EFFICIENT TASK ALLOCATION BASED ON GREEN COMPUTING IN PRIVATE CLOUD

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ABSTRACT: Cloud computing is an appearing paradigm in the latest computer industry where the computing is moved to a cloud of computers. Cloud Computing is appraised as one of the transpiring arena which incorporates technologies, concepts and generates a platform for IT framework and cost-effective business applications. Some of the main benefits of cloud computing are: elasticity, self-service provisioning and pay per use. Green computing concept is to improve environmental condition. Green computing can facilitate us to safe, secure place and healthy environment all over in the world. This paper will help us to take some initiatives currently under in the field of computers/electronics industry and new ways to save vast amounts of energy which is wasted in very large scale. The green computing technologies can reduce energy consumption.

Keywords: **-Cloud Computing, Green Computing, resource utilization, power consumption, Environment, Energy, Power, Local Cooling.**

INTRODUCTION

Cloud Computing is an appearing paradigm in the latest computer industry where the computing is moved to a cloud of computers. Cloud Computing is appraised as one of the transpiring arena which incorporates technologies, concepts and generates a platform for IT framework and cost-effective business applications. Some of the main benefits of cloud computing are: elasticity, self-service provisioning and pay per use. Green computing concept is to improve environmental condition. Green computing can facilitate us to safe, secure place and healthy environment all over in the world. This paper will help us to take some initiatives currently under in the field of computers/electronics industry and new ways to save vast amounts of energy which is wasted in very large scale. The green computing technologies can reduce energy consumption. The temperature of global world is increasing very quickly. The energy consumption may be reduced by introduction of green computing. The data centres use a large amount of power/energy and release a lot of amount of heat and gases. In our daily life we use AC's. Refrigerators, inverters, UPS and computers. T **Green Cloud Computing** Green computing is also known as green IT. It is the process of using computer and other resources in an environment efficient way. Recent computer systems are the combination of people, hardware, software and networks, etc.,[1] which produce more hazards to environment. Green is used to reduce power consumption and increases energy efficiency. Computer / Laptop sale is increasing day by day so power consumed by them is too large. By reducing energy consumption, global warming can be reduced. Green Computing tries to provide solution to various environment related issues and provides an alternative technology.

Research Motivation Although cloud computing has been widely adopted by the industry, but the research on cloud computing is still at an infancy stage. There are many issues in Cloud computing such as Virtual Machine Migration, Data security, Energy Management, Server Consolidation etc. as discussed in previous section that have not been fully addressed. Energy management is one of the challenging research issues. Cloud Infrastructure is the most important component in a cloud. It may consists tens of thousands of servers, network disks and devices, and typically serve millions of users globally. Such a large-scale data center will consume enormous amount of energy. For example, according to research of Google datacenter used about 2.26 million MW hours of power to operate in 2010, resulting to carbon footprint of 1.46 million metric tons of carbon dioxide. In other words, a single data center can consume power which is equal to a power consumed by small town. In order to reduce power consumption, it is necessary to balance the load among the different nodes

II.LITERATURE SURVEY

YuyangPenget. al (2016) has proposed an evaluation energy efficient virtual machine allocation and genetic based algorithm based meta heuristic which support a power aware VM request allocation of multiple sustainable cloud data centers.This approach provides a novel metrics which diagnoses the efficiency of power of each cloud datacenters.

HuiguiRonget. al (2016) has reviewed the progress of energy-saving technologies in high-performance computing,energy conservation technologies for computer room and renewable energy applications during the construction and operation of data centers. From multiple perspectives of energy consumption and environment protection, a comprehensive set of strategies are proposed to maximize data centers efficiency and minimize the environment an impact. This research also provides energy-saving trends for data centers in the future. **FahimehFarahnakianet. al (2015)**has investigated the effectiveness of VM and host resource utilization predictions in the VM consolidation task using real workload traces. The experimental results show that the approach provides substantial improvement over other heuristic algorithms in reducing energy consumption, number of VM migrations and number of SLA violations.

Maurizio Giacobbeet. al (2015)has applied a new strategy to reduce the carbon dioxide emissions in federated Cloud ecosystems. More specifically, they have discussed a solution that allows providers to determine the best green destination where virtual machines should be migrated in order to reduce the carbon dioxide emissions of the whole federated environment.

MoonaYakhchiet. al (2015) has presented an approach based on Cuckoo Optimization Algorithm (COA) to detect over-utilized hosts. They have employed The Minimum Migration Time (MMT) policy to migrate Virtual Machines (VMs) from the over-utilized hosts to the under-utilized hosts. The results generated by Cloud sim

simulator, demonstrated that the proposed approach has lowest energy consumption compared to the other famous algorithms.

ChenxiQiuet. al (2015) has stated the functioning of CSB (Cloud Service Brokerage) as an intermediary between tenants and cloud providers that can bring about great benefits to the cloud market. CSBs buy the cloud resources, i.e., servers, with lower prices from cloud providers and sell the resources to the tenants with higher prices. To maximize its own profit, a CSB may distribute tenants' requests to the clouds that waste energy resources.

Yibin Liet. al (2015) has proposed a novel Energy-aware Dynamic Task Scheduling (EDTS) algorithm based on DVS (Dynamic Voltage Scaling) to minimize the total energy consumption for smart phones, while satisfying stringent time constraints and the probability constraint for applications.

YunNi Xiaet. al (2015) has presented a novelstochastic framework for energy efficiency and performance analysisof DVS-enabled cloud. This framework uses virtual machinerequest arrival rate, failure rate, repair rate, and service rateof datacenter servers as model inputs.

Problem Formulation The number of online services - such as search, social networks, online gaming and video streaming— has exploded. Due to data locality issues and the demand for fast response times, such services are usually distributed across geographically diverse set of data centers. This has led to the construction of large-scale computing data centers consuming enormous amounts of electrical power. Despite of the improvements in energy efficiency of the hardware, overall energy consumption continues to grow due to increasing requirements for computing resources. So, we investigate heterogeneous workloads of various types of Cloud applications and develop algorithms for energy-efficient mixing and mapping of VMs to suitable Cloud resources in addition to dynamic consolidation of VM resource partitions. So, the aim of the thesis is to consolidate the load balancing in an efficient way so that the resource utilization can be maximized and the energy consumption of the data center could be minimized that can further result in reducing global warming. We have concluded the parameters that should be analysed and improved that will result in reduction of global warming and will increase the profits of cloud provider and the client.

Objectives To improve the overall efficiency of the system, we have to reduce the power consumed at the IT data center in cloud environment. As we have already discussed, power consumption in the cloud is directly proportional to the electrical bills and thereby decreasing the margins and profits of the cloud provider and the client. Moreover, carbon footprints are also associated with the amount of power consumed. The main objectives of this research work are written as follows:

1. Implement and study the performance of existing load balancing and power saving algorithms.

2. Design the improved load balancing algorithm with power saving architecture for proper allocation of tasks to the data center.

