MAXIMIZING USER CONTENTMENT BY SAMBA

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Abstract - *One of the communication techniques is that in which number of user is targeted by a sender. Cinematographic streaming services can be used for love or recorded events. In Cinematographic streaming* ***over multicast network, user's bandwidth requirement*** *is diverse because of bandwidth heterogeneity issue. For examples laptop, HD-TV, mobile devices all are working in different bandwidth. However, the available bandwidth needs to be assigned optimally when cinematographic streaming takes place over a multi cast network. Assignment of bandwidth based on user requirement, the users are grouped into different categories which help in handling bandwidth distribution simply. MDC (multiple description video) is used in media streaming to address this heterogeneity issue. In MDC, Cinematic source is encoded into multiple independent descriptions. A receiver is associated with one of the descriptions. A receiver joins different description to meet their bandwidth necessity. Streaming quality at receiver side is interrelated to the number of descriptions acknowledged. So it is important but big problem for MDC cinematic multicast is assigning bandwidth to each description in order to make best use of available bandwidth so that user contentment can be optimized. In this paper we present if the description number is greater than or equal to a certain threshold (e.g. minimum 100kb/s and maximum10Mb/s bandwidth requirement, such threshold is seven descriptions), there is an precise and simple solution to achieve maximum user contentment, (meeting all the bandwidth requirements) but for the situation when the description number is lesser, we present heuristic called simulated annealing for MDC bandwidth assignment (SAMBA) to allocate bandwidth to each description and we Simulate the assignment techniques*

Key Words: ***MDC, optimal bandwidth assignment, simulated annealing, streaming.***

1. INTRODUCTION

Due the penetration of broadband Internet access and advances in cinematic compression techniques, there has been growing interest in both stored and live streaming services. Internet has been around which greatly changed the way market is operated and process of business all over the world. Broadband internet paved the way for live streaming video such as hockey matches and other live events. This greatly enhanced the method content is transferred to many users at a time. Videos are huge and requisites techniques of compression. This has directed to many companies to develop portals that deal with videos services over internet [3]. Many user need multicasting of a live video concurrently as shown in figure1 In figure video streaming being read by numerous users of Internet with different devices.

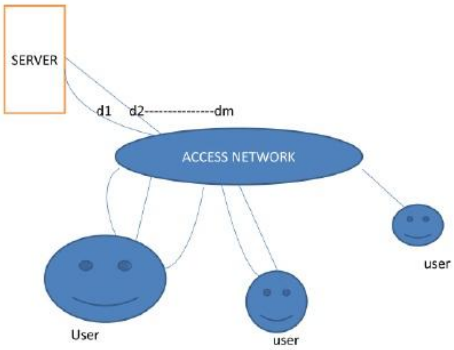


Fig.1.Video streaming using MDC to heterogeneous users.

As shown figure 1.Multiple users able to access video with varied bandwidth requirement because each devices have different bandwidth and configuration containing varied RAM and CPUs .For example YouTube, MSN. The registered users are provided live streaming by these vendors. One of the major problems is optimal allocation of bandwidth because of bandwidth heterogeneity issue. This also means that user's bandwidth requirement is not fixed. Assignment of bandwidth with fair quality in video streaming which increases user contentment is the challenging task to be addressed.

A Simple technique for solving the above problem is to generate various streams with dissimilar bitrates to which many users are related. But this technique has problem that number of streams of dissimilar bitrates are limited. A better approach is to use multiple description coded (MDC) video that provides facility of encrypting of video into numerous descriptions that are independent and having dissimilar bandwidth to which users are related. MDC is capable of assigning heterogeneous users with prerequisite bandwidth with multiple options relating to bitrates. This also enables the users to use dissimilar devices in order to access the given resource live. Descriptions are used to know the different necessities of users. They make the bandwidth assignment easy. Users can associate with more than a descriptor. Streaming quality at receiver end is related to the number of descriptions received [1]. In this case the addition of bandwidths of altogether these descriptors should finest match the necessities of user [3].

User needs to catch best match bandwidth that maximizes the quality of video i.e simply solving the problem of bandwidth allocation for heterogeneous users. Allocation of bandwidth can be optimized. Hence this can be considered as optimization problem.

