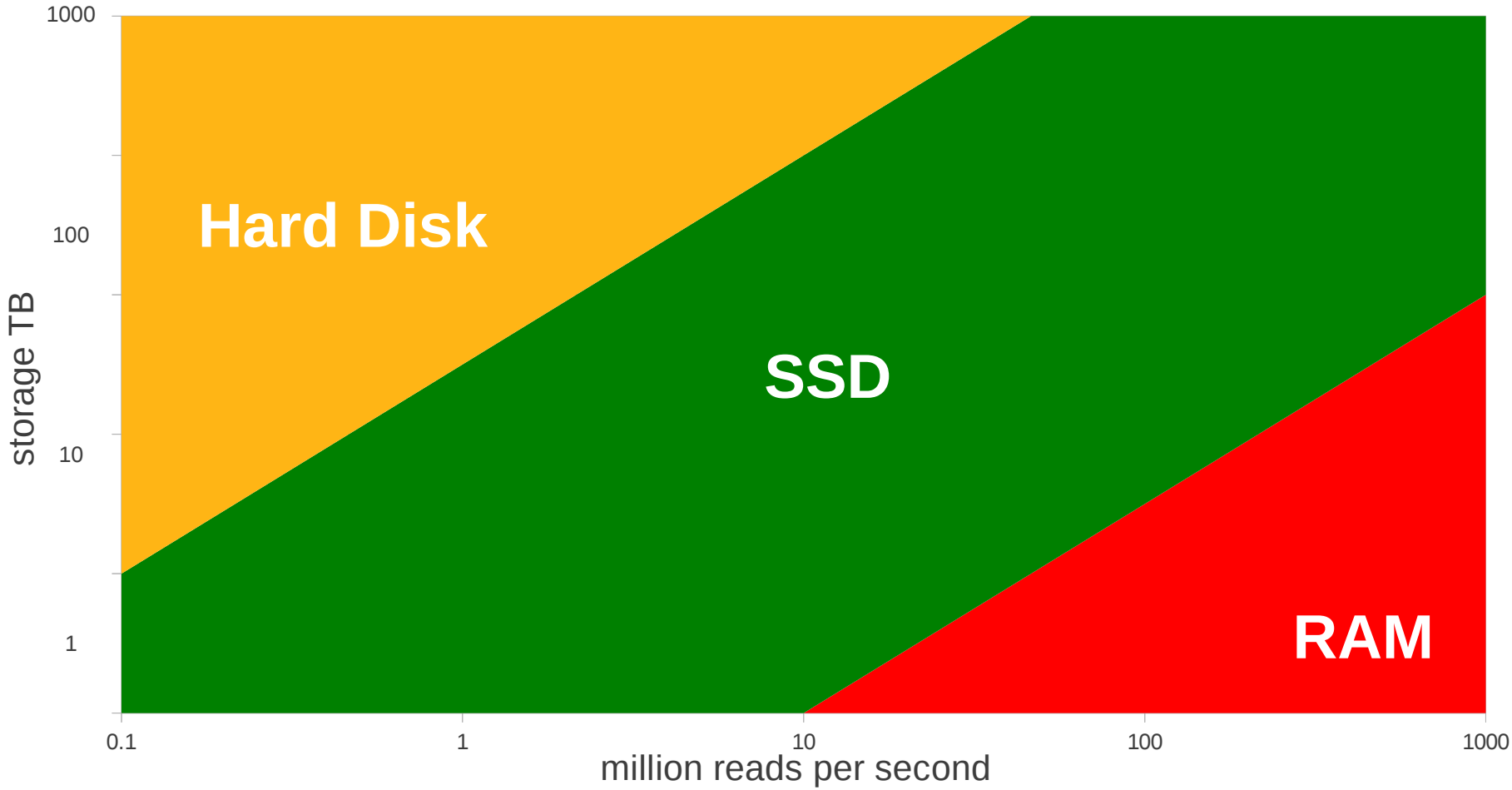
Marriage made in heaven?

RAM	$75 / GB	250 W / TB
SSD	$2 / GB	2 W / TB

Cheapest Space / Transactions



Which workloads?

- Middle ground of performance
- Read dominated
- Up to 1k requests per second per CPU
- Medium latency 10–100ms per request

eg web serving SAAS, 1GB data per customer

12 core xeon	64 GB RAM	$5,000	64 customers	$78 each	400 W
2 core ARM	512 GB SSD	$1,000	512 customers	$2 each	4 W

Business case for low power cloud?

- Not just more slower processors
- Not a replacement for all workloads
- low cost commodity middle ground
- Use SSD not RAM or hard drive
- Needs optimised software

Upside is potentially 10-100x cheaper

Questions?

