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# Cloud Computing:Service models,Types,Database and ssues

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***Abstract- The evolution of cloud computing over the past few years is potentially one of the major advances in the history of computing. From a user's perspective, cloud computing involves performing a task using someone else's computers and possibly software. Cloud has given a new meaning to distributed, and off-premises computing. Cloud computing is an architectural model that leverages standardization and consolidation to allow effective and safe sharing of pooled resources. cloud computing refers to the use of scalable, real-time ,Internet-based IT services and resources, incorporating beyond SaaS many key technology trends of the 2000s. Although, Cloud offers great benefits, it also introduces a myriad of security threats to the information and data which is now being ported from on-premises to off-premises. This paper discusses the various service models such as IaaS, PaaS, SaaS. Some products offer Internet-based services—such as storage, middleware, collaboration, and database capabilities—directly to users such as Iaas,Paas,Saas.Most cloud computing systems in operation today are proprietary, rely upon infrastructure that is invisible to the research community, or are not explicitly designed to be instrumented and modified by systems researchers. This paper also explores the types of cloud computing environment. Paper also discuss the cloud database including deployment model, characteristics.Also it identifies some technological and legal issues in cloud computing.***

***Keywords- Service models; cloud computing types; cloud database; cloud computing issues; Deployment model.***

## I. INTRODUCTION

Cloud computing is the use of computing resources (hardware and software) that are delivered as a service over a network (typically the Internet). The name comes from the use of a cloud-shaped symbol as an abstraction for the complex infrastructure it contains in system diagrams. Cloud computing entrusts remote services with a user's data, software and computation. Cloud computing has changed the whole picture that distributed computing used to present e.g. Grid computing, server client computing. [1]Cloud storage enables users to remotely store their data and enjoy the on-demand high quality cloud applications without the burden of local hardware and software management. Cloud computing enables hardware and software to be delivered as services, where the term service is used to reflect the fact that they are provided on demand and are paid on a usage basis – the more you use the more you pay. Draw an analogy with a restaurant[4]. This provides a food and drinks service. If we would like to eat at a restaurant, we do not buy it, just use it as we require. The more we eat the more we pay.

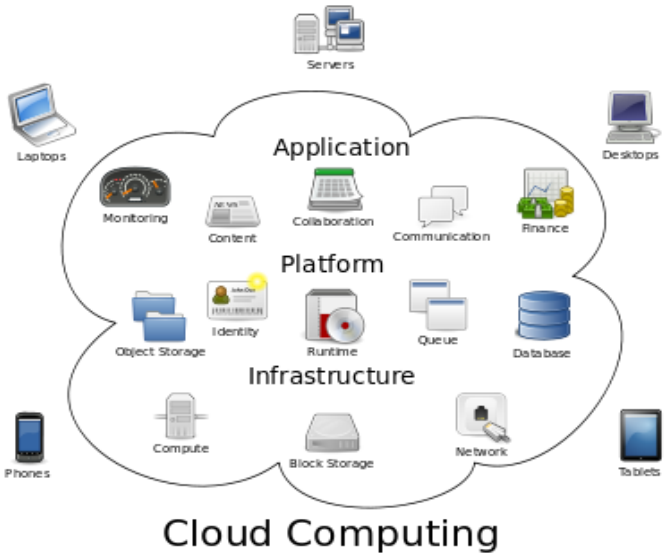


**Figure 1 - Structure of cloud computing**

 

Cloud Computing provides computing facilities in the same way as restaurants provide food, when we need computing facilities; we use them from the cloud. The more we use the more we pay. When we stop using them we stop paying. users are at the mercy of their cloud service providers for the availability and integrity of their data. Recent downtime of Amazon's S3 is such an example [2].General structure of cloud computing shown below [7].

Advantages of cloud computing:-

1. It dramatically lower the cost of entry for smaller firms trying to benefit from compute intensive business analytics, cloud computing makes dynamic provisioning of resources possible.
2. It can provide an almost immediate access to hardware resources, with no upfront capital investments from users, leading to a faster time to market in many business.
3.Cloud computing can lower IT barrier to innovation, as can be witnessed from the many promising startups,from the online application such as facebook to more focus application like MINT(for managing finance).
4. Cloud computing makes it easier for enterprise to scale their services-which are increasingly reliant on accurate information according to client demand.

