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Cloud Computing: Concept, Terminologies, Issues, Recent Technologies

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Abstract: In recent computing trends where processing capabilities, storage capacity, automation for computing, etc. are increasing rapidly as per demand, cloud computing emerges as a forerunner for such type of processing environment. Cloud computing is a network-based computing paradigm which maintains a huge pool of computing resources. Access to such computing resources is open to demanding users through internet. The distribution and flexibility of cloud environment makes it one of the best distributed computing environments. Services offered by a cloud service provider are charged as per their use by end-user while at any instance users can hold or release number of services. This study deals with the important concepts of cloud computing, issues, some important terminologies of cloud computing and shows how cloud computing is effective for future computing trend shifts.

Key words: Cloud computing, Quality of Services (QoS), distributed computing, virtualization, scheduling

INTRODUCTION

Several definitions exist in literature for cloud computing which define cloud computing as a distributed computing environment that provides on-demand service access to the demanding agents (Bilgaiyan *et al*., 2014a). Cloud computing environment also provides fast access to resources and rapid application development facilities. Basically, the services offered by any cloud paradigm is open to all type of users but still there exist some limitations on access of some specific type of resources to some limited and particular users. Such, distribution of access to resources is based on different deployment models of cloud computing (Bilgaiyan *et al*., 2014b; Kulkarni *et al*., 2012). Services offered by a cloud service provider are accessible through the internet which means a user is able to access those services from any geographical point on earth. There are some leading cloud service providers like Amazon AWS, Amazon EC2, GoGrid, Mosso, Google, Microsoft etc. that offer some common cloud services (Kulkarni *et al*., 2012; Chaisiri *et al*., 2012). Low investment, more services, scalability, elasticity, IT outsourcing, etc. are some of the great benefits of processing in cloud computing environment.

Services offered by cloud service providers are categorized into three service models, i.e., Platform as a Service (PaaS): this model contains application or service development environment services which includes web servers, development tools and software, etc. Software as a Service (SaaS): these services include some basic and regularly used software, gaming software, office software, etc. Infrastructure as a Services (IaaS): this service model includes physical resources like storage, router, processing capabilities, etc. (Kumar and Anand, 2013; Almorsy *et al*., 2011).

According to different kinds of users and their needs, there exist four types of cloud deployment models as shown in Fig. 1. Those are: Public clouds: Services offered by public clouds are open to all kind of users. It is the most common deployment model in which computing services are available to any kind of user. To provide and support lacs of public domain users, various services are built in the form of data centers which are publicly open to all type of users. Some of the famous Public cloud service offerings are Amazon Web Services (AWS), Google AppEngine, Go-grid and Microsoft Azure. Private

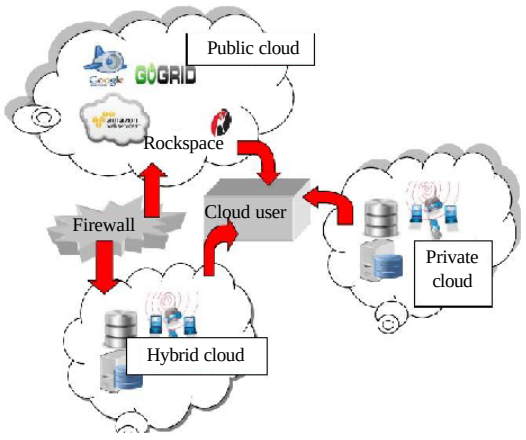

Fig. 1: Deployment models for cloud

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clouds: they provide different kinds of solutions to some specific users, i.e., there are still many scenarios where some users like big organizations may look to maintain their own clouds according to their specific needs. For that some cloud offerings like Amazon Ec2 and Microsoft provide private cloud facility which consists of services available only to a specific domain of users. Community clouds: These kind of cloud services are same as private users but the only difference is that the private cloud services are limited to a particular organization and its users but in community cloud the services are shared among a community of organization or users. Hybrid clouds: In most cases some users like big firms need to integrate some services with different deployment models of clouds, i.e., different services can require different scope of access for which different cloud models integrate to achieve such need. The process of mixing two or more models of cloud is called hybrid model of cloud (Jain and Pandey, 2013; Sabahi, 2011; Ahmed *et al*., 2012).

