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RESEARCH ARTICLE

Migration Prediction Approach for Predict the Overloaded and Under Loaded Workload in Cloud Environment

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Abstract – The resource necessity of any application substance differs dynamically dependent on its plan and other computational conditions like processor, memory, etc. A migration prediction approach is proposed to foresee the over-burden and under stacked hosts, in light of the previous history of execution time taken for different workloads during VM migration. The rough set theory is incorporated in this proposed model to analyze the execution time taken for different workloads. The rough set theory is a popular prediction technique to predict execution time for different workloads during VM. The migration delay is minimized based on the past execution time of each processor for different categories of jobs. The execution time for each processor is calculated and maintained inside the prediction table. The quantity of future migrations is calculated based totally at the feasible allocations that can be made, in order that the migration delay is minimized based at the beyond execution time of each processor for extraordinary categories of jobs. Finally, optimized resource utilization is executed to give the exceptional answer amongst all possible solutions and it reduces makespan fee of jobs.

Index Terms – Work Load, Migration, Prediction, Rough Set Theory, Delay.

1. INTRODUCTION

The over-provisioning and under provisioning of assets fluctuating dependent on client demands, brings about wastage of assets as well as may bring about high computational foundation cost. Hence this paper proposes a migration prediction approach to predict the VM migrations depending upon the past migration history time taken for different workloads during VM migration. The rough set theory is incorporated in this work to analyze the processor speed taken for different workloads.

The rough set theory is a popular prediction technique to predict execution time for different workloads during VM migrations. Migration metric is used to measure and monitor the resources, which results to evaluate the execution time before a migration call is issued.

This work proposes a migration prediction approach to predict the over-provisioning and under provisioning of resources to avoid unnecessary allocation of resources and to minimize the migration delay.

1.1. Different Prediction Approaches

Generally, two learning algorithms (Neural networks and linear regression) are applied for foresee destiny asset necessities in the cloud regarding time. They provide an exact assessment of the quantity of a real machine depends on the use of CPU and memory. The multiple usage prediction approaches are used to assess the drawn out use of every asset dependent on the nearby history of the servers. It includes one of a kind capabilities specifically, overloaded host detection approach with a couple of usage prediction and underneath loaded host detection technique with a couple of utilization prediction. This approach is mainly used to diminish the energy utilization of a cloud server farm [1].

Neural networks are used to predict the desired sources the use of long transient memory intermittent neural network and automobile scale digital belongings depending on anticipated traits [2]. Linear regression is a factual strategy to appraise a forecast work as indicated by the past usage esteems. It reduces the migration and the electricity intake of the servers.

The clustering technique is additionally used to gauge the future cloud jobs. So, it can easily decide when Physical Machines (PMs) are put into rest mode and when they need to oblige new VM demands. The input is divided into a different category of having a separate predictor [3]. The exhibition of virtual machine relocation can be improved by decreasing the information move rate. The data compression technique is used to decrease the data transfer overhead.

The digital system consolidation is to reduce the entire energy intake by lowering the real servers in a server farm. The CPU utilization is assessed to anticipate overloaded and under

RESEARCH ARTICLE

loaded hosts dependent on past information of every server using linear regression-based CPU usage prediction method. This avoids the unnecessary VM migration and SLA violations [1].

The virtualization technology is also support green computing to enhance the quantity of servers. The idea of skewness is utilized to quantify the uneven server utilization. So, prediction is used to degree the destiny aid availability of VMs primarily based on the beyond information. It is useful to combine CPU, memory, and network intensive workloads for prediction measurement [4].

1.2. Rough Set Concept

The rough set concept is a well-known prediction technique to predict execution time for different workload during live migrations. It represents a dataset as a table wherein a row execution time and column represents the different categories of jobs.

Rough set theory is represented as a couple A = (U, A), in which U: represents a nonempty set of objects. A: a non-empty restricted set of attributes such that a: U ►Va for each a ε A. The set Va is called as the fee set of a. The paintings is to be distributed to the provider issuer the usage of rough set theory such that S= SP1, SP2, SP3…SPn be the n wide variety of provider carriers and J = J1, J2, J3…Jm be the set of m jobs generated through the customers. This information is represented in a matrix form [5].

