INTERNATIONAL TELECOMMUNICATION UNION

ITU-T G.423

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

INTERNATIONAL ANALOGUE CARRIER SYSTEMS

GENERAL CHARACTERISTICS OF INTERNATIONAL CARRIER TELEPHONE SYSTEMS ON RADIO - RELAY OR SATELLITE LINKS AND INTERCONNECTION WITH METALLIC LINES

INTERCONNECTION AT THE BASEBAND FREQUENCIES OF FREQUENCY - DIVISION MULTIPLEX RADIO - RELAY SYSTEMS

ITU-T Recommendation G.423

(Extract from the *Blue Book*)

NOTES

1 ITU-T Recommendation G.423 was published in Fascicle III.2 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.423

INTERCONNECTION AT THE BASEBAND FREQUENCIES OF FREQUENCY-DIVISION MULTIPLEX RADIO-RELAY SYSTEMS[1), 2)]

(amended at Geneva, 1964)

1 General principles

The CCIR issued Recommendations 380 [1] and 381 [2] so that, as far as possible, radio-relay links using frequency-division multiplex should have characteristics which allow direct interconnection at baseband frequencies with systems of the same capacity on metallic lines having the same line frequencies.

Direct interconnection is advantageous, for example, in the following cases:

1) at a junction between a system on metallic lines and a radio-relay system of the same capacity, when it is not required to extract groups of telephone channels;

2) at a junction point between a radio-relay system and a short cable extension (see § 3 below). A cable extension is regarded as "short" if it does not require its own line-regulating system.

The pre-emphasis characteristics at the output of cable system repeaters have not been fully standardized by the CCITT. Moreover, line transmission in a repeater section of a system has various special features due, for example, to the presence of various pilots and to the power feeding of the repeaters. Further, points *R* and *T* defined in Recommendation G.213 may be very near to each other, or they may be linked by several kilometres of cable.

For these reasons, it is unnecessary to provide a direct interconnection of a telephony radio-relay link with either a symmetric cable pair or coaxial cable for a telephone system, such that the input and output levels of the relay link correspond exactly to the normal levels at the input and output of a repeater in the cable system. It is preferable to make the interconnection at a point in the telephone equipment where the level is independent of the frequency. Consequently, interconnection with multiplex telephone equipment in the baseband of a radio-relay link (which in accordance with CCIR Recommendation 381 [2] is always considered to be at one end of the line-regulating section on a radio-relay link) should always be effected in a main repeater station[3)]. Interconnection with another system whether cable or radio-relay link will be effected in this station between points *T* and *T'* defined in Recommendation G.213.

2 Baseband frequency limits, impedance and relative power levels

CCIR Recommendation 380 [1] includes a table which shows preferred values given by the CCIR for the following:

- baseband frequency limits;
- nominal baseband impedance;
- input and output relative power levels at the radio equipment (*R'* and *R*);

together with an annex on definitions which corresponds to CCITT' Recommendation G.213.

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1) Brought up to date by the Secretariat after the Plenary Assembly of Mar del Plata, 1968.

2) Similarly to the corresponding CCIR Recommendations, this Recommendation applies to line-of-sight and near line-of-sight radio-relay systems and also to tropospheric scatter systems of the capacities concerned.

3) Described in § 3.18 of Recommendation G.211.

Table 1/G.423 shows the frequency arrangements, corresponding to the baseband frequency limits in CCIR Recommendation 380 [1], recommended by the CCITT for radio-relay systems that may be interconnected with metallic lines. These frequency arrangements are produced by CCITT standardized frequency-translating equipments for cable systems.

Figures 1/G.423 to 10/G.423 show diagrams of the frequency arrangement for the radio-relay baseband, recommended for purposes of interconnection with coaxial cable systems.

Note 1 - All the diagrams in Figures 1/G.423 to 10/G.423 show the line pilots, the mastergroup pilots, the supermastergroup pilots, the 15-supergroup assembly pilots and the additional measuring frequencies which *may* be in the band transmitted (see § 3).

Note 2 - The meaning of the symbols used in these Figures is given at the beginning of this fascicle.

Note 3 - Some of the diagrams in the figures of other Recommendations also apply to radio-relay links (see Table 1/G.423).

