Middleware and Web Services

Lecture 9: Cloud Architectures

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Overview

- Introduction
- Cloud Architecture

What is a Cloud?

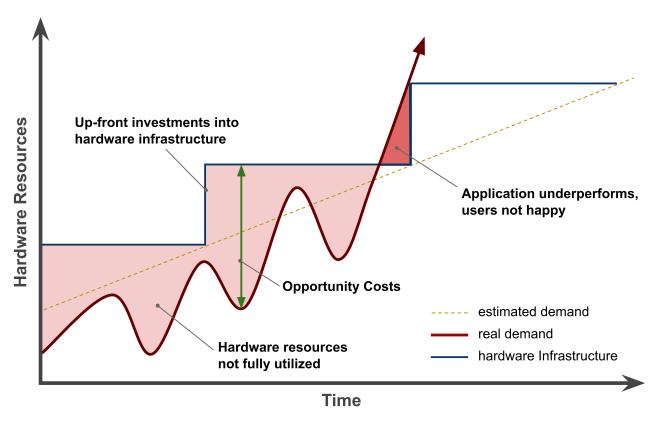
- A different way of thinking
 - Got your grand mum's savings under your pillow?
 - → probably not, you better have them in your bank
 - Data is your major asset
 - you better have them in a "bank" too
 - Someone can abuse your data?
 - banks bankrupt too, sometimes it is a risk you take
 - there is a market and a competition
- Outsourcing of application infrastructure
 - Reliability and availability
 - − Low costs − pay-per-use
 - Elasticity can dynamically grow with your apps

What is a Cloud?

- Any app you access over the web?
- A datacenter?
 - Offers virtualization
 - Any company having a datacenter wants to move to
- Cloud provider should also offer services, such as:
 - scalability, storage
 - Possible to configure programmatically
 - → integration to enterprise administration processes
 - → usually REST interface

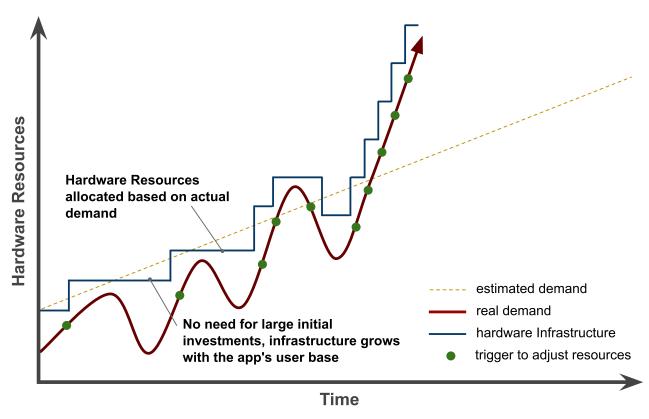
Traditional Solution to Infrastructure

- Traditional hardware model
 - *Up-front hardware investments*
 - Hardware not optimally utilized



Good Performance – Cloud Solution

- Cloud Computing model
 - No up-front hardware investments
 - Hardware optimally utilized



Cloud Computing Concepts

Resource Pooling

- Resources reused by multiple tenants (multitenancy)
- Resources: CPU, memory, storage, network

• On-demand and Self-service

- Resources are provisioned as they are requested and when they are required
- No human interaction, automatic

