Basic principles of Cloud applications and their architectural styles

A Software Architecture lecture

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Do I hear Cloud again?

Brief history of cloud computing

- 2006 - Amazon Web Services
- 2007 - Heroku (PaaS)
- 2010 - Microsoft Azure
- 2010 - OpenStack (IaaS)
- 2011 - OpenShift (PaaS)
- 2011 - Google Cloud Platform

In general

- When single server stops being enough
- with increasing demand for faster deployment
- with increasing demand for cheaper services
- with increasing number of technologies

When single server is not enough

- More data
- Complex operations

When single server is not enough

- More data
- Complex operations

Vertical scaling is limited

- Faster CPU
- More RAM
- Bigger disk

Horizontal scaling is not

- Add server

Vertical scaling

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- Trivial architecture
- Simple to implement

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- Expensive
- Hardware failure cause bigger outages
- Limited

Horizontal scaling

+

- Theoretically unlimited
- Cheaper
- Easier fault-tolerance
- Easy upgrades

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- Complex architecture
- Harder to implement
- Bigger footprint

Faster deployment

Better integrated management tools enable easier and more effective deployment of cloud infrastructure.

> *Deploying new applications used to take the bank 8–12 weeks. Now it's done in just a few hours. New applications are delivered faster, with better quality, improving service for internal and external customers. [*]*

[*] https://www.redhat.com/en/resources/mufg-union-bank-serves-customers-faster-private-cloud-red-hat

Before (hours to days)

- User creates IT ticket requesting new virtual server
- Admin creates and configures new machine
- User receives login information

Now (minutes)

- User logs in to the self-service portal
- Selects virtual server template
- Creates new machine in couple of mouse clicks
- Once the virtual server boots, it's ready to use

Cheaper services

Usually:

- no upfront costs
- no termination fees
- pay-as-you-go
  - unit of resource per hour

Google Compute Engine example

- $0.033174 / vCPU hour
- $0.004446 / GB hour

XaaS

Everything as a service:

- HaaS - Hardware as a Service
- IaaS - Infrastructure as a Service
- PaaS - Platform as a Service
- SaaS - Software as a Service
- ...

Infrastructure as a Service

- Virtual Machines
- Networking
- Storage

Ability to

- Use custom / to modify Operating System

Networking

- SDN - Software defined networking
- Custom networks, subnets
- Custom firewall rules
- Custom DNS
- Load Balancing

- OpenvSwitch
- OpenDaylight

Storage

Block storage:

- Block device (disk)
- Needs to be attached to the virtual server
- Easy to use, well supported

Object Storage:

- Cloud native storage
- Every object has ID - URI
- REST API - HTTP GET, PUT

- Amazon S3

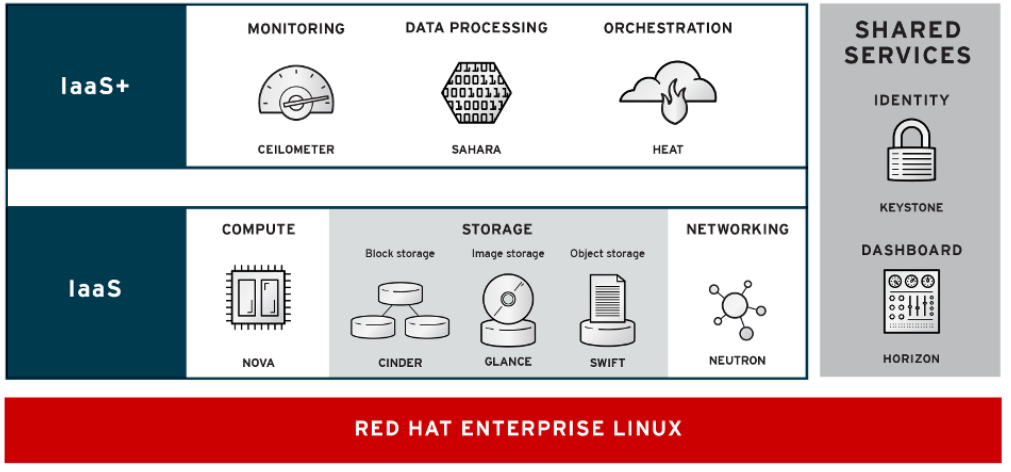
Storage II

Shared / Distributed Filesystem

- Cloud native
- Spans across multiple devices / servers
- Enables concurrent writes

