Leaping into "The Cloud"

Rewards, Risks, and Mitigations

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Microsoft

Better Software East – November 9, 2011

About Us

Seth

- Microsoft Engineering Excellence: Best practices for services and cloud
- Bing: Massive, distributed, data processing service
- Microsoft ExP: Data Driven Decision Making
- Amazon.com: Video, Music, and Kindle eBook services

Ken

- Principal Test Manager Bing
- Office 2010, MSN, Hosted Exchange
- Director of Test Excellence

What Do You Know?

- Just beginning with cloud
- Who has a major project coming up
- Who has already implemented a cloud service
- Anything ever gone wrong

Introduction

- About Clouds
- Cloud Rewards
- Getting Into The Cloud
- 5 Amazing Cloud Case Studies
  - Rewards, Risks & Mitigations
- Testing in The Cloud

The latest version of this slide deck can be found at:
http://www.setheliot.com/blog/bsc-east-2011/

About Clouds

The Cloud in Three Steps

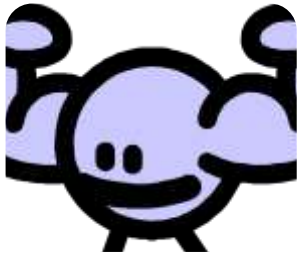
1. Standardized IT capability or service
   - No customizing for each customer
   - Economies of Scale - rote, repeatability
2. Pay Per Use
   - The power of zero
3. Self-Service Deployment
   - Fully Automated

[Staten, 2010]

The Cloud's Secret Sauce

Virtualization

Elasticity



Power

Happiness

Three Layers of of Clouds

Cloud Category	The Cloud handles...	Examples
Cirrus	16,500 to 40,000 ft	
Altocumulus	6,500 to 23,000 ft.	
Cumulus	Surface to 10,000 ft	

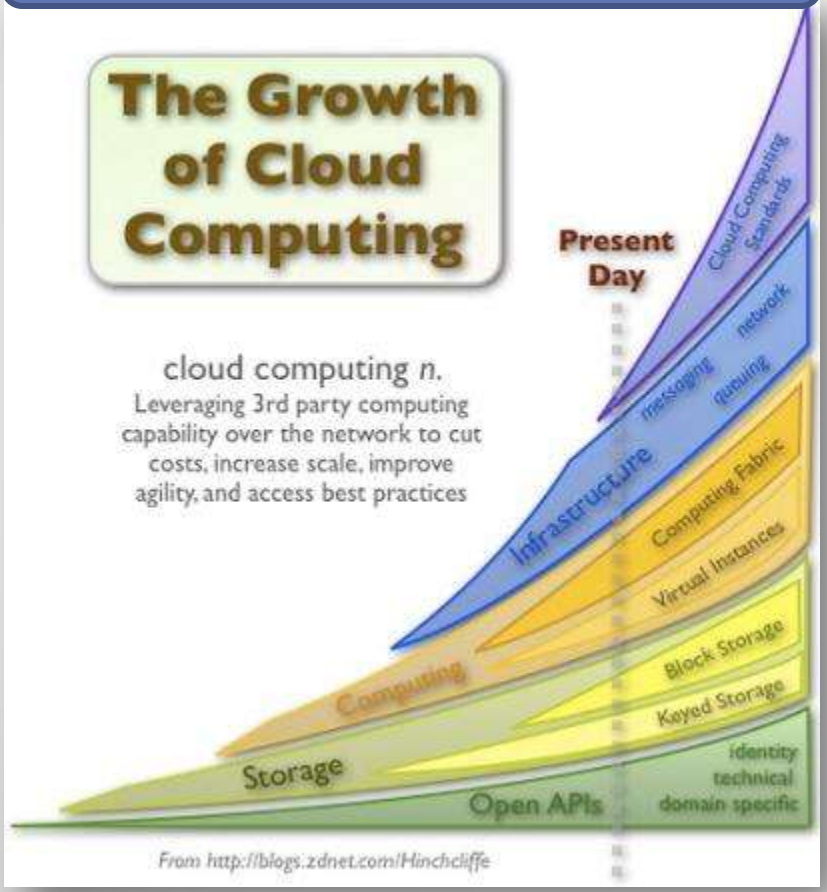
Three Layers of of Clouds

Cloud Category	The Cloud handles…	Examples
SaaS: Software	e.g., Office Application Functionality	Microsoft Office Web Apps Google Docs
PaaS: Platform	Relational Database Management Systems	Microsoft SQL Azure Amazon RDS
	Frameworks and Runtimes	Microsoft Windows Azure - .NET Google App Engine – Java, Python
	Messaging Queue	Microsoft Azure Queue Amazon SQS
IaaS: Infrastructure	Servers	Amazon EC2 - Linux, Windows Rackspace Cloud Servers - Linux
	Storage	Amazon S3 / SDB - BLOB / Table Microsoft Windows Azure Storage
	CDN	Windows Azure CDN Amazon CloudFront
	Network	Amazon Virtual Private Cloud

XaaS = …as a Service

Are Clouds for Real?

Unparalleled Market Growth



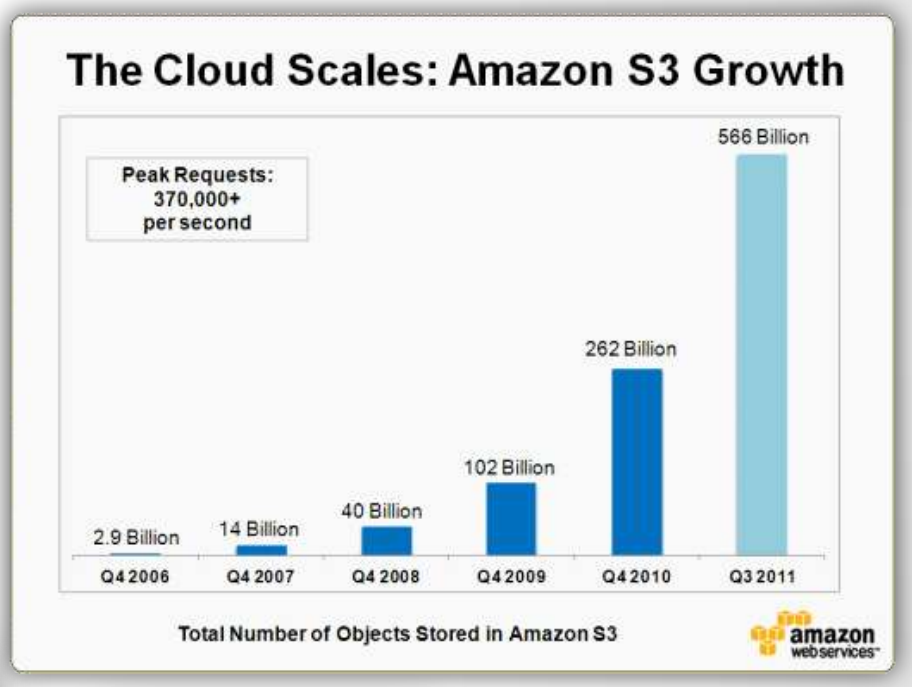
[Hinchcliffe, 2009]

- Massive Adoption [R&M, 2010]
  - Global cloud computing to grow from $37.8 billion 2010 to **$121.1 billion in 2015**
  - **CAGR of 26.2%** from 2010 to 2015.
  - **Annual US Federal** cloud computing **spending** to hit **$7 billion** landmark by **2015**

CAGR: Compound Annual Growth Rate

Really? Are Clouds for Real?

- Massive Investments
  - Cloud To Command 90% of Microsoft's R&D Budget [Forbes, 2011]
    - **~8.6 Billion in 2011**
- Amazing Growth
  [Amazon Growth, 2011]
- Steep competition
  - 90 Cloud Computing Companies to Watch in 2011
    [CCJ, 2011]



amazon web services
salesforce
vmware
zuora
rackspace HOSTING
HOSTING.com
Appistry
rPath
Joyent

Cloud Rewards

The Promise of the Cloud

Promises, Promises…

The Cloud Makes Many Promises

You are Empowered to Leverage These

- You Have an active role

Cloud Promise + Your Actions = Rewards

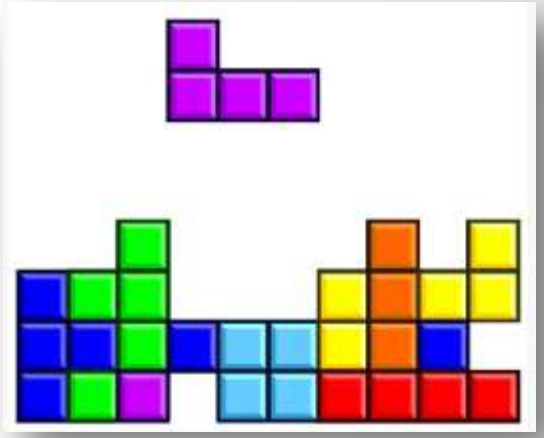
Rewards, A 40,000 ft. View

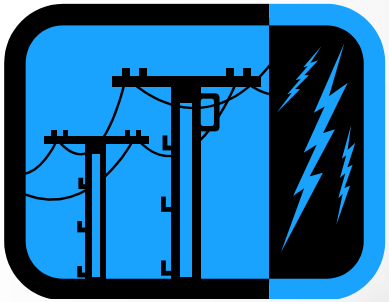
On demand capacity	Elasticity
Lower Cost	The Cloud is your data center
Disaster Recovery	Backups
Fault tolerance	Redundancy
Ease of management	Automation and APIs
Rewards Guaranteed	Don't rely on SLA
Easy Integration	Many Services - One Provider

Lower Cost - The Cloud is your data center

Lower Cost…

- Asset Utilization
  - Data center server utilization averages 5%-20% [Berkeley 2009]
- Hardware Costs
  - Data center performance - only increases with additional investment.
- Power Efficiency
  - Power Usage Effectiveness (PUE) for Data Center
  - Industry average 2.0
  - Microsoft Chicago:1.22
  - Microsoft Quincy 1.15 [Microsoft DC, 2011]





Continued….

Lower Cost - The Cloud is your data center (cont)

- Security
  - Network security devices
  - Security software licenses
  - Staffing
  - Regulatory compliance
  - Physical security requirements
- Supply Chain Management
  - Ordering servers and components costs money and time
- Personnel
  - Operating data centers
  - Scaling and managing physical growth

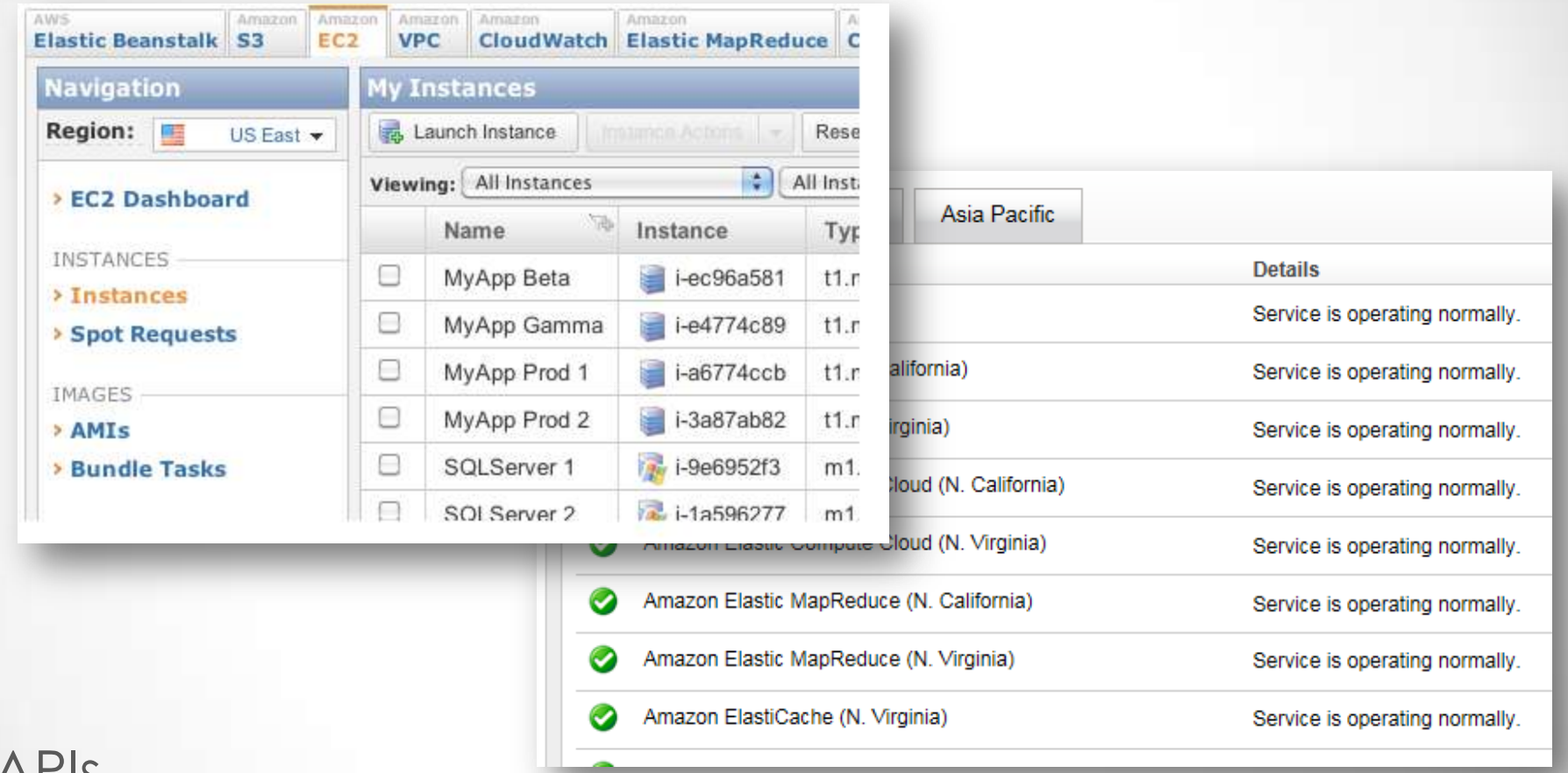
Disaster Recovery & Fault Tolerance

Service Robustness Enabled by The Cloud

- Multiple, smaller servers for **Redundancy**
- Handle load spikes via **Elastic Scalability**
- **Backups** leverage IaaS storage
- Use the tools via API – **Automate**

But how about when clouds turn stormy?

