XVII A.P.
DÜSSELDORF
21.5-1.6 1990
CCIR

XVIIth PLENARY ASSEMBLY
DÜSSELDORF, 1990

INTERNATIONAL TELECOMMUNICATION UNION

REPORTS OF THE CCIR, 1990

(ALSO DECISIONS)

ANNEX TO VOLUMES X AND XI – PART 3

SOUND AND TELEVISION RECORDING

CCIR INTERNATIONAL RADIO CONSULTATIVE COMMITTEE

Geneva, 1990

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ANNEX TO VOLUMES X/XI-3

SOUND AND TELEVISION RECORDING

(Study Groups 10 and 11)

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SECTION 10/11F: EXCHANGE OF RECORDED SOUND PROGRAMMES

REPORT 622-2

SOUND RECORDING ON MAGNETIC TAPE FOR THE INTERNATIONAL EXCHANGE OF PROGRAMMES

Use of special section for checking the technical parameters of stereophonic tapes

(Question 52/10, Study Programme 52A/10)

(1974-1978-1982)

1. Extensive studies carried out in the OIRT, in Australia and some other countries have shown that the quality of the international exchange of programmes recorded on stereophonic tapes can be improved, if the recordings have at the beginning a special section containing alignment test signals.

2. It is advisable from the point of view of the OIRT [CCIR, 1978-82], that such a special section contains alignment test signals as described in Table I, so that each tape will contain, in the following order (see Fig. 1):

2.1 the tape identification strip for the beginning of the tape, as specified in IEC Publication 94; the leader should preferably be coloured or annotated;

2.2 a special section for the alignment of the reproducing equipment, recorded under the same conditions as those applying to the programme itself. For this purpose, sinusoidal test signals, identical in phase, should be fed to the inputs of both recording channels.

In general, these test signals will be generated electronically and recorded directly onto the master copy (see Note) of the programme intended for international exchange. This section consists of three parts as listed in Table I.

Note. – *Master copy:* in the assembly of a recorded programmes by editing techniques, the first tape produced which contains all the intended programme durations and sequences.

2.3 A second leader for stereophonic recordings following the special alignment section, for operational purposes:

2.4 the stereophonic programme section of the tape;

2.5 the red identification strip marking the end of the tape (as specified in IEC Publication 94, Third Edition 1978).

3. Further studies are necessary so that during the next period a special section with uniform levels can be recommended which will allow § 7 of Recommendation 408 to be replaced.

TABLE I – *Special section*

Recorded signal	Frequency (Hz)	Level(1)(2) (dB)	Duration (s)	Channel
1. Signal for testing, or adjusting, level and balance of channels	1000	– 10	$10\ (^{+1}_{-0})$	*A*, *B*
2. Signal for testing frequency response and phase	40	– 10	$5\ (^{+1}_{-0})$	*A*, *B*
	10 000	– 10	$10\ (^{+1}_{-0})$	*A*, *B*

(1) According to the present practice in the OIRT, this is 10 dB below the nominal value of the maximum recorded level.

(2) [CCIR, 1974-78] proposes that these test tone levels should be in accordance with CCITT practice (CCITT Recommendation N.13, Geneva, 1981).

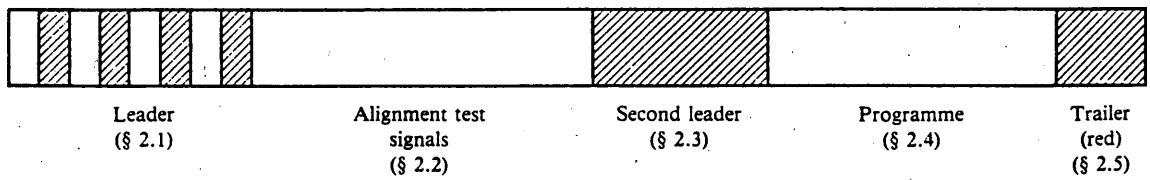

FIGURE 1 – *Different parts of a tape*

REFERENCES

CCIR Documents

[1974-78]: 10/351 (Australia).

[1978-82]: 10/34 (OIRT).

REPORT 950-2

DIGITAL RECORDING OF AUDIO SIGNALS

(Question 52/10, Study Programme 52B/10)

(1982-1986-1990)

1. Introduction

Two elements must be defined when specifying a digital audio magnetic tape recorder: the digital audio interface standard used at the recorder input and output, and the recording standard.

1.1 The digital audio interface used at the recorder input and output should conform with the digital audio interface adopted by the CCIR for digital audio studio equipment.

1.2 The recording standard includes the specification of the tape format, including channel coding, modulation methods, the error protection system and the distribution of the recorded signals on the surface of the tape.

Contributions are invited, particularly on the problems connected with the definition of the recording standard, including those associated with the provision of necessary operational facilities.

2. Systems under investigation

2.1 In [CCIR 1978-82], basic parameters for digital sound recording, as used in an experimental stationary-head magnetic tape recorder at NHK are described. The NHK equipment had four channels: two digital audio channels derived from eight magnetic tracks, one auxiliary analogue audio channel and one time and control code channel. The audio bandwidth was 20 kHz in the digital channels, and the signals were uniformly quantized with 16-bit encoding. A sampling frequency of 50.4 kHz was used in the prototype equipment. It was subsequently acknowledged, however, that this sampling frequency might not be compatible with other classes of service that might use sampling frequencies of 32 or 48 kHz. The equipment required redundancy of about 30% of the total channel capacity for error correction and synchronization codes.

2.2 [CCIR, 1982-1986] presents a general approach to the design of recording codes using a sampling frequency of 48 kHz and a quantization accuracy of 16 bits/sample. These codes are also applicable to TV and film audio. The proposed code formats are based on the use of universal segments having a length of 8 samples (4, 2 or 1 sample lengths are permitted). Annex II to [CCIR, 1982-1986] gives an example of the recording code intended for professional applications which uses the 8/14 channel code and a shortened Reed-Solomon code for correcting single and burst errors.

2.3 [CCIR, 1986-90] describes a new professional audio recording format which has been developed and brought into experimental operation by T.D.F. The basic format was devised for recording two channels. The source coding complies with CCIR Recommendation 646. Each audio channel is distributed over four magnetic tracks. In order to optimize both manual and electronic editing, a block format has been chosen for error-correcting codes. Input and output comply with CCIR Recommendation 647, and some features have been included in order to retain, as far as possible, the whole information (audio and data) transmitted by the serial interface. Annex I gives a list of characteristics available in this format which are thought to be particularly appropriate for such professional equipment.

2.4 Two new formats devised by industry are described in a document in three parts being circulated to the IEC National Committees. The document is based on contributions from Japan and the Federal Republic of Germany; the three parts give the general requirements, the requirements specific to Format A and the requirements specific to Format B respectively. Formats A and B correspond to the proposed systems for longitudinal digital audio recording on 6.3 mm tape known as "DASH" and "Prodigi" respectively.

CCIR Documents

[1978-82]: 10/185 (Japan).

[1982-86]: 10/40 (11/92) (USSR).

[1986-90]: 10/6 (France)

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NEKHAMKIN, M. A. and SHCHERBINA, V. I. [1982] Karkasy kodov zvukovykh signalov v televizionnykh i radioveshchatelnykh studiyakh (Code structures for sound signals in radio and TV broadcasting studios). *Tekhnika kino i Televideniya*, **8**, 40-44.

SHCHERBINA, V. I. [1982] Tsifrovoe kodirovanie zvukovykh signalov v TV studiyakh (Digital coding of sound signals in TV studios). *Tekhnika kino i Televideniya*, **5**, 40-42.

WEISSER, A., KOMLY, A., VIALLEVIEILLE, A., MAILLARD, M. AND TRTINJAK, V. [1986] - Description of a New Format for Digital Audio-Tape Recording with Stationary Heads 80th AES Convention - Preprint No. 2323.

ANNEX I

Minimum operational requirements achieved with the format described in § 2.3

Dynamic: An 18 bit dynamic range is considered as a minimum (20 bits desirable).

Reliability:

- Loss of one magnetic track making up an audio channel should be completely correctable.
- Loss of 1 cm of tape at 19 cm/s (2 cm at 38 cm/s) should be completely correctable.
- Up to 2 cm of tape at 19 cm/s (4 cm at 38 cm/s) could be lost with good error concealment.

Status and user data channels:

- Status data streams can be compressed, but should be recorded along with the audio samples.
- An auxiliary track should be provided for recroding 2 x 48 kbit/s of user data per audio channel.

Validity flag:

Validity flags should be recorded along with the audio samples without affecting the channel capacity.

SECTION 10/11G: EXCHANGE OF RECORDED TELEVISION PROGRAMMES

REPORT 630-4

INTERNATIONAL EXCHANGE OF TELEVISION PROGRAMMES ON MAGNETIC TAPE

(Questions 28/11, 18/11, Study Programmes 18K/11, 18L/11, 18M/11, 18N/11, 18P/11, 18Q/11, 18S/11, 18U/11, 28A/11, 40A/11)

(1974-1978-1982-1986-1990)

1. Introduction

Television tape recording is covered in the following Questions and in their dependent Study Programmes:

Question 18/11 Recording of television programmes

Question 28/11 International exchange of recorded television programmes. *Addition to television programmes (on film or magnetic materials) of data for controlling automatic equipment*

Question 40/11 Methods of synchronizing various recording and reproducing systems

The present Report describes the state of progress of the studies listed in the Study Programmes dependent on Question 18/11, "Recording of television programmes".

2. Analogue television tape recording standards for international exchange

This topic is covered by Study Programme 18K/11, "Analogue recording of television programmes on magnetic tape".

Standards for the international exchange of analogue television tape recordings are contained in Recommendation 469.

In accordance with Opinion 16, Recommendation 469 has been drafted to make reference to:

- IEC Publication 347 "Transverse track recording";
- IEC Publication 602 (Type B helical video recorders) and amendment No. 1 (1987);
- IEC Publication 558 (Type C helical video tape recorders and amendment No.1 (1987);

For type C, tighter mechanical tolerances for the audio tracks have been agreed between EBU and SMPTE (see EBU Recommendation N6-1989).

All the standards and Recommendations relating to the analogue magnetic recording of television signals, which are in current use by the EBU, are given in EBU Document Tech. 3084 (2nd edition, May 1975) 'EBU standards for television tape recordings' EBU Technical Standard N6-1989 - Helical scan television recording on 25.4 mm tape and EBU Document Tech. 3097 (3rd edition, 1982), 'EBU time and control codes for television tape recording (625-line television systems)'.

The OIRT countries use Type C and Type B recordings on 25.4 mm magnetic tape for the international exchange of television programmes in compliance with Recommendation 102/1 of the OIRT Technical Commission (1985) [CCIR, 1982-86a]. It is hoped that other contributions will be submitted giving details of current standards and Recommendations.

Report 964, "Exchange of television programmes recorded with two or more synchronous sound tracks on a separate support", covers the exchange of television programmes recorded with two or more synchronous sound tracks on a separate support, for "simulcast" or similar applications.

Some studies connected with Study Programme 18K/11 are still in progress and some additional specifications are available, as described in the paragraphs below.

2.1 *Reference audio level*

It may be desirable to revise the values recommended for the reference and the maximum flux levels in Recommendation 469, § 2, when new recording techniques, or new tapes with a different magnetic coating having a higher coercivity begin to be used for the international exchanges of programmes.

2.2 *Alignment signal to be recorded on the programme leader*

2.2.1 *Video*

Recommendation 469, § 5, indicates that an alignment video signal should be recorded for a minimum of 60 s, on the leader, but does not give details of the preferred alignment signal (or signals).

2.2.2 *Sound*

Recommendation 469, § 5, indicates the alignment sound signal that should be recorded on any channel carrying programme sound.

In the EBU, a sound alignment leader is used to meet the requirement of stereophonic and monophonic recordings. The specifications for such recordings can be found in Tables II and III of Recommendation 469.

In Australia, the alignment tones on audio tracks 1 and 2 are reversed relative to the ones shown in Table III of Recommendation 469. [CCIR, 1986-90].

Studies are in progress in many organizations, and it is hoped that further contributions will soon be submitted, so that the CCIR may formulate a Recommendation which would cover the (possibly different) alignment signals acceptable by all countries.

2.3 *Standard format for the programme label*

Recommendation 469, § 8, requests that the fundamental information, necessary for identification of the recorded programme, should be provided on labels conforming with the standard format as exemplified in Annex III of the same Recommendation.

Annex III shows an example of labels which conform with the standard format, as was adopted within the EBU some years ago.

The EBU has standardized the following elements of the label:

- the dimensions of the label,
- the information provided on the label,
- the space allocated to each item of information,
- the relative position of such spaces,
- the shape and layout of the tick-box area, and the positions of the several boxes and their captions.

