Minimizing the Bandwidth for multiple description best quality-Coded Video

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***Abstract*—It is well known that, very often the user bandwidth along with magnitude gets changes in the video streaming over different network. The main goal of the paper is to provide the best streaming quality under certain bandwidth. Here multiple description encodes video means when we are watching a certain video,we will be having problems like buffering, to overcome this we are providing the user the best quality under his bandwidth.**

We prove that the optimization problem is NP-hard. we will converting a source video into multiple descriptions with the help of an algorithm. Multiple descriptions in nothing but a packets ,this algorithm converts the source into multiple descriptions with the help of an algorithm and send to receiver according to his bandwidth. The case that occurs when the description number is smaller is, we present an approach called simulated annealing for MDC bandwidth assignment (SAMBA). It is required to assign bandwidth to each description.

The main reason why we choose SAMBA is, based on exhaustive search it achieves virtually optimal. Due to this main reason we had to choose this algorithm.

***Index Terms*—Multiple-description-coded video, optimal description bandwidth assignment, simulated annealing, streaming.**

I. Introduction

We provide the best streaming quality video without loss of data. As there is usage of internet is more,there are lot more videos compression techniques which has been increasing the interest in both stored and live video.MDC has actually become a natural choice for video encoding stream over different networks.

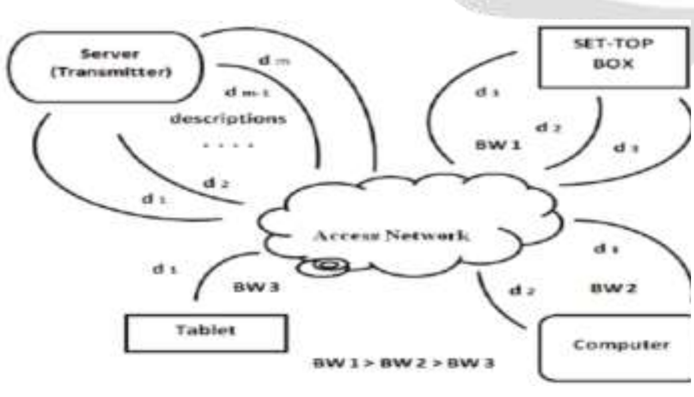

Fig. 1. Video streaming using MDC to heterogeneous users

There are different websites which offer numerous videos online like Youtube, Helo etc.

In order to stream a video to large group users, it is neither efficient for the server nor feasible. If we do so there will be a heterogeneity issue in order to meet user bandwidth requirements. An uncomplicated way in which we can encode the video into number of streams in which user can join the best match their user bandwidth requirements.

MDC is the best approach to convert source video into multiple descriptions according to user bandwidth using an algorithm. This algorithm divides the source video into description and after the division gets over, it combines the descriptions and send to the user according to his bandwidth

.

In Fig. 1 video streaming using MDC heterogeneous users. The number of descriptions that divides are *d1,d2…….dm*.

In this paper, we study minimizing the bandwidth according user bandwidth. Let us take a case like what if descriptions bandwidth are set high and set low. If the description bandwidth is set high ,then the receiver who has lower bandwidth will not get beneficiated. if description bandwidth is set low then the receiver having high bandwidth will get low quality video and he will be in loss. So we want to achieve the best quality streaming encoded video.

The work that has been done by us are:

1) *Problem formulation and complexity analysis*: Identify the given heterogeneous user bandwidth to formulate the code to each description assignment. Here we are satisfying the function of user bandwidth coding efficiency as well as bandwidth requirement by using this we are optimizating problem as a NP-hard.
2) *An exact solution for description number larger than a certain threshold:* Whenever the number of description is greater than or equal to a particular value, we are calculating to give solution fo the problem by solving it and also we are providing the optimal bandwidth to the available descriptions.
   Our solution will take computational time to calculate the exact description number.

3) *An efficient heuristic for smaller description number:* Here are we are using the Samba algorithm to provide the heuristic performance for smaller descriptions. We are providing the perfect bandwidth according to the user requirement.

II. Related Work

A. Literature Review: Most of the previous work on MDC focus on the error solvation but no one consider the assignment of description of bandwidth to achieve the performance. In Layer coding each description in MDC can be joined independently. This descriptions are not coupled as strong in the layer coding but MDC can be achieved better error containment in case of lost of packets. We can gain a simple and effective algorithm by optimizing the band width requirements that matches n the network.

B. Review of Simulated Annealing: As we know that Samba is based on the simulated annealing, we are reviewing its principle here. It was proposed by Kirk Patrick in 1983 as a frame work to find a solution for a combinatory problem. When a combinatorial problem is given we try our level best to find its solution by using cost function. Simulated Annealing has a better chance to approach Global optimum. That's the use of using simulated annealing. There are four things that are needed of apply simulated annealing to a problem.