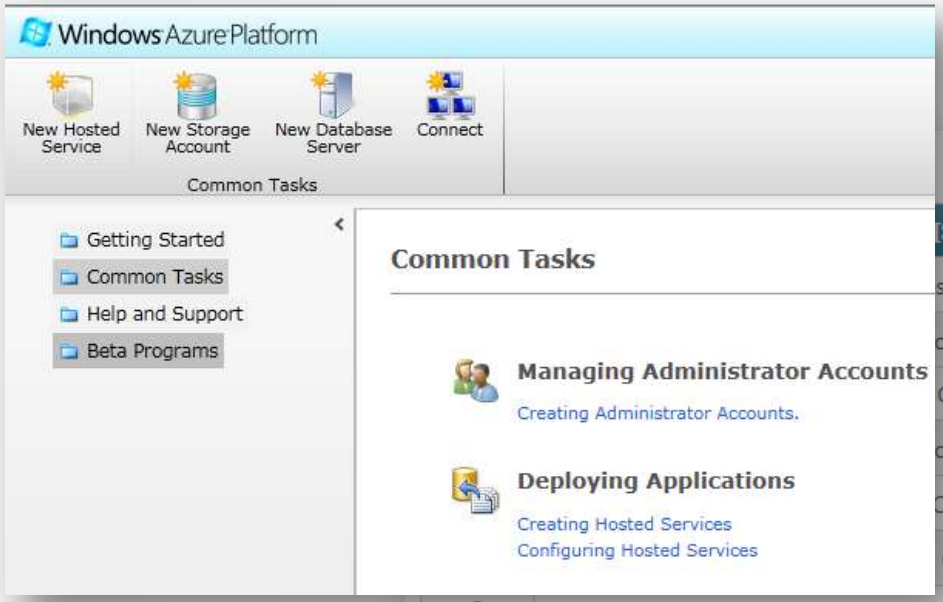
Ease of management - Automation and APIs



APIs

- Configure Instances, Load Balancers.. Everything
- Monitor via Amazon CloudWatch

Ease of management - Automation and APIs



	[Sub-Region]	Description
	ss Control [East Asia]	Service is running normally.
	ontrol [North Central US]	Service is running normally.
	Control [North Europe]	Service is running normally.
	ontrol [South Central US]	Service is running normally.
	Control [Southeast Asia]	Service is running normally.
	Control [West Europe]	Service is running normally.
✓	AppFabric Access Control 2.0 [East Asia]	Service is running normally.
✓	AppFabric Access Control 2.0 [North Central US]	Service is running normally.
✓	AppFabric Access Control 2.0 [North Europe]	Service is running normally.

APIs

- Hosted Services
  - creating, updating, and deleting; returning properties; updating and managing deployments
- Monitoring:
  - Windows Azure Diagnostics: configurable service metrics put in BLOB
  - Windows Azure Profiling: real-time pre-selected metrics in Visual Studio

Rewards Guaranteed - Cloud SLAs

	Microsoft	Amazon	Rackspace	Google
Service	Azure Compute	EC2	Cloud Servers	Apps for Business
SLA	99.9% 99.95%[1]	99.95%	100%	99.9%
Service Credit	10%-25%	10%	5%-100%	3-15 days
Storage	Azure Storage	S3	Cloud Files	
SLA	99.9%	99.9%	99.9%	
Service Credit	10%-25%	10%-25%	10%-100%	

1. If two or more role instances in different fault and upgrade domains [Cloud SLAs]

Example: Azure Storage Uptime = $100\% - \frac{Failed\ Storage\ Transactions}{Total\ Storage\ Transactions}$

- Failures Transactions includes completed but too slow

SLAs, What are They Good For?

- Service Credits will likely not compensate for lost business and negative customer impact.
- Providers pay out service credits, but the cost in publicity is more.
  - The market will reward those that **keep their SLAs**
  - But Enterprise cloud users cannot afford to bet on the wrong provider.
- 99.9% uptime = 9 hrs/yr down
- Must architect defensively
  - More when we get to case studies

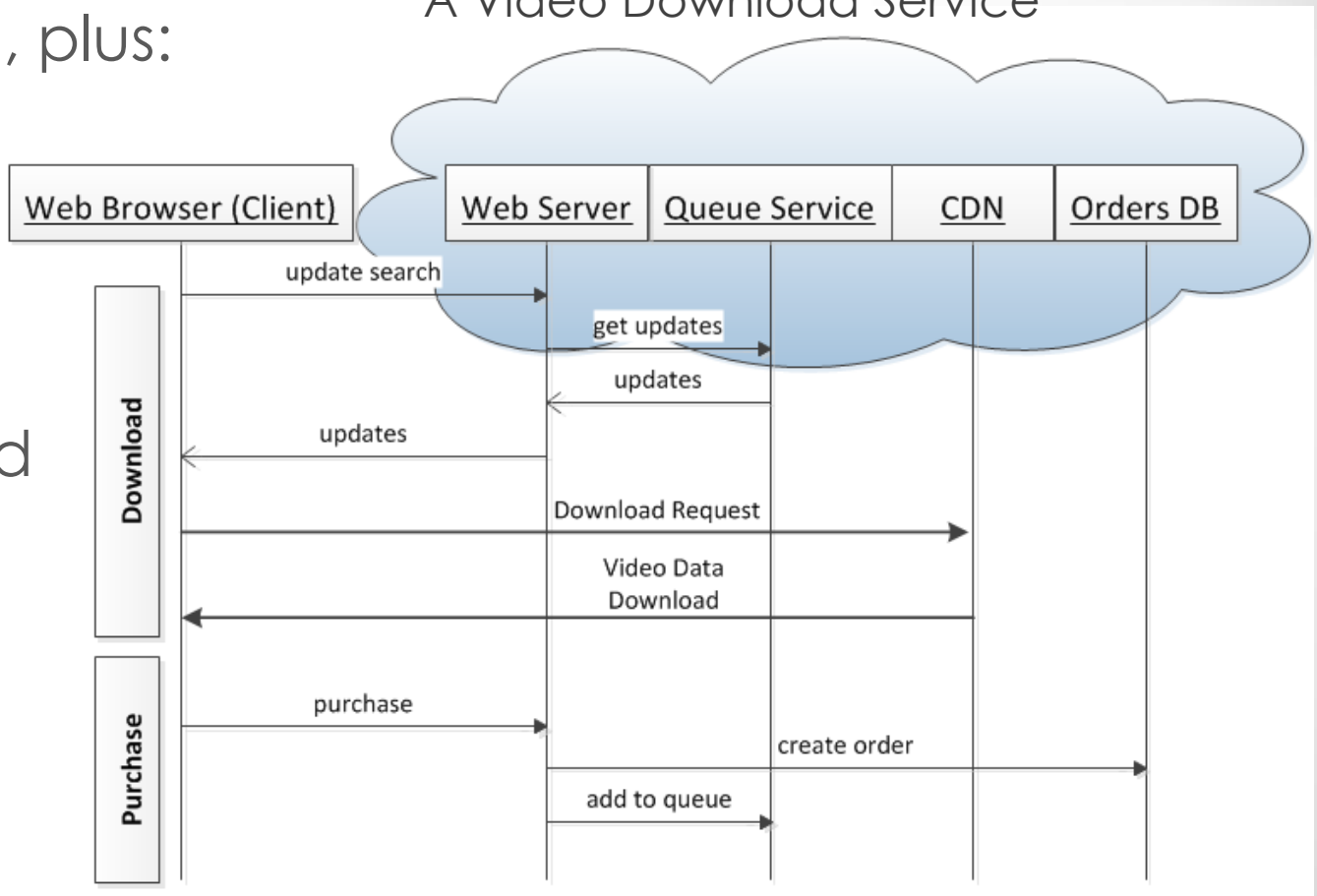
Easy Integration - Many Services, One Provider

Your Application, plus:

- Storage
- Databases
- Web Servers
- CDN

….all in the Cloud

A Video Download Service



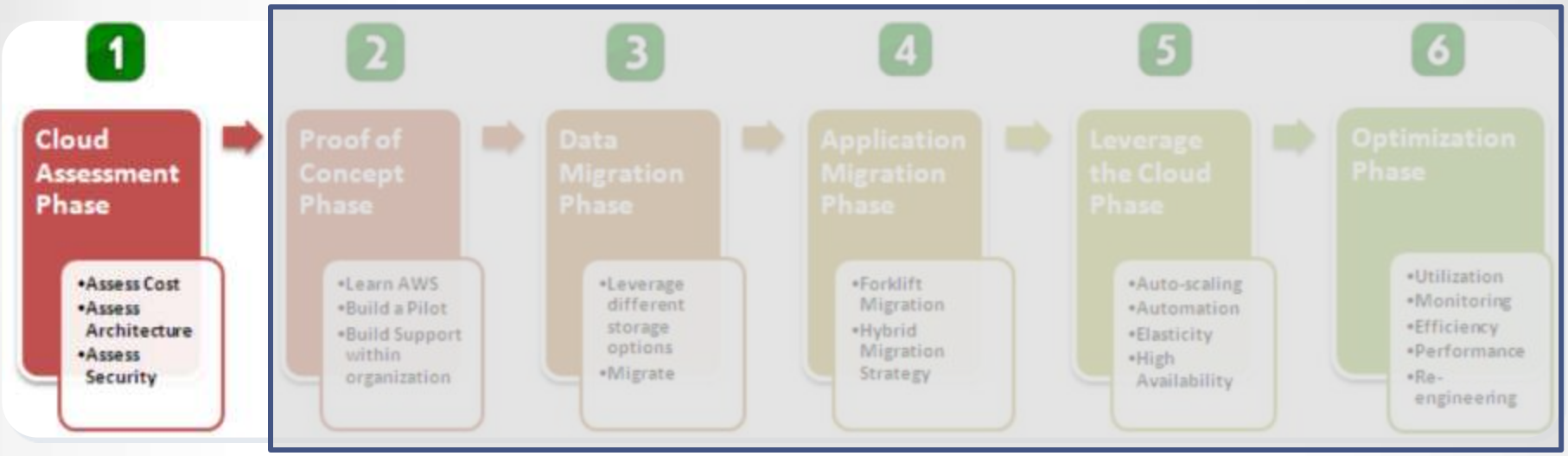
Availability and Interoperability within a single cloud provider

- Simpler than building full solution.

