

# MySQL in the Cloud

## Tricks and Tradeoffs

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CTO RightScale

# MySQL & Amazon EC2 @RightScale

- Operating in Amazon EC2 since fall 2006
- Cloud Computing Management System
- Replicated MySQL product offering mid '07
  - 100's of customer deployments
  - Automation to launch slaves, failover, backup, ...
- Animoto.com scaled to 4000 servers in 3.5 days

# Cloud Computing & Databases

1. Infinite computing resources
2. Available on-demand
3. Pay per use
4. Delivered across the Internet

❖ Fully Automatable Infrastructure

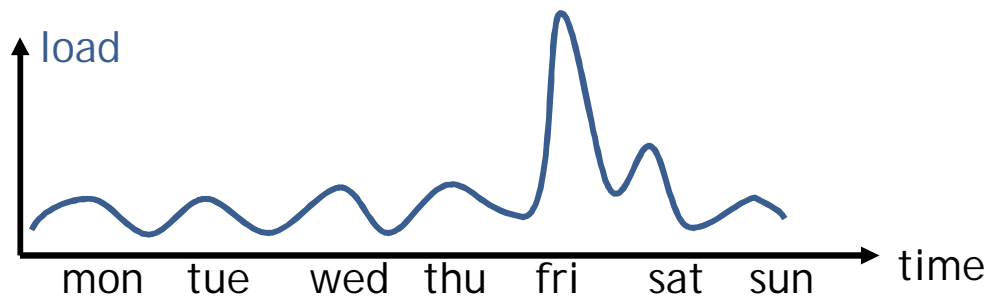
As many DB machines as you want!

No cost for short periods

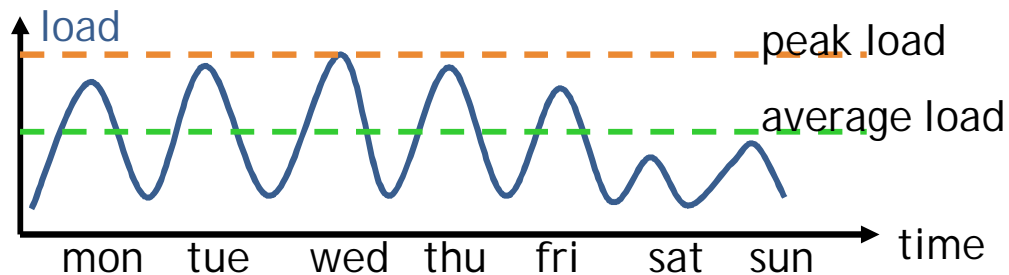
Save work, More reliable

# Cloud Computing Vision

- No up-front costs



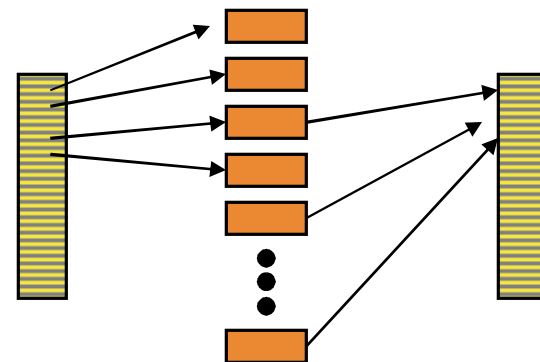
- Pay for average, not peak



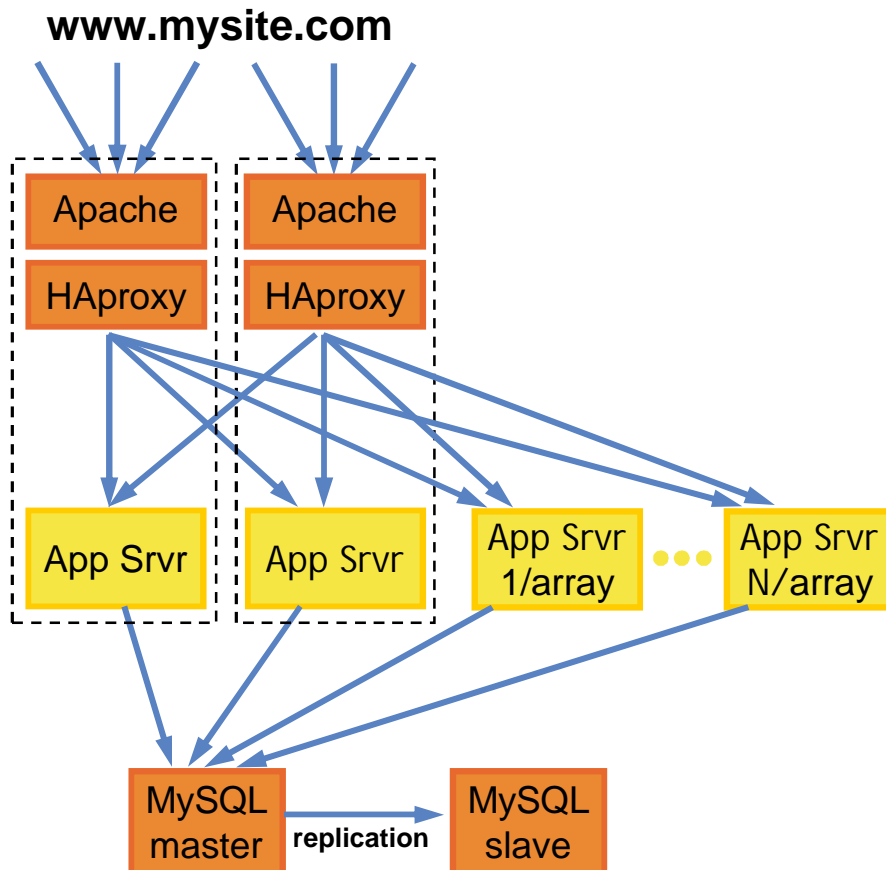
- Easy Dev & Test



- Scale batch apps



# Scale-up/down Automation



- Scale-up
  - App server load > 50%
  - Majority voting
  - Add app servers
  - Tie into load bal & db
- Scale-down
  - App server load < 20%
  - Majority voting

- Home
- Manage
  - Servers
    - Deployments
    - Active Servers
    - Arrays
    - Alerts
    - Terminated Servers
  - Storage
    - S3 Browser
    - EC2 Image locator
  - Queues
- Design
- Report
- Settings

Recent Events 08:31

Event Age

## Deployment Scalable Photo Site

Clone Delete Help

Deployment for auto-scaling photo site demo. The base site contains mysql master/slave and two front-ends (apache, haproxy, rails/mongrel). In addition, the photo array auto-scales additional rails/mongrel servers based on load. [\[edit\]](#)

- Servers
- Inputs
- Scripts
- Volumes
- Alert Escalations
- Audit
- History
- Xref
- Changes

Filter by Nickname:  Apply  
 (Accepts '%' as wildcard)

Deployment is unlocked [\[lock\]](#) (Locking prevents deletion of servers.)

