An Inimitable Mechanism and Architecture for Security in Cloud using Multi Cloud

N. Velmurugan, S. Godfrey Winster

Abstract: ***Confidentiality, Privacy and Protection of data (CPPD) are the major challenges in the cloud environment for cloud users such as industrials and organizations. Hence major companies are loath to migrate to cloud and also still using the private cloud because of lock in CPPD of cloud. Cloud Service Providers (CSP) are unable to elucidate strength of the storage and services due to lack of data security. To solve the above issue, we trust, algorithms are not the only solution for data security. In this regards, we suggest to change the architecture and develop a new mechanisms. In this paper, we are proposed two thinks. First is move to single cloud architecture to multiple cloud architecture and second is develop an innovative algorithm. And one more think also considered and proposed an inimitable mechanism to use an innovative algorithm in the multi cloud architecture for improving CPPD.***

Key words: Inter cloud, Multi cloud, Security, Confidentiality, Privacy, Protection.

I. INTRODUCTION

An individual data generation is show in figure 1 in the last three years. This is only at own PC (personal computer). In the internet, by 2020, it's predictable that 1.7MB of data will be produced every second for every person on earth. For example, 2595 terabyte of data created in every minute at US only. And more statistics for a day as follows: 500 million tweets, 300 billion emails, 4PB on facebook, 65 billion messages on whatsapp etc., Other than the above, Some of the companies such as Google, Microsoft, Amazon and IBM are creating online data around one Exabyte (1EB) per day. According to increasing of data, Service providers are needs to increase our physical storage in the different locations. Availability of physical resources, high security of data in cloud is more expensive for cloud service provider when compare to growth of data creation by individuals or industry or organizations. The Cloud has tried to provide all the applications, infrastructure, network and storage facilities, but unable to deliver by the single cloud service provider. So they need support from other service providers for providing services.

The Inter cloud discourses use the applications, storage, network or any type of facility of the platform of some other clouds. The Inter cloud atmosphere offers profits like distinct Geographical locations, flexibility and eluding CSP lock-in to cloud consumer.

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Advantages for the CSPs are scaling their on demand services and well service level agreements (SLA) to the cloud consumers. The Inter cloud is created on the every single cloud does not have immeasurable physical resources, more novel security and depletions in expenditure**.** So Cloud service providers needs inter cloud. At the same time, Cloud consumers wants to do resiliency, release of vendor lock in, more novel security and cost performance optimization.

The remaining splitting up of this artifact is orderly like Segment 2 discusses contextual works related to analysis of inter clouds and it types. It provides multi cloud architecture, services and libraries. Segment 3 describes concepts of multi cloud architecture, explanations of graphical representation of architecture and proposed architecture block diagram. Segment 4 results and achievement clarifications and 5 decision and forthcoming research directions.

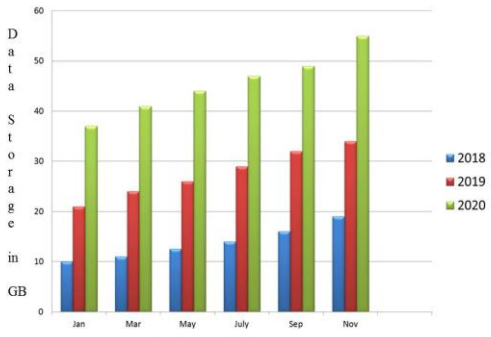

Fig. 1 - Individual data creation

II. BACKGROUND

Inter cloud computing defined as by Global Inter-Cloud Technology Forum [1], “A conceptual network that allow CSPs to resources from other CSPs. Inter cloud permit datacenters to interconnect with other data centres if required”. On the other hand, cloud resource services based on the impression of merging many diverse individual clouds into one unified mass in terms of on-demand services or operations.

For example, Telephone, mobile companies, banking sector have functioned as an Inter cloud, interfacing with other companies networks in territories if they have not presence.

A. Classification of Inter Cloud

Inter clouds infrastructures are classified as governmental and private on the basis of their ownership.

