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CONTENTS

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EFFICIENT ARCHITECTURE FOR STREAMING OF VIDEO OVER THE INTERNET

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ABSTRACT

Due to enormous growth of the Internet and growing demand of multimedia contents worldwide, introducing the concept of streaming over the transmission channel. The streaming of multimedia contents such as Audio, Video, and Animation files over the internet has received huge attention from academic as well as industry point of view. The main purpose of the paper is to stream video over the internet. As video has been play an important role for communication & entertainment for many years. We proposed as architecture for streaming Audio / Videos over the internet efficiently. In our architecture, if we compare it with other, it has capabilities to support live streaming as well as pre recorded Video / Audio poses many challenges, we addressed some of these challenges occur in streaming. We cover issues related to the streaming techniques. To introduced this issue with necessary information and provide on detailed view on the streaming techniques. We also discuss previous research in streaming.

KEYWORDS

Streaming Challenges, Streaming video, Streaming Architecture.

INTRODUCTION

Recent advancement in computer technology, video compression techniques, high capacity storage devices and high speed internet work have made internet feasible to provide real – time streaming over the internet. The real-time multimedia consists of time varying constraints because video data must be played out continuously. Real-Time multimedia of live video or stored pre-recorded video is the important part of real-time multimedia. [1]

Video has been playing an important role in entertainment and communications for past decades. Initially videos are transferred in analog form. The evolution of digital integrated circuits and computers forced the digitization of videos. Digitalization creates revolution in the field of compression and communication of videos. In mid 90's the popular and growing internet motivate the video communication over networks. The conventional approach to deliver multimedia contents streaming such as audio and video streaming used the best effort approach [2] and a buffer for solving the problem of delay jitter. However the current best-effort internet does not offer any quality of service (QoS) guarantee to streaming video over the internet. [1] [3]

Real time transportation of live video or stored pre recorded video is the part of real time multimedia. In this paper, we are proposing an architecture for video streaming, which transmit stored video as well as live videos. There are two modes of transmission of stored or live video over the internet, namely the download mode and streaming mode. In streaming mode, due to the real-time nature of the video typically have bandwidth, delay and loss requirements. [1]

There are mainly three ways to stream video over a computer networks: a point-to-point, broadcast and multicast transmission. The common form of communication is point-to-point such as videophone and unicast video streaming over the internet. The most popular form of the video communication is broadcasting of videos i.e. one-to-many. For example of broadcasting videos is live TV and cable network. Another form of video communication is multicasting. Multicasting has a properties lie between point-to-point and broadcasting. For example of multicast is IP-Multicast over the internet. Multicast is not much popular or not widely used, but other approaches with capability of multicasting are being developed, e.g. application-layer multicast via overlay networks. [4]

For storing the digitalized video are used multimedia databases for proper storage and retrieval of the videos. The intension behind the development of the VDBMS (Video Database Management System) is providing a database which can be searched contents according to different criteria, so videos can be retrieved by contents and can be streamed to the users. In VDBMS uses a real time stream manager for streaming requests. Initially a video is stored in raw data form, but when video is captured a set of features is computed at real-time. These features are extensible and can be extended at any time. A recorded video is passed down to storage manger which stores it in a hard disk. VDBMS provides a query manager to process all users query related to video. A video can be retrieved by name or by providing keywords which is compared against the metadata fields. [5] [6]

Video streaming is always preferred over to file download. Video streaming attempts to overcome the problems associated with file download and also provide some additional capabilities. Video streaming has lots of advantages including low delay and low storage requirements. File download mode of transmission used stored videos to transmit over the internet, they downloaded entire file at once. The files download waste downloading time, transmission bandwidth and storage. So we usually support streaming mode to transfer videos over internet that reduced the overheads of storage, bandwidth and downloading time.

We continue by providing a brief overview of the challenges of video streaming, architecture and techniques to stream videos over the internet. Section 2 reviews video streaming challenges. Section 3 introduces architecture that supports real-time and non real-time video streaming over the internet. We have concluded our discussion and mention some scope for future research.

