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AStudyonVirtualMachines Placementin Distributed Cloud DataCenters for ReducingEnergyConsumption and Carbon Emission

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Abstract:-
Cloud computinghasbecomeabuzzwordin the ITindustry.Cloud computingisbeingused widelyin mantITcompanies.Itprovidesvariousbenefitsto theuserslikecostsavingsand easeofuse.Becauseof thisbenefitsthedemandforcloudservicesareincreases.Duetothis energyconsumptionin datacenterincreasesaswellascarbonisemittedinlargeamount. Therefore, we require to develop some another methodology for environment friendly computingi.eGreenCloud Computing.We proposed our approachtoward this.

Keywords:-CloudComputing, DataCenter, Energy-Efficiency and PowerConsumption, CarbonEmission.

1. INTRODUCTION

TheCloudcomputingofferslotof applicationsandservicesto itsuser.Cloudcomputingis solutionforaddressingchallengessuchas licensing,distribution,configurationandoperationofenterprise applicationsassociatedwiththetraditionalITinfrastructures,softwaresalesanddeploymentmodels[1]. ThecloudcomputinghasrevolutionizedtheInformationandCommunicationTechnology(ICT)industry bytheenabling on-demandprovisioning of computing resourcesbasedonapay-as-you-gobasis[2].

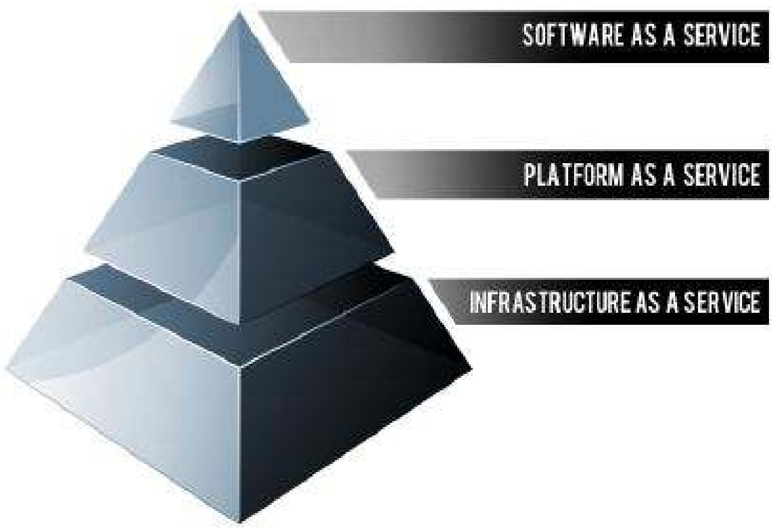

Fig.1.1CloudComputingServiceModels[13]

Thecloudcomputingdividedintothreetypesof servicemodels:

SoftwareasaService(SaaS):

SaaScloudprovidessoftwareservicestoitsendusers.Thecapabilityprovidedtotheconsumer isto useprovider'sapplicationsrunningoncloudinfrastructure.Theconsumerdoesnotmanageorcontrol the underlying cloud infrastructure including network, servers, operating systems, storage, or even individual application capabilities, with the possible exception of limited user-specific application configurationsettings[4][17].

