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

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TITLE: Multi-point Video Communication for B-ISDN

PURPOSE: Proposal

Abstract

Early consideration of multi-point is vital to avoid lost opportunities for implementation of better multi-point systems and ensure an appropriate infrastructure optimised for multi-point video communication. Intimate working with the network experts is essential for this development. To ensure successful implementation of new multi-point video services it is recommended that the Experts Group should contribute to Study Group XI in the development of B-ISDN signalling protocols and initiate close collaborative working between video coding and network experts.

1. Introduction

A multi-point capability is seen to be a fundamental requirement of future video services. Currently the strategy of the Experts Group in respect of multi-point video communication has not been fully defined. In this document it is proposed that the standardisation activity of the Experts Group should be focussed on a multi-point video coding system for B-ISDN. Early multi-point consideration will eliminate delay to availability of a multi-point standard and ensure optimal performance and new capabilities for future multi-party video services on the B-ISDN.

Most multi-point systems on existing networks employ the traditional switched-presence type of multi-point conferencing, in which a multi-point control unit (MCU) switches signals received from all participants. This approach, which is well-suited to circuit-switched networks, may impose unnecessary restrictions on the development of fully featured multi-point video connections within the ATM network. The flexibility of ATM transport offers the potential for implementation of better and more powerful multi-point systems which have been difficult or inefficient to implement in the past.

The timeframe for a multi-point standard is an important factor. If the strategy is adopted in which the standard is initially developed for a point-to-point system with in-built features for "future multi-point working", it will be unable to meet the expected strong demand for multi-point communication at the time of first commercial usage of the new ATM standard. At that time it is envisaged that existing point-to-point video services will have matured, and multipoint services will be in place, for example on N-ISDN. Users will have become familiar with multi-point services and there will therefore be a strong demand for a good multi-point capability on any superseding standard. If a full multi-point working capability is not immediately available on the new ATM video standard, it may be a disappointing inadequacy.

2. Types of Multi-point Systems

Multi-point systems can be characterised by both video "presence" and multi-point network topology. In a "switched presence" system the video signal from the current active conferee is transmitted to all participants in the conference. The selection of the current active conferee may be made on the basis of loudest audio volume or manual selection by a chairperson. "Continuous presence" means that each member of the conference can be seen by each of the other members at all times. This provides a heightened sense of "location" and "identity" for all conferees.

Research indicates that "continuous presence" provides a service with the potential for a much higher user acceptance than "switched presence" [1,2] and is desirable for future multi-point systems[3]. An extension to "continuous presence" is also possible, in which a subset of the total number of conferees is displayed on each user's terminal, the subset being tailored to each user's individual preference. As the number of participants in a conference grows beyond the number that can be sensibly displayed on the terminal, it is possible to select from the last "N" active conferees, the number and position of conferees to be displayed on the terminal.

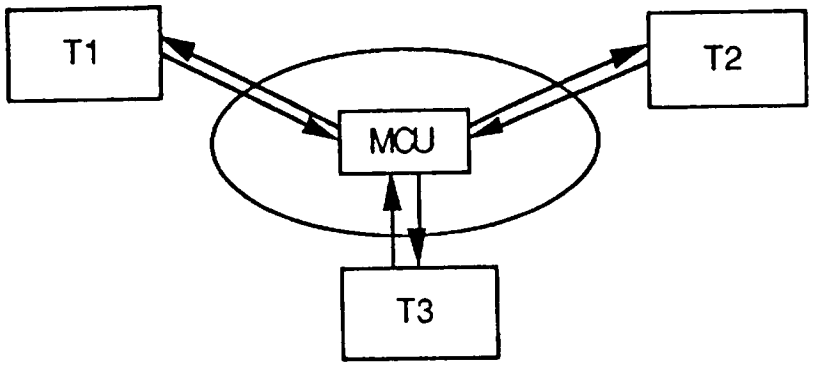

Fig. AVC-37/1. Star Multi-point Topology

The star is the most common topology for implementing a multi-point conference (Fig. AVC-37/1). This topology features a multi-point control unit (MCU), to which all parties are connected. The MCU normally carries out audio mixing, and in "switched presence" mode it performs switching of the video signals. In a "continuous presence" system the MCU decodes, mixes, and re-codes the incoming video signal. This configuration minimises the network transmission resources but introduces delays through the decoding-recoding process. It also limits the flexibility of the terminal display.

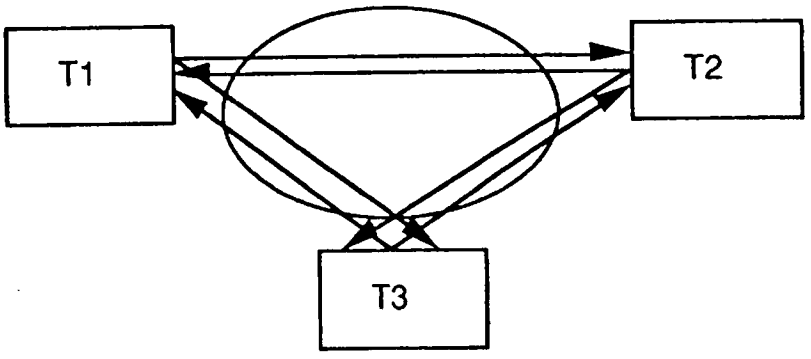

Fig. AVC-37/2. Mesh Multi-point Topology

An alternative is the mesh topology (Fig. AVC-37/2) where all video signals are multi-cast to all conferees. Except in the case of a small number of conferees, this system is costly on transmission resources for existing circuit-switched networks. However it provides minimum delay, complete flexibility of terminal display, and minimises the cost to the network provider as the MCU is avoided.

