An introduction to cloud computing

Executive Summary

Cloud computing is a consequence of economic, commercial, cultural and technological conditions that have combined to cause a disruptive shift in information technology (IT) towards a service-based economy. The underlying driver of this change is the commoditisation of IT.

While there are many well-documented benefits of cloud computing from economies of scale to acceleration of speed to market, there are also three main groups of risks associated with it; the risk of doing nothing, transitional risks related to this disruptive change in our industry and the general risks of outsourcing.

Canonical's view is that open source technology will help solve many of these latter concerns by not only enabling enterprises to deploy, experiment and test cloud computing concepts behind the firewall, but also by encouraging the formation of competitive marketplaces based around standards.

Canonical is therefore launching Ubuntu Enterprise Cloud, an open source system, based on Eucalyptus, that enables our users to build their own private clouds that match the popular emerging standard of Amazon's Elastic Compute Cloud (EC2).

By using Ubuntu Enterprise Cloud, an enterprise can gain and experiment with many of the benefits of cloud computing while keeping the service behind the firewall and running on its own infrastructure. It's cloud computing that the enterprise controls. By matching emerging industry standards, Canonical aims to simplify any future migration to an external provider. By providing an open source system, Canonical

intends to foster an ecosystem so that when the enterprise chooses to move outside the firewall, it will have a choice of service providers.

In summary, Canonical aims to give Enterprise IT a mechanism to prepare for a future life in the clouds along with a simple path for migration between clouds.

Ubuntu Enterprise Cloud is currently provided as a technology preview in the Ubuntu 9.04 Server Edition distribution.

Introduction

Today it feels as though IT is under assault from a heady mix of terminology such as utility computing, disruptive technologies, innovation, network effects, open source, agile development, software as a service (SaaS), mashups, web 2.0, web 3.0 and commoditisation … the list goes on. It's easy to start drowning as wave after wave of new concepts crash onto the scene. The latest wave is cloud computing.

To some, cloud computing is a future where you won't host your own infrastructure. To others, the cloud is an electricity grid of utility software. While there has been much debate over what cloud computing means, the reality is the term is generic. It describes a combination of business and technological factors that are causing a change to our industry and is no more precise than the term 'industrial revolution'.

Sorting through the tangled mess of today means first getting a clear understanding of what is causing this change. This article is an explanation of the underlying processes behind this onslaught. It aims to provide the reader with a simple pattern to help make sense of the maelstrom. We will examine the fundamental forces behind change, what cloud computing really is, the benefits and disadvantages of cloud computing and why open source matters. Finally, we will also cover how Canonical plans to help you safely navigate this storm.

The fundamental forces behind change

Back in the 1990s, Paul Strassmann demonstrated that there was no link between IT spending and business value. While there has been some argument over the validity of the research, Strassmann's work created an idea that rapidly spread. This idea was that not all IT is the same, not all IT has value and some IT has commoditised.

Commoditisation is a neologism that describes how a rare and poorly-understood innovation becomes well-defined and ubiquitous in the eyes of the consumer. In other words, it's a transition that describes how a once-exciting and new activity (an innovation) becomes commonplace and standardised (more of a commodity).

The most often-quoted example of this is the electricity industry and how this innovation led to the formation of national grids in the 1930s. Today, to most consumers, electricity is something you get from a plug and few companies describe their use of electricity as a source of competitive advantage.

In Figure 1, we plot business activities against an axis of ubiquity (how common something is) and certainty (how well-defined and understood something is).