First is specific and utilized by a government or non-profit public institutions. Examples are science community clouds like Australia's National eResearch Collaboration Tools and Resources (NeCTAR) and Canada's Cloud-Enabled Space Weather Modelling and Data Assimilation Platform (CESWP). Second is a private society. Private clouds categorized as Cloud portfolio and Independent. Cloud portfolio is a group of clouds belonging to the same company or organisation. Examples are multi private clouds fitting to a company or organisation. Independent is distinct cloud platform, it is not a part of a group of clouds. Examples are AWS (Amazon Web Services), iCloud, Google Drive etc [2,3,4]. This is shown in the figure 2.

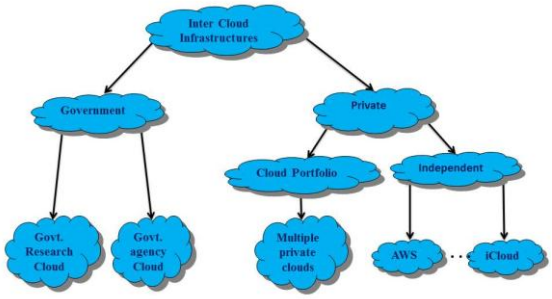

Fig. 2 – Classification of Inter cloud infrastructure

A concept of inter cloud or cloud of clouds is referred to a conceptual model for cloud computing services based on encompass of various different individual clouds into one seamless mass for providers and consumers. R. Buyya et al. have analyzed and finalized about inter cloud architectural types. Inter cloud has two types such as Volunteer Federation and Independent. A federation cloud is attained when a group of CSP willingly to join their set-ups to permit for sharing of applications, infrastructures, networks and storage between each other. This is mostly feasible for government private cloud portfolios. Independent represents the usage of multiple, autonomous clouds by a user or a service. That atmosphere does not infer volunteer interconnection and distribution of providers' infrastructures. Cloud users or their agents are directly responsible for handling resource provisioning and scheduling. This methodology is rudimentary autonomous of the CSPs and can be used to consume resources from both government and private clouds. This methodology is called as Multi Cloud [2, 3]. The above conceptual is classified and depicted in figure 3.

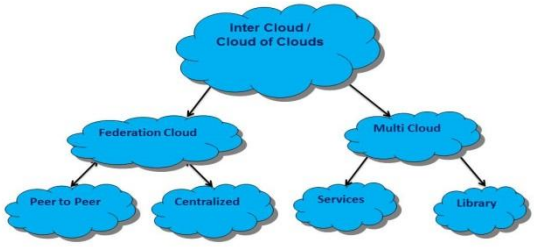

Fig. 3 – Architectural classification of Inter cloud

One more term hybrid cloud is defined as encompass of more various cloud deployment model such as a private and a public cloud. This type of cloud is one of the multi cloud category that bonds various clouds deployment models. Inter cloud resources are used when local ones (hybrid) are insufficient [4]. From architectural perception, volunteer federations Inter cloud categorised as follows:

Centralise – In the architectures view, there is a vital object available for cloud resource allocations. Typically, this object acts as a depository where obtainable cloud resources are registered. This object has other duties like acting as marketplace for resources.

Peer to Peer – In the architectures view, cloud service providers interconnect and exchange directly with each other without brokers for sharing of resources. The federation is shown in figure 4(a) and 4(b)

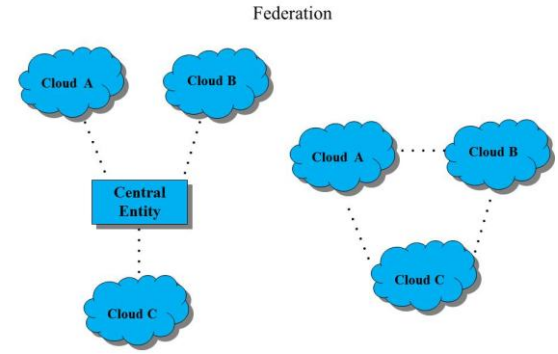

Fig. 4 (a) – Centralized Inter cloud Federation

Fig. 4 (b) – Peer – Peer Inter cloud Federation

Independent Inter cloud categorised as follows:

Services – Application provisioning service that can be hosted through externally or internally (in-house) by the cloud consumers. This type of services mostly includes trader modules in themselves. Usually, application creators specify Service Level Agreement (SLA) or a set of provisioning procedures and respect to predefined attribute based service performed like deployment and execution.

