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Cloud Computing in Resource Management

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ABSTRACT

Swiftly increasing demand of computational calculations in the process of business, transferring of files under certain protocols and data centers force to develop an emerging technology cater to the services for computational need, highly manageable and secure storage. To fulfill these technological desires cloud computing is the best answer by introducing various sorts of service platforms in high computational environment. Cloud computing is the most recent paradigm promising to turn around the vision of "computing utilities" into reality. The term "cloud computing" is relatively new, there is no universal agreement on this definition. In this paper, we go through with different area of expertise of research and novelty in cloud computing domain and its usefulness in the genre of management. Even though the cloud computing provides many distinguished features, it still has certain sorts of short comings amidst with comparatively high cost for both private and public clouds. It is the way of congregating amasses of information and resources stored in personal computers and other gadgets and further putting them on the public cloud for serving users. Resource management in a cloud environment is a hard problem, due to the scale of modern data centers, their interdependencies along with the range of objectives of the different actors in a cloud ecosystem. Cloud computing is turning to be one of the most explosively expanding technologies in the computing industry in this era. It authorizes the users to transfer their data and computation to remote location with minimal impact on system performance. With the evolution of virtualization technology, cloud computing has been emerged to be distributed systematically or strategically on full basis. The idea of cloud computing has not only restored the field of distributed systems but also fundamentally changed how business utilizes computing today. Resource management in cloud computing is in fact a typical problem which is due to the scale of modern data centers, the variety of resource types and their inter dependencies, unpredictability of load along with the range of objectives of the different actors in a cloud ecosystem.

Keywords-- Cloud Computing Research, Challenges, Resource Management, Virtualization, Utility Computing, Cloud Platform

I. INTRODUCTION

Cloud computing is a completely new IT technology and it is known as the third revolution after personal computers and internet. We can also summarize that the enhancement and development of Distributed Databases, Parallel Computing, Grid Computing and Distributed Computing result in cloud Computing. John McCarthy in the 1960s already envisioned that computing facilities will be provided to the general public like utility[1]. In simple words we can refer the cloud computing as a platform based on internet providing myriads of services on the basis of plug and play.

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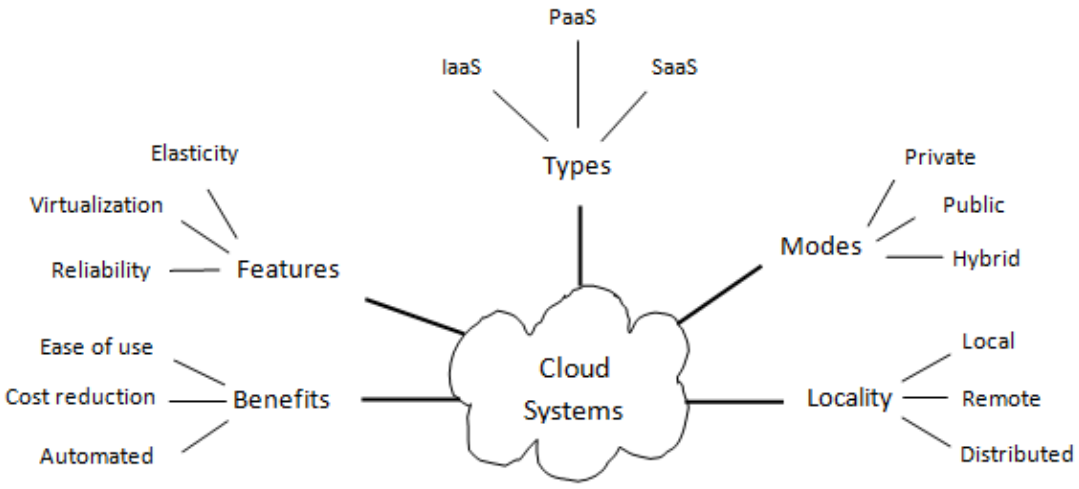

Figure: 1 – Main Aspects of Cloud Computing System

National Institute of Standards and Technology refers to include common key elements massively used in cloud computing. "It is a model for enabling convenient, on-demand networking access to a shared pool of configurable computing resources that can be rapidly provisioned and released with the minimal management effort or service provider interaction"[2]. It refers to some key elements which need to be analyzing first. Typically cloud computing provides a number of benefits which could not otherwise be realized which includes scalability and quality of service.

