Distributed Cloud Architecture: Resource Modelling and Security Concerns

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***Abstract*— Cloud Computing is an emerging field in Computer Science. This paper talks about Distributed cloud architecture to make use of independent distributed resources provided by the users. The main contributions include Distributed Cloud architecture, Resource modeling of Cloud and Security concerns. Firstly Resource modeling is discussed and based on that a Hierarchical model for Distributed Cloud is proposed. At last this paper talks about the security concerns with the Distributed Cloud.**

Keywords- Cloud Computing, Distributed Cloud, Resource, Virtual Machines

I. INTRODUCTION

Cloud computing is a common terminology used in both business and Academic fields. Cloud computing refers to a special way of computing over internet where dynamically scaled shared resources (Mostly Virtual) are provided as a service to avoid costs of resource over provisioning[1,2,3]. Cloud computing is a combination of several concepts from virtualization, resource pooling, resource monitoring, dynamic provisioning, utility computing, multi-tenancy and elasticity. The main entities of cloud computing are service providers, physical resources, virtualized resources and end users. Virtualization is the key concept in the cloud computing. Xen [4] is the main virtualization management tool used by most of the cloud providers. Hyper-V, KVM, Sun xVM Etc are some of the Virtualization Management tools used. Different cloud providers use different programming framework for designing the cloud such as Amazon uses Amazon Machine Interface, Google uses Map reduce, Sun uses, Solaris OS, java etc , Azure uses Microsoft.NET and open clouds such as Eucalyptus uses Hibernate, Axis2, java and Open Nebula uses Java and Ruby. There is no specific Framework or requirements for the implementation of Cloud.

Companies like Amazon, Google, IBM, and Yahoo are leading providers of some of the services offered by the cloud. There are open source clouds which are mostly used for scientific applications such as Nebula, Hadoop, Eucalyptus, NIMBUS etc. All cloud providers provide services defined by their service models Infrastructure as a Service, Platform as a Service, or Software as a Service. All these cloud providers provide services which fall under Infrastructure as a Service, Platform as a Service or Software as a Service. Currently all these cloud providers rely on huge data centers and is predominantly a centralized architecture.

Clouds are of three types, Public, Private and Hybrid cloud [1, 2, 5, 6]. In Public clouds resources are dynamically provisioned over the internet using web based application or web services and are open to everyone. In Private clouds resources are used and managed within the organization without any restriction on usage. In Hybrid clouds resources are provided by both internal and external providers.

Amazon uses Xen for virtualization of resources and their management. Amazon EC2 uses web services to provide resizable compute capacity in cloud. As will all the cloud computing platforms Amazon EC2 is Elastic i.e. you can increase or decrease the capacity of resources used dynamically. Users will be able to control these resources. Amazon EC2 allows user to create multiple instances with variable configurations of each instance. You will be able to choose type of OS needed, configure the memory, CPU and storage required for each instance.

Amazon S3 is storage for internet using which a user can store and retrieve any amount of data, anytime from anywhere using simple web services. Amazon uses Hadoop (Cite Amazon) an open source distributed processing framework to manage the tasks and configure the storage resource in Amazon Cloud. Amazon uses EBS (Elastic Block Store) to provide durable block level storage for use with Amazon instances. EBS is network-attached storage that is attached to Amazon instances which allows user to use them as a physical hard drive.

Distributed [8, 9] computing uses multiple autonomous computers over a network to solve computational problems as one single unit. Allocation of resources in Distributed computing to solve a specific task is NP-hard [10, 11]. There have been many models to optimize the resource allocation problems in Distributed Computing. Cloud computing and distributed computing or grid computing share a lot of similarities which can be used to build a distributed cloud.

When it comes to modeling, there is no specific cloud resource description which describes the resources in cloud. Computer Networks and their resources can be described using many existing frameworks such as RDF (Resource description framework) and Network description language.

Distributed cloud [7] computing refers to managing, provisioning of distributed resources. Increase in a high end configurations of resources with people, schools of which very less percentage are actually used. These unused percentages of resources can be efficiently used for both service provisioning

and Computation using the Distributed Cloud. Distributed cloud should have all the characteristics of existing cloud architecture including proper management of resources, data security and privacy, and trust.

II. RESOURCE MODELLING

In Distributed Cloud we have resources offering services across the world. These services are allocated to the user using a Resource Management System. We will create a resource model which defines the resources based on the services offered. Distributed Cloud or Cloud Resource providers will have to describe the resources and services they offer to the Resource Manager. Resource Modeling describes the resource offered by the Cloud and are used in optimization techniques, Cloud Management and Control of resources. Resource needs to be described in terms of functionalities and Services offered.

