Certified Openstack Administrator

5 Days, Lecture and Hands-on Labs

1. OpenStack Architecture Overview
    - Alta3 Proof of Concept Deployment
    - Nodes
    - Controller Node
    - Neutron Node (Networking Node)
    - Compute Nodes (Compute)
    - Storage Node
    - OpenStack Deployment Recommendations
    - Big Picture
    - OpenStack Big Picture
    - IaaS (Infrastructure as a Service)
    - PaaS (Platform as a Service)
    - SaaS (Software as a Service)
    - OpenStack XaaS
    - OpenStack Foundation
    - OpenStack Foundation, Design Summits, and Releases
    - Versions
    - OpenStack Versions
2. Horizon
    - Overview
    - Dashboard
    - Horizon Dashboard
    - Overview of Domain, Project (Tenant), and User
    - Admin > System > Hypervisors
    - Project > Compute > Overview
    - Identity > Projects
    - Instances
3. Managing Guest VMs
    - Python Clients
    - IaaS - Horizon & CLI
    - CLI uses OpenStack python-clients
    - The OpenStack python-openstackclient (OSC)
    - Using the CLI python-openstackclient
    - Finding a python-openstackclient command at the Linux CLI
    - Common CLI python-openstackclient commands to know…
4. Hypervisors
    - Overview
    - The Virtual Machine Stack
    - The Old Way without Virtualization
    - Virtualization
    - A Snowflake Computer on Bare Metal
    - A Virtualized System installed on a Bare Metal Hypervisor
    - The Top Half of the Hypervisor
    - The “Bottom Half” of the Hypervisor

- Why is the Hypervisor shown as an upper and lower portion?
- Images
- “Imaging” the Operating System
- Imaging our Machine
- Migration
- “Migrating” the Virtual Machine
- Compute
- “Compute”
- Compute Space Example
- Assemble the Node
- Install the Hypervisor
- The Compute Space
- Resulting Compute Space with just 2 Intel Xeon E5-2699 v3 CPUs
- Compute Cloud
- A “360-Core” Cloud
- Clouds not Cloud
- Remember we talked about “Migrating?
- Migrating
- Instantiation
- Oversubscribing 16:1 is the OpenStack Default!
- Virtualization Types
- Virtualization Techniques
- x86 CPU Privilege Level - No virtualization
- Popek and Goldberg Virtualization Requirements (1974)
- Binary Translation - VMware 1998 x86 Solution
- Para Virtualization
- Kernel-Only Instructions (No Virtualization)
- Hardware Assisted Virtualization

5. Keystone
    - Overview
    - Keystone
    - Tokens - what they are and why you need them
    - Token Types - UUID tokens (old) vs PKI tokens (new)
    - Projects, Roles, Users & Groups
    - How Domains work with Projects, Roles, Users & Groups
    - OpenStack Shell Command Permissions
    - Keystone Authentication Message Flow
    - How to use curl with the Keystone Identity API
    - Permissions
    - Keystone Access - Token and Service Catalog
6. Nova
    - nova-api
    - nova-scheduler
    - Nova Architecture
    - Nova Cert
    - Nova Compute
    - Nova Hypervisor Support
    - Nova Console
    - Nova Conductor
    - Nova Compute Interfaces
    - Nova Components
    - Nova Review
    - Management
    - Nova-api CLI

7. SDN
    - Stack
    - Network Functions Virtualization (NFV)
    - Overview
    - Virtualize the Middleboxes
    - Goal: All routers share the same picture
    - Goal: “Network Omniscience”
    - Goal: “Networking Becomes Software Defined”
    - The Current State of Networking
    - SDN Déjà vu?
    - If H.248 behaved like SDN (OpenFlow)
    - Defining Software “Abstraction”
    - Abstracting the Network
    - SDN in a Nutshell
    - Isolating Networks
    - Yet Another Abstraction: Network Slicing
    - SDN Architecture
    - OpenFlow
    - Merchant Silicon Example
    - Requirement: Non blocking at 10 Gbps
    - OpenFlow
    - Forwarding an Audio Packet
    - Destination MAC Address
    - Type Field means “An IP header is next”
    - IP Source Address Validity Check
    - IP Destination Address
    - Deep Packet Inspection (DPI) “Crossing the Line”
    - The “Really Bad” Stuff is Always BELOW the Line
    - Fabrics are Really Fast
8. Data Center Fabric
    - Overview
    - Classic Hierarchical Network Design
    - TRILL
    - Path #1 - 4
    - Interfacing NFV with the Fabric
    - NFV Integration
    - vSwitch
    - Namespace and the “veth”
    - Heat Makes Clouds Rise
    - vSwitch vs Hardware Switch
    - Virtual Router
9. OpenStack Networking
    - Neutron
    - Why Traditional Networking is Inefficient
    - Network Virtualization
    - Agents and Plugins
    - Agents
    - Neutron Configuration
    - Architecture
    - Nova Networking
    - VLAN
    - VXLAN Packet Headers
    - GRE Packet Headers
    - Compute Node Network OVS Integration