3 Regulated-line sections - line-regulating and other pilots

In CCIR Recommendation 381 [2], the following pilots are recommended for the regulation of radio-relay links:

1) a continuity pilot outside the "total bandwidth" shown in Table 1/G.423;

2) a line-regulating pilot with a frequency of 308 kHz (or 60 kHz, depending on the radio-link capacity), and a level of -10 dBm0;

3) when required, an upper line-regulating pilot of frequency and level in accordance with CCITT Recommendations for the relevant cable systems.

3.1 *Pilot-blocking at an interconnection point*

The CCITT makes the following general recommendations to the CCIR: in all cases, the level of the continuity pilot of a radio-relay system should be reduced so that it is not greater than -50 dBm0 at an interconnection point with a system on a metallic line.

This interconnection point normally occurs at the limits of two regulated-line sections, one of them being on a metallic line and the other on a radio-relay system. This being so, at the interconnection point the following conditions should be observed:

1) the level of any line-regulating pilot on the metallic line should be reduced so that it is not greater than -50 dBm0, unless otherwise agreed by the Administrations concerned;

2) the absolute power level of any regulating pilot of the radio-relay link should be reduced so that it is below - 50 dBm0[4)];

3) any other pilot or additional measuring frequency of the metallic line system that is within the "total bandwidth" defined in Table 1/G.423 will be freely transmitted over the radio-relay system.

A radio-relay system may be extended by short cable sections that form part of the same regulated-line section: there may then be overall transmission of the pilot on that regulated-line section.

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4) In the case of low-capacity systems (up to 120 channels) a line-regulating pilot of 60 kHz with a level of -10 dBm0 may be used; in this case the suppression level should conform with the provisions of the CCITT (Recommendation G.243 and Recommendation G.322, § 1.4). The level of the line-regulating pilot established by the CCITT for lines differs according to whether it concerns coaxial cables or symmetric pairs (-10 dBm0 for coaxial cables and -15 dBm0 for symmetric pair systems).

4 Limits for residues of signals outside the baseband

The CCITT makes the following recommendations to the CCIR for residues of signals outside the baseband frequency limits:

4.1 In the absence of any special agreement between Administrations, the level of any pilot or supervisory signal transmitted outside the baseband of a radio-relay system at a frequency not specified by the CCIR should be reduced, within the radio equipment, to -50 dBm0 at point *R*.

Similarly, in the absence of special agreements between Administrations, the levels of all pilots or supervisory signals sent over the cable system outside the baseband of the radio-relay link should be reduced, within the equipment of the cable system, to -50 dBm0 at point *T*.

4.2 If a radio-relay system service channel, adjacent to a telephone channel in the baseband, uses the levels, frequency allocation and signalling levels corresponding to those which would be recommended by the CCITT for an ordinary telephone channel in the same position in the frequency spectrum, the channel filters are sufficient to avoid the risk of crosstalk interference.

4.3 If the condition referred to in § 4.2 above is not met, an additional filter may be necessary and must be provided in the radio equipment.

4.4 The frequencies mentioned in §§ 4.1 and 4.2 above must be sufficiently distant from the baseband to ensure that the filters (or other appropriate devices) required to eliminate them do not cause attenuation distortion in the passband to exceed the recommended values.

4.5 To avoid overloading the cable system, the level of any signal transmitted beyond point *R* outside the baseband must be kept down to -20 dBm0. Moreover, the level of the total power of the residues of such signals (including noise and intermodulation products) must be kept down to -17 dBm0.

5 Other requirements intended to ensure satisfactory transmission performance

5.1 *Return loss*

This characteristic is of great importance for carrier cable systems, which comprise a number of fairly regularly spaced repeaters. It is felt that, in the case of radio-relay systems, the cable sections linking the radio equipment to the multiplex equipment are generally fairly short and of unequal lengths, so that there is little fear of systematic undulation of the attenuation/frequency characteristic.

That being so, it is recommended that at interconnection points *T* and *T'* the return loss, in relation to the nominal impedance, should be at least 20 dB throughout the frequency band occupied by the telephone channels. The main purpose of this recommendation is to facilitate measurements and maintenance and to ensure some protection against the random reflections which occur at various points between the equipment and the cable sections; it takes into account the value of 24 dB for the return loss at *R* and *R*' recommended by the CCIR [4].

Note - The attention of the CCIR is drawn to the fact that, if the cables joining the radio equipment to the multiplex equipment in the intermediate stations are long enough (for example 1 to 2 km) and not equipped with amplifiers, systematic reflection effects may occur. These special cases must be studied in accordance with the principles established by the CCITT (see Recommendation G.214); they do not seem to justify a general recommendation.

