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An Ant Based Rate Allocation with Scalable Video coding for video streaming in Peer to Peer Networks

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Abstract-In our daily life, the consumption of wireless technology grows widely and more specially on video multicast application. Video multicast in wireless networks depends on bandwidth and also the data rate. P2P network shares the files directly in a connected pool of networks without having a central server. It is an issue in peer-peer networks to achieve reliable video multicast on multiple users, if one consumer affects with low data rate that will affect others receivers too. While sharing the video streams in Wireless Networks, have to maintain the quality as well as aware of congestion control. The research work focuses on reliable video multicasting in P2P networks. This paper proposes a novel method to overcome the above issue using Ant Colony Optimization (ACO) which combines with Scalable Video coding Technique (SVC) that achieves reliable video multicast in P2P networks. ACO is used to find optimal path between multiple sources of network and SVC encode the video streams for more efficient usage of network bandwidth.

Keywords: Peer-Peer Networks, Ant Colony Optimization, Scalable Video Coding, Video Multicast.

Introduction

Wireless mesh networks (WMN) are widely used because of its tolerant ability against network failure, simplicity and broadband capabilities. WMN are propitious technology for furnishing low cost internet access and also provide a new type of application and services for clients accessing the network. Multicasting is used for providing an efficient way to transmit the data from a source to many receivers in WMN. In a recent year Peer to Peer (P2P) technology deployed in WMN is a replacement for multicast because of its decentralized architecture provides scalability and resilience to node failure. P2P is a type of transient internet network that allows a group of users with the same networking program to connect with each other and directly access files from another's hard drivesthat eliminates the dedicated servers to control over it.It is a compelling content distribution paradigm because all the content is transferred directly between ordinary peers without passing through third party servers. Thus P2P has been successful and widely deployed in many areas over the Internet, from one-to-one communications and one-to-many communications such as file sharing and streaming. While sharing the streaming data on multiple channels creates delay and reduce the video quality of the entire network. In this paper describe ant based rate allocation and scalable video coding (SVC) for P2P streaming system application.

Ant based rate allocation inspired by as they walk along their path sensing intensity of pheromone (chemical substance) deposited by other ants. It minimize the effect on network performance by precisely deciding to whom the search messages (ants) should be forwarded, bringing about lower transmission capacity utilization in order to perform a search. Ant optimization used to solve the routing overhead and routing adaptions than traditional routing [17]. SVC is used to improve video quality in streaming application. In SVC, a video stream is encoded at the highest resolution and divided into layers such that each receiver can decode the video stream at its preferred rate and resolution with a set of layers. The base layer includes the information required for displaying the minimum quality video frames, and additional layers, namely the enhancement layers, provides refinements. As the user receives more enhancement layers, the video quality the user experiences accordingly rises. The video streaming rate is adapted to the allocated transmission rate of a node by sequentially dropping video frames in enhancement layers according to their priorities.

The rest of paper section II reviews the related work. Section III formulates the system model for solving rate allocation and provides better video quality. Section IV explains about simulation result and section V concludes the summary of results.

Related Work

P2P networks are widely used in multicast broadcasting. While transmitting data on the network it should constantly maintain data rate and video quality or else it cause congestion and poor image quality. In P2P networks, the system capacity scales up when increases the number of peers joins, as peer upload capacity is utilized. ACO is a popular and proven approach to solve the computational and complex distributed problems.

(UbaidAbbasi et al., 2009) focuses on the real-time content delivery of streaming applications like live and video on Demand (VoD). The adaptive video streaming mechanism is proposed to construct overlay networks in light of Small World (SW) of peers. The Scalable Video Coding (SVC) combines with key characteristics of push-pull mechanisms are used to improve the delivery ratio of packets and overall QoS. The push-pull mechanism allows receiving full video content by fetches the missing parts of video explicitly, and reduces the latency.

(Osama Abboud et al., 2010) proposed for streaming application by QoE aware layer selection algorithm that uses Scalable Video Coding (SVC) for supporting heterogeneous resources and reducing the impact of P2P network.

