



# Cloud Native at Netflix

## What Changed?

July 2013

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<http://www.linkedin.com/in/adriancockcroft>

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Cloud Native

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Netflix Architecture

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NetflixOSS

# Cloud Native

What is it?

Why?

# Engineers

Solve hard problems

Build amazing and complex things

Fix things when they break

# Strive for perfection

Perfect code

Perfect hardware

Perfectly operated



But perfection takes too long...

Compromises...

Time to market vs. Quality

Utopia remains out of reach

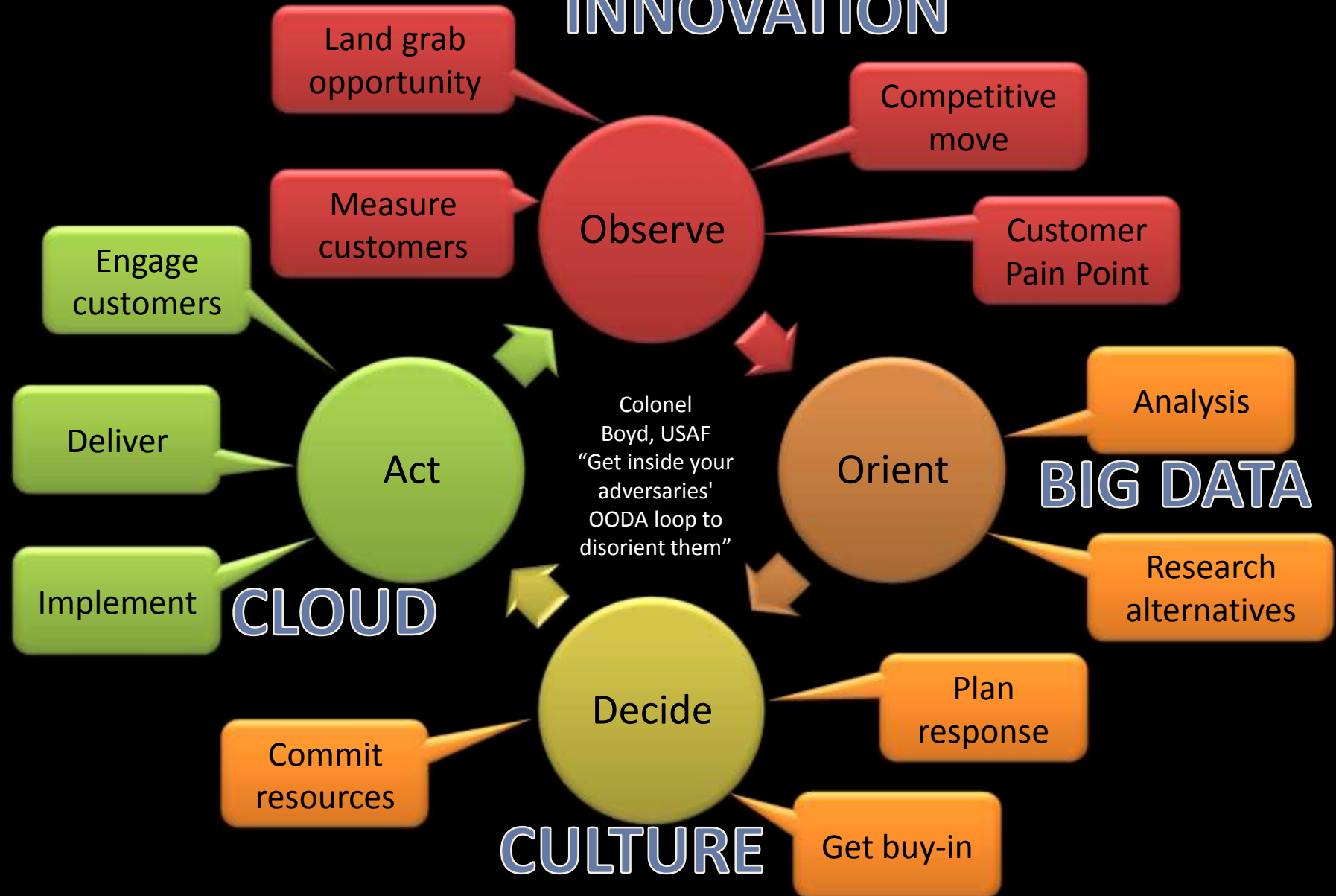
# Where time to market wins big

Making a land-grab

Disrupting competitors (OODA)

Anything delivered as web services

# INNOVATION





# How Soon?

Code features in days instead of months

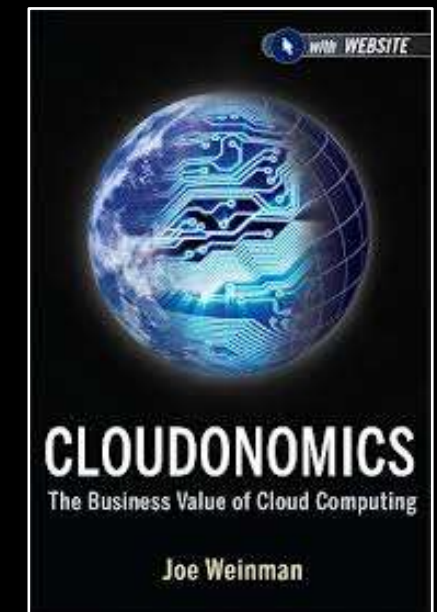
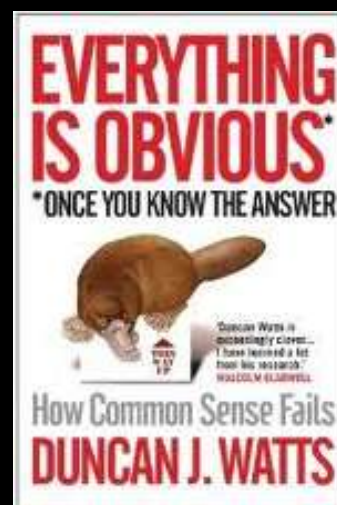
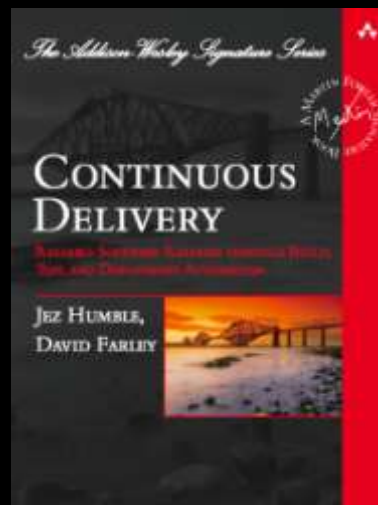
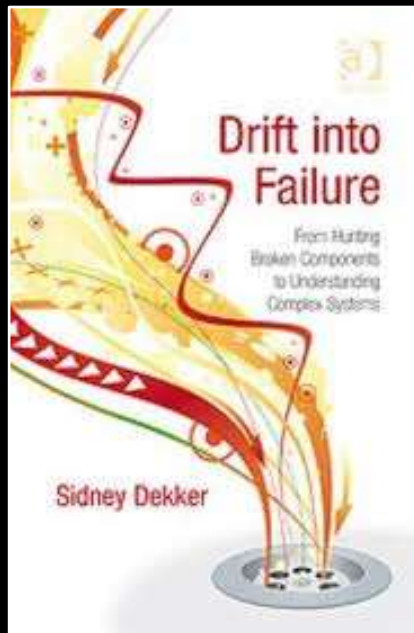
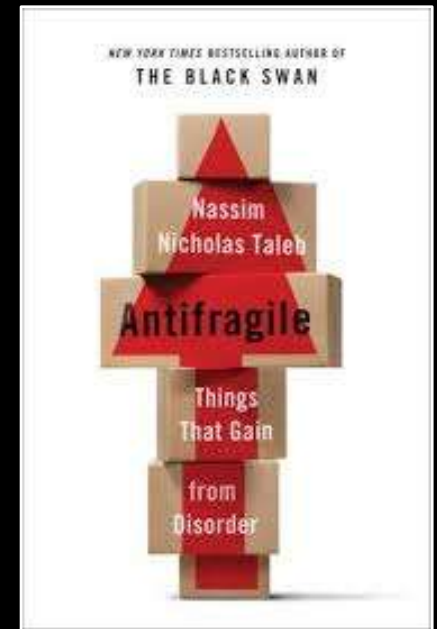
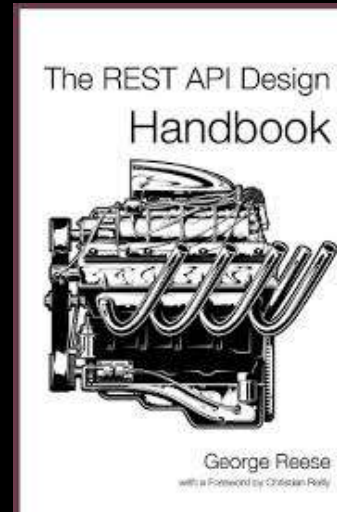
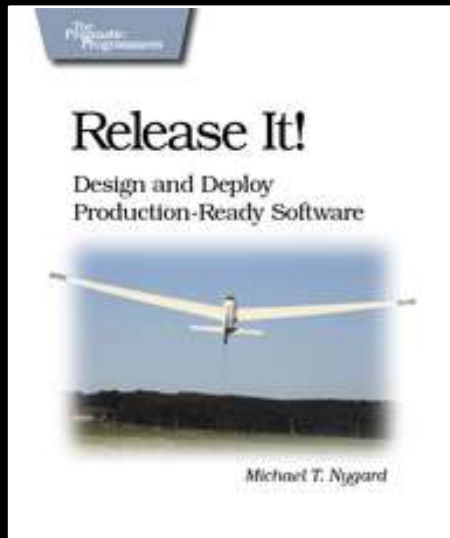
Get hardware in minutes instead of weeks

