OpenStack
and the new Software-Defined World
• IT consultants to the Intelligence Agencies
• Primarily NSA
• IT architectures and infrastructures
• Virtualization
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

VMware

Amazon Web Services

OpenStack
Vmware

- The Pizzabox
- 1 OS 1 App
- X86 underutilization
- Power space and cooling
Products - Workstation
Products – Server (GSX)
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

• Self-service Infrastructure!
Amazon EC2 Model

- **Free Tier**
- As part of [AWS’s Free Usage Tier](https://aws.amazon.com/free), 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

<table>
<thead>
<tr>
<th>Region: US East (N. Virginia)</th>
<th>Linux/UNIX Usage</th>
<th>Windows Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Standard On-Demand Instances</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Small (Default)</td>
<td>$0.065 per Hour</td>
<td>$0.115 per Hour</td>
</tr>
<tr>
<td>Medium</td>
<td>$0.130 per Hour</td>
<td>$0.230 per Hour</td>
</tr>
<tr>
<td>Large</td>
<td>$0.260 per Hour</td>
<td>$0.460 per Hour</td>
</tr>
<tr>
<td>Extra Large</td>
<td>$0.520 per Hour</td>
<td>$0.950 per Hour</td>
</tr>
<tr>
<td><strong>Second Generation Standard On-Demand Instances</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extra Large</td>
<td>$0.580 per Hour</td>
<td>$0.980 per Hour</td>
</tr>
<tr>
<td>Double Extra Large</td>
<td>$1.160 per Hour</td>
<td>$1.960 per Hour</td>
</tr>
<tr>
<td><strong>Micro On-Demand Instances</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Micro</td>
<td>$0.020 per Hour</td>
<td>$0.020 per Hour</td>
</tr>
<tr>
<td><strong>High-Memory On-Demand Instances</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extra Large</td>
<td>$0.450 per Hour</td>
<td>$0.570 per Hour</td>
</tr>
<tr>
<td>Double Extra Large</td>
<td>$0.900 per Hour</td>
<td>$1.140 per Hour</td>
</tr>
<tr>
<td>Quadruple Extra Large</td>
<td>$1.800 per Hour</td>
<td>$2.280 per Hour</td>
</tr>
<tr>
<td><strong>High-CPU On-Demand Instances</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medium</td>
<td>$0.165 per Hour</td>
<td>$0.265 per Hour</td>
</tr>
<tr>
<td>Extra Large</td>
<td>$0.660 per Hour</td>
<td>$1.140 per Hour</td>
</tr>
<tr>
<td><strong>Cluster Compute Instances</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quadruple Extra Large</td>
<td>$1.300 per Hour</td>
<td>$1.610 per Hour</td>
</tr>
<tr>
<td>Eight Extra Large</td>
<td>$2.400 per Hour</td>
<td>$2.970 per Hour</td>
</tr>
<tr>
<td><strong>Cluster GPU Instances</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quadruple Extra Large</td>
<td>$2.100 per Hour</td>
<td>$2.600 per Hour</td>
</tr>
<tr>
<td><strong>High-I/O On-Demand Instances</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quadruple Extra Large</td>
<td>$3.100 per Hour</td>
<td>$3.580 per Hour</td>
</tr>
<tr>
<td><strong>High-Storage On-Demand Instances</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eight Extra Large</td>
<td>$4.600 per Hour</td>
<td>$4.931 per Hour</td>
</tr>
</tbody>
</table>
Amazon EC2

AWS Management Console - Windows Internet Explorer

Welcome, kishoreckumar_62@yahoo.com | Sign Out

Overview | Amazon EC2 | Amazon Elastic MapReduce

Navigation
Region: US-East

> EC2 Dashboard
> IMAGES & INSTANCES
> Instances
> AMIs
> Bundle Tasks
> ELASTIC BLOCK STORE
> Volumes
> Snapshots
> ELASTIC IP
> Key Pairs
> Security Groups

