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Issues & Perspectives with Multimedia Cloud Computing

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Abstract: ***Because of Cloud Computing, Internet has become the emerging home of all services and applications such as sharing, computation, storage, accessing etc. Now with the increase usage of mobile devices such as smart phones, laptops and tablets etc., a big part of network traffic is comprises of multimedia data such as images, audio and video files. Now the most of the data generated, shared, stored and processed through various sources is multimedia such as sensor networks, medical records, data from satellite etc. are some of such sources. This type of rich media data requires huge storage and computing facilities. Even software required for their computing and manipulations are very heavy and costly. It is very difficult for a low configured mobile device to manage all these features with limited computing, storage and battery capacity. So demand for Multimedia Cloud Computing came into picture. As with cloud, users can run their applications directly on the cloud with the help of software deployed on powerful cloud servers. This mitigates the users from the burden of heavy and costly software installation and continual upgrades. Now multimedia as a service is a new emerging field of research. But security of cloud is always a matter of concern for both the cloud providers and the user. In this paper we have given an overview of need and challenges for media cloud computing. This paper includes a survey of some proposed architectures for the multimedia cloud computing along with several security and other issues faced by media cloud providers and users.***

Keyword: Multimedia, Security, Multimedia Cloud, Challenges, Issues with multimedia cloud.

I. INTRODUCTION

Cloud Computing is a large group of computing servers networked together to frees the user from the burden of owning large storage and computing powers [1] [2]. Cloud computing provides a dynamically scalable infrastructure of large pool of resources like computation, storage, networks, applications etc. connected via public or private networks to its clients through Software as a Service (SaaS), Infrastructure as a Service (IaaS), and Platform as a Service (PaaS) on pay per usage basis e.g., Amazon EC2, Google Apps, Salesforce, Amazon's S3, Windows Azure etc. [3]. This benefits the user by reducing computational cost, storage cost, software's licensing cost and application deployment cost etc. [4]. Cloud users can access services from cloud as they are owning a super computer with seamless storage and computing services. This helps by providing platform to users with minimum resources to deploy their applications over cloud.

But with the growing demand of multimedia files sharing, now 90 percent of the network traffic comprises of multimedia data as most of the data generated, stored, edited and shared through several mobile devices e.g. laptops, tablets, cameras, smart phones etc. is of type multimedia e.g., images, graphics, video/audio files etc. These types of rich media data and rich media applications can be stored, processed and edited at the cloud servers in distributed manner for cloud user's utilization. Because of limited computational power, storage capacity and battery life, mobile users needs to adapt cloud to maintain a tradeoff between computation and communication. So cloud computing has become a boon for mobile applications and services [5]. But multimedia data access, storage, sharing, editing, computation and transmission by millions of users via internet have rigid QoS and QoE requirements in terms of bandwidth, delay and jitter that would be a bottleneck for the ordinary cloud providers [6]. So general purpose cloud provider faces problem of unsatisfied users in terms of Quality-of-Service (QoS) and Quality-of-Experience (QoE) for media traffic [7]. In order to fulfill these needs cloud providers requires huge storage capacity, faster graphical processing units (GPUs), strong security aids, high speed network connectivity and longer battery life. Otherwise further requests from new clients will be rejected by the cloud server. This can create a bottleneck for the ordinary content delivery networks like YouTube etc. So rich media content's storage, processing and distribution while maintaining QoS and QoE are of major concern while designing multimedia cloud computing environment. Multimedia cloud can eliminate user from the burden of installation, maintenance and continual upgrades of expensive and heavy media software for accessing, editing and sharing multimedia data like images, videos, graphics, presentations etc. [3]. It also saves the battery life as all the computations are done remotely at cloud end.

In nutshell multimedia cloud service providers faces some security issues while cloud customer faces some service issues as most of the multimedia data stored in the cloud is highly sensitive for example sensor networks data, medical records, satellite data, personal photos and videos etc. According to [8] this can incorporates a major security issue with the expansion of cloud storage data centers for storing different types of multimedia files such as user's personal videos and photographs. Many ideas have been proposed to deal with the security issues related with media cloud storage, authentication, certification, encryption etc. in last few years. According to [9] there are five major

categories of security services: authentication, integrity, confidentiality, access control and non-repudiation. But most recent activities focuses more on the integrity of data. Some of the challenges [3] [10] faced by multimedia cloud providers while dealing with storage, accessing and processing of highly sensitive media data from the 3rd party cloud providers are as follows:-

A. Heterogeneity of multimedia services and contents

The media cloud should provide support for the different types of multimedia services and contents for several cloud users simultaneously such as multimedia streaming, photo sharing and editing, voice over IP (VoIP), video transcoding, image-based rendering, video conferencing, image search, multimedia content delivery etc.