Incident response in seconds instead of hours

# A new engineering challenge

Construct a highly agile and highly  
available service from ephemeral and  
assumed broken components

# Inspiration



# How to get to Cloud Native

Freedom and Responsibility for Developers

Decentralize and Automate Ops Activities

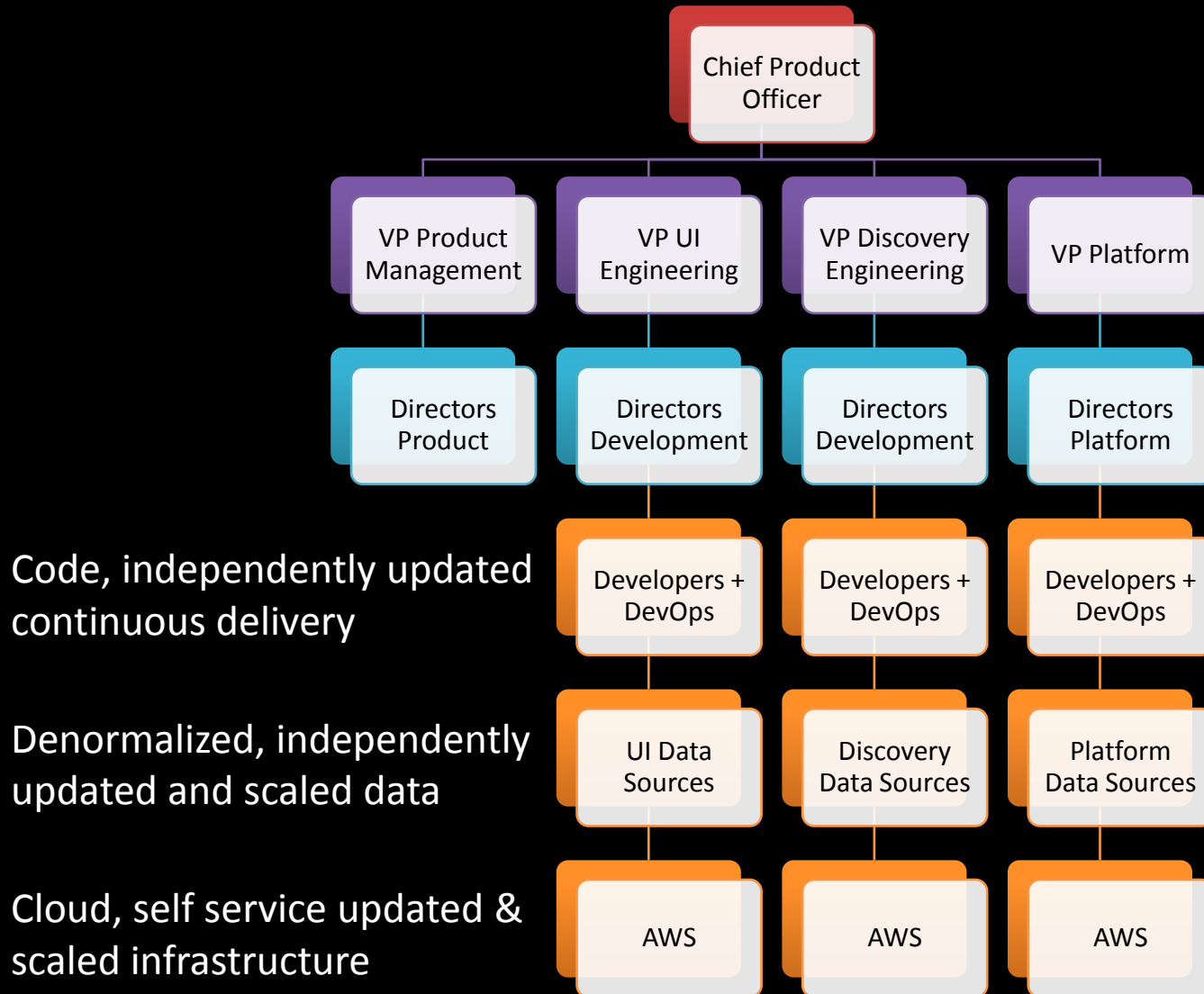
Integrate DevOps into the Business Organization

**Re-Org!**

# Four Transitions

- Management: Integrated Roles in a Single Organization
  - Business, Development, Operations -> BusDevOps
- Developers: Denormalized Data – NoSQL
  - Decentralized, scalable, available, polyglot
- Responsibility from Ops to Dev: Continuous Delivery
  - Decentralized small daily production updates
- Responsibility from Ops to Dev: Agile Infrastructure - Cloud
  - Hardware in minutes, provisioned directly by developers

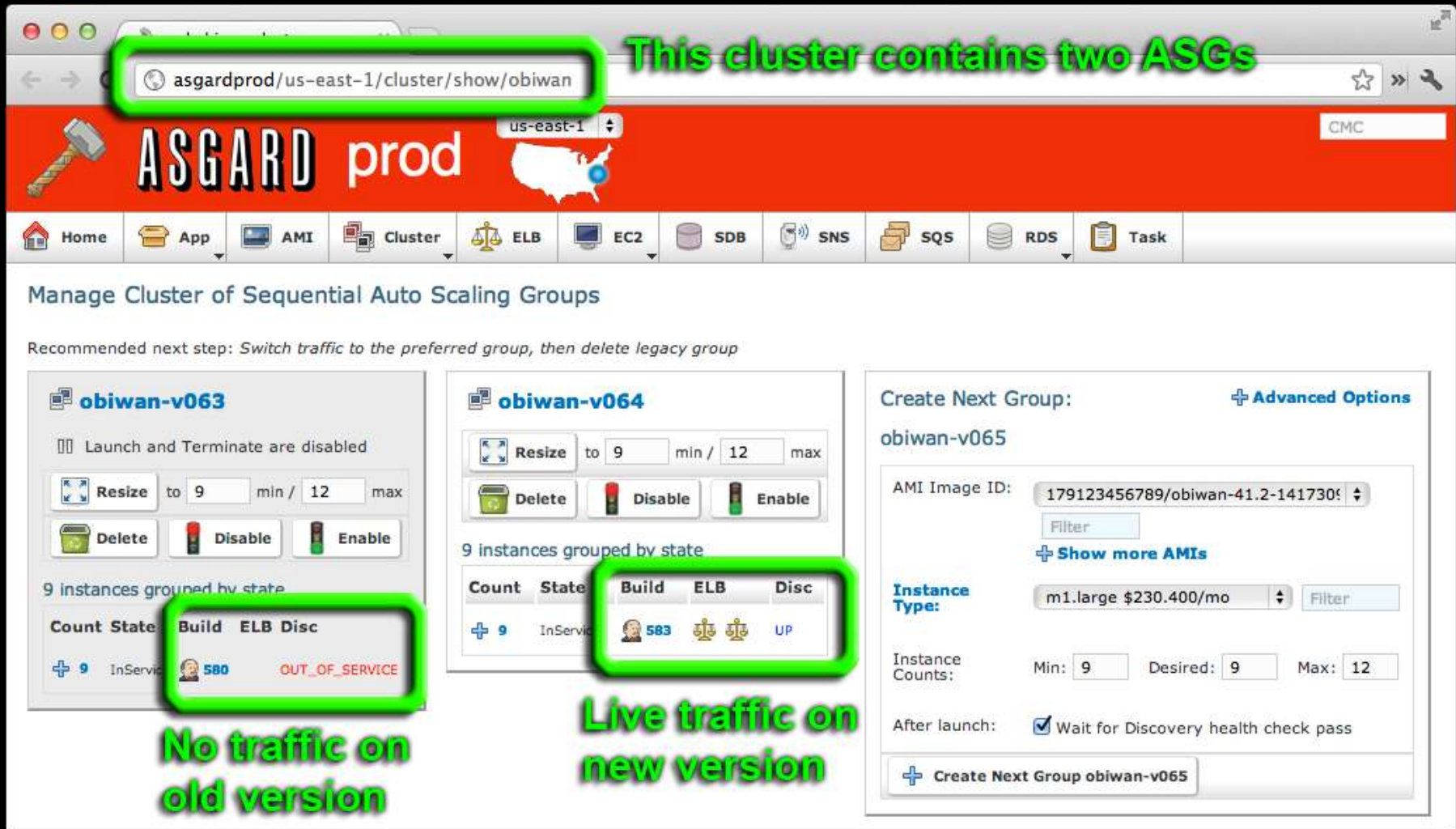
# Netflix BusDevOps Organization



# Decentralized Deployment

# Asgard Developer Portal

<http://techblog.netflix.com/2012/06/asgard-web-based-cloud-management-and.html>



The screenshot shows the Asgard Developer Portal interface. The browser address bar is highlighted with a green box, showing the URL: `asgardprod/us-east-1/cluster/show/obiwan`. A green annotation above the browser says "This cluster contains two ASGs".

