AnEfficient Technique for VM Database Segmentation over Cloud Environment

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Abstract:

Cloudcomputingmodelsusevirtualmachine(VM)clustersforprotectingresourcesfromfailurewith backupcapability.Cloud usertasks are scheduled by selecting suitable resourcesforexecuting the task in the VM cluster. Existing VM clustering processes suffer from issues likepreconfiguration,downtime,complexbackupprocess,anddisastermanagement.VMinfrastructur eprovidesthehighavailabilityresourceswithdynamicandon-demandconfiguration. The proposed methodology supports VM clustering process to place and allocateVM on the basis of requesting task size with bandwidth level for enhancing the efficiency andavailability.Theproposedclusteringprocessisclassifiedaspreclusteringandpostclustering onthe basis of migration. Task and bandwidth classification process classifies tasks with adequatebandwidthforexecution inaVMcluster.ThemappingofbandwidthtoVMisdonebasedontheavailability of the VM in the cluster. The VM clustering process uses different performanceparameterslikelifetimeofVM,utilizationofVM,bucketsize,andtaskexecutiontime.The mainobjectiveoftheproposedVMclusteringisthatitmapsthetaskwithsuitableVMwithbandwidthfor achieving high availability and reliability. It reduces task execution and allocated time whencomparedtoexistingalgorithms.

1. Introduction

both general purpose computers and data networks A method of service-oriented architecture known as "cloud computing" leverages virtualized resources to carry out computations. A number of resources are available in the cloud as a way of service. The different types of cloud services include SaaS, IaaS, and PaaS. To satisfy customer needs, many deployment models are used for the services. They fall under the categories of private, public, community, and hybrid clouds. While services are provided as a public cloud outside of the organization, private cloud resources are shared within the organization. A sort of cloud called community cloud allows service providers in the same category to share resources. A hybrid cloud, which combines two or more deployment types, offers the customer service. Cloud services are modeledby mapping thevirtualization layertotheappropriateVM.VMsareselectedfromtheVMlistandthenmappedtotherespective requestgeneratedbythe userofthecloudservice.

The cloud consists of a heterogeneous host in a data center that maintains a mobile resource-basedaccess environment.

VM accesses that leads to a performance problem seen in the areas of the battery life and energyconsumption. The entire performance factor in green computing is made us of to overcome thisproblem [1]. Mobile cloud computing (MCC) is a mobile resource sharing service that allowsmobile devices to have access to the appropriate cloud service. It has faced challenges in termsofscalability, suchas computationalstorageservices andother differentservices [2].

Mobile computing over cloud has the ability to target parameters such as traffic, quality, andcustomer demand. Traditional static cloud and dynamic cloud are compared to analyze theworkload.Thestaticcloudallowsuserstoaccessinfrastructureserviceswithaspecificconfiguration ,whilethedynamiccloudprovidesanagileresponsemethodtoupdatetheresourceconfiguration. Dynamic cloud has a variety of wireless nodes with device-to-device connectivityfortheachievementofabetterutilizationofthechannel andtraffic[3].VMcontention:IaaS hascreatedproblemsinthe areaofperformance.

This problem is overcome through the implementation of the data center as various ranges suchas single server with virtualization, single mega data center, and multiple geo- distributed datacenters [4]. A researcher engaged in cloud suffers from issues that include energy consumptionin data centers. The data center is a key element in the cloud that handles all kinds of resourcesneededinthecomputingenvironment.Inthecloud,thereare2typesofapproachesthatarerelatedtohardwareand software.Theseapproachesrequirereducedpowerconsumption incloudresourceswithoutanysituationofserviceunavailability[5].Cloudresourcesaremultiplexedover VMserversdesigned tohostcloudservicesinlargedatacenters.

VMmigrationistheprocessofmigratingfromonelocationtoanotherleadingtotheperformanceproble marisingbecauseofinferenceandthecostoftheoperation.iAwareimposesthemultisource supply demand model for minimizing the inference during the migration [6, 7].Intelligenttransportationsystems(ITS)areusedinthevehiclecloudcomputing(VCC)architecture, which consists of two-layered components such as the central cloud server and theremote system control (RSC). RSC is a remote administration manager for monitoring andmanagingdistributedsystemelementssuchasnetworkcommunicationlines.RSCusestwolocalser ver and road side unit (RSU) components. If the vehicle travels from one position to another,theVMofoneRSUismovedtoanotherRSU.Itrequirescontinuousserviceresponseoverthe automated vehicle control using VCC [5]. There are two main disputes seen in the intelligenttransportation systems (ITS), namely, efficiency in traffic and energy, quality, and productivity.Thedatacollectedfromvarioussensorsareovercomebyusingtheparallelizedfusiontechn ique.