B. Heterogeneity of QoS

Different types of multimedia data have different types of Quality of Service (QoS) requirements. So the media cloud provider have to provide support accordingly.

C. Heterogeneity of Networks

It is been a great challenge for the cloud provider to provide seamless services to various types of devices (e.g. mobiles, laptops, tablets etc.) connected via various types of networks (e.g. Internet, wireless LAN etc.) having distinguish network characteristics (e.g. bandwidth, delay and jitter).

D. Heterogeneity of Devices

The media cloud provider should adapt various kinds of devices, such as TVs, personal computers (PCs), tablets and mobile phones having different multimedia processing capabilities. Multimedia cloud providers should also be able to adapt different storage, computable and display devices like memory, GPUs, CPUs and power.

E. Security issue

Security is always a major issue for cloud providers as how users can be sure about the secrecy of their personal data, videos and photographs stored at a third party storage. Cloud provider can ensure secure storage and access of data through proper encryption techniques, authentication process and access control policies.

F. Consumption of Power

Power consumption has become a serious burden over energy resources and cloud providers with the growing scale and density of data centers and media traffic over the internet.

G. Inside Attacks

There are chances of stealing and phishing of media contents by the inside employees for misuse purpose.

H. Piracy and Legal Difficulties

There are no proper legal standards for multimedia clouds, as it's a new field. So it is always a risk for storing personal media contents outside the boundary.

I. Migration

As new clouds are launched day by day, but user does not have the freedom to shift all of his media contents to the new cloud even if his requirements changes. In other words migration is always a risky task for the cloud users.

J. Challenges over standards

Now several vendors are launching their private cloud environments. These environments are based upon their own conditions and security parameters. This can cause interoperability in near future.

In the following section we discuss about how multimedia contents can be supported by the existing cloud providers along with security and other issues. In further section we have concluded with future scope and proposal.

II. LITERATURE REVIEW

To our knowledge, very rare work exists on multimedia cloud computing. The related work presented in this section addresses security and other issues in multimedia cloud computing and how the QoS provisioning and support for multimedia computing can be provided in the cloud environment. A number of studies has shown the need of security in cloud computing especially for the multimedia content storage and the some proposed techniques exists to enhance security in cloud environment.

Warhekar et al. [11] discussed the gap between the PC and mobile devices as every mobile user is facing problems of limited computational power, battery life and storage capacity in terms of accessing rich media applications. According to them cloud computing can be used to cover this gap with the benefit of mobile connectivity and mobile devices. Through their proposed model they have shown the applicability of emerging cloud computing concepts for rich mobile multimedia applications. They have ensured the integrity and availability of media data along with user privacy and content security. They believe that their model can help users in accessing and managing effective multimedia contents like videos, images, audio file etc. across various devices even on basic smart phones. In order to illustrate effectiveness they have also compared and verified their results with mobile applications which are not using cloud.

Generally, multimedia computing over cloud is related with content delivery network (CDN), multimedia computing over grids, P2P multimedia computing and server based computing. More specifically, CDN addresses how to effectively deliver multimedia to the end user with less latency. Examples of CDN includes Amazon CloudFront, Akamai Technologies and Limelight networks. Youtube delivers videos with the help of Akamai's CDN. The infrastructure computing for multimedia from a high performance computing (HPC) aspects is addressed by multimedia computing over grids [12]. P2P multimedia computing architecture partitions all the multimedia workloads and computing tasks among the peers. That's why P2P multimedia computing follows a distributed computing architecture. Examples include PPlive, Coolstream and Skype. Server based multimedia computing deals with the desktop computing. For this clients only needs to interact with the servers and all multimedia computing is done by those set of servers [13]. Examples for this includes AT&T Virtual Network Computing and Microsoft Remote Display Protocol. Trajkovska et al. proposed a joint cloud-computing and P2P architecture realization with QoS cost functions for multimedia streaming [14].