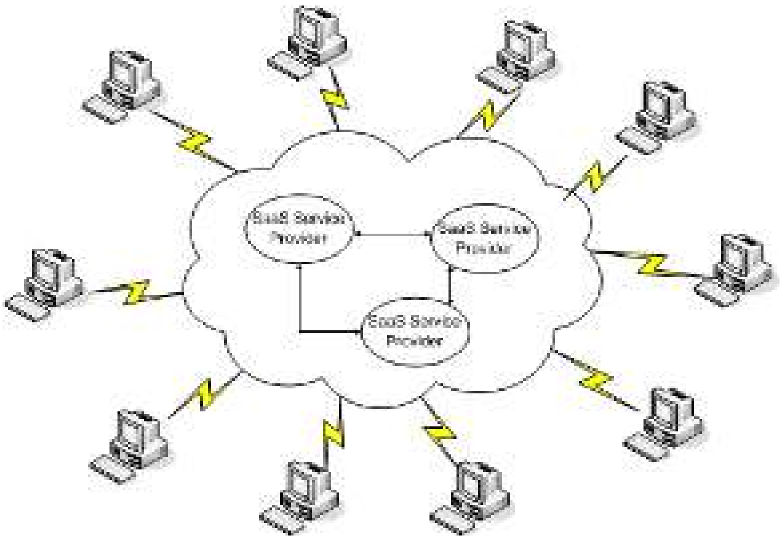

Fig.1.2 Software asa ServiceModel[13]

PlatformasaService(PaaS):

PaaSCloudsprovide application development, deployment tools and execution management services.Thecapabilityprovidedtotheconsumeristodeployontothecloudinfrastructureconsumer- created or acquired applications created using programming languages, libraries, services, and tools supportedby theprovider.Theconsumerdoesnotmanageorcontroltheunderlyingcloudinfrastructure includingnetwork,servers,operatingsystems,orstorage,buthascontroloverthedeployedapplications andpossiblyconfigurationsettingsfortheapplication-hostingenvironment[4][17].

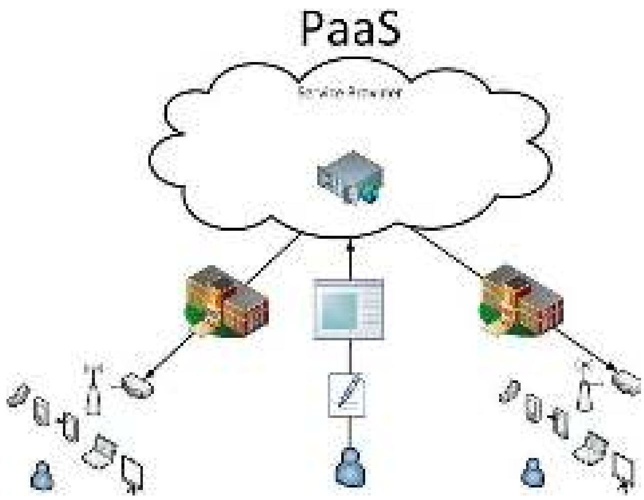

Fig.1.3Platform asaServiceModel[13]

Infrastructureasa Service(IaaS):

IaaSCloudsprovideavirtualcomputingenvironment,wherecomputingcapacity isdeliveredby assigningVirtualMachines(VMs)to IaaSusersondemand.Thecapabilityprovidedto theconsumeristo provisionprocessing,storage,networks,andotherfundamentalcomputingresourceswheretheconsumeris abletodeployandrunarbitrarysoftware,whichcanincludeoperatingsystemsandapplications. The consumerdoesnotmanage orcontroltheunderlyingcloudinfrastructurebuthas controloveroperating systems,storage,anddeployedapplications;andpossibly limitedcontrolofselectnetworkingcomponents (e.g., hostfirewalls)[4][17].

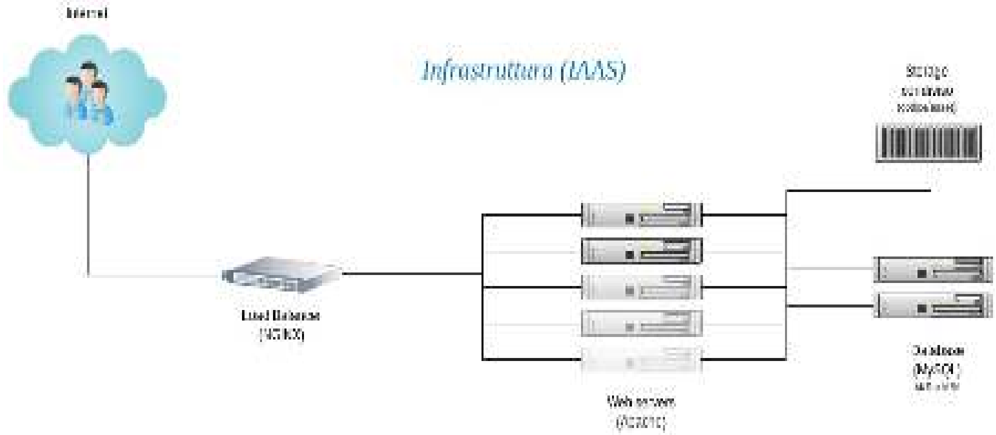

Fig.1.4InfrastructureasaServiceModel[13]