This technique follows the Dempster–Shafer theory with four components namely, sensor input,bootstrapping, hierarchical fusion, and state output [6, 8]. Cyber-ITS is a system that has datadivision,scheduling,andefficientsupportthroughtheuseofagenericmethodologicalframework. There are two types of functions carried out by the system, namely, data-centric andoperation-centric transformations. This model uses high-performance Computer design withregion-baseddecouplingcapability[9,10].

Inthismethod,adigitalmapoftheglobalpositioningsystemdataisprocessedinaparallelmannerusing quad tree-based domain decomposition technique. These data are divided into different subdomainswithquadstructure[11].Multi-CPUVMschedulingandvirtualCPUs(VCPUs)scheduling have been carried out due to the availability of various virtualization techniques in thecloudcomputingdomain[10].Theexistingproblemshavebeenanalyzedonthebasisofperformance parameters, which improve the efficiency in the cloud service deployment. The mainobjective of the proposed technique is to identify the suitable VM on the basis of bandwidth andrequestingtask ofallocatinganyissuesintheperformanceofcloudtothetask.

The VMs are configured in an isolated fashion, which suffers from repetitive booting of therespective volumes witha limited periodof delivery.This problem issolved by a clustermanagement approach based on a Docker container with a diverse configuration [12]. Thetraditional placement of the Docker container and the VM is carried out separately, so that it isimplemented using the container VM-PM model [13]. The Internet of Things plays a key role inthe processing of real-time data from hardware devices that generate large quantities of data.Thesedataarestoredina largedatacenter withBig dataanalysis methods.Ifthedataarehuge,ahuge number of servers would be used to store the received data. It faces an expensive problemthatis solvedbyusingacabinet-basedtoolcalledProCon[14].

Virtualizationtechnologyoffersthebenefitsofthephysicalserveroperatingonseveralcomputers withdifferentresources.Virtualstorageeliminatesread andwritedelayswithhighIOefficiency. Virtual disks are connected to VMs for processing and storing the user data viasynchronization [15]. Amazon cloud provider provides various kinds of services to the end userinreliableandsecurecomputingcapacity.AWSoffersthe ElasticComputeCloud(EC2)with differentversionsofVMandresources.TheproposedmethodusedEC2 instancesasareferenceforfurtheranalysis.

2. ProposedMethodology

Existing VM management techniques configure a VM to cloud workloads based on the energyparameters, but they suffer from a resource wastage problem in the data center. The proposedmodel groups the tasks based on the VM types with bandwidth parameters using classificationmethods. The VM types are customized on the basis of resource availability in the cloud. Theobjective of the proposed model is to map a task to the correct VM by considering variousprocesses such as resources mapping and classification [16]. The cloud requesting tasks areclassifiedbasedonthemetricssuchastotalnumberofqueues,requestcount,APIresponsecount,disp atchrateofthequeue,maximumsizeofthetask,actualandscheduledexecutiontime,delay,and task retention time. These metrics are collected using Cloud Watch monitoring service inAWS cloud. Thesemetricsare exported andusedforanalyzingthe proposedmodel.

Figure 4.1 shows the architecture of the proposed system. The customer makes a request for theresource from the cloud based on their current requirement. The request is considered as a taskexecutedin aVM.Therearevarioustasksgeneratedbythecustomeridentifiedbasedon variousperspectives. The identified task is classified on the basis of reliability parameter for achieving ahighperformance.BandwidthsareselectedfortheclassifiedtasksothatsuitableVMisallocatedto the requesting task. There are various bandwidths available in the requested task, which areidentifiedandclassifiedtoenablemappingthesuitableVMforservicedelivery.Thebandwidth-VM mapping section selects the VM from the VM clusters, which, in turn, selection is done bytheVMselector.TheVMsareclustersonthebasisofthetaskandbandwidthmeantforprovidingthe services without any interruption or delay. They are clustered in the respective VMs based onthe type of task requested, and the hypervisor eventually provides the link between the VMs andthephysical system.