The cost effective cloud computing provides specialized environment and simplified interface. When we are concerning on cloud computing, we understand that resource management is the process of allocating computing storage, networking and resources to a set of applications, cloud service providers and cloud users. The cloud computing paradigm has emerged, wherein a pool of computing resources is shared between the applications and that may be accessed over the internet. This term is used not only by technology community but the common public as well. Our objective with the paper is to bring forth an inclusive survey of recent researches into the challenging genre of *resource management in cloud environment*. Conveying upon the complexity of the problem, describe the state of art, and outline the fundamental open challenges.

" It is very difficult to give prediction about the uncertain and fluid future of the environment surrounding Cloud Computing – be it technology, its adoption structure, industry, regulatory regime. "

Niels Bohr (Noble Proize in Physics : 1922)

II. CLOUD COMPUTING BUILDING BLOCKS

There are various reasons for organizations to move cloud computing enabled solutions as they are required to pay only on the basis of consumptions. In addition, organizations can easily meet the needs of rapidly changing markets to ensure that they are always on the lending edge for their consumers[3]. Basically cloud computing services are distributed into three categories:

Software-as-a-Service (SaaS)

This category makes use of cloud computing infrastructure to provide single application to multiple users. Here applications are hosted by a vendor or service provider and made available to users over a network. It makes the users to get rid of operating the applications on their own system and also eliminates the task of software maintenance along with safeguarding and supporting. Salesforce.com and Google Apps. are the best examples of SaaS.

Platform-as-a-Service (PaaS)

Platform-as-a-Service is the delivery of computing platform which allows the users to develop and manage the web applications without the complexity of maintaining the infrastructure. It provides an infrastructure with a high level of integration for implementing cloud based applications. Examples of PaaS are Force.com, Google App Engine and Microsoft Azure.

Infrastructure-as-a-Service (IaaS)

It refers to the sharing of hardware resources for executing services using virtualization technology. Simply, we can say that it is actually renting of cloud infrastructure – servers, storage and networking – on demand, in a pay as-you-go model. Examples of IaaS are Amazon S3, Amazon Elastic Cloud Computing (EC2) and GoGrid.

III. DEPLOYMENT OF CLOUD COMPUTING

Cloud services are available to users by any of the models depending on the requirement and procedure. These services are popular due to the fact that they can reduce the cost and complexity of operating computers and networks. Even though, the cloud service providers have specialization in a particular area can bring services that a single company might not be able to provide or offer to the users. There are also four different cloud deployment models which are as follow:

Community Cloud

This cloud computing model is multi tenant infrastructure which is a collaborative effort in which the infrastructure is jointly shared and constructed by the several organizations. It also can be hosted by the third party to a community. This will provide the degree of economics to the organization.

Public Cloud

In this cloud computing model service providers makes system application along with storage services available to the user through internet and other resources but the cloud service providers have full control on it. Amazon EC2, S3, Google AppEngine and Force.com are the best examples of public cloud services. This service may be free or offered on a pay-per-usage model.

Private Cloud

This cloud computing model delivers the advantages similar to that of public cloud. The main difference is that whereas public clouds are providing services to the number of organizations, a private cloud is dedicated only to a single organization. It may be managed by the organization or a third party regardless whether it is located premise or off premise. It results in optimizing of resources; concerning security issues include data privacy, considerable data transfer cost and full control over process critical activities.

Hybrid Cloud

This cloud computing model is a blender of on-premises, private cloud and public cloud services. This integrated cloud service uses both public and private clouds to perform distinct functions within the same organization. Organizations opt to use this model in order to optimize the resources to enhance the core competencies by margining out peripheral business functions. It is particular valuable for dynamic or high changeable workloads.

