INTERNATIONAL TELECOMMUNICATION UNION

CCITT

THE INTERNATIONAL
TELEGRAPH AND TELEPHONE
CONSULTATIVE COMMITTEE

YELLOW BOOK

VOLUME VII - FASCICLE VII.1

TELEGRAPH TRANSMISSION AND SWITCHING

RECOMMENDATIONS OF THE R AND U SERIES

VII[TH] PLENARY ASSEMBLY
GENEVA, 10–21 NOVEMBER 1980

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ISBN 92-61-01131-4

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APPLICABLE AFTER THE SEVENTH PLENARY ASSEMBLY (1980)

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[1] "Telematic services" is used provisionally.

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[1] "Telematic services" is used provisionally.

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REMARK

The Questions entrusted to each Study Group for the Study Period 1981-1984 can be found in Contribution No. 1 to that Study Group.

CCITT NOTE

In this Fascicle, the expression "Administration" is used for shortness to indicate both a telecommunication Administration and a recognized private operating agency.

PART I

Series R Recommendations

TELEGRAPH TRANSMISSION

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SECTION 1

TELEGRAPH DISTORTION

Recommendation R.2

ELEMENT ERROR RATE

(Geneva, 1964)

The CCITT,

considering

(a) that in practice, the error rate on transitions is not used and, with the development of data transmission, it is the notion of element error rate that has come into use,

(b) that in general, the expression *element error rate* is used with the meaning of *error rate on unit elements.* Although this equivalence of meaning is acceptable for isochronous signal trains, this is not so for start-stop signal trains. In fact, there may be elements in start-stop signal trains whose duration is different from that of the unit elements (for example, the stop element of a start-stop signal in accordance with International Telegraph Alphabet No. 2),

unanimously declares the view

(1) that the following definitions be adopted:

element error rate: the ratio of the number of incorrectly received elements to the number of emitted elements.

unit element error rate for isochronous modulation: the ratio of the number of incorrectly received elements to the number of emitted elements.

(2) that, for start-stop signal trains, the notion of character error rate be used;

(3) that, when error rates are measured to assess the quality of a communication, the original message acting as a reference for the calculation of the error rate shall be considered as being free of error;

(4) that measurement of the element error rate assumes that it has been possible to record the elements received in such a way that they can be recognized as being correctly or incorrectly recorded. As the result of an error rate measurement thus depends on the recording system at the end of the connection, this system must be specified when the results of the element error rate are given. Whenever possible the element error rate should be measured at the output of the regenerating device which normally precedes the translation device; the signals should be translated for checking purposes.

Recommendation R.4

METHODS FOR THE SEPARATE MEASUREMENTS OF THE DEGREES OF VARIOUS TYPES OF TELEGRAPH DISTORTION

(New Delhi, 1960; amended at Geneva, 1980)

For separate measurements of the degrees of characteristic distortion, bias distortion and fortuitous distortion affecting a telegraph modulation or restitution, the following is recommended where circuits and voice-frequency telegraph (VFT) channels are used to carry information employing International Telegraph Alphabet No. 2, without regeneration;

1 Measure the degree of overall distortion (at the actual mean modulation rate) on text, for instance the **QKS** text specified in Recommendation R.51 *bis*. Let Δ be the measurement obtained.

2 Measure the degree of distortion on reversals at the modulation rate used in the measurement of § (1) above. Let Δ_1 be the measurement obtained. Δ_1 is the sum of the bias and fortuitous distortions.

3 By using a compensator fitted to the distortion-measuring equipment, for example a compensating winding on the distortion meter relay, reduce the degree of distortion reading obtained to its minimum value. Let this figure be δ. For practical purposes δ is the fortuitous distortion. $\Delta_1 - \delta$ is, for practical purposes, the bias distortion.

4 Keep the distortion meter adjusted as for the measurement of δ. Measure the degree of distortion at the actual mean modulation rate on text (**QKS** text, for instance). Let Δ' be the reading. $\Delta' - \delta$ is, for practical purposes, the characteristic distortion.

Note 1 – This method gives approximate results; it is possible that the equation $\Delta_1 + \Delta' - \delta = \Delta$ may not be exactly satisfied.

Note 2 – The method can be applied by using either an isochronous distortion-measuring set or a start-stop distortion-measuring set.

Note 3 – The fact that the separate measurement of degrees of different types of distortion is said to be possible and that a method is recommended for such a measurement does not mean that separate measurements of the degrees of different types of distortion are to be recommended when international routine maintenance measurements are carried out.

Recommendation R.5

OBSERVATION CONDITIONS RECOMMENDED FOR ROUTINE DISTORTION MEASUREMENTS ON INTERNATIONAL TELEGRAPH CIRCUITS

(New Delhi, 1960; amended at Geneva, 1964, Mar del Plata, 1968, and Geneva, 1980)

The CCITT,

considering

(a) Recommendations R.51, R.51 *bis*, R.54 and R.55;

(b) that, for the measurement of the degree of distortion of signals on an international telegraph circuit, it is necessary to specify the best condition of observation in order to be sure that the measurement obtained gives a good indication of what the performance of the circuit will be during periods of normal traffic;

(c) that the observation conditions should be such that their duration or their complexity does not unduly increase the load on the maintenance services;

(d) that certain Administrations, to determine these conditions, have carried out statistical measurements of the degree of individual start-stop distortion using distortion analyzers, the results of which seem to be in agreement;

unanimously declares the view

(1) that the tests should be carried out at nominal modulation rates of 50, 75, 100 and 200 bauds, depending on the type of circuits concerned;

(2) that the text transmitted during measurements should be that of Recommendation R.51 *bis*;

(3) that the degree of transmitter distortion of text signals should not exceed 1%;

(4) that, during normal maintenance tests, the duration of the observation should correspond to the examination of at least 800 significant instants, whatever the type of distortion meter used, isochronous or start-stop. At a modulation rate of 50 bauds this results in an observation period of about 30 seconds. At other modulation rates, the observation should last about 20 seconds;

Note – The period of observation required to assess properly the performance of tandem code-independent time-division multiplexers may be much longer than for voice-frequency telegraph equipment.

