Internal Memorandum

David Sarnoff Research Center
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To	**Distribution**	Memo #	**SBN-900906**	Date	**September 6, 1990.**
From	**S. B. Ng**	Location	**W-333**	Telephone	**x3035**
Subject	**ATRC 9/5/90 Video Study Group Meeting Summary**				

The ATRC Video Study Group met on 9/5/90 at the NAP facility in Briarcliff Manor. R. Hingorani, S. Ng, J. Shapiro, and J. Zdepski from Sarnoff, and F. Azadegan, A. Cavallerano, Y. Ho, and Kiran, a new member, from NAP were present at the meeting.

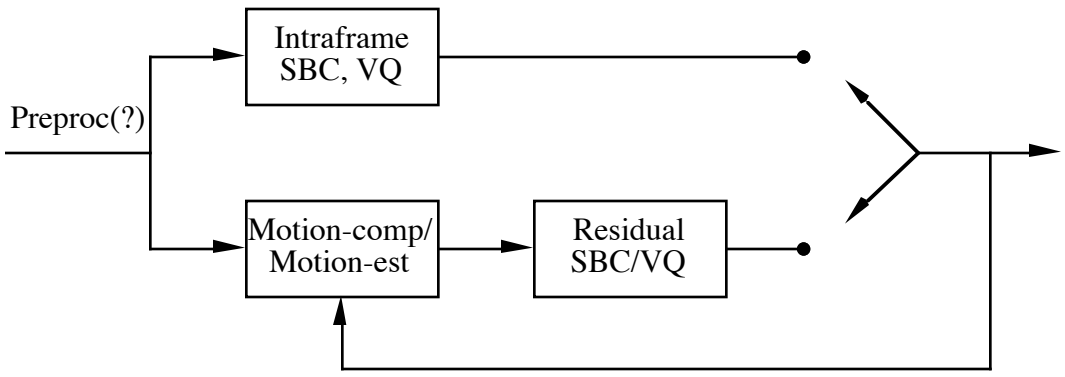
The following is a list of topics covered in the meeting.

- Description of NAP VQ system(s).
- Testing and evaluation criteria, including discussion on source material and the interlace format of test sequences.
- Discussion on the new schedule.

Our NAP colleagues informed us that the DVS system to be installed at NAP has encountered further delay. The latest date for its installation is in the week of September 17.

NAP VQ Systems:

Faramarz and Yo-Sung described the NAP VQ systems. The encoder block diagram is shown below.



The intra-frame operation uses a 16- (8 by 8) or 7-band QMF decomposition. The low-low band is either multi-stage VQ or DCT coded for transmission. The coder for the high bands can be straight VQ or adaptive VQ (classified VQ). The interframe operation is a block-match motion compensation followed by SBC (sub-band coding) and VQ on the residue. The motion compensation is performed using a 16 x 16 motion block with a ±16 pixels maximum displacement search. The block size was chosen to for low overhead information for the motion vectors (about 0.04 bpp.) The motion-compensated prediction error (a.k.a. residue) is further processed by a sub-band and VQ coder.

At least two systems are under study. The difference between the two systems lies mainly in the VQ of the motion-compensated prediction residue. In one system, a 4-band decomposition is used. The VQ is an adaptive VQ which features classification of vectors. Vector size is 4 by 4 (16-dimensional vector). The energy of each vector is compared to a set of threshold values to classify the vector into four classes. Each class uses code books of different sizes; the low-energy class with small codebook (128 code vectors) while the high-energy vectors are coded with a 10-bit (1024 code vectors) code book. The parameters are still under investigation. Because of the classification and the use of different size code books, the output bit rate will not be constant. This is in contrast to a classical fixed length (and fixed rate) VQ system. In addition, the classification information, an overhead, will require some protection against channel error.

The second system uses a 7-band (log-spaced) SBC followed by a multi-stage VQ (MSVQ). Without the classification of the first system, the second system is a fixed rate VQ which is expected to result in a simpler overall system design, and probably more robust in the presence of channel error.

Yo-Sung presented some simulation result of the second MSVQ system based on a sequence called “Flowers”. Without temporal processing, the reconstructed image has an SNR of 35 dB for a data rate of 1 bpp. With motion-compensation, and at a rate of 0.5 bpp, the achieved SNR was about 33 dB. No actual picture was shown other than a printed (half-tone?) image.

