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SERIES J: TRANSMISSION OF TELEVISION, SOUND
PROGRAMME AND OTHER MULTIMEDIA SIGNALS

Specific Recommendations for television transmission

Recommended operating guidelines for point-to-point transmission of television programmes

ITU-T Recommendation J.92

(Previously CCITT Recommendation)

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FOREWORD

The ITU-T (Telecommunication Standardization Sector) is a permanent organ of the International Telecommunication Union (ITU). The ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Conference (WTSC), which meets every four years, establishes the topics for study by the ITU-T Study Groups which, in their turn, produce Recommendations on these topics.

The approval of Recommendations by the Members of the ITU-T is covered by the procedure laid down in WTSC Resolution No. 1 (Geneva, October 1996).

ITU-T Recommendation J.92 was prepared by ITU-T Study Group 9 (1997-2000) and was approved under the WTSC Resolution No. 1 procedure on the 22nd of April 1997.

NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

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SUMMARY

This Recommendation provides guidelines to operate point-to-point television transmission using bit-rate reduction techniques and to avoid uncontrolled cascading.

RECOMMENDED OPERATING GUIDELINES FOR POINT-TO-POINT TRANSMISSION OF TELEVISION PROGRAMMES

(Geneva, 1997)

1 Scope

This Recommendation describes a number of operating guidelines that are recommended for use in point-to-point transmission of television signals. They cover the operating aspects listed below:

- television transmission over mixed analogue-and-digital or all-digital links;
- impacts from coding processes;
- signal format transitions within a TV chain (e.g. composite signals, component signals, etc.);
- insertion points for ITS and IDS signals.

2 Acronyms

This Recommendation uses the following acronyms:

DCT	Discrete Cosine Transform
IDS	Insertion Data Signals
ITS	Insertion Test Signals
SNG	Satellite News Gathering
VTR	Video Tape Recorder

3 Operational guidelines

The following guidelines concerning contribution and primary distribution (point-to-point transmission) of TV programmes are based on current practical experience with cascading of bit-rate reduction systems.

- The effects of the cascading of bit-rate reduction systems and signal format transitions can reasonably be assured only if the whole chain of TV processing and transmission is considered at the early planning stage.
- Guidelines should be established for the use of bit-rate reduction on transmission links, preferably together with equipment for TV production, as required for the complete TV chain.
- TV chains leading to a dubious quality should be avoided as far as possible.
- In general, contribution circuits require more quality head-room than distribution circuits, so coding schemes and bit-rates should be chosen accordingly. For example, once coding artifacts have been introduced, coding criticality is increased with an adverse effect on all downstream compression systems.
- Objective methods for the measurement of picture quality in quasi real-time on TV chains with cascaded coding processes and signal format transitions is a subject for further study.
- Programme providers and network operators should be made aware of the problems caused by uncontrolled cascading.

4 ITS and IDS

The implementation of ITS and IDS is optional, but when they are implemented, the following rules apply:

- An ITS and a blank line signal should be inserted to evaluate the performance of the analogue parts of the TV chain. It should be transmitted transparently through the digital parts of the TV chain using a separate data channel.
- An IDS identifying the video signal source should be inserted and transported through the digital parts of the TV chain using a separate data channel, normally the service data channel. This channel would not be scrambled, thereby permitting monitoring of the IDS without the need for descrambling.
- The IDS should be reinserted as appropriate in the composite analogue video output signal of the decoder.
- If IDS is absent at the input to the digital encoder, the encoder should automatically insert its own IDS instead. Moreover, to ensure that ITS and IDS go hand-in-hand, the encoder should insert new ITS if there is no IDS present at the encoder input. This includes blanking the blank line for noise measurement.

Appendix I

Background to the Recommendation

I.1 General considerations

Techniques used in television are changing rapidly in the digital domain affecting the whole signal chain from TV signal generation up to the reproduction of the pictures in the consumer's television set. The rationale behind this change is to open new features in the field of TV production techniques but, at the same time, to reduce costs for programme production and signal transmission.

