IJARCCE
ISSN (Online) 2278-1021
ISSN (Print) 2319 5940
International Journal of Advanced Research in Computer and Communication Engineering
ISO 3297:2007 Certified
Vol. 6, Issue 11, November 2017

An Novel Approach of Video Resource Delivery for CD Networks

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Abstract: Content Delivery Networks (CDNs) have been widely implemented to provide scalable cloud services. Such networks support resource pooling by allowing virtual machines or physical servers to be dynamically activated and deactivated according to current user demand. Significant portion of today's internet traffic emerge from multimedia services. When coupled with growth in number of users accessing these services, there is tremendous increase in network traffic. CDNs aid in handling this traffic and offer reliable services by distributing content across different locations. The concept of virtualization transformed traditional data centers into flexible cloud infrastructure. With the advent of cloud computing technology, multimedia providers have scope for establishing CDN using network operator's cloud environment. However, the main challenge while establishing such CDN is implementing a cost efficient and dynamic mechanism which guarantees good service quality to users. This thesis aims to develop, implement and assess the performance of a model that coordinates deployment of virtual servers in the cloud. A solution, which dynamically spawns and releases virtual servers according to variations in user demand has been proposed. Cost-based heuristic algorithm is presented for deciding the placement of virtual servers in OpenStack based federated clouds. Further, the proposed model is implemented on XIFI cloud and its performance is measured. Results of the performance study indicate that virtual CDNs offer reliable and prompt services. With virtual CDNs, multimedia providers can regulate expenses and have greater level of flexibility for customizing the virtual servers deployed at different locations.

Keywords: Content Delivery Networks, Resource Management, Video Streaming.

I. INTRODUCTION

This chapter initially describes how multimedia streaming has evolved over the Internet. Section 1.2 and 1.3 describe why Content Distribution Networks are needed and how they are important for distributing content.

1.1 Evolution of multimedia over the Internet

The most significant impact of technology on communications can be accounted to the advancement of the Internet. Ever since its initiation, information dissemination over computer networks increased remarkably and it has become the source of information for millions of users. The user demand for information exchange increased dramatically with the addition of World Wide Web (WWW) an information sharing model built on top of the internet. At the initial stages, the Internet was accessed primarily via dial-up. But in the course of time, rise in consumer and enterprise demand for high-speed access prompted the development of broadband technology. With the accelerated pace of development in broadband, much of the text-based communication is replaced by multimedia and the era of streaming audio and video has begun. Modern multimedia services have become an indispensable part of our personal and professional lives and it is feasible to access content across the globe due to the widespread adoption of broadband technology [1]. Increased adoption and use of broadband made multimedia services available to users at affordable prices. In the recent times, growth in Internet traffic can be seen as a consequence of increase of user demand for videos. Significant portion of online services distribute web based standard-definition videos as well as high-definition videos by leveraging the immense availability of broadband access. The modern services available these days use unicast transmission techniques that enable users to view selected videos from large repositories. In the year 2014, it was estimated that around 64 percent of global consumer Internet traffic emerged solely from the videos and according to a forecast by Cisco, the video traffic is expected to account up to 80 percent by 2019 [2],[3].

1.2 Need for Content Delivery Networks

Multimedia providers use web as a medium to deliver rich multimedia content to their users and earn significant financial incentives from the web-based services. Users from multiple geographic locations expect fast and reliable content access, with high availability. The challenges faced by multimedia providers turn critical with expanding number of users. Multimedia providers find their servers swamped by the huge demands from large number of users. At the same time, distant users who are located far away from the servers are likely to experience flaws in the services due to increased latency and jitter. Degraded service with high access delays and long download times causes annoyance to users [4]. As a result, multimedia providers encounter the challenge of delivering optimized video content

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to various users while ensuring high-speed access and superior experience. Multimedia providers are concerned with improving their service quality in order to reinforce their reputation. They have to focus on improving the experience of users from around the globe. In order to address all these issues, multimedia providers need a system of servers networked across the Internet for distributing their video content. Such interconnected network of servers is often referred to as the Content Distribution Network or Content Delivery Network[4]. Servers in a CDN cooperate transparently while delivering content to users. The statistics provided by Cisco illustrates the rapid expansion of CDNs. In the year 2014, it was estimated that around 57 percent of global internet video traffic traversed CDNs. Cisco further forecasted that by the year 2019, almost 72 percent of all internet video traffic will cross CDNs and more than half of overall Internet video traffic will be delivered by CDNs[2]. Other than online video providers, typical consumers of CDN services are music retailers, Internet advertisement companies, Internet service providers, mobile operators and consumer goods manufacturers [4].