5.2 *Attenuation/frequency distortion*

According to the Recommendation cited in [5], the levels measured at the frontier on a high-frequency cable line section must not deviate at any frequency by more than ± 2 dB from the nominal values, whatever the pre-emphasis characteristic used. At point *T*, for a cable system, one can expect to find variations of the same order in relation to a flat characteristic.

No value is fixed for the radio-relay links in the Recommendation cited in [6]. The CCIR has recommended [7] the same tolerance of ± 2 dB at the points *R* and *R'*.

5.3 *Variation of loss with time*

The CCITT is studying the results that can be obtained on cable line-regulating sections, taking into account Recommendations M.530 [8] and G.333. When this study is complete, it will be possible to point out to the CCIR that a similar recommendation would be desirable for radio-relay links.

TABLE 1/G.423

Frequency arrangements within the baseband of radio-relay links, which are recommended in the case of interconnection with systems on metallic lines

Capacity of radio-relay system (maximum number of telephone channels)	Recommended alternative arrangements of telephone channels	Diagram in figure	Limits of band occupied by telephone channels (kHz)	Pilots or frequencies which may be transmitted[a] (kHz)		Total bandwidth[b] (kHz)
				below (4)	above (4)	
1	2	3	4	5		6
24	2 G [c] 2 G [d]	2*a)*/G.322 1/G.327 [3]	12-108 6-108 or 12-120	- -	- -	12-108 6-108 or 12-120
60	SG 1	2*c)*/G.322	12-252	-	-	12-252
	SG 1	4/G.322	60-300	-	-	60-300
120	SG 1 and 2	4/G.322	12-552	-	-	12-552
	SG 1 and 2	4/G.322	60-552	-	-	60-552
300	5 SG	1*a)*/G.341	60-1300	-	1364	60-1364
	1 MG [e]	1*b)*/G.341	64-1296	60	1364	
600	10 SG	1/G.423	60-2540	-	2604	60-2792
	2 MG [e]	2/G.423	64-2660	-	2792	
900	3 MG or 1 SMG [f]	3/G.423	316-4188	300, 308	4287	60-4287
960	16 SG	4/G.423	60-4028	-	4092	
1260 [g]	21 SG 21 SG 4 MG	Plan 1 [h] Plan 2 Plan 3	60-5636 60-5564 316-5564	- - 308	5680 5608 5608	60-5680
1800	15 SG +3 MG	5/G.423	312-8204	300, 308	8248	300-8248
	15 SG + 15 SG [i]	6/G.423	312-8120			
	6 MG or 2 SMG	7/G.423	316-8204			
2700	15 SG + 6 MG	8/G.423	312-12 388	300, 308	12 435	300-12 435
	15 SG+ 15 SG+ 15 SG [i]	9/G.423	312-12 336			
	9 MG or 3 SMG	10/G.423	316-12 388			

G = group SG = supergroup MG = mastergroup SMG = supermastergroup

a) See § 3 of the present Recommendation and Recommendation G.322, § 1.4.

b) This is the bandwidth occupied by the telephone channels, the associated pilots and reference frequencies, excluding the continuity pilots of the radio-relay system.

e) For 12-channel radio-relay systems, either of the groups A (12-60 kHz) or B (60-108 kHz) recommended by the CCITT may be accommodated in the band 12-108 kHz.

d) In these variants, there are certain restrictions on the use of noise measurement channels or continuous pilot channels recommended by the CCIR.

e) This frequency arrangement is obtained from the basic mastergroup by modulating with multiples of the supergroup carriers.

f) The special case of 600 channels comprising two mastergroups in the band 316-2868 kHz (Figure 3/G.423) is regarded as a partially equipped 960-channel system.

g) According to CCIR Recommendation 380 [1], other limits of the band occupied by telephone channels may be used by agreement between the Administrations concerned.

h) Figure 1/G.344.

i) For the use of 15-supergroup assemblies, see Recommendation G.211.