3. Reduce the overall energy consumption and CO_2 emissions generated by the cloud datacenter.

4. Reduce the overall cost of the client and the cloud provider and to increase the profits.

5. To develop the proposed algorithm and compare the performance of proposed algorithm with existing algorithms.

Methodology: Cloudlet Lease Types – 1. Cancel able 2. Suspend able 3. Non-Pre-empt able

If the algorithm finds two or more low priority jobs the lease type of the job should be considered. If the lease type is Non-pre-empt able, then the job is ignored for the candidate set. Priority is given to cancellable lease type than suspend able lease type as the jobs with such lease type can be killed. The job with suspend able lease type should be suspended and resumed. If there are two or more low priority jobs with suspend able lease type then the level of completion of job is considered. The job which has finished only a minimum portion of job is chosen for pre-emption. Open the Cloud Sim Simulator in Net beans IDE of Java and create the heterogeneous virtual machines of different MIPS and processing power in multiple data centers with different hosts. The virtual machines are having service level packages with different resources inside it.

PARAMETERS	CANCELLABLE	SUSPENDABLE	NONPREEMPTABLE
COST	FREE	MEDIUM	HIGH

DEADLINE GUARANTEE	NO	NO	YES
SUSPENSION	YES	YES	NO
JOB KILL	YES	NO	NO
FAULT TOLERANCE	NO	WAITING STATE	YES

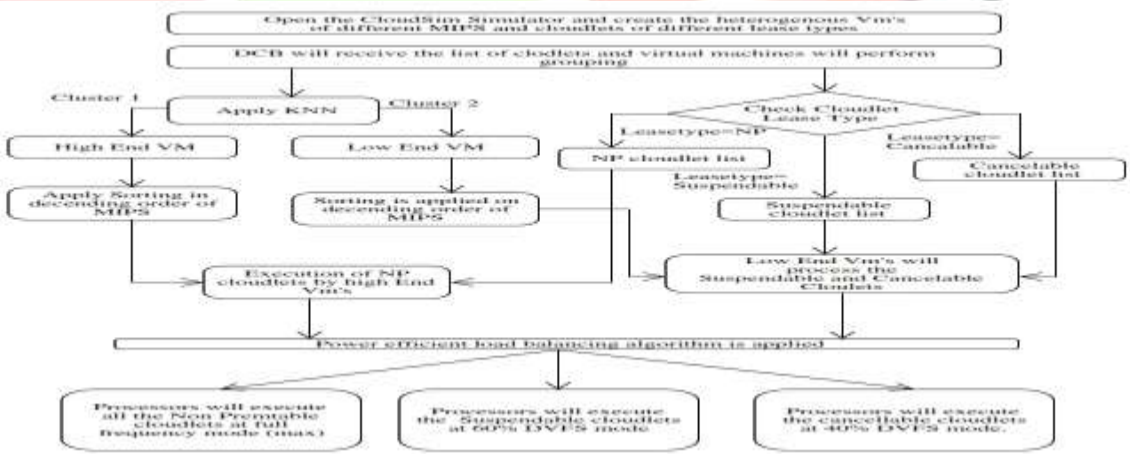
Create the multiple numbers of user cloudlets of different packages and length. The datacenter broker will receive the list of all the virtual machines and will categorize them into two classes:

Class A - High end VM – will process the Non-Pre-empt able cloudlets

Class B - Low end VM will process the suspend able and cancellable cloudlets.

Clustering is done at the VM level on the basis of VM capacity in terms of processor, memory, bandwidth by using K-Means Clustering mechanism. The machines in each class will be further sorted in descending order according to their MIPS. The DCB will group the Cloudlets according to their lease type and sort the non-pre-empt able cloudlets in ascending order of deadline. High priority cloudlets are assigned to machines belonging to class A whereas low priority (suspend able and cancellable) cloudlets are assigned to machines belonging to class B. If all the machines in the class A are occupied and any high priority cloudlet arrives, then it will executed by the VM of class B. When a high priority job arrives, availability of the VM is checked in class A. If the VM is available in class A, then job is allowed to run on the VM in class A. If the VM is not available, then algorithm finds a free VM in class B. Again, if the VM is not available in Class B, then the algorithm find a low priority job taking into account the job's lease type. Priority is given to cancellable lease type than suspend able lease type as the jobs with such lease type can be killed.

Flow Chart



Firstly create the multiple numbers of Cloudlets. Then create the heterogeneous Virtual machines. Fetch the input resources and the cloudlets. By Using load balancing algorithm, the broker will allocate the cloudlets to the available virtual machine depending upon its availability and current load. The machine will operate in the mode depending upon the nature of the task and its deadline. Cloud Sim simulation framework will be used for implementing the cloud environment. Three modes of DVFS are implemented in proposed work. Non-Premtable cloudlets will run at 100% mode, suspend able cloudlets will run at 70% mode and cancellable cloudlets will run at 40% mode. Dynamic voltage scaling is a power management technique in computer architecture, where the voltage used in a component is increased or decreased, depending upon circumstances. Dynamic voltage scaling to increase voltage is known as over volting; dynamic voltage scaling to decrease voltage is known as under volting. Under volting is done in order to conserve power, particularly in laptops and other mobile devices.

Proposed Algorithm

- The process of grouping a set of objects into classes of similar objects.
- Clusters are based on *centroids* of points in a cluster, *c*:
- Reassignment of instances to clusters is based on distance to the current cluster centroids.
- Cloudlets will be divided into the clusters according to the cloudlet's length, priority and cost.
- Euclidean distance will be computed for finding the distances of the Cloudlet with the Cluster's centroid.
- $Euclidean\ Distance = \sqrt{(RAM_1 - RAM_2)^2 + (BW_1 - BW_2)^2 + (MIPS_1 - MIPS_2)^2}$