Here in the paper, we optimize bandwidth allocation for descriptions given heterogeneous bandwidth requirements. We expect an optimal allocation because if description bandwidths are more, the low-bandwidth receivers may not be benefited from them because joining them may surpass their bandwidth, hence leading to reduced video quality. Whereas, if description bandwidths are too small, those high-bandwidth receivers may not be capable to satisfy their bandwidth by linking them, leading again to reduced video quality. Therefore, we expect optimal description bandwidths to attain the best overall video quality. Hence we present if the description number is greater than or equal to a certain threshold (minimum 100kb/s and maximum10Mb/s bandwidth requirement, such threshold is seven descriptions), there is an precise and simple solution to achieve maximum user contentment, (meeting all the bandwidth requirements) but for the case when the description number is less, we present heuristic called simulated annealing for MDC bandwidth assignment (SAMBA) to assign bandwidth to each description and we Simulate the assignment techniques.

2. Related Work

A. Literature Survey

MDC has many applications in cinematic streaming [4]–[7]. Most of the previous works on MDC focus on its error resilient methods to ensure communication toughness, and have not considered the assignment of description bandwidth to achieve system performance as examined in this paper.

Other methods used in multi-rate video multicast include layered coding (or scalable video coding), in which higher layer can be joined only if all the lower layers have been chosen. Performance analysis of layered coding and comparisons with MDC can be found in [8].

The work in [9]-[10] has addressed optimal bandwidth assignment problem for MDC. We change here in numerous main ways. Firstly, our paper provides formulation with coding efficiency consideration. After that, we show that when the description number is not less than a certain threshold, we have a simple and effective algorithm to achieve optimum which equals all the bandwidth necessities in the network. We also present that there is an optimal description number to achieve the best user contentment, Our approach based on simulated annealing is effective and attains performance nearly exhaustive search.

B. Analysis of Simulated Annealing

SAMBA is depended on simulated annealing, we analysis its principles here. In 1983 simulated annealing is suggested by Kirkpatrick *et al*as. It is a outline to get imprecise solution for difficult combinatorial optimization problems. It is based on statistical mechanics and motivated by the behavior of the physical system in the annealing process. Annealing is a procedure of heating and gradually cooling down to harden a subject and decrease its fragility.

In this, we try to get the optimal solution of lowest cost which is defined by a cost function. Conventional iterative enhancement heuristics iteratively discover a result of lesser cost by making small local changes and ends at a local optimum.

In, simulated annealing we can achieve global optimum. The basic idea is that in each iteration , the approval of a solution of higher cost is probabilistic. There is a parameter temperature which controls the possibility of accepting a greater cost solution. The greater the temperature, the more possible the acceptance of a higher cost solution. The temperature factor is firstly high and then slowly depressed down, which is similar to the temperature in the real annealing method.

Four elements are desirable to relate simulated annealing to a combinatorial problem:

1. A configuration or state of the system, as a point in the search space;
2. An cost or energy function that can be evaluated at each state, as the cost function in the combinatorial problem;
3. An transition function which picks a neighbor state, estimates its energy, and decides whether the system transfers to the state based on the probability;

An annealing schedule to control the initialization and dropping down of the Temperature parameter.

3. Problem Formulation

We have formulated as shown below in [2]

Let K_{ij} be a binary number with 1 specifying that user j chooses description i.

We have,

$$Vj = \sum_{i=1}^{n} Kij\ dj \qquad \text{eq 1.}$$

Let us consider heterogeneity factor H is the difference between extreme and lowest user bandwidth requirement i.e.

$$H = \max c_j - \min c_j + 1 \qquad \text{eq 2}$$

Let us define Rj the band width matching factor given by ratio of v_j and c_j i.e.

$$Rj = v_j / c_j \qquad \text{eq 3}$$

Let us Define coding efficiency factor α_n €(0,1) given n description, which decreases with n.The individual satisfaction of user j, is

$$Si=(d;c_j) = f(\alpha_n Rj) \qquad \text{eq 4}$$

Let the number of user in the network is N .then over all network satisfaction is given by

$$\text{Soverall} = \frac{\sum_{j=1}^{N} wj\; si(d,cj)}{\sum_{j=1}^{N} wj} \qquad \text{eq 5.}$$

Our Objective is the to find an optimal bandwidth d* so as to maximize Equation 5 subject to equations 1 ,2,3,4 i.e.

$$S^* = S(d^*) = \max S(d) \qquad \text{eq 6}$$

4. Procedures for Optimal Assignment of Description Bandwidth

A. *Threshold and the Exact Solution*

Consider that user bandwidth need ranges in [a,b], where a and b are the max and min user bandwidth requirement, i.e.,$a=\min c_j$ and $b=\max c_j$.