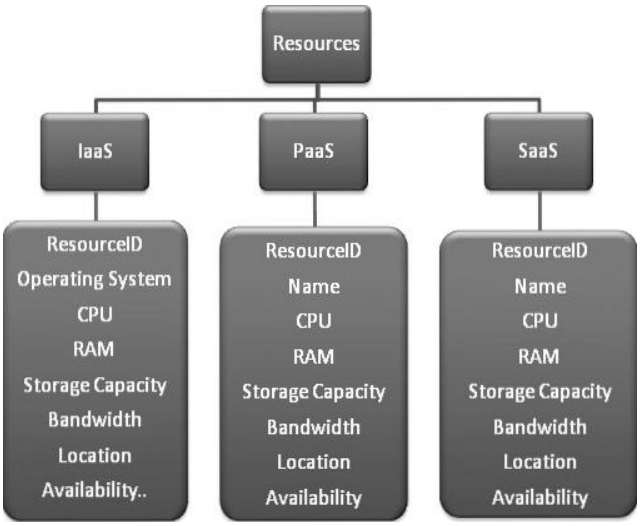

Figure 1. Cloud Resource Modeling

The resource offered by each node can be modeled as shown in Fig1. The same Resource Model can be used for both Distributed cloud and Cloud Computing system. Each of the resources modeled are detailed as:

- The ResourceID is a unique identifier for each node.
- The bandwidth indicates how fast data can be stored or retrieved. This can be an important factor if huge amounts of data need to stored or obtained.
- The storage capacity is how much storage the node has allocated for the distributed cloud. Both the available and total capacities are reported.
- The location of the node can be an important factor if localization is desired. The location of each node is represented by its network coordinates.
- The availability denotes how busy the node is. If it is receiving a lot of storage requests, it will set its availability to low or none. This does not indicate the amount of storage capacity remaining; it can be used for load balancing.
- Operating System indicates the type of OS running on the Virtual machine.
- CPU denotes the number of cores and speed in MHz for the VM provided
- RAM denoted the Memory associated with the VM
- Name denotes the Type of Service offered by resource. Ex: Java for PaaS

All these parameters are defines for different types of service models. There are different types of services classified under these service models such as Storage as a Service, Data as a Service etc. Again actual services offered under these services may or may not use these parameters. For example if we consider Storage as a Service it only needs information such as ResourceID, Storage Capacity, Bandwidth, Location and Availability.

III. DISTRIBUTED CLOUD COMPUTING ARCHITECTURE

In This Section we will discuss about the Distributed Cloud Computing Architecture. Traffic is the main concern with existing Cloud Architecture. Hidden Costs, High Latency and Need for High Bandwidth to support more and more users are main concerns with existing Cloud. Advantages of Distributed Cloud are efficient energy Usage, Bandwidth Conservation and Low Network Capacity.

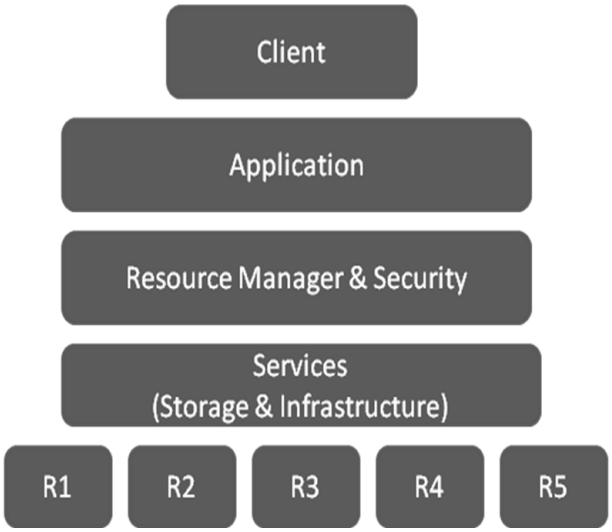

Figure 2. Distributed Cloud Architecture

Above figure Fig 2 Shows the outlined architecture of the distributed Cloud. Client is the End User and Application is the interface used by the End User to get access to the services. Resource Manager and Security is responsible for managing the resources based on the attributes provides by the Resource Model and assigning to take care about the security of services offered. Services layer is used to identify and manage the types of services offered i.e. this layer helps user to chose the types of services offered and helps managing the services providers to validate the services offered. R1, R2…Rn are the distributed resources in the Cloud.

IV. HIERARCHICAL MODEL OF DISTRIBUTED CLOUD

Based on the service offered and Cloud infrastructure is composed of Storage Cloud, Computing Cloud, Infrastructure Cloud and Data Cloud. Using the Hierarchical model we can offer Storage, Data, Computing and Infrastructure as services to the Users. We first identify based on the Area or Locality and Divide the whole System into Zones, and Locations which will help us manage the resource efficiently.