## II. SERVICE MODELS

Cloud computing providers offer their services according to three fundamental models[5]: infrastructure as a service (IaaS), platform as a service (PaaS), and software as a service (SaaS) where IaaS is the most basic and each higher model abstracts from the details of the lower models. In 2012 network as a service (Naas) and communication as a service (CaaS) were officially included by ITU (International Telecommunication Union) as part of the basic cloud computing models, recognized service categories of a telecommunication-centric cloud ecosystem.

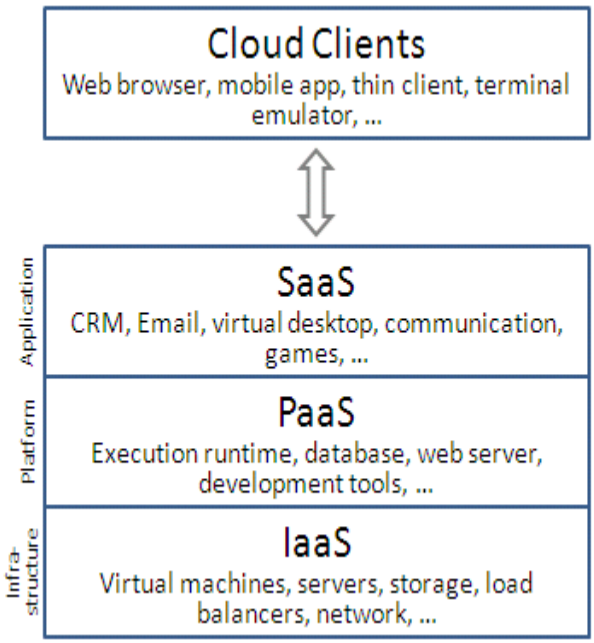


**Figure 2 - Service models**

- *Infrastructure as a service (IaaS)*

This covers a wide range of features, from individual servers, to private networks, disk drives, various long term storage devices as well as email servers, domain name servers as well as messaging systems[5]. In the most basic cloud-service model, providers of IaaS offer computers - physical or (more often) virtual machines - and other resources. IaaS clouds often offer additional resources such as images in a virtual-machine image-library, raw (block) and file-based storage, firewalls, load balancers, IP addresses, virtual local area networks (VLANs), and software bundles. IaaS-cloud providers supply these resources on-demand from their large pools installed in data centres. For wide area connectivity, customers can use either the Internet or carrier clouds (dedicated virtual private networks) [10].To deploy their applications, cloud users install operating-system images and their application software on the cloud infrastructure. In this model, the cloud user patches and maintains the operating systems and the application software. Cloud providers typically bill IaaS services on a utility computing basis: cost reflects the amount of resources allocated and consumed.

Examples of IaaS providers include Amazon CloudFormation, Amazon EC2.

- *Platform as a service (PaaS)*

"PaaS is intended to enable developers to build their own applications on top of the platform. As a result, it tends to be more extensible than SaaS, at the expense of customer-ready features. This trade-off extends to security features and capabilities, where the build-in capabilities are less complete, but there is more flexibility to layer on additional security."

In the PaaS model, cloud providers deliver a computing platform typically including operating system, programming language execution environment, database, and web server. Used by software development companies to run their software products. Application developers can develop and run their software solutions on a cloud platform without the cost and complexity of buying and managing the underlying hardware and software layers.

Examples of PaaS include: AWS Elastic Beanstalk, Cloud Foundry, Heroku, Force.com, OrangeScape.

 

- *Software as a service (SaaS)*

In the SaaS model, cloud providers install and operate application software in the cloud and cloud users access the software from cloud clients. The cloud users do not manage the cloud infrastructure and platform on which the application is running. This eliminates the need to install and run the application on the cloud user's own computers simplifying maintenance and support.

This is typically end user applications delivered on demand over a network on a pay per use basis. The software requires no client installation, just a browser and network connectivity. An example of SaaS is MicrosoftOffice365. Until its launch, if a user required say Word, they would have to purchase it, install it, backup files etc. With Office365 Word can be acquired for a small monthly fee, with no client installation, the files are automatically backed up, software upgrades are automatically received and the software can be accessed from anywhere. Decide you do not require Word anymore – stop paying the monthly fee. It is that simple [13].Examples of SaaS include: google apps, MicrosoftOffice365, Onlive,GT Nexus,Marketo, and TradeCard.

