



## A Study of Cloud Computing: Opportunities, Challenges and Resource Utilization

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**Abstract:** *Cloud computing is the means through which computing resources such as applications, infrastructures, business processes, hardware etc. can be delivered as a service whenever and wherever needed. This paper covers the various issues, challenges, and opportunities of such computing technology. The authors also highlight the resource utilization management of cloud computing with the concluding remark.*

**Keywords:** *Cloud Computing, Cloud Challenges, Resource Management*

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### I. INTRODUCTION

Cloud computing represents a new paradigm with an architectural shift from traditional distributed computing. It presents computing resources like hardware, software, platform or infrastructure as utility oriented services to the consumers. The service offerings on virtualized platforms are aimed to be accessible anywhere with complete management by the provider and it is based on subscription. Some of the claimed benefits of this technology are improved resource utilization, higher independence on device and location, and reduction in cost.

Cloud computing is proposed to transform the way Information Technology (IT) is deployed and managed, reduced implementation, maintenance costs and complexity, while accelerating innovation, providing faster time to market, and providing the ability to scale high-performance applications and infrastructures. A cloud technology is similar as with a utility grid technology. Many research results in the grids domain of resource management can be extended to the cloud domain. Cloud computing generates great deal of interest among service providers, consumers, system creators, and researchers. It has a significant and continuous growth in the virtualization market. The world-wide IT enterprise spending on cloud computing is expected to increase day by day. A Cloud computing is still an active area of research.

A cloud computing is a model for enabling convenient, on demand network access to a shared pool of configurable computing resources like networks, servers, storage, applications, and services that can be rapidly provisioned and released with minimal management effort or service provider interaction [3]. It is the outsourcing of IT infrastructure via internet. Cloud provides computing resources on demand via a service provider so as holding and maintaining particular hardware and software environment. This technology can run on different computing platforms and different hardware system for different applications [2].

Cloud services are there when one needs it, as much as needs, and it is like pay and go and only for what one consume. The service can be used for rapid elasticity in terms of scalability, resource optimization, capacity planning and other tasks [5]. On-demand self-service can use cloud services as needed without any human interaction. Cloud can be accessed through standard mechanisms by both thick and thin clients and therefore physical and virtual resources are assigned and reassigned according to demand [2].

There are some primary reasons like low IT investment, agility and flexibility, green computing, multi-tenancy, ease of implementation, etc. for the popularity of this distributed system infrastructure. With cloud computing the service consumer does not need to purchase resources. The pay-as-you-go feature of the cloud allows users to acquire resources on demand for example for say resource rent on hourly basis. This is of great value for small start-up companies as well as larger enterprises. The startup companies do not need a heavy investment on setting up an IT infrastructure whereas the cost of IT management and upgrading is greatly reduced for larger enterprises [4].

In cloud computing, the computing demands of a service consumer grow and shrink dynamically in accordance with its current resource requirement. This provides a significant benefit for handling temporary increases in resource usage for the service consumer.

There are various types of clouds are in operation. These include public clouds that comprise shared resources that can be used by the public consumers at large. A private cloud on the other hand is accessible to the members of a given group only. An enterprise cloud that serves the employees of a given company and a research and engineering cloud that unifies resources located in multiple institutions are two variants of the private cloud. According to the requirement of a system, different types of cloud can be used [2].

Further, achieving effective resource management is the important concern irrespective of the type of cloud used. A recent survey shows that security and performance are two top priorities for cloud service consumers. An effective resource management strategy is crucial for harnessing the power of the underlying distributed hardware and achieving a

high system performance. Service Level Agreement (SLA), is an important characteristic of clouds [1] often requires the handling of an advance reservation request that is characterized by a deadline.

The cloud computing dynamically provisions resources which enable its infrastructure to meet arbitrary varying resource and service requirements of cloud customer applications. The application requirements can be characterized by Quality of Service (QoS) requirements such as availability, security, reliability etc., mentioned in the SLA. SLA is a legal binding contract which states QoS guarantees that an execution environment i.e. service provider agrees to provide with its hosted application.

The cloud computing paradigm is composed of three service models or layers namely Software as a Service (SaaS), Platform as a Service (PaaS), and Infrastructure as a Service (IaaS) [2]. The SaaS model enables the customer to use the provider application hosted on the cloud infrastructure. In this model customer has little control over application configuration settings. PaaS model provides the capacity to the consumer to deploy the customer created applications onto the cloud infrastructure using the programming language or tools supported by the cloud provider. The consumer has control over the deployed applications. The IaaS model allows the customer to provision processing, storage, networks and other important software where a customer can deploy software such as operating system and applications. The consumer has control over operating systems, storage, and deployed applications.

The rest of the paper focuses on details of the underlying various cloud challenges and resource management on pools describing further and providing a high level outline of a technique are discussed in the following sections.

