

Review on Cloud computing

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Abstract - Cloud computing has come of age since Amazon's rollout of the first of its kind of cloud services in 2006. It is particularly relevant to Hong Kong because of the tremendous amounts of data that are being processed here daily in various sectors. The "cloud" is a set of different types of hardware and software that work collectively to deliver many aspects of computing to the end-user as an online service. "Cloud" is a collective term for a large number of developments and possibilities. It is not an invention, but more of a "practical innovation", combining several earlier inventions into something new and compelling. Much like the iPod is comprised of several existing concepts and technologies, cloud computing merges several already available technologies: high bandwidth networks, virtualization, Web 2.0 interactivity, time sharing, and browser interfaces. Cloud Computing is a popular phrase that is shorthand for applications that were developed to be rich Internet applications that run on the Internet. Cloud computing can help businesses transform their existing server infrastructures into dynamic environments, expanding and reducing server capacity depending on their requirements. A cloud computing platform dynamically provisions, configures, reconfigures, and deprovisions servers as needed. Servers in the cloud can be physical machines or virtual machines.

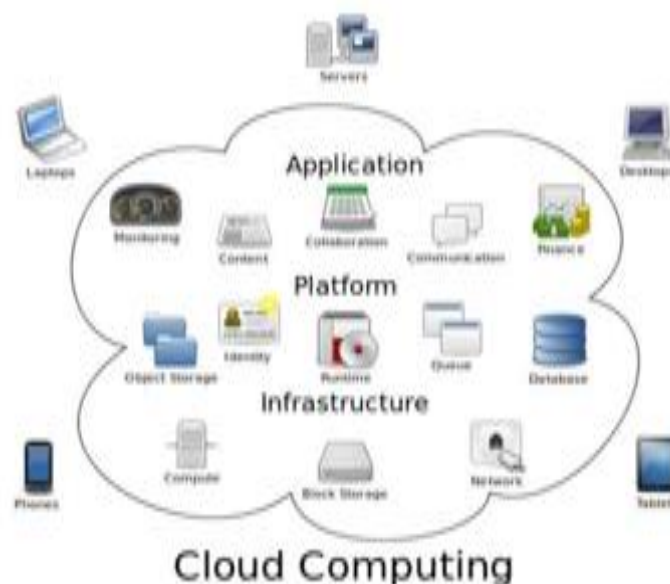
keywords - Cloud, IaaS, SaaS, PaaS, DTaaS, BaaS, EaaS

I. INTRODUCTION

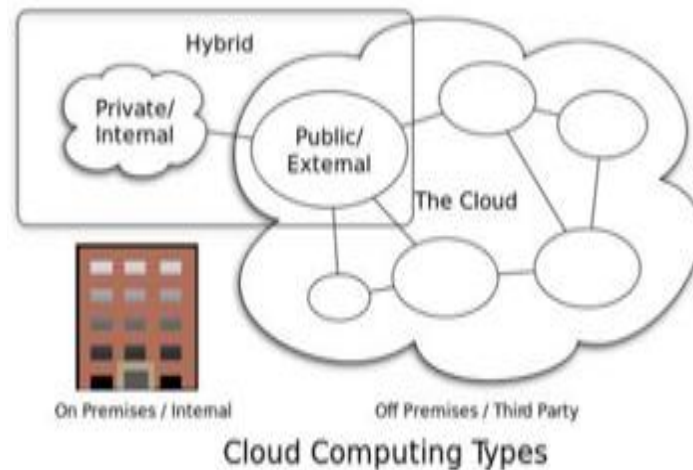
Cloud computing is taking services ("cloud services") and moving them outside an organization's firewall. Applications, storage and other services are accessed via the Web. The services are delivered and used over the Internet and are paid for by the cloud customer on an as-needed or pay-per-use business model.

Cloud Computing is the use of hardware and software to deliver a service over a network (typically the Internet). With cloud computing, users can access files and use applications from any device that can access the Internet. An example of a Cloud Computing provider is Google's Gmail. Gmail users can access files and applications hosted by Google via the internet from any device.

In the simplest terms, cloud computing means storing and accessing data and programs over the Internet instead of your computer's hard drive.



II. TYPES OF CLOUD COMPUTING



A. Public cloud:

A public cloud is one based on the standard cloud computing model, in which a service provider makes resources, such as applications and storage, available to the general public over the Internet. Public cloud services may be free or offered on a pay-per-usage model.

