Cloud Computing Architecture Issues and Future Research Directions

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Abstract

Cloud computing is a framework that permits simple, universal and on-time internet connectivity to a shared pool of computing powers such as routers, servers, software's and services that can be easily distributed and deployed with minimum effort management or interaction between service providers. Cloud Computing defines the structure of new era giving birth to parallel computing, grid computing and visualization technologies. Many believe that cloud will revolutionize the entire ICT industry. This paper comprehensively surveys cloud architecture and problems related to it. Many problems are defined from the context of cloud computing and also discussed compatibility issues which significantly needs further research and development.

Keywords: cloud computing, architecture, issues.

1. Introduction

Cloud computing is a framework that permits simple, universal and on-time internet connectivity to a shared pool of computing powers such as routers, servers, software's and services that can be easily distributed and deployed with minimum effort management or interaction between service providers [1].In this era of technology, cloud computing has become the most popular and trending concept being tossed everywhere. " It's becoming the word of the day" says Gartner's Ben Pring [2]. Cloud Computing provides an On-demand flexible services that can be accessed via internet. Cloud service provider (CSP) infrastructure provides shared resources which are accessed by cloud consumers on pay and use basis over the internet [3]. Cloud Computing provides layer of abstraction between essential computing resources and corresponding architecture [3]. Cloud Computing includes three basic service models and the client and server. Client cloud serves as hardware or software abstraction layer to communicate with cloud services. Basic cloud services are provided by CSP using servers. There are many types of delivery services but major are Software as a Service, Platform as a Service and Infrastructure as a Service. Consumer computing platform via infrastructure is provided by PaaS [4]. CSP platform provides interface to user through which he can create, evaluate and launch an application. IaaS provides services in form of servers, storage and computing resources to consumers. This benefits the user by not investing in costly IT infrastructures. These services are available on-demand and adaptive. The users pay for them when needed. Customer applications for use over internet are provided by CSP in SaaS [4]. Customers can access these applications remotely and need not to purchase or install them. These are controlled from a centralized location and offer network-based access [4]. Four kinds of cloud deployment models: public, private, community and hybrid cloud. Private clouds are

open to data centers of enterprises. This cloud service is controlled by an organization and is secured. Public cloud are open services used by general public over internet provided by service providers using personal structure. This service is accessed using PAYG (pay-as-you go) model. Security of openly accessed cloud is less. Organizations that are involved in similar activities operate over Community Cloud. This infrastructure can be operated by foreign companies with a negotiated agreement in place for usage [4]. This paper aims to discuss architecture of cloud computing. The primary concern is to look into the basic abstraction layers which are responsible for service delivery.

2. Basic cloud computing architecture

National institute of standards and technology (NIST) defined a conceptual model for cloud architecture shown in Fig.1. given beneath.

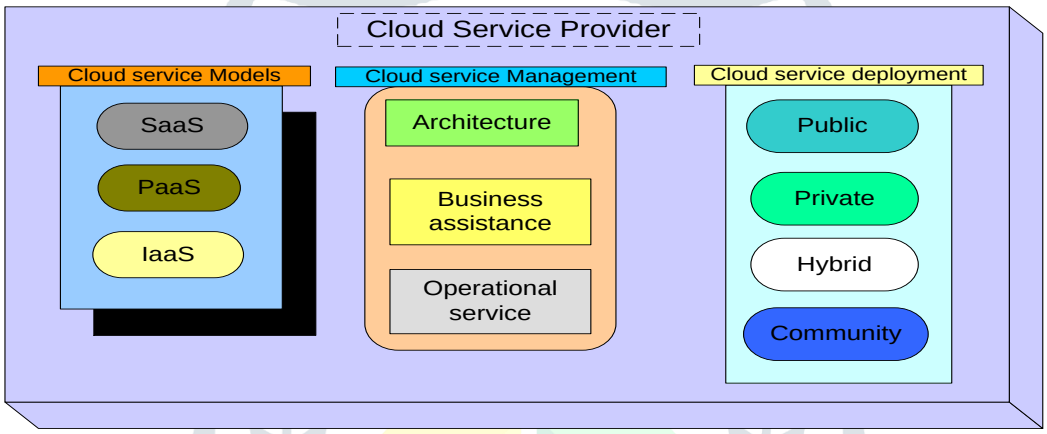

Fig 1. Basic architecture of cloud computing

2.1 Cloud Service Provider: The most complex module of cloud computing is cloud service providers. They are responsible for performing all the activities and provide services to cloud consumers and using their own infrastructure manage quality, efficiency and performance. There should be not be only to provide cloud services and infrastructure but they must also keep focus on providing management services to consumers within computing environment. Cloud service providers are responsible for managing, monitoring and operating activities performed after services are used and delivered to cloud consumers. They must be able to identify the basic requirements of cloud computing. In addition, they must address security and privacy issues properly of cloud as both can lead to potential failure of computing model [16].

