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Dynamic Resource Allocation in Cloud Environment - A Review

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Abstract*: Cloud computing is the growing technology in current days. It provides benefits to all types of users from small organization to large enterprises. We can access resources available on cloud anywhere and anytime. There are various types of resources available eon cloud for sharing with its users. Due to limited resources on cloud server there is need for efficient resource scheduling and allocation. The resource allocation strategy is classified into two types-static resource allocation and dynamic resource allocation. With static resource allocation the cloud user has to make prior request for the resources. With dynamic resource allocation the cloud resources are requested by the cloud user on the fly or as and when the application needs. This paper provides review of various dynamic resource allocation techniques.
Keywords: Cloud Computing, Resource Allocation, Resource Provisioning

I. INTRODUCTION

Cloud computing [1] comprises of 2 components —the front end and the back end. The front end includes client's devices and applications that are required to access cloud. And the back end refers to the cloud itself. The whole cloud is administered by a central server that is used to monitor client's demands (Fig 1).

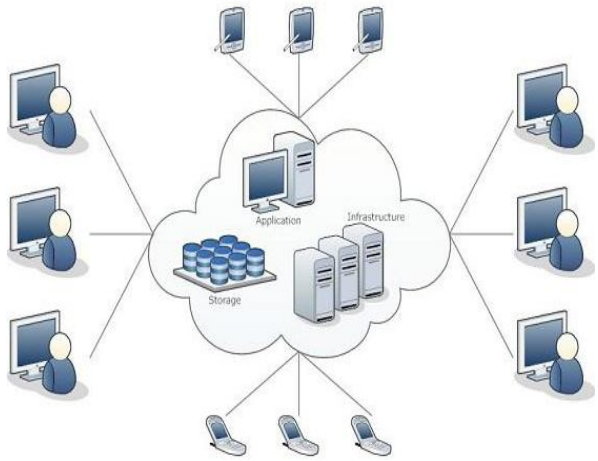

Figure 1: Cloud Computing

Cloud Computing has numerous advantages [2]. Some of them are listed below:

A. One can access applications as utilities, over the Internet.
B. Manipulate and configure the application online at any time.
C. It does not require to install a specific piece of software to access or manipulate cloud application.
D. Cloud Computing offers online development and deployment tools, programming runtime environment through Platform as a Service model.
E. Cloud resources are available over the network in a manner that provides platform independent access to any type of clients.
F. Cloud Computing offers on-demand self-service. The resources can be used without interaction with cloud service provider.
G. Cloud Computing is highly cost effective because it operates at higher efficiencies with greater utilization. It just requires an Internet connection.
H. Cloud Computing offers load balancing that makes it more reliable.

One of the main services of cloud environment is resource allocation. Resource allocation is process of assigning the available resources in an economic way and efficient and effective way Resource allocation is the scheduling of the available resources and available activities required by those activities while taking into consideration both the resource availability and the project time.
Resource allocation can be done by two methods. One of the methods statically allocates the resources and other dynamically allocates the resources. With static resource allocation the cloud user has to make prior request for the resources. With dynamic resource allocation the cloud resources are requested by the cloud user on the fly or as and when the application needs. This paper provides review of various dynamic resource allocation techniques. This paper provides review of different dynamic resource allocation strategies in cloud environment.

II. CHARACTERISTICS OF CLOUD COMPUTING

To better understand Cloud computing, the US National Institute of Science and Technology (NIST) define it as: "Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or client and service provider interaction. This cloud model promotes availability and is composed of five essential characteristics, three service models, and four deployment models".
NIST define cloud computing essential characteristics as follows [2]

A. On-Demand Self-service

A cloud user can individually provision computing capabilities, such as server time and network storage, thus, eliminating the need for a mediator, since the user can manage automatically and access the resources required as needed without requiring human interaction with each service provider.

B. Broad Network Access

Regardless of the end-user platform, users benefit from the cloud and control them through standard mechanisms.

C. Resource Pooling

Cloud resources, such as storage, processing, memory, and network bandwidth are pooled to provide for multiple clients using a multi-tenant model, according to the user's demand. Private cloud may only be offsite at a location controlled by the owner or the provider may allow clients to specify general server locations.