STREAMING VIDEOS: SOME CHALLENGES

Video streaming is difficult because the internet offers best effort service only to transfer videos over the internet. Due to this, it provides no guarantee on bandwidth, delay jitter and loss rate. The main purpose of video streaming is to design a system to deliver high quality video reliably over the internet. Bandwidth play an important role as it is unknown and time varying. If the sender transmits faster than the available bandwidth then congestion occurs, packets are lost, and there is a severe drop in video quality. If sender transmits slower than the available bandwidth then the receiver produces sub-optimal video quality. To overcome the bandwidth problem is to estimate the available bandwidth and then match the transmitted video bit rate to the available bandwidth [4]. Scalable videos are more preferred over non-scalable videos because scalable videos adapt the available bandwidth variations in the network.

The variation in end to end delay is referred to as delay jitter. Delay jitter occurred due to receiver doesn't receive frames at a constant rate. Any delay in frames resulting produce jitter, so it can produces problems in reconstruction of videos. This problem is resolved by introducing playout buffer before decoding at the receiver.

The third problem is losses. Different types of losses depending on the network type. For example if we have wired packet networks such as internet are affected by packet loss. On the other hand, wireless channel are affected by bit errors and burst errors. To overcome the problem of losses, a video streaming system is designed with error control mechanisms.

These are the challenges related to the transmission of videos over an internet. These are:

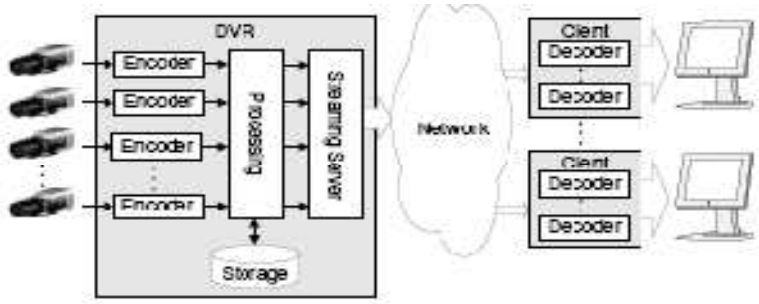
[8] Netapp streaming media solution overview

- Low quality streaming.
- High storage costs.
- Stream servers/networks unable to handle large demand.
- Multi-protocol means expensive, replicated systems.
- Bandwidth expensive and used inefficiently.
- VCR functionality.

As per Gorden Bell [7], the challenges today is not storing the information, but accessing it. It is no need to store thousands of hours of videos, later on it is not possible to retrieve particular frame. The conventional system has many problems associated with the accessing and retrieval of videos for streaming purpose. Therefore, new kinds of databases are needed: multimedia database. As our paper is particular about videos, so we used VDBMS to store over videos for accessing later on. A video database is very much different from the textual database. The way to access information in both the databases is different. In textual databases every word can be used as index. In video databases, we need to store metadata which is describing the data. Apart from finding information on the internet, delivery of the information as a stream creates a challenge, so it can be replayed immediately. [5]

STREAMING ARCHITECTURE

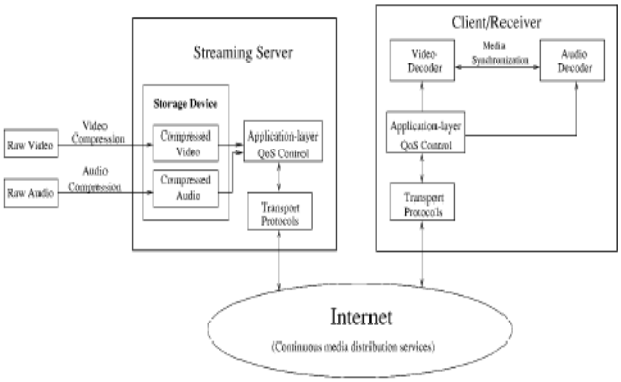
FIGURE 1: STREAMING ARCHITECTURE



As shown in Figure 1, the proposed architecture for an embedded streaming server that is independent of the used source coders and type of network connected. Multiple users can connect and multiple video channels can be transmitted at the same time for each user. In this system, we used multiple independent encoders per channel, creating streams at different frame rates. For each requested channel, one stream has to be selected. We support live streaming contents of video for surveillance purpose. **[9]**

As shown in Figure 2, the proposed architecture for video streaming that used real-time transmission of only *stored video*. In this system, live streaming of video content is not supportable. [1]

