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Research Article

AI Optimized QoS based On Demand Services with Incentive Mechanism in P2P Networks

Dr. K. Palanisamy[1] , M.Kasipandian[2], Dr. M. Rajesh Babu[3], Dr. S. Uma[4], Dr. M. Sangeetha[5], G.P. Sundar[6]
[1]*Principal, Jairam Arts and Science College, Salem, India*
Email: kpalani79@gmail.com
[2]*Assistant Professor, Department of MCA, Bharath Niketan Engineering College, Aundipatti, Theni(Dt)., TamilNadu, India*
Email: kasipandi1985@gmail.com
[3]*Professor & Associate Dean, School of Computing, Rathinam Technical Campus, Coimbatore, India*
Email: drmrajeshbabu@gmail.com
[4]*Professor, PG In charge, Department of CSE, Hindusthan College of Engineering and Technology, Coimbatore, India*
Email: druma.cse@hicet.ac.in
[5]*Assistant Professor, Department of CSE, SNS College of Technology Coimbatore, India*
Email: mslion2010@gmail.com
[6]*PG Student, Department of CSE, Hindusthan College of Engineering and Technology, Coimbatore, India*
Email: sundarpandy@gmail.com
Corresponding author email id: kpalani79@gmail.com

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ABSTRACT

This paper presents a parallel buffer filling Video-on-Demand (VoD) streaming technique in Peer-to- Peer (P2P) environments based on Artificial Intelligence (AI). Peer-to-peer (P2P) energy trading is an innovative concept poised to transform energy demand management and utilization. EnergyShare AI is a powerful peer-to-peer energy exchange system that operates on a P2P model that integrates advanced machine learning with distributed energy sharing. Most notably, a P2P video-on- demand streaming technique has to handle peer churn and asynchronous arrival of peers efficiently. Our answer to the challenge provides robust recovery by parallel buffer filling method and encourage the peer to maintain the required connectivity through modified grade-based incentive mechanism. In this paper, we develop analytical models and categorize peer into different potential groups. Quality of service (QoS) is the use of mechanisms or technologies that work on a network to control traffic and ensure the performance of critical applications with limited network capacity. It enables organizations to adjust their overall network traffic by prioritizing specific high-performance applications. Design of parallel streaming into different buffer zones of the client peer with incentives, makes us to understand and control the interplay between efficiency, fairness and incentive in P2P video-on-demand, based on QoS services. Through analytical analysis, we show that robust P2PVoD can be achieved.

Keywords: P2P video-on-demand, Quality of Service, incentive mechanism, video coding, multimedia streaming, stream reliability value.

INTRODUCTION

Recently Video over IP has become extremely popular. A large number of emerging applications, including Internet TV, broadcast of sports events, online games, and distance education, require support for video broadcast. YouTube is an ideal example. Peer-to-peer (P2P) energy trading is an innovative concept poised to transform energy demand management and utilization. Fuzzy based link monitoring scheme is employed to check the probability of link failure [1]. [2] forms an ideal VM planning and the executive's interaction to advance the QoS during administration execution. [3] made easier by introducing Quality of Service (QoS) measures into the path selection process, such as distance to SINK, availability of spectrum, communications cost, and node delay. The proposed disjoint routing protocol improves equal allocation of network burden over various routes, resulting in improvements to QoS. EnergyShare AI is a powerful peer-to-peer energy exchange system that operates on a P2P model that integrates advanced machine learning with distributed energy sharing [4]. Statistics show that roughly 60 hours of new videos are uploaded to the site every minute [2], over 4 billion videos are viewed a day, over 800 million unique users visit YouTube each month and over 3 billion hours of video are watched each month on YouTube. It is localized in 39 countries and across 54 languages, YouTube had more than 1 trillion views and were almost 140 views for every person on Earth in 2011[6].

Initially client-server model was the solution for streaming media applications. Later client-server model evolved into Content Distribution Network (CDN) such as Akamai [7], decreases the workload on the web servers, reduces network traffic bandwidth costs, serve more users and keep the user-perceived latency low. Server based techniques are still expensive because the bandwidth must grow proportionally with client population. Next alternative for the most efficient solution may consist of using IP multicast systems for these applications. Unfortunately, IP multicast deployment has not come to fruition due to lack of support and political issues. Researchers later developed an application layer capability for multicast routing called Application Layer Multicast (ALM). In ALM, multicasting is implemented at end-host rather than network routers.

In Video on Demand (VoD) service, although a large number of users may be watching the same video, they are asynchronous to each other and different users are watching different portions of the same video at any given moment. As media files are usually large, media streaming places big demand on the bandwidth resources of streaming servers. P2PVoD applications are based on the design philosophy of having peers watching the same video exchange available media blocks, in order to alleviate the server load by exploiting bandwidths from participating peers

The rest of the paper is organized as follows. Section II discuss about the related works. Motivation and problem definition is given in section III. Modified grade-based incentive mechanism is explained in section IV. In Section V, steps in the proposed parallel buffer filling mechanism along with mathematical analysis is given. In section VI, optimized streaming using Multiple Ant Colony Optimization is shown. Implementation and results are discussed in section VII and the paper is concluded in Section VIII.