In the EBU, the label captions for transverse track recordings are printed in two languages, one of which is the official language of the originating organization, the other being one of the two official languages of the EBU (English and French). For those EBU Member Organizations whose only official language is either English or French, the captions are printed in both English and French. Apart from being used within the EBU for the international exchange of recorded programmes, the same label is used by many EBU Member Organizations for their own internal purposes.

The information that should accompany each television programme is described in EBU Technical Standard N6-1989 and in Recommendation 102/1 of the OIRT Technical Commission (1985).

The information contained in the label is often supplemented on a separate sheet or label or punched card accompanying the recording.

It is hoped that contributions will be received suggesting a standard format for such information.

2.4 *Time and control code*

For general information on the time and control code see Report 963.

Information on time and control code recording levels can be found in documents listed in § 2.

2.5 *Data signals*

It is expected that the insertion of data signals into video tape recordings will find increasing application for a variety of purposes (see § 10 of this report) .

2.5.1 *Data placement*

These data signals can be recorded either on the longitudinal tracks or in the field-blanking interval of the video signal. Some of these are useful for national purposes while others will find increasing application for the international exchange of programmes.

2.5.2 *Field-blanking interval signals*

These may include:

- vertical interval time code;
- programme identification data;
- sub-title data (closed captions for persons with impaired hearing).

It should be noted that these signals may share the field-blanking interval with other analogue signals including technical performance monitoring signals such as I.T.S. and compressed digital audio.

The effective use of the field-blanking interval in videotape recording requires care in the editing and replay processes to ensure that these signals are not blanked, clipped or line shifted by time base correction or video processing.

In Australia [CCIR, 1982-86b] lines 21/334 are used for sub-title data using the system B (United Kingdom) teletext format.

An example of using line 16 for a data system to identify video tape cassettes is given in [CCIR, 1974-78a].

It is hoped that further contributions will be received (see § 10 of this report)

2.6 *Sub-title data recording*

Sub-title data, including closed captions for persons with impaired hearing, may be available separately on a computer floppy disc or conveniently recorded as data on the programme videotape. The data standard may be in one of the preferred teletext formats or a specific sub-titling format.

Organizations sub-titling television programmes, using teletext formats, should refer to Annex I of Recommendation 653 on teletext systems for the preferred operating practices.

It is hoped that contributions on this subject will be received.

2.7 *Specification of the timing stability of PAL broadcast video tape machines*

The composite output signals from a broadcast video tape recorder contain small timing perturbations which result from mechanical imperfections in the head assembly, the tape transport system and the video tape itself.

The output of a typical machine after a single record/replay cycle is likely to contain timing perturbations of about 6 ns peak-to-peak, with frequencies in the lower part of the audio spectrum. Such errors build up with successive generations of recording and the subjective effects can become significant with the use of normal production techniques. Furthermore, the effect of timing perturbations on a receiver using PAL decoding is considerably augmented if static phase errors exist in the regenerated sub-carrier supplied to the *U* and *V* demodulators.

If four generations of recording are used, CCIR [1974-78b] suggests that, based on experiments carried out in the United Kingdom, the target specifications for a single record/replay cycle should be as follows:

- 2.5 ns quasi peak-to-peak for random perturbations,
- 0.4 ns peak-to-peak for periodic perturbations.

2.8 *Measurement techniques*

The EBU publishes a series of documents dedicated to measurements and alignment techniques applicable to television tape recoreders.

Tech. 3219-1	Alignment and reference tapes
Tech. 3219-2	Operational alignment of television tape recorders (1985)
Tech. 3219-3	Electrical measurements for composite analogue television tape recorders
Tech. 3219-4	Special mechanical measurements for television tape recorders (1986)
Tech. 3219-5	Video measurement techniques for component analogue television tape recorders

A further document in the same series is in the course of preparation:

Tech. 3219-6	Audio measurements techniques for use with television tape recorders using audio channels using FM.

Documents 3219-2 and 3219-4 are included within [CCIR, 1982-86c].

In addition, equipment for measuring timing perturbations of the line synchronizing pulses (jitter), mentioned in § 2.7, is described briefly in [CCIR, 1978-82a]. Some experiments on the subjective effects of luminance jitter are described in [CCIR, 1982-86d].

Measurement techniques are also recommended in IEC Publication 698 "Measuring methods for television tape machines".

3. Digital television tape recording standard for international exchange

This topic is covered by Study Programme 18L/11, 'Digital recording of television programmes on magnetic tape'.

Standards for the international exchange of digital recordings on video tape in cassettes are contained in Recommendation 657.

In accordance with Opinion 16, Recommendation 657 will be modified to make reference to the appropriate IEC Publication when available.

Annex II of Recommendation 657 contains the basis for the digital television tape recording standard with the following content:

- users' requirements for digital television tape recorders;
- parameters of the tape format;
- mechanical characteristics of tape cassettes;
- source coding parameters for the digital video and audio signals;
- signal processing in the DTTR;
- parameters of the signals recorded on the longitudinal tracks;
- recommended operating practices;
- explanation of terms.

4. Recording of analogue component signals

This topic is covered by Study Programme 18K/11 "Analogue recording of television programmes on magnetic tape".

It is also covered by the Study Programme 42A/11, "Analogue component signals for studio applications". No CCIR Recommendation yet exists on this subject.

Studies about recording of time multiplexed analogue signals on 1 inch (25.4 mm) and 3/4 inch (19 mm) recorders in current use with minimum modifications has been reported in [CCIR, 1982-86e and f].

In its Technical Recommendation R 32-1984, the EBU has recommended to its members that, for electronic news gathering equipment using analogue component signals, they should use the L-format. This format is described in IEC Publication 961 (1989).

5. International exchange of television recordings for programme evaluation

This topic is covered by Study Programme 18N/11, "International exchange of television recordings for programme evaluation"; Recommendation 602, "Exchange of television recordings for programme evaluation", describes the format to be used for such programme exchanges, and the relevant operating procedures.

6. Editing of NTSC and PAL colour television recordings

This topic is covered by Study Programme 18P/11, "Electronic editing of NTSC and PAL colour television recordings".

No CCIR Recommendation yet exists on this subject; however, the preferred operating practice is described in the following:

6.1 *Picture shift following a video tape recorder (VTR) edit in PAL systems*

Undesirable horizontal picture shift following a VTR edit point may occur under certain conditions. When the picture content is similar before and after the electronic splice point, the shift may be easily visible and annoying; such picture jumps are especially irritating in the case of electronic animation. These horizontal picture shifts are the result of time-base-corrector action, which may be due to the PAL 8-field structure (a similar problem is experienced in 525 lines, 60 fields/s systems, with the NTSC four-field sequence) or to changes in the phase relationship between sub-carrier burst and line-synchronizing pulse caused by equipment instability or adjustment, or by a change to a source with a different burst-to-sync. phase relationship.

Report 624 defines the relationship between sub-carrier phase and line-synchronizing pulse. However, for sophisticated editing, it is mandatory [EBU, 1982] that the video signals to be edited are recorded with a phase $\Phi(E'_U) = 0°$, and with a deviation not greater than $\pm$ 20° (see Note 1) for the extrapolated E'_U-component of the video burst (see Note 2) at the leading edge of the line-synchronizing pulse of line 1 of field No. 1 (numbering of fields according to Report 624, Table II, item 2.16). The central value of $\Phi = 0°$ is called "the preferred sub-carrier-to-line synchronizing (Sc-H) phase for video signals recorded on tape". In addition, jitter and drift of sub-carrier phase with respect to line synchronizing should be less than $\pm$ 1.5 ns ($\pm$ 2.5°) (see Note 1) for synchronizing pulse generators (SPGs) providing the reference for editing suites. These SPGs must supply a "field No. 1" indication for the correct, field-coincident operation of associated PAL-coders, time-code generators and recorders. A visual display of the frame number of a selected edit point within the 8-field sequence derived from the time and control code is useful to the programme producer making the edit decisions in order to enable him to achieve, when necessary, edits without an undesirable picture shift [CCIR, 1978-82b].

The EBU has issued technical statements D23 - 1984 and D25 - 1986 describing in detail the EBU requirements for synchronizing pulse generators for 625 line/50 fields PAL signals.

Note 1. – Tolerance subject to further study.

Note 2. – The E'_U-component of the video burst is the $(E'_B - E'_Y)$-component as defined in Report 624.

7. Television tape recordings for electronic news gathering (ENG) applications

This topic is covered by Study Programme 18Q/11, "Television recordings on magnetic tape for electronic news gathering".

Recommendation 715 lists a number of provisions to be adopted in order to facilitate the international exchange of programmes based on the use of ENG recordings.

Report 803 provides some supplementary information and bibliography on the same subject.

8. Recording of high-definition television

This topic is covered by Study Programme 18S/11 "Recording of high-definition television programmes" and by ———— Report 1230. No CCIR Recommendation is yet available on this subject.

9. Recording of television programmes by new methods

This topic is covered by Study Programme 18M/11, "Recording of television programmes by new methods". No CCIR Recommendation or Report yet exist on this subject.

10. Addition to television programmes of data for controlling automatic equipment

This topic is covered by Study Programme 28A/11 "International exchange of recorded television programmes. Addition to television programmes (recorded on magnetic tape film or other materials) of data for controlling automatic equipment. Various techniques, such as bar-code labels, are being used in automatic multicassette systems to provide the necessary control information.

Joint Interim Working Party 10-11/4 has received a contribution from Australia proposing a standardization of a summary electronic data recording, during the leader period, providing cue sheet type information. The summary could contain information such as programme title, length of programme, number of breaks, length of programme segments, in and out times of programme segments (co-incident with the recorded time code), cue comments, remarks, etc. The recorded data can then be decoded at the initial loading of the videotape for display for operator confirmation of the recorded material and/or for computerized automation systems using machine control.

The system in use in Australia is as follows:

Cue position

The cue summary data information is recorded on tracks two and three (cue track) during the same period as the spoken identification recorded on track one.

Track two cue summary is recorded by the originating station and is inviolate for the life of the programme.

Track three is available for end-user purposes for cue summary recordings where information content requires change for an individual TV station.

Modulation Method

This is in accordance with CCITT Recommendation V23 employing the 1200 baud rate recorded at audio alignment level.

Data Format

Alpha-numerics are in accordance with 8-bit ASCII code. The serial data word comprises a start bit, eight message data bits with the 8th bit (the most significant bit) set to zero, a parity bit and a stop bit. Parity is even.

Information Description

The identification contains programme identification followed by pairs of time codes representing the "in" and "out" times of the programme segments. Recordings are required to have vertical-interval time code.

Information Protocol

The information is in the following sequence of ASCII characters:

i) Device Control 1 (DC1) carriage return (CR) line feed (LF) carriage return (CR) line feed (LF).

ii) The programme identification ended by CR LF CR LF.

iii) The "in" time of the first programme segment in the format HH:MM:SS:FF (the colon separators are mandatory) followed by CR LF.

iv) The "out" time of the first programme segment in the format HH:MM:SS:FF followed by CR LF CR LF.

v) The "in" and "out" times of the remaining programme segments formatted as in iii) and iv).

vi) The last programme segment "out" time and its appended CR LF CR LF is followed by the code Device Control 3 (DC3).

vii) An optional message.

viii) Code Device Control 4 (DC4) shall end the sequence.

The following restrictions are necessary:

i) As certain characters are integral to the operation of the system, the following control codes should not be used other than as prescribed.

Device Control 1 (DC1)
Device Control 3 (DC3)
Device Control 4 (DC4)

ii) Additionally, the sequence CR CR shall not be used unless separated by a printable character.

Cue summary information

The information protocol, as specified, is to enable the use of a printer for obtaining formatted printouts of the cue summary information. A typical print-out is illustrated below:

Print-out	Explanation	
TV SHOW 28-82 XYZ 734	PROGRAMME IDENTIFICATION UP TO 32 CHARACTERS/LINE	
00:02:30:02 00:16:21:15	IN TIME) OUT TIME)	1st Programme Segment
00:16:52:10 00:28:35:18	IN TIME) OUT TIME)	2nd Programme Segment

Time Code

The recording uses vertical interval time code, in accordance with IEC Publication 461, as this leaves the longitudinal cue track available for other operational requirements and provides a measure of protection against accidental erasure.

11. Storage of television tapes

Relevant information on recommended storage practices and environmental conditions for television programmes on tape can be found in EBU publication Tech. 3202, second edition (1990).

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[1974-78]: **a.** 11/52 (United Kingdom); **b.** 11/341 (United Kingdom).

[1978-82]: **a.** 11/251 (EBU); **b.** 11/95 (Australia).

[1982-86]: **a.** 11/334 (OIRT); **b.** 11/366 (Australia); **c.** 11/351 (EBU); **d.** 11/111 (France); **e.** 11/118 (Germany (Federal Republic of)); **f.** 11/315 (France).