D. Rapid Elasticity

In the cloud, provided resources can be dynamically and elastically allocated and released. This provides scalability for more or fewer resources on demand automatically. This is one reason Denial-of-Service (DoS) attacks are decreasing, as companies with adequate cloud accounts are no longer vulnerable.

E. Measured Services

The control and optimization of resources is done automatically in the cloud using metering capability, according to the type of service storage, processing, bandwidth, and active user accounts. This provides transparency for both the cloud vendor and the clients by monitoring, controlling, and reporting resource usage for the utilized service.

III. DYNAMIC RESOURCE ALLOCATION

From the perspective of a cloud provider, predicting the dynamic nature of users, user demands, and application demands are impractical. For the cloud users, the job should be completed on time with minimal cost. Hence due to limited resources, resource heterogeneity, locality restrictions, environmental necessities and dynamic nature of resource demand, we need an efficient resource allocation system that suits cloud environments. Cloud resources consist of physical and virtual resources. The physical resources are shared across multiple compute requests through virtualization and provisioning. The request for virtualized resources is described through a set of parameters detailing the processing, memory and disk needs. Provisioning satisfies the request by mapping virtualized resources to physical ones. The hardware and software resources are allocated to the cloud applications on-demand basis. For scalable computing, Virtual Machines are rented. The complexity of finding an optimum resource allocation is exponential in huge systems like big clusters, data centres or Grids. Since resource demand & supply can be dynamic and uncertain

Resource allocation is process of assigning the available resources in an economic way and efficient and effective way Resource allocation is the scheduling of the available resources and available activities required by those activities while taking into consideration both the resource availability and the project time. Resource provisioning and allocation solves that problem by allowing the service providers to manage the resources for each individual request of resource. Resource Allocation Strategy (RAS) is all about the number of activities for allocating and utilizing inadequate resources within the limit of cloud environment so as to meet the needs of the cloud application. It requires the type and amount of resources needed by each application in order to complete a user job

IV. LITERATURE REVIEW

Several works related to dynamic resource allocation were done in the past. Some these works are described below.

Bo Yin et. al. [4] discusses about multi-dimensional resource allocation. In this paper, study on the resource allocation at the application level is done, instead to map the physical resources to virtual resources for better resource utilization in cloud computing environment. A multi-dimensional resource allocation (MDRA) scheme for cloud computing is proposed that dynamically allocates the virtual resources among the cloud computing applications to reduce cost by using fewer nodes to process applications. In this model, a two-stage algorithm is adopted to solve this multi-constraint integer programming problem.

Amit Nathani et. al. [5] have proposed policy based resource allocation in IaaS cloud. Most of the Infrastructure as a Service Cloud (IaaS) uses simple resource allocation techniques like immediate and best effort. Immediate Resource Allocation Policy allocates the resource if available otherwise the request is rejected. Best effort policy also resources if currently available otherwise the request is placed in the FIFO queue. So it is not possible for the Service provider to satisfy all the requests as there is finite number of resources at a time. So Haizea is a resource lease manager that addresses these issues by using complex resource allocation strategies. Haizea uses resource leases as resource abstraction and implements these leases by allocating Virtual Machines (VMs). Haizea supports four resource allocation policies: Immediate, best effort, advanced reservation and deadline sensitive. Among the four, deadline sensitive leases by Haizea supports minimal rejection of leases and using this policy, maximum resource utilization is possible. Dynamic Planning based scheduling algorithm is implemented in Haizea which can admit leases and prepare a schedule whenever a new lease can be accommodated.

Sharrukh Zaman et. al. [6] discusses online mechanism for dynamic VM provisioning and allocation. Current cloud provider allocates virtual machine instances via fixed price-based or auction based mechanisms. The limitation in these mechanisms is they are all offline mechanism and they need to collect information and invoked periodically. This limitation is addressed by designing an online mechanism by dynamically provisioning and allocating Virtual machine Instances in Clouds.

Mayank Mishra et. al. [7] proposed dynamic resource management using Virtual Machine Migrations. Virtual machine related features such as flexible resource provisioning, and isolation and migration of machine state have improved efficiency of resource usage and dynamic resource provisioning capabilities. Live virtual machine migration transfers “state” of a virtual machine from one physical machine to another, and can mitigate overload conditions and enables uninterrupted maintenance activities. This paper focuses on the details of virtual machine migration techniques and their usage toward dynamic resource management in virtualized environments.

