Scalable Architecture on Amazon AWS Cloud

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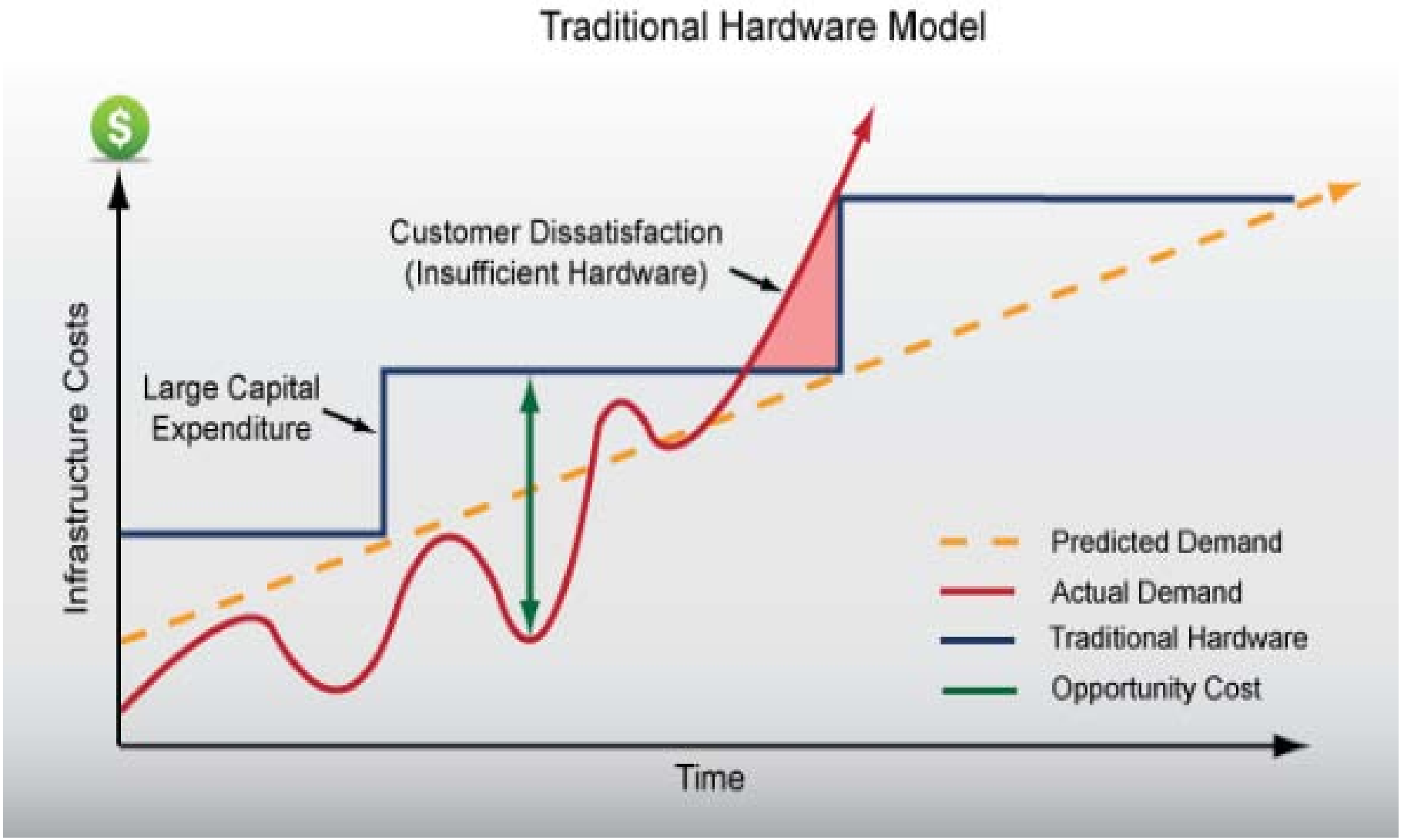
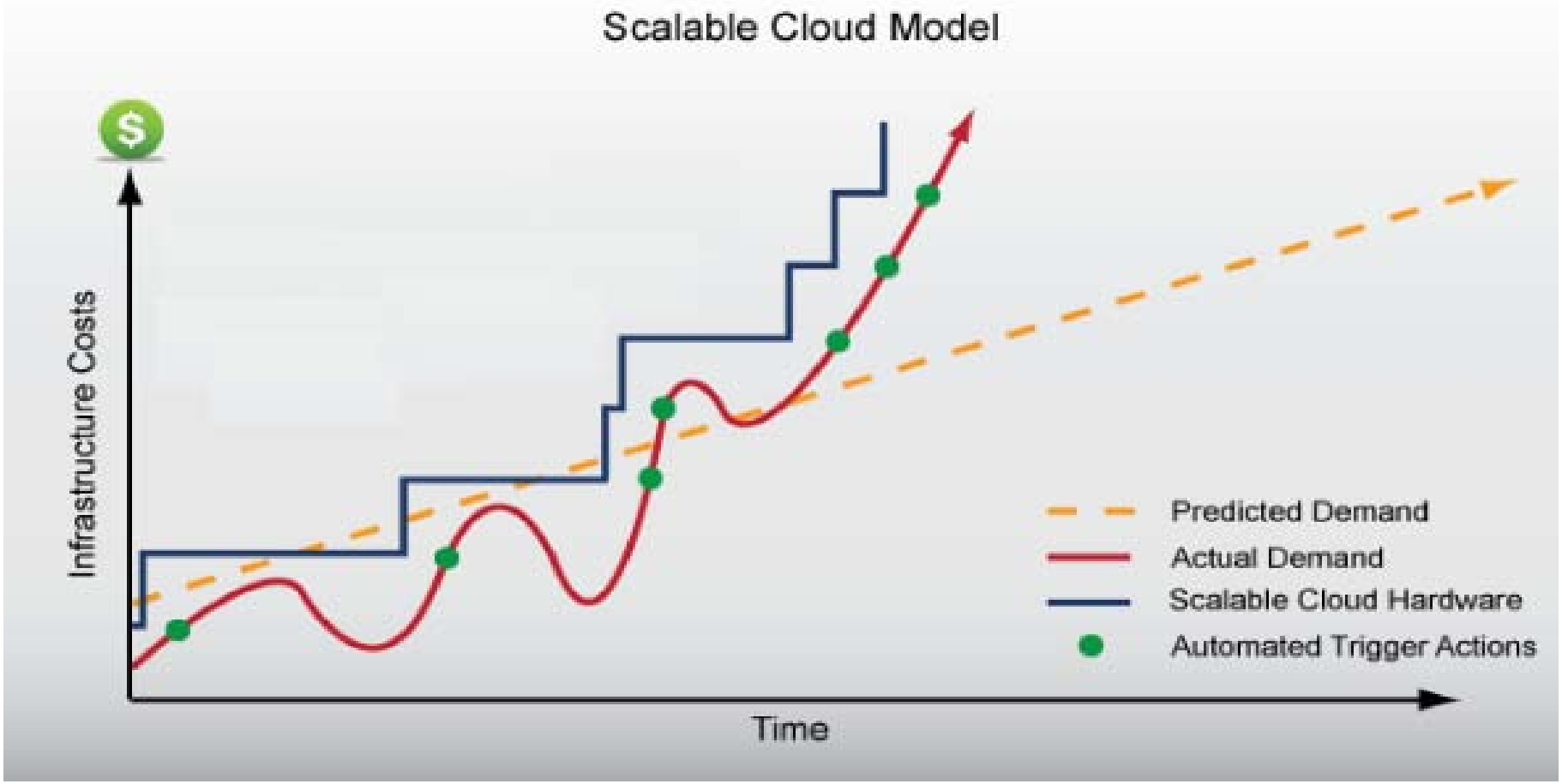