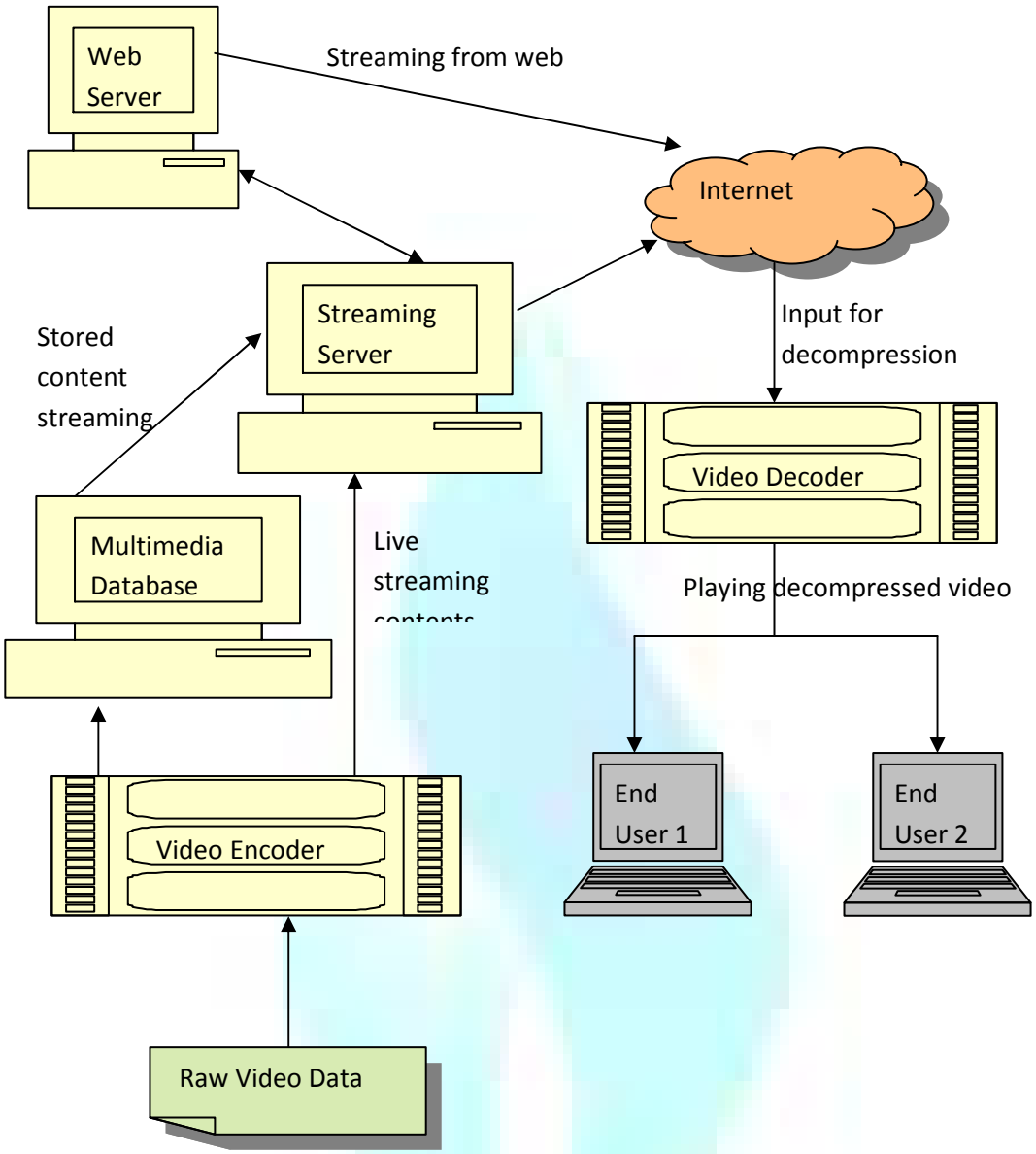
FIGURE 2: VIDEO STREAMING ARCHITECTURE



As we discuss two previously proposed architecture for streaming videos has supported either live or stored video. Both the system can not be able to transmit the live video and stored video as well. According to the current need of both type of real-time transmission of video contents over the internet, we proposed architecture to provide streaming of both type of video contents i.e. live or stored. Figure 3 shows architecture proposed by us to stream videos over internet. In Figure 3 we take raw video data as input to the video compressors such as MPEG2/MPEG4/H.264 Video Encoder etc. The video compressor pre-compressed the raw video data and get stored in storage devices or databases upon the clients request, a streaming server is used to retrieve compressed videos data from storage devices or databases and then send the video packets to the internet.

