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User Adaptive Mobile Video Streaming and User Behavior Oriented Video Pre-Fetching In Cloud

V.Venugopal, Mrs.R.Revathi

M.E.Network Engg, Dept of IT, Dhanalakshmi Srinivasan Engineering College, Perambalur, India.

Associate prof, Dept of IT, Dhanalakshmi Srinivasan Engineering College, Perambalur,India.

Abstract— With exponential increase in the effective video streaming in mobile network.There is an increasing need for optimizing the quality of video delivery along mobile network. Exist result shows the poor service quality of video streaming over mobile network such long buffering time and interrupt happen in the streaming video. We propose a new mobile video streaming method using cloud. In cloud we use user-Adaptive Mobile Video Streaming (AMoS) and the User Behavior Oriented Video Pre-Fetching (UBoP). We create private agent for video distribution process. It adjusts her streaming and reduces the traffic using SVC.It shows the social interaction between the mobile users. Video quality based on feedback of link quality. Result shows that the cloud can effectively provide the video streaming and video sharing on network. Efficient perfecting video content done in cloud. Prefetching done based on user resolution and bandwidth.

Keywords— cloud computing, video cloud, video base, scalable video coding.

I. INTRODUCTION

Over the past decade, increasingly more traffic is accounted by video streaming and downloading. In particular, video streaming services over mobile networks have become prevalent over the past few years . While the video streaming is not so challenging in wired networks, mobile networks have been suffering from video traffic transmissions over scarce bandwidth of wireless links. Despite network operators' desperate efforts to enhance the wireless link bandwidth, soaring video traffic demands from mobile users are rapidly overwhelming the wireless link capacity.While receiving video streaming traffic via 3G/4G mobile networks, mobile users often suffer from long buffering time and intermittent disruptions due to the limited bandwidth and link condition fluctuation caused by multi-path fading and user mobility . Thus, it is crucial to improve the service quality of mobile video streaming while using the networking and computing resources efficiently.

Scalable video coding and adaptive streaming techniques can be jointly combined to accomplish
Effectively the best possible quality of video streaming services. That is, we can dynamically adjust the number of SVC layers depending on the current link status.
However most of the proposals seeking to jointly utilize the video scalability and adaptability rely on the active control on the server side. That is, every mobile user needs to individually report the transmission status (e.g., packet loss, delay and signal quality) periodically to the server, which predicts the available bandwidth for each user. Thus the problem is that the server should take over the substantial processing overhead, as the number of users increases. Recently social network services (SNSs) have been increasingly popular. There have been proposals to improve the quality of content delivery using SNSs . In SNSs, users may share, comment or re-post videos among friends and members in the same group, which implies a user may watch a video that her friends have recommended . Users in SNSs can also follow famous and popular users based on their interests (e.g., an official facebook or twitter account that shares the newest pop music videos), which is likely to be watched by its followers.

In this paper, we design a adaptive video streaming and perfecting framework for mobile users with the above objectives in mind, dubbed in Cloud. Constructs a private agent for each mobile user in cloud computing environments, which is used by its two main parts: adaptive mobile video streaming, and social video sharing. The contributions of this paper can be summarized as follows:

- AMoS offers the best possible streaming experiences by adaptively controlling the streaming bit rate depending on the fluctuation of the link quality.
- The private agent of a user keeps track of the feedback information on the link status. Private agents of users are dynamically initiated and optimized in the cloud computing platform.
- Cloud supports distributing video streams efficiently by facilitating a 2-tier structure: the first tier is a content delivery network, and the second tier is a data center.With this structure, video sharing can be optimized within the cloud.
- Based on the analysis of the SNS activities of mobile users, UBoP seeks to provide a user with instant playing of video clips by perfecting the video clips in advance from her private agent to the local storage of her device.
- The strength of the social links between users and the history of various social activities can probabilistically determine how mucand which video will be perfected.