(HadiGoudarzi et al.,2011) proposes an algorithm based on ACO for handling the dynamic network of Unstructured P2P networks. They also use the assumed fountain codes for encoding media streams that resolves the difficulty of receiving different parts of media streams based on some specific order.

(Xiaotao Wu et al., 2007)proposed an enhanced hybrid ALM based P2P for considering the leverage application specific behaviour. The three step algorithm is used to construct ALM based P2P conference for achieving different capabilities of application behaviour. The hybrid architecture is used to balance the consumption of power and required bandwidth. In hybrid ALM Based P2P architecture, each bridging node can bridge mixing incapablenodes into a conference. It uses greedy algorithm when multiple parties try to form a conference to help in mixing incapable nodes to find nearest bridging nodes.

(Ant´onioHomem Ferreira, Carlos Martinho 2013)proposed an Ant-Based Algorithm for performing in-network resource search in a swarm-like P2P network. This approach focuses on minimizing the impact has on network performance without affecting user experience. This is done based on the total number of nodes already visited by the search ant through the pheromone marking, strategy and message forwarding adaptation. A distributed search engine can be implemented based on ant foraging behaviour. (ChangqiaoXu et al., 2014) propose an Ant-inspired Mini-Community based Video sharing solution (AMCV) for on-demand streaming services in wireless networks. AMCV bases the service efficiency by Two-Layer Architecture. 1) Mini-Community network layer is used to support discovery of fast content and access through algorithms innovatively by constructing static and dynamic connections between the communities. 2) Community Member Layer is used to support high efficient resource sharing and low maintenance cost by controlling with management resources and members in the community.

(A.Duraisamy, M.Sathiyamoorthy, 2013) proposes an ant colony optimization algorithm and bandwidth to prove the P2P is indeed more productivity by considering the factors of scalability, response time and reliability of serving the request. The designed mechanism tries to reduce load on a server by getting the video directly from nearby peers and also storing previous optimal peers path with captured throughput. (Gui Zhang, Chun Yuan, 2010) proposed unstructured P2P network for video streaming that supports H.264 and scalable Video Coding(SVC) considering heterogeneous networks and bandwidth fluctuation. BT-Like (Bit Torrent) mesh-pull approaches are used to achieve high bandwidth playback videos. Video streaming is encoded by using the scalable video coding and packed into RTP packets as per RFC3984.

Proposed peer to peer video streaming

In this section provide a detailed explanation of ant based (ACO) rate allocation algorithm and Scalable video coding method for media streaming over peer to peer networks. The overlay structure for P2P streaming as shown as Fig.1

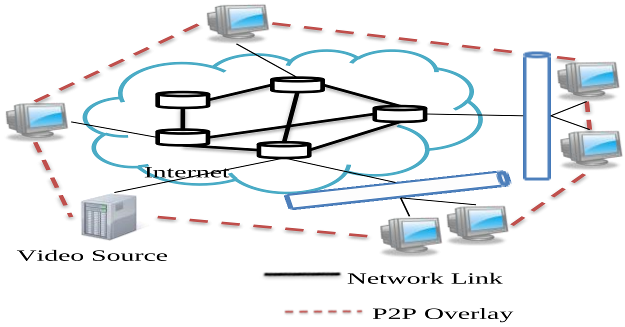

Fig.1 The overlay structure for P2P streaming

A. Foraging Behaviour of Ants

Ants establish the shortest path in the between nest and their food in a completely distributed and autonomous design. Ants first meander to scan for food. When they discover a food source, they come back to the nest while leaving a trail of chemical substance got back to pheromone on their path. The pheromone attracts in different ants and aides them to the food. The likelihood that the ants nearing later pick a path is proportional to the amount of pheromone on the path.

B. Ant-based Routing Algorithm

In the proposed algorithm, each node has a sort of routing table called pheromone table as shown in table 1.