Cloud computingis rapidly moving target. New technologicaladvances and applications servicesareregularly introduced.Thereexistmany openchallengesespeciallyinthecontextofenergy-efficientmanagementofDataCentersandmarketplaceforcloudcomputing[4]. Moderndatacenters, operatingundertheCloudcomputingmodelarehostingavarietyofapplicationsrangingfromthosethat runforfewseconds(e.g.servingrequestofWebapplicationssuchasecommerceandsocialnetwork portals)to thosethatrunforlongerperiodsoftime(e.g.simulationsorlargedatasetprocessing)onshared hardwareplatform.The needtomanagemultipleapplicationsinadatacentercreatesthechallengeofon- demandresources provisioningand allocation in responsetotime-varying workloads. Normally, datacentersresourcesarestaticallyallocatedinresponsetoapplications,basedonpeakloadcharacteristics,in orderto maintainisolationandprovideperformanceguarantees.Untilrecently,highperformancehasbeen thesoleconcernindatacenterdeploymentsandthisdemandhasbeenfulfilledwithoutpayingmuch attentiontoenergyconsumption [5][19].

Datacentersarenotonlyexpensivetomaintain,butalsounfriendlytotheenvironment.Carbon emissionduetodatacentersworldwideisnow morethanArgentinaandNetherlands[19]emission.High energycostandhugecarbonfootprintsareincurredduetothemassiveamountofelectricityneededto powerandcoolthenumerousservers hostedinthesedatacenters.Cloudservicesprovidersneedto adopt measurestoensurethattheirprofitmarginisnotdramaticallyreduceddue tohighenergycosts.Asa result, companiessuchasGoogle,Microsoft,andYahoo arebuilding largedatacentersinbarrendesertland surroundingtheColumbiaRiver,USAtoexploitcheaphydroelectricpower.Thereisalsoincreasing pressurefromGovernmentworldwidetoreducetoreducecarbonfootprints,whichhaveasignificant impactonclimatechange.Toaddresstheseconcerns,leadingITvendors haverecentlyformedaglobal consortium,calledTheGreenGrid,topromoteenergyefficiencyfordatacentersandminimizetheirimpact ontheenvironmental.Pike researchforecaststhatdatacentersenergy expenditureswillreducefrom$23.3 billionin2010to$16.0billionin2020,aswellascausinga28percentreductioninGHG(greenhousegas) emissionfrom2010levelsasaresult ofadoptionofCloudcomputingmodel indeliveringITservices[5].

2. RELATEDWORK

2.1 EXISTINGWORK

Theworkrelatedto theVM placementalgorithm indistributeddatacentersusingdifferentcarbon footprintratesandPUEsisdone.They performedsimulationswhichextendsCloudSimandusedenergyand carbon-efficient(ECE)VMplacementalgorithmwhichreducemorepowerconsumptionandcarbonfootprint in ecosystem ascomparedtopreviouslydefinedalgorithms[3].Existingenergyefficientresourceallocation solutionsproposedforvariouscomputingsystemcannotbeimplementedforgreencloudcomputing.The main goalofthispaperistoimprovetheutilizationofcomputingresourcesandreduceenergy consumptionunder workloadindependentof qualityof serviceconstraint[6].