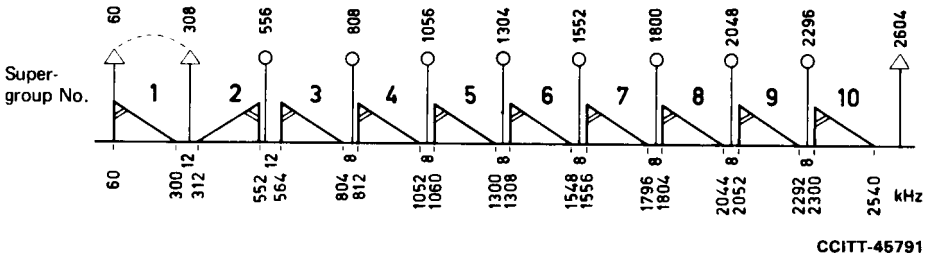


FIGURE 1/G.423

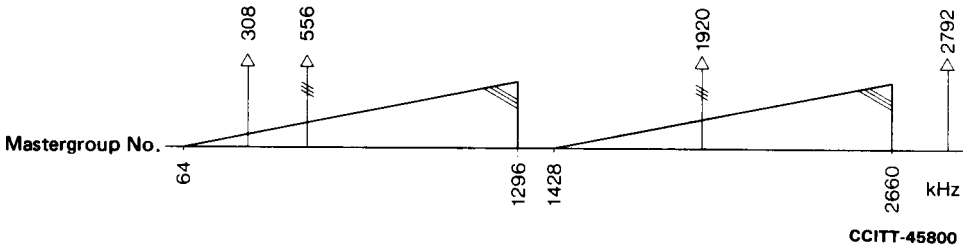


FIGURE 2/G.423

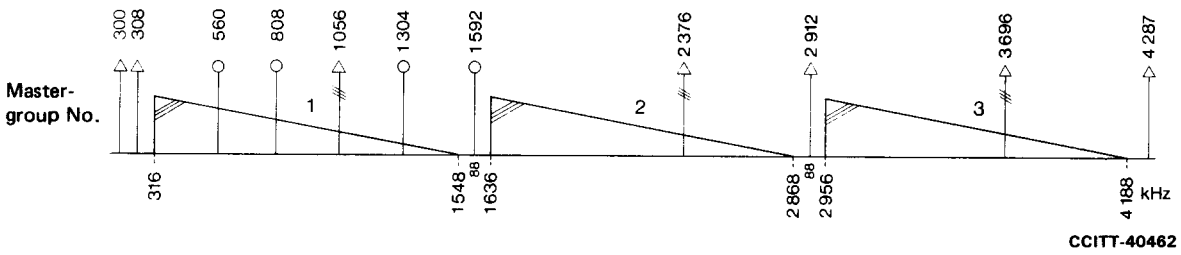


FIGURE 3/G.423

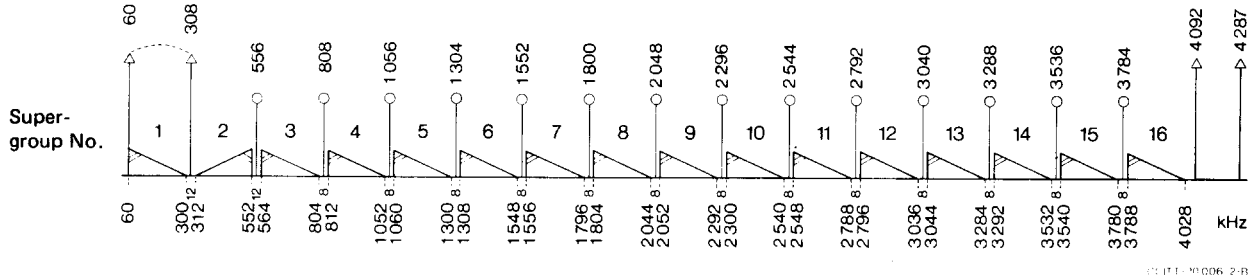


FIGURE 4/G.423

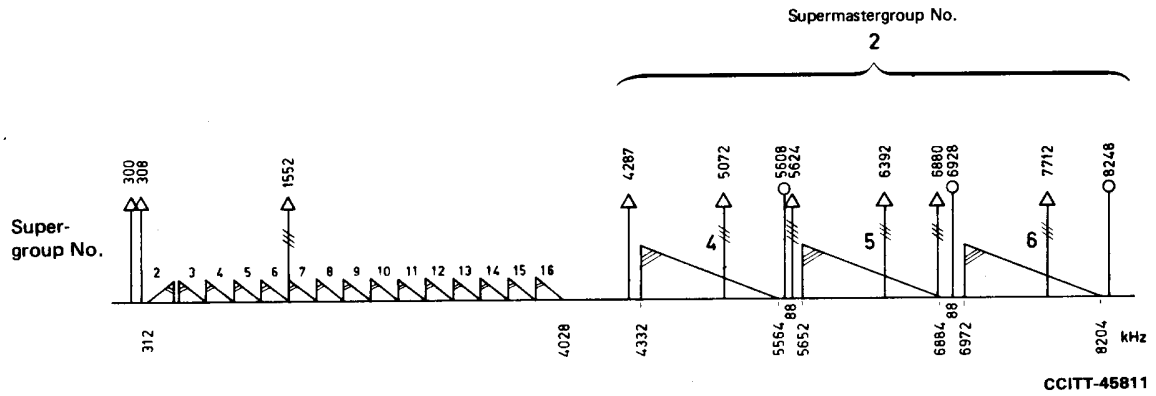


FIGURE 5/G.423

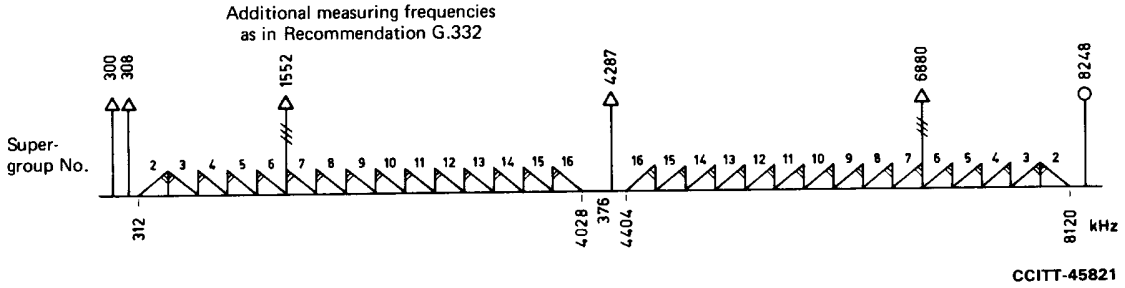


FIGURE 6/G.423

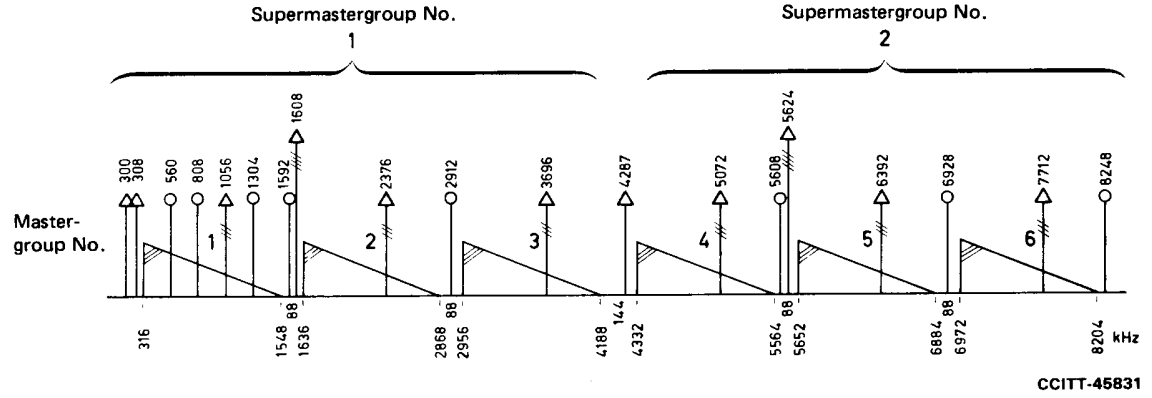


FIGURE 7/G.423

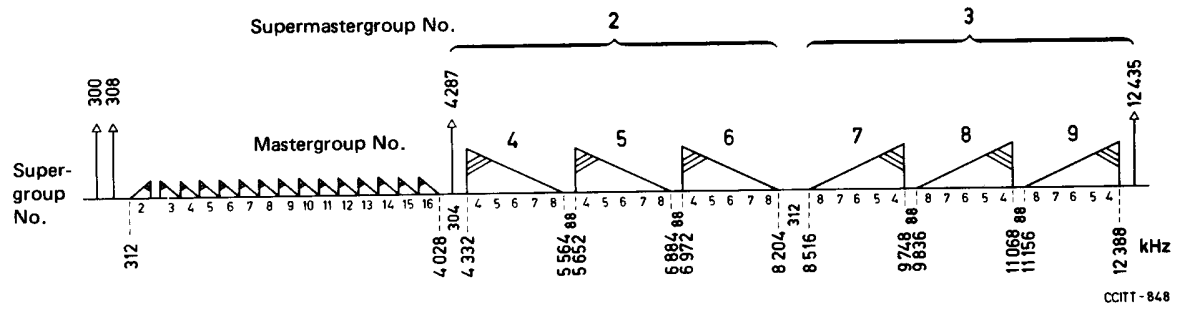
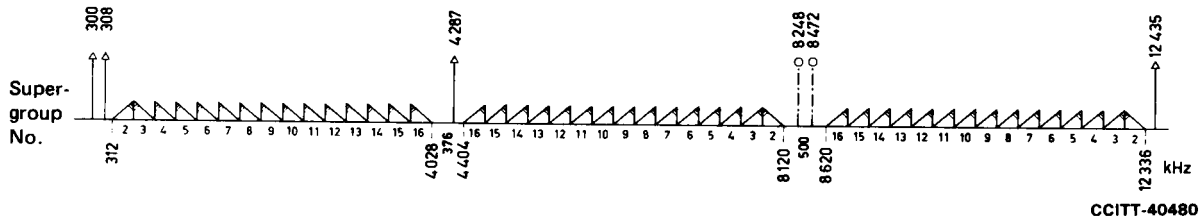


FIGURE 8/G.423



Note - For pilots and additional measuring frequencies transmitted in the frequency band of telephone channels, see Recommendation G.332.

FIGURE 9/G.423