Getting Into The Cloud

Plan Pick and Execute

Plan Your Cloud Migration

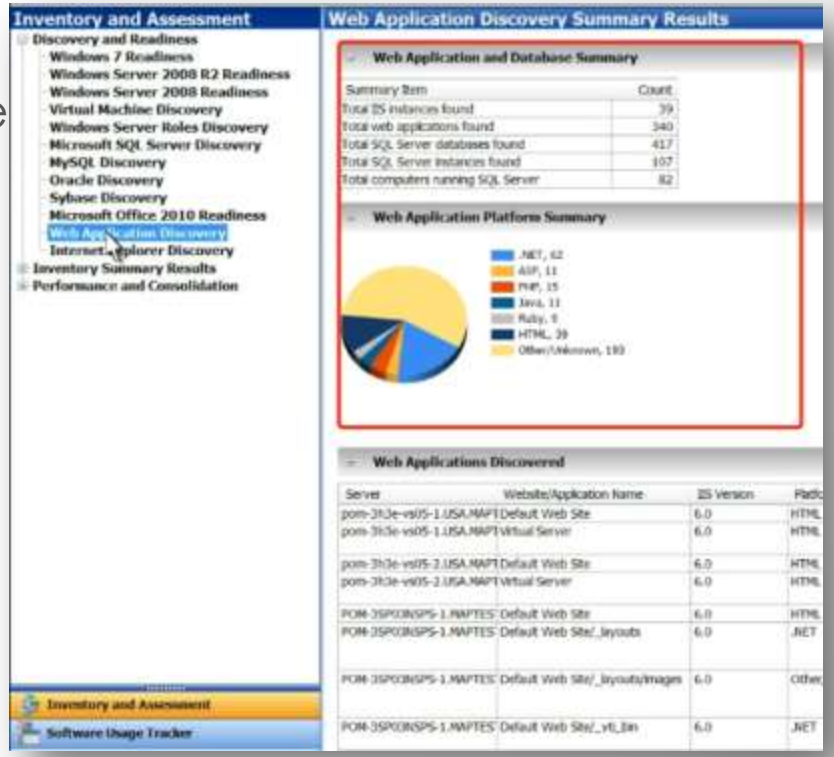


- Model courtesy of Amazon
  - Six step model
  - Plan, proof of concept, execution, optimize
- Leaping into the Cloud is mostly about planning and execution

Plan for each Application

The cloud providers ***want*** you there

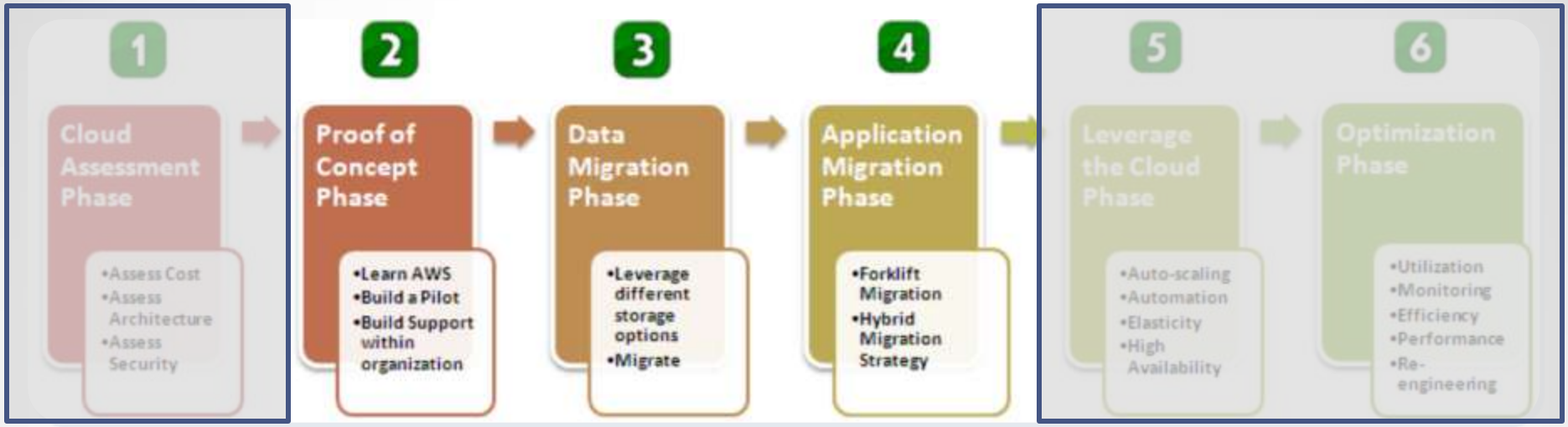
- Microsoft Azure
  - Microsoft Assessment and Planning (MAP) Toolkit [MAP Toolkit]
    - Automatically finds your web apps, web servers and DBs
    - Estimates what you need
      - Azure compute instance
      - SQL Azure DBs
      - Bandwidth
      - Storage



Windows Azure Platform Capacity Estimates

Item	Value
Web Applications included in Assessment	6.00
Databases included in Assessment	5.00
Small Windows Azure compute instances required	4.00
Medium Windows Azure compute instances required	1.00
Large Windows Azure compute instances required	1.00
Windows Azure monthly small compute hours	7,200.00
Windows Azure monthly network bandwidth (GB)	36.82
Windows Azure monthly storage (GB)	20.00
1 GB SQL Azure Web databases required	5.00
SQL Azure monthly network bandwidth (GB)	37.14

Execute you plan

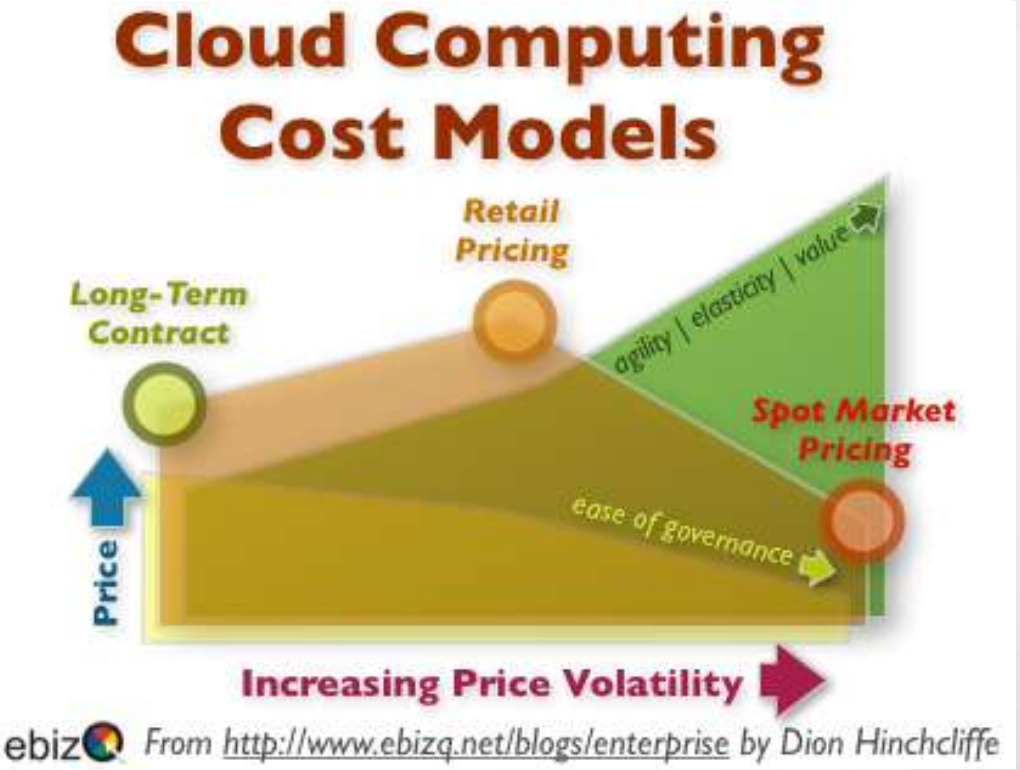


- Proof of Concept
  - Build a trial version in the cloud
  - Plan for data Migration and App Migration
- To do this, you will need to pick a cloud provider

Pick the Services you need

- Types of Services you need (Window/Linux)
- Type of Contract
  - Different pricing
  - Different SLAs
- Security Levels
  - FISMA Compliant – Federal Information Security Management Act [FISMA, 2002]
  - Other Security compliance

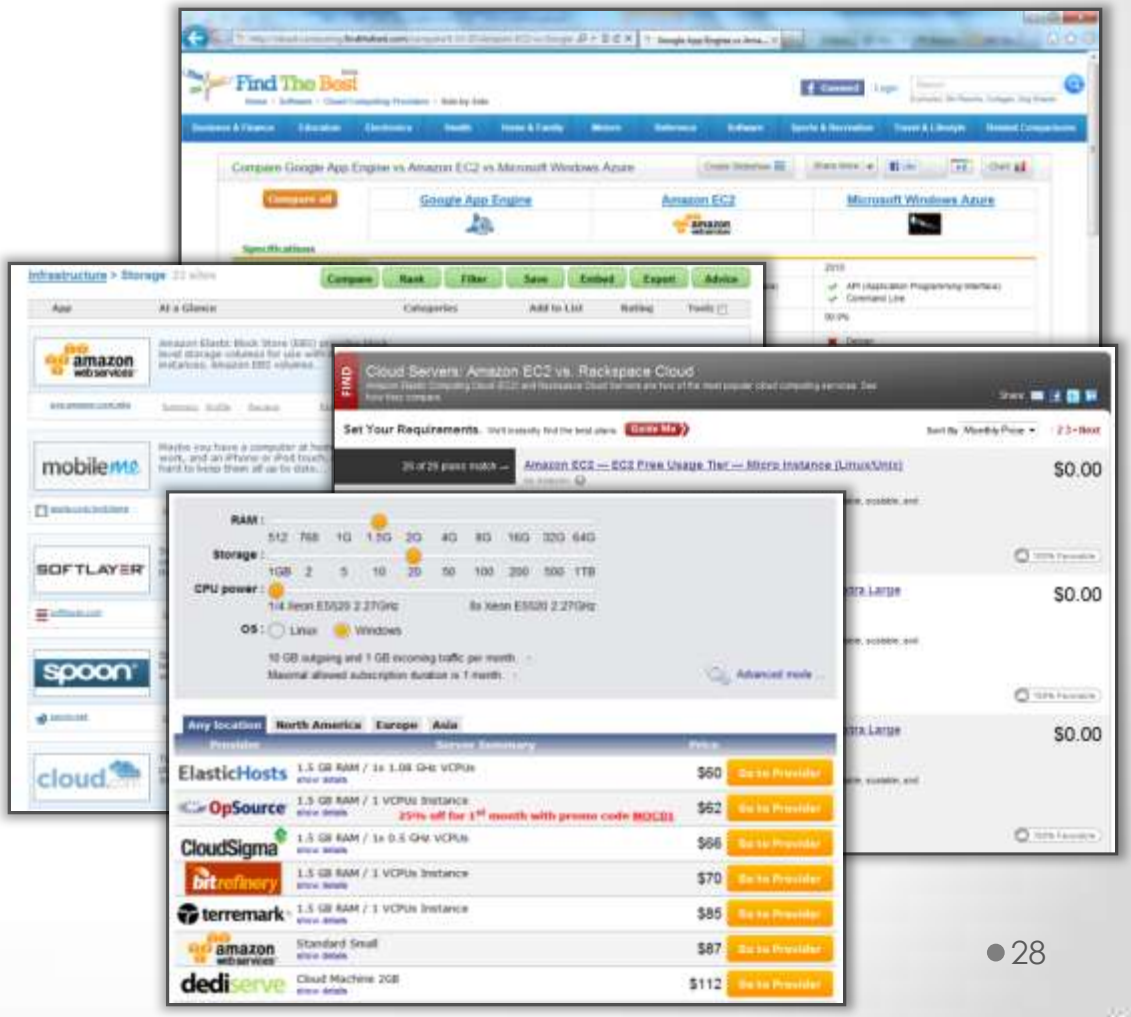
Dynamic Pricing Models



Pick the Right Cloud Provider

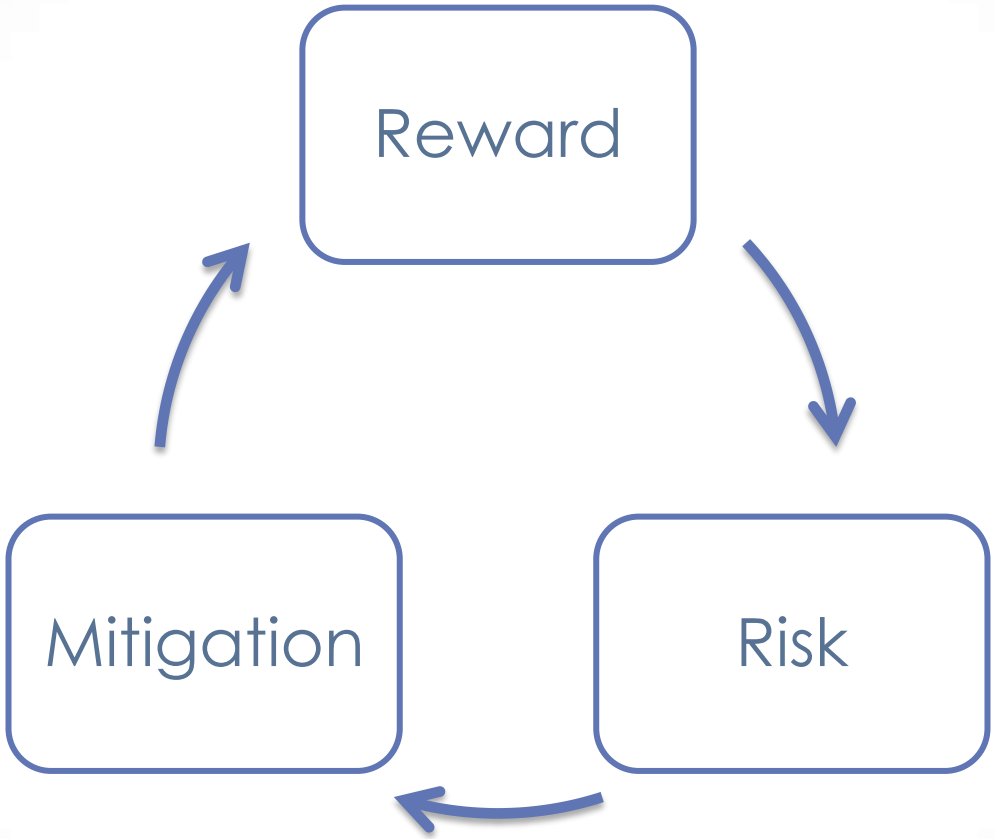
- Handy Cloud Computing Price Comparison Engines
  [Cloud Tweaks, 2011]