* http://www.rightscale.com/products/cloud-computing-uses/scalable-website.php



Architect to scale on-demand and provision as per current requirements

Ideal model for unpredictable and variable loads

Scalability Requirements

- Increase in resources → Increase in performance
- Predictability
- Low Latency
- High Reliability
- Dynamism: Number of users, volume of data, skews
- Operational efficiency
- Costs should not scale ☺

{Elasticity, Scalability, Resiliency}

Scalability Perspectives

- What needs to scale?
  - Compute
  - Memory
  - Network
  - Storage
  - Monitoring
  - IO Latency
  - Provisioning time
  - Backup / Restore times
  - Failover
  - Ops
- Vertical scalability
- Horizontal scalability
- Scale across geographies
- HPC workloads
- Data Processing workloads

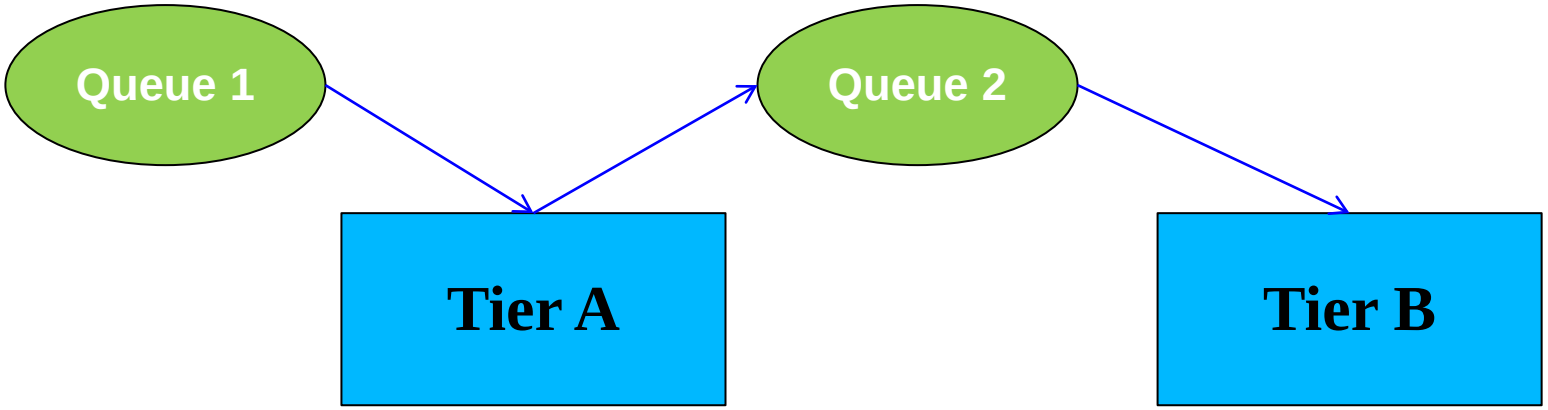
Vertical Scalability

- When scale is predictable and linear
- When you do not want to spend on re-architecting the application or deployment
- Increase instance sizes
  - 1 – 33.5 EC2 Compute Units
  - 613MB memory to 68GB memory
  - Size or number of EBS disks
- HPC Instances
  - 10 Gigabit ethernet
  - Higher IOPS for EBS disks

Limitations….

Scaling multi-tier stacks – 1

- Service Oriented Architecture
  - Loosely coupled
  - Standard service contracts
  - Web Services
  - Enables independent tiers for deployment & management
- Messaging / Queue layer



Scaling multi-tier stacks – 2

- Amazon SQS: Reliable, scalable, hosted queue; exposed as web service
- RabbitMQ: Open-source HA messaging system, clustering support
- BeanStalkD: Simple, fast work queue

Clustering Application Servers

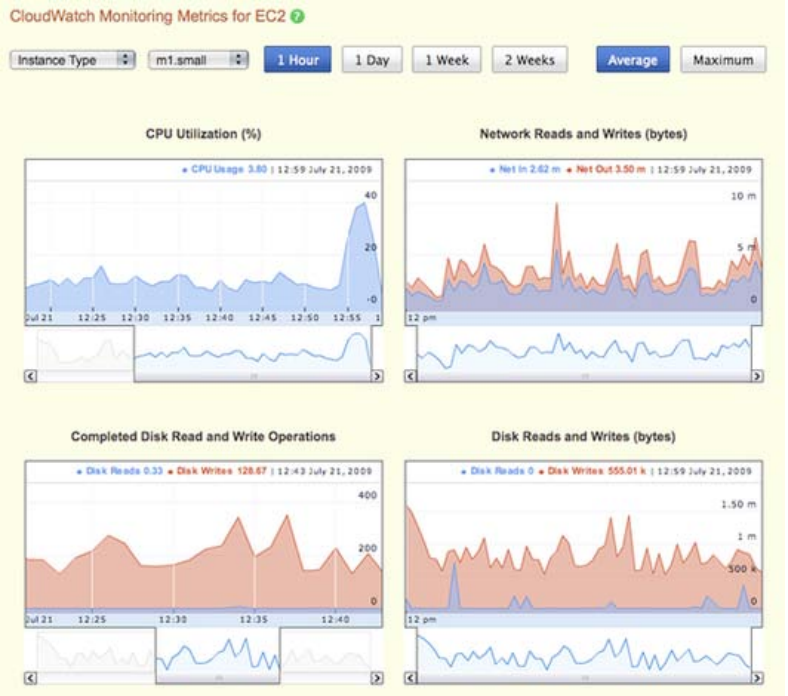
- JBoss App Server, IBM WebSphere Application Server
- Add or remove nodes on the fly – automate through scripting
- Stateless behavior can be added when necessary
- VPC does not work across availability zones (AZ) – in the pipeline though

