The OpenStack Cloud Computing Framework and Ecosystem

Thomas Michael Bohnert,
Andy Edmonds, Christof Marti
Philipp Aeschlimann, Lucas Graf, Toni Zehnder

#ICCLab / ZHAW
www.cloudcomp.ch
A Reality

Figure 1. Hype Cycle for Cloud Computing, 2012

expectations
Hybrid Cloud Computing
Cloud BPM
Cloud Management Platforms
Big Data
Cloud Application Development Services
BPaaS
IaaS + Middleware
Cloud Services Brokerage
Cloudbursting
Personal Cloud
Private Platform as a Service
Cloud-Optimized Application Design
Community Cloud
Cloud Security and Risk Standards
MDM Solutions in the Cloud
DevOps
Hybrid IT

Cloud Email
Platform as a Service
Browser Client OS
Cloud Collaboration Services
Cloud Parallel Processing
Private Cloud Computing
Application PaaS
Database Platform as a Service (dbPaaS)
Elastic Multitenancy
Cloud Computing
Real-Time Infrastructure
Public Cloud Storage
Cloud/Web Platforms
Enhanced Network Delivery
Infrastructure as a Service (IaaS)
Dedicated Email Services
Cloud Advertising
Salesforce Automation SaaS
Virtualization
Software as a Service (SaaS)

As of August 2012

Plateau will be reached in:
○ less than 2 years  ● 2 to 5 years  ● 5 to 10 years  ▲ more than 10 years  ● obsolete before plateau

Source: Gartner (August 2012)
Gartner Says Worldwide Public Cloud Services Market to Total $131 Billion (Ed. in 2013)

IaaS Continues as Fastest-Growing Market Segment

The public cloud services market is forecast to grow 18.5 percent in 2013 to total $131 billion worldwide, up from $111 billion in 2012, according to Gartner, Inc. Infrastructure as a service (IaaS), including cloud compute, storage and print services, continued as the fastest-growing segment of the market, growing 42.4 percent in 2012 to $6.1 billion and expected to grow 47.3 percent in 2013 to $9 billion.

"Although forecast growth is generally high across all regions, the adoption of cloud services varies significantly by country. Providers should not assume that a generic strategy applied to specific countries or regions of the world will produce the same outcome when applied to other countries, even countries with similar market characteristics," said Mr. Anderson. "Local economic factors, regulatory issues, the local political climate, the diverse landscape of global and local providers, including noncloud providers, and other country-specific factors ensure a unique marketplace in each country and region."

North America is the largest region in the cloud services market, accounting for 59 percent of all new spending on cloud services from 2013 through 2016. Western Europe, despite the growth challenges in the region, remains the second-largest region and will account for 24 percent of all new spending during the same time period. However, the highest growth rates for cloud services continue to come from the emerging regions of Emerging Asia/Pacific (led by Indonesia and India), Greater China and Latin America (led by Argentina, Mexico and Brazil).

"IT services providers, particularly those focused on delivering cloud services offerings or related services, must consider these disproportionately large mature markets if they want to play a leading role in cloud services growth worldwide," Mr. Anderson said. "Similarly, markets in Emerging Asia/Pacific, Greater China and Latin America should also be important considerations for IT services providers that want to capitalize on the high growth of these regions, particularly Latin America and Greater China."

Options

Google App Engine

amazon web services™

Joyent

CloudSigma

the Rackspace cloud

Windows Azure

HP Cloud Services
Consequences

Lock-in
Alternatives

Open Source & Open Standards
Challenges

Diversity

Software as a Service
Platform as a Service
Infrastructure as a Service

Availability
Cloud Computing Enablement

Open Source

- Xen, Xen Cloud Platform (XCP)
- KVM – Kernel-based Virtualization
- VirtualBox - Oracle supported Virtualization Solutions
- OpenVZ - Container-based, Similar to Solaris Containers or BSD Zones
- LXC – User-space chroot’ed installs
Open Source Software-as-a-Service

