Middleware and Web Services

Lecture 9: Cloud Architectures

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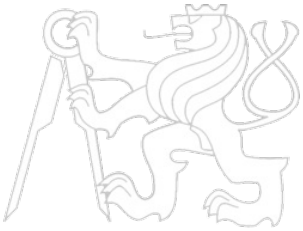

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Overview

- Introduction
- Cloud Architecture

What is a Cloud?

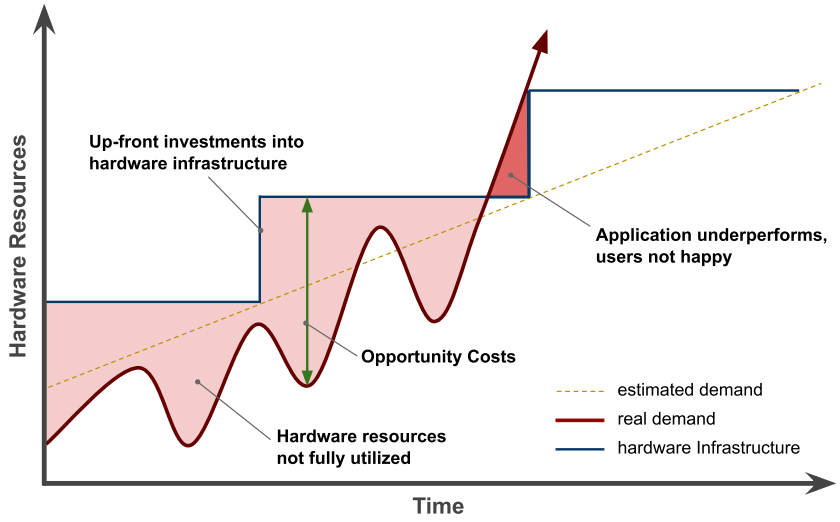
- A different way of thinking
  - *Got your grand mum's savings under your pillow?*
    → probably not, you better have them in your bank
  - *Data is your major asset*
  - *you better have them in a "bank" too*
  - *Someone can abuse your data?*
  - *banks bankrupt too, sometimes – it is a risk you 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

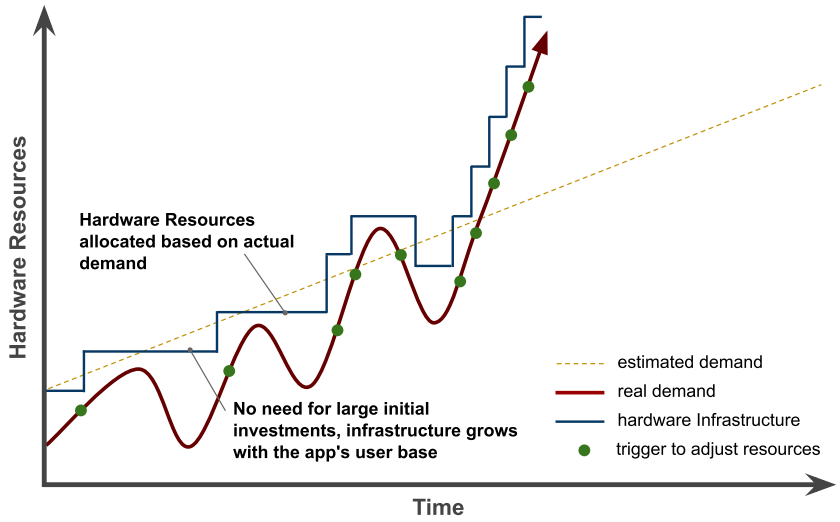
Traditional Solution to Infrastructure

- 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*



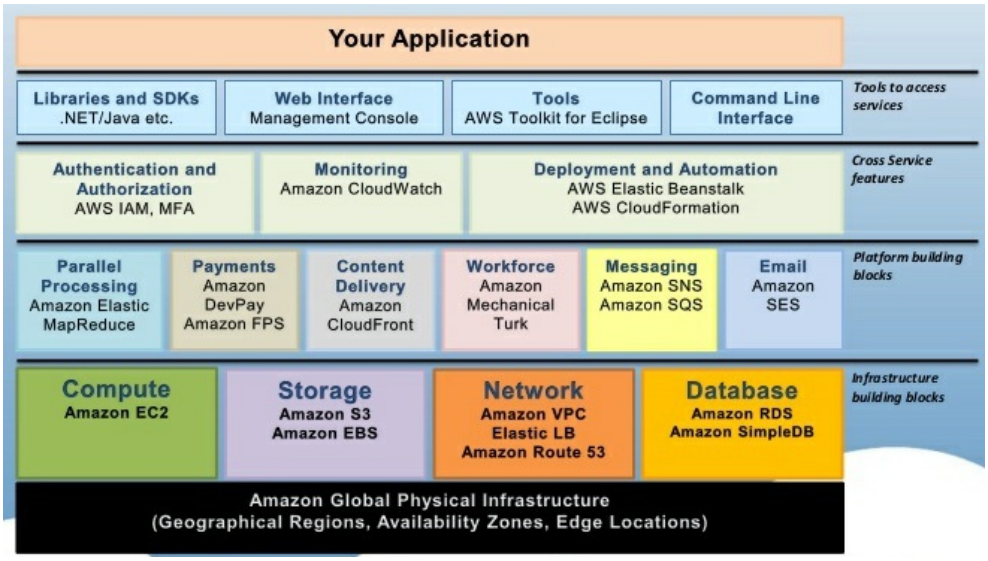
Cloud Computing Concepts

- **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*
    → MWaaS, DBaaS, ...
  - *SaaS – Software as a Service*
- Deployment Models
  - *Public Cloud*
  - *Private Cloud*
  - *Hybrid Cloud*

