ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Monthly Peer Reviewed Open Access International e-Journal

Interoperability of Inter-Cloud Cloud Computing System

Sayed S. Ateeq S.Rafeeq
M.Engg. Student,
Computer Science and Engineering Department,
Everest Educational Society's Group of Institutions
College of Engineering & Technology, Aurangabad.

Mrs. Seema Singh Solanki
Assistant Professor,
Computer Science Engineering Department,
Everest Educational Society's Group of Institutions
College of Engineering & Technology, Aurangabad.

Abstract :

Cloud computing has been one of the latest technologies which assures reliable delivery of on-demand computing services over the Internet. Cloud service providers have established geographically distributed data centers and computing resources which are available online service. Cloud computing is getting mature and the interoperabilityand standardization of the clouds is still waiting to besolved. The service providers need to ensure availability of various services,infrastructure and platform in agile and flexible way at the time of failure. This paperproposes an inter-cloud system architecture that enables to make use of multiple cloudsystems. Since the cloud systems exchange resources flexibly, any failed devices can bereplaced immediately even in a catastrophic disaster.

Keyword:

Cloud computing, interoperability, serviceproviders,Standardization, Inter Cloud Architecture,inter-cloud workinggroup, virtual machines, Flogger,HadoopDistributed File System (HDFS), etc.

I. INTRODUCTION:

The Intercloud is an interconnected global "cloud of cloud and an extension of the internet "network of networks" on which it is based. The term was first used in the context of cloud computing in 2007 when key in opined that "eventually we'll have the intercloud, the cloud of clouds". It became popular in early 2009 and has also been used to describe the datacenter of the future.

The Intercloud scenario is based on the key concept that each single cloud does not have infinite physical resources or ubiquitous geographic footprint. If a cloud saturates the computational and storage resources of its infrastructure, or is requested to use resources in a geography where it has no footprint, it would still be able satisfy such requests for service allocations sent from its clients.

The Intercloud scenario would address such situations where each cloud would use the computational, storage, or any kind of resource (through semantic resource descriptions, and open federation) of the infrastructures of other clouds. This is analogous to the way the Internet works, in that a service provider to which an endpoint is attached, will access or deliver traffic from/to source/destination addresses outside of its service area by using Internet routing protocols with other service providers with whom it has a prearranged exchange or peering relationship.

It is also analogous to the way mobile operators implement roaming and inter-carrier interoperability. Such forms of cloud exchange, peering, or roaming may introduce new business opportunities among cloud providers if they manage to go beyond the theoretical framework.

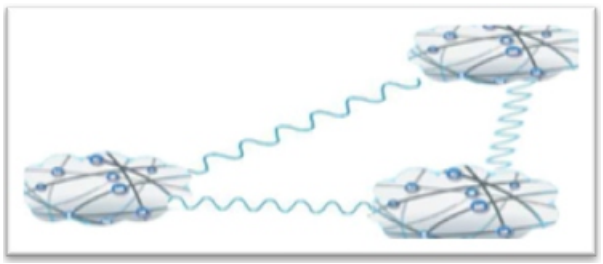

Figure 1.1. Intercloud cloud Computing [1]

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1.1. Inter-Cloud Cloud Computing:

With cloud computing applications being used more and more widely, they becomes more and more cloud computing service Different providers can interoperate, whetherthem have a common interface, has become a problem to besolved.The Inter-cloud is an interconnected global "cloud ofclouds" [1]. It can provide an extension of computing andstorage capacity to a single cloud.

1.2. Interoperability:

Suppose Imagine Following Example. A company using a cloud application despoilment in cloud computing provider a then the servers of provider a crashed, the company should transfer the application to provider B.Here the cloud computing service provided by A and B needguarantee the interoperability to each other.

1.3. Standardization:

In order to guarantee the interoperability Among different cloud computing platforms, it is essentialto work out standards to describe the cloud itself, the interfaceto communicate, and the data format. There are already severalstandardization organizations working on the cloud computingstandards, such as IEEE Standard Association, ISO/IEC JTC1SC38, etc.

II. INTEROPERABILITY OF CLOUDS:

It defines multiple cloud systems to work together flexibly and optimally, thereby making it possible to build a reliable service platform. The cloud systems that comes under an inter-cloud environment must support a standardize features. The cloud systems must ensure the data, network and infrastructure security for a secure and trust based inter-cloud system. The inter-cloud system should support data and virtual machine transmission among cloud systems. [2].

2.1. Data Transmission:

A kind of platform independent and operating system independent dataformat is needed here to exchange among different storage solution engines on cloudsystems.