(5) that, when making start-stop measurements using test equipment that does not register the peak early and peak late reading simultaneously, the observation period should be divided into two more or less equal parts: one part during which the significant instants in advance of their theoretical position could be observed and the other part during which the significant instants coming later than their theoretical position could be observed.

Recommendation R.9

HOW THE LAWS GOVERNING DISTRIBUTION OF DISTORTION SHOULD BE ARRIVED AT

(Geneva, 1964)

The CCITT,

considering

(a) that for the sake of comparative studies of degrees of distortion, it would be well if the procedures for measurement of distortion, and the layout of results, could be standardized. The distortion in question is:

– start-stop individual;

– isochronous individual;

– start-stop,

(b) that the degree of isochronous distortion is of no great practical interest, since it is the individual isochronous distortion that, when isochronous distortion is present, supplies all the useful information. Hence it is not proposed to include the degree of isochronous distortion in this Recommendation.

unanimously declares the following view:

1 *Start-stop individual distortion*

1.1 As regards start-stop individual distortion, the distribution curves will be plotted by means of a statistical distortion analyzer. The width of the measurement steps should make it possible to take measurements with steps of 1%, 2%, 4%, 8%. A measurement will cover about 20 000 transitions (measurement duration of about 15 minutes at 50 bauds: three transitions on the average per start-stop alphabetic signal).

1.2 The results will be shown on the graphs on the linear scale with distributional representation, or on the normal probability scale with cumulative representation, the ordinates being the probabilities and the abscissae the degree of distortion.

1.3 For individual distortion, the curves will give negative (early) and positive (late) distortion.

1.4 For more detailed studies, the number of transitions to be examined may be higher than 20 000, the number depending on the chosen probability that the nominal figure will be exceeded.

2 *Isochronous individual distortion*

2.1 There is the difficulty of synchronism between the transmitter and the distortion analyzer, when the measurements are made at two different points; moreover, the average propagation time of the signals is to be taken into consideration when loop measurements are made.

2.2 The methods of measuring and presenting the results will be the same as for the preceeding case, but the transmitter and the analyzer will have to be synchronized as accurately as possible, taking into account the distortion values to be measured.

3 *Start-stop distortion*

3.1 This is a matter of the (maximum) degree noted during a measurement. It is then necessary to decide on the length of the sample to be measured; the text to be measured will be composed at random. The measurement at 50 bauds will last 30 seconds, distributed as specified in § 5 of Recommendation R.5.

3.2 Distribution curves of these degrees of start-stop distortion will be drawn as a function of the number of samples.

Recommendation R.11

CALCULATION OF THE DEGREE OF DISTORTION OF A TELEGRAPH CIRCUIT IN TERMS OF THE DEGREES OF DISTORTION OF THE COMPONENT LINKS

(New Delhi, 1960; amended at Geneva, 1964, and 1980)

1 In general the isochronous standardized test distortion δ (Definitions 33.07 and 33.12, Recommendation R.140 of a telegraph circuit consisting of a number *n* of links in tandem lies between the arithmetic sum and the square root of the sum of the squares of the degrees of distortion of the individual links,

$$\sum_{i=1}^{n} \delta_i > \delta > \sqrt{\sum_{i=1}^{n} \delta_i^2},$$

n being the number of links in tandem. The few exceptions to this rule that have been observed related to extremely long circuits (for example, four links, each of approximately 3500 km looped at voice-frequency at the distant end to give the equivalent of four links (each 7000 km go and return) and a total length of approximately 28 000 km on cable and open-wire carrier telephone-type channels).

2 For such purposes as the planning of networks, the degree of distortion of a telegraph circuit consisting of *n* channels or links in tandem in the telex service (where a great number of channels will be interconnected at random) is given fairly approximately by:

$$\delta_{\text{inherent}} = \sum_{n}^{1} \delta_c + \sqrt{\sum_{1}^{n} (\delta_{\text{bias}})^2 + \sum_{1}^{n} (\delta_{\text{irreg.}})^2}.$$

Similarly, for the combination of a transmitter and a telegraph circuit consisting of n channels or links in tandem in the telex service, the degree of distortion is given fairly approximately by:

$$\delta_{\text{text}} = \sum_{1}^{n} \delta_c + \sqrt{\delta_t^2 + \delta_v^2 + \sum_{1}^{n} (\delta_{\text{bias}})^2 + \sum_{1}^{n} (\delta_{\text{irreg.}})^2},$$

where

δ_{inherent} = the probable degree of inherent start-stop distortion on standardized text,

δ_{text} = the probable degree of gross start-stop distortion in service,

δ_c = the degree of characteristic start-stop distortion of a single channel or link,

δ_t = the degree of synchronous start-stop distortion of the transmitter,

δ_v = the degree of start-stop distortion due solely to the difference between the mean transmitter speed and the standardized speed. (The difference to be considered is equal to six times the mean difference for one element.)

δ_{bias} = the degree of asymmetrical (bias) distortion of one channel measured using 1:1 or 2:2 signals (either 1:1 or 2:2 signals should be used according to which is normally employed for adjusting the channels),

$\delta_{\text{irreg.}}$ = the degree of fortuitous distortion of one channel measured using 1:1 or 2:2 signals.

3 The values of distortion (except for δ_c) inserted in the foregoing formulae must have the same probability of being exceeded (p). The degree of characteristic distortion δ_c of a channel is fairly constant for each type of voice-frequency channel and can be determined in laboratory tests. Nevertheless, the maximum degree of characteristic distortion is reached for only about 20% of the signals of International Telegraph Alphabet No. 2. Empirical values for δ_c can be obtained with reasonable accuracy by using methods recommended by Recommendation R.4.