Elastic Load Balancing, Auto Scaling

- **Amazon Elastic Load Balancing**
  - Distributes incoming traffic to your application across several EC2 instances
  - Detects unhealthy instances and reroutes traffic
- **Auto-Scaling**
  - Enabled by CloudWatch: Monitoring, custom metrics, free tier, graphs and statistics
  - Rule-based automatic scaling of your EC2 capacity
  - Based on metrics including resource utilization, software stack metrics or custom metrics
  - N+1 redundancy

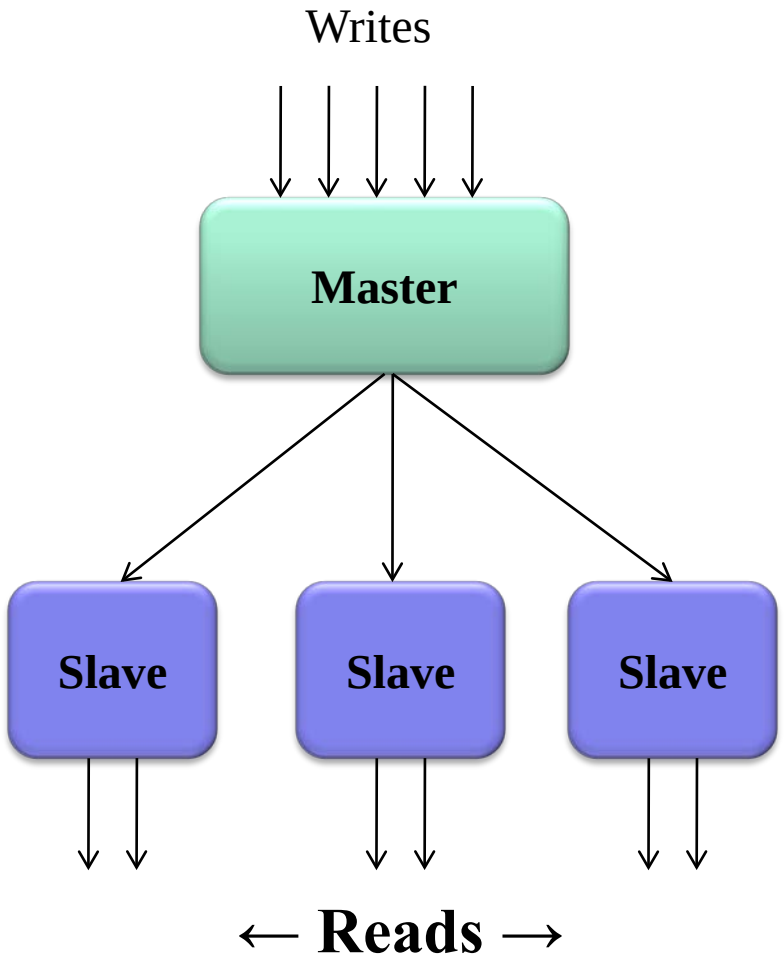
Monitoring & Logging

- **Amazon CloudWatch**
  - Monitoring for AWS cloud resources & applications
  - Collect and track metrics – CPU, latency, request counts, custom metrics
- **Monitoring with your own tools**
  - Using Hyperic or Nagios for monitoring specific layers of your stack or to leverage existing investments
- **Logging**
  - No dependency on instances – copy necessary logs to S3 periodically