CHARACTERISTICS OF CLOUD COMPUTING

The key characteristics exhibited by clouds are shown in Fig. 2 and they are discussed as:

Virtualization: Resources (i.e., computing resources, storage and network capacity) in clouds are virtualized and it is achieved at various levels including VM (Virtual Machine) and platform levels. Virtualization is not a new concept. It came from multi-programming where processes think that they have full control over CPU and other resources. Both concepts have some differences, i.e., multi-programming says that CPU will be shared among processes while in virtualization the CPU is shared among operating systems. One more important difference in virtualization in cloud and in multi-programming is that in muti-programming, processes know that they are being managed by some system calls while in cloud computing, virtualization may or may not notify the operating system about it.

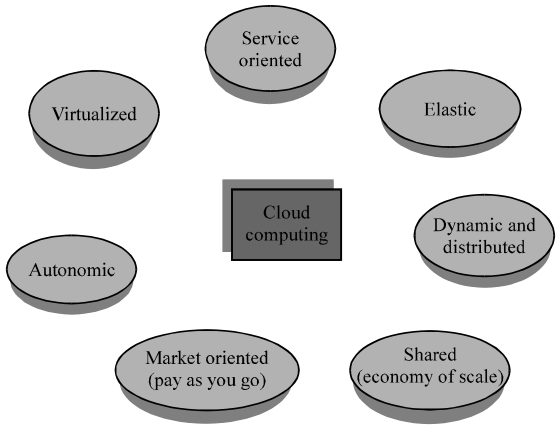

Fig. 2: Key characteristics of cloud computing environment

Service oriented: Cloud is implemented using Service-Oriented Architecture Model where all the components of cloud services are distributed over the network as an available service. Services can be in form of platform, software or infrastructure.

Elastic: Resources (i.e., compute, storage and network capacity) required for cloud applications can be dynamically provisioned and varied, i.e., increased or decreased at runtime depending on user's QoS requirements. Major cloud providers such as Amazon AWS, Gogrid, Mosso, Windows Azure, Engine Yard, Google, etc. even provide services for automatic scale-out and scale-in based on hosted application requirements.

Dynamic and distributed: Although, cloud resources are virtualized, the services of cloud are distributed geographically over the network. The property of elasticity and scalability at any point of time makes it dynamic in nature.

Shared: No matter what the numbers of available physical instances of any resource are they can be shared between a number of users which makes it more flexible in nature. It also increases the usability of resources so that utilization of system is increases.

Market-oriented (pay as you go): Pay as you go means a user needs to pay only for those services which are currently being held by him. That makes cloud computing market-oriented and efficient in terms of profit.

Autonomic: Automatic fault tolerance and service management makes the overall process automatic and reliable. Some issues are related to the data recovery at the time of fault tolerance which is disused (Vouk, 2008; Warneke and Kao, 2011; Jorissen *et al*., 2012; Buyya *et al*., 2009; Garg *et al*., 2013).

CLOUD ARCHITECTURE

Figure 3 shows the basic market oriented architecture where users interact with the cloud services at the uppermost layer. All service requests are then handled by service request manager component where scheduling

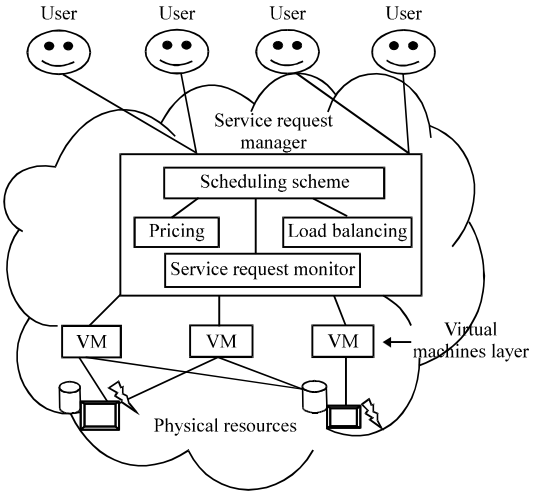

Fig. 3: Market oriented cloud architecture

schemes ensures the pricing, fair load balancing and monitoring the system state at the time of distribution of Virtual Machines (VMs). Then according to the scheduling scheme VMs are allocated to different service requests at the virtual machine layer. The lowest layer contains the physical instances of resources and all the virtually mapped services go on some specific physical resource for completing their computing task (Buyya *et al*., 2009).

