

# OpenStack

and the new Software-Defined World



# Zot Inc.

- IT consultants to the Intelligence Agencies
- Primarily NSA
- IT architectures and infrastructures
- Virtualization



"Your Trusted IT Advisor"

# Agenda

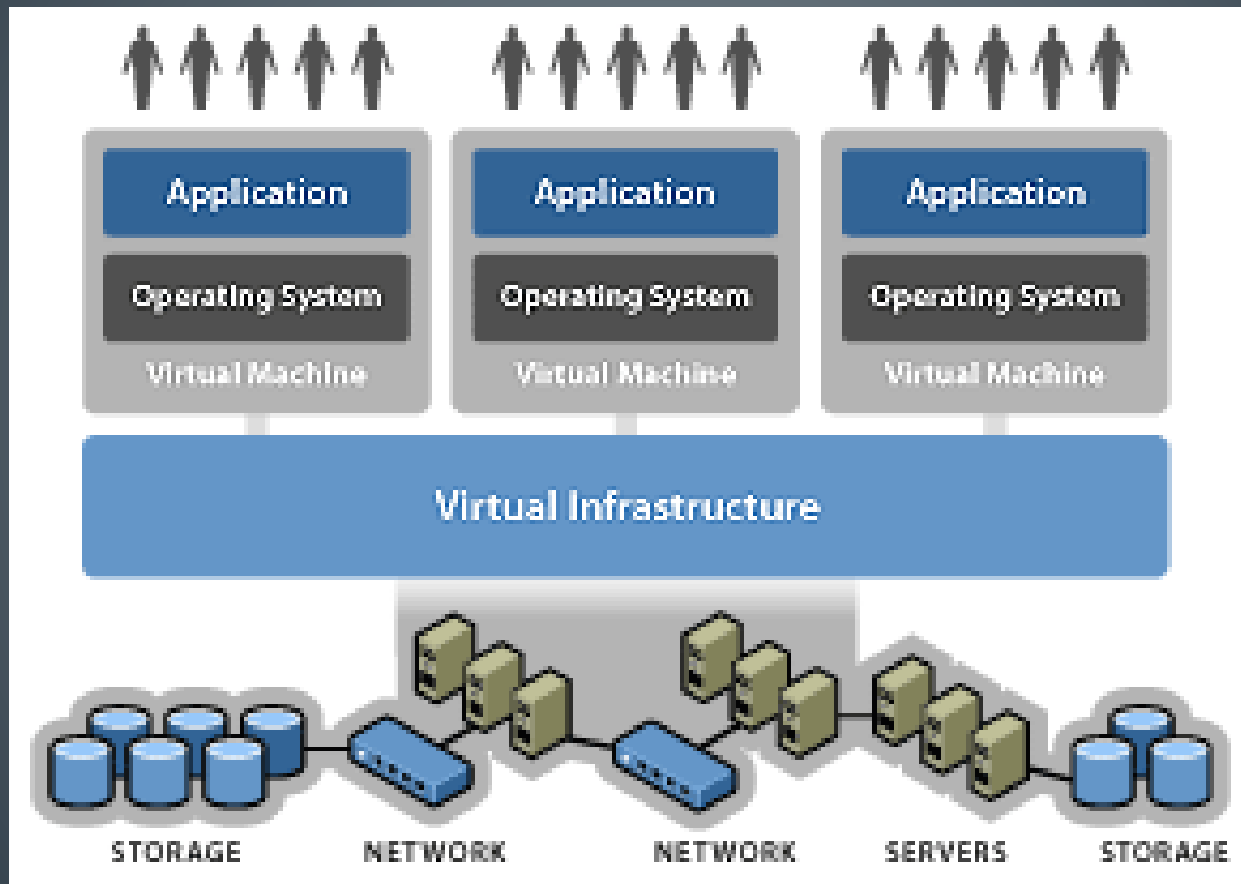
Deconstructing the Cloud – Answers to burning questions like:

- What is virtualization?
- History of Virtualization
- State of the art
- What's in a cloud?
- Directions

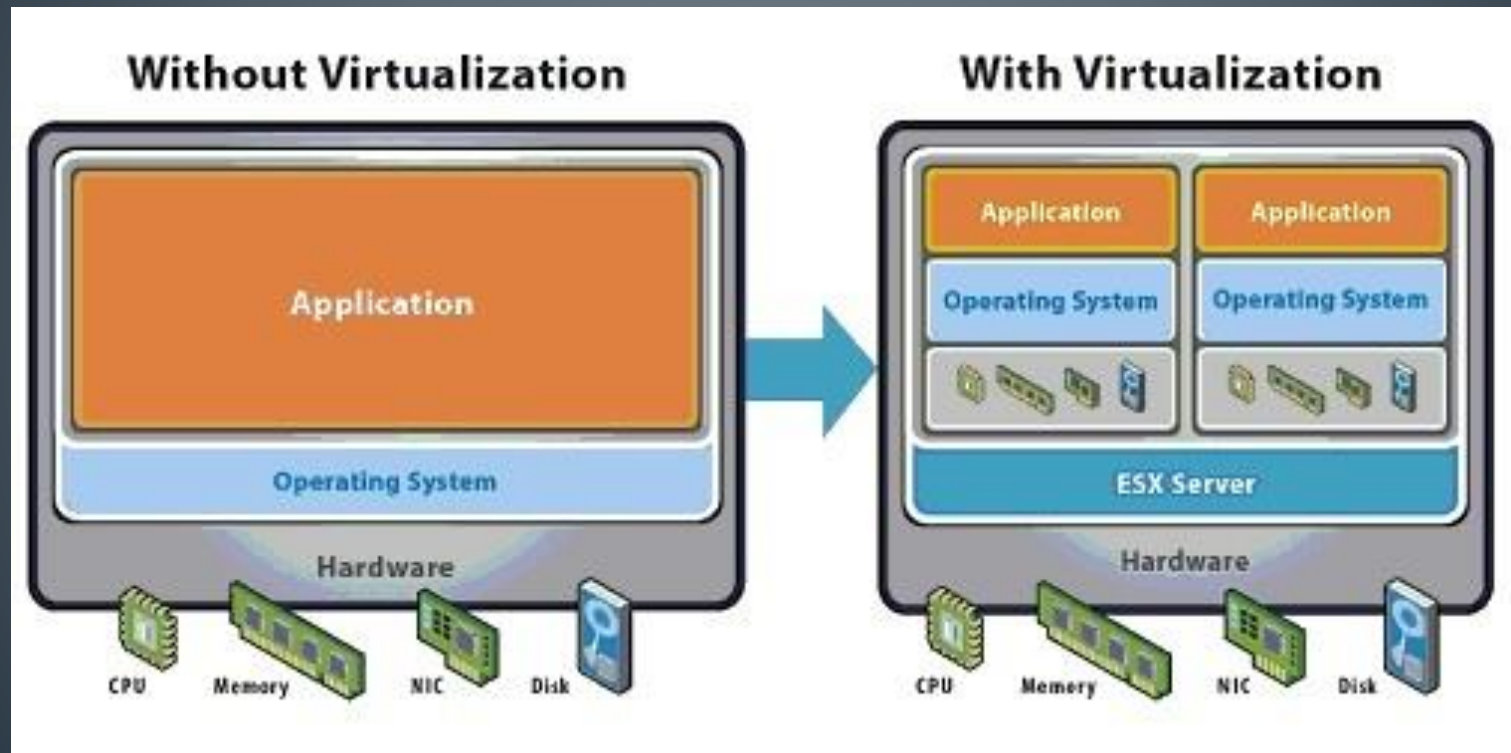
# What is virtualization?