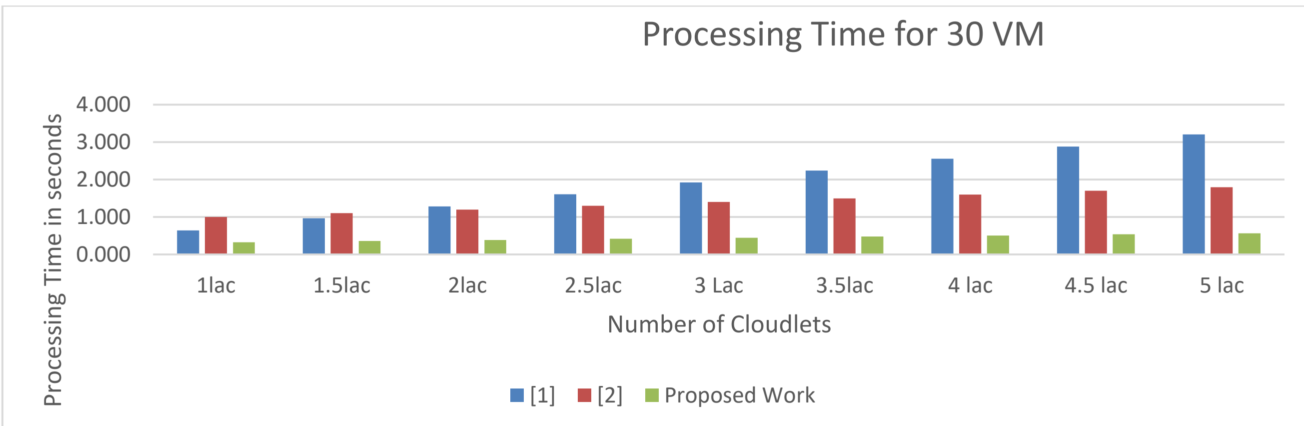
Tool Environment

Cloud Sim is an extensible simulation toolkit that enables modelling and simulation of Cloud computing systems and application provisioning environments. The Cloud Sim toolkit supports both system and behaviour modelling of Cloud system components such as data centers, virtual machines (VMs) and resource provisioning policies. It implements generic application provisioning techniques that can be extended with ease and limited effort. Currently, it supports modelling and simulation of C loud computing environments consisting of both single and internetworked Clouds (federation of Clouds). Moreover, it exposes custom interfaces for implementing policies and provisioning techniques for allocation of VMs under inter-networked Cloud computing scenarios. Cloud Sim offers the following novel features:

Results: Existing and proposed work with Graphs

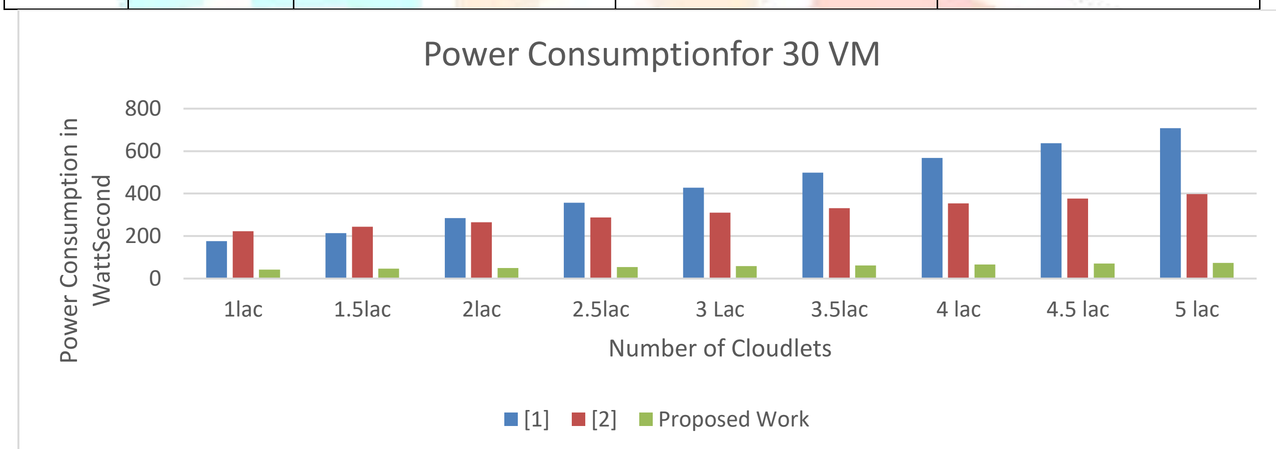
S no.	No of Cloudlets	Total Processing Time base 1	Total Processing Time base 2	Total Processing Time Proposed
1	5	0.000	0.000	0.000
2	10	0.000	0.000	0.000
3	40	0.000	0.000	0.000
4	60	0.000	0.001	0.000
5	100	0.001	0.001	0.000
6	150	0.001	0.002	0.000
7	200	0.001	0.002	0.001
8	300	0.002	0.003	0.001
9	400	0.003	0.004	0.001
10	500	0.003	0.005	0.002
11	700	0.005	0.007	0.002
12	1000	0.006	0.010	0.003
13	2000	0.013	0.020	0.007
14	3000	0.019	0.030	0.010
15	5000	0.032	0.050	0.016
16	7000	0.045	0.070	0.023
17	8000	0.051	0.080	0.026
18	9000	0.058	0.090	0.029
19	10000	0.064	0.100	0.033
20	20000	0.128	0.200	0.066
21	30000	0.193	0.300	0.098
22	40000	0.259	0.400	0.131
23	50000	0.321	0.500	0.164
24	60000	0.372	0.600	0.197
25	70000	0.449	0.700	0.230

26	80000	0.513	0.800	0.262
27	90000	0.578	0.900	0.295
28	1lac	0.642	1.000	0.326
29	1.5lac	0.963	1.100	0.358
30	2lac	1.283	1.200	0.386
31	2.5lac	1.604	1.300	0.418
32	3 Lac	1.925	1.400	0.447
33	3.5lac	2.240	1.500	0.477
34	4 lac	2.561	1.600	0.507
35	4.5 lac	2.885	1.700	0.537
36	5 lac	3.208	1.800	0.568



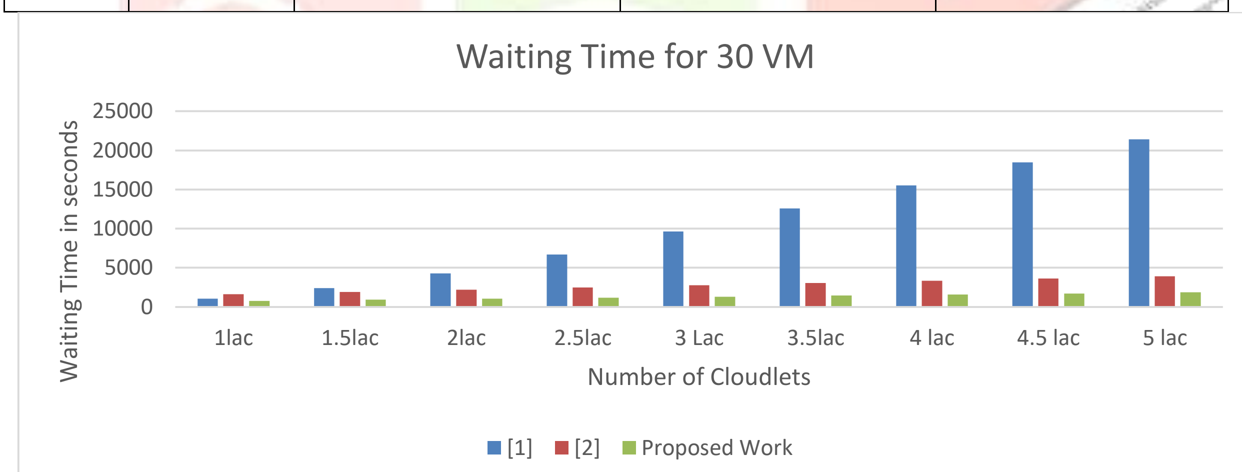
S no.	No of Cloudlets	Total Power Consumed Base 1	Total Power Consumed Base 2	Total Power Consumed proposed
1	5	0.011	0.011	0.002
2	10	0.020	0.022	0.004
3	40	0.062	0.089	0.016
4	60	0.086	0.133	0.025
5	100	0.148	0.222	0.043
6	150	0.214	0.333	0.061
7	200	0.290	0.444	0.085
8	300	0.428	0.666	0.126
9	400	0.576	0.888	0.167
10	500	0.717	1.110	0.210
11	700	1.004	1.554	0.293
12	1000	1.432	2.220	0.418
13	2000	2.855	4.440	0.839
14	3000	4.276	6.660	1.259
15	5000	7.127	11.100	2.099
16	7000	9.980	15.540	2.935
17	8000	11.402	17.760	3.360
18	9000	12.822	19.980	3.775