4 The probability of exceeding the degrees of distortion δ_{inherent} and δ_{text} calculated with the aid of the above formulae is (20/100) p.

Note – The laws governing the addition of distortion in tandem connected code-independent time-division multiplex systems, and in particular the duration of measurement to be assumed, are the subject of study.

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SECTION 2

VOICE-FREQUENCY TELEGRAPHY

Recommendation R.20

TELEGRAPH MODEM FOR SUBSCRIBER LINES

(Geneva, 1980)

The CCITT,

considering

(a) that the use of high-level telegraph transmission with single or double current may cause disturbing impulse noise in adjacent cable pairs that may be eliminated by applying low-level transmission with telegraph modems;

(b) that telegraph modems would substantially reduce the power consumption in the central office;

(c) that where connection to a subscriber has to be achieved over a non-metallic pair (e.g., a voice-channel frequency-division multiplex or pulse code modulation system) a telegraph modem has to be utilized;

(d) that the frequencies given below are already standardized in Recommendation V.21 [1];

(e) that suitable inexpensive telegraph modems can be used for full duplex transmission on 2-wire circuits at modulation rates up to 300 bauds;

unanimously declares the view

that where low-level telegraph transmission is used, the following method of transmission should be recommended for all modulation rates up to 300 bauds.

1 Channel allocation

The method of transmission is based on Recommendation V.21 [1] with the following frequency designations:

Central office to subscriber (channel 1) F_A = 1180 Hz,
F_Z = 980 Hz;

Subscriber to central office (channel 2) F_A = 1850 Hz,
F_Z = 1650 Hz.

It should be noted that there is equipment in use that applies alternative frequencies to those shown in this Recommendation.

2 Interface

Where the modem is a separate, self-contained unit, the following interchange circuits shall be used:

Common return (e.g. circuit 102 in Recommendation V.24 [2])

Transmitted data (e.g. circuit 103 in Recommendation V.24 [2])

Received data (e.g. circuit 104 in Recommendation V.24 [2])

Note – Further parameters, modem performance and facilities are the subject of further study (see Question 15/IX [3]).

References

[1] CCITT Recommendation *300 bits per second duplex modem standardized for use in the general switched telephone network*, Vol. VIII, Fascicle VIII.1, Rec. V.21.

[2] CCITT Recommendation *List of definitions for interchange circuits between data terminal equipment and data circuit terminating equipment*, Vol. VIII, Fascicle VIII.1, Rec. V.24.

[3] CCITT – Question 15/IX, Contribution COM IX-No. 1, Study Period 1981-1984, Geneva, 1981.

Recommendation R.30

TRANSMISSION CHARACTERISTIC FOR INTERNATIONAL VFT LINKS

(Mar del Plata, 1968; amended at Geneva, 1976)

1 Standardized carrier systems with 4-kHz and 3-kHz spacing permit homogeneous voice-frequency telegraph (VFT) systems providing the capacities of telegraph channels given in Table 1/R.30.

TABLE 1/R.30

Bearer bandwidth	50-baud 120-Hz spacing	100-baud 240-Hz spacing	200-baud 360-Hz spacing	200-baud 480-Hz spacing
4 kHz	24	12	8 (not normally used)	6
3 kHz	22	11	7	5

2 Audio-frequency circuits with heavy or semi-heavy loading permit 12-channel 50-baud systems; circuits with lighter loading permit 18 channels at 50 bauds.

3 Four-wire links are to be preferred for voice-frequency telegraphy.

4 The composition of a 4-wire link for voice-frequency telegraphy differs from that of a telephone circuit in that there are no terminating sets, signalling equipment and echo suppressors.

5 With 2-wire links, a duplex arrangement would not be feasible since the links could not be balanced with the necessary precision to avoid mutual interaction. If the low frequencies are used for transmission in one direction and high frequencies for the other direction, a 2-wire link can be used for voice-frequency telegraphy.

6 The conditions of use of international VFT links are described in detail in Recommendation H.22 [1].

7 PCM (pulse code modulation) channels complying with Recommendation G.712 [2] are also suitable as bearers for FMVFT (frequency-modulated voice-frequency telegraph) links. However, the increase in telegraph distortion in relation to the transmission level and the number of tandem-connected PCM channels is the subject of further study.

References

[1] CCITT Recommendation *Transmission requirements of international voice-frequency telegraph links (at 50, 100 and 200 bauds)*, Vol. III, Fascicle III.4, Rec. H.22.

[2] CCITT Recommendation *Performance characteristics of PCM channels at audio frequencies*, Vol. III, Fascicle III.3, Rec. G.712.

Recommendation R.31

STANDARDIZATION OF AMVFT SYSTEMS FOR A MODULATION RATE OF 50 BAUDS

(Mar del Plata, 1968, incorporating former Recommendations R.31, R.32 and R.34)

The CCITT,

unanimously declares the following view:

1 It is advisable to adopt, for amplitude-modulated voice-frequency telegraph (AMVFT) systems and for a modulation rate not exceeding 50 bauds, the series of frequencies formed by odd multiples of 60 Hz, the lowest frequency being 420 Hz as shown in Table 1/R.31.

TABLE 1/R.31

Channel Position	Frequency Hz	Channel Position	Frequency Hz
1	420	13	1860
2	540	14	1980
3	660	15	2100
4	780	16	2220
5	900	17	2340
6	1020	18	2460
7	1140	19	2580
8	1260	20	2700
9	1380	21	2820
10	1500	22	2940
11	1620	23	3060
12	1740	24	3180

2 This numbering is valid whatever use is made of the channel (e.g. traffic channel, pilot channel, etc.) or the method employed to obtain the line frequencies, e.g. by group modulation. For the numbering of channels that has been adopted in the international service see Recommendation R.70 *bis*.