II.LITERATURE REVIEW

In the adaptive streaming, the video traffic rate is adjusted on the fly so that a user can experience the maximum possible video quality based on his or her link's time-varying bandwidth capacity [2]. There are mainly two types of adaptive streaming techniques, depending on whether the adaptivity is controlled by the client or the server. The Microsoft's Smooth Streaming [27] is a live bit rate segments encoded with configurable bit rates and video resolutions at servers, while clients dynamically request videos based on local monitoring of link quality. Adobe and streaming solutions operating in the similar manner. There are also some similar adaptive streaming services where servers controls the adaptive transmission of video segments, for example, the QuavliveAdaptive Streaming. However, most of these solutions maintain multiple copies of the video content with different bit rates, which brings huge burden of storage on the server.

Regarding rate adaptation controlling techniques, TCPfriendly rate control methods for streaming services over mobile networks are proposed [28], [29], where TCP throughput of a flow is predicted as a function of packet loss rate, round trip time, and packet size. Considering the estimated throughput, the bit rate of the streaming traffic can be adjusted. A rate adaptation algorithm for conversational 3G video streaming is introduced by [30]. Then, a few cross-layer adaptation techniques are discussed [31], [32], which can acquire more accurate information of link quality so that the rate adaptation can be more accurately made. However, the servers have to always control and thus suffer from large workload.

Recently the H.264 Scalable Video Coding (SVC) technique has gained a momentum [10]. An adaptive video streaming system based on SVC is deployed in [9], which studies the real-time SVC decoding and encoding at PC servers. The work in [12] proposes a quality-oriented scalable video delivery using SVC, but it is only tested in a simulated LTE Network. Regarding the encoding performance of SVC, Cloud Stream mainly proposes to deliver high-quality streaming videos through a cloud-based SVC proxy [20], which discovered that the cloud computing can significantly improve the performance of SVC coding. The above studies motivate us to use SVC for video streaming on top of cloud computing. The cloud computing has been well positioned to provide video streaming services, especially in the wired Internet because of its scalability and capability[7]. Extending the cloud computing-based services to mobile environments requires more factors to consider: wireless link dynamics, user mobility, the limited capability of mobile devices [20]. More recently, new designs for users on top of mobile cloud computing environments are proposed, which virtualized private agents that are in charge of satisfying the requirements (e.g.QoS) of individual users such as Stratus [11] and Cloudlets[10]. Thus, we are motivated to design the AMVSC framework by using virtual a gents in the cloud to provide adaptive video streaming services.

III.FRAMEWORK OF CLOUD-UABOP

We will investigate and address the emerging techniques for cloud-UABOP, which construct private agents for active mobile users in the cloud, in order to offer "non-terminating" and "non-buffering" mobile video streaming service. Mobile Private agents are elastically initiated and optimized in the cloud platform. Also the real-time SVC coding is done on the cloud side efficiently. The proposed framework leverages the SVC technique, and offers the scalable and adaptive streaming experiences by controlling the combination of video streams (layers) depending on the feedback of the fluctuating link quality from mobile users. Also based on the analysis of the SNS activities of mobile users, the proposed framework seeks to prefetch the video clips in advance from user's private agent to the local storage of the device. The strength of the social links between users and the history of various social activities can determine how much and which video will be prefetched we first explain the cloud agent framework and give details of our proposal on adaptive video streaming and social-aware prefetching. Then the brief video delivery procedure is shown, and we discuss the performance evaluation of our proposal as well. The conclusion of the article is presented in the end.

As shown in Fig. 1, the whole video storing and streaming system in the cloud is called the Video Cloud (VC). In the VC, there is a large-scale Video Base (VB), which stores most of the popular video clips from the video service providers (VSPs). A temporary Video Base (tempVB) is used to cache new candidates for the popular videos. The VC also keeps running a collector to seek popular videos from the VSPs, and re-encode the collected videos into SVC format and Store into tempVB first. Specialized for each active mobile user, a sub-Video Cloud (subVC) is created dynamically once there is any video streaming demand from the mobile user. Each sub-VC has a sub-Video Base (subVB), which stores the recently fetched video segments. Note that the video deliveries among the subVCs and the VC in many cases are actually not "copy," but just "link" operations of the same file eternally within one cloud data center; even in other cases that videos are copied from one data center to another, it will be very fast . There is also an encoding function in subVC (actually a smaller-scale encoder instance of the encoder in VC), and if the mobile user demands a new video that is not in the subVB or in the VB, the subVC will fetch, encode and transfer the video. During the video streaming, mobile users will always periodically report link conditions to their corresponding