The data is derived from the TV, radio and telephony industries and it suggests that an S-Curve relationship exists between the ubiquity and certainty of an activity.
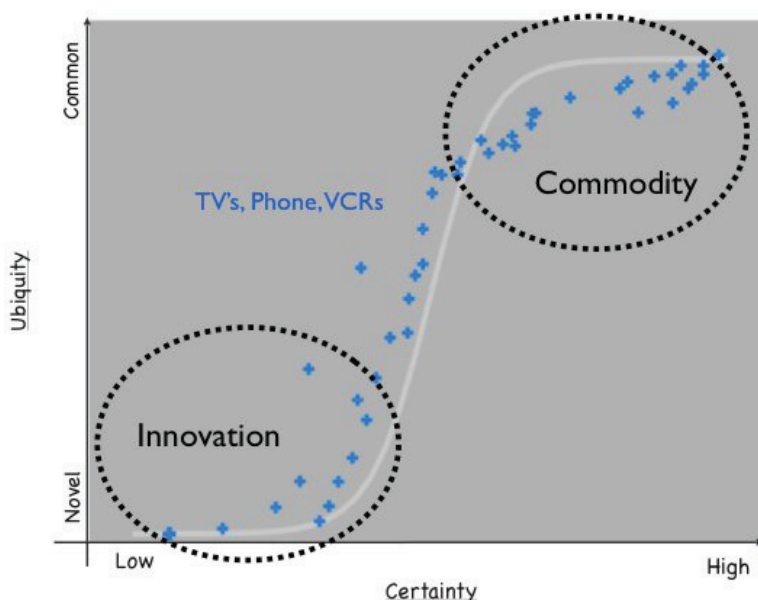

Figure 1

The graph shows a path for how a rare and poorly-understood innovation becomes a common and well-defined commodity.

All business activities are somewhere on that path and all of them are moving - commoditisation never stops and IT activities are no exception. However, the journey of an innovation to ubiquity is not an easy one and some of the changes can be disruptive to an existing industry. This is especially true as any activity moves from the product to the services stage of its journey.

Such a disruptive change is occurring in IT today. A quick glance at the current list of hot topics brings up subjects such as service-oriented architecture (SOA), web services and mashing-up services. All of these contain a strong service theme. The computing stack, which for brevity I'll characterise into the three layers of application, platform and infrastructure, is slowly shifting away from products towards standard components provided as Internet services.

This shift requires four simultaneously occurring factors:

- The suitability of activities to change (for example, an activity that is widespread and well-defined).
- The technology to support such a change.
- The concept of service provision to spread in the industry.
- The willingness of consumers to adopt such a shift (for example, more of IT being seen and treated as a commodity).

The last thing to note is that you have no choice when it comes to commoditisation. If you treat an activity as an innovation while everyone else uses standard services, then you are only likely to create a competitive disadvantage for yourself. Any company needs to continuously adapt to changes in the surrounding market just to retain its competitive position. Doing nothing is a risk in itself.

Commoditisation is a continual process that can be be highly disruptive. You have to continuously adapt to this change and it is happening in IT today.

What is cloud computing?

A combination of business attitude and technology, together with certain activities becoming common and well-defined, has led to a situation whereby some parts of IT are now suitable for service provision through volume operations. This is not confined to one particular layer of the computing stack but across all layers. This transition has given rise to the 'as a Service' industry which includes :-

- Infrastructure (or Hardware) as a Service providers such as Amazon and FlexiScale.
- Platform (or Framework) as a Service providers like Ning, BungeeLabs and Azure.
- Application (or Software) as a Service providers like Salesforce, Zoho and Google Apps.

Supporting this transition is a range of technologies from clustering to virtualization. In essence, these have provided an effective means of balancing the supply of computing resources to match the demand for volume operations.

While the concept of offering computing resources through utility-like service providers dates back to John McCarthy in the 1960's, many early attempts were unsuccessful as they tried to apply such ideas to activities that lacked both ubiquity and definition. Over the years, as numerous IT activities were widely adopted, they became more suitable for outsourcing to service providers. Managed hosting led the second wave of change and the new breed of volume operations specialists such as Amazon are leading this third wave.

The disruptive transition of the computing stack from a product to a service economy, the growth of a new breed of volume-based service providers and the underlying technologies supporting this change have been grouped together under the heading of cloud computing.

