Middleware and Web Services

Lecture 7: 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

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What is a Cloud?

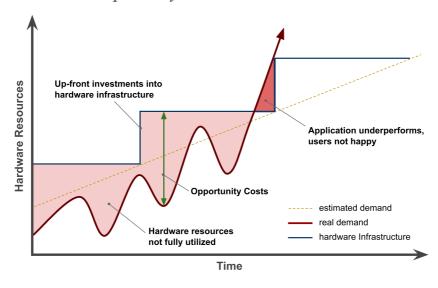
- Any app you access over the web?
- A datacenter?
 - Offers virtualization
 - Any company having a datacenter wants to move to
- Cloud provider should also offer services, such as:
 - scalability, storage
 - $-{\it Possible to configure programmatically}$
 - → integration to enterprise administration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

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Traditional Solution to Infrastructure

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

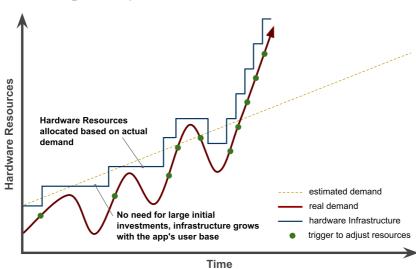


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Good Performance – Cloud Solution

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



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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

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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

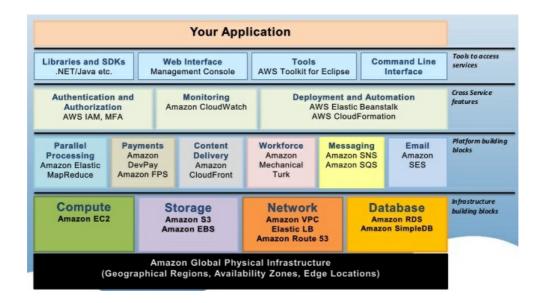
• Deployment Models

- Public Cloud
- Private Cloud
- Hybrid Cloud

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Cloud Provider Example – Amazon AWS



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 - Service Models
 - Multitenancy

Web 2.0 Web Architecture **Clients** Server HTTP Request/Response **Application Application** Data+Processes Data+Processes Web API Asynchronous calls **Software Software** to server (XHR) JEE, .NET, Ruby, HTML, JavaScript, Python, PHP,... JSON, XML, AJAX Dynamic creation and **Hardware** manipulation of HTML, **Hardware** dynamic JavaScript code specific hardware specific hardware environment environment Lecture 7: Cloud Architectures, CTU Winter Semester 2018/2019, @TomasVitvar

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

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IaaS: Infrastructure as a Service

Usage

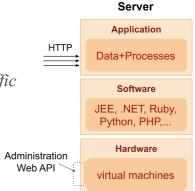
- Predefined machine instances (micro, small, large, extra-large)
 - → Linux OS, 613 MB of memory, 30 GB of Storage, Load Balancer, etc.
- Pay-per-use pay for resources you use (time or amount); no up-front costs

• IaaS Services Examples

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

IaaS providers

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



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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 support

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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, ...

Server

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Multitenancy

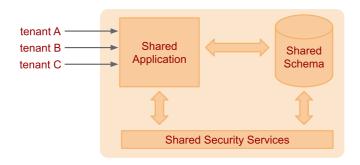
- Architectural approach where resources are shared between multiple tenants or consumers
- Implications
 - Centralization of infrastructure in locations with lower costs
 - Peak-load capacity increases
 - Utilisation and efficiency improvements for systems that are not well utilised
- Sharing options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

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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

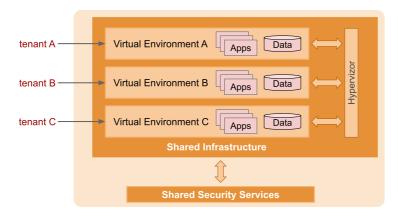


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Shared Infrastructure: Virtual Machines

- 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

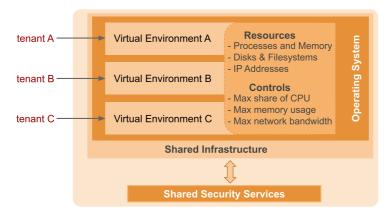


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Shared Infrastructure: OS Virtualization

- 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



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