Libraries – Application traders are take care of provisioning and scheduling of application modules across clouds. Usually, such mechanism make use of inter cloud libraries that ease the usage of multi cloud in an even way. The Independent Inter cloud is shown in figure 4(c) and 4(c).

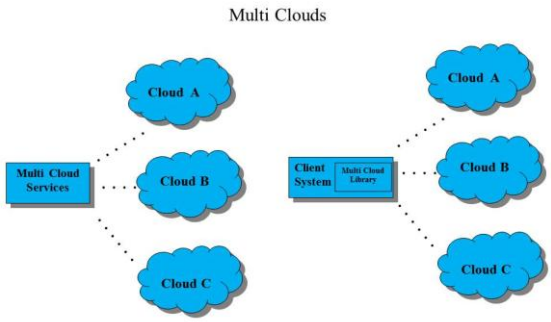

Fig. 4 (c) – Multi cloud Service

Fig. 4 (d) – Multi cloud Library

According to the above description of federation and multi cloud, CSPs are not willing to freely participate in an Inter cloud and install such agents.

We concluded that the multi cloud environment provides effectively opportunities and avenues to cloud consumers and service providers. In the next topic we discuss with multi cloud service and libraries.

B. Multi-Cloud services

Numerous companies providing paid independent multiple cloud service on basis of the performance, variety of cloud providers.

OPTIMIS (Optimized Infrastructure Services) - The OPTIMIS idea is to permit for outwardly developed convertors for such clouds that should simplify the communication between OPTIMIS mediator and agnostic CSPs. A drawback is together work with CSPs OPTIMIS mediators organised in their data centres.

Contrail - Contrail supports both categories such as federation and independent inter clouds. Like OPTIMIS, Contrail major disadvantage is development and keep various retailer exact Contrail adapters [6].

mOSAIC (Open-source API and Platform for Multiple Clouds) - The mOSAIC is permit to improvement and arrangement of applications that use various multiple clouds [7]. Resource broker, Cloud agency, Client interface, Application executor components are used to communication between clients and cloud providers, deployment, execution and monitoring usages.

STRATOS. STRATOS is a broker service of development between clients and cloud service provider [8]. STRATOS encompasses of Cloud Manager, Topology Descriptor File components.

Right Scale provides the facility for arranging and management of applications across multi clouds. Users can be able to manage virtual machines on multi clouds through the Rigth Scale console. A user is permit to specify the name of the CSP and location by service provisioned. Right Scale is accepts addition of private clouds by consumer to facilitate local resources usage. The services of EnStratus, Scalr and Kaavo are comparable with those of Right Scale. Obviously, there are variations in rating, cloud retailers and technologies and some terminologies [9].

C. Multi cloud libraries

Numerous Inter cloud libraries have been established in latest years. Java library JClouds, Python library Apache LibCloud, Ruby library Apache DeltaCloud and PHP library SimpleCloud are some examples [10, 11, 12]. All these libraries are designed to control the resources over geographical locations and manage Application Programming Interfaces (API) of multiple clouds. These types of libraries can be able to use comfort the development of cloud adapters for technologies like OPTIMIS and mOSAIC. By using these libraries, programmers can write own applications for specific brokers. Such brokers directly achieve primary cloud setups and meet all of the earlier outlined necessities. A major issue in the method is developers must to describe proper deployment and replication of the broker for obtainability reasons.

III. PROPOSED ARCHITECTURE

A. Introduction

In our previous work, we identified three different approaches (1) Multiple cloud architecture for files, (2) Multiple cloud architecture for big data, (3) Multiple cloud architecture for secret keys and files. The approach 1, different file formats are like text, image, audios, video and database stored in different cloud provider. The approach 2, categories of big data such as structured, unstructured and semi structured data are stored in various cloud service providers. The approach 3, secret keys and files like encryption and decryption keys and corresponding files are stored in various cloud service providers.