This kind of format is called Uniform Data Format (UDF). UDF is not a kind formatto describe concrete data like JPEG or mp3 formats do, it is like a kind of archive file to describe attributes of the files and also can package the file for transmission. [2]

2.2. Message Transmission:

Applications which run on several different cloud computing platforms may send, receive, and process messages fromeach other from time to time. The message transmission isan important factor to guarantee program runs regularly. Justlike the kind of Instant Message software (IM software), cloudapplications also need the ability to communicate with eachother by sending message.

The protocol best satisfies the demands here isXMPP, which is defined by the Internet Engineering Task Force (IETF) in RFC6120:"Extensible Messaging and Presence Protocol (XMPP): Core". [2]

2.3. Virtual Machine Transfer:

Some PaaS providers offer the platform to users to buildtheir own virtual machine. As for these PaaS providers, an important aspect of interoperability is capacity of transferringthe virtual machine.

2.3.1. Run-time Environment:

Some platforms do not providethe virtual machine platform to allow users install their ownoperating system, they provide a set of API instead. Theplatform offers the HAL to isolate the difference of thehardware, and build a gateway to allow the cloud communicate with others. [12].

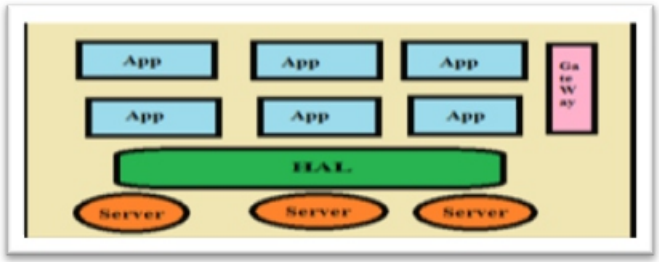

Figure 2.3.1. Run-time Environment [12]

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2.3.2. Complete Virtual Machine Platform:

Some platforms allow users to establish their ownvirtual machine and install the complete operating system, these platforms are calledcomplete virtual machine platform. Virtual machine transfer on the complete virtualmachine platform should satisfy the virtual disk file of the virtual machine is common format. [12].

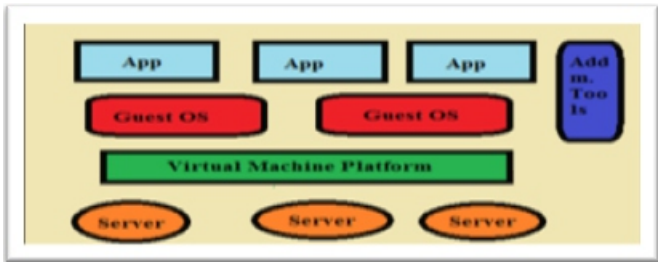

Figure 2.3.2. Virtual Machine Platform [12]

III. STANDARDIZATION OF INTER-CLOUD CLOUD COMPUTING:

For the purpose of this paper, in this section we provide detailed analysis of the cloud relatedstandards [9] by National Institute of Standards and Technology (NIST) that define the CloudComputing Reference Architecture (CCRA), IEEE standardization activity to define Intercloud Interoperability and Federation framework, and also the ITU-T Focus Group onCloud Computing (FG-Cloud).Suggestions are given how they can be used for the defining the general Intercloud architecture for interoperability and integration.A group of standards that define internalcloud management, components design and communications are well presented by DMTF,SNIA and OGF standards that correspondingly define standards for Open Virtualizations Format (OVF), Cloud Data Management Interface (CDMI), and Open Cloud ComputingInterface (OCCI). These standards are commonly accepted by industry and provide a basisfor lower level cloud services interoperability; they can be directly incorporated into theProposed ICAF.

3.1. IEEE Intercloud Working Group (IEEE P2302) :

IEEE Error! Reference source not found P2302 Intercloud Working Group recentlypublished a draft Standard on Inter-cloud Interoperability and Federation (SIIF) that proposesan architecture that defines topology, functions, and governance for cloud to cloud-interoperability and federation. Topological elements include clouds, roots, exchanges (whichmediate governance between clouds), and gateways (which mediate data exchange betweenclouds). Functional elements include name spaces, presence, messaging, resource ontology's(including standardized units of measurement), and trust infrastructure.

Governance elementsinclude registration, geo-independence, trust anchor, and potentially compliance and audit.The proposed IEEE P2302 SIIF architecture is originated from the position paper publishedby Cisco in 2009 that tried to leverage the basic routing and messaging Internet protocolssuch as BGP, OSPF, XMPP to address Inter-cloud integration and interoperability.