The ranking of the attributes is analyzed using rough set theory. The cloud user is considered only the subjective preference parameter and ignores the objective parameter. It is to decide the target weight of the appraisal files of cloud administrations [6]. Predicting execution time is to help the cloud users as well as cloud providers. It is also used to boost the throughput and limit the asset utilization in the cloud environment [7].

The rest of the sections are organized as follows. Section 2 focuses on the existing techniques for migration prediction approach which were reported. Section 3 reviews the structure of the proposed device and gives an overview of the work and contributions. Section 4, describes the experimental consequences are made. In Session 5, an overview of the work done, predominant conclusions arrived and the contributions made are handled.

2. RELATED WORK

Energy management using virtualization is a most important technique that minimizes the power consumption in cloud data center. Cloud service offered between cloud providers and cloud users must be reliable. But sometimes improper resource management leads to poor service. So, prediction and optimization methods are essential to avoid the inefficient resource management. But making prediction is very difficult in efficient resource management in cloud data center.

Stochastic load balancing scheme introduced that addresses the prediction of the resource demand distribution and the requirements of multidimensional asset with stochastic characterization. The wastage of resources will be happen if the allotment of tasks is improper [8].

In [9], analyzed and accurately predicted the run time for CPU intensive applications. In stochastic load balancing, the resources are wasted unnecessarily. So, the issue is solved by considering CPU intensive application.

On optimization of migration technique which reduces the number of future migrations. In their work, the processing node speed is calculated based on the range of jobs carried out in line with unit time and the allocation is based on the minimum number of migration nodes [10].

Fuzzy set approach is used as a ranking mechanism which consists of decomposition, priority and an aggregation. Using this approach, the optimal cloud provider is selected [2]. A hybrid prediction system using rough sets is proposed for processing medical data using fuzzy approach [11].

Memory allocation is used as an important function to select proper memory space as indicated by the client necessities. In this way, memory space forecast technique was applied to anticipate the free memory space [12]. The Cloud Service Parameter (CSP) is represented in a tabular form called information system using rough set representation. The line of the table addresses the rundown of CSP and the section addresses the characteristic of the separate CSP. The value of 1 tells that the CSP is specialized in a particular service and 0 tells that the CSP is not accomplished in a specific service. The algorithm checks whether the value is 1or 0 and return the results according to the value [5].

CPU use expectation strategy dependent on the linear regression technique. This methodology predicts the future CPU use around dependent on the use of each host. The stay migration manner is to foresee over-stacked and underneath-stacked hosts CPU usage. At whatever point; a number will become over-burden, a few VMs flow to extraordinary hosts to decrease SLA infringement rate. Prediction may be very difficult for green useful resource utilization in cloud records middle.

A Linear Regression based CPU Utilization Prediction algorithm (LiRCUP) is proposed to estimate a prediction function according to past CPU usage history more than one hour prior. The LiRCUP algorithm calculation decides the future CPU use in a host. This algorithm collects the CPU utilization of past 12 histories and decides the future CPU utilization in a host. This work can avoid an SLA violation [13].

RESEARCH ARTICLE

In [1], proposed a more than one utilization prediction method to increase the strength performance in cloud data facilities. This idea is utilized to appraise the drawn out usage dependent on the neighborhood history. It correctly predicts the over utilized and underutilized servers dependent on current just as future burden. It avoids the unnecessary migrations and reduces the SLA violation. The Cloud Broker manages cloud platforms and selects the resources from one or more cloud provides for usage-based evaluation [14]. A new model is introduced for estimating the migration time and downtime in live migration based on the memory utilization [15].

The processor workload prediction method was proposed for a multitenant environment. The migrated data of the VM must be moved in a secured manner [16]. A Minimum Cost Maximum Flow (MCMF) algorithm is implemented for dynamic workloads and flow versions. This method is combined with a prediction for achieving optimal performance [17].

An attribute ranking approach primarily based at the rough set theory changed into proposed to investigate the critical variables influencing the reception of cloud administrations by clients. Simultaneously, it can help the cloud specialist co-ops to explicitly work on their nature of administrations to more clients. The rough set idea is utilized inside the plan of the calculation to assess the importance of cloud administration barriers and to rank them. It obtains the different weights of the attributes from the abstract dataset and the objective dataset. The outcomes provide a perfect service matching [6].

