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An Analysis on Cloud Computing Technology Is Fostering the Foundation of Virtualization

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ABSTRACT

A computer has various resources comprising monitor, CPU (Central Processing Unit), networking devices, primary and auxiliary storage devices, printer-cum-scanner, track-pad and many more. In order to manage these resources, an operating system needs a scheduler which can define the pre-arrangement of resources lest some specific situation or a process demands it. Cloud computing systems are on the path of great success economically as they are capable of providing huge amount of different kinds of services and resources to their customers. Besides, intelligently developed recommendation systems have contributed vastly in successfully letting the customer decide if a particular service is required for him or not. In this epoch of cutting-edge technology, scheduling is one of the preferred strategies that assigns the user-defined requests to the resources allocated in a particular time frame. Requests can exist in virtual computational form, where elements such as process or thread are executed on hardware resources such as expansion cards, network links and processors. A cloud has infinite number of resources where scheduling approaches play a crucial role of taking great benefits from resources by effectively utilizing them. Extensively, resources should be automated intelligently to execute the requests effectively. While considering the procurement of automation, an algorithm is the key element which is accountable for successfully arranging tasks' execution among several resources while preserving data security.

KEYWORD: Cloud computing, Cloud computing--Law and legislation, Computer Science, Computer Science Information Systems, Engineering and Technology, Production scheduling, Scheduling Scheduling--Computer programs, Time management

INTRODUCTION

The integration of multiple heterogeneous technologies in cloud computing plans to leverage off the deployment of several services. Software as a Service provides on demand leverage of software provided online, whereas Platform as a Service offers a development environment to the user without taking care of hardware being used. Infrastructure as a Service (IaaS) offers an effortlessly usable, more expandable, elastic and flexible infrastructure for the deployment of various services. Using the best practice for scheduling, IaaS can be enhanced in terms of server utilization. Additionally, IaaS providers affirmatively pledge the opportunity to deploy surplus services economically, whereas customers do not have to worry about service execution using multiple resources. A CSP (Cloud Service Provider) like iCloud, Amazon Web Services, IBM (International Business Machines) Corporation cloud etc provides services dynamically utilizing a network where virtualized and scalable resources interact with each other. Cloud services are elucidated as the computing clusters, where transmission of resources is performed on distributed data centers. Services provided by CSPs can be accessed by numerous individual liveware. Moreover, these resources should be managed properly, so that they can be utilized to maximum limit incorporating minimum requirements. In order to manage the requests properly, an efficient and effective scheduling methodology needs to be adopted.

Credentials

In this section, the rudimentary details and the background of thesis has been discussed. Prior to the description of scheduling policies, one must make acquaintance with the whereabouts of cloud computing and virtualization.

Cloud Computing

First computer came into the existence in the form Abacus in 3000 B.C. Thereafter, Abacus was replaced with ENIAC (Electronic Numerical Integrator And Computer) drifting through numerous technology advancements. ENIAC was the first general purpose computer introduced in 1945 at Moore School of the University of Pennsylvania to solve large numerical problems. Latterly, to solve complex data and decision making, first mainframe

computer (System/360) was introduced by IBM in April 1964. Personal computers were introduced to use computer personally in homes and offices. To exchange data and information among geographically distributed users, "internet" was introduced. To access internet based services easily, distributed computing, grid computing and cloud computing were proposed, respectively. Cloud computing technique was introduced in 1960s [2]. John McCarthy once said, "computation may someday be organized as a public utility" [3]. Afterwards, in the early 1990s, grid computing was introduced. The key notion behind grid computing was to access computing power as electricity [4]. Grid computing has a major contribution in originating "Cloud Computing". The term "cloud computing" was used in its context by Ramnath Chellappa in one of his lectures in 1997 [5]. With the passage of time, the services changed initially from "e-utility" to "on demand computing" and then to SaaS [9]. This escalates the users' capacity and capability of doing any sort of work. Electric companies provide services similar to cloud i.e. electricity is provided whenever and wherever required. Cloud vendors dynamically configure provision and de-provision IT (Information Technology) facilities when needed, smoothly and transparently [11].

Cloud Computing Architecture

Cloud Computing architecture is comprised of several elements where each element or component is independent and loosely coupled to each other. Cloud architecture can be broadly divided into two components:

- **Front-end**
- **Back-end**

The part of the system that represents the client infrastructure is called front end, which is visible to the user. It comprises of various applications, browser and devices such as desktop, mobile, which assist in accessing various cloud services. To illustrate, if a liveware wants to access Gmail, then it can be accessed by using browsers like Mozila Firefox, Google Chrome, Netscape and so forth.

Converged Technologies in Cloud Computing

Cloud Computing is not a single technology, rather it is a convergence of various technologies like web 2.0, SOA (Service Oriented Architecture), virtualization, utility, grid computing and distributed system. These technologies lead to deliverance of internet-based services. Different technologies that converge into Cloud Computing have been shown in figure 1.3 [18]. Utility computing, also termed as "The Computer Utility", is a service providing model in an infrastructure management, where computing resources are facilitated to the user whenever required and modifications are performed on their usage basis instead of fixed price policy. System resources like storage, computation and services are packed and used as metered services. No initial cost or very little cost is required to access computing resources, rather they are substantially rented or leased [19].

Virtualization

Cloud computing technology is fostering the foundation of virtualization. The virtualization term concerns with the abstraction of cloud computing resources (storage, CPU, memory, network, database and application stack) from applications/services, so that a single physical resource/hardware can be shared among multiple users or applications. To rephrase, through virtualization process virtual copies of physical resources are created rather than actual ones. Server virtualization is the canonical example of virtualization, in which particular characteristics of a physical server are abstracted (decoupled) and recreated in VMM (virtualization software or hypervisor) such as vRAM, vNIC, vCPU etc.; these all are aggregated together promptly for producing virtual server instantly [28]. Cloud business model based multi-tenancy feature is enabled by virtualization technology by providing extensible and sharable resources platform to all the dwellers [29].