In the ensuing discussion, Faramarz raised the issue of high correlation (0.6) existing in the motion-compensated residue. There was no clear explanation of the observation.

Another VQ system from NAP, called entropy-constrained VQ (ECVQ) was briefly described. Apparently due to a number of concerns, primarily those related to the buffer control and error recovery aspects associated with a variable-length system, the effort on ECVQ has essentially stopped.

Testing Criteria:

The following is a list of some of the attributes that the Video SG feels should be included as testing criteria.

- Channel model (bit-stream simulation) to be included in the test.
- Color
- "Pop-quiz" sequences, i.e., sequences that have not been simulated in earlier runs.
- Test patterns (resolution charts, etc.)
- "Easy" sequence should also be included for a fair evaluation of the system.

On the issue of interlace format for the source materials, it was suggested that horizontally the resolution should be 660 lph. For 960-line interlaced frames, for example, there can be 1440 active pixels per line. There was no clear decision on the issue of image size. The question of display capability was raised. It was recognized that currently there was no appropriate display capability at either NAP or Sarnoff. NAP has a digital VTR which can be used to record image sequences for comparison, if and when the display facility becomes available.

Our European colleagues should be informed of the channel model requirement in the testing procedure.

General Discussion on Implication of the New Schedule:

There was a general consensus that the new schedule which requires software system completion by the end of October is overly ambitious. There is great concern that the deadline simply cannot be met, and that should the plenary committee decides to force decisions based on what can be achieved by October 31, some issues of fundamental importance would have to be overlooked in making the decisions. It is the collective opinion of the video group that more time should be given to allow a more realistic comparison/evaluation of the various systems. A more reasonable schedule, for example, may extend the deadline from October 31 to the end of November, which is still a month ahead of the original schedule deadline of January 1, 1991.

Allan has accepted the job of drafting a memo to be issued by the video group addressed to the ATRC plenary committee voicing these concern. To be included in the memo is the issue of a suitable display capability, or the lack thereof, for the testing of the various systems. In the mean time, both Sarnoff and NAP management will be briefed by their respective video group members regarding the formidable difficulty in meeting the October 31 deadline.

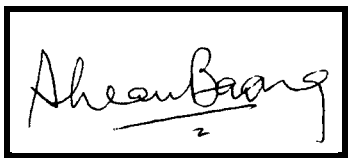
Sheau disclosed that the Testing and Evaluation (T&E) group comprising Sheau and Detlef is meeting on 9/19 at Briarcliff to chart out a complete T&E plan, and that any input to the group should be done as soon as possible.

Allan had a concern that the RF/modem group and the video group are not working together enough. To that end, he called for the system group to be activated so that better communication between the RF/modem and the video groups can be assured. (The system group members are Faramarz, and Carlo from NAP, Ray and Sheau from Sarnoff.)

Remarks:

The VQ systems of NAP appears to be a sound one. Because it is VQ, it should have an advantage over the variable-length coder that Sarnoff system uses. I have some doubt that the picture quality would be acceptable as an HDTV picture, especially when the data rate is reduced to the 0.3 bpp range. On the other hand, even the Sarnoff system (whether the flow-field or the superframe block-match systems) has not demonstrated a decent picture at 0.3 bpp! The technical people at NAP are well aware that without a channel model, the VQ system is likely to appear worse in performance when compared to a variable-length system. VQ has a built-in channel error protection/concealment which cannot be appreciated in a noiseless channel. This is a point made on numerous meetings by several Sarnoff members who feel strongly that a channel model must be in place before any system comparison can be made.

From our recent algorithm developement work, it appears that the superframe block-match system is performing as well as the flow-field system. In view of the extremely ambitious schedule, (October 31 or November 30,) we are starting to integrate the flow-field and the superframe systems. Error concealment should be started as soon as possible, while the effort in the buffer control must continue. I think the point here is that we need all the man power we have and more just to have a chance of meeting the deadline. In contrast, the NAP system can probably be implemented with relative ease.



SBN/sbn **S. B. Ng**

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