Very fuzzy ...
## Open Source Platform-as-a-Service

<table>
<thead>
<tr>
<th>Year Started</th>
<th>Sponsors</th>
<th>Supported Platforms</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>VMware</td>
<td>Java/Spring, Node.js, Grails, Ruby/Rails, Ruby/Sinatra, *)</td>
</tr>
<tr>
<td>2011</td>
<td>RedHat</td>
<td>JavaEE6/JBoss, Ruby, PHP, Python, Perl, Node.js</td>
</tr>
<tr>
<td>2010</td>
<td>WSO2</td>
<td>JavaEE6, JBoss</td>
</tr>
<tr>
<td>2011</td>
<td>Joyent</td>
<td>Node.js</td>
</tr>
</tbody>
</table>

*) some derived products (AppFog, Stackato,...) also support PHP, Perl, Python, Erlang, Scala, Clojure, .Net
# Open Source Infrastructure-as-a-Service

<table>
<thead>
<tr>
<th>Year Started</th>
<th>License</th>
<th>Supported Hypervisors</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>GPL</td>
<td>Xen, KVM, VMware*</td>
</tr>
<tr>
<td>2008</td>
<td>Apache 2 (since 2012)</td>
<td>Xen, KVM, VMware, OracleVM</td>
</tr>
<tr>
<td>2008</td>
<td>Apache 2</td>
<td>Xen, KVM, VMware</td>
</tr>
<tr>
<td>2010</td>
<td>Apache 2</td>
<td>Xen, KVM, VMware, VirtualBox, Hyper-V, qcow2</td>
</tr>
</tbody>
</table>

*) not in OpenSource Version
Open Cloud Computing Interface
Protocol and API for Management Of Cloud Service Resources.

OCCI was originally initiated to create a remote management API for IaaS, PaaS model based Services

OCCI is inclusive of an evolving world of cloud resources
Genesis of OpenStack

Quo Vadis?
Genesis of OpenStack

- Bexar: OpenStack Compute for mid-size prod, OpenStack Image Service added to core
- Cactus: OpenStack Compute for larger-scale prod
- Happy Birthday!
- Diablo: Major stability release, First 6-mo cycle release
- 1st Nova Public Cloud: Internap w/ Cloudscaling

- Dell adopts OpenStack for public Cloud offering

- 1st Swift Public Cloud: Internap w/ Cloudscaling

- 2nd Summit: 3rd Summit (Santa Clara) adds Conference
- Governance moves forward with project technical leads (PTL), policy board elections (PPB)
- Decision to shift from 3-mo to 6-mo dev cycle
- Canonical changes to OpenStack for Ubuntu

- Rackspace announces plans to launch independent Foundation in 2012
Building Momentum

2012

Jan

Feb

Apr

May

Aug

Sep

Oct

AT&T Joins OpenStack
Internal production (private)

Citrix Bails
(how's that going for ya?)

Essex
OpenStack Identity in core
OpenStack Dashboard in core

HP Cloud Launch
(Beta)

Board Elections

OpenStack Foundation "officially" launches

Folsom
OpenStack Block
Storage in core
OpenStack Networking in core

Gartner Report
(teeth gnashing followed)

Created framework for Foundation as a community

19 companies announce public support for Foundation

Framework & documents ratified by community

Framework & documents ratified by community

Inaugural OpenStack Foundation Board meeting

Drafting committee formed – creating legal documents

VMware, Intel, & NEC accepted as Gold members
Achieving Enterprise Grade

IBM Makes a Big Bet on OpenStack
OpenStack Service Model
OpenStack High-Level Architecture

Everything has an API
Message based
Discrete Pluggable Components
Key Component: Compute

- **Nova**: Provides virtual servers on demand
  - KVM, Xen, VMware, HyperV, VirtualBox, LXC
- Looks after scheduling, networking & Block Storage
  - Future componentisation via Cinder and Quantum
Key Component: Compute

Source: R. Bias, OpenStack Summit April 2013: The State of the Stack
Key Component: Image

- **Glance**: Virtual Machine Image Registration and Storage
  - Storage via pluggable backends
Key Component: Image

Source: R. Bias, OpenStack Summit April 2013: The State of the Stack
Key Component: Object Storage

- **Swift**: Store & Retrieve data
- Data (*objects*) are stored in buckets (*containers*), Eventually consistent design
Key Component: Object Storage