In cloud computing while using virtualization, there are 3 main components:

- Host that fulfills a user's request
- Virtualization layer which is responsible for the creation of virtual images.
- Guest or user who sends the request.

Virtualization Types

- Hardware Level Virtualization
- O.S. Level Virtualization
- Server Level Virtualization
- Application Level Virtualization
- Storage Level Virtualization
- Network Virtualization
- Desktop Level Virtualization

Taxonomy and Survey of Scheduling Approaches in Cloud Computing

On demand access of unlimited resources has come to true only because of cloud computing. While using the services offered by cloud, various parameters are considered by the provider i.e. cost, energy, deadline of tasks, under-loading/overloading of resources etc. In this chapter, a detailed survey of these scheduling influencing factors has been taken. The survey will help the researchers to have a detail knowledge of almost every cloud scheduling aspects. Services/request are sent to the cloud by users. These tasks are managed by using efficient scheduling approaches. Task dependency has a great impact on designing the scheduling approach. A survey, considering task dependency has also been taken in this chapter. The survey presents an analysis of numerous scheduling approaches in the aspect of task dependency applied in cloud environment. Management of abundant resources and assigning the specific resource that is required without influencing the other resources, in cloud computing is a major challenge. Mostly surveyed papers describe the problem and use elastic feature to add/remove resources and scale-up/down wherever addition performance require ment arises. Same way, adopted scheduling approach must be able to handle overprovisioning and under-provisioning scenario in cloud. Deduction in cost and energy consumption are other included constraints for desirable performance. Provisioning and de-provisioning in large scaled resources play crucial role in decision making. Combination of hybrid approaches having either sub-optimal or optimal solutions, are the simplified and smaller version of heuristics problem and are fruitful for the scientific community.

METHODLOGY

One of the major factors behind evolution and improvement in any subject is “Research”. However, research is a difficult task and requires deep knowledge and keen dedication from the researchers. In this chapter, various steps that approach towards research, have been discussed, which helps the computer science researchers to start their research. Although this methodology can be adopted for any research field [69]. Following steps have been adopted during this research:

Search relevant database and search engine.

In most of cases, people prefer "Google" as a search engine to search their relevant data or information. Most of the time, people also prefer encyclopedia such as Wikipedia, Yahoo etc for the search. But while choosing a search engine, one must consider the trustworthiness. It is recommended that researchers must search with relevant "keywords" using scholarly search engines like Microsoft Academic Search, Google Scholar, ACM Digital Library, DBLP (DataBase systems and Logic Programming), ScienceDirect, Scopus, IEEE etc. While considering these factors, the literature was searched from various search engines.

Sort scholarly research and articles.

Research papers can be classified into "analytical" and "argumentative" papers. An author logically analyses and provides his personal perspective regarding the topic in analytical research, whereas in argumentative research, on the basis of logical evidence, the author provides the arguments regarding the topic. After reading abstract of any research paper, researchers can easily identify the relevance of particular paper for their research. Then, he can differentiate the relevance or non-relevance of research papers.

Reading papers in elaborating manner

Researcher must read the paper thoroughly so as to enable him to make some logical arguments. Scrutinized papers were examined deeply by examining the used methodologies in detail.

TOOLS

CloudSim Though these simulators were able to simulate the management behavior of grid applications, yet could not differentiate the cloud multilayer services. Hence, CloudSim

simulator was suggested by Buyya et al. in 2009 [74]. He defined CloudSim as "a new, generalized, and extensible simulation framework that enables seamless modeling, simulation, and experimentation of emerging Cloud computing infrastructures and application services". This simulator is beneficial to the developers and researchers in investigating their design and methodology applicable in cloud environment without having deep understanding of cloud infrastructure. At initial stage of developing CloudSim, discrete events were simulated by SimJava engine [75]. It facilitated basic functionalities like creation of Cloud system entities (VMs, services, data center, host, broker), components' communication, events' queuing & processing and clock simulation. In recent CloudAnalyst, FederatedCloudSim, CloudMIG Xpress, CloudReports, RealCloudSim, DynamicCloudSim, Cloud2Sim etc. are some of the variations that have been evaluated [76].
This chapter demonstrated the general guidelines for research work how research should be performed during the whole tenure. The proposed methodology has been performed practically on CloudSim simulator. In this chapter, brief introduction of the tool has been provided.

CONCLUSION

With the establishment of virtualized data-centers on a large scale, cutting-edge technology requires more energy to deliver the services 24*7 hours. With this expansion and accumulation of information on a massive scale on datacenters, the consumption of excessive amount of power results in high operational costs and power consumption. Therefore, there is an urgent need to make the environment more adaptive and dynamic, where the over-utilization and under-utilization of hosts is well known to the system and active measures can be taken accordingly. To serve this purpose, an energy efficient method for the detection of overloaded and under-loaded hosts has been proposed in this chapter. To overcome the problem of overloaded and under-loaded hosts, VM migration approach has been adopted. For implementing VM migration, VM placement decision has also been taken to save energy and reduce SLA (Service Level Agreement) rate over the cloud. In the chapter, a novel adaptive heuristics approach has been presented that concerns the utilization of resources while ensuring the high level of relevancy to the SLA. After identification of under-loaded and overloaded hosts, VM placement decision has been taken in the way that it consumes minimum energy. Minimum migration policy has been adopted in the proposed methodology to minimize overall execution time. The validation of effectiveness and efficiency of the suggested approach has been performed by using real-world workload traces in CloudSim simulator

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