- Layer of abstraction
- Multiplexing
- Mainframes
- Why aren't we all on terminals?
  - Compute as a Utility described in the 1950s

# What is Virtualization?



# What is Virtualization?



# History of Modern Virtualization



**amazon**  
web services™



# Vmware

- The Pizzabox
- 1 OS 1 App
- X86 underutilization
- Power space and cooling





# Products - Workstation

The image displays a VMware Workstation interface running a Windows 8 virtual machine. On the left, a Bing Sports sidebar shows MLB game results for August 3rd. The main window shows a file explorer with a library of virtual machines and a browser displaying the VMware website. The website features a banner for 'Begin Your Cloud Journey' and various resource links.

**BING SPORTS**

MLB

AUG 3 FINAL

Marlins	4
Nationals	7

Top of 3 STON

Indians	1
Tigers	1

Top of 3 ROOT

Mariners	0
Yankees	0

Bottom of 3 FxAZ

Diamondbacks	1
Phillies	0

Top of 2 FxNo

Twins	1
Red Sox	0

Bottom of 2 ROOT

Pirates	0
Reds	1

Top of 2 MASN

Orioles	0
Rays	0

Top of 1 FoxH

Astros	0
Braves	0

Library

- My Computer
  - Windows 8 DP x64
  - Windows 8 RP x64
  - Fedora 15 x64
  - Windows XP Pro x32
  - Windows 7 Pro x64
  - VMware ESXi 5
  - Ubuntu 12 LTS x32
  - Autodesk 2012 ADN
  - Ubuntu 11.04 x64
  - Windows 7 Games
  - Fedora 17 x64
  - Micro Cloud Foundry
- Shared VMs
  - VMware ESXi 5-1
  - VMware ESXi 5-2
- bfg-u002.eng.vmware.com
  - Christian Test 2
  - clahey-actual
  - clahey5
  - clahey5
  - clahey\_tiny
  - Device-monger
  - docs.eng.vmware.com
  - echnris
  - echnris-deleteMe (1)
  - hog-dashboard.eng.vmware.com
  - jameslin-snapshot-test
  - jameslin-test
  - Kubunt1204 (1)
  - mdunn\_test@guest
  - sgupte-test
  - shartwell-webserver
  - Ub1204v64
  - Ubuntu 12.04 64-bit (1)
  - Windows XP Professional x64 Edition (2)
  - wks-vc1.eng.vmware.com

http://www.vmware.com/

vmware

United States [change] Search

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Cloud Computing Virtualization Solutions Products Services Support & Downloads Partners Con

Begin Your Cloud Journey

VMware Empowers Small Business TUI InfoTec to Deliver Innovative Cloud Services

Learn More

Server & Datacenter Desktop Virtualization Cloud Computing Application Platform Small & Midsize Business

Latest VMware to Acquire Nicira - July 23, 2012

VMware Forum 2012  
Attend a free virtualization event with VMware product experts and Hands-On Labs.  
Register Now

ESXi and ESX Info Center  
Plan your migration to VMware ESXi. Improve product experts and Hands-On Labs.  
Learn More

Introduction to Virtualization  
Learn how to reduce costs, increase availability and security, and empower teams.  
Register Now

Technical Resources

- The VMware Advantage
- Virtual Networking
- Virtual Storage
- Virtual Security
- Virtualization Management
- Script Automation

How To Get It

- Download Free Trial
- Contact Sales
- Find a Partner
- Buy VMware
- Get Volume Discount

Get Support

- Downloads & Patches
- Product Support Centers
- Manage Licenses
- Search the Knowledge Base

Community

- VMTH Communities
- VMware Blogs
- VMware on Twitter
- VMware on Facebook
- VMware on YouTube
- Community Terms of Use

Windows 8 Release Preview  
Evaluation copy, Build 8400

To direct input to this VM, move the mouse pointer inside or press Ctrl+G.