## **II. ANALYSIS OF VARIOUS CLOUD COMPUTING CHALLENGES**

Success in exploring any new models requires an adventurous spirit and technical astuteness, and willingness to stretch and learn new ways of doing things. It requires improvements in bandwidth, computing and database, and network storage systems. In spite of the benefits of such a new technology or business model called cloud computing, there are several open issues, risks and concerns at the service and architecture levels. They include security of the enterprise data that is stored in the cloud, trust, integration standards, availability, sustainability, dynamic cost model, regulatory violation and ambiguity i.e. different data privacy standards in different regions, data replication, coherency and erosion of integrity, application sprawl, dependencies among others, transition and execution risks, limited scope for customization, cultural resistance, loss of privacy, taxation issues, lack of technical personnel, reliability, governance, performance, human capital, compliance, integration with legacy systems etc.

Cloud computing is an effective and economic solution for distributed computing it poses a number of challenges i.e. By delegating the IT management to a third party the service consumer loses the ability to directly control and monitor the execution of the submitted workload. Therefore lack of control of sensitive data over cloud resources that are run and managed by someone else is an important challenge.

The inter-operability among multiple service providers is again challenging i.e. to avoid risk of lock-in to cloud vendors is desirable to be able to run the same virtualized application on clouds provided by multiple vendors. Appropriate standards need to be in place for addressing this concern.

The most important challenge faces by the cloud technology is the resource management i.e. the management of computing, storage and other resources in a distributed system is recognized as the most challenging problem. The dynamic nature of the resource pool comprising a large number of heterogeneous resources increases the complexity of resource management on a cloud significantly. The handling of a SLA adds to the challenges of devising effective resource management techniques. Various uncertainties that are associated with satisfying SLAs on an environment with a large and dynamic resource pool need to be handled. Most of the known risks or challenges still do not have an industry-wide solution and also exist in the current on-premise solutions, hosting, vendor management etc.

## **III. RESOURCE MANAGEMENT ON CLOUDS**

Appropriate management of resources by cloud middleware is crucial for effectively utilizing the underlying distributed resource infrastructure. It is often impractical to assume that detailed priory knowledge of management policies for all the resources will be available to resource brokers in a large, dynamic, and heterogeneous cloud environment. Moreover, user estimates of resource demands are often error prone. The various customers cloud operations are consolidate at one place and an effective resource sharing is achieved. The result of such is a reduction of power utilized by the resources.

A cloud environment is characterized by various service providers. Each provider has his own service terms, conditions, managerial systems, operating environments, security levels, etc. The specified expertise and value addition of a cloud service will help to find out the right or suitable cloud offering, deploy the application in the cloud, and handle it properly. The specific tools are available to find the most suitable cloud resource and map or adjust the requirements of application to it. They can also be dynamic by automatically routing the data, applications and infrastructure requirements based on some QoS criteria like availability, reliability, latency, price etc.

The cloud requires two operations to perform and manage its resources like scheduling and matchmaking. The scheduling determines the order in which particular job map to the specific resource is to be performed. The matchmaking on the other hand is the process of allocating job concern with user request to resources selected from the existing resource pool. Both of these operations are required for appropriately utilizing the power of existing resource pool. Ultimately it achieves a high system performance which leads to the user satisfaction which resulting in to increase revenue for the cloud service provider.

The complexity of resource management increases by two reasons. The one is the uncertainties associated with job execution times and the other is the strategy which is used by the Local resource manager for scheduling. Further, there

are two types of uncertainties that increase difficulty in scheduling and matchmaking. They are error associated with estimation of job execution times, and lack of knowledge of local resource management policies.

A workload of cloud is characterized by two types of request i.e. On-demand request and Advance reservation request. With an advance reservation request a service requester i.e. consumer follows an SLA with the service provider. The Advance reservation is characterized by a start time, an execution time for the job associated with the request and a deadline by which the job must be completed. On the other hand an On-demand does not have a deadline and needs to be completed on the best effort basis.

The Multi-resource coordinator and Resource liaison and controller are two important components of a resource management framework. The requests are sent to the Multi-resource coordinator where matchmaker maps each request to an appropriate resource. The Resource liaison and controller performs admission control for each resource and ensures that an Advance reservation allocated to the resource is able to meet its deadline. The Resource manager component within Resource liaison and controller negotiates access to a resource with the help of its Local resource manager. The Match advisor component of Resource liaison and controller determines a degree of fit between an Advance reservation and a resource; and then gives this information to Multi-resource coordinator for performing an effective matchmaking. The Scheduler of Resource liaison and controller performs the scheduling of each received request in such a way that its deadline if so, is met while high resource utilization is achieved.

#### **IV. CONCLUSION**

Cloud computing is still in its beginning phase in some of the regions and industry. It will provide industry with new options for managing infrastructures and new business avenues. It will be beneficial to all size of businesses. It is a globally connected and service technology hence whatever is required it is available on the fingertip. To handle it, an effective resource management strategy is required for achieving user satisfaction and generating high revenue for the cloud service provider. This paper discusses the various cloud computing challenges and the issues associated with devising effective resource management technique on cloud. Research is warranted for devising effective matchmaking and scheduling techniques.

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