16. Performance Evaluation of Interoperability With Respect To Data Migration and Energy Efficiency in Hybrid Cloud Architecture

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Abstract

Cloud computing is a computing model which provides different services and resources to the user with the help of cloud service providers and users can access resources from shared free pool cloud data centre. Some time user need to access the resources from another cloud with same platform with provider or different provider with minimum cost. The process of exchanging of information from one cloud to another cloud is called as interoperability. Interoperability is considered as one issue of mobility. When the data has been migrated interoperability need to be considered with respect to energy efficiency and migration of data. Cloud architecture consists of four different layers physical resources IaaS, PaaS and SaaS. Cloud computing has lots of advantages But still cloud computing have some limitations. In this research paper interoperability issue of cloud architecture has been studied using hybrid cloud architecture with respect to data migration and energy efficiency. Power models would help to reduce energy consumption when data has been transferred from one cloud to another. Hybrid cloud architecture gives optimized result for power consumption and migration. Performance evaluation of hybrid cloud is tested using cloud report simulator.

Keywords: Cloud Computing, Hybrid Cloud Architecture, Interoperability, Energy Consumption, Mobility.

Introduction

Cloud computing is an emerging technology which is used for business as well as in the field of education. Cloud providers provide the services to the customers/user as per their requirement with minimum cost. One of the major advantage of cloud is cost efficiency because in cloud computing there is no hardware and software cost required for installation. For real time

environment the users are working on different platform and data would be access from cloud data centre ubiquitously with location independency.

Interoperability is the ability to connect between multiple platforms and devices in order to exchange information and data with each other. In cloud with interoperability data would exchange from one cloud to another without hard drives. In interoperability the applications are deployed in the form of deployment model. Interoperability is the ability to exchange the data not only between different components but between the identical components running in different clouds. Mobility is nothing but moving the data from one place to another without the use of mobile devices. In cloud computing architecture the mobility is handled using ubiquitous devices which would help to exchange the data from cloud data centre with same or different providers. Mobility is defined in two form either data mobility or user mobility with respect to data migration and energy consumption.

Hybrid cloud provides the solution to interoperability in cloud computing. Hybrid cloud architecture always gives optimized results in terms of quality parameters. In hybrid cloud architecture, an application component may be deployed in a private cloud, with provision for a copy to be run in a public cloud to handle traffic peaks. The two components must work together.

In this research paper author discussed and provide a solution on the issue of mobility using hybrid cloud. In hybrid cloud architecture when the data is exchange from one cloud to another, platform would be either same or different. The issue of mobility is interoperability which has been discuss in this research paper with respect to

- Data migration
- Energy efficiency (Minimum Energy Consumption)

a) Hybrid Cloud Architecture

Hybrid cloud is defined as multiple cloud systems which comprise the characteristics of both private and public cloud and which also allows programs and data can be moved easily from one system to another system [1,2]. For carrying out day to day operations it may consider as private cloud and user need to scale out it may be considered as the public cloud. Hybrid itself means it's a combination of two means it is an integrated cloud services which combines the characteristics like security of private cloud and accessibility of public cloud to perform various functions within the same organization. A hybrid cloud offered in one of two ways: a vendor has

a private cloud and forms a partnership with a public cloud provider, or a public cloud provider forms a partnership with a vendor that provides private cloud [3]. In hybrid cloud, an organization manages some resources in house and some out-house. Typically, the hybrid approach allows a business to take advantage of the scalability and cost-effectiveness that a public cloud computing environment offers without exposing data to third-party vendors.

Problem Definition /Statement

User and data mobility are the two types of issues of mobility which has been discussed in this research paper. In cloud architecture when the data is transferred from one data centre to another with same or different platform the user and data has to face the issue of interoperability with respect to energy efficiency and migration of data. In this research paper hybrid cloud architecture provides an optimized solution to the problem of interoperability with respect to data migration and energy efficiency. To conduct experiment for the evaluation of performance of the architecture with respect to data migration and energy consumption cloud report simulator has been used. In cloud report hybrid cloud is modeled using data centre and customer with their configuration. To achieve the aim of the research i.e. energy efficiency and data migration solution for interoperability issue, hybrid cloud architecture has been proposed. Linear and cubic power model are use for the evaluation of power /energy consumption.

