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CLOUD COMPUTING FOR BUSINESS BENEFITS

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ABSTRACT

Cloud computing has become one of the most important strategic initiatives of the CTOs in companies, big-medium-small. The whole purpose of moving the applications to cloud is to free up data centre space, lower electricity and manpower costs and at the same time achieve scalability and extendibility. This paper examines the approaches and benefits of such a transition and the potential benefits

Keywords: Cloud Computing, Virtualization, Orchestration, Business Benefits

Cloud Computing Paradigm

Cloud Computing, has the potential to transform the IT industry by enabling software as a service without involving large investments on data centre and in software licenses. It is shaping the world and bringing in a new era the way IT hardware is designed and purchased. Software engineers, managers with game changing ideas for a new Internet based product does not require large investment outlays in data centre resources to implement their service or the manpower to operate it. Cloud Computing refers to (a) the applications delivered as services over the Internet (b) the hardware and systems software in the datacenters that provide those services (c) the operational maintenance of such a service with a defined QoS (quality of service).

Public Cloud: A good example of public cloud where anyone can host his/her software application on the internet through a service provider like Amazon Web Services (AWS) or Microsoft Azure by paying a small fee. Public Cloud, is therefore a data centre, networking and application maintenance service made available to general public, across nationalities, across countries, in a pay-as-you-go model. It is also known as Utility Computing.

Private Cloud: When an enterprise set up its own data centre with cloud computing technologies (eg, Docker, Virtualization etc.) and deploy applications it is called a Private Cloud. By definition, it means that it is not available to general public and restricted within a specific group of users.

Hybrid Cloud: When a private cloud resides alongside the public cloud. Eg: Google Mail service (eg @xyz.org - public cloud) and PeopleSoft Infrastructure on Private Cloud.

From a hardware point of view, three aspects are new in Cloud Computing

1. The scalability & extensibility of computing resources available on demand, thereby eliminating the need for Cloud Computing users to plan far ahead for provisioning.

2. The riddance of an up-front financial and manpower commitment by Cloud users, thereby allowing organizations to start at any level of computing power (small, medium, large) and change the extent of hardware resources deployed only when there is a change in their needs.

3. The ability to pay for use of computing resources on a micro-term basis as needed (e.g., computing power by the hour or storage by the day) and release them as needed, thereby rewarding conservation by letting machines and storage go when they are no longer useful.

4. Lower Cost with cloud computing, dedicated Disaster Recovery sites will become a thing of the past, and with it software licensing (often processor core based) will undergo a significant changes (since, for instance, an software licensed for a processor core might be using a fraction of a processor core hardware and therefore the licensing norms becomes obsolete). With the advent of NoSQL databases (popular in cloud computing environment) like Cassandra etc., relational databases might be thrown out of the data center in future, resulting into further costs savings.

Overall, Cloud computing paradigms have the ability to reduce costs by factors of 3-5, while higher utilization of the computing & storage provides enough profits for the companies offering cloud services. Interestingly, IBM Mainframe computers did allow users to use time-based use of the computer and the department used to be billed by the usage. Logical Partitioning (of Proc, RAM, I/O, and Storage) allowed this to be done in the 60s!

Popular Public Cloud Providers

Amazon Web Services

Amazon Web Services (AWS) is the undisputed market leader in cloud computing. According to Amazon, AWS generated $2.9 billion in revenue for the quarter ending June 30, 2016, up from $1.8 billion during the same quarter last year. Yearly estimate: $20bn. Amazon provides a wide range of IaaS, Paas, SaaS and other services which has made it quite a popular cloud hosting services. Recent edge services e.g. for IoT has created a larger potential for adoption of Amazon Cloud.

Microsoft Azure

Azure revenues are not reported separately, but clubbed within an overall financial reporting. For example, in Q4 2016 report, the Microsoft said that its "Intelligent Cloud" revenue increased 5 percent to reach $6.7 billion. Interestingly, Microsoft is using its Azure Cloud services to accelerate its revenues for its software services (such as Microsoft Dynamics range of product suite, Office 360 etc.) and defining new licensing models purely on the basis of monthly/quarterly/yearly rentals. Therefore Microsoft's approach is a combined services (software + cloud hosting) and creating augmented revenue streams in both. Azure is also providing advanced algorithmic services for Machine Learning, Artificial Intelligence and IoT edge services and security with its partnerships with Citrix and other companies.