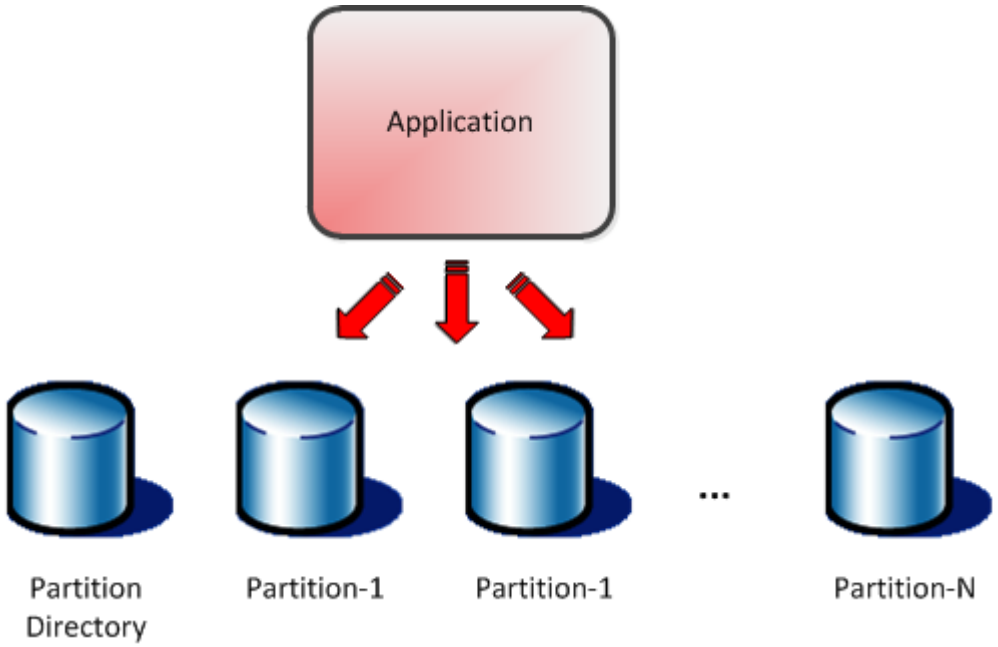
Databases - Replication

- Master-Slave Replication (MySQL, Oracle RAC)
- Writes on master
- Reads distributed across slaves
- Works well in read mostly scenarios
- Slave lag issue



Databases – Sharding - 1

- Partition data across masters
- Writes & Reads are distributed
- Application needs modification
- Needs choice of partitioning strategy for uniform data distribution



Databases – Sharding - 2

- **Issues**
  - Joins cannot be performed across shards
  - Application modification can be expensive
- **Example**
  - Evernote uses database sharding – localized failures, no need for joins
  - Each shard handles all data & traffic for about 100,000 users

http://blog.evernote.com/tech/2011/05/17/architectural-digest/#

Databases – Amazon SimpleDB

- Schema-less distributed key-value store
- Highly reliable and scalable (redundancy across geos)
- Automatic indexing of columns
- API based global access
- Supports multiple values for key/attributes
- Eventual consistency or consistency – speed or consistency?
- **Limitations**
  - No joins, No transactions, No aggregators, text searches
- **NoSQL**
  - MongoDB, Cassandra, Redis

Databases – Amazon RDS

- Relational Database Service (RDS) from AWS
- Scale your DB layer with minimum administration
- MySQL and Oracle supported
- Import existing databases & no changes to applications
- Multi-AZ deployments supported
- Manages backup of your database and enables restore from DB snapshots

Reserving Scalability

- Reserved Instances
  - AWS has finite hardware capacity
  - Provisioning times can vary
  - Use few reserved instances to “book” capacity in advance (also take advantage of lower prices)
  - Can be done across availability zones to ensure DR
- Larger EBS disks
  - Create larger EBS disks to ensure better performance
  - Netflix creates 1TB disks in this manner

Scalability using PaaS

- Amazon Elastic Beanstalk
  - Platform-as-a-Service with deployment, capacity provisioning, load balancing, auto-scaling & application health monitoring
  - Application versioning support (rollback if needed)
  - Uses EC2, S3, RDS, SimpleDB, Load Balancer, CloudWatch
  - Retain control of your infrastructure if desired
- Other PaaS products
  - CumuLogic, CloudBees, DotCloud, PHP Fog
  - Java, PHP, RoR, MongoDB, MySQL……

Elastic MapReduce (PaaS)

