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Virtual machine placement in energy aware load balancer using fog classifier

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Abstract

Cloud datacenter carries huge volume of data and tasks which is allocating resources to multiple workstations. Most of the cloud services are operating service level agreement (SLA) placements. During execution datacenter emits carbon and makes the energy. So operation cost always consideration fact. We need to address this challenge by using energy aware load balancer. This load balancer can be fixed in Virtual Machines (VM) and Classifier is required for selecting VMs. Employing the VMs is very important factor so fog enabled services is required for distributed geo physical load balancer with energy efficiency. In this paper we propose offloading VM services and Fog classifier for load balancing the cloud services. Placing the VM from one host to another we use Host Load Balancer with Energy Aware placement algorithm. In this case dynamical cloud environment can be tested and compare the host results. This is empirical approach for place the VMs without compromising the users. The simulations are done by using CloudSim and TensorFlow is used of generating deep belief network model for preparing VM placement. Our proposed method achieves 96% energy efficiency with minimum migration cost. The results are compared with existing placement methods based on active host availability.

Keywords Virtual machine, Fog classifier, Energy efficiency, Placement, Load balancer

Introduction

Cloud Services are very important factor to provide online based services such as software, application, platforms, etc. Virtual machine is selected based on request and infrastructure requirements from the user. Nowadays ubiquitous services are used for various computing applications [1]. Computing and storage services are playing extreme operations over the internet. The technological shirt is the major reason to enable convenient, on-demand and resource sharing operations. It is configurable computing paradigm with pay per usage model. Fog computing is the cloud edge level service to extend networking, storage and processing the clouds to the users at different resource utilization [2].

Clouds and Fogs are the employ of Virtual machine and the major focus for the VM is migration and replications. The above two factors are depended based on load balancing and energy efficiency. The major role is placing virtual machine and balancing the load in running conditions. Due to over machine maintenances and large volume of data processing work load for the VM is always in running stage. This factor is investigated by various literatures and we need to fix better relationship between VM workload [3] and number action users. In this case according to the result given Amazon web Service EC2 cloud [4] has number user varies means it has low value as 1% in intensive application and increases up to 60% CPU optimized load balancing conditions [1].

According the researchers point, various fog computing [5] problems and challenges are addressing in cloud applications. While implementing load balancer means we must consider two factors such as energy efficiency

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and placement of VMs [6]. In terms of Quality of Service we need provide for latency service providers and multiple users can be accessed via fog servers. The energy efficiency is obtained from fog server placements, profiles and applications. The number of downloading [7], access specification [8], service level agreements [9], number of updates [10] and amount data pre-loading [11] are considers for fixing VM with good energy efficiency factor.

In this paper, we give energy aware load balancer framework fixing VMs using Fog classifier. In this case we optimize the cloud with better energy efficiency factor. It is integrated linear programming model with minimize total energy consumption and multifactor VM workloads [12]. VMs workload can be measured by using number of user profiles and number nodes are in active stage. Using above two factors is considered for calculating data rate. Data rate is the major factor for fining energy efficiency once we achieve good and efficient energy means VM is placed in exact position [13]. This paper organize as follows, section 2 explains various related works, section 3 gives proposed classifier with energy optimization, section 4 experiments various methods and section 4 gives conclusion and future scope.

Related work

Data centers are the highest deliverable server to distribute the service across the world. For implementing cloud application a small number to 1000 server is required. Wong et al. large amount of energy is required when the server is increased [14]. The report is given by National Record Data Center US while setting server more than 90 billion kilowatt hour of electricity was used and every year it increased double the rate by 2021 annual report. So every year nearly 200 million tons of carbon pollution happened [15].

The geographical distributed data center sites have various cloud service providers such as Google, IBM, Microsoft and Amazon. Recently VMware provides good infrastructure computing resource sharing facility and multi user availability [16]. Manikandan et al. Placing Virtual machine is tedious process we need strong cohesion factor which addresses the problem for clustering, optimization and scheduling the resources. Cloud provider faces load balancing issue it affects overall VMs performance [17]. Yung et al. various selection processes is available for setting data center sites with respect to SLA and QoS factors. Each data center get power from different servers and it can be recorded by using on-site energy services [18].