- System state which is usually a point in the search space.
- Cost function that has to be evaluated at every state.
- A transition function which usually picks its neighbor state and decides whether the system moves according to its probability or not.
- Finally,an annealing schedule to control its temperature and its Initialization. In order to do we have to follow steps.
  - *A.* Set the initial state and initial temperature.
  - *B.* Move from one state to its neighbor state.
  - *C.* Repeat the step B ,till the topstate of lowest energy is recorded.
  - *D.* According to the annealing schedule lower down the temperature, if it is reached return to top state or else repeat step B.

On the other hand, in each iteration, the function should randomly pick a state from the neighbor- hood.

III. Problem Formulation

Multiple description coded video can also be used to solve this issue by formulating .It is an optimization problem. Consider a video stream to be accessed bya large pool of users with heterogeneous bandwidth requirements. The annealing is a process of heating and slowly coding down to tougher as a subject and reduce its brittleness. We consider that bandwidth is normalized to some unit.

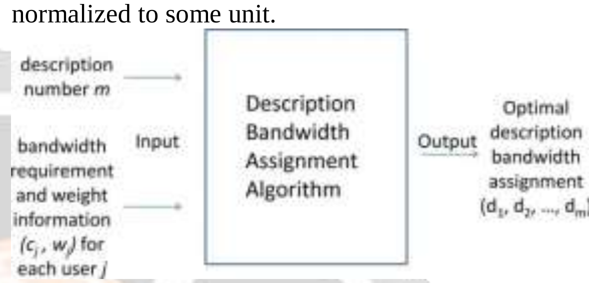

Fig. 2. Optimization model for MDC bandwidth assignment.

From the above figure we can say that the source data will be converted into multiple streaming data. The descriptions are based on network bandwidth which is based on the user bandwidth requirement. It actually happens at server side.With help of Description bandwidth assignment algorithm we are optimizing the bandwith according to user availability. In MDC,the enduser chooses to receive the maximum number of description under its edge bandwidth.When the description gets finish it combines the description that is obtained from the previous modules and handover it to the client at the client side.

TABLE I

Major Symbols Used in the Paper and Their Explanations

Symbol	Explanation
d_i	i^{th} description bandwidth
m	description number
n	number of users
h	heterogeneity factor
c_j	bandwidth requirement for user j
v_j	total joined video bandwidth
r_j	bandwidth matching factor, defined as the ratio of v_j and c_j
w_j	weight for user j, which represents the user importance
α_m	coding efficiency factor given m descriptions
β	base factor used to model coding efficiency factor
$\vec{d}$	description bandwidth assignment vector
S_{ind}	individual satisfaction given description band-widths and user bandwidth requirement
S	overall network satisfaction given description number and bandwidth assignment
S^*	optimal overall satisfaction
f	individual satisfaction function, which is a func-tion of r_j and α_m
K	matrix when K_{ij}=1 if and only if user i joins description j

These are the symbols used in this paper. Here the dimensional vector sorted in the increasing order and and represents a particular bandwidth assignment for the description. . Clearly we need

$$i, \quad < \quad \lfloor \log_2 h \rfloor + 1 \quad (1)$$

Let K_{ij} $\{0,1\}$ be a binary number with 1 indicating that user j chooses description . We have

$$(2)$$

We consider that bandwidth is normalized to some unit (say, 50 kb/s), and hence and d_i are integral. The heterogeneity. factor is defined as the difference between minimum and maximum user bandwidth requirement, i.e.,

$$h - \max_j c_j - \min_j c_j + 1. \quad (3)$$

Define r_j the bandwidth matching factor given by the ratio of v_j and c_j, i.e.,

$$r_j - \frac{v_j}{c_j} \quad (4)$$

Define $\alpha_m \in (0,1]$ as the coding efficiency factor given m descriptions, which decreases with m. We model user individual satisfaction as a monotonically increasing function f in terms of $r_j\alpha_m$. The individual satisfaction of user j is hence given by

$$S_{ind}(\vec{d}, c_j) - f(\alpha_m r_j) \quad (5)$$

Let n be the number of users in the network. The overall network satisfaction is hence given by

$$S(\vec{d}) - \frac{\sum_{j=1}^{n} w_j S_{ind}(\vec{d}, c_j)}{\sum_{j=1}^{n} w_j} \quad (6)$$

Our objective is then to find optimal bandwidth assignment $\vec{d}^*$ so as to maximize (6) subject to (1), (2), (4), and (5), i.e.,

$$S^* - S(\vec{d}^*) \quad \vec{d}_{\max} S(\vec{d}). \quad (7)$$

The problem is NP-hard (shown in the Appendix, by finding a polynomial reduction from the subset sum problem).

