

## EFFICIENT RESOURCE ALLOCATION IN CLOUD COMPUTING

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**Abstract:** Cloud computing focuses on delivery of reliable, Fault-tolerant and scalable infrastructure for hosting Internet based application services. Cloud computing has become a new age technology that has got huge potentials in enterprises and markets. 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. The other challenges of resource allocation are meeting customer demands and application requirements. One of the challenges posed by cloud applications is Quality-of-Service (QoS) management, which is the problem of allocating resources to the application to guarantee a service level along dimensions such as performance, availability and reliability. In this paper Modified best fit decreasing algorithm (MBFD) is discussed for reduce the energy consumption. And modified the MBFD algorithm as Energy aware Best Fit Decreasing (EABFD) algorithm.

**Keywords:** Cloud computing, Quality of service (QoS), Resource management, Energy Efficiency, Virtual machine, Migration, Cloudsim.

### I. INTRODUCTION

The adjective “Cloud” in Cloud Computing refers to the network used for service provisioning [6]. Current cloud computing providers mainly rely on large and consolidated datacenters in order to offer their services [5]. Cloud computing delivers infrastructure, platform, and software (applications) as services, which are made available to consumers as subscription based services under the pay-as-you-go model to customers, regardless of their location.[4] the main technical underpinnings of cloud computing Infrastructures and services include virtualization, service-oriented software, grid computing technologies, management of large facilities, and power efficiency. Consumers purchase such services in the form of infrastructure-as-a-service (IaaS), platform-as-a-service (PaaS), or software-as-a-service (SaaS) and sell value added services (such as utility services) to users. [2]. The basic principle of cloud computing is that user data is not stored locally but is stored in the data center of internet. The companies which provide cloud computing service could manage and maintain the operation of these data centers. The users can access the stored data at any time by using Application Programming Interface (API) provided by cloud providers through any terminal equipment connected to the internet.[3] Even though the cloud has greatly simplified the capacity provisioning process, it poses

several novel challenges in the area of Quality-of-Service (QoS) management. QoS denotes the levels of performance, reliability, and availability offered by an application and by the platform or infrastructure that hosts it. QoS is fundamental for cloud users, who expect providers to deliver the advertised quality characteristics, and for cloud providers, who need to find the right tradeoffs between QoS levels and operational costs. However, finding optimal tradeoff is a difficult decision problem, often exacerbated by the presence of service level agreements (SLAs) specifying QoS targets and economical penalties associated to SLA violations [8]. Resource allocation is a major issue in cloud computing environment. Resource allocation has variant level of issues like scheduling task, computational performance, reallocation, response time and cost efficiency. To accomplish the task with the lowest price is the important issue in cloud computing. Resource allocation is the process of providing services and storage space to the particular task given by the users. In this paper a cost efficient resource scheduling method has been discussed and implemented by considering the QoS parameters that the users specify for their tasks. QoS is taken as the major parameter to perform resource allocation. The task submitted by the users consists of multiple QoS requirements that has to be met. The proposed method considers all the QoS specified by the users while allocating the resources to particular tasks.[18]

### II. ARCHITECTURE OF CLOUD COMPUTING

People in IT industry are reassessing data center strategies to determine if energy efficiency should be added to the list of critical operating parameters.

Issues of concern include:

1. Reducing data center energy consumption, as well as power and cooling costs
2. Security and data access are critical and must be more easily and efficiently managed
3. Critical business processes must remain up and running in a time of power drain or surge.

These issues are leading more companies to adopt a Green Computing plan for business operations, energy efficiency and IT budget management. Green Computing is becoming recognized as a prime way to optimize the IT environment for the benefit of the corporate bottom line – as well as the preservation of the planet. It is about efficiency, power consumption and the application of such issues in business decision-making.[7] Simply stated, Green Computing benefits the environment and a company's bottom line. It can be a win/win situation, meeting business demands for cost-effective, energy-efficient, flexible, secure and stable solutions, while demonstrating new levels of environmental responsibility.

**A. Cloud:**

Cloud computing is becoming one of the most explosively expanding technologies in the computing industry today.[17] It enables users to migrate their data and computation to a remote location with minimal impact on system performance. These benefits include:

1. Scalable - Clouds are designed to deliver as much computing power as any user wants.
2. Quality of Service (QoS) - Unlike standard data centers and advanced computing resources, a well designed Cloud can project a much higher QoS than typically possible.
3. Specialized Environment - Within a Cloud, the user can utilize custom tools and services to meet their needs.
4. Cost Effective - Users finds only the hardware required for each project.
5. Simplified Interface - Whether using a specific application, a set of tools or Web services, Clouds provide access to a potentially vast amount of computing resources in an easy and user-centric way.