1.3 Significance of Content Delivery Networks

The network of servers deployed for distributing content conforming to the requirements of fast delivery and high bandwidth is called a CDN. Typically, a CDN consists of numerous edge servers, also called surrogate servers across wide geographic locations. These surrogate servers present at various locations act on behalf of the origin server of the multimedia provider to deliver content to users. This mechanism especially aided in reducing the issue of overloading origin server with large number of requests.

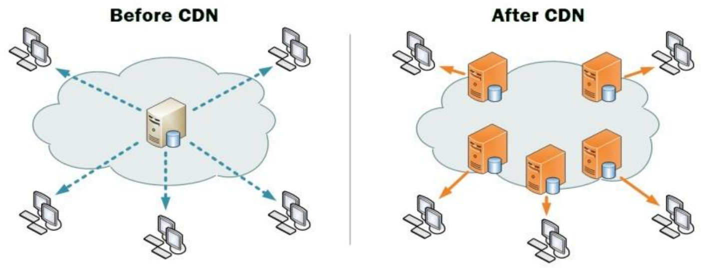

Fig 1. Content delivery methods before and after introduction of CDNs

Figure 1 presents content delivery methods before the introduction of CDNs and depicts how surrogate servers of a CDN offload requests from origin server. Moreover, the user experience is enhanced by addressing the requests locally[4].In practice, surrogate servers of CDNs typically host wide range of static content ranging from images to high definition videos. CDNs have the following features [4],[5]:

a) **Reliability**

With the availability of wide spread surrogate servers, a CDN helps in building a fault tolerant network. CDNs usually employ efficient load balancing mechanisms to perform seamlessly in case of service outages at any location. This helps a service to recover soon and resume its normal operations.

b) **Low latency**

CDNs help in off-loading the origin server. A website can have users from any part of the world and requests from these users need not be handled by the origin server, which might be situated far away from users. Instead, these requests can be addressed locally from surrogate servers of CDN. This particularly helps in serving content quickly as the travel time for request is less, giving rise to minimum latency. Limited latency helps in achieving reliable and steady performance.

c) **Scalability**

Scalability refers to the ability of a system to expand for handling large number of users and their requests, without any significant downgrade in performance. CDNs have provision for scaling resources, providing ability for system expansion. Resource scaling is especially important for flawless performance of system while handling variable demand from users.

d) **Request redirection**

CDNs have the capability to redirect user requests to a suitable server, which is situated close to the users. Request redirection mechanism helps in bypassing congestion and minimizing the delay while accessing content.

e) **Security**

CDNs can deliver security solutions for highly valued and confidential content. These security solutions facilitate CDNs to defend against denial of service attacks and restrict malicious activities from disrupting the services. Whooping surge in multimedia access over Internet prompted multimedia providers to start incorporating CDNs for improving their media delivery and meeting the needs of expanding users[6].

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II. EXISTING SYSTEM

Servers in the VHO serve VoD using unicast, while Live TV is typically multicast from servers using IP Multicast. When users change channels while watching live TV, we need to provide additional functionality so that the channel change takes effect quickly. For each channel change, the user has to join the multicast group associated with the channel, and wait for enough data to be buffered before the video is displayed; this can take some time. As a result, there have been many attempts to support instant channel change by mitigating the user perceived channel switching latency

Limitations:

- More Waiting Time
- More Switching latency
- Not Cost effective

III. PROPOSED SYSTEM

We propose a) To use a cloud computing infrastructure with virtualization to handle the combined workload of multiple services flexibly and dynamically, b) To either advance or delay one service when we anticipate a change in the workload of another service, and c) To provide a general optimization framework for computing the amount of resources to support multiple services without missing the deadline for any service. We consider two potential strategies for serving VoD requests. The first strategy is a postponement based strategy. In this strategy, we assume that each chunk for VoD has a deadline seconds after the request for that chunk. This would let the user play the content up to seconds after the request. The second strategy is an advancement based strategy. In this strategy, we assume that requests for all chunks in the VoD content are made when the user requests the content. Since all chunks are requested at the start, the deadline for each chunk is different with the first chunk having deadline of zero, the second chunk having deadline of one and so on. With this request pattern, the server can potentially deliver huge amount of content for the user in the same time instant violating downlink bandwidth constraint

Heuristic algorithm for monitoring virtual CDN

Virtual CDN controller makes all the decisions regarding the caching proxies using a heuristic algorithm. The goal of this algorithm is to spawn and turn off caching proxies in response to varying user demand, so that the overall expenditure is minimized while satisfying user requirements. Various heuristics are set for estimating the size of caching proxy and deciding its placement location. This algorithm spawns or shutdowns virtual proxies based on percentage of user demand from a cluster.

