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

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1. INTRODUCTION

In this contribution a short description is given of the organisation of the joint CCITT/CCIR Study Group CMTT. Furthermore it discusses the current activities of CMTT on video coding and the actions undertaken to develop Recommendations for distribution of TV-signals.

2. CMTT ORGANISATION

CMTT is a joint Study Group of CCITT and CCIR for the transmission of sound broadcast and Television signals. CMTT is placed under the organisation of the CCIR. This means that all working methods and roles of CCIR are adopted by the CMTT. According to the Terms of reference, CMTT should study, in cooperation with the Study Groups of the CCIR and CCITT, specifications to be satisfied by telecommunication systems to permit the transmission of sound and television broadcasting programmes.

In the current study period of the CCIR, 1990 - 1994, the CCIR Plenary Assembly has agreed on new working methods. The most important change is the possibility for CCIR to produce Recommendations between the CCIR Plenary Assemblies (PA) according to an accelerated procedure given in CCIR Res 97.

CMTT has two plenary meetings in one study period. An interim meeting is held in the middle of a study period and just before the end of a study period there is a the final meeting.

CMTT has three Working Parties, i.e:

- CMTT/A, for analogue transmission of TV signals, conversion standards and MAC systems,

- CMTT/B, for digital and hybrid analogue/digital transmission of TV-signals,

- CMTT/C, for transmission of sound -programme signals.

In CCIR the responsibility for urgent Questions and the preparation of urgent Recommendations, which cannot reasonably be developed by the Working Parties, is given to Task Groups. The Task Groups have to report directly to the Study Groups. The Recommendations prepared by a Task Group should be ready in a time scale of two to three years. Within CMTT the following five Task Groups are established:

- TG CMTT/1, Technical methods for ensuring privacy in international TV-transmission,

- TG CMTT/2, Digital transmission of component-coded TV and HDTV signals, secondary TV-transmission,

- TG CMTT/3, Television and sound-programme signals in the B-ISDN,

- TG CMTT/4, Transmission of sound programmes of digital studio quality using the H1-channel,

- TG CMTT/5, Satellite News Gathering (SNG), outside broadcast via satellite.

CMTT makes a distinguish between different applications for digital transmission of television signals (REC 604).

- contribution is used when signals are carried to production centres where post processing may take place,
- distribution is used when television signals are carried to a point where no further post processing can be expected,
- primary distribution is used when television signals are carried for example to broadcast transmitters,
- and secondary distribution is used to deliver the television signals to the television consumer.

The groups within CMTT to be identified as being important to the work of the Expert Group for ATM video Coding are the Working Party CMTT/B and the Task Groups CMTT/2 and CMTT/3. In these groups studies are carried out in the area of digital transmission of TV and HDTV-signals.

3. CMTT ACTIVITIES ON VIDEO CODING

3.1. Contribution applications:

Currently CMTT is working on the updating of two Recommendations for contribution quality applications.

The Recommendation 721, 'Transmission of component-coded digital TV-signals for

contribution-quality applications at bit rates near 140 Mbit/s', was approved at the last PA of the CCIR. There are some details concerning the mapping into the channel frame which need further study.

The Recommendation 723, 'Transmission of component-coded digital television signals for contribution-quality applications at the third hierarchical level of CCITT Rec G.702', has a substantial part which need further study.

3.2. HDTV digital transmission

On the basis of contributions, based on experiments carried out in several countries, CMTT has produced report 1092, 'Transmission of High-Definition Television Signals'. This report is continuously updated to include the last experimental results on matters of digital HDTV transmission.

3.3. Secondary distribution

For the studies concerning secondary distribution of television signals CMTT has drafted report AO/CMTT, 'Standards for digital secondary distribution systems'. This report is attached to this document in appendix I, for information.

In the light of the progress of its work, within the new Study Period, TG CMTT/2 will develop Recommendations for secondary distribution of TV signals. During the last meeting of this Task Group in Kingswood (UK) it was proposed to establish an Expert Group to speed up the necessary studies on secondary distribution. At this meeting a start was made to lay down the preliminary workplan for the studies on secondary digital TV distribution.
An ad hoc group was set up to consider a workplan document up to the next meeting of the Task Group in April 1991.

For the workplan the following uncompleted list of items to be studied were identified:

1. The functional requirements of distribution codecs with regard to resolution, potential applications and the interworking needs between these applications.

2. The user requirements attached to the various services foreseen, mainly picture quality; but some other aspects such as sound/video synchronisation, encryption, etc. have to be considered.

3. The development of a network reference model in order to identify some further requirements that could influence the design of videocodecs.

4. The development of a terminal model in order to distribute the various functions to be studied into functional groupings (videocoding, display resolution, service multiplexing, synchronisation, network adaptation scrambling, conditional access,

etc).

5. The development of a scenario for the introduction of digital services, taking into account the availability of various scenarios for the introduction of future broadband networks.