**B. Cloud Infrastructure:**

In Cloud computing infrastructure, there are four main entities involved:

1. Consumers/Brokers: Cloud consumers or their brokers submit service requests from anywhere in the world to the Cloud. It is important to notice that there can be a difference between Cloud consumers and users of deployed services.
2. Green Resource Allocator: Acts as the interface between the Cloud infrastructure and consumers. It requires the interaction of the following components to support energy-efficient resource management:

*Green Negotiator:*

Negotiates with the consumers/brokers to finalize the SLA with specified prices and penalties between the Cloud provider and consumer depending on the consumer's QoS requirements and energy saving schemes.

*Service Analyzer:*

Interprets and analyses the service requirements of a submitted request before deciding whether to accept or reject it.

*Consumer Profiler:*

Gathers specific characteristics of consumers so that important consumers can be granted special privileges and prioritized over other consumers.

*Pricing:*

Decides how service requests are charged to manage the supply and demand of computing resources and facilitate in prioritizing service allocations effectively.

*Energy Monitor:*

Observes and determines which physical machines to power on/off.

*Service Scheduler:*

Assigns requests to VMs and determines resource entitlements for allocated VMs. It also decides when VMs are to be added or removed to meet demand.

*VM Manager:*

Keeps track of the availability of VMs and their resource entitlements. It is also in charge of migrating VMs across

physical machines.

*Accounting:*

**Users/  
Brokers**

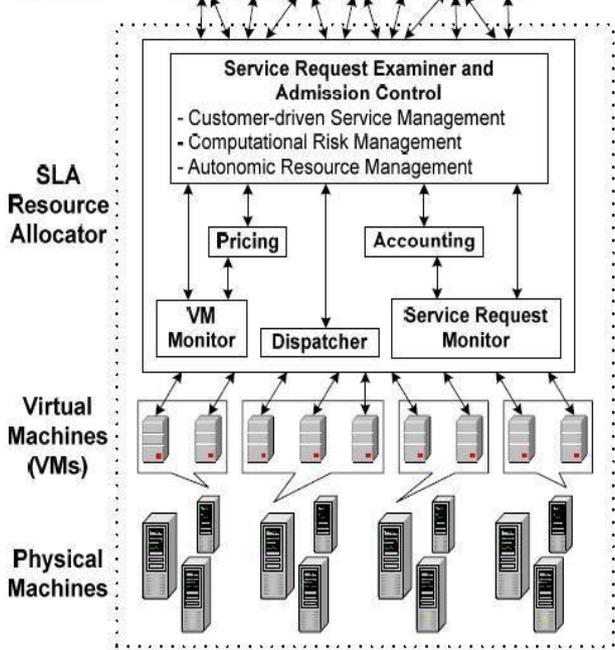


Figure 1: The High Level System Architecture

Maintains the actual usage of resources by requests to compute usage costs. Historical usage information can also be used to improve service allocation decisions.

3. VMs: Multiple VMs can be dynamically started and stopped on a single physical machine to meet accepted requests, hence providing maximum flexibility to configure various partitions of resources on the same physical machine to different specific requirements of service requests. Multiple VMs can also concurrently run applications based on different operating system environments on a single physical machine.

4. Physical Machines: The underlying physical computing servers provide hardware infrastructure for creating virtualized resources to meet service demands. In this paper conduct a survey of research in energy efficient Computing and energy efficient resource allocation policies considering QoS expectations and power usage characteristics of the devices.

