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Enhancing Reliability In Distributed Systems Through Cloud Computing

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Abstract:

Computing in the cloud is a relatively new technology that utilises a pay-per-use model to guarantee that users have access to the resources they need. Pay-per-use pricing is another example of a cost-based model. A number of resources, including storage that is supplied by the cloud, guarantee that customers will be able to keep essential data and information; yet, the user will incur costs since they will be storing information that may potentially be duplicated in nature. The migration technique in cloud datacenters is the focus of this article, which aims to be cost efficient. It is recommended that a redundancy management technique be implemented in order to fulfil this goal. This approach would replace information that is comparable with the index value. This is the reason why an index file is kept, which contains all of the keywords of the files in a way that is not redundant across them. When the size of the file that needs to be migrated is decreased, the amount of storage that is required also decreases. Therefore, storage resources are used effectively in order to guarantee decreased price throughout the transfer process. The simulation is carried out in NetBeans with CloudSim integration, and the results provide a 25% reduction in terms of cost and migration time compared to the material that is already available.

Keywords: Cloud Computing, Storage, Cost, Migration

Introduction:

The term "Big Data" is occasionally used to refer to the notion of massive amounts of data, which is typically intended to be handled via cloud computing. When compared to the internal storage capacity of the mobile device, cloud computing makes it possible for devices to store a greater amount of data [1]. In order for the mobile device to make advantage of the space that is available inside the cloud, it is necessary for the mobile device to acquire the cloud space [2]. On account of this, one-of-a-kind identifiers will be assigned to each and every gadget that is taking part in cloud computing. The structure of cloud computing may be shown in the figure that includes the following points:

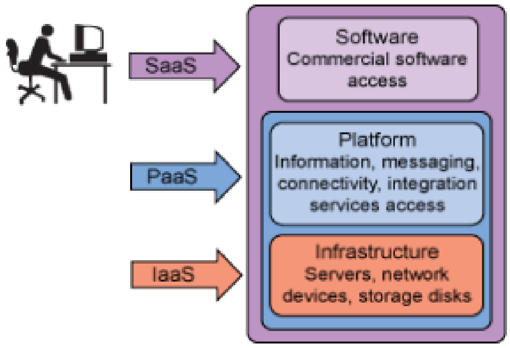

Figure 1: Showing Components of Cloud

Following is a description of the many components that make up cloud computing:

- Software is essential to the operation of cloud computing, which is referred to as SaaS [3]. In the event that the user authentication check is successful, the action will be carried out. This process of validation involves communication between the front end and the back end of the programme. To put it another way, software that is used inside the cloud will be the source of SaaS.
- Platform as a Service: The cloud computing will need a platform that is supporting [4]. The PaaS encompasses a wide range of components, including information, communications, networking, integration, and so on.
- Within the realm of cloud computing, infrastructure as a service (IaaS) is also a very significant component [5]. There will be servers, a network, devices, storage discs, and other components that make up the infrastructure.

VM Migration:

It is possible to partition a single physical memory into numerous virtual machines via the use of VM migration. These virtual machines may then share the same physical devices and operate concurrently [9]. The migration of virtual machines (VMs) is a method that allows us to increase the storage capacity of mobile devices. This process moves data to the cloud in a temporary capacity. VM migration may be broken down into the following categories:

Live Virtual Migration:

Live virtual migration is an essential method for optimising the growth of virtual environments in conjunction with physical knobs in data centres and for effectively balancing the load [10]. The term "live migration" refers to the process of moving virtual data from one physical host to another while the host is continually switched up. When carried out in the appropriate manner, this procedure has the potential to provide a perceptible impact from the perspective of the end user. Through the use of live migration, a supervisor is able to take a virtual machine offline for the purposes of preservation or upgrading without causing the user of the system to experience any downtime [11].

Advantages:

- It enables preventative maintenance to be performed. It is possible to address the prospective issue before it causes an interruption in service if it is anticipated that an impending failure is occurring.