The Task Group recognizes that amongst the items listed above there are various items that can only be addressed through a close cooperation with relevant groups of CCIR and CCITT, namely CCIR SG11, CCITT SGXV, CCITT SGXVIII, etc. Some other tasks are clearly the responsibility of CMTT.
The task of CCIR SG11 should be to define the quality objectives and the user requirements for secondary distribution of TV and HDTV signals.

4. DISCUSSION/CONCLUSION

The responsibility for the studies on video coding for broadcast applications lies with the CMTT. This includes contribution, primary and secondary distribution of broadcast sound, TV and HDTV signals. In order to come to Recommendations for secondary distribution TG CMTT/2 has identified several items to be studied. The Task Group CMTT/2 has drafted a preliminary workplan for studies on secondary distribution for the establishment of a TG CMTT/2 Expert Group to draft Recommendations.

In Study Group XV studies are carried out in the area of video coding for conversational applications, while the ISO/IEC group MPEG studies store and retrieval applications. Both groups have stated the intention to look at other applications, including the distribution of broadcast television signals. This might lead to an undesirable situation, in which the work is duplicated and several systems for the same application are specified in different standards. For future networks it is very important to take into account that there will be an increasing need for compatibility between various services. CMTT undertakes its projected work with the objective to define Recommendations for coding of TV signals for distribution services within the present study period. In this work the compatibility should be ensured. Liaisons with other groups, resulting in a close collaboration should be maintained to achieve this goal.

- Appendix I

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REPORT AO/CMTT

STANDARDS FOR DIGITAL SECONDARY DISTRIBUTION SYSTEMS

1. Introduction

Secondary distribution must be understood as the delivery of television programmes to consumers. Particular attention must be paid to the digital delivery of television signals over future Broadband Integrated Services Digital Networks (B-ISDN) which will be used for both communicative and distributive services including a whole range of visual services from videotelephony to television distribution according to future high definition standards.

Historically, it was the realization of this trend which caused the CMTT, at its Interim Meeting in 1987, to propose a change in its terms of reference, so that its perceived responsibility for studying digital delivery of television programming especially over optical fibre networks would be unequivocally resolved. The CCITT formally approved the proposed change at its IXth Plenary Meeting held in Melbourne, October 1988, subject to certain provisos [CCIR, 1986-90a].

To ensure that these studies are aligned with those on the broadband ISDN, the Plenary Assembly decided that CMTT should undertake its projected video coding studies for secondary distribution with the objective of consistency with the broadband ISDN being specified in CCITT Study Group XVIII and with coding for videotelephony in CCITT Study Group XV. Consistency with the video coding for broadcasting services should also be considered.

Different picture transmission requirements have hitherto led to the consideration of different bit rate reduction algorithms for each application and each transmitting channel. For instance, CCITT Study Group XV, IWP CMTT/2 and the ISO have proposed often similar but not identical algorithms for videotelephony, television contribution and distribution and still picture transmission respectively.

Greater compatibility between bit rate reduction algorithms will be required for the secondary distribution of pictures (mainly, but not exclusively in the broadband ISDN).

2. Interconnection requirements

There is already an increasing need for interconnection between services and many administrations require the new HDTV service to be compatible with the television service, i.e., for a television receiver to be connectable to an HDTV source as cheaply as possible. This need is likely to develop with the arrival of new visual services in the user's premises (still pictures,

videotelephony, etc.). Some terminals will even be of the "multiservice" type and will permit the reception and simultaneous display (by windowing) of several pictures (e.g., videophone conference picture insert on a television or HDTV screen). Because it uses ATM technology, the broadband ISDN will in addition permit the interconnection of terminals originally designed to operate at different bit rates; in other words, terminals (and bit rate reduction algorithms) will no longer be tied strictly to a single channel bit rate.

The need for interconnection imposes certain constraints on the picture sampling structure. In particular, practical consideration should, as has been proposed for HDTV, be given to a hierarchy of resolution standards based principally on progressive scanning. According to this proposal, the HDTV image has twice as many lines and points per line as a conventional television image. It is even possible to extend this hierarchy to lower resolutions and consider a 1/4 TV format. Such a system makes sense only if television and HDTV standards have the same picture frequency.

Several constraints, sometimes contradictory, have to be taken into account to design a transmission system for secondary distribution. They mainly concern:

- Bit rates

It is important to consider reduced bit rates to allow the distribution of numerous channels to the end users.

- Complexity

The coding methods for secondary distribution should result in low cost decoders to allow an economic introduction of the service.

- Picture quality

Users must be satisfied with the quality of the decoded signal. Precise criteria must be defined; nevertheless, it seems clear that the systems intended for secondary distribution of digital television must provide a better quality than the existing analogue composite systems.

3. Compatibility

In order to meet the need for interconnection between services using different picture formats, secondary distribution standards must ensure:

- upward compatibility (i.e., to enable a higher-resolution receiver to decode a signal transmitted with a lower resolution),

- downward compatibility (i.e., to enable a lower-resolution decoder to decode a higher-resolution signal as cheaply as possible).