RELATED WORKS

While a lot of research has been recently conducted on VoD streaming services via the Internet, the efficient implementation is still challenging. Initially researchers tried to provide solution for P2P VoD by using tree-based streaming in P2P network. The authors in [8] designed a scheme using patching technique that uses tree-based P2P system to support asynchronous users in VoD service. Here users are grouped based on their arrival time. Each group belonging to the same session form an application-level multicast tree, denoted as the base tree. The server streams the entire video over the base tree. When a new client joins the session, it joins the base tree and retrieves the base stream from it. Meanwhile, the new client must obtain the initial portion of the video that it has missed which is available at the server as well as other users who have already cached it. Thus, asynchronous requirement of VoD is addressed. Shortcoming of tree-based mechanisms is the unsteadiness due to peers leaving and joining the P2P system frequently and it is hard to preserve the tree architecture. It fails to utilize bandwidth of leaf nodes.

An alternate solution is to use the multiple tree architecture to overcome this issue. A media stream is split into sub-streams and pushed into multiple sub trees so that whenever a peer departs the tree, its child peer may carry on receiving content from an alternate path. The quality of streaming would be degraded due to peer churn, since some layers of video coding like Scalable Video Coding (SVC) or Multiple description coding (MDC) may be missed.

Cache and relay P2PVoD exploit the technique called interval caching which allows a peer to cache a moving window of video content in the memory. It will be used to serve client peers whose viewing point falling into the caching window by continuously forwarding the stream. This technique is utilized to solve the synchronous issues. Here the vulnerability comes from the fact that the users can be candidate parent only if its caching window cover the viewing point of child user in a tree-based system. Many such issues in the design of cache and relay P2PVoD are addressed in [10][11]. Work done in [12] tries to solve the peer churn issue by introducing prefetching technique into cache and relay P2P VoD.

To overcome the deficiency, a mesh based P2PVoD system BitoS [13] was designed in which the streaming paths are built entirely based on data requests. Cool Streaming [14] another mesh-based system that advocates this data-driven design. Challenge lies in maintaining diversity (different blocks are scattered among different neighbor so that upload bandwidth can be fully utilized.) as well as sequential playback requirement of asynchronous users. It uses a selection process to decide which block to download. Another work [15] uses segment which is a set of blocks and highest priority is given to the segment close to the playback.

MOTIVATION AND PROBLEM DEFINITION

The motivation behind applying peer to peer paradigm for VoD service arise from its ability to leverage the bandwidth resources of end systems actually participating in the communication. Further, P2P architecture is instantaneous to deploy, and can enable support of applications with minimal setup overhead and cost. It is highly scalable, fault tolerant and robust.

P2PVoD system design presents few fundamental challenges;

- High level of streaming instabilities caused by VCR operations
- Low levels of content overlap caused by asynchronous peer playback.
- Video should be streamed sequentially in order to play.
- Handle the selfish nature of real-world streaming peers called free rider.
- Providing more control to the end user in the client software to get more market share.
- peer churn, i.e. unreliable nature of the streaming source affects P2P network performance.

Given these challenges, an ideal P2PVoD solution should contain features, under which

- Peers should be willing to contribute upload bandwidth for their own beneficence.
- Utilization of the full potential of the P2P network by streaming in parallel.
- Switch over delay (i.e. latency) due to the failure of a streaming peer should be very low.
- For practical applicability, such P2PVoD design should also be simple and fully decentralized.
- when streaming, bandwidth falls below the bit rate of the video, it should be dealt carefully.

MODIFIED GRADE BASED INCENTIVE MECHANISM

The feasibility of P2P systems is strongly based on the cooperative behaviors of distributed peers. In practice, autonomous peers are not altruistic. These peers can be selfish and misbehave in order to maximize their benefits. As a result, there could be many free riders in a peer-to- peer system that either refuse to contribute or avoid contributing bandwidth or other resources. So incentive mechanisms have been proposed to ensure fair and mutual resource sharing and to reduce churn (i.e. make peers to stay connected to overlay). Here modified grade- based incentive mechanism [16] is used to tackle both the free-riding and the streaming QoS challenges. In this approach, a grade is allotted for each peer in the overlay based on its Peer Contribution to Network (PCN) value. Based on the grade, the credit points are provided accordingly. The following steps are adopted to determine the grade of the peer. These calculations are repeated by the network every time after uploading or downloading 1 unit of data.

- Calculate the total uploaded (TU) amount and the total downloaded (TD) amount of the peer, since the peer joined the network. TU □ □ pu TD □ □ pd

Where ∑pu denotes the total amount of data uploaded by the peer P and ∑pd denotes the total amount of data downloaded by the peer P.

