Network Support for A MPEG-7-based Large-Scale Video Archive System

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*Hsu Chih-Chang **Ishibashi Youichi ***Kogure Takuyo ****Hasegawa Humio
*Aoki Terumasa *Yasuda Hiroshi
* RCAST, The University of Tokyo ** TAO Yamagata Video Archive Research Center
*** Matsushita AVC Multimedia Soft Co., Ltd. **** Tohoku University of Art and Design

1. Introduction

According to the research result of the users' access pattern for the online video services, almost half of users stopped their requests at the near beginning of the video playback [1]. To cope with such a user's behavior, we believe that a multiple thumbnail digested videos display system is required. That is, upon the users' requests, it is preferable that the video server provides users the multiple digested videos that function as preview, instead of allowing users to download the normal size videos directly. By adopting the concepts of Active Networks, this work proposes a solution to the video delivery problems, which would occur in the above multiple digested videos display system.

2. Background

Network support is inevitable to provide a quality multimedia presentation for an efficient video archival and retrieval system. The current Video On Demand researches, such as video batching, video merging and video broadcasting, mainly focus on the protocols design of the long duration video deliveries [2]. They, however, cannot be adopted directly into the MPEG-7-based large-scale video archival and retrieval system that we have been developing [3], because of (i) the playback pattern of the multiple digested videos display system is quite different with that of the long duration video deliveries (ii) those protocols are not suitable for the large-scale systems that may contain more than tens of thousands of videos.

The main goal of this work is to design an efficient video delivery mechanism, which both reduces the video server loading and minimizes the users' waiting time of the video playback.

3. Active Video Delivery

3-1 Overview

We adopt the concepts of Active Networks to implement the video delivery mechanism, called Active Video Delivery (AVD). Active Networks is a new generation network architecture, which intends to solve those problems existed in the current passive network, such as (i) difficulty in integrating new technologies and accommodating new services; (ii) difficulty in supporting new applications which sometimes need to perform computations [4].

AVD enables the video server to efficiently deliver the multiple thumbnail videos display (16/64 digested videos) to users and to significantly reduce the users' waiting time of the video playback. The AVD controller (AVDC) is capable of changing the delivery ways for some specific video segments dynamically by injecting the programs to the related Active Routers along the transmission path. Figure 1 shows the basic algorithm of AVD:

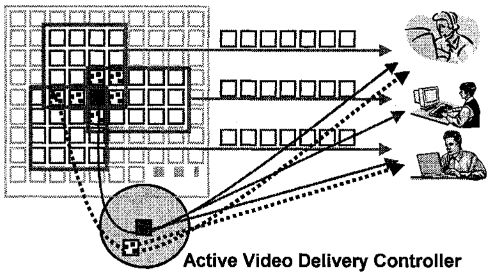

Figure 1. The Basic Algorithm of Active Video Delivery.

The Active Routers decide the best delivery ways for some specific video segments after analyzing the payloads of the packets received from the video server. That is, if the videos that are requested by only one user, the system does Unicast for all the segments of those videos; on the other hand, if there are more than one request on the same videos (shown as the solid/spot blocks) arrived on the same time slot, the system does Multicast-like delivery for parts of segments of those videos.

To achieve the above dynamic Multicast-like/ Unicast, we have implemented a specific protocol between the AVDC and the Active Routers, which are installed in the strategic points of the network.

3-2 Example Usage of Active Video Delivery

First, we assume that each video could be properly partitioned into several segments by applying the video scene change detection method that was developed by YRC [3]. Second, upon the users' requests, the AVDC dynamically selects the delivery methods for video segments, according to the different arrival times of users' requests, and their requested videos.

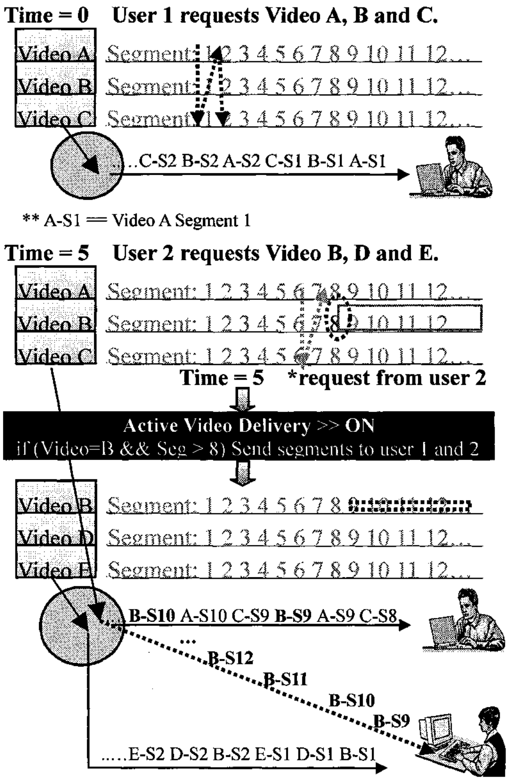

Figure 2. The Example of Active Video Delivery.

Figur2 shows the example of AVD. At time=0, there is only one user (i.e. user 1) who requests video A, B and C, so that the AVDC does Unicast for the segments of the requested videos to user 1 by following the rule shown as the dotted lines. After that, at time=5 (when the AVDC is about to send out *the 8th segment* to user 1), the request for video B from user 2 arrives. The AVDC would then enable the function of AVD and injects a packet analysis program to the related Active Routers, which would perform multicast-like delivery for some specific segments (i.e. *from the 9th segment to the last one segment*) of video B. By duplicating and redirecting those segments of video B, which are originally directed to user 1, to user 2 from the Active Routers along the transmission path, both the server loading of video distribution and the users' waiting time of the video playback can be significantly reduced.

4. Current Works

We evaluate the video server loading and the users' waiting time of the video playback with different video delivery methods, such as Unicast, Multicast, and AVD by using simulation. We build an Active Networks environment, (that includes several Active Routers and the current passive network routers), and the architecture of AVD (that includes a video server and an AVDC module).

Each Active Router in the network maintains a table of information about the destination and source addresses (DA & SA) of users' requests and all the Active Routers lower than itself in the hierarchy. Also, the AVDC maintains a database, which records the information about the retrieved results of users' requests, such as the requested videos, the users' information (source address, and from which Active Router the user's request is generated), and the status of delivered segments of those requested videos. In addition, it cooperates with the default gateway (an Active Router) of the video server in order to dynamically change the delivery ways for some segments of videos that are requested by multiple users at the same time slot.

5. Conclusions

This work (i) compares the performance gains in both the video server loading and the users' waiting time of the video playback of AVD with traditional delivery mechanisms; (ii) proposes an efficient video delivery mechanism, which can solve the problems existed in the video distributions (over the Internet) of a large-scale video archival and retrieval system and other online video services as well.

6. References

1 "Measurement and analysis of A Streaming –Media Workload", M.Chesire, In Proc. USITS, 2001. 03
2 "Video-on-demand broadcasting protocols: A comprehensive study". A. Hu, in Proc. IEEE INFOCOM, 2001.04.
3 "Annual Project Report 2001.03: TAO Yamagata Research Center,
4. http://www.arpa.mil/ito/research/anets