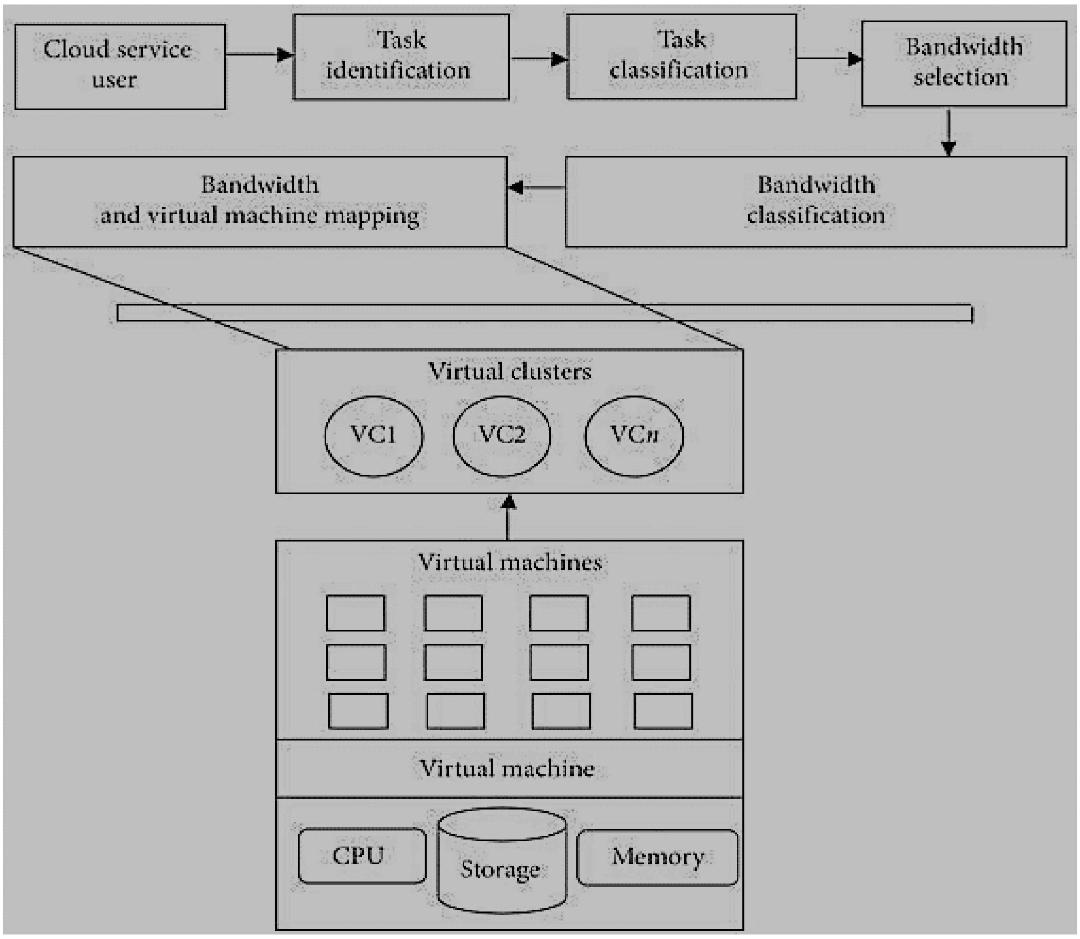

Figure1:Architectureoftheproposedsystem.

Figure 2 is the sequence diagram of the proposed system. It denotes how the incidents areactually related to each other. The activity diagram shows how the process starts and terminates,the various state changes, and activities that take place between these state changes. The firstphaseistheloginmodule,wheretheuserisauthenticatedtoaccessthesystem.Theusernameandpass wordareprovided.Thesefurtherprovideaccesstothecloudhomepage,whichconsists ofallthe main functionalities. This module allows only the authorized user to log in to the system. Itprovidesauthenticationandaccessonlytotheauthorizeduserandallowstheusertoselectany of the options that include creation of a virtual machine, viewing the existing machines, makingtask-based separation, and viewing the usage report. The first option in the module is helpful forthe user in creation of the module by just entering the values for the new VM. Instead of typingcommandsintheterminaltocreateavirtualmachine,thismodulehelpsuscreateaVMbysimplyen teringthevalues.

