SURVEY ON PREFETCHING TECHNIQUES IN P2P VIDEO ON DEMAND SYSTEMS

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SUMMARY

Video Streaming is a multimedia application that is constantly received by and presented to an end-user while being delivered by a provider. Prefetching is a mechanism which is before start playing the video, fetching the video from server and storing that in the neighbour peers, whenever we need we can able to easily get that video segment. Prefetching in video streaming is very important technique for improving the performance of video streaming. In video streaming prefetching we having more number of prefetching techniques and strategies to prefetch the video segments. In this paper we going to analyze and compare the various prefetching strategies in peer-to-peer video streaming.

KEYWORDS

P2P Network, Video on Demand(VoD), Prefetching, Prefetching strategies.

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1.INTRODUCTION

A **peer-to-peer** computer network is one of the network in which each computer in the network can act as a client or server for the other computers in the network. And these P2P network allowing to share the access to various resources such as files, peripherals, and sensors without the need of the central server. Each network type requires the same or a compatible program to connect to each other and access files and other resources to found on the other computer. P2P networks can be used for sharing contents like as audio, video, data, or anything in the digital format.

P2P is a distributed application architecture that is used to partition the tasks or workloads among all the peers. All the Peers are having equally honored participants in the application. Each computer in this P2P network is referred to as a Peer system. The owner of each computer on a P2P network would set out-of-the-way a portion of its resources such as like processing power management, disk storage, or network bandwidth - to be prepared for directly available to other network participant which are in P2P network, without the need for central coordination by servers . With this model, peers are both suppliers and consumers of resources, is compared to the traditional client–server model where only the server transmit, and clients receive. Emerging collaborative P2P systems are going beyond the period of peers doing similar things while sharing resources, and are looking for different peers that can bring in unique resources and capabilities to a virtual neighborhood thereby empowering it to engage in greater tasks beyond that can be achieve by individual peers, so far beneficial to all the peers.

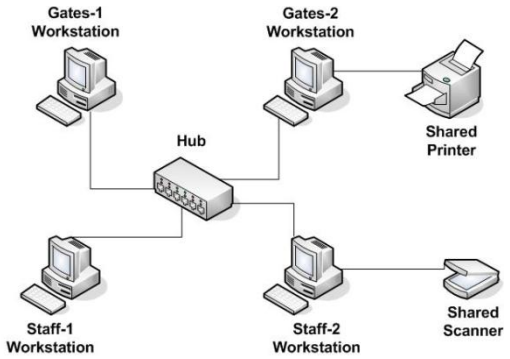


Fig 1:Peer to Peer network

Video Streaming is a emerging technology for distributing and watching digital videos over the network. Rapid growth of the Internet using people to obtain a variety of informations from the

office and home using web browser. People can access not only the text and the image data, also video data, and can watch news and concerts from all over the world. Usually, digital video can only be played after downloading the entire file to one's PC. Digital video data is massive data compared to text and image data and it takes long time to download that all. In order to solve this problem they proposed , a streaming technology has been developed that receives the data from a server and replays the video at the same time enabling the people to watch the video without boring and waiting.

Video streaming technology is developed based on 2 important key technologies. That two are video coding technology and the scalable video distribution technology.

Video streaming system consists of an encoder[1], distribution server and a client systems that receives the video data from the server. The distribution server stores the encoded video data and share out it on the client's demand. By accessing the server people can watch the video whenever and wherever on the Internet. Encoding and distribution of video segments is carried out in real time in the case of live distribution. Load balance is measured by placing the communicate server in the appropriate location on the P2P network.

In the past few years multimedia communications has become importent parts of the people's life. Video streaming is attracting wide-ranging attention and becomes the most popular activity over the internet. It supports the large number of users and it manages the more network bandwidth compare to other internet applications. Peer to Peer (P2P) techniques presents great scalability and supports for the larger number of users. In this paper we going to analyze and understand the performance of the different prefetching techniques in the P2P video streaming.