3 In the case of systems on telephone-type circuits with a spacing of 3-kHz operating in accordance with the standardized frequency series, channel positions 23 and 24 cannot be used.

4 The frequencies applied to the telephone-type circuit that is used as the voice-frequency telegraph bearer circuit should not deviate by more than 6 Hz from the nominal value when the telegraph channels supplied are operating over a telephone-type circuit composed exclusively of audio-frequency sections, and not more than 3 Hz in other cases.

5 The power levels of carrier waves transmitted on the line and measured successively in as short a period as possible should not differ from one another by more than 1.74 dB when they are operating on a constant impedance.

6 The power of each of the carrier waves transmitted on the line should not vary in operation by more than $\pm$ 0.87 dB when it operates on a constant impedance.

7 The amplitude of the signals transmitted should remain within the tolerances of Figure 1/R.31 in which the values t_0 and y_2 and y_1 are fixed as follows:

t_0 = 11 milliseconds,

y_1 = 95%,

y_2 = 110%.

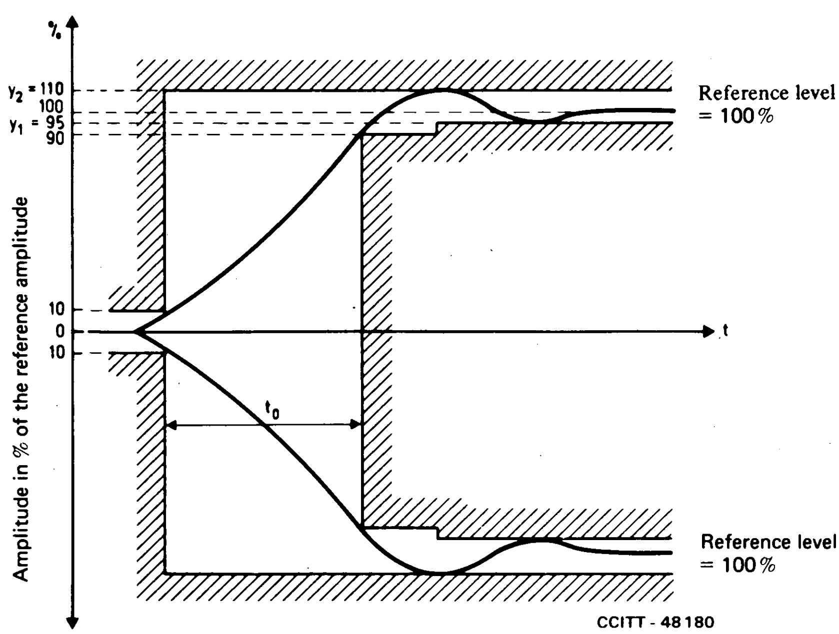


FIGURE 1/R.31

Diagram of tolerances to assess the waveform of the sent signals in AMVFT systems

8 Receivers with rapid-action level correction should not be so sensitive to secondary pulses following the signal pulse provided that the amplitude of the signal emitted does not exceed the reference level by more than 10% and that the reference level does not exceed the normal level by 10.4 dB. (This provision applies only to new systems.)

9 If 1:1 reversals at frequency f_p corresponding to the modulation rate are sent over a channel with mid-frequency F_0, the voltage at frequency $F_0 \pm 3 f_p$ must not exceed 3% of the nominal voltage at frequency F_0 and the voltage at the frequencies $F_0 \pm 5 f_p$ must not exceed 0.4% of the nominal voltage at frequency F_0.

Note – These tolerances will be required only for future systems. Administrations should try as far as possible to use systems satisfying these tolerances on international relations.

10 The unbalance of the emitted signal should not be greater than ± 4% (methods of measuring this unbalance are described in [1] and [2]). This tolerance takes account of the limit in § 11 below for new systems.

11 For new systems, the static relay should introduce a difference of not less than 45 dB between the two signalling conditions. (For existing systems the limit is 30 dB.)

12 In the event of failure of the control current in the sending static relay, the attenuation of the residual signal relative to this nominal level should be at least 27 dB. This attenuation of the signal need not occur immediately on the failure of the control current.

13 Systems should be able to tolerate slow level variations of at least ± 6 dB. Administrations should equip systems that are unable to tolerate such variations with a common amplifier to enable them to tolerate variations of at least ± 6 dB.

14 The permissible limit for the power of the telegraph signal on each telegraph channel when a continuous tone is being transmitted is given in Table 2/R.31.

TABLE 2/R.31

Normal limits for the power per telegraph channel in AMVFT systems

Number of telegraph channels in the AMVFT system	Allowable power per telegraph channel at a point of zero relative level when sending a signal corresponding to continuous stop (Z) polarity	
	microwatts	decibels
12 or less	35	−14.5
18	15	−18.3
24	9	−20.45

Note — These limits are such that the maximum instantaneous voltage will not exceed that of a sinusoidal voltage with a power of 5 milliwatts at a point of zero relative level. This power is the maximum permissible for voice-frequency circuits.

15 Audio-frequency is transmitted to line when stop polarity (condition Z) is sent.

16 When a signal, whose frequency is equal to the nominal frequency of the channel and whose level is 18.3 dB below the normal signal level of the channel, is applied to the detector of a 24-channel AMVFT system, the receiving relay should not respond.

17 It must be possible to subject any channel to a test without withdrawing from service a channel other than the return channel of the circuit planned.

18 In graded harmonic frequency telegraphy, it is desirable that the same frequencies be used separately for circuits established on different successive sections of a 4-wire circuit.

19 In graded harmonic frequency telegraphy, the attenuation of the filters that pass a group of frequencies must, in the suppressed frequency band, be higher by at least 35 dB than that shown in the transmission band.