- It is also possible to employ live migration for load balancing, which is a process in which work is distributed across many computers in order to maximise the utilisation of the CPU resources that are available.
- The virtual machine (VM) that is failing on the physical node may be moved to a healthy node.
- In order to maximise the use of the available resources, idle virtual machines might be moved to another location.

Warm Up Phase:

This is the step of startup that marks the beginning of the virtual machine migration [13]. By employing this method, virtual machines (VMs) are initialised inside data centres.

Stop-and-Copy Phase:

Following the completion of the warm-up phase, the virtual machine (VM) will be paused on the first host, the pages that are still defective will be duplicated to the goal host, and the VM will then be resumed on the goal host [14]. The amount of time that passes between terminating the virtual machine (VM) on the primary host and restarting it on the target host is referred to as "down-time." This time period may vary anywhere from a few milliseconds to a few seconds, depending on the amount of memory and apps that are installed on the VM. The utilisation of probability thickness capacity of memory change is one of the many methods that may be utilised to reduce the amount of downtime that occurs during live migration.

Post-Copy Memory Migration:

To begin the post-copy virtual machine migration, the virtual machine (VM) at the source is suspended [15]. An minor portion of the execution condition of the virtual machine (VM) is transferred to the goal when the VM is stopped. This includes the state of the CPU, registers, and, alternatively, memory that is not capable of being paged. Next, the virtual machine is continued at the target. While this is happening, the source is essentially pushing the remaining memory pages of the virtual machine (VM) to the goal, which is a process that is known as pre-paging. If the virtual machine (VM) attempts to access a page that has not yet been swapped, it will result in the creation of a page blame at the goal. These errors, which are referred to as system faults, are detected at the objective and then sent to the source, which then responds with the page that is being blamed. Execution of applications that are executing inside the virtual machine (VM) might be hampered by an excessive number of system errors. As a result, pre-paging has the ability to effectively modify the page transmission request in order to organise faults by pushing pages in the area of the most recent blame. In spite of the fact that its execution is dependent on the memory get to example of the workload of the virtual machine (VM), a flawless pre-paging plan would cover a far bigger portion of available system faults. After the system has been completed, post-copy will deliver each page in its entirety. During migration, it is interesting to note that pre-copy may trade a same page in various conditions if the page is dirty many times at the source. On the other hand, pre-copy maintains an up-to-date condition of the virtual machine (VM) at the source throughout the migration process, while post-copy allows the VM's state to be appropriated across both the source and the ultimate destination. Whereas post-copy is unable to recover the virtual machine (VM), pre-copy is able to do so in the event that the objective is not met during the migration process.

As part of the request, live virtual machine migration is used in order to offload the information to the virtual machines that are located inside the cloud [16]. The virtual machine migration process may be divided into two categories: the first is live, and the second is non-live. The non-live migration process will first cause the system to shut down, and then migration will take place following that closure. When a live virtual machine (VM) migration is performed, the VM remains on the system while the migration is carried out. The use of the recommended paper [17] will result in a reduction in the expenses associated with switching the virtual machine work from online to disconnected. As part of the proposed framework, the virtual machine migration will be enhanced. There will be a reduction in costs, and the use of resources will be maximised.

Data Migration:

A virtual machine (VM) migration involves moving the whole operating system (OS) from one physical environment to another of the same kind. Consequently, the whole programme that is now executing, including with all of its responsibilities, is moved from one virtual machine (VM) to another. Nevertheless, the whole technique is altered in the event that data migration occurs. Rather of moving the whole programme from one virtual machine to another, data migration involves moving just a portion of the application or a subset of the data inside the application. Certain factors, such as a deadline, a lack of resources, famine, prioritisation, and so on, might be the reason for data transfer. A deadline is the time limit within which a machine must complete its work; if the deadline is exceeded, then the machine will not be able to provide the best possible outcome. In the event that the work that has been assigned to a machine cannot be finished within the deadline, then the data or a portion of the data is transferred to another machine. This is done in order to ensure that the whole project can be finished within the allotted amount of time or within the predetermined amount of time. In addition, there is a need to transfer the data from one system to another in the event that there is a shortage of resources. Within the cloud, the broker is the one who is responsible for carrying out the migration task. This issue with resources has the potential to be one of the reasons why data migration occurs. In the event that the computers that are now operating have less resources available to help them fulfil their tasks, then it is necessary to migrate the data in order to meet the requirements. When a user makes a request for data migration, the broker will examine the availability of a virtual machine that is capable of completing the task within the allotted time. If the virtual machine is available, the broker will assign the task to another machine by moving the data.

However, the cloudlets that are looking for resources are unable to get resources from the virtual machine, which results in an issue of hunger. This results in an increase in waiting time, which in turn generates a rise in overall Makespan that goes beyond fitness level. The cloud environment assigns a priority to each and every task that is being performed. In the process of carrying out the task, the priority list is examined first, and then jobs are carried out in accordance with their respective priorities. On the other hand, priority may occasionally be the reason for data migration. This is due to the fact that if the work with the lowest priority and the shortest burst time is not finished within the allotted time, it might result in a great deal of trouble. In order to solve these issues, the data is transferred from one system to another. This ensures that the tasks are finished exactly when they are supposed to be.

Literature Survey:

In this part, a background examination of the different approaches involved with virtual machine migration and the preservation of storage space is given. It is necessary to have a method for the preservation of storage space in order to achieve better utilisation of resources and to save costs. Disc space conservation via the use of a power-aware cache management approach is presented in [18] due to this particular objective. For the purpose of work allocation, the offline greedy algorithm is used to guarantee the shortest search route between virtual machines (VMs), hence reducing energy. [19] also suggests reducing the amount of duplicate data while simultaneously ensuring the safety of the data. De-duplication is the term used to describe the procedure. The data that is going to be moved to the cloud is first examined to see whether or not it is redundant, and then an encryption procedure is carried out. Efficient use of space helps save money and energy at the same time. The virtual machine migration approach that was presented by X. Zhang is effective; nevertheless, more changes of the kind that were offered by [20] are still necessary. As part of this strategy, a block-level de-duplication process was devised, which ensured that every facet of the analysis mechanism was taken into consideration in order to achieve greater space conservation. The memory status of a virtual machine (VM) is transferred from one prime mover (PM) to another during live VM migration in [21], which encourages continuing management of programmes that are now executing. As a result of the fact that each live virtual machine migration results in migration downtime, during which the services that are operating on that VM are impacted, the lesser the migration downtime, the better.

The findings of our investigation, which can be found in [22], indicate that each and every calculation that aims to effectively distribute assets on demand via live migration provides answers to four questions. These questions are as follows: (1) determining when a host is regarded to be over-burdened; (2) determining when a host is deemed to be under-stacked. The identification of virtual machines (VMs) that should be moved from an overloaded host, as well as the completion of another position of the VMs that have been selected for migration from the overloaded and underloaded hosts. A approach that is employed for energy efficiency in virtual integration is described by Goudarzi and Pedram in [23]. This technique does not compromise the quality of service throughout the process. The technique that was suggested is dynamic and makes use of the local search in order to ascertain the overall energy cost in the system as well as the number of virtual machines that are hosted in the cloud infrastructure. The algorithm that has been suggested offers a flexible approach that may be used to improve the energy efficiency of the framework for distributed computing or even to increase the accessibility of assets inside the datacenter facilities. The provider of cloud services has the ability to decide how to take advantage of virtual machines (VMs) that have significant resource requirements and how to distribute their requests among the servers in order to maximise energy efficiency. On the other hand, it does not take into account the virtual machine that has been replicated over the cloud, and the processing requirements might also be raised by factor. It presents an algorithm that is based on the genetic algorithm and takes into consideration the demands of machines that have been made in the past as well as the demands that are now being made. Through the use of the physical machine and the maintenance of all other machines in power conservation mode, it is possible to reduce the amount of power that is consumed. Using this approach, load is balanced while simultaneously reducing the amount of power that is used via the cloud. In addition, it does not take into account the limits that are placed on the virtual machines that are reliant on a single physical system. An algorithm was presented by A. Hashmi in [24], and its primary objective is to make full use of a host by harnessing the power of virtual machines. The distribution of virtual machines (VMs) and the planning of assignments are the two most important tasks in cloud computing. The goal is to make use of a small number of hosts, dynamic load adjustment that is productive, the shortest possible response and turnaround time, and the least amount of power that is used. A single server centre is used to host all of the virtual machines (VMs) in this article. As a consequence of this, it does not take into account the components such as the system or web transmission capacity when determining the delay corresponding time (according to the distinct base between the client and the server farm).