- Neutron Networking (Generation 4)
- East West Traffic in Neutron Networking without Distributed Virtual Router
- Neutron Networking Distributed Virtual Router (Generation 5)
- East West Traffic with Distributed Virtual Router
- North South SNAT Traffic with Distributed Virtual Router
- North South Floating IP Traffic with Distributed Virtual Router
- Neutron Big Picture with Open vSwitch
- Network Namespace
- Heat Makes Clouds Rise
- OpenvSwitch
- Traditional VM Ethernet Processing
- Intel VMDq (Virtual Machine Device Queues)
- Intel SR-IOV (Single Root IO Virtualization)
- Wiring an OpenStack Node
- How do I Physically wire an OpenStack Node?
- Step one: Physical Wiring
- Step Two: Bonding
- Step 3 VLAN
- Step 4: Network Function Virtualization
- Step 5: Tie it all together in a single diagram
- OpenStack Network Function Virtualization
- Network Function Virtualization
- 8 Network Function Virtualization Components
- Why Two Bridges?
- Simple NFV (Network Function Virtualization) Example
- OVS-based openstack “wiring”
- Provider vs Tenant Networks
- Provider vs. Tenant Networks
- Tenant Networking Exam
- Provider Networks
- NFV Provider Network “wiring”
- OVS-based openstack “wiring”
- Connecting directly to the Provider Network
- Configuring Neutron
- Configuring Neutron
- Creating an OpenStack Provider Network from Neutron to NFV
- The neutron command structure
- The ml2_conf.ini file
- openvswitch_agent.ini file
- Attaching OpenStack to Network Function Virtualization
- Neutron Plugins

10. Glance
    - Architecture
    - Glance
    - Basic Architecture
    - Glance Command Line
    - Container Format
    - Disk Format
    - Common Image Properties
    - Image
    - Metadata Definition Catalog (Juno tries to herd the cats)
11. Swift
    - Overview
    - Swift

- Block vs Object Storage
- Object Storage Examples
- Defining an Object
- HTTP RESTful API
- Working with Swift
- Analyzing the Swift URL
- Data Types
- Comparing Storage Types: Object, File, Block
- Consistency vs Availability Example
- Saving a Swift Object
- Immutable Cluster Sizing
- Calculating part_power
- The Swift Proxy
- Multiple Swift Proxies and Load Balancing
- Swift Enhanced Consistent Hashing Ring
- Durability with MD5 Metadata
- Durability with Replication
- Swift Background Auditor
- Background Replicator
- Enhanced Consistent Hashing Ring
- Comparing Swift and Ceph
- Swift Regions
- How Ceph and Swift fit in OpenStack

12. Ceph
    - Overview
    - Storage Node - Ceph
    - Ceph Advantages
    - RADOS
    - Ceph Architecture
    - Building Ceph Storage Nodes
    - OSD
    - OSD (Object Storage Daemons)
    - Building Ceph Cluster for Geographic Disparity
    - Configuration to Prepare and Mount the Storage Devices to be Used with Ceph
    - Prepare and Mount the Storage Devices to be Used with Ceph
    - CRUSH
    - Introduction to the CRUSH Map
    - The Ceph Monitors
    - CRUSH Advantages over Other Forms of Data Mapping
    - CRUSH Rules
    - Replication
    - Data Storage and OSD Replication
    - Durability
    - Handing OSD Failures or other Topography Changes
    - How to Recover from a Ceph SSH Configuration Error
    - Ceph - Troubleshooting the Logs
    - Crush Map from Ceph Lab
    - Storage Node Log: cat /var/log/ceph/cat ceph-osd.0.log
    - Ceph Log /var/log/ceph/ceph.audit.log
    - Watch Cluster Activity in Real-time with ceph -w
    - Erasure Coding Defined
    - Deployment
    - Performance Rules of thumb
    - Ceph Deployment

