CCITT SGXV
Working Party XV/1
Experts Group for ATM Video Coding

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Subject: ATM Video Coding

Source: Bellcore, AT&T, DIS, David Samoff Labs, PictureTel, Apple Computer

Purpose: Discussion

By using ATM principles, a broadband ISDN network is "capable" of providing a wide range of bit rates on demand and it appears to be ideally suited for video coding applications using constant quality/variable bit rate concept (e.g., VBR codecs). Several advantages have been cited for the VBR mode of operation. These include 1) perceived higher subjective quality for a given average bit rate when compared to variable quality/constant bit rate codecs (e.g., CBR codecs); 2) shorter transmission delay, 3) service flexibility, and 4) a more efficient utilization of network resources. In general, major concerns in the operation of ATM networks are the "cell loss", "cell delay jitter" and "circuit provisioning" factors. Cell loss occurs mainly due to the finite length of network buffers and the delay requirements for real-time video applications. Cell delay jitter is due to the variable delay a cell may encounter when going through the network queues. The Experts Group has been assigned the task of defining ATM-based video coding scheme(s). To accomplish this task, a major effort is needed for performance analysis of ATM video coding systems both in terms of coding efficiency and network requirements. That is, the Group should clearly examine ATM related impairments such as cell loss and cell delay jitter and their impact on various coding schemes.

To perform such analysis, a number of video coding techniques and network configurations are available. Clearly, Experts Group's "Terms of Reference" deals with a wide range of bit rates and service applications and not all of them can be addressed simultaneously. Indeed, efforts should be made to define work areas and their priorities by considering the following related factors:

1. Service
   - — application dependent (e.g., one-way, interactive)
   - — application independent i.e., generic
2. Coding
   - — coded picture format
   - — target bit rate
   - — layering
   - — cell loss protection and recovery
   - — compatibility with existing AV Recommendations
3. Network
   - — BER, CLR, cell delay jitter

— statistical gain

— VBR source characterization

— video adaptation layer

From a service perspective, a single common video coding system, capable of supporting a variety of bit rates and applications seems to be attractive. Two main obstacles for such an approach exists; namely, 1) an overall lower coding efficiency, and 2) not all services may equally benefit from VBR or CBR mode of operation. The primary focus of ATM video coding work should first be shifted toward service applications showing the greatest promise in terms of network resource utilization, identified generally with "statistical multiplexing gain" and end-to-end bandwidth allocation. At the moment, this is an open issue. Some preliminary results indicate that "video conferencing applications" are good candidates. We feel however further studies are needed to confirm these and to prove the case for VBR coding. Similarly, for video coding purposes, a picture format(s) should be identified. This in turn is dictated by several factors mainly target quality, expected compression capability of the coding algorithm, and the "requirement" to have direct connectivity independent of the local national television standard. CIF format adopted by the CCITT while providing direct connectivity will be used primarily for low-bit-rate video applications. For higher video quality applications (e.g., below 10-12 Mbps), CCIR Recommendations 601 designed to be the first of an extensible family of compatible digital coding standards, should provide the next option. Applications requiring EDTV or HDTV quality should be given lower priority pending the clarification of related TV standards. Due to the availability of ISDN and AV.200 compatible audiovisual systems, we feel a level of compatibility should exist between the existing and the new coding scheme(s). To a large extent, this issue translates into **transcoding** between the CBR and VBR modes of operation. Accordingly, issues related to both backward and forward compatibilities need to be further studied.

As was mentioned earlier for performance evaluation of ATM video coding systems both coding and network aspects should be considered. A "realistic" network model simulating random bit error and cell loss should be developed and its affect on different coding schemes, and by implication, different cell loss recovery/protection strategies be studied. The model can also be used to study statistical multiplexing gain versus cell loss ratio, and the effectiveness of source characterization. It should also provide the capability to examine AAL related issues for video on an ATM-based access to the B-ISDN.

Finally, the group should coordinate its activities with the CCITT SG XVIII, Experts Group for ATM Network, who deal with issues such as call set-up, bandwidth allocation, policing, and congestion control.