IV. RESOURCE MANAGEMENT IN CLOUD

We consider the resource management as the process of allocating computing, storage, networking and indirectly energy resources to a set of applications, in the context that looks to jointly meet the performance objectives of the infrastructure providers, users of the cloud resources and applications. The objectives of the cloud users tend to focus on application performance. The conceptual framework provides a high level view of the functional component of cloud resource management systems and all their interactions. This field is classified into eight functional areas or we can say that resource management activities which are as follow:

- Global planning of virtualized resources
- Resource demand profiling
- Resource exercise estimation
- Resource pricing and profit maximization
- Local scheduling of cloud resources
- Application scaling and provisioning
- Workload management
- Cloud management systems

Cloud computing is appeared as a business necessity, being animated by the idea of just using the infrastructure without managing it. Although, initially this idea was present only in the academic area, recently, it was transposed into industries by companies like Microsoft, Amazon, Google, Yahoo! and Salesforce.com. This makes it possible for new startups to enter the market easier, since the cost of infrastructure is greatly diminished[5]. There are various sorts of issues just as number of servers becomes immense and dependencies between servers become complex in the terms of managing cloud systems in static manner. Cloud computing providers deliver common online business applications which are accessed from servers through web browsers.

V. SCOPE OF CLOUD COMPUTING RESOURCE MANAGEMENT

Business applications hosted in the cloud are probably the most promising cloud service and the most interesting topic for computer science education because it can give business the option to pay as they go while providing the big impact benefit of the latest technology advancement[6]. Resource management decisions by the Cloud Service Provider and Cloud Service User need accurate estimations of the condition of the physical and virtual resources which are required to deliver the applications hosted by cloud. The functional elements of *Resource Utilization Estimation* provide state estimation

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for compute, network, storage and power resources. It also provides input into cloud monitoring and resource scheduling processes.

VI. CLOUD COMPUTING SECURITY ARCHITECTURE

One of the biggest security worries with the cloud computing model is the sharing of resources. Cloud computing is a distributed architecture which centralizes resources of the server on the platform which is quite scalable to provide on demand computing resources and services. Cloud computing technology is profoundly developed network environment which deems to the users of high quality service and security. The cloud infrastructure is shared by several organizations and supports a specific community that has shared concerns. It may be managed by the organizations or the third party and may exist on premise or off premise[4].

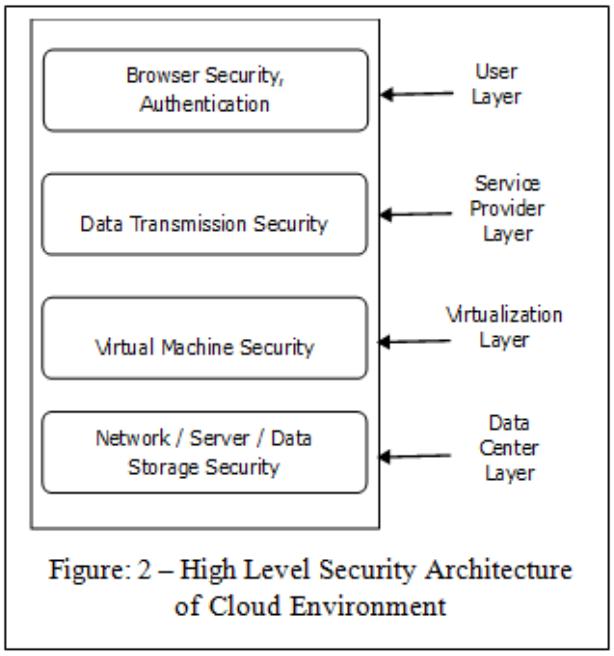

Figure: 2 – High Level Security Architecture of Cloud Environment

VII. CONCEPTUAL FRAMEWORK FOR RESOURCE MANAGEMENT

In *figure 4* the functional elements are mapped to the Cloud Provider and Cloud User roles in line with an IaaS cloud offering.

The cloud service provider is responsible for overseeing the exercising of compute, networking, storage, power resources and controlling this utilization via global and local scheduling process.