Source: R. Bias, OpenStack Summit April 2013: The State of the Stack
Key Component: Identity

- **Keystone:** authentication and authorization
  - all the OpenStack services.
- Service type catalog of services.
- Pluggable front and back ends
Key Component: Identity

Source: R. Bias, OpenStack Summit April 2013: The State of the Stack
Key Component: Dashboard

- **Horizon**: A modular web-based user interface for all the OpenStack services
- **Core functionality**
  - Other via cmd. line
Key Component: Dashboard

http://upload.wikimedia.org/wikipedia/commons/archive/f/fd/20100511010238%21MVC-Process.png
OpenStack Architecture: The Big Picture

- **OpenStack End Users**
  - OpenStack Compute API
  - Amazon Web Services EC2 API
  - Horizon Dashboard
  - Nova Console
  - Nova-Cert/Keystore

- **OpenStack Compute**
  - Nova-Compute
  - Nova-Scheduler
  - Nova-Network
  - Nova-Volume

- **OpenStack Object Store**
  - Swift-Proxy
  - Glance-Registry
  - Glance Database

- **OpenStack Identity Service**
  - Keystone (Service & Admin APIs)
    - Token Backend (kvs, memcache, etc.)
    - Catalog Backend (kvs, catalog, etc.)
    - Identity Backend (kvs, pam, sql, etc.)

- **OpenStack Image Service**
  - Glance-API
  - Glance-Image API
  - Glance Registry

- **OpenStack Database**
  - Horizon Database

- **OpenStack Compute API**
  - Nova-API (OS, EC2, Admin)
OpenStack Grizzly Release

OpenStack official projects

Integrated Projects (Grizzly release)

- OpenStack Compute (nova): https://launchpad.net/nova
- OpenStack Object Storage (swift): https://launchpad.net/swift
- OpenStack Image Service (glance): https://launchpad.net/glance
- OpenStack Identity (keystone): https://launchpad.net/keystone
- OpenStack Dashboard (horizon): https://launchpad.net/horizon
- OpenStack Networking (quantum): https://launchpad.net/quantum
- OpenStack Block Storage service (cinder): https://launchpad.net/cinder

Recent, important, cool

Incubated Projects (Grizzly release)

- Ceilometer: https://launchpad.net/ceilometer
- Heat: https://launchpad.net/heat
- Python ceilometer client library: https://launchpad.net/python-ceilometerclient
- Python heat client library: https://launchpad.net/python-heatclient

Even newer, important, cool

Library Projects

- OpenStack common library: https://launchpad.net/oslo
- Python nova client library: https://launchpad.net/python-novaclient
- Python swift client library: https://launchpad.net/python-swiftclient
- Python glance client library: https://launchpad.net/python-glanceclient
- Python keystone client library: https://launchpad.net/python-keystoneclient
- Python quantum client library: https://launchpad.net/python-quantumclient
- Python cinder client library: https://launchpad.net/python-cinderclient
Recent Component: Quantum

- **Quantum**: Quantum is an **SDN-based** project to provide "networking as a service" between interface devices (e.g., vNICs) managed by other Openstack services (e.g., nova).
## Recent Component: Quantum

<table>
<thead>
<tr>
<th>Nova</th>
<th>Quantum</th>
</tr>
</thead>
<tbody>
<tr>
<td>*-as-a-service</td>
<td>Compute</td>
</tr>
<tr>
<td>Major API abstractions</td>
<td>“virtual servers”: A host with CPU, memory,</td>
</tr>
<tr>
<td></td>
<td>disk, and NICs.</td>
</tr>
<tr>
<td></td>
<td>“virtual networks”: A basic L2 network</td>
</tr>
<tr>
<td></td>
<td>segment.</td>
</tr>
<tr>
<td></td>
<td>“virtual ports”: Attachment point for</td>
</tr>
<tr>
<td></td>
<td>devices connecting to virtual networks.</td>
</tr>
<tr>
<td>Interactions with other OpenStack services</td>
<td>virtual servers use “virtual images” from</td>
</tr>
<tr>
<td></td>
<td>Glance.</td>
</tr>
<tr>
<td></td>
<td>virtual ports are linked to vNICs on “virtual</td>
</tr>
<tr>
<td></td>
<td>servers”.</td>
</tr>
<tr>
<td>Supports different back-end technologies</td>
<td>“virt-drivers” for KVM, XenServer, Hyper-V,</td>
</tr>
<tr>
<td></td>
<td>VMWare ESX</td>
</tr>
<tr>
<td></td>
<td>“plugins” for Open vSwitch Cisco UCS, Linux</td>
</tr>
<tr>
<td></td>
<td>Bridge, Nicira NVP, Ryu Controller.</td>
</tr>
<tr>
<td>API Extensibility for new or back-end</td>
<td>keypairs, instance rescue, volumes, etc.</td>
</tr>
<tr>
<td>specific features.</td>
<td>quality-of-service, port statistics, security</td>
</tr>
<tr>
<td></td>
<td>groups, etc.</td>
</tr>
</tbody>
</table>