- Calculate the Peer Contribution to Network (PCN) of the peer. $P_{pcn} = \frac{TU}{TU+TD} = \frac{\sum Pu}{\sum Pu + \sum Pd}$

where $P_{pcn} = 0$ if TU=0 and TD=0 or any value;

- Allot the grade to the peer with respect to the calculated PCN value

$$P_g = \begin{cases} 1, & 1 \geq P_{pcn} > 0.75 \\ 2, & 0.75 \geq P_{pcn} > 0.5 \\ 3, & 0.5 \geq P_{pcn} > 0.25 \\ 4, & 0.25 \geq P_{pcn} > 0 \end{cases}$$

where $P_g$denotes the grade of the peer P based on the calculated P_{pcn}.

In order to encourage the high contributing peer and also to motivate low contributed peer to share his data, the P2P system should exercise the following fairness rule.

- The peer's Credit Points (CP) should be increased when it shares or uploads datato the network.
- The peer's Credit Points (CP) should be decreased when it downloads data from the network.

- CU_g= Credit points rewarded for uploading 1 unit of data in Grade g

CD_g = Credit Points detected for downloading 1 unit of data in Grade g, where g = 1, 2, 3, 4.

$$CU_g = \begin{cases} 2, & g = 1 \\ 1.5, & g = 2 \\ 1, & g = 3 \\ 0.5, & g = 4 \end{cases} \qquad CD_g = \begin{cases} -0.5, & g = 1 \\ -1, & g = 2 \\ -1.5, & g = 3 \\ -2, & g = 4 \end{cases}$$

The peer in the lower grade should lose more CP for downloading data than the peer in the higher grade. Calculate the total credit points available (CP_{avail}) subsequently for uploading or downloading 1 data unit.

For uploading one unit of data to the network, then $CP_{avail} = CP_{avail} + CU_g$. For downloading one unit of data from the network, then $CP_{avail} = CP_{avail} + CD_g$.

Transaction Procedure

Search for peers with files that the downloader needs. Let α be the size of the file (in units) to be downloaded and D_{max} being the maximum units a peer can download from other peers, where$D_{max} = CP_{avail}/CD_g$.

Since the CP_{avail} and grade will change after downloading each unit of data, we cannot exactly predict the value of α. However, the prediction of α helps the peer to understand the necessity of peer to stay in the higher grade and enjoy the benefits of it. If the downloading peer has sufficient CP to download each unit of data, with respect to its grade, then the requested unit of data can be downloaded from the selected peer. Continuous downloading without uploading will degrade the grade to its next lower level which will consume more CP to download the same number of data units. Eventually the CP of the peer will be spent completely earlier than expected so that the peer may be unable to download further. If the downloading peer has insufficient credit points (CP) to download a unit of data with respect to its grade (i.e. $D_{max} < 1$), then the peer must upload some units of data which will yield the required Credit Points (CP) to continue downloading.

PARALLEL BUFFER FILLING FOR MEDIA STREAMING

In this proposed mechanism, quality of the video stream is based on upload bandwidth, download bandwidth, peer churn rate, heterogeneity of the peer, buffering level of the peer, previous history of the peer, required content availability, familiar or rarest block or segment of the file, etc. Based on the above factors, Stream Reliability Value (SRV) is calculated dynamically for every peer, for every session, and for every change in peers' population. A peer's health is determined by the amount of file it has which is specified in the torrent to share.

Mathematical Analysis of Stream Reliability of a Peer

Bit rate, frame rate, and screen resolution are the parameters that decide the quality of the video. A user can request for a video specifying the desired bit rate, frame rate and resolution like 240p, 360p etc. Subject to the availability of the resources and efficient video coding techniques, requested user can receive the video at the expected level. Suppose due to unavailability of enough resources, video quality will be compromised and degrade to lower level to satisfy the real time requirements of the asynchronous users.

Peer Feasibility Ratio

Peer should have enough upload bandwidth to serve the requested video with the requested quality. The quality of the video and the file size of the video mainly depend on bit rate of the video. So, to check whether a peer is eligible to take part in the streaming, peer feasibility ratio is calculated and it is defined as the ratio between total upload bandwidth and bit rate of the video (include frame rate and resolution). Subsequently Peer Eligibility Value (PEV) is assigned for every peer in a group.

Peer Feasibility Ratio (PFR) =

$$\frac{\text{total upload bandwidth}}{\text{bit rate of the video}} \qquad PEV = \begin{cases} 1, & PFR > 1 \\ 0.5, & 0.5 < PFR \leq 1 \\ 0.2, & 0.05 < PFR \leq 0.5 \end{cases}$$

Upload Bandwidth Utilization (UBU)

It is the ratio between bandwidth available for upload and total upload bandwidth. Currently some amount of bandwidth may be in use for previous streaming request, UBU value has to be calculated for every new request received by a peer. Depending on the UBU value, Upload Bandwidth Value (UBV) is assigned as follows. This UBV identifies the potential peers.