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REPORT 803-2

INTERNATIONAL EXCHANGE OF ENG RECORDINGS FOR TELEVISION NEWS PROGRAMMES

(Questions 2/11, 18/11, Study Programme 18Q/11)

(1978-1986-1990)

Electronic News Gathering (ENG) is the collection of television news stories without the use of film, using small, hand-held, electronic, colour cameras with microwave links to the news-room and/or portable battery driven video tape recorders.

Recommendation 469 contains extensive specifications intended to facilitate the international exchange of television tape programmes recorded in conformity with professional analogue recording formats, namely transverse-track and Type B and Type C formats. Recommendation 657 gives the same information on professional digital recording format (D 1). It should be pointed out that some of the specifications and requirements described in Recommendation 469 do not necessarily apply in their entirety to ENG recordings. This is due to the peculiar programme content of the recordings, to the special environmental conditions which are characteristic of ENG operation, and the to fact that special recorders are often used for ENG purposes.

For several years the technical picture quality of ENG equipment was not yet as good as that produced by television studio equipment, and since the emphasis for news gathering is on portability and sensitivity, the requirements of news gathering sometimes makes some loss of technical quality of less importance than the news story. ENG cameras may be used with microwave-radio-links carrying the picture and sound back to the news-room. ENG cameras may also be used with small portable recording machines and the tape transported either direct to the news-room or to a convenient injection point where it may be replayed to line or to a radio-link connection to the news-room.

The availability of light-weight, battery operated video tape recorders – together with the development of time-base correctors to stabilise their outputs – are the two technical developments which have made ENG practicable.

Since the use of Electronic News Gathering is subject to revision, due to the application of new and emerging technology, additional and continuing studies are invited.

Recommendation 715 ——————lists a number of provisions to be adopted in order to facilitate the international exchange of programmes based on the use of ENG recordings.

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REPORT 1230*

RECORDING OF HIGH-DEFINITION TELEVISION ON VIDEOTAPE AND DISK

(Question 18/11, Study Programme 18S/11)

(1990)

1. Introduction

This topic is covered by Study Programme 18S/11 "Recording of high-definition television programmes". No CCIR Recommendation is yet available on this subject.

Experimental types of HDTV video tape recorders have been developed, based on analogue and digital techniques, and used for programme production trials by broadcasters. In addition, prototype disk recorders have been demonstrated which record short sequences and stills. The technologies used include optical, magneto-optical and electronic capacitance recording, with both analogue and digital modulation.

2. Analogue tape recording

Analogue HDTV recording techniques are similar to those used for conventional television, being based on FM modulation and high performance tapes. To accommodate the large bandwidth required, multiple channels combined with high writing-speed and narrow track-widths are used. A number of different approaches for dividing the baseband components of the HDTV signal between the channels have been demonstrated.

a) Highlights of this development on the 1125/60 standard are:

- a two-channel recorder with luminance (20 MHz) and line sequential colour difference (7 MHz) recorded on different channels, each of which is individually optimized. The signal-to-noise ratio obtainable with conventional (Co)γ - Fe_2O_3 tape was 42 dB for the luminance component and 45 dB for the colour difference component [Shibaya et al., 1982];

* This Report should be brought to the attention of the IEC.

- four channel recorders with 10 MHz bandwidth in each channel. Two channels are combined for carrying the luminance component (20 MHz) and one channel each for the two colour difference components (10 MHz). For that purpose, the luminance signal is bandsplit and 2:1 time-expanded prior to recording. This recorder (HDV 1000) has been implemented using a C-format transport, achieving up to 75 minutes of programme duration using 14" reels. The recorder parameter specifications are listed in Table I;

- a cassette-based machine with time-division-multiplexed luminance (20 MHz) and line-sequential colour-difference (7 MHz), subsequently time-expanded and recorded on two channels. 1/2" metal-particle tape is to be used, resulting in a recording time of 63 minutes with a cassette similar in dimensions to those of a conventional VHS cassette. The signal-to-noise ratio obtained is quoted to be 41 dB and 45 dB for luminance and colour-difference respectively [CCIR, 1986-90a; Shibaya et al., 1988]. This recording format includes four channels of high quality digital audio (16 bit linear, 48 kHz) multiplexed with video.

b) Highlight of this development on the 1250/50 standard is:

- the development of an analogue HDTV video tape recorder (BCH 1000) in the EUREKA Project 95. The recorder operates on the interlaced system with 1 250 lines and 50 Hz field frequency; it utilizes a modified BCN studio recorder and consequently uses a segmented scan recording process. The luminance signal is expanded in time and split into two signals for bandwidth reduction. The two colour difference signals are recorded without time expansion. Time reference signals are added in the horizontal blanking intervals for timebase correction of the luminance and colour difference signals [CCIR, 1986-90b]. The recorder parameters are listed in Table I.

3. Digital tape recording

Digital recording of HDTV has developed rapidly in response to the needs for greater transparency and operational flexibility and has resulted in a full performance recorder based on reel-to-reel techniques [CCIR, 1986-90c; Tanimura et al., 1987; Tsujikawa et al., 1988].

The machine characteristics are summarized in Table I.

[CCIR, 1986-90d] discusses some aspects of the modifications required to record HDTV signals complying with a 1375/50 standard on this machine.

The development of a cassette-based machine will require further study and will likely apply data compression techniques in the recording process [CCIR, 1986-90e].

4. Disc recording

Video discs are the appropriate mechanisms when random access to programme sequences is required. The technologies that have been explored for this application include optical recordings (write once, play only), magneto-optical recording (re-writable) and RAM based emulation of discs. For the case of FM-based component recording, maximum sequence length is limited to 15 min. In the case of digital recording, sequence length is reduced even further to 600 frames (for 30 Hz systems) [CCIR, 1986-90]. Further development remains to be carried out to make disc recording practical for professional studio recording.

TABLE I

Analogue HDTV VTR parameters

	HDV 1000	BCH 1000
Headwheel diameter	136.4 mm	50mm
Headwheel speed	60 rps	200 rps
Tape	1 inch	1 inch
Tape transport speed	0.483 m/s	0.66 m/s
Head/tape speed	25.9 m/s	33 m/sec
Nr. of video heads	8	8
Nr. of erase heads	2	2
Segments/field	1	8
Track width	70 um	85 um.
guardband width	19 um	15 um.
TBC reference burst	4.32 MHz	3.375 MHz
FM allocation	5-31 MHz	1-32 MHz
white level	20.23 MHz	25 MHz
black level	16.065 MHz	15 MHz
Max. reel diameter	14 inch	12.5 inch
Playing time	75 min	~ 1 hour

TABLE II

Digital HDTV VTR characteristics

Video	Sampling frequency	Y	74.25MHz
		P_R, P_B	37.125MHz
	Form of coding		Uniformly quantized PCM 8 bits per sample
	Number of active lines per frame		1035
	Number of samples per digital active line	Y	1920
		P_R, P_B	960
	Number of user's area line per frame		More than 5
	Frequency response	Y	0~27MHz±0.5dB ~30MHz+0dB/-1.5dB
		P_R, P_B	0~13.5MHz±0.5dB ~15MHz+0dB/-1.5dB
	S/N	Y, P_R, P_B	More than 56dB
	Pulse response	2T Pulse	Less than 1%
		Tilt	Less than 1%
		Linearity	Less than 1%
	Error correction code		Reed Solomon product code structure
Audio	Sampling frequency		48kHz
	Form of coding		At least 16bits per sample Possible to record up to 20 bits
	Number of channels	Digital	8 channels
		Analog	1 channel
		Time code	1 channel
	Frequency response	Digital	20Hz~20kHz+0.5dB/-1.0dB
Mechanism	Mechanical structure	Based on one inch Type C VTR	
	Maximum play time	96 minutes with 14 inches reel 63 minutes with 11.75 inches reel	
	Tape		Coated metal tape Coercivity (Hc): 1450 Oersted Retentivity (Br): 2450 Gauss
Tape speed		805.2mm/sec	
Video heads		Record : Sendust sputter (TW=33μ) Playback : Ferrite (TW=40μ)	
Scanner rotation speed		7200rpm	
Writing speed		51.5m/sec	
Minimum recording wavelength		0.69μm	
Number of video channels		8CH	

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[1986-90]: a. 10-11/4-143 (Japan); b. 11/456 (Federal Republic of Germany, Netherlands) c. 10-11/4-142 (Japan); d. 10-11/4-155 (USSR); e. 10-11/4-154 (Canada); f. 10-11/4-145 (Japan).

REPORT 1231

INTERNATIONAL EXCHANGE OF PROGRAMMES PRODUCED ELECTRONICALLY BY MEANS OF HIGH-DEFINITION TELEVISION

(Question 18/11)

(1990)

1. Introduction

This Report concerns the international exchange of HDTV programmes on film and tape.

Such exchanges consist of the delivery of programmes available in HDTV to broadcasters who wish to use them for emission in HDTV or for emission in conventional television systems.

2. International exchanges

When the HDTV programmes are produced electronically and the broadcasters wish to use them for HDTV emission, the delivery could conceivably be effected:

- by means of a video representation such as a tape copy of the edited master videotape in HDTV followed by any required standards conversion, or,

- by means of 35 mm cinematographic film (24 or 25 frames/sec) transferred from the edited master videotape.

When the HDTV programmes are produced electronically and the broadcasters wish to use them for conventional television emission, the delivery could conceivably be effected:

- by means of a video representation such as a tape copy of the edited master videotape in HDTV made after the required standards conversion, or,

- by means of 35 mm cinematographic film (24 or 25 frames/sec) transferred from the edited HDTV master videotape.

For electronically produced programmes, tape distribution can be expected to provide better picture quality by avoiding the double transfer of the electronic source to and from film.

Reference can be made to CCIR Report 1229 for a description of two systems currently available to transfer HDTV programmes onto 35 mm film.

From the viewpoint of movement portrayal, the use of 35 mm film transfers at 24 or 25 frames/s for exchange of electronically generated HDTV programmes between broadcasters would cause a significant loss of temporal information on all programmes, even those that were shot with that constraint in mind. The result would be that programmes with fast movement, such as sports, could exhibit an annoying judder if exchanged by means of film transfers. By contrast, the use of tape recordings for programme exchange would not cause additional impairments to movement portrayal.

High definition television interchanged on videotape can provide excellent resolution of picture details. If the programme exchange does not require standard conversion, then a tape copy will deliver all the original picture resolution to the receiving organization. Even if standards conversion is required, spatial filtering in the conversion process will be optimized to deliver to the output the highest possible resolution compatible with the output television system.

By contrast, if 35 mm film is used as the exchange medium, the double passage from the electronic to the optical domain (in the film recorder) and back (in the telecine) is certainly bound to affect picture resolution to a certain degree.

Tape must be preferred to film as the exchange medium in this respect.

Similar considerations may apply, to a lesser degree of importance, when consideration is given to colour fidelity and gray scale linearity.

3. Conclusions

For international exchange of HDTV-produced programmes between broadcasters, technical considerations suggest that clear preference should be given to an all-electronic process, i.e. to the exchange of videotape copies of the HDTV edited master videotape, with or without standards conversion, as the circumstances may dictate (see ———— Recommendation 714).

An electronic solution remains the only possible one when live international exchange is required.

4. Future considerations

It has been demonstrated that the origination of major productions electronically produced in HDTV is suitable for application in cinemas using electronic displays.

Those programmes can also be distributed to conventional film cinemas using 35 mm prints obtained by transfer of HDTV video tape masters to film.

A study on the applications of these technologies will be appropriate; cooperation with other international bodies on this matter is desirable.

REPORT 1232

THE RELEASE OF PROGRAMMES IN A MULTIMEDIA ENVIRONMENT

(Study Programme 18U/11)

(1990)

1. Introduction

The development of audio-visual media has progressed in a way that makes it more necessary than ever to harmonize the standardization that takes place in the CCIR, in the IEC, and in the ISO respectively.

The increasing integration of film and electronic methods in the production of programmes for both broadcasting and cinema release must be considered in the distribution of the work. Account must therefore be taken of the important work of the ISO regarding standards for the production and distribution of programmes on film.

The terms of cooperation among the CCIR, the ISO and the IEC are covered in Opinion 16.

2. The multimedia environment

It is recognized that the IEC has a wide field of action, extending well outside the broadcast equipment field, whilst the CCIR deals with broadcast systems only. Harmonization of efforts is needed in the common area of these fields of action, i.e., where the produced audio-visual message is transmitted and received.

The message itself may take several forms; it may be a television programme (entertainment, education, news, etc.), a recorded audio document, a teletext page, a movie, a computer output, etc.

The production of the message may use a variety of means and methods: normal television, high definition television, high quality audio recording, film, etc.

The fruition of the message may also happen in a variety of ways; on the home television display, by collective television or cinema displays, on computer displays and print-outs, etc.

The production installation can be seen as a production and postproduction facility that generates programmes for diversified outlets, e.g. in the case of television, terrestrial or satellite broadcasting, videodisc or video-cassette distribution facilities, cable systems, movie-theatre chains, etc.

