THE INTERNATIONAL TELEGRAPH AND TELEPHONE CONSULTATIVE COMMITTEE

CCITT

SIXTH PLENARY ASSEMBLY

GENEVA, 27 SEPTEMBER - 8 OCTOBER 1976

ORANGE BOOK

VOLUME III-3

LINE TRANSMISSION

Published by the
INTERNATIONAL TELECOMMUNICATION UNION
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CONTENTS OF THE CCITT BOOK
APPLICABLE AFTER THE SIXTH PLENARY ASSEMBLY (1976)

ORANGE BOOK

Each volume also contains, for its field and where appropriate:

— definitions of specific terms used;
— supplements for information and documentary purposes.

PART IV

SUPPLEMENTS TO SERIES G, H AND J RECOMMENDATIONS

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SUPPLEMENTS

Supplement No. 2 *(Geneva, 1964, amended at Mar del Plata, 1968 and Geneva, 1976; referred to in Recommendation G.131, B)*

TALKER ECHO ON INTERNATIONAL CONNECTIONS

The curves of Figure 2/G.131 may be used to determine whether a given international connection requires an echo suppressor. Alternatively they may be used to find what value of nominal overall transmission loss shall be adopted for the 4-wire chain of a complete connection so that an echo suppressor is not needed. Before the curves can be used it must be decided what proportion of calls are to be allowed to exhibit an objectionable echo and Recommendation G.131, B. gives guidance on this matter.

The coordinates of the graph represent two of the parameters of a telephone connection that govern echo, i.e. the reference equivalent of the echo path and the mean one-way propagation time. By making certain assumptions (discussed below) these two parameters become the principal ones.

Each curve divides the coordinate plane into two portions and the position, relative to the curve, of the point describing the connection indicates whether an echo suppressor is needed, bearing in mind the percentage of calls permitted to exhibit an objectionable echo.

Factors governing echo

The principal factors which must be considered in order to decide whether an echo suppressor is needed on a particular connection are:

a) the number of echo paths;
b) the time taken by the echo currents to traverse these paths;
c) the reference equivalent of the echo paths including the subscriber lines;
d) the tolerance to echo exhibited by subscribers.

These factors are discussed in turn in the following.

When circuits are switched together 4-wire there is only one echo path, assuming negligible go-to-return crosstalk. This is also substantially true if the circuits are switched together 2-wire. Reasonable values of echo return losses are achieved at the connection points, because the principal echo currents are those due to the relatively poor echo return losses at the ends of the two extreme 4-wire circuits, where the connection is reduced to 2-wire.

The time taken to traverse the echo path is virtually dependent solely on the length of the 4-wire connection, because the main circuits of modern national and international networks are high-velocity circuits.

The reference equivalent of the talker echo path for a symmetrical connection is approximately given by the sum of:

- twice the transmission loss of the connection between the 2-wire point in the talker's local terminal exchange and the 2-wire side of the 4-wire/2-wire terminating set at the listener's end;
- the echo balance return loss at the listener's end; and
- the sum of the sending and receiving reference equivalents of the talker's telephone and subscriber line.

In general, values of reference equivalents corresponding to low-loss subscriber lines should be used.

The echo experienced by subscribers on lines with more loss will be further attenuated. This is therefore a safe assumption.

The echo return loss is assumed to have a mean value of not less than 11 dB, with a standard deviation of 3 dB expressed as a weighted mean-power ratio over the band 500-2500 Hz. The mean value of the transmission loss is assumed to be uniform over this band and the standard deviation of transmission loss for each 4-wire circuit is assumed to be 1 dB for each direction of transmission. The correlation between the variations of loss of the two directions of transmission is assumed to be unity.

The data on tolerance to echo exhibited by subscribers given in Table 1 are furnished by the American Telephone and Telegraph Co. and are based on a series of studies completed in 1971. These tests provided information on the reference equivalent of the echo path for echo, just detectable, as a function of echo-path delay. In addition, ratings of quality on a five-point scale (excellent, good, fair, poor, unsatisfactory) were also obtained. Table 1 indicates the mean echo path loss for the threshold of detectability and for ratings of unsatisfactory. These mean values are the reference equivalent of the echo path for 50% detectability and 50% unsatisfactory. The standard deviation is also given.

TABLE 1 – **Results of echo tolerance tests**

One-way propagation time (ms)	Reference equivalent of echo path			
	Threshold		Unsatisfactory	
	Mean (dB)	Standard deviation (dB)	Mean (dB)	Standard deviation (dB)
10	26	≃ 4	9	≃ 6
20	35	≃ 4	16	≃ 6
30	40	≃ 4	20	≃ 6
40	45	≃ 4	23	≃ 6
50	50	≃ 4	25	≃ 6

Construction of Figure 2/G.131

The mean margin against poor or unsatisfactory echo performance is given by:

$$M = 2\,T + B - E + SRE + RRE$$

where

T = mean overall loss between the 2-wire points in the terminal local exchanges. The loss is assumed to be the same in both directions of transmission;

B = mean echo return loss at the listener end;

E = mean value of reference equivalent of the echo path required for an opinion rating of unsatisfactory [1)]

SRE = sending reference equivalent to the 2-wire point in the originating local exchange for short subscriber lines;

RRE = receiving reference equivalent to the 2-wire point in the originating local exchange for short subscriber lines.

[1)] This corresponds to the value of reference equivalent of the echo path at which 50% of the opinion ratings are unsatisfactory.

The standard deviation of the margin is given by:

$$m^2 = n(t^2_1 + 2rt_1t_2 + t^2_2) + b^2 + e^2$$

where

m = standard deviation of the margin;

t_1, t_2 = standard deviation of the transmission loss in the two directions of transmission of one 4-wire circuit, national or international;

b = standard deviation of echo return loss;

e = standard deviation of the distribution of reference equivalents echo path required for opinion ratings of unsatisfactory;

r = correlation factor between t_1 and t_2;

n = the number of 4-wire circuits in the 4-wire chain.

Inserting $t_1 = t_2 = 1$ dB; $r = 1$; $b = 3$; $e = 6$ dB gives $m^2 = 4n + 45$.

In Recommendation G.131, B. *c)*, Rules A and E refer to 1% and 10% probabilities of encountering unsatisfactory echo and for these cases nine 4-wire circuits will be assumed (3 national + 3 international + 3 national). For both the 1% and 10% curves therefore $m = 9.0$ dB.

For 10% probability, the margin may fall to 1.28 times the standard deviation. The corresponding factor for the 1% curve is 2.33. Hence the corresponding values of M are:

$M = 1.28 \times 9.0 = 11.5$ for 10% probability
$M = 2.33 \times 9.0 = 21$ for 1% probability.

Putting these values into $M = 2\,T + B - E + SRE + RRE$ gives the following values for the mean talker echo attenuation, $2\,T + B + SRE + RRE$.

$2\,T + B + SRE + RRE = 11.5 + E$ for 10% probability
$2\,T + B + SRE + RRE = 21 + E$ for 1% probability.

The values in Table 2 have been calculated (to the nearest whole decibel) using these equations. The figures in the length of connection column have been calculated assuming a velocity of propagation of 160 km/ms.

TABLE 2

Mean one-way propagation time (ms)	Length of connection (km)	Reference equivalent of mean echo path 2T + B + SRE + RRE (dB)	
		10% unsatisfactory	1% unsatisfactory
10	1600	21	30
20	3200	28	37
30	4800	32	41
40	6400	35	44
50	8000	37	46

Figure 2/G.131 has been constructed from these values and similar values calculated for other values of n.

Supplement No. 5 *(Mar del Plata, 1968, amended at Geneva, 1972 and 1976; referred to in Recommendation G.223 and H.51)*

MEASUREMENT OF THE LOAD OF TELEPHONE CIRCUITS UNDER FIELD CONDITIONS

1. *Speech power measurements using a voltage sampling method*

The Australian Administration has developed several sampling voltmeters for the measurement of speech levels in the telephone network. Associated control units allow the meters to operate automatically when a telephone call is established and to measure speech levels for only one direction of transmission on a 2-wire circuit. Both instruments produce coded outputs in dB relative to 0.775 volts on punched paper tape, and if connected to a point in the network where an accurately defined termination exists (e.g. say 600 ohms at MOD IN of a carrier system), speech power levels can readily be determined.

The speech voltage is sampled at regular intervals, quantized into one of 21 possible nominal levels spaced 2-dB apart over a 40-dB range, and after coding, is recorded in the form of punched paper tape. Subsequent computer processing of the output tapes allows the computation of "activity factor" and "mean power while active" (and other parameters, if required) for each telephone conversation or portion thereof.

The first voltmeter developed had a fixed sampling rate of 4.3 samples per second and had a teleprinter-type tape punch using 5-hole paper tape. A later design provides a variable sampling rate of up to 100 samples per second, and is equipped with a high-speed paper tape punch. This unit has a frequency response extending to about 700 kHz and can also be used for sampling broadband signals in the telephone network.

In the determination of activity factor, speech samples are considered inactive if the short-term mean power remains 15 dB or more below the long-term mean power while active, for periods of 350 ms or longer. At the low sampling rate of 4.3 samples per second, difficulty has been experienced in deriving an algorithm for the sufficiently accurate calculation of activity factor. Although a sampling rate of 40 samples per second has been found adequate for use with the present algorithm, algorithm studies are continuing in an attempt to lower the sampling rate and hence reduce both the paper tape output and tape processing time.

The general functioning of the variable sampling rate voltmeter is illustrated in Figure 1. Voltage samples are taken periodically and held on capacitor C. This voltage is logarithmically quantized and encoded by means of the counter which counts clock pulses from the instant of sampling, until the logarithmically decaying voltage (positive or negative) reaches the reference voltage level. At the completion of the counting, the encoded value is punched onto paper tape and the counter reset to await the next sampling instant.

The principle of the speech power flow direction indicator is illustrated in Figure 2. Providing the line termination is not highly reactive, a comparison of the line current and voltage polarities gives an indication of power flow direction. During reverse flow, the punch records 5 holes, rather than the encoded value of the voltage for that sample.

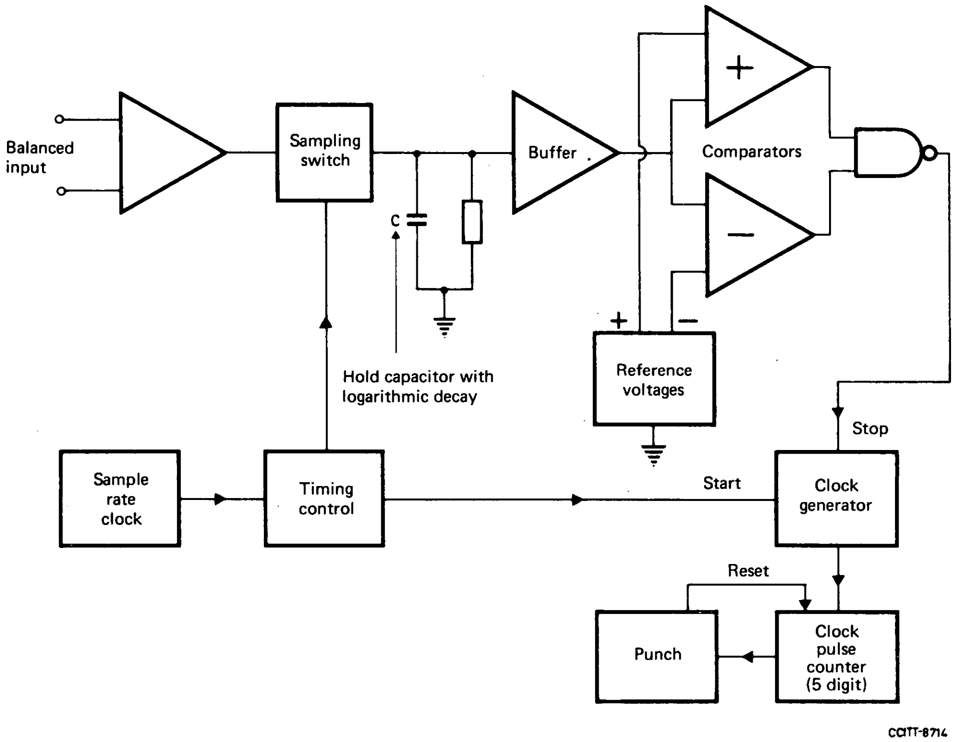


FIGURE 1 – **Logarithmic-recording digital speech-voltmeter (simplified block diagram)**

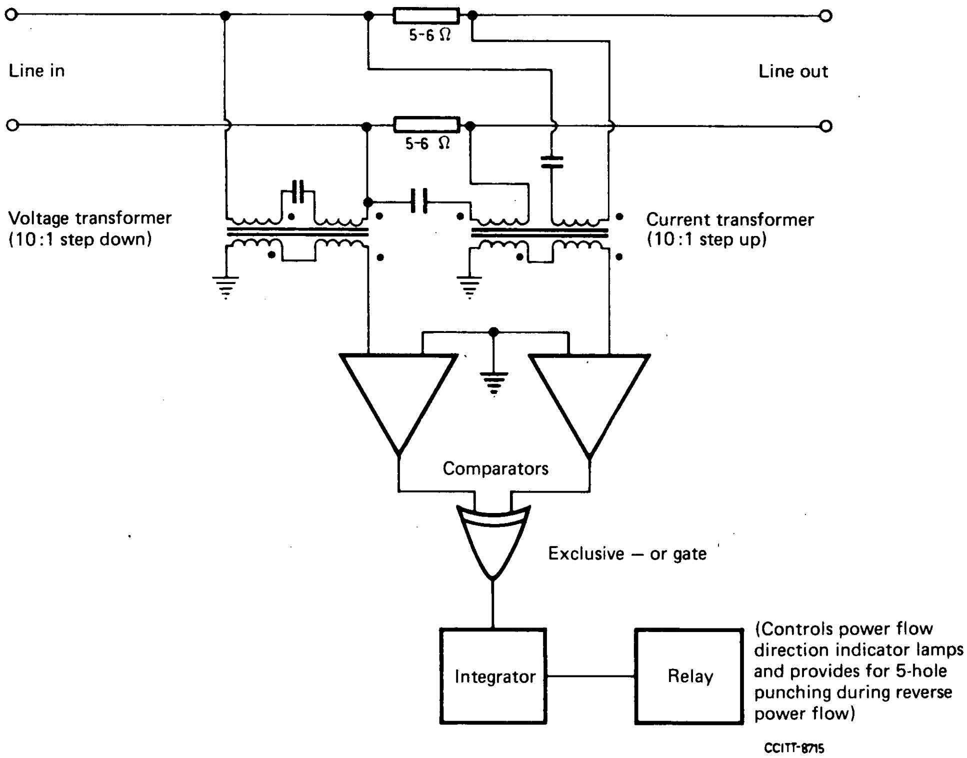


FIGURE 2 – **Speech power flow direction indicator (simplified block diagram)**

2. *A new method for the measurements of the overload level in FDM Systems*

The Hungarian Post Office proposes to introduce a new method for the measurements of the overload level, e.g. on amplifiers of FDM systems, by means of a white-noise test signal. The method is based on the fact that a significant modification of the probability density function $f(x)$ or of the distribution function $F(x)$ arises due to the nonlinearity of the transmission path.

A Gaussian white-noise signal of variable level is fed to the input of the amplifier under test. At its output a characteristic point or moment of $f(x)$ or $F(x)$ can be determined as a function of the distortion, by means of a suitable measuring device. In other words, increasing the level of the test signal causes the shapes of these curves to change (e.g. the distribution function, where there is an increased probability of occurrence of a level higher than the limiting level of the amplifier). This means that the output probability density function will no longer be Gaussian (see Figures 3 and 4).

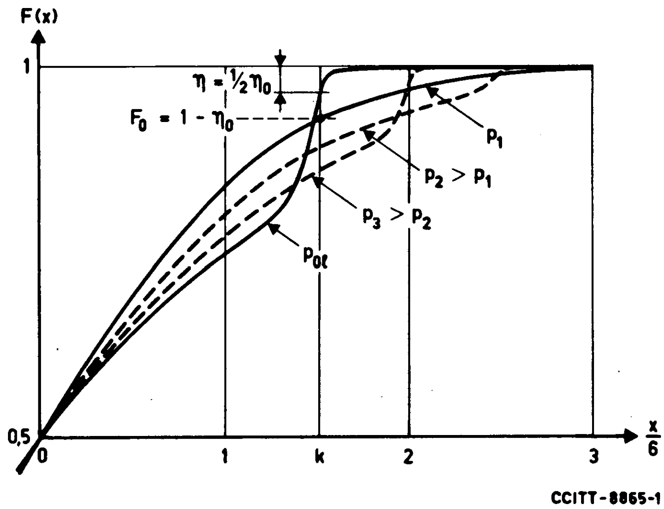


FIGURE 3

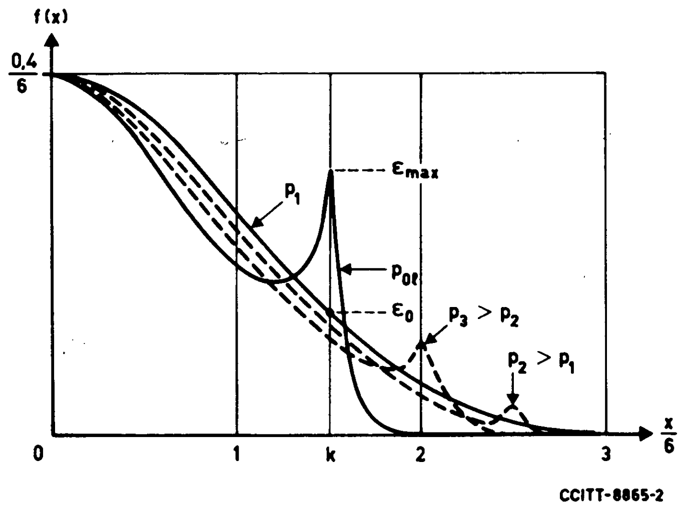


FIGURE 4

When operating in the linear dynamic range of the amplifier (i.e. in the low-level range, say curve p_1 the distribution function and the probability density function will both be Gaussian. One may choose a relative indication level $k\sigma$, where σ is the standard deviation (i.e. approximately the r.m.s. value) of the test signal, and k is a constant between 1 and 2 (it can be theoretically or practically determined and adjusted in the measuring equipment). At this relative level the p_1 curve yields fixed values of $(1 - \eta_0)$ and ε_0, respectively. By increasing the input level within the linear range of the amplifier, $(1 - \eta_0)$ and ε_0 values do not change. However, upon reaching the overload level the curves change rapidly (see curves p_2 and p_3). At the overload level (p_0), the corresponding distribution curve shows the point $(1 - \eta)$ to be near 1.

Defining $\eta = \frac{1-(1-\eta_0)}{2} = \frac{\eta_0}{2}$ we simply measure the rapid increase of the monitored relative level ($k\sigma$), while at the same time ε gives a relative maximum.

The test level where $\eta = \eta_0/2$ i.e. where the actual value is half of the theoretical Gaussian value, corresponds to the overload level for a suitable k value. At this point then, the output r.m.s. value can be defined as the overload level.

Since a theoretical relation exists between η_0 and ε_0, it is possible to design equipment to measure $\eta_0/2$ or ε_{max}. It is also possible to use the moment of the density function for this purpose. All these areas have been investigated in laboratory tests carried out by the Research Institute of the Hungarian Post Office. Measurements on diverse type amplifiers compare well with the measurements using the old definitions of the overload test. Further, it was possible to measure the overload level on narrow-band amplifiers, and on amplifiers with pre- or de-emphasis. The measuring set conforms to the white-noise signal source of the white-noise measuring method specified by Recommendation G.228.

3. *Results of speech power measurements under field conditions*

By the end of the study period 1968-1972 a preliminary set of results of speech power measurements under field conditions were submitted by several Administrations in response to CCITT Circular-Letter No. 150. These measurements were carried out in accordance with rules and definitions which were very similar to those now outlined in Annex 2 to Question 1/CMBD. In the course of collecting the information, some modifications to the preliminary set of rules were found to be necessary. After several points had been clarified and expanded the definitions and rules were then drafted in their present form.

The results of the measurements of the power on one channel are contained in Table 1. The symbols used are in agreement with those listed in Annex 2 to Question 1/CMBD.

The results of measurements on groups of channels and systems are shown in Table 2.

TABLE 1 – **Measurements on one channel**

Administration	$\bar{y}_c$ dBm0	σ_{yc} dB	y_p dBm0	Auxiliary conversations		Echo		Measuring point	Start/stop of measuring	Special remarks
				included	excluded	included	excluded			
Switzerland COM Sp. C-No. 77	–17.2	5.2	–14.1	X		X		+10 dBr audio frequency output channel translating equipment – secondary switching centre	Called subscriber answers → subscriber announcing end of conversation	National circuits
Australia Temp. Doc. No. 1 (March 1972)			–16.1	X		X		0 dBr	Called subscriber answer	National circuits
			–16.25	X		X		–2 dBr	Called subscriber answer	International cable circuits
			–16.7	X		X		–2 dBr	Called subscriber answer	International satellite circuits
United Kingdom Post Office COM Sp. C -No. 83+ -No. 87	–21.6	5.7	–17.9	X		X		–3.5 dBr nominal sending	Called subscriber answers → called subscriber clears	National circuits
Federal Republic of Germany Sup. 5 Vol. III			–17.8	X		X		–17.4 dBr input channel equipment	Called subscriber answer	International connections
Italy Temp. Doc. No. 11 (March 1972)	–20.8	4.7	–18.3	X		X		–3.5 dBr	Called subscriber answer	National connections
Hungary COM Sp. C-No. 84	–15.8 –15.4 –17.4	4.6	–13.5 –13.1 –15.1		X	X		–13 dBr	Called subscriber answer	Overall operator switched automatically switched
Netherlands COM Sp. C-No. 12 (1973-1976)			–21.8 –22.3	X X		X X		–3.5 dBr input channel equipment	Channel busy	National circuits

TABLE 1 *(continued)* – **Measurements on one channel**

(Activity and occupancy factors)

Administration	$\bar{\tau}_O$	$\bar{\tau}_B$	$\bar{\tau}_u$	y_{st}	$\bar{\tau}_{st}$	Level of total long-term mean power on channel, dBm0	Remarks
Switzerland COM Sp. C-No. 77	0.89	0.68	0.61	−12.1	0.10	−15.6 (22.8 + 4.4 μW)	$\bar{\tau}_B$ refers to measured channels
Australia	–	–	–	–	–	–	
United Kingdom Post Office	0.83	0.93	0.76	−5.4	0.14	−12.7 (12.4 + 41.0 μW)	$\bar{\tau}_O$ and $\bar{\tau}_B$ measured y_{st} : level of mean-signalling and supervisory-tones power, including switching spikes
Federal Republic of Germany	–	–	–	–	–	–	
Italy	–	–	–	–	–	–	
Hungary COM Sp. C-No. 84	0.69	0.61	0.42	−16.1 (average)	0.17		Minor conversation $\bar{y} = -17.7$ dBm0 τ (automatic) = 0.05; τ (operator) = 0.2
Netherlands COM Sp. C-No. 12 (1973-1976)	0.85 0.82	0.7 0.7				−19.2 −20.3	– Incoming – Outgoing $\bar{\tau}_B$: from traffic statistics

TABLE 2 – Measurements on groups of channels

Administration	Class of assembly of channels (group, supergroup, system)	Integration time	Frequency of evaluated samples	Number of telephone channels in operation	Number of non tele-phone channels in operation	Total mean power for all channels	Level of mean power per assembly of channels (See Note 1)	σy for samples	Total mean power for non tele-phone channels	Mean power per channel	Mean power per tele-phone channel
				A	B	mW0	dBm0	dB	mW0	µW0 (dBm0)	µW0 (dBm0)
Switzerland	Groups (30)	1 minute	60/hour	360 (12 per GP)	–	6.850	–6.4*	2.9	–		19.0 (–17.2)
	Supergroups (19)	1 minute	60/hour	1128 (60 Ch. per SG on 15 SG; 52-59 Ch. per SG on 4 SG)	–	21.900	+0.6*	1.6	–		19.3 (–17.1)
Federal Republic of Germany	Supergroups	5 minutes	~ 2/hour	405	5	6.880		0.8	~ 0.675	16.8 (–17.7)	15.3 (–18.1)
	Systems (960- and 1260-Ch)	5 minutes	~ 2/hour	1094	13	19.700		0.4	~ 1.755	17.8 (–17.5)	16.4 (–17.8)
Italy	Supergroups (4) (–18 dBm0 signalling)	1 minute	20/hour	240	–	4.3	+0.2**	1.0	–	17.4 (–17.6)	17.4 (–17.6)
	Supergroups (10) (–6 dBm0 signalling)	1 minute	20/hour	591	8	16.8	+2.3**	1.8	3.15	28.0 (–15.5)	23.1 (–16.4)
	16-supergroup assemblies (5) (–18 dBm0 signalling)	1 minute	20/hour	3968	162	78	+12.6**	0.8	8.1	18.9 (–17.2)	17.6 (–17.5)
	16-supergroup assemblies (5) (–6 dBm0 signalling)	1 minute	20/hour	2153	75	75.9	+15.3**	1.0	22.3	34.1 (–14.7)	25.0 (–16.0)