**III. RESEARCH CHALLENGES INHERENT TO RESOURCE ALLOCATION**

One of the most important aspects of cloud computing is the availability of "infinite" computing resources that may be used on demand. Users may rely on this "infinite" resource feeling because the distributed cloud through the resource allocation system (RAS), which is shown in Fig. 2 tries to deal with end users' demands in an elastic way. This elasticity allows the statistical multiplexing of physical resources, avoiding both under- and over provisioning, as is the case in most corporate information technology (IT)

infrastructures. Furthermore, there is a need to cope with resource heterogeneity.[5] This can be seen in distributed clouds, which are composed of computational entities with different architectures, software, and hardware capabilities. Thus, the development of a suitable resource model is the first challenge that an RAS must deal with. The RAS for a distributed cloud also faces the challenge of representing cloud applications and describing them in terms of what is known as resource offering and treatment. Together with traditional network requirements (bandwidth and delay) and computational requirements, (CPU and memory), new requirements (locality restrictions and environmental necessities) are now part of the distributed cloud's additional requirements. Similarly, the right mechanisms for resource discovery and monitoring should also be designed, allowing the RAS to be aware of the current status of available resources. Based on this information, the RAS is then able to optimize already allocated resources, and can also elect available resources to fulfil future demands. In Fig. 3, we see how the four challenges above are related. First, the provider faces the problems grouped together in the conception phase, where the provider should model resources according to the kind of service(s) it will supply and the type of resources it will offer. The next two challenges are faced in the scope of the operational phase. When requests arrive, the RAS should be aware of the current status of resources in order to determine if there are available resources in the distributed cloud that could satisfy the present request. Then, if this is the case, the RAS may select and allocate them to serve the request. When conceiving a distributed cloud, it is natural for its provider to choose the nature of its offering: service, infrastructure, and platform as a service (SaaS, IaaS, and PaaS).The next sections describe each of these four challenges.

**A. Resource Modeling**

The cloud resource description defines how the cloud deals with infrastructural resources. This modeling is essential to all operations in the cloud, including management and control. Optimization algorithms are strongly dependent on the resource modeling scheme used. Network and computing resources may be described by several existing notations, such as the Resource Description Framework (RDF) and Network Description Language (NDL). However, in a cloud environment, it is very important that resource modeling take into account schemas capable of representing virtual resources, virtual networks, and virtual applications. Virtual resources need to be described in terms of properties and functionalities, much like services and devices/nodes are described in existing service architectures. The granularity of the resource description is another important point. The amount of detail that should be taken into consideration when describing resources is related to the difficulty of achieving a generic solution for distributed clouds. If resources are described using many details, there is a risk that the resource selection and optimization phase could become hard and complex to handle. On the other hand, more details allow more flexibility

and leverage in the usage of resources. Additionally, resource modeling is associated with a big challenge in current cloud computing: interoperability. In this way, the main goal of interoperability in clouds is to realize the seamless flow of data across clouds, and between clouds and their local applications. Solutions such as intermediary layers, standardization, and open application programming interfaces (APIs) are interesting options for interoperability. According to [19] Interoperability in the cloud faces two types of heterogeneities: vertical and horizontal. The former is intra-cloud interoperability, and may be addressed by middleware and enforcing standardization. The authors highlight the Open Virtualization Format (OVF) as an interesting option for managing virtual machines (VMs) across heterogeneous infrastructures.