Zhu et al. [3] presented a fundamental framework and concept for multimedia cloud computing. They presented multimedia cloud computing from cloud-aware multimedia and multimedia-aware cloud perspectives as depicted in Fig. 1. They have presented how QoS support, load balancing, storage and distributed parallel processing can be provided with the help of Media Edge Cloud (MEC) computing architecture and multimedia-aware cloud (media cloud) that includes CPUs, HDDs and GPUs. MEC is like Cloudlet of servers running at the edge of a bigger Cloud. On cloud aware multimedia (cloud media) they addressed how multimedia applications and services can optimally utilize cloud-computing resources, such as authoring and mashup, adaptation and delivery, sharing and storage and rendering and retrieval as shown if Fig. 1. It aims to fulfill user's request closer to the edge of the cloud and also reduces latency time. This architecture aims to improve QoS and QoE for multimedia services and applications. They found that QoS for media cloud, overlay network of media cloud, P2P cloud for multimedia services, media cloud security and transport protocol still needs more research.

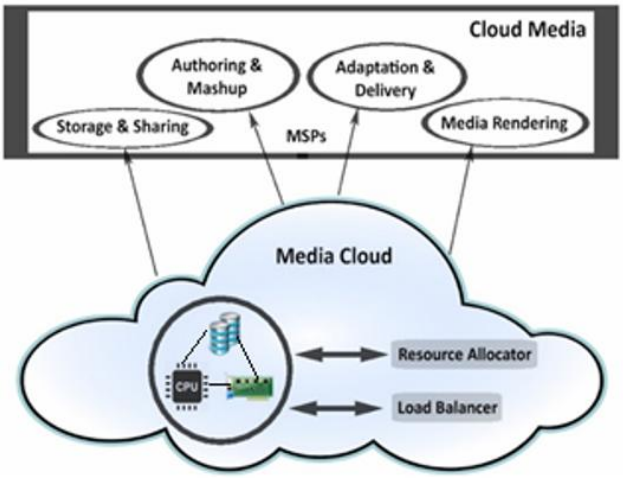

Fig. 1: Relationship between Media cloud and Cloud Media [3]

According to Kesavan et al. [15] Cloud offers many seamless applications and resources without any boundary. Now multimedia delivery, processing and management in distributed environment has become a great challenge for limited capacity devices. They have also discussed problems with controlling and processing of multimedia contents within the community. As a solution to this problem they have proposed an architecture of multimedia cloud with private controlled cloud that handles processing, storage and delivery of media contents among various authenticated clouders. This controlled private cloud of an organization can interact with other public cloud providers for services as shown in Fig. 2. They have also mentioned advantages of this architecture over existing solutions.

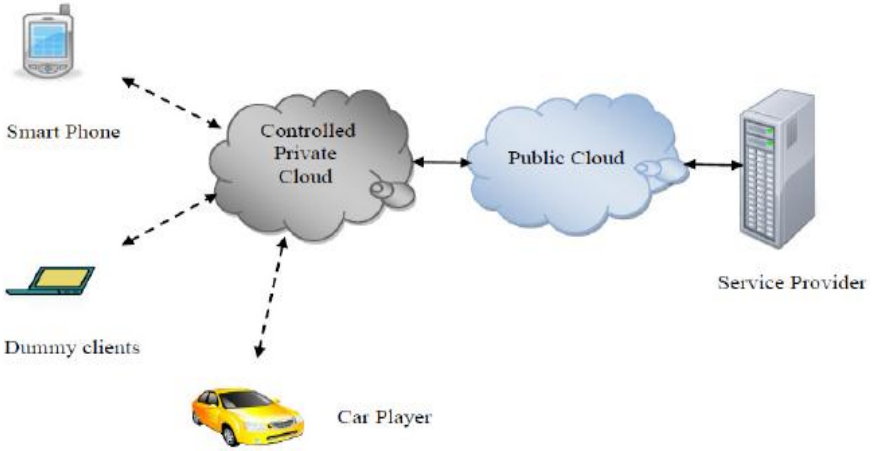

Fig. 2: Private Controlled Cloud [15]

Nagajyothi et al. [4] have considered that network congestion can occur due to user's mobility to various locations as user is still connected to its local cloud to access multimedia and other services. This can degrade the QoS for mobile users as different cloud providers are not having multiple cloud to service various geographical areas. They have proposed an analytical framework that can lead to improved QoS, better load management, reduced network congestion and also can provide better QoE on a global scale. Their approach is to provide an automated resource allocation and management mechanism that can efficiently move highly demanding services closer to the mobile user's location. They believe that this can reduce traffic loads due to multimedia streams. For their framework they have proposed a cloud storage system that will be able to provide scalable, robust, load-balanced and highly available services. The proposed system provide QoS as well as better QoE in distributed environment that makes it suitable for multimedia services such as video on demand etc. Furthermore, till now all research assumes that there is only one entity (the provider) that have all the control of a cloud. As a result sharing of resources is not done among different providers. This phenomenon can reduce the efficiency of cloud in future, as mobility and multimedia contents are becoming more and more popular. In case of mobility data stream have to travel long distances to reach mobile targets. One day Cloud providers may stuck in a situation where their resources will not be sufficient to fulfill the user's need. Then they have to create more cloud or borrow resources from other providers.