• Scalability and Elasticity

- Infrastructure may grow and shrink according to needs
- Automatic or manual

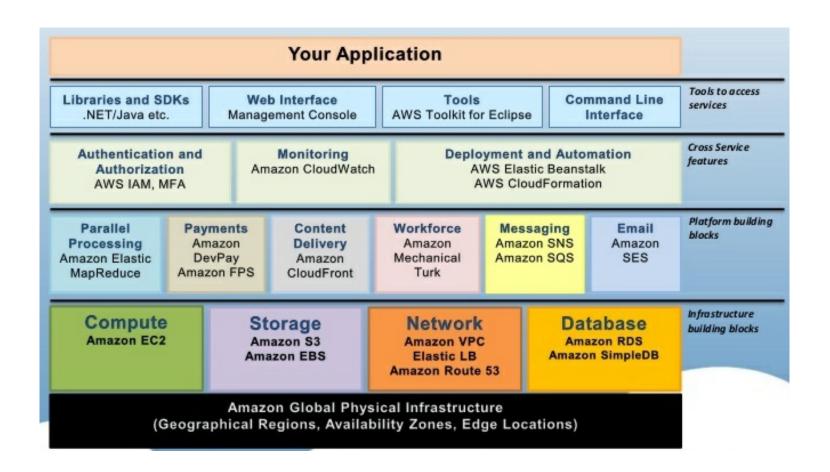
• Pay-per-use

- Consumers only pay for resources when they use them

Cloud Computing Concepts (Cont.)

- Service Models (aka Cloud Layers)
 - IaaS Infrastructure as a Service
 - PaaS Platform as a Service
 - \rightarrow MWaaS, DBaaS, ...
 - SaaS Software as a Service
- Deployment Models
 - Public Cloud
 - Private Cloud
 - Hybrid Cloud

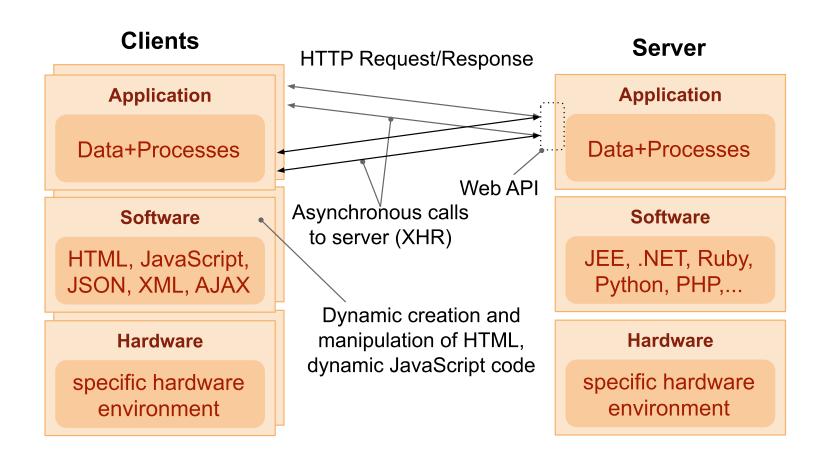
Cloud Provider Example – Amazon AWS



Overview

- Introduction
- Cloud Architecture
 - Service Models
 - Multitenancy

Web 2.0 Web Architecture



IaaS: Infrastructure as a Service

- Provides basic computing resources and services for application providers
 - Services for application providers
 - A consumer is able to deploy and run arbitrary software
- Infrastructure implications
 - Exposing of infrastructure resources through abstraction
 - Support for infrastructure resources compute (hardware/OS/VM), storage, network, etc.
 - Supports isolation for multitenant environments

IaaS: Infrastructure as a Service

Usage

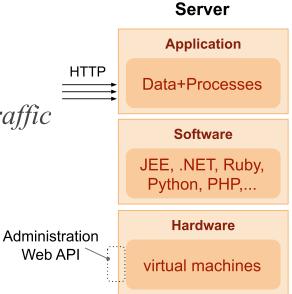
- Predefined machine instances (micro, small, large, extra-large)
 - → Linux OS, 613 MB of memory, 30 GB of Storage, Load Balancer, etc.
- Pay-per-use pay for resources you use (time or amount); no up-front costs

IaaS Services Examples

- Elastic Storage
- Monitoring resources
 - \rightarrow Amazon CloudWatch)
- Auto Scalling of running instances
- Load Balancing distributing incoming traffic across multiple instances

IaaS providers

- Amazon EC2, GoGrid, Rackspace, OpenNebula, ...