Benefits and risks of cloud computing

The shift of the computing stack provides an opportunity to eliminate complexities, cost and capital expenditure in much the same way that using an electricity provider removes the need for every company to build power generators.

The main benefits of cloud computing are therefore economies of scale through volume operations, pay-per-use through utility charging, a faster speed to market through componentisation and the ability to focus on core activities through the outsourcing of that which is not core (including scalability and capacity planning).

Providing self-service IT while simultaneously reducing costs may be highly attractive but it creates a competitive risk to doing nothing.

However, it should be remembered that we are in a disruptive transition at this moment. This transition creates commonly-repeated concerns covering management, legal, compliance and trust of service providers. A Canonical survey of 7,000 companies and individuals found that, while over 60 per cent of respondents thought that the cloud was ready for mission-critical workloads, less than 30 per cent are planning to deploy any kind of workload to the cloud.

In addition to these transitional risks, there also exist the normal considerations for outsourcing any common activity, including whether the activity is suitable for outsourcing, what the second-sourcing options are and whether switching between providers is easy.

Though service level agreements (SLAs) can help alleviate some concerns, any fears can only be truly overcome once customers can easily switch between providers through a marketplace. This already occurs in many industries from electricity to telephony and it is this switching, which has created competitive markets with competitive price pressures. Until such markets appear, it is probable that many corporations will continue to use home-grown solutions, particularly in industries that have already expended capital to remove themselves from lock-in, which is widespread in the product world.

While the cloud lacks any functioning marketplaces today, it is entirely possible that ecosystems of providers will emerge based on easy switching and competition through price and quality of service. In such circumstances, many of the common concerns regarding the uncertainty of supply will be overcome.

While the benefits of cloud computing are many and obvious, there exist the normal concerns associated with the outsourcing of any activity, combined with additional risks due to the transitional nature of this change.

Why open source matters

Open source companies give away their products freely while competing on services. Hence this disruptive shift of the computing stack is not only beneficial to them, they are also the companies least likely to be held back through a product mentality. Many of the winners in the cloud computing space are likely to come from an open source background.

It is also likely that open source will lead the way in creating defacto standards in the cloud in much the same way that Apache became the standard for the web. An open source reference implementation of a potential standard provides a fast means for multiple parties to operationally implement a standard without sacrificing strategic control to a technology vendor. The use of open source also encourages ecosystems to develop around a technology and, while there currently exists a plethora of different cloud offerings for the same activity (such as infrastructure provision), none have created a widespread ecosystem. Successful creation of an ecosystem is the difference between becoming the TCP/IP of the cloud computing world or the Banyan Vines.

As outlined above, the solution to many of the risks of cloud computing depends on the formation of viable ecosystems containing marketplaces of providers with easy switching between them. Such marketplaces depend on standards and understanding this issue is key for any reader wishing to explore the potential future of cloud computing.

In the analogy of the electricity industry, a power plant is used by a provider to create electricity as a standardised output. In the computing industry, while physical hardware is the equivalent of a power

plant, the output is the three layers of the computing stack. To standardise this would mean that providers would need to offer the same outputs. For example, a marketplace of application providers would need to consolidate around standardised applications. Competition, in such a marketplace, would be around price and quality of service for the provision of the same application.

For a product-based industry, this creates a fundamental shift in mindset to competition on service rather than feature differentiation. Such a change is inevitable as it is only those activities, which are well-defined and commonplace that are suitable for service provision. The ubiquity and feature-completeness of those activities means there is little advantage to the end consumer through further feature differentiation.

However, standardised output is not in itself enough as the analogy of computing to the electricity industry contains a flaw. In the electricity industry, you have no relationship with your provider. In the case of cloud computing, you do, it's called your data. Hence any future marketplaces will require not only standardised outputs and competition on service, but also freedom of data and, as a result, easy switching.

