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Virtualizing the Inter Communication of Clouds

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ABSTRACT
The cloud has been an attracting platform for the enterprises to deploy as well as to execute their business. However, clouds do not possess infinite storage resources and infinite computational in its infrastructure. If there is saturation then no new request will be processed. Hence, Inter-Cloud networking is required to provide efficiency, flexibility and scalability by resource sharing between other clouds. The field of Inter-Cloud communication is still a new field although there has been some basic knowledge about it; however the working knowledge about it is still far from reached. In this paper, the aim is to implement the Inter-Cloud communication with the use of another uprising technology called the Software Defined Network (SDN). SDN is a new prototype for the applications to exchange information with the network and to query the Application Programming Interface (API) to gather network information to plan and optimize the operations. A detailed result is presented of the improvements in virtualizing the Inter-Cloud communication improves the overall performance as compared to the current existing Inter-Cloud communication techniques.

Keywords
Cloud computing, Inter-Cloud, Software Defined Network (SDN), Software Defined Infrastructure, Application Programming Interface (API).

1. INTRODUCTION

Cloud computing is a field which has created a lot of interest in the Information and Communications Technology (ICT) community. This is making great development in the IT industry. Cloud computing is defined as a collection of different system which provides well managed resources inside the organization. Providing the Platform as a Service, Software as a Service, and

Infrastructure as a Service by the cloud provider to the organization follows the method of pay-as-you-go [1]. From the industry point of view, it is seen as an economical model which is used to rent the technical resources as per business requirement. This provides the added advantage of renting resources on demand which includes the upfront investment and licensing cost which would have put the business in a huge financial burden and in the due course making the business dynamic and easily adoptable to the client's requirement. The public, private and hybrid cloud of the organization intercommunicates with the help of middleware using the exchange server. The exchange server is used to connect different kind of workstations along with the different clouds as in Figure 1 a cloud co-ordinator is used connect one clouds with the exchange server [5].

There are numerous benefits of Inter-Cloud communication for cloud client that can be summarized as:

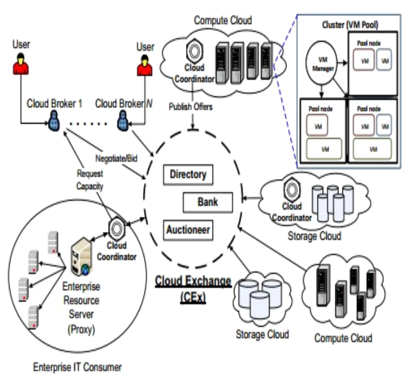

Figure 1. An Architecture of Inter-Cloud communication

- **Diverse Geographical Locations**

The cloud service providers have setup information centers worldwide. On the other hand, it is doubtful that any supplier can build information centers in each nation and regulatory area. Numerous requisitions have administrative prerequisites as to where information is archived. Consequently an information focus inside a district of nations may not be sufficient, and provision designers will require fine-grained control as to where assets are positioned. Just by using numerous clouds would one be able to pick up access to so broadly circulated assets and furnish well performing and enactment agreeable administrations to customers.

- **Better application resilience**

During the past several years, there have been several cases of cloud service outages, including ones of major vendors. The implications from one of Amazon's data centers failure were very serious for customers who relied on that location only. In a post-mortem analysis Amazon advised their clients to design their applications to use multiple data centers for fault tolerance [2, 13].

- **Avoidance of vendor lock-in**

By utilizing different clouds and having the ability to unreservedly travel workload around them, a cloud customer can effectively evade source bolt in. On the off chance that a supplier changes a strategy or valuing that effect contrarily its customers, they could effectively move somewhere else.

Software Defined Networking is putting forth both critical tests and unrestricted chances for what is to come in exchanging data and imparting the same around the globe. Software-defined networking (SDN) is an approach to computer networking which evolved from work done at UC Berkeley and Stanford University around 2008 [3]. Indiana University in May 2011 started a SDN Interoperability Lab in conjunction with the Open Networking Foundation to test how well diverse specialists' Software Defined Networking and Open-flow items work together. SDN empowers clients to system layers, dividing the information plane from the control plane. By empowering programmability, SDN can empower clients to streamline their system assets, increment arrange dexterity, administration development, quicken administration opportunity to-market, remove business sagacity and eventually empower dynamic, administration driven virtual systems.