- GlusterFS (distributed fs)
- Ceph (block & object storage, distributed fs)

IaaS (OpenStack)



Platform as a Service

- Application platform
- Languages, libraries, frameworks

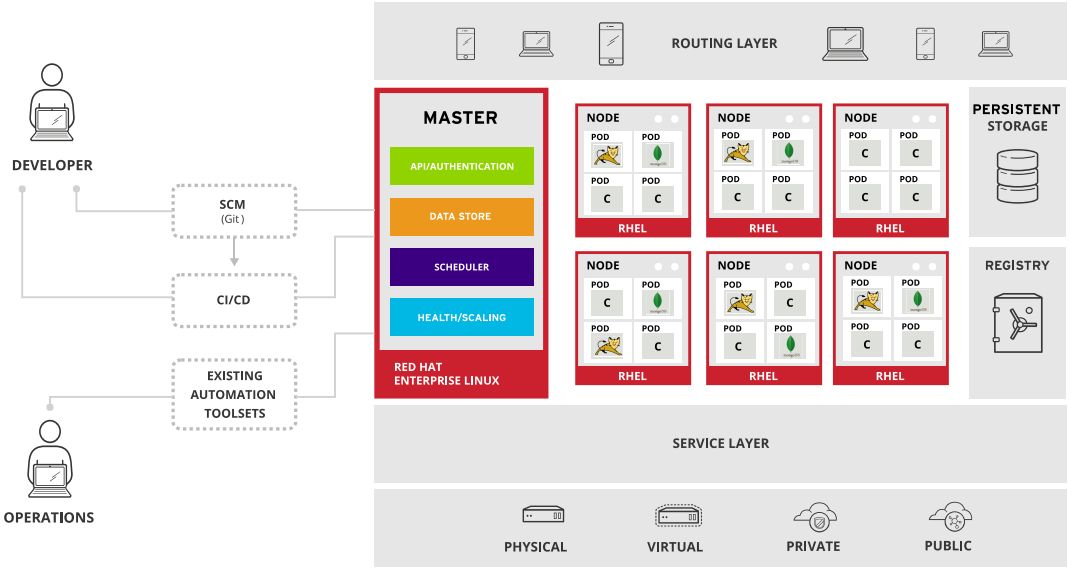
Ability to

- Deploy custom application

Not possible to

- Manage OS

PaaS (OpenShift)



Software as a Service

- Access to specific software

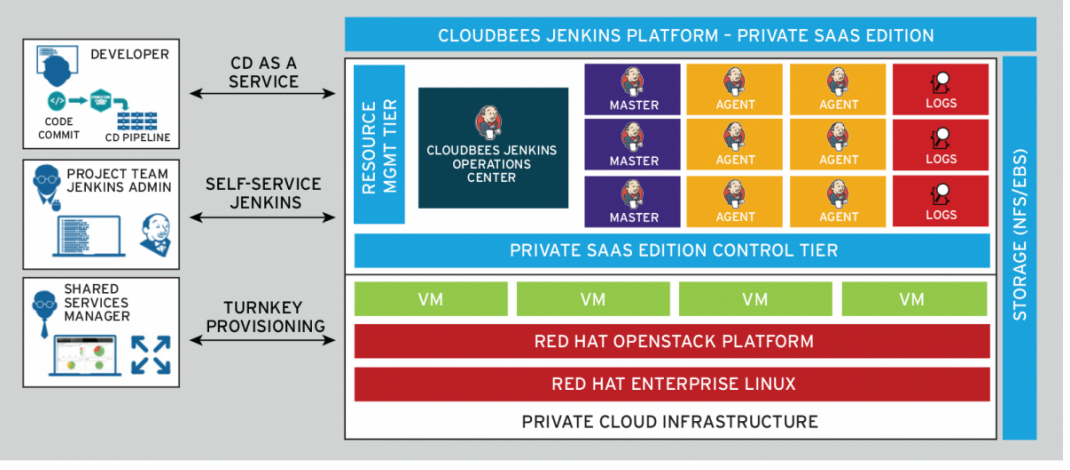
Ability to

- Immediately use application

Not possible to

- Change application

Saas (CD as a Service)