Literature Review

Ilango Sriram, Ali Khajeh-Hosseini [4] focused on creating standards and allowing interoperability, and describes ways of designing and building clouds. Various definitions of cloud computing were discussed and the NIST working definition by Mell and Grance was found to be the most useful as it described cloud computing using a number of characteristics, service models and deployment models.

Palvinder Singh, Er. Anurag Jain[5] discussed about new technology cloud computing & its definition, styles, and characteristics. In this paper, authors tend to delineate the definition, styles, and characteristics of cloud computing, cloud computing services, readying model and challenges of cloud computing. Authors were studied various issues of cloud computing along with model like ability, Performance, Service Level Agreement (SLA), knowledge Confidentiality and measurability, knowledge Integrity, Load equalization, Synchronization in numerous clusters in cloud platform, and standardization, the protection of cloud platform in this paper.

Grace A. Lewis **[6]** proposes various solutions to interoperability problem like standardization. The issue of interoperability is occurs when the data is transfer from one cloud to another with different provider. In this research paper author studied the inter operability issues as follows: 1) User Authentication 2) Data Migration 3) Workload Migration and Management 4) Load Balancing. The paper proposes various recommendations as a part of solution towards interoperability.

SuchethaVijayakumar1, LenitaVelezaSerrao2, Hancel Anacletus D'Souza [7], explores the role of standards in cloud computing interoperability. The goal of the paper was to provide basic insight into areas of cloud computing in which standards would be useful for interoperability and areas in which standards would not help or would need to mature to any value.

Rodrigo Calheiros et al [8] discussed the importance of CloudSim simulator by a case study using dynamic provisioning of application services in hybrid cloud federated cloud environment. The application services hosted under cloud computing model are complex provisioning, composition, configuration and deployment.

Bahman Javadi , Jemal Abawajyb, Rajkumar Buyya [9]provide a flexible and scalable hybrid Cloud architecture. This research paper has proposed resource provisioning policies significantly to improve the deadline violation rate and request slowdown and affect on these policies on performance has been discussed.

Seyed Reza Pakize, Seyed masood khademi,et.al [10] presented Cloud Analyst and Cloud Reports from first group and selection CloudSim from second group as the best tools independently. This paper has discussed the results of simulation using some of the parameters with three simulators. To simulate and evaluate cost of implementation, measure Resource Utilization and power consumption.

Mona Arjmandi, Nik Mohammad Balouchzahi, et.al [11] discussed dynamic migration of VM policy which was greatly beneficial for reduction of power consumption and reduction of migrations as well as energy consumption, though, the SLA breach has slightly increased. This paper has discussed about another solutions which can be used to reduce power consumption such as special hardware equipment, suitable switching power supply and some other methods which can considerably reduce the power.

Conor Mcbay, Sally Ida McClean [12], presented and suggested an approach for previously researched energy efficiency techniques, particularly Dynamic Voltage/Frequency Scaling and sleep states, more efficiently through the aid of an SLA-based priority scheduling algorithm.

Jasleen kaur, Navpreet Kaur Walia [13] reviews various energy saving approaches for Data Centers in cloud computing and also discusses various approaches proposed in the previous research works in this field. The paper presents a study focusing on energy consumption by data center servers and networks and energy efficient approaches in cloud computing. Based on the existing studies, it is seen that the servers consumes the largest amount of energy in data centers.

Background

Cloud computing is an emerging technology in this world. It is nothing but pool of shared resources which can be provided to the users as per their requirement by cloud service provider. In cloud computing user data is stored on cloud data center and user can access that data from anywhere with location independency. While that sharing of data from one cloud to another cloud build the concept interoperability using hybrid cloud. In Hybrid cloud architecture, cloud is modeled using the integration of atleast one or more than two clouds. These clouds are nothing but either public to private or private to community cloud . When the data is shared or transferred from either public to public or private or community cloud the interoperability occurs. Cloud architecture either use private cloud, public or community cloud to perform various operations on the cloud. Exchange of the information or data among different or same cloud with providers has to face interoperability in terms of power consumption and data migration. In this research paper hybrid cloud architecture provide solution in terms of optimization of interoperability with respect to data migration and energy efficiency which would help to improve the performance of the system architecture. To conduct this experiment in this research paper cloud report simulator of cloud sim has been used for evaluation of the hybrid cloud architecture.