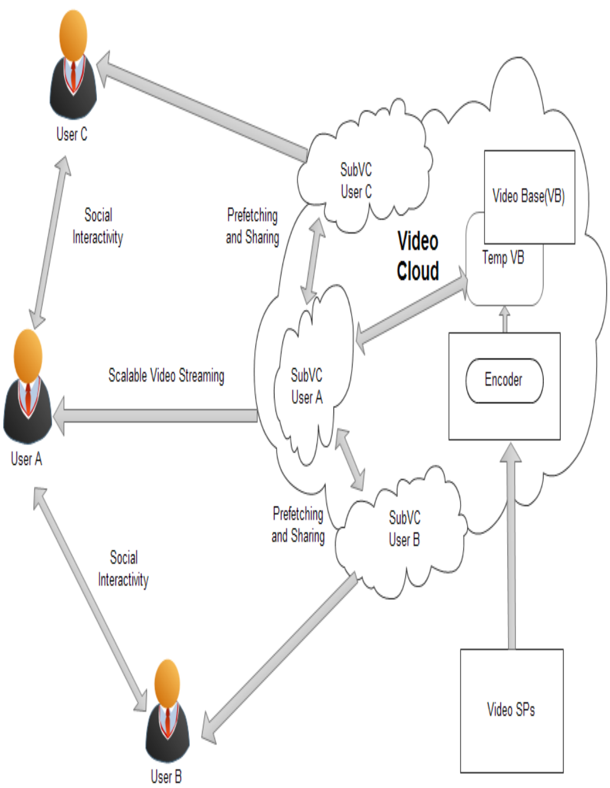

Fig.1 System model

subVCs, and then the subVCs make prediction of the available bandwidth of next time window and adjust the combination of BL and ELs adaptively. Each mobile device also has a temporary caching storage, which is called local-Video Base (localVB),and is used for buffering and prefetching.

IV.USER-ADAPTIVE MOBILE VIDEO STREAMING

Adaptive streaming offers the best possible streaming experiences by adaptively controlling the streaming bit rate depending on the fluctuation of the link quality. AMoS adjusts the bit rate for each user leveraging the scalable video coding. The private agent of a user keeps track of the feedback information on the link status. Private agents of users are dynamically initiated and optimized in the cloud computing platform. Also the real-time SVC coding is done on the cloud computing side efficiently. The video traffic rate is adjusted on the fly so that a user can experience the maximum possible video quality based on his or her link's time-varying bandwidth capacity. Some similar adaptive streaming services where servers controls the adaptive transmission of video segments. most of these solutions maintain multiple copies of the video content with different bit rates, which brings huge burden of storage on the server. a combination of the three lowest scalability is called the Base Layer (BL) while the enhanced combinations are called Enhancement Layers (ELs). To this regard, if BL is guaranteed to be delivered, while more ELs can be also obtained when the link can afford, a better video quality can be expected. The link quality monitor at mobile client keeps tracking on metrics including signal strength, packet round-trip-time (RTT), jitter and packet loss with a certain duty cycle. And the client will periodically report to the subVC.

Construct AMoS Private Agent and sharing

In the adaptive streaming, each user directly given request to the cloud server. After given request the private agent to create and transmit to the user. Each and every user to have the own private agent. The scalable video coding method used for data transmission with encryption and decryption process. Temp VB use to maintain and new user in the system. Video cloud use to store the all prefetch video in the database.