Thedocument also proposes to use an approach similar to the Content Distribution NetworkInterconnection (CDNI) but this doesn't address the generic problems with interoperabilityand integration of the heterogeneous multi-domain and multi-provider cloud basedinfrastructure.

The limitation of the proposed by IEEE P2302 architecture and approach isthat it tries to closely imitate the Internet approach in building hierarchical interconnectedinfrastructure by adding an additional Intercloud layer to support Inter-cloudcommunications at networking and messaging levels without addressing specific problems in Intercloud integration, management and operation.

3.2. Market-Oriented Standardization:

3.2.1 De Facto Standards:

The commercialization of the Inter-cloud Cloud computing happened earlier and distributed. Several companies are already providing cloud computing services. Like Amazon, it has Amazon Web Services (AWS), which offers a complete set of infrastructure and application services that enable consumer to run virtually everything in the cloud. Meanwhile, Microsoft and Google also have their cloud services, like Windows Azure and Google App Engine. he regulation their used becomes de facto standards.[6]

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3.2.3 Interoperability and Security:

Cloud computing network is a kind of open network, which is faced with various security threats. Under the requirement of interoperability, the cloud network need to ensure the security from aspects of encryption of communication protocols and trust model based on Public Key Infrastructure (PKI) and authentication.

As for encryption of communication protocols, XMPP has already provided the encryption characteristic in its standard.[2] XMPP supports the Simple Authentication and Security Layer (SASL) framework and Transport Layer Security (TLS) protocol. Securing subsequent protocol exchanges within a data security layer. [13] TLS protocol allows Client server.

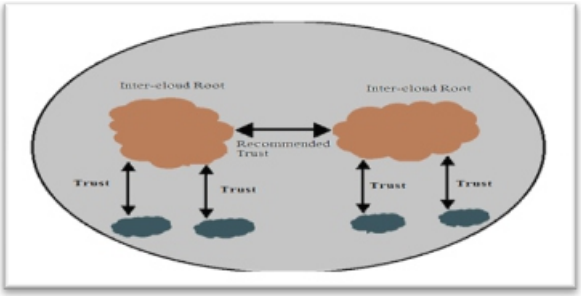

Figure 3.2.3. Intercloud Trust Management Model

Applications to communicate in a way that is designed to prevent eavesdropping, tampering, or message forgery.[14] The Intercloud Root in intercloud cloud computing model can serve as a Trust Authority. [15]

3.3. NIST Cloud Computing related standards:

Since the first publication of the currently commonly accepted NIST Cloud definition in2008, NIST is leading an internationally recognized activity on defining conceptual andstandard base in Cloud Computing, which has resulted in the following documents that createa solid base for cloud services development and offering:

1.NIST SP 800-145, A NIST definition of cloud computing.
2.NIST SP 500-292, Cloud Computing Reference Architecture v1.0.
3.NIST SP 800-146, Cloud Computing Synopsis and Recommendations.

This recently published document provides a good overview of the basic usage scenarios in clouds, analysis of open issues and recommendations for cloud systems to comply with the general requirements to critical IT systems. [9].

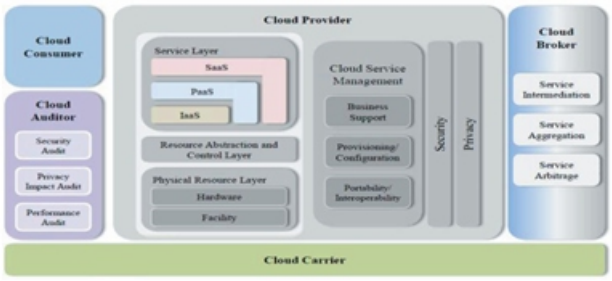

Figure 3.3. NIST Cloud Computing related standards. [9]

Figure above presents a high level view of the NIST Cloud Computing Reference Architecture, which identifies the major actors (Cloud Consumer, Cloud ServiceProvider, Cloud Auditor, Cloud Broker, and Cloud Carrier), their activities and functions incloud computing.

The CCRA is suitable for many purposes where network performance is not critical but needsto be extended with explicit network services provisioning and management functions whenthe cloud applications are critical to network Quality of Services (QoS), in particular latency, like in case of enterprise applications, business transactions, crisis management, etc. [9]

IV. PROPOSED WORK:

The intercloud architecture to be defined in this paper will provide a secure and reliable datatransmission and virtual machine transmission among cloud systems. For data transmission a Hadoop distributed file system (HDFS) mechanism is implemented among cloud systems. Avirtual machine transmission occurs when services required by a cloud client is not availableor does not provide support for required functionality.