The present system has coupling issue like cloud provider and cloud data center optimization. Normally both factors were affected by unbalancing scheduling and cloudlet from the VM [20]. Dynamically services can be accessed from data centers and migration is also reducing the load optimization. Xiang et al. utilization of servers and data center is always increased to automatically energy consumption is also increased. So we need good VM placement to handle the data centers and servers. The survey from iMatrix on 2022, some countries are increased the carbon tax if the industries emits the carbon while using servers and it affect environment sustainability [20].

George and Thimmana et al. monitoring the energy consumption and balancing the load is major issue so it is directly affect the entire server and it creates high consumption factor. Researchers are calculating different weight ratio which occupied by workload and physical resource availability. Based on ratio we consider below parameter while setting VMs using energy aware load balancer i. Calculate energy consumption factor and work load, ii. Find the minimum critical occupied resources, iii. Cross validation index with respect to VM and iv. Number of resources are in active stage. Above consideration are taken as important and we provide good VM placement with respect to energy consumption factor.

Cloud-fog model

In this work, Fog classifier is proposed to handle VMs placement based on type, programming model and linearity resources. The Fig. 1 shows the layer architecture model for setting cloud optimization. Here data transmission can be done by using IP over wide area network technology, core volume of servers used and connected. Passive optical network connection is established with optical line terminal and optical network unit for data transmission. Cloud data centers are connected with IP network and Fog classifier extends the service via edges. In this work we considered fog nodes are the access specifiers to handle the resource based on clusters.

Based on above input the major problem with data centers is placement of VM. Most of computing it is not done properly due the active and dynamic energy utilization. So we need consider below input while designing Fog classifier.

a. While placing VMs must check with sever whether it is fully utilized
b. To minimize the cost of the energy in data centers we need to shutdown the servers when it is in idle stage.
c. Minimize the energy consumption in the data centers and estimate the carbon tax of each resource allocation at physical infrastructures.
d. Select the data centers based on availability and virtual provisioning