Gihun Jung et. al. [8] discusses about agent-based adaptive resource allocation. Since both cloud users and data centers of a cloud service provider can be distributed geographically, the provider needs to allocate each user request to an appropriate data center among the distributed data centers, so that the users can satisfy with the service in terms of fast allocation time and execution response time. In this paper, an adaptive resource allocation model is proposed that allocates the cloud user‟s job to an appropriate data center. The method to adaptively find a proper data center is based on two evaluations: 1) the geographical distance (network delay) between a cloud user and data centers, and 2) the workload of each data center.

Xiao-Jun Chen et. al. [9] discusses about resource reconstruction algorithms for on-demand allocation. Resource reconstruction algorithms are used to solve the problem of on-demand resource allocation and can be used to improve the efficiency of resource utilization in virtual computing resource pool. The idea of resource virtualization and on the analysis of resource status transition these algorithms are used. These algorithms are designed to determine the resource reconstruction types and they can achieve the goal of on-demand resource allocation through three methodologies: resource combination, resource split, and resource random adjustment. These algorithms can do the resource adjustment on lower cost and form the logical resources to match the demands of resource users easily.

Ilhem Fajjari et. al. [10] discusses about optimized dynamic resource allocation algorithm for Cloud’s Backbone Network. Because

of the unpredictable and varying user‟s demands, a flexible and intelligent resource allocation scheme is necessary. This paper tackles the fundamental challenge of efficient resource allocation within cloud's backbone network. The ultimate goal is to satisfy the cloud's user requirements while maximizing cloud provider's revenue. The problem consists in embedding virtual networks within substrate infrastructure. A new dynamic adaptive virtual network resource allocation strategy named Backtracking-VNE is investigated to deal with the complexity of resource provisioning within cloud network.

K C Gouda et. al. [11] proposed a new approach that allocates resource with minimum wastage and provides maximum profit. The developed resource allocation algorithm is based on different parameters like time, cost, No of processor request etc. The developed priority algorithm is used for a better resource allocation of jobs in the cloud environment used for the simulation of different models or jobs in an efficient way. After the efficient resource allocation of various jobs, an evaluation is being carried out which illustrates the better performance of cloud computing with profit. A performance study of all the algorithms in various systems and case studies are also presented.

N. Krishnaveni et. al. [12] describe that Cloud computing becomes quite popular among cloud users by offering a variety of resources. This is an on demand service because it offers dynamic flexible resource allocation and guaranteed services in pay as-you-use manner to public. In this paper, we present the several dynamic resource allocation techniques and its performance. This paper provides detailed description of the dynamic resource allocation technique in cloud for cloud users and comparative study provides the clear detail about the different techniques.

Sukhpal Singh et. al. [13] emphasis on the development of energy based resource scheduling framework and present an algorithm that consider the synergy between various data center infrastructures (i.e., software, hardware, etc.), and performance. In specific, this paper proposes (a) architectural principles for energy efficient management of Clouds; (b) energy efficient resource allocation strategies and scheduling algorithm considering Quality of Service (QoS) outlooks. The performance of the proposed algorithm has been evaluated with the existing energy based scheduling algorithms. The experimental results demonstrate that this approach is effective in minimizing the cost and energy consumption of Cloud applications thus moving towards the achievement of Green Clouds.

Riddhi Patel et. al. [14] describe Modified best fit decreasing algorithm (MBFD) is discus for reduce the energy consumption and modified the MBFD algorithm as Energy aware Best Fit Decreasing (EABFD) algorithm. Resource allocation is one of the important challenges in cloud computing environment. It depends on how to allocate the resource to the particular task. Resource allocation can be done by two methods. One of the methods statically allocates the resources and other dynamically allocates the resources. The other challenges of resource allocation are meeting customer demands and application requirements.