Experimental Setup and Result Discssion

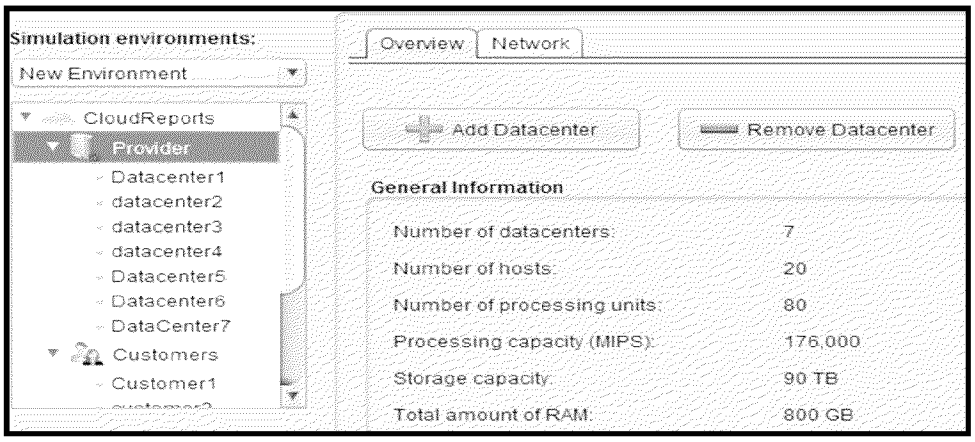
The experiment is set for the evaluation interoperability with respect to data migration & energy consumption using hybrid cloud architecture. In this experiment hybrid cloud architecture is modeled using at least one public and one private or community cloud. Hybrid cloud architecture would help to enhance the performance of the architecture with respect to resource utilization and energy consumption. An optimized result for energy/power consumption and data

migration is the main characteristics for the selection of hybrid cloud architecture. Performance evaluation of resource utilization and energy consumption is studied while data migrations are taking place.

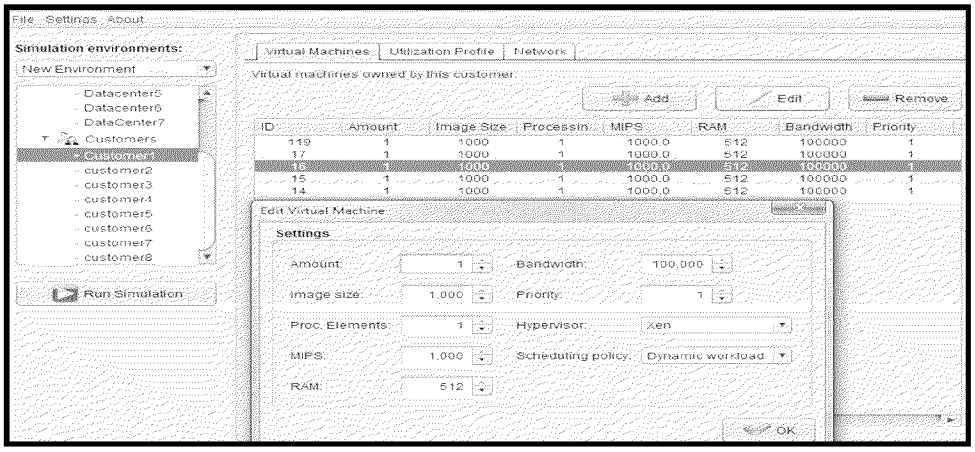
In the architecture, hybrid cloud is built upon the selection of the data centre and the customers. Hybrid cloud provides solution to the problem of interoperability in terms of less resource utilization which would assist to improve energy efficiency as well as to reduce data migration. Data migration [16] would takes place when the data/information is exchange from one cloud to another with either same platform or different along with cloud providers. When the private and public clouds are used in hybrid cloud with respect to interoperability they agree to interoperate among themselves through service broker as mediator.

Service broker policy [14] plays an important role in implementing interoperability in hybrid cloud. With the help of power federation of cloud and service broker it is very easy to interoperate between public and private cloud as per the need of the user to satisfy their demand of accessing resources or application from cloud data centre . After interoperating data between clouds there is a need to focus on the other important factors which affect on the interoperability such as data migration.

The experiment is conducted using cloud reporter (cloudsim simulator toolkit) which is used for simulation of performance evaluation of data migration and resource utilization with respect to interoperability using different power model. It also makes a glance on the effects of these parameters on the issue of interoperability. In hybrid cloud architecture the working is starts with private cloud. When the user sends request to the data center for resources, the request first goes to private cloud and if the need be the request transfers to the public cloud to acquire the resource utilization. The requests are transfer to the public cloud according to the threshold value. If the threshold is reached then cloud is burst and request goes to public. Virtualization techniques [15] used in cloud architecture would help to get an optimized result in terms of minimum power consumption and improves utilization of resources which improve energy efficiency.



