Homework Assignment 05
Technical Topic 02: Multimedia encoding techniques

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T. Kim and M. Ammar, *"A Comparison of Heterogeneous Video multi-cast Schemes: Layered Encoding or Stream Replication"* IEEE Transactions on multimedia, vol. 7, num. 6, December 2005

The present paper was published in IEEE Transactions on multimedia, 2005. It proposes a comparison of different multi-cast schemes. At the time this paper was published, coding of multimedia had been explored for more than fifteen years already.

The paper does not explore novel problem in the field of multimedia delivery, but poses explanation of already explored one to which different solutions had been developed over time. The problem which motivates this paper is the need of different techniques for delivery of multi-cast video stream to various (from system point of view) end users.

This work does not suggest a new approach for solving a known problem either. Instead the authors take three known schemes for multi-cast video stream delivery and compare them. The techniques that they compare are stream replication at different rates, cumulative and non-cumulative layering. The authors try to disprove the common belief that the stream replication scheme normally performs worst than the layered scheme.

This publication is significant in its effort to make designers consider thoroughly the existing schemes assuming the specifics of the network that content is going to be delivered to. However, I do not find the results provided, convincing enough to make the reader agree with the statement that replication scheme could be more effective than the layering schemes.

The argument of their concept follows two phases. First one is trying to find a proof that layered bandwidth overhead is higher as compared to replication. First, while trying to give theoretical background for their concept, the authors propose an inequality, representing the statement that they argue against, and then reject it immediately, saying that according to the literature this inequality is not fulfilled in most of the cases. A proper literature citation might have been of use here, because as it is now, appears not convincing enough.

Then the authors provide some experimental results to support their statement. They put a setting in which they vary the quantization step size to measure the data rate that layering demands. They place a graph, to support the conclusion that layering demands high data rates as the quantization gets denser. However, they did not mention whether they increase the quantization step beyond certain limit that it is normally accepted to work with. If so, these results are not realistic, because if they consider super specific and inapplicable in practice setting, it should not be considered an argument. After all when it comes to compression, there should always be a reasonable trade-off between the demand of high data rate (i.e. compression) and the quality of the signal.

Finally, to prove that replication might be bandwidth overhead effective, the authors state that layering scheme increase the amount of overhead as the users subscript to higher levels. I don't find this relative. It might have been if the authors have mentioned what amount of the users normally subscribe to higher levels and how much overload does this generate. In case of multi-cast groups with relative low level subscription, though, I still find the replication scheme more inefficient as compared to layering, because it demands multiple coding to achieve different rates.

In the fifth section, the authors state results from simulation experiments which they conducted with the multi-cast scenarios. As obvious from the graphs, the total bandwidth usage for "non-bottlenecked" network differs with 500Mbps between the layered and the replication approach. For "bottlenecked" network this difference lowers down to around 30kbps. Both these results are for network of 100 nodes. Assuming that with layering one can provide better quality of video stream delivery, I think that imposing 500Mbps bandwidth overhead to the network is acceptable. Furthermore, it is often the case that lots of nodes share a single link which becomes a bottleneck to the communication. In this case, trying to emphasize replication superiority among the layering approach does not make sense.

In the last section of the paper, the authors perform simulation based comparison of the protocol complexity for layering and replication. There is a graph, representing that the average number of multi-cast groups within a network is higher for layering than for replication. I don't find this conclusion relevant to supporting the authors' thesis. If there are more multi-cast groups, this means that users' requirements can be satisfied with higher preciseness - i.e. being able to choose the perfect rate for them among various proposed, the users will be prone to form more groups.

This paper maintains high level in terms of organization. It is relatively easy to read from non-specialists in the area, because it provides proper definition of most of the terms used, prior to they appear in the argumentation. The figures are clear and self-explanatory which makes it easier to understand the results of the experiments conducted.