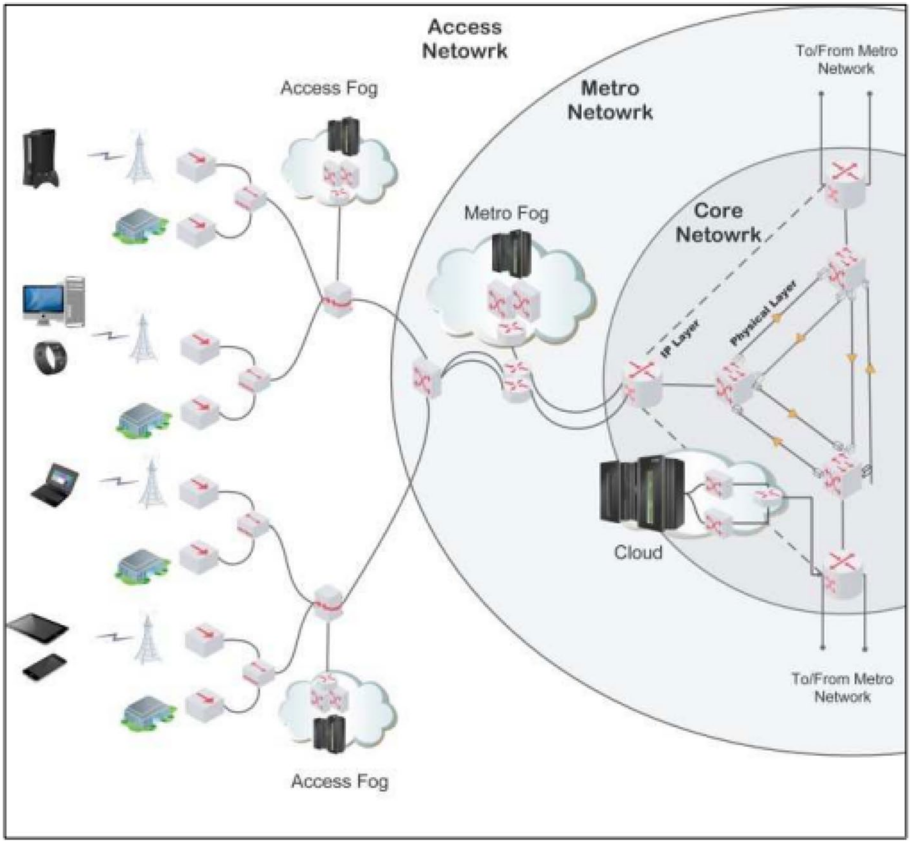

Fig. 1 Cloud data center with fog nodes

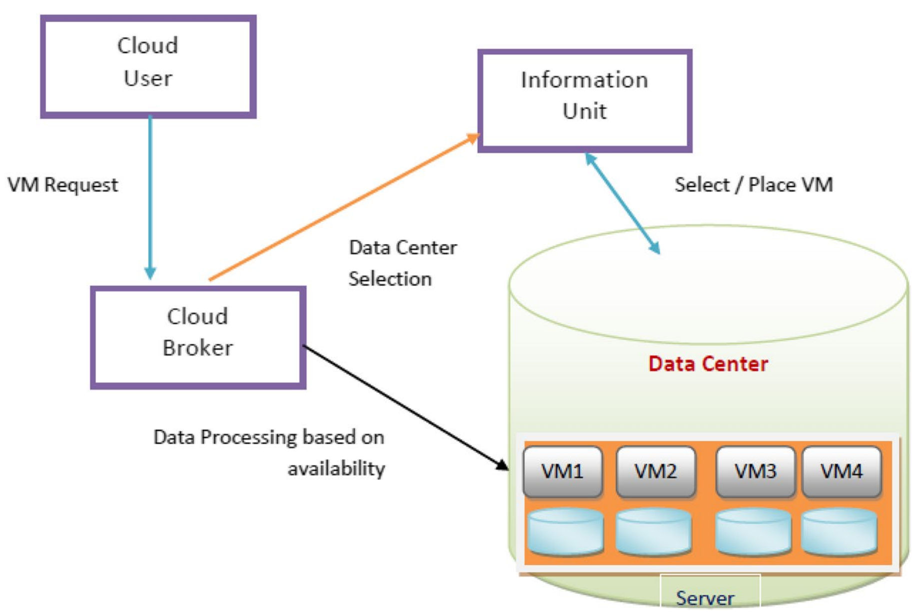

Fig. 2 VM Placement and Selection based on availability

Table 1 Fog classifier algorithm

Algorithm: Host Load Balancer with Energy Aware placement

Input: Host_List,VM_List
Ouput: VM_Allocation

1. All the over Utilized_Hosts and SwitchedOff_Host
2. Select HostList_UnderUtilized and HostList_OverUtilized
3. Find HostList_NewPlacement_VM and HostList_Sort(UtilizedHost)
4. Calculate Total_Workload(Data_Center)
$Workload_{Total} = \sum_{i=i}^{N} Ui \quad where\ Ui - Utilization\ Index\ with\ repect\ to\ number\ of\ host$
5. Maximum number for host calculated as
$Hmax_{Total} = \frac{Workload(Total)}{Upper\_Thershold}$
6. LowerTherholds ←|Hmax| >= Workload
7. for each select 1 to Hmax do
        Exclude HostList_UnderUtilized
    End for
8. HostList_OverUtilized ←1
9. for each select Hmax to 1 do
        Sort (HostList_Sort(UtilizedHost))
    End for each
10. Repeat Step 7 until Hmax = 0
11. While TRUE
12. if Host_NumberMin_Utilization £ HostList_NewPlacement then
        HostList_NewPlacement.add(Host_NumberMin_Utilization)
    End if
13. For all VM in HostList_MaxUtlization
        VM.getVMUtilization(Host_List,VM_List)
        Min_Power=MAX:25.Allocat_Host ← NULL
14. For each Host_List 1 to N do
If U_Host (After.Placement) > = Upper_Threshold then
Continue Next Host_List
Else if P_Host (After.Placement) – P_Host (Before.Placement) < Min_Power then
Continue Step 12 until Host_List ←NULL
Else
Allocate_Host = HostList_NewPlacement.add()
End it
15. if Allocated_Host == NULL then
        Allocated_Host ← Exclude.Host_List_UnderUtilized && Exclude.Host_List_UnderUtilized.add (Allocated_Host)
    endif
16. Migration.Map_Add(Host_List, VM_Allocation)
17. break the Code Not for all VMs reallocated
18. Host_Min_Utilization = Host_Min_Utilization + 1
19. End while5