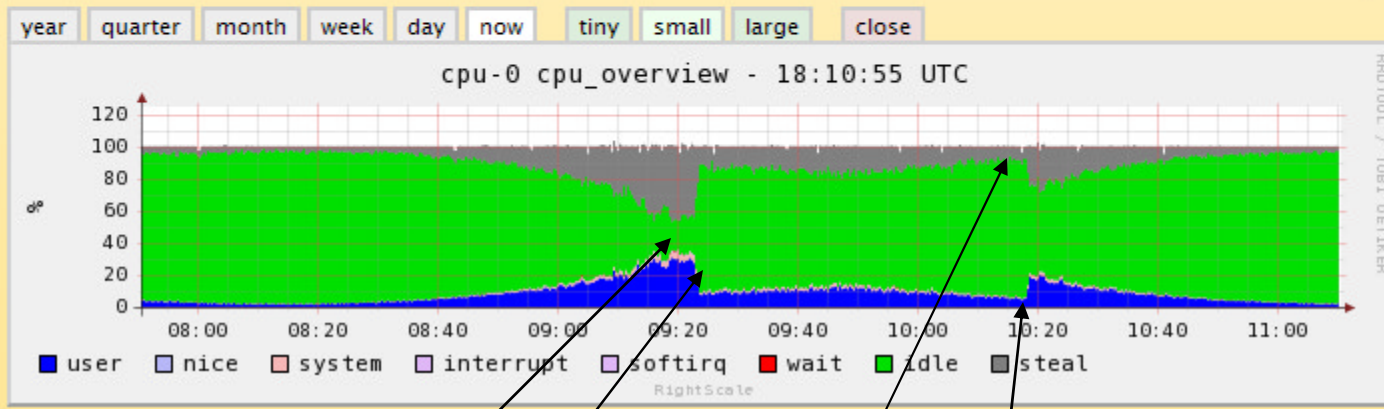
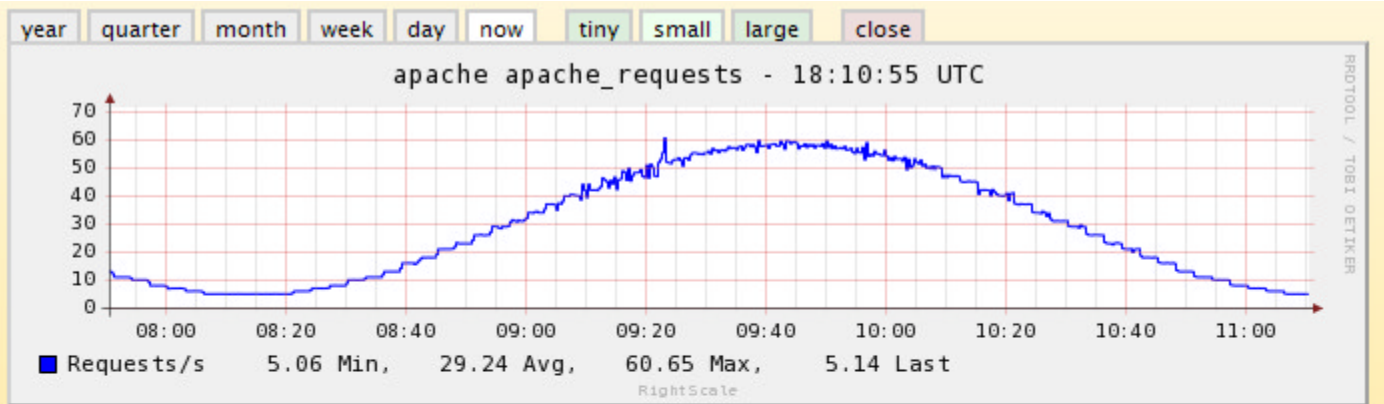
[start all](#)   [stop unlocked](#)

Nickname	Server Template	State	Elastic IP	Zone	Runtime	Actions
<a href="#">HTTPerf</a>	<a href="#">Httperf AutoScaling (LG)</a>	operational	-none-	us-east-1b	13.7 days	
<a href="#">MySQL Master</a>	<a href="#">MySQL Bootstrap v1.1</a>	operational	-none-	us-east-1b	13.7 days	
<a href="#">MySQL Slave</a>	<a href="#">MySQL Additional v1.1</a>	operational	-none-	us-east-1b	13.7 days	
<a href="#">www8a FrontEnd</a>	<a href="#">Rails FrontEnd v6</a>	operational	www8a	us-east-1b	13.7 days	
<a href="#">www8b FrontEnd</a>	<a href="#">Rails FrontEnd v6</a>	operational	www8b	us-east-1b	13.7 days	

[start all](#)   [stop unlocked](#)

Add Server

Server Array	Running Instances	Last Launch
<a href="#">Rails AppServer (C) v4</a>	-- none --	<a href="#">Rails AppServer (C) v4 #1765</a> -- 2h ago