The page header features the "ASGARD prod" logo and a "us-east-1" region selector. A navigation bar includes links for Home, App, AMI, Cluster, ELB, EC2, SDB, SNS, SQS, RDS, and Task.

The main section is titled "Manage Cluster of Sequential Auto Scaling Groups". Below this, a recommendation states: "Recommended next step: Switch traffic to the preferred group, then delete legacy group".

Two cluster panels are visible:

- obiwan-v063**: Shows "Launch and Terminate are disabled". It has a "Resize" button set to 9 min / 12 max, and "Delete", "Disable", and "Enable" buttons. Below, it says "9 instances grouped by state". A table shows:
 

Count	State	Build	ELB	Disc
+ 9	InService	580	OUT_OF_SERVICE	

 A green box highlights the "Build" column, with a green annotation below it saying "No traffic on old version".
- obiwan-v064**: Shows "Resize" to 9 min / 12 max, and "Delete", "Disable", and "Enable" buttons. Below, it says "9 instances grouped by state". A table shows:
 

Count	State	Build	ELB	Disc
+ 9	InService	583	UP	

 A green box highlights the "Build" column, with a green annotation below it saying "Live traffic on new version".

On the right, a "Create Next Group" panel is shown for "obiwan-v065". It includes fields for "AMI Image ID" (179123456789/obiwan-41.2-141730), "Instance Type" (m1.large \$230.400/mo), and "Instance Counts" (Min: 9, Desired: 9, Max: 12). A checkbox for "Wait for Discovery health check pass" is checked. A button at the bottom says "+ Create Next Group obiwan-v065".



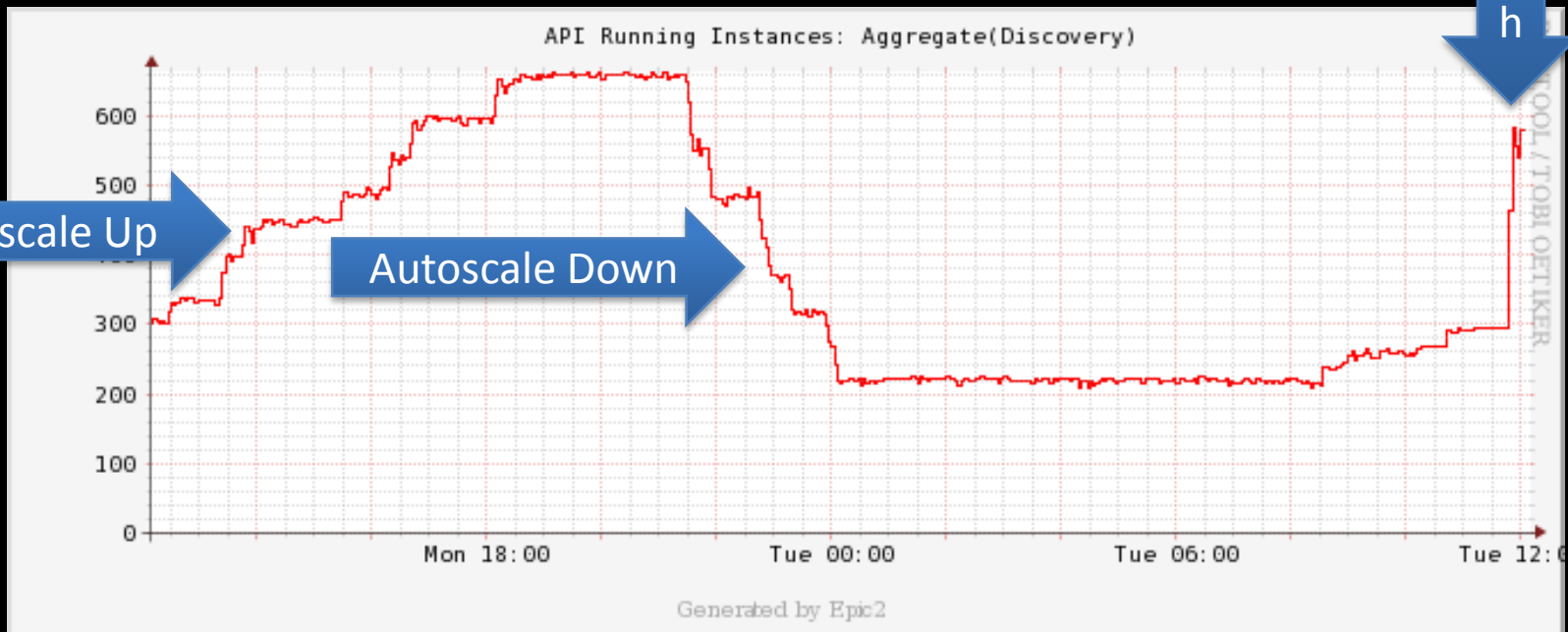
# Ephemeral Instances

- Largest services are autoscaled
- Average lifetime of an instance is 36 hours

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Autoscale Up

Autoscale Down



# Netflix Streaming

A Cloud Native Application based on  
an open source platform

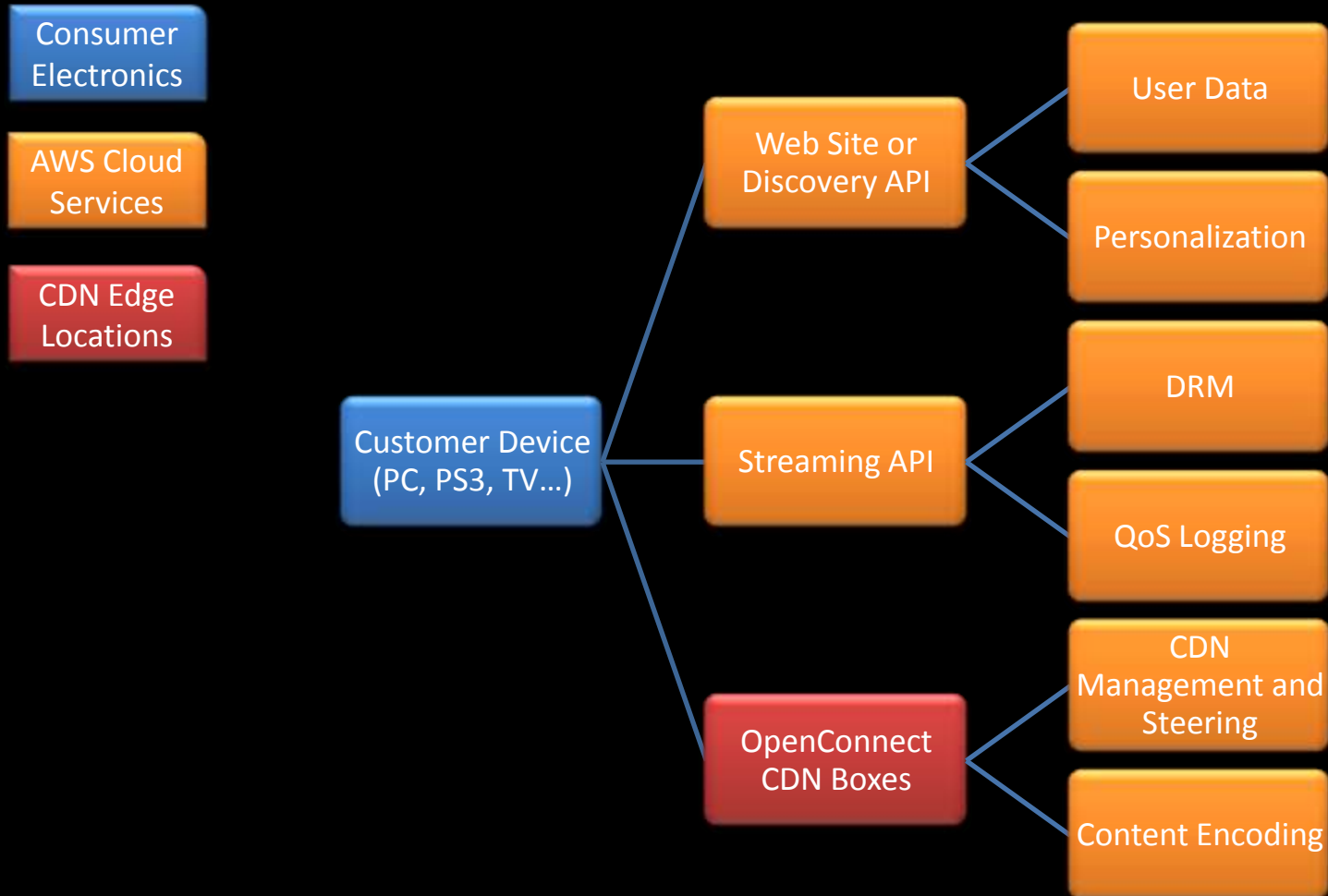
# Netflix Member Web Site Home Page

## Personalization Driven – How Does It Work?

The screenshot displays the Netflix home page for a member named Adrian Cockcroft. The interface is divided into several sections:

- Header:** The Netflix logo is on the left, and the member's name "Adrian Cockcroft" with a dropdown arrow and a link to "Your Account & Help" is on the right.
- Navigation Bar:** A row of tabs includes "Watch Instantly", "Just for Kids", "Browse DVDs", "Your Queue", and "Taste Profile". A search bar on the right contains the text "Movies, TV shows, actors, directors, genres" and a magnifying glass icon.
- Genre Links:** Below the navigation bar, there are links for "Genres", "New Arrivals", and "Instantly to your TV".
- Recently Watched:** A section on the left showing a poster for "JOHN MAYALL & THE JOHN MAYALL BAND LIVE! JOHN CLAPTON, GARY BARBER, MICK TAYLOR JOHN BIRTHDAY CONCERT".
- Top 10 for Adrian:** A row of six posters recommended for the member: "DEFYING DISEASE TED TALKS", "SAM KINISON Breaking the Rules", "ANCIENT INVENTIONS OF WAR, SEX AND CITY LIFE", "ROBOTIC MACHINATIONS TED TALKS", "The Mitchell and Webb look", and "Bartleby".
- Friends' Favorites:** A section titled "Based on these friends:" with two small profile pictures. Below are seven posters: "Breaking Bad", "LOST IN TRANSLATION", "THE TERMINATOR", "Audrey (Breakfast at Tiffany's)", "THE HUNT FOR RED OCTOBER", and "GOOD WILL HUNTING".

# How Netflix Streaming Works



Nov  
2012  
Streaming  
Bandwidth

Rank	Upstream		Downstream		Aggregate	
	Application	Share	Application	Share	Application	Share
1	BitTorrent	36.8%	Netflix	33.0%	Netflix	28.8%
2	HTTP	9.83%	YouTube	14.8%	YouTube	13.1%
3	Skype	4.76%	HTTP	12.0%	HTTP	11.7%
4	Netflix	4.51%	BitTorrent	5.89%	BitTorrent	10.3%
5	SSL	3.73%	iTunes	3.92%	iTunes	3.43%
6	YouTube	2.70%	MPEG	2.22%	SSL	2.23%
7	PPStream	1.65%	Flash Video	2.21%	MPEG	2.05%
8	Facebook	1.62%	SSL	1.97%	Flash Video	2.01%
9	Apple PhotoStream	1.46%	Amazon Video	1.75%	Facebook	1.50%
10	Dropbox	1.17%	Facebook	1.48%	RTMP	1.41%
	Top 10	68.24%	Top 10	79.01%	Top 10	76.54%



Table 3 - Top 10 Peak Period Applications (North America, Fixed Access)

March  
2013  
Mean  
Bandwidth  
+39% 6mo

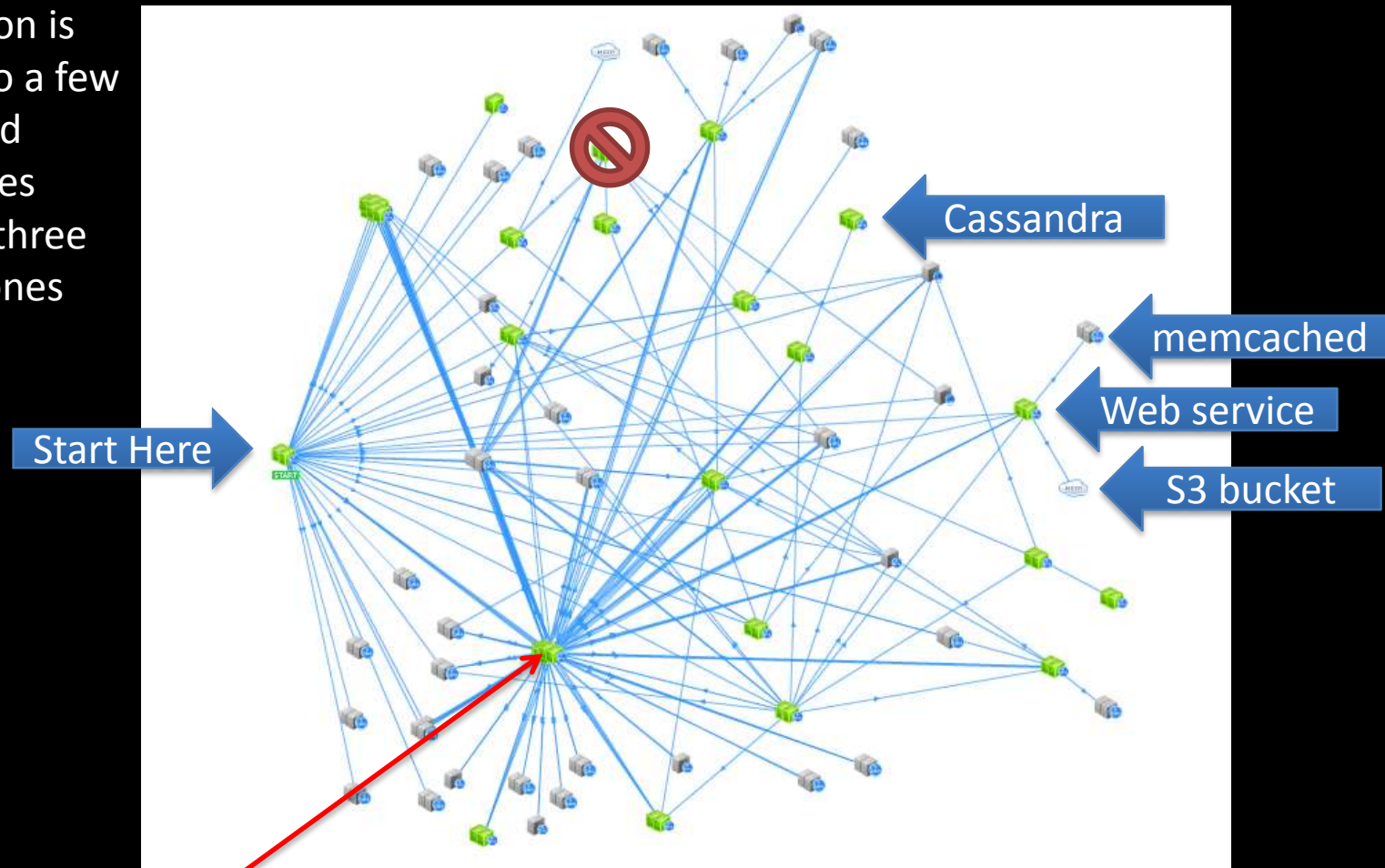
Rank	Upstream		Downstream		Aggregate	
	Application	Share	Application	Share	Application	Share
1	BitTorrent	34.81%	Netflix	32.25%	Netflix	28.88%
2	HTTP	7.53%	YouTube	17.11%	YouTube	15.43%
3	SSL	5.81%	HTTP	11.11%	HTTP	10.66%
4	Netflix	5.38%	BitTorrent	5.57%	BitTorrent	9.23%
5	Skype	4.88%	MPEG	2.58%	SSL	2.39%
6	YouTube	3.71%	Hulu	2.41%	MPEG	2.30%
7	Facebook	1.71%	iTunes	1.90%	Hulu	2.16%
8	Apple Photostream	1.34%	SSL	1.89%	iTunes	1.71%
9	Dropbox	1.21%	Flash Video	1.72%	Flash Video	1.53%
10	Carbonite	0.99%	Facebook	1.48%	Facebook	1.52%
	Top 10	67.38%		78.03%		75.82%



# Real Web Server Dependencies Flow

(Netflix Home page business transaction as seen by AppDynamics)