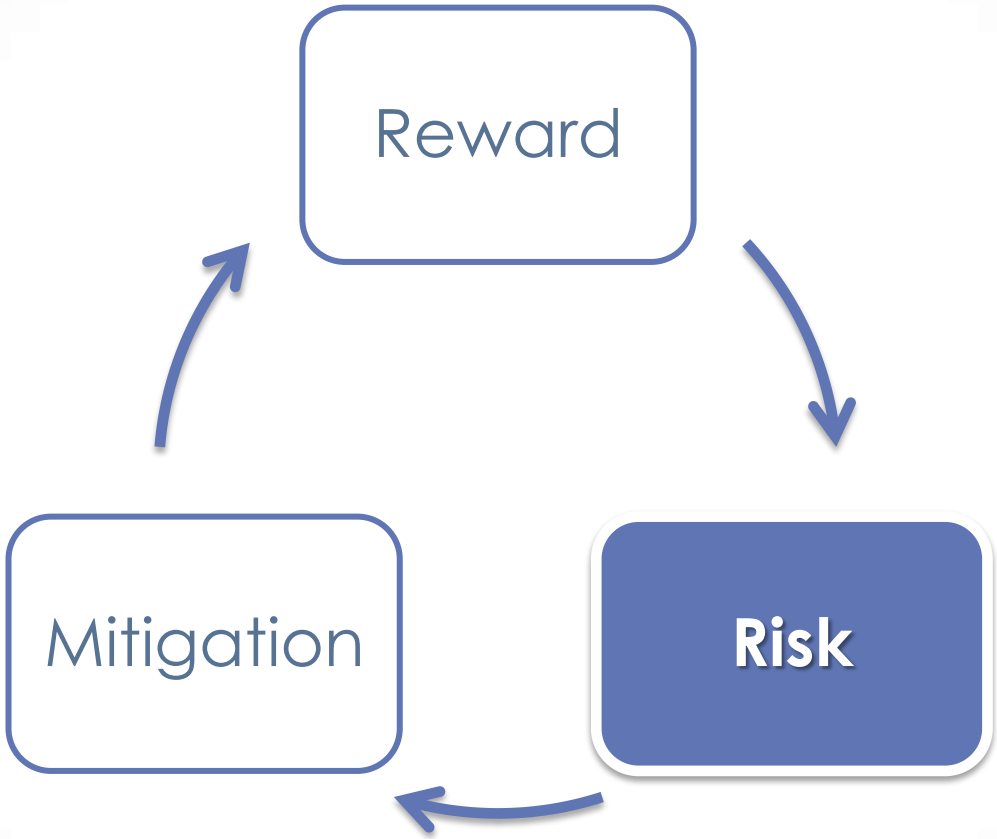
1. FindTheBest.com
2. ServDex.com
3. CloudSurfing.com
4. Cloudarade.com

