An introduction to

Building Clouds with Apache CloudStack

Open Source Summit Europe, Edinburgh

Dag Sonstebo
About me

• Cloud Architect @ ShapeBlue

• Background:
  • Cloud and virtualization architect with 20 years experience from the service provider, financial and manufacturing industries.
  • Specialize in:
    • Cloud infrastructure architecture and engineering.
    • Virtualization - VMware vSphere, Citrix XenServer, KVM.
    • Automation and configuration management, love Ansible.
  • Involved with CloudStack since version 2.1, Apache CloudStack project committer.
  • Downtime:
    • Motorbikes and travel. Struggling guitarist.

@CloudStack @dagsonstebo
What is CloudStack?

Apache CloudStack is a scalable, multi-tenant, open-source, purpose-built, cloud orchestration platform for delivering turnkey Infrastructure-as-a-Service clouds.
How to build an IaaS cloud

- PaaS
- Developer tooling
- Multi-cloud management
- CaaS
- Cloud Monkey
- Ecommerce platform
- Management

CloudStack API

Apache CloudStack

Choice of Hypervisor (KVM, VMWare, Xen, hyper-V, OVM, XCP-ng)

Networking, compute, Storage
CloudStack key features

• Broad & deep hypervisor support
  • XenServer, KVM, VMware, OracleVM, Hyper-V, XCP-ng
• Enterprise grade tenant Virtual Networking model with proven user isolation
• Scalable architecture
  • Support thousands of hosts and virtual machine guest
  • Largest known production cloud 35k+ physical hosts
• High availability
  • Configurations that provide automatic failover for virtual machines
• Choice of interfaces
  • Web UI, command line, REST-based API

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CloudStack history

- 2008 – Vmops launches (rebrands Cloud.com)
- April 2010 – Cloud.com Releases CloudStack under GPLv3
- July 2011 - Citrix acquires CloudStack
- April 2012 - CloudStack donated to Apache Software Foundation
- November 2012 – First Apache CloudStack Release
- March 2013 - CloudStack graduates from ASF Incubator
- 2014 – Majority of committers are not from Citrix
- 2016 – Citrix leave the project
- 2014-2018 - Lots of releases, adoption continues to grow
CloudStack today

• 3-4 releases per year
• LTS releases – 24 months support
• Widespread production deployment
  • Public cloud providers
  • Private cloud use-cases
• Diverse user driven – not vendor driven - developer community
The CloudStack community today

- ~200 project committers
- Diverse PMC
- Last 4 weeks (to 10th Oct)
  - 350 mailing list msgs
  - 60 mailing list contributors
  - 25 merged PRs, 16 authors
- Lots of meetups & events....

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Apache CloudStack Community

200+ active contributors,
700+ organisations
Now 7286 committers

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Cloudstack “known users”
CloudStack hidden user base

- 219 "known users"
- 117k package downloads the last 12 months
- 21k different IP addresses
What can you do with CloudStack?

• User friendly self service of all resources – compute, storage and networking – *with no requirements for highly skilled technical staff.*

• Automation of all provisioning and management through API.

• **Compute:**
  • Create Virtual Machines from templates or ISOs based on preset service offerings
  • VM lifecycle actions: start/stop/delete/storage/networking

• **Storage**
  • Manage storage volumes, templates and snapshots

• **Networking**
  • Create isolated, shared and multi-tiered networks
  • Manage firewall and port forwarding rules
  • Manage network services such as load balancing, NAT’ing, VPN, global load balancing and autoscaling

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CloudStack demo
<table>
<thead>
<tr>
<th>Name</th>
<th>IP Address</th>
<th>Hypervisor</th>
<th>Zone</th>
<th>Cluster</th>
<th>Resource state</th>
<th>State</th>
<th>Power State</th>
<th>Quickview</th>
</tr>
</thead>
<tbody>
<tr>
<td>ref-tri.744-k-M7-dsonstebo-kvm2</td>
<td>10.2.2.86</td>
<td>KVM</td>
<td>ref-tri.744-k-M7-dsonstebo</td>
<td>p1-c2</td>
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<td>Up</td>
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<td>+</td>
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<td>/acs/primary/ref-sri-744-k-M7-ds...</td>
<td>NetworkFilesystem</td>
<td>CLUSTER</td>
<td>p1-c2</td>
<td>ref-sri-744-k-M7-dsonebebo</td>
<td>Up</td>
<td>+</td>
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<td>p1-c1</td>
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<td>Account</td>
<td>Host</td>
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<td>batman</td>
<td>ref-1744-k-M7-dsonat dbo-kvm1</td>
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<td>Account</td>
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<td>Batman-VM1</td>
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<td>Batman-VM1</td>
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<td>172.16.2.102</td>
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<td>batman-tier-2</td>
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<td>172.16.1.0/24</td>
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<td>10.1.1.0/24</td>
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<td>ref-tri-744-k-M7-dsonstebo</td>
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### CloudStack Demo