# Products – Server (GSX)

10.1.1.90 - VMware Infrastructure Client

File Edit View Inventory Administration Plugins Help

Inventory Administration

wellvm3.racp.org.nz.racp.org.nz

- Alfresco
- HypericHQ
- Squid Proxy
- WhichDoctor I
- WhichDoctor II

wellvm3.racp.org.nz.racp.org.nz VMware Server, 2.0.0, 116503

Getting Started Summary Virtual Machines Performance Configuration Events Permissions

CPU/Real-time, 10/3/2008 10:58:59 AM - 10/3/2008 11:58:59 AM Change Chart Switch to: CPU

Graph refreshes every 20 seconds

Performance Chart Legend

Key	Object	Measurement	Units	Latest	Maximum	Minimum	Average
■	wellvm3.racp.or...	CPU Usage in MHz (Average)	MHz	0	2766	0	678.41
■	0	CPU Usage (Average)	Percent	0	35	0	9.10
■	wellvm3.racp.or...	CPU Usage (Average)	Percent	0	0	0	0
■	3	CPU Usage (Average)	Percent	0	40	0	7.98
■	2	CPU Usage (Average)	Percent	0	50	0	7.01
■	1	CPU Usage (Average)	Percent	0	35	0	7.79

Recent Tasks

Name	Target	Status	Initiated by	Time	Start Time	Complete Time
Power On Virtual Mach...	Alfresco	Completed	root	10/3/2008 11:49:36 A	10/3/2008 11:49:36 ...	10/3/2008 11:49:38 ...

Tasks root

# Products - ESX

There are vCenter Server instances with expiring license keys in your inventory. [Details...](#)

vmware® vSphere Web Client



root@localhost

Help

Search

vCenter

VMware vCenter Server Appliance

Getting Started Summary Monitor Manage Related Objects

localhost

- BlueShiftLab
  - 192.168.59.130
    - Server01
      - VMware vCenter Server Appliance

**VMware vCenter Server Appliance**

Guest OS: SUSE Linux Enterprise 11 (64-bit)  
Compatibility: ESXi 4.x and later  
VMware Tools: Running (3rd-party/Independent)  
DNS Name: localhost  
IP Addresses: 192.168.59.129  
View all 2 IP addresses  
192.168.59.130

Host:

CPU USAGE: 224 MHz  
MEMORY USAGE: 496 MB  
STORAGE USAGE: 17 GB

Powered On

Launch Console

**VM Hardware**

CPU	2 CPU(s), 224 MHz used
Memory	8192 MB, 496 MB used
Hard disk 1	25.00 GB
Hard disk 2	60.00 GB
Network adapter 1	VM Network (connected)
CD/DVD drive 1	Disconnected
Video card	4.00 MB
Other	Additional Hardware
Compatibility	ESXi 4.x and later

Edit Settings...

**VM Storage Profiles**

VM Storage Profiles	--
Profile Compliance	--
Last Checked Date	--

**Tags**

Assigned Tag	Category	Description
This list is empty.		

Assign...

**Recent Tasks**

All Running Failed

My Tasks More Tasks

**Work In Progress**

**Alarms**

All (1) New (1) Acknow...

localhost

Health status monitoring

# Amazon/Eucalyptus

- Big server farm
- Excess capacity
- Proposal for an external service in 2004
- Opened for business in 2006
- Exceeds \$1 billion in revenue 2011
- Crashes on Christmas 2012 (Netflix)

# Amazon EC2 Features

- Elastic Block store – cloud storage
- Amazon Cloud Watch – health and status
- Auto scaling – spawn instances on demand
- Elastic Load Balancing – distribute network load evenly among instances
- High performance computing - clusters
- VM import/export – build it at home, move it to the cloud

# Amazon EC2 Model

- **Free Tier\***
- As part of [AWS's Free Usage Tier](#), new AWS customers can get started with Amazon EC2 for free. Upon sign-up, new AWS customers receive the following EC2 services each month for one year:
- 750 hours of EC2 running Linux/Unix Micro instance usage
- 750 hours of EC2 running Microsoft Windows Server Micro instance usage
- 750 hours of Elastic Load Balancing plus 15 GB data processing
- 30 GB of Amazon EBS Standard volume storage plus 2 million IOs and 1 GB snapshot storage
- 15 GB of bandwidth out aggregated across all AWS services
- 1 GB of Regional Data Transfer

# Amazon EC2 Pay as you go

Region: <input type="text" value="US East (N. Virginia)"/>		
	Linux/UNIX Usage	Windows Usage
<b>Standard On-Demand Instances</b>		
Small (Default)	\$0.065 per Hour	\$0.115 per Hour
Medium	\$0.130 per Hour	\$0.230 per Hour
Large	\$0.260 per Hour	\$0.460 per Hour
Extra Large	\$0.520 per Hour	\$0.920 per Hour
<b>Second Generation Standard On-Demand Instances</b>		
Extra Large	\$0.580 per Hour	\$0.980 per Hour
Double Extra Large	\$1.160 per Hour	\$1.960 per Hour
<b>Micro On-Demand Instances</b>		
Micro	\$0.020 per Hour	\$0.020 per Hour
<b>High-Memory On-Demand Instances</b>		
Extra Large	\$0.450 per Hour	\$0.570 per Hour
Double Extra Large	\$0.900 per Hour	\$1.140 per Hour
Quadruple Extra Large	\$1.800 per Hour	\$2.280 per Hour
<b>High-CPU On-Demand Instances</b>		
Medium	\$0.165 per Hour	\$0.285 per Hour
Extra Large	\$0.660 per Hour	\$1.140 per Hour
<b>Cluster Compute Instances</b>		
Quadruple Extra Large	\$1.300 per Hour	\$1.610 per Hour
Eight Extra Large	\$2.400 per Hour	\$2.970 per Hour
<b>Cluster GPU Instances</b>		
Quadruple Extra Large	\$2.100 per Hour	\$2.600 per Hour
<b>High-I/O On-Demand Instances</b>		
Quadruple Extra Large	\$3.100 per Hour	\$3.580 per Hour
<b>High-Storage On-Demand Instances</b>		
Eight Extra Large	\$4.600 per Hour	\$4.931 per Hour

# Amazon EC2

The screenshot displays the AWS Management Console interface in a Windows Internet Explorer browser. The page title is "AWS Management Console - Windows Internet Explorer". The address bar shows the URL "https://console.aws.amazon.com/ec2/home#c=EC2&s=Instances". The browser's search bar is set to "powered by YAHOO! SEARCH". The console header includes navigation links for "Home", "Your Account", and "AWS Management Console BETA", along with a welcome message for "kishorekumar\_62@yahoo.com" and a "Sign Out" link.