The objectives of this algorithm are estimating number of proxies required, deciding the placement location of proxies, spawning proxies, redirecting users to proxies and shutting down some of the proxies when demand decreases.

Algorithm 1 : Heuristic Algorithm

Require: Cost function, Percentage of demand from user cluster, Tenant account credentials

Input: Q, SM, α, β1, β2, Ω1, Ω2, μO,U,μP1,U,μP2,U, μO,P1, μO,P2
for Demand **do**
U ← number of current users
if already proxies exist **then**
M ← maximum users handled by existing surrogates
5. end if
N← Difference (U,M)
if N > 0 **then**
nΩ ← Estimate number of proxies based on N
for each proxy **do**
if resources exist **then**
Estimate δ_O for N users

ϵ_1 ←Cost function ($Q, S_M, \alpha, \beta_1, \mu_{O,U}, \mu_{P1,U}, \mu_{O,P1}$)
ϵ_2 ← Cost function ($Q, S_M, \alpha, \beta_2, \Omega_2, \mu_{O,U}, \mu_{P2,U}, \mu_{O,P2}$)
if ($\varepsilon_1 < \delta_O$) or ($\varepsilon_2 < \delta_O$) **then**
P ← minimum ($\varepsilon_1, \varepsilon_2$)
Spawn new proxy at P and update database
Redirect users
else ($\varepsilon_1, \varepsilon_2 > \delta_O$) **then**
Stream from origin server

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20. end if
21. **else** no resources **then**
Stream from origin server
23. end if
24. end for
5. **else** decrement in users **then**
6. Estimate proxies to shutdown
7. Shutdown proxies and update database
28. end if
29. end for

Based on the percentage of demand, current number of users from a cluster are estimated (step 2). In case there are pre-existing proxies at any node, the total number of users served by all the proxies are calculated (step 4). The increment or decrement in users is calculated by finding the difference between current users and maximum users served by all proxies (step 6). When there is an increment, set of conditions are checked to spawn new caching proxies (steps 7 to 16) and in case of decrement, proxies are shut down considering hysteresis (steps 25 to 28).

