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A Rule-based Approach for Effective Resource Provisioning in Hybrid Cloud Environment

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A Rule-based Approach for Effective Resource Provisioning in Hybrid Cloud Environment

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Abstract **-** Resource provisioning is important issue in cloud computing and in the environment of heterogeneous clouds. The private cloud with confidentiality data configure according to users need. But the scalability of the private cloud limited. If the resources private clouds are busy in fulfilling other requests then new request cannot be fulfilled. The new requests are kept in waiting queue to process later. It take lot of delay to fulfill these requests and costly. In this paper Rule Based Resource Manager proposed for the Hybrid environment, which increase the scalability of private cloud on-demand and reduce the cost. Also set the time for public cloud and private cloud to fulfill the request and provide the services in time. The Evaluated the performance of Resource Manager on the basis of resource utilization and cost in hybrid cloud environment.

Keywords- *Cloud computing, Provisioning, VIM, Hybrid cloud, IaaS, Resource Allocation.*

I. INTRODUCTION

Cloud computing refers technology that enables functionality of an IT Infrastructure, IT platform or an IT product to be exposed as a set of services in a seamlessly scalable model so that the consumers of these services can use what they really want and pay for only those services that they use(Pay per use).Cloud computing is about moving services, computation or data–for cost and business advantage-off–site to an internal or external, location transparent, centralized facility or contractor. By making data available in the cloud, it can be more easily and ubiquitously accessed, often at much lower cost, increasing its value by enabling opportunities for enhanced collaboration, integration and analysis on a shared common platform [1]. The definition of cloud computing as per Gartner is "A style of computing where massively scalable IT-enable capabilities are delivered as a service to external customers using internal technologies".

Cloud computing is delivery of computing as a services rather than product. Cloud 'Services' refer to those type of services that are exposed by cloud trafficker and that can be used by cloud consumer ona 'pay-per-use' basis. In practice, cloud services are classified–Infrastructure as a Services(IaaS), Software as a Services(SaaS), Platform as a Services(PaaS),Data as a Services(DaaS)[2].

In Infrastructure as a service large amount computing resources are managed by IaaS provider which is allocated to user as demanded. IaaS is the concept of providing Hardware as a Service. IaaS offer basic storage and compute capabilities as standardized services over the network. Servers, storage systems, switches, routers, and other systems are pooled and made available to handle workloads that range from application components to high-performance computing application [2]. There are a number of successful IaaS providers: Amazon EC2, Joyent, Rackspace etc.

Platform as a Service is a way to rent hardware, operating systems, storage and network capacity over the internet. It delivers a computing platform or software stack as a service to run applications. This can broadly be defined as application development environment offered as a 'service' by the vendors. The development community can use these platforms to code their applications and then deploy the applications on the infrastructure provided by the cloud vendor. Here again, the responsibility of hosting and managing the required infrastructure will be with the cloud vendor. AppEngine, Bungee Connect, LongJump, Force.com, WaveMaker are all instances of PaaS.

Software as a Service also refers to application as a Service. Instead of running as application locally, the application resides on the cloud and online alternatives such as access via web interface is provided. SaaS is the service based on the concept of renting software from a service provider rather than buying it yourself. That eliminates the need to install. Yahoo mail, Google docs

applications, Salesforce.com CRM apps, Microsoft Exchange Online, Facebook are all instances of SaaS.

Data as a Service is refer data in various formats and from various sources could be accessed via services by users on network, in a transparent, logical or semantic way. Users could, for example, manipulate remote data just like operate on a local disk or access data in a semantic way in the Internet. The DaaS could be found at some popular IT services, e.g. Google Docs and Adobe Buzzword. A hybrid cloud is a composition of at least one private cloud and at least one public cloud. In Quality of services guaranteed the computing Clouds can guarantee QOS for users and Service Level Agreement is negotiated between cloud provider and user on the level of availability, serviceability, performance, operation, or other attributes of the service like billing and even penalties in the case of violation of the SLA[6].