UBU =

$$\frac{\text{bandwidth available for upload}}{\text{total upload bandwidth}} \qquad UBV = \begin{cases} 1, & UBU > 0.7 \\ 0.5, & 0.3 < UBU \leq 0.7 \\ 0.2 & 0.05 < UBU \leq 0.3 \end{cases}$$

Download Bandwidth Utilization (DBU)

It is the ratio between bandwidth available for download and total download bandwidth. This value is calculated for all the peers playing the intermediate role as transport nodes. Depending on the DBU value, Download Bandwidth Value (DBV) is assigned. DBV identifies the contributing peers.

$$DBU = \frac{\text{bandwidth available for download}}{\text{total download bandwidth}} \qquad DBV = \begin{cases} 1, & DBU > 0.7 \\ 0.5, & 0.3 < DBU \leq 0.7 \\ 0.2 & 0.05 < DBU \leq 0.3 \end{cases}$$

Connectivity Probability Level (CPL)

The video quality improves as the peer "connect probability" increases. Connect probability is inversely proportional to peer churn rate. If peer churn rate is high, overlay maintenance is difficult. To overcome peer churn problem, modified grade-based incentive mechanism, explained in section 4 is used. Best grade value indicates best peer used in selecting high reliable peers. Based on PCN value, CPL values are assigned as follows.

Peer Heterogeneity Level (PHL)

Peers are heterogeneous in their capabilities. At system level, it may be due to CPU power, memory, bandwidth, or by difference in the willingness of the peers to contribute etc. Peers Selection mechanism must be capable to tackle

$$CPL = \begin{cases} 1, & 1 \geq P_{pcn} > 0.75 \\ 0.75, & 0.75 \geq P_{pcn} > 0.5 \\ 0.5, & 0.5 \geq P_{pcn} > 0.25 \\ 0.25, & 0.25 \geq P_{pcn} > 0 \end{cases}$$

such heterogeneity problems as well. Since bandwidth and memory buffer are calculated separately, CPU power is

only considered for peer heterogeneity. It is defined as the ratio of CPU power utilized for P2P service and total CPU power available, used to assign Peer Heterogeneity Value (PHV). It is used to give priority for super peer over ordinary peers.

$$PHL = \frac{\text{CPU power utilized for P2P service}}{\text{total CPU power available}} \qquad PHV = \begin{cases} 1, & PHL > 0.5 \\ 0.5, & 0.3 < PHL \leq 0.5 \\ 0.3 & 0.02 < PHL \leq 0.3 \end{cases}$$

Memory Buffer Contribution (MBC)

It represents the moving buffer window allocated and maintained by a peer for P2P service. The peer which allocates more space will be very useful in achieving VCR operations of asynchronous users. MBC is the ratio between memory buffer used for P2P service and total memory capacity of the system. Based upon the Value of MBC, values are assigned for Buffer Contribution Level (BCL).

$$MBC = \frac{\text{memory buffer used for P2P service}}{\text{total memory capacity of the system}} \qquad BCL = \begin{cases} 1, & MBC > 0.5 \\ 0.5, & 0.2 < PHL \leq 0.5 \\ 0.3 & 0.02 < PHL \leq 0.2 \end{cases}$$

Required Content Availability (RCA) and Reputation Value (RV)

The peer which contains the required content or video in part or full and ready to share will be handy in achieving the goal of P2PVoD system. A peer is called seed if it has full content. Rating will be given for each peer according to the percentage of content it has. RCA is defined as available content size divided by total content size which determines Health Level (HL) of a peer for that particular file.

$$RCA = \frac{\text{available content size}}{\text{total content size}} \qquad RV = \frac{\text{sum of marks awarded for each transaction}}{\text{sum of maximum marks awarded for each transaction}}$$

Reputation assessment is done by consuming peer which a provider peer reveals to the P2P system by its transactional history and its capacity. The evaluation of a peer's transaction history is called its reputation value. It will be calculated after every transaction with another peer. For our convenience, three months transaction history and the mark awarded for every transaction will be recorded. At the end of each new day, mark recorded for the first day of the three months history will be removed and current day mark will get appended. Reputation Value is defined as the sum of marks awarded for each transaction and sum of maximum marks awarded for each transaction. RV lies between 0 and 1.

