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G.941

DIGITAL SECTIONS AND DIGITAL LINE SYSTEMS

**DIGITAL LINE SYSTEMS PROVIDED
BY FDM TRANSMISSION BEARERS**

ITU-T Recommendation G.941

(Extract from the *Blue Book*)

NOTES

1 ITU-T Recommendation G.941 was published in Fascicle III.5 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.941

DIGITAL LINE SYSTEMS PROVIDED BY FDM TRANSMISSION BEARERS

(Geneva, 1980; further amended)

The CCITT,

considering

(a) that there is an urgent need to provide long-haul facilities mainly for nontelephony services (e.g. data, facsimile, visual telephony) for national use and for international interworking, and these non-telephony services need digital transmission at a low and medium bit rate (e.g. primary and secondary hierarchical levels);

(b) that long-haul digital links begin to be available, but that nevertheless the implementation of these facilities on a general basis will take some time;

(c) that it is possible to use analogue FDM links specified in Recommendation G.211 [1], or the frequencies within or over the bandwidth used by analogue FDM line systems specified in Section 3 of the Series G Recommendations to carry a digital stream, and that some realizations are already available,

recommends

that the digital line systems provided by FDM transmission bearers should comply with the following requirements:

1 General characteristics

Two basic methods can be used for the transmission of digital signals on FDM transmission bearers:

- the first method consists of using either a part or the whole of the band normally employed for FDM systems [Data-in-Voice (DIV)],
- the second method consists of using a band outside the one normally employed for FDM systems [Data-over-Voice (DOV)].

The international interconnection should be performed at digital hierarchical levels using the interfaces specified in Recommendation G.703.

Since these digital line systems on FDM transmission bearers could form part of a digital path, their performance standards in terms of error rate, jitter and availability should be in accordance with the relevant Recommendations in Section 9 of the Series G Recommendations concerning digital line sections at the corresponding bit rates.

The systems should be designed in such a way that the quality requirements given in the relevant Recommendations for the analogue circuit are still met.

Administrations intending to use digital line systems provided by FDM bearers in their networks should ensure that compatible designs of equipment are used at each end of a link. For international links the systems to be used should be by the agreement of the Administrations concerned.

The application of digital line systems provided by FDM transmission bearers for the interconnection of digital and analogue networks is covered in Supplement No. 28.

2 Data-in-Voice systems

2.1 Characteristics of DIV systems providing digital transmission at hierarchical bit rates on analogue carrier-transmission systems specified in Recommendation G.211 [1].

Note - Examples of hierarchical DIV digital line systems are given in Annex A. Examples of DIV digital line systems at non-hierarchical levels either in the analogue or in the digital interfaces are given in Annex B.

2.1.1 Digital interface

The DIV system digital interface should conform to the appropriate sections of the Recommendation G.703.

2.1.2 *Analogue interface*

2.1.2.1 *Frequency band*

The DIV signal frequency band should be displaced into the frequency band specified in Recommendation G.211, § 1.

2.1.2.2 *Power level*

The relative power level at the distribution frame should conform to the appropriate §§ of the Recommendation G.233.

The mean power level of the wideband signal over the frequency band specified in § 2.1.2.1 should not exceed $-15 + 10 \log_{10} n$ dBm0, n being the total number of telephone channels in the analogue system which are replaced by the data channels.

In order to limit cross modulation effects, the power level of any individual spectral component in the frequency band specified in § 2.1.2.1 should not exceed -10 dBm0.

2.1.3 *Disturbances of the analogue signal by the DIV signal*

The total distributed noise produced by the DIV signal measured in any 3.1 kHz bandwidth corresponding to a telephone channel outside the frequency band specified in the Recommendation G.211, § 1 should be less than -73 dBm0p.

The single tone interference should be less than -73 dBm0.

2.1.4 *DIV system performance*

The performance relating to error rate, jitter and availability should conform to the appropriate Recommendations of the G.900 series.