Public cloud, Private cloud and hybrid cloud are types of cloud computing. Public clouds are run by third parties and the applications from different customers are too mixed together on the cloud's servers, storage systems, and networks. The datacenter hardware and software is what we will call a Cloud. It is external services clouds based on pay-per-use model. Private clouds are exclusively built and managed by a company's own IT organization or by a cloud provider. We use the term Private Cloud to refer to internal datacenters of a business or other organization, not made available to the general public.The benefits with private cloud are higher security and flexibility to manage the cloud according to the need. Hybrid clouds combination of both public and private clouds. It can help to provide on-demand, externally provisioned scale, higher security and efficiency.

II. RESOURCE MANAGER

Resource management is the efficient and effective deployment of an organization's resources when they are needed. Eucalyptus, Hadoop and Open Nebula are open source cloud computing framework. It has its own architecture. In these models all the requests of users for resources handle through cloud services manager. In this user request for the resources that handled through cloud service manager, which manage all resources and billing. Next CSM interact with Virtual Infrastructure Manager for user's resource requests. A user requests for the resources. Virtual machine next interacts with the Data Center Broker to fulfill request from available existing resources. Physical hosts, data center broker and VIM form a cloud. That is key element of cloud at Infrastructure as a services layer. This layer also called Hardware as a service layer. All the services of cloud are provides by cloud services manager. When user requests for resources the resource manager accept user request and tries to fulfill of user request for resources on private cloud. More preference of its resource utilize are given by private clouds. If the resources that are user requested are available in private cloud then request is fulfilled by allocating these resources. If the resources of private cloud are assign with other application, then resource manager allocate resource resources of public cloud by interact with its CSM. If the resources of private cloud are busy to fulfill other requests, then new request are kept in waiting queue to process later when that resource are available. It makes delay for provisioning resource and scalability is limited of private cloud.

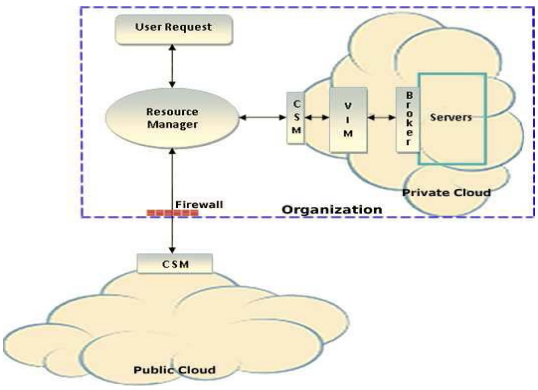

Figure1: Resource Manager

With Rule Based Resource Manager a private cloud can be scaled up to allocated resources on-demand even if that is overloaded. Rule Based Resource Manager proves to cost effective in term of utilization of private cloud resources.

Cloud Computing is service-based resources. In cloud environments the customer is able to access only the services that they need and use. Resource Manager is used for resource provisioning in hybrid environment. To increase scalability, the resources are borrowed from public cloud. The important issue is efficiently managing the allocation of resource needs between two clouds. The efficiency is determined by resources utilization and cost for using public cloud.

III. RELATED WORK

From the last fewer, cloud computing has evolved as delivering software and hardware services over the internet. The extensive research is going on to extend the capabilities of cloud computing. Given below present related work in the area of cloud's scalability and resource provisioning in cloud computing.

In 2010 ChunyeGong, Jie Liu, Oiang Zhang, Haitao Chen and Zhenghu has discussed Characteristics of Cloud Computing. In this paper summarize the general characteristics of cloud computing which will help the development and adoption of this rapidly evolving technology. The key characteristics of cloud computing are low cost, high reliability, high scalability, security. To make clear and essential of cloud computing, proposes the characteristics of this area which make the cloud computing being cloud computing and distinguish it from other research area. The cloud computing has its own technical, economic, user experience characteristics. The service oriented, loose coupling, strong fault tolerant, business model and ease use are main characteristics of cloud computing. Abstraction and accessibility are two keys to achieve the service oriented conception. In loose coupling cloud computing run in a client-server model. The client or cloud users connect loosely with server or cloud providers. Strong fault tolerant stand for main technical characteristics. The ease use user experience characteristic helps cloud computing being widely accepted by non computer experts. These characteristics expose the essential of cloud computing. [1]