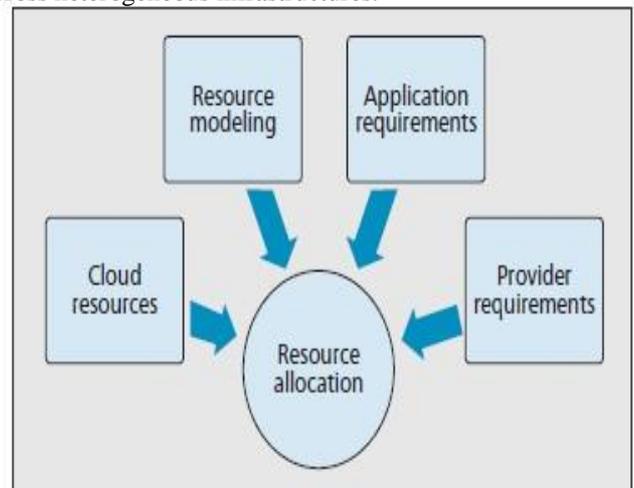


Figure.2 Resource allocation inputs

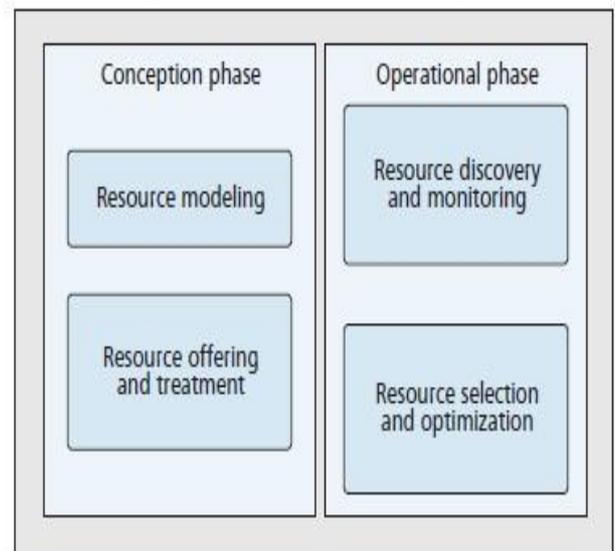


Figure 3.Relationship between resource allocation challenges.

The latter heterogeneity type is more difficult to address because it is related to clouds from different providers. Once each provider manipulates and describes their resources at their own abstraction level, the challenge is how to lead with these differences to permit interaction between clouds. A high level of granularity in the modeling may help to address

this type of problem, but perhaps at the cost of losing information. Distributed clouds may take advantage of accruing horizontal interoperability. In such a scenario, a provider may receive a request with specific locational constraints, and for some reason (e.g., the unavailability of resources close to the requested location) cannot fulfill that request. Then, as an alternative, the provider may “borrow” resources from another one by dynamically negotiating these.

### *B. Resource Offering and Treatment*

Once the cloud resources are modeled, the provider may offer interfaces that are elements of the RAS, in the cloud computing ecosystem. The middleware should handle resources (at a lower level) and, at the same time, deal with the application’s requirements (described at a higher level). [5] It is important to highlight that resource modeling is possibly independent of the way they are offered to end users. For example, the provider could model each resource individually like independent items on a fine-grained scale, such as the gigahertz of CPU or gigabytes of memory, but offer them as a coupled collection of items or a bundle, such as VM classes (high memory and high processor types). Since a distributed cloud craves a generic solution (i.e., to support as many applications as possible), resource offering becomes very cumbersome. Questions like “how can one achieve a good trade-off between the granularity of the resource modeling, and the ease of dealing with the generality level?” and “how many types of applications may one support to be considered generic enough?” must be considered by providers. Furthermore, handling resources requires that the RAS implement solutions to control all the resources in the cloud. Such control and management planes would need a complete set of signalling protocols to set up hypervisors, routers, and switches. Currently, to deal with these tasks, each cloud provider implements their own solution, which generally inherits a great deal from datacenter control solutions. They also employ solutions for the integrated control of hypervisors. In the future, new signaling protocols can be developed for resource reservation in heterogeneous distributed clouds. The RAS must ensure that all requirements may be met with the available resources. These requirements have been defined previously between the provider and each cloud user, and may be represented by service level agreements (SLA) and ensured by the provider through continuous monitoring [16]. You may recall that, in addition to common network and computational requirements, new requirements are present under distributed cloud scenarios. Below, we describe some of these. The list is merely illustrative, since there are many distinct use scenarios, each with possibly differing requirements. The topology of the nodes may be described. In this case, cloud users are able to set inter-node relationships and communication restrictions (e.g., downlinks and uplinks). This is illustrated in the scenario where servers — configured and managed by cloud users are distributed (at different physical nodes), while it is necessary for them to communicate with each other in a specific way. Jurisdiction

is related to where (physically) applications and their data must be stored and handled. Due to restrictions such as copyright laws, cloud users may want to limit the locations where their information can be stored (e.g., countries or continents) .This requirement should be re-evaluated to ensure that it does not conflict with topology requirements. The node proximity may be seen as a constraint, where a maximum (or minimum) physical distance (or delay value) between nodes is imposed. This may also have direct impact on other requirements, such as topology. Although cloud users do not know about the actual topology of the nodes, here they may merely request a delay threshold, for example. The application interaction describes how applications are configured to exchange information with each other. Cloud users may introduce some limitations (e.g., access control) according to their policies. Thus, application interaction and topology requirements may also be strongly related to each other. The cloud user should also be able to define scalability rules. These rules would specify how and when the application would grow and consume more resources from the cloud. Work in defines a way of doing this, allowing the cloud user to specify actions that should be taken (e.g., deploying new VMs) based on thresholds of observed metrics.