V. CONCLUSION

Clouds can make it possible to access applications and associated data from anywhere. Resource allocation is one of the important challenges in cloud computing environment. It depends on how to allocate the resource to the particular task. Resource allocation can be done by two methods. One of the methods statically allocates the resources and other dynamically allocates the resources. With static resource allocation the cloud user has to make prior request for the resources. With dynamic resource allocation the cloud resources are requested by the cloud user on the fly or as and when the application needs. This paper provided review of various dynamic resource allocation techniques.

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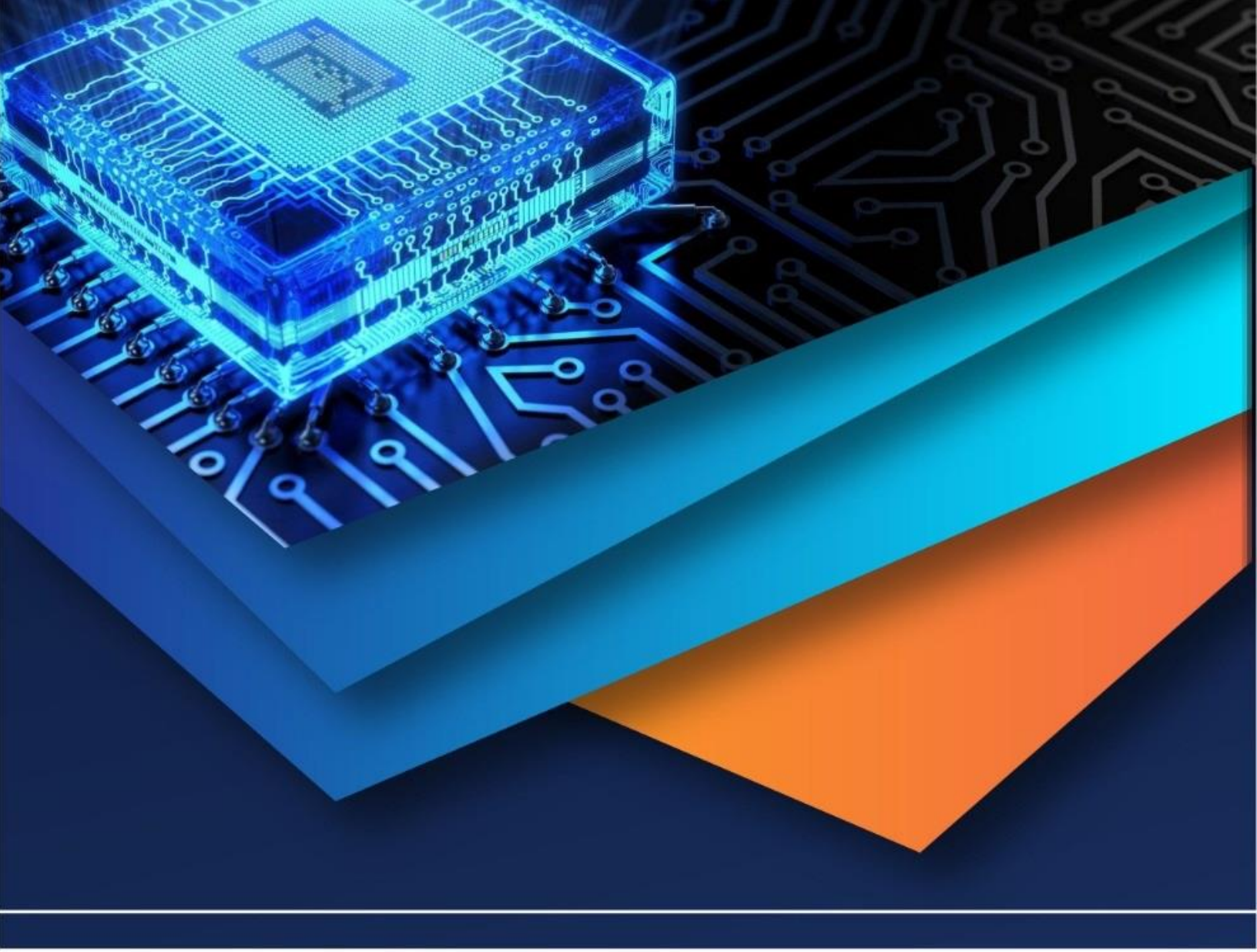

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