Table 2 Conditions and task allocation in VMs

Data Center—VM Placement	Dynamic Cost Award	Dynamic Energy Aware
Dynamically VMs are placed with Fog classifier algorithm which has combination of amount of utilized energy and cloud host	The cost factor is measure by using number of active host and energy availability from renewable sources. Here the power can be selected from smart grid model	Initialize the energy count set as 0 and increase the value based on usage of data center based on cost it will be impacted
Procedure – Cloudlet Accessing the VM Step 1: Select the number of Cloudlet task from resource pool Step 2: Obtain the VM_List and request send to cloud broker Step 3: Check the information set whether VM is available, if available request send to cloud data center and allocate VM otherwise consume the amount energy and cost Step 4: Data center is selected means record and monitor the energy if it is increase means fog classifier classify the node and allocate another VM based on availability Step 5: Then the server is selected by number of utilization index and VM process Step 6: The task is classified based on execution time and waiting time from resource pool selection. Round Robin policy is taken for allocating VM using scheduled manner Step 7: If the process is completed note the time taken for execution and energy consumption factor and reallocated the VM as empty		

In this paper we proposed three VM placement methods are experimented by referring energy consumption and cost. Factor 1: Verify the physical resource factors such as power supply unit, cooling, UPS backup and lighting, Factor 2: Data center availability, Factor 3: Distributing load balancing unit among the data centers, Factor 4. Renewable energy resources.

From the above Fig. 2, VM placement is done in data centers with respect to all geographical areas considered overhead energy as less, optimized server and footprint of each resource allocation. VM placement can be done by using maximise the renewable energy utilization and minimum total cost. In this method we sort the entire host in descending order based on utilization factor. If utilization is less means we consider that host as weak and we used that for overloading conditions. This process can be repeated while fixing good placement of VM. Here we considered detecting under loaded hosts, host utilization factor, data center workloads and vacated VMs. Existing method also considered for targeting the host. In this case we propose Fog classifier for selecting VM and host optimization.

Fog classifier—host load balancer with energy aware placement algorithm

The prediction of number of host and fetch the lower threshold values. In this case fog classifier divides the host into lower threshold hosts and higher threshold hosts. So VM can select based on minimum changes based on host availability (Table 1).

Cloud users can submit the VM Request to cloud broker and select the VM values for the user so this case the time can be obtained as.

VMi = (Type of Service, Hold_Time) the type selected by Amazon EC2 VM instance and running out measured by using first come first serve basis.

Power Consumption in Data Center – Data center connects the power from UPS or Networking devices. This is distributed to all the data center components and uses the less energy consumption (Table 2). The cost of energy can be obtained as follows

$$\mathrm{PowerSupplyUnit}_{\mathrm{Index}} \frac{Power(total)}{Power(utlized)} = \frac{Po - (Ps * Pu)}{Power(total)}$$

where Po – Overhead Power and Utilized power obtained from data centers.

Conditions

Experimental setup

Our proposed system is evaluated at Infrastructure as a service (Iaas) cloud environment using Amazon EC2 Cloud VM and CloudSim toolkit is used to test real time environments. It is large scale platform so evaluation can be done virtualized load balancer model. Here Fog classifier is added the features such as cluster the VMs, Host List, VM Allocation, Minimum power consumption factor and overhead values. The below Fig. 3 shows that VM Machine server with types.

