Chapter 4 – Understanding Cloud Computing

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Chapter 4 – Understanding Cloud Computing

This chapter provides an understanding of the cloud computing technology and related infrastructure. It provides awareness of what cloud computing is and sets the foundation for the next two chapters on cloud computing opportunities and issues. The first section provides an introduction to cloud computing. It describes how cloud computing can be used and the potential benefits that individuals and businesses can realise with the use of this technology.

The next section tries to explain “what cloud computing is”. It starts by describing cloud with an analogy of what we already do with the Internet everyday and relates that to cloud computing. It then offers an explanation of why and how this technology acquired the fancy “cloud” computing label. Next it describes how the IT industry defines cloud computing in relation to the services such as software, platform, and infrastructure. This section ends with a brief on the three main types of clouds, namely public, private, and hybrid clouds.

After that we look at the definition of cloud computing. There exists hundreds of definition of cloud computing, but many in the IT industry are now accepting the definition formulated by The National Institute of Standards and Technology (NIST), an arm of the United States Department of Commerce. Several definitions of how other experts in the IT industry define cloud computing are provided next. It will be some time before the industry agrees on and accepts a universal definition of cloud computing.

How cloud computing can be used by individuals is discussed next. Many individuals are already computing in cloud and making use of many applications via their mobile devices. Cloud computing offers many opportunities for small business that need IT infrastructure to function effectively. These small business can rent IT infrastructure and other services from cloud computing service providers and scale their requirements up or down accordingly.

This chapter finishes off by looking at some myths and facts of cloud computing. After the dot com bust, users have become sceptical about new technologies. This section demystifies the myths and presents facts about what cloud computing is and what it is not? It looks at the many questions that people unfamiliar with the cloud computing technology asks and then it attempts to offers facts and dispel the myth.

4.1 Introduction to Cloud Computing

The IT Industry and its commentators are abuzz with the phrase “cloud computing” and most of people still have no idea what this latest terminology means or what technology are they referring to. This section starts by addressing the question – “what is cloud computing, and provides an understanding of the technology”. Then out of the hundreds of definitions of cloud computing, some widely accepted ones are presented. Cloud computing is then related to technologies that have been around for ages. Finally, it is explained that cloud computing is the same old networking technology, but with the integration to the Internet a lot can be done differently with wider implications.

Individuals who might be considering cloud computing services for personal use will also benefit by the information provided in this section. Web sites like Flickr, Facebook, YouTube and others are used to store and share personal photos, music and videos for free. Easy as: 1). Register, 2). Upload, 3). Share. Free and easy, there has to be a downside, and there is - awareness regarding this is provided in the later sections.

Then, there is information regarding cloud computing for businesses! Businesses, who wish to get on the “flight to the clouds” like their peers and keep their heads above the “cloud” and competition. With cloud service providers, businesses can tap into the IT services that they need, when they need, for as long as they need; without investing in any IT infrastructure. The result is a far more agile and cost-effective IT services and this section looks at the “how” and “why”.

After looking at the good of cloud computing, the bad, and the ugly is revealed. Not all our experiences on the Internet have been totally positive. A range of security and trust issues exist. Individuals and businesses ask “how secured are their information once it is with the cloud service providers?” There is analysis on the ownership of data and information stored with the cloud service providers as well as taxonomy of data that you post on social networking web sites.

Finally, anecdotes about cloud computing is emphasized to support our endeavour to compute in the cloud. Cloud computing is not a hype, it is a reality. Cloud computing is not a fad, it is here to stay. The question is no longer “will cloud computing happen?” but “how you are going to exploit this technology?”

Cloud computing is the current hype of the Information Technology (IT) industry. Cloud computing is accessing on demand computing resources via the internet, such as software, storage and even infrastructure. Cloud computing has existed in concept for nearly 50 years, however only recently has technology progressed to where it has become a multi-billion dollar annual industry. The influx of new technology has created a highly competitive market in the Cloud computing provider arena. Analysts predict that by the year 2012, 20% of businesses will outsource their IT needs to the Cloud. The cost savings and increased productivity possibilities are enormous. The impact of outsourcing IT needs to third-party vendors will be difficult for business to ignore. The market demand will be extremely high, with tremendous profits to be made.

There will however be disadvantages to business, and obstacles that must be overcome before Cloud computing can reach its full potential. Protection of the clients' data must be a priority concern for third-party vendors, as well as legal compliance. The IT industry should address these issues to maximize the potential of the Cloud, and keep the sky secure. Cloud vendors and end-users alike share the responsibility to protect consumer data in the sky with tight encryption and limited access.

To cloud compute is to use remote computing resources via broadband connections, with the goal of maximizing computing and minimizing cost. Resources available upon demand are accessed on an as needed basis, as opposed to being physically present on a local drive or server. Cloud Computing means different things to different people and many different definitions exist for the cloud computing. Cloud computing is quite simply accessing and utilizing on demand computing resources remotely via the internet or a broadband connection.

The cloud is basically a collection of hardware, and software that provides IT related services. The advantages of these services being provided through a cloud is flexibility, because the cloud can provision and de-provision services based on demand. Clouds come in different forms there are public clouds, private clouds, and hybrid clouds which are a combination of both.

What is Cloud Computing?

What is cloud computing? Let's start with a simple concept. Emailing information to yourself from office and then retrieving and using that information at home is an example. Most of us are doing that, therefore we are already computing in cloud. This is a cloud user's beginners level, as cloud

computing can offer a lot more than this. What else can be done with cloud computing to actually become a “cloud user” and stay in tune with the latest trend and technology of the IT Industry?

A simple explanation for cloud computing would be not storing data and information on local hard disk or local servers, but storing it away from our physical location. When the need arises to use that data or reference that information, access is obtained via the Internet. Since access to that data and information is via the Internet, it is available from anywhere via Internet. Access to data and information is not confined to any location, and that is the essence of cloud computing!!

How did a simple explanation acquire a fancy name as “cloud computing”? Clouds can be seen somewhere in the sky whenever we look up regardless of physical location. Whenever we connect to the Internet, data and information is up there regardless of physical location. There are claims of technical reasons behind the name. Network configuration diagrams show connections to the Internet away from the local area network [LAN] and virtual private network [VPN] connections with a fluffy cloud symbol as in Figure 4.1 below. Any organisation or institution that uses an Internet application can claim to be computing in cloud.

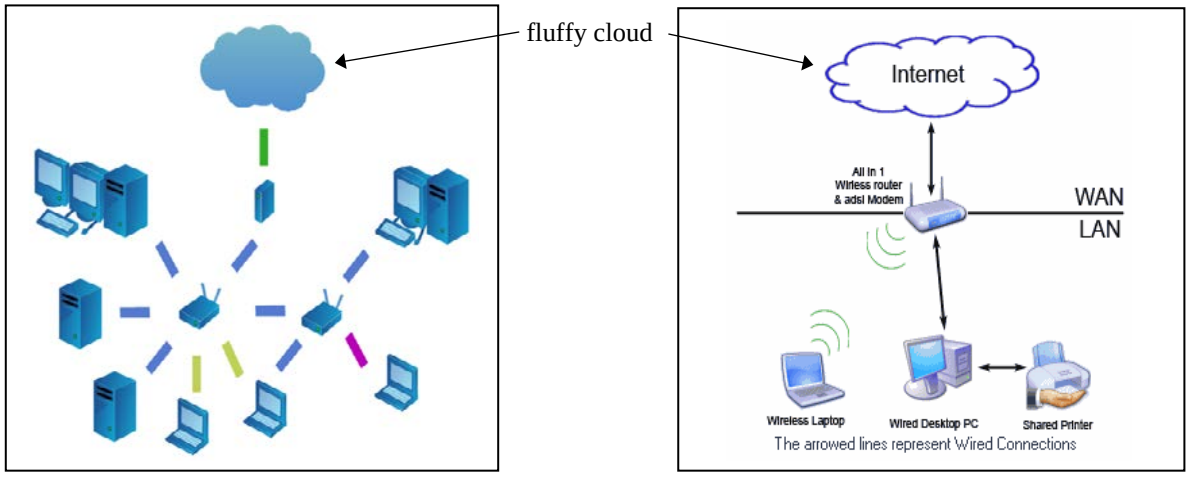

Figure 4.1: Network Configuration Diagram Showing Connection to Internet with Fluffy Cloud Symbol [Source: Google Images]

