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GENERAL ASPECTS OF DIGITAL TRANSMISSION SYSTEMS

TERMINAL EQUIPMENTS

CHARACTERISTICS OF CODECS FOR FDM ASSEMBLIES

ITU-T Recommendation G.795

(Extract from the *Blue Book*)

NOTES

1 ITU-T Recommendation G.795 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.

Recommendation G.795

CHARACTERISTICS OF CODECS FOR FDM ASSEMBLIES

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

The CCITT,

considering

that codecs capable of encoding/decoding FDM assemblies will:

a) be a useful element in the transmission networks of some Administrations during the period of transition from analogue to digital working;

b) have a limited life and application;

c) already be available in a number of realizations,

recommends

that FDM codecs should conform with the following requirements:

1 General

This Recommendation gives details of the analogue interfaces, the overall analogue-to-analogue performance of a coder/decoder pair and certain details of the digital interfaces to which FDM codecs should conform. The CCITT does not recommend any particular relationship between FDM assemblies and the digital hierarchies to be used in any codec realization nor does it recommend any particular frame structure or encoding law. Administrations intending to use codecs in their networks should ensure that compatible designs of codec are used at each end of a link. For international links, the codecs to be used should be by the agreement of the Administrations concerned. An Annex to this Recommendation gives details supplied by some Administrations of a number of FDM codec realizations.

The application of FDM codecs in a network is explained in Supplement No. 28.

2 Analogue interfaces

2.1 *FDM assemblies*

The constitution of the FDM assemblies at the analogue input and output should conform to Recommendation G.211, Figure 1 *a)*/G.211, for the basic group and Recommendation G.233, Figures 1/G.233 through 5/G.233, as appropriate for the basic supergroup, mastergroup, supermastergroup and 15 supergroup assemblies.

2.2 *Impedances and relative levels*

The impedances and relative levels at the analogue transmission ports should be as indicated in Recommendation G.233, §§ 3 through 6.

2.3 *Return loss*

The return loss against the nominal impedance of all analogue transmission ports should be at least 20 dB in the wanted frequency band. This limit relates to the intrinsic return loss, i.e. that is obtained when the cords connecting the measuring apparatus to the equipment are as short as possible. In view of the station cabling encountered in practice, the return loss recorded at the distribution frame of groups, supergroups, etc., may differ from the intrinsic return loss. This factor should be taken into account in designing and making links.

2.4 *Accuracy of carrier frequencies*

Designers of FDM codecs may find it expedient to translate the analogue signal frequency before coding and

after decoding. The accuracy of any carrier frequencies used should conform to Recommendation G.225. It is possible to lock the carriers to the digital signal so that no overall frequency error is caused by the FDM codecs.

3 Digital interfaces

Digital interfaces should conform to the appropriate sections of Recommendation G.703.

4 Encoding law and frame structure

At present the CCITT does not recommend any particular encoding law or frame structure. In some instances it may not be technically or economically feasible to encode one standardized FDM assembly into one standardized hierarchical bit rate. In these cases it is possible that more than one encoded FDM assembly or an encoded FDM assembly and lower order hierarchical bit streams may be combined to form one standardized hierarchical bit rate conforming to Recommendation G.703. Where one or several encoded FDM assemblies are combined with some lower order hierarchical bit streams, then the multiplexing techniques used must be plesiochronous.

5 Analogue performance

The analogue performance is recommended in terms of the overall performance of a coder/decoder pair.

5.1 *Noise*

A maximum value of 800 pW0p is recommended. In practice, this magnitude of noise is expected to occur only on codecs for the higher order FDM assemblies and that significantly lower values will be achieved with codecs for the smaller FDM assemblies (see the Annex to this Recommendation). The use of FDM codecs on comparatively short transmission paths becomes possible when lower levels of codec noise are achieved. The recommended allowance of noise is intended to take account of all sources of noise, i.e. noise due to:

a) analogue processing before the coder and following the decoder,

b) quantization,

c) errors and jitter on the received digital signal as indicated in the G.900 series of Recommendations.

Noise should be measured in accordance with Recommendation G.230 under the loading conditions given in Recommendation G.222, § 4, for the particular FDM assembly used (see Note).

Note - The contribution to this noise made by errors on the digital transmission path is likely to be small. The effect of errors is to give rise to impulsive type interference and its expression in pW0p depends upon the statistics of the error distribution. However, for design purposes, it should be assumed that errors occurring on the digital line system have a Poisson distribution with a long-term mean error ratio of 10^{-7}.

5.2 *Performance under conditions of light loading*

Under conditions of light loading, the quantizing distortion caused by a discrete tone (e.g. a test tone or signalling frequency) may give rise to a structured noise spectrum containing components considerably in excess of the average quantizing distortion level per channel. However, in practice, the presence of a small number of system reference pilots and carrier leaks is sufficient to maintain an adequately uniform noise spectral distribution.

5.3 *Overload point*

Should be as given in Recommendation G.233, § 6 (see Note).

Note - A higher loading is appropriate if digital speech interpolation techniques or 3 kHz spaced channels (Recommendation G.235) are used.

5.4 *Frequency response*

The amplitude/frequency response, the ratio between wanted and unwanted components and the group delay

distortion recommended is that given in Recommendation G.242 for through connections of the relevant FDM assemblies. This performance will be adequate to allow direct connection of the FDM codec analogue ports to the low frequency side of following translating equipment. However, if the analogue ports of the FDM codec are to be directly connected to the high frequency side of translating equipment, then the performance required of the FDM codec may appropriately be that performance normally required by the Administration of its translating equipment.

5.5 *Go-return crosstalk*

The go-return crosstalk ratio should not be worse than 80 dB.

This level of crosstalk may be difficult to measure because of the digital processing in the transmission path. It may be necessary to add to the disturbed path a low level activating signal (a sine wave or band limited white noise) to avoid gain enhancement effects.

5.6 *Unwanted modulation by harmonics of the power supply and other low frequencies*

The combined effect of a coder/decoder pair should correspond to a minimum side component attenuation of 57 dB (Recommendation G.229).

5.7 *Phase jitter*

The phase jitter on a signal caused by a coder/decoder pair should not exceed 1° peak-to-peak when measured in the frequency band given in Recommendation G.229, § 2.

Note - The value quoted above is indicated as guidance for design purposes. In practical applications, the codec should tolerate the jitter of the digital interfaces as specified in Recommendations G.823 and G.824.

6 Fault conditions and consequent actions

The decoder should detect:

a) loss of frame alignment;

b) loss of digital input signal;

c) the presence of Alarm Indication Signal (AIS) on the digital input port.

For all these conditions, the analogue output signal should be suppressed.

Note - Other conditions and consequent actions are under study.

ANNEX A

(to Recommendation G.795)

FDM codecs

Administration	Analogue interface	Digital interface	Noise performance
British Telecom	Supergroup (312-552 kHz)	8 448 kbit/s	140 pW0p
British Telecom	15 SG assembly (312-4025 kHz)	68 736 kbit/s	< 700 pW0p
China	Mastergroup (812-2044 kHz or 60-1300 kHz)	34 368 kbit/s	< 783 pW0p
NTT	Group (60-108 kHz)	1 544 kbit/s	< 340 pW0p