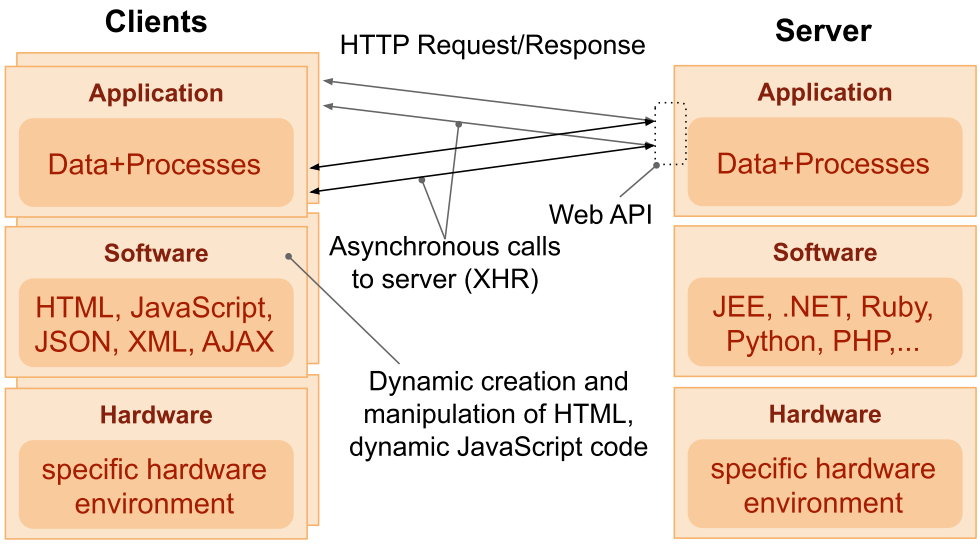
Cloud Provider Example – Amazon AWS



Overview

- Introduction
- Cloud Architecture
  - *Service Models*
  - *Multitenancy*

Web 2.0 Web Architecture

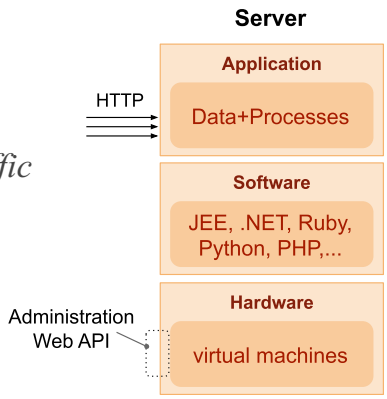


IaaS: Infrastructure as a Service

- 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*
    → Amazon CloudWatch)
  - *Auto Scalling of running instances*
  - *Load Balancing – distributing incoming traffic across multiple instances*
- IaaS providers
  - *Amazon EC2, GoGrid, Rackspace, OpenNebula, ...*

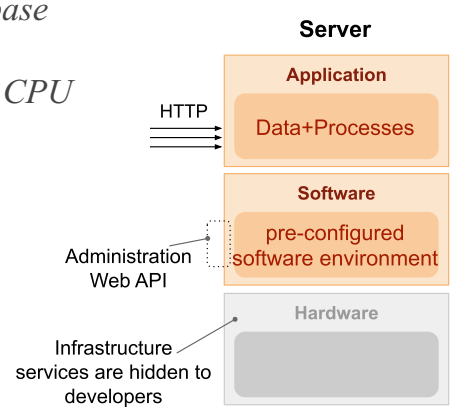


PaaS: Platform as a Service

- Provides scalable platform for applications
  - *Services for application providers*
  - *No costs of buying and managing underlying infrastructure*
    → 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*



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, ...*

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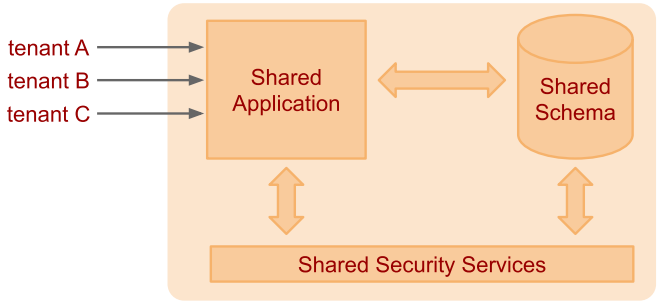
  - *Multitenancy*

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*
    - → *O/S virtualization*

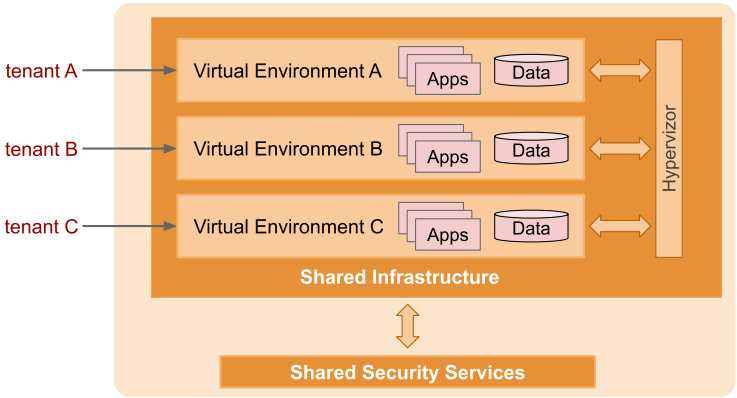
Shared Everything

- 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*