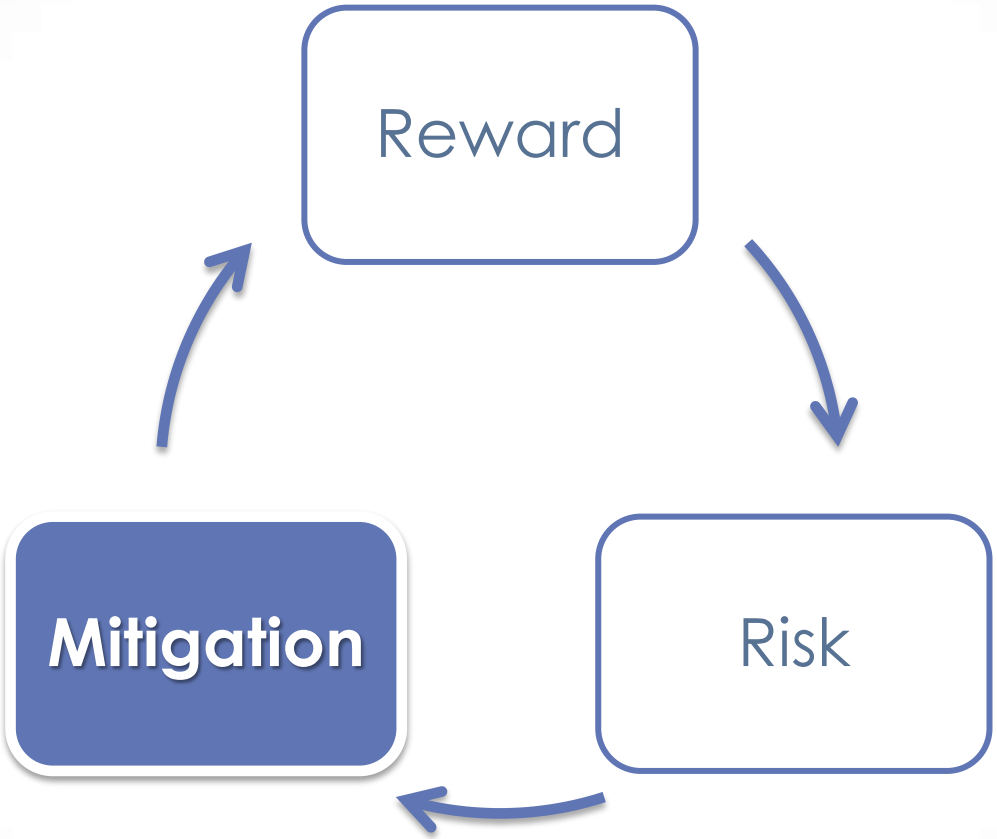


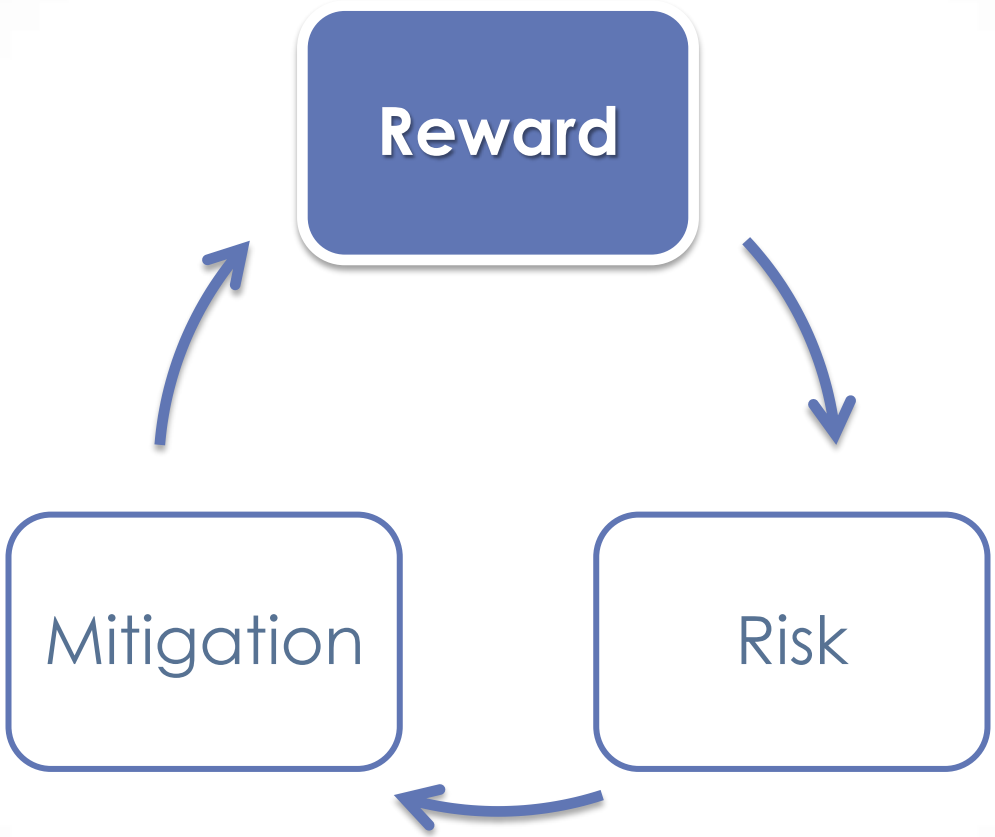
5 Amazing Cloud Case Studies

Rewards, Risks & Mitigations


Reward
Risk
Mitigation


Reward
Risk
Mitigation

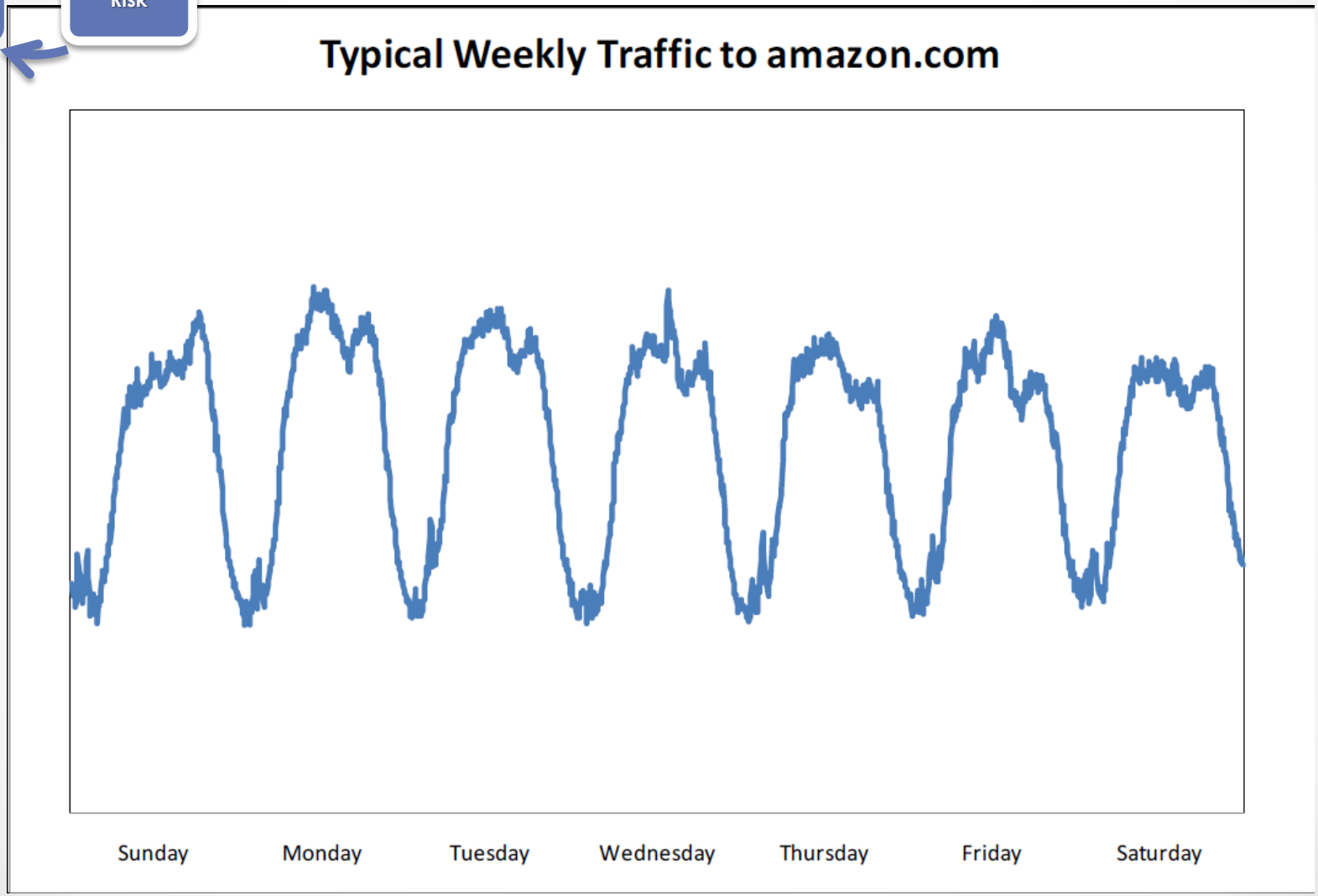

Reward
Risk
Mitigation


Reward
Risk
Mitigation

Amazon.com Elasticity and Cost Savings

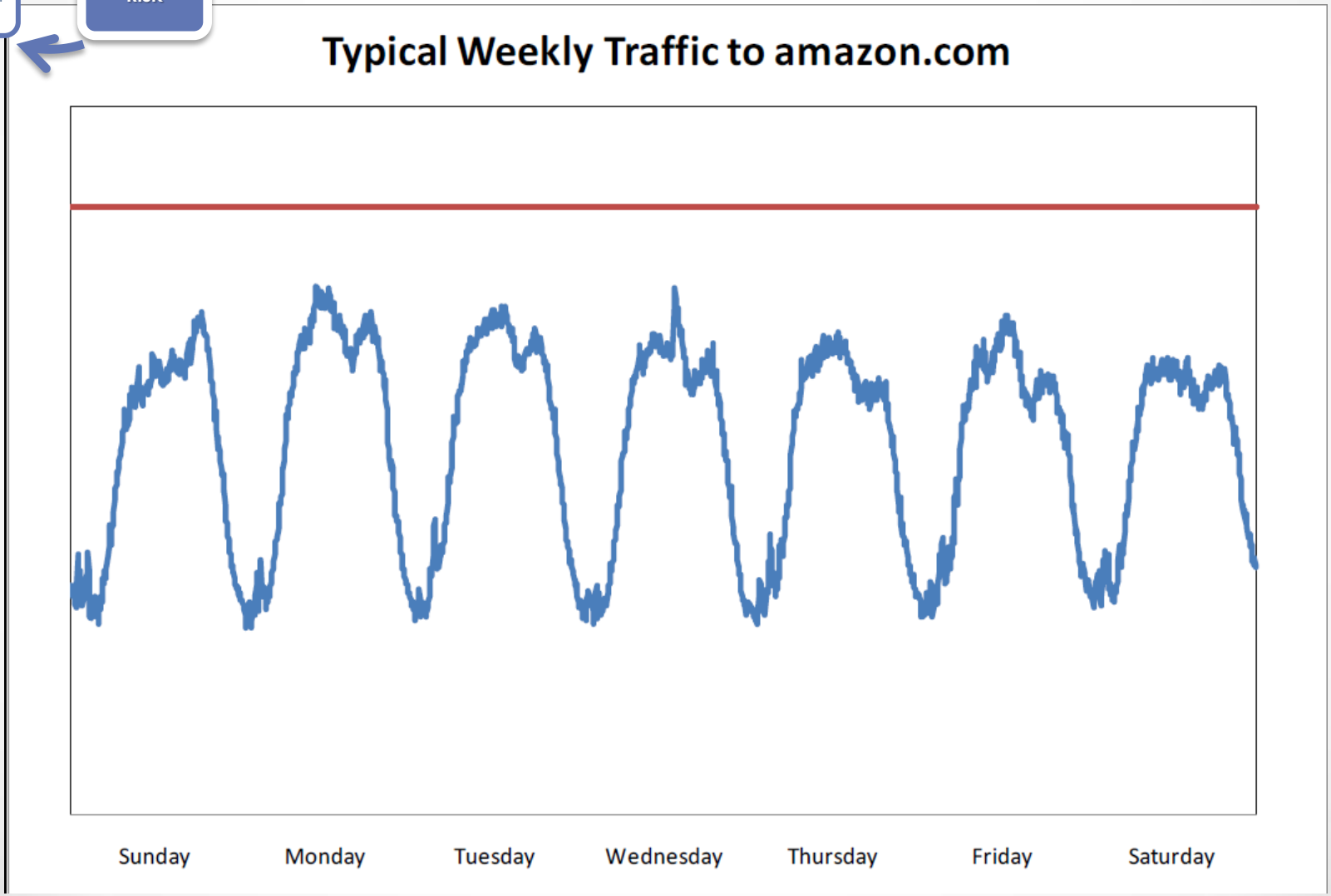
[Jenkins, 2011]

Website Traffic is Spikey



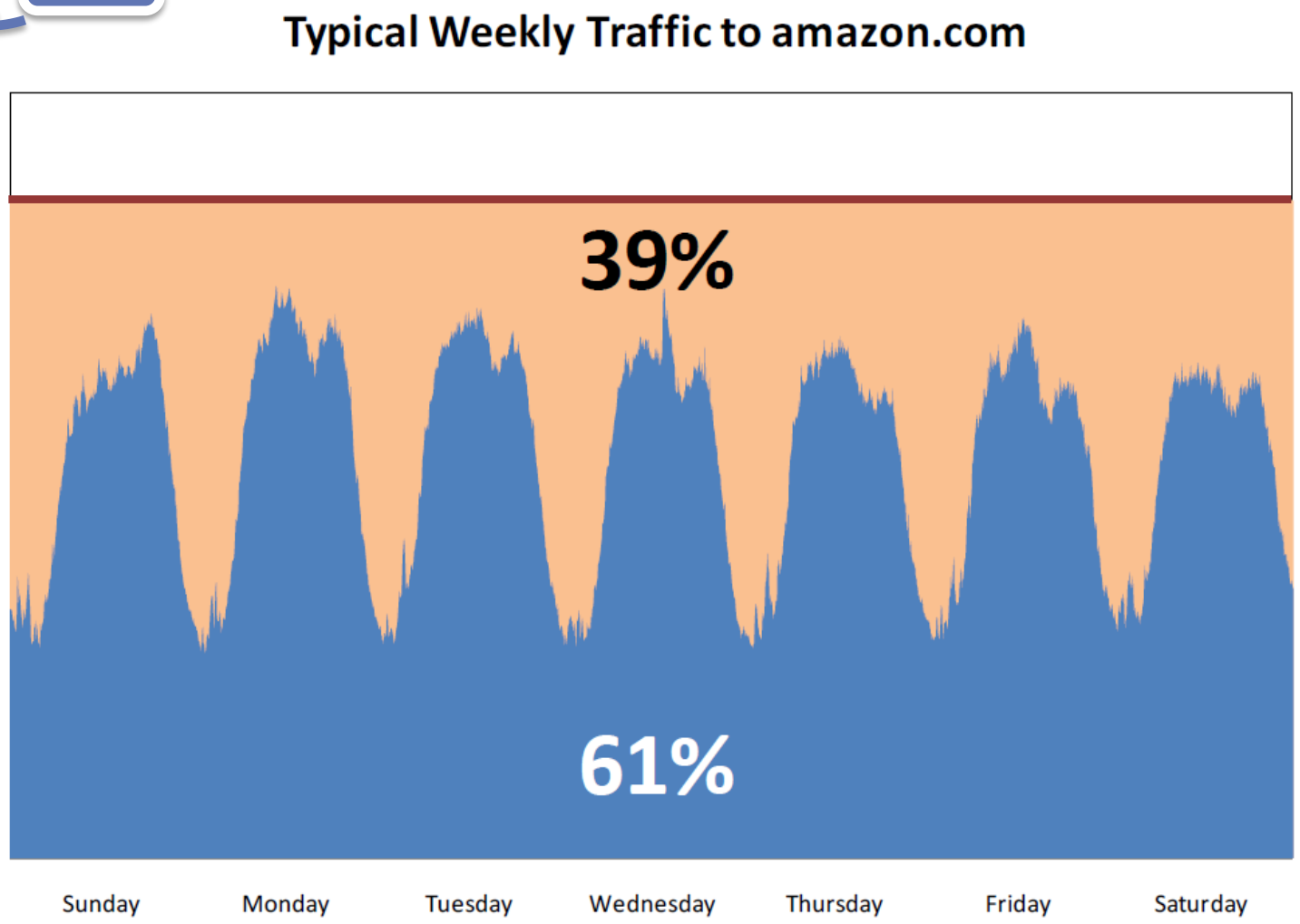

Reward
Risk
Mitigation

Add a Buffer


Typical Weekly Traffic to amazon.com
Sunday
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday

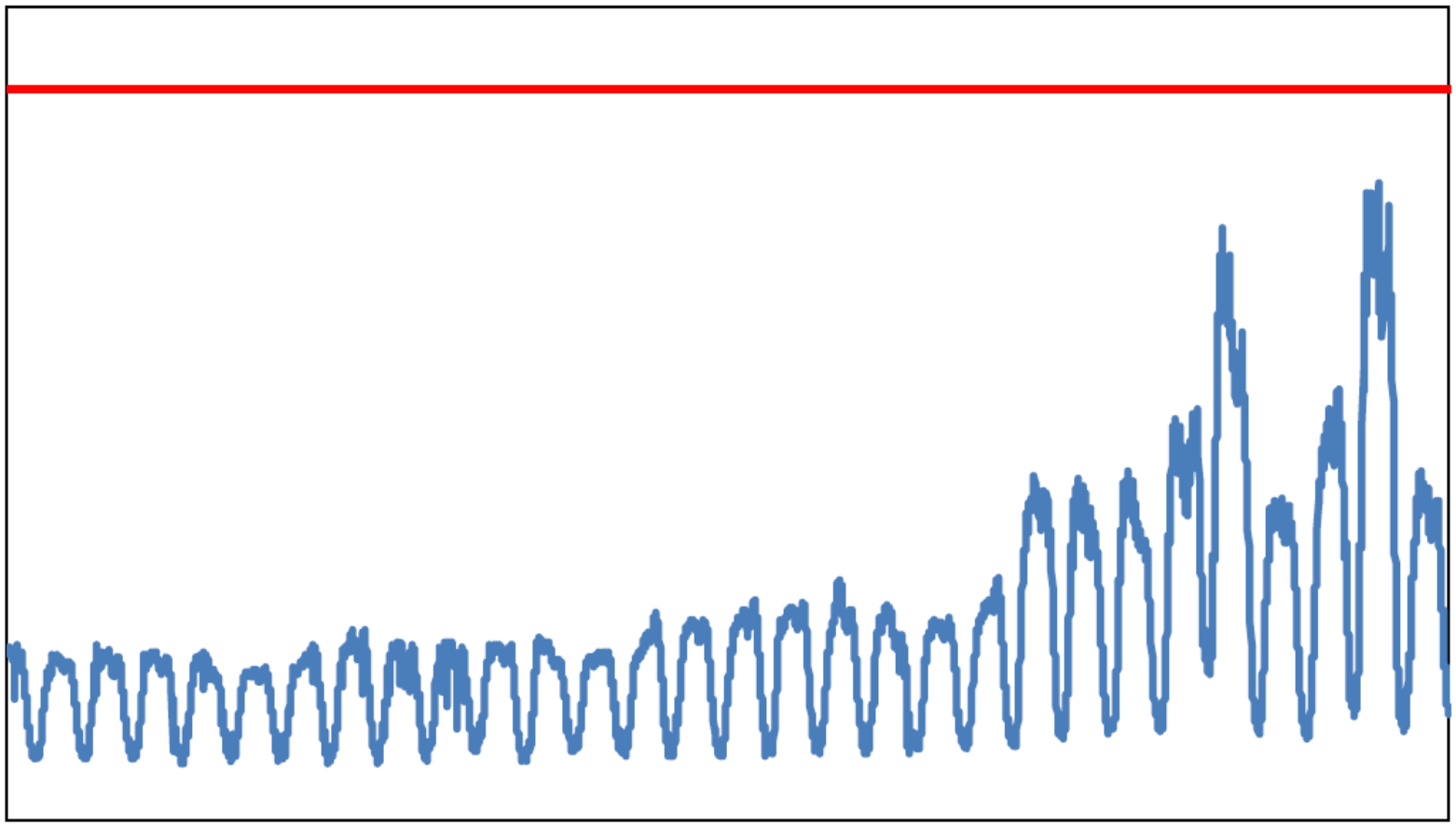

Reward
Risk
Mitigation

Major Waste!


Typical Weekly Traffic to amazon.com
39%
61%
Sunday
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday

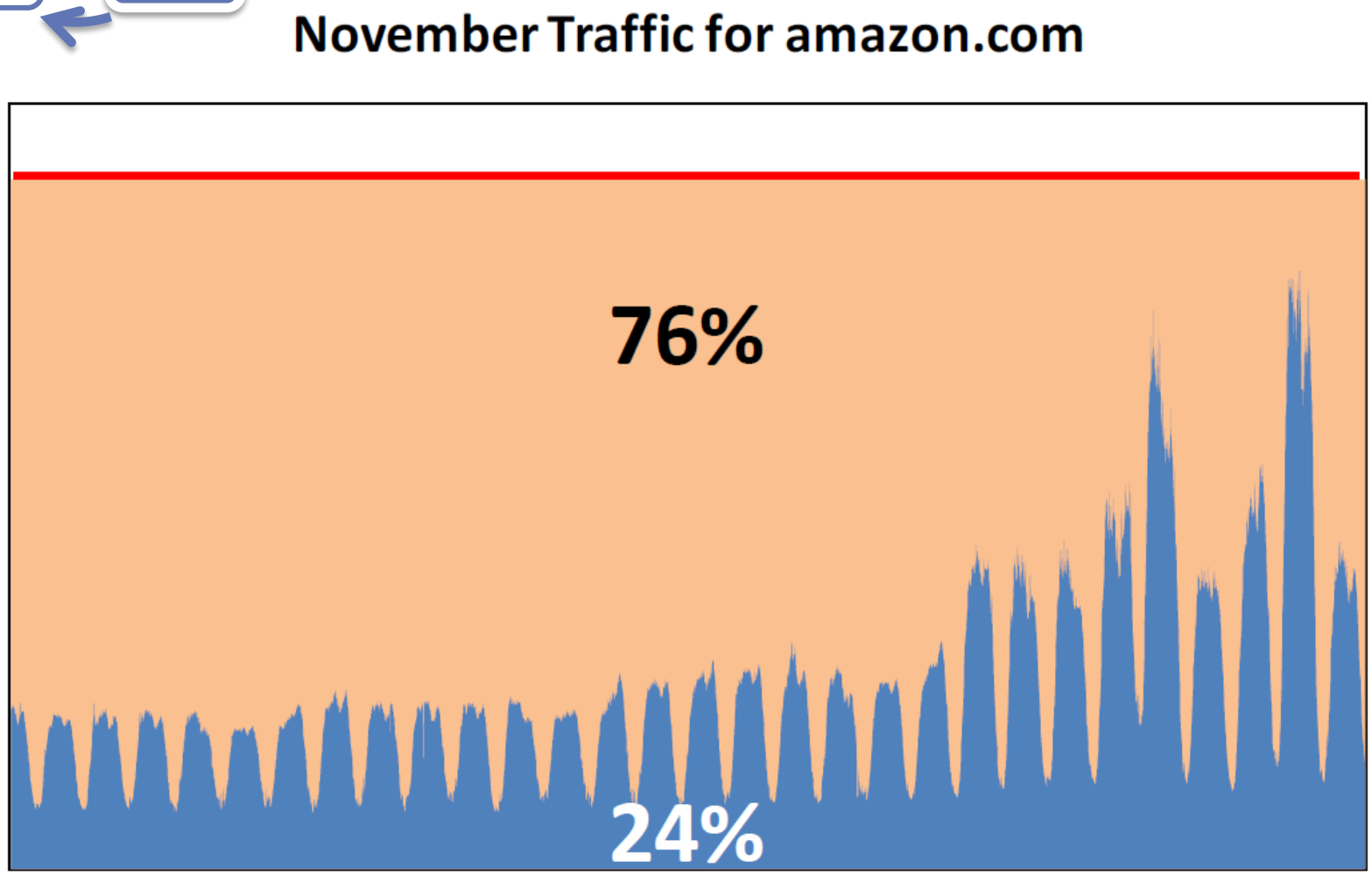
But it's Even Worse

Seasonality Spikes




Reward
Risk
Mitigation

Big Waste


November Traffic for amazon.com
76%
24%

Let's Move to the Cloud

- November 10th 2010 full migration to EC2
- Reduced spending on server capacity
- Fleet scales dynamically in increments as small as a single host
- Traffic spikes handled with ease
- Cultural change – aim for small server footprints