Exploding levels of information virtualized framework and distributed computing leave clients with extensive demands on their systems and administration assets. To-date methodologies to virtualize the system layer and include programmability which has left the industry divided cause of the complexity in making the selection more adaptive. In the meantime, endeavour clients and administration suppliers are looking for answers to empower virtual and versatile systems to underpin virtual units that are portable and detached from a physical system design.

Previously, the Internet Protocol (IP) network were designed by Autonomous Systems (AS) which used the forwarding, routing, bridging algorithms for delivering the data from source to destination. The principle of Autonomous Systems allows the designated destination to move with changing identity for packet delivery service. It was difficult to specify access control, quality of service, packet sequencing with that. The new standards introduced by Internet Engineering Task Force (IETF) such as Virtual Private Network increased the complexity for network elements and infrastructure for cloud computing.

The Software Defined Network is playing great role in Infrastructure orchestration. The Software Defined Network is deployed using newly designed Infrastructure said to be Software Defined Infrastructure (SDI) as in Figure 2. It is having two parts the Hardware section and the Software section [6].

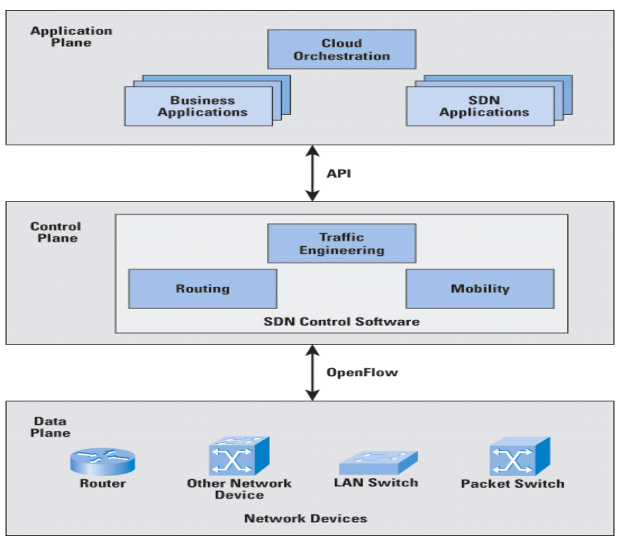

Figure 2. Logical structuring of Software Defined Network (SDN)

- **Hardware Requirements**

The network protocol needs optimizers, accelerators and adapters to increase their efficiency which result into expensive infrastructure. However, SDN provides the interoperability, granularity, dynamism, visibility of data transfer over the network. SDN combines the data from physical to application layers and enlighten their usage throughout the network. SDI balances all the above required parameters to fetch the information from the customer for infrastructure and services. The SDI augments the cloud computing customer expenses. As per requirement of cloud computing, it is very cost effective and flexible to optimize, secure and monitor the cloud network.

- *Software Controlling network*

The separation of data plane and control plane gives birth to new way of managing the resources and network elements. The control plane covers breadth and depth of IT Infrastructure. The information sent by customer is grabbed by SDI Controller and include them to infrastructure orientation for further service. The control plane can get the information from multiple vendors and further provisioning done as per work flow. SDI is simple, scalable and reliable to design and make updates to the network. The service level agreement dashboard shows dynamism for customer use.

Cloud administration suppliers might likewise have critical motivating forces from taking part into an Inter-Cloud activity. A fundamental thought of cloud computing is that a cloud administration might as well convey steady accessibility, flexibility and versatility to meet the concurred clients' necessities. A cloud supplier might as well guarantee enough assets constantly. The work load which needs to be done is not certain as the workload spikes can come out of the blue and hence cloud suppliers need to overprovision assets to meet them. An alternate issue is the immense measure of information focus force utilization. Keeping an abundance of assets in a prepared to utilize state constantly for adapting to surprising load spikes heads to expanded force utilization and cost of operation. The benefits of the cloud providers can be précised as follows.

- *Expand on demand*

Being able to offload to other clouds a provider can scale in terms of resources like cloud-hosted applications do within a cloud. A cloud should maintain in a ready to use state enough resources to meet its expected load and a buffer for typical load deviations. If the workload increases beyond these limits, resources from other clouds can be leased [4, 14].

- *Enhanced SLA to customer*

Realizing that even in a most dire outcome imaginable of data center outage additionally asset lack the approaching workload could be moved to an alternate cloud, a cloud supplier can furnish better Service Level Agreements (SLA) to clients.

These benefits should help both the cloud providers as well as the clients without violating the requirement of the applications. The fitting application i.e., provisioning and scheduling should satisfy the requirement in terms of performance, legal consideration and responsiveness.

