



INTERNATIONAL TELECOMMUNICATION UNION

**ITU-T**

TELECOMMUNICATION  
STANDARDIZATION SECTOR  
OF ITU

**H.263**

**Appendix I**  
(03/97)

SERIES H: AUDIOVISUAL AND MULTIMEDIA SYSTEMS

Infrastructure of audiovisual services – Coding of moving  
video

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Video coding for low bit rate communication

**Appendix I: Error tracking**

ITU-T Recommendation H.263 – Appendix I

(Previously CCITT Recommendation)

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## ITU-T RECOMMENDATIONS SERIES

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- Series C General telecommunication statistics
- Series D General tariff principles
- Series E Overall network operation, telephone service, service operation and human factors
- Series F Non-telephone telecommunication services
- Series G Transmission systems and media, digital systems and networks
- Series H Audiovisual and multimedia systems**
- Series I Integrated services digital network
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- Series K Protection against interference
- Series L Construction, installation and protection of cables and other elements of outside plant
- Series M Maintenance: international transmission systems, telephone circuits, telegraphy, facsimile and leased circuits
- Series N Maintenance: international sound programme and television transmission circuits
- Series O Specifications of measuring equipment
- Series P Telephone transmission quality, telephone installations, local line networks
- Series Q Switching and signalling
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- Series S Telegraph services terminal equipment
- Series T Terminals for telematic services
- Series U Telegraph switching
- Series V Data communication over the telephone network
- Series X Data networks and open system communication
- Series Z Programming languages

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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).

Appendix I to ITU-T Recommendation H.263 was prepared by ITU-T Study Group 16 (1997-2000) and was approved under the WTSC Resolution No. 1 procedure on the 27th of March 1997.

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## NOTE

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

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## VIDEO CODING FOR LOW BIT RATE COMMUNICATION

### Appendix I

#### error tracking

(Geneva, 1997)

#### I.1 Introduction

This Appendix describes a method to recover efficiently after transmission errors if erroneous MBs are reported via a feedback channel to the encoder. The capability of sending and processing feedback information is signalled via external means (for example, by Recommendation H.245). Furthermore, format and content of the feedback message are defined externally (for example, by Recommendation H.245).

#### I.2 Error tracking

Because INTRA coding stops temporal error propagation, it should be used for macroblocks which are severely affected by transmission errors. This requires that the location and extent of image artefacts can be made available to the encoder. The following algorithm provides an estimated error distribution based on feedback information received by the encoder. It considers spatial error propagation caused by motion-compensated prediction as well as the delay until the reception of the feedback message. The algorithm illustrates one possible approach to evaluate feedback messages for spatio-temporal error tracking. Other algorithms are possible.

Assume  $N$  macroblocks within each frame enumerated  $mb = 1 \dots N$  from top-left to bottom-right. Let  $\{n_{err}, mb_{first}, mb_{last}\}$  be the feedback message to the encoder, where  $mb_{first} \leq mb \leq mb_{last}$  indicates a set of erroneous macroblocks in frame  $n_{err}$ .

To evaluate the feedback message, the encoder must continuously record information during the encoding of each frame. First, the initial error  $E_0(mb, n)$  that would be introduced by the loss of macroblock  $mb$  in frame  $n$  needs to be stored. Assuming a simple error concealment where erroneous macroblocks are treated as not coded,  $E_0(mb, n)$  is computed as the Summed Absolute Difference (SAD) of macroblock  $mb$  in frame  $n$  and  $n - 1$ . Second, the number of pixels transferred from macroblock  $mb_{source}$  in frame  $n - 1$  to macroblock  $mb_{dest}$  in frame  $n$  is stored in dependencies  $d(mb_{source}, mb_{dest}, n)$ . These dependencies are derived from the motion vectors.

Assume that a feedback message arrives before frame  $n_{next}$  is encoded, such that  $n_{next} > n_{err}$ . Then, the estimated error  $E(mb, n_{err})$  in macroblock  $mb$  and frame  $n_{err}$  is initialized as:

$$E(mb, n_{err}) = \begin{cases} E_0(mb, n_{err}) & \text{for } mb_{first} \leq mb \leq mb_{last} \\ 0 & \text{else} \end{cases}$$

For subsequent frames  $n$ , with  $n_{err} < n < n_{next}$ , the error may be estimated as:

$$E(mb, n) = \sum_{i=1}^N E(i, n-1) \frac{d(i, mb, n)}{256}$$

where a uniformly distributed error in each macroblock is assumed after each iteration.

The estimated error  $E(\text{mb}, n_{\text{next}} - 1)$  is incorporated into the mode decision of the next frame. For example, macroblock  $\text{mb}$  is coded in INTRA mode, if  $E(\text{mb}, n_{\text{next}} - 1)$  exceeds a threshold.

In practice, error tracking information will only be stored for the latest  $M$  frames. Then, if  $n_{\text{err}} < n_{\text{next}} - M$ , no error-tracking information is available and the encoder must take special action. For example, the next frame may be coded in INTRA mode. However, other procedures are possible and may be more effective.