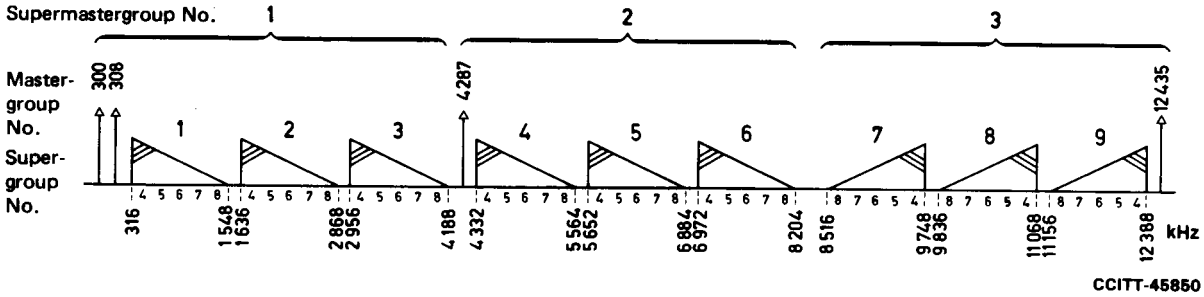


FIGURE 10/G.423

References

[1] CCIR Recommendation *Interconnection at baseband frequencies of radio-relay systems for telephony using frequency-division multiplex*, Vol. IX, Rec. 380, Dubrovnik, 1986.

[2] CCIR Recommendation *Conditions relating to line regulating and other pilots and to limits for the residues of signals outside the baseband in the interconnection of radio-relay and line systems for telephony*, Vol. IX, Rec. 381, Dubrovnik, 1986.

[3] CCITT Recommendation *Valve-type systems offering 12 telephone carrier circuits on a symmetric cable pair [(12 + 12) systems]*, Orange Book, Vol. III-1, Rec. G.327, Figure 1/G.327, ITU, Geneva, 1977.

[4] CCIR Recommendation *Interconnection at baseband frequencies of radio-relay systems for telephony using frequency-division multiplex*, Vol. IX, Rec. 380, § 3, Dubrovnik, 1986.

[51 CCITT Recommendation *Bringing a new international carrier system into service*, Vol. IV, Fascicle IV.1, Rec. M.450, §§ 2.2 and 2.3.

[6] *Ibid*., § 2.1.

[7] CCIR Recommendation *Interconnection at baseband frequencies of radio-relay systems for telephony using frequency-division multiplex*, Vol. IX, Rec. 380, Note 7, Dubrovnik, 1986.

[8] CCITT Recommendation *Readjustment to the nominal value of an international group, supergroup, etc., link*, Vol. IV, Rec. M.530.