19	10000	14.253	22.200	4.196
20	20000	28.500	44.400	8.392
21	30000	42.741	66.600	12.602
22	40000	56.992	88.800	16.799
23	50000	71.232	111.000	21.000
24	60000	85.474	133.200	25.194
25	70000	99.726	155.400	29.391
26	80000	113.969	177.600	33.583
27	90000	128.216	199.800	37.768
28	1lac	176	222	42
29	1.5lac	214	244	46
30	2lac	285	265	50
31	2.5lac	356	287	53
32	3 Lac	427	309	58
33	3.5lac	499	332	61
34	4 lac	567	354	66
35	4.5 lac	638	376	70
36	5 lac	708	398	74



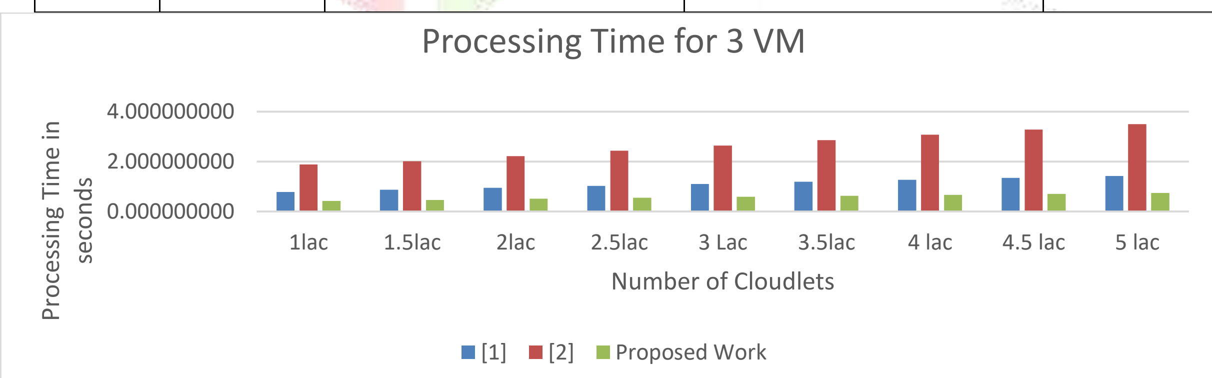
S no.	No of Cloudlets	Total Waiting Time Base 1	Total Waiting Time Base 2	Total Waiting Time Proposed
1	5	0	0	0
2	10	0	0	0
3	40	0	0	0
4	60	0	0	0
5	100	0	0	0
6	150	0	0	0
7	200	0	0	0
8	300	0	0	0
9	400	0	0	0
10	500	0	0	0
11	700	0	0	0
12	1000	0	0	0

13	2000	0	1	0
14	3000	1	1	1
15	5000	3	4	2
16	7000	5	8	4
17	8000	7	11	5
18	9000	9	13	6
19	10000	11	17	8
20	20000	43	67	32
21	30000	96	150	72
22	40000	171	266	129
23	50000	267	416	200
24	60000	385	600	288
25	70000	524	816	392
26	80000	685	1066	511
27	90000	867	1350	645
28	1lac	1070	1632	779
29	1.5lac	2408	1915	914
30	2lac	4281	2198	1048
31	2.5lac	6689	2481	1182
32	3 Lac	9633	2764	1316
33	3.5lac	12576	3047	1449
34	4 lac	15525	3330	1584
35	4.5 lac	18475	3613	1717
36	5 lac	21425	3896	1851



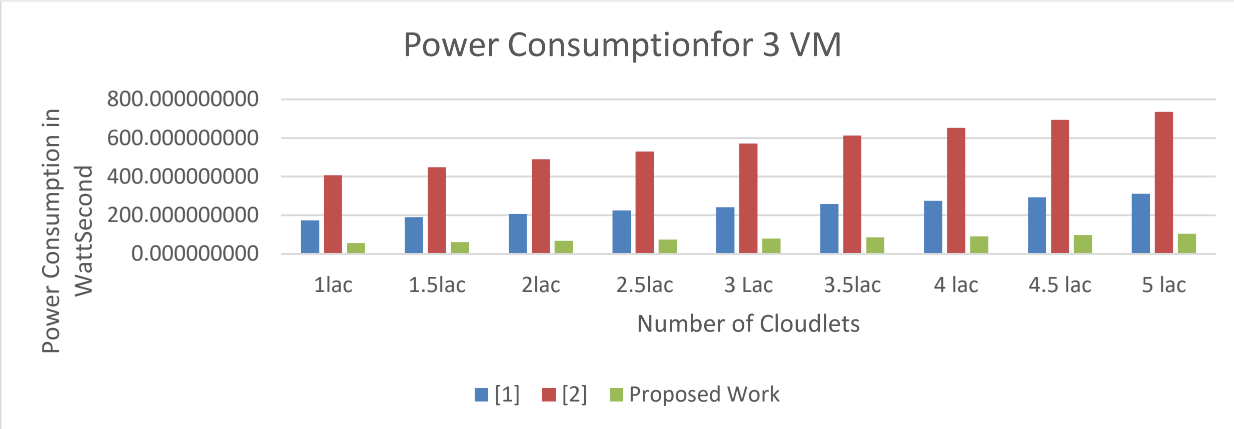
Sno.	No of Cloudlets	Total Processing Time bp1	Total Processing Time bp2	Total Processing Time
1	5	0.000040161	0.000095000	0.000021314
2	10	0.000080990	0.000196660	0.000042857
3	40	0.000315975	0.000746730	0.000169882
4	60	0.000469967	0.001100065	0.000253866
5	100	0.000785949	0.001846690	0.000425724
6	150	0.001174922	0.002749985	0.000639253