![CloudStack Dashboard](image-url)

#### Storage Volumes

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>VM display name</th>
<th>Hypervisor</th>
<th>Account</th>
<th>Zone</th>
<th>State</th>
<th>Quickview</th>
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<tbody>
<tr>
<td>ROOT-6</td>
<td>ROOT</td>
<td>Batman-VM1</td>
<td>VMware</td>
<td>batman</td>
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<tr>
<td>ROOT-7</td>
<td>ROOT</td>
<td>Batman VPC VM 002</td>
<td>VMware</td>
<td>batman</td>
<td>ref-tri-744-k-M7-dsonstebo</td>
<td>Ready</td>
<td></td>
</tr>
<tr>
<td>ROOT-6</td>
<td>ROOT</td>
<td>Batman VPC VM 001</td>
<td>VMware</td>
<td>batman</td>
<td>ref-tri-744-k-M7-dsonstebo</td>
<td>Ready</td>
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<td>ref-tri-744-k-M7-dsonstebo</td>
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<tr>
<td>Small Instance</td>
<td>Small Instance</td>
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<td></td>
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<tr>
<td>Medium Instance</td>
<td>Medium Instance</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ultra Tiny</td>
<td>Ultra Tiny - 1vCPU, 128MB RAM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tiny</td>
<td>Tiny - 1vCPU, 256MB RAM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
CloudStack Demo

Select a zone
A zone typically corresponds to a single datacenter. Multiple zones help make the cloud more reliable by providing physical isolation and redundancy.

```
ret-tri-744-k-M7-dsonste
```

Select ISO or template
OS image that can be used to boot VMs

```
Template
```

Disc image containing data or bootable media for OS

```
ISO
```
Add Instance

Please select a template for your new virtual instance.

- CentOS 5.3(64-bit) no GUI (vSphere)
- CentOS 5.5(64-bit) no GUI (KVM)

Root disk size (GB)
Add Instance

1. Setup
2. Select a template
3. Compute offering
4. Disk Offering
5. Affinity
6. Network
7. SSH KeyPair
8. Review

- Small Instance
  Small Instance

- Medium Instance
  Medium Instance

- Ultra Tiny
  Ultra Tiny - 1vCPU, 128MB RAM

- Tiny
  Tiny - 1vCPU, 256MB RAM

Previous Next Cancel
You do not have any ssh key pairs. Please continue to the next step.
<table>
<thead>
<tr>
<th>Name</th>
<th>IP</th>
<th>Type</th>
<th>Network</th>
<th>Account</th>
<th>Host</th>
<th>Status</th>
<th>Requires Upgrade</th>
<th>Quickview</th>
</tr>
</thead>
<tbody>
<tr>
<td>r-9-VM</td>
<td>10.1.35.164</td>
<td>System</td>
<td>batman-001</td>
<td>batman</td>
<td>ref-tri-744-k-M7-d_sonstabo-kvm1</td>
<td>Running</td>
<td>No</td>
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<td>batman-vpc-001</td>
<td>batman</td>
<td>ref-tri-744-k-M7-d_sonstabo-kvm2</td>
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<td>System</td>
<td>ROOTNET1</td>
<td>admin</td>
<td>ref-tri-744-k-M7-d_sonstabo-kvm1</td>
<td>Starting</td>
<td>Yes</td>
<td>+</td>
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Cloudbuilding Demo
<table>
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<tr>
<th>IPs</th>
<th>Network</th>
<th>VM name</th>
<th>Zone</th>
<th>State</th>
<th>Quickview</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.1.35.164 [Source NAT]</td>
<td>batman-001</td>
<td>ref-stl-744-k-M7-dsonstebo</td>
<td></td>
<td>Allocated</td>
<td>A</td>
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</table>
CloudStack Demo

Dashboard
Instances
Affinity Groups
Storage
Network
Templates
Events
Projects
Roles
Accounts
Domains
Regions
Infrastructure
Global Settings
Service Offerings