Load exceeds threshold

Additional servers operational

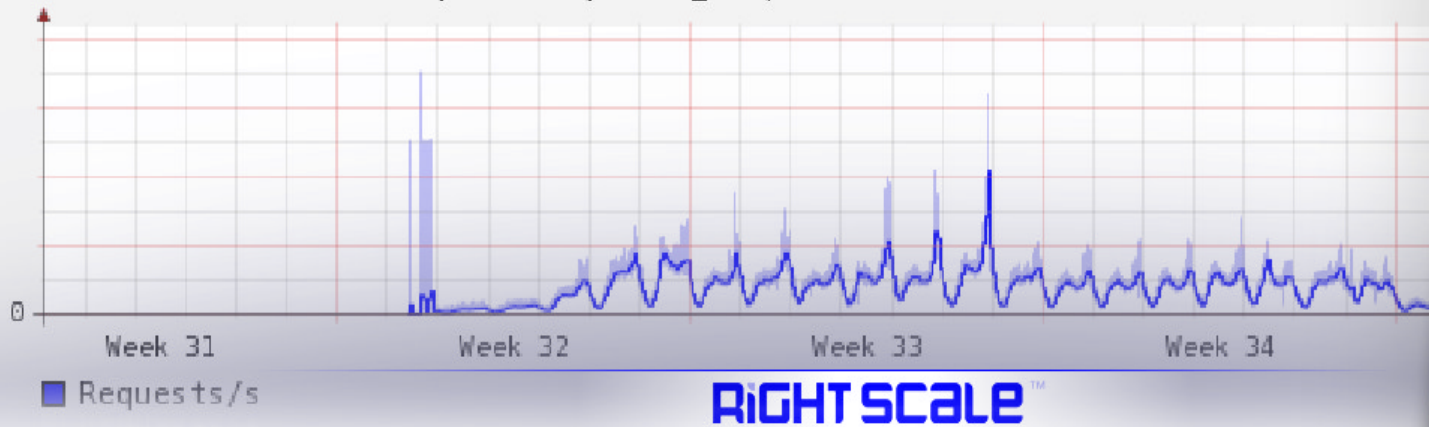
Load drops below threshold

Additional servers terminated

# Starcut (Olympics)

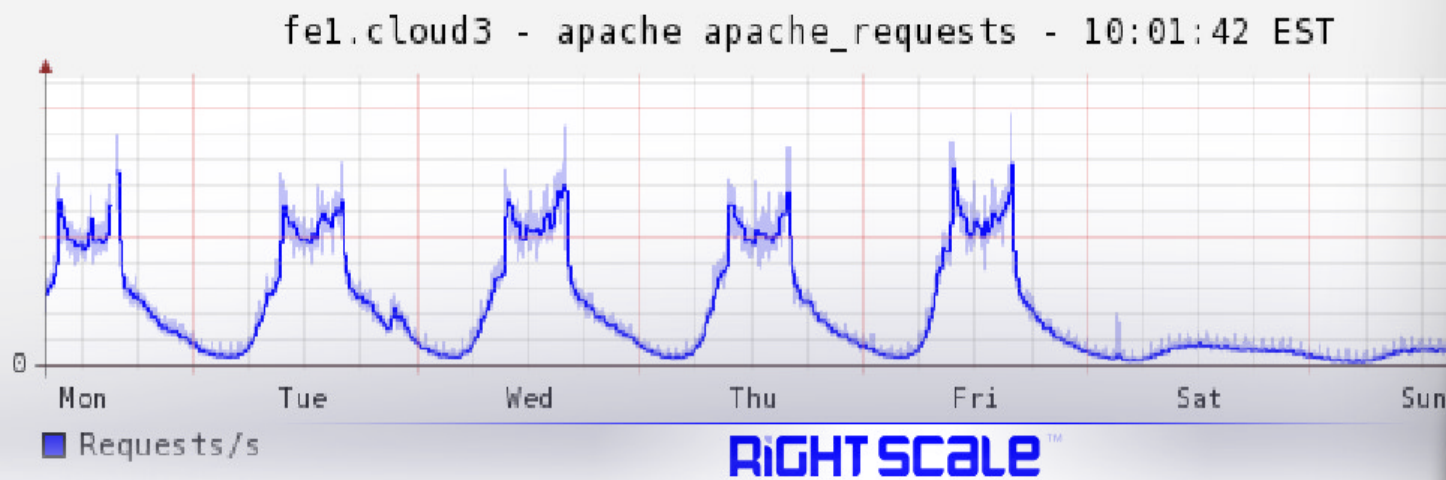
- Low cost to entry, scale up as demand grows
- Repeatable, "clean-room" design promotes stability and process
- Great sandbox for testing and benchmarking

apache apache\_requests - 18:00:22 UTC



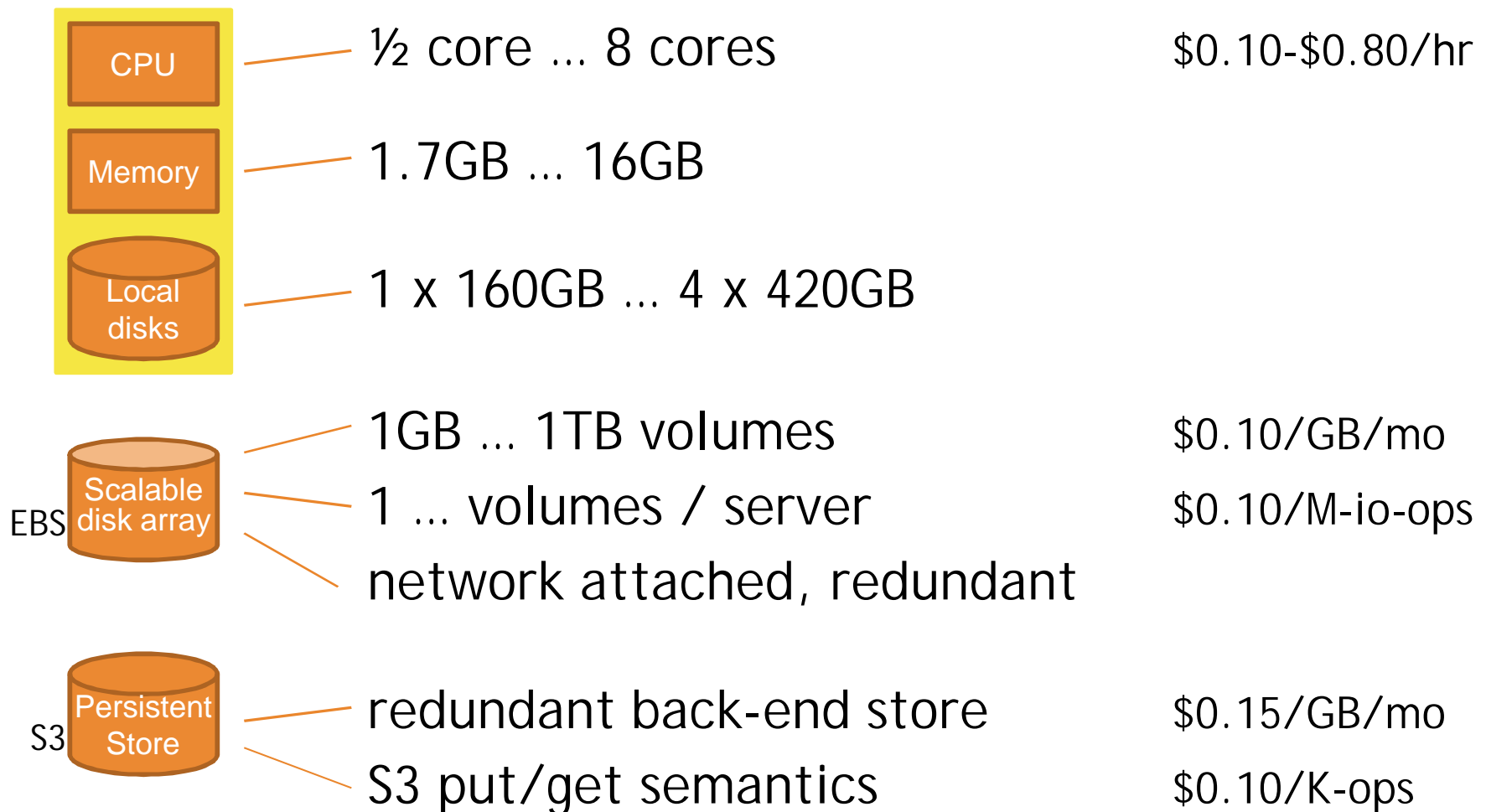
# Starcut (Stocks)