The end-user installation may be seen, in the case of television, as a display (home or collective or professional), which is fed by a variety of consumer devices, e.g. terrestrial broadcasting tuner, satellite tuner, teletext decoder, video-cassette player, videodisc player, cable terminal, computer interface, etc.

In the case of an audio message, the same concepts apply; the end-user installation takes the form of audio amplifiers and loudspeaker units or headphones fed from a variety of consumer devices, e.g. terrestrial or satellite broadcast tuner, wire distribution tuner, cassette player, disc or CD player, etc.

Furthermore, an audio user installation may also represent the audio part of a television user installation and receive signals from some of the television devices exemplified above.

In addition, both the video and the audio installation may output programme signals to some peripheral equipment, such as a cassette recorder and there may also be cross ties, e.g. in the case of an audio user installation that receives a radiodata signal, decodes it and outputs the information in image form on the television display.

There is a need to ensure technical harmonization between message generation and message fruition from several viewpoints.

Specifically, the following aspects can be highlighted:

1. Production quality commensurate to the highest service intended

It is important that the sound and picture quality at generation be commensurate to the quality requirements of the most quality-demanding service among those for which the production is intended, if the production is generated for multimedia distribution. For instance, the picture quality capability for electronic distribution of movies to cinemas is obviously much greater than that required for normal television broadcasting to the home.

This aspect is of interest to broadcasters, since they often generate productions for multimedia distribution. It is also of interest to broadcasters when they broadcast productions generated elsewhere, since it is their role to define and protect the picture and sound quality of the broadcast service they operate.

2. Harmonized quality capability throughout a service chain

For any given service it is important that the sound and picture quality capability of the various elements in the total chain from production to fruition, be commensurate to the intended service. This quality requirement for sound and picture particularly applies to the recording process (and to the digital recording process) inserted in the chain; it applies as well to the quality capability of the picture display or listening unit used.

3. Harmonized standards and operating practices between broadcast and non-broadcast audio-visual applications

It would, of course, be highly desirable that harmonized technical standards and operating practices be applied, where appropriate, in consumer equipment intended for broadcast applications and for non-broadcast applications. This would ease the interconnection of the components of a unified consumer audio and video presentation system.

It would also be highly beneficial that harmonized technical standards and operating practices be applied, where possible and appropriate, in programme production facilities operated by broadcasters and in consumer equipment.

REPORT 1233

HDTV RECORDING/REPRODUCTION EQUIPMENT FOR CONSUMER AND INDUSTRIAL USES

(Study Programme 18U/11)

(1990)

1. Introduction

HDTV recording for professional broadcast use is described in Report 1230.

For the semi-professional and consumer markets, the following progress has been reported to the CCIR.

2. HDTV video casette recorders

At the 130th SMPTE Technical Conference in October 1988 in New York, NHK (Japan Broadcasting Corporation) presented a paper about the first cassette type HDTV-VTR for industrial applications. Details are available in the literature [Shibaya et al., 1988].

A summary of the specification is listed in Table I:

A consumer video cassette recorder from the Netherlands was developed and it was demonstrated at the IBC, Brighton, in September 1988 and at the IFA, Berlin (West), September 1989. It recorded and displayed the HD-MAC signal including digital signals for the sound and data services and digitally assisted television (DATV), using digital video and audio processing; dropout compensation was included. Options gave the facility of recording/replaying D2MAC, PAL, SECAM or NTSC-signals.

Specifications and performances are summarized in Table II.

3. HDTV disk systems

Various disk systems for moving and still pictures have been developed to serve as HDTV package media. The video disk offers a number of advantages over the VTR, in such capabilities as quick access and trick reproduction. A disadvantage of them has been a difficulty in user-recording. However, recently developed experimental disks can be used for the user-recording either once or repeatedly depending on the type of disk. At present, for the usage of playback only, the optical type is the major one, but others such as magneto-optic and electrostatic capacitance type have also been developed.

The development of the disk systems, both for moving and still pictures, has now reached a point where models for practical applications are being produced and some are now used in actual operations.

In step with the development of better disk materials, the introduction of a series of experimental systems is expected that can be used not only for reproducing but also for recording pictures with motion. Moreover, a semiconductor laser which can shorten the wavelength to half of that generated by conventional semiconductor lasers has also been developed. With these developments, further improvement will be made to increase the recording capacity and reproduction time of optical disks.

Table III shows characteristics of the major disk systems for moving pictures developed in Japan.

Table IV shows characteristics of the major still picture disk systems developed in Japan.

From the Netherlands, a video disk player for HD-MAC signals was developed and it was demonstrated at the IBC, Brighton, in September 1988 and at the IFA, Berlin (West), September 1989 [Horstman, 1988]. It allowed replay of the complete HD-MAC signal with the full sound/data possibilities of D2MAC, together with a compact disk sound signal.

Table V summarizes the system parameters and performances.

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TABLE I

Characteristics of video cassette recorders

magnetic tape	1/2 inch, metal powder tape
cassette	new model, dimensions 121(W) x 205(L) x 25(H)mm
television standard	1125 lines, 60 fields/s
reproduced video	
modulation	FM
luminance bandwidth	20 MHz
luminance S/N	better than 41 dB
chrominance bandwidth	7 MHz
chrominance S/N	better than 45 dB
reproduced audio	
modulation	PCM
number of channels	4
sampling frequency	48 kHz
quantizing	16 bits linear
recording time	63 mins

TABLE II

Characteristics of the HDMAC VCR

Specification	
Drum diameter	62 mm
Tape	MP
Drum speed	3000 rpm
Rel. speed	9.67 m/s
Nr. of video heads	4
Segments/field	2
Track pitch	
incl. guardband	30 um
Nr. of tracks/frame	8
Expansion ratio	1.8
TBC reference	
Sync	negative
Burst	2.8 MHz
Extra time for sync and burst	7.4%
FM allocation	7-10 MHz
Performances	
Signal bandwidth (-6dB)	10.125 MHz
SNR (unweighted)	42 dB
Skew and jitter	< 15 ns
Playing time	1.1 hours

Table III

Characteristics of moving picture disks

Type		Optical				Electro-static capacitance
Pickup (Wavelength)		Semiconductor laser (780 nm)			(656 nm)	Capacitive pickup
Disk size		300 mm				260 mm
Recording time	CAV	14 min.	15 min.	-	-	40 min.
	CLV	30 min.	30 min.	20 min.	45 min.	-
Video signal		MUSE	MUSE	MUSE	MUSE	MUSE
Audio signal	No. of channels	2/4/6	2	-	-	2
	Modulation	TDM (3 levels)	TDM (4 levels)	-	TDM (3 levels)	RF-FM

Table IV

Characteristics of still picture disks

Type		Optical	
Function		Playback only	Playback only
Disk size		300 mm	120 mm
Video signal		MUSE	MUSE
No. of frames		54,000 (CLV) 34,000 (CAV)	640
No. of picture elements or bytes per frame		-	540 Mbytes
Audio signal	No. of channels	4	2
	Sampling frequency and bits/ sample	32 or 48 kHz/ 8 or 11 bits	32 kHz/ 8 bits

TABLE V

Characteristics of the HDMAC Video Disk Player

System parameters	
Recording method	CLV
Linear velocity	21.4 m/s
Wavelength of laser	780 nm
Aperture N.A.	0.5
Disc size	300 mm
Inner radius	85 mm
Carrier frequency	16.8 MHz
Deviation	1.7 MHz
Playing time	20 min
Video signal format	HDMAC
Audio channels:	
in HDMAC format	as D2MAC
modulation	TDM, duobinary
plus	
in CD format	2 HQ
modulation	EFM
Performances	
Channel bandwidth	12.1 MHz
SNR (unweighted)	32 dB
SIR (around 10.125 MHz)	> 32 dB
Residual time-base error	< 6 ns

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SECTION 10/11H: USE OF FILM IN TELEVISION

REPORT 294-7*

STANDARDS FOR THE INTERNATIONAL EXCHANGE OF PROGRAMMES ON FILM FOR TELEVISION USE

(Questions 28/11, 40/11, 41/11, Study Programmes 28A/11, 40A/11, 41A/11 and 41B/11)

(1963-1966-1970-1974-1978-1982-1986-1990)

1. Introduction

The several aspects of the international exchange of television programmes on film are covered in the following Questions and Study Programmes.

Question 41/11 "International exchange of programmes on film for television use"

Study Programme 41A/11: "Picture standards for the international exchange programmes on film for television use"

Study Programme 41B/11: "Optical sound standards for the international exchange of television programmes on film for television use"

Question 40/11 "Methods of synchronizing various recording and reproducing systems"

Study Programme 40A/11: "Recording of time and control code information on magnetic tapes for television"

Question 28/11 "International exchange of recorded television programmes. *Addition to television programmes (on film or magnetic materials) of data for controlling automatic equipment*"

Study Programme 28A/11: "International exchange of recorded television programmes. *Addition to television programmes (recorded on magnetic tape, film or other materials) of data for controlling automatic equipment*"

The present Report describes the state of progress of the studies listed in the mentioned Study Programmes.

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* The Director, CCIR, is requested to transmit this Report to the ISO, in accordance with Opinion 16.

2. Picture standards

2.1 Study Programme 41A/11, "Picture standards for the international exchange of programmes on film for television use", covers the technical characteristics and standards for the picture component of television programmes on film intended for international exchange.

Recommendation 265 describes such technical characteristics and standards; Recommendation 501 (with Annexes I and II) describes the methods for the subjective evaluation of the picture component of films for television presentation.

Recommendation 716 gives the dimensions and position of the area scanned by high definition television telecines on 35 mm cinematographic film. It is based on documents [CCIR, 1986-1990a, b, c, d].

2.2 Recommendation 265, § 3.4, stipulates the maximum and minimum film densities for accurate picture reproduction in television.

[CCIR, 1978-82] reports that in the United Kingdom the maximum film density range employed for optimum colour reproduction has been extended to a range between 0.2 and 2.5. Further information on United Kingdom practice, including film transfer characteristics and some details of tests with a telecine is given in [CCIR, 1982-86a].

2.3 Study Programme 41A/11, seeks a definition of the telecine characteristics required to give optimum television reproduction of colour film. [CCIR, 1974-78a] points to a need to distinguish between two uses of film in television and hence a need for two modes of telecine utilization (see Recommendations 265 and 501).

The first category of film used in broadcasting involves theatrical, documentary, and current events films. These films come to the broadcasting organization with an artistic integrity that should not be altered. The characteristics of the telecine intended for this category of film should produce a television image that matches the projected film image under the conditions described in Recommendation 501.

The second category involves the use of film in television production. Here the film images may be intercut with material from television cameras and the artistic decisions are made within the television organization. The type of telecine intended for this category of film requires additional signal processing and controls to permit matching the images from film with those from the television cameras or the original scene.

It is believed that DECIDES 1 of Study Programme 41A/11 should involve a specification of only the first type of telecine use.

2.4 DECIDES 3 of Study Programme 41A/11 deals with specifications of standards, tolerances, and methods of measurement of colour balance for films intended for television use. [CCIR, 1974-78b] presents data showing that the differing spectral selectivity of neutral images on various film materials makes it impossible to specify a simple objective measurement of colour balance using standardized measuring equipment normally used in laboratory practice. Reliable, objective measurements can only be made with densitometers having a spectral response closely matched to that of the CIE standard observer.

2.5 The safe area for television titles and sub-titles on anamorphic films is specified in ISO Standard 1223-1981.

3. Sound standards

Study Programme 41B/11 "Optical sound standards for the international exchange of programmes on film for television use", covers the technical characteristics and standards for the sound component of television programmes on film, intended for international exchange.

Recommendation 265 describes such technical characteristics and standards.

For reproduction of print films with optical surround sound tracks, the EBU has issued technical Recommendation R59-1989, which suggests a procedure for deriving sound signals for monophonic television and stereophonic television from these films. The EBU proposal [CCIR, 1986-90e] is reproduced in Annex I to this report.

4. Operating practices

Operating practices for the international exchange of television programmes on film are also described in Recommendation 265.

OIRT Recommendation 14/3 (1983) [CCIR, 1982-86b] specifies technical parameters by the OIRT for the international exchange of television programmes, which are essentially in agreement with Recommendation 265.

The matter of the information to be placed on the label of the film container is still of interest and some countries have been using, to their mutual advantage, a standard multi-lingual format for this label. Contributions on this topic are also requested.

Cueing leaders have been actively studied and are also a matter for ISO/TC 36. The EBU proposals [CCIR, 1970-74] are reproduced in Annex II to this Report. Further contributions are invited with the objective of agreement on a leader for use in television broadcasting which would also be acceptable for cinema use.

5. Data signals

Question 28/11, "International exchange of recorded television programmes. *Addition to television programmes (on film or magnetic materials) of data for controlling automatic equipment*", concerns the addition to recorded television programmes of data for controlling automatic television station equipment and contributions on this subject are requested. Study Programme 28A/11 considers this Question for both film and magnetic recording.