B. Mechanism

In the approach 1, we implemented a novel basic idea of the proposed architecture. The proposed architecture mechanism tells, single file was splits in to more chunks then the each chunk will be encrypted and stored in difference cloud service providers. In the figure 5, user send the file to Multi Cloud Director (MCD), MCD splits the file in n number of chucks and store in the n number of Cloud Service Provider (CSP). The figure 6 shows the graphical representation of the multi cloud storage over the different CSP and it shows how the mechanism was implemented. The mechanism as follows:

(1) User send the file (F) to MCD.
(2) File received by the MCD then the file splits into n number of chunks (F_1, F_2…..F_n).
(3) Each chunks are encrypted (eF_1, eF_2…..eF_n).
(4) MCD randomly selected the CSP (iCloud, Microsoft Azure, Amazon, Google, Oracle and IBM Cloud) to store the each encrypted chunks.
(5) Encrypted chunks are sent to different CSP.
(6) MCD maintains the CSP of every chunk. MCD will act for the reverse process to get original file.

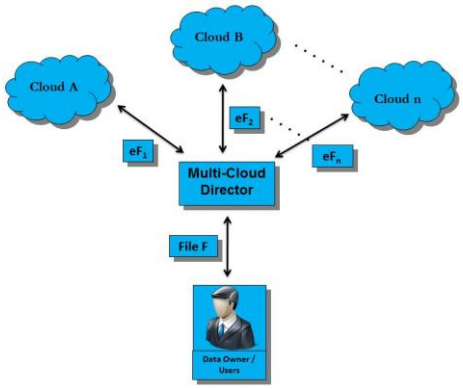

Fig. 5. Basic idea of our novel architecture

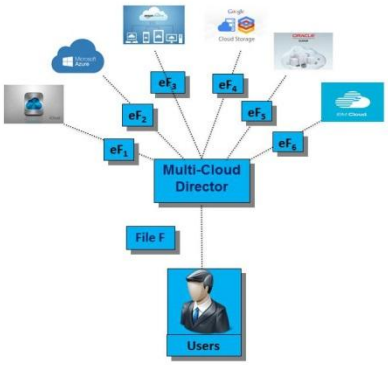

Fig. 6 – Graphical representation of Multi Cloud Architecture

C. Components

MCD is the main role of storage over the internet like splits, encryption, decryption, merging of all chunks in the proposed system. According to the role of MCD, User Split Encryption (USE), User Decryption Merge (UDM), Multi-Cloud Manager (MCM), and Authentication Manager (AM) are the components of its. In the architecture diagram figure 7, blue, green and pink arrow represents uploading chunks to multi cloud manager, upload and download to/from cloud and downloading chunks form multi-cloud manager respectively. The USE mechanism consists of splitting files, key generation and encryption process. The UDM mechanism consists of Decryption with keys, process of merging all chunks and finally original content is of file is received. Multi cloud manager is sending chunks to any one of the cloud storage and vice versa. Cloud A, Cloud B and Cloud C are the different cloud service provider.

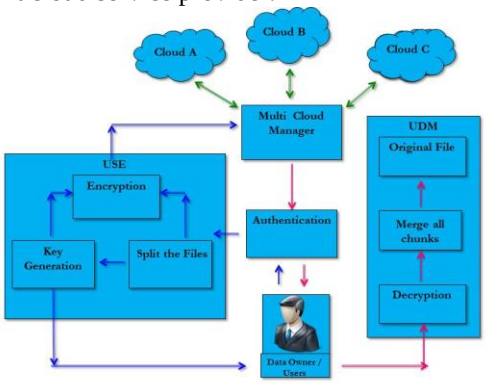

Fig. 7. Block diagram of Multi cloud architecture

User Split Encryption (USE)

USE is an important role of the novel architecture. It consists of three parts such as Split the Files, Key Generation and Encryption.

Split the Files will split the file (F) in to more than one chunks ($F=F_1, F_2, F_3…..F_n$) based on our needs.

Key Generation (KG) will generate the Encryption key using number of chunks. At this point, there are two types of key generation method for encryption. KG type1: single key for all chunks. KG type2: various key for each chunk.