How does the IT Industry define cloud computing? Cloud computing is an evolving technology and there are hundreds of definitions, but there is no concrete definition yet. The cloud service providers provide different services based on different capabilities such as SaaS (Software-as-a-Service), PaaS (Platform-as-a-Service), HaaS (Hardware-as-a-Service, IaaS (Infrastructure-as-a-Service), and XaaS (Everything-as-a-Service).

After analysing definitions from 20 different authors, (Vaquero et al., 2008) proposed the following definition for cloud computing.

"Clouds are a large pool of easily usable and accessible virtualized resources (such as hardware, development platforms and/or services). These resources can be dynamically reconfigured to adjust to a variable load (scale), allowing also for an optimum resource utilization. This pool of resources is typically exploited by a pay-per-use model in which guarantees are offered by the Infrastructure Provider by means of customized SLA [Service Level Agreement]". (Vaquero et. al., 2008)

Another simple way of understanding cloud computing is by examining existing client/server networks. Network users; have been connecting to network servers for all the services that are needed. With cloud computing, instead of connecting to the network servers, connection is made to the Internet [cloud] for all services. All services are available wherever we are, as long as there is a connection to the Internet. Armed with such portability and flexibility in the computing environment, businesses can reach their customers 24/7 anywhere in the world. Students can study online courses from anywhere in the world. And individuals can socialise on the Internet, Skype and do whatever they want, from wherever they are, and whenever they want.

What does this mean for cloud service providers like Google, Amazon, and others when everyone goes running to them wanting their space of "cloud"? They commission massive server farms to store data and information. They write hundred of programs to distribute and process data into useful information. They create complex and complicated database procedures for managing data, keeping it private and confidential. All this is done to ensure emails in our Gmail Account is only available to us. Traditionally, they would be looking at providing dedicated servers to different types of users. But in case of Google, and others, they have millions of users. And they are not going to buy millions of servers. So they end up putting as many users as possible on the same server. It is just like having hundreds of student lockers within the Faculty of IT, all students can go there, but only the ones with keys to the lockers can open the lockers and retrieve the contents.

For many organisations, operating a private data centre to keep up with the rapid growing data processing requests can be complicated and costly. Cloud computing offers an alternative. "Cloud computing", as a term for this Internet based service, was launched by industry giants like Google, Amazon, and others in late 2006. It promises to provide on-demand computing power with quick implementation, little maintenance, less IT staff, and consequently lower cost. (Aymerich et al.,

2008). Therefore it is promised that with nothing but a credit card, one can get on-demand access to 100,000+ processors from the clouds (Foster et al., 2008).

Cloud computing can be regarded to a certain degree, as the evolution of grid computing. Such a close relationship has caused confusion. The grid framework originally driven by scientific purposes (e.g. SETI@home project), and aimed at coordinating resources that are not subject to centralised control under standard, open, general-purpose protocols and interfaces (Foster et al., 2008). Cloud computing is born for commercial purposes and naturally service oriented. It is based on centralised data centres. The protocols and interfaces used may not be the same across clouds providers.

Google, Amazon, and others have shown how they can use the cloud computing infrastructure to handle millions of users and provide thousands of services. It has not been smooth sailing for them ever since they ventured into the cloud, but along the way, they have learnt a lot through security loop holes, plus trial and error methods and addressed a lot of these issues. And they can claim near perfection, but, with cloud computing, near perfection lasts only until someone proves otherwise.

There are three main types of Clouds. The Public Cloud runs on a bank of virtualized servers located off site, and the resources are shared by multiple clients and accessed via broadband. A Private Cloud is normally ran on-site, and exists behind the organizations firewall. Resources of a Private Cloud are not shared by any other party. A Hybrid Cloud is a combination of resources outsourced to third parties, with the bulk of the data banks and infrastructure remaining at home, behind the security of a trusted firewall (Johnston, 2009).

Cloud Computing Definitions

In recent years, the term “cloud computing” has been used and abused by vendors and their marketing groups to denote just about anything the vendor offers other than on-premise systems. Analysts too have piled on, each offering their own definition of cloud computing. A 2009 Wall Street Journal article outlined the confusion as follows: “The result has been fruitless arguments over what is “true cloud” or “false cloud,” as in the recent tit-for-tat speeches by Larry Ellison and Marc Benioff during Oracle Open World. (Scavo, 2011)

Such debates are likely to continue, but now there is at least one official source for the definition of cloud computing. The National Institute of Standards and Technology (NIST), an arm of the US Department of Commerce, has now published The NIST Definition of Cloud Computing.

Though other standards bodies may (or may already have) published their own definitions, NIST carries particular weight as it is often referenced in U.S. governmental procurement. The NIST definition is vendor-agnostic and buyer-centric.

The NIST Definition

The NIST document is short–the body of the document comprises just three pages, with the definition itself taking up less than two pages. In it, the authors describe the essential characteristics, service models, and deployment models for cloud computing.

- The five essential characteristics are: **on-demand service**, **broad network access**, **resource pooling**, **rapid elasticity**, and **measured service**.

- They go on to then list three service models, which should be already familiar to most observers: Software as a Service (**SaaS**), Platform as a Service (**PaaS**), and Infrastructure as a Service (**IaaS**).

- Finally, they list four possible deployment models for cloud computing: **private cloud**, **community cloud**, **public cloud**, and **hybrid cloud**.

In my mind, the section that is most useful for distinguishing what is or is not cloud computing is the first one, the "essential characteristics." So, let me quote NIST directly

Essential Characteristics:

– On-demand self-service: a consumer can unilaterally provision computing capabilities, such as server time and network storage, as needed automatically without requiring human interaction with each service provider.

– Broad network access: capabilities are available over the network and accessed through standard mechanisms that promote use by heterogeneous thin or thick client platforms (e.g., mobile phones, tablets, laptops, and workstations).

– Resource pooling: the provider's computing resources are pooled to serve multiple consumers using a multi-tenant model, with different physical and virtual resources dynamically assigned

and reassigned according to consumer demand. There is a sense of location independence in that the customer generally has no control or knowledge over the exact location of the provided resources but may be able to specify location at a higher level of abstraction (e.g., country, state, or datacenter). Examples of resources include storage, processing, memory, and network bandwidth.

– Rapid elasticity: capabilities can be elastically provisioned and released, in some cases automatically, to scale rapidly outward and inward commensurate with demand. To the consumer, the capabilities available for provisioning often appear to be unlimited and can be appropriated in any quantity at any time.

– Measured service: cloud systems automatically control and optimize resource use by leveraging a metering capability at some level of abstraction appropriate to the type of service (e.g., storage, processing, bandwidth, and active user accounts). Resource usage can be monitored, controlled, and reported, providing transparency for both the provider and consumer of the utilized service.