- Daily scale up/down to save costs
- Global reach for services is needed (Europe, USA, Asia)
- Big name clients demand carrier-grade reliability
- Full 24/7, 365 support expectations to us and us to our vendors



# Std MySQL/EBS configuration & Storage Array in the Sky

# Amazon EC2 Storage Architecture

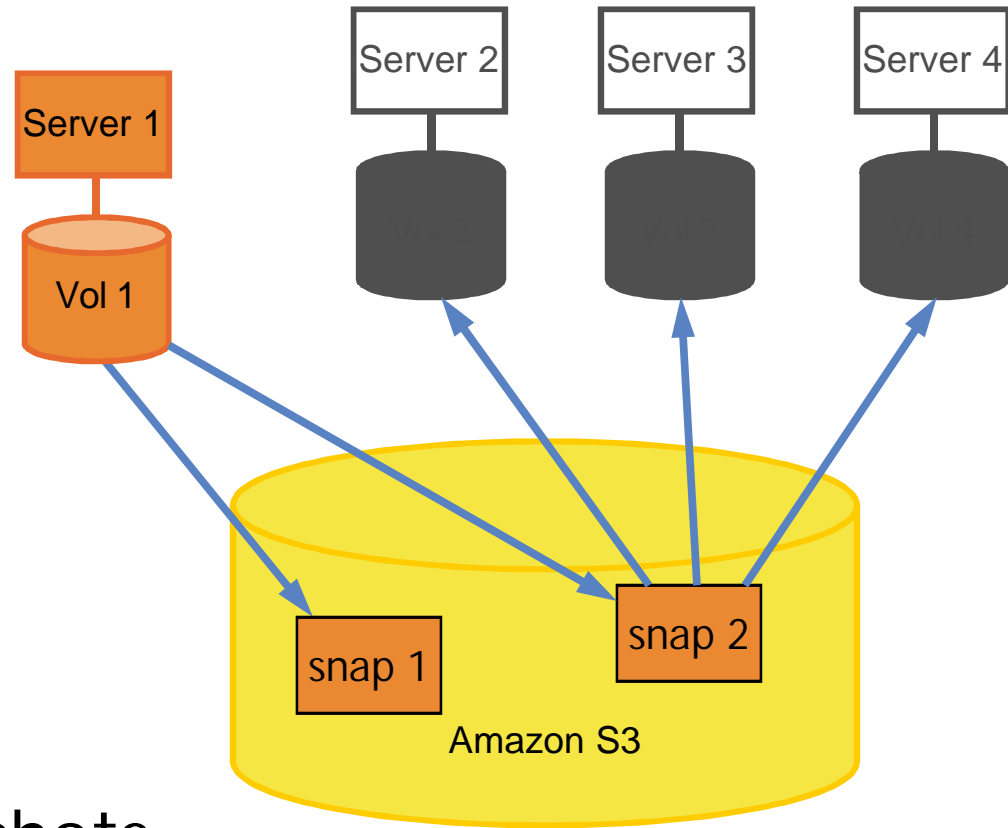


# Elastic Block Store (EBS)

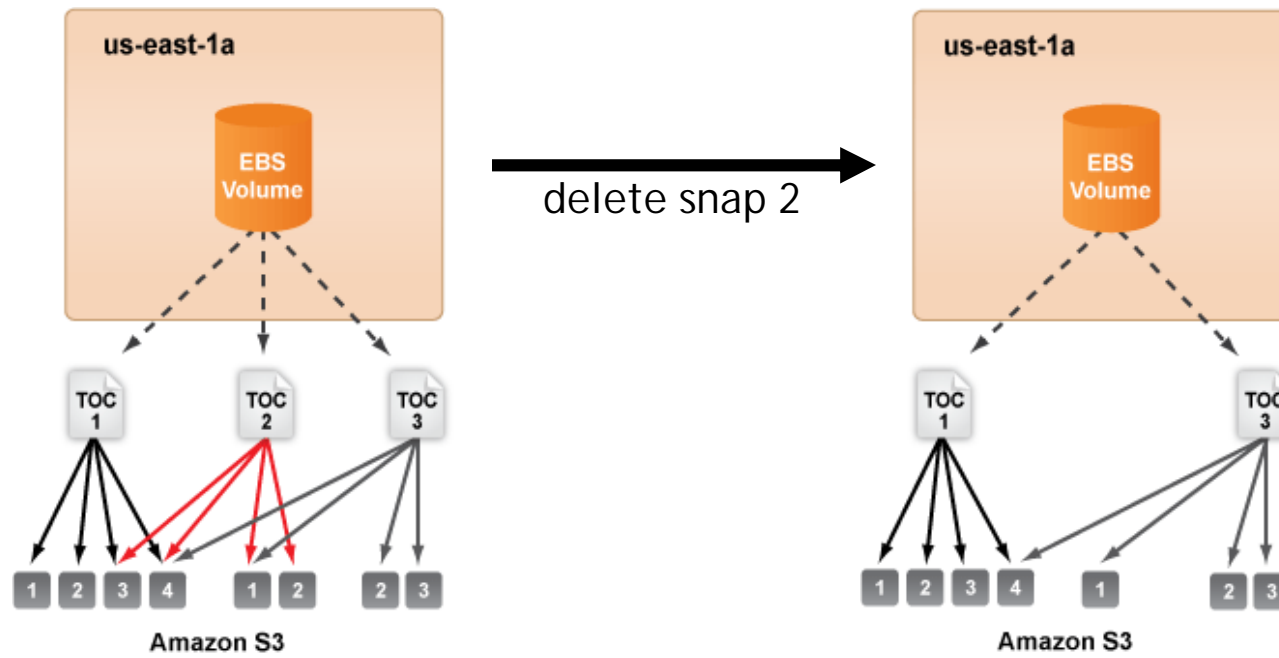
- Create volume: 1GB - 1TB size
- Attach to any one instance in same availability zone
- Pay \$0.10/GB per month + \$0.10/million I/O ops
- Snapshot backup a volume to S3
- Create new volume from snapshot