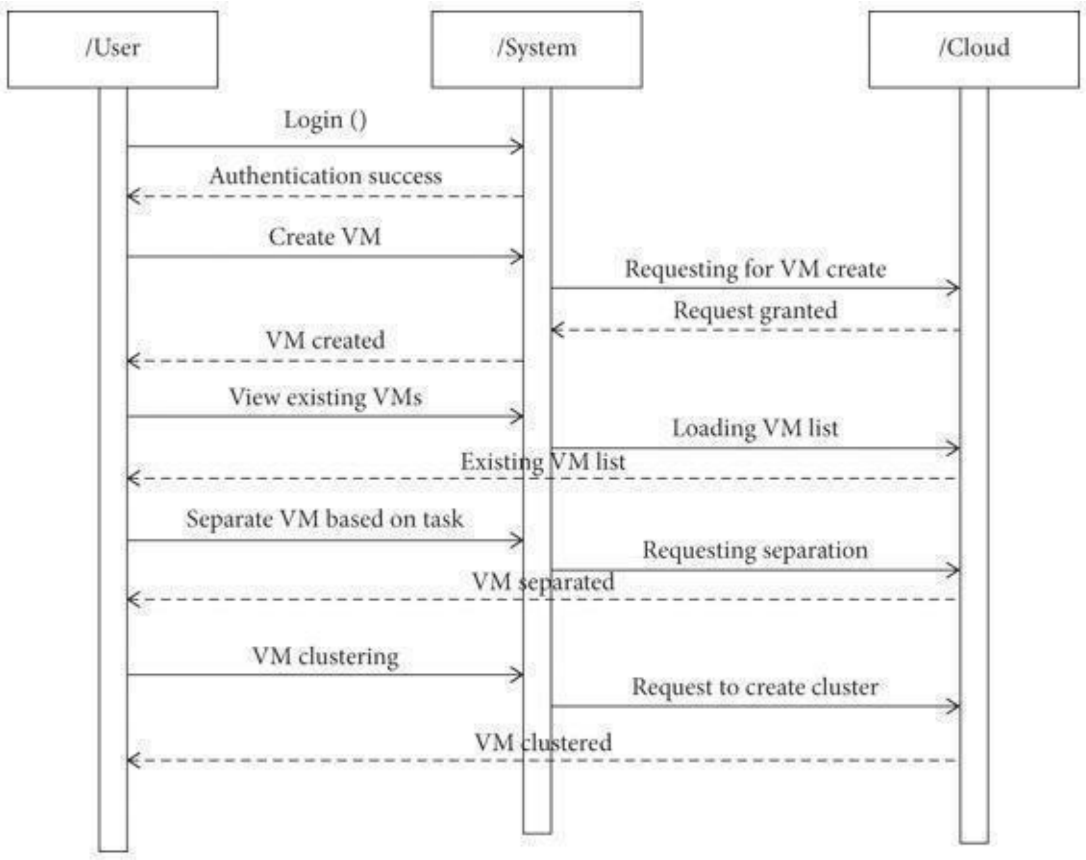

Figure2:PhasesoftheproposedVMclusteringprocess.

The second option in the module is for viewing the existing VMs, thereby enabling the user toview the type of VM created and used. Each VM has different specifications. This module canviewtheexistingVMswiththeirspecification,theoperatingsystemoftheVM.Thethirdoptioninthe moduleistask-basedseparation.Thisphasehelpsseparationofthetaskfromthecloudduserwith the help of this option. It separates the task in terms of CPU, memory, and IO. The fourthoptioninthemoduleisVMclustering.GroupsofVMswithsimilarfeaturesareclustered withthehelp of this option. The final option is the report, where the user can view a detailed usage of theVMs. In this module, the user has the ability to create new VMs for use based on requirements.The major use of thismoduleis that, unlikein the normal VM creation where the user needsto go to the terminal and type commands, the user just needs to type values for the VM creation.AnamefortheVMandthevariousparameterssuchasthenumberofCPU,vCPU,thediskname, NIC, and SSH are entered, where all these parameters are required for the creation of the VMtemplate.

The template, which is created, is instantiated by providing the disk name and the VM name,therebycreatingtheVM.Thismoduleisusedforhelpingtheuserinmakingseparationonthe

VM based on the type of task in each request. There are three major classifications on the task thatinclude memory-based, CPU- based and IO-based classification. The CPU-based classification ismeantfortheuserwhorequireshighprocessingspeedduringtheprocessingoftheinputfile.Int his,theinputfileisonlyprocessed,butnotstored.Thememory-basedclassificationisfortheusertohavebetter memory space. In this, the input file is only stored in the memory and not processed. TheIO-based classification is used for the user to have a responsive VM. In this option,the output is onlygeneratedfortheinputfileandnotstored inthememory.

Themixedoptionisusedfortheuserintheclassificationofataskwithmorethanonetype.Selectio nofthistypehelpstheuser intheselectionofeitherofthetwotypesofclassificationmethodsforeachtask. This module is used for allowing the user to view the existing VMs that are created in thesystem. This view option is in a tabular view, where all the existing VMs are listed along with thespecifications of each VM. The module is highly useful for getting knowledge of all the VMs thathave already been created in the system. All the active. VMs can be viewed with the help of thismodule.

