PA200 - Cloud Computing

Lecture 10: Cloud software architecture and containers

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Warm-up

Let's rehearse on the previous lectures...

Using OpenStack

- Spawn a single virtual machine
- Deploy the infrastructure

HEAT orchestration engine

- HOT templates render stacks
- Resources stack up to infrastructure
- HEAT takes HOT template(s) + environment

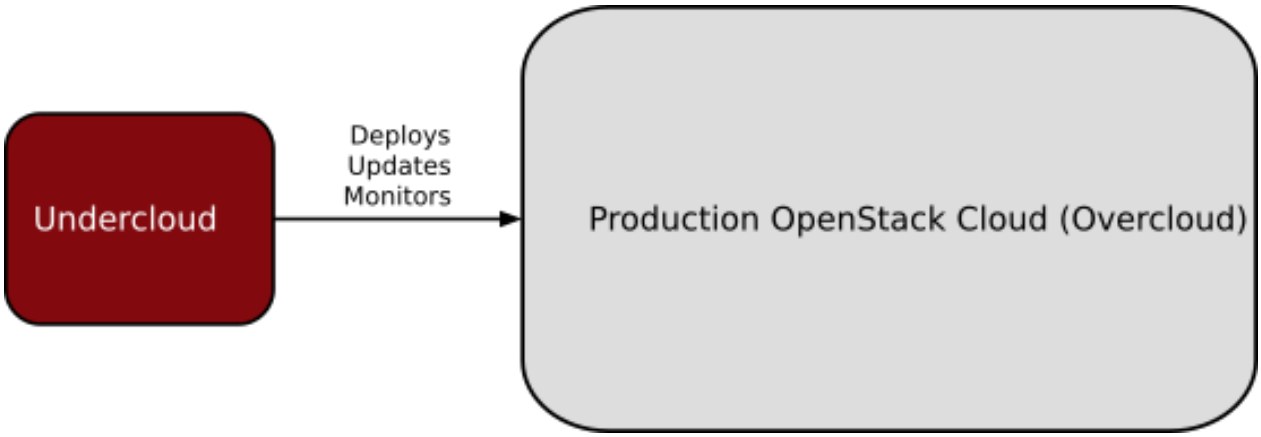
OpenStack administration

- PackStack, Fuel etc
- TripleO

OpenStack-on-OpenStack (1/2)

- Deployment cloud: Undercloud
- Workload cloud: Overcloud

OpenStack-on-OpenStack (2/2)



In this lecture...

- Cloud-naive software architecture
- Containers
- Container orchestration

On-premises applications (1/2)

- Monolithic
- Tied to the infrastructure
- Languages: a Visual Studio language, enterprise Java, Cobol
- Developed in a waterfall model

On-premises applications (2/2)

Problems:

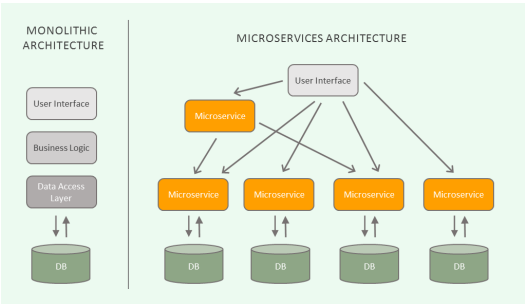
- Hard to scale, migrate, distribute
- Risky updates
- Low code reuse