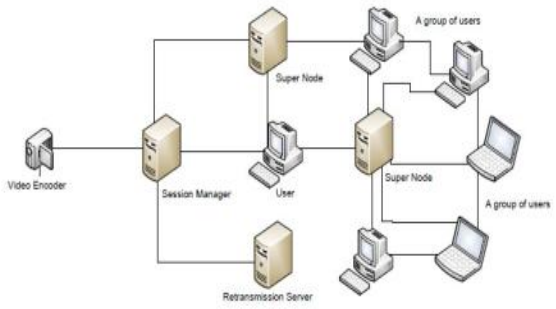


Fig 2: Video streaming system

Video streaming have two categories:

1.Live streaming

2.Video-on-Demand(VoD)

Live streaming: P2P live video streaming [2] has become a very popular and successful service on Internet. As one of the most successful profitable P2PLVS systems, PPStream has attracted millions of users all over the world. The source server broadcast the contents and all the clients play the contents at a same progress. In this systems shorter end-to-end delay is more desirable for better perception of stream.

Video on Demand: Video on Demand systems which allows user to select and look at the video or audio contents on demand when they need. IPTV technology is used to bring the videos on demand to the televisions and personal computers [3]. Television VoD systems either stream the video contents through a set-top box, a computer or other device, allowing viewing in real time, or download it to a device such as like a computer, digital video recorder (personal video recorder) or portable media player for viewing at any time.

The majority of cable- and telco -based television providers propose both VoD streaming, including pay-per-view and free content, whereby a user buy or selects a movie or television program and it begins to play on the television set almost instantaneously, or downloading to a DVR borrowed from the provider, or downloaded onto a PC, for viewing in the future use. Internet audio/video television, using the Internet, is an increasingly popular appearance of video on demand.

Prefetching [4] allows us to manage bandwidth in a complex presentation. This technique helps us to ensure that the presentation streams smoothly. For example, you can stream data for high-bandwidth clips while low- bandwidth clips play. To use prefetching, though you must completely understand how clips use bandwidth, as well as can able to understand how to create a presentation timeline. Prefetching is a powerful feature for managing bandwidth in a streaming presentation. It lets you stream portions of large clips, or all data for small clips, before the clips play. RealPlayer stores the prefetched data in memory until clip playback begins. Using

prefetched data, RealPlayer can display the clips faster when they begin to play. This can used to reduce or eliminate the buffering that normally occurs when clips start to play.

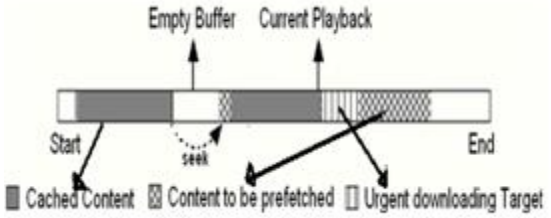


Fig 3: Prefetching and Caching in video streaming.

In section 2 we going to see about the related work , section 3 is the various prefetching techniques , section 4 is the comparison table between the various prefetching techniques, section 5 is the conclusion of this paper.

2. RELATED WORKS

In the past several researches has proposed for the video caching and prefetching in video streaming.

Cheng et al [5] proposed a strategy ,in this the scheduler adaptively fetches chunks to buffer at times. Rajaie at al [6] proposed a proxy caching mechanism for layered-encoded streams in internet to maximize the delivered quality of popular streams. Garbacki et al [7] proposed a random strategy that consider the rare segments in the play back position. In this we going to analyze the performance of the VoD systems without using prefetching (No prefetching) ,then Guided prefetching scheme is compared with the random prefetching scheme [8] , Popularity aware prefetching [9] is compared with Cooperative prefetching[9], Rarest first strategy[12] is comparing with Soon-most needed prefetching [10],Preference Prediction prefetching [15] is compared with User aware guided prefetching strategy[17],Prediction based prefetching [18] is compared with Prediction based prefetching with gossip based approach[19].

3. PREFETCHING TECHNIQUE

We having two types of hit ratio in VCR operations. First one is the “Relative hit ratio”, which is defined as “the number of prefetching requests are satisfied locally. This means the requested

segment is already available in a cache memory. Next one is the "global hit ratio", which is defined as "the number of prefetching requests are satisfied by fetching the segments from the neighbour peers. This means the requested segment is not available in the cache memory, so the peer fetches that segment from the neighbour peers.

3.1. Prefetching technique analysis

In this sub-section we analyse the performace of the various prefetching techniques in the P2P VoD systems.