The main content area is divided into several sections:

- Navigation:** Includes a "Region" dropdown set to "US-East" and a list of navigation links such as "EC2 Dashboard", "Instances", "AMIs", "Bundle Tasks", "Volumes", "Snapshots", "Elastic IPs", "Key Pairs", and "Security Groups".
- My Instances:** Features a toolbar with "Launch Instance", "Reboot", "Terminate", "Connect", "Output", and "More Actions" buttons. A "Showing: All Instances" dropdown and a search box are also present. A table lists the instance details:

Instance	AMI ID	Zone	Security Group	Type	Status	Platform	Key Pair
<input checked="" type="checkbox"/> i-2392ff4a	ami-0529ce6c	us-east-1a	basicwin32	m1.small	running	windows	basicwin

A context menu is open over the instance, listing actions: "Reboot", "Terminate", "Launch more like this", "Connect Help", "Get System Log", "Get Default Administrator Password", and "Bundle Instance".

Below the table, a section titled "1 EC2 Instance selected" provides detailed information for the selected instance:

- Instance:** i-2392ff4a
- AMI ID:** ami-0529ce6c
- Zone:** us-east-1a
- Security Groups:** basicwin32
- Type:** m1.small
- Status:** running
- Owner:** 970757705789
- Reservation:** r-8bf871e2
- Ramdisk ID:** -

The footer of the console contains copyright information: "© 2008, Amazon Web Services LLC or its affiliates. All right reserved." and links for "Feedback", "Support", "Privacy Policy", and "Terms of Use". It also identifies the company as "An amazon.com company".



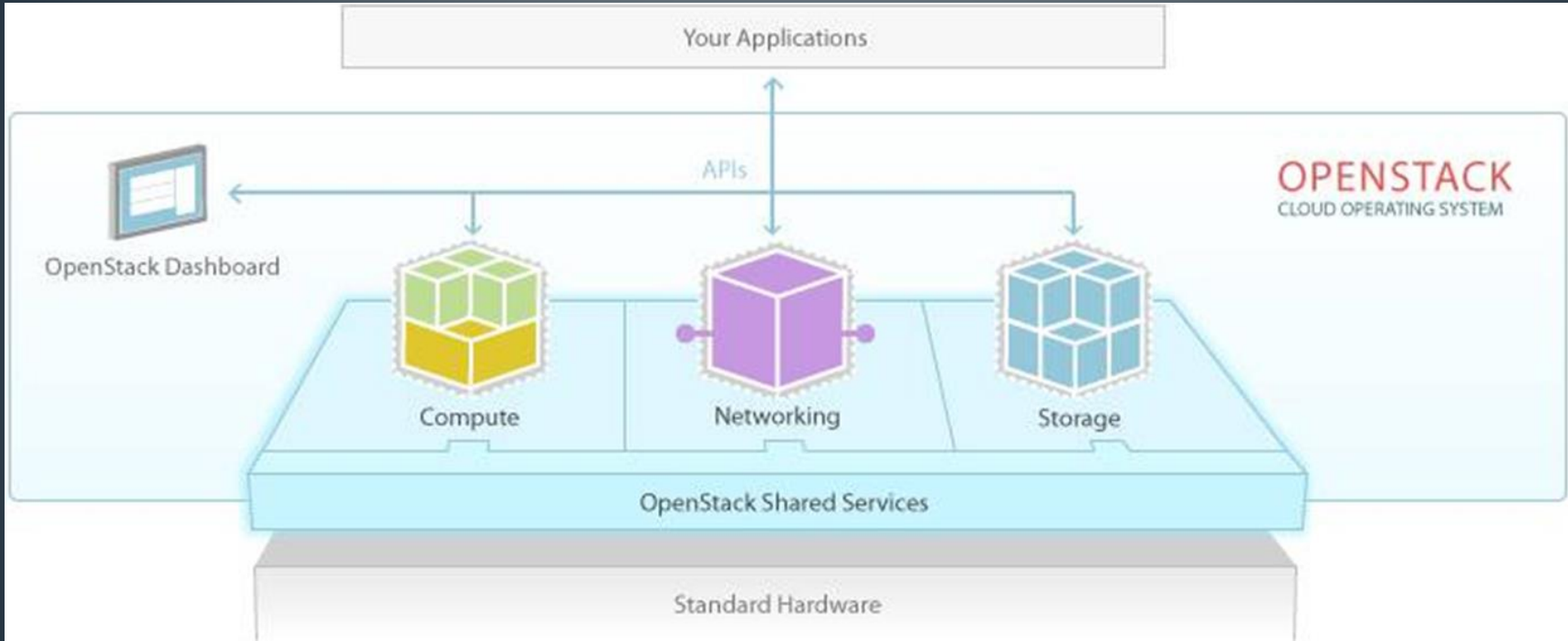
# Eucalyptus

- Open source version of EC2
- Now partnered with Amazon
- Allows public private transitions – hybrid clouds