Administration	Class of assembly of channels (group, supergroup, system)	Integration time	Frequency of evaluated samples	Number of telephone channels in operation	Number of non telephone channels in operation	Total mean power for all channels	Level of mean power per assembly of channels (See Note 1)	σy for samples	Total mean power for non telephone channels	Mean power per channel	Mean power per telephone channel
				A	B	mW0	dBm0	dB	mW0	μW0 (dBm0)	μW0 (dBm0)
K.D.D., Japan	Supergroup	1 minute	60/hour	60	0	1.34	+1.27*	1.23	–	22.33 (–16.5)	22.33 (–16.5)
	Supergroup	1 minute	60/hour	43	14	2.19	+3.40*	0.58	0.842	38.48 (–14.2)	31.35 (–15.0)
Hungary (See Note 2)	Groups (4)	1 minute	~ 60/hour	37	9	1.97	–3.1			42.83 (–13.7)	
	Supergroups (2)	1 minute	~ 60/hour	104	9	3.25	+2.1			28.76 (–15.4)	
United Kingdom	Groups (4) –Forward signalling	5 seconds	720/hour	48	–	0.48	–9.2*	3.3	–	10 (–20.0)	10 (–20.0)
	Groups (6) –Backward signalling	5 seconds	720/hour	72	–	1.07	–7.5*	2.8	–	15 (–18.3)	15 (–18.3)
	Groups (4) –Forward signalling	40 milliseconds	3600/hour	48	–	0.52	–9.0*	5.5	–	11 (–19.6)	11 (–19.6)
	Groups (6) –Backward signalling	40 milliseconds	3600/hour	72	–	2.6	–5.9*	5.7	–	22 (–16.6)	22 (–16.6)
	Supergroups (9)	5 seconds	720/hour	540	–	5.7	–2.0*	1.1	–	11 (–19.8)	11 (–19.8)
Poland (See Note 2)	Groups (10)	1 minute	30/hour	99	13	5.11	–2.9*	3.06	1.03	45.6 (–13.4)	41.2 (–13.9)
	Supergroups (3)	1 minute	30/hour	158	17	8.14	+4.3*	1.2	1.76	46.5 (–13.3)	40.3 (–13.9)

Notes to Table 2

1. If the assembly measured is only partially filled (i.e. A + B < N, where N is the capacity of the assembly) the level of mean power per assembly of channels can be defined in two ways:

a) Level of mean power (measured) per assembly

$$= 10 \log_{10} \frac{\text{Total mean power for all channels}}{\text{Number of assemblies measured}}$$

The results of this calculation are indicated by an asterisk in Table 2.

b) Level of mean power (possible) per assembly

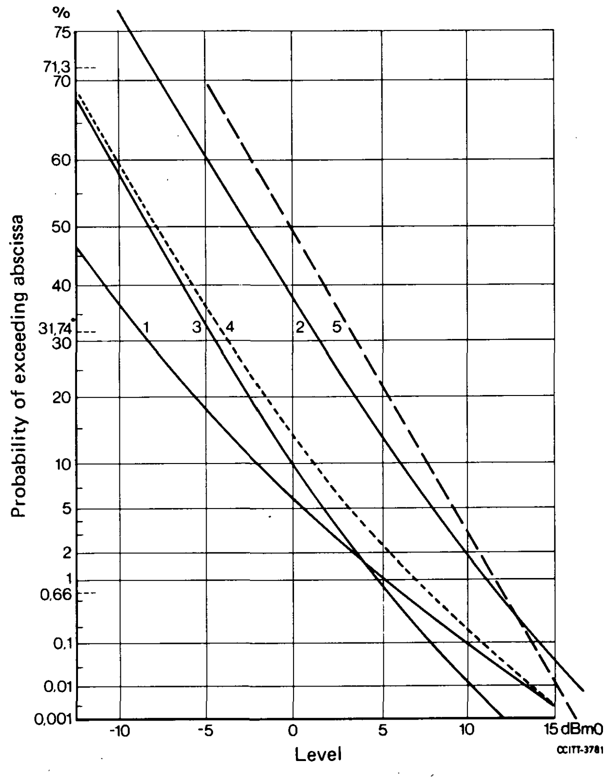
$$= 10 \log_{10} \frac{\text{Total mean power for all channels}}{\text{Number of assemblies measured}} \cdot \frac{N}{n}$$

where N = capacity of the assemblies, and n = total number of channels in operation (A + B in Table 2). The results of this calculation are indicated by a double asterisk in Table 2.

2. Calculated from information supplied by the Administration.

Figures 5 and 6 indicate distribution curves for the instantaneous signal levels on basic groups and supergroups. Measurement results obtained during study period 1973-1976 as shown in Figures 7 to 11 are also given in this Supplement.

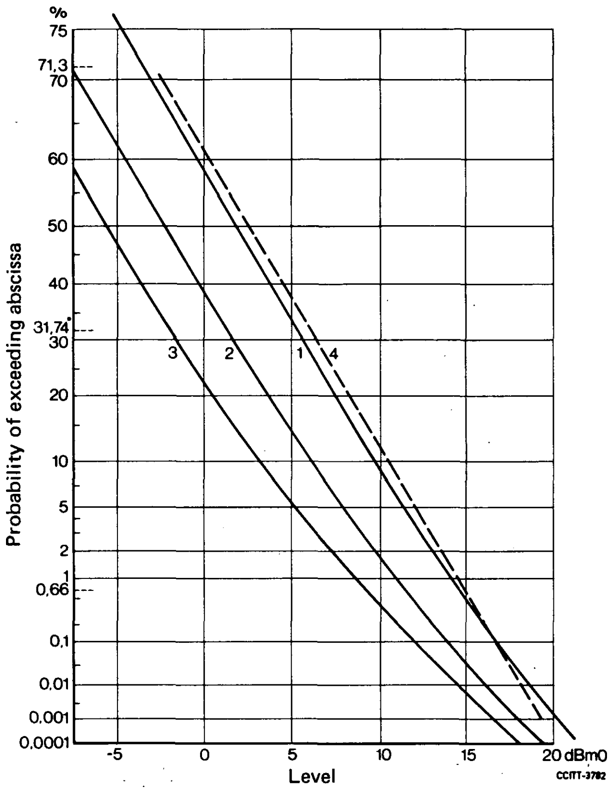
Note. – Supplement No. 5, *Green Book*, Volume III contains in its Part 1 measurement results obtained during 1964-1968 and in its Part 2 details of the international calibration procedure using tape recording prepared by the CCITT.



* Point of r.m.s. value for Gaussian signal

1. Group carrying telephony only
2. Group with nine telephone channels and one sound-programme channel
3. Group with 10 telephone channels and two channels carrying telegraphy
4. Curve representing the long-term mean signal, averaged over the 21 groups considered
5. Curve of conventional load (Gaussian)

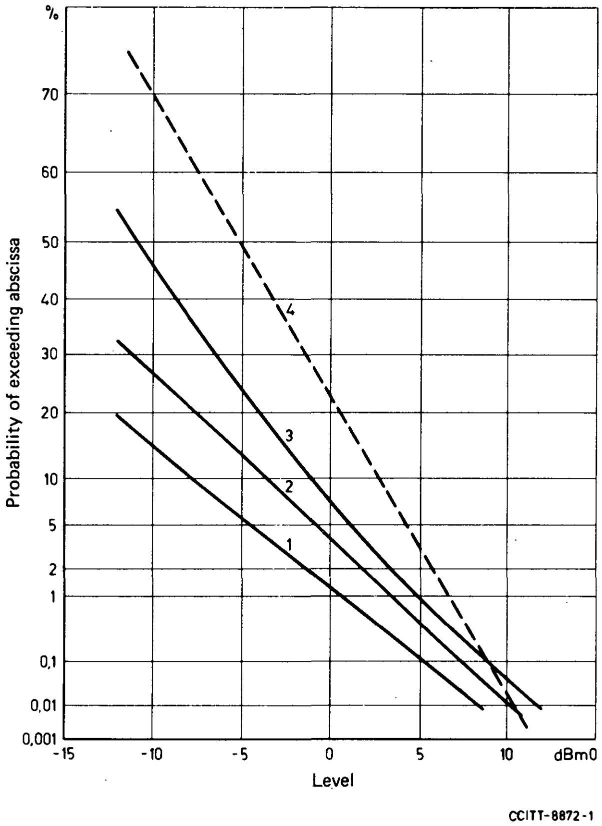
FIGURE 5 – **Amplitude distribution curves of signals on basic groups (Swiss Administration)**



* Point of r.m.s. value for Gaussian signal

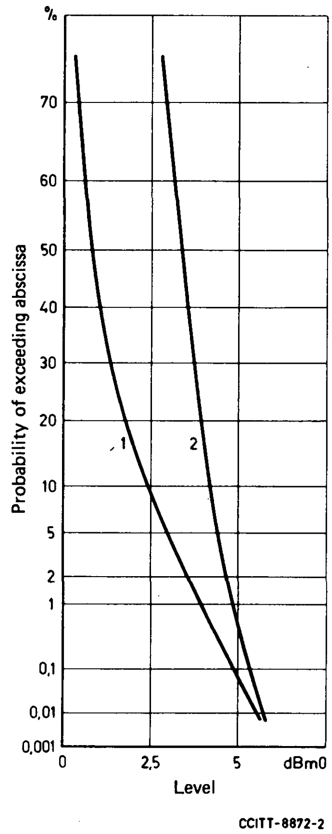
1. Supergroup with 54 telephone channels and two sound-programme channels
2. }To indicate the range in which most of the measured curves are situated
3. }
4. Curve of conventional load (Gaussian)

FIGURE 6 – **Amplitude distribution curves of signals on supergroups (Swiss Administration)**



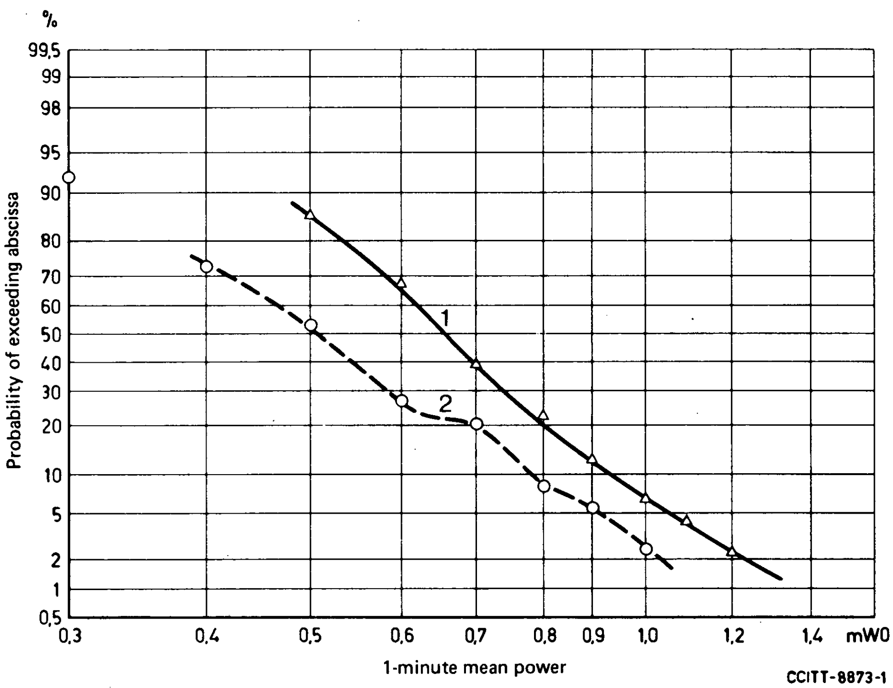
1. Groups carrying telephony (forward signalling)
2. Groups carrying telephony (return-path)
3. Supergroups
4. Curve representing Gaussian distribution

FIGURE 7 – **Amplitude distribution curves of signals (UKPO)**



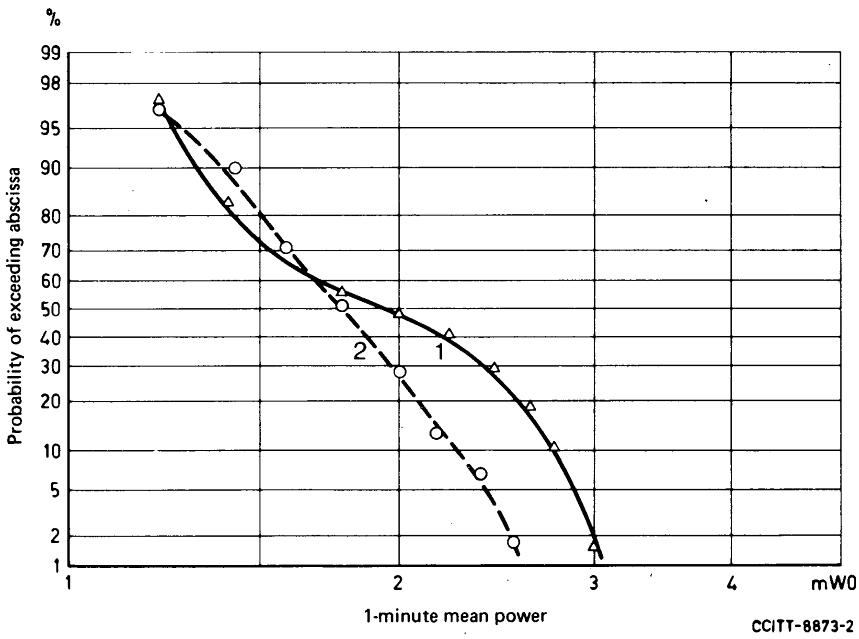
1. Supergroup with 60 telephony channels
2. Supergroup with 43 telephony channels and 14 non-telephony channels

FIGURE 8 – **Amplitude distribution curves of the one-minute mean-power on supergroups (KDD)**



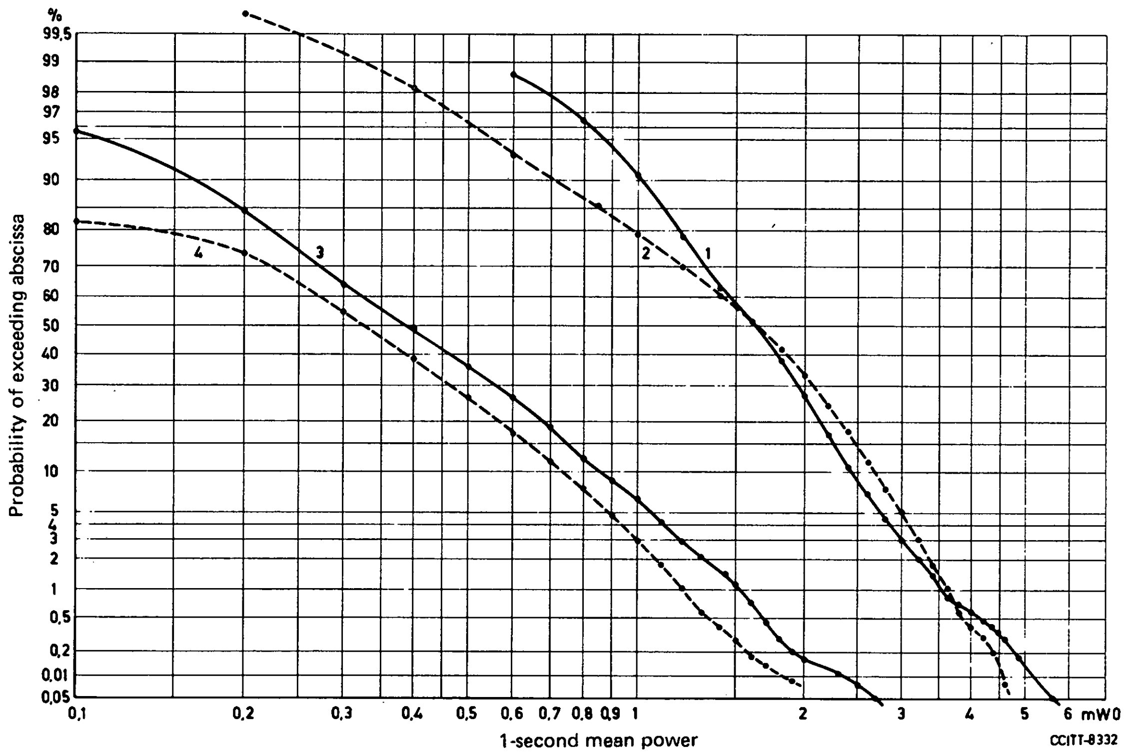
1. Measuring series extended over 10 working days (seven days for one group A, and one day for each of three groups B, C and D)
2. Replication of the measurements on group A during five working days

FIGURE 9 – **Distribution of one-minute mean-powers during busy hour on groups (Hungarian Administration)**



1. Measuring series extended over seven working days (five days on a supergroup E, and two days on a supergroup F)
2. Replication of the measurements on supergroup F during five working days

FIGURE 10 – **Distribution of one-minute mean-powers during busy hour on supergroups (Hungarian Administration)**



1. Measuring series extended over 2000 1-second measurements (supergroups E and F)
2. Measuring series extended over 3500 1-second measurements (supergroup F)
3. Measuring series extended over 4000 1-second measurements (groups A, B, C, and D)
4. Measuring series extended over 3500 1-second measurements (group A)

FIGURE 11 – **Distribution of the one-second mean-powers during the busy hour on groups and supergroups (Hungarian Administration)**

Supplement No. 11 *(Mar del Plata, 1968; amended at Geneva, 1972 and 1976; referred to in Recommendation G.371)*

DATA ON THE CABLE SHIPS OF VARIOUS COUNTRIES

Name of ship	Year of construction	Displacement (tons)	Overall length (m)	Draft (m)	Normal speed (knots)	Range (autonomy) (nautical miles)	Number of tanks	Cable capacity			Cable gear			Maximum operating depth (m)	Capability
								Cable		Repeaters	Forward cable drum (diameter) (m)	Bow sheave (diameter) (m)	Stern sheave (diameter) (m)		
								Cubic metres	Weight (tons)						
DENMARK															
Ship belonging to the Great Northern Telegraph Co.															
Northern	1962 and 1968	1744	82.2	5.3	12	10 000	3	330	600	–	1.90	2.00	–	4500	Reinforced for operation in icefilled waters
UNITED STATES OF AMERICA															
Long Lines	1963	11 326	156	7.9	15	10 000	3	4420	7000	125	3.66	3.05	3.66	All	Cable ship belonging to AT & T. Lays/repairs all types of telephone cable
FRANCE															
						(days)									
M. Bayard	1961	7197	121.2	6.43	14	55	4	2235	3300	70	2.10*	3.0	2.10* bow 3.0 stern	All	Lays/repairs all types of cable. Can lay in one operation 850 nautical miles or 8.38/25.4 central carrier cable with repeaters every 20 nautical miles. * 3 m in 1975
Ampère	1950	3465	91.3	5.14	12	25	3	415	900		1.80			All	Repair ship for all types of cable (not usable in winter in North Atlantic)

Name of ship	Year of con-struc-tion	Dis-place-ment (tons)	Overall length (m)	Draft (m)	Normal speed (knots)	Range (auton-omy) (nautical miles)	Number of tanks	Cable capacity: Cable: Cubic metres	Cable capacity: Cable: Weight (tons)	Cable capacity: Repeat-ers	Cable gear: Forward cable drum (diam-eter) (m)	Cable gear: Bow sheave (diam-eter) (m)	Cable gear: Stern sheave (diam-eter) (m)	Maxi-mum operat-ing depth (m)	Capability
Alsace	1940	3350	88.05	5.30	10	21	3	415	550		1.80			All	Repair ship for all types of cable (not usable in winter in North Atlantic)
Vercors	1974	10 670	133	7.3	16.5	35	3	2535	6000**	140	3	Linear	3.0 bow 4.0 stern	All	Laying and repair of all types of telephone and power cables. Capacity: 1300 nautical miles 1-inch cable or 650 n.m. 1.5-inch cable ** A different weight in the case of power cable
ITALY															
Salernum	1956	2834	102	5.60	16	(nautical miles) 10 000	3	850 (30 000 cubic feet)	1800		2.50	2.00	2.00	All	Lays and repairs cables
JAPAN															
KDD Maru	1967	4257	113.83	6.3	16	7000	3	1012	2700	70	3.6	3.0	(shute) 4.0	All	Cable ship belonging to KDD. Lays/repairs all types of telephone cable

NETHERLANDS

								a	a						
Dir. Gen. BAST	1969	630	54.96	3.2	10.6	2300	2	143	300	–	2.15	1.83	–	400	Lays and repairs principally shore ends

[a] Cable – Diameter, 7 m. Coiling depth, 2 m.

FEDERAL REPUBLIC OF GERMANY [b]

Kabeljau	1944	499	52	3.94	8	1500	2	375	670		2.20	2.20	2.20	700	Lays and repairs cables. Property of Norddeutsche Seekabelwerke AG, Nordenham

[b] The Administration of the Federal Republic of Germany points out that a number of cable ships are described in the publication *Underseas Cable World*, Volume 1, No. 5, June-July 1967.

UNITED KINGDOM

1. *Ships belonging to Cable and Wireless Limited*

Edward Wilshaw	1949	2496	96	5.8	10.5	6 000	3	540	1000	6	2.01	1.83	None	All	Lays/repairs armoured cables. Repairs light-weight cables
Recorder	1954	3349	103	5,6	11.5	10 000	3	602	1100	8	2.13	2.13	None	All	Ditto
Retriever	1961	4218	112	5.81	13	8 000	3	618	1545	11	2.13	2.13	1.52	All	Ditto
Mercury	1962	8962	144	7.5	14.5	8 000	3	2980	5290	144	3.04	3.04	1.82	All	Laying by sheave linear motor. Lays/repairs armoured and light-weight coaxial cables
*Neptune**	1962	8398	151	8.96	13.5	8 000	5	4957	9500	400	3.00	3.00	3.00	All	Ditto
Cable Enterprise	1964	4358	113	5.84	13	6 000	3	875	2150	13	2.13	2.13	1.52	All	Lays/repairs armoured cables. Repairs light-weight cables
Sentinel	1944	8567	147	8.54	13	10 000	4	3240	5426	128	2.0	2.0	2.1	All	Ditto

2. *Ships belonging to the United Kingdom Post Office*

Alert		6515	127.2	6.86	13	6 000	3	1583	2677	48	2.1	2.1	2.7	All	Lays/repairs all types of cable
Ariel		1509	76.9	4.88	11	2 500	3	456	693	Limited	1.9	1.9	None	3660	Lays/repairs armoured cables. Repairs light-weight cables
Iris		1512	76.9	4.88	11	2 500	3	456	693	Limited	1.9	1.9	None	3660	

* Subject to registration.