- *Network as a service (NaaS)*

A category of cloud services where the capability provided to the cloud service user is to use network/transport connectivity services and/or inter-cloud network connectivity services. NaaS involves the optimization of resource allocations by considering network and computing resources as a unified whole. Traditional NaaS services include flexible and extended VPN, and bandwidth on demand. NaaS concept materialization also includes the provision of a virtual network service by the owners of the network infrastructure to a third party (VNP – VNO).

## III. CLOUD COMPUTING TYPES

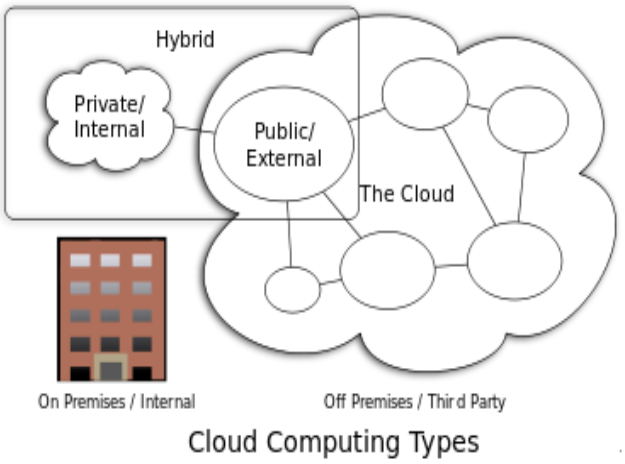


**Figure 3 – Types of Cloud Computing**

- *Public cloud*

The cloud infrastructure is made available to the general public or a large industry group and is owned by an organization selling cloud services[8]. Generally, public cloud service providers like Amazon AWS, Microsoft and Google own and operate the infrastructure and offer access only via Internet (direct connectivity is not offered).

- *Hybrid cloud*

The cloud infrastructure is a composition of two or more clouds (private, community, or public) that remain unique entities but are bound together by standardized or proprietary technology that enables data and application portability(e.g. cloud bursting for load balancing between clouds).

By utilizing "hybrid cloud" architecture, companies and individuals are able to obtain degrees of fault tolerance combined with locally immediate usability without dependency on internet connectivity. Hybrid cloud architecture requires both on-premises resources and off-site (remote) server-based cloud infrastructure.

Hybrid clouds lack the flexibility, security and certainty of in-house applications. Hybrid cloud provides the flexibility of in house applications with the fault tolerance and scalability of cloud based services.

- *Private cloud*

Private cloud is cloud infrastructure operated solely for a single organization[11], It may be managed by the organization or a third party and may exist on premise or off premise. Undertaking a private cloud project requires a significant level and degree of engagement to virtualize the business environment, and it will require the organization to re-evaluate decisions about existing resources. When it is done right, it can have a positive impact on a business, but every one of the steps in the project raises security issues that must be addressed in order to avoid serious vulnerabilities.

They have attracted criticism because users "still have to buy, build, and manage them" and thus do not benefit from less hands-on management, essentially "[lacking] the economic model that makes cloud computing such an intriguing concept".

- *Community cloud*

The cloud infrastructure is shared by several organizations and supports a specific community that has shared concerns (e.g., mission, security requirements, policy, and compliance considerations) [1]. It may be managed by the organizations

 

or a third party and may exist on premise or off premise[3]. The costs are spread over fewer users than a public cloud (but more than a private cloud), so only some of the cost savings potential of cloud computing are realized.

## IV. CLOUD DATABASE

Databases are repositories for information with links within the information that help make the data searchable[10]. A cloud database is a database that typically runs on a cloud computing platform, such as Amazon EC2, GoGrid and Rackspace. There are two common deployment models: users can run databases on the cloud independently, using a virtual machine image, or they can purchase access to a database service, maintained by a cloud database provider. Of the databases available on the cloud, some are SQL-based and some use a NoSQL data model. Distributed databases like Amazon's SimpleDB ,spread information among physically dispersed hardwae.But to the client, the information seems to be located at one place.

The advantages of such a database include the following:

Improved Availability: If there is a fault in one database system, it will only affect one fragment of the information, not the entire database.

Improved performance: Data is located near the site with the greatest demand and the database systems are parallelized, which allows the load to be balanced among the servers.

Price: It is less expensive to create a network of smaller computers with the power of one large one.

Flexibility: System can be change and modified without harm to the entire database.

There are disadvantages including:

Complexity: Database administrators have extra work to maintain the system.

Labour costs: With added complexity comes the need for more workers on the payroll.