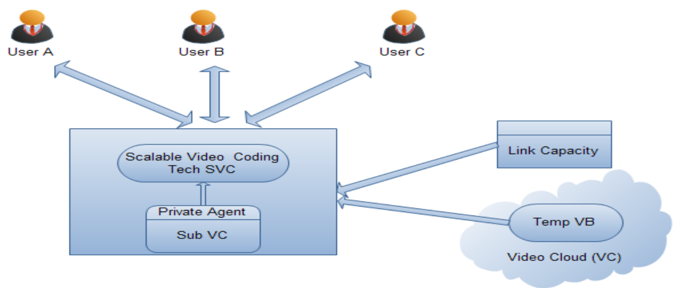

Fig.2 Create sub VC,VC and VB in AMoV

V.USER- BEHAVIOR ORIENTED VIDEO PRE-FETCHING

There are various types of social activities among users in SNSs, such as direct message and public posting. For spreading videos in SNSs, one can post a video in the public, and his/her subscribers can quickly see it; one can also directly recommend a video to specified friend(s); furthermore one can periodically get noticed by subscribed content publisher for new or popular videos.

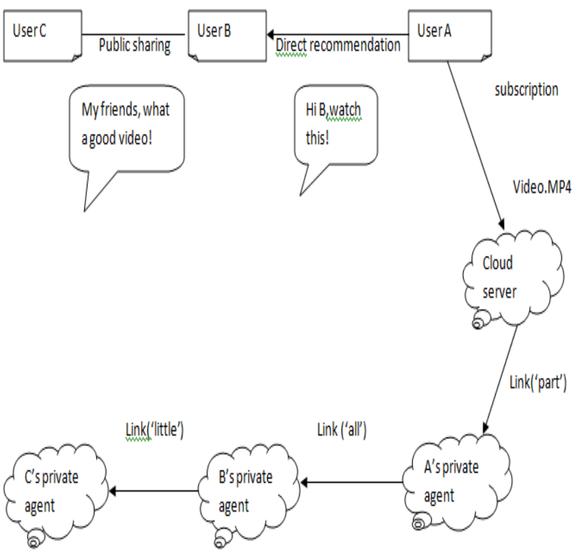

Fig.3 Behavior oriented sharing

we define different strength levels for those social activities to indicate the probability that the video shared by one user may be watched by the receivers of the one's.by one user may be watched by the receivers of the one's one's sharing activities, which is called a "hitting probability", so that subVCs can carry out effective background prefetching. One's sharing activities, which is called a "hitting probability", so that subVCs can carry out effective background prefetching at subVB and even localVB. The amount of prefetched segments is mainly determined by the strength of the social activities. And the prefetching from VC to subVC only refers to the "linking" action, so there is only file locating and linking operations with tiny delays; the prefetching from subVC to localVB also depends on the strength of the social activities, but will also consider the wireless link status.

A. Create private agent and sharing

In social network method group of user directly get the video to the server with use of private agent and also to get video between the user's in the group. If any user to have the video means first to search the video in the group and get the video link from same group users. If user to get the video from the group means not go to the video server, so to avoided the traffic between the user and server. Service provider to provide the video to the cloud VB. We classify the social activities in current popular SNSs into three kinds

- Subscription
- Direct recommendation
- Public sharing

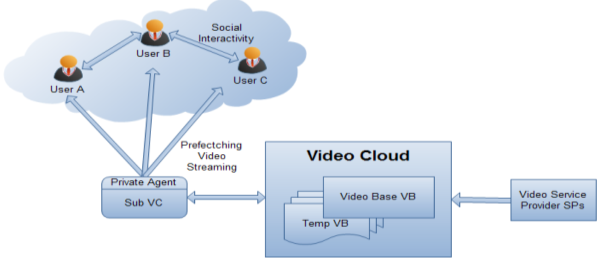

Fig.4 Create sub VC,VC and VB in UBoP

B. Prefetching Levels

- Parts : Because the videos that published by subscriptions may be watched by the subscribers with a not high probability
- All : The video shared by the direct recommendations will be watched with a high probability,
- Little: The public sharing has a weak connectivity among users, so the probability that a user's friends (followers) watch the video that the user has watched or shared is low.

C. Collect Social Network Users

Collection of social group user to communicate the cloud server and between the users. Link capacity to monitor the link between the user and server. The link frequency signal separate in three categories based on the signal strength. This interest-driven connectivity between the subscriber and the video publisher is considered as "median", because the subscriber may not always watch all subscribed videos. Direct recommendation: The recipients of the message may watch it with very high probability. This is considered as "strong". Public sharing: We consider this public sharing with the "weak" connectivity among users, because not many people may watch the video that one has seen without direct recommendation.