Business Continuity

A Cautionary Tale

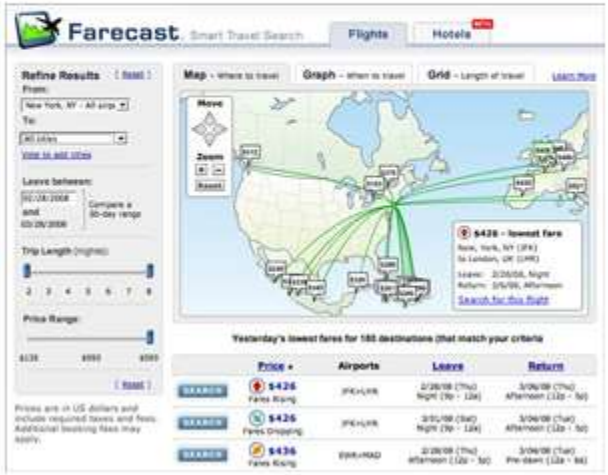
Microsoft Acquires Farecast For $115M

by **Mark Hendrickson** on April 17, 2008 **50 Comments** 1 retweet Share 3

Rumors about the acquisition of **Farecast** are accurate – in a very brief blog **post** CEO **Hugh Crean** says they've been acquired by Microsoft.

SeattlePI, which first **broke** the rumor last week, **says** the price tag was $115 million. While the two companies are an understandable fit given their proximity and partnership over MSN Travel, SeattlePI reports that Farecast entertained multiple offers before accepting Microsoft's.

Farecast is an airfare pricing comparision tool



April 2008

Farecast becomes Bing Travel

No Safety Net

Service housed in a single Datacenter.

No Budget for 2nd DC Buildout.

July 2009
Disaster Strikes!
An Electrical Fire @ Fisher Plaza

TV Stations, Radio Stations,
Online Games, & Bing Travel

Bing Travel is now

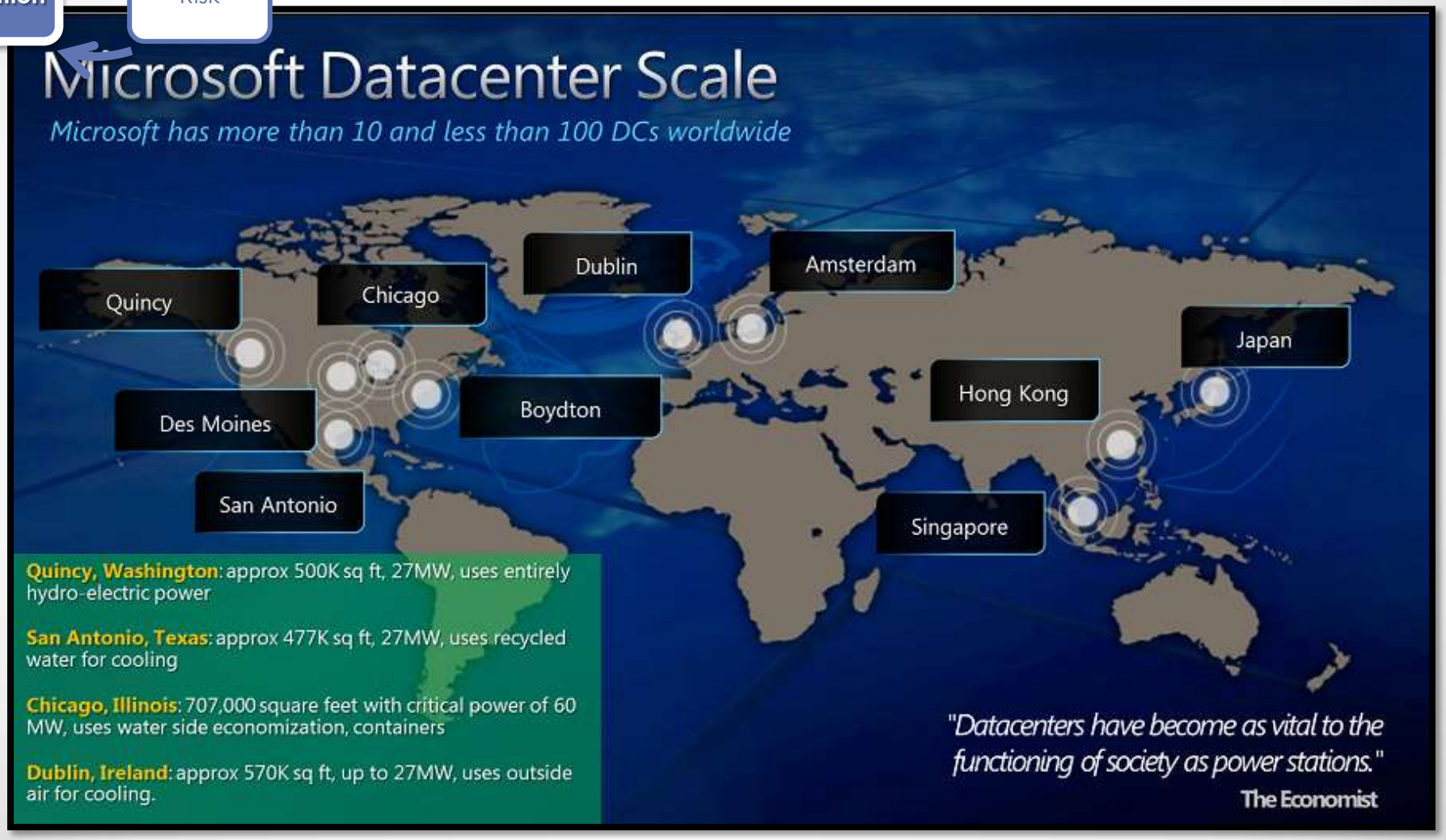
2+ Datacenters

Reward

Mitigation

Risk

Microsoft has Geo-Redundancy



…Therefore YOU have Geo-Redundancy

…in The Cloud

- Windows Azure Traffic Manager
  - Automatically load balance traffic to the *best data center*
- Amazon S3 Storage
  - "data is replicated over multiple locations such that failure modes are independent of each other. The locations are chosen with great care to achieve this independence"

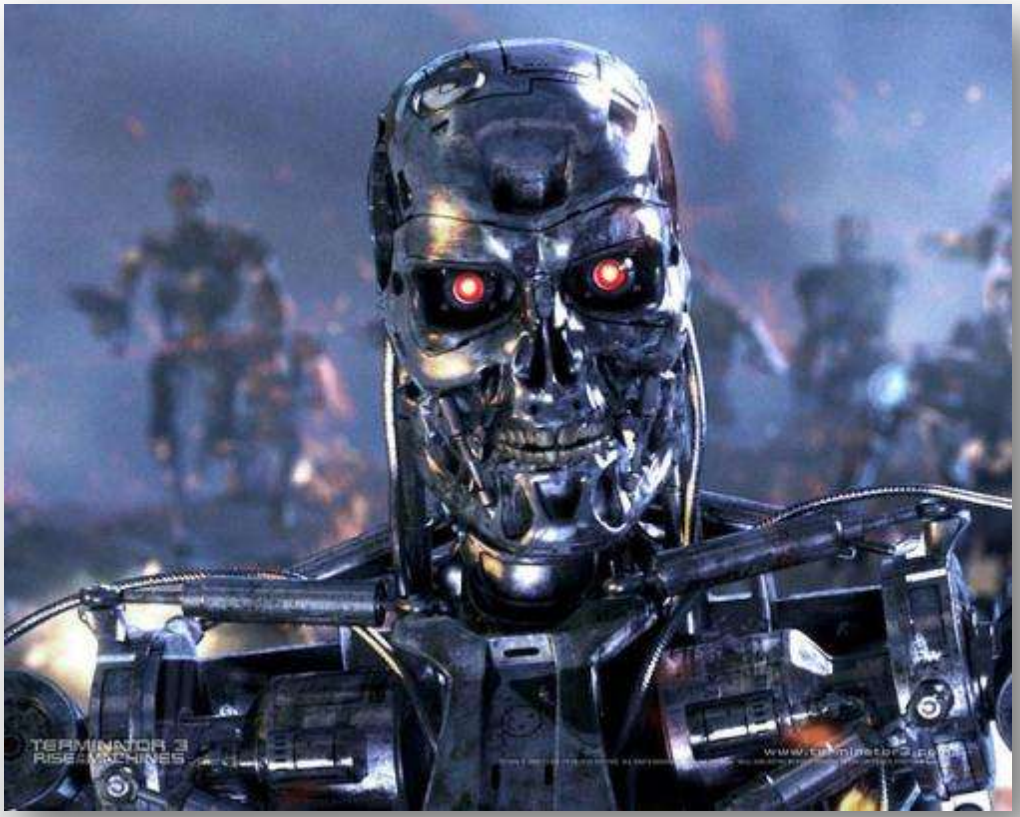
[Amazon geo, May 2010]

- RackSpace Cloud???
  - Three full copies of data across multiple "zones" within the *same data center*

…Or Do You?

Again, you are responsible for good design

April 21, 2011 – Skynet begins it's attack against humanity



http://en.wikipedia.org/wiki/Skynet

Credit to Don MacAskill for pointing this out

…Or Do You?

Again, you are responsible for good design

April 21, 2011 – Amazon AWS EC2/RDS Outage

- Took down

reddit hootsuite foursquare Quora

- But one website had reason to be SmugMug
  - …minimally impacted, and all major services remained online during the AWS outage
- Netflix stayed up too… more later…

…Or Do You?

Again, you are responsible for good design

April 21, 2011 – Amazon AWS EC2/RDS Outage

- Took down
- Bu
  -

- Netflix stayed up too… more later…

You must…
Design for Redundancy

Don't Be This Guy

Life of our patients is at stake - I am desperately asking you to contact

Posted by: md76040303317
Posted on: Apr 22, 2011 11:20 PM

This question is **answered**. Helpful answers available: **2**. Correct answers available: **1**.

Sorry, I could not get through in any other way

We are a monitoring company and are monitoring hundreds of cardiac patients at home. We were unable to see their ECG signals since 21st of April

Could you please contact us?

How Did SmugMug Do It?

Amazon EC2 (N. California)	✓	✓	✓
Amazon EC2 (N. Virginia)	⛔	⛔	⛔

- Availability Zones (AZs)
- Failures Should Not Span AZs
  - In this case they did!
- SmugMug uses Three AZs
- Designed to fail and recover
  - Any of our instances, or any group of instances in an AZ, can be "shot in the head" [SmugMug April 2011]
- Incident Response
  - We updated our own status board, and then I tried to work around the problem…. 5 minutes [later] we were back in business

Fault Tolerance

..or What Do You Need to Worry About When Running Your Own Data Center

- Servers and Server Hardware
- Networks and Load Balancers
- Data and Data Replication
- Authentication and Connectivity

For Example…. NETFLIX

First Year -New Data Center

Failure is Always an Option

- 1 Power Distribution Unit failure (500-1000 machines)
- 1 rack-move (500-1000 machines)
- 1 network rewiring (rolling 5% of machines)
- 20 rack failures (40-80 machines)
- 8 network maintenances (~30-min connectivity losses)
- 12 router reloads
- 3 router failures
- Dozens of minor 30-second blips for DNS
- 1000 individual machine failures
- 1000s of hard drive failures

[Google Cluster, 2008]

How Does The Cloud Help?