IV. Algorithms used

Here we using the algorithm that we used in our paper.in the part A ,we show that the description is no less than the threshold and in the part B we show how efficiently the SAMBA algorithm is used.

A. Threshold and the Exact Solution:

Considering that bandwidth of user requirement ranges in $[a, b]$, where and are the maximum and minimum user bandwidth requirement, i.e., $a - \min_j c_j$ and $b - \max_j c_j$.

Let us first consider the uncomplicated case where is equal to one. All the values in $[a, b]$ can be converted to a binary number by changing it base to 2. The number of binary digits for a particular value is bounded by the number of digits of in binary form, which is clearly .

A binary number can be regarded as a linear combination of 2's powers with coefficients either 0 or 1. For example, the bi- nary form of 25 is 11001. If the description bandwidth is as- signed to be a power of 2 (i.e., $1, 2, 2^2, \ldots, 2^{m-1}$), then the bi- nary form of the bandwidth requirement represents exactly the joining choice, with coefficient 1 to join the corresponding description and 0 otherwise.

B. SAMBA

SAMBA algorithm is used to solve problem when description number m is no longer greater than the threshold.

- In Samba,a state is defined as a vector d of description bandwidths. Each state is associated with an internal energy which is defined to be the negative of the satisfaction value.It starts with initial state with lower energy and and makes transition from its state to neighbor state. At each iteration.Samba randomly picks a neighbor state and decides whether it males a transition probability or not. By running SAMBA with different initial states, we have great chance to find the global optimum. The whole algorithm can hence be summarized in the following steps. *Step 0*) For the first iteration, set the initial temperature value and the initial state $\vec{d}_0$. Find out initial satisfaction S_0. Then set the highest satisfaction $S_{\max}$ S_0 and its associated state $\vec{d}_{\max}$ $\vec{d}_0$.
- *Step 1*) Update the temperature value.
- *Step 2*) Find a target state $\vec{d}_t$ in the neighborhood and evaluate its satisfaction . If $S_{\max}$, assign $\vec{d}_t$ and to $\vec{d}_{\max}$ and $S_{\max}$, respectively.
- *Step 3*) Make the transition decision according to the transition probability.
- *Step 4*) Repeat Steps 2 to 3 for a number times.
- *Step 5*) Set current state to and repeat Steps 1 to 4 for a number iterations. Return and $\vec{d}_{\max}$.

The algorithm randomly moves among the states because the transition probability to any picked state is high. It actually picks the target state from a smallest neighbor state.

V. Results

Here we are going to show ,how efficiently we got the results about optimizing the bandwidth according to user requirements.

A. *Simulation Environment and Parameters:*

In our simulation,we start comparing SAMBA with other simple bandwidth algorithms,linear assignment ,exponential assignment and random assignment.

Here we have function given by$f(\alpha_m r_j) \quad (\alpha_m r_j)^k$.this function is reasonably as strict givesa range from[0,1] where “0” is minimum and”1”as a maximum.

B.Illustrative Results

Here we show the graphical representation of algorithm.Each graph plotted gives us a different schemes or heterogeneity issue.Here the fig .4 shows the overall satisfaction s versus description number given different schemes that are available. In the graph, for each , overall sat- isfaction given by SAMBA overlaps with that given by exhaus- tive search, and is much better than those given by the other schemes. SAMBA performs virtually the same as exhaustive search. Exponential assignment performs better than uniform assignment, random assignment, and linear assignment when is not large.

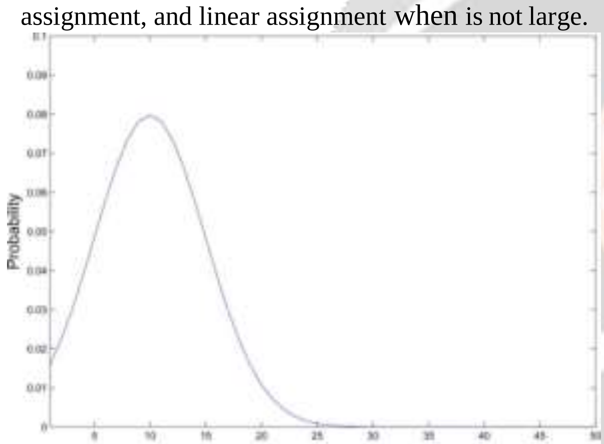

Fig. 3. Example bandwidth requirement distribution .

