Open source software for building a private cloud

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An introduction

me

- 10+ years working on high performance (distributed, grid, cloud) computing at DreamWorks Animation, NASA JPL, NIH Center for Computational Biology, Compaq
- started nephosity in March 2010

nephosity

- develops cloud computing platform for enterprises
- showcased by STRUCTURE 2010 as one of “10 most promising cloud computing startups of 2010”
What's behind the cloud?

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Motivation

Scenario

- You are (or your company is) developing a SaaS
- You require elastic compute resources

So you want to deploy in the cloud, but...

- Public clouds do not satisfy your (security, performance, etc.) requirements
- You want to use open source components in your cloud

What’s available to you?

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EC2 (more specifically, dynamic provisioning\(^1\) capabilities provided by EC2) is only one part of the equation

- Core is dynamic provisioning capabilities
- EC2 is not open source.

You need a machine image to run on EC2—what software (OS + platform) to install on the image? What are the (open source) alternatives for dynamic provisioning?

\(^1\)the ability to start up and tear-down compute resources on-demand
What about Hadoop?

Hadoop is also only part of the equation

- Hadoop-core provides map-reduce functionality
- HDFS provides data management functionality

How do you control Hadoop jobs? What alternatives to Hadoop are there?
Cloud computing stack

- **Infrastructure**
  - Hypervisor / machine image
  - Dynamic provisioning
  - Operating system

- **Platform**
  - Data management
  - Map-reduce
  - Workflow management
  - Messaging

- **Cluster management**
  - Configuration
  - Analytics
Disclaimer

- Will discuss only open source offerings that have been released
- Will present what’s available, not how to adopt/implement them
- Lists may be incomplete
- You will see some badly hand drawn graphics
Infrastructure

- Hypervisor / Virtual machine
- Dynamic provisioning
- Operating system

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Hypervisor / Virtual machine

- Hardware virtualization
- Allows multiple virtual machines to run on a single physical machine
Hypervisor / Virtual machine

- QEMU (virtualizer)
- KVM
- Xen
- VirtualBox (Desktop only)
Dynamic provisioning

de/allocate compute resources on demand
▶ You get compute resources when you want them
▶ Compute resources are reclaimed when you release them
Dynamic provisioning

Open source software

- Eucalyptus
- OpenNebula / Haizea
- Condor (via VM universe)
- TCloud Elaster (not yet released)
Operating system

- The interface between your software and the underlying hardware
- In cloud computing, operating systems are stored as machine images
- Images are distributed to local storage on-demand
- Loaded into memory and booted into the hypervisor by the dynamic provisioner
Operating system

- Various Linux distributions
  - Ubuntu
  - SUSE
  - Fedora
  - CentOS
- BSD (on VirtualBox)
Platform

- Data management
- Map reduce
- Workflow management
- Messaging

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Data management

- Distribute your data across your network
- Replicate your data across your network
- Optimize retrieval to improve computation time
- Optimize storage requirements
Data management considerations

- SQL vs. NoSQL
- Replication degree
- small file vs. BLOB storage
- Consistency
- Centralized vs. decentralized
- Access patterns
Data management

- HDFS (Hadoop)
- SphereFS (UIC)
- DDFS (Nokia)
- Cassandra (Facebook / Apache)
- MongoDB
- CouchDB (Apache)
- MySQL (Oracle)
- PostgreSQL
- Ceph (DreamHost), release as part of Linux v2.6.34
Map reduce

- Split and parallelize a task into many parts
- Combine the results of the split tasks for a final result
Open source offerings
- Hadoop (Yahoo)
- Sphere (UIC)
- Disco (Nokia)
Workflow management

- design
- specification
- coordinated execution of compute tasks
Workflow management

Open source offerings

- Oozie (Yahoo)
- Pig (Hadoop / Apache)
- Cascading (Concurrent)
- Azkaban (LinkedIn)
- pomsets (nephosity)
Unified framework for your application and all components to communicate with each other

Above the network hardware and network protocol layer

Your application handles only discrete messages
Messaging

Open source offerings

- qpid (Apache)
- RabbitMQ (SpringSource / VMWare)
- ZeroMQ (iMatix)
Cluster management

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Configuration management

- Configuration of your running cloud instances
- Software upgrades
- Dynamic configuration that cannot be stored onto OS images
- Relaxes storage constraints vs. using OS images
Configuration

Open source offerings

- Chef (Opscode)
- Puppet
- StarCluster (MIT)
Collection and visualization of the status of your cloud
  - Compute load
  - Network usage

Dynamic load balancing and scaling of your cloud
  - Start new instances
  - Tear down existing instances
Analytics

Open source offerings

- Graphite (Orbitz)
- Scalr
- Nagios
- Ganglia
Questions?

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