4.1. Hadoop Distributed File System:

The Hadoop Distributed File System (HDFS) [10] [11] is a distributed file system designed to run on commodity hardware.

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It has many similarities withexisting distributed file systems. However, the differences from other distributed file systemsare significant. HDFS is highly fault-tolerant and is designed to be deployed on low-costhardware.

4.2. HDFS Architecture:

HDFS is designed to reliably store very large files as a sequence ofdata blocks across machines in a large cluster. In HDFS, the NameNode executes file systemnamespace operations like opening, closing, and renaming files and directories, anddetermines the mapping of blocks to DataNodes. The DataNodes are responsible for servingread and write requests from the file system's clients.

The DataNodes also perform blockcreation, deletion, and replication upon instruction from the NameNode. HDFS's defaultreplica placement policy is to put two-thirds of replicas on different nodes within the samerack to improve performance, and put the other third of replicas on randomly chosen nodeson other different racks to improve availability.

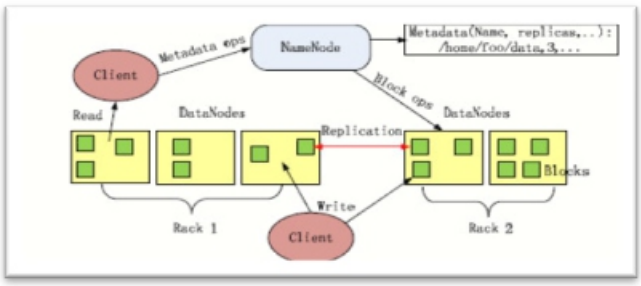

Figure 4.2. HDFS Architecture [10] [11].

4.3. Flogger Mechanism:

The mechanism is based upon Log Inspection- Log inspection collects and analyzes operating system and application logs for security events. To increase the transparency and accountability in cloud computing environment log of file access and transfer should be maintained For every file access by the Virtual Machine the flogger(Linux Flogger/Window Flogger) captures Virtualmachine attributes(Filename, path, date, time, IP address, MAC address), machinetype(virtual/physical), file owner identity(user and group), process owner identity, action taken on file. [17]

4.4. Proposed Migration Architecture:

The intercloud system architecture proposed is definedin a hierarchical structure so that the intercommunication among cloud systems becomessimple to understand and flexible to handle data and virtual machine transmissions. The root server consist data service and network management services withinbuilt. The root server also manages migration, securitylevel agreement and other interoperability issues. Both are below Architectures.

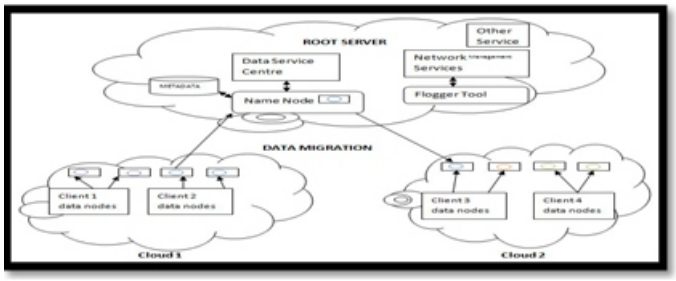

Figure 4.4. Data Migration [17]

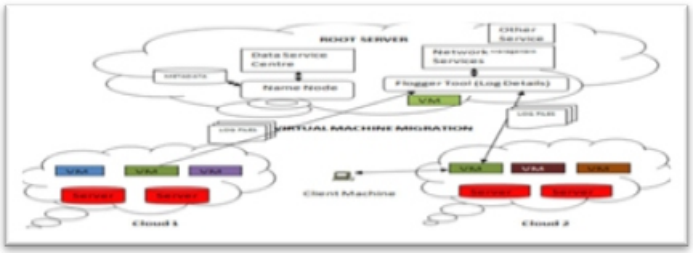

Figure 2. Virtual Machine [17]

This figure shows virtual machine migration from cloud 1 to cloud 2. The client machinerequiring a service that is not available within cloud 2 environment is provided by cloud 1 bymigrating one of its VM to cloud 2 environments with associated services to it.

V. CONCLUSION:

With a view to providing cloud systems with the high quality and reliability required forsocial infrastructures, this paper has proposed an Interoperability inter-cloud cloud computing systemwhichcontrols multiple cloud systems flexibly and optimally in a coordinated manner in order tomake a reliable service platform possible. . This architecture represents data transmission based on hadoop distributed file system and virtual machine migration enhancing securitywith flogger mechanism.

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But as each Cloud provider lays out its own set of specificimplemented Cloud services and applications in order to manage them. This results in a lackof interoperability among Cloud providers.

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