Cloud Federation : A Review

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Abstract : In the research field Cloud Computing is a booming area due to its plenty of advantages. There are plenty of researches are going on in the field of Cloud Computing like Resource Provisioning, Virtualization, Load Balancing, VM migration, Green Cloud Computing, etc. In the research field Cloud Computing attract the researchers and industrialization person because some area of its not properly explored in terms of performance or effectiveness. Now a days many organization moved on cloud and due to its extensive uses some small cloud providers are running out of the resources. So, Now question is arise how they managed this kind of situation? Hence, Cloud Federation and Inter-Cloud comes into the pictures where multiple cloud providers sell, rent or/and buy resources using formation of cloud or inter cloud communication. Cloud federation is a and inter cloud are the natural evolution of Cloud computing. The main agenda behind in the research field of Cloud Federation is to gain good QoS, cost efficiency, reliability, effective utilization of cloud and achieved excellent performance. In this paper, we are discussing a detailed survey of cloud federation and at the last we have identified open challenges and current trends in the area of Cloud Federation and Inter-Cloud application brokering.

Keywords: Cloud Computing ,Cloud Federation, Inter-cloud, multi-cloud.

I. INTRODUCTION

"A Cloud is a type of parallel and distributed system consisting of a collection of interconnected and virtualized computers that are dynamically provisioned and presented as one or more unified computing resources based on service level agreements established through negotiation between the service provider and consumers[3]".

Due to the popularity gain by Cloud computing in a very short period of time, It is attracting the interest of Information and Communication Technology community. Cloud computing is a new area of delivering computing services on demand over the Internet. It is a next logical step after Grid computing on the way to utility computing, where computing resources are available as subscription utility service just like water and electricity[3]. From business perspective, it is widely viewed as an economic model for renting technical resources [4].Being able to rent resources on demand and to avoid upfront investments in hardware and licenses proves to be very enticing for enterprises in a dynamic and unstable business environment.Cloud Computing providing **many services** on demand over the internet, like IaaS (Infrastructure-as-a-Service), PaaS(Platform-as-a-service) and SaaS (Software-as-a-Service) etc[1].

There are mainly three types of **people** are involved in the Cloud[1],

(1) Providers : Cloud service providers (Google, Amazon, Azure, IBM, and Oracle) are the owner of physical resources.

(2) Customers : These peoples are using resources as a service over the internet in order to provide service to its users

(3) End-users : These are the peoples who actually using those services anytime anywhere[4].

There are mainly three types of **deployment** model[2],

(1) Public: Infrastructure and resources owned by the provider and it is exist under the premises of provider. It is a accessible from all over the world and it has low security and less customization.

(2) Private: Resources are only operated by designated organization and it can exist on or off premises. This type of cloud only managed by the organization itself. It has more security, more control and more privacy over the cloud resources but it has limited scalability,limited to particular area. Private clouds can be further classified as follows:

Cloud portfolio – When the cloud is a part of a portfolio of clouds belonging to the same organisation. Examples for this are multiple private clouds belonging to a corporation[4]. **Independent –** Separate cloud infrastructure that is not a part of a portfolio of clouds[4].

(3) Hybrid: This type of cloud is a combination of private, public or community cloud. It has good scalability, flexibility, cost efficiency and security but it is facing some networking issues and security compliances.

(4) Community: In this type of cloud resources are shared by several organizations which have common vision or mission, agenda, security requirements, policy, and compliance considerations. It is operated by the same organizations in the community or a third party and can be exist either on-premises or off-premises. It is more secure than public clouds but it is less secure than private cloud and requires governing policies for administration.

II. CLOUD FEDERATION

A main agenda behind of Cloud computing is that a cloud service should be available whenever it is required irrespective of resource constraints which are available or not[4]. All the cloud provider should ensure that enough resources should be available at all times. But how much is enough? Workload spikes or request from end users can come unexpectedly, or we can not predict the workload thus, cloud providers need to overprovision resources to fulfill this type of requirement. Due to the availability of huge amount of resources all the time which lead to lots of power consumption and increased cost of operation[1].