IV. EXPERIMENTAL RESULTS

Fig2 Home page

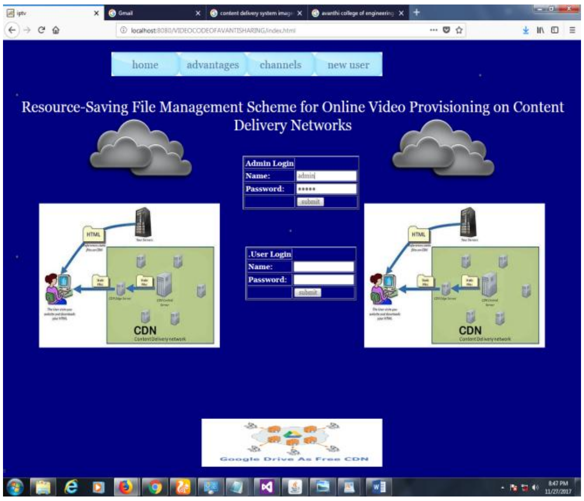

Fig3 Admin login

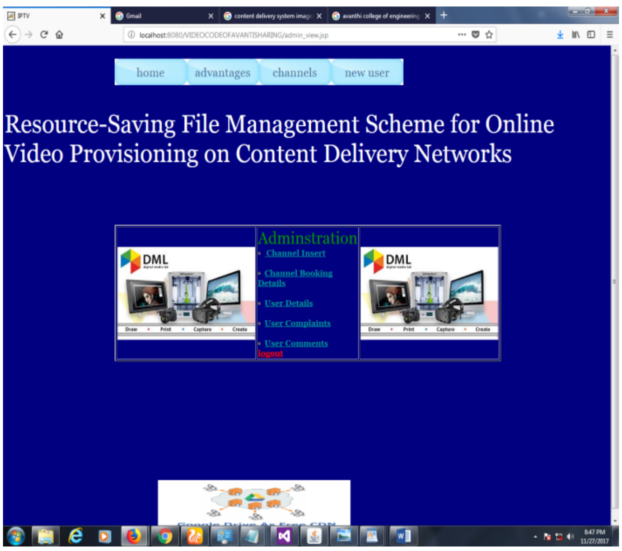

Fig 4 Admin home page

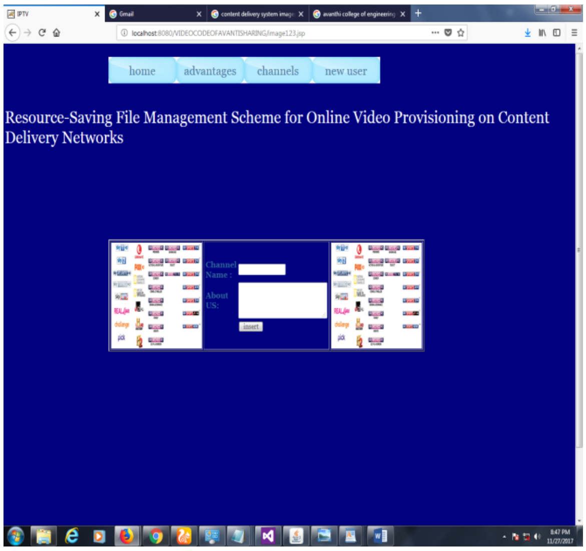

Fig 5 Channel insert page

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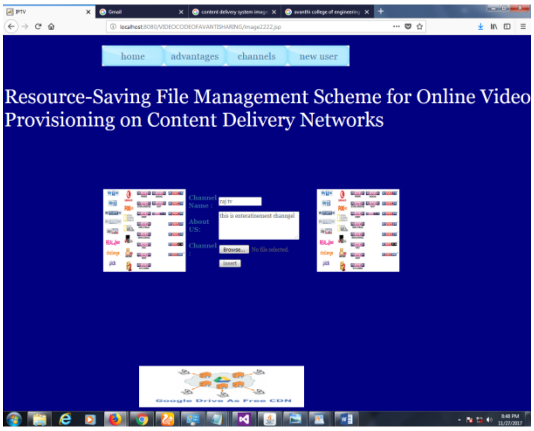

