Shifting the Data Center

Transitioning Red Hat IT to hybrid cloud infrastructure using OpenStack and Ceph Storage

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Our approach to digital transformation

Roadmap illustrates conceptual “waypoints” that *guide* the work rather than specifying a detailed plan.
Nicole has dysentery.

Date: June 30, 1848
Weather: hot
Health: poor
Food: 242 pounds
Next landmark: 41 miles
Miles traveled: 948 miles
Fast growing company

- Focus on business enablement and customer support

- Rapidly changing environment and organic growth
  - New applications
  - New technologies
  - Tech debt

- Portfolio of applications often built on shoehorned systems
  - Modern app layers on legacy infrastructure
Legacy Environment
(this might sound familiar)
One data center to rule them all

- VMs and bare metal
- Config Management
- Appliances
  - Storage
  - Load balancers
- All eggs in one basket
Automation Difficulties

● Many individual systems cobbled together
● Integration was the exception
● Automation meant screen-scraping and chaining APIs
Excess Redundancy

From the Department of Redundancy Department

- Infrastructure uptime was key
- Double/triple built
  - Active/standby Networking
  - Multiple RHV clusters
  - Active/standby Storage heads
- Cold DR site

https://xkcd.com/703/
Application Architecture

- Applications assumed 100% infrastructure uptime
- Some would not tolerate device failovers
- Active/passive DBs
  - Manual failback
So this happened...

- HA services still resided in the same physical site
- DR failover unrealistic
- Application recovery took ages
Public Cloud Options

- Some apps moved to public cloud vendors
- Extension of data center
- Worst of both worlds
  - Named pets on someone else’s hardware
We could do better, let’s fix.
Kill the DB Monolith

- Effort to move data away from massive SQL databases
- Broke tight integration with DB
- SOA work gave way to stateless NoSQL and RESTful API data patterns
Single Sign On

- Deployed Red Hat SSO
  - Remove authentication responsibility from applications
  - Handles session management

- Multisite
  - MariaDB Galera
  - Jboss Data Grid
  - External User store
    - Mongo
    - IdM
OpenShift

- OpenShift changed deployment practices in a profound way
- Container-based design principles
- Migrating app tiers
  - Decouple application from state and data tiers
- Built-in Updates
Multisite Active
Development Pattern Prereqs

- Guard rails to ensure success
- Applications deployed on OpenShift
  - Stateless
  - Changes expected
- Session management delegated to SSO
- Loose coupling and/or microservices
- Graceful fault tolerance
Multisite Routing Strategies

- CDN handles Global Server Load Balancing
- Geographic Proximity
- Edge servers allow for advanced logic
Multisite Data Strategies

- Synchronous data storage
  - MariaDB Galera
  - JBoss Data Grid

- Eventual consistency
  - MongoDB
  - Directory Server / IdM

- Storage file and block replication
Multisite PaaS

- OpenShift deployed in three sites
- PaaS abstracted underlying infrastructure
- Front-end with a CDN
OpenStack and Ceph
Why OpenStack

- Faster Delivery of applications and services
- Vast automation potentials
- Empower development teams
- Infrastructure as code
- Lower cost through software-defined services
One Leg on OpenStack

- New data center
- Replace RHV with OpenStack
- Minimal appliances
  - Load Balancer -> Octavia + proxy layer
  - Storage -> Ceph
- RHII-V cluster
  - Bootstrapping
  - Utility services
OpenStack

- Not a virtualization solution
- Cloud ecosystem
  - Including virtualization
- Software-Defined Data Center
- Integrated APIs and CLI tools

https://www.openstack.org/software/
Legacy Stack

- NETWORK
  - Firewall
  - LB
  - Distrib. Switch

- COMPUTE
  - Red Hat Virtualization
  - Server Hardware

- STORAGE
  - Storage Appliance

OpenStack

- NETWORK
  - Basic Firewall
  - OSP Security Groups
  - OSP LBaaS (Octavia)
  - OSP SDN (Neutron)

- COMPUTE
  - OSP Compute (Nova)
  - Server Hardware

- STORAGE
  - OSP - Ceph
OpenStack Director

**OVERCLOUD** (Deployed Cloud)

- **CONTROLLER NODES**
- **COMPUTE NODES**
- **STORAGE NODES**

**UNDERCLOUD** (Director)

Deploy, configure & manage nodes
RHHI-V

- **RHHI-V**
  - Integrated RHV + Gluster

- **Hosts**
  - Director
  - Red Hat IdM, DHCP, monitoring

- **HA VMs and Snapshots**
OpenStack Overcloud

https://docs.openstack.org/tripleo-docs/latest/install/introduction/architecture.html
Solution Implementation
Availability Zones

- Zones
  - Failure domains
  - Resource islands

- Separate racks, server hardware, upstream network gear, power circuits, etc.

- Taking down one AZ has no impact on others

- Three zones
<table>
<thead>
<tr>
<th>AZ1</th>
<th>AZ2</th>
<th>AZ3</th>
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</thead>
<tbody>
<tr>
<td><strong>PHYSICAL NETWORK STACK</strong></td>
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<td><strong>CONTROLLER CLUSTER (3 NODES MIN)</strong></td>
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<td><strong>COMPUTE CLUSTER (6+ NODES)</strong></td>
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<td><strong>CEPH CLUSTER (3 NODES MIN)</strong></td>
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<td><strong>UTILITY RHV/RRHI CLUSTER (3 NODES MIN, BACKED BY CLUSTER)</strong></td>
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<td><strong>BARE METAL UTILITY</strong></td>
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Network Integration

- Provider Networks
  - Stretched VLANs spanning availability zones
  - Faster, shared resource

- Tenant Networks
  - Private overlay networks
  - Slower, more secure

- Security Groups
Load Balancing - Octavia

- Quick and simple OpenStack native load balancing
- Advanced logic in application tiers
- Individual Amphora provides failure domain separation
Ceph Storage

● Benefits
  ○ Software-defined
  ○ Cheaper, reliable
  ○ Scale-out
  ○ Block, Object and File storage

● Use-cases
  ○ VM disk storage
  ○ Glance image storage
Lessons Learned
OSP Long Life Releases

- **Historical cadence**
  - 1 - 2 major releases per year

- **Long Life releases**
  - 5 years of support
    - 3 years production
    - 2 years extended life

- **Short Life releases**
  - 1 year of support

- We settled on OSP 13
Use Cases

- OpenShift
- Non-container workloads
- Red Hat SSO
  - Multicast
- Databases
- IdM
- LucidWorks
- Legacy workloads
IdM and Ansible Integration

- OpenStack Novajoin
  - Native IdM integration
  - Secures all endpoints automatically (~100 certs)

- Ansible for project provisioning
  - Creates IdM host
  - Provision VM, load balancer, storage
  - Scale-up events
  - Tower API endpoint for playbook
Load Balancing

- TLS terminate and re-encrypt not supported in Octavia
  - Drove some design, ie CDN & App tier

- Stretch VLANs between the AZs for Octavia
  - One virtual IP(VIP) on all three AZs

- Embrace simple
Autoscaling

- Heat-based templates, harder to implement auto scaling than hoped
- Tooling is there for your own solution
- Template-based provisioning accelerates scaling
Questions?
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<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Event Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thurs, May 9</td>
<td>3:15 - 4:00pm</td>
<td>Developing and running cloud-native apps on OpenShift in Red Hat's IT organization</td>
</tr>
<tr>
<td>Thurs, May 9</td>
<td>3:15 - 4:00pm</td>
<td>Developing and deploying applications in a multisite hybrid cloud</td>
</tr>
</tbody>
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