Ellison and Benioff's Definition

So, let's apply these characteristics to what Larry Ellison and Marc Benioff each describe as cloud computing. They have extensively debated with each other on the definition because of their vested interests. In my opinion, both are right and both are wrong.

Benioff's service, Salesforce.com, certainly meets the NIST definition of cloud computing, both in its CRM application, which meets NIST's definition of SaaS, and in its Force.com offering, which meets the definition of PaaS. He is also correct in criticizing the labelling of Oracle's Exalogic hardware as a "cloud in a box." By my reading of NIST's essential characteristics, one could construct a cloud service using Oracle's hardware, but the hardware itself should not be considered a cloud.

But if Benioff is referring to Oracle's newly announced Public Cloud Services as a "false cloud," he is wrong. Oracle's Public Cloud Services certainly meet the NIST definition of cloud computing. But it is primarily an IaaS offering, similar to Amazon's EC2. Assuming that Oracle will offer development capabilities on top of its Public Cloud Service, those would be PaaS, and

if it chooses to run applications on top of its Public Cloud Service, such as Oracle CRM On-Demand, those would be SaaS.

On the other hand, Ellison is wrong to label Salesforce.com's PaaS offering as a "false cloud." Ellision's argument is that Force.com utilizes proprietary extensions to Java and other programming languages, which make it difficult to migrate applications to other cloud providers. But there is nothing in the NIST definition of cloud computing that requires interoperability between different cloud service providers, as desirable as that may be. Ellison is simply turning what he sees as a disadvantage of Benioff's cloud into an argument that it is by definition not a cloud.

Application Hosting Context

The NIST definition is also useful for cutting through vendor marketing efforts to label anything they do off-premise as cloud computing. In particular, application vendors that simply host their on-premise solutions in their own, or partner, data centers should not be labelling those as cloud computing. In particular, simple hosting of an application does not qualify as cloud computing because it lacks the essential characteristics (see bolded sections in the quoted definition above).

With a hosted application, the customer generally cannot "unilaterally provision computing capabilities, such as server time and network storage, as needed automatically without requiring human interaction." In addition, with a hosted application there is generally no "sense of location independence." Rather, the customer usually knows the data center and may even know the data center, cage, or rack in which his hosted application resides, even if the application is hosted on a virtual server. Finally, with a hosted application, computing resources generally cannot be "elastically provisioned and released, in some cases automatically, to scale rapidly outward and inward commensurate with demand." Rather, the customer must negotiate provision of additional computing resources.

Notice also that the NIST definition does not mention anything about how cloud services are contracted. Some vendors point to subscription pricing as evidence of their hosted applications being cloud offerings. According to NIST, how the customer pays for the service has no bearing as to whether the service is cloud computing. It could be subscription pricing, it could be a perpetual license, or it could be something else.

The marketing hype and confusion over cloud computing will no doubt continue. But at least now NIST offers a reasonable and objective definition.

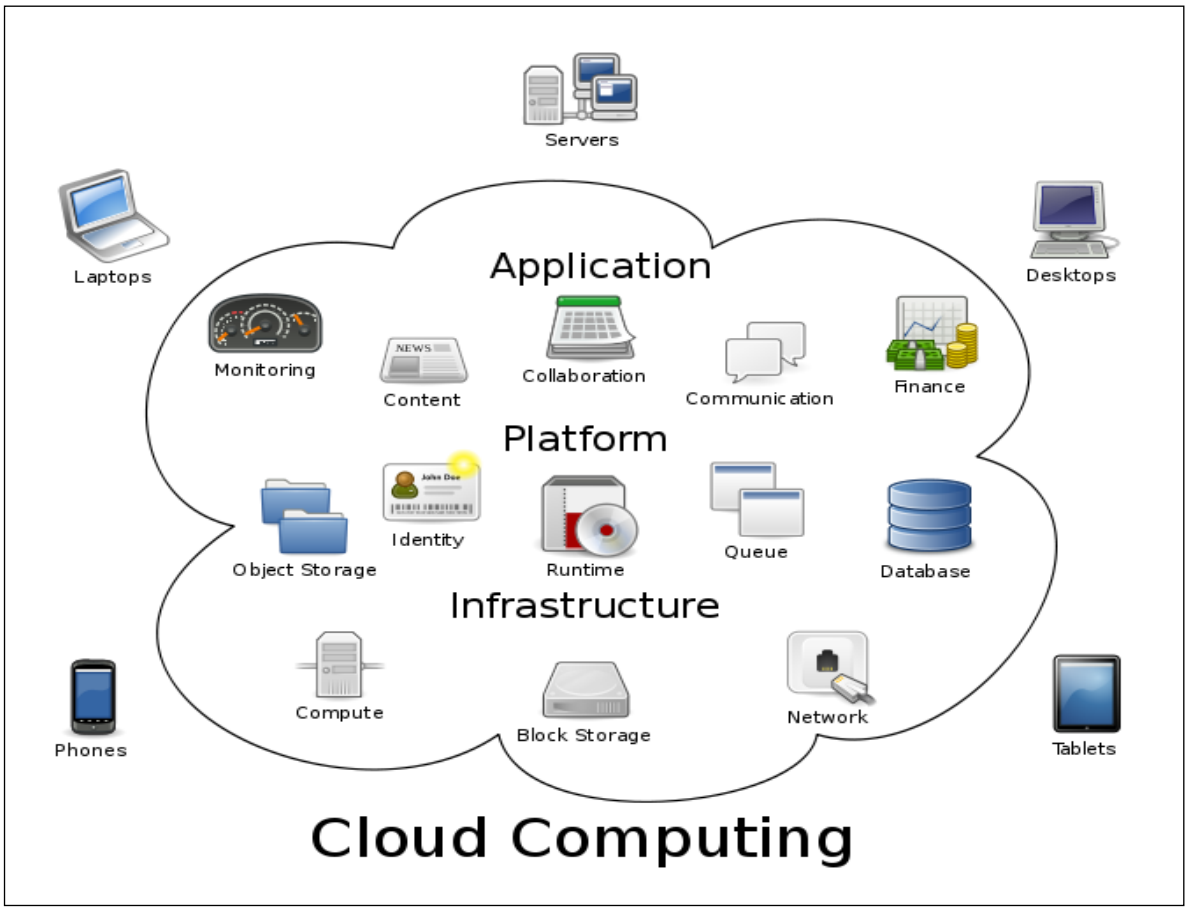

Figure 4.2: Cloud Computing Logical Diagram
Source: Wikipedia < http://en.wikipedia.org/wiki/cloud_computing>

As Defined by Other Experts

"What is cloud computing all about? Amazon has coined the word “elasticity” which gives a good idea about the key features: you can scale your infrastructure on demand within minutes or even seconds, instead of days or weeks, thereby avoiding under-utilization (idle servers) and over-utilization (blue screen) of in-house resources. With monitoring and increasing automation of resource provisioning we might one day wake up in a world where we don’t have to care about scaling our Web applications because they can do it alone?" - Markus Klems <http://markusklems.wordpress.com/2008/07/07/wow-is-a-cloud/>

"For me the simplest explanation for cloud computing is describing it as, 'internet centric software.' This new cloud computing software model is a shift from the traditional single tenant approach to

software development to that of a scalable, multi-tenant, multi-platform, multi-network, and global. This could be as simple as your web based email service or as complex as a globally distributed load balanced content delivery environment. As software transitions from a traditional desktop deployment model to that of a network & data centric one, "the cloud" will be the key way in which you develop, deploy and manage applications and services in this new computing paradigm via the Internet." - Reuven Cohen < http://www.elasticvapor.com/2008/06/describing-cloud.html>