13. Cinder
    - Overview
    - Cinder
    - Block - File - Object
    - The Linux Posix Filesystem Hierarchy
    - Cinder Components
    - Cinder Volume
    - Cinder Snapshot
    - Cinder Backend
    - Cinder Driver
    - Cinder Volume Type
    - Cinder Processes
    - iSCSI
    - NFS
    - Volume Attach Workflow
14. Ceilometer
    - Overview
    - Ceilometer - Telemetry
    - Metering Primer
    - Metering
    - Metering: Network
    - Architecture
    - Notification
    - Polling - Agent
    - Data Collector
    - Ceilometer Architecture
    - OpenStack Telemetry: It is more than just Ceilometer!
15. AMQP
    - Overview
    - How AMQP Fits with Similar Messaging Protocols.
    - AMQP in a Nutshell
    - Message Delivery Options
    - Direct Exchange
    - Fanout
    - Topic Exchange
    - Subscribe and Publish
    - Subscribe and Publish
    - Subscribe and Publish Message Flow
    - Embedding RPC in RabbitMQ Messages
    - Nova Messaging Service AMQP example
    - MQ Alternatives
    - RabbitMQ and zeroMQ
16. Other Services
    - NTP
    - Trove
    - OSLO
    - MySQL
    - Tempest
17. Git Essentials
    - Setting up the repository
    - Why OpenStack users should know Git and GitHub
    - Git repo-to-repo collaboration
    - Git usage: git clone
    - Git usage: git init –bare

- Git usage: git config –global
- Saving changes
- Git usage: git add
- Git usage: git commit -m “”
- Git usage: git push
- Git saves files not deltas
- Git usage: git status
- Git usage: git log –oneline
- Git usage: git checkout <commit || master>
- Collaboration
- Git usage: git remote <add || rm>
- Git usage: git branch
- Git usage: git pull –rebase
- GitHub is git + social

18. Cloud Automation
    - Overview
    - You’ve got VMs! Now what?
    - Configuration Management
    - Automation
    - Puppet
    - Chef
    - Ansible
    - Ansible Hosts
    - Ansible Playbook - YAML (Yet Another Markup Language)
    - Heat
    - Heat - Orchestration
    - Heat Architecture
    - Heat Orchestration Template Structure
    - Template Syntax
    - Ironic
    - OpenStack Ironic
19. HA
    - OpenStack Vulnerability
    - Vulnerability Assessment: #1 Databases (STATEFUL)
    - Vulnerability Assessment: #2 Networking
    - Vulnerability Assessment: #3 Stateful Services
    - Vulnerability Assessment: #4 The Stateless Services (Everything Else)
    - Planning
    - HA Design Follows RPO and RTO
    - Stateful vs Stateless
    - Failover, Fallback, and Switchover
    - Active/Passive vs Active/Active
    - HA Options by Vendor
    - Methods
    - Keepalived and HAProxy (keep alive’ dee)
    - VRRP Virtual Router Redundancy Protocol - RFC 3768
    - Native Cluster
    - Pacemaker
    - Totem
    - Resource Agents
    - Corosync
    - Distributed Replicated Block Device (DRBD)
    - Galera - Write Set Replication (WSREP)
    - Galera - Deadlock

- MySQL Cluster Replication: Multi-master and Circular Replication
- RabbitMQ HA
- MySQL HA using Pacemaker, Corosync, and DRBD
- HA for MySQL
- Planning
- Hypervisor Evacuation