Each icon is  
three to a few  
hundred  
instances  
across three  
AWS zones

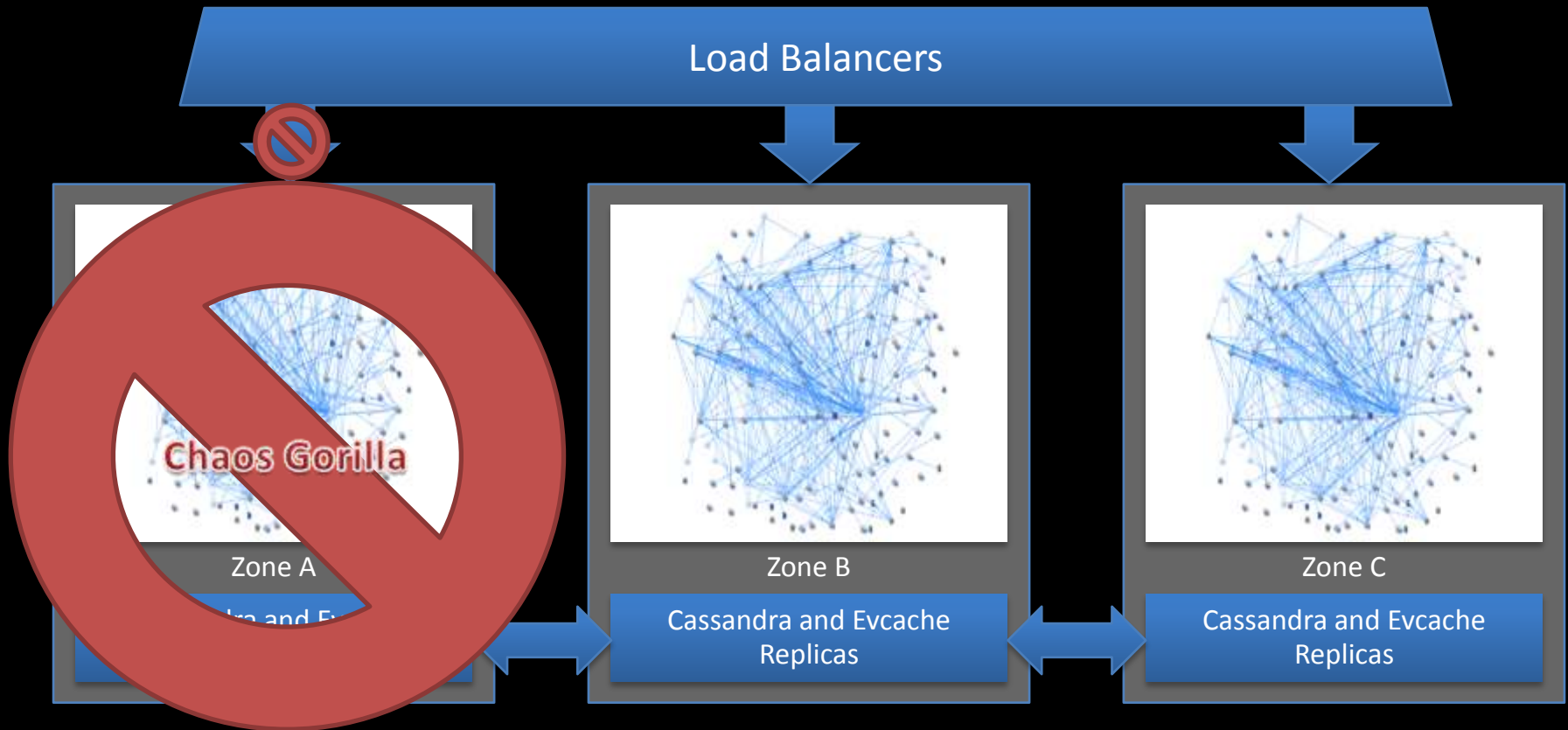


Personalization movie group choosers  
(for US, Canada and Latam)

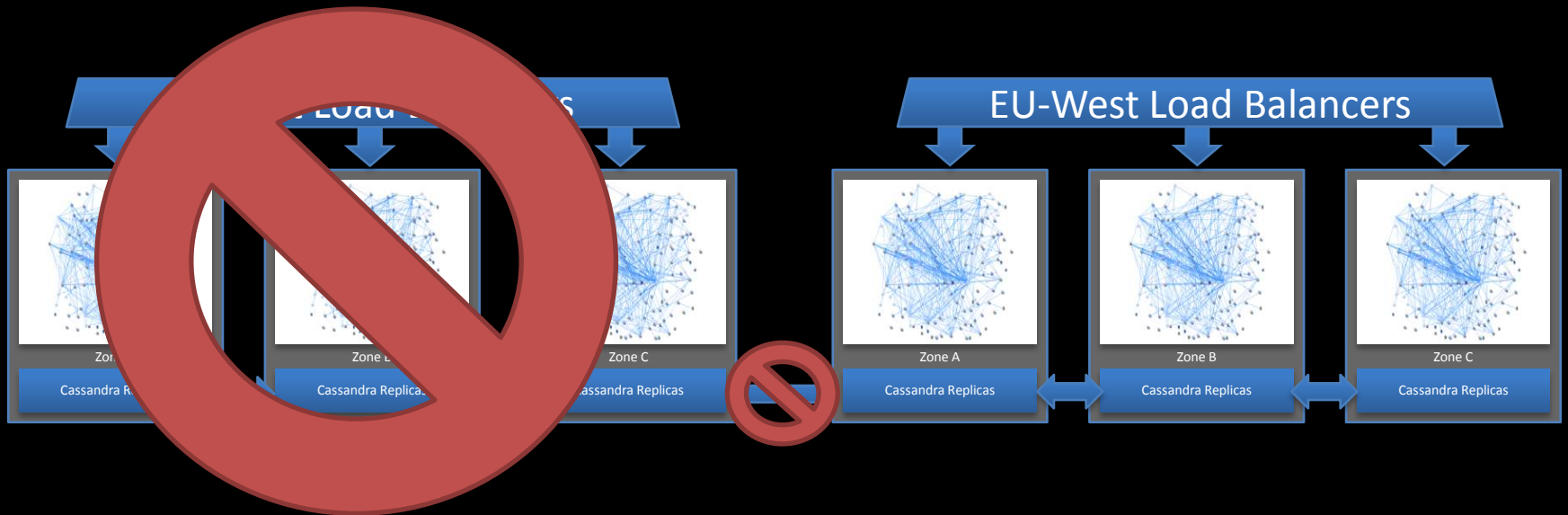


# Three Balanced Availability Zones

Test with Chaos Gorilla



# Isolated Regions





# Cross Region Use Cases

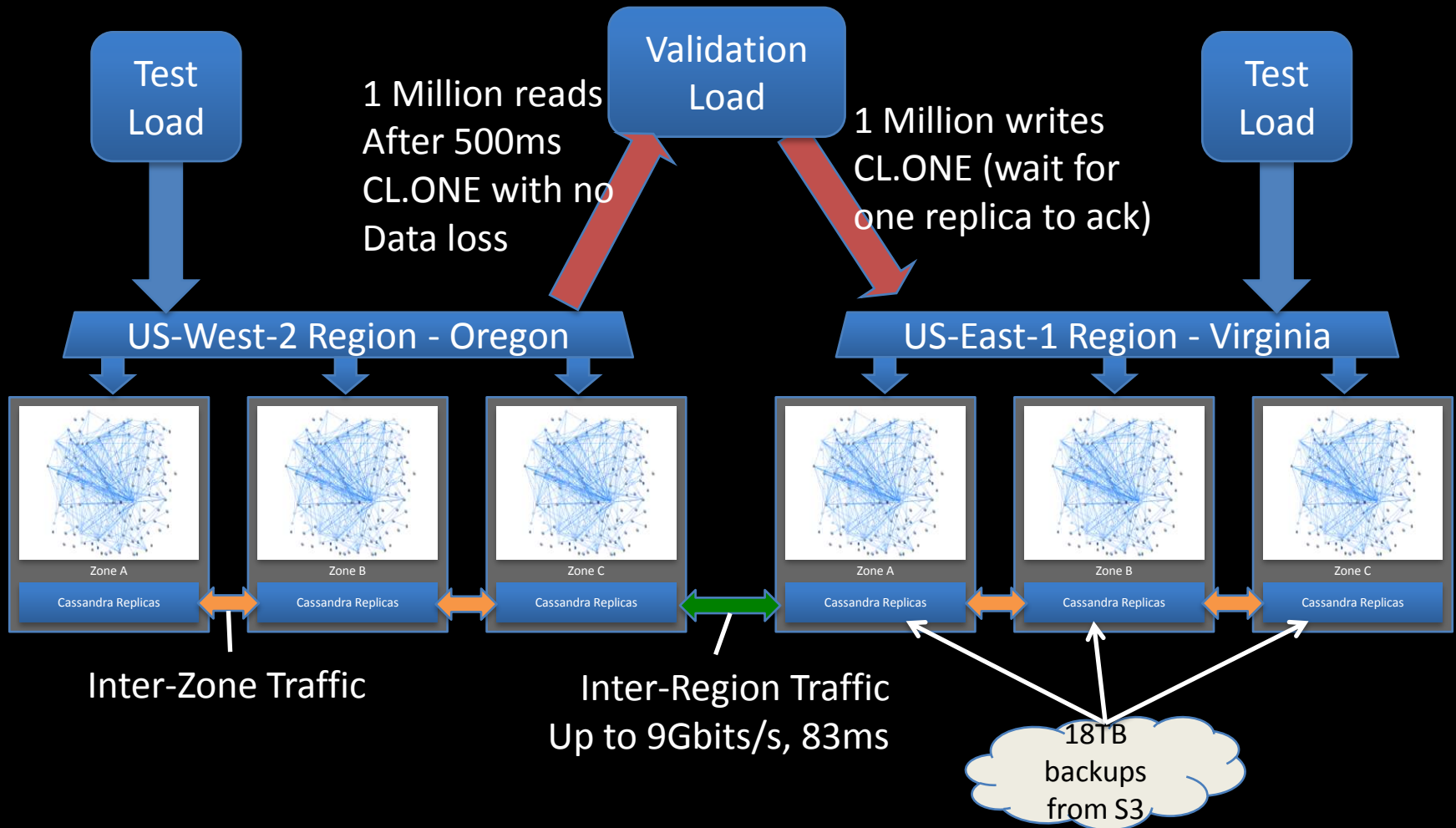
- Geographic Isolation
  - US to Europe replication of subscriber data
  - Read intensive, low update rate
  - Production use since late 2011
- Redundancy for regional failover
  - US East to US West replication of everything
  - Includes write intensive data, high update rate
  - Testing now