In this paper, a couple of clouds are built and then inter-connection between them is setup setting up a virtual network interconnection. The main focus on changing the currently existing inter cloud network by the use of Software Defined Network (SDN) which would virtualize the intercommunication between the two clouds. Later in the paper the result of the improvement that helps the consumer along with the service provider by increasing the QoS, decreasing the financial part of it and making the network more flexible is shown. In section 2, the information regarding the current works which are in progress for Inter-Cloud communication is shown. In section 3, a discussion about the Eucalyptus tool which is used to build the cloud for the test bed. In section 4, the details about the work which has been performed to improve the inter connection along with the outcome of the paper is shown. In the section 5, the outcome of the paper is shown in the graphical format. The final section 6 accomplishes the study and provides the avenues for the future work.

2. RELATED WORKS

IEEE, the world's largest professional organization advancing technology for humanity, introduced the founding members of the IEEE Inter-Cloud Testbed project. The IEEE Inter-Cloud Testbed is developing cloud-to-cloud interoperability and federation capabilities to enable cloud services to become as ubiquitous and as mainstream as the Internet. Results from the project will also assist in the development of the forthcoming IEEE P2302™ Standard for Inter-Cloud Interoperability and Federation, which is developing standard methodologies for cloud-to-cloud interworking [5].

In 2002, Wierzbicki et al. proposed Rhubarb [8]. It has only one coordinator per group and the hierarchy could be made using this groups. The proxy coordinator is used by system and all nodes inside the network make a permanent TCP connection with the proxy coordinator.

In 2004, Xiang et al. proposed a Peer-to-Peer Based Multimedia Distribution Service [9, 16]. They proposed an idea of a topology-aware overlay in which nearby hosts self-organize to the application groups while end hosts within the same group collaborate with each other to achieve Quality of Service (QoS) awareness.

According to Vinton Cerf, a co-designer of the internet's TCP/IP protocol, the important issue with cloud computing is interoperability between current clouds [10]. So, there is need of development of protocol and standards to interact with multiple clouds.

David Bernstein et al. study protocols and formats for cloud computing interoperability on [11]. A set of protocols, called Inter-Cloud protocols, and a set of mechanisms are numbered on this paper.

There is a Global Inter-Cloud Technology Forum whose aim is to promote standardization of network protocols and the interfaces needed for internetworking between clouds. A white paper with use cases and functional requirements for Inter-Cloud computing is published in [12].

The Metro Ethernet Forum (MEF) has technically working on standards cloud computing and Software-defined networking over carrier-grade Ethernet in 2013 [16].

1. EUCALYPTUS

Eucalyptus – an Opensource software structure for cloud computing that actualizes what is ordinarily alluded to as Infrastructure as a Service (IaaS); frameworks that give clients the capacity to run and control whole virtual machine occurrences sent over an assortment physical connection. Fundamental standards of the Eucalyptus plan, detail vital operational parts of the framework, and talk over compositional exchange, that has been made to allow Eucalyptus to be conveyable, measured and easy to use on foundation normally discovered inside scholarly settings. At last, a furnished confirmation that Eucalyptus empowers clients acquainted with existing Grid and HPC frameworks to investigate new cloud computing usefulness while looking after access to existing, recognizable provision advancement software and Grid center.

The architecture of the Eucalyptus framework as in Figure 3 is simple, adaptive and secluded with a hierarchical configuration reflecting normal resource environment discovered in numerous scholastic settings. In essence, the framework permits clients to begin, control, access, and whole virtual machines utilizing an emulation of Amazon Ec2's Soap and "Query" interfaces. That is, clients of Eucalyptus connect with the framework utilizing literally the same apparatus and interface that they use to connect with Amazon. There are four high-level components, each with its own Web-service interface, that comprise a EUCALYPTUS Installation [7, 15]:

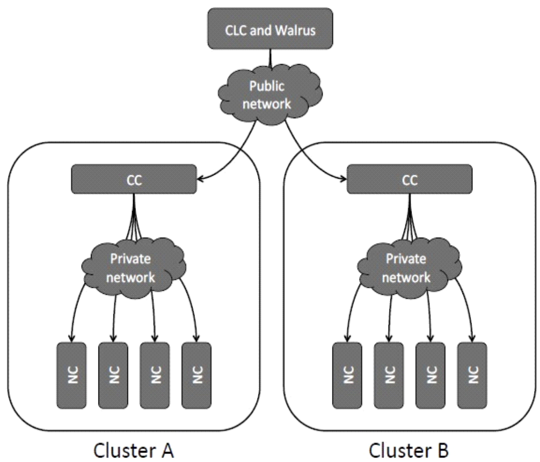

Figure 3. EUCALYPTUS employs a hierarchical design to reflect underlying resource topologies

2. *Node Controller*

It is used to track the termination, execution and inspection of the Virtual Machine instances on the host system where it runs.