Supplement No. 13 *(Geneva, 1976; referred to in Recommendation G.229)*

NOISE AT THE TERMINALS OF THE BATTERY SUPPLY

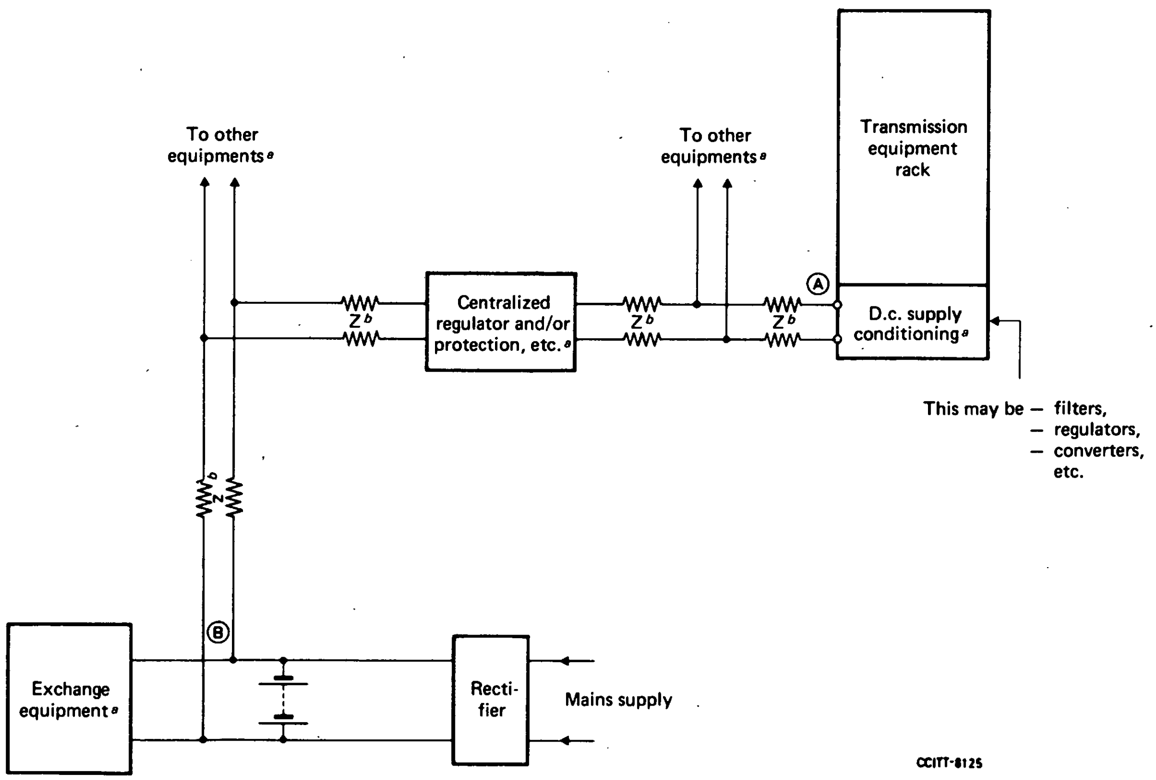
Study Group XV has, for documentary purposes, collected information about the magnitude of interference signals such as residual hum, spurious frequencies, noise, etc. present on the d.c. supply to transmission equipment. It is evident that widely different national practices are reflected in the values submitted. These are dependent, among other factors, on:

- the point where they are referred to (battery terminals, equipment terminals);
- whether exchange equipment and transmission equipment are supplied from the same battery or not; and
- the place where the filtering of excessive noise is performed (centrally or distributed to each user according to his requirements and risk of interference).

From the point of view of designing and purchasing equipment there would doubtless be advantages if a narrow range of values of these interferences could be indicated. However, bearing in mind the considerations indicated above and the information supplied by the various Administrations and organizations, it seems impossible to make the wide range any narrower, at least for the present time.

Furthermore, the information collected will have to be interpreted with due caution, since it may have been derived under different conditions and based on different assumptions.

The basic arrangement of the d.c. supply in a station is shown in Figure 1. The point A as defined in this figure is of particular interest to the work of the CCITT.



[a] This equipment may or may not be present.

[b] Z is the d.c. bus bar impedance and may assume different values. Any other impedance not represented in the diagram but present in an actual installation should also be taken into account.

FIGURE 1 – **Basic arrangement of the d.c. supply in a station**

The information made available up to now is summarized below.

New Zealand

Maximum noise on the battery supply: 0.5 mV (telephone weighted) or 50 mV (unweighted), the main component being at 100 Hz.

Netherlands

Maximum hum and noise measured at point B of Figure 1:

– At 50 Hz (mains frequency)	125 mV r.m.s.
– At 100 Hz (second harmonic)	250 mV r.m.s.
– in the band 100-5000 Hz	
– psophometric weighted	10 mV r.m.s.
– individual frequency	50 mV r.m.s.
– Above 5000 Hz	
– unweighted total	20 mV r.m.s.
– individual frequency	5 mV r.m.s.

ITT

Limits for the equipment in the case of a 60-volt battery: (measured at point A of Figure 1):

- A.c. hum: 2% of battery voltage (i.e. 1.2 V r.m.s.), which allows for the case where the equipment is fed from simple rectifier units;

– other frequencies:	up to 3 kHz	200 mV r.m.s.
	above 3 kHz	20 mV r.m.s.
	psophometric weighted	5 mV r.m.s.
	total peak-to-peak	1 Vm r.m.s.

The maximum a.c. voltage allowed to be fed back by an individual power supply equipment connected to the battery is fixed at 1/10 of the limits shown above.

France

Nominal battery voltage 24 volts.

Frequency	Maximum allowed voltage (r.m.s.)
50 Hz (or 60 Hz)	28 mV
100 Hz (or 120 Hz)	35 mV
150 Hz (or 180 Hz)	55 mV
200 . . . . . 400 Hz	100 mV

Note. – For higher-order harmonics of the mains frequency, higher values can be tolerated because of easier filtering possibilities.

Italy

The information concerns only the case of a power supply using d.c.-to-d.c. converters.

Nominal battery voltage: 48 V or 60 V.

The noise, measured with a psophometer, should not exceed 2 mV at the battery terminals (point B in Figure 1).

The d.c.-to-d.c. converter ensures the regular operation of the transmission equipment in the presence of a noise voltage at point A, having the value of 100 mV r.m.s. at any frequency between 50 Hz and 100 Hz.

As regards the noise fed back from the individual power supply of the transmission equipment to the battery, it is stated that the noise voltage measured at point A shall not exceed 30 mV r.m.s. in the band 0 to 10 MHz. For any disturbing frequency within the band 0 to 10 MHz, the voltage shall not exceed 10 mV r.m.s. In any case, the noise voltage measured with a psophometer shall not exceed 2 mV. In these measurements a 3-ohm resistor is used for simulating the impedance of the connection between the battery and the d.c.-to-d.c. converter.

Switzerland

The limits for single frequency components, impulses and transients on a d.c. battery supply of 48 V in a station are shown in Figures 2 and 3. The equipments connected to these supplies have to contain adequate suppression to ensure that the transmission performance requirements are met. (The limits indicated, refer to point A of Figure 1.)

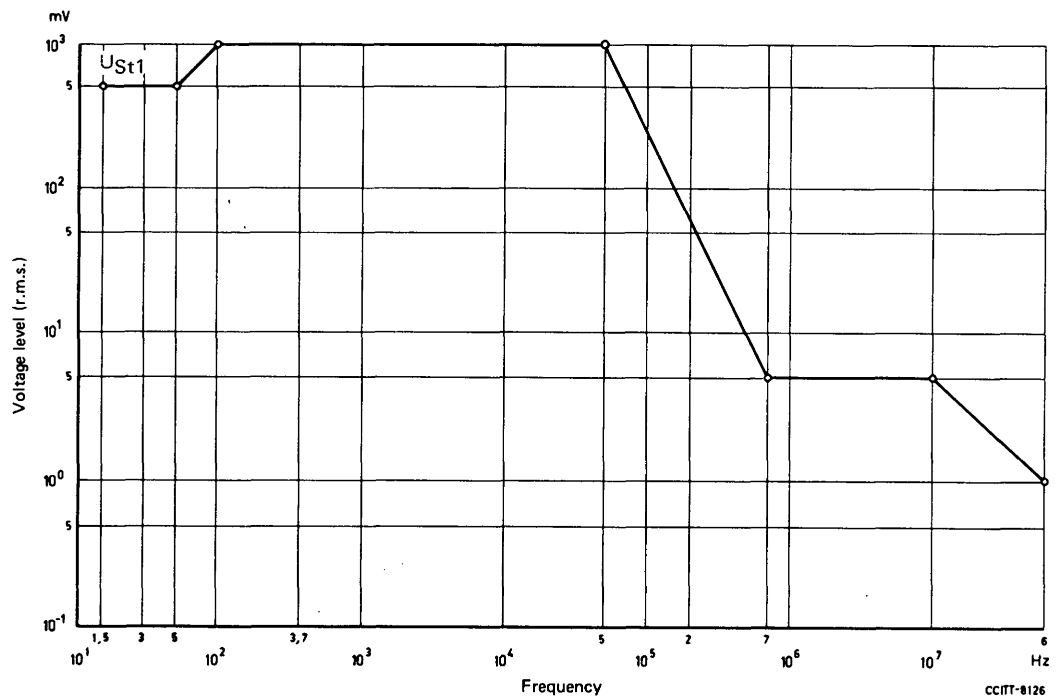


FIGURE 2 – Maximum level of single frequency components on the battery supply (48 V) in a station (Switzerland) (measured selectively at the terminals of the equipment)

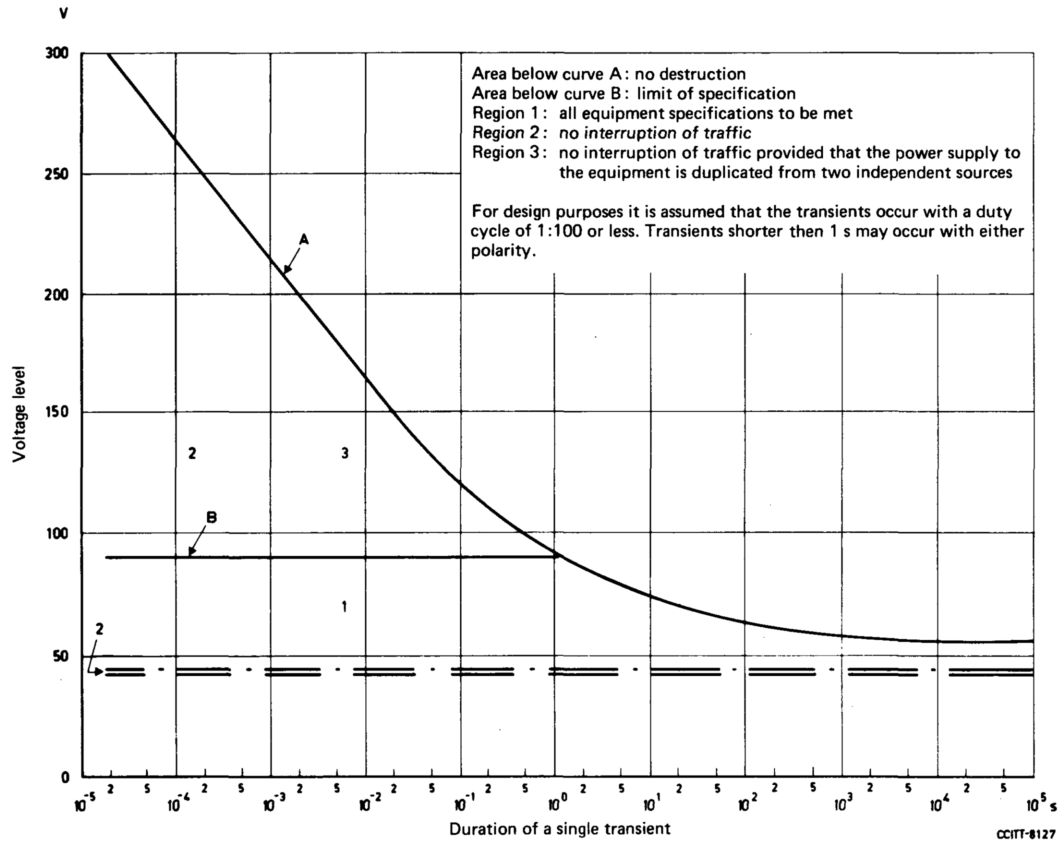


FIGURE 3 – Transients on the battery supply (48 V) in a station (Switzerland) (at the terminals of the equipment)

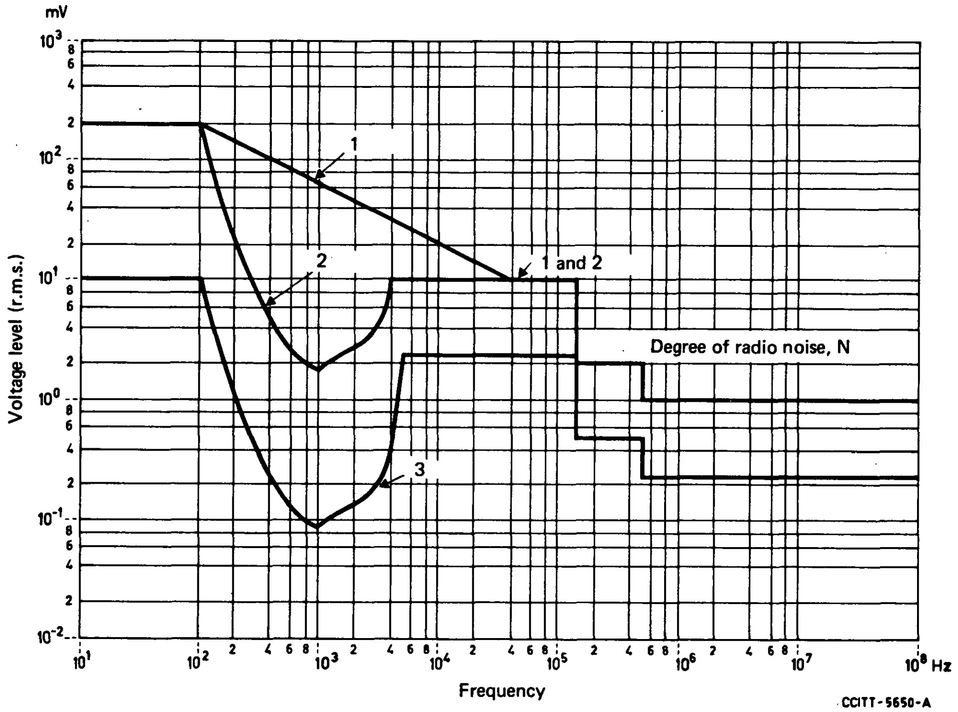
Federal Republic of Germany

The r.m.s. voltage measured selectively on the 60 V station d.c. supply, may amount to 200 mV up to 100 Hz and must drop with rising frequency to the value N according to the specification VDE 0875 for radio frequencies. Different limit values are fixed in the frequency range between 10 Hz and 38 kHz for systems with and without subscriber feeding (curves 1 and 2 of Figure 4).

The limits of the superimposed ripple must be met at the input end of the last fuse (or cut-out) ahead of the load circuit.

The central power supply system alone may give rise to 50% of the aforementioned limit values, as measured at the output end of the load-circuit fuse. The feedback effects contributed by the individual load units add up neither linearly nor on a square-law basis. The superimposed ripple, which an individual load may cause by feedback, has therefore been fixed at a lower value than the sum of the superimposed a.c. voltages on systems with subscriber feeding, namely at 26 dB at frequencies up to 4 kHz and at 12 dB at frequencies beyond 5 kHz (curve 3).

Measured with psophometric weighting (A-filter) the broadband r.m.s. voltage corresponding to curve 2 shall not exceed 2 mV and the r.m.s. voltage corresponding to curve 3 shall not exceed 0.1 mV.



Curve 1 : system without subscriber feeding
Curve 2 : system with subscriber feeding
Curve 3 : feedback contributed by an individual load unit

FIGURE 4 – **Permissible a.c. ripple on a 60 V d.c. power supply**

United Kingdom Post Office

The United Kingdom Post Office requires its transmission equipment to be capable of operating from power supplies on which the following maximum noise is present (referred to point A of Figure 1):

24 V negative supply

a) 2 mV r.m.s., psophometrically weighted;
b) 50 mV r.m.s., 50-Hz ripple;
c) 50 mV r.m.s., 100-Hz ripple;
d) 5 mV r.m.s., 3-kHz to 300-MHz spectrum (single frequency measured selectively).

50 V negative supply

Limits *a)* to *d)* above and:

e) 30 mV r.m.s., 25-Hz ripple;
f) impulsive noise spikes, 10 V peak-to-peak, duration 30 nanoseconds to 500 microseconds, periodic and random;
g) occasional noise spikes of 2 kV peak-to-peak with a half amplitude duration of 200 nanoseconds, followed by a damped oscillatory wave form;
h) negative-going voltage spikes of 250 V superimposed on the supply. Substantially linear rise-time of approximately 50 microseconds duration and an exponential decay having a time constant of approximately 50 microseconds.

Transmission equipment is expected to work satisfactorily with conditions *a)* to *g)*. For condition *h)* the equipment must be capable of withstanding this voltage without damage.

The information given here is from existing relevant specifications all of which are now under review.

KDD

Nominal battery voltage: 24 V.

The noise, measured with a psophometer, should not exceed 5 mV (r.m.s.) at the terminals (point B of Figure 1).

U.S.S.R.

Transistorized carrier equipment of attended stations of cable and microwave telecommunication links should be designed for a power supply of 24 V d.c. ± 10% (21.6 to 26.4 V) with a ripple of $250 \cdot 10^{-3}$ V in the frequency band up to 300 Hz and $15 \cdot 10^{-3}$ V in the frequency band above 300 Hz, measured by a square law scale electronic voltmeter (point A of Figure 1). The positive terminal of the power supply should be earthed.

Considering the appropriate technical and economical motivations, the equipment of microwave telecommunication links (e.g. when employing travelling wave tubes), as well as the line equipment of telecommunication cable links may be powered from a 220 V a.c. ± 3% power supply, $f = 50$ Hz ± 5% and the voltage deviation from the sinusoidal law not exceeding 10% (for microwave stations the frequency can decrease down to 42.5 Hz for a time period not exceeding 5 minutes).

Supplement No. 14 *(Geneva, 1976; referred to in Recommendation G.623)*

METHODS FOR MEASURING REGULARITY RETURN LOSS

(Contribution of the ITT)

1. *Sweep frequency method*

A block schematic of the test arrangement is given in Figure 1. This method allows the direct measurement of the returned power while the oscillator sweeps over the particular band.

The wide frequency-band hybrid transformer (H) has to be correctly matched at all ports and the cable impedance simulators (T1 and T2) are identical.

The frequency range of the oscillator for the evaluation of cables for 60 MHz FDM transmission would be, typically, 2 to 70 MHz.

The gain of the wideband amplifier (AMPL 1) has to be sufficient to achieve a regularity return loss measuring sensitivity of −60 dB.

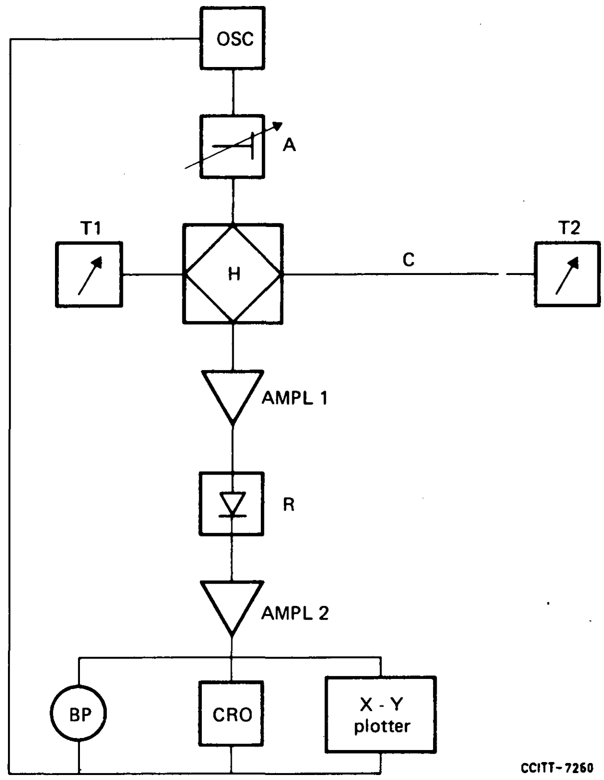
The output of AMPL 2 represents the measuring result and can be displayed both on the cathode ray oscilloscope and as the Y coordinate on the X-Y plotter.

The X-coordinate indication is controlled by a voltage proportional to the frequency of the swept-frequency oscillator. Thus the display shows the cable power-reflection factor as a function of frequency.

The integrating meter (BP) is for measuring the returned power averaged over the band. The meter alone averages the complex d.c. power signal applied to it, when the sweep rate of the oscillator is set just high enough to produce a steady reading.

The accuracy of the method depends largely upon the match between the cable under test and the impedance simulator T1 with which it is being compared. By varying the impedance of this simulator the mean level of the displayed characteristic (and the reading on meter BP) can be made to drop to a minimum in order to achieve optimum matching conditions.

The test frequency can be swept once slowly over the requisite range to make an X-Y plot, or faster and recurrently for a CRO display or an average returned power measurement. It is convenient to have crystal-controlled frequency markers at intervals of 1 and 10 MHz.



OSC = oscillator: fixed/sweep frequency
A = adjustable attenuator
H = wide frequency-band hybrid transformer
T1, T2 = cable impedance simulators
C = cable under test
AMPL 1 = wide-band amplifier
AMPL 2 = d.c. coupled low frequency amplifier
R = square law rectifier
CRO = cathode ray oscilloscope
BP = integrating meter

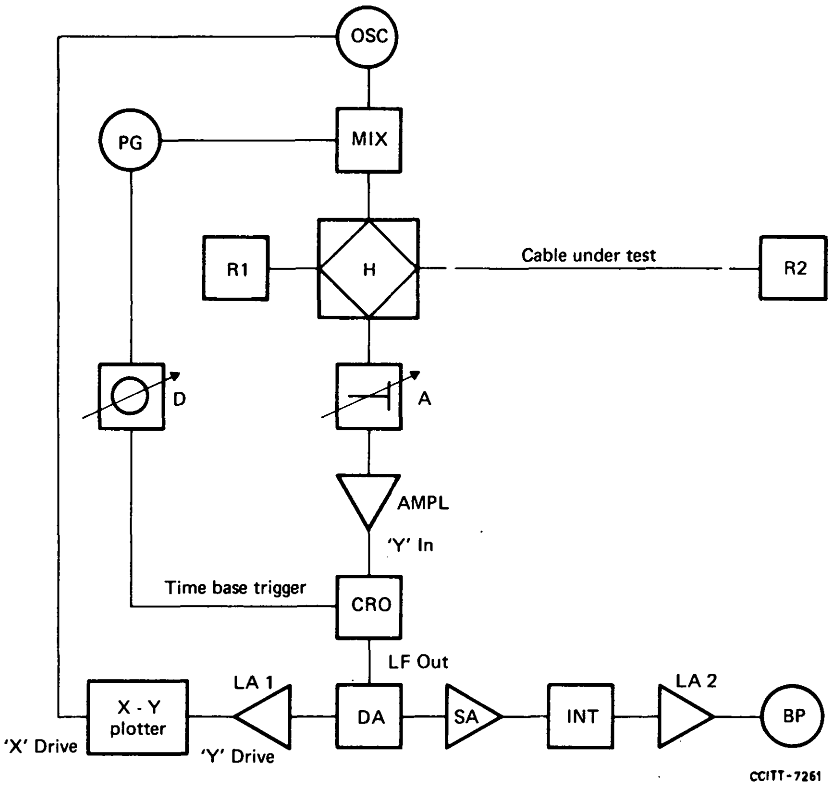
FIGURE 1 – Sweep-frequency method for measuring regularity return loss and average returned power

For the measurement of the average returned power in a 10-MHz band, the oscillator is arranged to sweep continuously over the band in question (the centre frequency being set manually) at a rate just sufficient to avoid flicker on the meter BP (say 10-20 Hz). The meter is calibrated in dB, so that the value can be recorded directly.

By manual adjustment of the oscillator (not sweeping) it is also possible to read directly the reflection at any particular frequency. Thus the precise level of peaks due to periodic irregularities may be conveniently noted.

2. *Carrier-wave burst method*

A block schematic of the test arrangement is given in Figure 2. The test signal used in this method consists of short bursts from a sine-wave signal (carrier). The power spectrum of this signal has its maximum at the frequency of the carrier. The bandwidth of the power spectrum depends on the duration of the bursts.



OSC = oscillator: fixed/sweep frequency
MIX = wideband mixer
PG = variable width (1-10 μs) pulse generator (fixed frequency 30 kHz approx.)
H = wide frequency-band hybrid transformer
R1, R2 = fixed HF resistors
A = adjustable attenuator
AMPL = wideband low-noise amplifier
D = variable time delay
CRO = cathode ray sampling oscilloscope
DA = detector amplifier
LA 1 = logarithmic amplifier
LA 2 = logarithmic DC amplifier
SA = square law amplifier
INT = resistance-capacitance integrator
BP = average returned power meter (power-in-band)

FIGURE 2 – Carrier-wave burst (CWB) method for measuring regularity return loss and average returned power

The carrier oscillator OSC has interval automatic level control and can be operated manually or swept continuously over an appropriate frequency range, typically from about 2 MHz to 70 MHz. The output pulses of the pulse generator have a repetition frequency of about 30 kHz, have extremely fast transition times and are continuously variable in width from approximately 1 to 10 microseconds, so that they can be adjusted to begin and finish wholly within a test cable length.

The oscillator signal applied to the mixer is gated by the variable-width pulse generator, so that a continuous train of short carrier bursts is produced at the output of the mixer.

The matching impedance on the wideband hybrid transformer is an HF fixed resistor $R1$, whose value is near to the nominal characteristic impedance of the cable. The fixed HF resistor $R2$, which is approximately equal to $R1$, provides an adequate far-end termination for the test cable.

Unlike the sweep frequency return loss method, a short length of flexible coaxial cable can be used between the equipment and the cable under test.

