

Cloud Computing and Web Service (IT4221)

Introduction

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Course Details

- Class Timing:
 - Wednesday: 10:50 AM - 11:45 AM
 - Thursday: 01:50 PM - 03:40 PM
- Venue: IT-CR (3rd Floor)
- Google Classroom Link:
<https://classroom.google.com/c/NjQ2Nzc2MDU5NDMz?cjc=u67ug6q>
(Class Code: [u67ug6q](#)) [Register by 11 January 2024 EOD]

Marks Distribution

- Mid-Semester Examination: 30%
- End-Semester Examination: 50%
- Assignment(s) / Class Test(s) / Quiz(zes): 20%
- Total: 100%

Books

- “Cloud Computing: A Practical Approach”, Anthony Velte, Toby Velte and Robert Elsenpeter
- “Cloud Computing: Principles, Systems and Applications”, Nikos Antonopoulos and Lee Gillam
- “Cloud Security: A Comprehensive Guide to Secure Cloud Computing”, Ronald L. Krutz and Russell Dean Vines
- Other books, research papers and online materials (*will be discussed in due course*)

Content Overview

- Introduction
- Storage
- Security
- Services
- Advanced topics

Introduction to Cloud Computing

- What is cloud computing?

Introduction to Cloud Computing

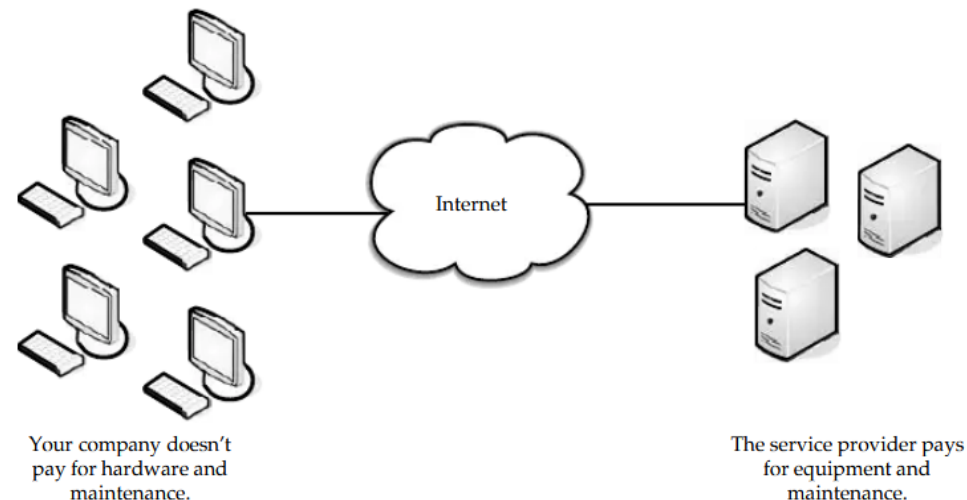
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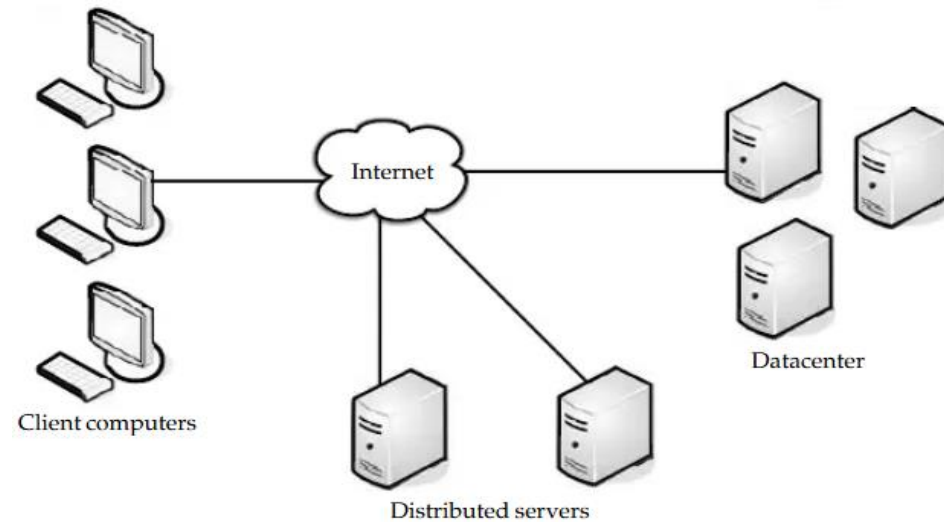
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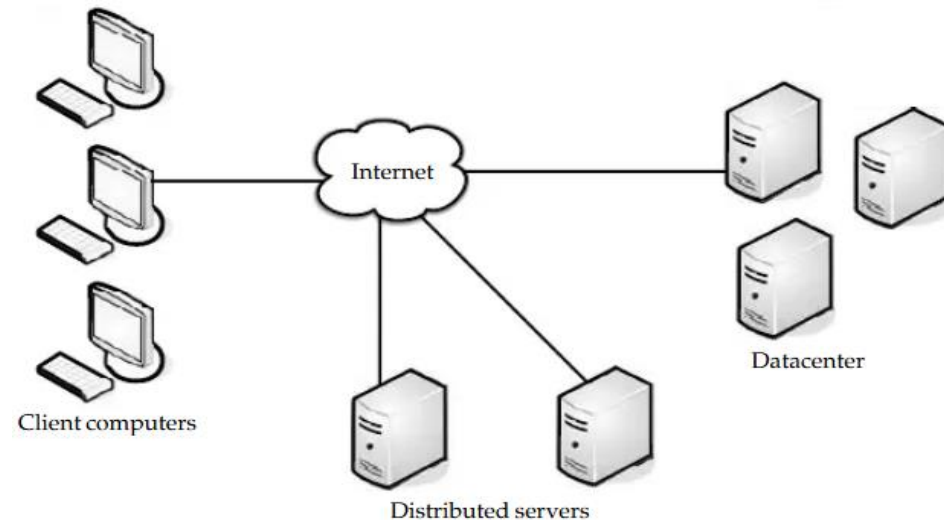
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- Each element has a purpose and plays a specific role in delivering a functional cloud-based application