# Snapshots

- Point-in-time snapshot
- Written to S3
  - (Not to bucket!)
- Incremental snapshots
- Restore to new volume
  - Instantaneous (lazy restore)



# Incremental Snapshots

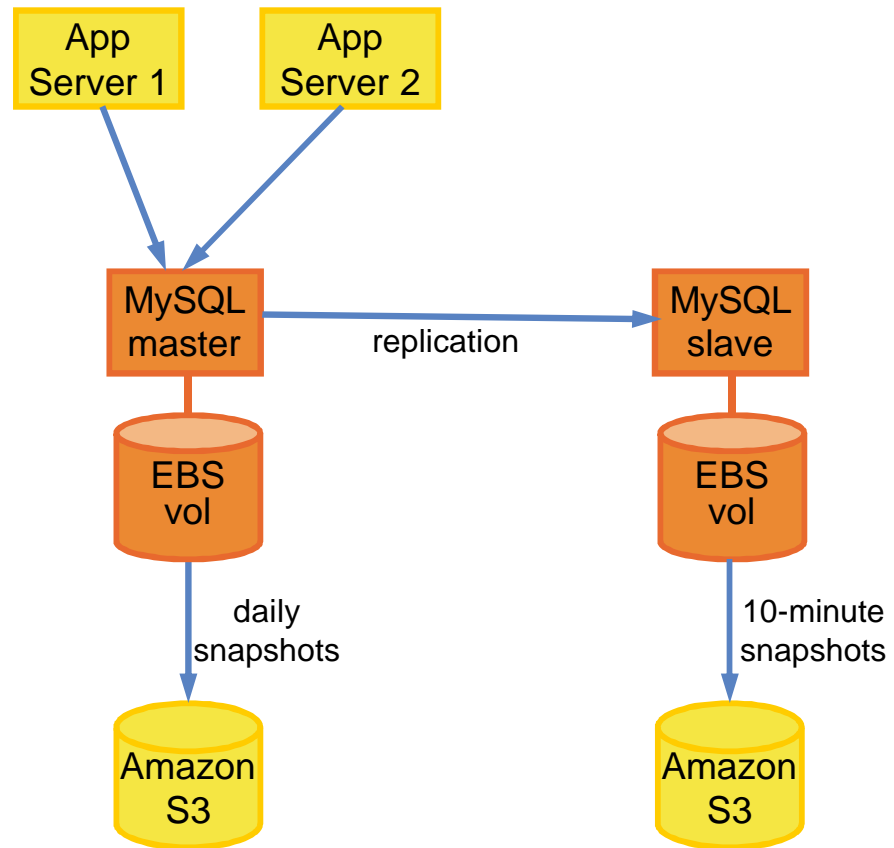


- Table of Contents vs. Data Blocks
- “Space used” difficult to gauge
- Frequent snapshots: minimal cost

# Keeping Safe

- Freeze data while snapshotting
  - XFS filesystem has freeze command
  - But: 2.6.18 kernel bug causes hung filesystem (ouch!)
- Volumes are fragile in transit!
  - Unmounting can leave data in flight
  - Mounting mistake will be destructive
- Use snapshots for safety!
  - *Always* snapshot after unmount
  - Create fresh volume from snapshot, mount that, retry in case of problem