Cloud-native applications

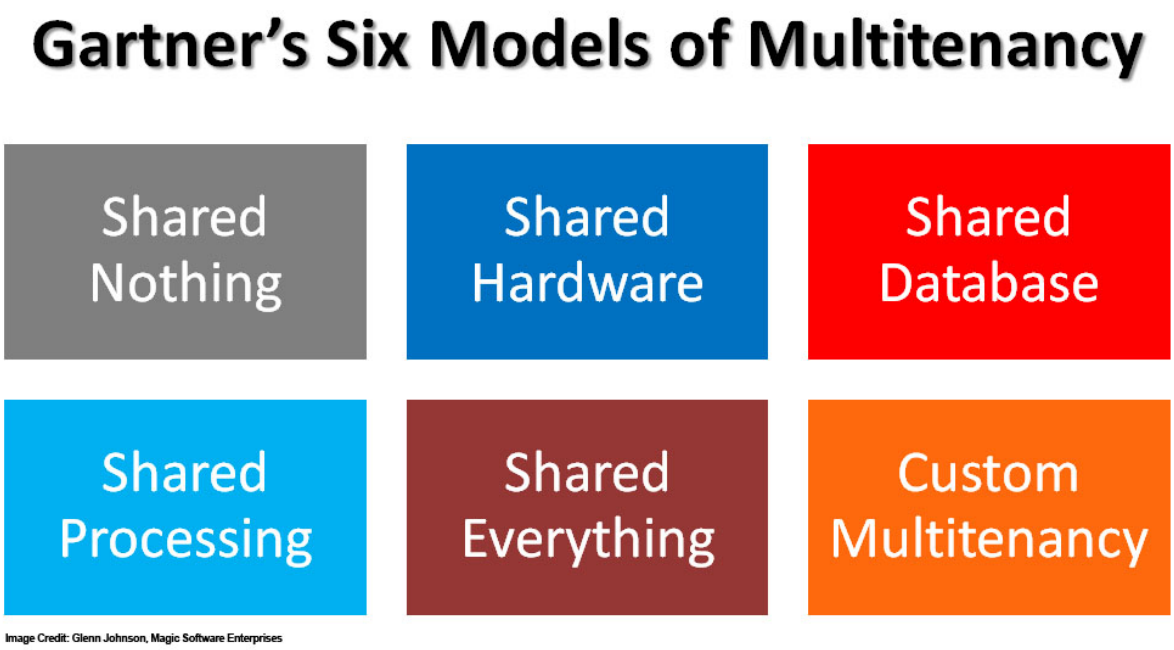
- Modular and stateless
- Shared resources
- Elastic and redundant by design
- Web-service architecture
- Rolling updates
- Agile, DevOps, CI/CI

Cloud-native: modularity

Microservices



Cloud-native: multitenancy



Cloud-native: elasticity and redundancy

- Services accommodate work load
- Services migrate towards the clients
- Service instances ensure redundancy

Cloud-native: application design

- Modular and task-specific
- Statelessness
- REST API RPC
- Application databases
- Web-centric languages (Go, Python, Node.js, Ruby etc.)
- Automated testing

Cloud-native: rolling updates

- Frequent, minor per-service updates
- Redundancy to replace updating instances
- CI/CD automation to ensure code quality

Cloud-native: team changes

- Service-centric teams

    - Cross-team collaboration
- Agile, minimal viable product development
    - Software developers <-> customers
- Software development & IT operations (DevOps)
    - System administrators <-> software developers
- Continuous integration, continuous delivery, continuous deployment