Home > Network - Guest networks > batman-001 > IP Addresses > 10.1.35.164 [Source NAT] > Firewall

<table>
<thead>
<tr>
<th>Source CIDR</th>
<th>Protocol</th>
<th>Start Port</th>
<th>End Port</th>
<th>ICMP Type</th>
<th>ICMP Code</th>
<th>Add rule</th>
<th>State</th>
<th>Actions</th>
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<tbody>
<tr>
<td>0.0.0.0/0</td>
<td>TCP</td>
<td>80</td>
<td>80</td>
<td></td>
<td></td>
<td></td>
<td>Active</td>
<td></td>
</tr>
</tbody>
</table>
CloudStack Demo

Port Forwarding

- Private Port: 80 - 80
- Public Port: 80 - 80
- Protocol: TCP
- State: Active
- VM: Batman-VM1
  - IP: 10.1.1.1

Add VM

Actions
Welcome to nginx on Fedora!

This page is used to test the proper operation of the nginx HTTP server after it has been installed. If you can read this page, it means that the web server installed at this site is working properly.

This is the default index.html page that is distributed with nginx on Fedora. It is located in /usr/share/nginx/html.

You should now put your content in a location of your choice and edit the root configuration directive in the nginx configuration file /etc/nginx/nginx.conf.
API examples

Examples of Cloudstack Rest API:

• List VMs for all users: http://10.2.2.98:8096/client/api?command=listVirtualMachines&listall=true
• List all my templates: http://10.2.2.98:8096/client/api?command=listTemplates&templatefilter=all
• Create new network "RootNet2"
  – http://10.2.2.98:8096/client/api?command=createNetwork&zoneld=ea2ed5f-2fbd-4390-a731-b4e252d2f5c7&name=RootNet2&displayText=RootNet2&networkOfferingId=d323ca4-976b-4cd3-b57c-58864b842a40&domainid=d30d22bf-6af-06227e0108af&account=admin
• Create a new VM attached to RootNet1
  – http://10.2.2.98:8096/client/api?command=deployVirtualMachine&response=json&zoneld=ea2ed5f-2fbd-4390-a731-b4e252d2f5c7&templateid=d3121fc3-6af-11e-aa6b-06227e0108af&hypervisor=VMware&serviceofferingid=89e3af9-3ed6-4975-a9a9-58953f94a9f2&iptonetworklist%5B0%5D.networkid=af048a31-f140-4907-b2ac-85ae67767ff9&displayname=RootVM2&name=RootVM2&keyboard=uk&domainid=d30d22bf-6af-11e-aa6b-06227e0108af&account=admin

Note: for simplicity, these commands are being run over an unauthenticated port (8096) - this is not recommended for production use and would usually be disabled
```
[root@trl-1441-v-cs411-dsonstebo-mgmt1 ~]# cloudmonkey list templates templatefilter=all name=CentOS7-VMware
count = 1

template:
id = 016840ac-8201-4d00-879b-b642b21cce37
name = CentOS7-VMware
account = admin
bits = 0
checksum = 9f17bb3eba92bf740eb1cf0148a4b17b
childtemplates:
created = 2018-06-11T14:45:57+0000
crossZones = True
details:
keyboard = uk
nicAdapter = E1000
rootDiskController = osdefault
directdownload = False
displaytext = CentOS7 VMware template
domain = ROOT
domainid = d30d22bf-6af6-11e8-a96b-06227e0108af
format = OVA
hypervisor = VMware
isdynamicallyscalable = False
isrebootable = False
```
Apache CloudStack – an open flexible platform

Compute

- XenServer
- VMware
- OVM
- KVM
- Hyper-V
- UCS
- Bare metal

Compute primary storage

- Local Disk
- iSCSI
- Fibre Channel
- NFS
- Ceph

User accessible secondary storage

- NFS
- Swift
- S3

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CloudStack networking – 2 models

Network

Isolation
- Basic – L3
- Advanced – L2

Services
- Routing
- Firewall
- DHCP
- DNS
- LB
- GSLB
- VPN
CloudStack - Scalable constructs

Region - Europe

Zone - London1

Zone - Amsterdam3

Pod

Cluster - Vmware

Cluster - KVM

Pod

Cluster - OVM

Host

Host

Pod

Region - USA

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CloudStack container Service

- Seamless Container as a Service offering in IaaS environment
- Built with Kubernetes & CloudStack
- Deploy cloud-native apps into clusters
- No changes to product catalogue or billing process
Recipe 1

completely ignore design best-practice …..