Rarest File Priority (RFP)

A peer may request for a file which is rarely available or very recently introduced. The peer having rare file will be rated high and will be given more priority. RCA deals only with the ordinary files available in multiple peers but RFP dealing with only rare files. To rate a file as ordinary or rare, a threshold number indicating minimum number of resource available is maintained. If it is less than the threshold number, then it is rated as rare file. Rarest File Priority (RFP) is defined as amount of rarest content available divided by total size of the rare file. If it is a seed, then it will have value 1.

$$RFP = \frac{\text{amount of rarest content available}}{\text{total size of the rare file}}$$

Stream Reliability Value (SRV)

SRV of each peer is calculated by taking the sum of PEV, UBV, DBV, CPL, PHV, BCL, RCA, RV, RFP divided by 3, so that SRV is normalized to have value between 0 and 3.

SRV =

$$\frac{PEV+UBV+DBV+CPL+PHV+BCL+RCA+RV+RFP}{3} \qquad \text{Peer Reliability} = \begin{cases} HRP, & 2 < SRV \leq 3 \\ MRP, & 1 < SRV \leq 2 \\ LRP, & 0 < SRV \leq 1 \end{cases}$$

The SRV calculation allows categorizing the peers into 3 groups namely High Reliable Peers (HRP), Medium Reliable Peers (MRP), and Least Reliable Peers (LRP).

Normally for streaming a video file, the chunk has to arrive in sequence within the stipulated time. The requesting peer will contact tracker to get the list of peers where the requested file is available. Best streaming source will be selected from the list and the remaining peer in the list will be inactive as shown in figure 1.

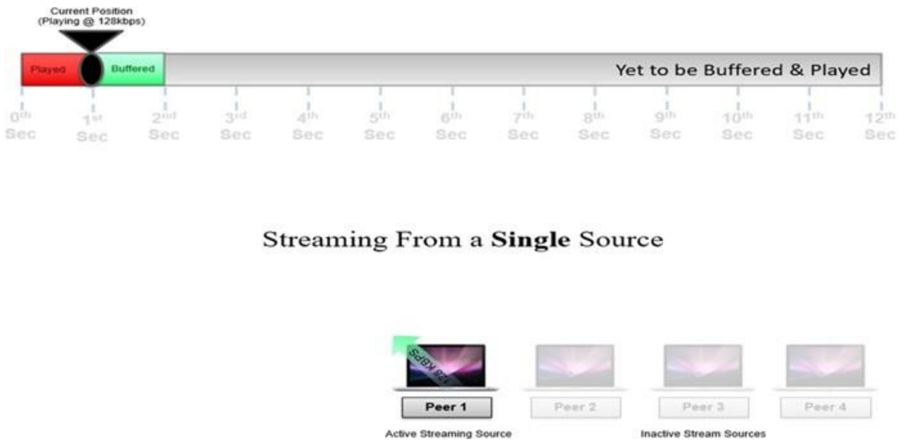


Figure 1 Streaming from single source

Figure 2 Soggy playback due to switching delay

Suppose if the streaming source departs either gracefully or suddenly, the destination peer will have to switch to next best peer from the list of inactive peers at the cost of some switching delay or jitter. At that instance, user will face a soggy playback as shown in figure 2.

To overcome the above said problem, proposed parallel buffer filling method is used. Here parallel streaming from multiple resources and buffering the content before the playback time helps to experience a smooth playback as illustrated in Figure 3. It uses multiple streaming resources to fill the client buffer simultaneously. It is achieved by filling the buffer in chunks as shown in Figure 3.