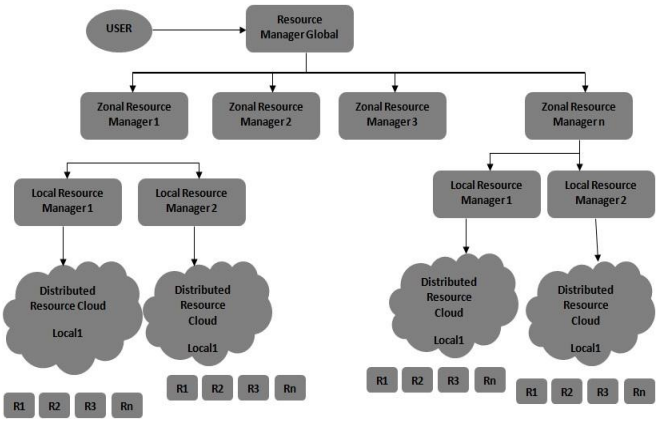

Figure 3. Hierarchical Model

Global Resource manager is the First point of contact for the users and Zonal Resource Manager is the layer till where users will be able to choose. Zonal Resource Manager is in charge of collecting information about the Local Resource Managers. All the End nodes are connected to the Local Resource Managers which keeps track about all the information about the Nodes. The Location Resource Manager is defined based on the Location Radius.

We will use a Hierarchical model for the Resource Management System to effectively handle the high number of user requests and managing them parallel based on the requirements and resource model. User will submit the request to Global Resource Manager. Global Resource Manager then based on the user Location and service requested assigns the task to Zonal Resource Manager. Zonal Resource Manger based on the Accurate Location assigns the Task to Local Resource Manager. Local Resource Manager checks the requirements and based on the Resource Availability and Network Bandwidth either assigns the resource in that location to the user or transfers request to a different location from the same zone.

Each Service has will be assigned with unique VM except for Storage. Multiple users can use a same storage based on the availability. Using the Hierarchical model managing the resources would be more efficient and different layers will have different responsibilities.

- Global Resource Manages is in charge of collecting the information regarding the status messages from the Zones.
- Zonal resource Manager is In charge of collecting the Information regarding the Local resource Managers and load on each Local resource Managers which would be helpful for resource allocation.
- Local resource Manager is responsible to get the information updates from each nodes, resource availability information, change in storage capacity, availability information etc.

Using this method we can manage the over provisioning of resources which is not handles by the existing cloud. Optimizing techniques are based on the Response time, throughput, and Network traffic. To achieve the elasticity property of the Cloud in a Distributed Cloud environment we need to use the VM migration techniques.

V. SECURITY CONCERNS

In a Distributed Cloud Environment using the services on remote machines bring up different security issues. Using virtualization for distributed cloud computing provides multiple security benefits, such as isolation of resources and data. Moreover, virtual machines are easily configurable, can be migrated to another physical machine, can be started on-demand, and can easily and quickly recover to a previous saved state. Backups or copying of virtual machines is hardware-independent, and can be easily replicated over many physical machines. Virtualization also adds a layer of abstraction between the physical machine and the virtual machine, thereby limiting users' access to the underlying physical machine.

Main security concerns include Authorization and Authentication, Confidentiality and Data integrity, and Virtual Machine security.

- Authorization and Authentication is to be provided by the Global Resource Manager. There should be different authorization levels for different set of services.
- We need to protect the Confidentiality and Integrity of Data stored, Computed and transferred in the remote VM's.
- Virtualization poses security threats in a distributed cloud computing system. A physical machine can host and instantiate many virtual machines. Each user of the distributed cloud can have one virtual machine instantiated on another physical machine. Each physical machine needs to keep up-to-date with the latest patches for all the virtual machines instantiated. Hardware or virtual machine failures can affect many users, and care must be taken to ensure that failures are local to each virtual machine. We will use multiple virtual machines on different physical machines for computation; thus, parallel computations can be performed, increasing the overall computing power available. To avoid the possibility of overloading a machine and to keep the elasticity property of cloud architecture, virtual machines can be migrated from one machine to another. Virtual machines communicate with each other over the Internet which introduces virtual machine jumping (or guest hopping), which exploits vulnerabilities of the hypervisor to attack a VM or the hypervisor from another virtual machine. Hyperjacking [12] is another

problem where a malicious user will run a thin hypervisor on the physical machine thus obtaining root-level access on the whole operating system. Other users' code running on virtual machines need to be sandboxed to prevent unauthorized access to the physical machine.

VI. CONCLUSION

Cloud is most popular and widely used system now days both in fields of academics and business. Distributed Cloud Computing allows use of resource efficiently. Users can make use of Distributed Cloud using for many applications and this architecture allows saving bandwidth. The main aim of this work is to create an efficient distributed Cloud System.

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