B. Private cloud:

A private cloud is designed to offer the same features and benefits of public cloud systems, but removes a number of objections to the cloud computing model including control over enterprise and customer data, worries about security, and issues connected to regulatory compliance.

C. Hybrid cloud:

A hybrid cloud is a composition of at least one private cloud and at least one public cloud. A hybrid cloud is typically offered in one of two ways: a vendor has a private cloud and forms a partnership with a public cloud provider, or a public cloud provider forms a partnership with a vendor that provides private cloud platforms

D. Community Clouds:

The community cloud is the cloud infrastructure that is provisioned for exclusive use by a specific community of consumers from organizations that have shared concerns (eg. mission security requirements, policy, and compliance considerations). It may be owned, managed, and operated by one or more of the organizations in the community, a third party or some combination of them, and it may exist on or off premises. In this, a private cloud is shared between several organizations.

III. CHARACTERISTICS OF CLOUD COMPUTING

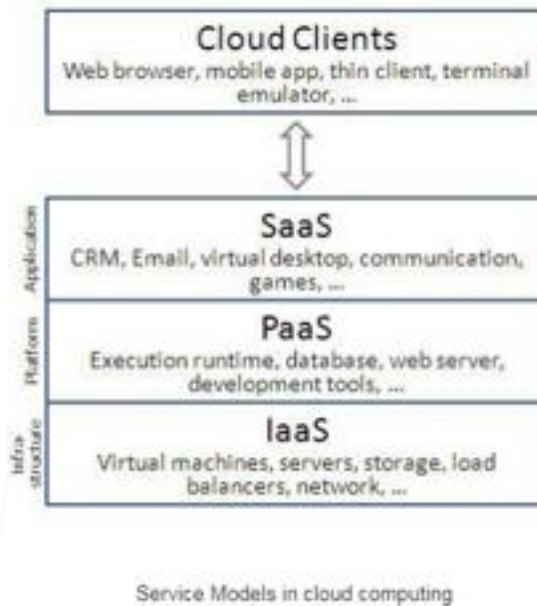
- **On-demand:** Resources should be always available when you need them, and you have control over turning them on or off to ensure there's no lack of resource or loss of information as well as wastage.
- **Scalable:** You should be able to increase or decrease the resource when necessary. The cloud providers should have sufficient capacity to meet customer's needs.
- **Multi-tenant:** Sometimes we are sharing the same resource e.g. hardware with another one, but this is transparent to the customer. Cloud provider is responsible for the security aspect, ensuring that one tenant won't be able to access other's data.
- **Self-service computation and storage resource:** Related processes including billing, resource provisioning, and deployment should be self-service and automated, involving much less manual processing.
- **Reliability:** Cloud provider should be able to provide customer reliability service, committing to uptimes of their service.
- **Utility-based subscription:** You will pay the cloud provider as a utility based subscription, just like paying your electricity bill – without any upfront investment.

IV. CLOUD COMPUTING ARCHITECTURE

The Cloud Computing Architecture (CCA) of a cloud solution is the structure of the system, which comprises of on-premise and cloud resources, services, middleware, and software components, their geo-location, their externally visible properties and the relationships between them. Cloud architecture typically involves multiple cloud components communicating with each other over a loose coupling mechanism, such as a messaging queue. This is depicted in the following Fig., which is given as follows:



V. SERVICE MODELS IN CLOUD COMPUTING



Infrastructure as a service (IaaS)

IaaS providers offer computers, more often virtual machines and other resources as service. It provides the infrastructure / storage required to host the services ourselves i.e. makes us the system administrator and manage hardware/storage, network and computing resources. The different instances of IaaS are as follows:

Network as a Service (NaaS): It is a category of cloud services where the capability provided to the cloud service user is to use network/transport connecting services. NaaS involves optimization of resource allocation by considering network and computing resources as a whole

- **Storage as a Service (STaaS):** STaaS, an instance of IaaS, provides storage infrastructure on a subscription basis to users who want a low-cost and convenient way to store data, synchronize data across multiple devices, manage off-site backups, mitigate risks of disaster recovery, and preserve records for the long-term.
- **Database as a Service (DBaaS):** This is also related to IaaS and provides users with seamless mechanisms to create, store, and access databases at a host site on demand.
- **Backend as a Service (BaaS):** It is a type of IaaS, that provides web and mobile app developers a way to connect their applications to backend cloud storage with added services such as user management, push notifications, social network services integration using custom software development kits and application programming interfaces.
- **Desktop as a Service (DTaaS):** It is an instance of IaaS that provides ability to the end users to use desktop virtualization without buying and managing their own infrastructure.