The cathode-ray sampling oscilloscope (CRO) is capable of operating up to 1 GHz. Its time base is synchronized to the 30-kHz carrier-burst signal to secure a stationary picture. The variable delay in the time-base trigger circuit enables a detailed examination to be made of the entire burst envelope and of the subsequent echo waveform.

As a result of the sampling technique, the measuring process is somewhat slower than the sweep-frequency method. There is the added disadvantage that the return loss/frequency characteristic of a cable cannot be directly displayed on the oscilloscope, only the burst and its return echo. However, connection errors are eliminated and one can, if necessary, test any desired portion of the cable. This is an advantage where it is suspected that periodic irregularities are not regularly distributed throughout the length.

In order to produce a plot of the return loss/frequency characteristic and to measure the mean return-loss power in 10 MHz bands, the low-frequency sampled signal from the CRO is fed through detector amplifiers, whose outputs are proportional to the return loss. One of these outputs passes through a logarithmic amplifier to provide the Y coordinate on an X-Y plotter; levels can be read off the plot directly, in decibels, over a range −60 dB to −15 dB.

The second detector-amplifier output is used to make average returned power measurements. Here the oscillator is set to scan over a desired 10-MHz band, and its centre frequency is adjusted manually for a slow repetition rate (5 Hz to 10 Hz). The output is converted by a square-law amplifier (SA) into an indication proportional to power. The complex waveform of this indication is averaged by a resistance-capacitance integrator (INT). The steady potential output of the integrator is passed to the power-in-band meter (BP) via the logarithmic d.c. amplifier, for display of the mean-power level, directly in decibels, over the range −30 dB to −40 dB.

The power measuring technique of the carrier-wave burst system has some similarity to that of a pulse echo test, with the burst considered as a pulse echo, whose pattern indicates the return loss characteristic of that section of the cable determined by the length of the burst. Since the beginning of the echo pattern corresponds to the beginning of the test cable from the point where it is connected to the hybrid transformer, it is essential to make allowances for any test lead that may be used by observing the echo level at a slightly later point in time.

As the observation point is moved further away from the trailing edge of the burst, the echo signals will become increasingly attenuated, depending on the equivalent cable length involved and on the frequency of the carrier.

To record the return loss/frequency characteristic, the test frequency is swept once slowly over the requisite range. It is convenient to record crystal-controlled frequency markers at intervals of 1 MHz and 10 MHz. Return loss calibration lines are also recorded for conditions corresponding to −60 dB, −50 dB, etc., conveniently simulated by the settings of attenuator A when the test cable is replaced on the hybrid transformer by a short circuit.

For the measurement of mean return-loss power in 10 MHz bands, the oscillator is adjusted to sweep continuously over any desired 10-MHz band at a slow repetition rate (5 Hz to 10 Hz) with the centre frequency selected manually.

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British Patent application No. 06755/74.

ROSMAN (G.) – "Assessment of Coaxial Cables for Frequency-Division Multiplex Transmission by means of a CW-Burst Test Signal"; *Proceedings of IEE*, January 1970, 117, pp. 45-50.

STILL (L. H.), STEPHENS (W. J. B.) and BUNDY (R. C. H.) – "The 60 MHz (FDM) Transmission System: Cable Testing"; *Post Office Electrical Engineers Journal*, October 1973, pp. 177-178.

Supplement No. 15 *(Geneva, 1976, referred to in Recommendation G.911)*

ALMOST DIFFERENTIAL QUASI-TERNARY CODE (ADQ CODE)

(Contribution of the U.S.S.R. Administration)

The choice of a type for the line signal is one of the major problems in the planning of digital systems. The signal to be transmitted over a digital line should meet a number of specific requirements, such as:

- the absence of a d.c. component,
- a small portion of low-frequency and high-frequency components in the signal energy spectrum,
- a small number of consecutive symbols of identical nature,
- a high level of the spectrum line corresponding to the clock frequency at the output of the non-linear converter in the timing-recovery circuit and low dependence of this component on the signal statistics,
- a possibility of testing the line without interrupting the information transmission, etc.

The U.S.S.R. Administration submits to Study Group XVIII for its consideration the almost differential quasi-ternary code (ADQ code) which is used for conversion of the original binary information to the line ternary signal transmitted over the digital cable path [1].

Conversion algorithm

In the conversion of a binary signal, the decision concerning the next symbol in the ADQ sequence is made by comparing the previous symbol in this sequence with one or two binary symbols to be converted. In this process, the value of an algebraic sum of the ADQ symbols *S* is taken into consideration. This is shown in Table 1 for all possible combinations of binary symbols and *S*.

TABLE 1

Last ADQ symbol	Algebraic sum of symbols (S)	Binary symbols		ADQ symbols at the converter output	
		First	Second	First	Second
+1	+1 ; 0	1	0; 1	−1	Derived in the next time slot
+1	0	0	0; 1	0	
+1	+1	0	0	0	
+1	+1	0	1	−1	−1
0	−1 ; 0	1	0; 1	+1	Derived in the next time slot
0	+1 ; 0	0	0; 1	−1	
−1	−1 ; 0	0	0; 1	+1	
−1	0	1	0; 1	0	
−1	−1	1	1	0	
−1	−1	1	0	+1	+1

Figure 1 shows the sequence of binary symbols and the corresponding ADQ signal.

The algorithm shown does not involve the use of the combinations 0; +1; +1 and 0; −1; −1. However, since such groups as 0; +1; +1; 0; −1; −1 or 0; −1; −1; 0; +1; +1 do not impair the properties of an ADQ sequence, they may be used for transmission of housekeeping and alarm signals.

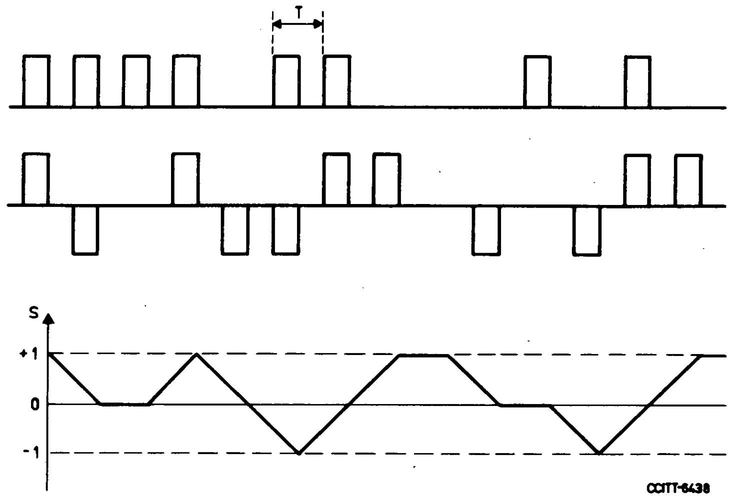

FIGURE 1

Properties of the ADQ signal

From the algorithm of ADQ code conversion it follows that:

- two consecutive 0s and more than two 1s (consecutive or separated 0) cannot be transmitted over a line,
- the algebraic sum S of the line signal symbols can assume the values $+1; 0; -1$ (Figure 1).

The latter makes it possible to test the line condition by the number of deviations of the sum S from the values given, which indicates the presence of a single error or error burst in the line.

Bibliography

[1] POLYAK (L.) – Almost differential quasi-ternary code used in PCM systems; *Elektrosvyaz*, No. 11, 1970.

PART V

QUESTIONS ENTRUSTED TO STUDY GROUPS XV, XVI, XVIII AND CMBD FOR THE PERIOD 1977-1980

(For the annexes to these Questions, reference should be made to Contribution No. 1 of the period 1977-1980 for the appropriate Study Group)

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QUESTIONS CONCERNING TRANSMISSION SYSTEMS ENTRUSTED TO STUDY GROUP XV FOR THE PERIOD 1977-1980

List of Questions

Question No.	Title	Remarks
1/XV	Characteristics of equipment and lines providing 15-kHz type circuits for monophonic and stereophonic sound-programme transmission	
2/XV	Limiting values for group-delay distortion of group and supergroup modulating equipment and through-group and supergroup filters	
3/XV	Setting-up of 5-kHz type sound-programme circuits	
4/XV	Visual telephone service	Of interest to Study Group XVIII
5/XV	Automatic identification and removal from service of faulty circuit in the international network	Of interest to Study Groups IV and XI
6/XV	Intelligible crosstalk on international circuits	Of interest to Study Groups XII and XVI
7/XV	Battery power supply	
8/XV	Interconnection of sound-programme circuits in the basic group	
9/XV	Crosstalk from a sound-programme circuit into a telephone circuit	
10/XV	Echo suppressor improvements, new methods of controlling echo, and testing methods	
11/XV	Unwanted modulation and jitter of signals	
12/XV	Interfering frequencies on telephone channels and wide-band group, supergroup, etc. circuits	
13/XV	Target design values for noise in terminal equipments	
14/XV	Limiting values for the group-delay distortion for a pair of channel transmitting and receiving equipments of one terminal equipment	

15/XV	Line regulators, group regulators, etc.	
16/XV	10 800 channels on 2.6/9.5 mm coaxial pairs	
17/XV	New 2.6/9.5-mm coaxial pair designs	
18/XV	Cables for systems with more than 10 800 channels	
19/XV	Analogue systems with more than 10 800 channels	
20/XV	Television transmission on 60-MHz systems	
21/XV	Use of a quinary group	
22/XV	Analogue systems with more than 10 800 channels on 2.6/9.5-mm coaxial pairs	
23/XV	Analogue systems with more than 2700 channels on recommended coaxial pairs	
24/XV	Return loss of analogue transmission equipment	Of interest to Study Group XVI
25/XV	Unification of the characteristics of telephone-type circuits used for transmission (telegraphy, facsimile, data, etc.)	To be studied by JWP/LTG
26/XV	Unification of certain characteristics of signals transmitted over telephone-type circuits	To be studied by JWP/LTG
27/XV	Signal power over the band of a telephone-type circuit	Of interest to Joint Study Group CMBD
28/XV	Characteristics of group or supergroup links for the transmission of wide-spectrum signals	To be studied by JWP/LTG
29/XV	Characteristics of wide-spectrum signals to be transmitted over group or supergroup circuits	To be studied by JWP/LTG
30/XV	Equipment of high-capacity submarine cable systems	
31/XV	Submarine cables and systems	
32/XV	Definition of the reliability of a transmission system and objectives	
33/XV	Reliability of transmission systems	
34/XV	Return loss at the input and output of modulators	
35/XV	Cable characteristics for digital transmission	Of interest to Study Group XVIII
36/XV	Digital line sections on FDM links	Of interest to Study Groups XVII and XVIII
37/XV	Physical characteristics of millimetric waveguides	Of interest to Study Group XVIII
38/XV	Physical characteristics of optical fibre cables	Of interest to Study Group XVIII

Question 1/XV – Characteristics of equipment and lines providing 15 kHz type circuits for monophonic and stereophonic sound-programme transmission.

(continuation of Questions 1/XV and 2/XV studied in 1973-1976)

Should any additions or amendments be made to Recommendation J.31?

Note 1. – The characteristics already recommended by CMTT and approved by the CCITT for 15-kHz type circuits for sound-programme transmission are described in Recommendation J.21. The replies of Study Group XV to Questions 1/XV and 2/XV (study period 1973-1976) are summarized in Annex 1.

Note 2. – The following points should be studied in particular:

a) Characteristics at audio-frequencies of the whole or sections of the hypothetical reference circuit:

1. Should a new point be added to Recommendation J.31 to deal with attenuation and phase equalizers in order to meet the requirements of Recommendation J.21?

2. What are the nonlinearity limits for the various sections of the hypothetical reference circuit?

3. What usable power reserve should the circuits have?

b) Characteristics of circuits for carrier-programme transmissions in a circuit section of the hypothetical reference circuit:

1. Should a restriction be placed on frequency position in the line band and the number of through connections:

- to reduce the range of adjustment and to simplify the phase equalizer?
- to ensure a tolerable phase difference between the A and B channels when switching over from a faulty normal circuit to a spare circuit?

2. What level of interfering signals can be tolerated in the frequency bands of the programme-channel pilots (65.2 kHz ± 300 Hz and 102.8 kHz ± 300 Hz) used with equipment which meets the requirements of Recommendation J.31.

Note 3. – It would be useful to study b), bearing in mind also the conditions to be met in order to provide either two circuits for monophonic programme transmission in the same group, or a pair of programme circuits to provide a stereophonic transmission.

Note 4. – In revising B. of Recommendation J.31 particular account should be taken of Recommendation H.14.

Note 5. – It would be useful to study, in association with Note 2, a) 3. above, whether means should be provided to ensure that excessive loading is not applied to a group link which is carrying programme circuits.

Two methods seem possible:

a) to incorporate a suitable arrangement within the programme-circuit modulating equipment;

b) to have a separate arrangement which might be of general application where it is considered necessary to protect group links from application of excessively high level signals. This latter arrangement may be of interest to Joint Working Party LTG.

ANNEX 1

Summary of the replies given to Questions 1/XV and 2/XV during the study period 1973-1976

ANNEX 2

Characteristics of equipment and lines to be used for 15-kHz sound-programme circuits for monophonic and stereophonic transmission.

(Contribution from the Federal Republic of Germany)

ANNEX 3

Characteristics of equipments and lines providing for stereophonic sound-programme transmission

(Contribution from France)

Question 2/XV – Limiting values for group-delay distortion of group and supergroup modulating equipment and through-group and supergroup filters

(new Question)

Considering the use of group or supergroup circuits for the transmission of wide-spectrum signals,

1. Is it desirable to issue Recommendations on group-delay distortion limiting values for a pair of group (or supergroup) modulating and demodulating equipment and for through-group (or supergroup) filters?

2. If so, what should these limits be?

Note. – For the study of this Question, Administrations are requested in the first stage to provide information on the characteristics of the equipment used.

So that an immediate start may be made with the comparisons, curves should be specified in microseconds for the frequencies 64, 66, 68, 70, 72, 76, 80, 84, 88, 92, 96, 98, 100, 102 and 104 kHz.

Question 3/XV – Setting-up of 5-kHz type sound-programme circuits

(continuation of Question 3/XV studied in 1973-1976)

Considering,

a) that the CMTT has been asked to study the characteristics of 5-kHz type sound-programme circuits;

b) that, to reply to this Question, the CMTT will have to define a hypothetical reference link together with the characteristics of this hypothetical link at audio-frequencies (e.g. frequency band effectively transmitted, attenuation/frequency distortion, phase distortion, weighted noise, intelligible crosstalk, variation of level, nonlinear distortion, frequency error, etc.);

c) that the constitution of the hypothetical reference circuit for each transmission system and the characteristics to be satisfied between audio-frequency terminals by each hypothetical reference circuit will result from the study mentioned under b) above;

d) that the dynamic characterstics of signals sent over monophonic-programme transmission circuits, and in particular the maximum and the mean power of such signals applied at a point of zero relative level, are being studied in connection with the Study Programme 5D-2/CMTT;

the following points should be studied:

1. *Characteristics at audio-frequencies of the whole or of sections of the hypothetical reference circuit*

1.1 frequency band effectively transmitted;

1.2 relative level of a programme link at the audio-frequency amplifier output (see points D, C, ... in Figure 3/J.13, Volume III);

1.3 impedance-matching conditions;

1.4 allocation of the general conditions specified by the CMTT;

1.5 nonlinearity limits for the various sections of the hypothetical reference circuit;

1.6 what usable power reserve should the circuits have?

2. *Characteristics of a sound-programme circuit-section of the hypothetical reference circuit provided by a carrier transmission system*

2.1 maximum number of sound-programme channels per group;

2.2 frequency positions of the sound-programme channels in the group and of the remaining telephone channels, if any;

2.3 relative level of the sound-programme transmission circuit in the group, compared with the relative level of the telephone channels;

2.4 permissible variation in relative level with time;

2.5 permissible carrier leaks in the frequency band of the sound-programme channel and provisions required to meet this requirement;

2.6 permissible frequency error at the end of a sound-programme circuit – section and measures required to meet this requirement;

2.7 provisions required to meet noise and crosstalk conditions (pre-emphasis, compandor, frequency position).

Note 1. – The attention of Joint Study Group CMBD is drawn to points 2.3 and 2.7.

Note 2. – It is important to consider the cost of the modulating equipment to provide the circuits in relation to the number of speech channels displaced and the cost of providing the group link.

ANNEX

Reply given to Question 3/XV during the study period 1973-1976

Question 4/XV – Visual telephone service

(continuation of Questions 4/XV and 5/XV studied in 1973-1976)

(of interest to Study Group XVIII)

Considering,

a) that a number of Administrations are examining the possibilities for the future introduction of a visual telephone service;

b) that experiments and trials of such a service are in progress in a number of countries;

c) that the scale of demand has not yet been established;

d) that differing facilities may be required by different classes of subscribers, but these have not yet been clearly identified and defined;

e) that the possibility of international use must be a basic feature of any such service;

f) that the problems of international working will be easier to resolve if they are studied while national plans are still in a preliminary and formative stage, *the following points should be studied:*

1. How should the visual telephone service be defined and what facilities should be offered?

2. What characteristics should be recommended for the subscribers' terminals?

3. What system of architecture should be recommended for the visual telephone system?

4. What transmission standards should be recommended for international links in a visual telephone connection?

5. What characteristics should be recommended for the signalling and switching systems for visual telephone transmission in the international network?

Note 1. – The results obtained from studies carried out between 1973 and 1976 and a Study Programme for the study period 1977-1980 are given in Annex 1. Annex 2 is a contribution from the United Kingdom Post Office.

Note 2. – The most important conclusion of the studies in the study period 1973-1976 is that the video standards (scanning, format, etc.) of the subscriber sets should be compatible with, if not identical to or readily convertible to, the local broadcast television standards.

ANNEX 1

Visual telephone service

ANNEX 2

An evolutionary visual telephone service

(Contribution from the United Kingdom Post Office)

Question 5/XV – Automatic identification and removal from service of faulty circuits in the international network

(new Question)

(of interest to Study Groups IV and XI)

Considering that the quality of service would be improved by the provision of automatic means of rapidly detecting faulty circuits and their removal from service as long as a fault persists, what contribution to this aim can usefully be made by provisions in transmission systems?

Note 1. – The operational reasons for setting this objective are given in Annex 1.

Note 2. – The study of this Question should be conducted along the lines indicated in Annex 2.

Note 3. – Annex 3 contains the views of Study Group IV expressed during the study period 1973-1976.

ANNEX 1

Observations made by Study Group XI in the course of the Study Period 1973-1976

ANNEX 2

Report by the Special Rapporteur during the study period 1973-1976

ANNEX 3

Automatic circuit busying derived from the group reference pilot

Question 6/XV – Intelligible crosstalk on international circuits

(new Question)

(to be studied in cooperation with Study Groups XII and XVI)

To what extent do transmission equipments and cables, both existing and of modern manufacture, allow the minimum ratio of intelligible crosstalk between telephone circuits, as defined in Recommendation G.151, D. to be raised from the value of 58 dB now recommended?

Study Groups XII and XVI have suggested, as a result of their studies of Questions 11/XII and 1/XVI, c) during the Study Period 1973-1976, that it would be desirable to replace the value of 58 dB by 65 dB.

Particular attention should be given to crosstalk in translating equipments, line equipments and bearer media, i.e. symmetric- and coaxial-pair cables, open-wire lines etc., and to the revision of relevant Recommendations affected by a change in Recommendation G.151, D.

Note 1. – Study Group XV proposes to carry out the study of intercircuit crosstalk on the assumption that there is no accumulation of intelligible crosstalk from separate crosstalk paths associated with the same disturbing circuit. Therefore the limit applicable to intercircuit crosstalk may be entirely allocated to each crosstalk path.

Note 2. – For at least some of the possible sources of crosstalk it may be necessary to balance significant additional costs of meeting a more stringent specification against consequential benefits in network performance. In order to enable a proper judgement in these cases Study Group XV hopes for an updating by Study Groups XII and XVI of Recommendation G.116 and its Annex. This updating should be based on the results of the studies of Questions 11/XII and 1/XVI, c) during the Study Period 1973-1976 which led to the suggestion for a new limit of 65 dB.

Note 3. – The assistance of Study Group XVI is also requested for the study of limits for go-return crosstalk on circuits used with speech concentrators, i.e. cases where go-return crosstalk must be considered equivalent to intercircuit crosstalk. What hypothetical reference connection for crosstalk should be assumed? What noise sources should be assumed to exist within this connection?

Question 7/XV – Battery power supply

(continuation of Question 11/XV studied in 1973-1976)

What recommendations should be made relating to battery supply installations and to noise at the terminals of these installations?

The following points should be taken into consideration:

a) the results of the studies of Question 11/XV, c) for the Study Period 1973-1976 (see Supplement No. 13 to Volume III, "Noise at the terminals of the battery supply");

b) with the introduction of digital techniques, both for transmission and for switching, a common approach to battery supply arrangements appears highly desirable;

c) there could be technical and economical advantages if unification in specifications for battery power supplies and the noise at their terminals could be obtained at an international level.

Question 8/XV – Interconnection of sound-programme circuits in the basic group

(continuation of Question 8/XV studied in 1973-1976)

Considering that some Administrations are thinking of interconnecting sound-programme circuits in the frequency band which these circuits occupy in the basic group, what procedure should be recommended to carry out this interconnection method?

Note 1. – In particular, if this method is used the insertion of several high-frequency compandors in tandem and one demodulator-modulator can be avoided when sound-programme transmissions use group links in tandem.

Note 2. – Advantages will primarily be:

1. reduction of the nonlinear distortion due to audio-frequency equipment;
2. reduction in modulation noise.

Note 3. – In 1972 Study Group XV noted that no Administration envisaged interconnecting 10-kHz type programme circuits unaccompanied by telephone circuits in the frequency band of the basic group. There is therefore no need to continue the investigation of Question 8/XV as far as this type of circuit is concerned.

With regard to 15-kHz type sound-programme circuits, Recommendation J.31 already contains some clauses concerning this method and states, in particular, that the use of normal through-group filters is generally satisfactory. However, it would be of interest to study whether this function could be fulfilled by the filters at present being studied for the through connection of broadband circuits for data transmission. These have a slightly narrower passband than through-group filters for telephony, give a smaller phase distortion and are more simply designed.

ANNEX

Reply given to Question 8/XV during the study period 1973-1976

Question 9/XV – Crosstalk from a sound-programme circuit into a telephone circuit

(continuation of Question 9/XV studied in 1973-1976)

The limit for crosstalk ratio from a sound-programme circuit into a telephone circuit is given as 58 dB (for cable circuits) in Recommendation J.22. Annex 1 to Question 9/XV (Study Period 1973-1976, pages 639-642 of Volume III.3 of the *Green Book*) indicates that this limit is inadequate to ensure an acceptable degree of immunity against disturbing crosstalk interference. Can a higher limit be recommended for this crosstalk ratio? Annex 2 to Question 9/XV (Study Period 1973-1976; pages 642-651 of Volume III-3 of the *Green Book*) gives some information concerning crosstalk mechanisms arising within FDM systems.

The Annex to this Question gives the results of the studies carried out in the Study Period 1973-1976.

Note. – The frequency offset adopted for some sound-programme equipments allows a reduction of crosstalk from a telephone circuit into a sound-programme circuit. However in the reverse direction, this reduction of crosstalk remains only for speech material, but is practically ineffective for music material.

ANNEX

Reply given to Question 9/XV during the study period 1973-1976

Question 10/XV – Echo suppressor improvements, new methods of controlling echo, and testing methods

(continuation of Question 10/XV studied in 1973-1976)

a) Considering that voice-operated devices of the general type covered by Recommendation G.161 may be further improved:

What improvements may be made by modifying the break-in characteristics in situations when minimum echo-path losses greater than 6 dB can be assured?

b) Considering that voice-operated echo suppressors of the general type covered by Recommendation G.161 may be implemented using digital techniques:

What should be the operating characteristics of such echo suppressors? Specifically, to what extent may departures from the operating values given in Recommendation G.161, B. be desirable in order to take advantage of digital techniques to produce echo suppressors which are, for example, cheaper, more easily maintained and subjectively more acceptable, while ensuring compatibility among different types of echo suppressors?

The Annexes to this Question describe two digital echo-suppressor implementations, the points of departure of these echo suppressors from Recommendation G.161 and the reasons for this, and the subjective tests used to evaluate these echo suppressors.

c) Considering that new and improved means of controlling echo, including adaptive echo cancellation, may be feasible in the future and may provide better service to subscribers using circuits that involve such means:

What new and improved devices and methods for controlling echoes should be recommended? [Refer also to Question 6/XII, d)].

d) Considering that knowledge of echo paths is important to the study of echo cancellers:

1. What is the distribution of echo return losses in various national networks as defined in Recommendation G.122?

2. What are the characteristics of echo-path impulse responses in various national networks? It is desirable that impulse response information should be of the type illustrated by Figure 1. However, information other than that of Figure 1 is welcome, if in the opinion of any Administration, it is pertinent to the design of echo cancellers.