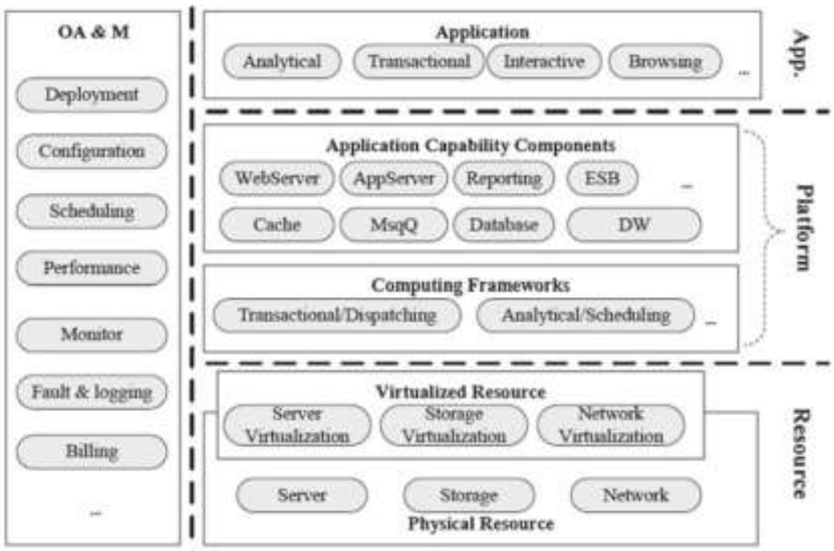
IBM Cloud

IBM, the original inventor of the systems that allow partitioning of hardware at an operating systems level, were a bit slow in adopting cloud services as a revenue stream. IBM's cloud business has been growing on the strength of the overall industry and currently estimated at an annual run rate of $6.7bn. IBM's most visible cloud service is its Bluemix PaaS, IBM Watson Artificial Intelligence offering which are primarily at software development teams.

Google Cloud Platform

Like Microsoft, Google doesn't provide separate revenue numbers for its cloud services. However, Google Business services (for office, document, mail, messaging etc.) had been there since several years now and was one of the first of its kind for enterprise customers. Like Amazon and Microsoft, Google offers a very full range of IaaS and PaaS services that span compute, storage, networking, big data, machine learning, developer tools and security. Some of its popular and well-known cloud offerings include App Engine, Compute Engine, Containers, Storage and Big Query among others.

Architecture of a Cloud Computing Environment



From Physical Servers to Logical Servers (a.k.a Virtual Machines)

Dedicated / Physical Server

A physical server, is a physical computer with processor, RAM, I/O. Storage (DAS/NAS/SAN) which runs an operating system like Linux, Windows, Unix (eg AIX, Solaris, HP-Unix etc.). Most of the physical servers have two or more physical CPUs with multiple cores on each.

Need for Virtual Machines

The administrator, often referred to as System Administrator uses a software (like VMWare, Xen, Microsoft Virtual Server etc.) to "slice & dice" a physical server into several virtual servers (each having compute, storage, I/O). These virtual servers are also known as instances, containers, emulations. Through virtualization are sometimes called virtual private servers, but they are also known as guests, instances, containers or emulations.

There are multiple benefits of Virtualizing or Logical Partitioning of a physical server:

(a) The physical server might be too big a resource pool for the application running.

(b) Applications run better if dedicated hardware resources are available

(c) Vulnerabilities related to the operating system, might result into the physical server getting compromised and therefore a masking through a virtual machine provides an inherent deterrent for a hacker

Limitation of Physics

Within a hardware, the processors, RAM, I/O and Storage are connected to a "housing" for the components. Since 1960s, operating systems have been smart enough to slice and dice the available hardware resources within this housing. Even within a processor, technologies were available to slice

& dice it, allowing logical partitioning. From the server management console the administrator would be able to have a complete view of all the partitions and can allocate hardware resources to applications depending on the computer load.

Interestingly, two or more separate hardware backpanes or Housing cannot be combined together through this method for a virtual view of all available resources residing in more than one physical server, without creating another layer of abstraction; often called as Hypervisor, and connecting both (or more) the physical hardware's to it.