The execution time expectation is discussed to anticipate the execution time quick and precisely. This concept is to amplify the throughput and limit the asset utilization Rough set principle is a famous prediction technique to foresee the execution season of occupations in a brief timeframe [7].

Fog computing technique is used to expand an orderly shape to explore the strength consumption delay difficulty in a fog-cloud computing device. It can figure the responsibility distribution issue and break down the basic issue into three sub issues around, which can be tackled inside the relating subsystem. The work gives direction on concentrating on the association and collaboration between the fog and cloud. It saves the communication bandwidth and reduces transmission latency. It also improves the performance of cloud computing [18].

The methods to address delay adjustment schemes can be classified into two categories as uniform adjustment scheme and adaptive adjustment scheme primarily based on a uniform distribution of the weight variant a few of the neighbor servers and performs a restricted diploma of person monitoring [19].

Job shop scheduling issue proposed to dependent on the limitation of machine availability to limit makespan. This paper proposes working time window algorithm which includes operating period and breaking duration. Working duration is running time of jobs and breaking period is preventing length of operating time. This proposed work is applied to real problem but complexity is more compared to normal task keep scheduling trouble [20].

Genetic algorithm is proposed based on cloud version to remedy the trouble of activity-store scheduling. This set of rules is used to reduce the completion time and overall value of version [21].

This paper focused on quantitative examination of live relocation in cloud server farm. This paper considered three factors to be specific VM size, network speed and cost to optimize the performance of VM migration [22].

Proactive Markov Decision Process (MDP)-based totally load balancing algorithm is proposed to reduce load balancing overhead based totally on a CPU time and electricity. It method to preserve a drawn out load stability for each the supply PM that plays VM relocations to modify its obligation and the objective PM that involved this VM,, and as a result prevents weight imbalance. It unexpectedly decides vacation spot PMs with much less overhead and postpone. This model is created to work on the genuine benefit of the datacenter [23].

NICBLE models are proposed to anticipate the non-versatile application responsibility dependent on execution time. The visitor VM arranged with 1, 2, 4, eight and sixteen virtual CPUs and predicted the real completion time. The guest system does not need any change. First the prediction tested from 1 core to 4 cores and then upgrade to 16 cores. It is based on the Xen hypervisor and took on by IAAS specialist organization and furthermore pertinent to other virtualization stages like KVM and VMware too [24].

In [25], proposed an n-individual cooperative recreation to evaluate the VM price. For evaluation, VM configurations, Cloud provider providers, Microsoft azure and Amazon EC2 are considered.. It is seen that the proposed approach burns-through lesser strength contrasted with first suit lowering (FFD) and superior first in shape reducing (EFFD).

The responsibility expectation model is developed for utilizing long short-term memory (LSTM) networks to achieve high accuracy in prediction. First, the collected data is normalized in the range (0, 1) using preprocessing measure and reshaped based on the training window size. It is a bunch of examples used to anticipate next design [26].

Qiang Fan planned a various leveled cloudlet network and proposed a responsibility distribution plan to limit the normal reaction season of User Equipment (UE) demand. Workload

RESEARCH ARTICLE

allocation scheme assigns UEs to various levels of cloudlets and the registering assets are ideally apportioned to each cloudlet in each schedule opening [27].

In [28], proposed two-level control model under a heterogeneous cloud surroundings. Two specific algorithms including empirical forecast algorithm and weighted priority virtual system (VM) selection set of rules are used to investigate the historic utilization statistics of the host. The WPA set of rules now not best considers the migration time however additionally considers the latest usage level.

VM consolidation method is supplied that takes into consideration each the modern-day and destiny utilization of resources. This method uses a regression-based totally model to approximate the future CPU and memory usage of VMs and PMs. It considers each the current and future utilization of sources to be able to consolidate VMs into the minimal huge sort of energetic Physical Machines [29].

Dian Shen. Brought a hard and fast of guidelines to allocate the bandwidth to VMs and map them onto feasible hosts. To lessen the overhead at the same time as adjusting the allocation, an efficient Lazy Migration (LM) set of rules is proposed with bounded performance [30].

Virtual gadget consolidation algorithm with a couple of usage prediction (VMCUP-M) is used to enhance the electricity efficiency of cloud information facilities. In this context, more than one usage refers to every useful resource kinds and the horizon employed to expect future usage. This set of rules is carried out throughout the digital gadget consolidation system to calculate the lengthy-term utilization of more than one useful resource kinds primarily based on the neighborhood history of the considered servers [31].