3.1.1. Guided prefetching vs Random prefetching technique

Shen et al [11] proposed the random prefetching technique. This technique is based on the one-dimentional segment popularity, in which the popularity of segment is determined by the number of accesses or request to that segment. But this is not accurately capture the correct segment which is need by the user. In VoD application with this random prefetch , the next position that the peer access may not the correct segment whish next to the current segment It may be the any segment of that video . Therefore from this random prefetching scheme does not work well to prefetch the correct video segment.

Yifeng He and Ling Guan [8] have proposed the guided prefetching scheme to minimize the expected delay at every viewing position . This scheme is based on the segment access probability, the scheme optimally determines which segment will be prefetched and cached. This guided prefetching scheme significantly reduces the seeking delay compared to the random prefetching scheme. In this they used concept of guided seek, it is performed based on the segment access information. This information are learned from the seeking statistics in the previous and/or concurrent sessions. With this guidance, users can jump to the desired position in the video efficiently and quickly. The segment access probability is projected from the seeking statistics of the peers in P2P network connection. Suppose the peer is viewing the segment-1 currently means, after that this peer may seek to any other interesting position.

For the continuous playback, it prefetch that appropriate interesting segment before the playback time of that particular segment. From this comparison the random prefetching scheme have the delay in upload time is 4.88 seconds in average, and the guided prefetching scheme have the delay in upload time is 2.61 seconds in average. And the average delay in download time is 4.99 second in random prefetching and download delay in guided prefetching is 2.59 seconds.

3.1.2. Rarest-first search vs Soon-most-needed search

In paper [12] most P2P video streaming systems, pieces that are left to download are split into two sets: a high priority set and a low priority set. The high priority set constitutes a sliding window that contain pieces which are important

in keeping the playback buffer full, which insures a continuous playback. This high priority set is requested in sequential order while the low priority set is requested using the rarest-first-strategy. This strategy works by prefetching those pieces that are least replicated in the neighbourhood peers. This shown weak playback performance due to because of it does not take into account whether the rare pieces will be needed soon enough by other peers.

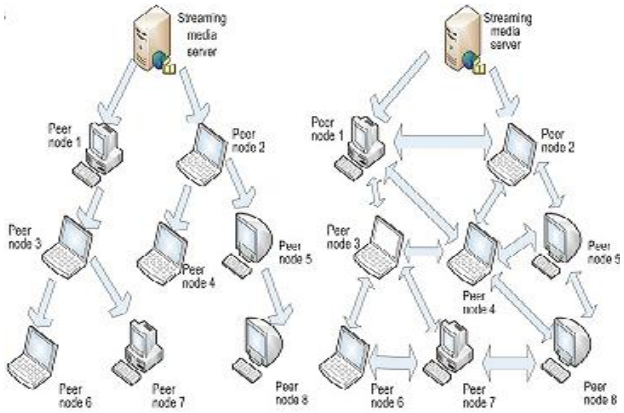


Fig 4: Rarest-first search strategy in P2P network

In a normal P2P VoD system, different peers are not aware of the playback positions and the high priority pieces required by neighbouring peers in the network. To overcome this problem, Zhao et al [13] proposed a new prefetching strategy called soon-most-needed, that works under the process of requesting pieces that will soon be needed by other peers. This strategy optimizes the neighbourhood by taking into account information inferred from the playback positions of

neighbouring peers by allowing the peers to actively vote for the pieces what they need currently. Each peer is allowed to vote for m pieces that are still missing from its video file every T seconds. This is called refresh interval. We suppose voting in synchronous order , all votes are received in the same time. This vote values will set in a way to be decreasing with increased piece number. Voting is starts from the piece s, which is the first non-received piece in linear order. These vote values are further scaled by the difference between the playback position and the first piece which is voted for.

After each peer has voted , it sends the SMN list with vote values to all the peers. This SMN[10] list is sent only to the downloaders not to the uploaders, because this is need not to prefetch any pieces. Then the votes are collected and aggregated by the downloader peer.
Comparing Soon-Most-Needed with the Rarest-First-Search, the rarest-first search generated 835 stalling events and while the soon-most-needed generated only 353 stalls. Almost it gives the 50% better performance. And the average duration of each stalling event is 45% shorter when we use SMN strategy.