Security: Database fragments must be secured and so must the sites housing the fragments.

Integrity: It may be difficult to maintain the integrity of the database if it is too complex or changes too quickly.

Standards: There are currently no standards to convert a centralized database into a cloud solution.

Deployment model:

There are two primary methods to run a database on the cloud:

Virtual machine Image - cloud platforms allow users to purchase virtual machine instances for a limited time[9]. It is possible to run a database on these virtual machines. Users can either upload their own machine image with a database installed on it, or use ready-made machine images that already include an optimized installation of a database. For example, Oracle provides a ready-made machine image with an installation of Oracle Database 11g Enterprise Edition on Amazon EC2.

Database as a service - some cloud platforms offer options for using a database as a service, without physically launching a virtual machine instance for the database[12]. In this configuration, application owners do not have to install and maintain the database on their own. Instead, the database service provider takes responsibility for installing and maintaining the database, and application owners pay according to their usage. For example, Amazon Web Services provides two database services as part of its cloud offering, SimpleDB which is a NoSQL key-value store, and Amazon Relational Database Service which is an SQL-based database service with a MySQL interface.

*Architecture and common characteristics*

- Most database services offer web-based consoles, which the end user can use to provision and configure database instances. For example, the Amazon Web Services web console enables users to launch database instances, create snapshots (similar to backups) of databases, and monitor database statistics.
- Database services consist of a database manager component, which controls the underlying database instances using a service API. The service API is exposed to the end user, and permits users to perform maintenance and scaling operations on their database instances. For example, the Amazon Relational Database Service's service API enables creating a database instance, modifying the resources available to a database instance, deleting a database instance, creating a snapshot (similar to a backup) of a database, and restoring a database from a snapshot.
- Database services make the underlying software stack transparent to the user - the stack typically includes the operating system, the database and third-party software used by the database. The service provider is responsible for installing, patching and updating the underlying software stack.
- Database services take care of scalability and high availability of the database. Scalability features differ between vendors - some offer auto-scaling, others enable the user to scale up using an API, but do not scale automatically. There is typically a commitment for a certain level of high availability (e.g. 99.9% or 99.99%).

Data model-

Relational Vs. Non-relational database:

- SQL database, such as Oracle Database, Microsoft SQL Server, and MySQL, are one type of database which can be run on the cloud (either as a Virtual Machine Image or as a service, depending on the vendor). SQL databases are difficult to scale, meaning they are not natively suited to a cloud environment, although cloud database services based on SQL are attempting to address this challenge.
- NoSQL databases, such as Apache Cassandra, CouchDB and MongoDB, are another type of database which can run on the cloud. NoSQL databases are built to service heavy read/write loads and are able scale up and down easily, and therefore they are more natively suited to running on the cloud. However, most contemporary applications are

 

built around an SQL data model, so working with NoSQL databases often requires a complete rewrite of application code.

## V. CLOUD COMPUTING ISSUES

Privacy-

The cloud model has been criticized by privacy advocates for the greater ease in which the companies hosting the cloud services control, thus, can monitor at will, whether permitted or not by their customers, the communication between the host company and the end user, as well as the user's stored data. Instances such as the secret NSA program, working with AT&T, and Verizon, which recorded over 10 million telephone calls between American citizens, causes uncertainty among privacy advocates, and the greater powers it gives to telecommunication companies to monitor user activity. Using a cloud service provider (CSP) can complicate privacy of data because of the extent to which virtualization for cloud processing (virtual machines) and cloud storage are used to implement cloud service[6]. CSP operations, customer or tenant data may not remain on the same system, or in the same data centre or even within the same provider's cloud; this can lead to legal concerns over jurisdiction. While there have been efforts (such as US-EU Safe Harbor) to "harmonise" the legal environment, providers such as Amazon still cater to major markets (typically the United States and the European Union) by deploying local infrastructure and allowing customers to select "availability zones." Cloud computing poses privacy concerns because the service provider may access the data that is on the cloud at any point in time. They could accidentally or deliberately alter or even delete information.

Postage and delivery services company Pitney Bowes launched Volly, a cloud-based, digital mailbox service to leverage its communication management assets. They also faced the technical challenge of providing strong data security and privacy. However, they were able to address the same concern by applying customized, application-level security, including encryption.

