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QoS Provision in a Cloud-Based Multimedia Storage System

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ABSTRACT: Cloud computing is a relatively new trend in Information Technology, which is growing rapidly, that involves the provision of services, which we call them as resources, over a network such as the Internet. Mobile Computing is another area where mobile devices such as smartphones and tablets are believed to replace personal computers by combining network connectivity, mobility, and software functionality. In near future these devices will take over the traditional desktop and laptop devices and effortlessly switch between different network providers. To maintain network connectivity all the time different service handover mechanisms may be used so that user can access cloud services without interruption. But if user mobility is considered then as user is moving geographically to various locations with these mobile devices then he is connected to its local cloud to access the cloud services. Because of this mobility factor, network congestion may increase which causes degradation of QoS. And different Cloud providers are not in a position where they can easily build multiple Clouds to service different geographical areas like they do with services that run on individual servers. Hence, a new method for service delivery will take into account which will improve QoS in order to provide better QoE to the clients and better load management to the providers, as well as helps to reduce network congestion on a global scale. This paper gives a insight that as the demand for specific services increases in a location, it might be more efficient to move those services closer to that location Using an analytical framework. This will help to reduce high traffic loads due to multimedia streams and will offer service providers an automated resource allocation and management mechanism for their services.

KEYWORDS: Mobile computing, Web services, Communication system traffic control

I. INTRODUCTION

CLOUD COMPUTING refers to the delivery of computing resources over the Internet in which large groups of remote servers are networked to allow the centralized data storage, and online access to computer services or resources. Cloud services are made available to users on demand via internet from cloud provider's machines which we call them as servers. These servers are designed to provide easy, scalable access to applications, services and resources and are totally managed by cloud service providers. A cloud service provider offers some component of cloud computing typically Infrastructure as a Service (IaaS), Software as a Service (SaaS) or Platform as a Service (PaaS).

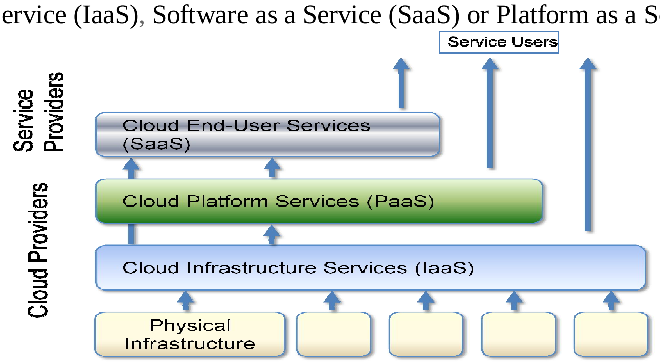

Fig1: Cloud Infrastructure

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- **Amazon Elastic Compute Cloud (EC2):** is a web service that provides resizable compute capacity in the cloud. It is designed to make web-scale cloud computing easier for developers and is simple web service interface which allows you to obtain and configure capacity with minimal friction. Amazon EC2 reduces the time required to obtain and boot new server instances to minutes, allowing you to quickly scale capacity, both up and down, as your computing requirements change. It changes the economics of computing by allowing you to pay only for capacity that you actually use[4].

- **iCloud:** is a cloud storage and cloud computing service from which allows users to store data such as music and iOS applications on remote computer servers for download to multiple devices. It also acts as a data syncing center for email, contacts, calendars, bookmarks, notes, reminders, iWork documents, photos and other data. The service also allows users to wirelessly back up their iOS devices to iCloud instead of manually doing so using iTunes[3].

Mobile devices (e.g., smartphone, tablet pcs, etc) are increasingly becoming an essential part of human life as the most effective and convenient communication tools not bounded by time and place and can access services through wireless network. Mobile Cloud Computing is a promising solution to bridge the widening gap between the mobile multimedia demand and the capability of mobile devices. [2] Thus, when it comes for data available in the form of videos Cloud allows its customer not only to access videos that are on demand but also application in the form of services to view and manipulate it[5].

This paper is based on Cloud Based Mobile Media Service delivery. In this, services are mainly populated on local clouds. As per the user's demand media services on local cloud have the capability of moving these services to the nearby clouds. This may result in less traffic congestion on network which results in improving QoS on the network and also providing better QoE to the clients.

II. RELATED WORK

Media-Edge Cloud (MEC) is recently proposed architecture which improves the performance of cloud technologies. This architecture aims to improve the QoS and Quality of Experience (QoE) for multimedia applications. This is achieved by a "Cloudlet" of servers running at the edge of a bigger Cloud. This architecture mainly handles requests closer to the edge of the Cloud and hence helps to reduce latency. If further processing is needed, then requests are sent to the inner Cloud, so the "Cloudlets" are reserved for QoS sensitive multimedia applications. This aims to divide the network hierarchy within the Cloud, in such a way that physical machines that are closer to the Cloud's outer boundaries will handle QoS sensitive services. Since these machines reside on the border of the Cloud, the data has to travel less distance within the Cloud before it is sent out to the clients. This not only improves QoE for clients but it also reduces network congestion within the Cloud.