3.1.3.Popularity aware prefetching vs Co-operative prefetching

In popularity aware prefetching [14] technique which is using the users access patterns to prefetch the data segments. In this the management server (also called tracker) maintains a log which is stores the users access pattern. This statistics collected from thr users request which are used to determine the optimal number and placement of the replicates for each video file. Thease popular segments are distributed among all the peers which are participating in the P2P VoD session connection. As the result of this all the popular video segments are obtained before the playback. Each peer records the information about the seek operation and send it to the tracker in the periodic interval. The accounting functions are performed by the tracker on the statistics .The list of the popular contents are distributed among all the peers. This technique improves the hit ratio by considering the users access pattern. The periodic exchange of the seeking information creats overhead int his process.

In cooperative prefetching technique [9], peers sharing the state information with each other peers in a periodic interval. The state information is the buffer map of available segments and the current playback position. In the management of buffer, each peer cache the latest 3 min of video segments. Each peer holds the initial 3 min of video and never replaces this part during its existence. Caching the first few minutes of video is sufficient to serve the 50% of users session.

Playback segments refers to the record of segments after it generates its last state-message. Instead of exchanging all the complete record of available segments, to avoid the overhead each peer only sends playback segments. Before forwards the message to its neighbour peers , a peer performs a relevant operation on receiving a state message. Each peer performs the necessary operations to remove the redundant segments and it creates the available segments list in the session.

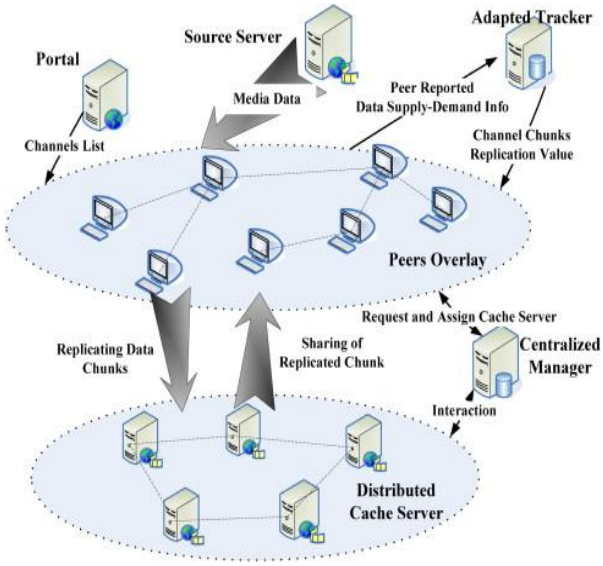


Fig 5: Co-operative prefetching in video streaming

3.1.4.Preference prediction strategy vs User aware guided prefetching

In paper [15] Cheng et al proposed preference prediction strategy which is used to prefetch the video segments based on the user's preferences can be predicted. In this they focused on the video sharing in the online social network. Information statistics hosted by the online social network used to identify the user's interest. Cheng et al proposed [15] a reputation model which is based on trust between friends to guide the desirable content. Using this information predicting

the user's preference on the video segments. Yang et al[16] proposed recommendation system strategy based on the rating information shared among the friends.

In paper[17] Zhi Wnag proposed the prefetching strategy called user aware guided prefetching , which is based on user's preferences learnt from the video access pattern.This user's preference are predicted by the user's historical selections, social closeness between the viewing users and the popularities of the videos.How the users select videos in the social networks.1. Videos which are aggregate in the online social network. 2. User's preferences of videos shared by the friends. 3. Week correlation between the video and blog viewings, 4. Predicting the user's preference videos from the historical selections. Metrics to predict the user's preference is historical selection of the source user, which is observed to have strong correlation with future selection, and social closeness between the viewing user and the source user, the shared videos.

3.1.5. Prediction based prefetching vs Prediction based prefetching with gossip based approach

In paper [18] Xu and Chen proposed the prediction based prefetching technique which is used to prefetch the video segments based on the prediction of user's interest. Supporting VCR operations is a challenging task in P2P VoD systems.Caching the different portions of video segments asynchronously affects the efficiency of the coordinating content delivery.In this prediction based approach because of the dynamic characteristics of user interactivity makes difficult to support for the VCR- operations like jump, forward, rewind and pause. The evaluation performance of prediction based prefetching In terms of the hit ratio it achieves 38%.