There is also FLA (Federation Level Agreement) between cloud providers in which providers obey the rules and regulations which is decided by both the cloud providers. It is a area of new business where providers can sell/buy their computational resources. Provider can also take participation in inter cloud. Inter Cloud broadly classified as given below[1].

Volunteer Federation– Set of cloud providers(CP) willingly collaborate with each other in order to exchanges resources. Example of this types of clouds are governmental clouds or private cloud portfolios.

Further classification of Volunteer Federation are given below [3]:

Peer-to-Peer – In this architectures, clouds can communicate and negotiate directly with each other without mediators.

Centralized – In this types of architecture, there is a one central entity that either performs or facilitates resource allocation and this entity acts as a repository where available cloud resources are registered. Also it has other responsibilities like acting as a marketplace for resources.

Independent – Many CP are used in aggregation by an application or its broker. It is essentially independent of the CP and can be used to utilize resources from both governmental and private clouds[3].

III. FEDERATION ADVANTAGES [1]

Vendor lock-in avoidance: Due to the multiple CP, client can easily migrate to another CP in case, user's current CP change the pricing or policy.

Cost-effectiveness: By having plenty amount of resources available all the times its actually effectiveness for cost.

Diverse geographical locations: All the CP should have Data Center worldwide but it is not possible for every CP's to establish data centers in every country. But they can do it by using cloud federation.

Under-utilized: As we know during night data center has lower utilisation and in the morning it has extensive uses it may vary from location to location. So, CP can now sell their underutilized resource to others CP.

Guaranteed performance: Due to limited resources, it is some CPs are facing a problems if workload will increase suddenly, which lead to decline of performance and violation of SLA. This is drawback are overcome by the cloud federation in which CP are renting resources from foreign CP's, there by guaranteeing the agreed QoS.

Better SLA to customers: a cloud provider can provide better Service Level Agreements (SLA) to customers, as the result of competitive.

Guaranteed availability: In case of natural hazards, the cloud system will be able to recover the services by federating with other cloud service providers in unaffected areas.

Cloud Federation brings many advantages for both the clients and providers like for a given cost, reducing the time to completion, increasing the system throughput or optimizing the resource utilization.

FEDERATION APPROACHES [1] :

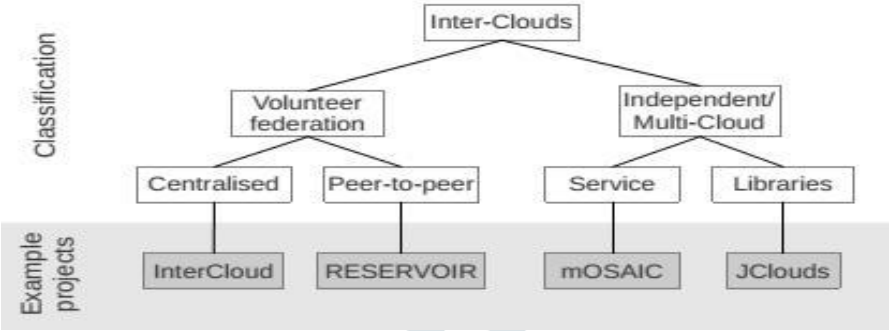

Figure 1 Classification of inter cloud [1]

A. CENTRALIZED APPROACH

There is a single broker common to all clouds in charge of establishing the federation. As shown in Figure 2 there is a trusted third party entity allowing a cloud to look for other clouds federation according to its requirements and its main purpose is to perform a matching between a clouds.