### *C. Resource Discovery and Monitoring*

Resource discovery stems from the provider needing to find appropriate resources (suitable candidates) to comply with requests. In addition, questions like “how can one discover resources with (physical/geographical) proximity in a distributed cloud?” and “how can one minimally impact the network, especially costly inter domain traffic?” also fall within the responsibility of resource discovery, and cannot be answered trivially. Furthermore, considering distributed clouds, any new signalling overhead should not affect other essential quality-of-service requirements. A simple implementation of the resource discovery service uses a discovery framework with an advertisement process, for the NV scenario. It is used by brokers to discover and match available resources from different providers. It consists of distributed repositories responsible for storing resource descriptions and states. Considering that one of the key features of cloud computing is its capability of acquiring and releasing resources on demand, resource monitoring should be continuous, and should help with allocation and reallocation decisions as part of overall resource usage optimization. A careful analysis should be done to find an acceptable trade-off between the amount of control overhead and the frequency of resource information refreshing. The above monitoring may be passive or active. It is considered passive when there are one or more entities collecting information. The entity may continuously send polling messages to nodes asking for information or do this on demand when necessary [16]. On the other hand, the monitoring is active when nodes are autonomous and may decide when to send asynchronously state information to some central entity. Naturally, distributed clouds may use both alternatives simultaneously to improve the monitoring

solution. In this case, it is necessary to synchronize updates in repositories to maintain consistency and validity of state information.

#### D. Resource Selection and Optimization

With information regarding cloud resource availability at hand, a set of appropriate candidates may be highlighted. Next, the resource selection process finds a configuration that fulfills all requirements and optimizes the usage of the infrastructure. In virtual networks, for example, the essence of resource selection mechanisms is to find the best mapping of the virtual networks on the substrate network with respect to the constraints. Selecting suitable solutions from a set is not a trivial task due to the dynamicity, high algorithm complexity, and all the other different requirements relevant to the provider. Resource selection may be done using optimization algorithms. Many optimization strategies may be used, from simple and well-known techniques such as simple heuristics with thresholds or linear programming to newer, more complex ones, such as Lyapunov optimization. Moreover, artificial intelligence algorithms, biologically inspired ones (e.g., ant colony behavior), and game theory may also be applied in this scenario. Authors in [16] define a system called Volley to automatically migrate data across geo-distributed datacenters. This solution uses an iterative optimization algorithm based on weighted spherical means. Resource selection strategies fall into a priori and posterior classes. In the a priori case, the first allocation solution is an optimal one. To achieve this goal, the strategy should consider all variables influencing the allocation. For example, considering VM instances being allocated, the optimization strategy should figure out the problem, presenting a solution (or a set of possibilities) that satisfies all constraints and Meets the goals (e.g., minimization of reallocations) in an optimal manner. In an a posterior case, once an initial allocation that can be a suboptimal solution is made, the provider should manage its resources in a continuous way in order to improve this solution. If necessary, decisions such as to add or reallocate resources should be made in order to optimize the system utilization or comply with cloud users' requirements. Since resource utilization and provisioning are dynamic and changing all the time, it is important that any a posterior optimization strategy quickly reach an optimal allocation level, as a result of a few configuration trials. Furthermore, it should also be able to optimize the old ones, readjusting them according to new demand. In this case, the optimization strategy may also fit with the definition of a priori and dynamic classification.

#### IV. ENERGY AWARE ALLOCATION OF DATACENTER RESOURCES

In this paper a QoS based resource allocation is carried out for saving the energy. When there is a tie of this manner it is difficult to choose the best resource so that an optimum and cost efficient allocation can be achieved. That is why resource allocation and resource scheduling becomes NP hard problems becomes we have to find the best fit resource