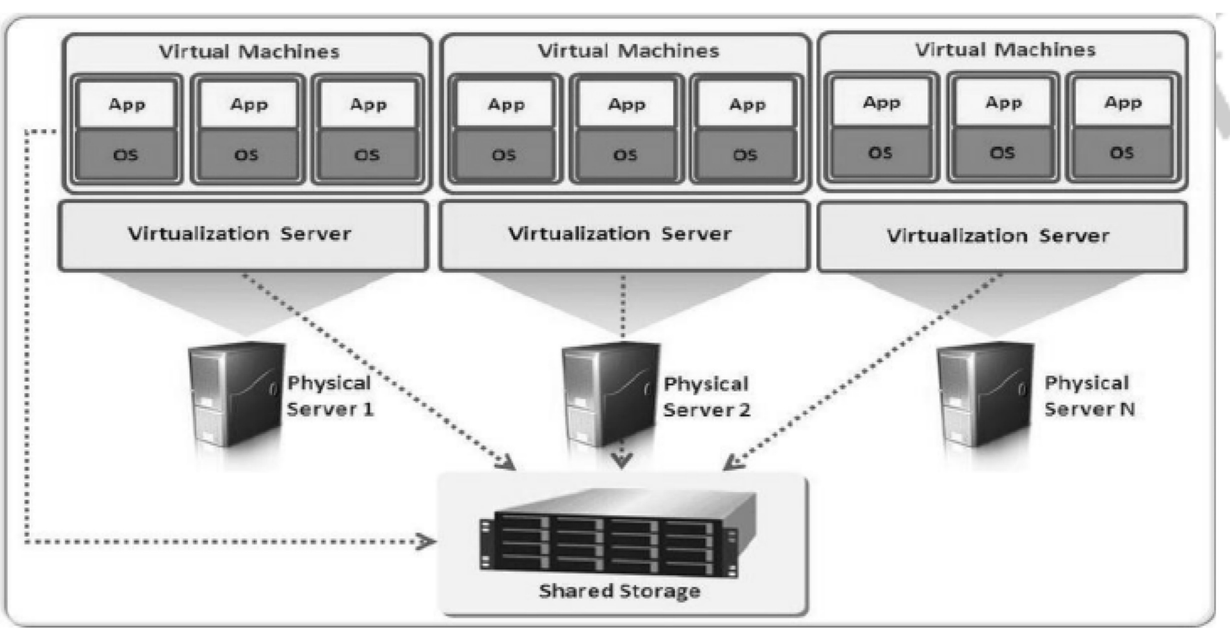

Fig. 3 VM Workloads at different types

Table 3 Data center selection based on VM request from resource pool

Data Center	Data center utilization	Available energy (KW)	Energy aware request from server (KW)	Cloud information set (Pool)	Power Unit
DC1	10%	500	200	50	Power(Total)
DC2	20%	1000	500	100	Power(Total)
DC3	50%	1500	1000	150	Power(Total)
DC4	100%	2000	1500	200	Power(Total)

Table 4 Energy aware consumption results after allocating VMs based on user requests

Parameter	Index
Router Power Consumption	500KW
Transponder Request Power Consumption	250KW
Number of Bandwidth	1000KW
Data Rate	50Gpbs
Distance from Each Cluster	5 to 10 kms
Span Time	1.5 ms
Number of Data centers	4
Number of Nodes	20
Number of user	800
User downloading rates	{1,5,10,25,50,100}Mbps
Number of VMs	50
VM Popularity based on User Downloading rate	{1,5,10,25,50,100}%

VM – Types	VM— RAM	VM – Memory	Bandwidth of VM	VM CPU	Instructions per seconds
Small_VM	512 MB	3 GB	100 mb/s	3	200
Medium_VM	1 GB	3 GB	100 mb/s	3	500
Large_VM	2 GB	3 GB	100 mb/s	3	1000
X-Large_VM	5 GB	3 GB	100 mb/s	3	2000

We designed the data centers with Data center utilization, Available energy, Energy aware request from server and cloud information set. We are operating the data center we used hypervisor created by virtual machine with memory, bandwidth, CPU shown in Tables 3 and 4.

VMs placement

We used optimal placement using Data Center selection using core network topology consist of 30 nodes and 120 bidirectional link. In below Fig. 4 Core network topology from CISCO Network index representation. Here