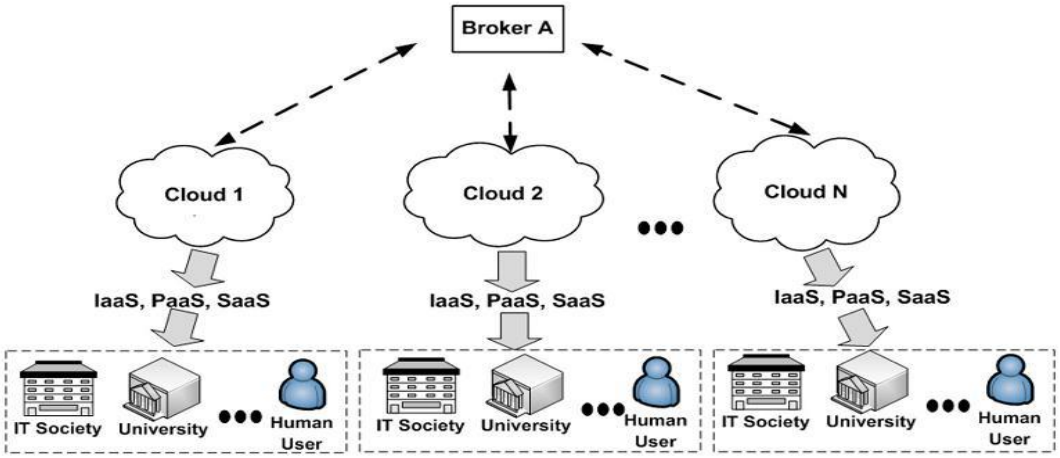

Figure 2 Centralized approach [1]

B. DECENTRALIZED APPROACH:

As shown in figure 3 clouds negotiate the partnership by themselves. They manage discovery, communication, negotiation of agreements, and matching and selection of the best Partners for federation according to their requirements by themselves.

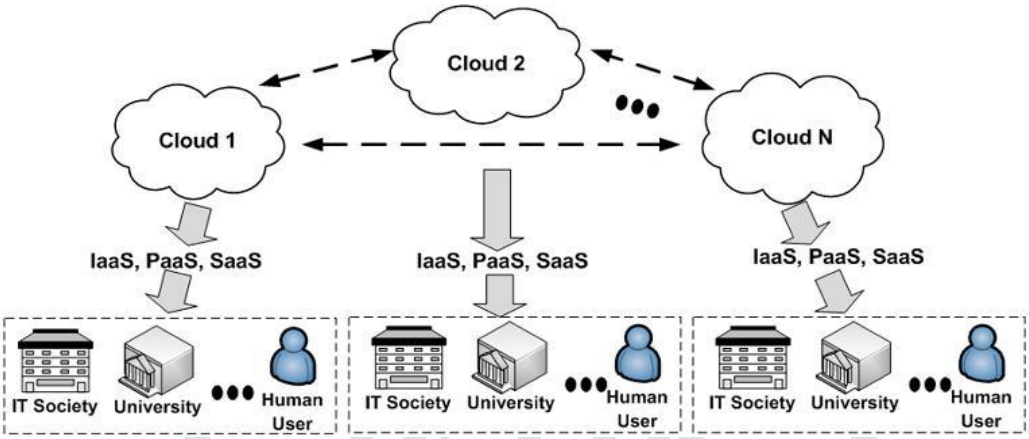

Figure 3 Decentralized approach [1]

C. HIERARCHICAL APPROACH

As shown in figure there is a multiple brokers interact among each other to establish the federation. Clouds are connected to a broker and at the same time, each Broker can also interact with other brokers in order to look for clouds whose requirements match the requirements of clouds requesting partnerships.

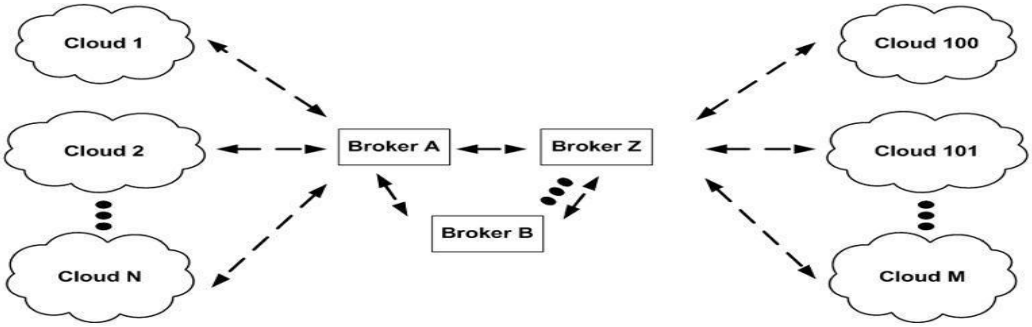

Figure 4 Hierarchical approach [1]

