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

Transport of MPEG-2 signals on packetised networks

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## Measurement of MPEG-2 transport streams in networks

ITU-T Recommendation J.133

ITU-T J-SERIES RECOMMENDATIONS

**CABLE NETWORKS AND TRANSMISSION OF TELEVISION, SOUND PROGRAMME AND OTHER  
MULTIMEDIA SIGNALS**

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# **ITU-T Recommendation J.133**

## **Measurement of MPEG-2 transport streams in networks**

### **Summary**

MPEG-2 Transport Streams that are transmitted over any real networks are exposed to certain effects caused by the network components which are not ideally transparent. One of the predominant effects is the acquisition of jitter in relation to the PCR values and their position in the TS. This Recommendation specifies measurements that enable determination of this jitter.

### **Source**

ITU-T Recommendation J.133 was prepared by ITU-T Study Group 9 (2001-2004) and approved under the WTSA Resolution 1 procedure on 29 July 2002.

## FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications. The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. 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 Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

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In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

## 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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# ITU-T Recommendation J.133

## Measurement of MPEG-2 transport streams in networks

### 1 Scope

A MPEG-2 Transport Stream that is transmitted over any real network is exposed to certain effects caused by the network components which are not ideally transparent. One of the predominant effects is the acquisition of jitter in relation to the PCR values and their position in the TS. The four measurement parameters defined in the following describe the various jitter components which can be differentiated by demarcation frequencies.

### 2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

#### 2.1 Normative references

- [1] ITU-T Recommendation H.222.0 (2000) | ISO/IEC 13818-1: 2000, *Information technology – Generic coding of moving pictures and associated audio information: Systems*.
- [2] ETSI TR 101 290 V1.2.1 (2001), *Digital Video Broadcasting (DVB); Measurement guidelines for DVB systems*.

#### 2.2 Informative references

- [3] ISO/IEC 13818-9:1996, *Information technology – Generic coding of moving pictures and associated audio information – Part 9: Extension for real time interface for systems decoders*.

### 3 Abbreviations and acronyms

This Recommendation uses the following abbreviation:

PCR    Program Clock Reference

### 4 System clock and PCR measurements

#### 4.1 Reference model for system clock and PCR measurements

This clause presents a reference model (see Figure 1) for any source of a Transport Stream (TS) concerning the generation of PCR values and delivery delays. It models all the timing effects visible at the TS interface point. It is not intended to represent all the mechanisms by which these timing effects could arise in real systems.

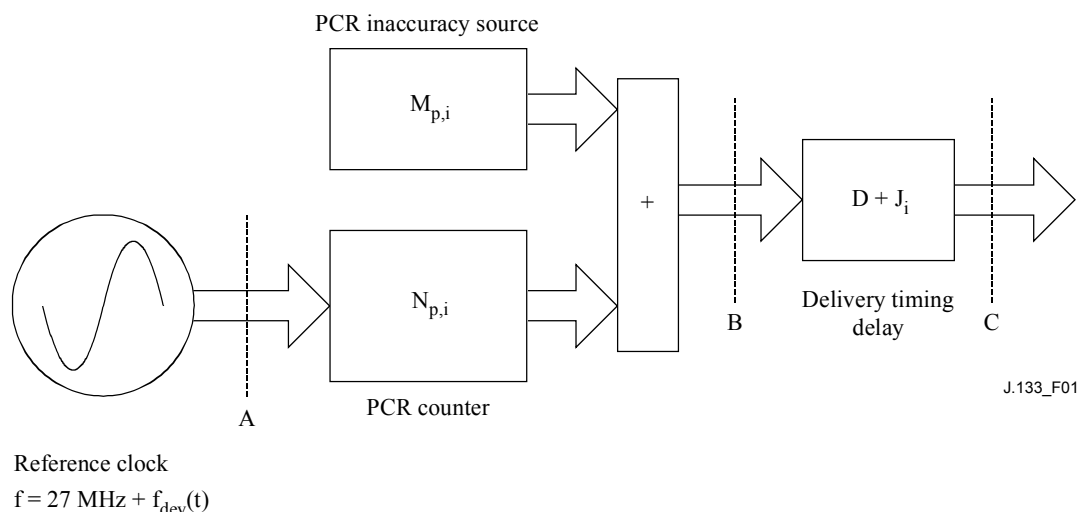


**Figure 1/J.133 – Reference model**

Reference points are indicated by dashed lines. This is a model of an encoder/multiplexer (up to reference point B) and a physical delivery mechanism or communications network (between reference points B and C). The components of the model to the left of reference point B are specific to a single PCR packet identifier (PID). The components of the model to the right of reference point B relate to the whole Transport Stream. Measuring equipment can usually only access the TS at reference point C.