2.2 Cloud service models: Cloud consumers are categorized into separate groups depending on the service provided to them. These are software-as-a-service (SaaS), platform-as-a-service (PaaS) and Infrastructure-as-a-service (IaaS) consumers. Consumers using cloud services to provide basic computing resources are referred to IaaS consumers' consumers refers to the organization or an individual using a platform for developing an application without installing tools for development, security or coding on system. SaaS consumers refers to the people who use internet on daily basis [16].

2.3 Cloud service management: cloud service management is responsible for managing necessary functions for customers.it assists three major services i.e. architecture, business assistance and operational service. Architecture provides design and deployment support to the cloud customers and promotes processes of cloud architecture including business strategies and architecture.it also provides timely support for integration and alignment of initiating deployment plans to cloud customers. Such assistance helps to adopt and align early business changes to cloud customers [16]. Business assistance enables the cloud customers to deal with the services related to business.it comprises billing, agreement and account management of customers including cost of services offered to customers. Operational services deal with the level of services agreed upon to be delivered to cloud customers.it manages and monitors the cloud service operations.

2.4 Cloud service deployment: There are four deployment services in cloud computing architecture.

2.4.1 Public: This service is openly used by general public for free. Any government, academic or business organization can own or manage it.it operates on cloud provider premises.

2.4.2 Private: This cloud service can be accessed by a single organization or business unit. Any third party or an organization can manage and operate it.it may operate inside or outside premises

2.4.3 Community: Cloud Service accessed by a specific community of cloud customers that have mutual concerns such as security and policy concerns.it may be purchased or operated by any community or organization.it may reside on premises or off premises.

2.4.4 Hybrid: This service is a result of combination of public, private and community cloud services.in hybrid all the services are bound together by standard technology that allows potability of applications and data (e.g. Cloud bursting for load balance between clouds) [1].

3. Issues in Cloud Computing

Cloud computing is offering a way how cloud customers/application can interact with cloud services, leading them to the phenomenon called "Hazy cloud" [17].it seriously hampers the growth of cloud environment by lock-in the vendor forcibly which prevents the customers from choosing alternative vendors/provides simultaneously at different level in an organization to optimize resources. More specifically, private clouds APIs make it harder to combine cloud services with an organizations existing system (e.g. Highly interactive pharmaceutical companies' application model). The interoperability here relates connection between different clouds as well as between local system of an organization and a cloud. The main objective of interoperability is to recognize smooth dynamic dataflow between local applications and cloud. Interoperability is important for cloud computing on several levels. In order to enhance the processing power and IT infrastructure, a company needs to maintain 31 in-house IT infrastructures and resources aligned with its core businesses while transferring limited functions and operations (e.g. Resource system for humans on cloud).In this situation, regular communication between on-site applications(EPR system) and cloud services (HR system) becomes critical to run business. If interoperability

is poor such as private APIs and ambiguous data systems used by SaaS HR cloud dramatically raise the problems, placing the IT department in terrible situations. Additionally, for optimization an organization need to automate the number of operations to cloud services provided by various vendors for efficiency purpose. For e.g. it is obvious that SME will use Gmail for e-mail services and for HR services will use SalesForce.com. The various features present in email system such as appointment booking, calendar, address book must communicate with HR systems employee directory.

4. Related Literature

In september2011, NIST performed and developed its research on reference cloud architecture. They developed a reference model for cloud architecture that contains essential components of cloud computing. This model briefly defines all the components accurately and is easy to understand. NIST developed the basic model for cloud architecture but there is further need to explain cloud architecture from both technological and business view, particularly in relations to cloud service management as lot of people use cloud computing and expect lot from it. F. Liu et al. (2011). IBM team has conducted a research related to cloud computing architecture. They developed a reference architecture for cloud using their experience and performed research on cloud products and services of IBM that are provided to their cloud clients. This IBM reference architecture includes various important elements such as operating model, mechanism of service management processes, scalability etc. IBM also develop certain tools for management and development so that clients can manage and create cloud services by their own. They also provide solutions for constructing own computing environment CCRA Team and M. Buzzetti et al. (2011).Cloud Security Alliance (CSA) constructed a reference for cloud and named it as Trusted Cloud Initiative (TCI).To meet the enterprises requirements in terms of security, TCI is formed by combining four structures and architectures such as Jericho, ITIL, TOGAF and SABSA.TCI architecture is very complex and difficult to implement practically as it require more knowledge and research to combine different structures and architectures J. Orea et al. (2011).The paper has discussed several issues in private cloud architecture. Administrative control and private cloud infrastructures are suggested. They have addressed several private cloud areas such as marketing, data protection and regulations. This promises maximum profits in long term investments V. Davidovic et al. (2015). Cloud Computing problems and security concerns have been identified. All these problems are related to security. Furthermore, they have discussed architectural framework of cloud computing in detail Ali, M., Khan et al. (2015). Infrastructure-as-a-service model has been postulated and details of IaaS in cloud computing has been discussed in this review. Also, the responsibilities of service providers and availability to consumer are discussed S. Bhardwaj et al. (2010). The front end and back end description of cloud computing architecture is presented. consumers are included in front end and service providers are included in back end R. Dhakar et al. (2009). Proposed cloud architecture for business logistics. The objective is to provide logistic support to cloud architectural services. Multiple frameworks with aim of reducing costs in business logistics has been proposed G. Niharika et al. (2015). Topologies, kinds and issues related to research in inter-cloud and cloud computing are discussed. Services offered by cloud and essential models of deployment has been