In [32], proposed a stochastic load balancing scheme which pastimes to provide probabilistic assure in opposition to the resource overloading with digital gadget migration, at the same time as minimizing the overall migration overhead. With characterizing the resource demands of VMs as random variables, our scheme offers the probabilistic assure in competition to useful aid overloading, that is, the aggregate VM call for any useful resource in a PM does not exceed its capability with a excessive possibility. The VM migration set of rules in the scheme goals to reduce the migration charge for load balancing considering the network topology and improves the worst overall performance the machine must experience from the hotspots.

Kaige Qu done a higher accuracy than a bench mark method for the simulated fBm traffic, making the maximum of a compromise among the 3 web page tourist's parameters. For the proposed aid name for prediction scheme, packet-degree simulations display occasional QoS violation for a real-international packet arrival hint especially for the stringent QoS necessities, and QoS delight for a synthesized packet arrival hint with less traveler's burstiness. The proposed penalty aware deep Q-mastering set of rules achieves overall performance gains in phrases of each training loss bargain and episodic common reward maximization [33].

In [34], proposed an allocation scheme for optimization primarily based mostly on customer necessities in a cloud facts center. VMs are first allotted to PMs according with their CPU, reminiscence and bandwidth useful aid requirements. Then, a number of them are migrated to make sure reliability. CPU utilization thresholds are set to decide whether or not migration is wanted and the strength consumption in advance than and after allocation are used to select which VMs are reallocated. A suitable approach for VM migration and PM shutdown can enhance reliability and reduce electricity consumption

Therefore the main objective of the effective resource allocation for any cloud user or cloud provider is to enhance the QoS parameters and resource usage inside the cloud surroundings.

3. PROPOSED SYSTEM

Migration Prediction approach is predicting future resource utilization of scheduled VMs and to increase resource utilization. Migration Prediction approach consists of Resource Checker and Prediction Estimator. Resource Checker defines a resource model depend on the number of resource requirements received and the available resources. It also stores the past history of execution times for different workloads in the migration prediction table. Before a VM migration takes place, the migration prediction table is referred first.

Prediction Estimator predicts the VM to be allocated and VM to be migrated based on the migration prediction table. The expectation strategy is utilized to guarantee that the approaching client demands are being overhauled utilizing the base measure of server farm power.

3.1. Migration Prediction

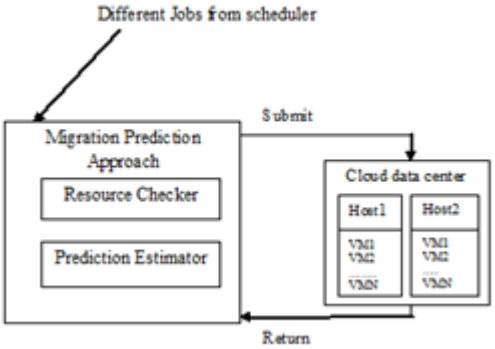

Figure 1 Structure of Migration Prediction

RESEARCH ARTICLE

Figure 1 shows the structure module in the research work. The migration prediction approach is used to predict the over utilizing and underutilizing of host in the cloud datacenter and reduce the migration delay. This module comprises of two parts to be specific: Resource Checker and Prediction Estimator. Resource Checker detects the over utilized and under-utilized host while the Prediction Estimator is utilized to stay away from the unnecessary VM relocation dependent on the past history of CPU execution time.

3.2. Resource Checker

Cloud providers offer offerings to users dependent on the Service Level Agreement (SLA). According to SLA, the issuer offers sufficient property which includes CPU, Memory, I/O tool and bandwidth to the consumer. Sometimes over provisioning of resource may decrease the revenue of the service provider and under provisioning of resources may break the SLA. Thus, efficient resource provisioning is a challenging task. In the proposed model, the resource checker is used to optimize the provisioning of resources. Resource checker plays fundamental functions which include detection of: overloaded host detection and under loaded host detection methods. Here in this work CPU usage is mainly considered for analyzing the system performance. This model checks whether the current CPU usage exceeds the threshold value CPU_t=0.8GHz, and accordingly decides the utilization of CPU. The Algorithm 1 depicts the process involved in the Resource Checker.