Platform as a Service (PaaS): PaaS provides the users the ability to develop and deploy an application on the development platform provided by the service provider. Cloud providers deliver a computing platform including operating system, programming language execution environment, database, and web server. For example- Google AppEngine, Windows Azure Compute etc

Software as a Service (SaaS): SaaS provides users to access large variety of applications over internet that are hosted on service provider’s infrastructure. Thus, the end users are exempted from managing or controlling an application the development platform, and the underlying infrastructure. SaaS changes the way the software is delivered to the customers.

- **Testing as a Service (TaaS):** This provides users with software testing capabilities such as generation of test data, generation of test cases, execution of test cases and test result evaluation on a pay-per-use basis.
- **API as a Service (APIaaS):** This allows users to explore functionality of Web services such as Google Maps, Payroll processing, and credit card processing services etc.
- **Email as a Service (EaaS):** This provides users with an integrated system of emailing, office automation, records management, migration, and integration services with archiving, spam blocking, malware protection, and compliance features.

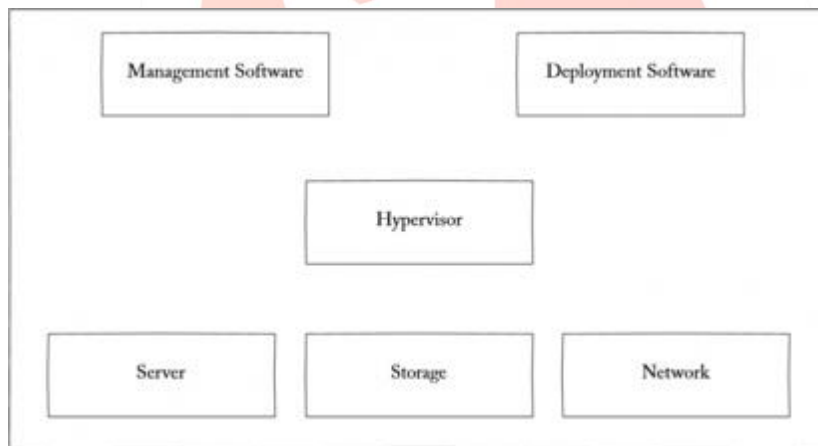
Other Cloud Service Models:

- **Communication as a Service (CaaS):** CaaS has evolved in the same lines as SaaS. CaaS is an outsourced enterprise communication solution that can be leased from a single vendor. The CaaS vendor is responsible for all hardware and software management and offers guaranteed Quality of Service (QoS). It allows businesses to selectively deploy communication devices and modes on a pay-as-you-go, as-needed basis. This approach eliminates large capital investments.
- **Data as a Service (DaaS):** DaaS provides data on demand to a diverse set of users, systems or application. The data may include text, images, sounds, and videos. Data encryption and operating system authentication are commonly provided for security.
- **Security as a Service (SECaaS):** It is an ability given to the end user to access the security service provided by the service provider on a pay-per-use basis. It is a new approach to security in which cloud security is moved into the cloud itself whereby cloud service users will be protected from within the cloud using a unified approach to threats.
- **Identity as a Service (IDaaS):** It is an ability given to the end users; typically an organization or enterprise; to access the authentication infrastructure that is built, hosted, managed and provided by the third party service provider.

VI. CLOUD INFRASTRUCTURE

It refers to the software along with the hardware components such as storage drive, hardware, servers, virtual software, other cloud management software, and other networking devices; all work together to support the computing requirement of the cloud computing model. Moreover, the cloud technology holds a software abstraction layer that virtualizes the cloud resource & presents them to users locally.

Cloud Infrastructure Management Interface (CIMI) is an open standard API that is used to manage the cloud infrastructure. It enables its users to handle all the cloud infrastructure easily by providing a means to interact with the provider & their consumer or developer.



The hypervisor can be defined as the firmware (a permanent set of instruction or code programmed into the read-only memory & is a low-level program) that acts as a manager for the virtual machine. It is also called Virtual Machine Monitor (VMM) which creates & runs the virtual machine. It provides the guest OS with a virtual operating platform to manages the execution of other applications. There are two types of the hypervisor.

These are:

- Native Hypervisor
- Hosted Hypervisor

In cloud technology, virtualized resources are kept & maintained by the service provider or the department of IT; these resources comprise of servers, memory, network switches, firewalls, load-balancers & storage. In the cloud computing architecture, the cloud infrastructure referred to the back-end components of the cloud.