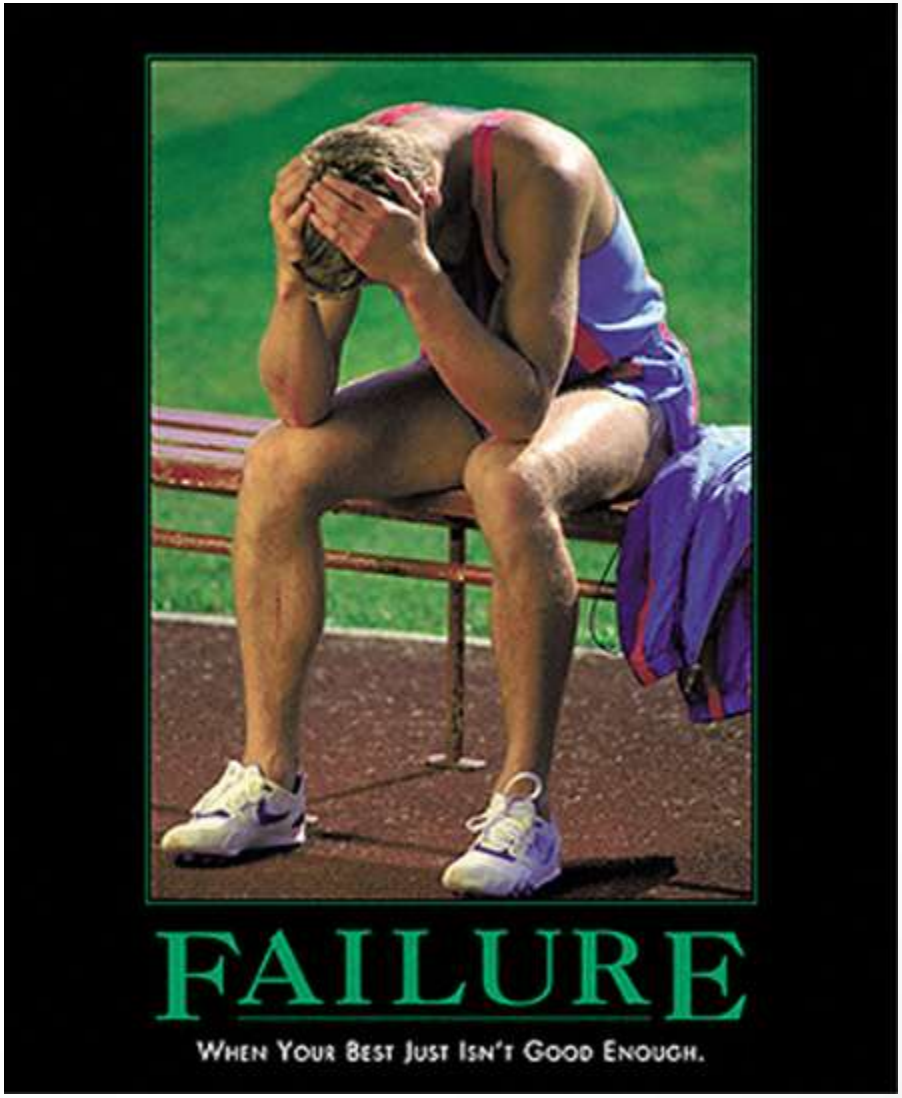
The Cloud is better

- Fault-tolerant hardware and network infrastructure
- Advanced Ops personnel and processes
- State of the art: Power, Cooling, Security

The Cloud is *not* better

- but gives you better tools to….

Embrace Failure



[http://despair.com]

Embrace Failure

Design For Failure

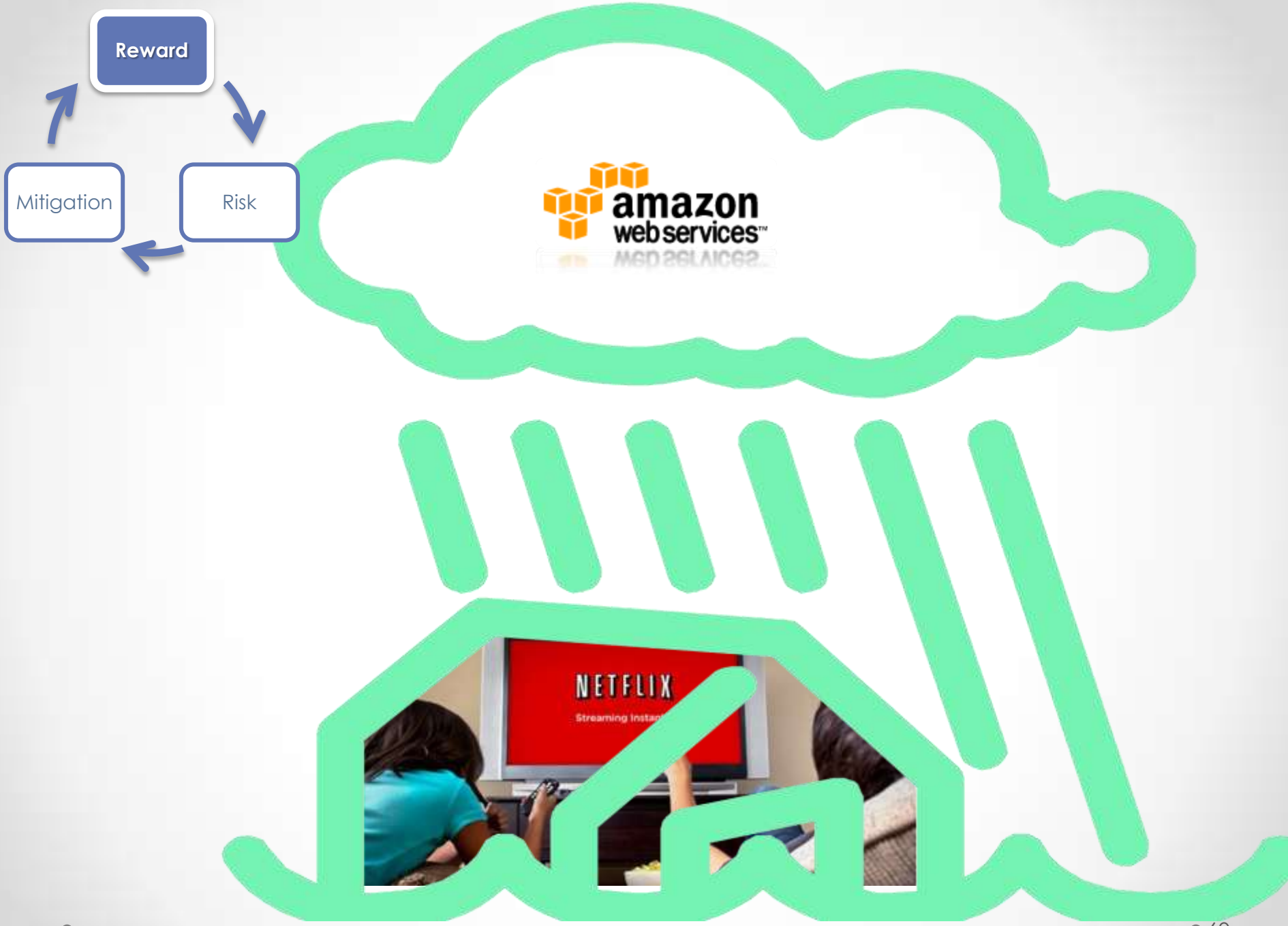
- Each System has to succeed, even on its own
  - Small Stateless Services
  - Recommendation System Down? Show popular titles instead of personalized picks
- Assume host failures happen
  - Remember, "shot in the head"
  - Cloud Advantage: Re-Spawn!
- Short Timeouts and Quick Retries – Fail Fast
  - Co-tenancy can introduce variance in throughput at any level of the stack.
  - Requires Idempotent Interfaces
- Research and Test with Full Scale / Real Data
  - Cloud Advantage: Elasticity

[Netflix AWS, Dec 2010]
[Twilio AWS, Apr 2011]

Monkeys with Rifles

[Netflix Army, July 2011]

- Netflix *Simian Army*
  - **Chaos monkey** randomly disables production instance in AWS
  - **Chaos Gorilla** simulates an outage of an entire Amazon AZ
  - Janitor Monkey, Security Monkey, Latency Monkey…..
- Microsoft *Host Sniper* takes out servers on Office Web Apps


Reward
Risk
Mitigation
amazon
web services™
NETFLIX

Security

"...every cloud customer retains responsibility for assessing and understanding the value and sensitivity of the data they may choose to move to the cloud. As the owners of that information, cloud customers also remain accountable for decisions regarding the protection of that data wherever it may be stored."

[Microsoft Security, 2010]

For Example….

Amazon AMIs

Amazon Machine Image

- Create and share virtual server configurations
- Like Open Source –Give a little, Get a lot

AMI Key Vulnerability

- June 2008, Amazon Closes Hole [Cloud Security 2008]
  - EC2 Servers copied from an image all had same SSH host keys
  - Amazon's or User fault?
    - Like a community with where all houses use the same key
    - Hey you could get your house re-keyed (regen host key)
- June 2011, Users Publish API Authentication Keys
  - Amazon's or User fault? [IT World, 2011]
    - Like including a pic of yourself showing your credit card shared on FaceBook, with a sign that says "charge me"
    - Violates Amazon Security Guideline – RTFM?
- Could Amazon do More?
  - Auto-scanning perhaps?

Amazon AMI Mitigation

Testing in The Cloud

Facebook is a Cloud Platform

Apps power Facebook

Facebook + Heroku = PaaS

- Deploy and Run FB Apps [FB Heroku, 2011]

Rewards:

- Supports Ruby, Node.js, Python, or PHP
- Now need to setup host
- Instant Scaling

What are the Risks?

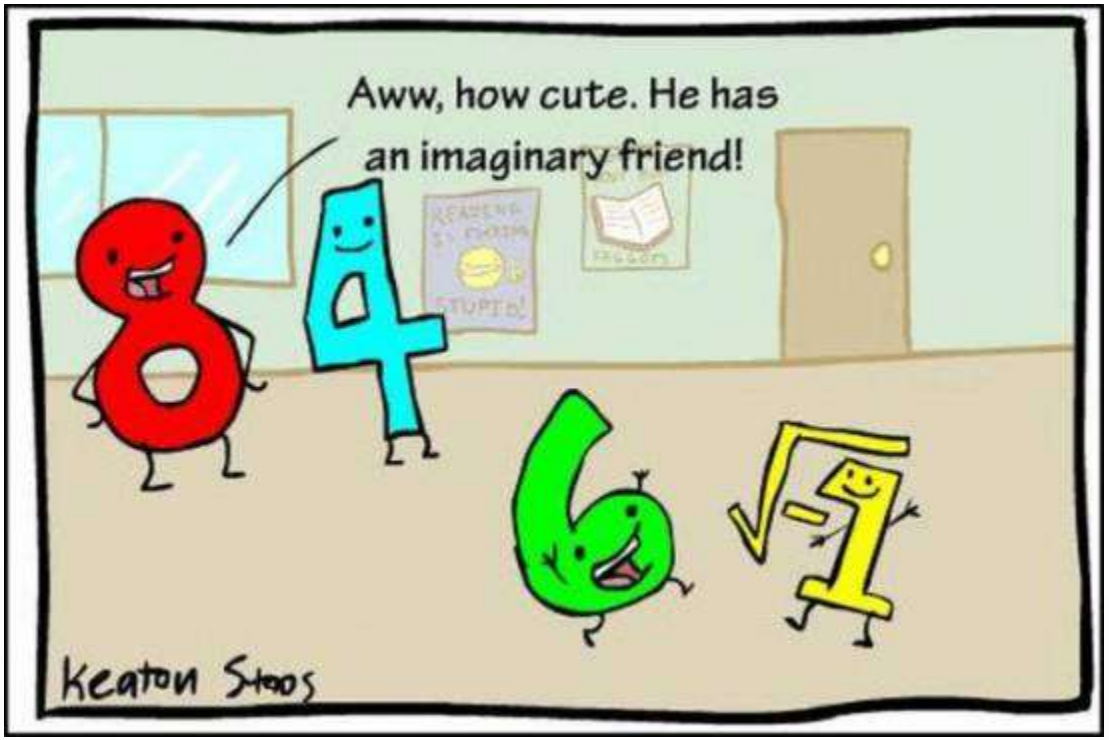
How do We Test it?

- Does it work?
- Is it stable?
- Users getting a Good Experience?

These risks are not cloud specific.

But the mitigation is….

Imaginary Friends



Facebook Imaginary Friends

…they call them **Test Users**

- Invisible user accounts
- Not visible by others; can only be friends with other Test Users
- Experience your app as a regular user

Power of the Cloud

- Automated:
  - Programmatic interface
  - Web UI
- Create up to 500 of them

[FB Test, 2011]

Control 1 Million Users

Control 1 Million Users

- Uses Cloud IaaS Providers:
  - GoGrid, Windows Azure, Amazon EC2
- Generate high scale load from geo-dispersed origins

- 1 million **concurrent** virtual users
  - Plus Live Traffic
- 6 gigabits per second
- 6 terabytes of data transferred per hour
- Over 77,000 hits per second Plus Live Traffic
- 800 Amazon EC2 instances / 3200 cloud computing cores

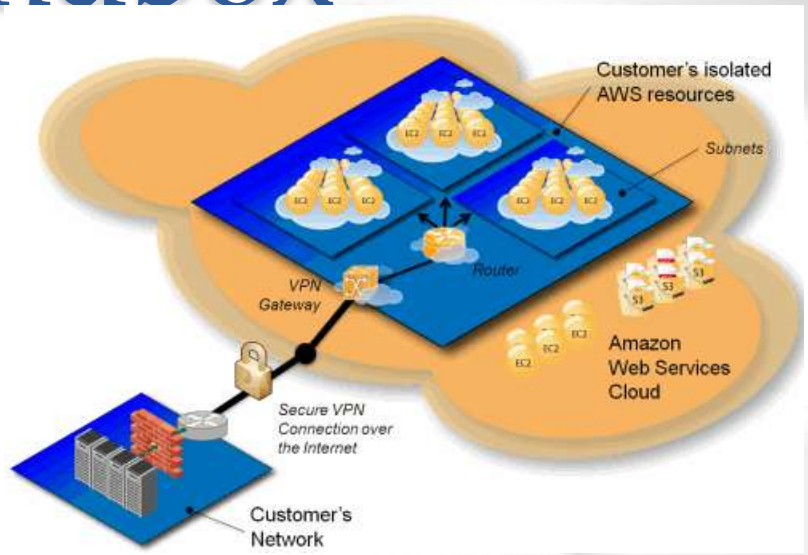
[SOASTA, 2010]

Microsoft Exchange

- Cloned itself to The Cloud
- Enterprise version had 70,000 tests running in 5000 lab servers
- How to test cloud version in production?
  - Same tests can run
    - In lab for Enterprise version
    - In **Azure** for Cloud version
- Azure Test in Production Framework
  - Outside Corp Net
  - Capacity
  - Cost
  - Manageability

Virtual Sandbox

- Production Environment
- Staging Environment
- **Dev and Testing Environment**



Can you have it all in one big Cloud?