"I view cloud computing as a broad array of web-based services aimed at allowing users to obtain a wide range of functional capabilities on a 'pay-as-you-go' basis that previously required tremendous hardware/software investments and professional skills to acquire. Cloud computing is the realization of the earlier ideals of utility computing without the technical complexities or complicated deployment worries of the past." - Jeff Kaplan < http://www.thinkstrategies.com/blog/>

"People are coming to grips with Virtualization and how it reshapes IT, creates service and software based models, and in many ways changes a lot of the physical layer we are used to. Clouds will be the next transformation over the next several years, building off of the software models that virtualization enabled and cloud computing affords." - Douglas Gourlay < http://blogs.cisco.com/datacenter/simon_crosby_on_gigaom/>

"The way I understand it, “cloud computing” refers to the bigger picture…basically the broad concept of using the internet to allow people to access technology-enabled services. According to Gartner, those services must be 'massively scalable' to qualify as true 'cloud computing'. So according to that definition, every time I log into Facebook, or search for flights online, I am taking advantage of cloud computing." - Praising Gaw < http://cloudcomputing.sys-con.com/node/612033>

"There sure is a lot of confusion when it comes to talking about cloud computing. Yet, it does not need to be so complicated. There really are only three types of services that are cloud based: SaaS, PaaS, and Cloud Computing Platforms. I am not sure being massively scalable is a requirement to fit into any one category." - Brian de Haaff < http://cloudcomputing.sys-con.com/node/612033#feedback>

"I was chatting with a customer the other day who was struggling with some of the implications of cloud computing. The analogy that finally made sense to them is what I will call 'cloud dining.' I am the cook in the house and I am tasked with feeding the family. If my 10-year old is lobbying for Italian, I am cook at home or order out. The decision may also vary from day to day. For instance, I might not have all the ingredients and have to order out, or, like this weekend, it may be 103 outside and cooking at home is not all that appealing. Now, the same can be said for supporting a given application in a cloud computing environment. In a fully implemented Data Center 3.0 environment, you can decide if an app is run locally (cook at home), in someone else's data center (take-out) and you can change your mind on the fly in case you are short on data center resources (pantry is empty) or you having environmental/facilities issues (too hot to cook). In fact, with automation, a lot of this can be done with policy and real-time triggers. For example, during month end processing, you might always shift non-critical apps offsite, or if you pass a certain cooling threshold, you might ship certain processing offsite." - Omar Sultan < http://cloudcomputing.sys-con.com/node/592855>

"Cloud computing overlaps some of the concepts of distributed, grid and utility computing, however it does have its own meaning if contextually used correctly. Cloud computing really is accessing resources and services needed to perform functions with dynamically changing needs. An application or service developer requests access from the cloud rather than a specific endpoint or named resource. What goes on in the cloud manages multiple infrastructures across multiple organizations and consists of one or more frameworks overlaid on top of the infrastructures tying them together. The cloud is a virtualization of resources that maintains and manages itself." - Kevin Hartig <http://cloudcomputing.sys-con.com/read/579826.htm>

"Clouds are vast resource pools with on-demand resource allocation. The degree of on-demandness can vary from phone calls to web forms to actual APIs that directly requisition servers. I tend to consider slow forms of requisitioning to be more like traditional datacenters, and the quicker ones to be more cloudy. A public facing API is a must for true clouds. Clouds are virtualized. On-demand requisitioning implies the ability to dynamically resize resource allocation or moving customers from one physical server to another transparently. This is all difficult or impossible without virtualization. Clouds tend to be priced like utilities (hourly, rather than per-resource), and I think we'll see this model catching on more and more as computing resources become as cheap and ubiquitous as water, electricity, and gas (well, maybe not gas). However, I

think this is a trend, not a requirement. You can certainly have clouds that are priced like pizza, per slice." - Jan Pritzker < http://virtualization.sys-con.com/node/595685>

"I would like to propose a 'Cloud Pyramid' to help differentiate the various Cloud offerings out there. [At the top of the pyramid] users are truly restricted to only what the application is and can do. Some of the notable companies here are the public email providers (Gmail, Hotmail, Quicken Online, etc.). Almost any Software as a Service (SaaS) provider can be lumped into this group. As you move further down the pyramid, you gain increased flexibility and control but you're a still fairly restricted to what you can and cannot do. Within this Category things get more complicated to achieve.

Products and companies like Google App Engine, Heroku, Mosso, Engine Yard, Joyent or force.com (SalesForce platform) fall into this segment. At the bottom of the pyramid are the infrastructure providers like Amazon's EC2, GoGrid, RightScale and Linode. Companies providing infrastructure enable Cloud Platforms and Cloud Applications. Most companies within this segment operate their own infrastructure, allowing them to provide more features than others." - Michael Sheehan < http://cloudcomputing.sys-con.com/read/609938.htm>

4.2 Cloud Computing For Individuals

It is evident that cloud computing will change the computing environment. This section looks at how cloud computing will influence the way in which individuals compute. Cloud computing will save them money, time, and effort if used and implemented correctly. Individuals provide and store their personal data and information with cloud service providers based on trust and promise of security, however, time and again their data and information is compromised and abused. How this happens and why this happens is investigated and discussed.

Software as a service (SaaS) refers to the paradigm where software and other solutions are delivered to the end user as a service using the Internet rather than as a product that can be installed on the user's computer. An example of SaaS for individuals is Google Apps consisting of Gmail, Google calendar and Google docs, which allow one to store and access documents online rather than on their personal computers. (Ambrose & Chiravuri, 2010)

SaaS for individuals can be conceptualized in terms of two dimensions: cloud services and cloud storage (Vogels, 2009). Similar to cloud services, which refer to the online delivery of software, cloud storage refers to the online delivery of data storage, for example, Amazon EC2 - part of Amazon's web services. Cloud storage is more popularly known as Storage as a Service (STaaS).

Processing power and storage capacity of large companies like Google can be utilised for free or by paying an insignificant amount. There is no need to reinvent the wheel or to start from scratch, because cloud service providers like Google, MSN, Yahoo, Amazon and others have done the hard yards. For individual users, Google, MSN, Yahoo and others will provide free web-based emails, and a range of web based applications, including common productivity software applications.

Save money by not paying for processing power and storage. Just pay for devices like $29 mobile phones, $20 Tablet PCs, and other portable devices. They are cheap because they don't have much processing power and storage capacity. However, these devices provide connection to cloud service providers. And once connected, the cloud service provider will do all the processing and store whatever is required. Time and effort is not spent on processing. It is just like using Google's Search Engine to find information on whatever is needed, as compared to going to the Library and taking the information out by browsing through several dozen books.

Some common scenarios that require use of cloud storage and cloud service providers are: the hard disk on the PC is reaching its storage capacity – where can more files be stored? Hundreds of photos and videos that were taken while holidaying in Fiji needs to be shared with family and friends? Personal documents, photos, music and video clips are not allowed to be stored on the office PC – what is the alternative? There is a free and easy solution to all storage and sharing problems – cloud storage and cloud service providers as in Table 4.1 below.