Each node has an entry for every possible destination in the network, and every table has an entry for each neighbouring node. The (i, j) member of the pheromone table indicates the pheromone intensity between the current node and its jth neighbour fordestination i. Pheromone table determines the routing behaviour of network nodes. Pheromone table determines the routing behaviour of peer to peer network nodes. When an ant arrives at a node, it chooses its next node based on pheromone intensities of pheromone table in a probabilistic manner.

Table 1. Pheromone Table

Destination	Neighbour			
	a1	a2	. . .	a_m
d1	p(1,1)		. . .	p(1,m)
d2	p(2,1)		. . .	p(2,m)
. . .	. . .	. . .	. . .	. . .
dn	p(n,1)	p(n,2)	. . .	p(n,m)

Here, node j is one of the neighbours of node k where the ant is currently visiting which is called random proportional transition rule.

$$P_k(i,j) = \begin{cases} \frac{\phi_{i,j}}{\sum_{l \in \Im} \phi_{i,j}} & if\ i \in \Im \\ 0 & if\ i \in \Im \end{cases} \quad (1)$$

In this equation $\Im$ is the set of node $k's$ neighbours that the ant has not visited yet and $\phi_{i,j}$ is the i,j element of the pheromone table, denote the pheromone amount on link k,j for all ants intended to node i.

Every ant saves the path it tour so that when the destination is found, it could find its pathback to the source. In its path backward to source, the ant updates pheromone tables of each and every node it has visited in the forward path according to the definite rules. Eq.2 denotes the updating rule.

$$\phi_{i,j}(t+1) = (1-a) * \phi_{i,j}(t) + \Delta\phi \quad (2)$$

Here $\Delta\phi$ is the amount of pheromone added to the link and it refers the pheromone evaporation. The amount of $\Delta\phi$ depends on network parameters which is congestionand delay. At the starting part of the algorithm, all network node links are start with a little amount of pheromone, $\phi_{i,j}(0)$ then, the pheromone is updated according to eq.2

C. Ant-Based Rate Allocation

Ant-based routing algorithms have several properties that make them an applicable selection for peer to peer networks. Specifically, simple, purely distributed multipath unstructured peer to peer networks which is an important and desirable property. The shortest path is accidentally broken; an alternative path eventually becomes the new shortest path.

Assign a pair (R, A) to each media (video) provider where $R_i A_i$ characterize the rate and availability of node i respectively. R_i is the rate that node i claims it can support. The availability of node i, denoted by A_i, is a measure of time during which node i is on. The set T contains all the nodesthat have therequested stream available.

In the first step, the node D starts its pheromone table. At that point as indicated by its desirable rate, R, it generates various agents, which is call ants. Presently have a system in which the source has a direct link to every receiver. Here, by the source mean the source of ants and in the same manner, collectors are media providers who get forward ants. The main thing to do is to allocate pheromone to links. Having done that, ants take after the links with more pheromone in a probabilistic method.

Add pheromone to links according to the availability and rate of the media provider at the end of the link. Pheromone on link i is related to

$$\Delta\phi = A_i * R_i \quad (3)$$

Assume that the node D has produced N forward ants. The total number of ants is proportional to N.Every node receives various forward ants. The more ants a node receives, the higher rate it is asked to give. In light of getting forward ants, the node generates some backward ants and sends them again to D. The quantity of backward ants created by node i is corresponding to the rate that the node can provide, i.e. R_i. It must be referred that backward ants do not transmit traffic themselves but they refers the rate by which traffic is transmitted to D.On receiving these backward ants, D modernizes its pheromone table according to eq.2, where $\Delta\phi$ is given by eq.3. It is very clear that the pheromone values for individuals nodes that can provide higher rates through longer periods of time produce rapidly.Proposed peer to peer video streaming as shown in Fig.2