Snapshot 1:Simulation Environment Of Provider In Hybrid Cloud Architecture



Snapshot 2 : Vm Configuration Of Customer In Hybrid Cloud Architecure Using Linear Model

Table 1: Parameters Considered In Cutomers Utilization Profile In Hybrid Cloud Architecture

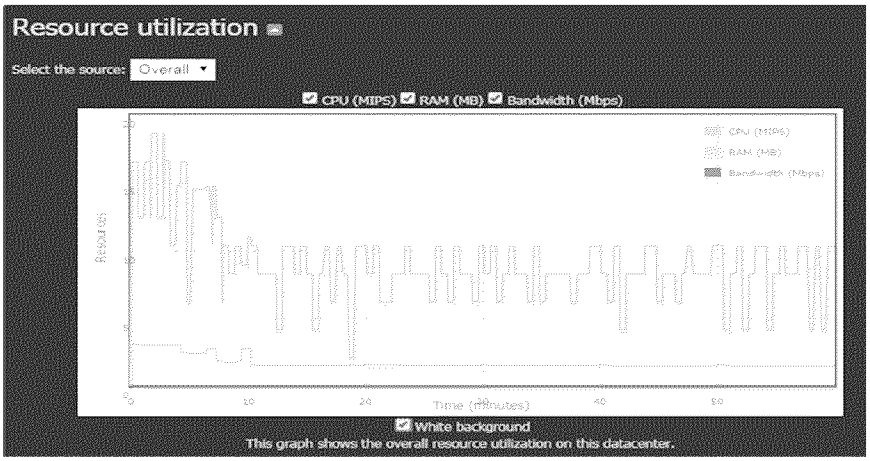
Broker Policy	Round Robin
CPU,RAM,BANDWIDTH utilization Model	Full
Processing element	01
File size	500

Evaluation of the architecture for interoperability issue of mobility with respect to data migration and energy efficiency is done using two use cases which are as given below:

Case1: Data Migrations & Enery Efficiency (Resource Utilization &Power Consumption) In Hybrid Cloud Architecture Using Linear Model

In case1, simulation is carried out on even number of DC's and odd number of customers using linear power model. In hybrid cloud architecture, private and public clouds are identified according to their size and configuration of the cloud. Private data center consists less VM's and public cloud consists more number of VM's . Power model play an important role to reduce power consumption and resource utilization in optimized way using hybrid cloud architecture.

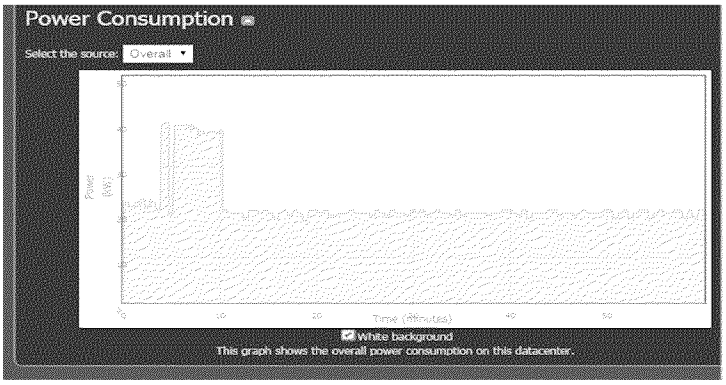
The key behind the data migration is "First consumer request is directed to private cloud by default through the data centre broker and when threshold is reached the resource request is redirected to public cloud for the remaining resource utilization if needed." Another aspect of interoperability is data migration. In hybrid cloud architecture basic two techniques was used which would help to minimize migration and improve resource utilization are distribution and consolidation. Distribution technique help to distribute the load across VMs to manage workload and consolidation would use to switch off unused server and all the work gathered at one place and then manage the workload.



Snapshot 3 : Overall Resource Utilization Of Data Center Using Linear Model

experiment was condcucted to solve the issue of interoperability with respect to RU. case1 was considered for resource utilization,power consumption and data migration using linear model and the snapshot shows that the CPU utilization was around 20 MIPS in first 5 minutes and after 10 minutes it was reduced drastically upto 11 MIPS and was maintained there

after.The RAM utilization was started with arise of 4MB up to 10 minutes and was reduced to 3MB and maintained there after.