But, this concept of MEC does not take into account user mobility, for improving cloud performance. Furthermore, all the research at present assumes that only one entity (the provider) is in control of a Cloud and as a result different providers cannot "share" resources in a manner that can improve the utilization efficiency of their hardware. This can potentially lead to problems in the future as mobility and multimedia-rich content becomes more popular and high bandwidth data streams will have to travel great distances and reach moving targets. Cloud providers may find themselves in situations where their hardware resources are not adequate and they may have to create more Clouds to handle the load and relieve network congestion.

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III. SYSTEM ARCHITECTURE AND IMPLEMENTATION

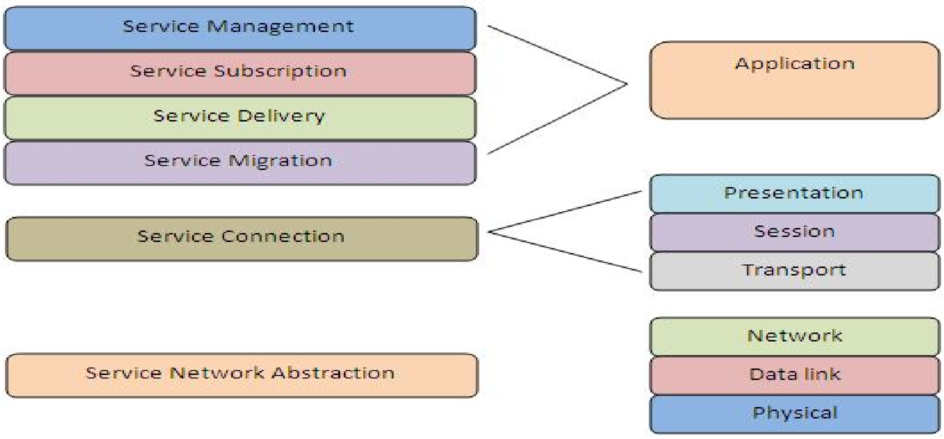

Fig2: Service Delivery Framework [1]

The Service Management Layer (SML): Deals with how services are registered in a Cloud. This also includes the overall Service and Security Level Agreement (SSLA) between the Cloud providers and the service providers and the unique Service ID.

The Service Subscription Layer (SSL): Deals with the subscription of clients to the service and holds information that handles the subscriptions such as User IDs, the list of services subscribed to by individual client and the associated client SLAs between clients and services.

The Service Delivery Layer (SDL): Is responsible for the delivery of services to individual clients. The layers below receive instructions from this layer with regard to connecting to individual clients as well as populating Clouds.

The Service Migration Layer (SMiL): Is responsible for the Migration of services between Clouds. It deals with resource allocation across Clouds to facilitate service population. It also holds the mechanism that performs the handover of client connections between services.

The Service Connection Layer (SCL): Monitors connections between clients and services. Some of this layer's functions map directly to the Session Layer in the OSI model.

Service Network Abstraction Layer (SNAL): Makes the network technology transparent to the upper layers in order to simplify and unify the process of migration. The function of this layer is to act as a common interface between the service delivery framework and the underlying network architecture such as IP overlay network or new technologies which divide the Internet into a Core network surrounded by Peripheral wireless networks.

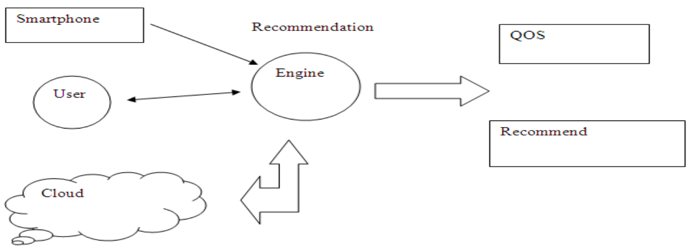

Fig 3: System Architecture

Implementation mechanism: In order to gather QoS data and know the network conditions in a specific area, we are using another mechanism that we call the QoS Monitor. It is considered to be part of the SCL and acquires such data by querying the clients for network conditions. The mechanism that we are assuming here that can resolve human-friendly service names to unique Service IDs. In the SDL we need mechanisms that will connect service subscribers to the correct instance of a service for service delivery purposes. A record of Service IDs and in which Clouds their instances are running and also uses input by the QoS Tracking are maintained by the Service Tracking and Resolution or STAR. STAR will make a decision on which Cloud is better suited to service a client request based on the location of the client, using this information. STAR achieve this functionality is by look up routing tables in order to identify which Cloud is closer to a user. Service delivery mechanism using STAR is shown in fig.2 Service to reject the new client and forward them to another Cloud if possible. This gives control to service providers and also becomes a contingency mechanism in case STAR makes a wrong decision. The STAR server can be scaled similarly to the DNS system since it is essentially the same type of service albeit with some extra parameters. Once a Cloud ID is found, then the ID is resolved into the IP addresses of the Cloud controllers that the client can contact to access the service. The process is shown in the Fig. 3. It should be noted that alternatively the Cloud ID can be returned to the client, at which point, the client will have a choice of which DNS to use to find the IP addresses[1].