Storage Provider	**Provided As**	**Storage Space**	**Requirements**	**Web Site**
1. MegaUpLoad	MegaUpLoad	50 GB	Need to Sign Up	http://megaupload.com
2. ADrive	ADrive	50 GB	Need to Sign Up	http://www.adrive.com
3. Windows Live	Windows Live SkyDrive	25 GB	Need to Sign Up	www.skydrive.live.com
4. Humyo.Com	Humyo Free	10 GB	Need to Sign Up	http://www.humyo.com
5. Google	Gmail/GoogleDocs/Picasa	10 GB	Need to Sign Up	http://www.gmail.com
6. OrbitFiles	OrbitFiles	6 GB	Need to Sign Up	http://www.orbitfiles.com
7. Mesh	Live Mesh	5 GB	Need to Sign Up	https://www.mesh.com
8. XDrive	XDrive	5 GB	Need to Sign Up	http://www.xdrive.com
9. divShare	divShare	5 GB	Need to Sign Up	http://www.divshare.com
10. eSnips	eSnips	5 GB	Need to Sign Up	http://www.esnips.com

Table 4.1: Top 10 Free Cloud Storage - Storage as a Service (STaaS) Providers and What they Provide?

Several thousand cloud computing applications have become available in the last few years. These applications are generally free to individuals. One suite of online applications that promotes creating, sharing, and collaborating is Zoho <http://zoho.com>, which offers a word processor, spreadsheet, presentation tool, and note taker, among other services. Another increasingly popular and diverse online productivity and collaboration application is Google Docs <http://docs.google.com>, which requires a free Google account.

For end-users, cloud computing means simplified, self-service access where IT "products" (think services like e-mail or travel booking) are listed in browse-able service catalog (for instance, app stores) and can be instantly ordered and used. Cloud also means payment based on usage and very high expectations for service availability (24/7) and access (from anywhere and with any device). End-users have become spoilt by the immediate gratification derived from their experiences consuming cloud services in their private lives. They now expect IT services to be delivered with the same speed and reliability within the enterprise. (Viarengo, 2010)

Almost everyone that is connected to the Internet has a Facebook account or is registered with and using a social networking web site from the hundreds out there in the cloud. Friends, relatives, and old school mates are discovered in different parts of the world via the cloud. People are being abused and targeted in social networking web sites. Fraudsters create fake identities of others and celebrities to mine information for further fraudulent activities. School students commit suicides after discovering malicious and derogatory remarks posted about them on Facebook.

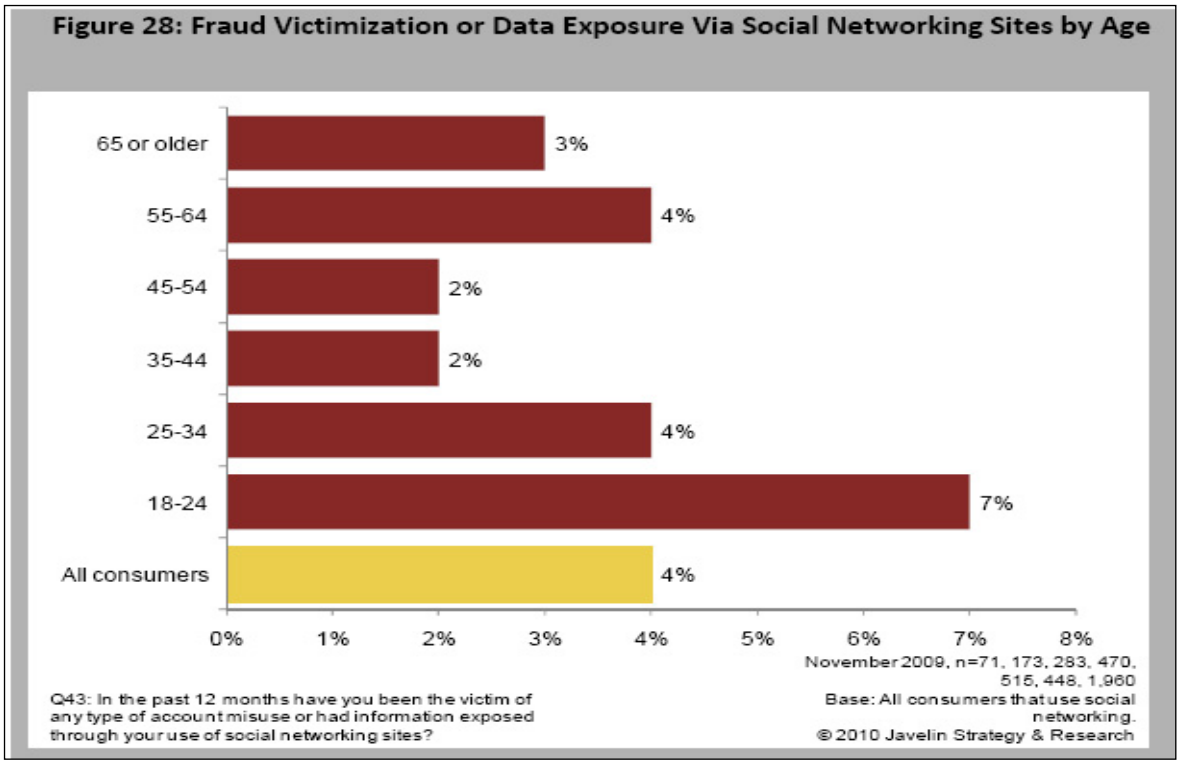

Figure 4.3: Fraud Victimisation or Data Exposure Via Social Networking Sites By Age.
[Source: Javelin Strategy and Research]

Employees are fired because they were on Facebook during the day, after calling in sick. Employers dig up the "digital dirt" on prospective job applicants and employees and then use it in hiring and firing decisions. Law enforcement officers "lurk" on social networking web sites to track activities of known criminals and catch potential ones. Evidence from Facebook postings has been produced in court to prove infidelity during divorce proceedings and settlements.

Anyone can become a victim of the scandalous cloud. Victims to online scams have become more cautious with information that they exchange with others in the cloud. Some victims have completed abandoned socialising online. When I try to preach about online safety to my IT students, they tell me they are "too smart" to get victimised. Maybe, they are, they were born in the knowledge economy and grew up with the digital mouse. Probably, some have still not seen a live mouse. But we cannot be ignorant, as I have seen Internet users with years of experience being scammed. It requires a scammed victim to prevent others being victimised.