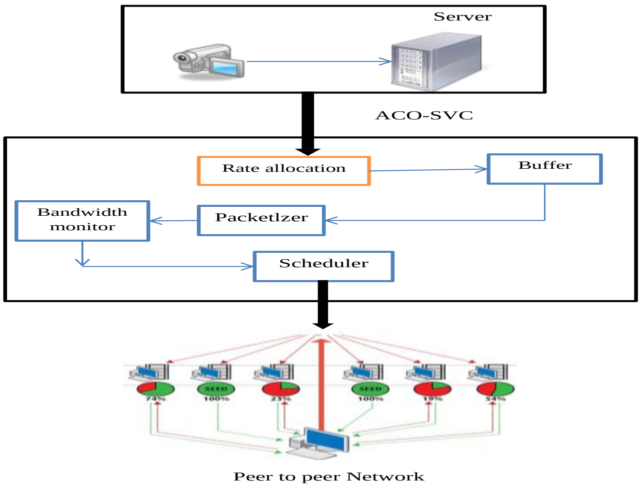

Fig.2 Proposed peer to peer video streaming

Each network path contain in two segments connected through an intermediate node incoming packets from the first segment that simply forwards after possible buffering delay, tothe client on the second segment. The network channels between the client and the server are denoted as lossless links, variable bandwidth. The variable approach of the bandwidth implies that the rate at which the channels data placed in the server's buffers, changes are made by a function of time. The other end, the client waits for a starting playback delay after its request for a stream. It can starts decoding the media stream, and plays it sequentially. This will be easily imagined in the context of peer-to-peer applications, wireless video transmissions via numerous interfaces, or even content distribution networks. The video is encoded into multiple layers for every good quality, and the accessible aggregated rate between the client and any server represents the share of the total link bandwidth reserved or allocated, by the streaming application.

The video sequence bit stream using a scalable (layered) video encoder. The bit stream is then fragmented into network packets utilizing basic rules. The first rule is each network packet contains data relative to video frame and the second rule is an encoded video frame can be fragmented into several network packets as shown as fig.3.

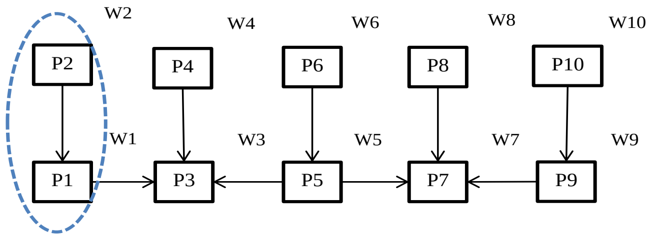

Fig.3 Network packets

Let $P = \{p_1, p_2, \dots, p_n\}$ be the ordered sequence of N network packets, after fragmentation of the encoded bitstream. Every network packet P_n is characterized by its size S_n in bytes, and its decoding timestamp t_n^d. From the user viewpoint, all the video packets are not equivalently valuable, due to the nature of the video information. Therefore, every network packet can be characterized by aweight w_n which represents the reduction in the alteration apparent by the user, in the situation where packet p_n is successfully decoded.

D.SVC for Network Transport

One typical application for SVC is bit-rate adaptation for transport over peer to peer systems. The media is not specifically exchanged from source to user, however is relayed through peers of an overlay system. For this utilization case motioning inside the bit stream is a paramount feature for permitting the source node and relay nodes to apply bit stream adaptation. A relay or peer node may like to discover which parts of the bit stream could be dropped first and foremost, if adaptation is needed. This may be the situation when network congestion occurs. A SVC bit stream can backing up to three dimensions of scalability, a peer node needs to get itemized data about the significance of the video data as far as reconstructed quality. Anyway a peer might additionally depend on absolute essentialness values for adaptation. Along these lines, the encoder should already have chosen the adaptation path through a global bit stream identification of video.

E.SVC Stream Adaptation

The main objective for SVC stream adaptation is to guarantee optimum video quality for a given proposed ACO-SVC approach where these imperatives may be either static after the session set up or might progressively change over the session duration. Terminal capabilities like processing power or screen size which is supported profile, display resolution and level combination. Network capabilities like the maximum bandwidth, such as a network status information ,dynamically changing constraint, the currently available packet loss ratio or bandwidth.Optionally also user related capability like a personal preference indication for sequential resolution versus spatial detail.