7	200	0.001567559	0.003669945	0.000852677
8	300	0.002349851	0.005499945	0.001280798
9	400	0.003135800	0.007346520	0.001703602
10	500	0.003917409	0.009169670	0.002130956
11	700	0.005485651	0.012846250	0.002978495
12	1000	0.007835501	0.018345890	0.004258786
13	2000	0.015666663	0.036668345	0.008525642
14	3000	0.023498507	0.054997545	0.012790626
15	5000	0.039165169	0.091665670	0.021309053
16	7000	0.054832515	0.128340665	0.029822428
17	8000	0.062663676	0.146663530	0.034087884
18	9000	0.070495520	0.164993075	0.038352099
19	10000	0.078331021	0.183339295	0.042623203
20	20000	0.156657703	0.366658195	0.085225288
21	30000	0.234985067	0.549983960	0.127826543
22	40000	0.313316088	0.733328395	0.170472172
23	50000	0.391642769	0.916649505	0.213065567
24	60000	0.469970133	1.099977285	0.255689197
25	70000	0.548301155	1.283321730	0.298288082
26	80000	0.626627836	1.466642850	0.340887228
27	90000	0.704955200	1.677220000	0.383506744
28	1lac	0.784575373	1.888223333	0.426464663
29	1.5lac	0.867565423	2.011342242	0.465252542
30	2lac	0.946452427	2.222363435	0.505226522
31	2.5lac	1.025663586	2.433343312	0.548763535
32	3 Lac	1.106637764	2.644342322	0.585252552
33	3.5lac	1.188734624	2.866342242	0.627473736
34	4 lac	1.269474735	3.077444222	0.664242472
35	4.5 lac	1.347575363	3.288454242	0.706525242
36	5 lac	1.427653638	3.499644242	0.747262525



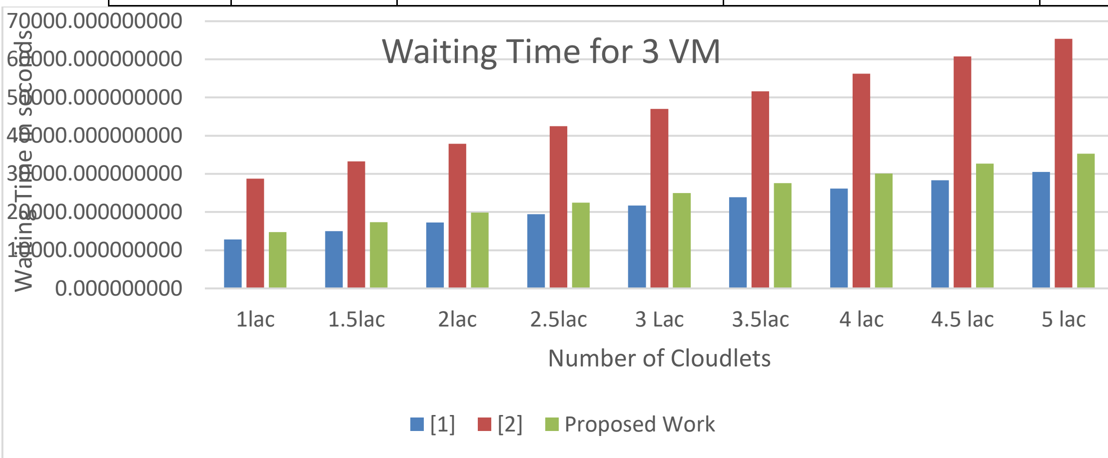
Sno.	No of Cloudlets	Total Power Consumed bp1	Total Power Consumed bp2	Total Power Consumed proposed
1	5	0.008915705	0.021090000	0.002728248
2	10	0.017979780	0.043658520	0.005485714

3	40	0.070146450	0.165774060	0.021744927
4	60	0.104332711	0.244214430	0.032494901
5	100	0.174480752	0.409965180	0.054492716
6	150	0.260832684	0.610496670	0.081824322
7	200	0.347998024	0.814727790	0.109142670
8	300	0.521666848	1.220987790	0.163942144
9	400	0.696147600	1.630927440	0.218061084
10	500	0.869664872	2.035666740	0.272762315
11	700	1.217814448	2.851867500	0.381247297
12	1000	1.739481296	4.072787580	0.545124583
13	2000	3.477999112	8.140372590	1.091282116
14	3000	5.216668480	12.209454990	1.637200187
15	5000	8.694667592	20.349778740	2.727558780
16	7000	12.172818256	28.491627630	3.817270760
17	8000	13.911336072	32.559303660	4.363249177
18	9000	15.650005440	36.628462650	4.909068627
19	10000	17.389486736	40.701323490	5.455770021
20	20000	34.778009992	81.398119290	10.908836822
21	30000	52.166684800	122.096439120	16.361797458
22	40000	69.556171536	162.798903690	21.820438010
23	50000	86.944694792	203.496190110	27.272392513
24	60000	104.333369600	244.194957270	32.728217212
25	70000	121.722856336	284.897424060	38.180874490
26	80000	139.111379592	325.594712700	43.633565188
27	90000	156.500054400	366.645675326	49.088863248
28	1lac	173.578353732	407.537525726	55.636363533
29	1.5lac	190.574343723	448.636534562	61.636353533
30	2lac	207.468386343	489.563353472	67.252423226
31	2.5lac	224.477327242	530.683752736	73.633534346
32	3 Lac	241.478353473	571.634772553	79.626252422
33	3.5lac	258.366352426	612.645367253	85.626262242
34	4 lac	275.467348358	653.436682227	91.363535343
35	4.5 lac	292.467385362	694.378825327	97.262353435
36	5 lac	310.637742826	735.473527532	103.733633553