20 In graded harmonic frequency telegraphy, in order to facilitate local tests, the frequencies used for communications set up between two international offices in one direction should also be used in the opposite direction, if possible.

References

[1] *Measuring method to determine the asymmetry of an amplitude-modulated telegraph signal,* Blue Book, Vol. VII, Supplement No. 11, ITU, Geneva, 1964.

[2] *The measurement of the distortion produced in the sending terminal equipment of an A.M.-V.F. telegraph system,* Blue Book, Vol. VII, Supplement No. 12, ITU, Geneva, 1964.

Recommendation R.35

STANDARDIZATION OF FMVFT SYSTEMS FOR A MODULATION RATE OF 50 BAUDS

(former CCIT Recommendation B.48, Geneva, 1956; amended at New Delhi, 1960, Geneva, 1964, Mar del Plata, 1968, Geneva, 1972, 1976 and 1980)

Note – In this Recommendation, frequency-modulated voice-frequency telegraph (FMVFT) equipment with and without crystal control are distinguished. In order to improve the quality of transmission and to minimize maintenance costs, the application of equipment with crystal control is recommended.

1 The nominal modulation rate should be standardized at 50 bauds.

2 For the nominal mean frequencies, the series formed by the odd multiples of 60 Hz should be adopted, the lowest frequency being 420 Hz in accordance with Recommendation R.31, § 1, the mean frequency F_0 being defined as half the sum of the two characteristic frequencies corresponding to the permanent start polarity F_A and stop polarity F_Z. For the numbering of channels that has been adopted in the international service, see Recommendation R.70 *bis.*

3 The mean frequencies at the sending end should not deviate from their nominal value by more than:

a) for equipment without crystal control 2 Hz;

b) for equipment with crystal control 0.5 Hz. [1]

4 The unbalance due to the modulation process $\delta = 2\frac{|F'_0 - F_l|}{F'_A - F'_Z}$ should not exceed 2%,

where

F'_A and F'_Z are the two characteristic frequencies measured over a period of 10 seconds;

F'_0 is the mean static frequency measured $= \frac{F'_A + F'_Z}{2}$;

F_l is the mean dynamic frequency measured with 1:1 rectangular signals during 10 seconds.

[1] The tightening of this tolerance is for further study.

Measurement should be made applying to the input of the transmitter 1:1 rectangular signals with the build-up and hangover time below 1 µs and with the unbalance below 0.1%. In the event that in service the transmitter is controlled by an electro-mechanical relay (with a certain transit time), the measurement should also be made with that type of relay inserted between the 1:1 signal generator and the input to the transmitter. Both forms of measurements need not necessarily be included in the maintenance procedure but should be included in laboratory type tests.

Note – To determine the unbalance due to the modulation process by the method indicated above, it is necessary to measure the frequencies F'_A, F'_Z and F_l and to calculate the mean frequency F'_0 and the unbalance

$$\delta = 2\frac{|F'_0 - F_l|}{F'_A - F'_Z} .$$

A more rapid method for checking whether or not the unbalance is less than the limit fixed is to measure:

– the mean dynamic frequency F_l with 1:1 signals during 10 seconds;

– the mean dynamic frequency F_m with 2:2 signals during 10 seconds;

$$\delta = 2\frac{|F'_0 - F_l|}{F'_A - F'_Z} = 4\frac{|F'_0 - F_m|}{F'_A - F'_Z}$$

or to subtract:

$$|F_l - F_m| = \frac{1}{4}(F'_A - F'_Z)\delta \approx \frac{1}{4}(F_A - F_Z)\delta \leq 0.4 \text{ Hz.}$$

The absolute value of the difference between the two frequencies measured, F_l and F_m, must be less than 0.4 Hz.

5 The difference between the two characteristic frequencies (corresponding to the start and the stop conditions) should be 60 Hz.

6 The maximum tolerance on this difference should be ± 3 Hz.

7 The total average power transmitted to the telephone-type circuit is normally dependent on the transmission characteristics of the circuit as follows:

a) For circuits with characteristics not exceeding the limits given in Annex A, the total average power transmitted by all channels of a system should preferably be limited to 50 µW at a point of zero relative level. This sets, for the average power of a telegraph channel (at a point of zero relative level), the limits given in Table 1/R.35.

b) For other circuits, the total average power transmitted by all channels of a system is limited to 135 µW at a point of zero relative level. This sets, for the average power of a telegraph channel (at a point of zero relative level), the limits given in Table 2/R.35.

TABLE 1/R.35

Normal limits for the power per telegraph channel in FMVFT systems for bearer circuits with characteristics not exceeding the limits given in Annex A

Number of telegraph channels in the FMVFT system	Allowable power per telegraph channel at a point of zero relative level	
	in microwatts	in absolute power level decibels
12 or less	4.0	–24.0
18	2.7	–25.7
24	2.0	–27.0

TABLE 2/R.35

Normal limits for the power per telegraph channel in FMVFT systems for other bearer circuits

Number of telegraph channels in the FMVFT system	Allowable power per telegraph channel at a point of zero relative level	
	in microwatts	in absolute power level decibels
12 or less	10.8	−19.7
18	7.2	−21.4
24	5.4	−22.7

Note — The figures in Tables 1/R.35 and 2/R.35 assume the provision of a pilot channel on the telegraph bearer at a level of −27.0 dBm0 and −22.7 dBm0 respectively.

8 In service, the levels of the signals corresponding to continuous stop polarity and continuous start polarity should not differ by more than 1.7 dB in the same channel. Both of these levels must lie between ± 1.7 dB with reference to the level given in Table 1/R.35 or Table 2/R.35 as applicable.

9 The frequency for the transmitted condition corresponding to the start polarity is the higher of the two characteristic frequencies and that corresponding to the stop polarity is the lower.

10 In the absence of a channel-modulator control telegraph current, a frequency should be transmitted within ± 5 Hz of the frequency normally transmitted for the start polarity. This frequency need not be sent immediately after interruption of the control current.