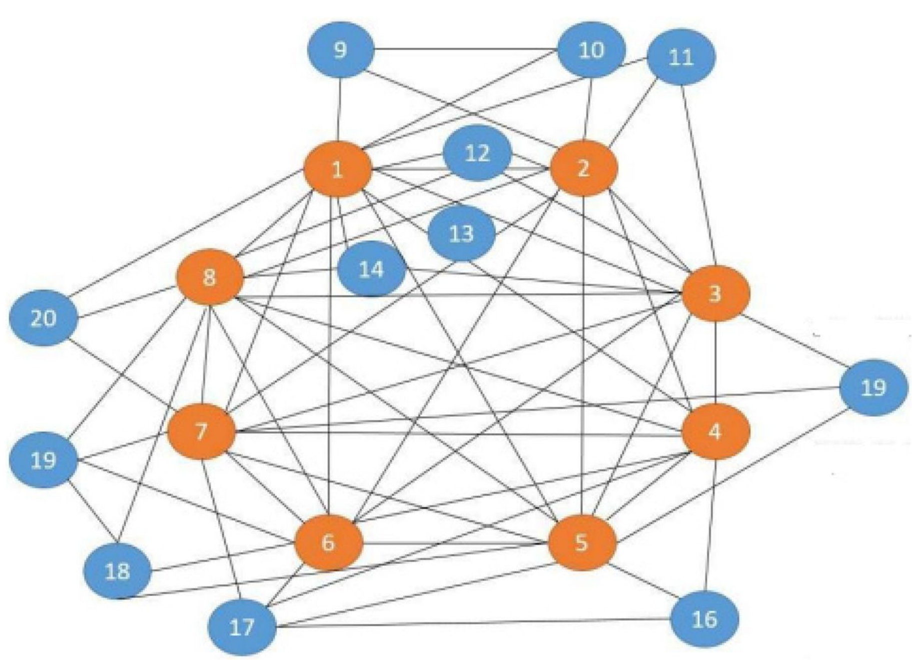

Fig. 4 Core network topology VM allocation using active users

Table 5 Data center, server and VM characteristics for experiments

Data Center:

System Architecture = ×86
Operating System = Linux
VM Type = Amazon EC2
Resource Cost = 1.0
Memory Cost = 0.05
Storage Cost per usage = 0.01
Bandwidth at Resource Level = 0.1

Server:

HOST-TYPES = {1,2,5,10,25}
HOST-IPS = { 500,1000,1500,2000}
HOST-Power = 500KW
HOST-RAM = {1 GB,2 GB,5 GB}
HOST-BW = 1Gbps
HOST-STORAGE = 2 GB
HPPROLIANTML110G4XEON3040(), HPPROLIANTML110G5XEON3075()–2 Servers are used

Virtual Machine:

VM_TYPES = 5
VM_MIPS = {1000,500,250,100,50}
VM_PES = 250KW
VM_RAM = 1 GB
VM_BW = 100Mbps
VM_SIZE = 2.5 GB

the 1300Gbps data rate can be applied with XGPON Model selected from VMs. Also more the 30 K user request sent to internet traffic and 60% user can active in dynamic stage. So the VM workload assigned as cluster group 1,4,8,16,25,50,100 and index set as 100%,50%,25%, 10%, 5% and 1%. The number of VM is considered as CPU capacity and active user status. The VM workload may varies based on CPU capacity and requirements. In this case data rate varies as 1Mpbs, 5Mpbs, 10Mpbs and 25Mpbs. For example lower to higher data rate can be assigned based on VM usage.

CloudSim experimental inputs

From above Table 5, experiments are set in cloudsim and apply our proposed algorithm for evaluating cloud. Here Fog classifier classify the cloud based on usage and availability. Proposed method is allocate maximum number of task to active host. The energy consumption is propotional to the action host in the dataset. If we increase the number of host means result will be decreased or shutdown the data center.

Based on above Table 6 and Fig. 5, VM Types tested by using various data center and number of host. In this case the energy consumption is below 35% and accuracy index average in 96% achieved. Also each stage number VMs are shutting down based on number of VM migrated. From this result our proposed algorithm is compared with existing VM placement and accuracy index values using TensorFlow. TensorFlow is the comparison tool to compare the results with various representations.