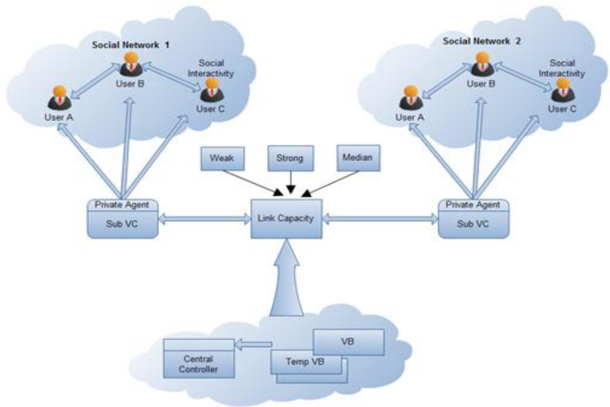

Fig.5 Collect Social Network

D. Analyse Link Capacity and Sharing

The amount of prefetched segments is mainly determined by the strength of the social activities. And the prefetching from VC to subVC only refers to the "linking" action, so there is only file locating and linking operations with tiny delays; the prefetching from subVC to localVB also depends on the strength of the social activities, but will also consider the wireless link status. A non-existing video in cloud, the collector in VC will immediately fetch it from external video providers via the link; after re-encoding the video into SVC format, the subVC will transfer to the mobile. The link capacity use to manage data availability, throughput time,number of video segement,bandwidth allocation and update the wireless link satus this all to maintain by the tem VB and VB.

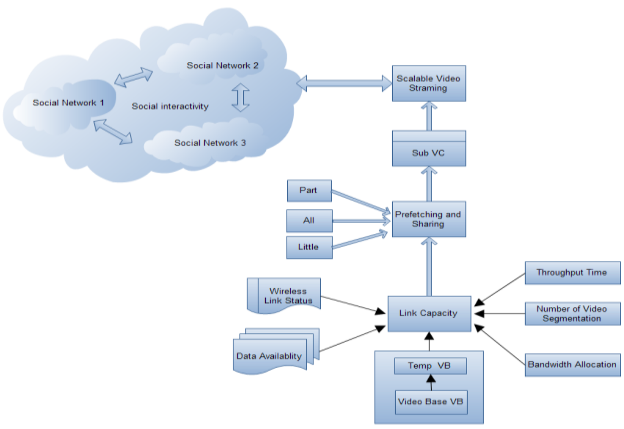

Fig.6 Process Link Capacity and Sharing

E. prefetching based on bandwidth and resolution

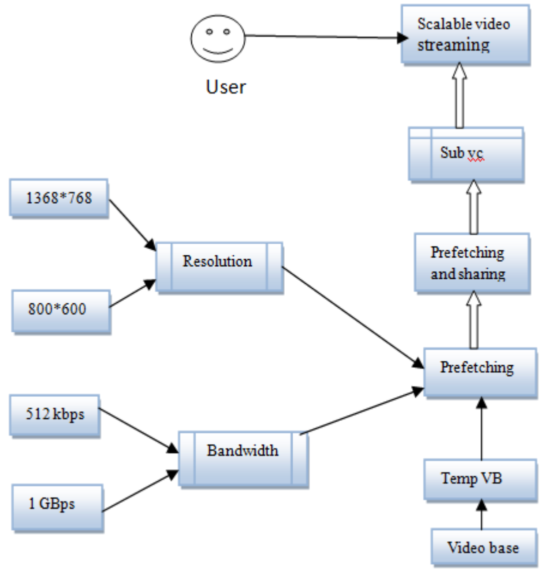

Fig.7 prefetching process

The Scalable Video Coding (SVC) technique of the H.264 AVC video compression standard defines a base layer (BL) with multiple enhance layers (ELs). spatial scalability by layering image resolution (screen pixels), temporal scalability by layering the frame rate, and quality scalability by layering the image compression. By the SVC, a video can be decoded/ played at the lowest quality if only the BL is delivered. Video streaming services should support a wide spectrum of mobile devices; they have different video resolutions, different computing powers, different wireless links (like 3G and LTE). the available link capacity of a mobile device may vary over time and space depending on its signal strength, other users traffic in the same cell, and link condition variation. based on user available bandwidth and resolution the prefetching done by server side.