Snapshot 4: Overall Power Consumption Of Data Center Using Linear Model

This experiment was also conducted for power consumption using linear model and the snapshot shows that the power/energy consumption was around 22kwh in the first 5 minutes and after 10 minutes it was 40kwh. Then after it was drastically reduced upto 22 KWH for next minutesand maintained there after.

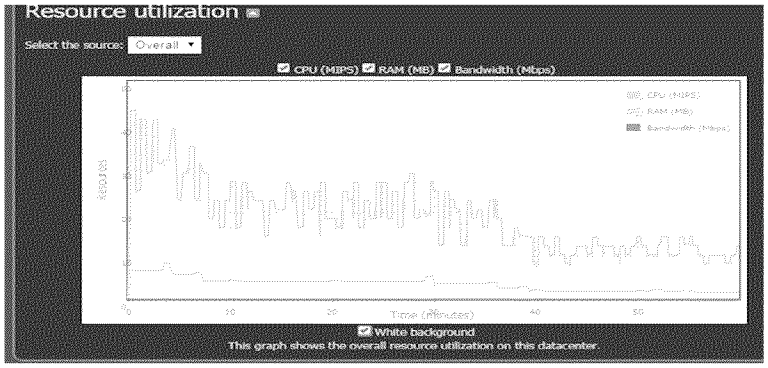
The same experiment was studied the issue of data migrtaion . There are total six migrations was done in the experiment. Datamigration directly affect on resource utilization and power /enegry consumption of DC. Number of migrations are directly related to RU and PC which was analysed in the experment of case1 and case2 . More migration was increased resource utilization and power consumtion. Two migrations were used with the help of distribution techniques and consolidation was used in remaing 4 migrations for this experiment .

Case2: Data Migrations & Enery Efficiency (Resource Utilization &Power Consumption) In Hybrid Cloud Architecture Using Cubic Model

The experiment conducted using same simulation for case2.The provider and VM Parameters are same as in case1 but the difference is that experiment is conducted for case2 using cubic power model.

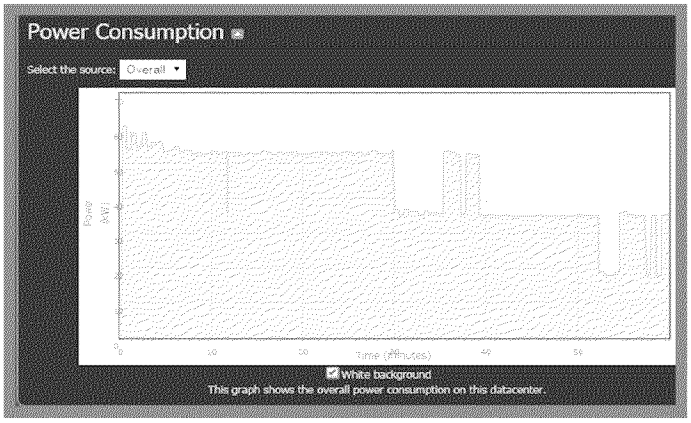
Experiment was conducted for resource utilization ,energy/power consumption and data migration using cubic model . Snapshot 5 shows that the CPU utilization was around **45 MIPS** in first 5 minutes and after that it was reduced upto around 28 MIPS upto 35 minutes that it was reduced drastically upto **18 MIPS** and was maintained there after. The RAM utilization was

started with a rise of 10MB up to 10 minutes and was reduced to 7 MB and maintained there after.



Snapshot 5 : Overall Resource Utilization Of Data Center Using Cubic Model

The experiment was also conducted for power consumption/energy consumption and the snapshot 6 shows that the power/energy consumption was around 60kwh in the first 2 minutes and then after upto 30 minutes it was 58 kwh. Then after it was drastically reduced upto 40 KWH for next minutesand maintained there after.