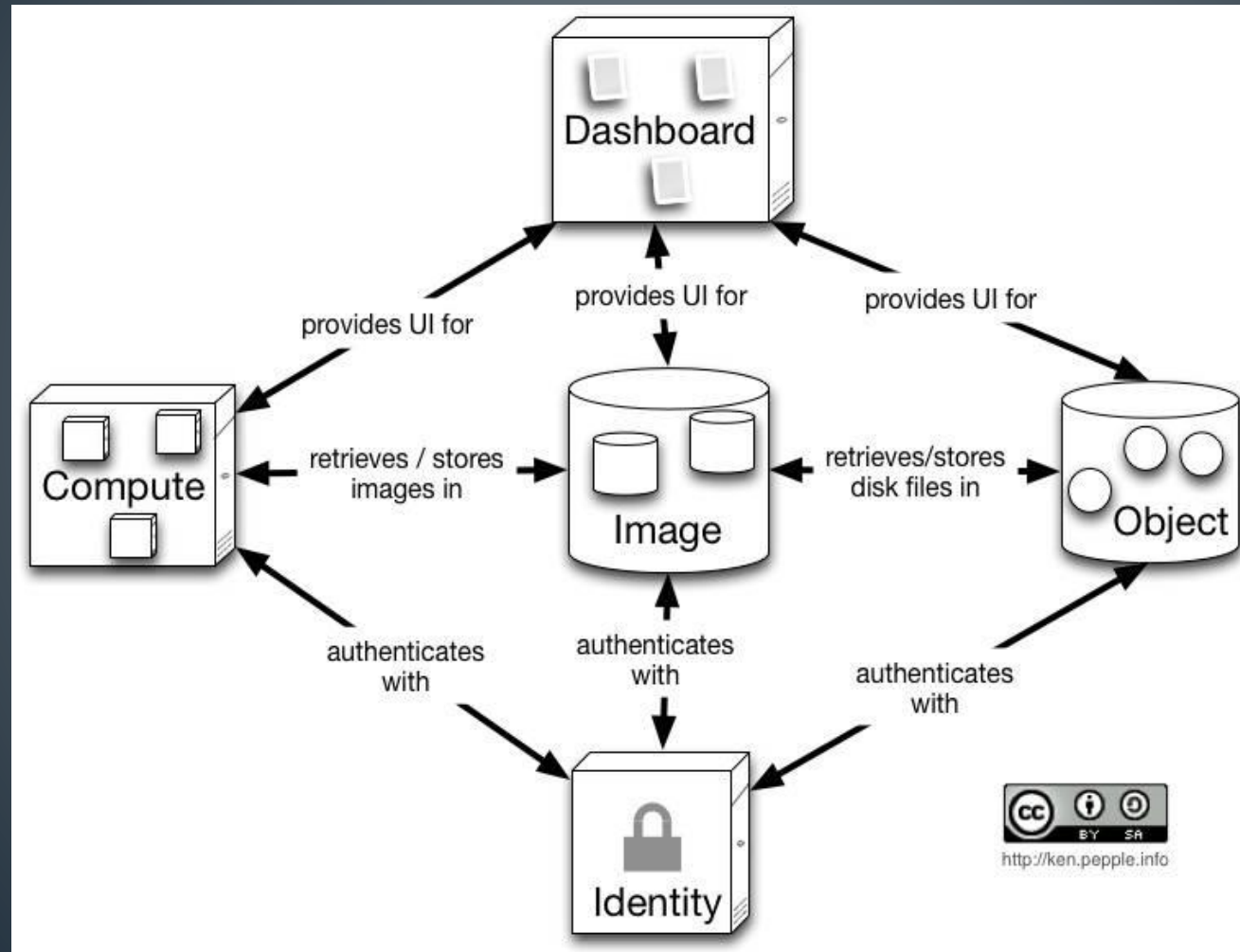
# OpenStack

- July 2010 – NASA and Rackspace announce OpenStack release Austin
- The back story
  - Early summer 2010 “Apache-Licensed Cloud Computing, in Python. It’s live, it’s buggy, it’s beta. Check it out.”
  - Rackspace begins parallel development
  - NASA and Rackspace meet for Thai food
  - Working at the Rainbow Mansion
  - 5 weeks later . . . NASA administrators agree to release everything under the Apache license
- June 2012, NASA moves its compute architecture to Amazon

# OpenStack Architecture



# OpenStack Architecture



# OpenStack Compute

- Nova - Openstack defines as compute, but is really a manager of compute assets
- nova-api - interprets commands
- nova-scheduler- determines where to run VM
- nova-compute - start VM
- nova-network - assign address
- Not a hypervisor – sits on top

# OpenStack Network

- Quantum (Folsom release)
- Virtual Distributed switch/Nexus 1000v
- Essex release - simple flat, DHCP, VLAN, Floating IPs (NAT)
- Network proxy node
- Bridging

# OpenStack Storage

- Glance – image repository (MySQL database)
- Data equivalent to part of VMDK
- Swift – object store
- Data disks, ISOs, the junk drawer
- Volumes – elastic storage (iSCSI)
- SAN/NSA attached disks
- Flavors - define amount of memory, CPU, disk size

# OpenStack Interface - Horizon

The screenshot shows the OpenStack Horizon interface for the 'Instances & Volumes' section. The user is logged in as 'admin'. A success message indicates that the instance 'test-www.demo.com' has been launched. The 'Instances' table lists four instances, with one in the 'Spawning' state. The 'Volumes' section is partially visible at the bottom.

**Instances & Volumes** Logged in as: admin [Settings](#) [Sign Out](#)

**Success:** Instance "test-www.demo.com" launched.

**Instances** Launch Instance Terminate Instances

<input type="checkbox"/>	Instance Name	IP Address	Size	Status	Task	Power State	Actions
<input type="checkbox"/>	<a href="#">test-www.demo.com</a>	10.4.128.20	4GB RAM   2 VCPU   10.0GB Disk	Active	None	Running	<span>Edit Instance</span>
<input type="checkbox"/>	<a href="#">test-www.demo.com</a>	10.4.128.19	4GB RAM   2 VCPU   10.0GB Disk	Build	Spawning	No State	<span>Edit Instance</span>
<input type="checkbox"/>	<a href="#">myserve</a>	10.4.128.18	2GB RAM   1 VCPU   10.0GB Disk	Active	None	Running	<span>Edit Instance</span>
<input type="checkbox"/>	<a href="#">myserver</a>	10.4.128.16	2GB RAM   1 VCPU   10.0GB Disk	Active	None	Running	<span>Edit Instance</span>

Displaying 4 items

**Volumes** Create Volume

<input type="checkbox"/>	Name	Description	Size	Status	Attachments	Actions
--------------------------	------	-------------	------	--------	-------------	---------



# Why is OpenStack Important?

“Amazon [is] at war with every IT vendor out there,” says Sebastian Stadil, the CEO of an open source cloud management outfit Scalr, the founder of the Silicon Valley Cloud Computing group, and a former resident of the Rainbow Mansion. “I think one of the reasons OpenStack is getting so much traction — despite, to be frank, iffy stability — is that it represents the industry’s only hope to survive.”