My Instances

Viewing: All Instances

Instance: i-2392f44a
AMI ID: ami-029ce6c
Zone: us-east-1a
Security Group: basicwin32
Type: m1 small
Status: running
Platform: windows

Reboot
Terminate
Launch more like this
Connect Help
Get System Log
Get Default Administrator Password
Bundle Instance

1 EC2 Instance selected

Instance: i-2392f44a
AMI ID: ami-029ce6c
Security Groups: basicwin32
Status: running
Owner: 97075705789
Reservation: r-8bf871e2
Raiddisk ID: -

© 2008, Amazon Web Services LLC or its affiliates. All right reserved.
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.” (Nebula)
  - Rackspace begins parallel development (Cloud Files Platform)
  - 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

Your Applications

OpenStack Dashboard

Computes

Networking

Storage

OpenStack Shared Services

Standard Hardware

OPENSTACK CLOUD OPERATING SYSTEM

APIs
OpenStack Architecture
OpenStack Architecture Evolving
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 (Fulsom release) Now “Neutron” (conflict with Quantum Corporation)
- Virtual Distributed switch/Nexus 1000v (VMware comparison)
- 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
- Cinder – Block storage replaces Nova-volume (Folsom)
  - Volumes – elastic storage (iSCSI)
  - Integrates with:
- SAN/NSA attached disks
- Flavors - define amount of memory, CPU, disk size
OpenStack Management

- Authentication – Keystone
- Resource Metering – Ceilometer, think “billing” (Grizzly
- Orchestration – Heat, the ability to script and automatically deploy OpenStack resources using templates, compatible with AWS CloudFormation
OpenStack Interface - Horizon

Images & Snapshots

Images

<table>
<thead>
<tr>
<th>Image Name</th>
<th>Status</th>
<th>Public</th>
<th>Format</th>
<th>Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>cirros-0.3.0</td>
<td>Active</td>
<td>Yes</td>
<td>QCOW2</td>
<td><img src="Launch" alt="Launch" /> <img src="More" alt="More" /></td>
</tr>
</tbody>
</table>

Instance Snapshots

<table>
<thead>
<tr>
<th>Image Name</th>
<th>Status</th>
<th>Public</th>
<th>Format</th>
<th>Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>test-snap</td>
<td>Queued</td>
<td>No</td>
<td></td>
<td>![Delete Snapshot](Delete Snapshot)</td>
</tr>
</tbody>
</table>

Volume Snapshots

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Size</th>
<th>Status</th>
<th>Volume Name</th>
<th>Actions</th>
</tr>
</thead>
</table>

No items to display.
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

Cloud Clients
Web browser, mobile app, thin client, terminal emulator, ...

\[\text{SaaS}\]
CRM, Email, virtual desktop, communication, games, ...

\[\text{PaaS}\]
Execution runtime, database, web server, development tools, ...

\[\text{IaaS}\]
Virtual machines, servers, storage, load balancers, network, ...

Infra structure
Platform
Application
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
- Clustered NAS
Storage

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

- Virtualization
- Commoditization
- Software defined networks
- Software defined storage
- Software defined data centers
- Distributions
- Hybrid
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
Software-defined networking centralizes the control plane, using a controller through which IT can write and enforce rules for how different types of data are routed. The network keeps a distributed forwarding plane but can use commodity OpenFlow-enabled switches and routers, since the network's intelligence is in the controller.
Storage

- Commodity storage
  - Lefthand Storage
  - iSCSI
  - Isilon

- Software Defined Storage
  - Nexenta
  - ScaleIO
Distributions

- Dell OpenStack-Powered Cloud Solution – crowbar
- HP Converged Cloud Strategy
- IBM Common Cloud Stack including SmartCloud Orchestrator
- Piston Cloud
- Red Hat Distribution OpenStack
- Nebula 1
The Hybrid Movement

• “Cloud bursting” – surging capacity from private to public when required
• Amazon - from public to private – Eucalyptus
• VMware - from private to public – vCloud Hybrid Service
• Microsoft – private to public – Windows Azure
Comments and Questions?
Thanks for listening!

Pat Holben
Zot Inc.