No Recommendation or Report is yet available on this topic.

6. Synchronization of picture and sound

Question 40/11, "Methods of synchronizing various recording and reproducing systems", and Report 468 of the same title, deal with the synchronization of pictures and sound. The Report takes into account IEC Publication 461 on time and control code for video tape recording. Annex I to Report 964 (EBU Technical Recommendation R25) covers the special case of international exchange of television programmes with two or more sound tracks on a separate support.

Further contributions are expected on the problems of synchronizing film pictures and film sound.

7. New developments

A feasibility study performed by the Society of Motion Picture and Television Engineers in the United States is reported in [CCIR, 1986-90f]. The report considers the use of a second frame rate of 30 frames per second (fr/sec) for the production and distribution of motion picture films. The document reports the findings of the SMPTE when 30 fr/sec films are used for cinematographic projection.

(a) with regard to flicker, there is significantly greater perception at 24 fr/sec than at 30 fr/sec, with the perception being further increased at elevated screen luminances. (Normal optical projection practices, using a two-bladed shutter, were used);

(b) with regard to strobing effects in motion, a significant improvement in material shot and displayed at 30 fr/sec, compared to that at 24 fr/sec was noted;

(c) one unanticipated additional benefit of filming at 30 fr/sec was noted, being the reduction of granularity apparent on the screen. This improvement was observed to be even greater at elevated screen luminances.

The study also considered a possible change in film format from four perforations per frame to three perforations per frame for 35 mm film, to reduce film consumption. The combination of this change, with operation at 30 fr/sec would result in a net saving in excess of six per cent in print length.

The technical consequences of scanning such films in the TV environment are not yet clear. Contributions on this subject are invited.

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[1982-86]: a. 11/78 (United Kingdom); b. 11/103 (OIRT).

[1986-1990]: a. 10-11/4-126 (CBS); b. 11/294 (EBU); c. 11/527 (Chairman of JIWP 10-11/4); d. 11/586 (Japan); e.11/552 (EBU); f. 11/135 (CBS).

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CCIR Report 795-2 - Transmission of two or more sound programmes or information channels in television.

ANNEX I

Reproduction of films with optical surround sound on television

Nowadays, many 35 mm feature films are released with stereo (optical) sound tracks which are also encoded for reproduction in the cinema using surround sound systems. These systems derive a number of audio reproduction channels by means of matrix sytems. Noise reduction is applied to each track separately. The frequency response is greater than that of conventional optical tracks which need the traditional "Academy" filter.

Broadcasters may wish to transmit these higher quality prints and they may need to generate:

- a mono signal for conventional single channel television;
- a stereo signal for the stereo transmission systems approved in principle by the EBU.

The EBU recommends the following when a film with a stereo optical track with surround sound is broadcast:

- The telecine should be capable of reproducing each optical track separately,
- Noise reduction processing should be applied to each signal individually,
- The resultant two signals should be used as a stereo signal,
- The two signals should be combined by summing the two tracks to produce a monophonic signal,

Notes

The above procedure will give the best overall results, but the following should be appreciated:

- The levels into the noise reduction processors should be carefully set.
- The dynamic range of the signals may be greater than is suitable for the domestic environment. It has been found that in some cases better results are achieved by raising low level signals rather than by compressing the peaks or limiting high levels. This subject, however, requires further study. Any compression should be applied in an identical manner to both signals.
- If it is required to suppress the encoded surround information, then matrix decoding and stereo re-encoding have to be performed.
- If a stereo optical sound sensor is not available, a compromise procedure is to use a normal mono optical head with a single noise reduction processor. This will give accurate centre information, but will cause anomalies with wide stereo material, in particular, the suppression of low level stereo components.

- If noise reduction equipment is not available, the noise levels and dynamics of the signal will be incorrect and there will be a consequent loss in audio quality.

- These recommendations have been found suitable for Dolby stereo films and in principle should work for other proprietary systems.

ANNEX II*

UNIVERSAL FILM LEADER FOR CINEMA AND TELEVISION

1. Introduction

Many different film leaders have been designed during the history of motion picture films. Basically, the leader is a length of film attached to the head of the programme film to assist in lacing the telecine machine or cinematograph projector. If, however, it is marked with suitable visual information it may be used to ensure that the correct amount of time is allowed for the machine to run up to speed and to arrive at the beginning of the programme information at a specific moment. It is also usual for the leader to bear marks which facilitate the synchronization of the reproduction of the sound record with that of the picture information. General advice on leaders is contained in Recommendation 265.

The reason for the existence of many different leaders lies in the fact that the visual requirements for cinema projection tend to be different from those for television use. There is the further complication that there are some systems using 24 frames per second and others using 25 frames per second. The latter is encountered where the field rate of the television system is 50 Hz.

It is very desirable that there should be a substantial reduction in the number of leaders encountered because operational errors arise from failure to recognise the significance of certain marks (particularly marks concerned with the synchronization of the sound) when an unfamiliar leader is used. There would also be an advantage in having a leader which is suitable for use in cinematograph projectors and in telecine machines: it should also permit the synchronization of all commonly-encountered separate sound systems and give a sufficiently accurate run-up timing when used in systems having either 24 or 25 frames per second.

This Annex describes a draft leader intended to fulfil these requirements.

The design incorporates a very small number of signs, and thus provides a basis for the possible development of more elaborate national leaders. The intention is that this structure should enable any operator in any country to deal with familiar images. The original leader can thus be retained with any film that is exchanged.

The draft was developed by Sub-group G3 of EBU Working Party G, who based its work on various national or international proposals for leaders in order to produce a leader suitable for the maximum number of users. Copies of the leader were made by Sveriges Radio, which used them experimentally for cinema projection and showing on television. These experiments have confirmed that this leader is suitable for both applications.

2. Description of the leader

The general form of the proposal follows that of ISO Document ISO/TC 36 (October, 1968) entitled "Leaders and run-out trailers for 35 mm and 16 mm release prints". Other relevant documents are AFNOR Pr S 25-003, DIN 15 698, BSI 69/5182 and ASA PH22.55-1966. The changes incorporated in this draft are those considered necessary to provide a leader which is suitable for films used in television, as well as for presentation in motion picture theatres.

Leaders are normally divided into three sections:

- a protective section of blank film,
- an identification section,
- a synchronizing section.

Only the last two sections are represented in Fig. 1 (Universal film leader) of this Report and some details concerning the design are given below.

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* This Annex is based on [CCIR, 1970-74].

2.1 *Identification section*

The identification section will begin at frame No. 307 (marked HEAD) and will finish at frame No. 241. It will carry information in accordance with the provisions of Recommendation 265, § 3.9.

Frames Nos. 288 and 264 are allocated count numbers 12 and 11, respectively, and although they fall within the identification section, they are an extrapolation of the synchronizing section for use in certain dubbing operations where a very long run-up time is necessary.

2.2 *Synchronizing section*

2.2.1 *Projection speed*

The distances between the principal marker frames (Nos. 48, 72, 96, etc.) are 24 frames, conforming to normal cinema leader practice. Thus the "blinks" caused by the projection of the lower-density image in the marker frames will occur at intervals of one second, once the projector has run up to speed.

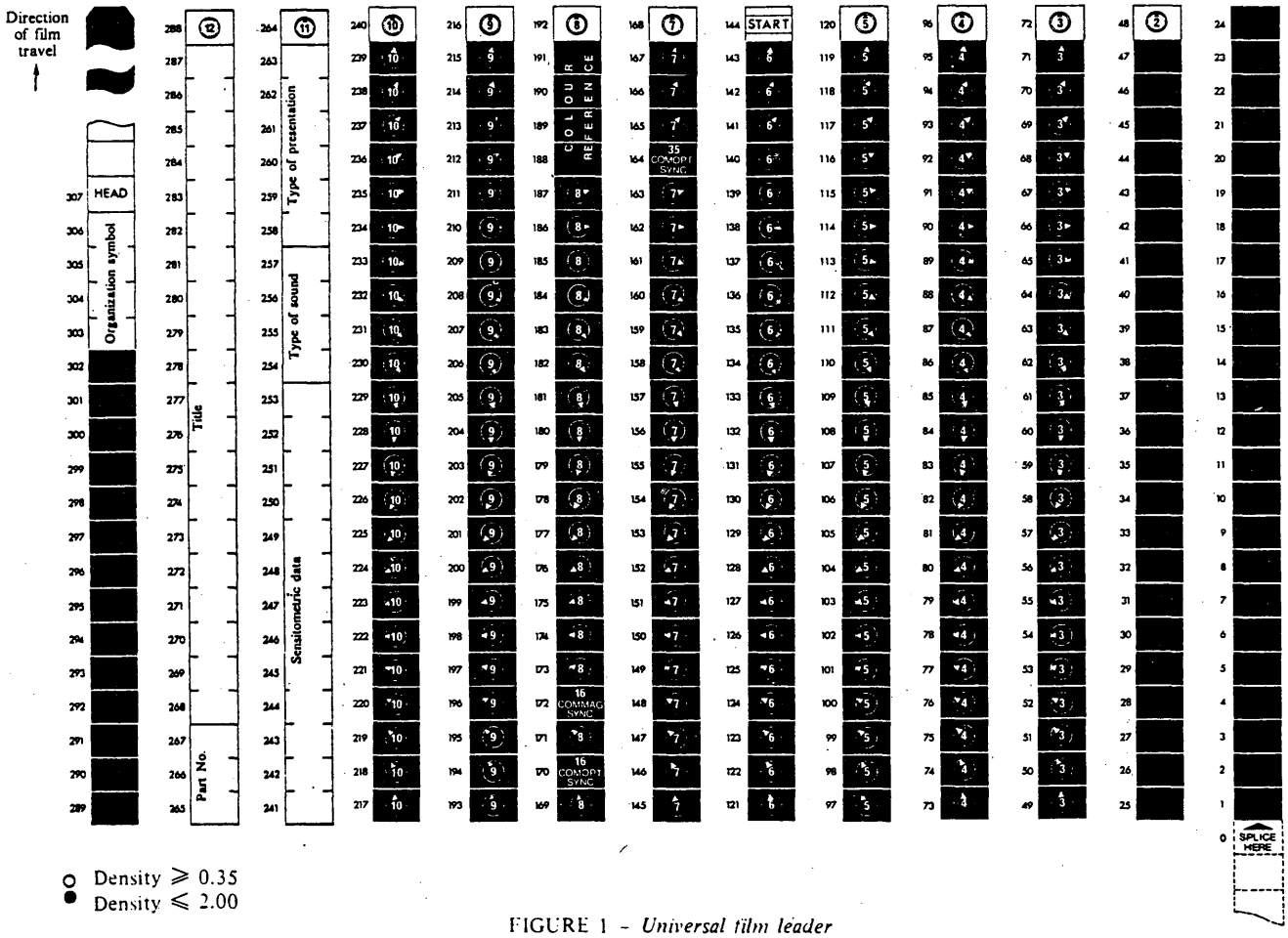

FIGURE 1 - *Universal film leader*

For part of the passage of the synchronizing section through the projector or telecine, the speed of the machine will be increasing from zero to the normal 24 or 25 frames per second and even when stability is reached, the importance of precise one-second measurements is not, as a rule, of great operational significance since the cue to start the machine must be made with a prior knowledge of its run-up characteristics.

For this reason, it is suggested that there is no substantial value in having leaders which are equally suitable for both 24 frames per second and 25 frames per second. The majority of systems function at 24 frames per second and, therefore, the leader should be based on this rate.

2.2.2 *Frame-by-frame details of the synchronizing section*

Frame 240	The synchronizing section starts at frame 240 with the count number 10 surrounded by two circles with markings for every 15°. The number and the "clock" are in black-on-white, but the minimum density is controlled to prevent overload of telecines. A triangular black pointer marks 0°.
Frames 239 to 217	Count number 10 is in white-on-black. The rate of 24 frames/s is indicated by a white pointer rotating around a centrepoint 15° for every frame.
Frame 216	Count number 9. Otherwise as for frame 240.
Frames 215 to 193	Count number 9. Otherwise as for frames 239 to 217.
Frame 192	Count number 8. Otherwise as for frame 240. This frame corresponds to START of the Academy Head Leader or PICTURE START of the SMPTE Universal leader.
Frames 191 to 188	Four black frames marked COLOUR REFERENCE (printed lengthwise with the film) and intended to be replaced by four frames of colour reference picture in the leader of all master material.
Frames 187 to 173	Count number 8. Pointer indications from 75° to 285°.
Frame 172	Indicator for position of sound reproducer for 16-mm film with magnetic stripe, 16 COMMAG SYNC, printed in white letters. (Correctly spaced with respect to frame 144.)
Frame 171	Count number 8. Pointer indication 315°.
Frame 170	Indicator for position of sound reproducer for 16-mm film with an optical track, 16 COMOPT SYNC (correctly spaced with respect to frame 144).
Frame 169	Count number 8. Pointer indication 345°.
Frame 168	Count number 7. Otherwise as for frame 240.
Frames 167 to 165	Count number 7. Pointer indications from 15° to 45°.
Frame 164	Indicator for position of sound reproducer for 35-mm film with an optical track: 35 COMOPT SYNC (correctly spaced with respect to frame 144).
Frames 163 to 145	Count number 7. Pointer indications from 75° to 345°.
Frame 144	START. The reference image for synchronization of all sound tracks.
Frames 143 to 121	Count number 6. Pointer indications from 15° to 345°.
Frame 120	Count number 5. Otherwise as for frame 240.
Frames 119 to 97	Count number 5. Pointer indications from 15° to 345°.
Frame 96	Count number 4. Otherwise as for frame 240.
Frames 95 to 73	Count number 4. Pointer indications from 15° to 345°.
Frame 72	Count number 3. Otherwise as for frame 240.
Frames 71 to 49	Count number 3. Pointer indications from 15° to 345°.
Frame 48	Count number 2. Otherwise as for frame 240.
Frames 47 to 1	Black.
Frame 0	White with black text "SPLICE HERE" with a pointer which marks the junction between leader and programme, namely, between frames 1 and 0.