11 The frequency spectrum of the emitted signal, when transmitting 1:1 signals at the modulation rate of 2 f_p (f_p = frequency of modulation), should be in accordance with the limits specified in Figure 1/R.35, which shows the levels of the spectra of different components with respect to the amplitude of the non-modulated carrier as ordinates and the frequencies as abscissae.

12 The receiving equipment should operate satisfactorily when the receiving level falls to 17.4 dB below the nominal level. The receiving equipment should have been restored to start polarity when the receiving level has fallen to 23.5 dB below the nominal level. The nominal level is the level resulting from the choice of power per channel (see Tables 1/R.35 or 2/R.35 as applicable) depending upon the number of channels (12, 18 or 24) on the circuit. The alarm-control level is left to the choice of each Administration.

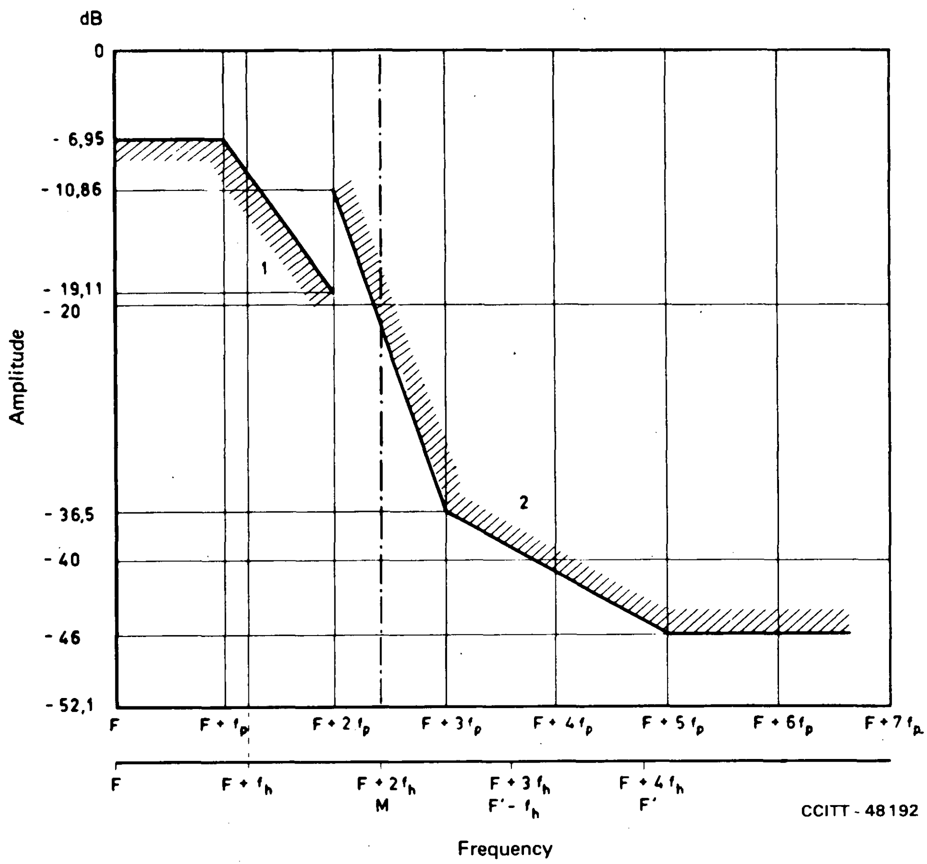
13 On delivery by the manufacturer of 50-baud FMVFT equipment, the following values must not be exceeded for the degree of distortion on a telegraph channel. These values correspond to closed circuit measurements, made with the audio-frequency line terminals of the sending and receiving equipments connected together through an artificial line. Before the series of measurements taken in accordance with Recommendation R.51, the levels are adjusted to their normal values, the mean frequencies are checked to see whether they are within:

1) for equipment without crystal control ± 2 Hz;

2) for equipment with crystal control ± 0.5 Hz, [2)]

of their nominal value (see § 3 above) and the difference between the two characteristic frequencies is within the permitted tolerance of less than 3 Hz (see § 6 above). Bias distortion is eliminated by adjustment in the channel receivers. The other channels of the system are modulated with unrelated signals when the effect of inter-channel interference is to be included in the measurement. These "unrelated signals" can conveniently be 1:1 signals from different generators at approximately 50 bauds but not synchronous to each other or to the signal on the channel under test.

[2)] The tightening of this tolerance remains for further study.



F = carrier frequency of a channel
f_p = frequency of modulation = 25 Hz
f_h = frequency shift = 30 Hz

M = centre line between adjacent channels
F' = carrier frequency of the adjacent channel

Curve 1 = lower limit in the pass band
Curve 2 = upper limit in the stop band

Note — The reference level (0 dB) is the mean value of the levels of the signals corresponding to continuous stop and continuous start polarity, which are measured at the characteristic frequencies F_Z and F_A.

FIGURE 1/R.35

Frequency spectrum for 1:1 signals in 50-baud/120-Hz FMVFT systems

a) The transmission levels being normal, the artificial line introducing no frequency drift, but the measured channel being subject to fortuitous distortion due to interchannel interference: 5% for the degree of inherent isochronous distortion.

b) The level being maintained constant, but at a value different from the normal level, for all constant levels between 8.7 dB above the normal reception level and 17.4 dB below the normal reception level, the other conditions being the original measurement condition: 7% for the degree of inherent isochronous distortion.

c) In the presence of interference by a single sine-wave frequency equal first to one and then to the other characteristic frequency, with a level of 20 dB below the signal level, the other conditions for the start of measurements being maintained: 12% for the degree of inherent isochronous distortion (i.e. total distortion including the increase due to the interfering frequency, not distortion due to the interfering frequency alone).

d) By introducing a frequency drift (Δf Hz) of the signals during transmission through the artificial line, Δf being not more than 5 Hz and the initial condition of the test otherwise being preserved:

– for equipment without crystal control – for equipment with crystal control but without compensation for frequency drift	(5 + 2.5 Δf Hz) %
– for equipment with crystal control and compensation for frequency drift	7%

for the degree of inherent isochronous distortion.