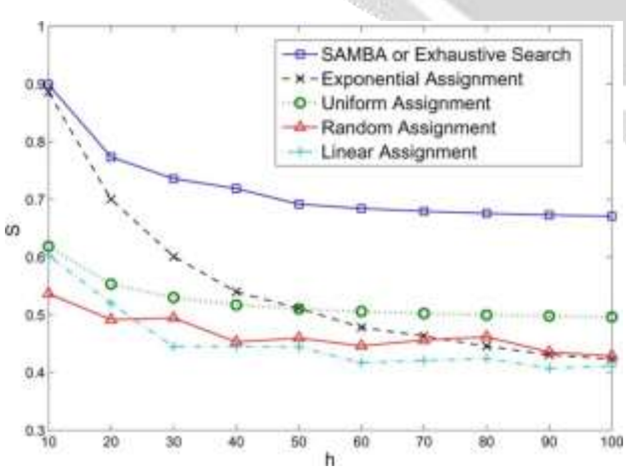

Fig. 4. Overall satisfaction versus description number given different schemes.

Here in the fig.5 we can see that the overall satisfaction s versus theMean value given different bandwidth assignment selection.From the graph,it is known that SAMBA gets overlap with given exhaustive search and it is not affected by the chane in the mean value.It expects that,Samba performs better then exponential assignment,linear assignment and random assignment.

Here in the fig.6,we can see that the overall satisfaction versus number of description given different bandwidth assignment schemes.The more the description the more the meet the heterogeneous assignment bandwidth requirements.Finally,Samba settles to the value as its bandwidth requirements fully matched after reaching to a certain bandwidth.

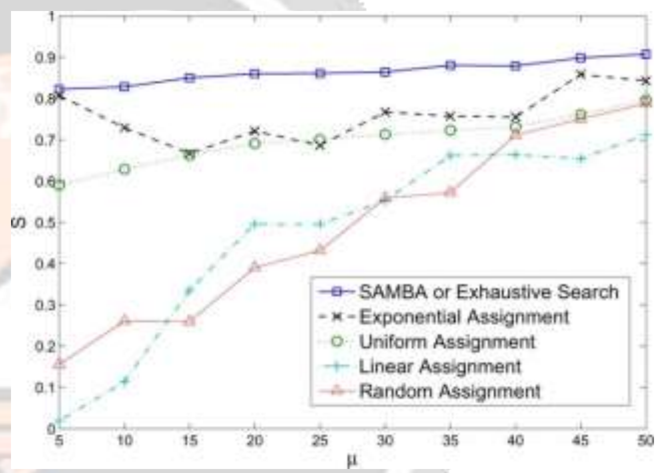

Fig. 5. Overall satisfaction versus mean value given different schemes.

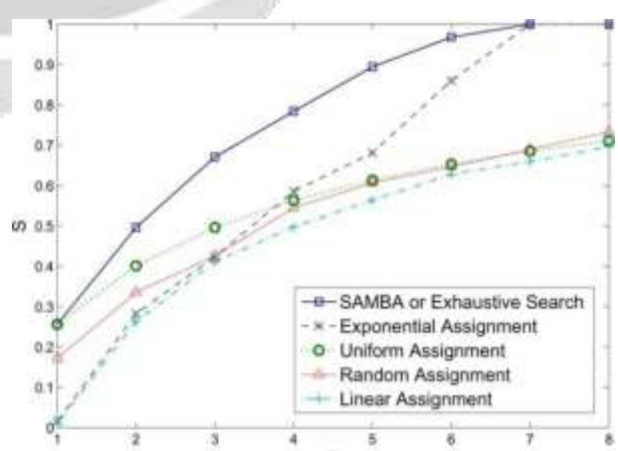

Fig. 6. Overall satisfaction versus heterogeneity factor given different schemes.

VI. CONCLUSION

In this paper, we know that how to minimize the bandwidth according to the user requirement for MDC to large of users. As the users are habituated t the internet access . When the video gets buffered for a few minutes they gets irritated. In order to stop this, our paper gives a solution for the problem by providing best streaming quality under a certain bandwidth. we formulated it as a Optimization problem.and also a Np-hard problem.the rate at which the the description delivers to the client according to the available bandwidth is called description coding rates.this have straight forward impact to the delivery performance. On the other hand MDC provides a resilient to packets losses by creating different streams which can be coded independently. By introducing SAMBA algorithm,on the system performance gets increase and we can make significant improvement on the use of network bandwidth.as we convert source code into multiple description through an algorithm it gives best output without the loss of packets.When co pared to other assignment alogorithm,SAMBA performs the best.And it also provides the efficiency output which uses simulated anneling and this algorithm achieves much more user satisfaction.than the ny other methods like linear,random assignment.

APPENDIX

When we were doing this paper we found it as a polynomial reductionfrom the sum of subset problem.

In order to have $L_c \leq_P$, we prove any input of L_c can be transformed into input of in polynomial time. Also the output of is equivalent to that of L_c and can be transformed back in polynomial time as well.

The input of L_c is $(x_1, x_2, \ldots, x_m, t)$, with all and positive integers. The output is a “yes” or “no” to decide whether is sum of a subset of $\{x_i\}$. We assume $x_i \neq$, because after excluding zeros the problem is still equivalent to the original one.

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