2.2.3 *Technical design*

2.2.3.1 The following approximate densities are suggested:

white or low density $\geq$ 0.35
black or high density $\leq$ 2.00

2.2.3.2 The backgrounds shall be of 4 × 3 format with a white frame line between the frames.

2.2.3.3 The START-mark and the count numbers are confined to half picture-height to allow legibility when set up as a still frame in a flying-spot telecine.

2.2.4 *Separate sound recording*

In the case of the SEPMAG system, the sound film should have a very small perforation (approximately 1 mm square) at the point in the sound recording corresponding to the START reference point on the leader. So that the user may locate this point easily, a piece of adhesive tape may be attached to the sound film in advance.

Another method for ensuring that the picture and sound coincide at the start is to use the leader described above for the sound film.

REPORT 469-3

RECORDING OF COLOUR TELEVISION PROGRAMMES ON CINEMATOGRAPHIC FILM

(Questions 18/11, Study Programme 18R/11)

(1970-1974-1982-1990)

1. Introduction

A serious limitation in the international exchange of colour television programmes has been the lack of a means for transferring the electronic video-frequency signal to motion-picture film, without significant loss in quality. Although several systems are in limited commercial use at present, all rely upon some form of optical image-transducer and, in consequence, are limited by the aperture of the optical system and noise level characteristics.

Because of the limited use of the various systems, and shortcomings in the quality of recordings, it is premature to answer Study Programme 18R/11. Therefore, this Report is for information purposes only and describes practices used for photographic film recording of colour television programme material from video-frequency signals. Also noted are systems under development which use direct electron beam recording or using laser optics, which may ultimately result in significant improvement in the film recording process.

2. Present-day systems

The following is a brief description of representative film recording systems in current use and those known to be under development.

2.1 *Triniscope*

This is a three-tube picture presentation, registered optically for colour photography through a system of dichroic mirrors. Although registration is a problem, this system provides enough brightness for photography with finer grain reversal and negative-positive film systems. It has been used for several years by a few organizations.

2.2 *Three-gun displays*

More common is a single-tube presentation using conventional or special three-gun display tubes. Signal processing is frequently used to correct errors in colour, sharpness or contrast. Conventional tubes require the use of higher speed, 16 mm colour negative or reversal films for adequate exposure. A special tube with a clear face-plate is used to provide just enough brightness to expose a finer grain 16 mm colour reversal film, from which inexpensive multiple copies can be made by photographic duplication. Otherwise, multiple copies are made by repeated recording from video tape onto high-speed reversal colour films.

2.3 *Sequential display*

One organization is providing a recording service in which red-, blue- and green-separation records are made, sequentially, from a colour video-tape recording. These separate records on black-and-white film are combined by photographic printing, to provide a photographic colour print or a master from which multiple copies can be made.

2.4 *Electron beam colour-film recording*

A system using electron beam equipment has been developed for use in making colour separation records.

2.5 *Colour-film recording using a laser beam*

Several organizations are using laser beams for producing colour-film recordings. Equipment is available for producing the colour television image.

Note - Report 1229 concerns the recording of HDTV programmes on cinematographic film.

REPORT 1229*

RECORDING OF HIGH-DEFINITION TELEVISION PROGRAMMES ON CINEMATOGRAPHIC FILM

(Question 18/11, Study Programme 18T/11)

(1990)

1. Status of equipment

1.1 Introduction

The use of HDTV to produce films for the international exchange of television programmes and for other uses, such as direct projection in the cinema, is of increasing importance. The intrinsic high quality of the HDTV image, and the accompanying sound, allows film recordings of high quality for programme exchange. The development of the methods to perform this transfer with a low level of impairment is advancing rapidly. This equipment must include both image processing, to adapt the video signal to the film emulsion characteristics, and transformation from the HDTV scanning parameters to those of conventional 35 mm film. In particular, frame rate converters may be necessary, which require sophisticated processing. The equipment must also include high quality sound recording capability.

Two methods have been identified that offer the desired levels of image quality:

Laser beam recording

The colour film stock (positive or negative) is exposed directly by three modulated laser beams (corresponding to R,G,B) scanning the film frame. This method can operate in real-time and provides a resolution limited principally by the size of the focussed laser beams.

* This Report should be brought to the attention of the ISO, the IEC and the SMPTE.

Electron beam recording

The HDTV image is separated into the three components (R,G,B) and a separate monochrome inter-negative film is made for each component by direct exposure to a modulated and scanned electron beam in a vacuum chamber. The deflection and modulation of the electron-beam is very similar to that occurring in a CRT. Subsequently, the processed inter-negative films are synchronized and printed through appropriate colour filters onto a colour film-stock in a conventional optical printer of high stability. The process is confined to non-real-time applications, generally operating in conjunction with an incremental HDTV reproducer and a frame memory.

In all such processes, high quality images can only be achieved by careful matching of the processed video to the colour and gamma characteristics of the colour film stock.

Note. - Report 469 concerns the recording of 525/625 television on cinematographic film.

1.2 Laser beam recording

[CCIR, 1986-90a] describes a 35 mm film recording system for high-definition television which has been developed in Japan using three laser beams of red, green and blue. Since substantially high outputs can easily be obtained with sharp beams from these lasers, films of fine grain, yet low sensitivity, can be used as recording media for real-time write-in. Thus high-resolution pictures can be obtained on colour films with low granular noise and high colour saturation. To obtain high-quality in moving areas of the image, the equipment uses motion-adaptive scan conversion techniques.

Colour films for the recording can be selected from various types such as negative, inter-negative, intermediate or positive (print film), and the loss of quality in an optical printing process can thereby be minimized.

The sound is also recorded by using a laser beam with a recording system of variable-area type. The equipment has been developed for this purpose. This system, as in the case of video recordings, utilizes the high intensity of laser which enable the use of low sensitivity high resolution film. The colour print film can be used as well as the ordinary 35 mm sound negative film, and an excellent sound quality can be obtained with good frequency response and good signal-to-noise ratio. This recording system, combined with a noise reduction system, provides suitable high quality sounds, well matched to the picture of HDTV.

1.3 Electron beam recording

[CCIR,1986-90b] describes an electron-beam recording (EBR) for transfer of high-definition television pictures onto 35 mm cinematographic film which has been developed in Japan. In this method, the electron beam stimulates the emulsion of the film directly. No optical system is needed. The depth of focus of the electron beam is large enough to allow the film plane to drift for as much as 3 mm without affecting focus. In addition, as the electron beam does not penetrate into the film base, there is no problem of halation. The electron beam is easily deflected electromagnetically to form a raster, thus a sharp and precise latent image is made on the film, although the recording must be performed in a vacuum. In order to make a sound track of better quality, electron beam recording for the sound tracks has also been developed. Electron beam recording improves transient characteristics and gives an overall distortion of less than 1% at 1 kHz, and frequency characteristics of -3 dB at 25 kHz.

Another advantage of EBR for sound is that a fine grain low sensitivity film such as Fuji 71337 can be used which improves the S/N ratio. Since the electron beam does not penetrate into the film base, there is no need to use the gray base to eliminate halation.

2. Experiences of motion picture production using HDTV electronic means

[CCIR, 1986-90c] describes an experiment of motion picture production using HDTV electronic means. In fact, the encouraging results obtained by earlier experiments have induced RAI to produce in 1986 its first HD feature film. The production entitled "Julia & Julia" has used an international cast and a highly skilled technical team composed of specialists belonging both to RAI and to the Italian cinema. The movie has been distributed on a 35 mm film and on magnetic tape around all the main international circuits; its distribution on video disks is foreseen.

2.1 Tape to film transfer.

The image transfer from magnetic video tape to 35 mm. film is among the most delicate processes of the production cycle.

An EBR system as described in item 3. has been used.

2.2 Production of the electronic master

2.2.1 Shooting

The techniques and the equipment used for the shooting have been the following :

- the shooting in the studios and outdoor has been done with two cameras, two VTRs, one video mixer and other auxiliary equipment.

- the film cameras have been used when it was necessary to frame the scene from more than two angles simultaneously and to make slow motion or helicopter shots;

- since the production was destined to be projected in cinemas, a HD large screen videoprojector has been widely used (120" diagonally) in order to be able to evaluate better the quality of the pictures;

- for the outdoor shooting the equipment have been installed in a van and in a camera-car;

- for the studio shooting the chroma-key technique has been largely used to simulate outdoor scenes visible from windows.

2.2.2 Video post-production

The electronic editing has been done in two stages : off-line editing with NTSC equipment and on-line editing with HD equipment.

The reason of this choice was the cost and the lack of availability of an adequate number of HD VTR as well as the possibility to separate the moment of the artistic from the technical decisions.

The working copies for the off-line NTSC editing have been obtained by optical conversion, reproducing the original HD recordings, with a 59,94 Hz field frequency instead of 60 Hz.

A video mixer has been used in the on-line editing mainly to dissolve, and a colour corrector has been used to balance the colorimetry in some scenes.

2.2.3 Sound post-production

The audio work has been done with conventional techniques. The necessity to produce sound tracks in different standards (60 Hz, 59.94 Hz, 50 Hz, 24 photogramme/s) has engendered a considerable amount of synchronizing and dubbing work.

The final sound track has been successively recorded in dolby stereo on the video tapes belonging to the various standards and has been optically printed on the filmed copy.

2.3 The results

From a technical and a production point of view, the most important results have been the following:

a. despite the lack of experience with TV techniques, the director and the director of photography have easily learned how to use electronic means and have appreciated the advantages of being able to control in real time the artistic and technical choices.

b. the existing technology is enough to satisfy the majority of the production needs; nevertheless it would be useful to use additional equipment, such as :

- a portable VTR in order to record in particular conditions, i.e. for helicopter shots, shooting on boats, etc.

- a system which will allow to correlate the position and the movement of images in the background and foreground, in order to produce more realistic chroma-keys and more complex special effects.

c. The performances of HDTV equipments have been generally positive and adequate to the needs; nevertheless, some aspects have not been completely satisfactory, in particular the lag of camera tubes which limits the motion in dark scenes, and the low S/N ratio of the analogue VTR which does not allow to go any further than the third generation.

d. The passage from 30 frames per sec. of the electronic system to the 24 frames per sec. of the film, may lead to an uncorrect motion portrayal (judder). Since this defect is visible only after the transfer on film, a judder simulator has been used during the shooting in order to control and, if necessary, modify the camera and actor's movements in the most difficult scenes.

The problems mentioned in "c" above have already been partly overcome by a new generation of equipment, characterized by cameras with a major sensitivity (an additional 1f/stop in comparison to the former model) , and by digital component VTR with a bit-rate of 1,2 Gbit/sec. and with a multigeneration capability satisfactory even for the most complex post production. When HD CCD sensors will be available the lag problem will be solved as well.

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SECTION 10/11I: UTILIZATION AND SYNCHRONIZATION OF DIFFERENT PROGRAMME SUPPORTS

REPORT 468-4

METHODS OF SYNCHRONIZING VARIOUS RECORDING AND REPRODUCING SYSTEMS

(Questions 53/10, 40/11, Study Programme 47A/10)

(1970-1974-1978-1986-1990)

1. Several documents answer in part the question of synchronization between the various forms of sound and/or image: [CCIR, 1966-69a, b, c and d; CCIR, 1974-78].

2. Required capability of synchronization

There are several methods of synchronization between sound tapes, television tapes and films applicable to the various modes of operation.

It is frequently necessary to have available two or more synchronous sound tracks.

In some cases (synchronous copy or play-back), synchronization must be maintained in the forward direction only.

In the process of programme production (lip synchronization or editing) synchronization must be maintained in both forward and reverse directions.

Additional capabilities of synchronization systems may prove useful although not essential, for example, maintaining synchronization in case of film breakage, automatic loading and phasing of several sources.