Hypervisor

Virtualization, by definition, is uses a single hardware to supply the compute resources needed by several "virtual" machines, wherein each one of these is setup and configured as if it were running on its own physical hardware. The virtual machines are each allotted a slice of the physical server's resources and use those physical resources exclusively. A virtual machine (alternatively known as virtual server) is created with a help of a system software that helps the physical server to be sliced & diced in multiple virtual servers. This process is called server virtualization, and the software that allows this to be carried out is called a Hypervisor. Popular Hypervisors are VMWare, Xen, Microsoft Hyper-V, Oracle VB etc.

At an OS level, within a physical server, there are available tools (including that of the native operating systems) where virtual machines can be created within the single piece of hardware. However, the limitations one enters into when two or more physical hardware resources are combined together. A modern Hypervisors, typically enables multiple physical servers (connected over a network) to be treated as one, and then virtual machines created. This is the fundamental element of cloud computing, which enables the CIO to drive server consolidation, clustering, etc.

Most Hypervisors use optimized binary translations or a CPU supported solution for complete end to end virtualization.

Strategies for Virtualization: Containers vs Virtual Machines

Cloud containers virtualizes a single application - e.g., you have a Watson AI container or an Authentication container (for security) and that's all it does, provide a virtual instance of that application. Cloud containers typically use Linux-based servers, for its ability to run Unix open source. In addition to separation mechanisms, the kernel often provides features to limit the impact of one container's activities on other containers. A computer program running on an ordinary person's computer's operating system can see all resources (connected devices, files and folders, network shares, compute power etc.) of that computer. Such instances, called containers, partitions, may look like real computers from the point of view of programs running in them. This isolation & separation means that if anything goes wrong in that single container it only affects that individual container and not the whole VM or whole server. Containers promise a streamlined, easy-to-deploy alternative to virtual machines. Docker, Rkt (pronounced as rocket), Solaris Container are some of the most popular containers.

Cloud containers are portable - once the container has been created, it can be implemented to different servers very easily. From a software lifecycle management perspective this is a great advantage, since containers can be copied to create development, test, and integration and live environments rather quickly without much of resources being used. From a software testing audit perspective this has an inherent advantage, because it ensures that the underlying OS is not causing a difference in the test outputs. One disadvantage of containers is the virtual environment gets splitted into lots of smaller chunks and therefore this creates an overhead on the compute power available.

Problems of container administration management are a common issue, even with advanced containers like Docker. Whereas virtual machines are generally considered easy to manage, since those fewer VMs compared to containers.

Therefore while VMs provide a greater flexibility of running different services / softwares, traditionally container strategies are more adopted where similar services, same softwares are used by multiple clients. Typical example of a successful container based strategies are often seen in Web hosting cloud services, where a container would come with a http server (eg. Apache webserver), an application server (eg JBoss), a content management server (eg OpenCMS) and a database (eg mySQL).

Cloud Orchestration, Automation and DevOps

Cloud automation describes a task or function carried out without human intervention, whereas Cloud orchestration refers to the coordination of such automated tasks, ultimately referring to a work process.Automation tools occur in a particular order within a pre-defined workflow and this is precisely where cloud orchestration is key. Cloud Foundry, Kubernetes are popular tools for cloud orchestration

How does orchestration relate to DevOps? Essentially, well-orchestrated IT processes enable and empower continuous integration and continuous delivery, uniting teams in the creation of a set of templates that meet developer requirements. Such templates are in many ways living documents that embody DevOps philosophy. Automation is a technical task, orchestration is an IT workflow composed of tasks, and DevOps is a philosophy that empowers and is powered by sophisticated, orchestrated processes. As is already obvious, orchestration has the potential to lower overall IT costs, free up engineering time for new projects, improve delivery times, and reduce friction between system and development teams.

Conclusion

Cloud computing is here to stay and transform the data centre landscape completely in a decade's time. However, the issues with regulatory compliance, privacy, security and maturity of technologies involved are going to be of paramount importance.

As organizations seek to improve the IT costs, the traditional IT department is going to be fragmented in Cloud Service providers (with companies like Amazon, Microsoft, Rackspace, IBM etc.), Network providers (most likely be the local telecom service providers such as Reliance, Tata Technologies, AT&T etc.), Application providers (applications available as a SaaS offering from companies like SAP, Microsoft, Google etc.), Analytics advisors (KPO organizations like 24x7, MuSigma etc.), and maintenance service & system integrators (like TCS, Infosys etc.), so as to enable the CIO/CTO office to stay focused on strategy and management of the vendors. Special applications development work perceived to be of strategic differentiator would probably continue in-house. However, the biggest spend head "Data Centre" would move to the cloud.

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