

# CPS221 Lecture: Cloud Computing

last revised 10/22/14

## *Objectives*

1. To introduce the notion of cloud computing
2. To define the terms Software as a Service, Platform as a Service, and Infrastructure as a Service

## *Materials:*

1. Projectable of Cloud Computing Layers

### **I. Introduction**

- A. The term "cloud computing" has become something of a buzzword in the past few years.
- B. Actually, there is no universally agreed-upon meaning to the term. In general, though, "cloud computing" refers to computing using some resources that are
  1. Provided by an external supplier in exchange for financial payment
  2. Accessed via the Internet (hence "in the cloud") - typically via a web browser.
  3. The user need not know the physical location of the resource - only how to get to it via the Internet.
- C. Individuals can make use of some kinds of cloud computing - e.g. files stored in the cloud that can be accessed from anywhere, not just a particular computer. (In this case, advertising revenue may be the source of the financial payment to the service provider.)

D. More typically, though, we think of commercial applications where the end user is an organization or firm who pays a service provider for services provide via the cloud.

1. Advantages to the customer (that warrant paying the cost) include:
  - a) Avoiding up-front capital costs (similar to leasing vs buying for cars)
  - b) Avoiding personnel costs connected with maintaining the service (e.g. staff available 24 x 7)
  - c) Rapid expandability (no need to purchase additional equipment)
2. Service providers may be able to provide services via the cloud to the end user at lower costs than the end user would incur if doing the same thing itself due to
  - a) Economies of scale
  - b) More efficient sharing of resources.

E.g. one factor that motivated Amazon to get into cloud computing was the observation that most of the time their servers were only about 10% utilized because they needed enough hardware to respond to peak loads. Amazon can sell services using this underutilized capacity for less than it would cost an end user to install this capacity itself.

3. One reason for the interest in various forms of cloud computing is that, for the end user, purchasing services through the cloud is often cheaper than providing those services via ownership - especially when the costs of technical staff are taken into consideration.

E. As far back as the 1960's, John McCarthy expressed the opinion that "computation may someday be organized as a public utility." (Cited on Wikipedia page - reference not given) Cloud computing may be regarded as a step in that direction.

## II. Models of Cloud Computing

A. It is common to discuss to talk in terms of three major models of cloud computing: Infrastructure As Service, Platform as Service, and Software as Service. As we shall see, these can be regarded as layers, in that each of the upper ones builds on the one(s) below it.

These are not rigid categories, but serve as a helpful basis for discussion.

PROJECT: Three layers diagram

B. In the Software as a Service model (SaaS), the service provider provides everything except the data.

1. Examples at Gordon:

a) We used to run Microsoft Exchange on a server that we owned here on campus. Now our email is a service purchased from Microsoft - mail.gordon.edu links to a Microsoft server farm that runs Exchange. The only thing Gordon is responsible for is the actual mail content.

b) We used to run Blackboard on a server that we owned here on campus. Now blackboard.gordon.edu links to a server farm managed by Blackboard. The only thing Gordon is responsible for is the actual course pages.

2. Personal Examples:

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Services such as Google Docs would be an example of this.

C. In the Platform as a Service model (PaaS), the service provider provides complete platforms - not just CPUs, but components like programming languages and development environments, a web server, a database management system, etc - whatever the end user needs. The end user is only responsible for application software and data.

Example: A web site that is hosted in the cloud - the owner provides the content, but everything else is provided as PaaS.

D. In the Infrastructure as a Service model (IaaS), the service provider provides basic infrastructure, and the end user is responsible for everything else.

1. The infrastructure will include such things as

a) Server CPU's with basic operating systems (typically Windows or some variant of Linux) - often provided via virtualization - e.g. they may actually be virtual machines running on systems belonging to the service provider.

b) Disk storage

c) Load balancers and other network facilities

2. The service provider is responsible for guaranteeing the availability of these systems via something like a VPN. But the end-user is responsible for installing and maintaining everything else needed by the end-user - eg

a) Programming languages and IDEs

b) Web server software

c) Database management systems

d) Application software.

3. A related area - sometimes considered a subcategory of this and sometimes a separate category - is Storage as a Service (STaaS), in which the service provider only provides storage space - and everything else is provided by end-user.

Example:

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Google Drive

- E. Actually, it is possible that a SaaS provider itself makes use of PaaS or IaaS to actually run their software. This would not typically be visible to the end user.

Example: Our church uses a software system known as Church Community Builder for internal communication - a form of Software as a Service - which we contact at [nscbc.ccbchurch.com](http://nscbc.ccbchurch.com). However, I've notice that sometimes when I'm downloading a file the URL for the file will refer to [amazon.com](http://amazon.com) - suggesting that the company we contract with actually buys platform services from amazon.