While many will argue that such effects can be created through agreed and open specifications (known as open standards), the historical problem has always been not what is in the standard but how providers seek to extend beyond it. In the service world, such extensions or feature differentiations are the antithesis of portability and would severely limit the growth of any ecosystem. While a service provider might consider it to be an advantage to lock in a consumer, it is these very same concerns that continue to slow user adoption.

In a service world, it makes little sense for the code that describes an activity to be anything other than open source or at least based on an open source reference implementation that ensures portability between providers. In such a world, service providers will need to seek competitive advantages through operations and not feature differentiation.

As a general rule of thumb, the future of open source and the development of cloud computing appear to go hand in hand. We've already seen the first shoots of this future with the Distributed Management Task Force's (DMTF's) proposals for a standard to enable portability between virtual machines and the creation of open source systems such as Eucalyptus.

Eucalyptus, a system developed by University of California Santa Barbara (UCSB), is an open source environment that enables you to create and build your own cloud that matches the Amazon EC2 application program interface (API). Creating your own internal cloud is a way of testing, deploying and experimenting with the benefits of cloud computing without the need to venture outside of the corporate firewall.

It is Canonical's view that the open source Eucalyptus system will help to create an ecosystem of providers and is likely to develop into a defacto standard for cloud computing at the infrastructure layer of the stack.

Open source is likely to feature strongly in the future of cloud computing and the development of any standards.

What is Canonical doing about the cloud?

Canonical supports and sponsors Ubuntu, the fastest-growing Linux-based operating system with over 10 million users and a huge community of developers. As a service-focused company that specialises in the free provision of software for common activities, Canonical is well positioned to compete in this cloud computing world.

The software we provide is used for everything from customer relationship management (CRM) to databases. We focus on those common workloads and those commodity-like activities, which have become ubiquitous in IT. Our approach of providing standardised open source components is specifically aimed at enabling companies to quickly implement standard services, which can be used to support more innovative activities.

In our recent survey, 85 per cent of respondents said they would use Ubuntu on the cloud. For this reason, we have introduced Ubuntu Server Edition onto Amazon EC2 (see www.ubuntu.com/ec2) to enable our users to take advantage of the benefits that cloud computing can create.

While we are aware that as the cloud industry develops, many of the adoption issues will be resolved, we also realise that our users need specific support in this time of transition. We take the view that many of our users and enterprise customers wish to experiment with cloud computing but within the confines of their own environments.

For this reason, we will be releasing Ubuntu Enterprise Cloud, which includes Eucalyptus in the Ubuntu distribution. We will also be working on supporting efforts to ensure the portability of infrastructure between different service providers. This will minimise any future impact on our users due to migration. As part of these efforts, we will be looking to build a consortium of providers and management tools to help promote open source in the cloud computing space.

Our aim is to support the growth of both private and public clouds based around an entirely open source stack, and to provide portability between both environments. Canonical will also be offering commercial support for internal clouds along with technical consultancy for installation.

Canonical will be providing open source cloud computing systems in the Ubuntu distribution. This will give Enterprise IT a mechanism to deal with common workloads while preparing for a life in the clouds.

Summary

Cloud computing is a disruptive change, caused by the underlying commoditisation of IT. Canonical expects to see a future dominance of the open source model in cloud computing, which will solve the major adoption concerns for users.

At this moment in time, IT is in transition from 'as a product' to 'as a service' for common workloads and activities. Unsurprisingly the cloud currently lacks standards and there remain several unresolved legal, management and compliance questions. This is on top of the normal concerns raised by the outsourcing of a common activity including: whether the activity is suitable for outsourcing, whether second-sourcing options exist and whether there is easy switching between providers.

To support our users in this time of transition, Canonical will be launching Ubuntu Enterprise Cloud by including Eucalyptus in the Ubuntu distribution. This will provide our users with an open source system that enables them to build their own private clouds, which match the current emerging standard of the Amazon EC2 API.

Canonical views this system as a stepping stone on the road to a future marketplace of external cloud providers. Hence, we are also providing Ubuntu for use with leading cloud providers and promoting infrastructure portability between clouds.