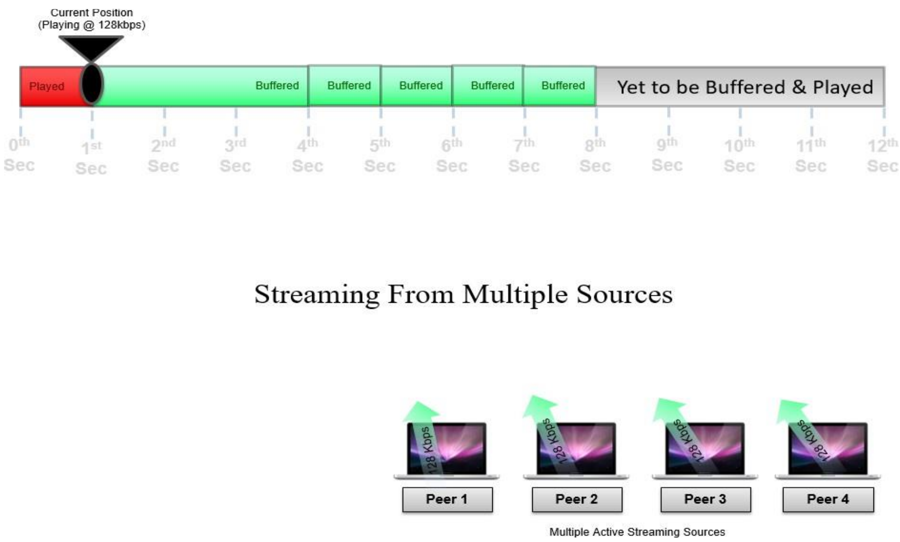


Figure 3 Streaming from multiple resources

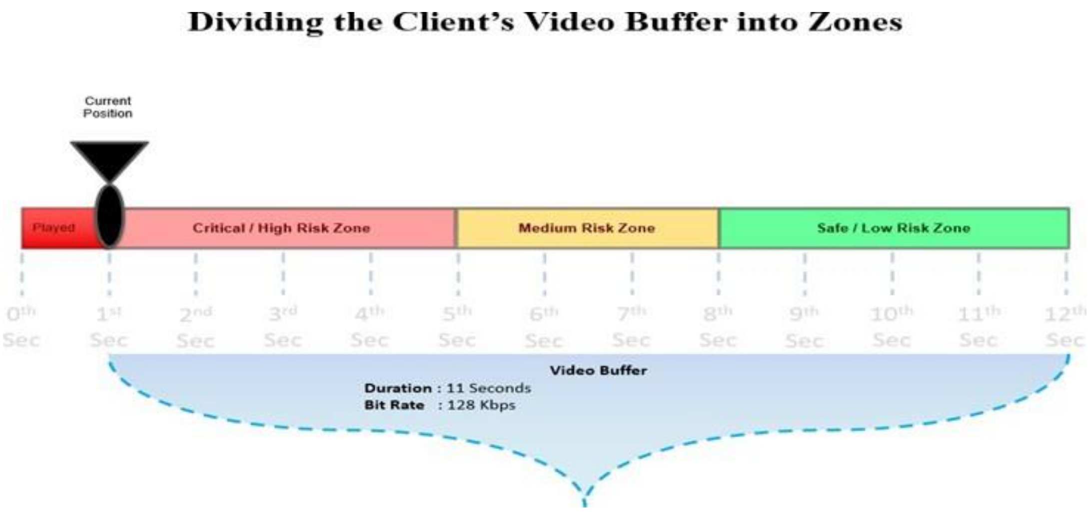


Figure 4 Client Video buffer showing HRZ, MRZ, LRZ

Here buffer space for 8 seconds has been filled earlier than the playback time, so that the video playback is very smooth. The proposed mechanism requires dividing buffer into 3 zones namely High-Risk Zone (HRZ), Medium Risk Zone (MRZ), Low Risk Zone (LRZ). The buffer near to the playback is called HRZ. Next to the HRZ, MRZ is available. End portion is LRZ. This is shown in Figure 4.

Each buffer zone is split into chunk spaces (i.e. A1, A2, A3 and A4 are the chunk spaces in HRZ for the first 4 seconds) each capable of storing video data for 1 second. Similarly, B1, B2, B3 and C1, C2, C3, C4 are chunk spaces in MRZ and LRZ respectively.

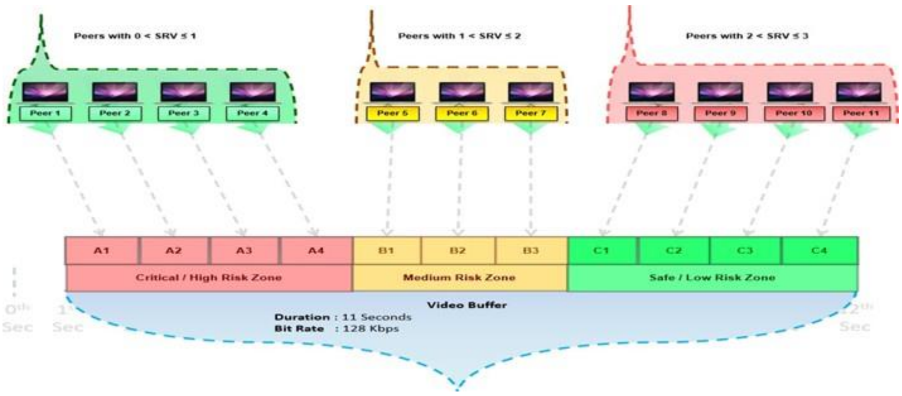


Figure 5 Parallel buffer filling

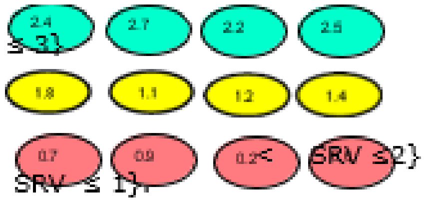
Using this parallel buffer filling, the proposed method effectively streams the video in parallel from multiple streaming sources and also eliminates the switch over delay by dynamically calculating the SRV of the streaming sources. Also, the playback time identifies the critical levels in the video buffer and groups them with the source peers based on their streaming reliability so that the video chunks could be downloaded from source peers far effectively. If the bit rate of the requested high-definition video is unable to meet, still smooth playback can be achieved by reducing the quality of the video.

Parallel Buffer Filling Method

Step 1: Identify all the potential streaming sources in the P2P network. **Step 2:** Calculate the Stream Reliability Value (SRV) for each streaming source peer.