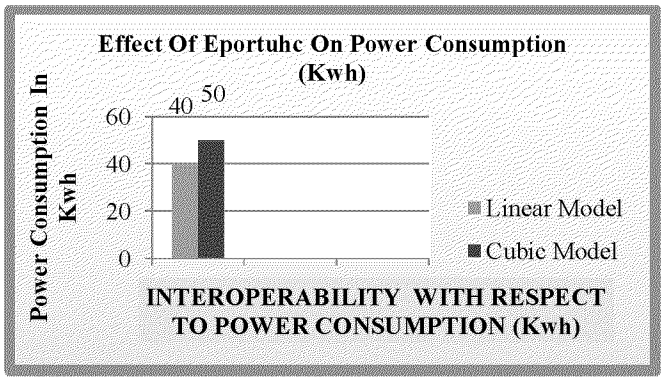


Snapshot 6: Overall Power Consumption Of Data Center Using Cubic Model

The same experiment was conducted to study data migrtaion issue using cubic model . Experiment was conducted to study the issue of data migration for case2 . In case 2 there are total 19 migrations was done in the experiment. Datamigration directly affect on resource utilization and power /enegry consumption of DC. More migration was increased resource utilization and power consumtion. In this experiment distribution texchnique was used in 9 migration and consolidation was used in remaining 10 migrations. one thing that should be

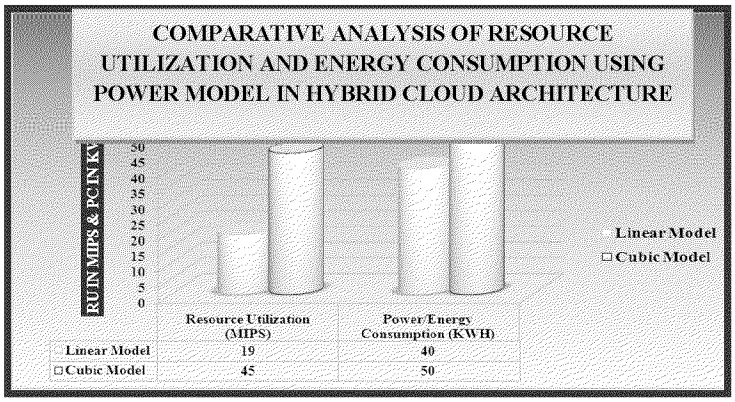
noticable is that when the consolidation techniques start at the time of the migraion of VM12 to VM0 from host 0 to 1the power consumption was reduced upto 34 minutes .

Result And Discussion



Graph 1: Effect Of Eportuhc On Interoperability With Respect To Power Consumption

GRAPH 1 shows the effect of hybrid cloud architecture on interoperability with respect to power /energy consumption. In hybrid architecture power /energy consumption was high 50kwh when cubic model was used and it is 40 kWh when linear model was used. GRAPH 2 shows the comparative analysis of cubic and linear power model for interoperability with respect to resource utilization and energy /power consumption in hybrid cloud architecture.



Graph 2: Comparative Analysis of Resource Utilization and Power Consumption Using Linear & Cubic Model in Hybrid Cloud Architecture

From the graph 2, it has been observed that resource utilization in hybrid cloud architecture using linear model for data centre was i.e. 19 MIPS which is less than cubic model 45 MIPS. In contrast to linear model, the power/energy consumption in hybrid cloud architecture using linear model was less 40 KWH as compared to cubic model 50KWH. The aim of the research is to solve the issue of interoperability with respect to data migration using energy

consumption and resource utilization in which resource utilization was high and power consumption is low. From the results it has been observed that the cubic model used in hybrid cloud architecture gives optimized results in terms of RU & PC as compared to linear model. Hybrid cloud architecture gives optimized solution for this experiment which checks interoperability with respect to data migration and energy efficiency (resource utilization and power consumption).

Conclusion

Hybrid cloud architecture was modeled and simulated by the combination of one private cloud and two public clouds. Private cloud has more number of hosts with minimum VM's and public clouds have less number of hosts with more number of VM's. Public clouds are big in size and configuration as compared to private cloud. The aim of the research work is to design an architecture which was performance oriented and efficient for real time environment which focused on time factor. The architecture was modeled and simulated using cloud sim toolkit using java (JDK 1.8) net beans and cloud report is used as IaaS provider. The issue of mobility i.e. user and data mobility has been discussed in this research paper using hybrid cloud architecture. It works for interoperability with respect to energy efficiency (more resource utilization with less power consumption) and data migration in terms of resource utilization and energy/power consumption. Hybrid cloud is combination of both clouds so it takes advantage of both clouds public cloud which is fast accessible and private cloud is more secured which gives an optimized value of resource utilization and data migration. Hybrid cloud architecture provides a solution to the interoperability through migrations. Data is migrated from one cloud to another distribution and consolidation technique would help to improve performance of the architecture. Future scope of the research is implementation of another power model other than linear and cubic to check the performance of the architecture.

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