SECURITY ISSUES IN CLOUD

Security issues are a major concern in cloud computing environment. Existence of third party in cloud environment also increases risk factor in the process. As users are unaware of the actual location of storage points of their valuable and sensitive data, so there is a need of some policies which will increase trust of users on computing over clouds. So, present cloud computing strategies involve visibility of data locations to a limited extent under some particular policies, provided certain conditions are fulfilled such as high sensitivity of data which can be traced subject to agreements (Hashizume *et al*., 2013). The following are some key security issues:

Third-party involvement: Cloud computing paradigm includes one or more cloud service providers for the same processing request. So, in this case cloud broker can either be one of the providers in which case it is a third-party for the rest or else it can be some other provider in which case it is a third-party for all involved service providers. Hence, when users process their data in the environment, the data goes through the third party which will decide how and where the data will be processed. As a result, trust on third-party is a major issue in such scenario (Hashizume *et al*., 2013; Ramgovind *et al*., 2010).

Data security and fault tolerance: The transparency in data storage and processing involves risk of data loss. The physical location transparency layer ensures that users will be unaware of the physical locations of actual storage and processing points. In case of occurrence of any natural disaster or hardware failure which will physically affect the storage point, the data will be lost which will be a difficult task to detect and recover, owing to transparency (Chen and Zhao, 2012; Jansen, 2011; Hamlen *et al*., 2010).

Communication risks: As most of the data is transmitted through the internet and other networks, this exposes data to various risks such as hacking, loss of confidentiality, compromise in integrity and other network security related issues. These issues also need to be addressed as a major trust issue in cloud computing environment (Lee, 2012; Ristov *et al*., 2012).

Authentication issues: Since, the data is stored at remote locations, it is an issue to maintain proper ownership information to prevent misuse of data. Awareness of what and how much private information is collected is necessary to be known to the users so that they can control the amount and nature of their private data collection (Bisong and Rahman, 2011).

SCHEDULING IN CLOUD COMPUTING ENVIRONMENT

When processing takes place on cloud computing environment different kind of services are required to be scheduled on some specific kind of resources so that a complete processing system takes place while importance is always given to the cost of processing. For that some effective schemes are required. This problem regarding tasks to be scheduled on to the resources is termed as task scheduling problem in cloud computing environment (Hu *et al*., 2010).

In cloud computing, service requests have heterogeneous resource requirements because some services are CPU intensive whereas others services are I/O-intensive. Cloud resources need to be allocated not only to achieve QoS but also to reduce energy usage which will make it green in nature and improve the profits of the service providers (Tayal, 2011).

Table 1: Latest cloud technologies and leading cloud service provider

Technical feature	Engine yard	Microsoft Azure
Platform technologies	PHP, Ruby, JAVA, Node.JS	.NET, Node.JS, JAVA, iOS, Windows Phone, Android, Python, PHP, Ruby
Servers	MySQL, NGINX, riak	Microsoft MySQL Servers, Share Point Server, MongoDB, LAMP, Redis, Apache, RabbitMQ
Architecture	An AWS cloud-based Active Directory Domain Service Deployment	Azure Active Directory with Azure Content Delivery Network
Security	Inbuilt Firewalls, Unique Users, Private Subnets, 128-Bit Encrypted Data Storage, Hardware Based Crypto System, SAS70 Type-II Certification, SSH Keys, Wireless Networks Uses WPA2 Encryption	Automated Protection Using Hyper-V Replica, Windows Firewall, 128-Bit Encrypted Data Storage, HTTPS, SSL, Hardware Based Cryptosystem, Security Token Service
Load balancing	Round Robin, Haproxy	Round Robin, Failover, Performance
Services offered	IaaS (Custom Deployment, Vertical Scaling, Recovery Tools, Backup), PaaS (Codebase upgrade to latest Technologies, Application development with their maintenance), SaaS (Application Performance analysis, launch services)	PaaS (Application Development), Mobile Services (Android, windows, iOS Phones Application Development), IaaS (Storage)