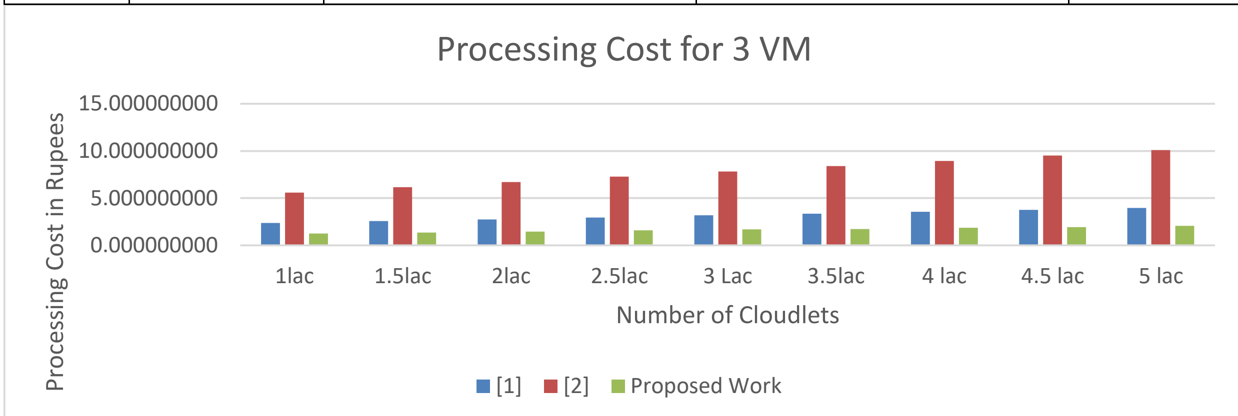
Sno.	No of Cloudlets	Total Waiting Time bp1	Total Waiting Time bp2	Total Waiting Time Proposed
1	5	0.000008332	0.000020000	0.000031425
2	10	0.000079822	0.000198323	0.000167143
3	40	0.001888820	0.004490007	0.002149040
4	60	0.004357953	0.010183352	0.003939487
5	100	0.012556358	0.029573447	0.015017055
6	150	0.028518682	0.066707972	0.033602217
7	200	0.051202831	0.120051322	0.058598097
8	300	0.115783379	0.270910680	0.141464276
9	400	0.206884347	0.484974220	0.235256657
10	500	0.323825316	0.758435363	0.382376334
11	700	0.636196223	1.490335473	0.716334214
12	1000	1.300491989	3.045650413	1.483405971
13	2000	5.211696067	12.199792788	6.077951216
14	3000	11.732108768	27.457424280	13.791319863
15	5000	32.611229193	76.329666530	37.999017102
16	7000	63.933023842	149.644230922	73.493101667
17	8000	83.509151153	195.456308350	96.858044937
18	9000	105.691492805	247.362054203	122.594871909
19	10000	130.496873019	305.439789343	153.167925171
20	20000	522.084727327	1221.943972790	604.532561275
21	30000	1174.748585183	2749.466229105	1351.773748956
22	40000	2088.546750619	4888.308679085	2426.729865888
23	50000	3263.410886093	7638.080219105	3774.956380373
24	60000	4699.336053700	10998.830705772	5436.560625630
25	70000	6396.435511552	14971.093618711	7398.988310631
26	80000	8354.575928193	19554.135627265	9653.575497141
27	90000	10573.762405550	24137.342324644	12213.413582798
28	1lac	12793.523525234	28720.543435783	14773.366333653
29	1.5lac	15013.478252428	33303.457727223	17333.363653465
30	2lac	17234.453728424	37886.535353722	19893.363636373
31	2.5lac	19453.472431463	42469.564543422	22453.472827222

32	3 Lac	21673.564762263	47052.544624226	25013.888322377
33	3.5lac	23893.567342363	51635.453277225	27573.746537363
34	4 lac	26114.563653435	56218.547828263	30133.646453833
35	4.5 lac	28333.758566355	60801.464635537	32693.663533727
36	5 lac	30553.646353427	65384.475366363	35253.636366363



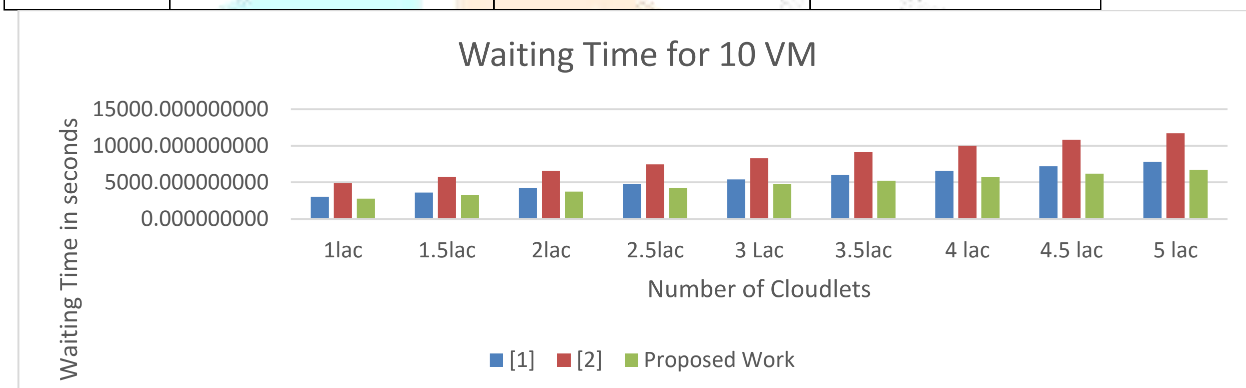
Sno.	No of Cloudlets	Total Processing Cost bp1	Total Processing Cost bp2	Total Processing Cost proposed
1	5	0.000122531	0.000289845	0.000065030
2	10	0.000247100	0.000600010	0.000130757
3	40	0.000964040	0.002278273	0.000518311
4	60	0.001433870	0.003356298	0.000774546
5	100	0.002397931	0.005634251	0.001298885
6	150	0.003584687	0.008390204	0.001950359
7	200	0.004782621	0.011197002	0.002601518
8	300	0.007169394	0.016780332	0.003907715
9	400	0.009567326	0.022414233	0.005197690
10	500	0.011952016	0.027976663	0.006501545
11	700	0.016736720	0.039193909	0.009087387
12	1000	0.023906115	0.055973310	0.012993555
13	2000	0.047798988	0.111875121	0.026011732
14	3000	0.071693944	0.167797510	0.039024201
15	5000	0.119492932	0.279671959	0.065013921
16	7000	0.167294002	0.391567369	0.090988227
17	8000	0.191186875	0.447470430	0.104002135
18	9000	0.215081832	0.503393872	0.117012253
19	10000	0.238987946	0.559368189	0.130043393
20	20000	0.477962651	1.118674153	0.260022353
21	30000	0.716939438	1.678001062	0.389998782
22	40000	0.955927384	2.237384933	0.520110597
23	50000	1.194902089	2.796697640	0.650063043
24	60000	1.433878877	3.356030697	0.780107740
25	70000	1.672866823	3.915414598	0.910076938

26	80000	1.911841528	4.474727335	1.040046933
27	90000	2.150818315	5.034542424	1.170079076
28	1lac	2.364663533	5.595355532	1.236353344
29	1.5lac	2.577463552	6.154635353	1.346454744
30	2lac	2.745543672	6.716454336	1.444646454
31	2.5lac	2.946635474	7.275646463	1.584746633
32	3 Lac	3.174735328	7.834645633	1.684874635
33	3.5lac	3.346453483	8.396454353	1.735353533
34	4 lac	3.557445534	8.955454432	1.843635332
35	4.5 lac	3.745354292	9.516445343	1.937736336
36	5 lac	3.974652827	10.074645350	2.064636353