In 2010 Pushpendra kumar pateria, Neha Marria discussed resource provisioning in sky environment. Resource manager is used for resource provisioning and allocate of resource as user request. Offer the rule based resource manager in sky environment for utilization the private cloud resource and security requirement of resource of critical application and data .Decision is made on the basis of rule. Performance of resource manager is also evaluated by using cloudsim on basis of resource utilization and cost in sky environment. Set priorities request and allocate resource accordingly. Sky computing provides computing concurrent access to multiple clouds according user requirement. Define the Cloud services like Software as a service (SaaS), Platform as a Service (PaaS) and Infrastructure as a service. [2]

In 2010 Zhang Yu Hua, Zhang Jian ,Zhang Wei Hua present argumentation about the intelligent cloud computing system and Data warehouse that record the inside and outside data of Cloud Computing System for data analysis and data mining. Management problem of CCS are: balance between capacity and demand, capacity development planning, performance optimization, system safety management. Architecture of the Intelligence cloud computing system is defined with Data source, data warehouse and Cloud computing management information system. [3]

In 2008 discussed about the Phoenix by Jianfeng Zhan, Lei Wang, Bipo Tu, Yong Li, Peng Wang, Wei Zhou and Dan Meng. In this paper discuss the designed and implemented cloud management system software Phoenix Cloud. Different department of large organization often maintain dedicate cluster system for different computing loads. The department from big organization have operated cluster system with independent administration staffs and found many problem like resource utilization rates of cluster system are varying, dedicated cluster systems cannot provision enough resources and number of administration staff for cluster system is high. So here designed and implemented cloud management system software Phoenix Cloud to consolidate high performance computing jobs and Web service application on shared cluster system. Phoenix Cloud decreases the scale of required cluster system for a large organization improves the benefit of scientific computing department, and provisions resources. [4]

In 2010 Shu-Ching Wang, Kuo-Qin Yan, Wen-Pin Liao and Shun-Sheng Wang discussed about Load Balancing in Three-Level Cloud Computing Network. Cloud computing utilize low power host to achieve high reliability. In this Cloud computing is to utilize the computing resources on the network to facilitate the execution of complicated tasks that require large-scale computation. Use the OLB scheduling algorithm is used to attempt each node keep busy and goal of load balance. Also proposed LBMM (Load Balance Min-Min) scheduling algorithm can make the minimum execution time of each task on cloud computing environment and this will improve the load unbalance of the Min-Min. In order to reach load balance and decrease execution time for each node in the three-level cloud computing network, the OLB and LBMM scheduling algorithm are integrated. The load balancing of three-level cloud computing network is utilized all calculating result could be integrated first by the second-level node [5]

In resource provisioning resource are allocated to applications with service level agreement (SLA). The Ye Hu, Johnny Wong, Gabriel Iszlai and Marin Litoiu discussed resource allocation to an application mix is done such that SLA of all application is met. Here two server strategies namely shared allocation (SA) and dedicated allocation (DA) are considered for the resource allocation. The allocation strategies evaluated by heuristic algorithm on basis of smallest number of servers required to meet the negotiated SLA. Probability dependent priority found. [6]

In 2011 M.Noureddine and R.Bashroush demonstrate modality cost analysis based methodology for cost effective datacenter capacity planning in the cloud. Provisioning appropriate resources to each tenant /application such that services level agreement (SLA) met. The objectives are to use methodology to guide

resource provisioning. The quantitative methodology explained for planning the capacity of cloud datacenter. Set the applications in modalities and measure the cost of hardware resources. Discussed three experiments, MCA-S, MCA-M and MCA-L that represented user profiles and measure the resource overhead. A validation tool is used to simulate load and validate assumptions. Office Lync Server Stress (LSS) generate simulated load. [7]