Input: Set of Jobs and VMs.

Output: Allocation of Jobs to resources.

1. Declare the set of Jobs J and VMs V with Task T
2. Select the VM from the available resources
3. Assign v'=v
4. For all n belongs to J
5. While (v'! =Null)
6. r'=Get (n, r, v')
7. v'=v'-r'
8. end while
9. end for
10. Get (n, r, v')
11. For each r, find the match from available resources v'
12. Allocate r to n
13. end for

Algorithm 1 Resource Checker

Where

v - virtual machine-capable of executing task.

v'- temporary variable for assigning virtual machine.

r - resource-source from which virtual machine is allocated.

r'- temporary variable for assigning resource.

n - total number of resources

t - task execution of work.

3.3. Prediction Estimator

The execution time of different processor types are calculated based on different categories of workload. In this model four different categories of jobs such as small jobs, mediumsmall jobs, mediumlarge jobs and large jobs for three different processor types are considered. The execution time for each processor is calculated and maintained in the prediction table. The number of future migrations is calculated based on the possible allocation that can be made.

The processing speed of different categories of jobs executed per unit time on every processor is determined. The quantity of future relocations expected is determined for effective work assignment.

3.3.1. Estimator

The rough set method is suitable for qualitative and quantitative analysis. This is utilized to track down the negligible subsets (reducts) of qualities. The simple notations utilized in hard set theory are information gadget, approximation, discount of attributes and others. A records framework is characterized as I= (U, A), in which U is a non-void association of confined items known as universe, the limited characteristic set A= $\{a_1, a_n\}$, in which each attribute a $\sum$ A is a entire capability a: U ->Va, where Va is known as the area or price set of attributes ai. In approximation, rough set method gives a simple form to uncertainty. The lower estimation is the finished arrangement of items in U. The upper estimation is the arrangement of components in U. Reduction of attributes represents the minimum attributes subsets that retain the decision attributes.

The rough set method based on quantitative analysis is suitable for resource estimation model. The resource estimation is done based on the past history of execution time stored in the prediction table. Thus, the resource utilization is dynamically predicted and managed by the provider. The information system consists of records that can be obtained from past history of different processor execution time. Each record in the records machine accommodates of condition attributes and decision attributes. Condition attributes consists of processor type, job type and execution time. Prediction is based on the decision attribute of execution time. The Algorithm 2 estimated the resources.

RESEARCH ARTICLE

Input: Processor type, job type and execution time

Output: Estimated resources depends on rough set theory

1. Get the information table of cloud user.
2. Get processor type, job type and execution time.
3. Assign a1=processor type, a2=job type and a3=execution time.
4. Set Condition attributes C= {a1, a2, a3}.
5. Set i=1, Decision attribute=d.
6. if (i ≤ n) then (n=number of attributes)
7. Evaluate all condition attributes
8. end if

Algorithm 2 Resource Estimation Model

Evaluate all the relevance of the condition attributes with admire to selection

$$\text{Attribute } SD = \frac{|\text{pos}_c(d)| - |\text{pos}_{c-a}(d)|}{|U|} \quad (1)$$

Where SD addresses the dependence of choice characteristic d, pos represents the set of condition attributes and U is the set of factors in the records desk.

Given an information table, the decision attribute d can be tested by the condition attributes a1, a2 and a3. The resource estimation model checks the resource requirement in the condition attributes and then predicts the execution time based on the job type. The equation (1) shows the stronger dependency among the condition attribute and decision characteristic.

4. RESULTS AND DISCUSSIONS

4.1. Experimental Environment

The proposed model is carried out in Open Nebula on Ubuntu 14.04 cloud setup which includes two host nodes and a storage node. The operating machine of the host node is red hat server 5.3 which consists of Intel I5 processor, 3GHZ CPU, 8GB RAM and 1TB hard disk. The virtual machine operating system in host is Ubuntu12.04, 1GHz CPU, 1GB RAM and network bandwidth is 200Mbps. The execution time is predicted based on processor speed and job size. The virtual machine selects core1, core2 and core4 processors for testing the different jobs in parallel.