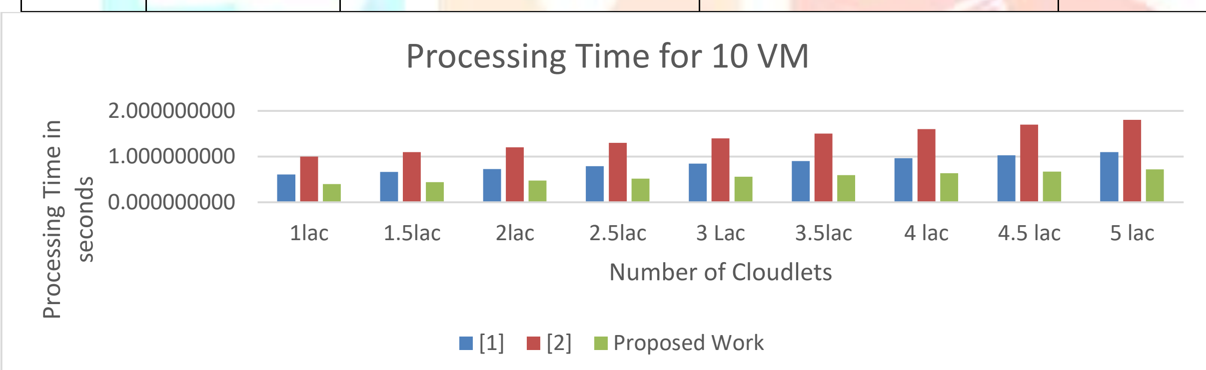
No of Cloudlets	Total Waiting Time bp1	Total Waiting Time bp2	Total Waiting Time Proposed
5	0.000000000	0.000000000	0.000001220
10	0.000000000	0.000000000	0.000020336
40	0.000365913	0.000600000	0.000384600
60	0.000914055	0.001500000	0.001003327
100	0.002740951	0.004500000	0.002682182
150	0.006395943	0.010500000	0.005728559
200	0.011567325	0.019000000	0.009582756
300	0.026472899	0.043500000	0.024561684
400	0.047452952	0.078000000	0.043168891
500	0.074510166	0.122500000	0.070715767
700	0.146807908	0.241500000	0.137195428
1000	0.300895955	0.495000000	0.281564147
2000	1.209351156	1.990000000	1.132626061
3000	2.725019250	4.485000000	2.566101589
5000	7.576084294	12.475000000	7.037604721
7000	14.854933416	24.465000000	13.768987566
8000	19.404532137	31.960000000	18.112373418
9000	24.561178039	40.455000000	22.521741791
10000	30.324605550	49.950000000	28.033847674
20000	121.336754602	199.900000000	111.555604530

30000	273.034105083	449.850000000	253.477742851
40000	485.419635218	799.800000000	449.191031086
50000	758.488666609	1249.750000000	706.092802099
60000	1092.245842873	1799.700000000	1010.946872223
70000	1486.692840275	2449.650000000	1373.684769820
80000	1941.820673340	3199.600000000	1790.423705334
90000	2457.631792632	4049.550000000	2282.552682621
1lac	3034.141784670	4899.660000000	2774.662625522
1.5lac	3611.646346524	5749.770000000	3266.263653533
2lac	4212.464566547	6599.880000000	3758.363537227
2.5lac	4813.464524252	7449.990000000	4250.648338628
3 Lac	5423.568342132	8299.000000000	4742.736363727
3.5lac	6011.457292245	9149.110000000	5234.363637727
4 lac	6614.896723436	9999.220000000	5726.525252552
4.5 lac	7214.457926242	10849.330000000	6218.636363527
5 lac	7818.562134543	11699.440000000	6710.635353562



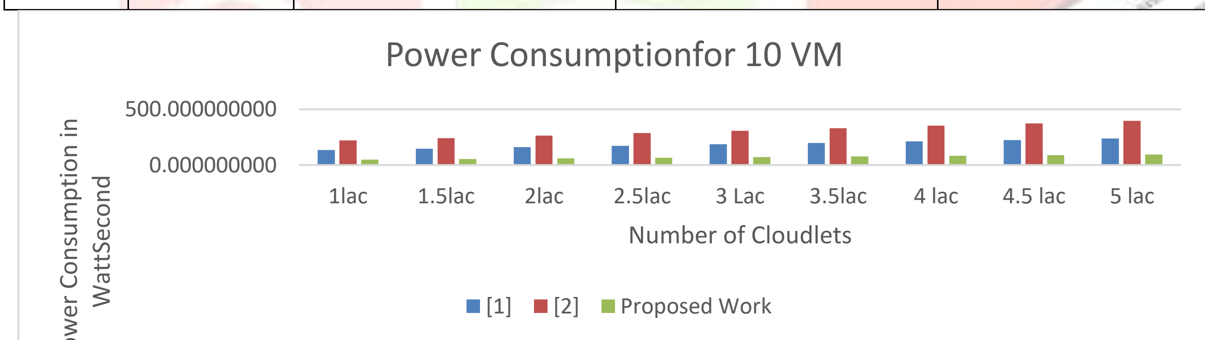
Sno.	No of Cloudlets	Total Processing Time bp1	Total Processing Time bp2	Total Processing Time
1	5	0.000037498	0.000050000	0.000018391
2	10	0.000060792	0.000100000	0.000040656
3	40	0.000243690	0.000400000	0.000155916
4	60	0.000365256	0.000600000	0.000237079
5	100	0.000608450	0.001000000	0.000390426
6	150	0.000912698	0.001500000	0.000583661
7	200	0.001216396	0.002000000	0.000776256
8	300	0.001824044	0.003000000	0.001172376
9	400	0.002431584	0.004000000	0.001553363
10	500	0.003038760	0.005000000	0.001957212
11	700	0.004252652	0.007000000	0.002729131
12	1000	0.006075015	0.010000000	0.003913658
13	2000	0.012149227	0.020000000	0.007824385
14	3000	0.018220096	0.030000000	0.011737086
15	5000	0.030355373	0.050000000	0.019534432
16	7000	0.042493069	0.070000000	0.027339738

17	8000	0.048560882	0.080000000	0.031266006
18	9000	0.054630250	0.090000000	0.035128540
19	10000	0.060698400	0.100000000	0.039058535
20	20000	0.121385385	0.200000000	0.078069040
21	30000	0.182069699	0.300000000	0.117186532
22	40000	0.242757790	0.400000000	0.156218445
23	50000	0.303439979	0.500000000	0.195368543
24	60000	0.364127083	0.600000000	0.234315652
25	70000	0.424816933	0.700000000	0.273351527
26	80000	0.485499040	0.800000000	0.312383654
27	90000	0.546181831	0.900000000	0.351574351
28	1lac	0.606873429	1.000000000	0.397262625
29	1.5lac	0.664534242	1.100000000	0.437262622
30	2lac	0.725433537	1.200000000	0.472828272
31	2.5lac	0.786462224	1.300000000	0.517363636
32	3 Lac	0.844361563	1.400000000	0.558277272
33	3.5lac	0.904526271	1.500000000	0.597262528
34	4 lac	0.963525242	1.600000000	0.637226252
35	4.5 lac	1.027564646	1.700000000	0.672525224
36	5 lac	1.095664653	1.800000000	0.716363353