3. What time variability and nonlinearity are present on echo paths in various national networks?

e) Considering that efficient laboratory testing techniques are needed for echo-control device evaluation:

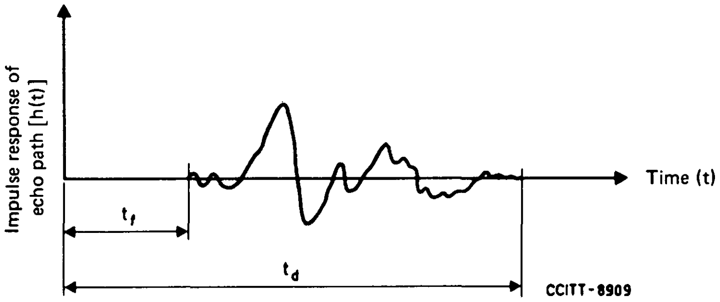
What objective and subjective measurement techniques should be recommended for echo-control devices in order to accurately predict and be assured of their subjective performance in service?

Note. – e) is connected with the study of a) of Question 6/XII.

ANNEX 1

Performance evaluation of an echo suppressor using digital logic control functions

(Contribution from COMSAT)



h(t) = impulse response of the echo path
t_f = the time between the application of an impulse and the first instant at which the returned echo exceeds a threshold
t_d = the time between the application of an impulse and the last instant at which the echo exceeds a threshold

Desired Information:

1. t_f
2. t_d
3. $\int_{t_f}^{t_d} h^2(t)dt$
4. Description of the test signals used to obtain the impulse response. Only those frequencies transmitted by the overall connection can contribute to the echo heard by the distant subscriber. This fact should be taken into account in deciding the test signal used.
5. Thresholds used to determine t_f and t_d.
6. Relative levels (dBr) of the points *a* and *b* of the *a-t-b* path (see Recommendation G.122).

FIGURE 1

ANNEX 2

Digital common control echo suppressor

(Contribution from American Telephone and Telegraph Company)

ANNEX 3

Digital echo suppressor

(Contribution from France)

Question 11/XV – Unwanted modulation and jitter of signals

(continuation of Question 11/XV, studied in 1973-1976)

1. What recommendations are required to limit the amount of unwanted modulation and phase jitter acquired by signals sent over transmission systems?

2. What are suitable measuring methods for equipments and circuits?

Note 1. – The results of the studies under Question 11/XV (Study Period 1973-1976, "Interference at harmonics of the mains frequency") in particular Recommendation G.229, Supplement No. 13 and Annexes 1 and 2 to this Question should be taken into account.

Note 2. – There are sources of interference other than the mains supply causing unwanted modulation or jitter (e.g. noisy carrier generators).

Note 3. – Recommendation G.151, G. gives limits for telephone circuits, and Recommendation J.21, 3.1.7 for sound-programme circuits, of the highest unwanted side component causing spurious modulation.

Note 4. – Recommendation H.12, 3.7 gives a provisional guide for the tolerable phase jitter on a leased circuit (telephone type).

Note 5. – The requirements of the various services carried by transmission systems should be taken into consideration. (Telephony, data, telegraphy, sound-programme transmission, etc.). It is expected that, at least in some cases, the total amount of unwanted modulation is of interest.

Note 6. – Since the limits for phase jitter are at the present time not well defined, the study of this Question might usefully be started by carrying out phase jitter measurements on items of equipment. Study Group IV has a Question relating to phase jitter on telephone-type circuits, and on groups and supergroups. These results should be taken into account.

Note 7. – The results of these studies are of interest to Study Group XII, and in particular to Joint Working Party LTG and CMTT regarding the overall performance (e.g. hypothetical reference circuits). Any conclusions of Study Group XV should therefore be submitted to the above groups for comments.

Note 8. – Recommendation O.91 describes a phase jitter meter applicable to telephone-type circuits. However it is unlikely that this instrument can be used in its present form for measurements on individual items of equipment (translating equipment for example).

ANNEX 1

Method of measuring unwanted side components

ANNEX 2

Other sources of unwanted modulation

(Contribution from the United Kingdom Post Office)

Question 12/XV – Interfering frequencies on telephone channels and wideband group, supergroup, etc. circuits

(continuation of Question 12/XV, studied in 1973-1976)

Considering

a) that certain frequencies may appear in the band of a group, supergroup, etc., which, if they are multiples of 4 kHz, will cause no interference to telephone channels with such a spacing;

b) that harmonics of frequencies which are not a multiple of 4 kHz, such as group and supergroup reference pilots, may cause interference in telephone channels and wideband circuits;

c) that 3-kHz spaced channels as well as wideband services may also suffer interference from frequencies which are a multiple of 4 kHz;

d) that certain sources of interference such as d.c./d.c. converters, fluorescent lighting, electromagnetic radiation from broadcasting transmitters as well as from adjacent transmission equipment, may cause disturbances in telephone channels and/or wideband circuits;

e) that it is desirable to place a limit on the level of such interference;

f) that the results of preceding studies culminated in the issue and/or amendment of Recommendations G.232, G.233 and G.235 to that effect for carrier leaks, etc.,

the following points should be studied:

1. What Recommendations are required for any carrier leaks, harmonics of carriers, harmonics of pilot signals which are not (or are only provisionally) covered by existing Recommendations?

2. Is it desirable to fix similar limits for interfering frequencies of different origin?

3. If so, what should these limits be?

4. What degree of exposure to interference (e.g. field strength) should reasonably be assumed in order that transmission requirements are met?

5. What are suitable methods for the measurement of electromagnetic interference (e.g. field strengths)?

Note. – Attention is drawn to the following points:

- Recommendation H.14, B. and C. (revised 1976);
- reference connection defined by Joint Working Party LTG, (see the revised Annex to Question 28/XV);
- Question 19/V: "Effects of radio station emissions on telecommunication circuits".

ANNEX 1

Cumulation effects on carrier leaks

(Contribution from the Federal Republic of Germany)

ANNEX 2

Extract from Study Group XV's reply to Question 12/XV for the Study Period 1973-1976

ANNEX 3

(Contribution from Italy)

Question 13/XV – Target design values for noise in terminal equipments

(continuation of Question 13/XV studied in 1973-1976)

What recommendations should be made for the noise design objectives of terminal equipments other than those covered by Recommendation G.222, d)?

Note. – Such equipment may include active through-connection filters, equalizing equipment, additional regulating equipment, standby switching equipment, etc. These items are not explicitly defined in the hypothetical reference circuits, as they do not necessarily form part of them, but they may nevertheless be present in an actual circuit. Aspects of standby switching equipment are also studied under Question 9/IV.

ANNEX

Noise contributed by through-connection and equalizing equipment

(Contribution from the U.S.S.R. Administration)

Question 14/XV – Limiting values for the group-delay distortion for a pair of channel transmitting and receiving equipments of one terminal equipment

(continuation of Question 14/XV studied in 1973-1976)

Considering,

a) that the channel translating equipment causes most of the group-delay distortion found in a telephone circuit;

b) that Recommendation G.232 gives limiting values for the group-delay distortion of the channel translating equipment in the band 400-3000 Hz;

c) that the maximum group-delay distortions at the limits of the band for the individual equipment may add up to values in the chain of circuits of a complex worldwide connection which exceed those defined in Recommendation G.133 [see d) of Annex 2 to this Question];

the following points should be studied:

1. Is it desirable to recommend limiting values for the group-delay distortion at the edges of the transmission band of a pair of channel transmitting and receiving equipments?

2. If so, what values should be recommended and for which frequencies?

Note. – Annexes 1 and 2 describe the status of the studies at the end of the Study Period 1973-1976. Annex 1 lists points referred by Study Group XV to Study Groups XII and XVI requesting information essential for a complete answer to this Question.

ANNEX 1

Results of the studies of Study Group XV in the Study Period 1973-1976 concerning group-delay distortion requirements at the edges of the VF band

ANNEX 2

Information received from Study Group XVI (final meeting, November 1975) for the study of Question 14/XV

Question 15/XV – Line regulators, group regulators, etc.

(continuation of Question 15/XV, studied in 1973-1976)

What recommendations should be met by line regulators, group regulators, supergroup regulators, etc., from the standpoint of:

a) the dynamic stability of a link,

b) protection against noise, short-term outages and disturbing signals?

Note 1. – For this study, it was considered necessary to examine the following points, on which Administrations are invited to supply any relevant information:

1. During switchovers or other short-term disturbances, what conditions should be met by telephone-type channels or wider-band channels?

What objective is contemplated for the length of an outage until the resumption of normal service?

What error levels can be tolerated in such a case; i.e., in what range of levels is service considered to be restored?

2. What is the present or intended practice for switchover in the event of outages of line links, regulated line-sections or parts thereof?

What changes in level are liable to occur?

Is the line-regulating pilot involved?

Do such modifications (if they occur) have a lasting or transient effect?

3. Same question for group, supergroup, etc. links, cable systems and radio-relay systems.

4. What regulation difficulties, if any, have been observed in the interconnection of different systems, resulting from any differences which may exist between the basic designs applied by the engineers who built each of the systems (e.g. regulation rate, envelope gain)?

Note 2. – The study of *a)* above should make it possible to produce a more precise amended version of the clause in Recommendation G.214 relating to the dynamic stability of the line-regulating system for cable systems.

Note 3. – For *b)* above, the aim will be to determine what the sensitivity of group and supergroup regulators should be with respect to steady-state or transient interfering signals, such as signalization, wide-spectrum data or facsimile-signal components in the vicinity of the pilot (see Recommendation H.52). In particular N. c) 1. of Recommendation G.232 and 1. of Annex 2 of Recommendation G.232 and d) of Recommendation G.242 should be re-examined.

Note 4. – Annex 1 contains the results of the studies conducted between 1968 and 1976, together with a programme of work for the Study Period 1977-1980. Annex 2 summarizes some of the information supplied by Administrations during the Study Period 1973-1976.

ANNEX 1

General objective for regulated-line sections and group (supergroup, etc.) regulators

ANNEX 2

Summary of the main results contained in the contributions supplied by Administrations in the study period 1973-1976

Question 16/XV – 10 800 channels on 2.6/9.5-mm coaxial pairs

(continuation of Question 16/XV studied in 1973-1976)

In what way should Recommendations G.623 and G.333 be amended to bring to 10 800 the number of circuits that can be transmitted on 2.6/9.5-mm, or equivalent, coaxial pairs?

Note. – Annexes 1 and 2 list various points to be studied for each of the these Recommendations, respectively.

ANNEX 1

Points to be studied in connection with the revision of Recommendation G.623

ANNEX 2

Points to be studied in connection with the revision of Recommendation G.333

ANNEX 3

Proposals by the French Administration for values to be inserted in point A. c) 3. of Recommendation G.623

Question 17/XV – New 2.6/9.5-mm coaxial pair designs

(new Question)

In view of technical developments, it would seem useful to consider the various manufacturing processes for coaxial pairs capable of meeting the electrical requirements specified in Recommendation G.623 particularly for the 12-MHz and 60-MHz systems dealt with in Recommendations G.332 and G.333 respectively, and to amend Recommendation G.623 accordingly.

Annexes 1 and 2 describe the coaxial-pair types which meet this purpose.

ANNEX 1

Construction of 2.6/9.5-mm coaxial pair

(Contribution from Canada – Bell Northern Research)

ANNEX 2

Method of constructing a pair similar to a 2.6/9.5-mm pair

(Contribution from the French Administration)

Question 18/XV – Cables for systems with more than 10 800 channels

(continuation of Question 18/XV studied in 1973-1976)

What types of cable could be standardized by the CCITT for the transmission of very large carrier systems (more than 10 800 circuits) or for other services using a wide frequency band for analogue transmission?

Note 1. – This Question also concerns the amendments required to those Recommendations on the pairs used for 10 800 channel systems; waveguides are excluded.

Note 2. – The Annex indicates the type of information to be furnished for study of this Question

Note 3. – This Question is to be studied in conjunction with Question 35/XV, c) 1.

ANNEX

Information to be furnished for study of the cables

Question 19/XV – Analogue systems with more than 10 800 channels

(continuation of Question 19/XV studied in 1973-1976)

a) Is it desirable to study an anologue system with at least twice the bandwidth of the 60-MHz system?

b) If so, the following points should be studied:

1. What should be the transmission bandwidth and the number of telephone channels of such a carrier system?

2. What frequency plan could be recommended for such a system set up on coaxial pairs?

3. What kinds of new modulation stages (e.g. quinary groups – see Question 21/XV) should be recommended?

4. What should be the possibilities of connection to the 60-MHz system?

5. What further characteristics of this new system and the new modulation stages should be defined, e.g. pilots, additional measuring frequencies or other characteristics in accordance with existing Recommendations?

Note 1. – The frequency plan should offer the possibility of mixed operation of telephone and television channels.

Note 2. – The standardization of an appropriate new coaxial pair should be performed within the framework of Question 18/XV.

Note 3. – It is necessary to investigate a hypothetical reference circuit for such a system.

Note 4. – Such systems will have to interwork closely with the existing systems of the coaxial cable network and take into account the present standardized characteristics.

Question 20/XV – Television transmission on 60-MHz systems

(continuation of Question 20/XV studied in 1973-1976)

Considering,

that the 60-MHz coaxial-pair system may be used to perform wideband services such as carrying the colour television signals defined by the CCIR;

and that it is desirable in this case to use the same repeaters as when telephone signals only are transmitted,

what complementary recommendations should be issued as regards the line (cables and repeaters) and the terminal translating equipments?

Note 1. – The following points should be considered in particular:

a) What line-frequency allocation should be recommended for the transmission of television signals only and simultaneous telephony and television?

b) Which is the better method of video-frequency translation, direct modulation or premodulation? If it is better to adopt the premodulation method, what should be the carrier frequency?

c) What should be the recommended modulation method and what should be the recommended value of the relative power level of the television signal?

d) what pre-emphasis characteristic should be used for the video signal?

e) what conventional test signal should be considered at the video band input, particularly for transmission of colour signals?

Note 2. – Annex 1 gives the reply to Question 20/XV for the Study Period 1973-1976.

Note 3. – Annex 2 gives some proposals by NTT and Annex 3 gives some remarks by the Federal Republic of Germany for a field trial of TV transmission on a 60-MHz system.

Note 4. – e) should be studied in cooperation with Joint Study Group CMTT (under the auspices of the CCIR) (see Report 643 from the CMTT and CCIR Recommendations 421-3 and 451-2).

ANNEX 1

Reply to Question 20/XV

(Study Period 1973-1976)

ANNEX 2

Television transmission over 60-MHz systems

(Contribution from NTT)

ANNEX 3

Television transmission on 60-MHz systems

(Contribution from the Federal Republic of Germany)

Question 21/XV – Use of a quinary group

(continuation of Question 21/XV, studied in 1973-1976)

Considering,

a) that modern coaxial cable systems for 300, 960, 2700 and 10 800 telephone channels have been standardized by the CCITT and that in the future, analogue systems with even larger bandwidths seem to be possible;

b) that it is necessary in the telephone network to through-connect smaller and larger groups of channels between systems of the same or different channel capacities;

c) that the achievement of the objective mentioned in b) above requires a through connection via modulation stages in the defined basic group, basic supergroup, basic mastergroup and basic supermastergroup or a direct through-connection of blocks of channels in the line transmission position in accordance with Recommendation G.242;

d) that, in the case of a future extension of the transmission capacity of coaxial cable systems (more than 10 800 channels), it will certainly be necessary to introduce a new modulation stage (quinary group):

e) that mainly 12-MHz systems in accordance with Recommendation G.332 should be used as short-haul systems working into a 60-MHz network;

f) that, in the 60-MHz system, it is intended to provide not only frequency plans for telephony but also frequency plans for television and for both telephony and television (Question 20/XV), *the following question should be studied:*

1. Is it advisable to introduce a basic quinary group for modulating and through-connecting purposes in the 60-MHz system?

If so, how should this basic quinary group be built up?

Note. – Quinary groups will also have to be studied within the framework of Question 19/XV in the case of systems with more than 10 800 channels.

2. What alternative to the present frequency plans for the 60-MHz system is recommended, if a basic quinary group is introduced?

3. What different possibilities should be recommended for the indirect and direct through-connection between:

– 12-MHz system and 60-MHz system,

– 60-MHz system and 60-MHz system,

– 60-MHz system and a system of higher order?

Note. – The Annex reproduces a contribution to the study of the Question.

ANNEX

Translating procedure and line-frequency allocation for the 60-MHz system and FDM systems with frequencies above 60 MHz

(Contribution from NTT)

Question 22/XV – Analogue systems with more than 10 800 channels on 2.6/9.5-mm coaxial pairs

(new Question)

Considering,

a) that progress in technology may permit an extension of the bandwidth of the 60-MHz system already recommended by the CCITT on the 2.6/9.5-mm coaxial pair;

b) that due to this progress it may be expected that, although the bandwidth will be extended, the spacing of the repeaters will be the same as in the 60-MHz system:

c) that for this reason the extension of bandwidth would result in an increase in the number of telephone channels provided and, therefore, more economic use of the existing 2.6/9.5-mm coaxial pair network may be expected;

d) that such possible systems have to interwork closely with the existing systems of the coaxial cable network,

1. Is it desirable to study such systems and to make relevant Recommendations?

2. If so, what should be the characteristics of such systems?

Note 1. – In particular, the following points should be considered:

1. transmission bandwidth;

2. frequency plan and number of telephone channels and/or television channels;

3. pilots, additional measuring frequencies;
4. noise performance, hypothetical reference circuit;
5. interconnection with other coaxial cable systems.

Note 2. – Attention is drawn to the studies carried out under Questions 19/XV, 20/XV and 21/XV.

Note 3. – Annex 1 gives a Contribution from the American Telephone and Telegraph Company. Annex 2 is a Contribution from France and Italy.

ANNEX 1

Systems with 13 200 channels on 2.6/9.5-mm coaxial pairs

(Contribution from the American Telephone and Telegraph Company)

ANNEX 2

Comments on Question 22/XV (5. of Note 1)

(Contribution from France and Italy)

Question 23/XV – Analogue systems with more than 2700 channels on recommended coaxial pairs

(new Question)

Considering,

a) that progress in technology may permit an extension of the bandwidth of the 12-MHz system already approved by the CCITT on recommended coaxial pairs;

b) that due to this progress it may be expected that, although the bandwidth will be extended, the spacing of the repeaters might be the same as in the 12-MHz system;

c) that for this reason, the extension of bandwidth would result in an increase in the number of telephone channels provided and, therefore, more economic use of the existing coaxial pair network may be expected;

d) that such possible systems have to interwork closely with the existing systems of the coaxial cable network,

1. Is it desirable to study such systems and to make relevant recommendations?
2. If so, what should be the characteristics of such systems?

Note 1. – In particular, the following points should be considered:

1. transmission bandwidth.
2. frequency plan and number of telephone channels and/or television channels.
3. pilots, additional measuring frequencies.
4. noise performance, hypothetical reference circuit.
5. interconnection with other coaxial systems recommended by the CCITT.

Note 2. – Attention is drawn to the studies carried out under Questions 19/XV, 20/XV and 21/XV.

Note 3. – A contribution from France and Italy is annexed.

ANNEX

Comments on Question 23/XV (5. of Note 1)

(Contribution from France and Italy)

Question 24/XV – Return loss of analogue transmission equipment

(new Question)

(of interest to Study Group XVI)

Considering,

a) that Recommendation M.640, B.e) provides that "the impedance at the access points" (for line and 4-wire circuit measurements) "should have a return loss against the nominal impedance of the measuring apparatus of the station (for example 600 ohms, non-reactive) of not less than 20 dB over the range of 300-3400 Hz and not less than 15 dB over the range 300-600 Hz."

b) that Study Group XVI has recommended a study of the possibility of improving the return loss at low frequencies of equipment likely to be connected to the "access points concerned" (see the new wording of Question 9/XVI, 3. of Annex 1).

The following points should be studied:

1. Should a provision establishing tolerances for the impedance at the audio-frequency sending and receiving terminals of channel translating equipments be inserted in Recommendation G.232, M.?

2. If so, what limits for return loss in relation to the nominal impedance should be recommended in the 300-3400 Hz band?

3. What other Recommendations should be similarly amplified or modified, because they relate to equipments likely to be connected to the "access points" concerned?

Note 1. – The nominal value of this impedance has already been fixed at 600 ohms by Recommendation G.232, M.

Note 2. – A Recommendation already exists for echo suppressors [*Green Book*, Volume III, page 77, Recommendation G.161, B.c) 1.4] and for PCM equipment (Recommendation G.712, 4.2).

Question 25/XV – Unification of the characteristics of telephone-type circuits used for transmission (telegraphy, facsimile, data, etc.)

(continuation of Question 25/XV, studied in 1973-1976)

(to be studied by the Joint Working Party LTG)

Recommendation H.12 mentions the characteristics of leased telephone-type circuits of ordinary and special quality.

The Recommendations in Sections 2, 3 and 4, in Part II of this Volume and Recommendation G.712 specify circuit characteristics which sometimes are slightly different owing to the fact that in the past they were adopted by different Study Groups.

a) Is it possible to unify these characteristics so that finally only one common set of values may be recommended?

b) Is it possible to change the limits fixed for group-delay distortion in Recommendation H.12, B. so as to adapt them better to the characteristics of real circuits, including voice-frequency extension links? It is suggested that the possibility of increasing the tolerance from 0.5 ms to about 1 ms in the 2400-2600-Hz band should be studied.

Note 1. – The study of a) above may be considered to be terminated as far as analogue-type circuits are concerned but should be continued in respect of digital-type circuits. It will therefore be necessary to check whether the existing Recommendations are applicable for any systems providing telephone-type circuits and whether additional characteristics should be specified for circuits containing PCM sections conforming to Recommendations G.711 and G.712.

Note 2. – The attenuation/frequency distortion might be brought into line with the characteristics contained in Recommendation M.580.

Question 26/XV – Unification of certain characteristics of signals transmitted over telephone-type circuits

(continuation of Question 26/XV, studied in 1973-1976)

(to be studied by Joint Working Party LTG)

The Recommendations in Sections 2, 3, 4 and 5 of Part II in this Volume mention different signal characteristics (levels, etc.).

a) Is it possible to introduce the maximum uniformity in these characteristics so that all services other than the telephone service respect the same standards? If so, what would these characteristics be?

b) It is not considered necessary to specify limits for the power of the components at frequencies outside the band 0 to 4 kHz so as to avoid the risk of crosstalk between neighbouring circuits of various types, mainly in the terminal sections of the circuits, generally established on metal cable pairs. This is essentially a national problem; however, such restrictions are of interest to the manufacturers of equipments which may be used in leased circuits. Administrations are therefore requested to provide, for purposes of documentation, contributions indicating the rules which they apply in this connection for both digital and analogue circuits. Annexes 1 and 2 give examples of such rules.

Note 1. – Joint Working Party LTG considered that the best way to define these limits [see b) above] would be to indicate the maximum power levels measured in a 4-kHz band using psophometric weighting.

Note 2. – The study of a) above may be considered to be terminated as far as analogue-type circuits are concerned but should be continued in respect of digital-type circuits. It will therefore be necessary to check whether the existing Recommendations are applicable for any systems providing telephone-type circuits and whether additional characteristics should be specified for circuits containing PCM sections conforming to Recommendations G.711 and G.712.

Note 3. – Question 27/XV deals with the problem of signal power in the telephone circuit band.

ANNEX 1

Out-of-band components accompanying signals applied to voice-band leased circuits

(Contribution from the United Kingdom Post Office)

ANNEX 2

Rule adopted on the French network concerning limitation of the out-of-band power for transmission of signals of services other than telephony

(Contribution from France)

Question 27/XV – Signal power over the band on a telephone-type circuit [1)]

(continuation of Question 27/XV, studied in 1973-1976)

(of interest of Joint Study Group CMBD)

a) Is it desirable to fix a uniform signal power level of – 15 dBm0 (long-term mean over the whole band) for new services (i.e. provided *either* on existing systems fitted with modern equipment *or* on new systems to be standardized by the CCITT in the future) transmitted on telephone-type circuits, in order to prevent overloading of carrier systems and to align the power of non-telephone signals with the conventional load adopted for telephony?

Pending a general reply to a) above, b), c), d) and e) below should be studied.

b) Should the existing Recommendation H.51 be modified in the sense of lowering to – 13 dBm0 the permissible level for data transmission regardless of the type of operation, full-duplex, simplex or half-duplex (1-minute mean power level)?

c) Should the permissible levels for phototelegraph signals, as indicated in Recommendation H.41, be modified?