In January 31, 2011, Sivadon Chaisiri, Bu-Sung Lee, and Dusit Niyato discuss about the Optimization of Resource Provisioning Cost. Under the resource provisioning optimal cloud provisioning algorithm illustrates virtual machine management that consider multiple provisioning stages with demand price uncertainty. In this task system model of cloud computing environment has been thoroughly explained using various techniques such as cloud consumer, virtual machine and cloud broker in details. [8]

The agent-based adaptive resource allocation is discussed in 2011 by the Gihun Jung, Kwang Mong Sim. In this paper the provider needs to allocate each consumer request to an appropriate data center among the distributed data centers because these consumers can satisfy with the service in terms of fast allocation time and execution response time. Service provider offers their resources under the infrastructure as a service model. For IaaS the service provider delivers its resources at the request of consumers in the form of VMs. To find an appropriate data center for the consumer request, propose an adaptive resource allocation model considers both the geographical distance between the location of consumer and data centers and the workload of data center. With experiment the adaptive resource allocation model shows higher performance. An agent based test bed designed and implemented to demonstrate the proposed adaptive resource allocation model. The test bed implemented using JAVA with JADE (Java Agent Development framework). [9]

IV. RULE BASED RESOURCE MANAGER

Hybrid cloud is a composition of two or more clouds that remain unique entities but that are bound together, offering benefits of multiple deployment models. In hybrid cloud we propose Rule Based Resources Manager for successfully utilizing the private cloud resources and considering the security requirements of applications and data. With resource manager a private cloud can be scaled up to allocate resources on-demand even if private cloud overloaded. Also the scalability beyond the capacity of private cloud is achieved by using public cloud resources. Decision is made on the basis of rules presented in following paragraph.

As shown in figure 1, User request for resources and its request enter to the Resource Manager. In our approach we categorized user's request into two types based on their resource requirements that is critical data processing and data security. These requests are assigned according to priority, if the user's need to perform critical data processing or security demand is high then the request is classified as a high priority and if the request is to run non critical tasks then it classified as low priority. The Resource Manager recognizes the suitable cloud to be used to fulfill a request. The high priority request always access resources from the private cloud itself, because it have confidential (secure) information. Next low priority requests can be fulfilled from either public cloud or private cloud. But if the private cloud resources are available, it must be used first as these resources are possess by the enterprise and should be utilized. Sometimes high priority request fulfilled by private cloud but its resources are already assigned to fulfill previous requests of low and high priority. In this situation we find those already allocated low priority requests and reallocate these low priority requests for which the remaining cost on public cloud is minimum to public cloud. The algorithm for Resource Manager is as follows:

```
RESOURCE_MANAGER (New_VM_Requestc+s)
{
PROCEDURE 1:
If (New_VM_Requestc+s <=  Availablec+s)
{
    Then:
/*--------This Redirects New_VM_Requestc+s to Private_Cloud -----*/
  Allocate NEW_VM Requestc+s on Private Cloud
    Response.Redirect (Private_Cloud);
}
/*--- Rule Two will always ensure high priority Requests on Private server
PROCEDURE 2:
If (New_VM_Requestc+s > Availablec+s && New_VM_Requestc+s == High_Priority_Request)
{
/*(For First 10milli-sec check low priority on private server) */
```

For Time 0 to 10ms

{

/* -- It Will free Space from Private Cloud Sever---*/

Check Low Priority Request on Private sever

}

If (Low Priority.Request.Count<0)

{

Put New _VM_ Requestc+s in Waiting_ Queue

[Because no Space on private server so waiting Queue]

If (time>100ms)

{

Move To another public server

Break;

}

If (Low Priority.Request.Count>0)

{

Re-Allocate Existing Low_Priority_Request to Public Sever

Then

Handle New_VM_Requestc+s to Private Server

}

If (time >100 ms and less than 200ms)