- Key Generation (KG) type1: single key (k) with file (F) -> $kF_1, kF_2, kF_3…..kF_n$
- Key Generation (KG) type2: various key (k) with file (F) -> $k_1F_1, k_2F_2, k_3F_3….. k_nF_n$

Encryption will encrypt the chunks using key and algorithm for every chunk. Like KG type, algorithm usage is two types for encryption. AL type1: single common algorithm for all chunks. AL type2: various algorithms for each chunk.

- Algorithm (AL) type1: common algorithm (A) for all chunks of a file (F) -> $AkF_1, AkF_2, AkF_3…..AkF_n$
- Algorithm (AL) type2: various algorithms for each chunk of a file (F) -> $A_1k_1F_1, A_2k_2F_2, A_3k_3F_3….. A_nk_nF_n$

User Decryption Merge (UDM)

UDE is another important role of the novel architecture. It consists of three parts such as Decryption, Merge all chunks and getting original file.

Decryption done by using Key(s), Algorithm(s) of each chunk are given by the MCM.

Merge all chunks of a downloaded file based on the index which was received from the MCM. The original file will be generated from the chunk. To understand the scenario,

If type1 is used to decrypt process, $d(AkF_1)$, $d(AkF_2)$, $d(AkF_3)….d(AkF_n)$, for merge all the chunk $d(AkF_1)+d(AkF_2)+d(AkF_3)+….+d(AkF_n)$->F.

If type2 is used to decrypt process, $d(A_1k_1F_1)$, $d(A_2k_2F_2)$, $d(A_3k_3F_3)$.... $d(A_nk_nF_n)$ for merge all the chunk $d(A_1k_1F_1)+d(A_2k_2F_2)+d(A_3k_3F_3)+...+d(A_nk_nF_n)$->F

Multi Cloud Manager (MCM)

MDM have three important works as follows: (1) Transfer the encrypted chunks to various clouds ($C_A, C_B, C_C….$) and maintain the index, key, algorithm and its types of every chunk. (2) User request received from AM (3) Collection of chunk from various CSP.

Authentication Manager (AM)

AM role is more important to the architecture. It has following tasks. (1) User authentication (2) User requested categorized and transferred to USE or MCM. If the user authenticated, the request category is two types. First type is uploading a new file to cloud and second is downloading a file from CSP. According to the request, the AM transfer the file to USE or transfer the request to MCM.

IV. RESULTS

According to proposed architecture, CPPD in cloud environment is achieved in the following ways: (1) We moved from the single cloud to multi cloud architecture. (2) An innovative mechanisms are developed (3) various algorithms are used in various components of MCD. In the multi cloud architecture, we used type 1 Key(K) and type 1 Algorithm (AL). The result of the type 1 is shown in figure 8. Table-1 is listed the path of achievement of CPPD. Confidentiality is achieved through MCM, Privacy is achieved through various CSP. Protection is achieved through AM.

Table 1 – CPPD achievements

Research Term	Definition	Achieved through
Confidentiality	Protecting data or information from being accessed by unauthorized users. In other hand, authorized people only can access.	Multi Cloud Manager (MCM)
Privacy	An organization or individual has to control what data in a computer can be shown to third parties.	Cloud Service Provider (CSP)
Protection	Process of defensing important information from fraud, negotiation or loss.	Authentication Manager (AM)

V. CONCLUSION AND FORTHCOMING RESEARCH DIRECTIONS

Primary task of this paper is need of multi cloud and how it derived from the inter clouds. Next, multi cloud concepts and its types such as multi cloud services and libraries are explained in neat manner. Then this paper shows the novel multi cloud architecture, an innovative mechanism to use algorithms. Keys and Algorithms are implemented using the above innovative mechanism. From our earlier work, CPPD is taken to research work and we developed a novel multi cloud architecture for improving the above. New mechanisms are designed and developed to implement in our new multi cloud architecture. In this paper we considered only text messages. In the future, we need to concentrate on images, audio, video and big data categories. And remain the approaches are taken and implemented which is listed in chapter III proposed architecture.

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