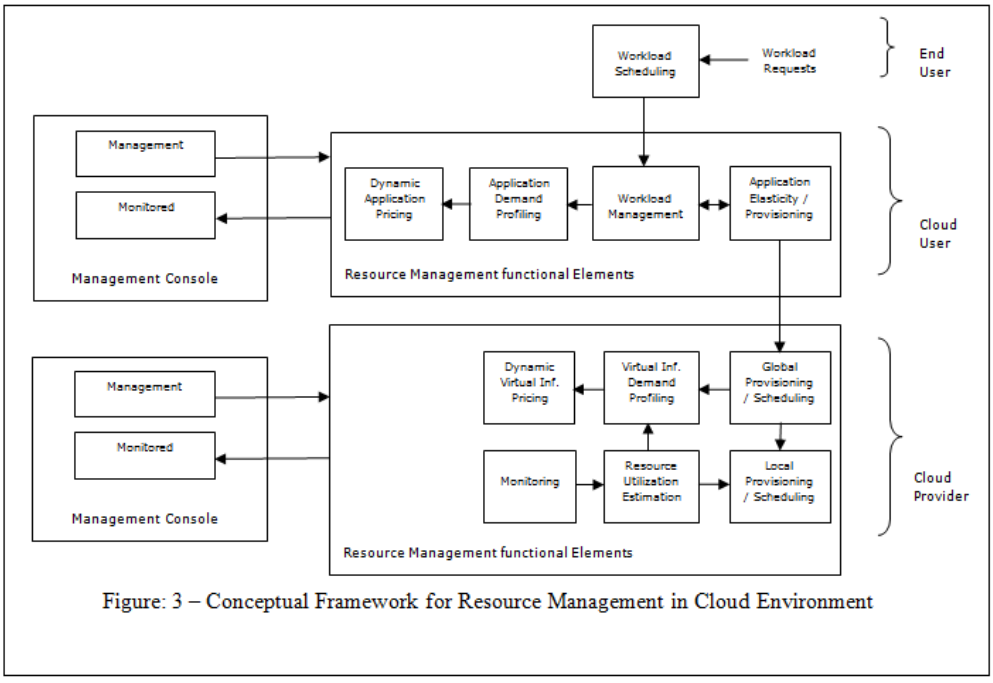

Figure: 3 – Conceptual Framework for Resource Management in Cloud Environment

As shown in *figure 4* arrows represent the principal information flows between functional elements. The diagram shows the responsibilities of the actors in an IaaS environment. The portioning is different in the case of ***PaaS and SaaS environment.***

The framework is depicted from IaaS perspective. However, it is applicable to the PaaS and SaaS perspectives - the functional elements remain the same, but the responsibility for supplying of more of them rests with

the Cloud Provider whereas in the case of PaaS, the role of Cloud User is split into a Platform Provider along with an Application Provider. The degree of resource allocation responsibility falling on each varies depending on the scope of the provided platform. In the case of SaaS, the Platform and Application Provider are basically the same organization which is also the Cloud Provider. In all sorts of resource management functionality the responsibilities would then have on these organizations.

Resource Management and Virtualization

One of the most important technologies is the use of virtualization. It is the way to gist the hardware and system resources from an operating system. In computing, virtualization means to create a virtual version of a device or a resource, such as a server, storage device, network or even an operating system where the framework divides the resource into one or more execution environments[7]. One of the most basic concepts of virtualization technology gives employed in cloud environment is resource consolidation and management.

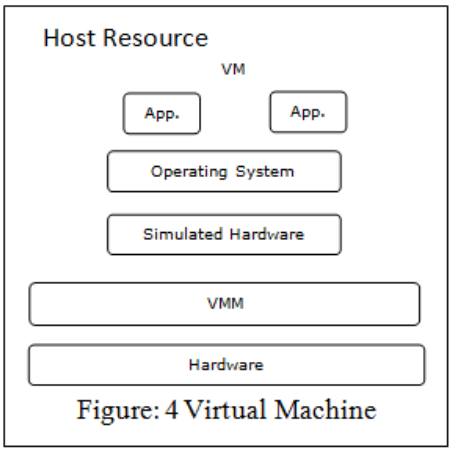

Figure: 4 Virtual Machine

Hypervisors or Virtual Machine Monitors are used to perform virtualization within a cloud environment across a large set of servers. These monitors lie in between the hardware and the operating systems. The figure mentioned below defines one of the key advantages of cloud computing which allows for a consolidation of resources within any data center.

Within a cluster environment managing of multiple operating systems is performed to allow for a number of standalone physical machines which is further combined to a virtualized environment. The entire processes require less physical resources than ever before. Thousands of physical machines amidst with megawatts of power are required for the deployment of large clouds, which brings forth the necessity of developing an efficient Cloud Computing system that utilizes the strengths of the cloud while minimizing its energy footprint.