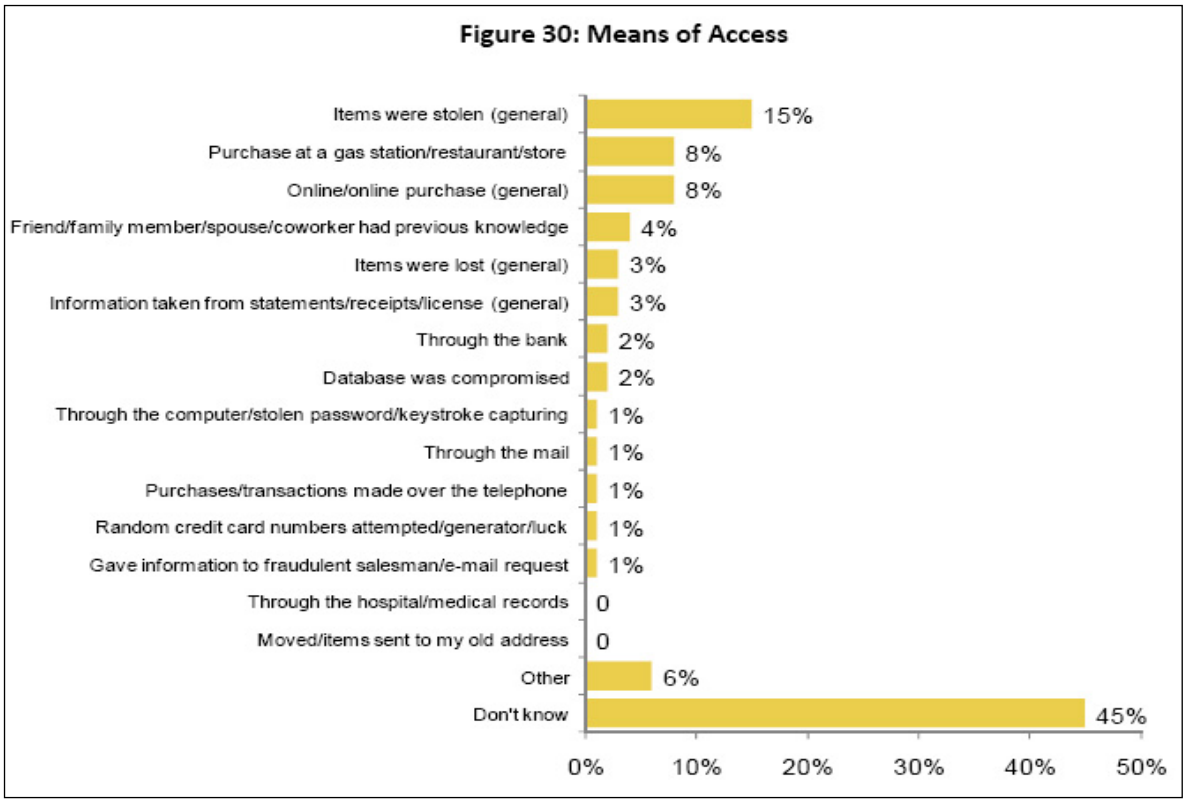

Figure 4.4: How Information Are Obtained From Victims to Conduct Fraud and Abuse on Social Networking Sites. [Source: Javelin Strategy and Research]

When my students are asked, who owns the information they post about themselves on their FaceBook pages, they proudly tell me that they do. This is a common misconception amongst millions of social networking users out there. When they are told, that I can take that information and use it in whichever way I want, they cry foul. I am told it is unfair, illegal and I get lectures about ethics and morals. Many of us have ethics and morals, and they dictate our behaviour in the clouds, but does it do the same for millions of users on social networking web sites?

What social networking users don't realise is what they have agreed to while registering with a social networking web site and clicking on the "I Accept" button. Who owns the personal information that any user posts about themselves on social networking web sites? To avoid potential nastiness, here are some facts that users needs to know before posting on social networking websites and the information derived from their postings that they don't own or have control over.

Taxonomy of Social Networking Data

(Schneier, 2010) in “A Taxonomy of Social Networking Data” presented at the OECD Internet Governance Forum, states “social networking sites deal with several different types of user data”, and listed below is how he categorises them:

- Service data is the data that you give to a social networking web site in order to use it. Such data might include your legal name, your age, and your credit-card number.

- Disclosed data is what you post on your own web pages: blog entries, photographs, messages, comments, and so on.

- Entrusted data is what you post on other people's pages. It's basically the same stuff as disclosed data, but the difference is that you don't have control over the data once you post it - another user does.

- Incidental data is what other people post about you: a paragraph about you that someone else writes, a picture of you that someone else takes and posts. Again, it's basically the same stuff as disclosed data, but the difference is that you don't have control over it, and you didn't create it in the first place.

- Behavioural data is data the social networking web site collects about your habits by recording what you do and who you do it with. Just like who are your friends on Facebook and what activities both you and friends like in common. It might include games you play, topics you write about, your friends in common, news articles you access (and what that says about your political leanings), and so on.

- Derived data is data about you that is derived from all the other data. For example, if 80 percent of your friends self-identify as gay, you're likely gay yourself.

There are other ways to look at user data. Some of it you give to the social networking web site in confidence, expecting the web site to safeguard the data. Some of it you publish openly and others use it to find you. And some of it you share only within an enumerated circle of other users. At the receiving end, social networking web sites can monetize all of it: generally by selling targeted advertising. Different social networking sites give users different rights for each data type. Some are always private, some can be made private, and some are always public. Some can be edited or deleted. I know one site

that allows entrusted data to be edited or deleted within a 24-hour period, while other don't allow you to change it again. Some can be viewed and some cannot. (Schneier, 2010)

Schneier's taxonomy gives indication about what type of information to post on social networking web sites and what type of information to avoid. A good rule is to ask "what control would I have once I post the information up there?" Analysing the information provided should empower individual users of the Internet when it comes to interacting with and using the cloud computing.

End users access cloud based applications through a web browser or a light weight desktop or mobile app while the business software and data are stored on servers at a remote location. Cloud application providers strive to give the same or better service and performance as if the software programs were installed locally on end-user computers. At the foundation of cloud computing is the broader concept of infrastructure convergence (or converged infrastructure) and shared services. This type of data centre environment allows enterprises to get their applications up and running faster, with easier manageability and less maintenance, and enables IT to more rapidly adjust IT resources (such as servers, storage, and networking) to meet fluctuating and unpredictable business demand.

Users access cloud computing using networked client devices, such as desktop computers, laptops, tablets and mobile phones. Some of these devices - *cloud clients* - rely on cloud computing for all or a majority of their applications so as to be essentially useless without it. Examples are thin clients and the browser-based Chrome book. Many cloud applications do not require specific software on the client and instead use a web browser to interact with.

4.3 Cloud Computing For Business

Cloud computing is going to change business processes. This section looks at how businesses can use cloud computing and what cloud computing technology can offer them. We are now in what is considered the "knowledge" economy. In this knowledge economy, the currency is "information". Wealth in this economy is measured by the amount of information that can be accessed, manipulated and provided. Founders of FaceBook, Google, Yahoo, and many other cloud service providers and social networking web sites have become overnight billionaires by trading information. Their trade and trading secrets are known now. The world is full of people with a voracious appetite for information. For business considering of going into the trade of information, their link to the people of this world is through cloud computing.

Organizations are being founded with very little physical capital. For a services or knowledge intensive business, free tools and low-cost computing cycles can mostly be expensed, changing the fund-raising and organizational strategies significantly. Smartphone's, Tablet PCs and other devices built without mass storage can thrive in a cloud-centric environment, particularly if the organization is designed to be fluid and mobile. Coburn Ventures in New York, for example, is comprised of a small team of mobile knowledge workers who, for the first five years, had no corporate office; the organization operated from Wi-Fi hot spots, with only face-to-face meetings. (Jordan, 2010)

Computing as a utility has reached the mainstream. Vendors [cloud] now rent all or portions of physical machines for hourly periods for web services. The cloud computing model provides flexible support for "pay as you go" systems. In addition to no upfront investment in large clusters or supercomputers, such systems incur no maintenance costs. Furthermore, they can be expanded and reduced on-demand in real-time. The cloud computing model emphasizes the ability to scale computing resources on demand. The advantages for businesses are numerous. (Napper, 2009)

Consider the following scenarios: businesses that are planning to start small, but do not have the capital to invest in IT infrastructure that is critical for the business to succeed; businesses thinking of backing up their critical data online as part of their data recovery contingency plan; businesses thinking of using an Application Service Provider [ASP] to supplement existing business and avail it 24/7 for their customers? These businesses can consider the following solution:

Small businesses can get up and running without investing in IT, office space, and other physical establishment requirements. They will be able to advertise market, sell and communicate with their customers using services provided for free by many web sites. I know of some small business and car dealerships that have closed their offices, laid off their staff, and the owner/operator now sells on TradeMe <www.trademe.co.nz> in New Zealand. And they don't pay any sales of business related taxes.

