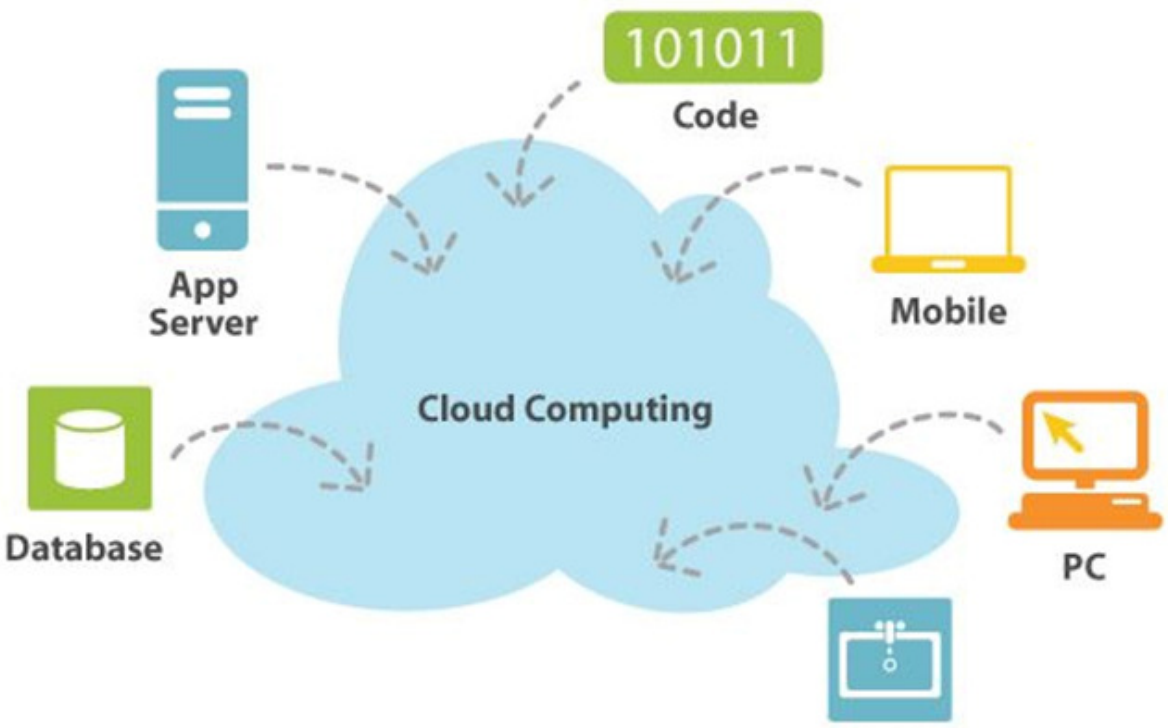
Cloud Computing

INTRODUCTION

Cloud computing is where software applications, processing power, data and potentially even artificial intelligence are accessed over the internet. ***or in simple words*** any situation in which computing [processing] is done in a remote location (out in the clouds), rather than on your desktop or portable device.

Many private individuals now regularly use an online e-mail application such as ***Gmail, yahoo mail and hotmail***. Exchanging messages and sharing photos and video on social networking sites like ***Facebook*** is now also very common. However, these types of cloud computing activities are just the beginning. Indeed, it is likely that within a decade the vast majority of personal and business computing will be internet based.

Already over two million businesses have adopted the ***Google Apps*** online e-mail and office suite. Twenty per cent of companies now also report at least some use of the ***Google Docs*** online word processor. Microsoft's ***Azure*** cloud computing platform also became commercially available. Mobile computers like Apple's ***iPad***, as well as netbooks and tablets running Google's new ***Chrome OS*** operating system, are additionally very much intended as cloud access devices for a new computing age.



Understanding CLOUD COMPUTING!

So what is the ***cloud***? For years the Internet has been represented on network diagrams by a cloud symbol. When, around 2008, a variety of new services started to emerge that permitted computing resources to be accessed over the Internet, the label "cloud computing" therefore emerged as an umbrella term.

The "***cloud***" is a label for online computing resources rather than the entire Internet. The term "***cloud computing***" is also useful to separate the kinds of things we have been doing online for a couple of decades from a totally new age of online software and processing power.