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 - Thick clients: Include regular computers (that may use a web browser like Firefox to connect to the cloud)

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 - Software is installed allowing multiple instances of virtual servers to be used

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 - Avoiding single point of failure, achieving scalability

Deployment Models of Cloud

- Public Cloud
- Private Cloud
- Community Cloud
- Hybrid Cloud

Public Cloud

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- Examples
 - Google App Engine
 - Microsoft Windows Azure
 - IBM Smart Cloud
 - Amazon EC2

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- Cloud serves a diverse pool of clients (and possibly attackers)

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 - A subscriber cannot verify that data has been completely deleted from a provider's systems

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- Restrictive default service-level agreements (SLAs)
 - Default SLAs of public clouds specify limited promises that providers make to their subscribers

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- Examples
 - Eucalyptus
 - Ubuntu Enterprise Cloud (UEC)
 - Amazon VPC (Virtual Private Cloud)
 - VMware Cloud Infrastructure Suite
 - Microsoft ECI datacenter

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 - Applies to private clouds implemented at a customer's premises
- Outsourced Private Cloud
 - Applies to private clouds where the server side is outsourced to a hosting company

On-site Private Cloud

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- Security perimeter does not guarantee control over the private cloud's resources but subscriber can exercise control over the resources

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 - With an on-site private cloud, a subscriber organization chooses the physical infrastructure, but individual clients still may not know where their workloads physically exist within the subscriber organization's infrastructure

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- Data import/export and performance limitations
 - On-demand bulk data import/export is limited by the on-site private cloud's network capacity, and real-time/critical processing may be problematic because of networking limitations

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 - Installing cloud software and managing the installations will incur significant up-front costs, even if the cloud software itself is free, and even if much of the hardware already exists within a subscriber organization

On-site Private Cloud

- Limited resources: An on-site private cloud, at any specific time, has a fixed computing and storage capacity that has been sized to correspond to anticipated workloads and cost restrictions

Outsourced Private Cloud

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- Security of data and processing conducted in the outsourced private cloud depends on the strength and availability of both security perimeters and of the protected communication link

Outsourced Private Cloud

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- Risks from multi-tenancy
 - The implications are same as those for an on-site private cloud

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 - The main difference is that the techniques need to be applied both to a subscriber's perimeter and provider's perimeter, and that the communication link needs to be protected

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 - Main start-up costs for the subscriber relate to:
 - Negotiating the terms of the service level agreement (SLA)
 - Possibly upgrading the subscriber's network to connect to the outsourced private cloud
 - Switching from traditional applications to cloud-hosted applications
 - Porting existing non-cloud operations to the cloud
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- Extensive resources available
 - A subscriber can rent resources in any quantity offered by the provider
 - Provisioning and operating computing-equipment at a huge scale is a core competency of providers

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- Examples
 - Google Apps for Government
 - Microsoft Government Community Cloud

On-site Community Cloud

- Community cloud is made up of a set of participant organizations
- Each participant organization may provide cloud services, consume cloud services, or both

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- Each organization implements a security perimeter

On-site Community Cloud

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 - If there are N community members, a decision must be made, either implicitly or explicitly, on how to share a member's local cloud resources with each of the other members
 - Policy specification techniques like role-based access control, attribute-based access control can be used to express sharing policies

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 - Identity- and access-control configurations among participant organizations may be complex