Themajorityof powerusagewithinadatacenterisusedforotherpurposesthanactualITservices. Dynamicprovisioning,multitenancy,serverutilization,datacenterefficiency arethefourkey factorsthathave enabled the cloud computing to lower the energy usage and carbon emission [7]. The ICTindustry is responsiblefor2%ofworld'sCO2emission;ICTconsumesabout8%oftotalelectricityworldwide.Itisfocus onhow todynamicallyrouteondemandcircuitthatisestablishedtotransferenergy.Theresultshow thatupto about30%incarbonemissioncanbeachievedusingourapproachescomparedto otherbaselineshortestpath routingstrategies[3][8].Alotofresearchhasbeendoneinpower efficientresourcemanagementindata centers,e.g.[20],[21].

ICTconsumeslotofenergyandmostofitisconsumedbydatacenters[9].Energyefficiencyand CO2reductionwithinthecloudinfrastructureimpliesthat:

- Executionofapplicationsrequireslessenergy,and
- EnergyconsumedduringtheexecutioncomesfromrenewablesourcesorlowCO2emittingsources [10].

ExistingAlgorithm:

1. EnergyandCarbon-Efficient(ECE)VMPlacementAlgorithm[3].
2. CarbonEfficientVMPlacementandMigrationTechnique(CEPM)[12].
3. PowerAwareBestFitDecreasing(PABFD)algorithm[14].
4. TheBestFitDecreasing(BFD)VMplacementalgorithm[16].
5. Banker'sAlgorithmandStochasticIntegerProgramming(BASIP)algorithm[24].

ConventionalAlgorithmsareasfollow:

1. RoundRobin
2. DVFS(DynamicVoltageFrequencyScaling)

2.2 OVERVIEWONPROPOSEDWORK

Proposed Approach:

Efficient VM Placement for Reducing Energy Consumption and Carbon Emission Approach (EVPRECCE)

Step1: AccordingtoVMrequestfindingthenearestdatacenter.

TheVMrequestcomesfromtheclient fordeployingtheir application usingcloud services.Nearestdatacentercanbefoundbytheirlocation.

Step2: Afterfindingdatacenter,checkwhetherhostisoverloadedorunderloaded.

According toconditionofhost nextstepwillbeimplemented.

Step3: Ifhostisunderloadedthentransferringall VM'stoanotheractivehost.

Selectingwhichhost iscapableofdeployingthatVM's.Keepunderloadedhostonsleep mode.

Step4: IfhostisoverloadedthenfindwhichVM'sshouldbetransferred.

Afterthat selectingappropriateexistinghostwithindatacenter.ThendeploytheVM.

Step5: Checkthat hostisavailabletoactiveornotwithindatacenter.

Ifhostisavailablethenactiveit.Ifhostisnotavailablethenfindanothernearestdata center.Repeatstep2,3and4.

CloudSimisatoolwhichcontainsit'sinbuildclassesand packages[22].Itwillbeusedfor implementationof projectrelatedto CloudComputing.Itcontainspackageswhichcontainingthesourcecode, examples,jars,andAPIdocumentation.

CloudSimhasfunctionalities:

- Support formodelingandsimulationoflargescaleCloudComputingDataCenters,
- Supportformodelingandsimulationofvirtualizedserverhosts,withcustomizablepolicies forprovisioninghost resourcestovirtual machines,
- Supportformodelingandsimulationofenergy-awarecomputationalresources,tosupportfor modelingandsimulationofdatacenternetworktopologiesandmessage-passing applications,
- Supportformodelingandsimulationoffederatedclouds,tosupportfordynamicinsertionof simulationelements,stopandresumeof simulation,
- Supportforuser-definedpoliciesforallocationofhoststovirtualmachinesandpoliciesfor allocationofhost resourcestovirtualmachines[23].

CloudReportsisa toolwhichwillbeusedtocreateGUIofprogramming.Itisgraphic toolthat simulatesdistributedcomputingenvironmentsbasedonthe Cloudcomputingparadigm.ItusesCloudsimasits simulation engine and provides an easy-to-use user interface, report generation features and creation of extensionsinaplug-infashion[13].