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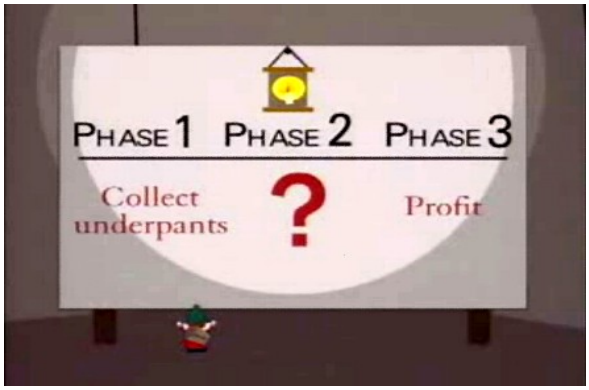

There has been a lot of talk about low power "green" cloud computing, using ARM and similar CPUs.

Is this really cost effective?

Will we all be shifting away from x86 architectures in a few years?

What would change the status quo?

Slower processors more power efficient

But require many more of them

Much more parallelism, hard

Processors are much more power efficient when run slow.

But we all know about Amdahl's law

And we all know that getting developers to write parallel code is not easy.

Is there a big enough gain to make this shift worthwhile?

Some numbers

	RAM	power	cost	SHA1 speed
dual core 1GHz ARM	1 GB	4 W	$50	120 MB/s
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Almost linear performance, not compelling. Amdahl's Law.

If we actually look at the price, power and performance of cheap computers, we do not really see a huge benefit.

Using a rough benchmark, you seem to get what you pay for.

This is not going to change anything.

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One characteristic of modern applications is that the use a lot of RAM.

Facebook last year had 200TB of data in memcache.

We cannot replicate that on low power computers. First RAM uses a fair amount of power, also the cheap CPUs are only 32 bit, and cannot generally address as much memory as x86 servers.

Why are we so RAM obsessed?

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Why have we built everything in RAM?

There is a huge performance gap between RAM performance and disk.

Disk is too slow for web applications to read from.

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But we have suddenly got a technology to fill that gap, flash memory.

Over the last few years it has started to turn into a mainstream commodity storage medium.

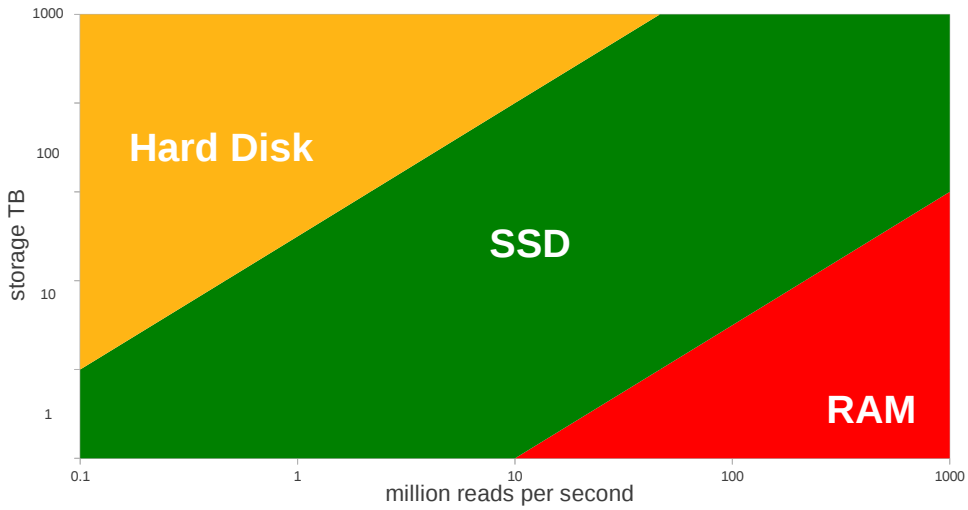
Marriage made in heaven?

RAM	$75 / GB	250 W / TB
SSD	$2 / GB	2 W / TB

And flash is cheap compared to RAM, and very low power.

Because it fits in that gap between fast RAM and slow hard drives it gives us a new option.

Cheapest Space / Transactions



There is a middle ground

Hard drives are great if you have lots of data and very few accesses to it.

RAM is great if you need to access a small amount of data very fast.

In the middle flash gives you a middle ground of fast enough access to quite big data.

And as its price falls, this slice increases.

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This middle ground covers a fair amount of useful web workloads.

Not for high speed trading, or for backups.

But responsive web applications. The kind of stuff clouds are used a lot for.

Business case for low power cloud?

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- Not a replacement for all workloads
- low cost commodity middle ground
- Use SSD not RAM or hard drive
- Needs optimised software

Upside is potentially 10-100x cheaper

So it does look like there is a real opportunity for low power cloud if we change the architecture enough.

Flash is becoming a new commodity technology, and matches up well with low power CPUs.

Like most cloud applications, you can't just take old code and run it.

But it can be substantially cheaper for commodity workloads.

Questions?

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