Management Software firstly helps to configure the infrastructure then maintaining it. The Deployment software, on the other hand, is used to deploy & combine all applications on the cloud.

Network, as we all know is the key part of cloud technology allowing users to connect to the cloud via the internet. Multiple copies of data are kept stored in the cloud. This is because, if any storage resource fails - then the data can be extracted from another one. So, storage is another essential component of cloud infrastructure.

Server helps to handle & compute all cloud resources & offer services like allocation, de-allocation, sharing and monitoring the cloud resources and in some cases used to provide security.

VII. APPLICATIONS OF CLOUD COMPUTING

Online File storage

MediaFire, megaupload, hotfile, 4Shared, rapidshare, yourfilehost are such examples which are used to host files including documents, images, presentation, videos, etc. The interface is easy to use, and users can upload and download files from these sites. Here users can utilize 200GB of storage space and a file size of 2GB. The charge for the premium version of these cloud storage application is an average of \$9.

Photo editing software

Picnik, Pixlr, etc. are popular free online photo editing software. This online software has features such as cropping of the image, resizing, rotation based on degrees, special effects, addition and editing features are also included in a GUI (Graphical User Interface) format. Some of them offer paint tools and other adjustment features. The brightness and contrast can also be editable, and users can layer the images. In the case of Pixlr, though it has various high-level, complex features, still it's easy to use.

Digital video software

Hulu is a free application for videos that are found online for free. Cloud users can download popular movies, television shows, and documentaries and view them on their web-browser. Hulu is a joint venture of three firms viz. - Fox Entertainment Group, NBC Universal and ABC Inc. There are other popular video sites like - WatchMoviesOnline, the most famous YouTube, Google video, etc.

Twitter-related applications

One example is bit.ly which converts long URL into a short small-sized unique URL. When a user clicks that small unique URL, it redirects the user to that real website. Sometimes it seems harmful as hackers can put malicious attachments or programs with it which can further affect the user. Ly made a partnership with Twitter, to allow twitter users to use shortened URLs. There is also another site name Twitpic which allows the user to upload pictures to be linked from twitter. It uses twitters login, creates shortened URLs that can be invoked from twitters microblogging.

Creating image-album

Some of the examples are flickr, photobucket, webshots, imagebam and ziddu that allows users to host images on the web. These sites are a part of the cloud that allows users to organize images into albums and create slideshows for free.

Web application for antivirus

One example is Cloud Antivirus, this application on the cloud is provided by Panda Security - a Spanish company which provides functionality to keep the virus away from a clean system and also detects and fix a system infested with malware or other forms of computer viruses. It has been rated as the best free antivirus application by PC World. This also includes the feature to download it into the systems, and the checking of malware is done by sending the information of the file to the data-center of the cloud.

Presentation software

Sliderocket is an online free application to create a presentation. It allows importing of Microsoft's PowerPoint presentations. Since it is a web-based cloud application, the presentations can be accessed from anywhere within the globe. But the free version doesn't allow cloud users to edit presentations offline.

Word processing application

Writeboard is another online word processing and document editing application. It has a unique feature that multiple users can access the same document using this application, edit that document and save the document after editing, but the document will have different versions. But it doesn't allow importing the word files.

Finding a way on the map

Another area where cloud applications became worth popular was finding directions and locations on the web. The leading sites are mapquest, Google Maps, and Yahoo Maps. They are the most useful free online application that helped millions of users in various ways by showing direction and paths and helped people get to their destinations over the last decade.

E-commerce software

Cloud based e-application allows users and e-business to respond quickly to market opportunities & challenges the modern e-commerce is facing. It became for business tycoons to focus on the usage of cloud computing without considering the time and effort involved in implementing a reliable solution. Whatever cloud computing solution they select, the free online application will need to access customer data, product data, fulfillment systems and other operational systems to support e-commerce. Cloud-based e-commerce application provides IT firms, and business leaders evaluate new opportunities without a huge amount of upfront investment.

Miscellaneous applications

One of the 1st utilization of free SaaS applications is to check for the status of packages & items. Applications such as UPS, FedEx, US Postal Service, etc. provide free tracking of packages online. Another application name - XE provides services online from foreign exchange tools.

So every users and reader must need to know the benefits that cloud computing gives by providing free applications for users. This can reduce cost OS storage and buy paid software to do different tasks.

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