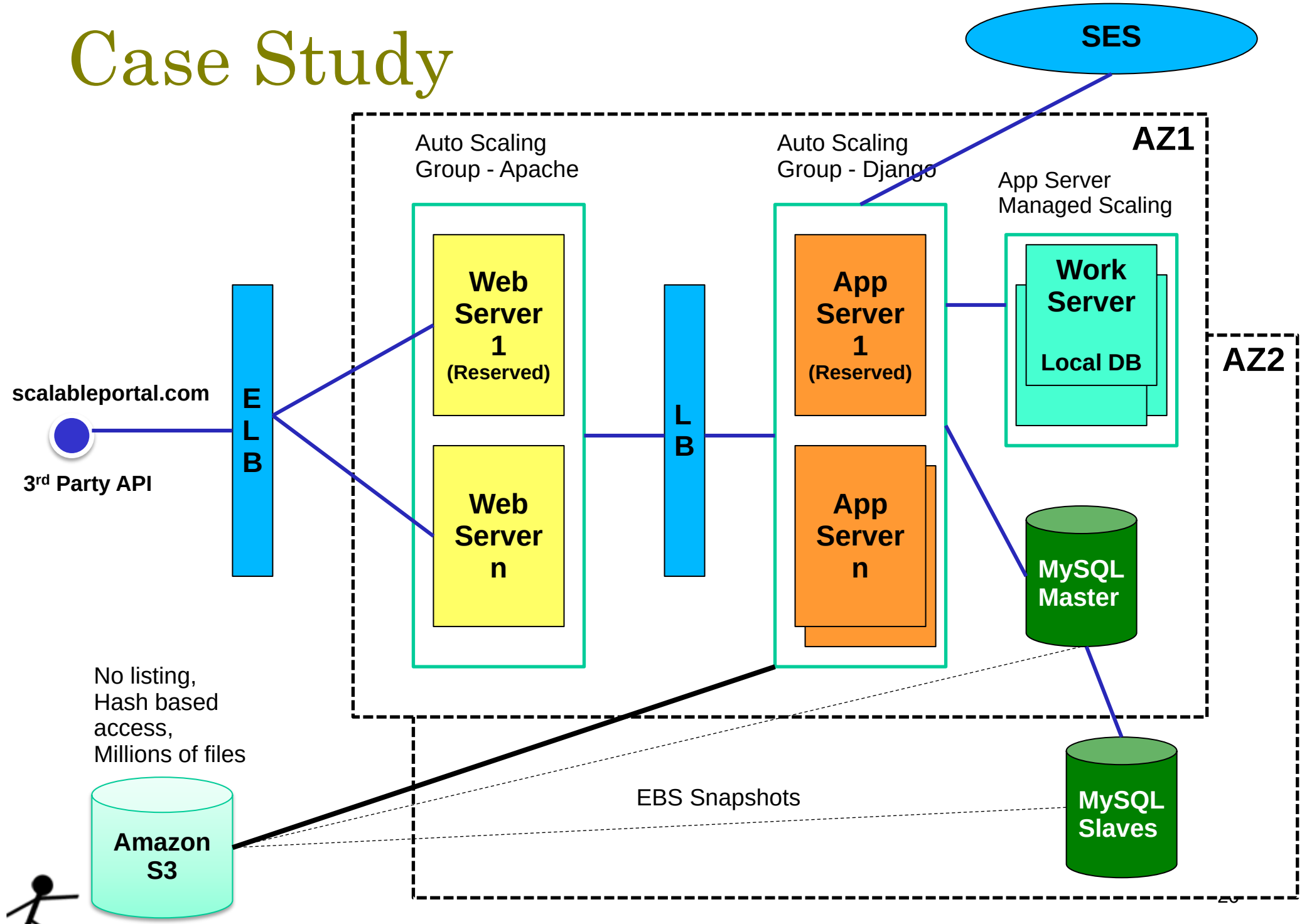
- Hosted Hadoop Framework
  - Manages job flows & provisioning of all infrastructure
  - AWS Console to create & manage workflows
  - Supports custom jars, Hive, Pig, streaming & processing in multiple languages/stacks
  - Debug & profile jobs
  - Run across geographies
- Data processing, analytics

Scalable Managed MapReduce Platform

Automation for managing scale

- CloudFormation
  - Templatize your stack
  - Predictable provisioning of your stack
- RightScale
  - Sophisticated cloud management platform
  - Templates, automation, orchestration, portability
- Tools, Connectors, Enablers
  - Automated orchestration & setup
  - Snapshot management
  - Monitor security groups and firewalls

Case Study


SES
AZ1
Auto Scaling
Group - Apache
Auto Scaling
Group - Django
App Server
Managed Scaling
Web
Server
1
(Reserved)
Web
Server
n
L
B
App
Server
1
(Reserved)
App
Server
n
Work
Server
Local DB
AZ2
scalableportal.com
E
L
B
3rd Party API
MySQL
Master
No listing,
Hash based
access,
Millions of files
EBS Snapshots
Amazon
S3
MySQL
Slaves