As stated already that ***cloud computing*** is where software applications, processing power, data and potentially even artificial intelligence are accessed over the Internet. Building on this basic definition, it can also be stated that cloud computing is where ***dynamically scalable, device-independent and task-centric*** computing resources are provided online, with all charges being on a usage basis.

Cloud computing is ***dynamically scalable*** because users only have to consume the amount of online computing resources they actually want. Just as we are used to drawing as much or as little electricity as we need from the power grid, so anybody can now obtain as many or as few computing resources from the cloud as they require at any particular point in time.

Cloud vendors including ***Amazon Web Services (AWS)*** now quite literally sell computer processing power by the hour. For example, anybody can now rent "virtual server instances" from ***Amazon's Elastic Compute Cloud*** or "***EC2***" service for as little as $0.02 an hour (or indeed you even sign up for a one-year trial of the ***AWS Free Usage Tier*** for nothing). As Amazon explain, "EC2 reduces the time required to obtain and boot new server instances to minutes, allowing [customers] to quickly scale capacity, both up and down, as [their] computing requirements change".

Cloud computing is ***device-independent*** because cloud computing resources can be accessed not just from any computer on the Internet, but also any type of computer. Provided that it has an Internet connection and a web browser, it really does not matter if the computer being used is a traditional desktop or laptop PC, or a netbook, tablet, smartphone, e-book reader, or any other kind of cloud access device. Such device independency is also a killer feature of cloud computing because it means that users can move between computing devices -- such as their work PC, home PC, laptop and netbook -- without having to worry that they will always have access to the latest versions of their files.

Cloud computing is ***task centric*** because the usage model is based entirely around what users want to achieve, rather than any particular software, hardware or network infrastructure. Users do not have to purchase or install

anything before using a cloud computing resource. Nor do they have to maintain or pay for anything during periods in which no resources are being used.

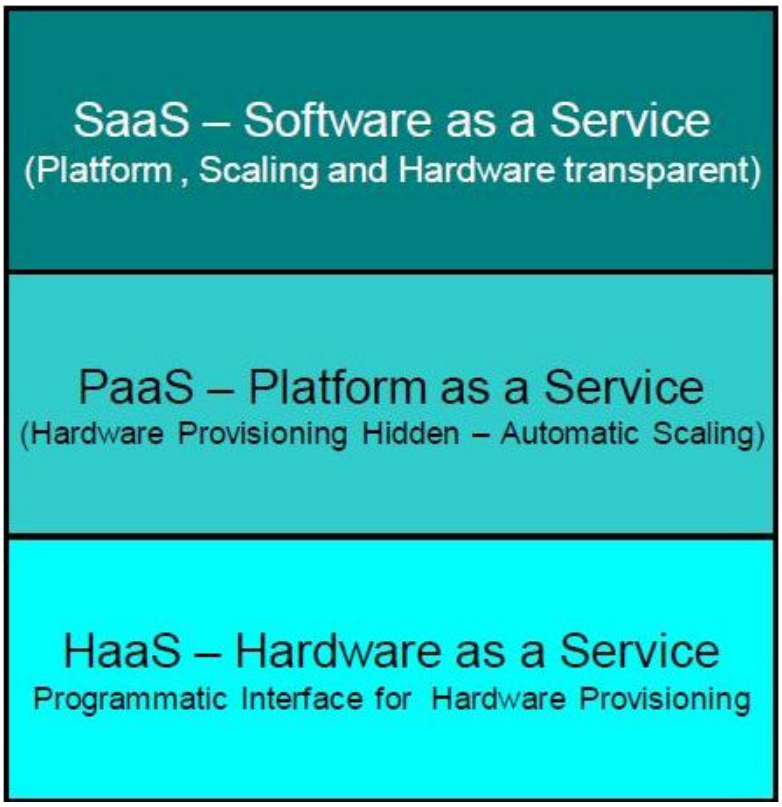
The above means that cloud computing empowers its users to just get on with what they want to do. Due to the fact that ***cloud computing is charged on a usage basis***, it has no fixed costs.

Traditionally computing has involved substantial fixed costs, such as those costs incurred in the building and equipping of a data centre. However, because cloud computing is dynamically scalable and task-centric, for users such fixed costs disappear. All of the costs of cloud computing are therefore on a per-usage or variable basis.