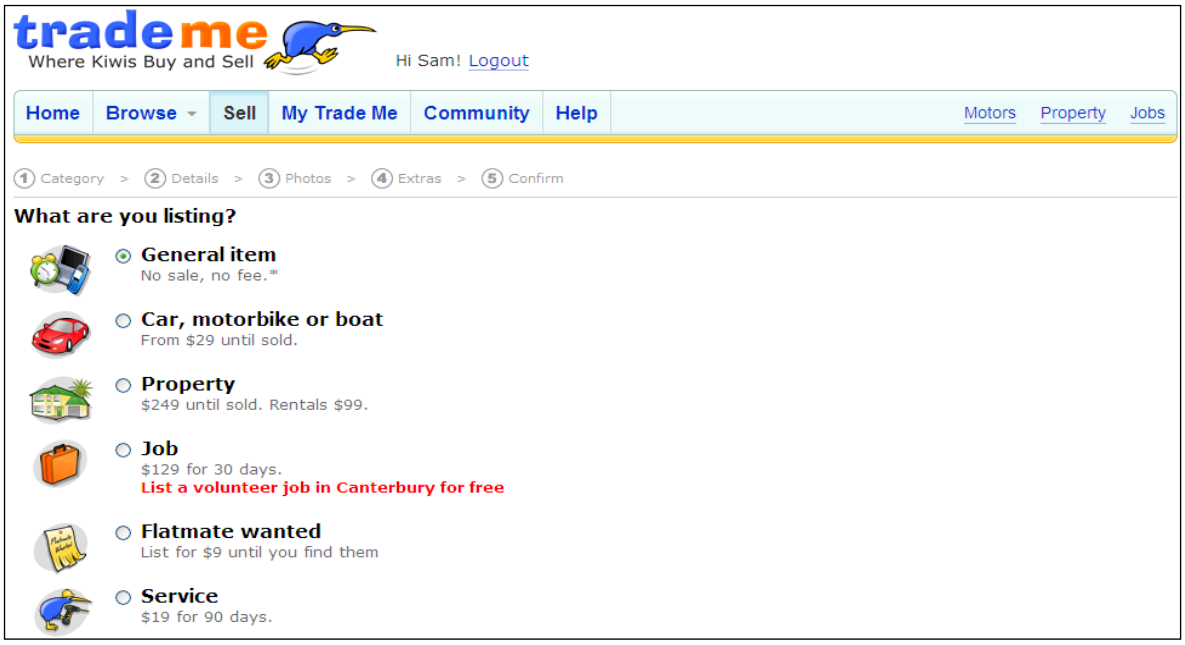

Figure 4.5: Selling Terms and Conditions of TradeMe New Zealand for Registered Members.
Source: www.trademe.co.nz>

For businesses, whether large, small and medium enterprises [SME], including self-employed entrepreneurs and individuals, web sites like Amazon <www.amazon.com>, e-Bay <www.ebay.com>, and others allows to sell for free or for a nominal fee and in return provide all the services, and applications required, including secured payment transactions and network security of Fortune500 companies. There are huge monetary savings combined with social benefits of not having to open shop in the morning and close it at night. Business is open 24/7, generating revenue while the owner/operator is enjoying the sun, the sand and the sea wherever they wish because they are connected to the cloud.

Cloud computing has promised many technological and sociological benefits. The computing power is generated from highly centralised and standardized data centres which contain up to millions of servers, with a considerable economy of scale. From an enterprise standpoint, cloud computing can deliver on-demand computing power at a very low if not any cost of the upfront infrastructure and ongoing maintenance. Cloud computing also promises to provide better performance, reliability and scalability (Erdogmus, 2009).

Pharmaceuticals giant Eli Lilly and Co., for example, is using cloud computing to direct IT analytics power at the right place at the right time. Under increasing pressure to cut fixed IT costs without compromising service levels, Lilly began working with an application cloud company to

provide computing capabilities to its global network of scientists. During one drug development process, Lilly effectively paid $89 to its cloud provider to analyse the relevant data; a task that, if performed internally, would have required the purchase of 25 servers. (Harris & Nunn, 2010)

Large data centres like Google, Yahoo, Microsoft, and others benefit from economies of scale. Adding another thousand users is the same as adding another user in a normal organisation. When another company pays to use their cloud computing infrastructure and service for their customers, it comes with negligible cost and maximum profit. A Server Specialist who is looking after 5 Servers can easily look after 500 Automated Servers. Services that are successfully deployed for one client can then be deployed for all clients adding value to the service. Those that have been using HotMail, YahooMail or GMail for a while would have noticed the introduction of so many new features, functionality and increase in online storage capacity. Economies of scale allowed enhancements that were provided to users who were not paying for it.

Statistics regarding cloud computing for businesses: IDC estimates the market for public cloud products and services at $16B in 2010, growing to $56B by 2014. Gartner more optimistically estimates the cloud market at $150B by 2013 while Merrill Lynch estimates the market at $160B by 2011. AMI Research estimates that cloud spending alone will reach $100B by 2014. Regardless of the exact numbers or estimates of cloud computing that each of these companies used, the conclusion is that market for public cloud infrastructure, platforms and applications is large and growing much more quickly than any other type of IT spending. (Nichols, 2010)

A recent survey by international research firm Vanson Bourne of IT and business decision makers found that 70% respondents think cloud computing will help their businesses. (Vanson Bourne, 2010) Cloud computing is on-demand computing. Cloud service providers processing power and storage capacity is not continuously in demand 24/7. There are peak demand periods and lull within a 24 hour cycle. As more corporate customers buy cloud services, the provider does not have to buy more processing power and storage. The cloud service provider is able to schedule and dedicate optimum processing power for its clients. For example, a corporate client in UK will process its transactions at 5pm. That UK client can have access to as much processing power as it needs, because the other clients are still in bed on the other side of the world.

Cloud service providers that offer Software-as-a-Service utilise integration. Integration is single-software, multiple-users. The term "single-software, multiple-users" means there is one instance

of software (single-software) that is used by a number of different customers (multiple "users"). This is one of the main concepts behind cloud computing. Many different customers can use the same application, with their own data, over the Internet. Software updates and new features are easy and inexpensive to deploy to customers because everyone uses the same version of the software. Innovation, upgrades, features and functionality additions can happen on the fly for everyone because there is only one software to upgrade. Easy, cost effective and continuous.

Small businesses in the developing countries are faced with various investment, hardware and software as well as network infrastructure issues. The high cost of hardware and broadband coupled with the lack of reliable infrastructure pose tremendous hurdles for small and medium businesses. The investment and infrastructural hurdles made sure that the businesses faced difficulty competing in the current era of globalization. Lack of IT resulted in a very inefficient business process, resulting in a tremendous loss of opportunities for these businesses. The high cost of OS and productivity apps added severe strain on the financial health of the businesses in the developing countries. They are either forced to give up on their plans for a strong IT infrastructure or forced to the use pirated versions of the software. This puts them in a disadvantaged position compared to their counterparts in the advanced nations. The unreliable power and broadband infrastructure ensured that many of the developing nations didn't have the opportunity to build world class data centers catering to the local needs. (Swaminathan, 2008).

4.4 Cloud Computing - Myths and Facts

Everyone's talking about cloud computing, and many have even started using it. Cloud computing is the current "big thing" in the technology world. But guess what? Cloud computing isn't new. In fact, it's really just the joining up and packaging of existing technologies and deploying them in a way that might actually help you save time and money and improve efficiency. Many things are said and done in the name of cloud computing, and while some of them are true, that also means many are potentially misleading at best. Individuals and business who are thinking of computing in cloud are confused because of so many mixed messages out there about cloud computing and cannot comprehend what is myth and what is fact about this technology.