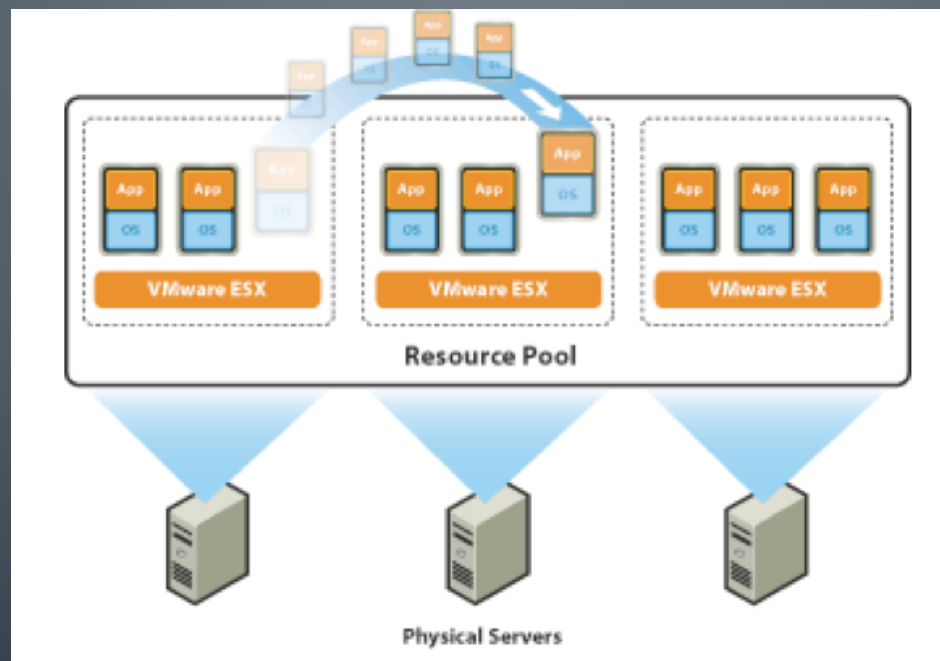
Wired April 2, 2012

# State of the Art

- Encapsulation
- True virtualization
- vMotion
- Snapshots
- Storage vMotion
- Fault Tolerance

# State of the Art

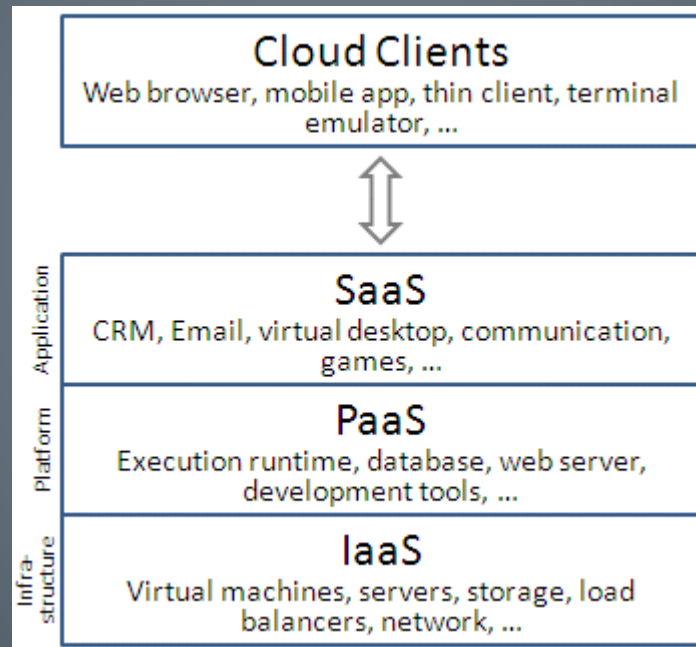
- DRS
- Power management
- Storage DRS
- Hot Add CPU and Memory
- Para-virtualization and Pass-through



# What's in a cloud?

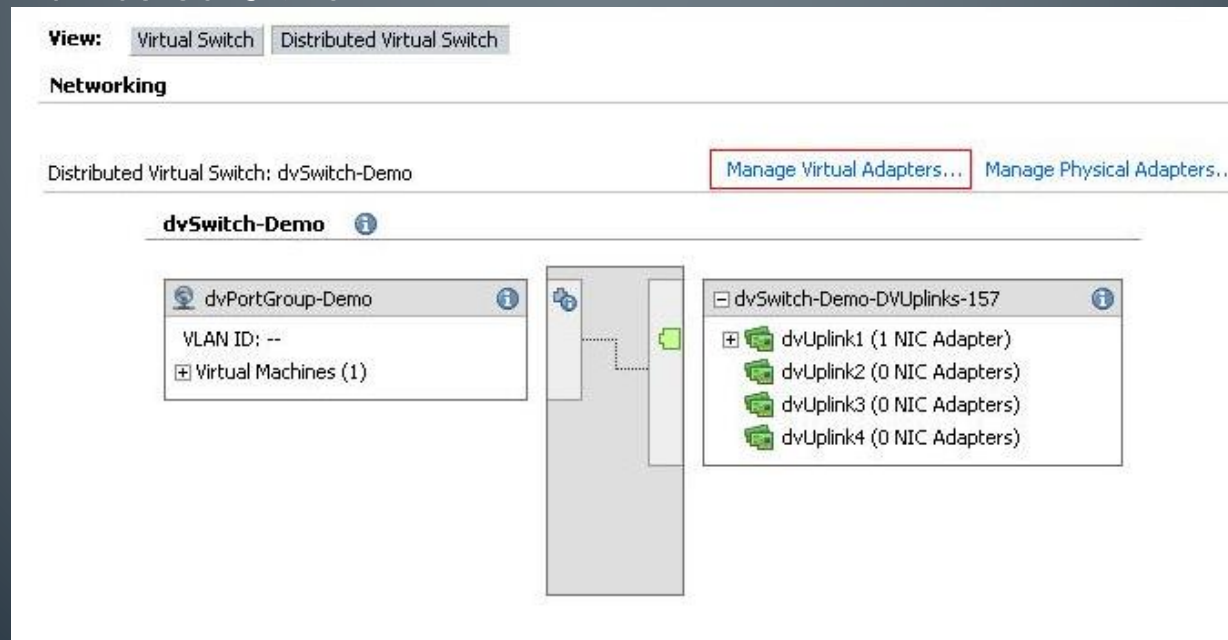
- Compute
- Storage
- Network
- How is this different than what we have now?