PaaS: Platform as a Service

- Provides scalable platform for applications
 - Services for application providers
 - No costs of buying and managing underlying infrastructure
 - \rightarrow hardware and software
- Infrastructure implications
 - Scalable platform, deploy on-demand
 - Self service interface to deploy applications and services
 - Support for monitoring and measuring platform usage
 - Model supporting isolation in multi-tenant environments

PaaS: Platform as a Service

Usage

- Choose software platform, e.g., JEE, .NET, Python, etc.
- Pay-per-use pay for the resources you use; no up-front costs

PaaS features

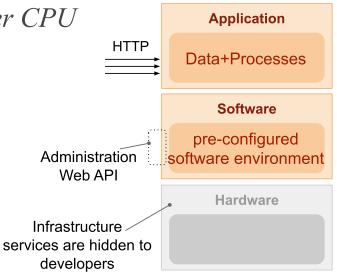
- Auto Scalling and Load Balancing of applications
- Persistent Storage usually NoSQL database
- Local development environment
- Backends for app instances with higher CPU and memory demands
- Administration APIs for its services

• PaaS providers

- Google App Engine, Heroku, Windows Azure, etc.

Limitations

- HTTP request limit (30 60 sec)
- No writes to file system no thread sunnort



Server

SaaS: Software as a Service

- Software delivery model for applications hosted in the cloud
 - typically software for end-users
 - services accessed using a web browser
 - provides API for programmatic access
- SaaS characteristics
 - Typically build on top of IaaS or PaaS
 - Configurable and customizable modern Web applications
 - Usually basic version for free, need to pay for pro version
 - Global availability any computer, any device
 - Easy management automatic and fast updates
 - − Pay-per-use − pay for the time you use
- SaaS providers
 - Google Apps, Salesforce, iCloud, Flickr, Picasa, ...

Overview

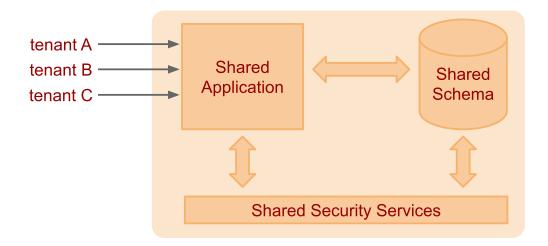
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Multitenancy

- Architectural approach where resources are shared between multiple tenants or consumers
- Implications
 - Centralization of infrastructure in locations with lower costs
 - Peak-load capacity increases
 - Utilisation and efficiency improvements for systems that are not well utilised
- Sharing options
 - Shared Everything
 - Shared Infrastructure
 - → Virtual Machines
 - \rightarrow O/S virtualization

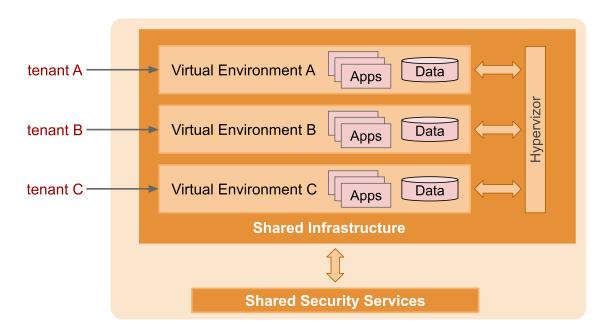
Shared Everything

- Resources are shared between all tenants or consumers
 - tenant: a service consumer
- Common for the SaaS model
- The application should provide tenant isolation
- Data for multiple tenants is stored in the same database tables



Shared Infrastructure: Virtual Machines

- Infrastructure shared via virtual machines
 - each tenant has its own virtual environment
 - Isolation provided by hypervisor
 - → hypervisor: virtual machine manager, runs virtual machines
 - Resource contention depends on VM capability and configuration
 - Adds an additional layer and processes to run and manage



Shared Infrastructure: OS Virtualization

- Infrastructure shared via OS Virtualization
 - Each tenant has its own processing zone
 - Isolation provided by the operating system
 - Resource contention depends on zone configuration
 - No VMs to run and manage, no abstraction layer between app & OS