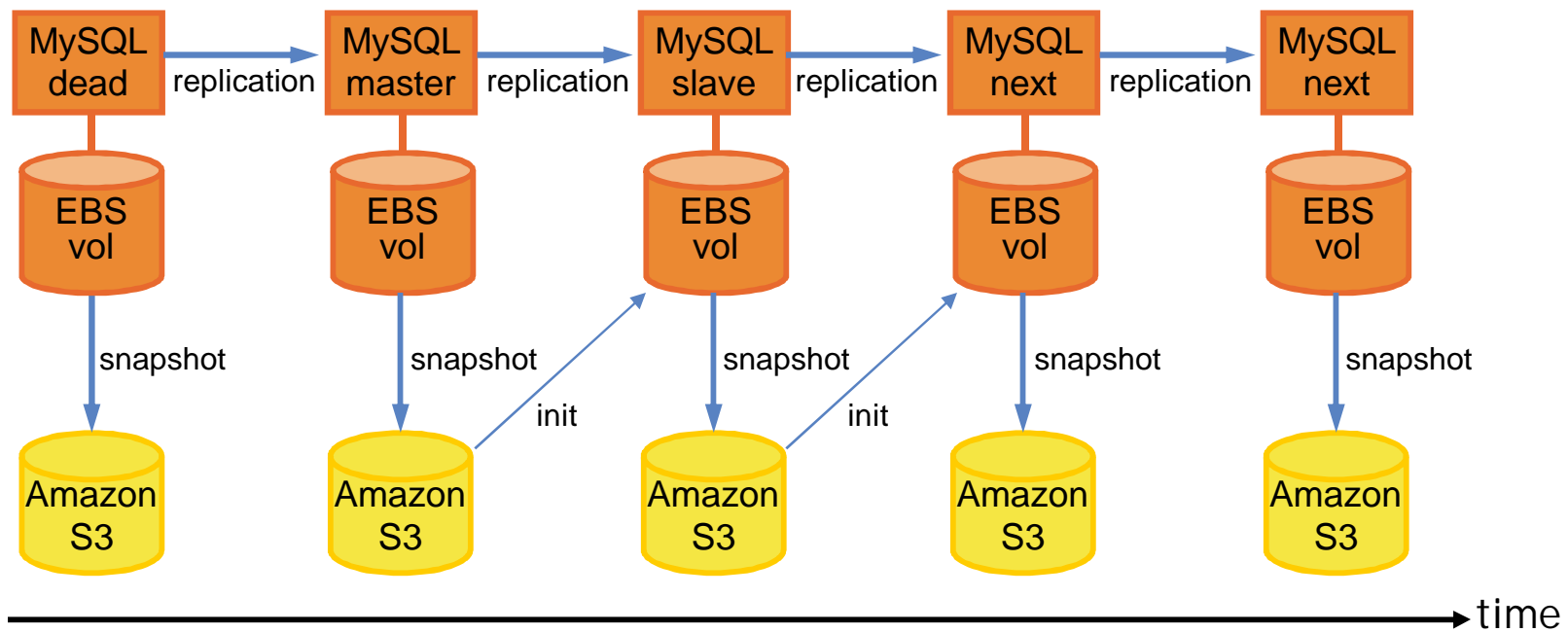
# MySQL/EBS Replication



# Database operations pain points

- Master hardware failure no replica 'til hw fixed
- Master software failure no replica 'til root caused
- Testing schema change extra system: 99% idle
- Migrate to new hardware 2x rack space, SAN ports, ...
- New DB requirement machines, ports, disks, ...
- QA, test, stage, DR, demo, ... always to few,  
always too idle

# Failure? Allocate fresh resources!



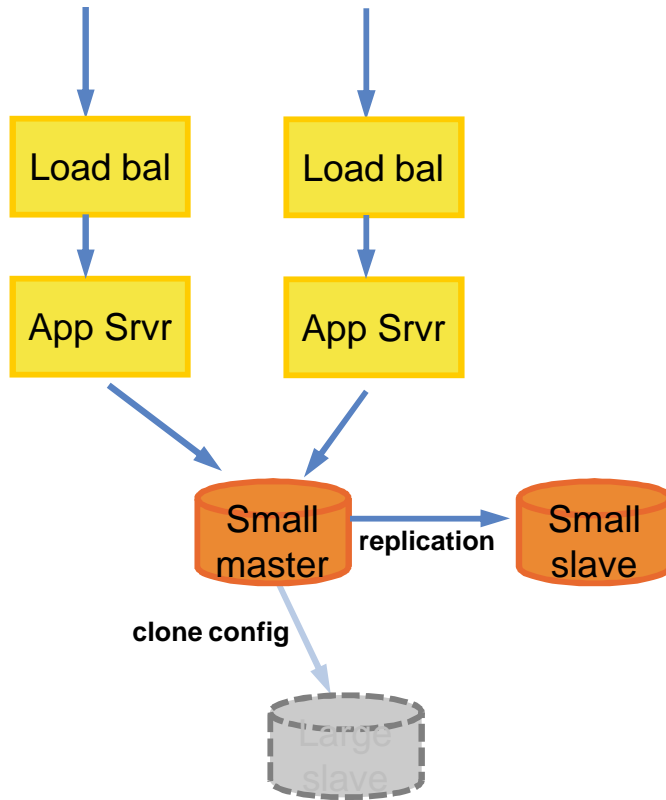
- Extra resources are free for short periods!  
(e.g. 4-core/16GB + 1TB EBS => <\$30/day)