from the group of fit resources that can be allocated to the task.[18] As we have considered storage cloud which falls under the category of IaaS cloud, the QoS parameters that we have considered are Memory space wastage, response time, CPU utilization and throughput in addition to this for cost efficiency we have considered upload time and down load time which is initially calculated for uploading a file or downloading a file. One of the techniques to report the energy inefficiency is to influence the competencies of the virtualization technology. A virtualized server is commonly called a virtual machine (VM). Virtualization forms the foundation of cloud computing, as it provides the capability of pooling computing resources from clusters of servers and dynamically assigning or reassigning virtual resources to applications on-demand[1].The virtualization technology [9] permits Cloud providers to create multiple Virtual Machine (VMs) requests on a single physical server, hence increasing resources utilization & Return On Investment (ROI). The virtual machines are run as guests by a hypervisor, such as Xen[15] ,KVM[11] and VMware[8]. Energy consumption can be reduced by switching idle nodes to low-power modes (i.e. sleep, hibernation), therefore eliminating the idle power consumption. additionally, by using Dynamic migration the VMs can be dynamically consolidated to the minimal number of physical nodes respected to their current resource needs.[10]Yet, efficient resource management in Clouds is not trivial, as modern service applications often involve rapidly changing workloads resulting dynamic resource usage patterns. Hence, antagonistic consolidation of VMs can result into degraded performance, when applications have growing demand of resources, which results in an unpredicted rise of the resource usage & if they are not fulfilled, the application can suffer increased response times, time-outs or failures. Reliable Quality of Service (QoS) defined via Service Level Agreements (SLAs) should be established between Cloud providers and their customers is must for Cloud environments[12]; thus, Cloud providers have to more concentrate on the energy-performance trade-off – the minimization of energy consumption, at the same time meet the SLAs. As the traditional static migration strategy causes unnecessary overheads of migrations . Hence, to ensure user's tasks continue to run during migration process, to reduce the SLA violations of virtual machines, and to reduce the costs of power consumption that are caused by low workload resources, and such as lack of consideration of these aspects,

#### A. Allocation of VM

The problem of VM allocation can be divided in two: the first part is the admission of new requests for VM provisioning and placing the VMs on hosts, whereas the second part is the optimization of the current VM allocation. The first part can be seen as a bin packing problem with variable bin sizes and prices. To solve it applied a modification of the Best Fit Decreasing (BFD) algorithm that is shown to use no more than  $11/9 \cdot OPT + 1$  bins (where OPT is the number of bins given by the optimal solution). In our modification, the Modified Best Fit Decreasing (MBFD)

algorithms,[13] sort all VMs in decreasing order of their current CPU utilizations, and allocate each VM to a host that provides the least increase of power consumption due to this allocation. This allows leveraging the heterogeneity of resources by choosing the most power-efficient nodes first. The pseudo-code for the algorithm is presented in Algorithm 1. The complexity of the allocation part of the algorithm is  $n.m$ , where  $n$  is the number of VMs that have to be allocated and  $m$  is the number of hosts.

Algorithm: Modified Best Fit Decreasing (MBFD)

```

1 Input: hostList, vmList Output: allocation of VMs
2 vmList.sortDecreasingUtilization()
3 foreach vm in vmList do
4   minPower ← MAX
5   allocatedHost ← NULL
6   foreach host in hostList do
7     if host has enough resource for vm then
8       power ← estimatePower(host, vm)
9       if power < minPower then
10        allocatedHost ← host
11        minPower ← power
12   if allocatedHost ≠ NULL then
13     allocate vm to allocatedHost
14   return allocation
    
```

**B. Selection of VM**

The optimization of the current VM allocation is carried out in two steps: at the first step select VMs that need to be migrated, at the second step the chosen VMs are placed on the hosts using the MBFD algorithm. To determine when and which VMs should be migrated, introduce three double-threshold VM selection policy. The basic idea is to set upper and lower utilization thresholds for hosts and keep the total utilization of the CPU by all the VMs allocated to the host between these thresholds. If the CPU utilization of a host falls below the lower threshold, all VMs have to be migrated from this host and the host has to be switched to the sleep mode in order to eliminate the idle power consumption. If the utilization exceeds the upper threshold, some VMs have to be migrated from the host to reduce the utilization. The aim is to preserve free resources in order to prevent SLA violations due to the consolidation in cases when the utilization by VMs increases. The difference between the old and new placements forms a set of VMs that have to be reallocated. In this paper I Proposes a modification of Modified Best fit Decreasing (MBFD) algorithm as the Energy Aware Best Fit Decreasing (EABFD) algorithm. The Proposed algorithm put Energy Constraint together on MBFD algorithm for better energy conversation and resources utilization. It sorts all VMs according to their decreasing order of CPU utilization and allocates each VM to next VM that decreases Energy Consumption by proper allocation of resources. And Selecting the host from hostList for allocating the resources which has to take for minimum time for allocation. The EABFD algorithm allows the leveraging the heterogeneity of resources by choosing the most energy efficient node first. Figure 4. Shows the methodology of

proposed work.