# Benchmarking Global Cassandra

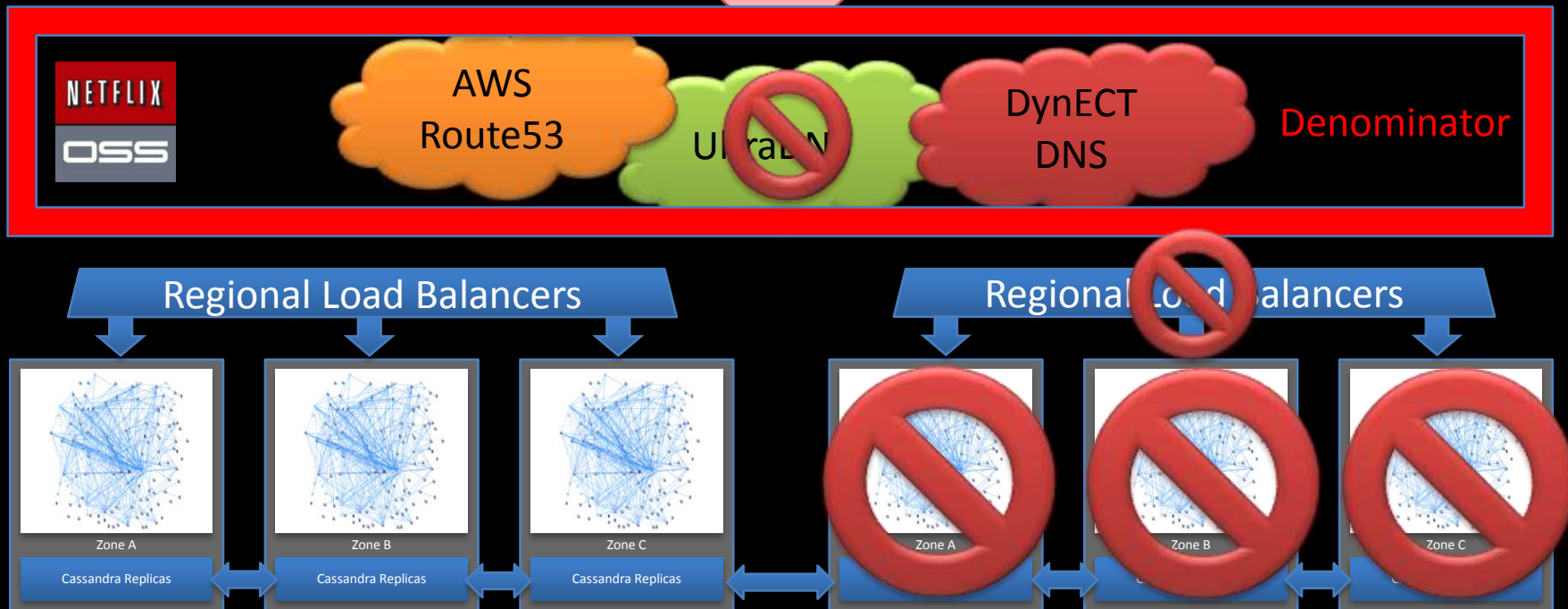
Write intensive test of cross region replication capacity

16 x hi1.4xlarge SSD nodes per zone = 96 total

192 TB of SSD in six locations up and running Cassandra in 20 min

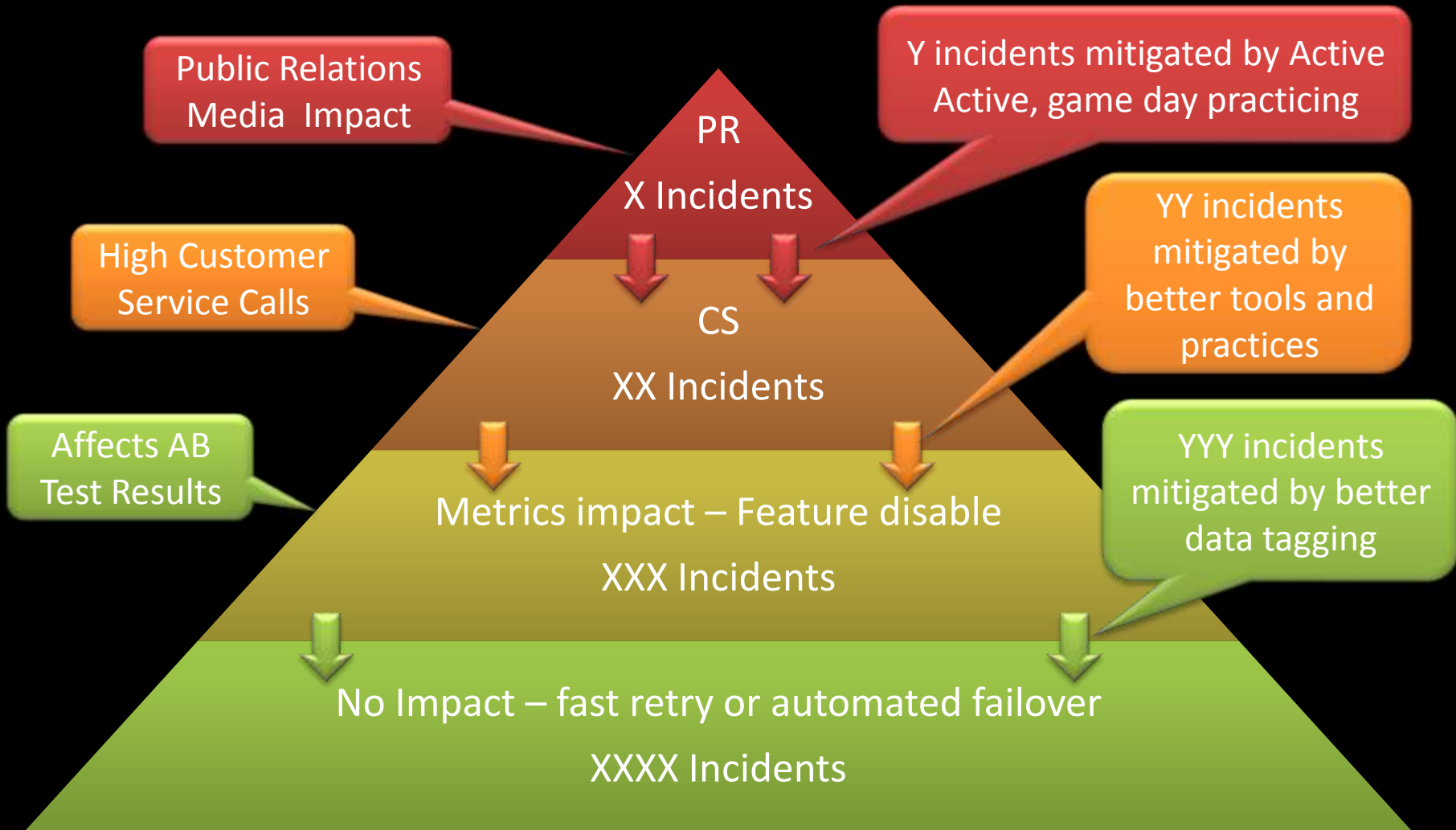


# Managing Multi-Region Availability



Denominator – manage traffic via multiple DNS providers with Java code  
2013 Timeline - Concept Jan, Code Feb, OSS March, Production use May

# Incidents – Impact and Mitigation



# Cloud Security

Automated attack surface monitoring

Crypto key store management (CloudHSM)

Scale to resist DDOS attacks

[http://www.slideshare.net/jason\\_chan/resilience-and-security-scale-lessons-learned](http://www.slideshare.net/jason_chan/resilience-and-security-scale-lessons-learned)