There are some limits…

- EC2 has limit of 20 instances
- S3 has limit of 100 buckets
- Simple Email Service (SES) has a daily sending quota

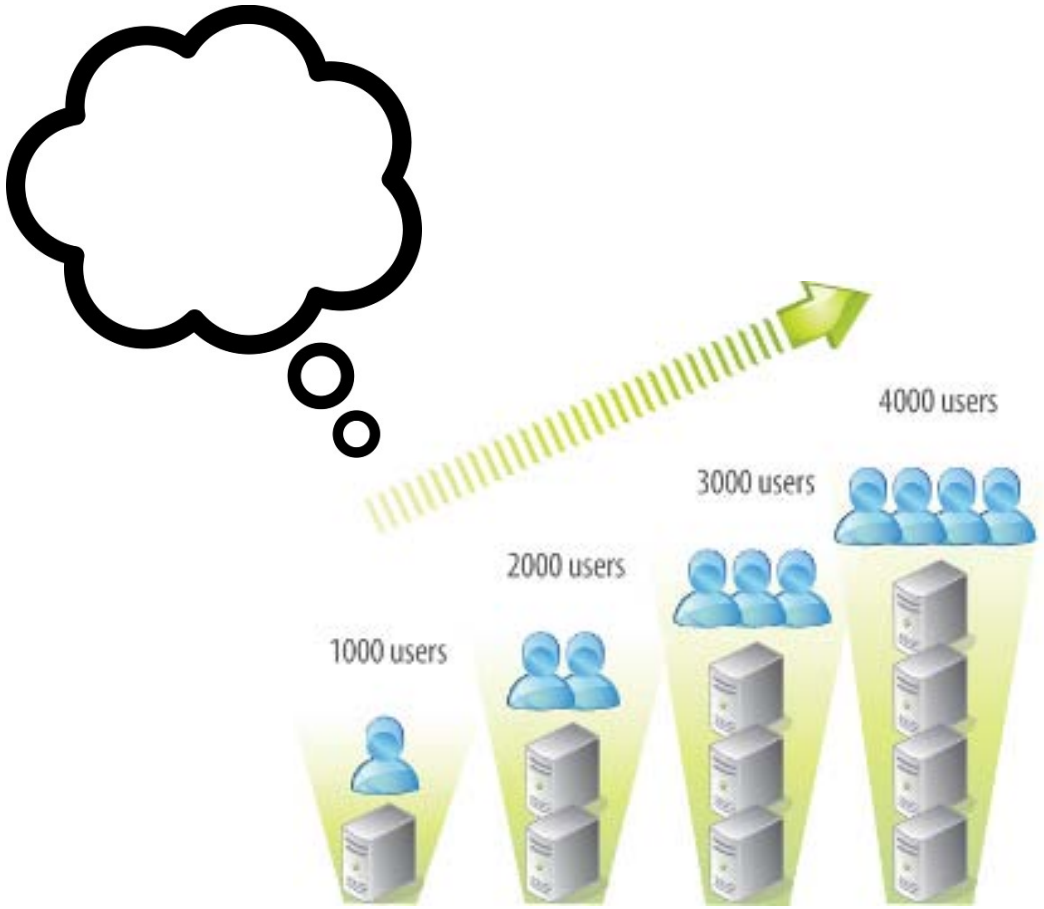
NOTE: All of these limits can be increased or waived by requesting AWS. Ensure to do this before you hit the limits in production.

Scale but minimize costs - 1

- **Use of Reserved Instances**
  - Commitment for upto 1-3 years with some upfront payment
  - Actual usage cost is much lower
  - If used for more than 6 months in a year, can be 30-45% cheaper than on-demand instances
- **Reduced Redundancy Storage**
  - Reduce costs by storing non-critical data at lesser redundancy and lesser availability/durability of 99.99%
- **Instance Sizes**
  - Run some smaller instances as part of clusters

Scale but minimize costs - 2

- **Data Transfer beyond 10TB**
  - Consolidate AWS accounts so that higher usage translates to saved costs. $0.15 upto 10TB and $0.11 beyond 10TB.
- **Identify extra capacity**
  - Use monitoring to identify unused capacity & optimize
- **Spot Instances**
  - Bid for unused capacity – choose your maximum price
  - Get more within your existing budget



Questions?