Since the complexity of a decoder depends on the number of pixels to be processed during a frame period, downward compatibility is obviously more difficult to achieve if it is not taken into account in the compression algorithm.

Coding methods for secondary distribution of digital television should be defined with the objective of conformity with the features of the B-ISDN developed in CCITT Study Group XVIII.

They should be designed with the objective of the greatest compatibility with primary distribution and contribution codecs and also with the codecs defined for other communicative applications, as defined in CCITT Study Group XV.

4. Systems for secondary distribution of digital television

Document [CCIR 1986-90b] presents the main features of four compression systems based on the Discrete Cosine Transform (DCT) intended for secondary distribution applications at bit rates around 15 and 30 Mbit/s. One of these systems is a simplification to the intra-field mode of the hybrid DCT coding algorithm described in Document [CCIR 1986-90c]. Subjective evaluations were carried out to compare these four systems using a double stimulus method with graphic scale, including a high anchor point (4:2:2 reference) and a low anchor point (PAL coded-decoded sequences). The results of the tests show that the four algorithms provide a visual picture quality better than PAL and sometimes very close to 4:2:2, and therefore may fulfil the picture quality requirements for secondary distribution.

Document [CCIR 1986-90d] reports the results of subjective assessments of the hybrid DCT algorithm, based on computer simulations at different bit rates and from them the conclusion can be drawn that the performance at 10-15 Mbit/s is suitable for secondary distribution.

A system based on purely intra-field DCT has been studied by CMTT/2 and its specifications are in [CCIR 1986-90e]. This system has not been proposed for contribution purposes, but a codec at 34 Mbit/s has been compared with the existing prototype codecs during the tests undertaken by IWP 11/7. The results of the tests are in [CCIR 1986-90f]. The basic quality was satisfactory for most of the test sequences, the performance in the presence of errors was good and the system recovery time was satisfactory.

5. Codecs and display devices

Conformity of video coding studies for secondary distribution by CCITT Study Group XV and CMTT with the B-ISDN studies of CCITT Study Group XVIII will allow the advantages available through a multiservices network to be extended to the end user by minimizing the number of video terminals needed to access a range of interactive and distributive video and still image based services. The objective is to achieve the highest level of service integration through minimizing the number of coding techniques used across a wide range of video services and maximizing commonality of display devices.

To achieve this objective there will be a requirement for video terminals to be able to present video and still image material from a range of services other than that of their primary application, but within the limits of the display resolution. Thus, for example, a videotelephone terminal should be able to access and present (at the quality limit imposed by its low resolution display) a video signal originating as high resolution TV quality. The use of layered coding may be necessary to allow a terminal to extract only that part of the coded video signal that it is capable of representing. This layered coding structure means that information describing the different levels of image resolution are separately transmitted in a way that permits their selective

reception and reconstruction at a decoder. The coding methods may also need to be matched to the characteristics of ATM, the cell-based information transfer mode of B-ISDN.

Use of a common display device goes some way toward rationalization of a user's terminal needs for access to multiple video services. However, when this is combined with a single common decoder utilizing a layered coding structure, the objective of maximizing the commonality between interactive and distributive services can best be realized. An important issue however, is where and to what extent is conversion between different video formats to be performed. The question of whether this function should be performed at the source or in the display or a combination of both, requires further study.

Another important issue requiring further study is the definition of an interface between the codec (or other video sources) and the display, including the fundamental issue of whether the interface should be analogue or digital.

Note should be taken of the report of CCITT Study Group XVIII on Question 22/XVIII, "Broadband - ISDN influence on principles for video coding", from its June 1989 meeting [CCIR, 1986-90g].

Note should also be taken of the liaison statement from CCITT Study Group XVIII to IWP CMTT/1 coming from the June 1989 meeting, covering the role relationships between CMTT, CCIR Study Group 11 and CCITT Study Groups I, XV and XVIII for video coding studies and proposed amendments to CMTT Decision 18-5 to account for these role relationships [CCIR, 1986-90h].

6. Conclusion

Given the increasing need for compatibility between various visual services which will be eventually provided over future digital networks for distribution to the home, it will be necessary to ensure that coding algorithms have the following characteristics:

i) simple but compatible coding algorithms in order to minimize the costs of terminal equipment;

ii) an image quality which is equivalent to, or better than that presently available at the home;

iii) compatibility between individual services and with services derived from primary distribution systems;

iv) use of low bit rates to offer the widest possible range of services to the home.

REFERENCES

CCIR Documents

[1986-90]: a. CMTT/164 (CCIR); b. CMTT/217 (France); c. IWP CMTT/2-66 (France); d. IWP CMTT/2-76 (France); e. IWP CMTT/2-58 (France); f. IWP CMTT/2-97 (France); g. IWP CMTT/2-109 (CCITT Study Group XVIII); h. CMTT/221 (CCITT Study Group XVIII).