The model consists of a system clock frequency oscillator with a nominal frequency of 27 MHz, but whose actual frequency deviates from this by a function  $f_{dev}(p,t)$ . This function depends on the time (t) and is specific to a single PCR PID (p). The "Frequency Offset PCR\_FO" measures the value of  $f_{dev}(p,t)$ . The "Drift Rate PCR\_DR" is the rate of change with time of  $f_{dev}(p,t)$ .

The system clock frequency oscillator drives a PCR counter which generates an idealized PCR count,  $N_{p,i}$ . p refers to the specific PCR PID p, and i refers to the bit position in the Transport Stream. To this is added a value from a PCR inaccuracy source,  $M_{p,i}$ , to create the PCR value seen in the stream,  $P_{p,i}$ .

The simple relationship between these values is:

$$P_{p,i} = N_{p,i} + M_{p,i} \quad (1)$$

$M_{p,i}$  represents the "Accuracy PCR\_AC".

The physical delivery mechanism or communications network beyond point B introduces a variable delay between the departure time  $T_i$  and the arrival time  $U_i$  of bits:

$$U_i - T_i = D + J_i \quad (2)$$

In the case of a PCR,  $U_i$  is the time of arrival of the last bit of the last byte containing the PCR base (see 2.4.3.5 of ITU-T Rec. H.222.0 | ISO/IEC13818-1 [1]). D is a constant representing the mean delay through the communications network.  $J_i$  represents the jitter in the network delay and its mean value over all time is defined to be zero.  $J_i + M_{p,i}$  is measured as the "Overall Jitter PCR\_OJ".

In the common case where the Transport Stream is constant bitrate, at reference point B, the Transport Stream is being transmitted at a constant bitrate  $R_{nom}$ . It is important to note that in this reference model this bitrate is accurate and constant; there is no error contribution from varying bitrate. This gives us an additional equation for the departure time of packets:

$$T_i = T_0 + \frac{i}{R_{nom}} \quad (3)$$

$T_0$  is a constant representing the time of departure of the zeroth bit. Combining equations (2) and (3) we have for the arrival time:

$$U_i = T_0 + \frac{i}{R_{nom}} + D + J_i \quad (4)$$

## 4.2 Measurement descriptions

The following measurements require a demarcation frequency for delimiting the range of drift rate and jitter frequencies of the timing variations of PCRs and/or TSs.

The demarcation frequency used should be chosen from the Table 1 and indicated with the measurement results.

A description of the derivation of the demarcation frequencies is included in Appendix I.

**Table 1/J.133**

| Profile     | Demarcation frequency | Comments                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|-------------|-----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>MGF1</b> | 10 mHz                | This profile is provided to give the total coverage of frequency components included in the timing impairments of PCR-related measurements.<br><br>This profile provides the most accurate results in accordance with the limits specified in 2.4.2.1 of ITU-T Rec. H.222.0   ISO/IEC 13818-1. If jitter or drift-rate measurements are found out of specification when using other profiles, it is suggested to use this one for better accuracy.                                                                        |
| <b>MGF2</b> | 100 mHz               | This profile is accounting for intermediate benefits between the profiles MGF1 and MGF3, by giving reasonable measurement response as well as reasonable account for low frequency components of the timing impairments.                                                                                                                                                                                                                                                                                                  |
| <b>MGF3</b> | 1 Hz                  | This profile provides faster measurement response by taking in account only the highest frequency components of the timing impairments. This profile is expected to be sufficient in many applications.                                                                                                                                                                                                                                                                                                                   |
| <b>MGF4</b> | Manufacturer-defined  | This profile will provide any benefit that the manufacturer may consider as useful when it is designed and implemented in a measurement instrument. The demarcation frequency has to be supplied with the measurement result. Optionally any other data that the manufacturer may consider to be relevant may be supplied.<br><br>For testing against ISO/IEC 13818-9 ( $\pm 25$ ms jitter limit) a demarcation frequency of 2 mHz is required. A filter for such demarcation may be implemented under this MGF4 profile. |

## 4.3 Program Clock Reference – Frequency Offset (PCR\_FO)

### Definition

PCR\_FO is defined as the difference between the program clock frequency and the nominal clock Frequency (measured against a reference which is neither PCR- nor TS-derived).