Let us consider the simple case where a=1 i.e. equal to the basic unit. Each values in range [a,b] can be changed to a binary number by changing its base to 2. The number of binary digits for a particular value is bounded by the number of digits of b in binary form, which is clearly $\log_2 b+1$.

A binary number can be viewed as a linear combination of 2's powers with coefficients either 1 or 0. For Example, the binary form of 29 is 11101. If the description bandwidth is assigned to be a power of 2.then the binary form of the bandwidth requirement signifies precisely the joining choice, with coefficient 1 to join the corresponding description and 0 otherwise. As in the example above, the user with bandwidth 29 units will choose to link descriptions with bandwidth 16, 8, 4 and 1 units. The maximum number of binary digits indicates the description number, which is $\log_2 b+1$.

From above, it is clear that if $m>= \log_2 b+1$, all the bandwidth necessities can be completely matched.

Let us assume a is any integer greater than 1. In this case, bandwidth requisite can be expressed as (a-1) + x, where x € [1,b-a+1] hence x can be given by in binary form with at most $\log_2(b-a+1)+1$ digits. According to the definition of heterogeneity factor in (3), we have h=b-a+1. Therefore, the threshold value for the description number in terms of h is

$$\text{Log}_2 h + 2 \qquad \text{.eq 7.}$$

If m no fewer than this value, the description bandwidths are hence $(a\text{-}1,\ 2^0, 2^1, \ldots..2^{\log h)}$. With this assignment, all the bandwidth requirements can be fully matched. It simply takes O(m) calculations to resolve the bandwidths for the descriptions.

B. *SAMBA*

Here, we deal an effective heuristic SAMBA to resolve the problem when description number is less than the threshold given by eq7.

If m is fewer than the threshold, the problem is to examine in an m-dimensional integer space for the best description bandwidths. The search space is distinct and limited, because each description can only yield integral bandwidth no greater than the extreme bandwidth requirement in the network.

In SAMBA, state is explained as a vector of description bandwidths which is sorted in the growing order. Each state is associated with an "interior energy", which is defined to be the negative of the contentment value as in simulated annealing, we search for minimized objective function.

SAMBA starts with an early state and iteratively travels to other state looking for lower internal energy so higher user satisfaction.

Each state has a neighborhood given by a radius r. By saying state d_1 is a neighbor of state d_2,we mean $||d_1\text{-}d_2|| < r$.At each iteration, SAMBA arbitrarily picks a neighbor of the present state as the target state, and decides whether or not to do the transition according to a transition probability. We express a temperature T, which exponentially decreases as the algorithm iterates. Let i be the current iteration number and K be the total number of iterations. We have

$$T = e^{i/K} - e^{-1} \qquad \text{eq 8}$$

The higher T is, the larger is the neighborhood radius r. We define r

$$r = \max\{2,\ hT/(1-e^{-1})\} \qquad \text{eq 9}$$

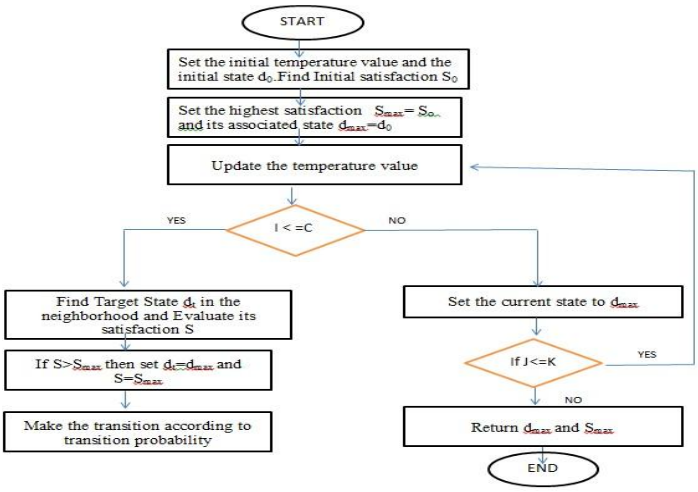
Let us assume current state id d and target state is d_t. The energy difference between the two states is given by the difference of their satisfaction value, i.e. $S(d)\text{-}S(d_t)$.

if $|S(d) - S(d_t)| <0$, the transition probability p is defined as 1. Otherwise, p is a decreasing function of $|S(d) - S(d_t)|\ /T$ with initial value close to 1.