VI.VIDEO STORAGE AND STREAMING FLOW

The two parts, cloud-assisted adaptive video streaming and social-aware video prefetching in the framework, have tight connections and will together service the video streaming and sharing: they both rely on the cloud computing platform and are carried out by the private agencies of users; while prefetching, the streaming part will still monitor and improve the transmission considering the link status.

Once a mobile user starts to watch a video via a link, the localVB will first be checked whether there are any prefetched segments of the video.

If there is none or just some parts, the client will report to its subVC, and if thsubVC has the video, the subVC will initiate for transmission the remaining segments. But once there are no prefetched parts of the video in the subVB, the tempVB and VB in the central VCwill be checked.

In the case that there is no such a video in tempVB or VB, the collector in VC will immediately fetch the video from external video providers via the link, and the subVC will re-encode in SVC format, taking a bit large delay, and then stream to the mobile user. Streaming flow is better quality compare to the exit method.

VII.CLICK-TO-PLAY DELAY

It is obvious that the video prefetching among localVB, subVB and VB can be significantly fast due to the high link capacity of cloud data centers. Then we only show our test results on how long one user has to wait from the moment that he/she clicks the video in the mobile device to the moment that the first segment is displayed, which is defined as “click-to-play” delay. As shown in Fig. 6, if the video has been cached in localVB, the video can be displayed nearly immediately with ignorable delay. When we watch videos which are fetched from the subVC or the VC, it generally takes no more than 1 second to start. Even if the user accesses the content by 3G/4G link, he/she will suffer a very short delay (around 1s). For the cases to fetch videos which are not in the cloud (but in our server at lab), denoted by “outside,” the delay is a bit higher. This is mainly due to the fetching delay via the link from our server at lab to the cloud data center, as well as the encoding delay in the cloud. However this won’t happen frequently, since most of the popular videos will be cached in the VC. Furthermore the access delays that analyzed earlier are much larger than those click-to-play delays, which means this social aware-prefetching can perform perfectly to match the user demands. More measurement and tests will be carried out as future work.

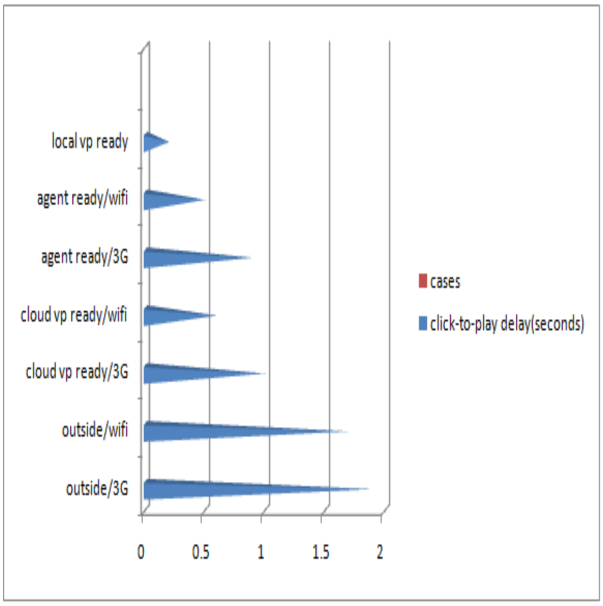

Fig.7 Click-to-play delays for various cases

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VIII.CONCLUSIONS AND FUTURE REMARKS

In this paper, we discussed user adaptive mobile video streaming and User Behavior Oriented Video Pre-Fetching. Which efficiently stores video in the cloud and dynamically create private agent for each users? It try to provide video streaming based on link quality using of SVC technique and try to provide "non-buffering" video streaming experience by prefetching based on their social network services. Show that the cloud computing technique brings significant improvement to the adaptability and scalability of the mobile streaming, and the efficiency of intelligent prefetching.

Regarding the future work, we will carry out large-scale implementation and with serious consideration on energy and price cost.

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