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 - The network-based limitations are similar to those of the outsourced-private cloud scenario

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 - For a participant organization, that intends to provide cloud services within the community cloud, the costs appear to be similar to those for the on-site private cloud scenario (i.e., significant-to-high)

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- Extensive resources available
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 - VMware vCloud

Hybrid Cloud

- A hybrid cloud is composed of two or more private, community and/or public clouds

Hybrid Cloud

- A hybrid cloud is composed of two or more private, community and/or public clouds
- Significant variations in performance, reliability and security depending upon the type of clouds chosen to build hybrid cloud

Hybrid Cloud

- A hybrid cloud is composed of two or more private, community and/or public clouds
- Significant variations in performance, reliability and security depending upon the type of clouds chosen to build hybrid cloud
- A hybrid cloud can be extremely complex – may change over time with constituent clouds joining and leaving

Cloud-service Models

- Software as a Service (SaaS)
- Platform as a Service (PaaS)
- Infrastructure as a Service (IaaS)

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- Example: Google Spread Sheet

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 - Example: Google App Engine

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 - Example: Amazon Web Services

Benefits of Cloud Computing

- Scalability

- If you, as a subscriber, are anticipating a huge upswing in computing need (or even if you are surprised by a sudden demand), cloud computing can help you manage
- Rather than having to buy, install, and configure new equipment, you can buy additional CPU cycles or storage from a third party
- Since your costs are based on consumption, you likely wouldn't have to pay out as much as if you had to buy the equipment
- Once you have fulfilled your need for additional equipment, you just stop using the cloud provider's services, and you don't have to deal with unneeded equipment
- You simply add or subtract based on your organization's need

Benefits of Cloud Computing

- Simplicity
 - Not having to buy and configure new equipment allows you and your IT staff to get right to your business
 - The cloud solution makes it possible to get your application started immediately, and it costs a fraction of what it would cost to implement an on-site solution

Benefits of Cloud Computing

- Knowledgeable vendors
 - Typically, when new technology becomes popular, there are plenty of vendors who pop up to offer their version of that technology
 - This isn't always good, because a lot of those vendors tend to offer less than useful technology
 - By contrast, the first comers to the cloud computing party are actually very reputable companies
 - Companies like Amazon, Google, Microsoft, IBM, and Yahoo! have been good vendors because they have offered reliable service, plenty of capacity, and you get some brand familiarity with these well-known names

Benefits of Cloud Computing

- More internal resources
 - By shifting your non-mission-critical data needs to a third party, your IT department is freed up to work on important, business-related tasks
 - You also don't have to add more manpower and training that stem from having to deal with these low-level tasks
 - Also, since network outages are a nightmare for the IT staff, this burden is offloaded onto the service provider
 - Outages may still happen, but let Amazon worry about getting the service back online

Benefits of Cloud Computing

- Security
 - There are plenty of security risks when using a cloud vendor, but reputable companies strive to keep you safe and secure
 - Vendors have strict privacy policies and employ stringent security measures, like proven cryptographic methods to authenticate users
 - Further, you can always encrypt your data before storing it on a provider's cloud
 - In some cases, between your encryption and the vendor's security measures, your data may be more secure than if it were stored in-house

Limitations of Cloud Computing

- Leakage of sensitive/confidential information/data

Limitations of Cloud Computing

- Classification of data
 - Public data
 - Information that is similar to unclassified information
 - All of a company's information that does not fit into any of the next categories can be considered public
 - While its unauthorized disclosure may be against policy, it is not expected to impact seriously or adversely the organization, its employees, and/or its customers

Limitations of Cloud Computing

- Classification of data
 - Private data
 - This classification applies to personal information that is intended for use within the organization
 - Its unauthorized disclosure could seriously and adversely impact the organization and/or its employees
 - For example, salary levels and medical information are considered private

Limitations of Cloud Computing

- Classification of data
 - Sensitive data
 - Information that requires a higher level of classification than normal data
 - This information is protected from a loss of confidentiality as well as from a loss of integrity due to an unauthorized alteration
 - This classification applies to information that requires special precautions to ensure its integrity by protecting it from unauthorized modification or deletion
 - It is information that requires a higher-than-normal assurance of accuracy and completeness

Limitations of Cloud Computing

- Classification of data
 - Confidential data
 - This classification applies to the most sensitive business information that is intended strictly for use within the organization
 - Its unauthorized disclosure could seriously and adversely impact the organization, its stockholders, its business partners, and/or its customers
 - This information is exempt from disclosure under the provisions of applicable federal laws or regulations
 - For example, information about new product development, trade secrets, and merger negotiations is considered confidential

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 - Less scrupulous service providers might share that data with a marketing firm

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 - It may be the case that you need a very specific application and you'll have to commission its development yourself