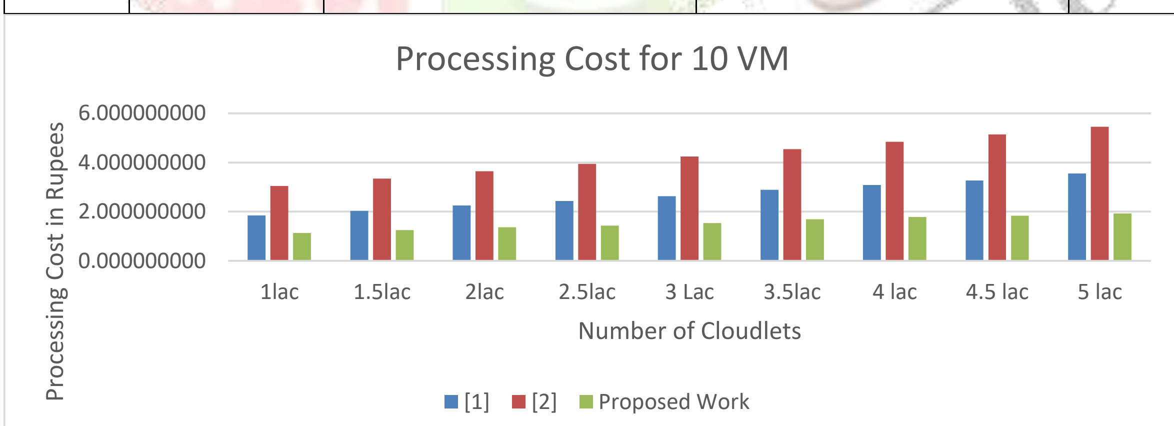
Sno.	No of Cloudlets	Total Power Consumed bp1	Total Power Consumed bp2	Total Power Consumed proposed
1	5	0.008324445	0.011100000	0.002354003
2	10	0.013495750	0.022200000	0.005203920
3	40	0.054099206	0.088800000	0.019957198
4	60	0.081086901	0.133200000	0.030346083
5	100	0.135075794	0.222000000	0.049974477
6	150	0.202618977	0.333000000	0.074708579
7	200	0.270039954	0.444000000	0.099360736
8	300	0.404937678	0.666000000	0.150064141
9	400	0.539811611	0.888000000	0.198830488
10	500	0.674604709	1.110000000	0.250523197
11	700	0.944088823	1.554000000	0.349328734
12	1000	0.012974842	2.220000000	0.500948196

13	2000	2.697128373	4.440000000	1.001521273
14	3000	4.044861249	6.660000000	1.502346973
15	5000	6.738892869	11.100000000	2.500407345
16	7000	9.433461355	15.540000000	3.499486512
17	8000	10.780515894	17.760000000	4.002048799
18	9000	12.127915590	19.980000000	4.496453121
19	10000	13.475044832	22.200000000	4.999492495
20	20000	26.947555375	44.400000000	9.992837180
21	30000	40.419473189	66.600000000	14.999876052
22	40000	53.892229401	88.800000000	19.995961019
23	50000	67.363675248	111.000000000	25.007173535
24	60000	80.836212532	133.200000000	29.992403413
25	70000	94.309359189	155.400000000	34.988995408
26	80000	107.780786954	177.600000000	39.985107758
27	90000	121.252366429	199.800000000	45.001516901
28	1lac	134.725901259	221.000000000	50.262626276
29	1.5lac	147.567423574	243.100000000	55.262626622
30	2lac	160.346864267	265.200000000	60.262252526
31	2.5lac	173.675342342	287.300000000	66.252424232
32	3 Lac	186.635827264	309.400000000	72.625242467
33	3.5lac	199.542376534	331.500000000	78.525282522
34	4 lac	212.652385367	353.600000000	84.252727281
35	4.5 lac	225.643299753	375.700000000	90.626242481
36	5 lac	239.572413843	397.800000000	96.262728281



Sno.	No of Cloudlets	Total Processing Cost bp1	Total Processing Cost bp2	Total Processing Cost proposed
1	5	0.000114405	0.000152550	0.000056110
2	10	0.000185475	0.000305100	0.000124040
3	40	0.000743499	0.001220400	0.000475699
4	60	0.001114397	0.001830600	0.000723327
5	100	0.001856379	0.003051000	0.001191189
6	150	0.002784642	0.004576500	0.001780749
7	200	0.003711225	0.006102000	0.002368356
8	300	0.005565157	0.009153000	0.003576919
9	400	0.007418762	0.012204000	0.004739311

10	500	0.009271257	0.015255000	0.005971455
11	700	0.012974842	0.021357000	0.008326578
12	1000	0.018534871	0.030510000	0.011940570
13	2000	0.037067291	0.061020000	0.023872198
14	3000	0.055589512	0.091530000	0.035809849
15	5000	0.092614244	0.152550000	0.059599553
16	7000	0.129646354	0.213570000	0.083413542
17	8000	0.148159252	0.244080000	0.095392585
18	9000	0.166676894	0.274590000	0.107177176
19	10000	0.185190819	0.305100000	0.119167591
20	20000	0.370346808	0.610200000	0.238188642
21	30000	0.555494652	0.915300000	0.357536108
22	40000	0.740654018	1.220400000	0.476622477
23	50000	0.925795375	1.525500000	0.596069425
24	60000	1.110951732	1.830600000	0.714897053
25	70000	1.296116463	2.135700000	0.833995508
26	80000	1.481257572	2.440800000	0.953082529
27	90000	1.666400766	2.745900000	1.072653344
28	1lac	1.851570832	3.046000000	1.133526255
29	1.5lac	2.034567234	3.347000000	1.246463638
30	2lac	2.252342123	3.648000000	1.364547722
31	2.5lac	2.434123628	3.949000000	1.437363353
32	3 Lac	2.632123652	4.241000000	1.538373242
33	3.5lac	2.889764321	4.542000000	1.688336353
34	4 lac	3.087654286	4.843000000	1.783837363
35	4.5 lac	3.267342198	5.144000000	1.836363552
36	5 lac	3.556423459	5.445000000	1.933633343



COMPARISON	EXISTING WORK	PROPOSED WORK
1. DVFS Mode	Not Used	Used
2. KMN classification vm	Not Used	Used
3. Cloudlet leaves	Not Used	Used
4. Fault tolerance	Not Used	Used

Conclusion The proposed thesis overviews cloud computing and its background describing the architecture, models and benefits moving further towards the concept of green cloud computing as the energy efficiency is one of major problem with cloud computing.

The proposed work thus puts forward an efficient energy consumption technique. Keeping in mind the problems formulated in the existing system. The proposed technique cloud environment is developed in java, deployed on cloud sim toolkit and the experimental results have been compiled as per quantitative analysis. In proposed techniques power saving in green cloud environment has been done using k means clustering at virtual machine level to classify the machines as low level and high level virtual machines. The cloudlets are also categorized into 3 parts: Suspend able cloudlets, cancellable cloudlets and non-premtable cloudlets. The processors are running using DVFS mechanism that will operate in different frequency and power modes to execute the cloudlets of different leases.

Future Scope This work shows the energy consumption of the heterogeneous workload other processing element like no of CPU required by a cloudlet can also be considered to further increase the efficiency of work load consolidation techniques. To achieve green cloud computing server data center can use renewable energy resources like the solar system, bio gas plant energy, wind energy can provide power to data centers as there are eco friendly sources of energy

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