# The Service Model



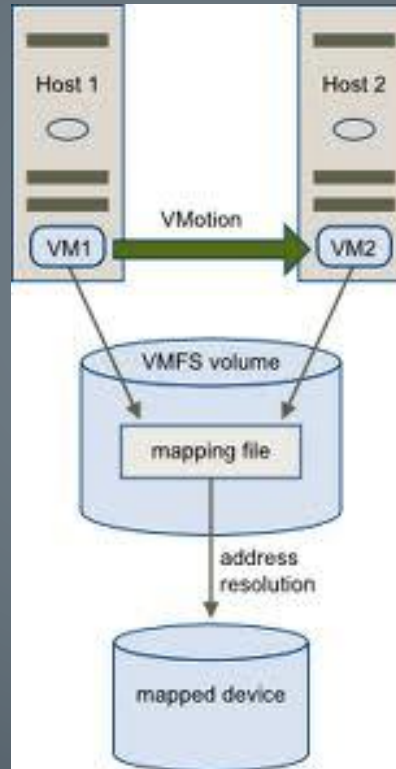
# Abstractions

- Compute
  - VCPUs
  - One to one mapping
  - Over-subscription
- Network
  - Virtual Switch
  - Virtual Distributed Switch



# Abstractions

- Storage
  - VMDK
  - RDM
  - iSCSI



# Network

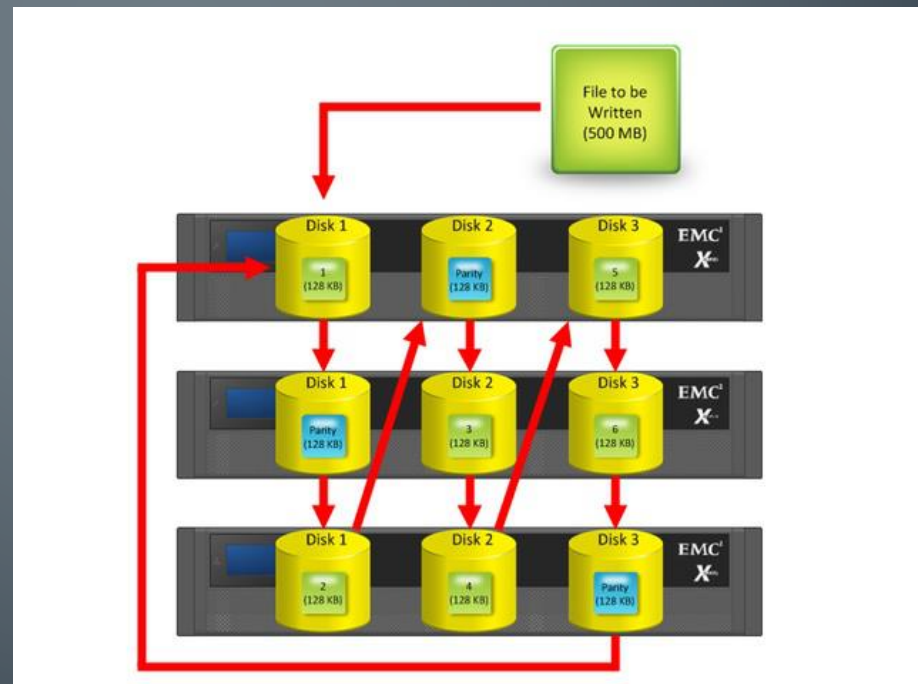
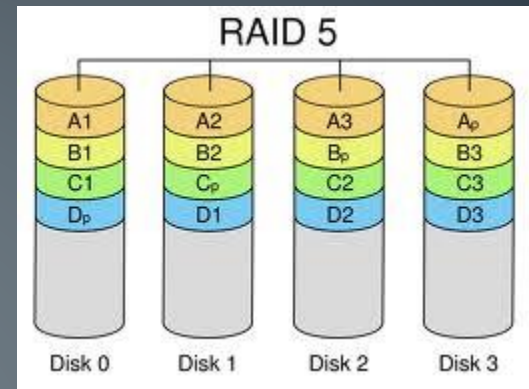
- Proprietary
  - Cisco
  - Brocade
  - Juniper
- ASIC
- Merchant Silicon
- Commodity