Technical feature	Amazon web services	GoGrid
Platform technologies	JAVA, JAVA Script, PHP, Mobile, Node.JS, Ruby, Python, Windows and .NET	JAVA, Ruby, python
Servers	Microsoft Windows Server Failover Clustering, SQL Server 2012, Open Source Chief Server, Darvin Streaming Server, NodeJS, Open VPN Access Server, Torrent Server	SQL Servers 2012, MongoDB, Cassandra, Hadoop, Hbase, Riak
Architecture	An AWS cloud-based Active Directory Domain Service Deployment	Hybrid Cloud Hosting with Self Reconfiguration of the system component to maintain demand services
Security	SSL Protected APIs, Inbuilt Firewalls, Unique Users, Private Subnets, 128-Bit Encrypted Data Storage, Hardware Based Crypto System, SAS70 Type-II Certification, SSH Keys, Wireless Networks Uses WPA2 Encryption	Real Time Compliance Reporting for HIPAA and PCI, Unified Security Management, Login Monitoring, Asset Discovery, Firewalls
Load balancing	Round Robin, Haproxy	Weighted SSL Least Connect, Weight Round Robin, Source Address Hashing, Notes on Weighting
Services offered	PaaS (Application Development), IaaS (Strorage, Processing)	IaaS (Storage, Processing, Firewalls)

RECENT CLOUD TECHNOLOGIES AND SOLUTION PROVIDERS IN CLOUD

There are a number of leading service providers in IT market which provides best solutions for cloud users with the most recent and innovative technologies. Table 1 represent an overview to the technology and solution used by some popular cloud service providers (Rimal *et al*., 2009; Pfeiffer, 2014; GoGrid, http://www.gogrid.com/; Amazon Web Services, http://aws.amazon.com/; Engine Yard, https://www.engineyard.com/; Microsoft Azure, http://azure.microsoft.com/en-us/).

CONCLUSION

This study gives a brief discussion about basic terminologies of cloud computing. Researchers can assess the overall scenario related to the cloud computing environment. It is seen that cloud services are more powerful and flexible in terms of processing and variety of services. The distribution of cloud system makes it more dynamic in nature and also increases its popularity among all existing computing paradigms.

Security is one of the major issues in cloud computing and is tentatively to be overcome in upcoming research works on cloud. The latest technologies make the cloud services more effective and powerful in terms of performance. Future research in this area will be broadly on optimization of cloud services without compromising on QoS. Also, security issues will need to be handled so as to provide trust to cloud users.

REFERENCES

Ahmed, M., A.S.R. Chowdhury, M. Ahmed and M.H. Rafee, 2012. An advanced survey on cloud computing and state-of-the-art research issues. Int. J. Comput. Sci. Issues, 9: 201-207.

Almorsy, M., J. Grundy and A.S. Ibrahim, 2011. Collaboration-based cloud computing security management framework. Proceedings of the 4th IEEE International Conference on Cloud Computing, July 4-9, 2011, Washington, DC., pp: 364-371.

Bilgaiyan, S., S. Sagnika and M. Das, 2014a. An analysis of task scheduling in cloud computing using evolutionary and swarm-based algorithms. Int. J. Comput. Appl., 89: 11-18.

Bilgaiyan, S., S. Sagnika and M. Das, 2014b. Workflow scheduling in cloud computing environment using cat swarm optimization. Proceedings of the 4th IEEE International Advance Computing Conference, February 21-22, 2014, Gurgaon, India, pp: 680-685.

Bisong, A. and S.S.M. Rahman, 2011. An overview of the security concerns in enterprise cloud computing. Int. J. Network Secur. Appl., 3: 30-45.

Buyya, R., C.S. Yeo, S. Venugopal, J. Broberg and I. Brandic, 2009. Cloud computing and emerging IT platforms: Vision, hype and reality for delivering computing as the 5th utility. Future Gener. Comput. Syst., 25: 599-616.

