CPET 581/499 Cloud Computing: Technologies and Enterprise IT Strategies
Assignment 1

Assigned date: 1/22/2015
Due Date: 1/29/2015, before 5 PM, as an email attachment.
Questions from Chapter 1. Distributed System Models and Enabling Technologies, pp. 58-63

Question 1. (20 points)
Briefly define the following basic techniques and technologies that represent recent related advances in computer architecture, parallel processing, distributed computing, Internet technology, and information services:

a. High-performance computing system
HPC system emphasizes the raw speed performance, and is often measured in terms of FLOPS as the computing capability.

b. High-throughput computing system
HTC concerns more about high throughput. This means that it is interested in how many tasks can completed per unit time instead of how fast an individual task can complete.

c. Peer-to-peer network
P2P network is a distributed application architecture that partitions tasks among peers. In this system, every node acts as both client and server, and the system is self-organizing with distributed control. The peer IDs form an overlay network at the logical level, which can be either structured or unstructured.

d. Computer cluster versus computational grid
Computer clusters are built by a collection of interconnected stand-alone computer, which work cooperatively together as a single integrated computing resource.

Computational Grids offer an infrastructure that couples computer, software, and sensors, etc., together, and is often constructed across certain networks.

Major differences between computer clusters and computational grids:
the grid tend to be more loosely coupled, heterogeneous, and geographically distributed.

e. Service-oriented architecture (SOA)
SOA originated from the idea of building systems (software and hardware) in terms of services or web-based services. A system that is based on the SOA which groups functionality as a suite of interoperated services that can be used within multiple separated systems.

f. Pervasive computing versus Internet computing
Pervasive computing means the growing trend towards embedding microprocessors in everyday objects so they can communicate information everywhere. It is also sometimes called ubiquitous computing.

Internet computing is able to distribute the computing task among different computing facilities across the Internet.

g. Virtual machine versus virtual infrastructure
Virtual machine is an abstraction provided by a middleware layer that exports an illusion of identical resources (CPU, memory, disks, ect) as the physical machine.

Virtual infrastructure is what connects resources (such as compute, storage and networking) to the distributed applications. It is a dynamic mapping of the system resources to specific applications.

h. Public cloud versus private cloud
In **Public cloud**, service providers make resources (software applications, storage, infrastructure, platforms etc) available to the general public over the Internet.

In **private cloud**, proprietary networks and data centers that used cloud computing technologies and is managed by the organization it serves.

Question 2. (20 points)
An increasing number of organizations in industry and business adopt cloud systems. Answer the following questions regarding cloud computing:

a. List and describe the main characteristics of cloud computing systems.
Main characteristics: dynamic, efficiency, scalability, service-oriented, high availability and reliability, low cost.

b. Discuss key enabling technologies in cloud computing systems.
Key enabling technologies: platform deployment, virtual clusters on demands, multi-tenant technologies, massive data processing, web-scale communication, distributed storage, licensing and billing services.

c. Discuss **different ways** for cloud service providers to **maximize their revenues**.
Cloud services are used in a pay-as-you-go manner.
- Maximize the revenue through **increased Utilization**
  - Cloud providers can support large number of users all at the same time.
  - One physical machine can support several virtual machines.
- **Management and Automation** that can simplified software installation and maintenance, centralized control over versioning.
- Build cloud service platform at the places where the electricity, network resources are cheaper and cooling is easier.

Question 3. (25 points)
Compare the similarities and differences between traditional computing clusters/grids and the computing clouds launched in recent years. Consider all technical and economic aspects as listed below. Answer the following questions against real example systems or platforms built in recent years. Also discuss possible convergence of the two computing paradigms in the future.

a. Hardware, software, and networking support
Hardware Resources: as cloud platform are built on top of datacenters, the hardware resources of cluster/grid cloud be part of a larger computing cloud.

Software Support: Cloud typically needs some kind of web services or software like a Web browser.

Networking Support: needs networking support components (LAN, WAN, SAN, etc) since cloud may be more sparsely distributed.

b. Resource allocation and provisioning methods
Cloud resources are **dynamically provisioned** by data centers upon user demand request while clusters are not. Additionally, cloud system provides **compute power, storage space and flexible platform**s for upgraded web-scale application services.

c. Infrastructure management and protection
Cloud computing **relies heavily on the virtualization** of all sorts of resources, and it **needs stronger protection** than cluster/grid.

d. Support of utility computing services
Cloud computing **inherently supports utility computing services**, just like utility services-electricity and water, while cluster/grid are usually deployed by individual enterprise and do not provide to public as utility.

e. Operational and cost models applied
Cloud is more cost effective that cluster/grid.
- Customers do not need to buy infrastructure before using it.

QaS and SLA add extra requirements on the operational and cost models

Question 4. (15 points)
Characterize the following three cloud computing models:

a. What is an IaaS cloud? Give one example system.
The **IaaS computing model** put together infrastructure demanded by users, namely servers, storage, networks, and datacenter fabric.
The user
- Can deploy and run on multiple VM running guest OS on specific applications.
- Does not manage or control the underlying cloud infrastructure.
- Can request and release the needed resources.

Examples: AWS, GoGrid, Rackspace

b. What is a PaaS cloud? Give one example system.
The **PaaS computing model** provides the user to deploy user-built applications onto a virtualized cloud platform. The PaaS provider
- Middleware, database, development tools and some runtime supports like Web 2.0 and Java, etc
- Both hardware and software integrated with specific programming interfaces
- API and software tools (e.g., Java, python, Web2.0, .NET, etc)

The user is free from managing the cloud infrastructure.
Examples: Google AppEngine, Windows Azure, IBM BlueCloud

c. What is a SaaS cloud? Give one example system.
The SaaS computing model refers to web-based, browser-initiated application software over thousands of paid cloud customers. The SaaS model applies to
- business processes
- industry applications
- Enterprise applications: CRM, ERP, HR, and collaborative apps

On the customer side, there is no upfront investment in servers or software licensing.
On the provider side, costs are rather low, compared with conventional hosting of user apps
Examples: Salesforce.com, Google Docs, Microsoft Dynamics, and Microsoft Office 365

Question 5. (20 points)
Briefly explain each of the following cloud computing services. Identify two cloud providers company name in each service category.

a. Application cloud services
SaaS:
- Delivery of software from the cloud to the desktop.
- Browser initiated application software
- Eliminate the need to install and run the application from the user's computer resulting in simpler maintenance and support
- No upfront investment in servers or software licensing
- Examples: GoogleDocs, Salesforce.com

b. Platform cloud services
PaaS:
- Delivers a computing platform as a service
- Includes hardware and software layers
- Users can write applications that can run on the cloud, using the virtualized platform and services.
- Examples: Google AppEngine, Microsoft Azure

c. Compute and storage services
IaaS:

d. Collocation cloud services
Location as a Service:
- Provides a collection services to house, power and secure all the physical hardware and network resources.
- It requires multiple cloud providers to work together to support supply chains in manufacturing.
- Examples: www.CenturyLinktechnology.com (formerly Savvis), Internap: www.internap.com

e. Network cloud services
NaaS (Network as a Service)
- Include Virtual LANs for interconnecting all the hardware components
- Provide network services such as firewall
- Network resources required to support services such as virtual private cloud
- Example: AT&T, Quest

Desktop as a Service (DaaS), http://www.questsys.com/desktops-as-a-service.aspx