A compressed video data has to be stored in multimedia database server first, and then the streaming server will be able to use the final compressed video on demand. In on demand distribution of stored video user allowed to rewind and/or forward the video. In our architecture, we can also directly send the compressed videos to the streaming server for transmission over the internet. In this manner we stream videos as a live streaming content. In live streaming there is a direct connection between encoder and the streaming server established first. There is no forward and backward option allowed in live streaming of video.

FIGURE 1: PROPOSED STREAMING ARCHITECTURE



In this condition, our architecture is helpful to provide high quality video transmission over the internet. They consist of:

- Raw Video Data
- Multimedia Database Server
- Encoder,
- Streaming Server
- Web Server
- Decoder
- End User

Raw Video Data: raw video data is a simply a data in analog form. A raw data is uncompressed data which we can not transmit it over the internet. Before transmission of raw video data we need to digitalize the video first. In this proposed architecture, we need high quality videos such as MPEG2/MPEG4/H.264 video encoder storing it into multimedia databases after compression to make it available to different clients on the same network. We also need to stream live video contents to feed it directly to the streaming server with some non-stored videos which is already in compressed form.

Multimedia Database Server: Multimedia database server is used to store the videos after been compressed by an encoder. We maintained a database to store videos where we keep records of all the videos after compressing videos. These video contents are capable of streaming on demand of clients. We keep updated our database with the latest videos related to every popular field such as education, movies, sports, politics etc.

Encoder: the encoder play out an important role in video streaming. Encoder is used to transform our raw video data into compressed and transferred form, so we can easily transmit this video over the internet. The encoder compressed video in Mpeg2/MPEG4/H.264 format which is perfect for high quality video storage and streaming. The output of the encoder can be saved to the multimedia database for further retrieval of video on demand and/or streamed directly through streaming.

Streaming Server: streaming server plays an important role to stream videos over the internet. To provide high quality video streaming, streaming server required t process real-time multimedia video under timing constraints in order to restrict artifacts (e.g. jerk in video) during playback at the clients. In addition to support high quality video streaming, streaming server also need to support

VCR [10] like control operation such as stop, play, pause, fast forward and fast backward. Streaming server also need to retrieve real-time multimedia components in a synchronous manner. A streaming server typically consists of the following three parts: [1]

- Communicator
- Operating System
- Storage devices

The streaming server is used to transmit video from the encoder directly, or play video from the multimedia database on demand. Server is able to play stored videos as well videos which are not stored but real-time converted into a playable format.

Web Server: a web server is used to delivered content to clients connected to it. It is using the Hypertext Transfer Protocol (HTTP) to deliver web pages to the clients over the internet. In this architecture, we can access video contents from the web server. A streaming server communicates with web server for video streaming over the internet.

Decoder: the decoder also plays out an important role in video streaming. Decoder is used to transform stream compressed video data into decompressed form to play out video in end users system. In decoder, decompressed video converted MPEG2/MPEG4/H.264 format into analog video which is perfect to play in end user video player (VCR).

End User: The end users are basically a machine, which request a server for videos from server. A server can be a streaming server and/or web server. The end users are large in numbers. Multiple users can access same video at a time. Whenever end users need video, it sends a request to the web server or streaming server which manages to respond to a request made by an end user. The server handles multiple clients at a time.

The architecture used to play videos on a LAN, keeping records on all the videos stored in central server i.e. multimedia database. It also used to customize and atomize the playback of the stream video.

SUMMARY

Video has been playing an important role in entertainment and communications for past decades. Initially videos are transferred in analog form. The evolution of digital integrated circuits and computers forced the digitization of videos. The two mode of transmission of digital videos over the internet are download mode and streaming mode. We have three ways to stream video over a computer networks: a point-to-point, broadcast and multicast transmission.

There are few challenge areas in the field of streaming videos over the internet are bandwidth, delay jitter and loss rate. We have compared our architecture to previously known architecture; we find that the previous architecture weren't capable of live streaming. But in our proposed architecture we have both kind of streaming i.e., live video streaming and stored video streaming. The proposed architecture consists of raw data video, Multimedia Database Server, Encoder, Streaming Server, Web server, Decoder, and End User to facilitate live as well as stored video streaming over the internet.

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