FORMULAFORCALCULATINGPUEFACTORANDCARBONFOOTPRINT

$$[illegible] = \frac{[illegible]\ P\ [illegible]}{[illegible]}$$

$$[illegible] = \sum_{[illegible]=1}^{[illegible]} \sum_{[illegible]=1}^{[illegible]} \left([illegible] \times \left([illegible] \times \sum_{[illegible]=1}^{[illegible]} \left(P[illegible]\right) \times h[illegible]\right)\right)$$

[3]

Symbol	Description
PUE	PowerUsage Effectiveness
cl	Numberofclustersat eachdatacenter
hst	Numberofhostsateachcluster
Cf	Datacenter/clustercarbonfootprintrate
TotalCF	Cloudtotalcarbonfootprint
ht	VirtualMachineholdingtime
P	Proportionalpower
dt	Numberofdatacentersites

Table.2.2.1SymbolandDescription

3. OVERALLSETUP

Loweringtheenergy usageofdatacentersisachallengingandcomplexissuebecause computingapplicationsanddataaregrowingsoquicklythatlargerserversanddisksareneededtoprocess themfast enoughwithintherequiredtimeperiod.

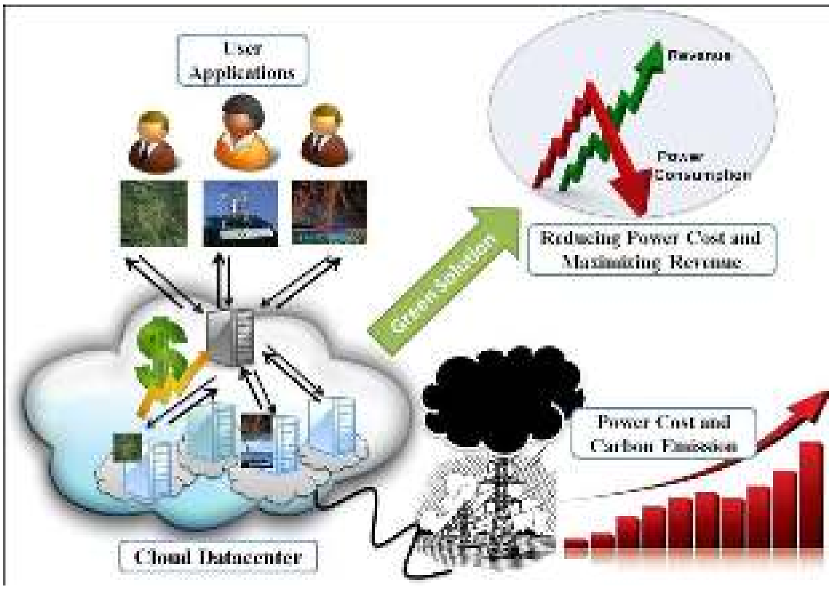

Fig.3.1GreenCloudComputingScenario[5][11][18]

GreenCloudcomputingisenvisionedtoachievenotonlyefficientprocessing andutilization ofcomputinginfrastructure,butalsotominimizeenergyconsumption. Thisisessentialforensuringthatthe futuregrowthofCloudcomputingissustainable[5].Cloudcomputing,withincreasinglypervasivefront- end client devices, such as iPhones interacting with back-end data centers, will cause an enormous escalation ofenergyusage.Toaddressthisproblem,datacenterresourcesneedtobemanagedinan energy-efficient mannerto drive Green Cloud computing. In particular, Cloud resources need to be allocatednotonlytosatisfyQoSrequirementsspecifiedbyusersviaServiceLevelAgreements(SLAs), but alsotoreduceenergy usage.Thiscanbeachievedbyapplyingmarket-basedutility modelstoacceptuser requeststhatcanbefulfilledtoenhancerevenuealongwithenergy-efficientutilizationof Cloud infrastructure[5].

4. CONCLUSIONANDFUTUREWORK

Inthispapertheproblemofenergy consumptionandcarbonemissionindistributed clouddatacentersis discussed.Overallstudyonexistingmethodologyisdiscussed.Wehaveplannedto implementationourproposedalgorithminfuture.

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