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GENERAL ASPECTS OF DIGITAL TRANSMISSION SYSTEMS

TERMINAL EQUIPMENTS

CHARACTERISTICS OF 24-CHANNEL TRANSMULTIPLEXING EQUIPMENTS

ITU-T Recommendation G.794

(Extract from the *Blue Book*)

NOTES

1   ITU-T Recommendation G.794 was published in Fascicle III.4 of the *Blue Book*. This file is an extract from the *Blue Book*. While the presentation and layout of the text might be slightly different from the *Blue Book* version, the contents of the file are identical to the *Blue Book* version and copyright conditions remain unchanged (see below).

2   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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Recommendation G.794

CHARACTERISTICS OF 24-CHANNEL TRANSMULTIPLEXING EQUIPMENTS

(Malaga-Torremolinos, 1984, amended at Melbourne, 1988)

1   Introduction

The 24-channel transmultiplexer is a transmultiplexing equipment which satisfies Recommendations G.791 and G.792 and provides interconnection between a digital signal at 1544 kbit/s and two analogue basic groups (24-channel TMUX-P).

2   Digital interfaces

2.1   *Coding law*

The coding law used is μ-law specified in Recommendation G.711.

2.2   *Interfaces*

The 1544 kbit/s interfaces satisfy Recommendation G.703, § 2.

2.3   *Frame structure*

The 1544 kbit/s frame structure satisfies Recommendation G.704, § 3.1.1.

2.4   *Multiframe structure*

The multiframe structure carried on the F-bit satisfies Recommendation G.704, § 3.1.1.

3   Analogue interfaces

3.1   *Ports*

The analogue interface consists of two 12-channel groups (band 60-108 kHz) which satisfies Recommendation G.232.

The preferred signal levels at the group distribution frame satisfy Recommendation G.233.

3.2   *Pilots*

The 24-channel transmultiplexer should transmit and receive the group pilot in Recommendation G.241.

3.3   *Pilot detection and regulation*

The transmultiplexer may or may not regulate levels on the basis of the levels of the group pilots. If so, the transmultiplexer must meet the conditions of Recommendation G.241.

4   Correspondence between analogue and digital channels

A fixed correspondence is established between the analogue and digital channels. The following correspondence:

PCM 1:   Basic group 1

Channels 1 to 12: 60-108 kHz

PCM 1:   Basic group 2

Channels 13 to 24: 60-108 kHz

5   Synchronization of transmultiplexer

The transmultiplexer must produce virtual analogue carrier frequencies with the accuracy specified in Recommendation G.225 ($\pm\ 10^{-7}$).

For this purpose, it is recommended:

a)   either that the transmultiplexer should have an internal clock of sufficient accuracy;

b)   or that the transmultiplexer should be synchronizable with an external signal which may be:

    1)   a frequency produced by a central generator: 4, 12, 124 kHz;

    2)   or one of the incoming PCM streams which has sufficient accuracy (this may be the case, for example when this PCM stream 1544 kbit/s is produced by a TDM switching equipment).

Note 1 - In the case of a digital filtering transmultiplexer, when synchronization on the incoming PCM stream is not possible, the remote digital terminal should have the sending side synchronized with the receiving side so as to avoid slipping at the transmultiplexer input.

Note 2 - In the case of external synchronization, transmultiplexers often have an internal oscillator locked to the external signal. If, upon loss of the external sync signal, this internal oscillator is allowed to continue to supply the clock for the outgoing digital signal (now in the free-running mode), then this oscillator should have a minimum free-running accuracy of 50×10^{-6}. This is intended to allow the distant end digital terminal to receive an adequate frequency for alarm purposes only, so as not to confuse maintenance and trouble-shooting activities. Also, a local alarm should be given in the event of a fault in the synchronization system or in the absence of the external synchronization signal.

Note 3 - In the case where the transmultiplexer is to be used in a TDMA satellite application, the effect of the satellite Doppler frequency variation must be taken into account. This can be done in two ways:

-      either, the TDMA terminal incorporates the Doppler buffer memories of appropriate capacity in the earth station to satellite direction. In this case, the two directions of the TMUX must be synchronized from one of the two 1544 kbit/s PCM streams transmitted by the TDMA receive terminal;

-      or, the TDMA terminal does not incorporate Doppler buffers. In this case, the PCM to FDM direction of the TMUX may be synchronized from one of the two 1544 kbit/s streams transmitted by the TDMA receive terminal. In the FDM to PCM direction, the 1544 kbit/s streams transmitted by the TMUX must be made synchronous with the TDMA system transmit clock: this supposes that a synchronization signal (contradirectional with the data) is provided by the TDMA transmit terminal to the TMUX. In the case where the processing in a digital filtering transmultiplexer is made synchronously for the two directions, Doppler buffer memories of appropriate capacity must be incorporated in the PCM interfaces.