So here's a simple guide to help you see through the myths and facts so that as a potential individual user or business user of cloud computing, you can make up your own mind.

Cloud applications are better

Well, it depends on what you mean by better. If it means easier to use and share, fewer configuration options, and fewer opportunities for things to go wrong, then yes, by and large cloud applications (think Google Docs versus the traditional Microsoft Office package) can be considered “better.” This is largely because of the software limitations that run in your browser, although that’s now changing with the latest HTML5-capable browsers.

If you like the advanced features that Windows/Mac screens can give you, and then you may have to sacrifice a drop in functionality in return for ease of access if you move to the cloud. And, since the cloud is the Internet, it makes it far easier to integrate online with what traditionally has been seen as offline (e.g., your website and your database).

Data’s not secure in the cloud, is it?

Not 100 percent. Nothing is, but it’s probably much more secure than anything on your own PC or server. The physical security of your office, unless you work in a high-security facility, is not as secure as a data center. Additionally, the firewalls and other security measures employed by data centers are beyond the financial means of even the largest charities. And you can always go for a private or community cloud. Moreover, there has been a shift in the perception of acceptable risk in recent years. On the whole, we now see online banking, investment management and so on as acceptable — or at least risks worth taking — so maybe it’s time for cloud computing.

Cloud is green

Well, it might reduce your power consumption, but those data centers on which the cloud are built have to run on something. In 2010, they accounted for 1.3 percent of the world’s electricity consumption. So to some extent, it’s pushing the problem around. Electric car companies claim their vehicles have low emissions, but those batteries have to be made somewhere don’t they? Though, it is true to say that one big virtual server is more efficient than the equivalent number of physical servers. So to check the green box, you need to choose a data center that consumes renewable resources like those found in Canada and the Nordic countries.

Cloud costs more in the long run

It depends how you work it out. I could make a convincing demonstration either way with persuasive charts and numbers, but the greatest benefit of cloud is that it allows you to focus your resources and energies on your mission, not on IT. When you work out the costs of buying and maintaining servers, upgrades, power consumption, etc., it's easy to illustrate that cloud can cost less over time.

It's on the Internet, so it will be slow

Not as much of a problem these days. Internet connections are faster and more reliable while the servers in the data centers are more powerful and able to crunch the numbers more quickly. You can also "borrow" power on demand in the cloud. As long as it's a true cloud application, performance should not be a problem. With the cost of broadband connections decreasing dramatically and with the healthy competition amongst many different providers of broadband internet services this issue might not last long.

Beware the cloud-wash

Some vendors do little more than add the word "cloud" to their marketing materials and hope to catch a ride on the gravy train. A hosted Windows application does not a cloud app make. It just moves all the old problems to another server. Cloud usually implies virtualized servers, a transparent infrastructure (you shouldn't need to log on to the server just to use your app), multi-tenanted applications and contractually managed solutions (not technically managed).

It's just a passing fad

May be that is right, but if you've been in the technology industry as long as I have, you notice that what goes around comes around — but it's generally better. Dumb terminals? Now we call them netbooks. X.25 packet switching network? Now we call it the Internet. Distributed computing? Now we call it cloud. Only it's much better this time around.

So is it time to move to cloud?

The issue is complicated when you've already invested in "on premise" systems, but I have to say, if I was starting a new business, I would definitely be looking at cloud solutions so I could focus on the cause, not the computers.

Cloud is not built for fault tolerance

A well architected cloud should have fault tolerance built in. I do agree that Amazon EC2 instances go down due to some issues on their datacenters. However, EC2 need not be the poster boy/girl of Clouds. With EC2, it is imperative for the app developer to architect their app using EC2 instances running in different availability zones. A single Amazon EC2 instance is not Cloud per se, though I can argue against my own claim. AWS EC2 is called cloud because it offers you an option to run multiple instances in different availability zones and use the programmatic control they offer to these instances to almost eliminate the downtime and make your app sit on a fault tolerant infrastructure. Here is a request to my friends who are over enthusiastic in offering their own views on Cloud Computing. The concept of Cloud Computing is much deeper than what many in the industry want it to be. Let's hope everyone accept the widely adopted definitions and go forward.

Virtualization is an important part of Cloud Computing

This is plain wrong. Even though most of the Cloud environments use virtualization, it is not necessary. Take the case of Google. They have built their cloud without the use of virtualization, using low end 386 machines. One can take 10K 386 machines and throw MapReduce kind of fabric on top of it and call it a Cloud. Just because majority of the cloud environments use virtualization, one cannot claim virtualization to be essential for the very definition of Cloud.

Clouds are not useful in HPC

Even though HPC requires powerful CPU for their processing, it is possible to tap into the Cloud for some of the HPC computations. Sometime back, scientists from MIT did some benchmark tests on Amazon EC2 and found that it is a credible candidate for small sized HPC applications like low order coupled atmosphere-ocean simulation. We have already covered here at Cloud Ave about how Wolfram Research is tapping the power of cloud computing inside mathematica to do some HPC calculations. Platform Computing is tapping into Clouds to seamlessly redirect peak workloads from their internal HPC infrastructure to external cloud resources on a pay-per-use basis

in order to optimally meet service levels. Even though I do agree with the argument that the cloud cannot replace the cluster of high end machines, I don’t accept the bold claims, like the one made by some industry experts HPC cannot be done on Clouds.

Compatibility Issues - Cloud computing is too proprietary.

At present, no two clouds are alike -- both in nature and in IT. Amazon's cloud platform is nothing like Google's, which is nothing like Microsoft's, which is nothing like and you can insert the name of any other up-and-coming cloud provider here. And yet "proprietary" has not proved to mean "useless" -- not by a long shot. Think back to the early days of the personal computer. The first wave of PCs were all from different makers, used different hardware, and weren't remotely cross-compatible. Programs written for the Apple II weren't assumed to have any interchangeability with the Atari, the Amiga, or even the IBM PC itself.

Reliability - Cloud computing is not reliable.

File this one under "guilty until proven innocent." The cloud's been acquiring a leaden lining as of late -- a bad reputation for being questionably reliable. When T-Mobile's Sidekick service crashed recently and lost a ton of user data, criticism flew in all directions -- much of it aimed at clouds-in-the-abstract. The story has a happy ending -- everyone's data appears to have been recovered -- but does anyone want to sit through an experience like that again

Migration - Cloud computing is a one-way street.

Sadly, there's more than a grain of truth to the complaint that once you get things into the cloud, it's a chore and a half to get them out again. This gripe mostly comes from the mouths of those who trust their data to a cloud-based service, only to find they have very limited options when it comes to migrating back out later -- a totally justified complaint. Anyone in the business of building a cloud-based system should start thinking now about how customer data is going to be migrated in -- and back out -- of the cloud.

Scalability - It's too difficult to make use of the cloud's scalability.

This is a common complaint from the programmer's side: Cloud computing is hard to program for effectively. Sure, it's easy enough to get something up and running, but getting it to scale -- that's

another story entirely. Ask the folks at Twitter, who started off their service as a Ruby on Rails application and are now incrementally rewriting the service in Scala.

Big Deal - Cloud computing is just virtual computing by another name

This objection seems more out of simple ignorance of what clouds are meant to do. Clouds aren't just fancy virtual computing environments -- they make use of virtual computing along with many other technologies to accomplish things that aren't possible with individual pieces of iron. Some of this confusion probably arises from the way certain cloud providers present themselves to the developer.