F.ACO-SVC Algorithm

Step 1: Initialize pheromone table.

Step 2: Fix β such that N $=\beta\Re$ is in the order(direction) of a few kilobytes.

Step 3: Send N forward ants to the supplying video peers listed in T.

Step 4: Upon reception of backward ants from the supplying video peer i

Step5: $R(a) = (1 - p(a)) * (p1 * AVQ + p2 * ps))$, $R(a)$ indicate rating for a specific action, p denote probability AVQ *is* average quality and ps playback smoothness. Consider, video quality, interrupt ratio and playback smoothness respectively.

Step 6: local segmentation is done by

$AVQ = \frac{\sum_{i-next-n}^{next} segment\_max\_layer(i)}{N}$,,
$segment\_max\_layer(i)$ is the highest layer id in segment i.

Step 7: Continuous (sequence) video play with the similar layer is called one run r and its length is denoted as
$Nr.PS = \frac{\sqrt{\sum_r Nr^2}}{N}$.

Step 8: peer interruption probability define $P(a) = \frac{1}{1+e^{f(a)}}$

Step 9: Repeat steps 2 and 3 until the end of video streaming session.

Performance Evaluation

In this proposed work, OMNET++ is used to build the simulation peer to peer streaming environment and the proposed techniques are simulated to evaluate the performance utilizing buffing delay, Mean response time, retransmission delay and data rate for tramitting the viedo file. Table.2 shows the parameter values of simulation setup.

A. Simulation metrics

Table.2 parameter values

Parameter Value	
Sequence Length	89998 frames
Video Size	7.2e + 06 bytes
Format	QCIF (176 × 144 pixels)
Video Run Time	1.6e + 06 msec
Mean Bit Rate	1.9e + 05 bps
Peak Bit Rate	1.8e + 06 bps
Video Encoding	H.264

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Frame Rate	26 fps
Video sequence	Hall

Introduce a cost function C as the weighted sum of the expected number of jitters $E\{j\}$ and the average jitter-recovery buffing delay.

$$C = (1-\alpha)\bar{D} + \alpha\, E\{j\} \quad (4)$$

Mean response time

$$E(T) = {(1/\mu)}\Big/_{(1-\rho)} = {}^{1}/_{\mu} - \lambda \quad (5)$$

Where λ denotes arrival rate and μ denotes the service rate, T denotes mean response time, ρ is called per-server utilization.

Retransmission delay is three times the actual one-way delay of the link in the first transmission. The extra delay t_e determine using below equation

$$\frac{S_{playoutBuffer}[byte].8}{x_{MPEG}[bps]} > \frac{3RTT[s]}{2} + t_e[s] \quad (6)$$

Where bps denotes bits per second and RTT refers the retransmission time.

Throughput is the rate of successful delivery of video packets over a peer to peer network.

$$Throughput\ (bit/sec) = \frac{packet\ size}{time} \quad (7)$$

Data rate of video streaming traffic when users do not interrupt the video download. It is the size of the viedo file transmitted at the particular time.

B. Simulation results

The simulation plot the upper bound which is the time to download the whole video, and the lower bound which is the base buffering time needed for nonstop video playback accepting all the future bandwidth availabilities are known from the earlier. The expanding video bit-rate ratios (R/μ) utilized, which longer buffering times are required to adjust for the higher video bit-rate ratios. Second, the registered buffering time is strikingly near the lower bound, implying that the prescient buffering algorithm can accomplish close ideal buffering time and keep up a high effective playback ratio. This demonstrates that by utilizing the certainty interim mean attain significantly better effective playback ratio (Fig. 4) but with just unimportant in the buffering time. At last, the normal buffering time is for the most part closer to the lower bound by and large exhibit altogether more and bigger varieties in the accessible bandwidth. Hence to adjust for the larger bandwidth varieties the prescient buffering algorithm must develop the buffering time longer to guarantee consistent playback. Nodes can quickly receive high playback continuity if contain different type of distance and the retransimmion delay is very low.