- Amazon Virtual Private Cloud (Amazon VPC)
- Provision a private, isolated section of AWS
- IP addresses, subnets, routing tables
- Even Sandbox for Non-Cloud services

And remember the power of zero!

Test Oriented Architecture

Even Cloud Services need Testing

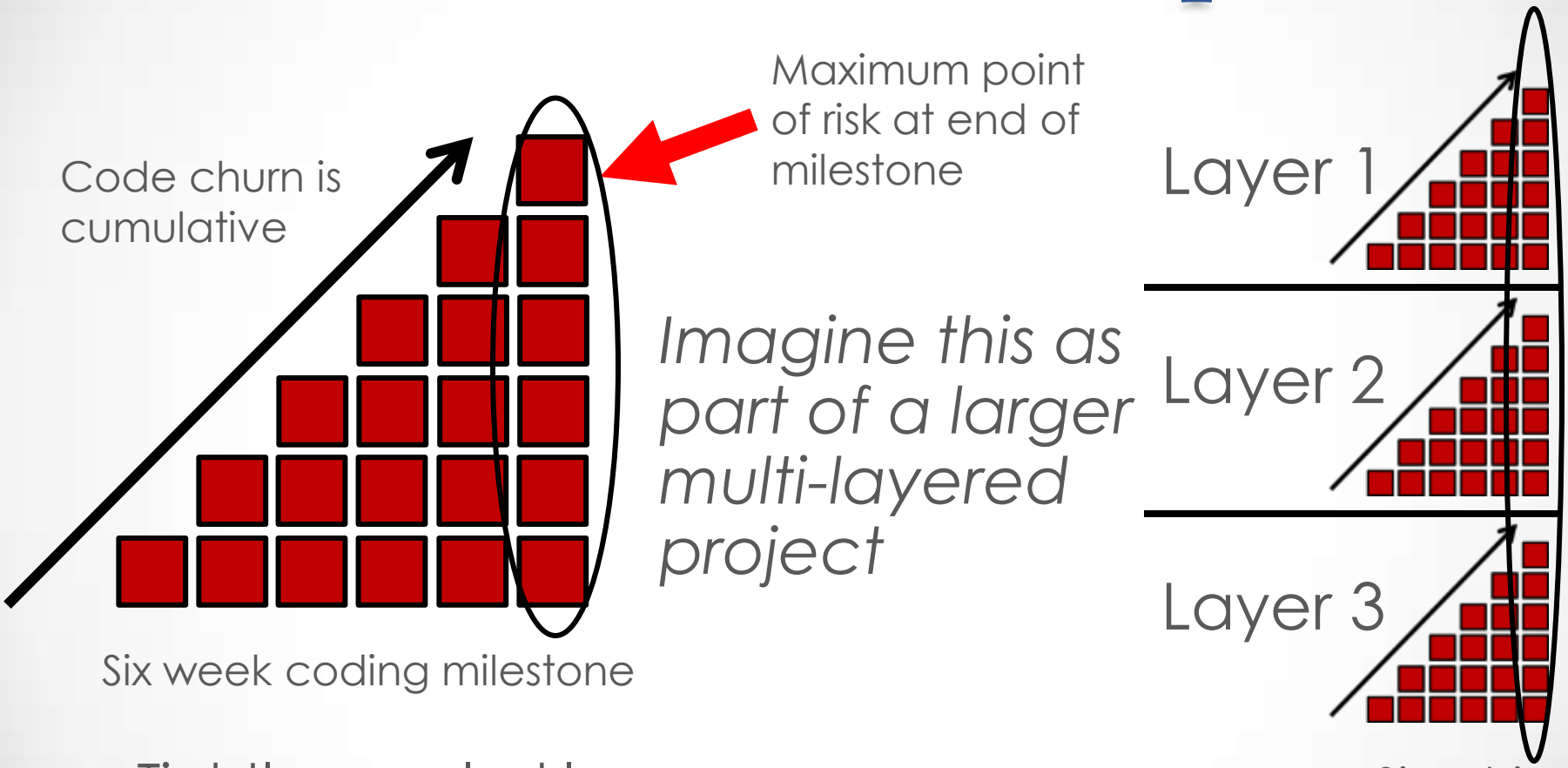
Ken's Services Theorem

- Services are like Ogres
- Ogres are like Onions
- Onions have Layers
- Therefore services have Layers

The Problem is

- The layers of a service spin at different rates
- Movement toward continuous deployment

Code Churn Example 1

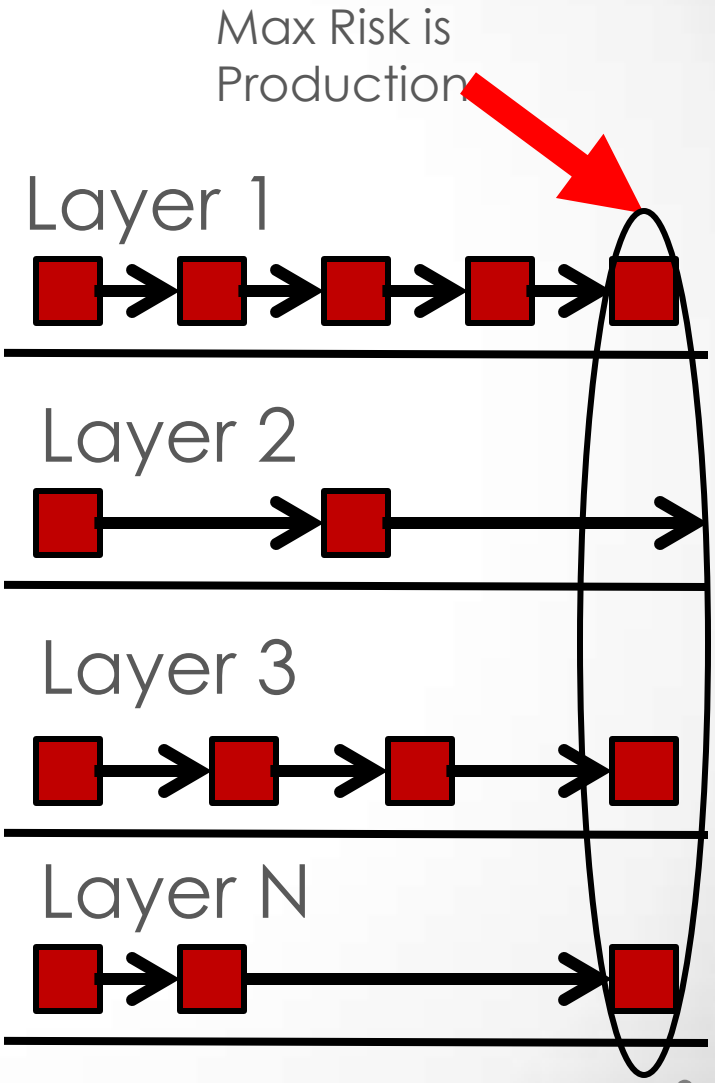


- Tightly coupled layers
- Long stabilization phase
- Complicated end-to-end integration

Code Churn Example 2 (CD)

Rapid release cadence (weekly or daily)

- Risk per release decreases because of more incremental change
- Change builds over time in production
- Next release is always the most risky



Practical TOA

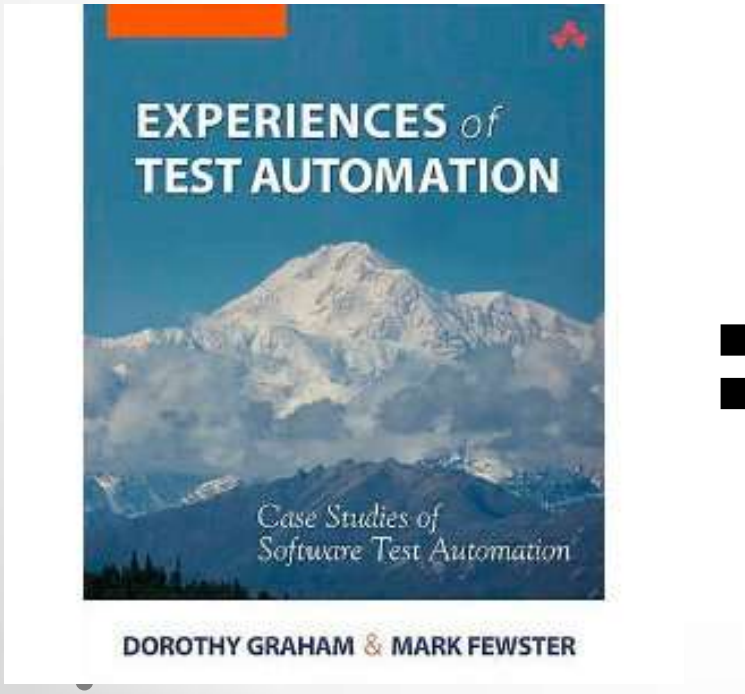
- More Loose Coupling across stack
  - Your service in the Cloud

- More Self Service Deployments
  - Automated roll forward
  - Rollback triggered by live site monitors
  - Canary deployment zones

Practical TOA

- Automated Tests and Monitors are the same thing

Heavy Test Automation



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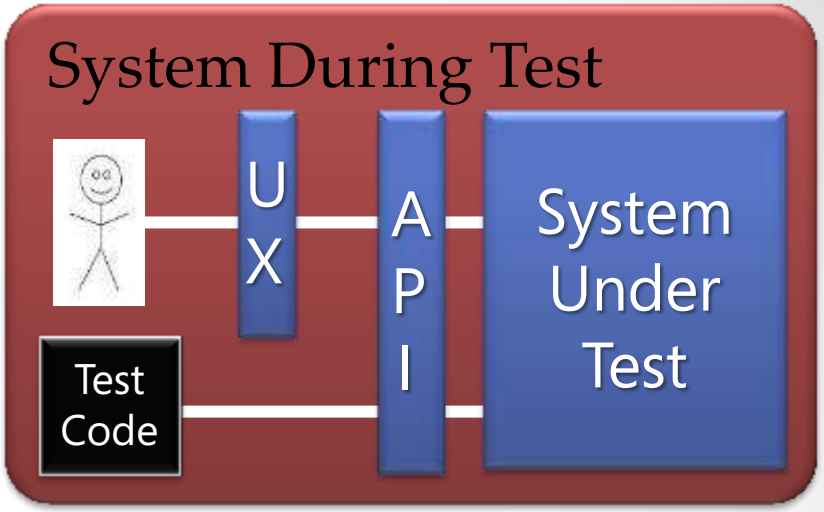
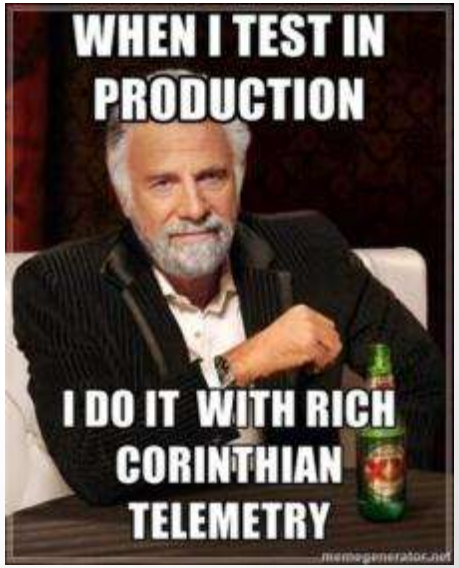
Big Live Service Monitors

Practical TOA

- Ship Test Hooks into production
  - Runtime Flags to access test path
  - Isolated Data Centers and Hosts
  - Runtime routing of traffic from v-Current to v-Next
- Rich Telemetry
  - Your services telemetry
  - Runtime flags for richer debug telemetry
  - Fix the bugs users are seeing



From *Alan Myrvold* **"Patterns of Testability"**



Summary

- About Clouds
- Cloud Rewards
- Getting Into The Cloud
- 5 Amazing Cloud Case Studies
  - Rewards, Risks & Mitigations
- Testing in The Cloud

The latest version of this slide deck can be found at:
http://www.setheliot.com/blog/bsc-east-2011/

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Thank You

Session BW7

Leaping into "The Cloud": Rewards, Risks, and Mitigations

Ken Johnston, Seth Eliot

Thank you for attending this session.
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