2.2 *Characteristics of the analogue link to carry the DIV signal*

The analogue link used to carry the DIV signal should include no more than three through connections. It could be necessary to avoid certain positions of the DIV signal band in the analogue carrier transmission system.

Note - Reference to H series Recommendations could be made concerning characteristics such as attenuation distortion, phase jitter and group-delay distortion.

3 **Data-over-Voice systems**

3.1 *Characteristics of DOV systems providing 2048-kbit/s digital transmission on analogue FDM line systems defined by Recommendations G.332 [2], G.334 [3], G.344 [4], G.345 [5] and G.346 [6]*

3.1.1 *Digital interface*

The digital interface of the DOV system should be as specified in Recommendation G.703, § 6.

3.1.2 *Disturbances of the analogue signal by the DOV signal*

The increase to the total distributed noise due to the DOV signal measured in any 4 kHz bandwidth should be less than 750 pW0p for a reference length of 2500 km (less than 0.3 pW0p/km).

Note - The total distributed noise of the line when analogue and DOV signals are present should be below 7500 pW0p for a reference length of 2500 km (less than 3 pW0p/km).

The level of single tone interference should be less than -70 dBm0.

3.1.3 *DOV system performance*

The performance relating to error rate, jitter and availability should be in accordance with Recommendation G.921.

3.2 *Characteristics of the FDM line systems used to carry the DOV signal*

To allow the through-connection of DOV signals on FDM line systems, spurious analogue signals within the frequency band of the DOV signal should be suppressed before the coupling point up to a power level of -60 dBm0 within 4 kHz bandwidth.

ANNEX A

(to Recommendation G.941)

Examples of hierarchical DIV systems

Administration	Digital interface	Analogue interface	DIV system performance
NTT	1544 kbit/s Rec. G.703, § 2	Mastergroup (812-2044 kHz)	Rec. G.911
FRG	2048 kbit/s Rec. G.703, § 6	Mastergroup (812-2044 kHz)	Rec. G.921
NTT	6312 kbit/s Rec. G.703, § 3	Mastergroup (812-2044 kHz)	Rec. G.912
FRG	8448 kbit/s Rec. G.703, § 7	Supermastergroup (8516-12 388 kHz)	Rec. G.921
Italy	8448 kbit/s Rec. G.703, § 7	15 supergroup assem. (312-4028 kHz)	Rec. G.921

ANNEX B

(to Recommendation G.941)

Examples of systems other than those recommended in Recommendation G.941

(see Note 1)

Administration	Bit rate (kbit/s)	Analogue interface	Design bit error ratio for regeneration section
France (see Note 2)	704	Supergroup (312-552 kHz)	10^{-8}
Netherlands	2048	2 supergroups	10^{-8}

Note 1 - Modems for the transmission of digital signals at 48-72 kbit/s or twice these bit rates are covered in Recommendations V.36 and V.37.

Note 2 - The digital interface of this DIV equipment is at 2048 kbit/s according to Recommendation G.703 § 6, and with a frame structure according to Recommendation G.704 § 3.3.1. Only 11 (including TS0) among the 32 time slots are effectively used: the useful bit rate is then equal to 10 times 64 kbit/s. The other characteristics of the DIV system satisfy to § 2 of this Recommendation.

References

- [1] CCITT Recommendation *Make-up of a carrier link*, Vol. III, Rec. G.211.
- [2] CCITT Recommendation *12-MHz systems on standardized 2.6/9.5-mm coaxial cable pairs*, Vol. III, Rec. G.332.
- [3] CCITT Recommendation *18-MHz systems on standardized 2.6/9.5-mm coaxial pairs*, Vol. III, Rec. G.334.
- [4] CCITT Recommendation *6-MHz systems on standardized 1.2/4.4-mm coaxial cable pairs*, Vol. III, Rec. G.344.
- [5] CCITT Recommendation *12-MHz systems on standardized 1.2/4.4-mm coaxial cable pairs*, Vol. III, Rec. G.345.
- [6] CCITT Recommendation *18-MHz systems on standardized 1.2/4.4-mm coaxial cable pairs*, Vol. III, Rec. G.346.