The fact that cloud computing has only variable costs is of extreme importance for small companies. This is because small businesses have traditionally not had access to the sophisticated, customized types of business application available to larger organizations. However, because they do not charge an initial fixed-cost outlay, cloud computing suppliers including ***Clarizen***, ***Employease***, ***Netsuite***, ***Salesforce*** and ***Zoho*** are now leveling the software-access playing field by allowing companies of all sizes access to the latest types of business application.

CLOUD COMPUTING LAYERS

Cloud computing can encompass activities such as the use of social networking sites and other forms of ***interpersonal computing*** as examined on the ***Web 2.0 page***. However, most of the time cloud computing is concerned with accessing online software applications, data storage and processing power. The fundamental, practical building blocks of cloud computing are therefore what are known as **software as a service *(SaaS),* platform as a service *(PaaS)*** and **infrastructure as a service *(IaaS)***



Software as a Service (SaaS)

Software as a service is where ***computer applications are accessed over the Internet*** rather than being installed on a local computing device. So, for example, people may use an online word processor like ***Google Docs,*** an online database application like ***Zoho Creator***, an online photo editor like ***Pixlr***, or an online invoicing application such as ***Zoho Invoice***. Many ***SaaS*** applications are free to use, at least initially. You can find links to a great many in the Cloud Computing ***Directory***.

SaaS can provide its users with many benefits. These include the general cloud computing advantages of dynamic scalability and any device independence, as well as the benefit of being able to use an application without incurring fixed costs. Many SaaS applications are also collaborative. This allows multiple users to share documents and even to work on them at the same time. For example, in the ***Google Docs*** spreadsheet different users can work on different cells simultaneously. The cells different users are working on are locked-off and highlighted in different colors. A real-time chat window can also be opened up alongside the spreadsheet to further enhance collaboration.

Taking collaboration further still, the outputs of some ***SaaS*** applications can be embedded in other web pages as web service gadgets. For example, a ***Google Docs*** or ***Zoho Sheet*** chart can be mashed into another website. There it will automatically update when the data in the online spreadsheet that is generating it is changed. ***SaaS*** applications are also constantly updated, which can free users from the "upgrade hell" of a major traditional software package revision.

The **disadvantage of SaaS** is that it is basically a take-it-or-leave-it form of cloud computing. This means that businesses and individuals who require direct access to cloud computing hardware on which they can run their own applications cannot use SaaS. Rather, they need to cloud compute at the platform or infrastructure level using either ***platform as a service (PaaS)*** or ***infrastructure as a service (IaaS).***

Platform as a Service (PaaS)

A platform is a software environment ***used to develop and run applications***. For example, Microsoft Word is an application that runs on the Microsoft Windows platform. When people choose to cloud compute using ***platform as a service*** or ***'PaaS'***, they obtain access to an online platform provided by a cloud computing vendor. They can then use this platform to develop and deliver their own online (***SaaS***) applications.

Applications developed using ***PaaS*** may be used privately by just one or a few users within a particular company. However, they can also be offered free or for-

a-fee to anybody on the web. This means that if you have a great idea for a new online application then you can use ***PaaS*** to turn it into a reality.

Several cloud suppliers now offer ***PaaS*** tools. Most notably these include ***Google App Engine, Microsoft Windows Azure,*** and ***Force.com***. All such offerings effectively provide their customers with a box of cloud computing Lego. New applications are then constructed from the plastic bricks on offer.
With ***Force.com***, some applications can even be built using a simple drag-and-drop interface. Relatively non-technical people can therefore create new online applications very quickly. Indeed, ***Force.com*** claim that their "simplified programming model and cloud-based environment mean [customers] can build and run applications five times faster, at about half the cost of traditional software platforms". ***Google App Engine*** and ***Force.com*** also allow an initial application to be created for free!

Whilst ***PaaS*** is great in many situations, its users do need to be mindful of the involved **flexibility verses power trade-off**. What this means is that whilst ***PaaS*** makes it relatively easy to create new online applications, users are nevertheless constrained by the particular programming languages and tools provided by their ***PaaS*** supplier. In other words, ***PaaS*** vendors have total control over which Lego bricks they allow their customers to build with. Whilst this ensures that applications built using the tools on offer will always function correctly, it is nevertheless restrictive. It is for this reason that many companies and some individuals choose to cloud compute at the infrastructure level.