# What Changed?

“Impossible” deployments are easy

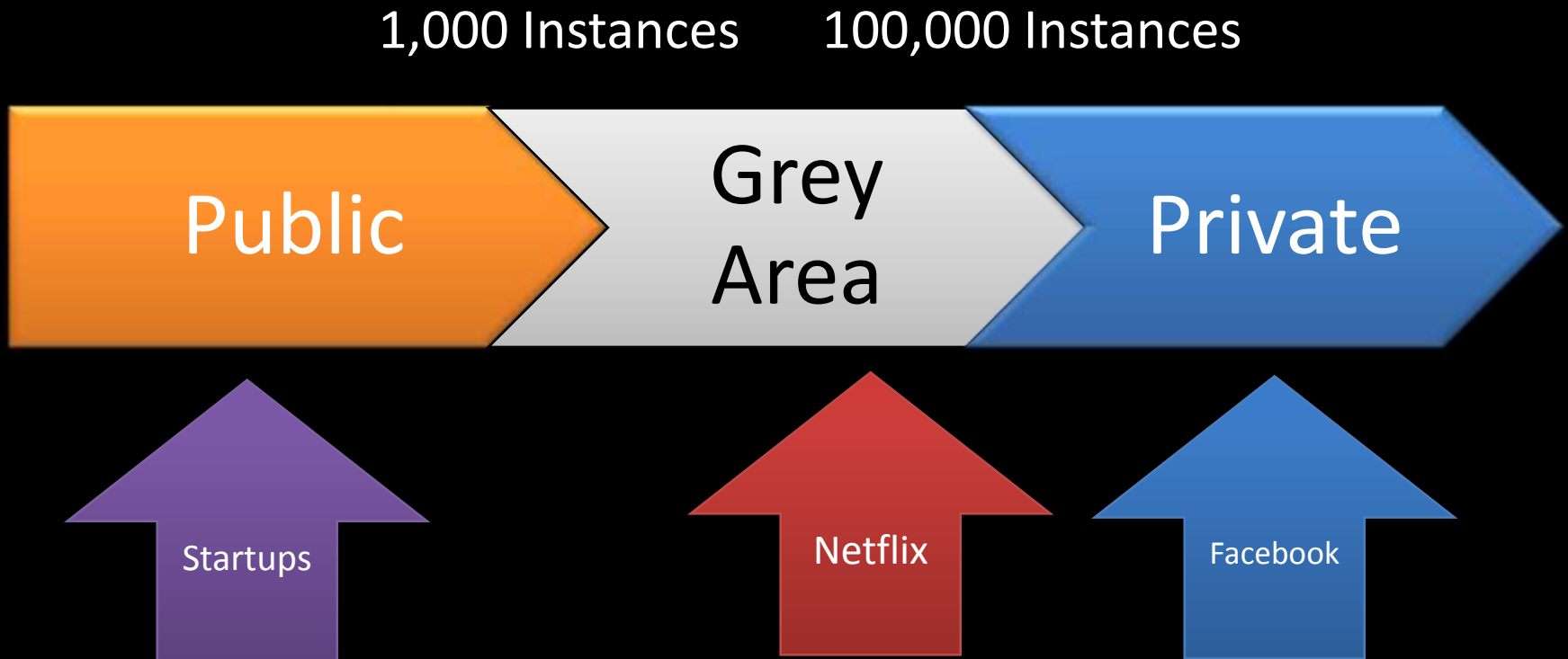
Jointly building code with vendors in public

Highly available and secure despite scale and speed

# The DIY Question

Why doesn't Netflix build and run its own cloud?

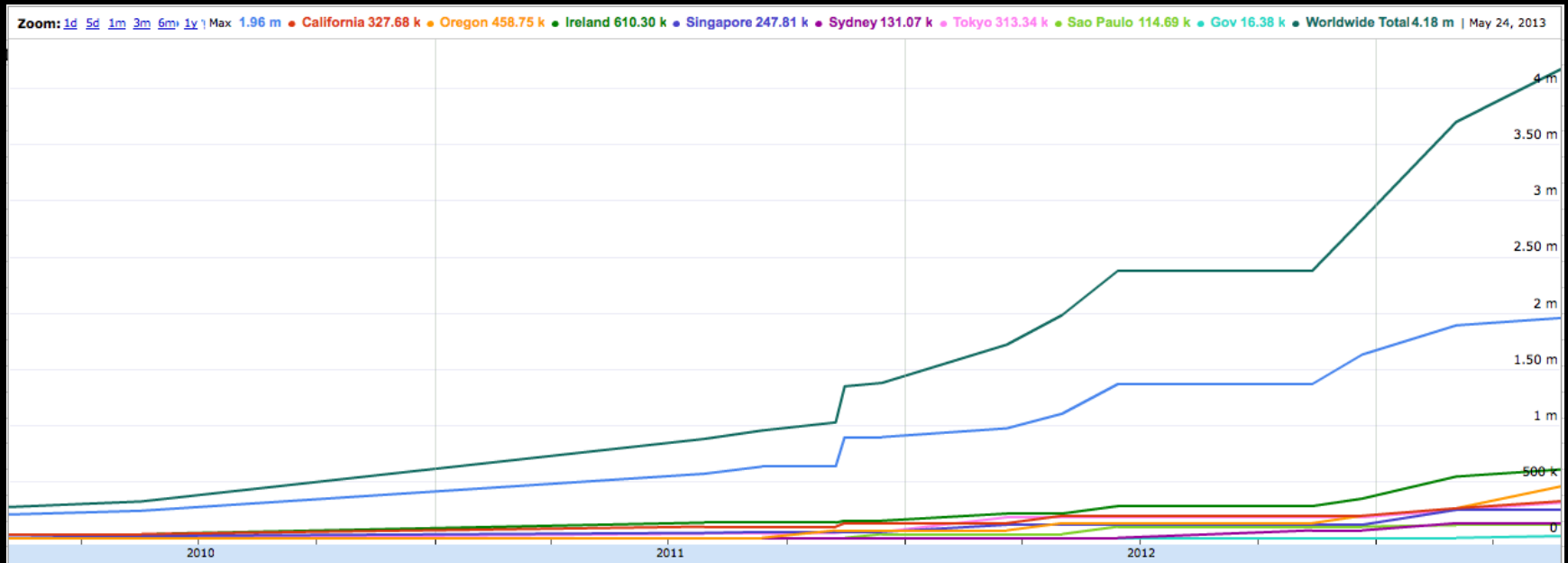
# Fitting Into Public Scale





# How big is Public?

AWS Maximum Possible Instance Count 4.2 Million – May 2013  
Growth >10x in Three Years, >2x Per Annum - <http://bit.ly/awsiprange>



AWS upper bound estimate based on the number of public IP Addresses  
Every provisioned instance gets a public IP by default (some VPC don't)



A Cloud Native Open Source Platform

See [netflix.github.com](https://netflix.github.com)

Establish our  
solutions as Best  
Practices / Standards

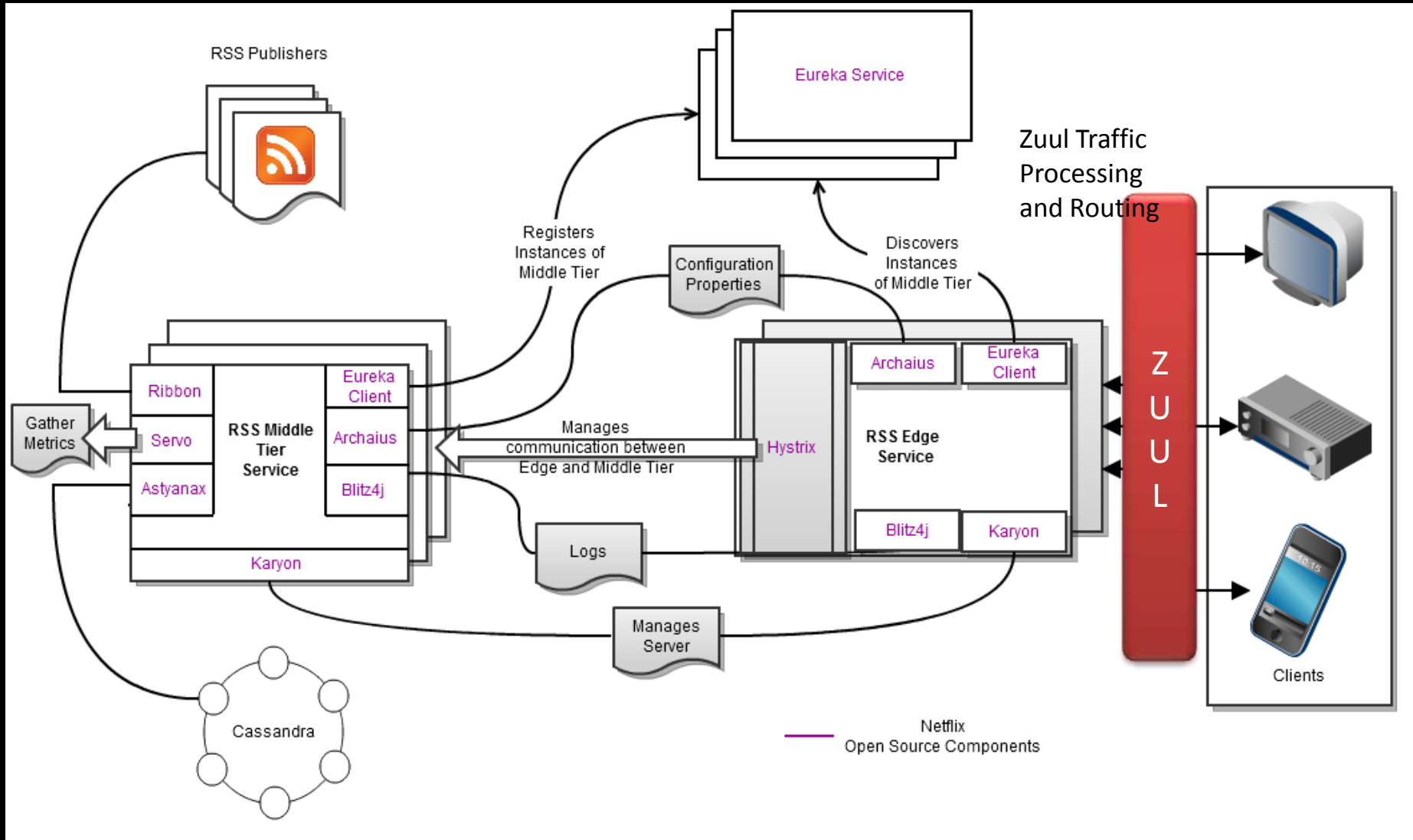
Hire, Retain and  
Engage Top  
Engineers