In the B-ISDN other multi-point topologies may also be attractive for implementing switched-presence, continuous-presence or hybrid multi-point video systems.

3. Exploiting the New ATM Network Characteristics

The characteristics of the ATM network can be exploited to implement better multi-point systems compared with circuit-switched networks.

3.1 Bandwidth-on-Demand

The flexible bandwidth-on-demand characteristic allows asymmetric bandwidths to be allocated in each direction. This means that in a continuous-presence type of multi-point connection, transmission bandwidth may be exactly allocated for the number of parties in the call, and parties may be added or dropped during the call. This powerful flexibility is not possible on circuit-switched networks where the user channel capacity is fixed in each direction. As a consequence the ATM network can implement a much more efficient, economical and versatile continuous-presence multi-point service.

3.2 Multi-casting

The potential multi-casting capability of the ATM network may be exploited for multi-point conferencing (and distributive) services to achieve economy of transmission. For multiple destinations, cell copying or multiplication by ATM switches at nodes can avoid duplication of transmission from the source to the copying nodes. This feature can be used to provide the physical basis for multi-point service routing.

3.3 Selective Routing

Flexible bandwidth of transmission in combination with multi-resolution layered coding systems can achieve economies of transmission and reduce the cost of multi-point terminal equipment. In the distributed continuous-presence system format each video sequence is displayed on only a portion of the screen, and a lower resolution picture is quite adequate. Thus each received video signal may be decoded only at lower resolution. For the multi-resolution coding system, the picture information is coded and transmitted in resolution layers, and a complete reconstruction is possible from decoding a sub-set of layers. Thus the receiver may request the dropping of higher resolution layers at the encoder, or if the encoder cannot re-configure its output layers, only the lower layers need be routed through network nodes to the receiver. This reduces the aggregate bandwidth per site for the multi-party connection and will reduce the cost of transmission. The transmission or routing only of essential layers helps to reduce traffic congestion and increases efficiency of network utilisation.

3.4 Dynamic Adaptation of Bandwidth and Time-sliced Decoding

The user may request addition and dropping of layers during the call as he changes the format of display on screen. For example he may wish to scale the view of a particular participant to full screen, and as he does this additional resolution layers may be requested either manually or automatically, from the transmitter.

As the receiver operates on a lower resolution picture when displaying multiple participants, its processing can be time-multiplexed to decode several of the received video streams, avoiding the need for multiple decoders. This reduces the hardware and cost of the multi-point receiver.

3.5 Multimedia Multiplexing

The ATM network also offers the capability to transport different media in separate virtual channels. Video and audio information may be carried in independent virtual channels which will facilitate processing e.g. selection, dropping and mixing of audio and video signals by the MCU in centralised multi-point conferencing systems. A greater variety of services and features may be offered, for example mixed video and audio conferencing services, provision of multi-channel sound by the MCU to give better identification of speaker, and multi-lingual conferencing services. Through multi-casting more channels and greater diversity of media may be delivered economically to receiving sites.

4. Multi-point Signalling

An appropriate signalling protocol will be required to achieve effective support for multi-point video services. Some fundamental functionalities will need to be provided. These include:

- the ability to support connections to multiple destinations within a single call, including user-controlled addition/deletion of connections

- multi-party addressing with the capability to provide some bridging and branching functions for multi-point communications
- for layered coding models addition and dropping of individual layers, and selective routing of layers through nodes

Work has already commenced within SGXI and SGXVIII on a signalling system for B-ISDN. The Integrated Services Control Part (ISCP) being developed will incorporate the signalling for the support of a variety of multi-point services including video. The Experts Group is very well placed to advise on multi-point signalling requirements for video. Early acceptance and action on this role will ensure the resulting signalling system will be flexible and able to support the range of new multi-point video systems on B-ISDN.

5. Conclusions

It is proposed that the activities of the ATM Video Coding Experts Group should be focussed on an inherent multi-point video communication system. The B-ISDN offers unprecedented opportunities for realisation of better and more sophisticated multi-point systems than are possible on existing networks. Early consideration of multi-point in the development of the video coding system is vital to enable the establishment of an overall framework which is optimised for efficient and economic implementation on the B-ISDN. Appropriate signalling protocols will need to be developed which support the multi-point video service. To successfully develop a complete and versatile multi-point video standard, close involvement of the networking experts is essential, and it is recommended that close collaborative working be initiated e.g. direct participation enabling face-to-face detailed discussions, of networking experts in the video experts' meetings, and vice-versa. A future joint meeting with Study Group XVIII would be desirable.

6. References

[1] G. Rohman, "System Aspects of Multi-point Videoconferencing", IEEE Globecom 87, pp 723-725.

[2] G. Rohman and L. Muehlbach "Multi-point Teleconferencing - Empirical Studies with Different Variants", 12th International Symposium on Human Factors in Telecommunications, The Hague, May 1988.

[3] L. Chiariglione, F. Miroglio and E. Viale, "Video Switching by Speech in a Multi-Conference Unit", IEEE Globecom '85, pp 433.