Despite these rapid changes, it should be kept in mind that at least for a long transition period the introduction of digital techniques for generation, editing and distribution of TV programmes coexists with different signal formats including analogue ones (e.g. formats used up to now for archiving) and with an increasing use of systems individually applying (different) bit-rate reduction algorithms to the picture signals. Signal format transitions as well as different bit-rate reduction processes will be involved in the programme production (e.g. SNG using digital contribution links from remote sites, recording of the TV signals on digital VTRs, storing the signals on "tapeless" production servers), in the transmission of TV programmes for broadcast via satellites or terrestrial transmitter networks, for cable distribution and for the economic delivery of programmes to individuals in the evolving area of video or information on demand.

Many combinations of signal format transitions and bit-rate reduction processes may be found in the future for contribution, post-processing, and distribution. If unexpected results are to be avoided, account should be taken of all effects caused by the cascading of signal formats and the impact from these processes on the use of point-to-point transmission schemes for the delivery and distribution of TV programmes.

I.2 Television transmission over mixed analogue-and-digital links

In current practice it may well happen that various television transmission links are cascaded, which may be analogue or compressed digital with various degrees of compression. Furthermore, these links may be part of the whole TV chain where post-processing including further signal compression and/or signal format conversions could be applied.

Such cascading of television and signal compression processes is generally degrading the received picture quality, but the amount of such degradation depends on circuit configuration, the processing of the TV signal for post-production as well as on the characteristics of the picture material fed into the TV chain, since transmission systems as well as production processes can interact with undesirable results.

For instance, when a received analogue signal, with a poor signal-to-noise ratio or with significant PAL artifacts or showing quantizing noise from a preceding compression step, is DCT encoded for further digital transmission or processing, noise or other artifacts may overload the encoder with adverse effects on the digital picture.

I.3 ITS and IDS signals

ITS and IDS were introduced as a means of monitoring the performance of composite analogue transmission chains and for identification of the video signal source respectively.

ITS have no direct relevance to the monitoring of compressed component digital transmission systems, since they would be severely degraded by such systems if included in the compression process.

However, it is of interest to transmit them transparently through such digital systems, using a separate data channel. This enables the analogue sections of mixed analogue/digital transmission chains to be monitored correctly, even when a digital section separates two analogue sections for example.

Note that the blank line, used for signal/noise measurement, should be included in this process.

Advantage can be taken of the fact that the ITS do not need to be refreshed at frame rate, to reduce the bit rate required to transport them. 10-bits per sample should be used to ensure "high fidelity" transmission of the ITS.

I.4 Interaction of signal formats and compression schemes in the TV chain

In the future, operating scenarios for programme production for news presentation and for the preparation of broadcasting sequences will inevitably include a variety of compression algorithms. These will be used within complex and varying configurations of TV chains for signal transport, server-based editing and archiving, and server-based broadcasting. Various bit rates have to be handled within studio and operation environments as well as within wide area networks including B-ISDN. As a consequence, several signal formats and compression schemes may be cascaded.

The degradation of picture quality (not surprisingly) is strongly dependent on the picture content, but furthermore degradation caused by single sections of the TV chain can accumulate. Picture sequences, which are relatively uncritical for a single section, may become critical by the addition of artifacts generated by cascaded compression systems. Pixel shifts involved between succeeding coding steps may lead to additional degradation of the picture quality and should be avoided.

Even if there is awareness that the introduction of new digital techniques for production and transport of TV signals needs to be based on a compromise between enhanced functionality, lower costs and resulting picture quality; nevertheless, care must be taken that the uncontrolled cascading of different compression systems is avoided in order to minimize visible degradation of the picture quality at the end of the TV chain. The isolated treatment of coding algorithms in separate sections of the whole chain may lead to serious problems with planning and implementation of new systems. In addition, impacts on the internal and external network operation and topology have to be studied and new solutions will be necessary in the near future.

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