Cloud Operations Management System

Role in Operation

In this changing era, it has been stated on the basis of the latest reports that several companies are obtaining more than seventy percent cost of their information and communication technology on operation and management resulting in allocating of only few percentage of their funds on new development and researches. An infrastructure operation manger is deployed by the companies which fabricate and operate infrastructure based on the commandments provided by the administrators. In a cloud environment, the operation manger manipulates the infrastructure. Cloud users are in the high expectations that they are going to construct the system which works in an inexpensive way in comparison to the conventional systems. This turns to be the main cause which gives rise to a necessity of new and different operations management technology and it is premises that the uniform infrastructure control has been made possible by the technology of visualization.

Challenges & Risk / Security Issues

Computing is being transformed to a model consisting of services that are commoditized and delivered in a manner similar to utilities such as water, electricity, gas and telephony. In such a model, users access services based on their requirement regardless of where the services are hosted. Several computing paradigms have promised to deliver this utility computing vision of "computing utilities" into reality[8]. Perhaps the biggest threat that may emerge when a technology gains sufficient interest from enough people is that it will begin to be observed as panacea.

We have categorized five challenges. The first three relate to known general problems that are hard to solve in theory resulting in required additional efforts to produce practical solutions. The last two refer to significance resource management challenges that emerge from the development of the cloud computing paradigm.

- Achieving predictable performance for cloud-hosted applications
- Achieving global manageability of cloud environments
- Engineering scalable resource management systems
- Economic behavior of pricing strategies
- Challenges in mobile cloud computing

In the cloud, it is common to have various resources, such as machine instances, fail. Except for tightly managed Platform as a Service cloud providers, the burden of resource management is still in the hands of the user is often provided with limited or immature management tools to address the issues[9]. IP address which may be reused has been considered a big issue in the concern of network security. Sometimes though the old IP address is being assigned to new user still the chances of accessing still exists in the DNS cache and the data belonging to a particular user may become accessible to some other user violating the privacy of the original user[10].

VIII. FUTURE PROSPECTS & ADVANTAGES

The increasing of resources in computing and management results to the massive demand of cloud system making this concept one of the most luring and dynamic topics of this era.

Distributed File System

Google developed the patented distributed file system Google File System (GFS) providing efficient and reliable access to data using large clusters of commodity servers. It shares many of the same goals as previous distributed file systems such as performance, scalability, reliability and availability. Its design has been driven by key observation of application workloads and technological environment, both current and anticipated, which reflect a marked departure from earlier file system design assumptions[11].

MapReduce

MapReduce refers to a group of programming techniques in which data is processed in sets. Built on top of Google File system, Google's MapReduce framework is the heart of the conceptual and computational model for their approach to cloud computing[12]. The main concept behind the same is that the pseudo code which is coded by the developer carries two discrete functions *map* and *reduce* during the data collection process.

Architecture Design of Data Centers

Traditional data centers have had a relatively high degree of customization, with particular servers, mainframes, and so forth requiring careful planning. A data centre, which is home to the computation power and storage, is central to cloud computing and contains thousands of servers, switches and routers. Data centers will continue to exist, though over time the private clouds will increasingly resemble their public counterparts.

IX. CONCLUSION

It is fact that the research and analysis of cloud computing is still in its initial period, apparent impacts may be brought by cloud computing. As the prevalence of cloud computing continues to raise, the need for power saving mechanisms within the cloud also increases. While a number of cloud terminologies are discussed in this paper, there is a need of amendments in cloud infrastructure both in the academic and commercial sectors where management of different segments will be in quick span of time and believing that green computing will be one of the major segments of the coming generation cloud computing. Its uses in the management sectors in modern era not only embellish the utilization rate of resources to address the imbalance in the development between regions, but also can make more extensive use of cloud computing to our work life. Consequently cloud services must be designed under assumption that they will experience frequent and open unpredictable failures. Services must recover from failures autonomously, and this implies that cloud computing platforms must offer standard, simple and fast recovery procedures[13]. To sum up, we can further conclude that research and development related to cloud computing technology forms a virtual role in the future of resource management and internet technology. Getting view on the basis of ongoing research efforts and continuing advancements of computing technology, we come into cropper that this technology hover to have a major impact on scientific research as well as management planning.

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