3. *Cluster Controller*

It schedules the Virtual Machines execution with the information it gathers on a specific node controller, it also manages virtual network instance.

4. *Storage Controller (Walrus)*

It is a put/get storage service implemented on Amazon's S3 interface, which provides a mechanism for virtual machine image and store data accessing and storage [15].

5. *Cloud Controller*

It is the entry-point into the cloud for the users and administrator's. Queries are made to the node manager to receive information regarding the resources, making high level scheduling decisions, and implementing them by sending requests to cluster controllers.

3. PROPOSED WORK

In this paper our aim is to modify the existing Inter-Cloud communication which is currently setup by the use of an exchange server for the two clouds to communicate between each other by the use of Software Defined Network (SDN). In an Inter-Cloud system, hubs from a cloud might utilize resources, administrations or data from different clouds. The principle objective of an Inter-Cloud system is to make open interfaces that might govern the exchange and probability of information from a cloud to the others. With a specific end goal to outline these characteristics, there is a need of making a productive protocol to exchange messages between clouds. Connections ought to be created between the devices that will be the boundary of the cloud. All cloud protocols ought to have the capacity to be interpreted to different protocols that must be reasonable in different clouds. Also, a common protocol might be wanted to trade data between clouds.

There are some present customer platforms that have the ability to join different clouds concurrently, so they have the ability to utilize more than one particular protocol. They might be utilized as gateway between clouds. At the same time this alternative is bad to join numerous clouds because of a several reason. On one hand, clients that may as well go about as portals between clouds may as well have numerous resources and computing limit with a specific end goal to join numerous clouds. Also, they ought to have the capacity to interpret protocols between clouds and the point when another cloud is included; the software of all gateways ought to be changed. Then again, general clients might as well have a redesigned rundown of all gateways in its cloud with a specific end goal to achieve the administrations offered by different clouds. With a specific end goal to settle this issue, a proposal of a layered engineering that permits associations between clouds which happens between the Dnodes of the clouds. The architecture of the cloud is formed by 3 layers. The lowest one is the Access Layer, which is formed by the regular nodes of the cloud. The medium layer is called the Distribution Layer, which is formed by Dnodes and the highest layer is called Organization Layer, formed by Onodes [15]. There are logical connections setups between Dnodes of two clouds and in charge of information exchange. On the other hand Onodes are used to setup logical connections between different Dnodes of other clouds. Dnodes use Onodes to get information regarding which Dnodes of the other cloud is more suitable to setup connection. The cloud suppliers need is an application programming interface (API) for the network layer so they can control the stream of their particular requisitions over their foundations. Though, the software-defined system has arrived through Openflow. Openflow and the software-defined system help cloud suppliers be more agile with system administration. So far, the administrators have needed to utilize the same network administration conventions that the merchants designed and underpinned through standard bodies, like Internet Engineering Task Force (IETF). With Openflow, a system software engineer can compose code to administer particular sorts of streams crosswise over network mechanisms dependent upon expense of the supplies, load on the network and the quality of different sorts of activity, for instance. At present, there are numerous tests going ahead in the industry that are tucked behind the paper drape of nondisclosure. The question which arises is how much would Software Defined Network help the suppliers in reaching their goal. That would be the first handful of outlets to underpin Openflow over the greater part of their cloud suppliers' stages.

As seen in Figure 4 the existing Inter-Cloud communication occurs through a packet switch router, which does setup a physical interconnection between the clouds. However, by the use of the SDN technology to virtualize the Inter-Cloud communication the packet switch router is skipped and a virtual direct path is setup between the clouds as seen in Figure 5.