presented and the importance of services offered by inter-cloud are examined G. Niharika et al (2015). The survey has been performed on security issues and challenges in cloud computing. In addition, cloud deployment models and services offered has been discussed and they have classified challenges faced in cloud computing Verma et al. (2015). content based image retrieval (CBIR) model of SaaS architecture implemented using Microsoft Azure hybrid cloud has been proposed. This is particularly used for CBIR and digital images. Microsoft Azure is used to access and retrieve large image sets that is suitable for hybrid applications M. Meena et al. (2016). Mobile cloud architecture has been evaluated. Analysis & comparison between mobile applications and mobile cloud architecture is performed J. Bou Abdo et al. (2017). Platform-as-a-Service multiple-cloud model, functions and approaches are discussed. They have defined two types of models but major emphasis is on architecture of multi-cloud related to PaaS J. Ferrer et al. (2016).

5. Conclusion and Future scope

This paper gives a brief description of basic cloud computing architecture and simply explains the construction of cloud infrastructure. This research focuses on several cloud provider components. it consists of three major modules that include cloud service models, cloud service management and cloud service deployment. There are different processes and operations that a cloud provider needs to know before offering any cloud services to customers. Practically, management of cloud service will be more beneficial when done under experts in their own field being a cloud provider requires knowledge of both business and technology. We are expecting more and higher from cloud computing, therefore we would like to perform analyses on integrating various frameworks and standards into single cloud computing architecture in future

REFERENCES

[1] P. Mell and T. Grance, “The NIST Definition of Cloud Computing Recommendations of the National Institute of Standards and Technology,” Natl. Inst. Stand. Technol. Inf. Technol. Lab., vol. 145, p. 7, 2011

[2] G. Gruman, e. Knorr, what cloud computing really means. InfoWorld, 2009.

[3] Hu, F., Qiu, M., Li, J., Grant, T., Taylor, D., Mc Caleb, Hamner, R. (2011). A review on cloud computing: Design challenges in architecture and security. Journal of Computing and Information Technology, 19(1), 25-55.

[4] Ali, M., Khan, S. U., & Vasilakos, A. V. (2015). Security in cloud computing: Opportunities and challenges. Information sciences, 305, 357-383.

[5] Liu, F., Tong, J., Mao, J., Bohn, R., Messina, J., Badger, L., & Leaf, D. (2011). NIST cloud computing reference architecture. NIST special publication, 500(2011), 292.

[6] CCRA Team and M. Buzzetti, “Cloud Computing Reference Architecture 2.0: Overview”, IBM Corporation, 2011

[7] J. Orea et al., “Quick guide to the reference architecture: Trusted Cloud Initiative”, Cloud Security Alliance, 2011.

[8] V. Davidovic, D. Ilijevic, V. Luk, and I. Pogarcic, “Private Cloud Computing and delegation of control,” in Energy Procedia, 2015, vol. 100, no. C, pp. 196–205.

[9] S. Bhardwaj, L. Jain, and S. Jain, “Cloud Computing: a Study of Infrastructure As a Service (Iaas),” International Journal of Engineering., vol. 2, no. 1, pp. 60–63, 2010

[10] R. Dhakar, A. Gupta, and A. Vijay, “Cloud Computing Architecture,” Chinacloud.Cn, vol. 40, pp. 29–53, 2009

[11] G. Niharika and V. Ritu, “Cloud architecture for the logistics business,” in Procedia Computer Science, 2015, vol. 50, pp. 414–420.

[12] Verma and S. Kaushal, “Cloud Computing Security Issues and Challenges: A Survey,” July, 2011, pp. 445–454.

[13] M. Meena, A. R. Singh, and V. A. Bharadi, “Architecture for Software as a Service (SaaS) Model of CBIR on Hybrid Cloud of Microsoft Azure,” in Procedia Computer Science, 2016, vol. 79, pp. 569–578

[14] J. Bou Abdo and J. Demerjian, “Evaluation of mobile cloud architectures,” Pervasive Mobile Computing, vol. 39, pp. 284–303, 2017

[15] J. Ferrer, D. G. Pérez, and R. S. González, “Multi-cloud Platform-as-a-service Model, Functionalities and Approaches,” in Procedia Computer Science, 2016, vol. 97, pp. 63–72.

[16] Takabi, H., Joshi, J. B., & Ahn, G. J. (2010). Security and privacy challenges in cloud computing environments. IEEE Security & Privacy, 8(6), 24-31.

[17] M. Nelson, "Building an Open Cloud," Science, vol. 324, p. 1656, 2009.