Based on above Table 7, the proposed method is compared with existing method virtualized load balancer and decision tree index methods with selecting VM Types, Data center and number of host. In this case comparison is taken as accuracy and number data centers are shutdown. From the two factors our proposed

Table 6 Experimental result of VMs placement and accuracy index

VMTypes	Data Center	No. of Host	Energy Consumption (KW)	VM Migration	SLA(%)	Accuracy (%)	No. of Shutdown
Small_VM	DC1	100	12.01	245	6	94	122
	DC2	200	13.88	331	6	94	145
	DC3	500	15.78	467	5	95	134
	DC4	1000	21.34	568	5	95	156
Medium_ VM	DC1	100	18.91	255	6	94	123
	DC2	200	20.21	278	4	96	144
	DC3	500	27.89	346	7	93	167
	DC4	1000	30.12	452	5	95	178
Large_VM	DC1	100	21.98	435	6	94	125
	DC2	200	23.67	467	6	94	165
	DC3	500	29.02	521	4	96	178
	DC4	1000	31.05	547	5	95	165
X-Large_VM	DC1	100	23.45	325	5	95	112
	DC2	200	27.89	431	4	96	143
	DC3	500	30.05	478	6	94	154
	DC4	1000	33.65	522	5	95	167

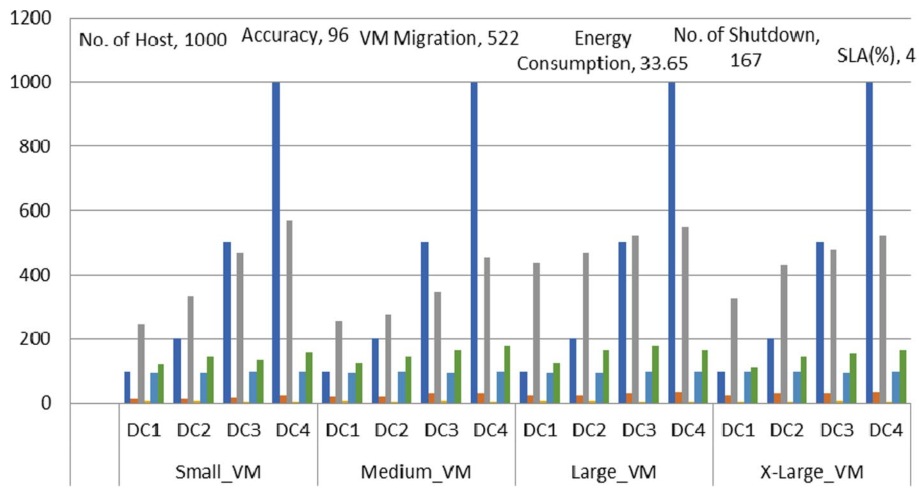

Fig. 5 Graphics representation of VM usage and accuracy

method Host Load Balancer with Energy Aware placement algorithm gives good accuracy and number of data centers also shut downed.

Conclusion

Virtual machine placement is major consideration in cloud computing environment. Because in cloud environment has more number of data centers, nodes, active user and dynamically changing resources. So we provided a solution to handle the cloud environment and balancing the load with less energy consumption using Fog classifier. We presented a framework with less energy consumption over a cloud-fog model. In this case VMs workloads are considered as major key player and simulate the cloud using CloudSim. Number hosts, Data Center and VM Types are taken and proposed Host Load Balancer with Energy Aware placement algorithm is applied to simulate the environment. From this our proposed system achieves 96% energy efficiency and it is compared with existing methods. In future may be our proposed algorithm is applied for hybrid or heterogeneous cloud environment.

Table 7 Comparison of VM types with existing and proposed method

VMTypes	Data Center	No. of Host	Virtualized Load Balancer		Decision Tree Index		Fog Classifier	
			Accuracy (%)	No. of Shutdown	Accuracy (%)	No. of Shutdown	Accuracy (%)	No. of Shutdown
Small_VM	DC1	100	81	65	85	89	94	122
	DC2	200	82	67	86	67	94	145
	DC3	500	80	63	83	68	95	134
	DC4	1000	78	45	84	78	95	156
Medium_VM	DC1	100	79	56	83	87	94	123
	DC2	200	76	57	87	76	96	144
	DC3	500	76	58	85	85	93	167
	DC4	1000	79	67	87	67	95	178
Large_VM	DC1	100	81	54	88	89	94	125
	DC2	200	83	56	84	76	94	165
	DC3	500	82	43	85	79	96	178
	DC4	1000	81	67	85	87	95	165
X-Large_VM	DC1	100	79	57	86	88	95	112
	DC2	200	75	78	88	83	96	143
	DC3	500	76	76	85	87	94	154
	DC4	1000	79	72	87	87	95	167

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