S. K. Mandal, in his article [25], discussed the process of satisfying a greater number of requests within a certain time frame. It is necessary to make effective use of the physical computers, which means that the virtual machine arrangement strategy should be sufficient to restrict the number of physical machines that are used, taking into consideration the cost and the service level agreement (SLA). The numerous open-source cloud processing arrangements were discussed in this study, along with certain virtual machine arrangement techniques that were welcomed by those arrangements. The visualisation of a suggested approach for the layout of virtual machines, which is referred to as VM Scheduler, has been completed in this work. The results made it very clear that the suggested VM Scheduler is performing far better than any of the alternative position arrangements that were investigated in terms of restricting cost, limiting designation time, and minimising SLA violation. Despite the fact that the relocation of virtual machines has not been taken into consideration in this study, the execution has the potential to be improved even further. Once the execution of a virtual machine has been completed on a particular physical system, that machine may be replaced with a more suitable virtual machine that is operating on a different physical computer. This helps to reduce the number of physical assets that are used, which in turn helps to reduce the cost. The study effort that is presented in [26] presents a comprehensive and progressive overview of the most significant VMP (Virtual Machine Placement) literature with the particular objective of having a distinctive look into the situations. Cloud computing data centres feature a large number of excellent virtual machines (VMs) that are based on real-world scenarios. Within the context of this particular scenario, Virtual Machine Placement (VMP) is one of the most challenging difficulties in cloud foundation administration. This is due to the fact that there are a large number of potential streamlining criteria and a variety of information that may be taken into consideration. VMP writing encompasses a variety of significant topics, including energy efficiency, Service Level Agreements (SLA), cloud benefit markets, Quality of Service (QoS), and carbon dioxide outflows, all of which have a significant impact on both the practical and environmental spheres.

Dabrowski et al. in [27] illustrates a target method that can be used to look at VM-situation calculations in big clouds, spanning a large number of PMs and a large number of VMs. This technique may be used to assess such computations. In addition to this, it demonstrates a technique by analysing 18 possible estimates for the beginning position of virtual machines in on-demand foundation clouds. This article examines computations that are made possible by open-source code for framework clouds as well as by the online canister pushing writing technology. The exploration of computations for the distribution of virtual machines (VMs) to physical machines (PMs) in foundation clouds has been the focus of a significant amount of study in recent times. Numerous computations of this kind handle unmistakable concerns, such as the beginning arrangement, the consolidation, or the trade-offs between acknowledging the administration level understandings and motivating the supplier working costs. In point of fact, even in situations when similar problems are addressed, every single research group evaluates suggested computations under specific settings, using distinct processes, and usually focusing on a small group of virtual machines and project managers.