Infrastructure as a Service (IaaS)

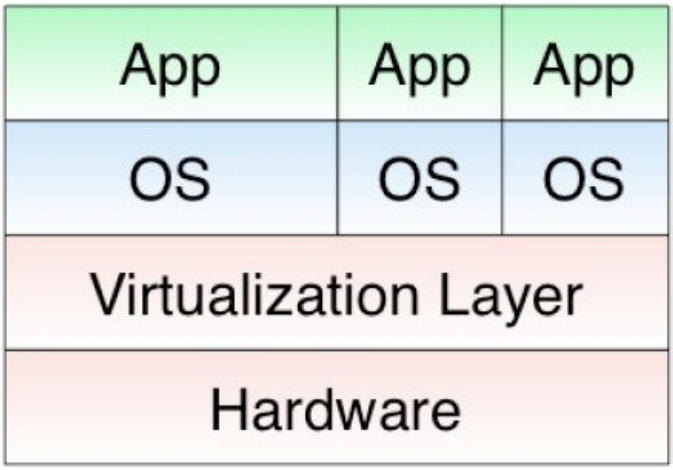
Infrastructure(hardware) as a service or ***"IaaS"*** is where a cloud supplier provides online infrastructure on which their customers can ***store data and develop and run whatever applications*** they please. ***IaaS*** therefore allows companies to move their existing programs and data into the cloud and to close down their own local servers and data centers.

Whilst computing applications run on platforms, platforms in turn run on computing infrastructure. So, for example, whilst the Microsoft Word application runs on the Microsoft Windows platform, in turn the Microsoft Windows platform runs on the infrastructure of an IBM-compatible PC.

The fundamental building block of cloud computing infrastructure is the server. Cloud computing servers are basically computers on which online applications can be run and data can be stored. When provided by an ***IaaS*** vendor, cloud servers can also be real or virtual.

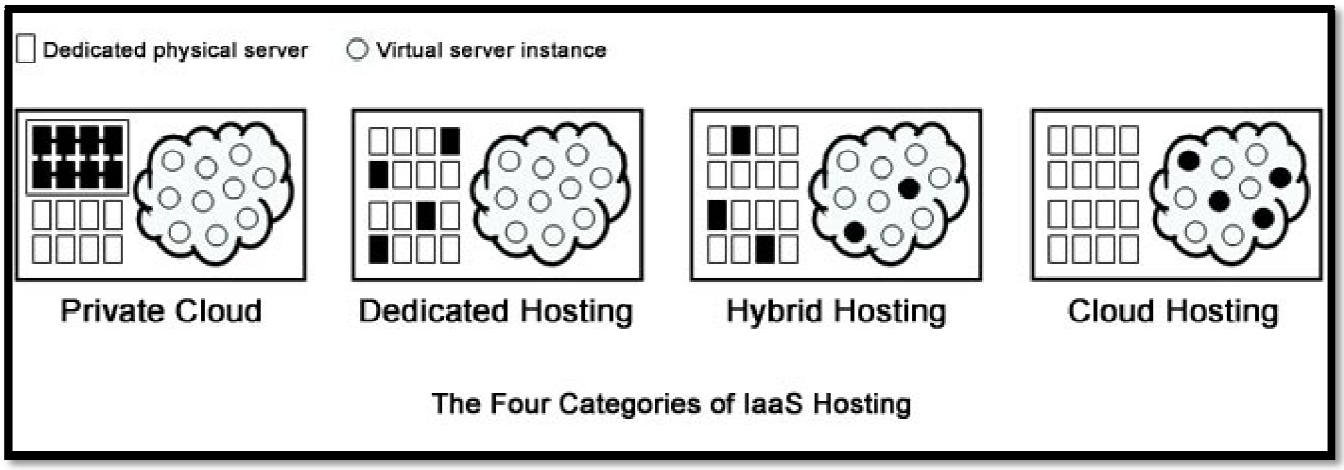
Real or "dedicated" servers are individual circuit boards – known as blades – mounted within equipment racks in a data centre. In contrast virtual servers – also known as "virtual server instances" – are software-controlled slices of real, physical servers. Virtual servers are created by a process

called **virtualization** that allows many users to share the processing power of one physical server.



Dedicated physical servers and virtual server instances can perform exactly the same functions. However, there are some differences between them. For a start, virtual server instances are cheaper to supply as each does not require its own piece of physical hardware in a cloud data centre. On the other hand, virtual server instances are sometimes seen as less secure by those who do not want to share server hardware with other customers. For this reason, four categories of ***IaaS*** are available. These are most commonly known as "private clouds", "dedicated hosting", "hybrid hosting" and "cloud hosting".