4.2. Performance Evaluation

Data are presented as an information table, column labeled as attributes; rows are entered by attribute values. The information table comprises of data that may be obtained from beyond execution time. Each file comprises of condition attributes and decision attributes. Condition attributes are processor type, job type and execution time. Decision attribute is execution time. The following Table 1 shows the processor type, job type and execution time.

Processor Type	Job Type	Execution Time(s)
Core 1	Small Jobs	20.59
	Mediumsmall Jobs	71.62
	Mediumlarge Jobs	118.37
	Large Jobs	167.84
Core 2	Small Jobs	19.30
	Mediumsmall Jobs	47.64
	Mediumlarge Jobs	62.96
	Large Jobs	87.92
Core 4	Small Jobs	19.01
	Mediumsmall Jobs	26.08
	Mediumlarge Jobs	37.16
	Large Jobs	55.45

Table 1 Information Table for Prediction

According to the user requirements, the execution time of decision attribute select from the condition attribute table. The user selects the processor based on the task type and execution time. The execution times of different categories of jobs are run in equal on the 1, 2 and 4 center virtual machines. The run time is predicted based on the different category by using job shop optimization. It thoroughly may be seen that forecast outcomes and exploratory outcomes are essentially in incident for 1, 2, and four middle virtual machines. It shows that the expectancy version can count on the execution time with a high accuracy.

Figure 2 depicts the comparison of execution time of different processor according to the different category of jobs. The x coordinate shows the different processors and y coordinate shows execution time of different jobs.

RESEARCH ARTICLE

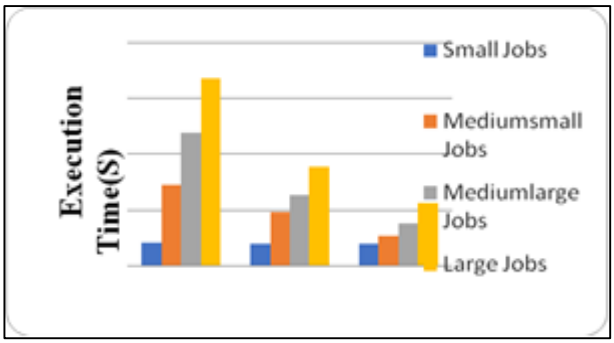

Figure 2 Comparison of Execution Time for Different Processor

Table 2 suggests the variety of migrations possible for every category of job for different processor. The number of migration possible for small, mediumsmall and large is 1.

The resource estimation model makes good decisions regarding when and where to relocate in such a manner to decrease unnecessary migrations. Initially the approximate execution pace in one of a kind category of jobs finished per unit time of every preparing node is determined. The migration is finished to the dealing with node with least range of migrations based totally on the past history. So, it is used to reduce migration delay.

Table 3 shows the execution time of the j^{th} job of i^{th} job type on processor k. The process with a triplet (i, j, k) denotes the number of jobs j of job type i require processor k.

Processor Type	Number of Jobs			
	Small Jobs	Medium small Jobs	Medium large Jobs	Large Jobs
Core 1	2	1	2	1
Core 2	3	2	3	3
Core 4	2	3	3	3
Average	2.33	2	2.67	2.33
Number of Migration	1	1	0	1

Table 2 Number of Migrations of Different Jobs

Processor/Jobs	Small Jobs		Medium Small Jobs		Medium Large Jobs		Large Jobs	
	Allocation	$E_{i,j,k}$	Allocation	$E_{i,j,k}$	Allocation	$E_{i,j,k}$	Allocation	$E_{i,j,k}$
Core 1	(1,2,1)	20.59	(2,1,1)	71.62	(3,2,1)	118.37	(4,1,1)	167.84
Core 2	(1,3,2)	19.30	(2,2,2)	47.64	(3,3,2)	62.96	(4,3,2)	87.92
Core 4	(1,2,4)	19.01	(2,3,4)	26.08	(3,3,4)	37.16	(4,3,4)	55.45

Table 3 Different Allocation based on Jobs

5. CONCLUSION

The proposed version for resource control in cloud computing is used to reduce the migration delay and reduce the make span. The resource checker model checks the available resources based on prediction estimation table. Rough set theory is used for quantitative analysis in the predication estimation. The prediction table maintains the execution time according to the processor type. Main limitations in this module are storing the prediction table securely. The clients expect great quick stacking administrations and alertness.

RESEARCH ARTICLE

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RESEARCH ARTICLE

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