In the paper [29], A. Shankar and colleagues suggested a GGA method. The GGA algorithm performs well in the majority of situations, regardless of whether the number of restrictions is big or low. Because genetic operators are applied to the solution that is chosen as the initial solution, it is essential to choose a solution that is plausible. Because of this, it is possible to limit the number of generations in order to get a solution within a certain amount of time. It is possible that it will not finish up receiving the best possible answer; but, the solution that it does end up getting will be superior than the one it started with.

Distributed Systems Reliability:

The concept of reliability in distributed systems is an essential parameter that guarantees that these systems are able to provide consistent and correct computations or services in accordance with the requirements of the end-user or application. The idea of dependability involves a number of different factors, some of which are recoverability, fault tolerance, and availability. Due to the fact that distributed systems are decentralised, meaning that their components are dispersed over a variety of physical and logical locations, assuring dependability becomes a difficult and time-consuming endeavour.

Challenges in Enhancing Reliability:

- Failures of Components: In a distributed system, every component, including servers, databases, and network connections, has the potential to fail for a variety of reasons, including hardware malfunctions, software defects, or external assaults. The management of these failures in order to guarantee the continuing functioning of the system is a significant problem.
- Network problems: the latency of the network and the segmentation of the network may have a substantial impact on the performance and reliability of distributed systems. In order to keep the integrity of the system intact, it is vital to ensure that all of the system nodes are communicating and transferring data in a consistent manner.
- Data Consistency It is of the utmost importance to guarantee that data is consistent throughout all distributed databases or storage systems, particularly when there are several concurrent accesses and modifications. In this context, the use of methods such as distributed

transactions and consensus algorithms is rather important.

- Workload Demands That Are Dynamic Distributed systems often have workloads that are constantly changing, which requires them to dynamically scale their resources up or down. There is a lot of difficulty involved in effectively regulating these dynamics without sacrificing the system's performance or dependability.

Cloud Computing As A Reliability Enhancer:

A revolution in the deployment, management, and scaling of distributed systems has been brought about by cloud computing technologies, which have brought about considerable advantages for improving the dependability of these systems. Cloud computing enables developers and system administrators to concentrate on application logic and performance rather than infrastructure administration. This is made possible by cloud computing's ability to abstract the complexity of the underlying hardware and software resources.

Advantages Offered by Cloud Computing:

- Scalability is the capacity of cloud platforms to dynamically allocate or deallocate resources according on the current needs of the system. This characteristic ensures that the distributed system is able to manage spikes in workload without experiencing a decrease in performance.
- The term "elasticity" refers to the ability of cloud services to automatically modify resources to meet the requirements of the system, hence assuring optimum utilisation and cost-efficiency. This elasticity is essential for ensuring that the system continues to function reliably despite the variations in load circumstances.
- Cloud services ensure that there is a high availability of computing resources, which ensures that dispersed systems have the resources they need to operate effectively at any given moment. This is referred to as "on-demand availability."

Distributed systems are able to attain improved levels of dependability, responsiveness, and performance by using the scalability, elasticity, and on-demand resource availability that cloud computing provides. A significant many of the difficulties that are inherent in the design and administration of distributed systems are addressed by the service models that are offered by the cloud. These models provide a solid basis for the construction and management of dependable distributed applications.

Conclusion:

This study places an emphasis on the various data migration approaches that are currently in use. The transfer of data is a complicated process that encompasses both time and geography. Because of the time complexity, the usage of data migration is avoided, which in turn decreases the utilisation of cloud computing in the present period. The system that is being presented makes use of the buffer approach for managing replication, in addition to the optimum VM selection process, which is used to reduce costs. The result that was achieved demonstrates a 25% improvement in terms of both the cost and the execution time. For existing data migration to be improved, it is necessary to make certain modifications to the procedures that are now in use. These modifications include the management of redundancy, the integrity check, and the determination of priority for migrations. Should there be a reduction in the costs, space, and time complexity involved with migration, then the utilisation of cloud computing in the near future may be significantly enhanced.

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