{

Put New_VM_Requestc+s in Waiting_Queue

}

If (time>=200ms)

{

Move To another public server

}

}

PROCEDURE 3: (

/*--------This Redirects to Public Cloud-----*/)

If (New_VM_Requestc+s > Availablec+s && New_VM_Requestc+s == Low_Priority_Request)

{

Redirect Requests to Public _Cloud;

}

V. EXPERIMENTAL EVALUATION

With performance of Resources Manager experimental results are present. CloudSim3.0 is used for simulation. CloudSim is a toolkit of simulation of Cloud Computing Scenarios. CloudSim written in java 6.1.Java is a programming language designed for use in the distributed environment of the internet. The private and public cloud having 20 and 90 heterogeneous type servers are considered for simulation. Pay-per-use model is used for billing. Few requests are getting when private cloud is overloaded, we made 50 resource allocation requests at different time intervals that is–low priority and high priority. Set the time for public cloud and private cloud to fulfill the request. For Rule Based and Non-Rule Based approaches we simulated different combinations of priorities among these requests. Computing resource is more costly than storage resource utilization. We consider only computing resource utilization.Private cloud utilization is found to be 64% in Non Rule Based approach and 70.59% for Rule Based approach. Our approach depends on Rule Based Resource Manager that proves to be cost effective in money spent for using cloud resource. Our approach considers security requirements of confidential and never permits to pass the organization's firewall and provide the services in time.

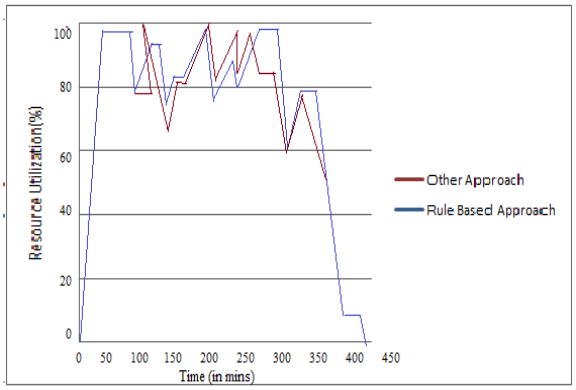

Figure2: Utilization Resources of Private Cloud

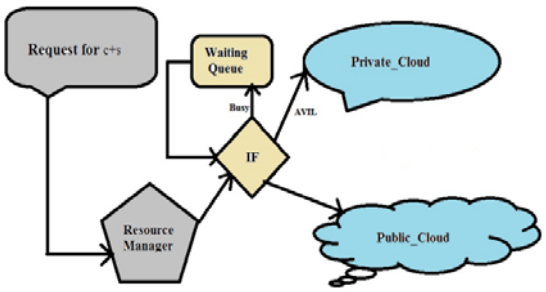

Figure 3: Resources Provisioning

Resource Utilization	Resource Utilization in Rule Based Approach	Resource Utilization in Non-Rule Based Approach
High Priority Requests	70.38%	65.73%
Low Priority Request	64.70%	65.73%
Mixed Priority Request	70.10%	65.73%

Table1: Comparison of Resource Utilization Under Different Set of Priority.

VI. CONCLUSION

Under the resource provisioning in Cloud Computing, the long-held dream of computing as a utility, has the potential to transform a large part of the IT industry, making software even more attractive as a service and shaping the way IT hardware is designed and purchased. Developers with innovative ideas for new Internet services no longer require the large capital outlays in hardware to deploy their service or the human expense to operate it. They need not be concerned about over- provisioning for a service whose popularity does not meet their predictions, thus wasting costly resources, or under- provisioning for one that becomes wildly popular, thus missing potential customers and revenue. The Methodology based on Infrastructure as a Service layer to access resources on-demand. A Rule Based Resource Manager is proposed to scale up private cloud and presents a cost effective solution in terms of money spent to scale up private cloud on-demand by taking public cloud's resources and that never permits secure information to cross the organization's firewall in hybrid cloud. Also set the time for public cloud and private cloud to fulfill the request.

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