6 Signalling

Two different approaches can be envisaged:

6.1 *No signalling translation in TMUX*

This is applicable to applications such as in-band end-to-end signalling, and common channel signalling such as CCITT No. 6 or CCITT No. 7.

6.2 *Translation of analogue signalling (Recommendation Q.21) into 1544 kbit/s PCM line signalling (Recommendation G. 733)*

This translation is applicable to the predominant forms of analogue and digital signalling recommended by CCITT for international circuits (excluding signalling system R2) consisting of 12-channel analogue groups *and* 1544 kbit/s PCM digital signals.

7 Fault conditions and consequent actions

The principle governing the handling of alarms is as follows:

The behaviour of the 24-channel transmultiplexer vis-à-vis a 24-channel PCM multiplex equipment should be the same as that of another 24-channel PCM multiplex equipment. Vis-à-vis a channel translator, it should behave like another channel translator.

Table 1/G.794 summarizes the fault conditions and consequent actions in accordance with the frame structure, defined in Recommendation G.704.

Fault conditions and consequent action for the 24-channel transmultiplexer

Fault Conditions		Prompt maintenance alarm indication (7)	Alarm indication to the remote equipment (3)	AIS sending (4)	Blocking of faulty speech channels	Pilot cut-off to the remote FDM terminal
PCM alarm	Loss of frame alignment and multiframe alignment or Loss of incoming signal (2)	Yes (8)	Yes		Yes (PCM → FDM)	
	Digital error ratio 10^{-4} or 10^{-3} (10)	Yes (8)	Yes			
	Reception of alarm indication from the remote equipment (2, 3)	Yes				
	AIS receiving (4)	Yes			Yes (PCM → FDM)	
FDM alarm	Absence of group pilot (5)	Yes		Yes (9)	Yes	
	Pilot level deviation alarm (11)	Yes, if regulation is present				
System alarm	Failure of power supply (2)	Yes				Yes, depending on network applications
	System failure (6)	Yes	Yes, depending on network applications	Yes, depending on network applications	Yes, depending on network applications	Yes, depending on network applications
	Synchronisation failure	Yes				

Note 1 - A *Yes* in the table signifies that an action should be taken as a consequence of the relevant fault conditions. An open space in the table signifies that the relevant action should not be taken as a consequence of the relevant fault condition, if this condition is the only one present. If more than one fault condition is simultaneously present, the relevant action should be taken if, for at least one of the conditions, a *Yes* is defined in relation to this action.

Note 2 - The fault conditions "Loss of incoming signal", "Loss of frame alignment and multiframe alignment", "Reception of alarm indication to the remote equipment" and "Failure of power supply" are defined in Recommendation G.733.

Note 3 - For "Alarm indication to the remote equipment", data link bits are used.

Note 4 - The AIS can be used only in the new frame structure to be specified by Study Group XVIII.

Note 5 - The level, at which "Absence of group pilot" is detected, is under study.

Note 6 - The "System failure", which is only for the digital filtering transmultiplexer, corresponds to a fault detected by the transmultiplexer's supervision system, when it has one.

Note 7 - The consequent action "Prompt maintenance Alarm indication" and "Alarm indication to the remote equipment" are defined in Recommendation G.733.

Note 8 - When AIS is detected, the "Prompt maintenance alarm indication" associated with the "Loss of frame alignment and multiframe alignment" with the "Loss of incoming signal" or with the "Digital error ratio 10^{-4}" should be blocked.

Note 9 - The AIS is sent only if the 24 channels of a single PCM stream are in the alarm condition.

Note 10 - Depends on network applications.

Note 11 - "Pilot level deviation alarm" corresponds to a variation on the level of the incoming pilot from its nominal value by more than $\pm$ 4 dB, as stated in CCITT Recommendation G.241, § 1. This applies only to transmultiplexers with automatic internal level regulation.