Note. – In particular, one should consider whether it is possible to lower the level of the frequency-modulated signal from – 10 dBm0 to – 15 dBm0. As concerns amplitude-modulated phototelegraphy, the Annex below describes tests carried out by the International Press Telecommunications Council (IPTC) and gives the opinion of that Organization.

d) Should the permissible levels for black-and-white facsimile signals, as indicated in Recommendations T.10 and T.10 *bis*, be modified?

e) Should the level of the telegraph signal be modified in the case of the system for simultaneous telegraphy and telephony which is the subject of Recommendation H.32?

Note 1. – On existing systems where the limit of – 15 dBm0 cannot be respected, – 13 dBm0 (1-minute mean power level) could be considered an acceptable compromise for data transmission and voice-frequency telegraphy signals, provided this is confirmed by studies being carried out.

Note 2. – This Question also concerns Study Group IX (Question 2/IX), Study Group XIV (Question 5/XIV), Study Group XVII (Question 15/XVII) and Joint Study Group CMBD (Question 1/CMBD).

All these studies should be coordinated within the general framework of Question 1/CMBD (in particular see Annex 1 to Question 1/CMBD).

ANNEX

Peak power for phototelegraph signals

(Contribution from the International Press Telecommunications Council)

Question 28/XV – Characteristics of group or supergroup links for the transmission of wide-spectrum signals

(continuation of Question 28/XV, studied in 1973-1976)

(to be studied by Joint Working Party LTG)

Recommendations H.14 and H.15 contain some provisional characteristics of group or supergroup links for the transmission of wide-spectrum signals (data, etc.).

What characteristics should be specified for these links and what values should be recommended for these characteristics?

[1)] To be studied first by all Study Groups concerned and then by Joint Working Party LTG which would then submit proposals to Joint Study Group CMBD (Question 1/CMBD).

In particular, how should other groups within the modulating equipment be protected against interfering frequencies penetrating the local line which carries the wide-spectrum signal?

In what way on the other hand should the transmission of speech channels out of adjacent groups into the local line be prevented?

Note 1. – The study of this Question should be continued in order to make any revision that may be required in Recommendation H.14. Administrations are especially invited to supply contributions on the characteristics of non-corrected group links. The Italian Administration has already furnished measurement results which are shown in Annex 1. See also Recommendation J.31, B., the study of which is being continued in connection with Question 1/XV.

Note 2. – A study should also be made of the characteristics of group links used with the systems referred to in Recommendation X.40, Volume VIII.2. Annex 2 contains a proposal on this subject.

Note 3. – With the present equipment specifications, problems could arise from carrier leaks in certain cases of group links, in particular for the transmission of data. Therefore Study Group XV, at its final meeting, has modified the specifications of Recommendation G.232, E. at the request of Joint Working Party LTG. Joint Working Party LTG should confirm that the modifications are acceptable.

Note 4. – Annex 3 gives the summary of the studies of Question 28/XV during the Study Period 1973-1976.

ANNEX 1

Wideband data transmission tests

(Contribution from Italy)

ANNEX 2

Group-delay equalization of group links used for data transmission

(Contribution from the Federal Republic of Germany)

ANNEX 3

Summary of the studies during the study period 1973-1976

Question 29/XV – Characteristics of wide-spectrum signals to be transmitted over group or supergroup circuits

(continuation of Question 29/XV, studied in 1973-1976)

(to be studied by Joint Working Party LTG)

a) Recommendations H.52 and H.53 give the provisional characteristics for these signals; they should therefore either be confirmed or modified and completed.

b) What measurement technique should be used to ensure observance of the provision concerning the limitation of the power spectrum of wideband data signals outside the 60-108 kHz range, e.g. −73 dBm0p in any 4-kHz band?

Note. – If the residual spectrum is not uniform over a bandwidth in the order of 4 kHz, there is a problem of evaluating the psophometric noise power by means of commercial selective power level meters with a bandwidth other than 4 kHz.

c) Recommendation H.52, b) gives limits for the signal power outside the band 60-108 kHz. Is it permissible to allow lower requirements for some particularly stable, discrete frequencies?

Note. – Such frequencies are related to clock and carrier frequencies used by the terminal equipment.

Question 30/XV – Equipment of high-capacity submarine cable systems

(new Question)

Recommendation G.371 was formulated on the basis of experience with the development of submarine cable systems of very small capacity compared with the capacity of systems being developed at the present time, e.g., systems approaching 25-MHz bandwidth in each direction of transmission.

How should the Recommendation be amended so that it may be applied to submarine cable systems of all capacities, envisaged as well as existing?

Note 1. – Annex 1 gives, as a basis for study, some proposals on the revisions now considered necessary.

Note 2. – Annex 2 sets forth the reasons for undertaking this study.

ANNEX 1

Proposals for the amendment of Recommendation G.371 to take account of large-capacity systems, i.e., up to about 25 MHz

(Contribution from Cable and Wireless Ltd., ITT and United Kingdom Post Office)

ANNEX 2

Reasons for the amendment of Recommendation G.371

(Contribution from the French Administration, CIT-ALCATEL and Câbles de Lyon)

Question 31/XV – Submarine cables and systems

(continuation of Question 31/XV, studied in 1973-1976)

Recommendation G.631 specifies certain characteristics of submarine cable used at great depths in order to restrict the proliferation of different types of cable and hence to facilitate maintenance.

These specifications are confined to cables used for systems with line frequencies not exceeding 45 MHz.

How should Recommendation G.631 be amended and/or supplemented to cover systems using frequencies above 45 MHz?

Note. – In the study of this Question, it would be useful to keep up to date the information received concerning the characteristics of existing cable types and the possibilities of jointing different types of cable, which appear in the Annex below.

ANNEX

Submarine cables [2)]

[Report of Mr. Blanchi (France), Special Rapporteur; study period 1968-1972]

Question 32/XV – Definition of the reliability of a transmission system and objectives

(continuation of Question 32/XV, studied in 1973-1976)

a) How may the reliability of a transmission system be defined?

b) What availability and reliability objectives should be recommended for cable transmission systems?

Note 1. – Study of this Question should take note of the following:

a) the reliability definition should be readily applicable to all types of transmission systems, not only cable systems;

b) means of measuring system reliability characteristics and describing the results are required;

c) means of combining the individual reliabilities of systems operating in tandem to provide an overall reliability for the combination are required.

Note 2. – When answering b) above Administrations will have the opportunity of providing, if possible, the following minimum information:

- characteristics considered (failure rate, down-time, etc.);
- attribute of considered characteristics: observed, estimated, extrapolated and predicted (IEC Publication 271, 2nd Edition, 1974);
- classification and evaluation of failures;
- classification and evaluation of interruptions;
- environmental conditions;
- system characteristics (repeater spacing, depth of laying, type of equipment, capacity, feeding, redundancies, etc.);
- date of construction of equipment and date of installation of system;
- date of data collection;
- maintenance criteria: preventive, corrective, controlled.

ANNEX 1

Report from the Reliability Working Party for the study period 1973-1976

ANNEX 2

Report from Mr. G. Lajtha (Hungary), rapporteur on reliability in 1968-1972

2) This Annex has been up-dated with the informations received during the study period 1973-1976.

Question 33/XV – Reliability of transmission systems

(continuation of Question 33/XV, studied in 1973-1976)

How may availability and reliability objectives be best achieved for cable transmission systems?

Note. – Study of this Question should take note of the following:

a) system design factors – repeater spacing, etc.;

b) emergency provisions – standby power arrangements, automatic line switching, provision of spare transmission lines, etc;

c) as maintenance of cable systems is studied by Study Group IV, a common programme should be developed by both Study Groups (XV and IV) on the best means of achieving availability and reliability objectives;

d) the CCITT should confine itself in the first instance to preparing Recommendations on customer-to-customer objectives for each service, each service objective subdivided no further than into allocations for switching systems and transmission systems. These Recommendations are the subject of Question 2/CMBD for the overall objectives and Question 32/XV for the objectives of transmission systems.

Nevertheless, it will be useful to assemble information on particular arrangements and reliability parameters adopted in the design of cable transmission systems and contributions are invited.

A decision will be taken at a later date as to the way in which this information might be used in formulating Recommendations or included in other CCITT Publications.

Question 34/XV – Return loss at the input and output of modulators

(new Question)

Recommendation G.233, g) sets a limit to the return loss at the input and output of mastergroup and supermastergroup modulators and basic 15-supergroup assembly modulators.

1. Should similar Recommendations be issued for the demodulators and through-connection filters which constitute, together with the modulators, the corresponding "through-connection equipment"?

If so, what limit values should be recommended?

2. Should limits also be fixed for the return loss at the input and output of modulators, demodulators and through-connection filters forming part of group and supergroup through-connection equipments?

Question 35/XV – Cable characteristics for digital transmission

[continuation of Question 13/D (22/XV), studied in 1973-1976]
(of interest to Study Group XVIII)

a) *General characteristics*

What electrical characteristics and methods of measurement should be considered on factory lengths and already-installed sections of cables for digital transmission? (See Annex 1.)

Note. – Consideration should be given to the various possible bit rates and to the effect of the structure of the line codes.

b) *Standardized cables*

1. *Coaxial pairs*

1.1 What measurements should be made on the standardized coaxial pairs already installed to determine if it is feasible to use them for digital transmission? (See Annex 1.)

1.2 What changes or amendments are required to Recommendation G.623 (2.6/9.5 mm) to take account of digital transmission? (See Annex 2.)

1.3 What changes or amendments are required to Recommendation G.622 (1.2/4.4 mm) to take account of digital transmission? (See Annex 2.)

1.4 What changes or amendments are required to Recommendation G.621 (0.7/2.9 mm, provided for digital transmission)?

2. *Symmetrical pairs*

Considering the work of Study Group XVIII on digital transmission systems, are any changes in Recommendation G.611 required?

c) *New cables*

1. Are further new Recommendations required for new types of coaxial cable; if so should only those cables be specified which can be used both for analogue and digital transmission? (See Annex 3.)

2. What changes or amendments are required to Recommendation G.612 covering symmetrical pair cables for the transmission of digital system with bit rates of the order of 6-34 Mbit/s?

Studies should be pursued with a view to finding a new measurement method and reducing the number of types of cables.

Annex 4 contains proposals for new methods of measuring crosstalk.

ANNEX 1

Characteristics of coaxial-pair cables for digital transmission

ANNEX 2

Draft Recommendations on 2.6/9.5-mm and 1.2/4.4-mm coaxial pairs for digital transmission

ANNEX 3

New types of coaxial cable for high bit-rate digital transmission

ANNEX 4

Digital crosstalk measurement (method used by the Administrations of France and the Netherlands)

Question 36/XV – Digital line sections on FDM links

(new Question)

(of interest to Study Groups XVII and XVIII)

What Recommendations should be made regarding systems for transmitting digital signals at a low and medium bit-rate on FDM links (in groups, supergroups, etc.) or using part of, or a complete, existing analogue line for digital signal transmission?

The following specific points require study:

a) What characteristics should be recommended for each system (e.g., bit rate, line code, modulation technique, line interface, etc.)?

b) What group (groups, supergroups, etc.) are to be preferred for these systems in view of the risk of adjacent group interference?

ANNEX

Digital transmission on FDM systems

Question 37/XV – Physical characteristics of millimetric waveguides

(new Question)

(of interest of Study Group XVIII)

What characteristics of circular waveguides using the TE_{01} mode operating in the frequency band between about 20 and 110 GHz, should be recommended for digital transmission?

The following specific points require study:

1. waveguide design, manufacture, transmission characteristics;
2. methods of route selection, installation and joints;
3. parameters to be measured on the laid waveguide and methods of measurement.

ANNEX

Items to be studied for millimetric waveguides

Question 38/XV – Physical characteristics of optical fibre cables

(new Question)

(of interest to Study Group XVIII)

What characteristics of optical fibres operating in the infrared or in the visible frequency regions should be recommended for digital transmission?

The following specific points require study:

1. physical and mechanical characteristics of the fibres, transmission characteristics (e.g. attenuation, pulse dispersion, etc.);
2. make-up of cables; methods of jointing; methods of installation;
3. method of measurement on factory lengths and already-installed sections of optical fibre cables;
4. characteristics of light sources and receivers;
5. optical coupling methods at terminal and intermediate repeater points.

ANNEX

Items to be studied for optical fibre cables

QUESTIONS CONCERNING TELEPHONE CIRCUITS ENTRUSTED TO STUDY GROUP XVI FOR THE PERIOD 1977-1980

List of Questions

Question No.	Title	Remarks
1/XVI	Transmission characteristics of circuits and connections in the switched telephone network	
2/XVI	Characteristics of leased circuits	Of interest to JWP/LTG
3/XVI	Statistical evaluation of the transmission performance of the switched telephone network from the point of view of customers' opinion	Of interest to Study Group II
4/XVI	Transmission aspects of unbalance about earth	Of interest to Study Group V; coordination with Question 13/V
5/XVI	Impairment clauses for networks and circuits	Coordination with Question 4/XII
6/XVI	Transmission aspects of telephone conference calls	
7/XVI	Revision of the manual on *Transmission planning of switched telephone networks*	
8/XVI	Noise clauses for telephony	Coordination with Question 4/CMBD; to be studied jointly with Question 5/XII
9/XVI	Return loss of PCM channel equipments	
10/XVI	Incorporation of digital encoding processes in the world-wide telephone network	Coordination with Question 18/XII
11/XVI	Recommended values of loudness ratings	Coordination with Question 19/XII
12/XVI	Transmission aspects of the maritime mobile satellite service	Of interest to Study Group II
13/XVI	Echo, propagation time and stability in telephone connections	Continuation of b) of Question 1/XVI studied in 1973-1976; coordination with Question 6/XII

Question 1/XVI – Transmission characteristics of circuits and connections in the switched telephone network

(continuation of Question 1/XVI, studied in 1973-1976)

Are the present Recommendations concerning the objective transmission requirements of circuits, exchanges, and connections in the switched telephone network satisfactory?

If not, in what respect are they unsatisfactory and how should they be amended?

The following subdivision of topics may be used in contributions to this Question.

a) *Reference equivalents*

This covers such topics as reference equivalents, relative levels, nominal transmission losses, etc.

b) *Hypothetical reference connections*

What amendments should be made to Recommendation G.103?

c) *Crosstalk*

To include go-return crosstalk ratio, direct crosstalk ratio, etc.

d) *Attenuation and group-delay distortion*

To include circuits and exchanges.

Note 1. – Noise and unbalance about earth are the subjects of separate Questions (Questions 5/XVI and 8/XVI for noise, and Question 4/XVI for unbalance).

Note 2. – All categories of circuits may be included in the study regardless of the transmission media or the modulation technique.

Note 3. – Annex 1 relates to d) above and gives the results of a study on attenuation/frequency distortion and group-delay distortion of connections. The results of a study of Study Group XIII on international traffic routing (an extract of which can be found in Annex 2) were also taken into consideration.

ANNEX 1

Attenuation/frequency distortion of connections

ANNEX 2

Traffic-weighted distributions of number of circuits

Question 2/XVI – Characteristics of leased circuits

(continuation of Question 2/XVI, studied in 1973-1976)

(of interest to Joint Working Party LTG)

What transmission characteristics should be recommended for leased international telephone-type circuits?

Note 1. – Annexes 1 and 2 contain further information for the study of this Question.

Note 2. – The contents of Recommendations in the Series H and M should be taken into consideration, as well as the results of studies from other CCITT Study Groups concerning leased circuits.

ANNEXES 1 & 2

Items to be studied for leased international telephone-type circuits

Question 3/XVI – Statistical evaluation of the transmission performance of the switched telephone network from the point of view of customers' opinions

(continuation of Question 3/XVI, studied in 1973-1976)

(of interest to Study Group II)

What should be the transmission performance objectives of the switched telephone network in terms related to the transmission experienced by the customer?

Note 1. – A set of transmission performance objectives could be attempted in respect of the following aspects.

The list is not intended to be exhausive.

1. *Percentage of unsatisfactory calls*

a) own-exchange calls;

b) other-exchange calls.

In principle, due account must be taken of referenc equivalent, sidetone, linear quality impairments (e.g.: FDM system noise, room noise, attenuation/frequency distortion), and non-linear impairments (e.g.: quantizing distortion).

2. *Percentage of calls with low stability*

a) calls with 3 dB or less stability (near-singing distortion condition);

b) calls with 0 dB or less stability, measured in the following conditions:

- both ends connected;
- one end connected;
- both ends disconnected.

The 3-dB criterion relates to the subjective effect of near-singing distortion. The 0-dB (i.e. oscillation) criterion with only one end connected relates to conditions such as awaiting answer or during dialling on manual hold, etc., while the both-ends-disconnected case relates to the clear-down of long-distance connections there being PABX extensions at each end.

3. *Percentage of calls with objectionable echo*

Recommendation G.131, B.c) is relevant.

4. *Percentage of calls with intelligible crosstalk*

a) between subscribers on the same distribution point;

b) others.

The two criteria for intelligible crosstalk reflect the possible need for a more stringent limit in respect of subscribers likely to know each other, and also in a fixed relation to each other. It should be noted that the nominal limiting conditions for crosstalk studies are not necessarily the same as those appropriate to other reductions in quality.

Note 2. – An objective for each characteristic corresponding to the traffic-weighted average connection is clearly necessary to achieve a good overall standard, but in addition this ought to be supported by an aim appropriate to nominal limiting conditions which arise from the adverse combination of individually-acceptable tolerances. If this can be done, it would ensure that no subscriber, however unfortunately placed, will systematically experience difficulties with a large proportion of the calls he makes, even if these calls are made to other subscribers similarly situated in the same network. However, economic considerations cannot be disregarded.

The study of this Question should be supported with transmission performance assessments using appropriate hypothetical reference connections or the measurement results obtained by Study Group IV on switched connections.

Note 3. – The Annex to this Question represents considerations on the transmission aims referred to in Note 2.

ANNEX

Statistical evaluation of the transmission performance of the switched telephone network from the point of view of customer opinions

(Contribution from the United Kingdom Post Office)

Question 4/XVI – Transmission aspects of unbalance about earth

(continuation of Question 4/XVI, studied in 1973-1976)

(of interest to Study Group V, coordination with Question 13/V)

a) What recommendations can be made regarding unbalance to earth with a view to ensuring adequate transmission quality in all respects?

b) What techniques of measurement are necessary?

Note 1. – It is recognized that there already exist certain Recommendations on the subject of unbalance, namely, K.10, O.121, 6.4 of Q.45, etc., as well as Question 13/V. These are primarily directed to afford protection from induced voltages and do not necessarily ensure adequate transmission performance, for instance, in respect of noise or crosstalk.

Note 2. – The Annex represents a contribution on reproducibility of longitudinal balance measurements demonstrated with the help of suitable tests. Further information on some transmission aspects of balance about earth can be found in Annex 3 to Chapter V of the CCITT Manual on *Transmission planning of switched telephone networks.* Refer also to the existing Annex 2 to Question 4/XVI, *Green Book,* Volume III, pages 759-768.

ANNEX

Reproducibility of longitudinal balance measurements

(Contribution from Bell Northern Research, Canada)

Question 5/XVI – Impairment clauses for networks and circuits

(continuation of Question 5/XVI, studied in 1973-1976)

(coordination with Question 4/XII)

Bearing in mind the present distribution of world telephone traffic, are the present Recommendations concerning transmission impairments (noise, crosstalk, attenuation/frequency distortion, reference equivalents, delay, etc.) adequate from the points of view of:

a) the subjective effect of the transmission quality experienced by customers?

b) future planning?

If not, what changes are proposed?

1. what is the level of single-tone interference tolerable in the 300 Hz-3400 Hz band of an international telephone circuit, and how should it be expressed?

2. what recommendations could be issued to limit the noise introduced in international connections by national circuits set up on PCM systems which do not comply with Recommendation G.712 and/or use 7-bits encoding?

3. what clarifications are necessary in the existing Recommendations in the light of draft Recommendation G.102 (see Note 1 below), e.g., identification of recommended values as:

- performance objectives for networks and circuits;
- design objectives for equipments, etc.?

4. should there be a limit for the mean value of the traffic-weighted distribution of noise power level delivered by a national sending system referred to the send virtual switching point of the first international circuit in the international chain? If so, what should the limit be?

Note 1. – Annex 1 explains the reasons why Study Group XVI proposed to extend the wording of this Question and contains a draft text of a Recommendation G.102 which is proposed for study during the study period 1977-1980. This draft text applies to various types of transmission impairments (not only to noise, which was the subject of Question 5/XVI during the study period 1973-1976). The attention of all Study Groups which may be concerned is drawn to this draft text.

Note 2. – Annex 2 gives specific proposals of changes to Recommendations concerning circuit noise in the G.100 Series in the light of the general considerations of Annex 1. These proposed changes will be considered by Study Group XVI and Joint Study Group CMBD in the study period 1977-1980.

ANNEX 1

Explanation of transmission objectives

ANNEX 2

Specific proposals for changes to Recommendations on circuit noise in the G.100 Series

Question 6/XVI – Transmission aspects of telephone conference calls

(continuation of Question 6/XVI, studied in 1973-1976)

What should be recommended in respect of transmission performance to enable international telephone conference calls to be satisfactorily accomplished?

In particular,

a) What transmission characteristics should be recommended in respect to the bridging equipment to be used?

b) What transmission restrictions should be recommended for the other facilities used in connections for international conference calls?

Note 1. – Characteristics of interest for the bridging equipment include:

- insertion loss;
- features for the control of stability and echo;
- features for the control of the cumulative effect of circuit-noise due to the number of stations participating.

Note 2. – In b) above, consideration should be given to:

– the cumulative effect of room noise and reverberation due, in particular, to the use of loudspeakers and special kinds of microphones;

– the use of satellite circuits;

– the consequences of connecting several stations in each of the countries concerned by a single international circuit.

Note 3. – Annex 2 (*Green Book*, Volume III, pp. 775-779) from AT&T is a description of conference equipment.

Note 4. – Annex 2 (*Green Book*, Volume III, page 780) contains information provided by Study Group II on the technical aspects of international conference calls.

Note 5. – The following Annex provides information from the United Kingdom Post Office on transmission and routing considerations for conference calls.

ANNEX

International conference calls

Question 7/XVI – Revision of the manual on "Transmission planning of switched telephone networks"

(continuation of Question 7/XVI, studied in 1973-1976)

How should the manual on *Transmission planning of switched telephone networks* be revised?

Question 8/XVI – Noise clauses for telephony

(continuation of Question 8/XVI, studied in 1973-1976)

(coordination with Question 4/CMBD; to be studied jointly with Question 5/XII)

If the hourly-mean clause in Recommendation G.222 (CCIR Recommendation 393-2) were deleted:

1. would sufficient control over the noise of the systems concerned in the Recommendations to protect against high noise on long or consecutive calls be exercised by the remaining noise clauses; or
2. would the distribution of 1-minute means for any month need to be more completely specified; or
3. is some other form of additional clause preferable, and if so what?

Note. – The Annex supports the view that the existing 1-minute mean clauses and 5-ms mean clause are sufficient by themselves, whereas Annex 2 to Question 5/XII suggests that additional 1-minute mean clauses are necessary.

ANNEX

One-hour mean noise power on radio-relay links

(Contribution from the Federal Republic of Germany)

Question 9/XVI – Return loss of PCM channel equipments

(continuation of Question 9/XVI, studied in 1973-1976)

What specification should be adopted for return loss against the nominal value at the audio-frequency ports of PCM channels?

Note 1. – The present provisional Recommendation advocates a value of 20 dB over the frequency range 300-3400 Hz.

Note 2. – Another proposal has been made to adopt the following values:

15 dB over the frequency range 300-600 Hz
20 dB over the frequency range 600-3400 Hz.

Note 3. – The values proposed in Note 2 above are in accordance with Recommendation Q.45 which applies to an international exchange. It remains to be seen whether this Recommendation is relevant to transmission equipments.

Note 4. – Annex 1 reproduces the reply to this Question for the study period 1973-1976, whereas Annex 2 gives some additional considerations on the specification of impedance tolerances at voice-frequency interfaces.

ANNEX 1

Reply to the Question given for the study period 1973-1976

ANNEX 2

Specification of impedance tolerances at voice-frequency interfaces

(Contribution from L. M. Ericsson)

Question 10/XVI – Incorporation of digital encoding processes in the worldwide telephone network

(continuation of Question 10/XVI, studied in 1973-1976)

(coordination with Question 18/XII)

a) What should be the planning rules concerning the use of:

1. analogue-to-digital and digital-to-analogue encoding processes;
2. digital-to-digital converters (e.g. PCM to delta modulation) in the national and international parts of worldwide telephone connections?

b) What Recommendations should be made concerning the performance of:

1. FDM assemblies (e.g. comprising 60, 300, 600, 900/960 channels) carried by TDM-PCM systems;
2. TDM-PCM assemblies carried by analogue FDM systems?

c) What should be the transmission parameters of a digital exchange offering all the auxiliary functions of a telephone network (e.g. manual assistance)?

d) What should be the overall objectives for the impairments introduced by the digital hypothetical reference connections shown in Recommendation G.104 and how should they be allocated among the individual items of equipment making up the connections?