Source: Dan Wendlandt – Quantum Hacker & PTL
Recent Component: Quantum

But what is SDN?
Recent Component: Quantum

But what is SDN? A revolution
Recent Component: Cinder

- **Cinder**: The goal of the Cinder project is to separate the existing nova-volume block service into its own project.

Source: R. Bias, OpenStack Summit April 2013: The State of the Stack
Recent Component: Cinder

- **Cinder**: The goal of the Cinder project is to separate the existing nova-volume block service into its own project.

Source: R. Bias, OpenStack Summit April 2013: The State of the Stack
Recent Component: Ceilometer

- **Ceilometer**: Complete monitoring environment for services, resources, and hardware infrastructure
  - Build-in support for Rating, Charging, Billing
Technology scope, okay, but what about Enterprise grade?...

What about: momentum, sustainability, support, maturity, accountability, ...?
Technology scope, okay, but what about Enterprise grade?...

<table>
<thead>
<tr>
<th>Developer Growth</th>
<th>Over <strong>517 contributors</strong> to Grizzly; a <strong>56% increase</strong> from Folsom release</th>
</tr>
</thead>
<tbody>
<tr>
<td>Top Contributors by Employer</td>
<td>Red Hat, Rackspace, IBM, HP, Nebula, Intel, eNovance, Canonical, VMware, Cloudscaling, DreamHost and SINA</td>
</tr>
<tr>
<td>Total Number of Features</td>
<td>Approximately <strong>230 new features</strong>; a <strong>35% increase</strong> in the total lines of code from September to March</td>
</tr>
<tr>
<td>Attracting New Plugins &amp; Drivers</td>
<td>5 new Networking plugins and <strong>10 new Block Storage drivers</strong></td>
</tr>
<tr>
<td>Patches Merged</td>
<td>Approximately <strong>7,620 patches merged</strong></td>
</tr>
<tr>
<td>Testing</td>
<td>On average, deploying an OpenStack cloud for testing <strong>700 times per day</strong></td>
</tr>
</tbody>
</table>

Source: Overview of the OpenStack Grizzly release.
Technology scope, okay, but what about Enterprise grade?...

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Qingye Jiang (John) - Open Source IaaS Community Analysis CY13 - Q1

http://www.qyjohn.net/?p=3120

Source: R. Bias, OpenStack Summit April 2013: The State of the Stack
Enterprise grade: The Foundation

- Open Source Software Projects can be quite “challenging”.
- They live or die alongside of the motivation of the committed developers.
- Motivation in a non-commercial environment is largely based by recognition
- Recognition by technical merit, … links to ego … strong opinions …
- How to build trust without loosing the commitment of contributors?
  - Balance between control and creative liberty
- Proven tool: OSS Foundations
Enterprise grade: The Foundation

Mission:

“The OpenStack Foundation is an independent body providing shared resources to help achieve the OpenStack Mission by Protecting, Empowering, and Promoting OpenStack software and the community around it, including users, developers and the entire ecosystem.”