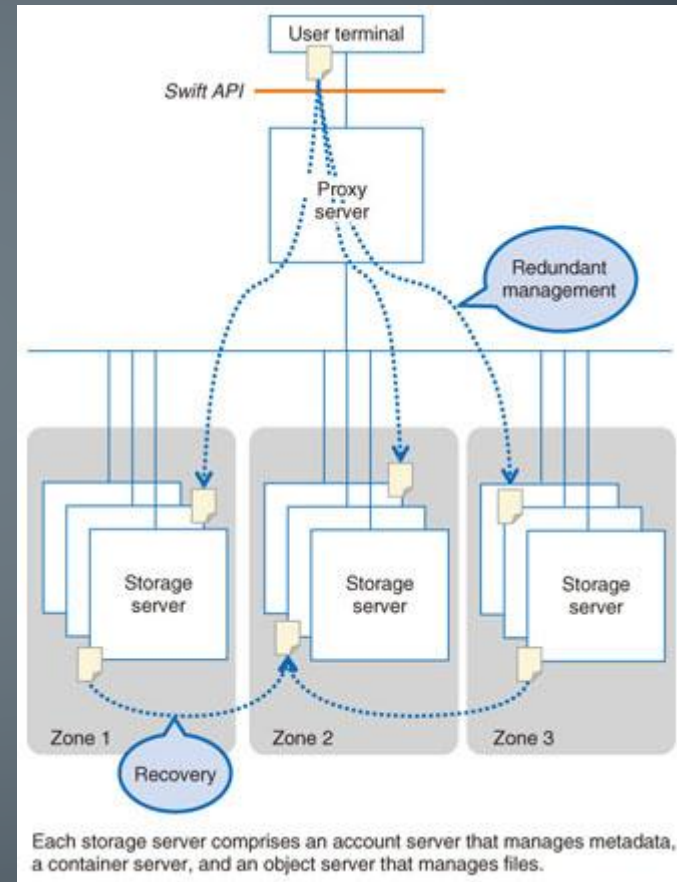
# Storage

- Direct Attached
- RAID
- SAN
- NAS
- Clustered NAS



# Storage

- Object based storage
- Google File system
- Hadoop
- Swift



# Directions

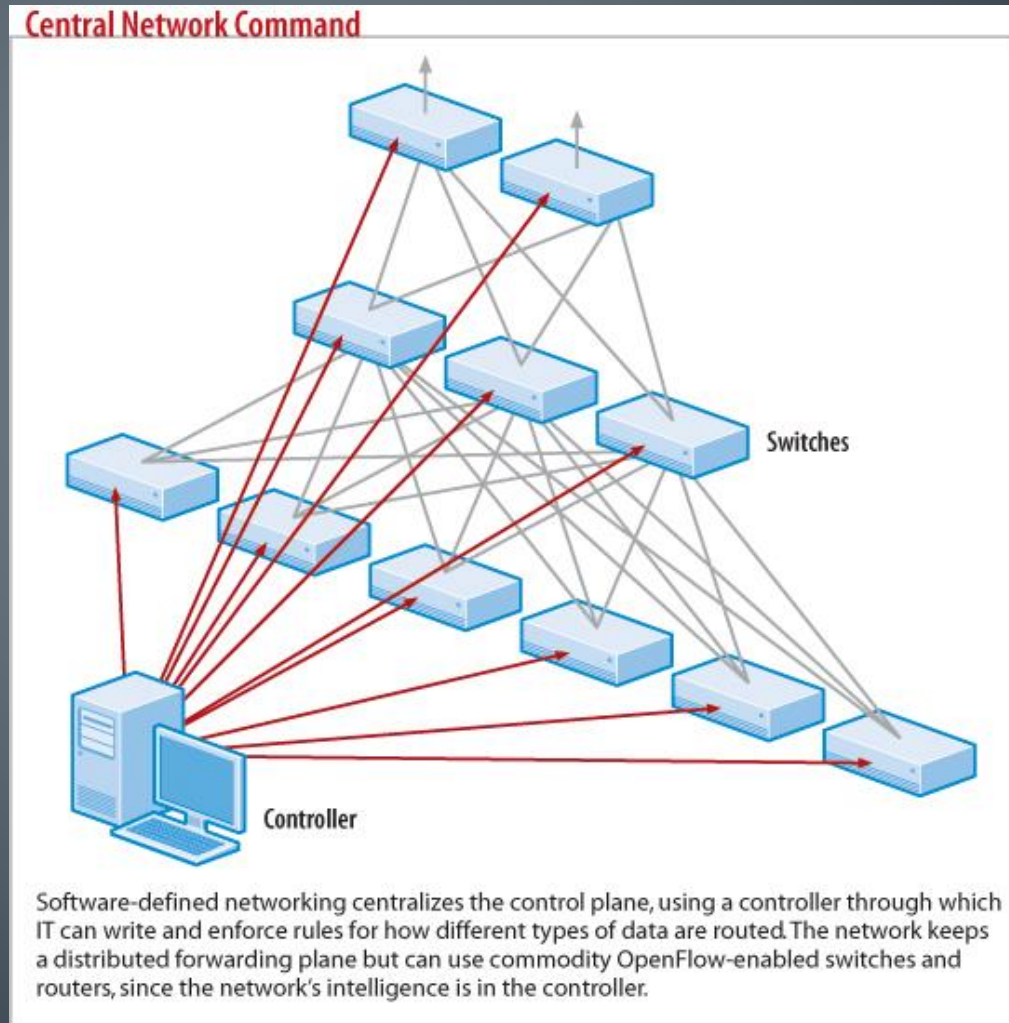
- Virtualization
- Commoditization
- Software defined networks
- Software defined storage
- Software defined data centers

# Compute

- Time sharing / multiplexing
- Hyperthreading- For each processor core that is physically present, the operating system addresses two virtual or logical cores, and shares the workload between them when possible. They appear to the OS as two processors, thus the OS can schedule two processes at once. In addition two or more processes can use the same resources. If one process fails then the resources can be readily re-allocated.
- Multi-core - a single computing component with two or more independent actual central processing units (called "cores"), which are the units that read and execute program instructions.
- Where does it end? Intel has already released 48 core experimental processors

# Network

- Software Defined Networks
- OpenFlow
- Nicira
- Big Switch



# Storage

- Commodity storage
  - Lefthand Storage
  - ISCSI
  - Isilon
- Software Defined Storage
  - Nexenta
  - ScaleIO

**Comments and Questions?**

# Thanks for listening!

Pat Holben

Zot Inc.