Note. – Annex 1 records a summary of studies during the study period 1973-1976 and outlines some of the points which require further study.

Annex 2 is a contribution to the study of a) above.

Annex 3 is a contribution to the study of the Question as a whole.

Annex 4 is a contribution to the study of b) above.

ANNEX 1

Reply to Question 10/XVI (given by Study Group XVI at the end of the study period 1973-1976)

ANNEX 2

Preliminary study of a planning rule governing the number of unintegrated PCM encoding processes in telephone connections

(Contribution from the United Kingdom Post Office)

ANNEX 3

Incorporating PCM circuits into the existing network

(Contribution from the United Kingdom Post Office)

ANNEX 4

Digital coding of FDM assemblies

Question 11/XVI – Recommended values of loudness ratings

(new Question)

(coordination with Question 19/XII)

In Recommendations P.48, P.64 and P.76 a new method of characterizing telephone instruments and local lines in terms of "loudness rating decibels" is introduced with the intention that this measure will eventually replace reference equivalent decibels.

The desire to depart from use of reference equivalents as presently defined by the CCITT (Recommendation P.72) arises for the following reasons:

- reference equivalents cannot be added algebraically; discrepancies of the order of 3 dB may be found;
- replication accuracy of reference equivalents is not good; changes in crew can give rise to a spread of values for one item extending over a range as large as 5 dB;
- increments of real (distortionless) transmission loss are not reflected by equal increments of reference equivalent. As an example, statistical analysis has shown that a 10-dB increase in loss results in an increase in reference equivalent of only about 8 dB.

The use of loudness ratings defined broadly in accordance with the principles being studied would largely obviate these troubles.

In the expectation that for many planning purposes a simple relationship can be used to derive sending and receiving loudness ratings from the corresponding traditional reference equivalents, an appropriate relationship (see Note 3 below) would be:

$$\text{Loudness rating} = \text{M (Reference equivalent)} - \text{K}$$

in which M is of the order of 5/4 and K is a constant, the value of which is to be determined, taking account of:

- the implications on planning procedures of such a change of units (see Annex 1 to Question 19/XII);
- measurement results of the loudness ratings of subscriber local systems.

How shall values currently recommended in terms of reference equivalent be re-expressed in terms of loudness ratings?

Note 1. – Conversion rules are required for sending, receiving, overall, sidetone, echo, and crosstalk reference equivalents. These relationships may not all be linear ones.

Note 2. – Annex 1 to Question 19/XII gives further explanations and a discussion of some of the factors to be considered.

Note 3. – Annex 2 to Question 19/XII gives a more precise idea of the form of the relationship.

Question 12/XVI – Transmission aspects of the maritime mobile satellite service

(new Question)

(of interest to Study Group II)

What are the consequences of the operation and system design of the maritime mobile satellite service in respect of telephone transmission?

Note. – For the study of this Question, it would be advantageous to refer to Annexes 1 to 5 below, which reproduce draft CCIR Recommendations and Reports on this Question.

ANNEX 1

DRAFT RECOMMENDATION AB/8

Systems in the maritime mobile satellite service

Hypothetical telephone reference circuit

(Study Programme 17A/8, Decision 15)

ANNEX 2

DRAFT REPORT AJ/8

Quality objectives for communication circuits in the maritime mobile satellite service

(Study Programme 17A/8)

ANNEX 3

DRAFT REPORT AK/8

Overall transmission characteristics of telephone circuits in the maritime mobile satellite service

(Study Programme 17A/8)

ANNEX 4

DRAFT REPORT AL/8

Methods for the subjective assessment of speech quality in the maritime mobile satellite service

(Study Programme 17A/8)

ANNEX 5

DRAFT REPORT AM/8

Use of echo suppressors and voice-activated carrier switching in maritime mobile satellite systems

(Study Programme 17A/8)

Question 13/XVI – Echo, propagation time and stability in telephone connections

[continuation of b) of Question 1/XVI, studied in 1973-1976]

(coordination with Question 6/XII)

How should Recommendations be revised to take account of transmission planning aspects of echo, propagation time, and stability in telephone connections?

Note 1. – Recommendation G.114 deals with mean one-way propagation time.

Recommendation G.122 deals with the influence of national networks on stability and echo in international connections.

Recommendation G.131 deals with stability and echo in an international connection.

Recommendation G.161 deals with echo suppressors for long or short propagation times.

Note 2. – New methods of echo control (e.g. echo cancellers) should be considered.

Note 3. – A circuit may sometimes be required to contribute echo-control loss (when no echo suppressors are used in the connection) and at other times should contribute near-zero loss (when echo suppressors are used).

Note 4. – Question 6/XII deals with the subjective effects of echo and delay in telephone connections.

QUESTIONS CONCERNING DIGITAL NETWORKS ENTRUSTED TO STUDY GROUP XVIII FOR THE PERIOD 1977-1980

List of Questions

Question No.	Title	Remarks
1/XVIII	Overall aspects of integrated digital networks and integration of services	Of interest to CCIR Study Groups 4 and 9
2/XVIII	Switching and signalling in the ISDN	(See Question 1/XI)
3/XVIII	Synchronization of digital networks	(See Question 27/VII)
4/XVIII	Maintenance and operation of the digital networks	Of interest to CCIR Study Groups 4 and 9 (see Questions 6/IV, 17/VII and 2/XI)
5/XVIII	Reliability and availability of digital networks	To be studied in collaboration with Joint Study Group CMBD (coordinating)
6/XVIII	Interfaces in digital networks	Of interest to CCIR Study Groups 4 and 9 and to CMTT and Study Group IV
7/XVIII	Definitions for digital networks	Of interest to CCIR Study Groups 4 and 9 and to CMTT
8/XVIII	PCM and digital multiplexing for telephony and other signals	Of interest to CCIR Study Groups 4 and 9 and to CMTT
9/XVIII	Analogue-to-digital conversion for telephony and other signals	Of interest to Study Group XII and to CMTT
10/XVIII	Other methods of encoding than PCM	Of interest to Study Group XII
11/XVIII	System characteristics for digital-line sections on cable	
12/XVIII	System characteristics of digital-line section on millimetric waveguides	
13/XVIII	Characteristics for digital line sections on optical fibre cables	
14/XVIII	Interworking between PCM multiplex equipments based on different standards	Of interest to Study Group XVI and CCIR Study Group 4

15/XVIII	Interference to digital systems	Of interest to Study Groups V and XV
16/XVIII	Transmultiplexer equipment	Of interest to Study Group XV and to CCIR Study Groups 4 and 9
17/XVIII	Performance requirements for digital echo suppressors	Of interest to Study Groups XV and XVI
18/XVIII	Bit sequence independence of 64 kbit/s digital paths	

Preamble to the list of Questions assigned to Study Group XVIII (Digital networks) for study during the period 1977-1980

Study Group XVIII (Digital networks) is responsible, inter alia, for coordination of the studies of a number of Study Groups concerned with specialized aspects of digital networks, including integrated digital networks dedicated to particular services. This coordination is necessary to ensure that the approaches of all Study Groups, in particular Study Groups IV, VII, XI, XVII and GAS 6, to the digital network are compatible.

A number of the Questions hereafter assigned to Study Group XVIII unavoidably, at this time, include issues, the detailed study of which, will best be undertakn by the specialist groups. A part of the Study Group XVIII coordinating role in respect of such Questions is the identification and definiton of the derived Questions needing urgent study by other groups.

For as long as Questions are of joint interest to two or more Study Groups, it is for each Administration to ensure coordination at the national level between experts in the various fields concerned, so that its contributions to the Questions examined by Study Group XVIII will reflect the opinion of the Administration as a whole.

In the case of transmission systems , the study of the media (cables, waveguides, optical fibres) has been assigned to Study Group XV but the study of the associated transmission equipments has been assigned to Study Group XVIII for the time being, until the study of the general requirements to be met by transmission systems has made further progress.

Question 1/XVIII – Overall aspects of integrated digital networks and integration of services

[continuation of a) and b) of Question 1/D, studied in 1973-1976]

(of interest to CCIR Study Groups 4 and 9)

On what general philosophy should the design and introduction of digital systems be based? For example, what principles should be applied for the implementation of dedicated integrated digital networks (IDNs) for various services and what provisions should be made to facilitate the evolution towards the possible future integrated services digital network (ISDN)?

Under this Question Study Group XVIII will study the evolution of the IDN dedicated to telephony. It is recognized that this network will carry signals other than speech as in the case of the existing analogue telephony network. The telephony IDN will be further studied as the basis for a possible future integrated service digital network. To this end and to coordinate the studies of digital networks, the studies under this question will include the examination of the results of studies of networks for other services carried out by the competent Study Groups concerned. Study Group XVIII will advise the other Study Groups on the performance of common digital building blocks, e.g. transmission systems, which form part of IDNs dedicated to other services. It will also advise on the performance of hypothetical reference connections which the other Study Groups may devise for their services.

The following specific points require study:

a) What should be the overall performance of, and what allocation of impairments should be made to, the hypothetical reference connection (HRC) defined in Recommendation G.104 and can this HRC be the basis for the ISDN? Account should be taken of the various existing signal sources which may be connected to analogue ports in the network.

b) How should the design and performance objectives be defined taking into account impairments such as digital errors, jitter, slips, quantizing distortion and time delay? (See Annex 3.)

c) That part of the study of jitter defined on this Question is especially urgent. Progress with the study of jitter requirements of the different systems involved in integrated digital networks depends on a prior answer to the points raised in this Question.

Administrations are urgently requested to produce contributions giving information not only about the values to be specified for jitter but also about general properties of jitter (amplitude, spectral components, transfer function, etc.) and about the best way to specify equipment for jitter (maximum value, transfer function, specifications at interfaces or any other method).

d) Should any restriction be placed on the input signal to digital paths and if so should this be a general restriction or specified as necessary for particular bit rates?

Note 1. – Account must be taken of the following factors:

a) Networks will progress from their present states towards integrated all-digital operation through a transitional period involving the coexistence of analogue and digital systems, transmission (including cable, radio-relay and satellites), and switching (space and time division). The timing and pattern of this transition will vary from country to country according to their geographical, economic, social, etc. conditions.

Digital systems should have such characteristics as will ensure, as far as possible:

– satisfactory transmission performance of connections set up over such mixed networks, taking account of telephone and other usages;

– ultimate assimilation into national integrated networks which are themselves mutually compatible.

b) The change from analogue to digital operation presents opportunities for introducing new facilities to users. The international study of digital systems could usefully include the examination of possible unification of national approaches in this respect.

Note 2. – Under this Question general matters regarding the organization and planning of the ISDN will be considered, while other more detailed aspects of the ISDN will be studied under other Questions of Study Group XVIII.

Note 3. – When studying a) above, the results of the joint meeting of Chairmen and Vice-Chairmen of Study Groups VII, X, XI, XVII (former Special A) and XVIII (former Special D), an extract from which is reproduced in Annex 1, should be taken into account.

The Chairmen of these Study Groups shall be responsible for coordinating the studies of their group concerning the problem of integration of services, with the Chairman of Study Group XVIII acting as convenor for this coordination.

Note 4. – After the final meeting of Study Group XVIII, the Chairman of Study Group XVIII, in agreement with the Chairman of the Editing Group on new Questions, proposed to keep for further study the conclusions of the joint meeting mentioned in Note 3. These are reproduced in Annex 2.

Note 5. – Annex 4 reproduces an extract from a Contribution from the Danish, Finnish, Norwegian and Swedish Administrations to the joint meeting of Chairmen and Vice-Chairmen.

Note 6. – The problems associated with the transmission of non-speech signals over a digital or part digital telephone network are highlighted in Annex 5, submitted by Australia.

ANNEX 1

Extracts from the Report of the meeting of Chairmen and Vice Chairmen of Study Groups VII, X, XI, XVII (former Special A) and XVIII (former Special D) (Geneva, 15-16 September 1975)

ANNEX 2

Conclusions of the meeting of Chairmen and Vice Chairmen in September 1975

ANNEX 3

Reply to a) and b) of Question 1/D in the Study Period 1973-1976

ANNEX 4

Coordination of studies on digital networks

(Contribution from the Danish, Finnish, Norwegian and Swedish Administrations)

ANNEX 5

The effect of PCM derived circuits on non-speech signals in the telephone network

(Contribution from Australia)

Question 2/XVIII – Switching and signalling in the ISDN

(continuation of Question 3/D, studied in 1973-1976)

(see Question 1/XI)

Considering,

a) the possibilities of digital exchanges being used in integrated switching and transmission networks, dedicated to particular services (IDN) and also in networks carrying a number of services (ISDN);

b) that common-channel type signalling is recognized as the most suitable inter-exchange signalling method in digital networks;

c) that a new common-channel signalling system for telephony and data is under study using a message transfer part which is optimized for operation over 64 kbit/s digital links and which is in its functional structure and specification identical for both services;

d) that under Question 1/XVIII, patterns of shared use of digital network facilities are studied with a view to future ISDNs (see Annex 2 of Question 1/XVIII;

1. what characteristics of digital exchanges are necessary to facilitate the use of digital exchanges in integrated switching and transmission networks dedicated to particular services (IDN) and also in networks carrying a number of services (ISDN);

2. what services other than telephony and data can make appropriate use of the message transfer part of the new digital common channel signalling system under study; what are the requirements for the user parts if sharing of the message transfer part applies.

Note 1. – The role of Study Group XVIII on this Question will be:

a) to coordinate studies relating to the use of digital exchanges in integrated switching and transmission networks dedicated to particular services (IDN) and also in networks carrying a number of services (ISDN);

b) to identify those characteristics which are essential to the integration of services and to ensure that the study of these characteristics is carried out by the appropriate specialist Study Group.

Note 2. – Due account should be taken of the draft Recommendations contained in Annex 1 and of the need for these Recommendations to be completed.

ANNEX 1

Reply to a) of Question 3/D in the Study Period 1973-1976

ANNEX 2

Reply to b) of Question 3/D in the Study Period 1973-1976

Question 3/XVIII – Synchronization of digital networks

(continuation of Question 5/D, studied in 1973-1976)

(see Question 27/VII)

a) What techniques should be used for the synchronization of dedicated IDNs and of the ISDN?

What special provisions should be made to facilitate the evolution of dedicated IDNs towards the ISDN?

b) What are the performance characteristics which should be recommended for the network synchronization of dedicated IDNs and of the ISDN?

c) What influence will satellite digital links have on the requirements for international synchronization?

d) What modifications or additions should be made to Recommendation G.811 (plesiochronous operation of international digital links)?

Note 1. – Studies under this Question should take into account Recommendation G.811, and the Annexes to this Question.

Note 2. – Studies of this Question should be based on the results of those carried under Question 1/XVIII. Concerning the various services to be taken into account for dedicated IDNs, priority in the study should be given to the telephony IDN while dedicated IDNs for other services (e.g. data) should be studied in close cooperation with the appropriate Study Groups (e.g. Study Group VII).

ANNEX 1

Reply to a) of Question 5/D in the Study Period 1973-1976

ANNEX 2

Rapporteur's report on synchronization systems

ANNEX 3

International plesiochronous connection via satellite link

[Contribution from the Kokusai Denshin Denwa Co., Ltd. (KDD)]

Question 4/XVIII – Maintenance and operation of the digital network

(continuation of Question 4/D, studied in 1973-1976)

(of interest to CCIR Study Groups 4 and 9; see Questions 6/IV, 17/VII, and 2/XI)

What characteristics should be recommended for digital systems (including switching, signalling, synchronization and transmission systems) to facilitate maintenance and operation?

What special maintenance and operation provisions should be made to facilitate the evolution of dedicated IDNs toward the ISDN?

The following specific points require study:

a) What characteristics of digital network should be measured (e.g. error rate, jitter, etc.)?

b) How should these characteristics be measured?

c) What recommendations have to be made for the measuring equipments which are included in the digital equipments?

d) What are the ranges of performance limits for parts of the network which could give an indication of the ranges of measurement capability needed in measuring equipments?

e) What system, path, terminal equipment, network, network alarms and other indicators of performance and related operational procedures should be recommended?

f) What arrangements should be recommended to provide separate measurements of the performance of analogue-to-digital conversions and of digital-to-analogue conversions in digital terminal equipment including digital signals to be used in those measurements?

g) What tests should be recommended for a digital path for either maintenance or installation purposes.

Note 1. – Studies of this Question should be based on the results of those carried under Question 1/XVIII. Concerning the various services to be taken into account for dedicated IDNs, priority in the study should be given to the telephony IDN while dedicated IDNs for other services (e.g. data) should be studied in close cooperation with the appropriate Study Groups (e.g. Study Group VII).

Note 2. – Recommendations for measuring equipments not included in the digital equipment will be made by Study Group IV, taking into account the results achieved by Study Group XVIII under this Question.

Note 3. – At some future date much of the detailed work under this Question should be undertaken by Study Group IV, although this may not be appropriate at the present time.

ANNEX

Reply to Question 4/D in the Study Period 1973-1976

Question 5/XVIII – Reliability and availability of digital networks

(new Question)

(to be studied in collaboration with Joint Study Group CMBD)

What overall reliability and availability objectives should be established for digital networks?

What special provisions for the reliability and availability should be made to facilitate the evolution of dedicated IDNs towards the ISDN?

The following specific points require study:

a) Is it sufficient to establish an objective for the total available time that the network, or a portion of the network, is available or is it also necessary to indicate the frequency of interruptions?

b) How can the overall objectives be subdivided into the various systems and circuits making up the network?

c) How can network reliability and availability characteristics be measured?

Note 1. – Studies of this Question should be based on the results of those carried under Question 1/XVIII. Concerning the various services to be taken into account for dedicated IDNs, priority in the study should be given to the telephony IDN, while dedicated IDNs for other services (e.g. data) should be studied in close cooperation with the appropriate Study Groups (e.g. Study Group VII).

Note 2. – Replies to this Question will be transmitted to Study Group CMBD as contribution to Question 2/CMBD by the Rapporteur for Reliability.

Question 6/XVIII – Interfaces in digital networks

(continuation of Question 7/D, studied in 1973-1976)

(of interest to CCIR Study Groups 4 and 9 and to CMTT and Study Group IV)

What interfaces need to be established in digital systems (including switching, signalling, synchronization and transmission elements) in addition to those recommended in Recommendation G.703 and elsewhere (see Annex 1 which refers specifically to proposals for an interface at 64 kbit/s)?

a) What common principles can be established for interfaces in IDNs and the ISDN, and if so, could it be possible to identify a type of signal, common to all stages of the hierarchy?

b) What should be the characteristics recommended for interfaces including:

1. characteristics of the signals crossing the interfaces, including possible restrictions the interfaces might impose on those signals;
2. physical characteristics such as cabling across the interfaces;
3. electrical characteristics such as impedance, etc., seen looking each way from the interface?

Note 1. – The points left for study in Recommendation G.703 should be completed.

Note 2. – Detailed interface studies specifically relating to the work of Study Group VII and Study Group XI should be carried out by those Study Groups.

ANNEX 1

Interface characteristics at 64 kbit/s

Question 7/XVIII – Definition for digital networks

[continuation of c) of Question 1/D studied in 1973-1976]

(of interest to CCIR Study Groups 4 and 9 and CMTT)

What definition should be given to terms used for digital systems (including switching, signalling, synchronization and transmission systems) which form part of digital networks?

Note 1. – Studies of this Question should be based on Recommendation G.702.

Note 2. – The Rapporteur for this Question will act as coordinator for the study of related definitions produced in other Study Groups, e.g. Study Groups VII and XI.

ANNEX

Proposed amendments to Recommendation G.702 requiring further study

Question 8/XVIII – PCM and digital multiplexing for telephony and other signals

(continuation of Questions 2/D, 6/D and 10/D, studied in 1973-1976)

(of interest to CCIR Study Groups 4 and 9 and to CMTT)

What PCM and what digital multiplexing arrangements with an aggregate bit rate greater than 64 kbit/s for telephony and/or other signals (e.g. data, sound programme, etc.) should be recommended?

What are the characteristics of such arrangements?

In particular, arrangements and their characteristics require study for the following applications:

a) PCM multiplex equipment,

b) digital multiplex equipment,

c) multiplexing arrangements to be used between digital exchanges.

The following points in particular require to be studied:

1. The completion of the following Recommendations:

G.741, G.742, G.743, G.744, G.745, G.751, G.752 and

especially the specification of jitter requirements at the equipment input and output. (See Annex 3 and Annex 4 from the Italian and the French Administrations respectively.)

2. To consider what additional level in the digital hierarchy should be defined, in particular:

– above the fourth order at 139 264 kbit/s;

– above the third orders at 32 064 or 44 736 kbit/s.

3. The definition, if possible, of multiplexing equipments needed to have a flexible digital network (see Recommendation G.741). These multiplexes may be PCM MUX, synchronous MUX, +/– justification MUX, positive justification MUX.

4. What are the values and limits to be specified for the performance characteristics of PCM channels at audio frequencies when the transmit side and the receive side are measured separately?

5. When defining the specifications for the multiplex equipment, should provision be made to combine the streams of the n-th order directly in the stream of the $(n + 2)$-th order (e.g. from the primary multiplex directly to the third order or from the second order directly to the fourth order, etc.)?

Annex 6 gives, by way of example, some considerations as to the choice of the bit rate for a third-order digital system which takes account of the development of a flexible digital network.

Note 1. – Study of this Question includes study of digital hierarchies.

Note 2. – The study of coding parameters for analogue-conversion processes in application *a)* above will be studied under Question 9/XVIII.

Note 3. – Account should be taken of the studies relevant to *c)* above, undertaken under Question 2/XVIII.

Note 4. – The studies of digital multiplex equipments having input tributaries at 64 kbit/s should take account of the needs of the user Study Groups (e.g., Study Group VII).

ANNEX 1

Extracts from the reply to Question 2/D in the Study Period 1973-1976

ANNEX 2

Proposed modification to Recommendation G.711 concerning the adjustment of the relationship between encoding law and relative audio level

(Contribution from the United Kingdom Post Office)

ANNEX 3

Jitter specifications for digital multiplex equipments

(Contribution from the Italian Administration)

ANNEX 4

Jitter in a digital multiplex equipment; masks proposed for a multiplexer and a demultiplexer input and output

(Contribution from the French Administration)

ANNEX 5

PCM multiplexing equipment for sound-programmes

(Extract from the reply to Question 10/D in the Study Period 1973-1976)

ANNEX 6

The choice of a digit rate for third-order digital equipments

(Contribution from the U.S.S.R. Telecommunication Administration)

ANNEX 7

Comments from the Netherlands Administration

Question 9/XVIII – Analogue-to-digital conversion for telephony and other signals

(continuation of Questions 10/D and 11/D, studied in 1973-1976)

(of interest to Study Group XII and to CMTT)

What are the characteristics to be recommended for analogue-to-digital conversion for telephony and other signals?

The following specific points require study.

a) Analogue-to-digital conversion in general using PCM and other analogue-to-digital conversion methods (e.g., delta modulation), and in the case of delta modulation the following points should be studied:

1. What companding method should be recommended?
2. Should the information about the step size be transmitted as a separate signal combined with a main signal by means of FDM or TDM, or should the main signal contain this information?
3. Should a delta-modulation channel transmission rate be standardized? If so, what value should be recommended?

b) The application of these conversion methods to the various signals, such as:

1. voice-frequency signals;
2. visual-telephone signals;
3. FDM telephone-channel assemblies.

Note 1. – Analogue-to-digital conversion for TV and sound-prgramme signals are being studied by CCIR Study Groups 10, 11 and CMTT; the studies are coordinated by the IWP CMTT/1 of the CMTT.

Note 2. – When studying analogue-to-digital conversion methods for telephony other than that recommended in Recommendation G.711, compatibility and/or easy convertibility with this method should be taken into account. In considering the possible use of these new analogue-to-digital conversion methods special attention should be paid to the resultant effects if they are used in association with the existing digital networks, and to the effects on the evolution of specialized IDNs into the ISDN.

Note 3. – Equipment which provides the conversion of FDM channel assemblies to time-slot assemblies are studied under Question 16/XVIII.

Note 4. – Annexes 1 and 2 give the reply to Question 10/D of the study period 1973-1976, concerning visual-telephone and FDM-assemblies signals respectively.