In this strategy the peer just predicts the next seeking state and sequentially prefetches the segments in the predicted state into its prefetch buffer according to its download bandwidth.

In paper [19] Tianyin xu proposed the new PREP a prediction-based prefetching used in practical gossip-based P2P VoD systems to support VCR-like operations. In this they used Reinforcement learning technique,PREP transforms users streaming service procedure into a set of states and it presents aa prediction model to predict the users VCR behavior through analyzing the large

volumes of users viewing logs on the tracker. According to the predicted VCR behavior a distributed data scheduling algorithm to fetch the video segments..

In this PREP used to gain hit ratio close to 75%, while reducing the response latency close to 70% with only less than 15% extra stress on the server.Using the data scheduling strategy takes the advantage of the inherent peer collaboration of gossip protocols to optimize the prediction performance and it reduce the response latency.

Table 1:Comparision of various prefetching techniques Based on the hit ratio:

S.no	Prefetching techniques	Achieved hit ratio
1.	Random prefetching	30%
2.	Popularity aware prefetching	40%
3.	Cooperative prefetching	55%
4.	Rarest first prefetching	35%
5.	Soon-most needed prefetch	70%
6.	Prediction based prefetching	38%
7.	Prediction based with gossip protocol	75%

In this table we compared the various prefetching technique based on the hit ratio. The random prefetching technique achieved the minimum hit ratio of 30%. But the prediction based prefetching with gossip based achieved the highest amount of hit ratio of 75%.

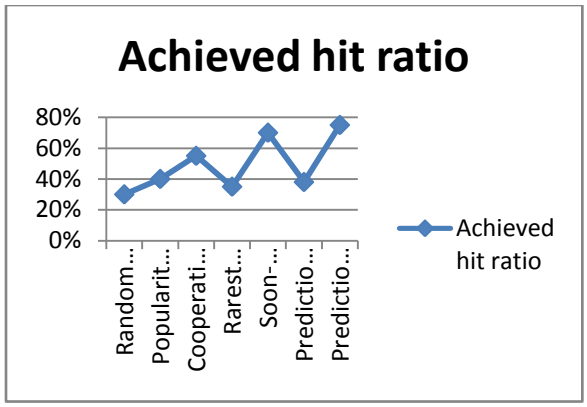
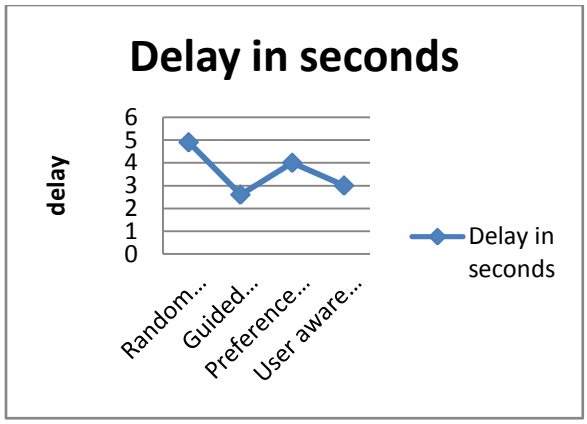


Table 2:Comparision of various prefetching techniques Based on the delay:

S.no	Prefetching techniques	Delay
1.	Random prefetching	4.9 sec
2.	Guided prefetching	2.6 sec
3.	Preference prediction strategy	4.0 sec
4.	User aware guided prefetch	3.0 sec

In this table we compared the various prefetching technique based on the delay in accessing the video segments in P2P network. Using the Random prefetching technique it takes the 4.9 seconds to play the video segment. But using the guided prefetching it takes only 2.6 seconds to play the video segments.



Conclusion

In this paper we compared the various prefetching techniques in the P2P VoD systems. Predicting a set of videos that are likely to be watched by the users in the future and fetching that prefixes of those videos before they request is the very challenging task in the video streaming process.All the users like to have the zero delay in video playing, in that only users can able to view the video anytime without any interruption. Now a days all trying to achieve this zero delay only, and they proposing the new techniques in prefetching video. For the future perspective, we aim to acieve and get the high hit ratio and less access latency in the video playback.

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