The basic uses of this module provide a view of the existing VMs and differentiate active VMs. Themodule displays the information of the existing virtual machines such as their user, ID, group, andname.

2.1 AnalysisofVariousPerformanceMetrics

2.1.1 VMParameter-LevelAnalysis

ThereAredifferentfeaturesconsideredwhileclusteringtheVMforagoodmaintenanceofreliabil ityin the cloud. The capabilities available in the migration process need to keep the copy of the VM atthe original source end. Two types of copying process happen in the VM, namely, recopying andpostcopyingprocess.Theclusterprocessusesthesetechniquesforachievingbetteravailabil ity.TheCPUishaltedduringthemigrationprocessingthesourcemachine,aswellasthedestinatio nmachine.Delta-based compression of VM has more number of dependent VMs with respective references forfuture VM consolidation at the target machine. Data-level compression is used for getting thereduction in the contents related to the VM at the source machine. The workload is classified assynthesis-basedandidle-basedworkload.Synthesis-basedworkloadisapreallocatedloadassignedbeforetheVMmigration.Idle-basedworkloadisassignedtothetaskonthebasisofthedemand in nature. VM size depends upon various factors, namely, vCPU number, memory size in GB, thebandwidthofthememoryinGB/s,thefrequencyoftheCPUinGHz,singleandallcorefrequenciesinGHz,performanceofremotememoryaccess,temporarystorageinGB,numberofdatadisks,andnumberofEthernetNICs. Initially, thetargetmachine memoryisconsideredasdirtypages.Later,itisreplacedwiththerespectivecontentsaftermigration.Resource availabilityofthetargetmachineisalsoaddressedduring the migrationof the VM.Table 1showstheVMfeaturesinmultipleperspectives.

2.1.2 UserTaskClassification-LevelAnalysis

Cloud user tasks are classified on the basis of factors that include the name of the user base (UB),regions and the number of requests per single user, requested task size in bytes, duration in terms ofpeak hours in GMT, and the average number of peak users offline and online. Table 1 shows theclassification of tasks with user parameters of different sizes. These tasks are mapped with the VMparameters for achieving high reliability. Cloud regions maintain the resources for users with thecorresponding user base. The requesting size and related task size are analyzed in order to findaveragenumberofusersinbothpeakandnonpeakhoursoftheparticularregion.Thecomparisonoftaskclassificationisshowninтable2

UB2	1	60	90	4	10	1000	100
UB3	2	40	75	5	8	1000	100

UB4	3	55	80	7	11	1000	100
UB5	4	30	85	8	9	1000	100
UB6	5	45	100	6	12	1000	100

Table2: Thecomparisonoftaskclassification

Cloud region collects the user requests from the user base (UB) and identifies the request size. Thetasks are allocated to the respective resources in the cloud region based on the peak. HeterogeneousVMsareavailableforhandlingtheuser-requestingtaskwithdifferentcategories.Virtualmachine managerschedulesthetasktorespectiveVM.Alargenumberofrequestingtaskstobehandledha vearrivedintheclouds thatareperformedbyalargenumberofVMs.Itisproposedthatthenumber ofvirtual machines be increased on the basis of number of tasks requested and nonpeak hours throughauto scaling technique. It handles the maximum number of VM on the basis of demand. Figure 4.3showsthetotalnumberoftaskson theVMsoverthecloud region.

Table4.3:Usertaskclassificationandcomparison.

Name ofthe userbase	**Regions**	**Requests per userper**	**Task sizeperrequest(bytes)**	**Peakhoursstarts(GMT)**	**Peakhoursend(GMT)**	**Avg peak users**	**Avgoff-peakusers**
UB1	0	60	100	3	9	1000	100