• **Ingredients:**
  • A hypervisor host
  • some NFS storage
  • CloudStack Management server
  • Cloudstack MySQL server
Method:
1. Read the recipe & understand your ingredients
   http://docs.cloudstack.apache.org/en/latest/
2. Read up on Cloudstack networking
3. Does CloudStack support?......
   .......It’s the hypervisor stupid
4. Do not try to do this in AWS – you need hypervisor hosts

@CloudStack @dagsonstebo
Method:
5. Install MySQL
6. Install Cloudstack
7. Start cloud XXX
8. Follow the GUI build wizard…
My first CloudStack build

Host 1
- Centos
- MySQL DB for Cloudstack
- Cloudstack Management server
- NFS storage
- KVM

Switch with VLAN support
My first CloudStack build

**Host 1**
- Centos
- MySQL DB for Cloudstack
- Cloudstack Management server
- NFS storage
- (KVM...)

**Host 2**
- Hypervisor host of your choice (as long as its KVM or Xen)

Switch with VLAN support

@CloudStack @dagsonstebo
Learning Cloudstack features – use somebody elses

- **Interoute VDC**
  - Full stack IaaS offering based on Cloudstack
  - Includes hybrid “VDC Edge”
  - Massive growth – now 17 global zones
Learning CloudStack features - use somebody else's

EXOSCALE

- Swiss based cloud provider, based on CloudStack
- “made for developers”
- Abstracted a number of CloudStack features
Recipe 2

- Production grade storage
- Add more hosts
- Consider pod, clusters
- Introduce 2nd hypervisor
- Build a management farm
  - Split MySQL, use master/slave
  - Redundant pair of management servers
- Split storage, guest, public and management networks across physical network segments

@CloudStack @dagsonstebo
Design considerations – the real world

- Analyse your workloads
- **Capacity planning:**
  - Storage
  - CPU/memory
- **Version of CloudStack (go LTS)**
- Choose networking model
- **Management farm**
  - Resilience – multiple management servers & DB servers
- **Hypervisor choice**
  - Good for your workloads
  - Compatible with your hardware?
  - Cost?
Design considerations – the real world

- Network design: isolate management, guest, public & storage traffic
- Scale
  - scale point – usually by adding pods
- Plan templates
- Plan service offerings
- Plan disk offerings
- Tagging model?
- Collecting & analysis of your usage data
The perception problem

“CloudStack – Never heard of it!”

Architect at unnamed company, 2016, which now runs a 800 host production Cloudstack production environment

@CloudStack @dagsonstebo
“we’ve spent 4 years and millions of dollars trying to build our services on Openstack. We’ve just decided to start again with Cloudstack”

CTO, > [$ billion revenue] international service provider, August 2019
Openstack is complex
CloudStack is simple

- User Interface
  - Administrator
  - End User
  - Console
- Developer API
- Integration API
- Availability and Security
  - Backup
  - LB
  - HA
  - Monitoring
- Dynamic Workload Management
- Resource Management
  - Servers
  - Storage
  - Network
- Service Management (Billing, Metering, Accounts, etc.)
- Virtualization Layer
  - Servers
  - Network
  - Storage
- Operational Integration (OSS/BSS, Monitoring, Identity Management, Etc.)
- Image Libraries
  - Application Catalog
  - Custom Templates
  - Operating System ISOs
- Administration
- End User
- Console
- User Interface
- Developer API
- Integration API
- Availability and Security
- Dynamic Workload Management
- Resource Management
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Why CloudStack?

- Integrated end-to-end IaaS product
- Proven at scale, widespread adoption
- Rapid time to value
- Low implementation & operational costs
- Truly multi-tenant
- Focused, user led, development community
- Narrow scope / easy integration
- #CloudStackWorks
Where to go next


- **Mailing lists** [https://cloudstack.apache.org/mailing-lists.html](https://cloudstack.apache.org/mailing-lists.html)
  
  Start with users list

- **Events & meetups**
  CloudStack European User Group
  [https://www.linkedin.com/groups/4294158](https://www.linkedin.com/groups/4294158)
  CloudStack Collaboration Conferences
  [http://cloudstackcollab.org](http://cloudstackcollab.org)
#CloudStackWorks

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