# Vertical Database Scaling

1

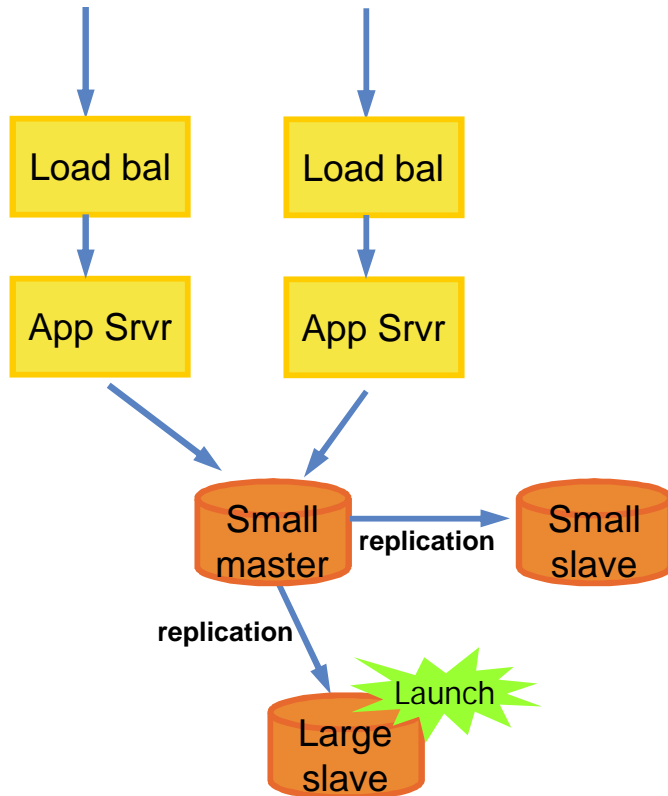
Clone Server Config

www.rightscaledemo.com



# Vertical Database Scaling

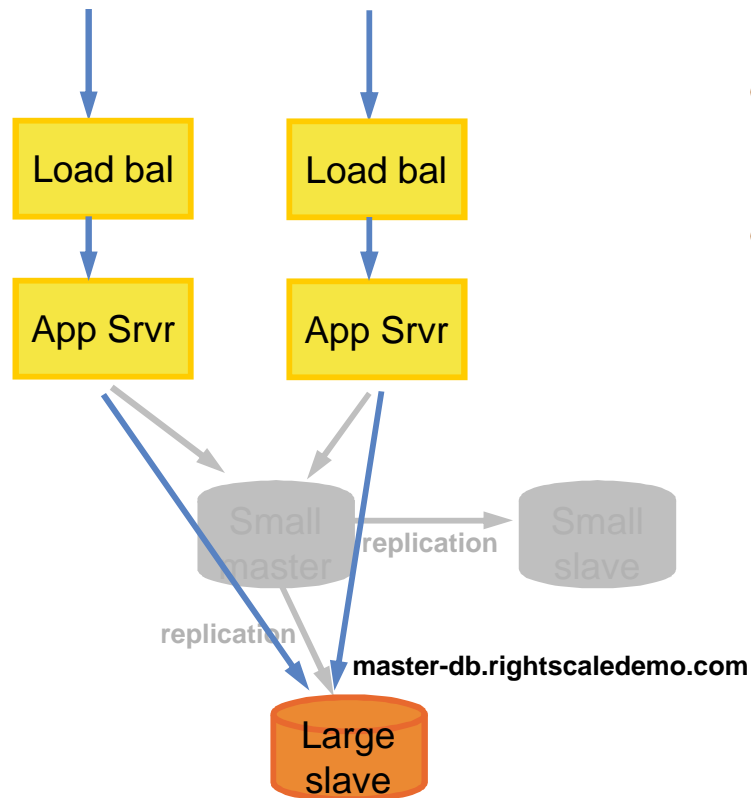
www.rightscaledemo.com



- 1 Clone Server Config
- 2 Launch large slave

# Vertical Database Scaling

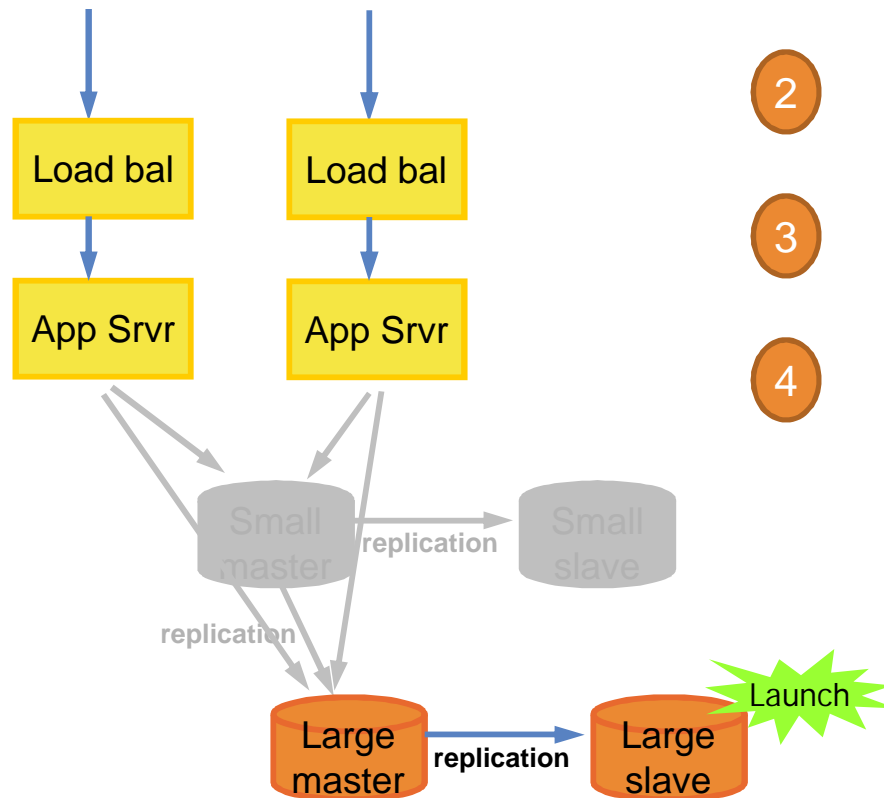
www.rightscaledemo.com



- 1 Clone Server
- 2 Launch large slave
- 3 Promote to master

# Vertical Database Scaling

www.rightscaledemo.com



- 1 Clone Server
- 2 Launch large slave
- 3 Promote to master
- 4 Launch new slave

Watch demo in  
webinar recording at  
[www.rightscale.com/webinars](http://www.rightscale.com/webinars)

# Cloud Principle #1: grab the next one!

- Database management
  - Always roll forward, never fail-back
  - Animoto upgraded L -> XL @600 servers
- App server management
  - Always roll forward, never fix in-place
  - www1 bust? Launch www3! Then troubleshoot
- Good sysadmins have the urge to fix... ☹️

# MySQL/EBS Toolbox server

RIGHTSCALE<sup>SM</sup>

Home

Manage

Clouds

Design

- ServerTemplates ▾
- RightScripts
- RightGrid
- Macros
- Alerts
  - Specifications
  - Escalations
- Credentials

Report

Settings

Recent Events 18:53

Event	Age
▶ MySQL EBS sysbench lq completed: Email action	8m

EC2 US Server  
Template MySQL  
S3/EBS Toolbox [rev 3] ▾

Clone

Diff

Info

Scripts

Alerts

Inputs

Xref

Revisions

[help](#)

## Operational Scripts

- DB EBS restore [rev 3]
- DB S3 restore [rev 2]
- DB S3 restore filename [rev 2]
- DB EBS slave init grow EBS [rev 2]
- DB EBS create backup scripts [rev 1]
- DB EBS backup [rev 6]
- DB register master [rev 2]

# Many small databases

Database pain cycle:

1. Recognize the DB is important
2. Buy expensive DB hardware
3. Consolidate DBs onto expensive hardware
4. Recognize the DB is now even more critical
5. Buy more expensive DB hardware
6. Repeat!

**Cloud Computing = Infinite servers and disks  
+ Fully automatable**

# Many Small Databases

- Sharding
  - Split by user
  - Need to manage mappings



continuent

- Read slaves
  - Many slave to increase read performance
  - Need to manage failover

# EBS Performance

- Functionality (snapshots) trump performance
- Very difficult to benchmark
  - Multiple levels of cache, some hidden
- Sequential I/O limited by network
  - 70-90MB/sec typ, 100MB/sec max
  - 4 local drives striped yield more
- Random I/O (sustained)
  - 400-1000 read ops/sec
  - 100-400 write ops/sec
- Stripe to increase performance

# Clouds are Multiplying!

- Amazon US + EU
- GoGrid, Flexiscale
- Eucalyptus open source release
- RackSpace CloudServers
- Sun cloud announcement
- And many more...
- Operating principles are the same
  - Storage architectures differ
  - From better local drives to traditional SANs

# Public vs. Private Cloud

- Public cloud:
  - shared cloud computing infrastructure
  - connected to the public internet
- Private cloud:
  - cloud infrastructure dedicated to a single party
  - may not be connected to the public internet
- Hybrid cloud
  - private and public clouds used together
  - leverage the benefits of both