Huang et al. [8] have conducted an in-depth survey on storage security activities going on recently in cloud computing for multimedia data. They have focused on four key issues that are data confidentiality, data manipulation, data integrity and access control in encrypted domain. According to them to make whole cloud storage system secure, reliable and trustworthy for multimedia data it is essential for the cloud to be equipped with strong storage security solutions. Although many security solutions have been proposed for cloud storage but still there is no widely accepted model present that can be implemented. They feel that cloud storage system must be dynamic enough for making adaption of new cryptographic algorithms possible. They have also proposed many key solutions and ideas in their literature to deal with these issues and also have some suggested futuristic research areas. According to them security of multimedia data is cloud environment is still in its infancy.

Fernando et al. [16] have performed a detailed survey on mobile cloud computing. It is difficult to adopt because of the problems like frequent disconnections, resource scarcity and mobility. They have also discussed other issues in user's level and operational level as well. But still mobile cloud computing can become a dominant model in near future.

More users are accessing the Internet through mobile devices with the increase usage of smartphones, laptops and tablets etc. [17]. With the usage of cloud servers and storage the gap between the requirements and capabilities of mobile devices can be bridged with the benefit of mobile connectivity. Wang et al. [18] have looked at the trends, benefits and opportunities for new mobile multimedia services and applications. They have also analyzed challenges such as cost, response time, bandwidth, scalability etc. faced by cloud providers to make mobile cloud computing implementation possible. They have also addressed other major issues like security, privacy and energy consumption. They have addressed challenges in context of Cloud Mobile Gaming (CMG) to make multiplayers gaming possible for mobile users where the main challenge is that all the complex commands in response to games are executed on cloud servers and the resulting video has to be streamed back to the mobile. Their paper focuses on addressing these challenges. They have also proposed a dynamic adaption technique that through which complexity and richness of graphics rendering can vary depending on the network, device and cloud computing constraints.

Cerqueira et al. [19] said that in current era most of the contents shared, accessed and generated by mobile devices are of multimedia type. The main issues related with multimedia transactions are of low scalability, high congestion, low battery backup and poor user experience. They have discussed all recent research activities and issues related with human-centric multimedia mobile cloud computing. They found that while consuming and sharing multimedia contents, the modeling and understanding the user experiences, behaviors, psychological factors and feelings are key issues. They believe that this will optimize the usage of networks devices and also enriches the multimedia network environment with enhanced, powerful and cooperative features. This can result into better scalability, high processing and adaptability. This can also optimize the usage of devices/networks. According to them this model for multimedia applications, can become the dominant model in the near future.

Hefeeda et al. [20] have proposed a new design for cloud to provide rapid development, cost efficiency, elasticity and scalability for large scale multimedia content security systems. According to them their system can be used for the protection of various media contents like images, songs, audio clips, music clips and videos (2-D videos, 3-D videos). Their system can be used with public and/or private clouds. Their system support two novel components, first is the method requiring small storage to create signature of 3-D videos and second is a matching engine for various media objects. They have deployed it on their private cloud and on Amazon cloud and also have experimented it with 1 million images and 11,000 3-D videos to prove the accuracy and scalability of the proposed system. According to their results their system is better than the protection system used by the YouTube in terms of 3-D videos. So 3-D signature method can be of great effect, since 3-D video are not properly handled by the commercial systems.

Tekeoglu et al. [21] discussed about Chromecast, one of the HDMI device that can turns a larger screen into smart screen as streaming of multimedia applications is possible with cloud computing. Cloud videos can be streamed onto another big screen and control them with mobile-devices such as a tablet, smart-phone or a laptop as a remote. Many mobile operating systems and multimedia content providers (YouTube, Hulu, Netflix etc.) are providing support for multimedia streaming through Chromecast using Discovery and Launch (DIAL) protocol. Most of the content is encrypted by Chromecast but packets transmitted between cloud and the remote device are in clear text that are

vulnerable to session-hijacking or replay attacks. They have examined the packets exchanged between large screen and the remote device and investigated known protocols and vulnerabilities for Chromecast. Finally they have proposed a method to detect the existence of Chromecast behind a home-router.