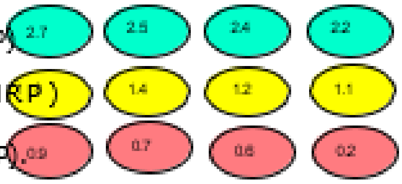
Step 3: Group the streaming sources based on the calculated SRV as shown below.

1. High Reliable Peers (HRP) {2 < SRV ≤ 3}
2. Medium Reliable Peers (MRP) {1 < SRV ≤ 2}
3. Least Reliable Peers (LRP) {0 < SRV ≤ 1}.



Step 4: Sort each group based on the SRV of the streaming source

1. High Reliable Peers (HRP)
2. Medium Reliable Peers (MRP)
3. Least Reliable Peers (LRP).



Step 5: Divide the video buffer into N equal parts, where N is the number of seconds of the video.

1	2	3	4	5	6	7	8	9	10	11	12

Step 6: Based on the playback time identify the following three zones in the video buffer:

1. Critical / High Risk Zone (HRZ)

1	**2**	**3**	**4**	5	6	7	8	9	10	11	12

2. Medium Risk Zone (MRZ)

1	2	3	4	**5**	**6**	**7**	**8**	9	10	11	12

3. Safe / Low Risk Zone (LRZ).

1	2	3	4	5	6	7	8	**9**	**10**	**11**	**12**

Step 7: Now fill the video buffer as given below

a) Critical / High Risk Zone (HRZ) by High Reliable Peers (HRP),

b) Medium Risk Zone (MRZ) by Medium Reliable Peers (MRP),

c) Safe / Low Risk Zone (LRZ) by Least Reliable Peers (LRP).

MULTIPLE ANT COLONY OPTIMIZATION (MACO) FOR RELIABLE AND OPTIMIZED STREAMING

In MACO [13], more than one colony of ants is used to search for optimal paths, and each colony of ants deposits a different type of pheromone represented by a different color. Each colony of ants gets attracted by the pheromone deposit of the ant of their own colonies and ants of one colony are repelled by the pheromone deposit of the ants of other colonies due to repulsion mechanism [14, 15]. An artificial ant is a simple program or a small message consisting of simple procedures that simulate the laying and sensing of pheromone, and data structures that record trip times and the nodes that it passes. Migrating from node to node, an artificial ant emulates laying of pheromone by updating the corresponding entry in the pheromone or routing table in a node which records, for example, the number of ants that pass that node. All the routes from the source to destination should be explored and recorded in the probabilistic routing or pheromone table with the help of artificial ant. Ant's explorations quickly converge in finding the shortest path between any two nodes in the network.

MACO for Optimizing P2PVoD

When ACO is compared with P2P networks, many similar characteristics are found. First feature is their ability to adapt to a changing environment. If an obstacle is placed on the path from the food source back to the anthill, ants are capable of finding the shortest path around the obstacle and possibly find food sources closer to the anthill. Similarly, P2P network exhibit self-organization character. Since peers' population changes continuously due to peer churn, the topology of the P2P network changes and get stabilized by itself. Second feature is that ants are autonomous by nature. There is no supervisor ant, which coordinates the labor of the ants, but still the collective organization of the colony is well-ordered. Likewise, peers are autonomous and there is no central authority to control it and it will adapt to changes in the environment and to keep on functioning even one of the peers stops functioning (or ant dies). The dynamic peering relationships make the video distribution efficiency unpredictable. Different data packets may traverse different routes to users. Consequently, users may suffer from video playback quality degradation ranging from low video bit rates, long startup delays, to frequent playback freezes and packet drop due to network congestion and network failures.

Adopting the problem-solving paradigm of MACO, two sets of mobile agents similar to ant are used. Both colony of ants will explore the network and record its routes in their own routing table. Each ant will prefer the routes recorded in their own routing table and keep away from the routes used by other colony of ants. So, more than one path is explored between a pair of nodes to solve network congestion and network failure issues. Now consider the parallel buffer filling mechanism for filling buffer with video chunks. Initially the ant will calculate the cost of all the routes between the source N_1 and N_6 as shown in figure 6.