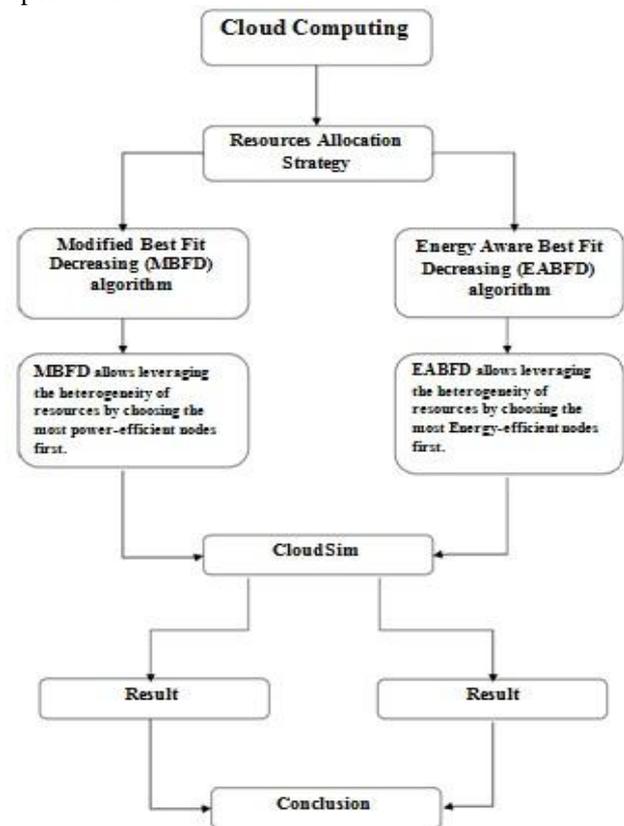


Figure 4: Methodology of Proposed Work

**V. EXPERIMENTAL SETUP**

**A. Cloudsim overview:**

CloudSim's goal is to provide a generalized and extensible simulation framework that enables modeling, simulation, and experimentation of emerging Cloud computing infrastructures and application services, allowing its users to focus on specific system de-sign issues that they want to investigate, without getting concerned about the low level details related to Cloud-based infrastructures and services.[14]

**Main Features**

The main Features of Cloudsim are:

- Support for modeling and simulation of large scale Cloud computing data centers.
- Support for modeling and simulation of virtualized server hosts, with customizable. Policies for provisioning host resources to virtual machines.
- Support for modeling and simulation of energy-aware computational resources.
- Flexibility to switch between space-shared and time-shared allocation of processing cores to virtualized services.
- Support for modeling and simulation of data center network topologies and message-passing applications.
- Support for modeling and simulation of federated

clouds.

- Support for dynamic insertion of simulation elements, stop and resume of simulation.
- Support for user-defined policies for allocation of hosts to virtual machines and policies for allocation of host resources to virtual machines.

Entity	Tool/Software
Operating System	Windows 8
Simulation Engine	Cloudsim 3.0
Front-end IDE	NetBeans 8.0.3
Programming Language	Java
Performance Monitor	CloudAnalyst
Result Analysis	CloudReports
Real Test-bed	Xen Hypervisor Cloud

Table: Environment Setup for Implementation

## VI. CONCLUSION

Energy Aware Best Fit Decreasing (EABFD) algorithm for resource allocation has been proposed. Literature review shows that resource allocation is one of the most crucial parts of cloud architecture and can make a significant change in the utilization of resources. Resources being the core of datacenters, managing resources and allocating them in an efficient manner through Energy Aware Best Fit Decreasing algorithm make the cloud systems more efficient. In order to effectively meet the varying requirements of cloud users Energy Aware Best Fit Decreasing algorithm is designed to be dynamic and scalable. This algorithm minimizes energy consumption by providing a constraint for energy. Energy saving is done by proposed algorithm by efficient consolidation of VM. We believe that this work can be further extended and additional functionalities can be added to it. Thus Energy Aware Best Fit Decreasing algorithm for resource allocation is a potential candidate for adaptation in enterprise level cloud software.

## VII. FUTURE WORK

Cloud demand and cloud resource utilization are factors that most of the IT industries and other organization will demand the most in future. My future work is to saving the energy by implementing the proposed algorithm by efficient consolidation of VM. Compare the existing algorithm and proposed algorithm. The Proposed algorithm can be analyzed for Scalability, Resources utilization, Workload and efficiency.

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