IV. ANALYTICAL APPROACH

For the first, we define the time to prefetch blocks of data, which is given by:

$$T_{Prefetch}=L+C*p \qquad \text{eq. (1)}$$

In this equation, L is the network latency and C is the per block time of copying data between the in-cache memory and network buffers. Ideally should be at least equal to the number of blocks required to display a video frame of data. On a lightly loaded wired network we can consider these values constant for each link. However, in a mobile environment, changes as the client moves and the number of network links increase. We can express L as follows:

$$L=F_{n,s,\theta}+F_{cloud}+F_{Protocol} \qquad \text{eq. (2)}$$

Where, ($F_{n,s,\theta)}$ is the latency incurred by the number of links(n) between client and service, the network bandwidth on each link (S_i) and the network load on each link (θ_i), Fcloud is the Cloud latency caused by the network topology and hierarchy within the Cloud $F_{protocol}$ is the latency caused by the transport protocol. If the time to prefetch blocks is larger than the time it takes for the device to consume them, then we have jitter. This can be expressed as:

$$T_{prefetch}(p)\geq T_{cpu}*p \qquad \text{eq. (3)}$$

Where, (T_{cpu}) the time it takes for a device to consume a number of blocks by playing them as audio and video frames. (T_{cpu}) is therefore dependent on the type of video being displayed and the hardware capabilities of the mobile device. We now substitute for $T_{prefetch}$ in (3) with the expressions in (1) and (2). Rearranging, we get:

$$F_{n,s,\theta}+F_{cloud}+F_{Protocol}\geq(T_{cpu}-C)*p$$

Exploring network latency in detail, for each link we have transmission delay and queuing delay. Therefore, the total network latency will be the sum of the latencies for each link between client and service. Hence, we can express as:

$$F_{n,s,\theta}=\Sigma(D_{ti}+Q_i)$$

If we denote the transport block size as b, then the time to transmit p blocks over a link is equal to the number of blocks multiplied by the block size and divided by the bandwidth of the link.

$$F_{n,s,\theta}=\Sigma((p*b)/S_i+Q_i)$$

So, we have, $F_{cloud}+F_{Protocol}+\Sigma((p*b)/S_i+Q_i)\geq (T_{cpu}-C)*p$

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On a lightly loaded system, we consider $F_{protocol}$, F_{cloud} and Q_i to be negligible
.

$$\Sigma(b/S_i))\geq (T_{cpu}\text{-}C)$$

Let be the soft limit that we are aiming for in order to prevent jitter and S_L is the migration time.

$$H_L\text{-}S_L\text{=}a_tM_t$$

Where, a_t is the rate of network latency increase as the number of network links increases. We can calculate al at the mobile device and we can also find Mt between two Clouds. H_L is given by the mobile device, so we can calculate to S_L find where to set out QoS trigger for service migration. We can visualized how the increasing number of links between a user and a service can bring the connection near the QoS limit and how we can use a soft limit to trigger service migration in order to prevent this. We can also see that for a given migration time, we need to adjust S_L so that during the migration the QoS will not reach the H_L[1].

V. CONCLUSION

In this paper, we studied the challenges which are faced by the mobile user in future networks. The service delivery models which are used currently are not that much sufficient and not consider the needs of mobile user in future. A cloud storage system was proposed in order to provide robust, scalable, highly available and load-balanced services. In the meantime, the system also needs to provide quality of service provision for multimedia applications and services. The proposed system achieves the QoS in distributed environment which make the proposed system especially suitable to the video on demand service. It often provides different service quality to users with various types of devices and network bandwidth. We believe that our implementation will provide the better quality of service (QoS) as well as better quality of experience (QoE) to the user.

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BIOGRAPHY

Minal Padwal is pursuing her M.E.(Master of Engineering) degree from Savitribai Phule Vidyapith (Pune University) with special interest in Mobile Media Environment in Cloud Computing, Artificial Intelligence, Big Data under the guidance of Mrs. Manjushri Mahajan having expertise in Cloud Computing, Artificial Intelligence and Linux Programming.