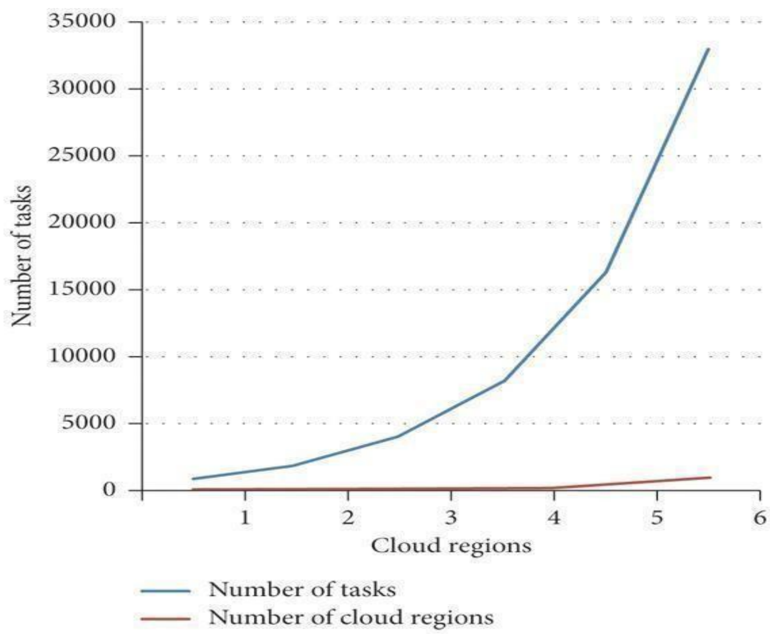

Figure3: Comparisonofcloudregionsandusertasks.

2.2 VirtualMachineAnalysisofDataCenters

Virtualmachinesarecreatedwithdifferentparameterssuchasthenameofthedatacenters,regionsofthedatacenter,thearchitectureoftheVM,theplatformoftheVM,typeofVMM,resourcesc ost,and physical hardware units. Data centers perform various operations, which include migrationprocessineitherthesamedatacenterwithmigrationordifferentdatacenterswithmigr ation.Linuxwith X86 architecture is used for deciding the required number of physical machines at the datacenters in different regions. Describes the VM attributes for task allocation and execution. Cloudcustomerneedshigherbandwidthbecauseofthelackinthecurrentbandwidthlevel.Clou dprovidersprovidesufficientbandwidthinordertoretainthecustomers.Table3providesthebandwidthlevelofvariousdomainusersforeffectiveutilization.

Table3:Comparisonofbandwidthutilization.

Domainofserviceproviders	Currentbandwidthutilization(%)	Expectedband width level(%)

Banking andinsurance	61	19
Telecommunications	73	10
ITservices	39	16
Cloudservices	62	4
Educationservices	36	4
Governmentservices	41	10

2.3 DelayandBandwidthMatrixAnalysis

Cloud services are deployed in various data centers as regions. Delays seen between the regions arecompared for efficiency. The main objective of this delay analysis is to identify the fast responsewithminimumresponserate.Thebandwidthmatrixprovidesanefficientroutebetweentherequestsintheshortestpathwithmaximumavailability.Delayinthenetworkduringthetransferofjobs across various regions is shown in Table 6. The delay between the same region is also minimum,whereas the delay of the different regions is maximum with respect to the distance between theregions. The same region transfer rate is fast when compared to different regions, so it depends onthe bandwidth level and delay, which is shown in Table 7. Figure 4 indicates the response rate ofvariouscloudregionsinms(Milliseconds).Responsetimeofvarioususerbasesismeasuredinthreelevels,namely,average,minimum,andmaximum.TheCloudAnalystmodelisusedfortheproposedanalysiswithdelayandbandwidthallocationofthetaskexecution.Thecustombandwidthanddelaymatrixarespecifiedon the internetcharacteristicsoptionwithvarious regions.

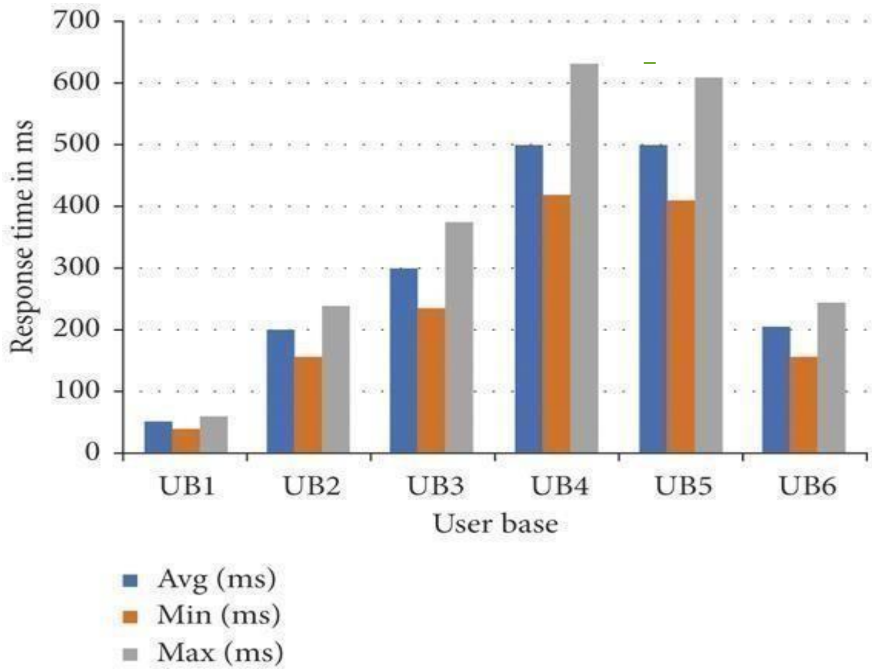

Figure4: Comparisonof the responsetime ofthecloudregion.