According to Shini.S.G et al. [22] cloud forms an exchange platform for several healthcare organizations and can also be useful for storing and accessing medical records. So cloud has become baseline for several medical imaging applications. They have discussed about both positive and negative effects of cloud on data security. While exchanging the medical records they have highlighted various possible security attacks like Distributed Denial of Service attacks, Confidential Data Leakage, Data ownership, Access Control and Zero tolerance possible on cloud. They have also discussed that how these attacks can affect the cloud users. They have also discussed about present systems and their limitations.

According to Peerzada et al. [23] although cloud is the future of next generation IT enterprises but some security issues with cloud are massive traffic handling, service availability, application security and authentication. These issues can hamper the services provided by the cloud. They have focused on the secure access and storage of multimedia contents delivered by the content delivery cloud edge servers. They have discussed some encryption algorithms like DES, Blow Fish and control mechanism like CHAP. After this they have also suggested a hybrid algorithm for media content delivery from content delivery cloud edge servers. In future they will explore their research to justify their concept with implementation.

Gupta et al. [24] have proposed a framework for multimedia storage in cloud environment. They have explored a security method based on roll based access control mechanism with an encryption algorithm that is a combination of Tow-Fish and RSA algorithms (developed by Riverst, Shamir, Adleman) and a signature verification scheme to enhance security. In their framework the original media file is stored on the local server, the password for performing encryption/decryption is sent to the gmail account and the encrypted file-name with description is stored on the cloud server. Their scheme is more secure in comparison to previous as they have used combination of RSA and Two-Fish algorithms for encryption and decryption. They have proved their results by successfully uploading and storing various files (audio, video, text, image etc.) and by plotting graphs for accuracy, restriction time and download time.

Sharma et al. [25] has implemented a technique that can enhance the security of multimedia contents over the cloud. They have implemented a hybrid algorithm for multimedia contents' security based on the RSA and DES algorithms along with some authentication mechanism based upon the private keys. According to them their proposed scheme can also enhance the multilevel performance of the system and also provides security from unauthorized accesses as at every access different random private key is generated. Guleria et al. [26] also have adopted RSA and DES cryptographic algorithms for data optimization and security with some access control mechanism. In their scheme key is transported using RSA that is an asymmetric algorithm.

In their work Sandhu et al. [27] has fragmented the data onto different servers. By this intruder needs to fetch all the fragments in order to access the data. They have applied the DES cryptographic algorithm along with the MD5 security algorithm for security. Data is encrypted with DES algorithm before storage and user's authentication is checked before every access. Their method not only can identify malfunctioning servers but can also achieve the reliability, integrity and availability of securely coded data. Ali et al. [28] have proposed a framework to deal with the secure dissemination of documents as well as of secure media contents through cloud computing. For objects residing in the cloud their proposed model provides fine-grained continuous usage control constraints. It allows multimedia object's owners to specify their usage policies such as number of time the object can be used, duration of each use etc. By using DES a data security system in cloud computing is presented by Neha et al. in [29].

N.Saravanan et al. [30] have used RSA algorithm for cloud and also implemented it using cloud SQL in google App engine. Kaur et al. [31] have proposed to apply Advanced Encryption Standard (AES) algorithm and Elgamal algorithm to protect intellectual property of multimedia contents. According to Nithyabharathi et al. [32] a secure channel can be built for data transmission by applying encryption before storing the data and checking authentication before every access. They have favored to use RSA and AES cryptographic algorithm for this purpose.

III. CONCLUSION AND FUTURE WORK

This paper presented the fundamental concept of general purpose cloud computing environment along with different service models, deployment models and also the general security issues for cloud. After general purpose cloud introduction we have discussed fundamental concept of multimedia supported cloud computing environment. We have discussed the requirements and challenges of multimedia cloud computing for rich multimedia communication and computation as media is dominating the internet traffic in today's era. We have performed a survey on various architectures proposed for multimedia cloud computing. Security is always taken as a barrier for cloud adoption as how one can trust a third party for their personal images, videos and other secret data. We have discussed various security and other issues discovered from different authors in order to handle rich multimedia data like images, videos etc. by the cloud and the solutions or possibilities proposed by them.

Still there are many areas of research possible in multimedia cloud computing. For example QoS provisioning of media contents still needs more solutions. Besides to fulfill high demands of media contents, an advanced transport protocol, P2P cloud for fast access of media contents, media cloud security and dynamic load balancing algorithms also needs more investigation. Apart from all these an advanced encryption algorithm and authentication framework is most required for multimedia cloud computing. In our future work we will try to implement an advanced hybrid cryptographic algorithm at client end that can enhance security of multimedia data in cloud environment. Beside this we will also try to propose an authentication framework that can protect user's data from unauthorized accesses.

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