By introducing a frequency drift (Δf Hz) of the signals during transmission through the artificial line, Δf being more than 10 Hz, and the initial conditions of the test otherwise being preserved:

- for equipment with crystal control and compensation for frequency drift 13%

for the degree of inherent isochronous distortion. The measurements shall be made after the transient effects of changing frequency have ceased.

e) Equipment with crystal control, with any climatic conditions specified for the tested equipment, the initial condition of the test otherwise being preserved: 8% for the degree of inherent isochronous distortion. The bias distortion caused by changes of climatic conditions should not be eliminated.

14 Frequency drifts on modern telephone-type circuits are generally less than 2 Hz. Hence it is not necessary to recommend frequency drift control. For circuits on which a maximum frequency drift of not greater than ± 2 Hz cannot be guaranted, and on which the distortion resulting from the frequency drift is not acceptable, compensation seems necessary. Two methods can be used:

a) compensation for each channel up to about 15 Hz;

b) compensation for all the channels by using a pilot. In this case, the receiving end must be able to request and obtain a pilot frequency. Administrations should agree among themselves on the advisability of sending the pilot and the choice of frequency. The frequencies 3300 Hz or, preferably, 300 Hz are recommended for this pilot, with a tolerance of:

   1) for equipment without crystal control ± 1 Hz

   2) for equipment with crystal control ± 0.2 Hz.

   The mean power emitted at the relative zero point on this frequency should not exceed −27.0 dBm0 or −22.7 dBm0 as appropriate (see Table 2/R.35).

15 The number of significant modulation conditions is fixed at two; this number may be increased, if necessary, by agreement between the Administrations concerned.

ANNEX A

(to Recommendation R.35)

Limits required by a bearer circuit for FMVFT application if the total power transmitted by all channels is set at 50 microwatts

A.1 *Loss/frequency distortion*

The variation with frequency of the overall loss of the link with respect to the loss at 800 Hz should not exceed the limits shown in Table A-1/R.35.

TABLE A-1/R.35

Frequency range (Hz)	Overall loss relative to that at 800 Hz
Below 300	Not less than −2.0 dB, otherwise unspecified
300- 500	−2.0 to +4.0 dB
500-2800	−1.0 to +3.0 dB
2800-3000	−2.0 to +3.0 dB
3000-3250	−2.0 to +4.0 dB
3250-3350	−2.0 to +7.0 dB
Above 3350	Not less than −2.0 dB, otherwise unspecified

A.2 *Random noise*

The mean psophometric noise power referred to a point of zero relative level should not exceed 32 000 pW0p (−45 dBm0p), using a psophometer in accordance with Recommendation P.53 [1].

A.3 *Impulsive noise*

The number of counts of impulsive noise that exceeds −28 dBm0 should not exceed 18 in 15 minutes when measured with an impulsive noise counter in accordance with Recommendation O.71 [2].

A.4 *Error rates*

The telegraph character error rate that may be caused by interruptions and noise in the bearer circuit should not exceed the limits stated in Recommendations R.54 and F.10 [3].

Note – The study of the reduction of levels on bearer circuits having characteristics other than those specified in this Annex, is continuing – see Question 2/IX [4].

References

[1] CCITT Recommendation *Psophometers (apparatus for the objective measurement of circuit noise)*, Vol. V, Rec. P.53.

[2] CCITT Recommendation *Specification for an impulsive noise measuring instrument for telephone-type circuits*, Vol. IV, Fascicle IV.4, Rec. O.71.

[3] CCITT Recommendation *Character error rate objective for telegraph communication using 5-unit start-stop equipment*, Vol. II, Fascicle II.4, Rec. F.10.

[4] CCITT – Question 2/IX, Contribution COM IX-No. 1, Study Period 1981-1984, Geneva, 1981.

Recommendation R.35 ***bis***

50-BAUD WIDEBAND VFT SYSTEMS

(Geneva, 1964)

The CCITT,

considering

(a) that Voice-frequency telegraph (VFT) systems standardized by the CCITT for 50-baud channels are described in Recommendations R.31 (for amplitude modulation) and R.35 (for frequency modulation). Systems that comply with these Recommendations are those normally recommended by the CCITT. However, it may sometimes be advisable to use a VFT system for a speed of 50 bauds in which the channels have wider spacing than in systems complying with Recommendations R.31 and R.35,

(b) that the use of channels with a spacing of more than 120 Hz for a modulation rate of 50 bauds offers certain advantages in the following cases:

i) on links with not much traffic (which it is not intended to increase to more than 12 channels for a long time to come);

ii) on links where channels are required to have less distortion than on channels established in accordance with Recommendations R.31 and R.35;

iii) as far as maintenance is concerned, wideband equipment requires less attention,

(c) that in particular, if telephone-type circuits carrying VFT systems are unstable, the use of wideband channels together with frequency modulation is recommended,

(d) Moreover that, if systems are standardized so that only one modulation method is used, the cost of equipment should be lower.

unanimously declares the view

that when Administrations agree to set up a 50-baud VFT system with spacing of more than 120 Hz, the VFT equipment should have the following characteristics:

1) VFT systems for wideband 50-baud channels should be homogeneous systems using frequency modulation only;

2) equipment in conformity with Recommendation R.37 is recommended for this purpose.