2.4 AnalysisofVMClustering

VM clustering is the process of grouping various VMs using virtual networks for achievinghigh availability of cloud resources. This clustering process is done in a source machine, aswell as a target machine. There are two important concepts considered for good accuracy,namely, pre-clustering and post-clustering. A preculturing process occurs at the source end,whereas post-clustering occurs at the target machine end. Preculturing interconnects the VMalong with the state of the processor, data, and VM-related parameters. These VMs thenmigratetothetargetmachine.The postclusteringprocess collects theVMsinorderandfindstherelationships,formingaclusterbyinterconnectingthereceivedVMs.Thisprocessresumes all the states of the VM and related elements into the original state. Table 8 shows the variousVM clusters with the required parameters. There are two types of VMs grouped, namely,activeandinactive.UtilizationoftheCPUplaysavitalroleduringtheclusteringprocess.VMlifetimeis consideredinallocatingbetterperformanceduringtheclusteringprocess.

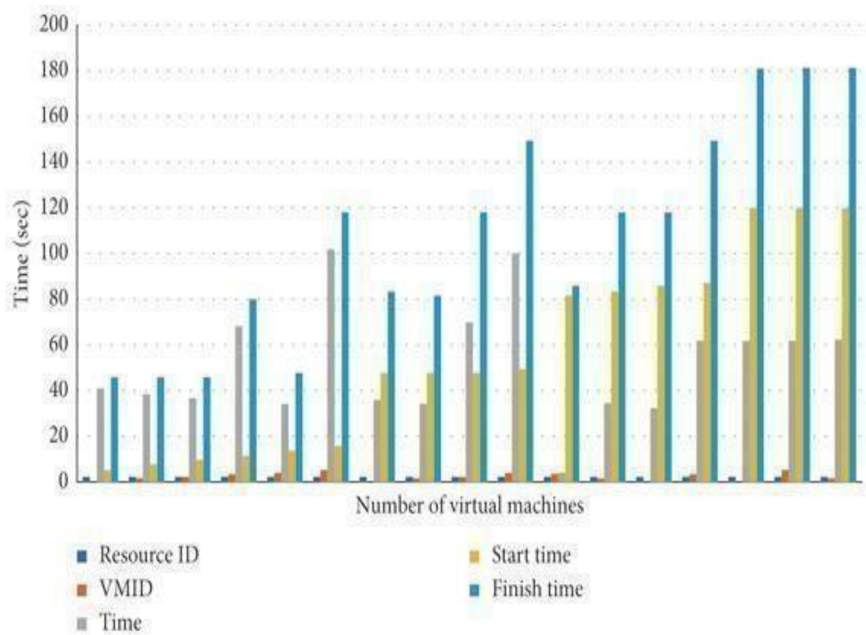

Figure5: TimecomparisonofVMcluster2

2.5 ProposedVMClustering

The clustered virtual machines (VMs)are created from a physical machine (PM). Themapping of VM and PM is performed by the hypervisor. The objective of clustering is toexecutetherequestingtask,whichiscategorizedwithdifferentparameters.Thebandwidthisclassified,andthecorrespondingVMsaremapped.TheVMsareclusteredinawayofsimilarcategories of VM grouped together. The allocation of VMs is extremely simple and efficientfortheexecutionofatask.TherearelargenumbersofclusteredVMsthatfunction asdynamicbehavior clustering. The completion time of the VM is analyzed, and clusters of VMs areshowninFigures 5-7.

