ABSTRACT

The demand for multimedia service is increasing dramatically with the popularity of the World Wide Web (WWW). The streaming of high quality videos consume a significant amount of network resources. Hence, this service may cause a bottleneck in the communication network due to the high bandwidth demand. Proxy Servers are suggested as a solution to intermediate buffering schemes and they have been used to speed up the transactions and reduce the remote server bandwidth demand, service delay and networking error. The streaming of video and audio data over the communication network has become much popular. Now usually, the demand for video storage is very high and it posses several challenges for video data management. Hence, the design of efficient video-on-demand architectures and an optimal caching and streaming strategies for video contents at Proxy Server has become increasingly important. The large size of the video and the storage limitation of the Proxy Servers have made caching of the complete video on the Proxy Server impossible. This work proposes innovative strategies for efficient proxy caching and buffer management to override the challenges. Certain efficient distributed VoD architectures, load sharing algorithms and effective streaming approaches are developed here to improve the Video-on-Demand engineering. Simulation results show that, the proposed strategies greatly improve the performance when compared to the commonly used strategies.

Chapter one presents an introduction to multimedia applications and in particular it provides an insight into Video on Demand (VoD) concepts. The various needs and the current challenges of Video on Demand systems are discussed. General VoD architectures and various components to implement the VoD application are also discussed. The protocols required for Proxy Servers to communicate with each other are also presented. It also deals with the motivation and objective of this research work.

Chapter two gives a review of current literature on various algorithms for efficient utilization of Proxy Server storage, for balancing the load among the Proxy Servers, and also various distributed architectures to improve the overall performance of the VoD system. A detailed survey of various proxy caching techniques and load sharing mechanisms are made. An in-depth review of various streaming approaches like batching, patching, broadcasting, piggybacking and chaining are presented here.
As the Proxy Server storage capacity is limited, dynamic buffer allocation algorithms are required for efficient utilization of Proxy Server buffer to achieve high video availability. In chapter three we deal with the design of such complexities. Another buffer allocation algorithm using VBR characteristics of the video is also presented. This algorithm uses the Frame Differencing Technique to improve the storage rate at the Proxy Server. To improve the performance of the system, efficient VoD architectures are proposed in which closely located Proxy Servers are interconnected to achieve high availability with the increased aggregate storage of video prefixes among the Proxy Servers. This architecture combines the advantages of both client server and peer to peer approaches with the help of the central coordinator called the Tracker. Also an efficient load sharing algorithm in combination with the dynamic buffer allocation technique for the proposed architecture is presented. This algorithm achieves increased service rate at the Proxy Server, reduced client waiting time and reduced bandwidth demand from the Central Multimedia Server.

Chapter four presents the following algorithms

- Regional popularity based replication and Placement (RPR-P),
- Regional Popularity Based Proxy prefix caching and Load sharing algorithm (RPPCL) and
- Stochastic model based Prefix Placement Strategy to Achieve Reduced Transmission Cost.

It is not efficient to cache the entire video at the Proxy Server as the size of the video is huge and the cache size of the Proxy Server is limited. Hence the initial portion (prefix) of the video can be stored in the Proxy Server to serve the client requests from the Proxy Server immediately. Thus, the downloading of the complete video from the remote Central Multimedia Server can be avoided. The proposed algorithm efficiently partitions the video and determines the video prefix and the size of the prefix to be cached at the Proxy Server along with efficient prefix distribution schemes. These algorithms reduce the client response time, network traffic and also the main server load.

Chapter five presents algorithms, which combine peer to peer techniques with the current server-client streaming approach to build a new system that is both scalable and robust. Specifically, we propose an algorithm C2C-Chain: Client-to-Client chaining protocol for VoD Applications. Here we explore the combination of proxy prefix caching and load sharing scheme
to chain the end points in the proposed coordinator based cooperative Proxy Server’s architecture. This architecture uses a proxy-to-proxy and client-to-client streaming approach to cooperatively stream the video using chaining technique with unicast communication among the clients. This approach considers two major issues of VoD 1) Prefix caching scheme to accommodate more number of videos closer to the client maximizing the service rate at the Proxy Server and minimizing the load of the remote main server 2) Cooperative proxy and client chaining scheme for streaming the videos using unicasting. This approach minimizes the request-service delay, the client rejection rate and bandwidth requirement on server to proxy and proxy to client path.

Chapter six presents a concluding summary and discusses the scope for further research work in this field.

Finally, a list of references and a list of publications made are presented.