Legal-

As with other changes in the landscape of computing, certain legal issues arise with cloud computing, including trademark infringement, security concerns and sharing of propriety data resources.One important but not often mentioned problem with cloud computing is the problem of whom is in "possession" of the data[14]. If a cloud company is the possessor of the data, the possessor has certain legal rights. If the cloud company is the "custodian" of the data, then a different set of rights would apply. The next problem in the legalities of cloud computing is the problem of legal ownership of the data. Many Terms of Service agreements are silent on the question of ownership.

Security-

As cloud computing is achieving increased popularity, concerns are being voiced about the security issues introduced through adoption of this new model. The effectiveness and efficiency of traditional protection mechanisms are being reconsidered as the characteristics of this innovative deployment model can differ widely from those of traditional architectures[16].The relative security of cloud computing services is a contentious issue that may be delaying its adoption. Physical control of the Private Cloud equipment is more secure than having the equipment off site and under someone else's control. Physical control and the ability to visually inspect the data links and access ports is required in order to ensure data links are not compromised. Issues barring the adoption of cloud computing are due in large part to the private and public sectors' unease surrounding the external management of security-based services. It is the very nature of cloud computing-based services, private or public, that promote external management of provided services. This delivers great incentive to cloud computing service providers to prioritize building and maintaining strong management of secure services. Security issues have been categorised into sensitive data access, data segregation, privacy, bug exploitation, recovery, accountability, malicious insiders, management console security, account control, and multi-tenancy issues. Solutions to various cloud security issues vary, from cryptography, particularly public key infrastructure (PKI), to use of multiple cloud providers, standardisation of APIs, and improving virtual machine support and legal support [15]. Cloud computing offers many benefits, but it also is vulnerable to threats. As the uses of cloud computing increase, it is highly likely that more criminals will try to find new ways to exploit vulnerabilities in the system. There are many underlying challenges and risks in cloud computing that increase the threat of data being compromised. To help mitigate the threat, cloud computing stakeholders should invest heavily in risk assessment to ensure that the system encrypts to protect data; establishes trusted foundation to secure the platform and infrastructure; and builds higher assurance into auditing to strengthen compliance. Security concerns must be addressed in order to establish trust in cloud computing technology.

Sustainability-

Although cloud computing is often assumed to be a form of "green computing", there is no published study to substantiate this assumption. Citing the servers' affects on the environmental effects of cloud computing, in areas where climate favors natural cooling and renewable electricity is readily available, the environmental effects will be more moderate. (The same holds true for "traditional" data centres.) Thus countries with favorable conditions, such as Finland, Sweden and Switzerland, are trying to attract cloud computing data centres. Energy efficiency in cloud computing can result from energy-aware scheduling and server consolidation. However, in the case of distributed clouds over data centres with different source of energies including renewable source of energies, a small compromise on energy consumption reduction could result in high carbon footprint reduction.

 

Abuse -

As with privately purchased hardware, customers can purchase the services of cloud computing for nefarious purposes. This includes password cracking and launching attacks using the purchased services. In 2009, a banking trojan illegally used the popular Amazon service as a command and control channel that issued software updates and malicious instructions to PCs that were infected by the malware[2].

IT governance -

The introduction of cloud computing requires an appropriate IT governance model to ensure a secured computing environment and to comply with all relevant organizational information technology policies. As such, organizations need a set of capabilities that are essential when effectively implementing and managing cloud services, including demand management, relationship management, data security management, application lifecycle management, risk and compliance management.

## VI. CONCLUSION

In this article we have discussed cloud computing service models, its types, cloud database and various cloud computing issues. Cloud computing enables hardware and software to be delivered as services, Infrastructure-as-a-service products deliver a full computer infrastructure via the Internet. Platform-as-a-service products offer a full or partial application development environment that users can access and utilize online, even in collaboration with others. Software-as-a-service products provide a complete, turnkey application—including complex programs such as those for CRM or enterprise-resource management via the Internet. Cloud computing types specify the use of cloud services as private, hybrid and public environment. Cloud database runs on cloud computing platform, some databases are sql-based while some are nosql.As there are some issues mentioned above along with some challenges such as resource pooling, which is the mechanism by which cloud environments can increase utilization levels, reduce costs and make use of cheaper resources, such as commoditized servers and inexpensive hard disks, on-demand self-service can also be its weakness. Because cloud environments are often virtualized, any errors in assigning security permissions during the provisioning process could, rapid elasticity which enables organizations and business units to scale their operations up and down quickly to meet demand.

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