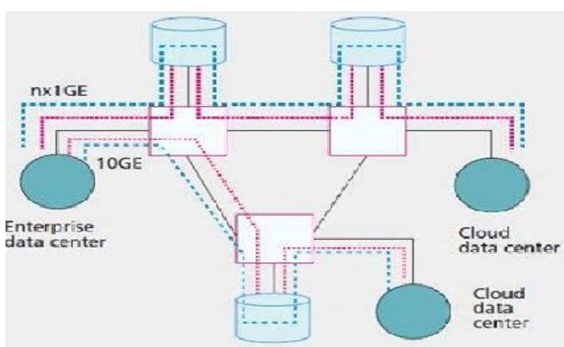

Figure 4. Inter Cloud communications through Exchange Servers

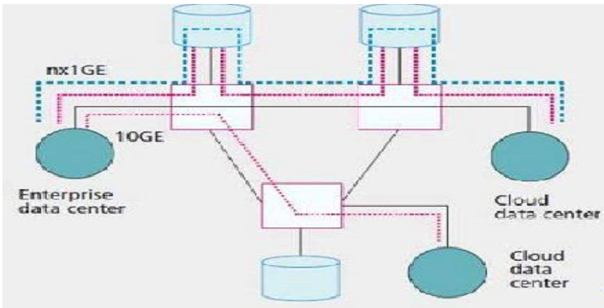

Figure 5. Inter Cloud communications through the use of SDN

4. RESULTS AND OUTCOME

The use of SDN in turn improves the overall performance of the device and the accessibility also increase by folds as the graphical output for Latency and Throughput can be seen in Figure 6 and 7 respectively.

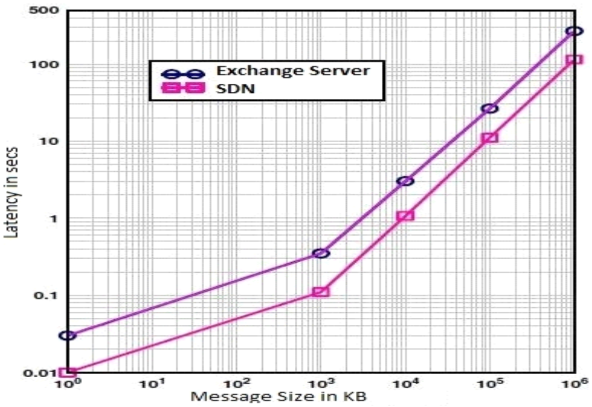

Figure 6. Latency: Exchange Server vs. SDN

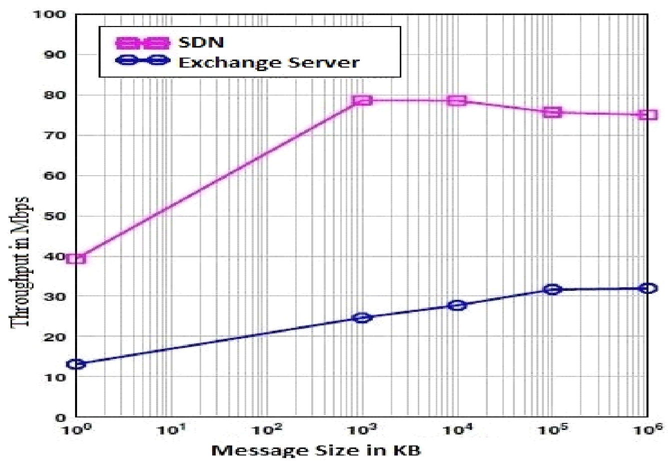

Figure 7. Throughput: Exchange Server vs. SDN

5. CONCLUSION

It is clear that programmable networks and SDN speak to paramount shifts that empower more adaptability in future systems, these technological achievements are still in its early budding stage. Just the precise adopters have deployed SDN, they have begun in small scale, testing the thought in a particular part of their infrastructure, demonstrating pertinence before making bigger speculations and conveying all the more extensively over their network infrastructure. SDN application is case particular, accordingly to follow how a SDN could profit, it is important to evaluate the network and create precisely what is required. The predominant thing that needs to be remembered is the mechanisms and applications live on the network and what requirement would be needed by the network later down the line. Thinking ahead and recognizing what a network may need to do in the coming years can give organizations an edge when acknowledging distinctive approaches to optimize a network. At last, works with an outlet free accomplish who carries a careful comprehension of network administration, organize architectures and conventions. This may as well incorporate information of how to execute the best network, comprehension visualized frameworks and the way of distributed computing workloads and how these elements affect the network. This approach will direct a logical and useful SDN decision that will fit the overall s network architecture, guaranteeing the network platform presses on to uphold ICT and business targets - make a system that permits you to develop as opposed to depending on one that holds you back.

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