Latest: http://wiki.openstack.org/Governance/Foundation/Mission
Enterprise grade: The Foundation

Source: OpenStack Foundation.
Enterprise grade: The Foundation

Project Technical Leads

- Elected by core code contributors every 6 months prior to Design Summits
- Set technical direction for the project they lead
- Make tough calls when needed
- **Net:** Most of the technical decisions made on a day-to-day basis are made by this person, who is elected by the technical community

Source: OpenStack Foundation.
Enterprise grade: The Foundation

Technical Committee

Responsibilities

- Artist formerly known as the Project Policy Board (PPB)
- Set technical policies that cross projects, work with PTLs
- Determine which new projects are “incubated”

Source: OpenStack Foundation.
Enterprise grade: The Foundation

Board of Directors

Responsibilities

♦ Oversees Foundation operations
♦ Sets overall budget & goals & hires Executive Director
♦ Advocates for the Foundation and the entire OpenStack community

Membership

♦ Individual Members elect 1/3 of the seats
♦ Gold Members elect 1/3 of the seats
♦ Platinum Members appoint 1/3 of the seats
♦ Members must follow a code of conduct, committing to advancing OpenStack, staying active in the community, and performing their duties with integrity

Source: OpenStack Foundation.
Enterprise grade: The Foundation

Membership of the Foundation: Three types

"Individual Members" who participate on their own or as part of their paid employment. It’s free to join as an Individual Member and Individual Members have the right to run for, and vote for, a number of leadership positions.

"Platinum Members" (was called “Strategic”) are companies which make a significant strategic commitment to OpenStack in funding and resources. Platinum Members each appoint a representative to the Board of Directors.

"Gold Members" (was called “Associate”) are companies which provide funding and resources, but at a lower level than Platinum Members. Associate Members as a class elect representatives to the Board of Directors.

Source: OpenStack Foundation.
Enterprise grade: The Foundation

Funding Sources

Platinum Member Fees
- $500,000 per year (paid annually) with a three-year commitment.
- Contributing resources equivalent to 2 FTEs
- AT&T, Canonical, HP, IBM, Nebula, Rackspace, Red Hat, and SUSE

Gold Member Fees
- Total company revenue times 0.025%, minimum of $50,000, maximum of $200,000.
- Cisco, ClearPath Networks, Cloudscaling, Dell, DreamHost, ITRI, Mirantis, Morphlabs, NetApp, Piston Cloud Computing and Yahoo!

Corporate Sponsorships
- Other companies can support the OpenStack foundation at a lower cost by becoming a Corporate Sponsor
- Additional funds will be raised through event sponsorships, like the OpenStack Design Summit & Conference, industry conferences and regional events

Source: OpenStack Foundation.
OpenStack@ICCLab

Second public SWISS OpenStack Proof-of-Concept (next to CERN)
Fully operational Cloud (IaaS)
25 Computing units, 8×2.4 Ghz Cores, 64GB RAM and 4×1TB local storage per unit.
12TB NFS or iSCSI Storage
10Gbit Ethernet (data) 1Gbit (ctrl)

Hadoop as a Service

Open Cloud Computing Interface

Cloud Monitoring

SDN-ready

SmartOS for OpenStack
OpenStack @ ICCLab

ICCLab – Development / Productive Environment

[Diagram showing the network setup with VLANs for Development and Productive environments, including management servers, compute nodes, and network switches.

- VLAN1: Development, OpenStack Mgt, Network 192.168.10.0/24
- VLAN2: Production, OpenStack Mgt, Network 252.168.20.0/24
- VLAN3: Development
- VLAN4: Production

Each node has a connection to VLAN1 and VLAN3 for Development and to VLAN2 and VLAN4 for Production.

Management Server:
- Hosting VMs
- Development Controller
- Foreman/Puppet deployment server

ToR Switch:
- (OpenStack Management)
- VLAN1: Development
- VLAN2: Production

Network Switches:
- VLAN1: Development, network 192.168.10.0/24
- VLAN2: Production, network 252.168.20.0/24
- VLAN3: Development
- VLAN4: Production

Compute Nodes:
- Running Nginx/Swift
- Each node has a connection to VLAN1 and VLAN3 for Development.
How can **YOU** take part?

Swiss OpenStack User Group!
Meet-up soon to be announced

@openstackch

http://linkd.in/os-ugch

Join in!