T, the lesser the contentment of the target state is, the lesser is the transition probability. Further, with big, any target state has transition probability near 1. Therefore, we have

$$p(d,dt) = \begin{cases} 1, & \text{if } S(dt) > S(d) \\ e^{\,S(dt)-S(d)/T} & \text{,otherwise} \end{cases} \qquad \text{eq10}$$

SAMBA algorithm can be summarized in the following steps shown in flow chart.



5. Explanatory Simulation Results

Here, we show expressive simulation results to show the efficiency of our algorithm. Here we describe simulation environment.

A. Simulation Atmosphere and Limitations

In simulation, we related SAMBA with exhaustive search, which always achieves the optimum. We have also compared SAMBA with uniform assignment i.e. all the descriptions have similar bandwidth, exponential assignment i.e. in which the description bandwidth is exponentially improved, linear assignment i.e. the description bandwidth is linearly improved, and random assignment i.e. randomly assigns bandwidth for each description.

Let individual satisfaction function given by f $(\alpha_m, r_j) = (\alpha_m, r_j)^k$, where k € R^+. The function is realistic as it is strictly increasing in [0,1] and the max and min are 1 and 0, s.

For preciseness, we assume coding efficiency as $\alpha_m = \beta^{m-1}$, where $\beta<1$(the value of β depends on the underlying MDC techniques used).

The number of users of bandwidth requirement c is proportional to some distribution given by N(c) .We practice a simple reduced normal curve as the bandwidth distribution ,i.e., $c \sim N_T(\mu,\sigma^2)$. Fig 2.show a truncated normal $c \sim N_T(\mu,\sigma^2)$.

Every user has its “importance” as a weight w(c), as a function of bandwidth requirement. According to eq 5, simulation on w(c) with uniform bandwidth requirement distribution is equivalent to simulation on N(c) with constant weight. Hence, we attention on the impact of N(c) and expect the similar result for w(c).Unless otherwise stated, we use baseline parameters , $k=2, \beta=1, m=3$ and v_j € [1,100].

B. Illustrative Result

Fig. 3 plots the overall satisfaction S versus heterogeneity factor h given different bandwidth assignment schemes. The satisfaction S is decreasing with h because it becomes more hard to equal the bandwidth requirements if heterogeneity factor becomes greater.

Fig. 4 plots the overall satisfaction S versus number of descriptions m given unlike bandwidth allocation schemes. The complete satisfaction S increases with description number m because more descriptions can provide more options of bitrates to achieve heterogeneous user bandwidth necessities.

Exponential assignment achieves the same performance after m touches the threshold. because, in this situation, the precise assignment A is optimal and its descriptions have exponentially growing bandwidths. linear assignment, Uniform assignment, and have the same performance.

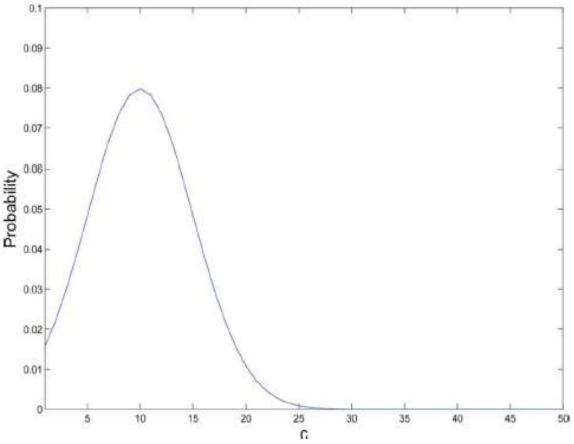


Fig.2 . Example bandwidth requirement distribution $c \sim N_T(10, 5)$.