## Cloud Definition:

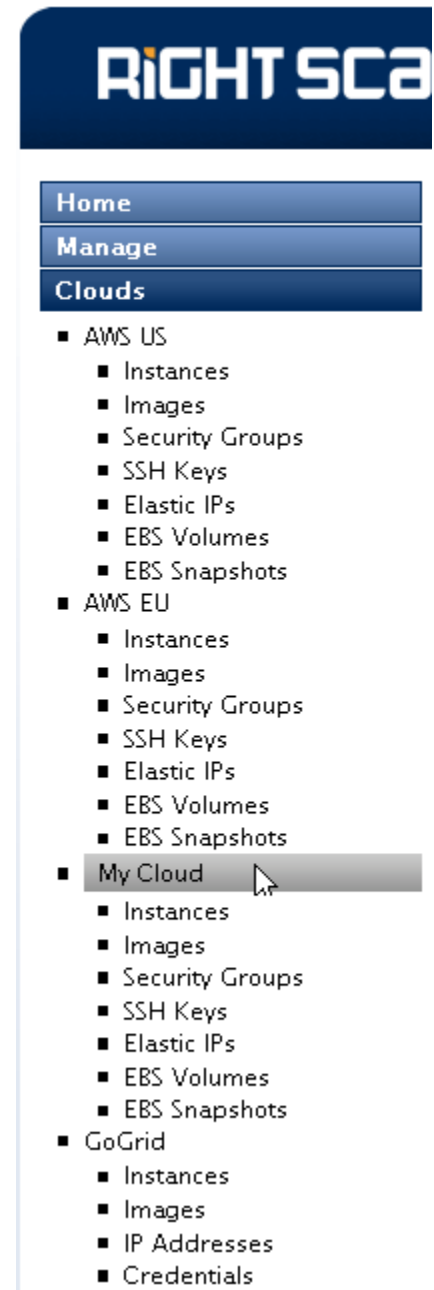
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# Hybrid Cloud Use-Cases

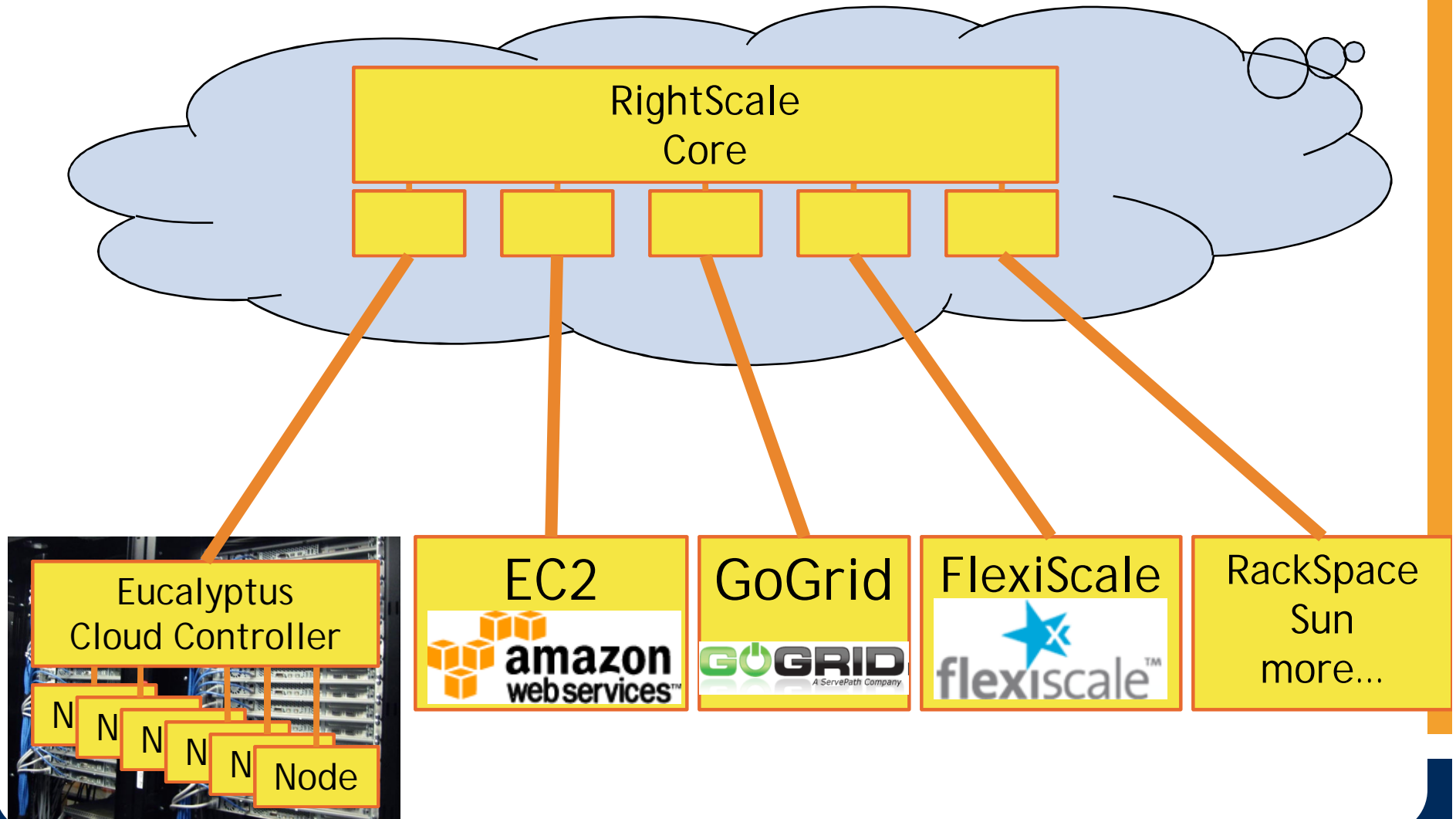
- *Develop in public, deploy in private*
  - Outsourced/distributed development
  - flexibility of test & dev resources
- *Develop in private, deploy in public*
  - existing in house dev resources
  - ability to scale in public cloud
  - public-facing app
- *Private core, public expansion*
  - Transaction intensive in-house core
  - Batch processing in public cloud

# RightScale Supports Hybrid Clouds

1. Commandeer some machines
2. Install Eucalyptus
3. Register with RightScale
4. The power of RightScale for your cloud
5. Invite friends to your cloud



# Multi-Cloud Architecture



# Clouds Surpass Traditional Hosting

- Servers on-demand
- Disk Volumes on-demand
- Multiple datacenters
- Reassign IPs / VIPs across datacenters
- Multiple geographies
- Multiple providers
- **Automation tying it all together**

# RightScale Cloud Management Platform

- Automation
- Multi-Cloud
- Fully transparent
- Fully customizable
- Replicated MySQL/EBS Server Templates