Goals

Build up Netflix  
Technology Brand

Benefit from a  
shared ecosystem

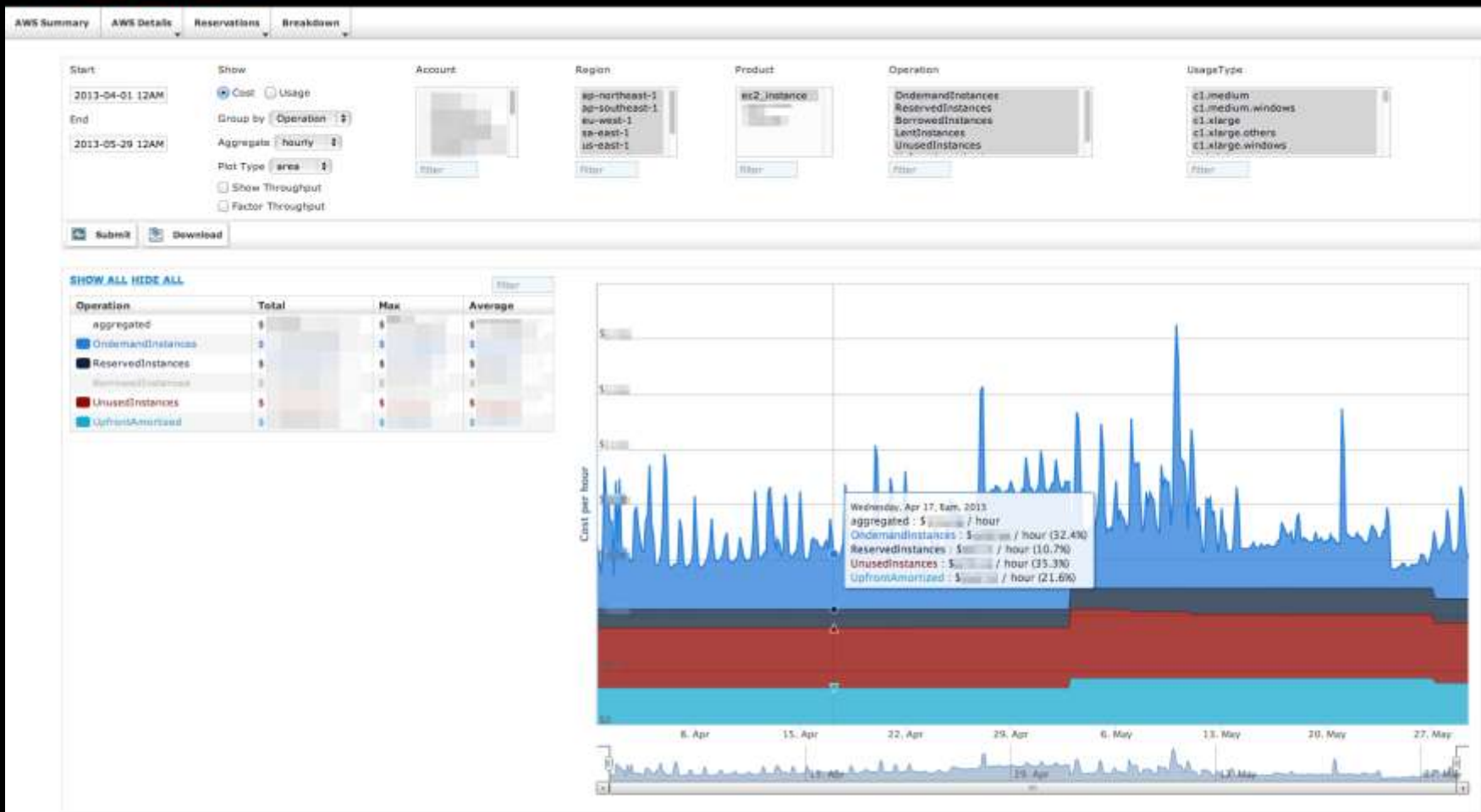
# Example Application – RSS Reader



# Ice – Detailed AWS “Chargeback”

<http://techblog.netflix.com/2013/06/announcing-ice-cloud-spend-and-usage.html>

## AWS Usage Dashboard





Boosting the @NetflixOSS Ecosystem

See [netflix.github.com](https://netflix.github.com)

# What's Coming Next?

More  
Features

Better portability

Higher availability

Easier to deploy

Contributions from end users

Contributions from vendors

NETFLIX

OSS

More Use Cases

# Vendor Driven Portability

Interest in using NetflixOSS for Enterprise Private Clouds

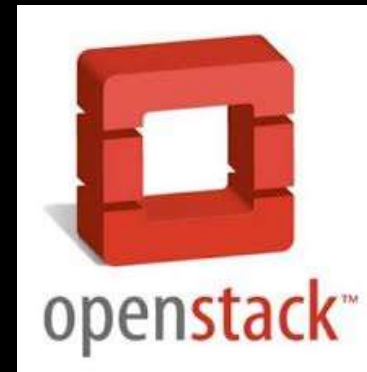
The logo for Eucalyptus, featuring a green square icon followed by the word "EUCALYPTUS" in blue.

“It’s done when it runs Asgard”  
Functionally complete  
Demonstrated March  
Released June in V3.3

Offering \$10K prize for integration work



Vendor and end user interest  
Openstack “Heat” getting there  
Paypal C3 Console based on Asgard







Functionality and scale now, portability coming

Moving from parts to a platform in 2013

Netflix is fostering a cloud native ecosystem

Rapid Evolution - Low MTBIAMSH

(Mean Time Between Idea And Making Stuff Happen)

# Slideshare.net/Netflix Details

- Meetup S1E3 July – Featuring Contributors Eucalyptus, IBM, Paypal, Riot Games
  - <http://techblog.netflix.com/2013/07/netflixoss-meetup-series-1-episode-3.html>
- Lightning Talks March S1E2
  - <http://www.slideshare.net/RuslanMeshenberg/netflixoss-meetup-lightning-talks-and-roadmap>
- Lightning Talks Feb S1E1
  - <http://www.slideshare.net/RuslanMeshenberg/netflixoss-open-house-lightning-talks>
- Asgard In Depth Feb S1E1
  - <http://www.slideshare.net/joesondow/asgard-overview-from-netflix-oss-open-house>
- Security Architecture
  - [http://www.slideshare.net/jason\\_chan/resilience-and-security-scale-lessons-learned/](http://www.slideshare.net/jason_chan/resilience-and-security-scale-lessons-learned/)
- Cost Aware Cloud Architectures – with Jinesh Varia of AWS
  - <http://www.slideshare.net/AmazonWebServices/building-costaware-architectures-jinesh-varia-aws-and-adrian-cockroft-netflix>

# What Changed?

*Speed wins, Cloud Native helps you get there*

*NetflixOSS makes it easier for everyone to become Cloud Native*

<http://netflix.github.com>

<http://techblog.netflix.com>

<http://slideshare.net/Netflix>

<http://www.linkedin.com/in/adriancockcroft>

@adrianco #netflixcloud @NetflixOSS