IaaS Classification



Under the first IaaS category of a **private cloud** (or more fully a **vendor managed private cloud**), a customer rents a number of co-located servers in part of a data centre. This means that their cloud hardware is as separate as possible from that of other users. Private clouds are therefore considered the most secure form of IaaS. However, a private cloud cannot be dynamically scaled and is the most expensive form of IaaS as a block of servers is permanently dedicated to one customer.

In the second IaaS category of **dedicated hosting**, a customer rents dedicated physical servers on demand from anywhere within a data centre. Whilst this means that the hardware they use is mixed-in with that of other customers, in this IaaS category once again customers do not share the particular servers they use with anybody else. As well as being less costly than a private cloud, dedicated hosting can therefore be dynamically scaled. This means that the customer is able to increase or decrease the number of servers they are both using and paying for on a daily or even hourly basis.

Under the third IaaS option of **hybrid hosting**, a customer rents on demand a mix of dedicated physical servers and as well as some less expensive virtual server instances. For example, a company may run all of its applications on dedicated physical servers, but store its data on virtual server instances. Or a business may rent virtual service instances by the hour to cope with occasional peak processing demands. Once again, the whole offering is dynamically scalable, with both dedicated and virtual servers able to be added or taken away as required.

Finally, in the last IaaS category of **cloud hosting**, a customer rents as many or as few virtual server instances as they require on demand. This means that customers share all of the servers they use with other customers. Some companies subsequently see this as too risky. However, cloud hosting is also the lowest-cost and by far the most technically and environmentally efficient form of IaaS. This is because cloud hosting allows an IaaS provider to run all of their physical servers in use to capacity and to close down those not required.

IaaS Providers

Many companies now offer ***IaaS*** services. For example, as already noted, Amazon has a product range called ***Amazon Web Services*** or "***AWS***". This falls under the fourth ***IaaS*** category of cloud hosting, with Amazon offering the rental of virtual server instances.

At the heart of ***AWS*** is ***Amazon Elastic Compute Cloud*** or "***EC2***". This allows customers to run either new or existing applications in Amazon's data centres. ***EC2*** is described as "elastic" because customers can increase or decrease the infrastructure capacity they are using within minutes.

EC2 users can purchase and activate one, hundreds or even thousands of virtual server instances simultaneously. They do this by setting up ***Amazon Machine Images*** or "***AMIs***" that contain all of the applications, data and configuration settings that their virtual servers will need. ***AMIs*** can be created from scratch, or chosen from a range of pre-configured templates. ***AMIs*** can even be pre-loaded with licensed software from vendors including IBM.

Another key component of ***AWS*** is the ***Amazon Simple Storage Service*** or "***S3***". This enables customers to store data online in so-termed "buckets". As Amazon explain "***S3*** provides a simple web interface that can be used to store and retrieve any amount of data, at any time, from anywhere on the web. It gives any developer access to the same highly scalable, reliable, fast, inexpensive data storage infrastructure that Amazon uses to run its own global network of web sites".

Another ***IaaS*** provider is ***Rackspace***, which provides private clouds, dedicated hosting, and cloud hosting services. The latter include ***Rackspace Cloud Servers*** (as a competitor to ***Amazon EC2***) and ***Rackspace Cloud File***s (as a competitor to ***Amazon's S3***). IaaS services can also be purchased from ***GoGrid***, which offers cloud hosting, hybrid hosting and dedicated hosting solutions.

Cloud Computing Revolution

As well as being more ***cost-effective*** and more ***green***, cloud computing will be increasingly essential for many next-generation computing developments. In other words, cloud computing will be driven not only by a desire and necessity to do existing things in more effective ways, but by a demand to do entirely new things.

One of the defining characteristics of cloud computing is that it enables value to created via collaboration and ***data sharing***. Local software and data inevitably constrain collaboration and the anytime, anyplace, anywhere use of information resources. As a consequence, we will be prevented from obtaining the benefits of new developments such as "crowdsourcing" unless many of us cloud compute.

More than anything, the ***Cloud Computing Revolution*** is something to take part in rather than to read about. So go on, try an online word processor or spreadsheet or video editor or whatever takes your fancy.

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