Cloud-native challenges

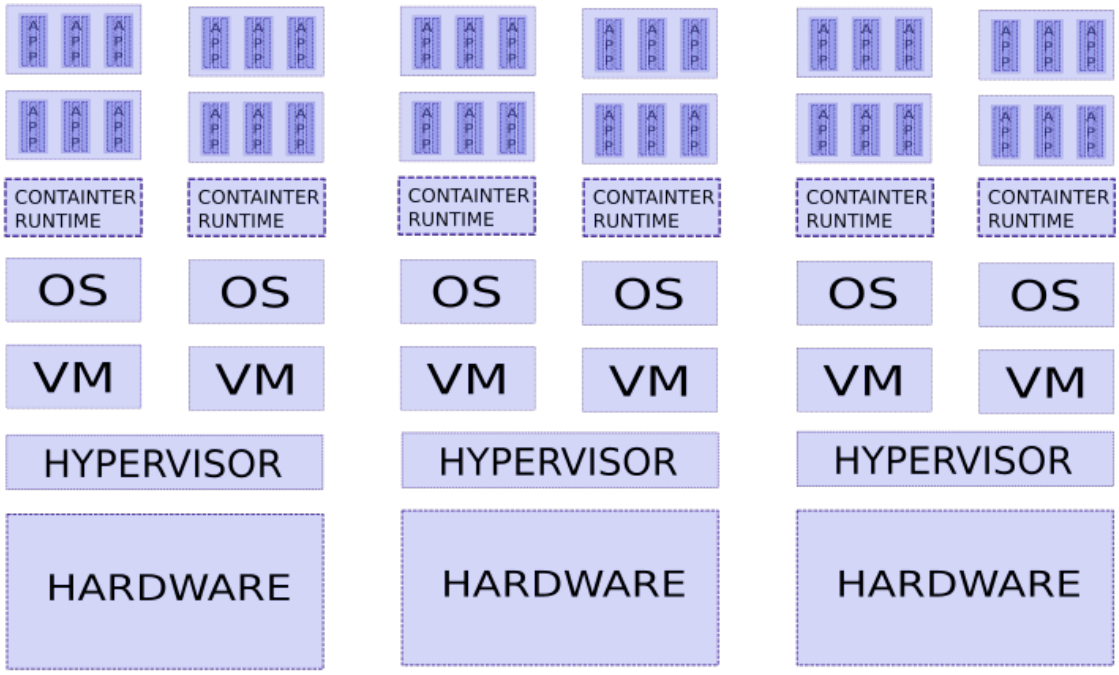
- Root cause analysis/debugging/testing
- Logging/monitoring
- Security
- Expensive changes to legacy apps & teams

Containers: agenda

- Concurrency and isolation
- Container automation
- Container orchestration

Concurrency and isolation

Multiple systems, VMs, containers, processes, threads



Linux containers

LXC concepts

- Namespaces present resources to process
- Cgroups govern resource isolation and usage
- Container is temporary and transient, much like a process

Docker to manage containers

Docker concepts

- Dockerfile to build Docker image
- Docker image to run the container(s)
- Containers are live image instances

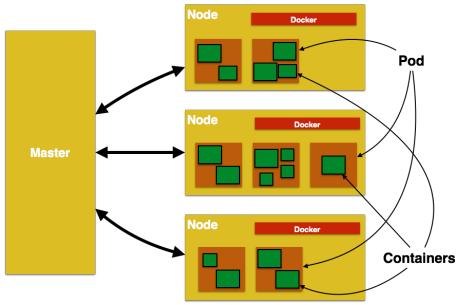
Docker features

- Container is temporary and transient, but it can be
    - deployed, suspended, replicated, moved, backed up etc.
- Docker Hub shares Docker images
- Docker Compose hitches containers on the same host
- Docker Swarm orchestrates multi-node deployments
    - Clustering, redundancy, load-balancing etc.

Container orchestration: Kubernetes (1/2)

- Cluster
  - master + nodes (on bare metal or VMs)
  - nodes run pods
- Pods
  - Pod contains one+ containers
  - Application runs in its pod
- Controllers
  - Pod management logistics (e.g. Deployment, StatefulSet)
- Services
  - Represent application to the world

Container orchestration: Kubernetes (2/2)



Kubernetes pros&cons

- Automates application maintenance
  - Deployment (e.g. Helm), health, balances load, resilience
- Simplifies management of shared resources
  - Storage, secrets etc.
- Utilizes hardware resources
  - Soft & hard limits per-app
- Learning curve is high

Containers are on the rise

- Facilitates microservices design
- Portability
- Composability and throttling
- Easy scaling

Containers challenges

- Keeping software up to date is difficult
- Isolation can be insufficient
- Overhead can be noticeable

Recap: cloud software architecture

- Requires changes in software design towards:
    - Modularity
    - Statelessness
    - Automatic testability
- Requires changes in team work
    - Team focusing on service
    - Agile, MVP
    - DevOps

Recap: containers

- Container for concurrency and isolation
- Docker for container lifecycle automation
- Kubernetes for container-based clouds

Questions

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