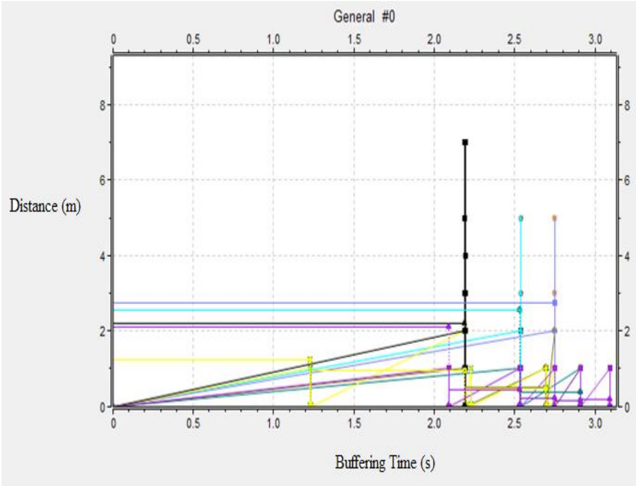

Fig. 4 Buffering time for different distance simulation runs

The simulation and analytical results of the expected number of jitters for diverse normal buffering delay values. Fig. 5 demonstrates the comparison for throughput with buffer delay.

On serve a good match between the analysis and simulation results. Also, not surprisingly, the mean number of jitters decreases as the buffering delay increases. Note that the variations in the analysis curve of Fig.5 are because of the Variable bitrate (VBR) nature of the video. The comparisons for different node are comparative and is prohibited to reduce redundancy.

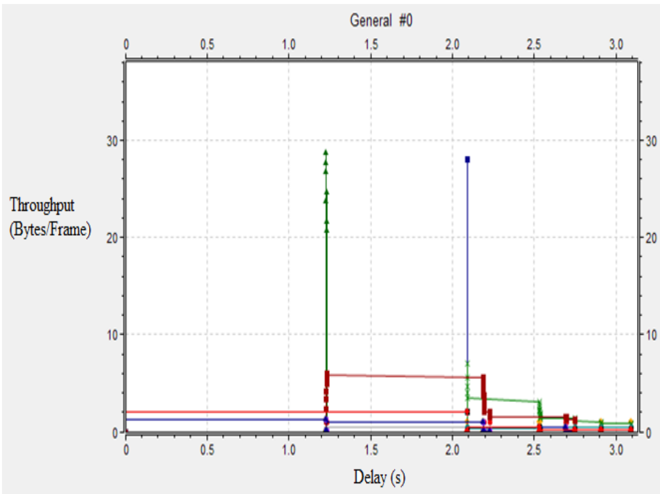

Fig.5 Fixed buffering schemes with 2 different nodes (6 and 8)

Fig.6 results demonstrate a maximum of the mean response time however they are not detailed by point enough to estimate the accurate area of the most extreme (in the accompanying signified as λ peak). This is attained all the more accurately by the curves which are, actually, inferred utilizing the structure comparisons created in Hence, in the accompanying, Main aim at finding an mathematical equation for the mean response time T as a function of λ and further model parameters. This comparison might be separated regarding λ and whether is conceivable to find the derivation of the induction which would lead to an explicit mathematical equation of λ peak

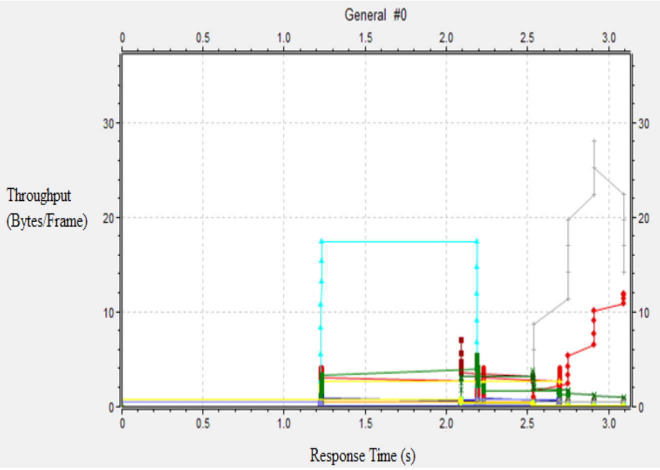

Fig.6 Mean response time

In Fig.7, it is obvious that by reducing the delay timer, the amount of iterations of retransmission will be extremely decreased.