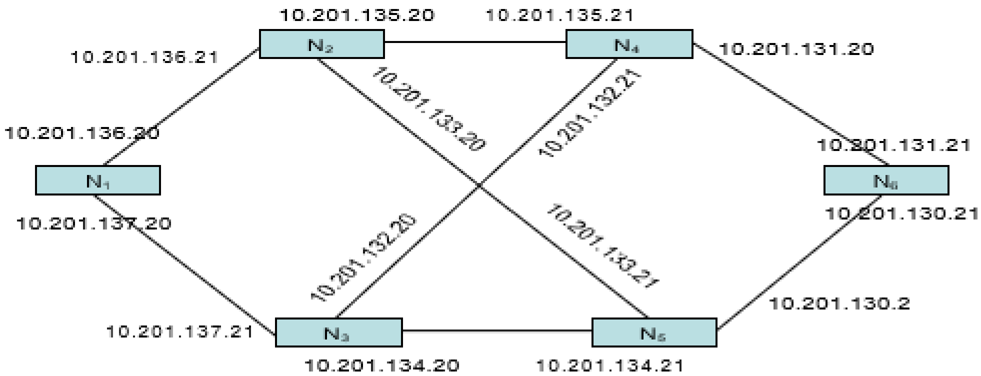


Figure 6 Sample network topology for routing and load balancing

Cost of the route is a function of link cost, bandwidth, congestion, packet latency, TTL, Round Trip Time (RTT). Cost of each route is calculated and ranked accordingly. In our example, out of many routes, the best path will be used by HRP, the next best path will be used by MRP, and the third best path will be used by LRP. In due course of time, an optimal path may become non optimal due to congestion, network failure etc. There are chances to discover new or better path due to change in network topology and peer population. Extra paths are kept in reserve and it will be used when any path is congested, or met with failure. The cost of the route is calculated dynamically and ant helps in exploring new paths. The cost of all routes is calculated at regular interval of time and routes are ranked periodically and made available to different groups of peers like HRP, MRP, LRP for parallel filling of the buffer space of a destination peer to stream the data at playback rate.

Implementation

For implementation of media streaming using MACO in P2P network, consider the sample network topology shown in figure 6. Here N_i indicate i^{th} router in the network and each IP address indicate a network connected to the router. Each will have any number of peers. The features required to find multiple paths and rank the path according to the TTL or RTT should be incorporated into artificial ant. These features are shown in ant header format shown in table 1.

Table 1 Ant header format

Field	Description
ANT ID	An integer to identify the ant
ANT TYPE	Gives information about the ant colony to which the ant belongs
SOURCE	It is the IP address of the source machine

DESTINATI ON	It is the IP address of the destination machine
FROM	IP address of the intermediate machine from where packet came from
TO	IP address of the intermediate machine to where packet has to go
DIRECTION	It indicates the forward or return direction
HOPCOUNT	It indicates the number of routers that the ant has crossed
RETURNHOP	Number of routers, ant has to cross to reach the source from destination
IPLIST	list of IP address, indicate the path between a source and destination

Results and Discussion

One portion of the result is shown in table 2. Each row in the table indicates a path between source and destination. The last number in each row indicate number of ants travelled in that corresponding path and also it indicates the pheromone level deposited in that path. Pheromone table shown in table 2 is formed by one type of ant (e.g. blue ant). Similar pheromone tables will be formed and stored for other colonies of ant. From pheromone table, it is easy to identify the shortest path which is highlighted and it is used by the HRP to stream the HRZ. According to the SRV value of the peers, remaining path will get allocated for the peers belong to MRP and LRP so that video stream is delivered within real time. It helps to find new path and maintain the robustness of peer churn problem.

Table 2 Pheromone Table

"10.201.137.20,10.201.137.21,10.201.132.20,10.201.132.21,10.20 1.131.20,10.201.131.21,10.201.130.21",4
"10.201.137.20,10.201.137.21,10.201.132.20,10.201.132.21,10.20 1.135.21,10.201.131.20,10.201.131.21,10.201.130.21",1
"10.201.137.20,10.201.136.20,10.201.136.21,10.201.135.20,10.20 1.135.21,10.201.131.20,10.201.131.21,10.201.130.21",1
"10.201.137.20,10.201.137.21,10.201.134.20,10.201.134.21 ,10.201.130.20,10.201.130.21",46
"10.201.137.20,10.201.137.21,10.201.132.20,10.201.134.20,10.20 1.134.21,10.201.130.20,10.201.130.21",1
"10.201.137.20,10.201.137.21,10.201.134.20,10.201.132.20,10.20 1.132.21,10.201.131.20,10.201.131.21,10.201.130.21",1
"10.201.137.20,10.201.136.20,10.201.136.21,10.201.135.20,10.20 1.135.21,10.201.132.21,10.201.131.20,10.201.131.21,10.201.130. 21",1
"10.201.137.20,10.201.136.20,10.201.136.21,10.201.133.20,10.20 1.133.21,10.201.130.20,10.201.130.21",1

Conclusion

In this paper, a new parallel buffer filling architecture for on demand services is proposed and analytically modeled to handle Quality of Service (QoS) problem like jitter, throughput etc. This model uses an effective incentive mechanism to control peer churn and eliminate free rider in P2PVoD. The proposed design enhances the performance of the video streaming by effectively streaming the video in parallel from multiple streaming sources and selecting high reliable peers to stream for high-risk zone in buffer. It utilizes the full Potential of the P2P network. MACO is applied to enhance the reliability and performance of video delivery and optimize the robustness of P2PVoD.

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