IV. DIFFERENCE BETWEEN CLOUD FEDERATION AND MULTI CLOUDS[3]1][4]

Cloud Federation	Inter Cloud	Multi Cloud
A relationship between two or more independent homogeneous or heterogeneous cloud platforms which establish a trusted federation agreement in order to benefit of a particular form of business advantage	A model which allows on-demand reassignment of resources and transfer of workload through a interworking of cloud systems of different cloud providers based on coordination of each consumer's requirements for service quality with each provider's SLA and use of standard interfaces.	Usage of multiple, independent clouds by a client or a service. CPs or end-users are responsible to manage resources across multiple clouds.
Is achieved when a set of cloud providers willingly interconnect with their infrastructures in order to allow sharing of resources among each other.		Multi - cloud environment does not imply volunteer inter connection and sharing of provider's infrastructures Clients or their representatives are directly responsible for managing resource provisioning and scheduling.
Federation uses a provider version of the interfaces.	Inter - cloud is based on standards and open interfaces.	Multi cloud uses a provider version of the interfaces.
Connections between clouds are made under neath via special protocols from cloud to cloud.	Hybrid Cloud is not Inter cloud.	Connections between clouds are made via over the top via user APIs.
In the phone network, standards for inter connections of phone companies utilize SS7 networking, standardized numbering plans, and origination or termination agreements to result in a system where any phone can dial any other phone worldwide. The mobile phone system adds a roaming layer on top of this providing and even more comprehensive notion of Federation.	Both federations and multi-clouds are types of Inter-Clouds!.	In the phone network, you may choose not to use the Federation capabilities, perhaps because they are too expensive (direct dial long distance and mobile roaming can be expensive!) for example. In this case you can use a Calling Card, where you manually use the phone network at hand, say through a "toll free" mechanism, to connect to your Calling card, and then through that system, you manually direct it to dial the end phone. In this way we are using the "user API's" of the phone system (phone numbers) to construct an over the top end to end connection.
This technology architecture is "from the Network to the User" with "implicit demand for resources" where the provider managed all the things.		This technology architecture is "from the User into the Network" type of "explicit demand for resources" where the user is very specifically controlling the computing they want.

V. CLOUD FEDERATION CHALLENGES[1][3][5]

1) **Better (SLA) Service-Level Agreement :** Due to the cloud of cloud environments and for the new business opportunities we must required new and better global SLA because each and every cloud providers has its own SLA management mechanisms.
2) **Autonomics System** : Due to the federation or cloud of cloud it is too much difficult to manage system for human hence, to overcome this issue, we should have autonomics computing. By using autonomic computing technology, we will able to handle different system requirements like, fault tolerance, security, performance, reliability, QoS, without human intervention.
   Autonomic Management System should be able to carried out following things:
   2.1) Self Configuration : A system should be able to do automatic configuration of resources or components without human intervention.
   2.2) Self Healing : A system should be able to detect and correct the errors or faults.
   2.3) Self Optimization : A system should be able to do automatic maximum optimization of resource allocation.
   2.4) Self Protecting : A system should be able to provide automatic system security and integrity.
   3) Security : We thinking that Security is first issue to be overcome, because in the Federation of Clouds each cloud uses different Identity Management (IdM), Authentication, and Authorization. Hence, in order to perform authentication among heterogeneous clouds we need to set up global IdM and authentication management or improve existing system.
   4) Heterogeneous Platform : Google, Amazon, Microsoft, SalesForce and Oracle they all have their own solution and interfaces for services. So in order to do federation among them we needed or set up a platform. Hence in a heterogeneous cloud federation scenario, interoperability is a key concept.
   5) Avoid Vendor Lock - In : Existing Cloud Computing are generally lock the clients into a single Cloud platform, infrastructure or application, and preventing the portability of data or software created by them. So, set up one standard interfaces which will enable interaction between distributed sites.

VI. CONCLUSION

In this survey paper , we have presented many terminology about cloud computing like services, deployment models, and characteristics of cloud. Also, we have classified and analyzed the state of the art in Inter - Cloud developments. Then after we have discussed Cloud Federation advantages and difference between Multi cloud and Cloud Federation. Further, we have analysed some open and current challenges of cloud federation. And at last, the improvement or development of new Inter-Cloud environments is essential for the better utilization of under utilized resources.

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