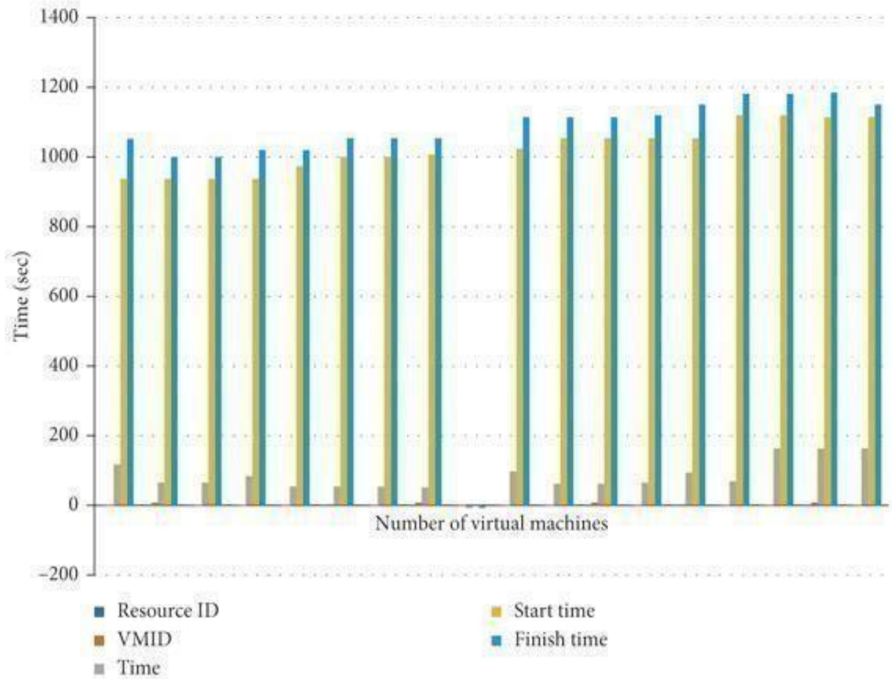

Figure6: TimecomparisonofVM cluster3

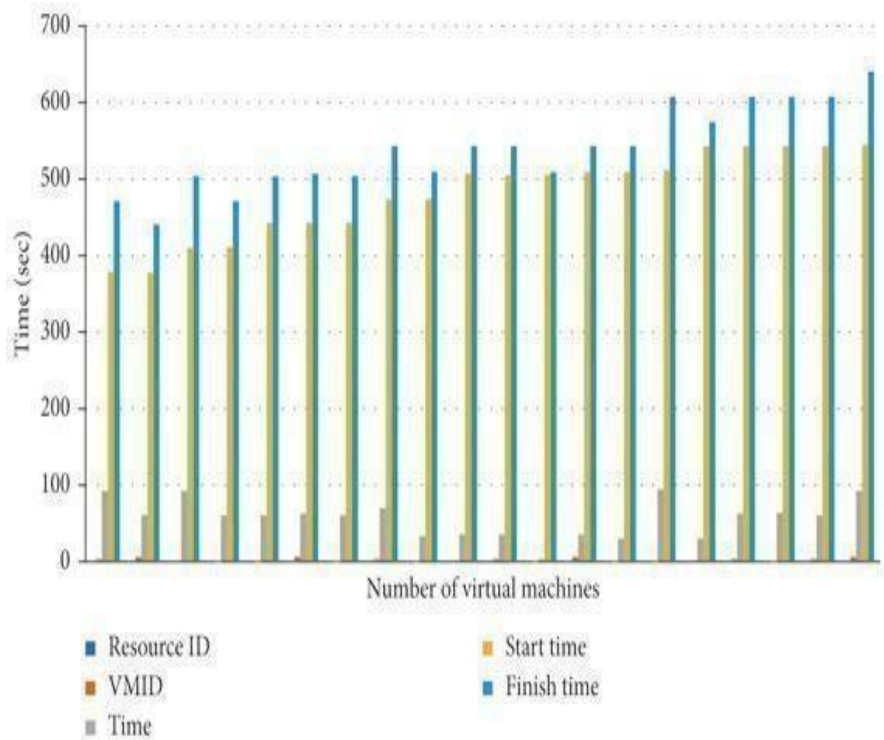

Figure7:TimecomparisonofVMcluster4.

5. ConclusionandFutureScope

The focus of the proposed system is on theclustering of VM basedon various performanceparameterslikethetypeoftherequestingtaskandbandwidth.Therequestingtasksa reclassifiedintoCPU-based,storage-based,andIO-basedmixedtypes.Tostartwith,therequestingtaskisvalidated,and then, the tasks are allocated to the task classification process. The task classification processcategorizesthetaskintodifferenttypesdependingupontheproperties,whichexistinthet ask.Thesetasksareclusteredusingtheclusteringalgorithm,inwhichthecategoriesaregroupedt ogether.Thereare two types of clustering process being carried out, namely, pre clustering and post clustering. Thebandwidth is also clustered based on the task in the task cluster. There are two types of clustersmaintained in the proposed technique, namely, the task cluster and the bandwidth cluster with thesame features. The VM is classified and mapped to the suitable requesting task for execution. Theproposed technique's main objective is to map the requesting task to a suitable VM, in which thelatencyintheservicehandlingisminimizedwithhigherefficiency.

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