3. Usual methods of synchronization

3.1 General considerations

Electro-mechanical methods such as sprocket-driven perforated film and tape have been in use for a long time.

[CCIR, 1982-86a] describes a solution for the synchronization of a film scanner with its sound follower(s).

More recently electronic methods of synchronization have become available utilizing a sequence of markings (perforations, printed marks or recorded pulses) on the tapes or films to be synchronized. In the case of television tape recordings, formats for television systems using 25 pictures/s and 30 pictures/s have been standardized for time-and-control codes; they are described in IEC Publication 461, 2nd edition. Additional details on a code for 25 pictures/s are contained in EBU document Tech. 3097, 3rd edition.

The markings are usually related to the picture frame rate and can be identified by the use of a numbering code or a form of timing information.

In normal play-back or recording operation, phase comparison between markings may be used for synchronization. Electronic counting of the marks or even individual recognition of each mark would be needed for synchronization in both directions.

3.2 Magnetic time-coding recording

Report 963 describes in more detail the use of the time-and-control code in television tape recording, and Report 630 details some operating practices to be followed in using it.

Report 964 and [CCIR, 1982-86b] addresses the problem of the international exchange of television programmes having two or more synchronous sound tracks on a separate support, which requires resorting to appropriate synchronization methods.

3.3 Optical time-coding recording

In 1986 the SMPTE approved the two Recommended Practices listed in the Bibliography, which specify a time and control code for use on film [CCIR, 1986-90a]. The basic principle of this time code is described in Annex 1. Briefly, two versions of the time code are specified: version type C, an 80 bit-per-picture code, very similar to the time code for television tape recordings described in Report 963; and version type B, a 112 bit-per-picture code, which can however be decoded by type C decoders. The time code can indifferently be used for film running at 24, 25 or 30 frames per second, and it is specified as being indifferently recordable on the:

- optical control and data track of 35mm release print film,
  of 35mm camera film,
  of 16mm film.
  of Super 8 release prints,
- magnetic control and data track of Super 8 film,
- low-dispersion magnetic coating track of 35mm film.

In [CCIR, 1986-90b] the AATON time code is described. This code is recorded as a time marking optical data matrix on each picture of a 16 mm or 35 mm film. The optical data, after processing, may be recovered optically, without physical contact with the film. It contains a coding system compatible with the time and control code used in video and audio (IEC Publication 461), (see Annex II) .

4. Conclusions

The different methods available are not mutually exclusive but are complementary and enable maximum simplicity and economy to be achieved in synchronization.

There are a large number of different synchronization systems in use, and although it might be considered desirable that a format be recommended which could be used with all types of picture and sound recordings, it would appear that a unique solution may not be recommended as the optimum for all cases.

REFERENCES

CCIR Documents

[1966-69]: **a.** X/51 (Spain); **b.** X/134 (USA); **c.** X/163 (France); **d.** X/189 (Spain).

[1974-78]: 10/58 (OIRT).

[1982-86] **a.** 11/83 (United Kingdom); **b.** 11/44 (EBU).

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SMPTE Recommended Practice RP 135-1986
"Use of Binary User Groups in Motion-Picture Time and Control Codes"

SMPTE Recommended Practice RP 136-1986
"Time and Control Codes for 24, 25 or 30 Frame-per-Second Motion Picture Systems."

ANNEX I

EXCERPTS FROM

SMPTE RECOMMENDED PRACTICE

RP 136–1986

Time and Control Codes for 24, 25 or 30 Frame-Per-Second Motion-Picture Systems

1. *Scope*

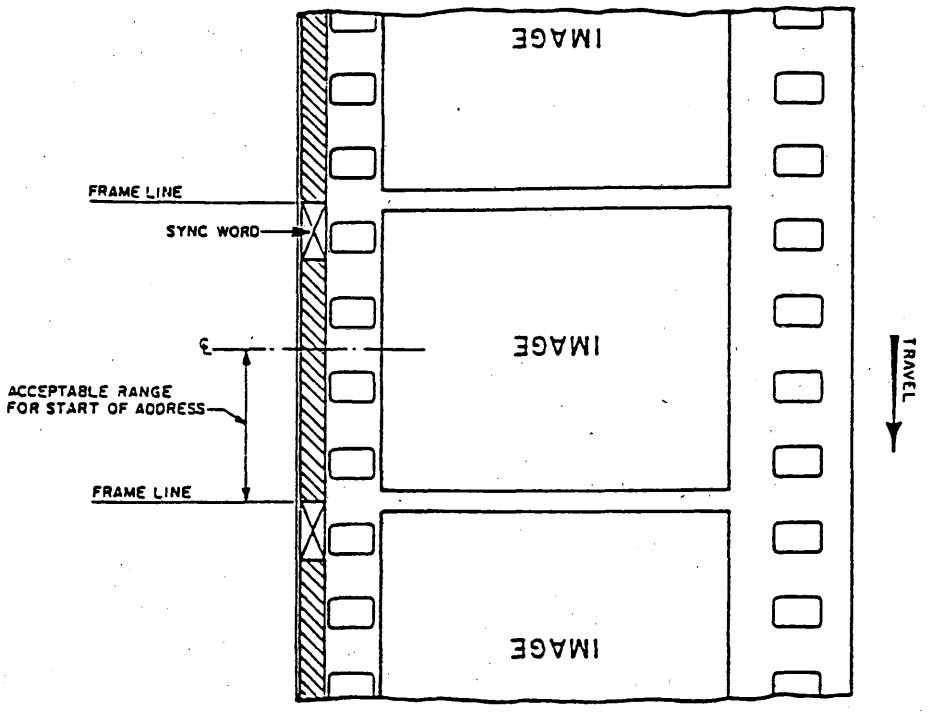
This practice specifies digital code formats and modulation methods for motion-picture film to be used for timing, control, editing, and synchronization purposes. This practice also specifies the relationship of the code to the motion-picture frame. The codes described in this practice are similar to the continuous code described in American National Standard for Television—Time and Control Code—Video and Audio Tape for 525-Line/60-Field Systems, ANSI/SMPTE 12M-1986.
(CCIR Note - This ANSI/SMPTE text is in conformity with IEC Publication 461, to which Report 963-1 makes reference.)

There are two types of codes described in this practice. The first type, type C, is a continuous code which is very similar to the continuous code specified in ANSI/SMPTE 12M-1986. This type of code can be used in situations where the film is moving continuously at the time of both recording and reproduction.

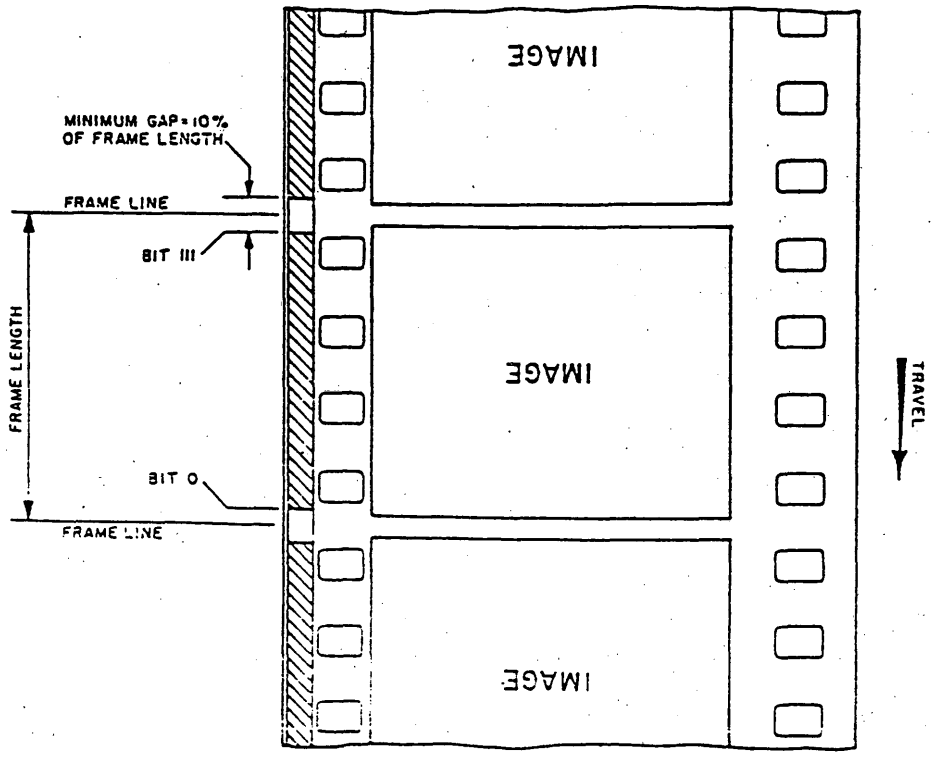
The second type of code, type B, is a noncontinuous, block-type code, composed of blocks of data, each complete in itself, with gaps between the blocks. It is designed so that the code may be recorded and played back on equipment with intermittent film motion but still be decoded with the same type of electronic equipment used to read the type C or continuous time code.

The codes described in this practice can be used at various frame rates, the ones currently of interest being 24, 25, and 30 frames per second.

Approved 23 April 1986



Type C Code



Type B Code

(The figures illustrate the preferred longitudinal placement of a frame of time code relative to the picture frame. It it not intended to identify the track position on the film. The figures apply to all film formats, even though 35-mm film is shown.)

ANNEX II

DESCRIPTION OF THE AATON OPTICAL TIME-CODE

The Aaton code is composed of 13 x 7 = 91 dots (13 successive lines divided into 7 columns), each dot representing 1 bit, with the 0 or 1 value given by its transparency or opacity. It contains 64 wanted information bits (including 32 user bits) and 27 synchronization-control bits. The 64 wanted information bits correspond to the IEC standard. The 27 service bits comprise 19 synchronization bits, 2 direction bits and 6 check sum bits which make this code more reliable than that of longitudinal systems.

Recording of the optical matrix

- for 16 mm: in a rectangle 1.45 x 4 mm, between the perforations, leaving the overlying area 16 free
- for 35 mm: outside the perforations on the side opposite the audio track, in a rectangle 1.45 x 8 mm, compatible with all 35 mm formats (including overlying 35 mm)

In both 16 and 35 mm, the tolerances of the matrix positioning and of the dimensions of the picture elements comprising the matrix are examined to support the non-linearity of the drive.

The yellow-green light emitting diodes (LEDs) are adapted to the recording on the negative of the take. The code functions in a wide range of exposure variations. The red diodes are preferable for playback.

The code can be used at speeds ranging from 1 fr/sec to 40 fr/sec.

These features (physical dimensions, recording system/data organization) give this code great flexibility and reliability. In the course of numerous experiments in takes and in playback, no malfunction was observed.

Recording in clear

In 35 mm, independently of the optical matrix recorded on each picture, two alphanumeric symbols per picture (placed next to the matrix block) can be brought out in clear without additional optomechanical equipment.

In 16 mm, these alphanumeric symbols are periodically recorded instead of the matrix.

In addition to the time code, the information contained in the user bits also appears regularly in the clear on the edge of the film, as follows:

- Production number PR16
- Date 03.03.87
- Camera number EQ4
- Reel number R 20
- Scene number SC 2-31
- Take number TK-04

REPORT 963-1

TIME AND CONTROL CODE FOR TELEVISION RECORDINGS ON MAGNETIC TAPE

(Question 40/11, Study Programme 40A/11)

(1982-1986)

1. To assist the location of the required sequences on tape for editing programmes, and to actuate automatic equipment, time and control information may usefully be recorded on the longitudinal track assigned for that purpose in various recording formats. In the case of television tape recordings, and of the separate sound recording that may possibly be associated with them, a format has been standardized for a time and control code; this format as well as the signal wave form is described in IEC Publication 461, 2nd edition and [EBU, 1982], the latter additionally containing figures for recording parameters and details of operational practices. In particular it gives the appropriate means for counteracting the various kinds of delay which can disturb the correct relationship between time code information and the associated video signal. User bits should not carry time-critical information and dubbing without decoding-re-encoding should be used carefully. In both cases, delays may arise which cannot be compensated.

The EBU document also contains a full description of the vertical-interval time-and-control code, which is designed to supplement the longitudinal code in those operating conditions in which the latter is difficult or impossible to use. This vertical-interval time-and-control code is in the form of digital data inserted in appropriate lines of the vertical-blanking interval of the recorded video signal; it can thus be read and recovered at any slower-than-normal play-back speed.

2. Information on the use of the time-and-control code in the international exchange of television programmes on magnetic tape is given in Report 630.

A definition of the PAL 8-field sequence is given in Report 624. Neglecting the continuity of this sequence in editing may give rise to visible and disturbing picture shifts (Report 630). To enable editing to be carried out without causing interruption of the 8-field continuity, the time-and-control code information must include a relationship to television frame numbers within the PAL 8-field sequence. This can be achieved by the time information itself (see IEC Publication 461, 2nd edition) [EBU, 1982].