Classification of cloud types

- Public cloud
- Private cloud
  - Dedicated Cloud
- Hybrid cloud

Public cloud

- Publicly available, shared with others
- Cost effective, ready to use

- Amazon Web Services
- Google Cloud Platform
- Microsoft Azure

Private cloud

- On premise, usually for internal use
- Might be partially available to public
- Exclusively used by owner
- More expensive, requires set up period

- OpenStack
- CloudStack
- Eucalyptus
- OpenShift
- Mesos

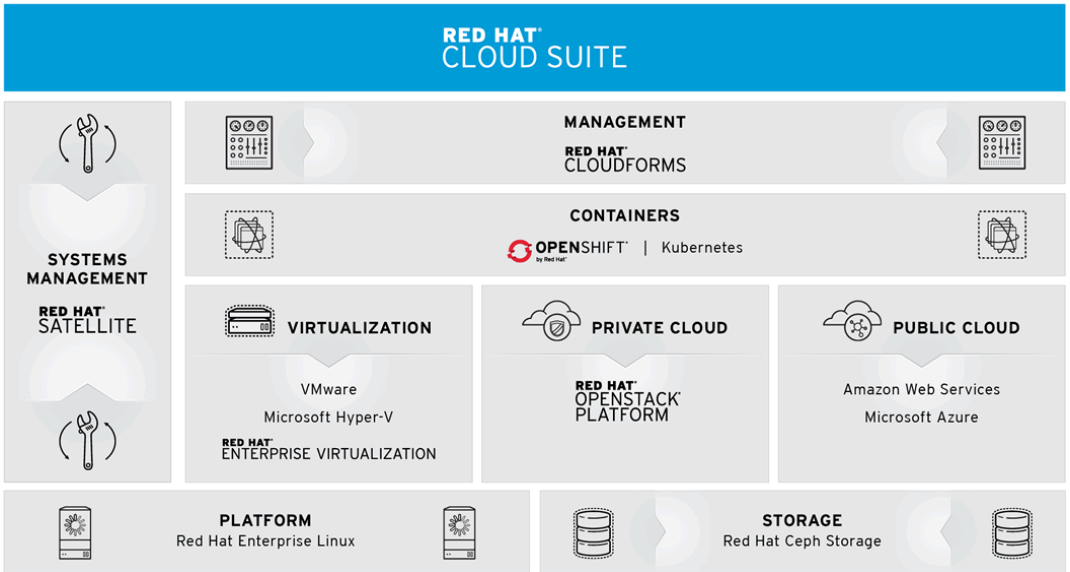
Dedicated cloud

- Managed by provider, for single customer
- OpenStack
- OpenShift

Hybrid cloud

- Integrated cloud service utilizing both private and public clouds
- Federation

- CloudForms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PRIVATE CLOUD
RED HAT OPENSTACK PLATFORM
PUBLIC CLOUD
Amazon Web Services
Microsoft Azure
PLATFORM
Red Hat Enterprise Linux
STORAGE
Red Hat Ceph Storage

Reading assignment

- https://youtu.be/iw2Wkf5uva0
- https://youtu.be/XZmGGAbHqa0
- http://www.allthingsdistributed.com/files/amazon-dynamo-sosp2007.pdf

Questions?

Practical part

Google Cloud Platform

https://console.cloud.google.com/

IaaS

https://cloud.google.com/solutions/gaming/minecraft-server

https://cloud.google.com/storage/docs/quickstart-console

https://codelabs.developers.google.com/codelabs/cloud-networking-101/

https://codelabs.developers.google.com/codelabs/cloud-compute-the-cosmos/

PaaS

https://cloud.google.com/python/getting-started/tutorial-app

https://cloud.google.com/vision/docs/quickstart

https://codelabs.developers.google.com/codelabs/cloud-hello-kubernetes/

https://codelabs.developers.google.com/codelabs/cloud-running-a-nodejs-container/