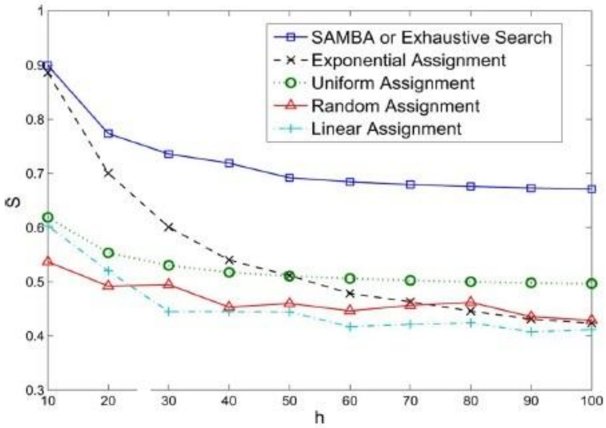


Fig3 . Overall atisfaction (S) versus heterogeneity factor h given different schemes.

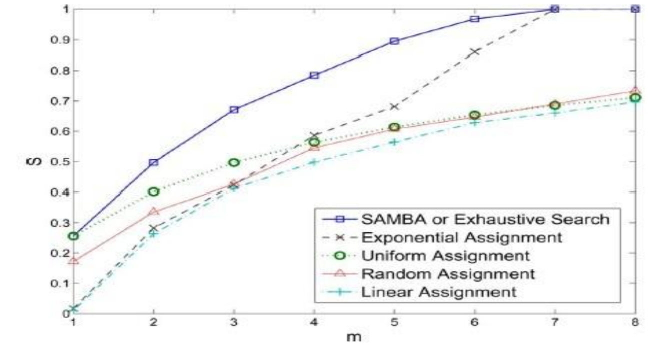


Fig.4 . Overall satisfaction (S) versus description number (m) given different schemes.

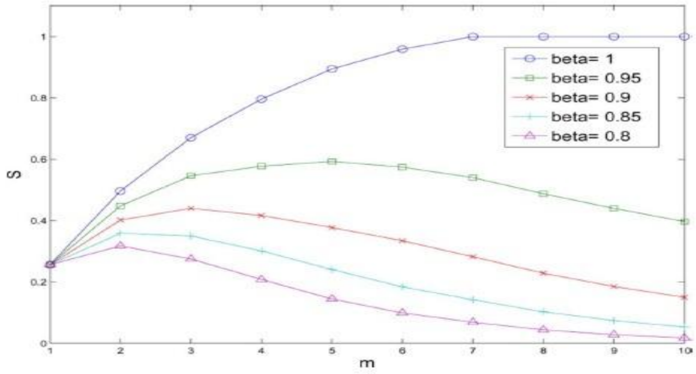


Fig.5 . Overall satisfaction (S) versus description number (m) given β.

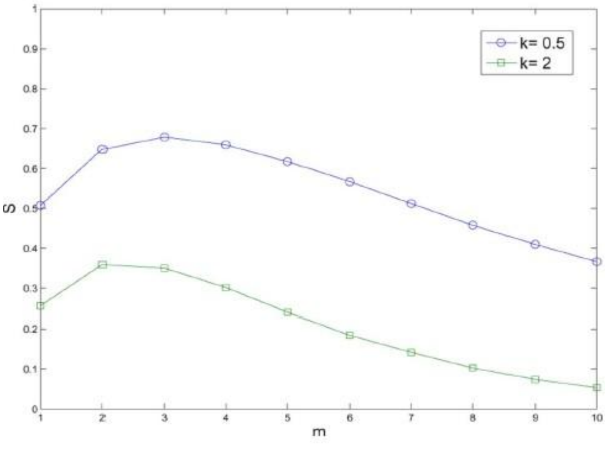


Fig. 6 Overall satisfaction (S) versus description number (m) given k.

6. CONCLUSIONS

In this paper, We study optimal assignment of description bandwidth for MDC for cinematic streaming to huge group, so that heterogeneous bandwidth requirements can be best fulfilled. We gave mathematical formula as an optimization problem and recommend algorithms to solve it. We present that when the description number greater than a definite threshold, easy and efficient allocation algorithm of run-time complexity of O(m) can fully match all the bandwidth necessities. For the general situation when m is smaller than the threshold value, we have suggested and studied the heuristic SAMBA, which uses simulated annealing to proficiently get the optimal description bandwidth allocation. There exists an best choice for description number to achieve maximum user contentment. Simulation results have shown that SAMBA achieves much better user contentment than other allocation methods and strictly matches the optimum based on exhaustive search. Also considering coding efficiency, we demonstrate that certainly there is an optimal description number to get maximum user contentment.

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