Chaisiri, S., B.S. Lee and D. Niyato, 2012. Optimization of resource provisioning cost in cloud computing. IEEE Trans. Servic. Comput., 5: 164-177.

Chen, D. and H. Zhao, 2012. Data security and privacy protection issues in cloud computing. Proceedings of the IEEE International Conference on Computer Science and Electronics Engineering, March 23-25, 2012, Hangzhou, China, pp: 647-651.

Garg, S.K., S. Versteeg and R. Buyya, 2013. A framework for ranking of cloud computing services. Future Gener. Comput. Syst., 29: 1012-1023.

Hamlen, K., M. Kantarcioglu, L. Khan and B. Thuraisingham, 2010. Security issues for cloud computing. Int. J. Inform. Secur. Privacy, 4: 39-51.

Hashizume, K., D.G. Rosado, E. Fernandez-Medina and E.B. Fernandez, 2013. An analysis of security issues for cloud computing. J. Internet Services Appli. (In Press). 10.1186/1869-0238-4-5.

Hu, J., J. Gu, G. Sun and T. Zhao, 2010. A scheduling strategy on load balancing of virtual machine resources in cloud computing environment. Proceedings of the 3rd International Symposium on Parallel Architectures, Algorithms and Programming, December 18-20, 2010, Dalian, China, pp: 89-96.

Jain, A. and U.S. Pandey, 2013. Role of cloud computing in higher education. Int. J. Adv. Res. Comput. Sci. Software Eng., 2: 966-972.

Jansen, W.A., 2011. Cloud hooks: Security and privacy issues in cloud computing. Proceedings of the 44th Hawaii International Conference on System Sciences, January 4-7, 2011, Koloa, Kauai, HI., USA., pp: 1-10.

Jorissen, K., F.D. Vila and J.J. Rehr, 2012. A high performance scientific cloud computing environment for materials simulations. Comput. Phys. Commun., 183: 1911-1919.

Kulkarni, G., R. Sutar and J. Gambhir, 2012. Cloud computing-infrastructure as service-amazon EC2. Int. J. Eng. Res. Appl., 2: 117-125.

Kumar, P. and S. Anand, 2013. An approach to optimize workflow scheduling for cloud computing environment. J. Theoret. Applied Inform. Technol., 57: 617-623.

Lee, K., 2012. Security threats in cloud computing environments. Int. J. Secur. Appl., 6: 25-32.

Pfeiffer, M., 2014. Implementing active directory domain services in the AWS cloud. Amazon Web Services, March 2014, pp: 1-23. https://d0. awsstatic. com/whitepapers/Implementing_Active_Directory_Domain_Services_in_the_AWS_Cloud.pdf.

Ramgovind, S., M.M. Eloff and E. Smith, 2010. The management of security in Cloud computing. Proceedings of the Information Security for South Africa, August 2-4, 2010, Sandton, Johannesburg, pp: 1-7.

Rimal, B.P., E. Choi and I. Lumb, 2009. A taxonomy and survey of cloud computing systems. Proceedings of the 5th International Joint Conference on INC, IMS and IDC, August 25-27, 2009, Seoul, South Korea, pp: 44-51.

Ristov, S., M. Gusev and M. Kostoska, 2012. Cloud computing security in business information systems. Int. J. Network Secur. Appl., 4: 75-93.

Sabahi, F., 2011. Cloud computing security threats and responses. Proceedings of the 3rd IEEE International Conference on Communication Software and Networks, May 27-29, 2011, Xian, China, pp: 245-249.

Tayal, S., 2011. Tasks scheduling optimization for the cloud computing system. Int. J. Innov. Eng. Technol., 5: 111-115.

Vouk, M.A., 2008. Cloud computing-issues, research and implementations. J. Comput. Inform. Technol., 4: 235-246.

Warneke, D. and O. Kao, 2011. Exploiting dynamic resource allocation for efficient parallel data processing in the cloud. IEEE Trans. Parallel Distrib. Syst., 22: 985-997.