ANNEX 1

Coding of visual telephone signals

(Extract from the reply to Question 10/D of the study period 1973-1976)

ANNEX 2

Coding of FDM assemblies

(Extract from the reply to Question 10/D of the study period 1973-1976)

Question 10/XVIII – Other methods of encoding than PCM

(continuation of Question 11/D, studied in 1973-1976)

(of interest to Study Group XII)

a) What methods of digital encoding of speech signals other than that recommended in Recommendation G.711 should be recommended by the CCITT?

b) In particular, should characteristics be recommended for digital systems using delta modulation and if so, what should be these characteristics?

Note. – Study of this Question should consider the following points:

1. standardization of a bit-rate for commercial speech signals transmission;
2. acoustical tests (subjective or objective) of the speech transmission quality arising from the use of different companding laws;
3. the companding law and minimal transmission rate to be chosen to ensure high quality speech signals.

c) What is the field of application for transmission systems using delta modulation (DM)? Can telecommunication lines of lower quality and cost as compared with that of PCM transmission be used to carry DM signals (for example, radio-relay links with fading, low-quality cable links, etc.)?

d) What is the field of application for companded and non-companded DM?

e) Can the DM systems be used to build up an integrated digital network and what problems should be considered as concerns the interworking of companded and non-companded DM systems?

f) If so, then should the interworking of a DM-based digital network with the existing analogue network be taken into account? What number of modulation/demodulation points is permissible especially with respect to data transmission?

g) Should a DM channel be considered as a multipurpose channel? If so, what types of signals, other then speech, should be considered in this regard?

h) What studies should be undertaken in order to assess the speech signal transmission quality?

i) What characteristics of the DM channels should be standardized?

1. What companding method should be recommended?
2. Should the information about the step size be transmitted as a separate signal combined with a main signal by means of FDM or TDM, or should the main signal contain this information?
3. Should DM channel transmission rate be standardized? If so, what value should be recommended?

j) Should a Question be studied concerning the digital conversion of DM signals into PCM signals and vice-versa?

k) Should a Question be studied concerning programme transmission by means of DM?

l) What studies should be undertaken on the digital switching of DM streams?

m) Are there many proposals concerning the make-up of digital DM systems? While developing a primary DM system (2048 kbit/s), should one aim at the increase of the channel number, e.g. up to 40 channels (2048 : 40 = 51.2 kbit/s)?

Note 1. – Item i) will be studied under Question 9/XVIII.

Note 2. – The Rapporteur appointed to this Question should consider how the points raised under this Question should be studied (e.g. as a whole under this Question or certain points should be included in the studies of other Questions of Study Group XVIII.

ANNEX 1

Bit rate suitable for a telephone circuit with companded delta-modulation

(Contribution from the U.S.S.R. Telecommunication Administration)

ANNEX 2

Digital primary transmission system with companded delta-modulation

(Contribution from the U.S.S.R. Telecommunication Administration)

Question 11/XVIII – System characteristics for digital line sections on cable

(continuation of Question 13/D, studied in 1973-1976)

What recommendations should be made regarding systems for digital transmission on standardized cables?

The following specific points require study:

a) *Digital line sections on cables*

1. What characteristics should be recommended for each type of digital line section on cable (e.g., bit rate, modulation rate, line code, hybrid or fully regenerative techniques, line interface, etc.)?

2. What objectives should be recommended for the performance characteristics, for each type of digital-line section on the basis of the hypothetical digital paths in Recommendation G.721 and the performance characteristics studied under Question 1/XVIII.

b) *General characteristics of digital-line sections on cables*

When drafting Recommendations for digital line sections on cable, can some aspects be considered applicable to all types of line sections? In particular can common methods be used in ensuring that general requirements, studied and recommended under other Questions of Study Group XVIII and applicable to transmission systems on all types of transmission media, will be met?

The following specific points require study:

1. the specification and allocation of digital errors and jitter.

Note. – The overall allocation to digital paths will be studied under Question 1/XVIII;

2. the effect on the characteristics of digital-line sections of any restriction which may be placed on the input signal to digital paths.

Note. – The study of the need for and the nature of any restrictions will be studied under Question 1/XVIII;

3. Recommendations, appropriate to digital-line sections to restrict the effects of interference from sources external to the system.

Note. – General aspects of this subject are studied under Question 15/XVIII;

4. the achievement of reliability and availability objectives.

Note. – General aspects of this subject are studied under Question 5/XVIII;

5. alarms and supervision.

Note. – General aspects covering the whole digital network are covered under Question 4/XVIII.

Information on existing system or systems under study relevant to these points should be supplied as contributions to the study of the more general Question as indicated against the specific points listed.

ANNEX

Reply to B., C., G., H. and L.3 of Question 13/D (22/XV) of the Study Period 1973-1976

Question 12/XVIII – System characteristics for digital-line sections on millimetric waveguides

a) What are the characteristics to be recommended for each type of digital-line section on millimetric waveguides (e.g.: bit rate, modulation technique, repeater spacing, line interface, etc.)?

The following specific points require study:

1. band utilization, band and channel filters;

2. modulation, demodulation and IF aspects;

3. specific methods for power feeding and supervision of the digital-line section;

4. methods of measurement;

Note 1. – Account must be taken of the recommended digital-system interfaces.

Note 2. – It would be useful in these studies to indicate which points are considered suitable for future recommendations.

b) *General characteristics of digital line sections on millimetric waveguides*

When drafting Recommendations for digital-line sections on millimetric waveguides, can some aspects be considered applicable to all types of line sections? In particular can common methods be used in ensuring that general requirements, studied and recommended under other Questions of Study Group XVIII and applicable to transmission systems on all types of transmission media, will be met?

The following specific points require study:

1. the specification and allocation of digital errors and jitter.

Note. – The overall allocation to digital paths will be studied under Question 1/XVIII;

2. the effect on the characteristics of digital-line sections of any restriction which may be placed on the input signal to digital paths.

Note. – The study of the need for and the nature of any restrictions will be studied under Question 1/XVIII;

3. Recommendations, appropriate to digital-line sections to restrict the effects of interference from sources external to the system.

Note. – General aspects of this subject are studied under Question 15/XVIII;

4. the achievement of reliability and availability objectives.

Note. – General aspects of this subject are studied under Question 5/XVIII;

5. alarms and supervision.

Note. – General aspects covering the whole digital network are covered under Question 4/XVIII.

Information on existing system or systems under study relevant to these points should be supplied as contributions to the study of the more general Question as indicated against the specific points listed.

ANNEX

Items to be studied for digital-line sections on millimetric waveguides

Question 13/XVIII – Characteristics for digital-line sections on optical-fibre cables

a) What are the characteristics to be recommended for each type of digital-line section on optical fibres (e.g. bit rate, line code, modulation technique, repetition technique, repeater spacing, line interface, etc.)?

The following specific points require study:

1. specific methods for power feeding and supervision of the digital-line section;

2. methods of measurements.

Note 1. – Account must be taken of the recommended digital interfaces.

Note 2. – It would be useful in these studies to include which points are considered suitable for future Recommendations.

b) *General characteristics of digital-line sections on optical-fibres cables*

When drafting Recommendations for digital-line sections on optical-fibres cables, can some aspects be considered applicable to all types of line sections? In particular can common methods be used in ensuring that general requirements, studied and recommended under other Questions of Study Group XVIII and applicable to transmission systems on all types of transmission media, will be met?

The following specific points require study:

1. The specification and allocation of digital errors and jitter.

Note. – The overall allocation to digital paths will be studied under Question 1/XVIII;

2. the effect on the characteristics of digital-line sections of any restriction which may be placed on the input signal to digital paths.

Note. – The study of the need for, and the nature of, any restrictions will be studied under Question 1/XVIII;

3. Recommendations, appropriate to digital-line sections to restrict the effects of interference from sources external to the system.

Note. – General aspects of this subject are studied under Question 15/XVIII;

4. the achievement of the reliability and availability objectives.

Note. – General aspects of this subject are studied under Question 5/XVIII;

5. alarms and supervision.

Note. – General aspects covering the whole digital network are covered under Question 4/XVIII.

Information on existing system or systems under study relevant to these points should be supplied as contributions to the study of the more general Question as indicated against the specific points listed.

ANNEX

Items to be studied for optical-fibre transmission system

Question 14/XVIII – Interworking between PCM multiplex equipments based on different standards

(continuation of Questions 2/D and 9/D, studied in 1973-1976)

(of interest to Study Group XVI and CCIR Study Group 4)

What measures are required and what recommendations have to be made to enable interworking between digital systems based on different standards?

The following specific points require study:

a) conversion between different encoding laws in primary PCM multiplex equipment (as specified in Recommendation G.711) taking into account the possible use of 64 kbit/s paths for signals other than telephony;

b) conversion between different frame structures of primary PCM multiplex equipment (as specified in Recommendations G.732 and G.733) and between second-order multiplex equipment (as specified in Recommendations G.742, G.743 and so forth).

Note. – When studying this Question, priority of consideration should be given to interconnections over international satellite links.

ANNEX 1

Extract from the reply to Question 9/D of the Study Period 1973-1976

ANNEX 2

Digital access to channel time-slots for digital paths between 1544 kbit/s and 2048 kbit/s multiplexes

(Contribution from the Swiss Administration)

Question 15/XVIII – Interference to digital system

(continuation of Question 12/D, studied in 1973-1976)

(of interest to Study Groups V and XV)

What Recommendations are needed to restrict the effects of interference at harmonics from the mains supply, from d.c. converters, and from electromagnetic radiation, etc. in digital systems, such that the overall performance requirements are met?

The following aspects should be taken into consideration for the studies:

1. such interferences can cause spurious modulation, jitter, etc.;
2. noise at the terminals of the battery supply, see Supplement No. 13 (results of studies carried out by Study Group XV on Question 11/XV);
3. Recommendations G.151, G. and J.21 state permissible overall limits for the spurious modulation of signals in the case of telephony and sound-programme transmission respectively;
4. Recommendation G.229 indicates the assumptions used by Study Group XV relating to exposure of line systems to railway traction currents and remote power feeding arrangements;
5. impairments (e.g. jitter, digital errors, etc.) allocation to hypothetical reference digital paths, multiplex and digital-line sections should be in agreement with the studies carried out under Question 1/XVIII.

Note 1. – The studies under this Question could usefully be started by measuring the performance of existing digital systems with respect to the relevant impairments.

Note 2. – Study Group XV in Question 12/XV is carrying out studies in relation to analogue systems regarding interference from d.c./d.c. converters, fluorescent lighting, electromagnetic radiation, etc.

ANNEX

Interference at harmonics of the mains, etc.

(Contribution from the Swiss Administration)

Question 16/XVIII – Transmultiplexer equipment

(new Question)

(of interest to Study Group XV and to CCIR Study Groups 4 and 9)

What provisions should be made to enable direct conversion of signals with FDM structure into signals with TDM structure and vice-versa?

The following specific points should be included in the study:

a) What hierarchical levels should be recommended for direct FDM/TDM conversion by means of transmultiplexers?

b) For what services other than telephony, if any, should transmultiplexers be suitable?

c) What provision should be made for the conversion of signalling in transmultiplexers?

Note 1. – Impairments of signal quality assigned to transmultiplexers will be studied under Question 1/XVIII in conjunction with Study Group XVI (Question 10/XVI).

Note 2. – Characteristics to facilitate the operation and maintenance of transmultiplex equipment will be studied under Question 4/XVIII.

ANNEX

Transmultiplexer equipment

(Contribution from the French Administration)

Question 17/XVIII – Performance requirements for digital echo suppressors

(new Question)

(of interest to Study Groups XV and XVI)

a) When a digital echo suppressor is inserted into an analogue path, what are the additional (over and above Recommendation G.161) performance requirements of such a device?

b) When a digital echo suppressor is inserted into a digital path, what are the additional (over and above Recommendation G.161) performance requirements of such a device?

Note. – The study of this Question is to be coordinated with Question 10/XV.

Question 18/XVIII – Bit sequence independence of 64 kbit/s digital paths

(new Question, identical to Question 32/VII)

Considering,

the existence of digital-line sections whose characteristics do not permit the transmission of long sequences of zeros:

1. What means should be recommended to achieve a high degree of bit sequence independence of 64 kbit/s digital paths which are carried by digital-line sections that are not bit sequence independent?

Note. – One possible means might be the insertion of scramblers at the 64 kbit/s interface in the country where the digital path is not bit sequence independent.

2. What will be the technical impact of such studies on the international interworking between public data networks?

Note. – Study Group XVIII should study 1. above in cooperation with Study Group VII, Study Group IX, Study Group XI and Study Group XVII.

Study Group VII should study 2. above.

QUESTIONS CONCERNING CIRCUIT NOISE AND AVAILABILITY ENTRUSTED TO JOINT STUDY GROUP CMBD FOR THE PERIOD 1973-1980

List of Questions

Question No.	Title	Remarks
1/CMBD	Loading of carrier systems	To be studied in collaboration with Question 27/XV-JWP LTG
2/CMBD	General studies concerning reliability and availability	To be studied in collaboration with Question 6/CMBD
3/CMBD	Measurement of the usable power margin of wideband amplifiers and transmission systems	Also of interest to Study Groups XV, XVI and the CCIR
4/CMBD	Noise clauses	
5/CMBD	Characteristics of an impulsive-noise measuring instrument for wideband data transmission.	
6/CMBD	Availability and reliability of local networks	To be studied in collaboration with Question 2/CMBD
7/CMBD	Hypothetical reference circuits and associated noise objectives	Of interest to Study Groups VII, IX, XII XV, XVI, XVII and the CCIR

Question 1/CMBD – Loading of carrier systems

(continuation of Question 1/C, studied in 1973-1976)

(to be studied in collaboration with Question 27/XV-GM LTG)

a) What is the actual power level of the signals transmitted (in one direction) over a telephone channel and over larger standardized FDM assemblies (groups, supergroups, etc.)?

b) What steps, if any, should be taken to ensure that the actual load corresponds to the conventional load (–15 dBm0/channel) assumed for design purposes in Recommendation G.223?

Due account must be taken of the following aspects:

- the proportion of channels used for purposes other than telephony (sound-programme transmission, telegraphy, facsimile, data transmission, etc.). The class of transmission system (e.g. national and international land systems, submarine system, communication satellite systems) may attract different proportions of the various services and Administrations able to furnish information on this aspect are invited to do so;
- the power of the non-speech signals (see Question 27/XV, studied by Joint Working Party LTG);
- the power of telephone speech;
- the various occupancy and activity factors appropriate to the signals delivered by the various services;

c) What are the appropriate mathematical models and methods for describing and estimating frequency-division multiplex signals encountered in practice?

d) What should be the margins against saturation needed for systems carrying multiplex signals with characteristics significantly different from telephony, as described in Note 1 of Recommendation G.223, 1.?

Note. – The following Annexes 1 to 5 contain further information for the study of this Question. Supplement No. 5 to Volume III gives details of measurements that have been made together with some information on methods of measurements.

ANNEX 1

Signal on telephone-type circuits; simultaneous transmission of various signals

ANNEX 2

Rules and definitions for the measurement of the loading of telephone channels and transmission systems

ANNEX 3

Mathematical models of multiplex signals

Equivalent peak power in multichannel speech transmission systems

(Contribution from Philips Telecommunicatie Industrie BV)

ANNEX 4

Load Measurements on sound programmes

(Contribution from Italy)

ANNEX 5

Characteristics of signals transmitted over sound-programme circuits

(Contribution by the United Kingdom Post Office)

Question 2/CMBD – General studies concerning availability and reliability

(continuation of Question 2/C, studied in 1973-1976)

(to be studied in collaboration with Question 6/CMBD)

What overall availability and reliability objectives should be established for the telecommunication network?

Note 1. – Consideration must be allowed in this study for the introduction of new techniques and new systems such as common-channel signalling and digital systems.

A distinction should be made between objectives for the availability and reliability of the service provided to customers and the design objectives for new equipment and systems.

Note 2. – To undertake this study successfully, it is necessary that the points mentioned hereafter (list of points to be studied by other Study Groups) be treated urgently with a high priority. The definition of an interruption in the service is required for the different services. Some replies have been received (see Annexes 6 and 8). The Study Groups concerned with the studies of transmission systems require this information before suitable reliability objectives can be suggested. Annex 7 gives the status, in the transmission and switching Study Groups, of the study of parameters causing transmission interruptions.

Note 3. – In order to facilitate the broad study, which is the subject of this Question, Joint Study Group CMBD will act as a central agency and coordinate with other groups to gather the information necessary to establish the above objectives (see Annex 1).

Joint Study Group CMBD will continue its work in defining the terms necessary for this study programme (see Annexes 4 and 5 and 3. of Annex 2).

Reliability rapporteurs will be appointed, each of whom must be familiar with the work of one of the concerned CCITT Study Groups: I, II, IV, VII, IX, X, XI, XIV, XV, XVII and XVIII; CCIR Study Groups 4 and 9 and the CMTT.

These rapporteurs should work mainly by correspondence and take part (as far as reliability problems are concerned) in the work of Joint Study Group CMBD. They should be appointed on the proposal of the Chairmen of the Study Groups concerned at the beginning of the study period 1977 – 1980.

The rapporteurs for reliability should attend the meetings of the Working Party on Questions 2/CMBD and 6/CMBD. It would also be desirable if they attended that portion of the meetings of Joint Study Group CMBD that covers Questions 2/CMBD and 6/CMBD.

The rapporteur for reliability in a particular Study Group should report on the work done by this Study Group which may have an effect on the study of Questions 2/CMBD and 6/CMBD, for instance as regards:

– the questions on availability and reliability given to certain Study Groups (Questions 22/IV, 3/IX, 6/XIV, 32/XV, 33/XV, 5/XVIII in the CCITT; Questions 5-2/9 and 24/4 in the CCIR);
– certain aspects of the availability of telephone connections being studied by Study Group IV;
– the points referred to in Note 2 above.

Lists of points to be studied by other Study Groups:

To pursue the study on availability the following points of Question 2/CMBD, are necessarily to be studied by the responsible Study Group. As indicated in Note 2 above, these points should be treated urgently with a high priority, since replies are needed before it is possible to suggest availabiliy objectives.

1. *Interruptions to service* (attention is drawn to the difference established between service interruptions and transmission interruptions; see Annexes 6 and 7 and Definition 6.5 in Annex 4).

What is the type and magnitude of faults which will cause an interruption in the following services:

a) telephony (Study Group II and Study Group XII);

b) data of all speeds (Study Groups VII and XVII);

c) facsimile (Study Group XIV);

d) sound-programme transmission (Joint Study Group CMTT);

e) television (Joint Study Group CMTT);

f) telegraphy (Study Groups I and IX)?

This information is necessary both for switched networks and point-to-point circuits.

2. *Disconnection of the connection (Study Group XI)*

What are the characteristics of interruptions or other faults that will cause a connection to be disconnected, taking into consideration the various types of signalling systems used?

3. *Tolerability of transmission breaks in the switched telephone network (Study Group II)*

Certain types of transmission systems are liable to exhibit an impairment consisting of repeated breaks of transmission. Views are sought on the following points in order that suitable objectives may be established as design basis for networks and systems:

a) the incidence of transmission breaks, i.e. the frequency of breaks of defined duration, which would justify a telephone user to consider a connection unusable;

b) the incidence of such unusable connections which would be consistent with an acceptable quality of service for the international network.

Note 1. – The hypothetical reference connection defined in Recommendation G.103 (Figure 1/G.103) should be assumed, where appropriate, in this study.

Note 2. – Study Group IV uses as a definition of an interruption for the study of short breaks, that it occurs when there is a decrease in level of 10 dB.

4. *Availability of telephone service from the standpoint of traffic engineering considerations relevant to the availability of a connection*

Communication to the CCIR

It is noted that CCIR Study Group 9, already has Question 5-2/9 and two associated Study Programmes on reliability of radio-relay systems and that CCIR Study Group 4 has a similar question for the fixed service using satellites (Question 24/4).

ANNEX 1

Plan of work for the study of Question 2/CMBD in 1977-1980

ANNEX 2

Report of the Working Party on Question 2/CMBD in 1973-1976

ANNEX 3

Probability of successful service completion

(Contribution from the NTT)

ANNEX 4

Draft definitions concerning reliability, availability and related concepts

ANNEX 5

List of Definitions concerning failures

ANNEX 6

Table

Service interruption as defined by Study Groups responsible for various telecommunications services

ANNEX 7

Table

Duration of transmission interruptions and other parameters as defined by the responsible Study Groups

ANNEX 8

Reports from the rapporteurs for reliability at the end of the study period 1973-1976

ANNEX 9

Establishment of availability objectives for cable and radio-relay systems

(Contribution from the Federal Republic of Germany)

ANNEX 10

Common objective for cables and radio-relay systems

(Extract of the reply adopted at the Munich Meeting)

Question 3/CMBD – Measurement of the usable power margin of wideband amplifiers and transmission systems

(also of interest to Study Groups XV, XVII and the CCIR)

Considering,

a) that wideband cable systems and radio-relay systems are generally operated with pre- and de-emphasis;

b) that the overload limit of those systems is frequency dependent, if measured with sinusoidal test signals of levels related to a flat level point according to the provision of Recommendation G.223, 6.1;

c) that the measurement of system performance with the aid of a uniform-spectrum random noise loading is widely used (see Recommendation G.228 and CCIR/399-2);

1. Is it acceptable, for the determination of an overload limit of a system or repeater(s), that the load be simulated by a uniform-spectrum random noise signal?

2. If so,

   – what particular measuring procedures must be observed?

   – how should the overload limit be recognized?

   – what relation between the r.m.s. value of the limiting white-noise load and the equivalent r.m.s. sine-wave power level of the peak of a multiplex signal according to Recommendation G.223, 6.2 should be adopted?

3. If not, what other measurement method could be recommended to secure an adequate overload margin?

Note. – The Administrations who submitted material on this subject, either to the rapporteur or in Contributions directed to Question 1/CMBD are invited to provide Contributions in the new study period.

Question 4/CMBD – Noise clauses

(continuation of Question 4/C, studied in 1973-1976)

What changes are necessary to Recommendations on noise due to transmission systems as a result of the study of Questions 5/XII and 8/XVI?

Note 1. – As far as possible, noise objection should be common both to line systems and radio-relay systems.

Note 2.[3] – It is assumed that noise surges and clicks from power supply systems and from switching apparatus are reduced to negligible proportions and will not be taken into account when calculating the noise power.

[3] Note 4 of CCIR Recommendation 393-2.

Question 5/CMBD – Characteristics of an impulse-noise measuring instrument for wideband data transmission

(continuation of Question 7/C, studied in 1973-1976)

What filter characteristics should be recommended in Recommendation H.16, c).

1. in the case of circuits being measured at basic group and supergroup bands?
2. in the case of circuits being measured at baseband?
3. in the case of other wideband circuits?

Note. – Annex 1 to this Question in Volume III of the *Green Book* describes filter characteristics used by the American Telephone and Telegraph Company.

Question 6/CMBD – Availability and reliability of local networks

(continuation of Question 9/C, studied in 1973-1976)

(to be studied in collaboration with Question 2/CMBD)

Administrations are invited to provide information, if such information is readily available, on the availability and reliability of their local networks.

Note. – Although the wording of this Question refers to "local networks", Administrations may give information on their national network if they find it more appropriate.

Question 7/CMBD – Hypothetical reference circuits and associated noise objectives

(continuation of Question 10/C, studied in 1973-1976)

(of interest to Study Groups VII, IX, XII, XV, XVI, XVII and the CCIR)

The CCITT recognizes that in a large part of the world there is a need for systems capable of providing routes longer than 2500 km, on which all channels have a noise performance (excluding frequency-division modulation noise) lower than 3 pW/km. The structure of these routes, for example the distance between modulation (dropping) points, differs substantially from that of the 2500-km hypothetical reference circuits now recommended for cable and radio-relay systems. To meet the need for systems of such length and performance, the following points should be studied:

a) Should new hypothetical reference circuits be defined?

b) What changes if any should be made to existing 2500-km hypothetical reference circuits and associated noise objectives?

Note 1. – By way of an example, Annex 1 below briefly describes the 6400-km hypothetical reference circuit currently used by the American Telephone and Telegraph Company and the Canadian Telecommunications Carriers Association. Other hypothetical reference circuits could be contemplated, e.g. circuits of a length which would be a multiple of 2500 km.

Note 2. – There are related studies proceeding within CCIR Study Group 9 and CCITT Study Groups XII and XVI, the progress of which will have to be taken into account. There is also a CCITT Study Group XV interest and the views of that Study Group should be sought.

ANNEX 1

Hypothetical reference circuit for long-haul, broadband radio-relay and cable systems for telephony

(Contribution from the American Telephone and Telegraph Company and the Canadian Telecommunications Carriers Association)

ANNEX 2

Noise performance requirements for telephone circuits and systems in large countries

(Contribution from the Canadian Telecommunications Carriers Association)

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