3. The same time and control code may also be used on 6.3 mm tapes, by means of an additional centre track thus enabling the operation of the equipment already in use for synchronous play-back, recording and editing. In this case, however, it will be necessary to increase the distance between the two audio tracks to at least 2 mm [CCIR, 1978-82].

REFERENCES

EBU [April, 1982] EBU time and control code for television tape recordings (625-line television systems). Doc. Tech. 3097, 3rd edition.

CCIR Documents

[1978-82]: 10/14 (Germany (Federal Republic of)).

REPORT 964-1

EXCHANGES OF TELEVISION PROGRAMMES RECORDED WITH TWO OR MORE SYNCHRONOUS SOUND TRACKS ON A SEPARATE SUPPORT

(Question 40/11)

(1982-1986)

The broadcasting organizations are making increasing use of television programme recordings accompanied by two or more independent or stereophonic sound tracks. To facilitate the international exchange of programmes, the EBU has established Recommendation R25 (see Annex I) which sets out the methods to be used for sound recording, according to the type of support used to record the picture, when such programmes are exchanged between EBU member organizations. Such exchanges can only be made after prior agreement has been reached by the parties involved.

Contributions on this topic are invited. (It is to be hoped that the technical content of this Report can be adopted as a CCIR Recommendation by the end of the next study period.)

ANNEX I

EBU TECHNICAL RECOMMENDATION R25 – 1983 (2nd edition)

Exchange of recorded television programmes with two synchronous sound tracks on a separate support

1. Introduction

There is an increasing interest, amoung EBU Member organizations, in the possibility of producing and exchanging recorded television programmes having two synchronous audio tracks. Two synchronous audio tracks would be used, for instance, when a music programme is simultaneously recorded for television and for radio broadcasting in stereo, or when it is desired to record separately the commentary and the international sound for certain types of programmes.

In the past, such demands have been met by resorting to film production techniques, using one or more separate magnetic films for the sound. The recommended practice for the exchange of film programmes with two sound tracks on a separate magnetic film is specified in Section 3.

The use of the EBU time-and-control code provides the possibility of synchronising a multi-track audio tape to a television tape. The recommended practice for the exchange of programmes on transverse-track television tape accompanied by two sound tracks on a separate audio tape is specified in Section 4.

It should be stressed that the international exchange of programmes conforming to the methods specified here can be undertaken only if prior agreement has been reached between the parties concerned.

Of course, the introduction of Format B or Format C television tape recordings has also made it technically possible to record television programmes with two or even more sound tracks recorded on the same tape as the video. However, such recordings cannot be exchanged internationally at present, without prior agreement.

2. Scope

The present paper specifies the EBU recommendations for the exchange of television programmes having two high-quality sound tracks, when the vision support is 16-mm film, or transverse-track video tape.

3. Vision on 16-mm film

3.1 *Sound support*

When the vision component of the programme is on 16-mm film, the two sound components should be on a separate 16-mm magnetic film.

3.2 *Sound recording specifications*

The dimensions and position of the tracks and the recording characteristics for the magnetic film should conform to EBU document Tech. 3098 [3]. See also CCIR Recommendation 265 [6], Fig. 2.

3.3 *Picture film specifications*

The picture film should conform to CCIR Recommendation 265 [6].

3.4 *Allocation of tracks*

The allocation of tracks on the separate 16-mm magnetic film should be as follows:

– for stereo sound:
  centre track: left channel;
  edge track: right channel;
– for independent synchronous sounds (see *Note*):
  centre track: dubbing or subtitling sound;
  edge track: original transmission sound.

Note. – The original sound component of a television programme may consist of:

a) synchronous speech (speaking persons visible in the picture);
b) commentaries (speaking persons not visible in the picture);
c) music and sound effects (international sound).

(c) is also called the dubbing sound.
(a) + (c) is called the subtitling sound.
(a) + (b) + (c) is called the original transmission sound.

3.5 *Programme leader and label*

The programme leader should conform to EBU document Tech. 3203 [4]. See also Annex 1 to CCIR Report 294 [8]. The programme label should conform to EBU document Tech. 3211 [5].

4. Vision on transverse-track tape

4.1 *Sound support*

When the vision component of the programme is on transverse-track television tape, the multiple sound components should be on a separate audio tape, 6.3, 12.7 or 25.4 mm wide. The use of 25.4-mm wide audio tape is not preferred unless there is a need to exchange not only the stereo sound of the programme, but also additional sound channels.

4.2 *Sound recording specifications*

If separate audio tape 6.3 mm wide is used, it should carry three tracks. The outer audio tracks are recorded to the edge of the tape and are separated by a 2-mm space centred on the width of the tape; the time-and-control track (track 2) is approximately 0.35 mm wide and is also centred on the width of the tape.

If a separate audio tape 12.7 mm wide is used, it should carry four tracks.

If a separate audio tape 25.4 mm wide is used, it should carry eight tracks.

In the three cases, the audio tape should be recorded at 19.05 cm/s or 38.1 cm/s in conformity with IEC Publication 94-1 [9].

The use of compandors is not recommended for such recordings.

The dimensions of the tracks on the multitrack sound tape 12.7 mm or 25.4 mm wide should conform to IEC Publication 94-6.

4.3 *Video recording specifications*

The video tape-recording should conform to EBU document Tech. 3084 [1]. See also CCIR Recommendation 469 [7] and IEC Publication 347 [10].

4.4 *Synchronization*

Synchronization between the video tape and the audio tape should be obtained by the use of the EBU time-and-control code, recorded without time-offset of this code on each of the two tapes.

If the integrated audio and time code heads with in-line gaps cannot be used for crosstalk reasons and separate code heads have to be used, the resulting time difference on tape between the audio and the code recording shall be compensated electronically within the recorder itself.

4.5 *Time-and-control code specifications*

The code recording should conform to EBU document Tech. 3097 [2].

If a separate audio tape 6.3 mm wide is used, the nominal characteristic of the short-circuit magnetic tape flux for the time-and-control code should be constant with frequency in the frequency band 50 Hz to 10 kHz, and the peak-to-peak recording level of the time code should be 700 nWb/m ± 3 dB.

4.6 *Allocation of tracks*

The allocation of the sound tracks on the separate audio tape and on the video tape should be as follows, in the cases of stereo sound and of independent synchronous sound, as appropriate (numbering of tracks in accordance with IEC Publication 94-1 [9]):

- Audio tape, 6.3 mm wide (three tracks):
  - track 1: left channel (stereo), or dubbing/subtitling sound;
  - track 2: time-and-control code;
  - track 3: right channel (stereo), or original transmission sound.
- Audio tape, 12.7 mm wide (four tracks):
  - track 1: left channel (stereo), or dubbing/subtitling sound;
  - track 2: right channel (stereo), or original transmission sound;
  - track 3: mono mix for stereo programmes, or preferably empty;
  - track 4: time-and-control code.
- Audio tape, 25.4 mm wide (eight tracks):
  - track 1: empty;
  - track 2: television left channel (stereo), or dubbing/subtitling sound;
  - track 3: television right channel (stereo), or original transmission sound;
  - track 4: optional television mono mix (stereo programmes);
  - track 5: available or radio left channel;
  - track 6: available or radio right channel;
  - track 7: monitoring mono mix, or preferably empty;
  - track 8: time-and-control code.
- Video tape:

The audio track of the transverse-track television tape should carry the mono mix in the case of stereo sound or the original transmission sound in the case of independent synchronous sound; the cue track should carry the time-and-control code.

4.7 *Presentation of recordings*

Each reel of video tape should preferably be coupled to only one reel of audio tape. The audio tape should be wound with the oxide inside, and with the leader out.

4.8 *Programme leader and label*

The video tape programme leader and label should conform to EBU document Tech. 3084 [1]. A programme label similar to the one specified in Tech. 3084 for the video tape can be also used for the associated audio tape.

REFERENCES

[1] *EBU standards for television tape-recordings.* EBU document Tech. 3084, 2nd edition, 1975.

[2] *Time-and-control code for television tape-recordings (625-line television systems).* EBU document Tech. 3097, 3rd edition, 1982.

[3] *EBU standard for sound recording on 16-mm magnetic film.* EBU document Tech. 3098, 1972.

[4] *Universal film leader for cinema and television.* EBU document Tech. 3203, 1973.

[5] *Label for the exchange of programmes on film.* EBU document Tech. 3211, 1975.

[6] *Standards for the international exchange of monochrome and colour-television programmes on film.* CCIR Recommendation 265-4, XVth Plenary Assembly, Geneva 1982, Vol. XI, 295-303.

[7] *Standards for the international exchange of television programmes on magnetic tape.* CCIR Recommendation 469-3, XVth Plenary Assembly, Geneva 1982, Vol. XI, 317-324.

[8] *Standards for the international exchange of monochrome and colour television programmes on film.* CCIR Report 294-5, XVth Plenary Assembly, Geneva 1982, Vol. XI, 304-308.

[9] *Magnetic tape-recording and reproducing systems. Part 1: General conditions and requirements.* IEC Publication 94-1, 4th edition, 1981.

[10] *Transverse track recorders.* IEC Publication 347, 1972.

DECISIONS

DECISION 59-3*

TELEVISION PROGRAMMES ON DIGITAL TAPE AND ON FILM

(1983-1985-1987-1989)

CCIR Study Groups 10 and 11

CONSIDERING

(a) that Recommendation 657 defines the specifications for high-quality digital television tape recording based on the 4:2:2 level of Recommendation 601 (D1 format), but that a number of implementation aspects and of operating practices remain to be defined for it;

(b) that Study Programme 18L-1/11 addresses the study of a further digital tape recording format "allowing more economic implementation in a smaller size" at a lower bit rate than the D1 format;

(c) that Study Programme 18S/11 addresses the recording of high definition television programmes, an application in which digital techniques will likely become increasingly important;

(d) that Study Programme 18T-1/11 addresses the transfer of electronic high definition television programmes onto cinematographic film;

(e) that programmes on 35mm cinematographic film, originally intended for screening in motion picture theatres ("theatrical films"), will be a component of programming for HDTV emission services in the future, and specifications and operating practices need to be recommended by the CCIR for this application of theatrical film to broadcasting purposes;

(f) that the studies delineated above should urgently be pursued, to keep abreast with the fast pace of technological development and with progress in operational implementation of high definition television;

(g) that several of the studies delineated above cover areas in which the IEC and the ISO are active in the respective domains of competence;

DECIDE

1. that a Joint Interim Working Party 10-11/4 be established within the terms of reference of Study Groups 10 and 11;

2. that the terms of reference of the JIWP should be as follows:

2.1 to define the remaining implementation and operating aspects of the single digital television recording format specified in Recommendation 657 for the international exchange of television programmes (the D1 format);

2.2 to define the requirements, specifications and operating practices for a further digital television tape recording format offering economies from a reduced bit rate recorded on tape but providing a subjective picture quality adequate for emission, in accordance with Study Programme 18L-1/11;

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* The Director, CCIR is requested to bring this Decision to the attention of the IEC, of the ISO and of the SMPTE.

2.3 to define the requirements, specifications and operating practices for a single digital tape recording format to be recommended for the international exchange of high definition television programmes, in accordance with Study Programme 18S/11;

2.4 to study the systems capable of satisfactorily transferring onto cinematographic film, high definition television programmes generated by electronic means and to define the relevant operating specifications, in accordance with Study Programme 18T-1/11;

2.5 to define the specifications and operating practices to be recommended for the use of 35mm theatrical films as a source of high definition television programming for broadcasting use;

3. that in order to avoid duplication of efforts, the Chairman should maintain appropriate liaison with the IEC and the ISO, since booth those Organizations are active in some of the areas of concern to the JIWP; the Chairman will also maintain liaison with IWP 11/6, IWP 11/7, IWP 11/9 IWP 10/12, and with other IWPs and JIWPs whose work may affect the work of JIWP 10-11/4.

4. that the JIWP should regularly report to Study Groups 10 and 11 on progress in its work, and it should submit draft Reports and Recommendations as such progress warrants ;

5. that the work of the JIWP should be completed in the course of the 1990-1994 Study Period;

6. that the JIWP should as far as possible work by correspondence, however it may meet when this is considered necessary by its Chairman with the concurrence of the Chairmen of Study Groups 10 and 11 and of the Director, CCIR;

7. that the Chairman and the composition of JIWP 10-11/4 should be as shown in the Annex.

ANNEX

The following Administrations, International Organizations and Recognized Private Operating Agencies have indicated that they wished to participate in the work of Joint Interim Working Party 10-11/4:

Administrations:

Germany (Federal Republic of)
Australia
Canada
Denmark
Egypt
United States of America
France
India
Italy
Japan
United Kingdom
USSR

International Organizations and Recognized Private Operating Agencies:

NANBA
OIRT
EBU
CBS
NDR/ZDF

Chairman of Joint Interim Working Party 10-11/4:

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