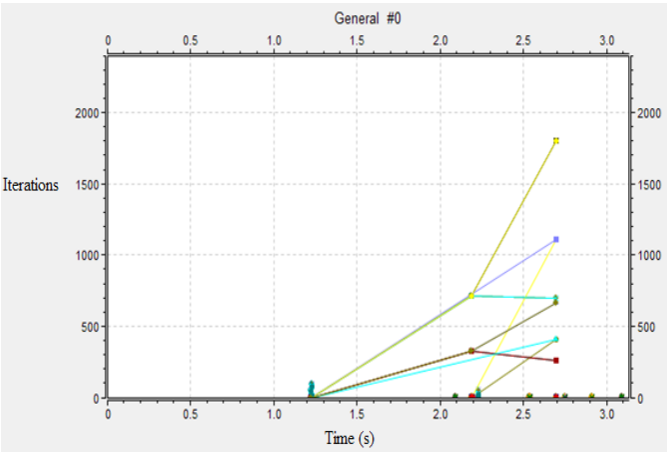

Fig.7 Retransmission delay

Retransmission-based error control is extremely feasible to recover loss at the very least cost of bandwidth network loss ratios are not inserted to keep the decoder from its failure. In spite of the fact that the most of the ratios are small, accept that SCO-SVC scheme can benefit from various retransmissions to recuperate more loss for real time video streaming if the standardized delay ratios are low.

A novel approach in which the sampling video disk recoder of the video is utilized to control the data rate. Observing in fig.8 that the maximum data rate was around 2.1 Mbit/s.

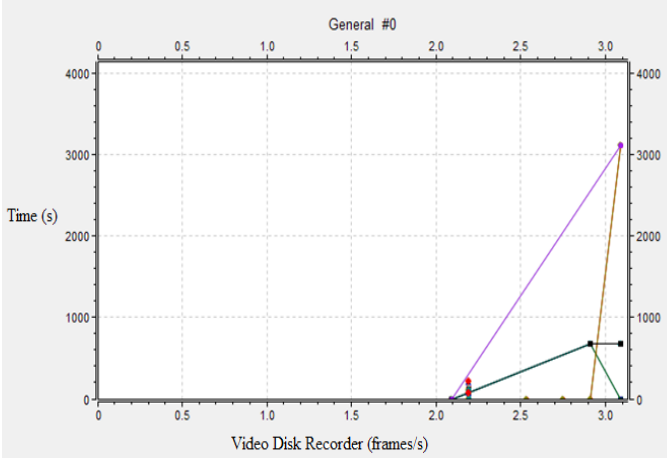

Fig.8 Data rate at destination side

In the situation where permit data rate adaptation, vitality saving might be gotten by expanding the transmission rate when the channel is in a decent state and the other way around diminishing the transmission rate when the channel is in a bad state.

Conclusion

This proposed work addresses the issue of the reliable video multicast on multiple users with scheduling of video packet on a network topology that offers multiple paths between the streaming server and the media cliend. Utilize an encoded video streaming model that factors in the variable significance of video packets, and in addition their interdependencies. A formal analysis of packet transmission timing prompts the inference of efficient algorithms to discover the transmission strategy that expands the video quality at the cliend. In this paper proposed fast, Scalable Video coding for Video Streaming in Peer to Peer Networks utilizing ACO-SVC nature inspiried-based approach. Simulation results demonstrate that proposed nature inspiried-based result performs well regarding final video quality, and is also suitable for the instance of continuous streaming under delay constraints. Because of its complete displaying of video streams and its strength to imprecise bandwidth estimation, the proposed low complexity nature solution gives a fascinating solution for video streaming in multipath peer to peer infrastructures.

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