20. Cloud Security
    - Overview
    - Keystone Identity ManagerKeystone Authentication
    - Securing APIs
    - Security groups: iptables and Linux bridges
21. OpenStack Labs
    - Started with OpenStack
    - Openstack python-clients and getting to help with grep
    - Introduction to OpenStack API Endpoints
    - Verifying OpenStack Services
    - Horizon
    - Exploring Horizon
    - Project and Quota in Horizon
    - Adding Users to a Project in Horizon
    - Launching Instances as a User
    - Managing a Project using Horizon
    - Compute and Identity
    - Managing Projects at the CLI
    - Host Aggregate and Availability Zones
    - User, Roles, and Permissions
    - Administering Role Permissions with Groups
    - Keystone (identity) credentials
    - CLI OpenStack RC files
    - Managing flavors at the CLI
    - Launching Instances from the CLI
    - Controlling Customer VMs with admin
    - Networking
    - Building Keystone's Service Catalog
    - Provision Virtual Networking on a Freshly Booted Cloud
    - Security Groups
    - Floating IP Addresses
    - Neutron Networking with Horizon
    - Neutron Networking VMs with Floating and Private IPs
    - Storage
    - Logs
    - Glance
    - Creating Block Storage Volumes with Cinder in Horizon
    - Creating Block Storage Volumes with Cinder at the CLI
    - Launching Instances with Key Pairs
    - Swift Object Storage
    - Ansible
    - Automate the Cloud with Ansible
    - Version Controlling
    - Git and GitHub

Course Overview

Review this course online at https://www.alta3.com/courses/openstack

Outline

OpenStack Architecture

- 💬 Lecture: OpenStack Architecture Overview
- 💻 Lecture + Lab: Openstack python-clients and getting to help with grep
- 💻 Lecture + Lab: Introduction to OpenStack API Endpoints
- 💻 Lecture + Lab: Verifying OpenStack Services

Horizon

- 💬 Lecture: Horizon
- 💻 Lecture + Lab: Exploring Horizon
- 💻 Lecture + Lab: Project and Quota in Horizon
- 💻 Lecture + Lab: Adding Users to a Project in Horizon
- 💻 Lecture + Lab: Launching Instances as a User
- 💻 Lecture + Lab: Managing a Project using Horizon

Managing Guest VMs

- 💬 Lecture: Managing Guest VMs
- 💻 Lecture + Lab: Managing Projects at the CLI
- 💻 Lecture + Lab: Host Aggregate and Availability Zones
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- 💻 Lecture + Lab: Launching Instances from the CLI
- 💻 Lecture + Lab: Controlling Customer VMs with admin

Hypervisors

- 💬 Lecture: Hypervisors

Keystone

- 💬 Lecture: Keystone
- 💻 Lecture + Lab: Launching Instances with Key Pairs

Nova

- 💬 Lecture: Nova

SDN

- 💬 Lecture: SDN

Data Center Fabric

- 💬 Lecture: Data Center Fabric

OpenStack Networking

- 💬 Lecture: OpenStack Networking
- 💻 Lecture + Lab: Building Keystone's Service Catalog
- 💻 Lecture + Lab: Provision Virtual Networking on a Freshly Booted Cloud

- 💻 Lecture + Lab: Security Groups
- 💻 Lecture + Lab: Floating IP Addresses
- 💻 Lecture + Lab: Neutron Networking with Horizon
- 💻 Lecture + Lab: Neutron Networking VMs with Floating and Private IPs

Glance

- 💬 Lecture: Glance
- 💻 Lecture + Lab: Glance

Swift

- 💬 Lecture: Swift
- 💻 Lecture + Lab: Swift Object Storage

Ceph

- 💬 Lecture: Ceph

Cinder

- 💬 Lecture: Cinder
- 💻 Lecture + Lab: Creating Block Storage Volumes with Cinder in Horizon
- 💻 Lecture + Lab: Creating Block Storage Volumes with Cinder at the CLI

Ceilometer

- 💬 Lecture: Ceilometer

AMQP

- 💬 Lecture: AMQP

Other Services

- 💬 Lecture: Other Services

Git Essentials

- 💬 Lecture: Git Essentials

Cloud Automation

- 💬 Lecture: Cloud Automation

HA

- 💬 Lecture: HA

Cloud Security

- 💬 Lecture: Cloud Security

Storage

- 💻 Lecture + Lab: Logs

Ansible

- 💻 Lecture + Lab: Automate the Cloud with Ansible