Fig 6 Upload the video for channel

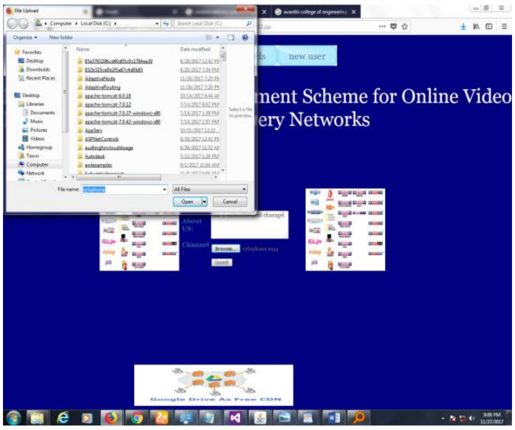

Fig 7 Adding video to channel

Fig 8 Channel booking details

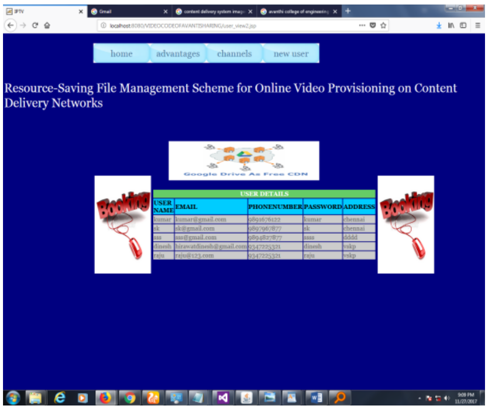

Fig 9 User details

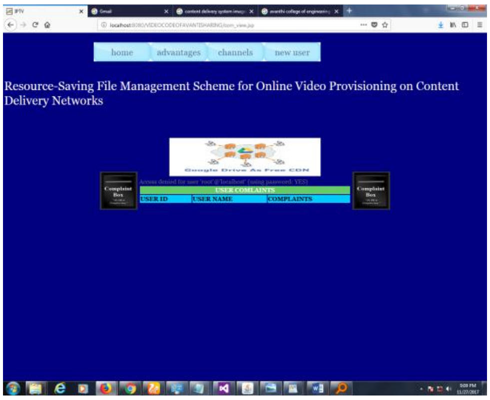

Fig 10 User compaints view

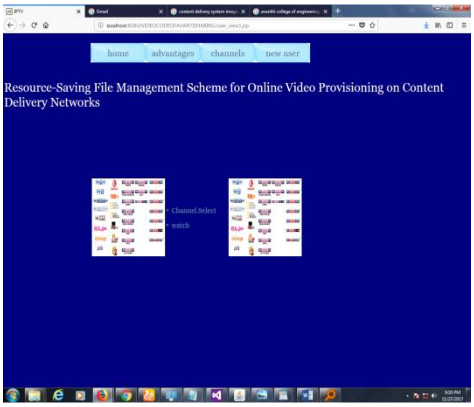

Fig 11 User home page

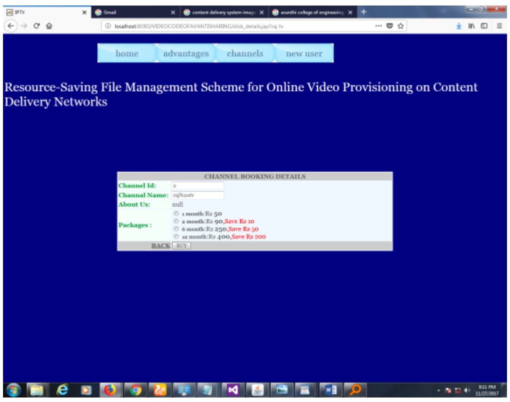

Fig 12 Channel booking

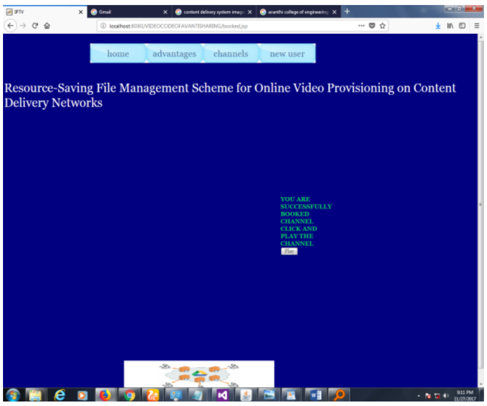

Fig 13 Booking confirmations

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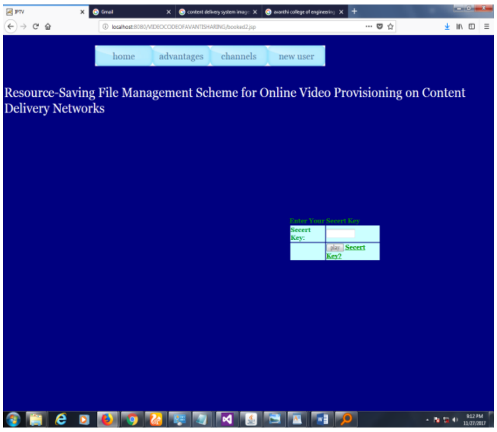

Fig 14 Scrent key to activate

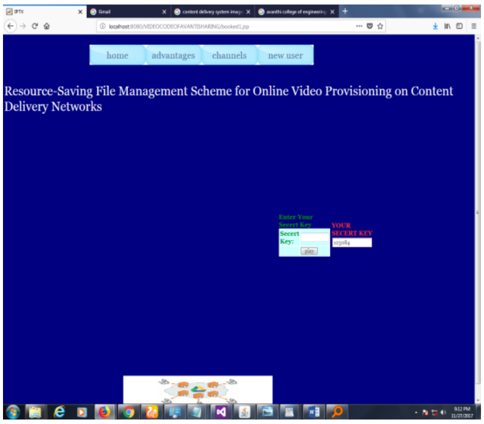

Fig 15 of user Activation

V. CONCLUSION

The performance study included measurement of service quality using metrics which haven't been effectively measured in the field of cloud based CDNs. Results of the performance study indicate that cloud based CDNs offer reliable and prompt service. Analysis of the results obtained from various experiments helped in understanding the reason for variations in CDN service at different locations. In general, the experimental results presented here indicate that spawning virtual caching proxies is an elegant solution to address user requests within short duration. For example, the CDN operational latency was 28.12 seconds when a large size caching proxy was spawn (results from Volos). This may benefit multimedia provider in quickly spawning a cache node in the network operator's cloud and handle large number of connections from users especially during holiday season or weekend.

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BIOGRAPHIES

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