Recommendations R.36 – R.38 B

REPORT ON VOICE-FREQUENCY TELEGRAPH CHANNELS FOR USE ABOVE 50 BAUDS

(Common introductory report on Recommendations R.36, R.37, R.38 A and R.38 B)

(Geneva, 1964; amended at Mar del Plata, 1968, and Geneva, 1980)

1 The CCITT has examined the characteristics of telegraph circuits for use above 50 bauds. It has been noted that modulation rates of 75, 100, 150, 200 and 300 bauds are envisaged. The CCITT considers that the number of different types of VFT channels to be provided should not fully correspond to such a detailed list, for two basic reasons:

a) With the exception of 300 bauds, a particular rate circuit can be provided over a higher rate channel. In some cases a lower rate channel might also be considered, this being the situation where a 300-baud circuit may sometimes be supported on a nominally 200-baud channel.

b) The lease charges envisaged are generally such that a marginal tariff difference may exist between circuits operated at the next higher rate.

2 The CCITT has therefore established VFT standards for nominal 100- and 200-baud channels in addition to the earlier standards for channels for operation at nominally 50 bauds.

Note – The performance of a circuit operated at a modulation rate of 75 bauds via one VFT channel conforming to Recommendation R.35 should be quite satisfactory. Similarly, the performance of a circuit operated at a modulation rate of 300 bauds via one VFT channel conforming to Recommendation R.38 A may be satisfactory. However when a circuit consists of two or more channels in tandem, the use of a regenerative repeater may be required. To judge this, it is advisable to conduct distortion measurements on the end-to-end circuit concerned and also on the individual VFT channels employed. In general, it is recommended that circuits operated at a particular modulation rate should not be routed over nominally lower rate VFT channels, whenever this can be avoided.

3 Very different possibilities for using these channels may be envisaged:

– start-stop transmission or synchronous transmission;

– tandem operation of several channels;

– use of point-to-point circuits, circuits with broadcast or switched circuits;

– integration into the world network;

– data transmission.

4 Signal regeneration devices do not normally form an integral part of a VFT channel, as their presence reduces the flexibility to assign a channel for a different use.

5 With regard to channels for 200 bauds, it has been agreed that the spacing for such channels should normally be 480 Hz because of the advantages of 480 Hz spacing compared with 360-Hz spacing with regard to distortion and the cost of equipment. But when the advantage of having a greater number of telegraph channels on the same bearer circuit is considered essential by the Administration (e.g. on long submarine cables employing narrow band 3-kHz telephone channeling equipment), the use of 360-Hz spacing between 200-baud telegraph channels may be justified.

6 For the above reasons, Recommendations R.36, R.37, R.38 A and R.38 B have been adopted.

7 Recommendation R.36 applies to heterogeneous systems and Recommendations R.37, R.38 A and R.38 B apply to homogeneous systems.

8 For the homogeneous systems referred to by Recommendations R.37, R.38 A and R.38 B, only frequency modulation is recommended.

Comparative table of values for the degree of tolerable distorsion on telegraph channels with various modulation rates

Reception condition	Inherent isochronous distorsion (%) for different types of VFT channels				
	Recommendation				
	R.35 (50 bauds 120 Hz)	R.35 *bis* (50 bauds 240 Hz)	R.37 (100 bauds 240 Hz)	R.38A (200 bauds 480 Hz)	R.38B (200 bauds 360 Hz)
With the normal reception level	5		5	5	6
In the case of slow level variation of + 8.7 dB to − 17.4 dB with respect to the normal reception level	7		7	7	8
In the presence of interference by a single sinewave frequency equal to either of two characteristic frequencies with a level of 20 dB below the signal level of the test channel	12		12	10	15
With introduction of a frequency drift (Δf Hz) of the signals:					
a) for a drift $\leqslant$ 5 Hz: Equipment without crystal control; Equipment with crystal control but without compensation for frequency drift	$(5 + 2.5\ \Delta f)$		$(5 + 1.3\ \Delta f)$	$(5 + 0.7\ \Delta f)$	$(6 + 1.2\ \Delta f)$
Equipment with crystal control and compensation for frequency drift	7		7		
b) for a drift $\leqslant$ 10 Hz: Equipment with crystal control and compensation for frequency drift	13		10		

COEXISTENCE OF 50-BAUD/120-Hz CHANNELS, 100-BAUD/240-Hz CHANNELS, 200-BAUD/360-Hz OR 480-Hz CHANNELS ON THE SAME VOICE-FREQUENCY TELEGRAPH SYSTEM

(New Delhi, 1960; amended at Geneva, 1964 and 1980)

1 Common views

1.1 Channels with higher modulation rates (100 or 200 bauds) must be capable of being inserted in systems of amplitude-modulated 50-baud/120-Hz channels conforming to Recommendations concerning them respectively as well as in systems of frequency-modulated 50-baud/120-Hz channels (conforming to Recommendation R.35). However, it is preferable that these high-speed channels should, as far as possible, be placed in a frequency-modulated system (conforming to Recommendation R.35). However, 200-baud/360-Hz channels can be set up only on systems established on bearer circuits having a spacing of 3 kHz.

1.2 If there are 50-baud channels on a mixed system, the distortion limits for the 50-baud channels on homogeneous 50-baud channel systems will have to be respected; hence, 100-baud and 200-baud channel equipment will have to be designed to this end. If this is not possible, the power levels on the 100-baud and 200-baud channels will have to be reduced.

1.3 The 100- and 200-baud channels should have performances comparable to those that could be obtained in a homogeneous system, as specified in Recommendations R.37, R.38 A, R.38 B, provided that the condition indicated under § 1.2 above is respected. They should, in particular, satisfy § 13a) of Recommendations R.37, R.38 A, or R.38 B respectively.

1.4 The mean power transmitted to line at a point of zero relative level is normally dependent on the transmission characteristics of the bearer circuit as follows:

a) 50 µW total for FMVFT aggregates carried on circuits complying with the limits specified in Annex A to Recommendation R.35;

b) 135 µW total for other circuits and for AMVFT.

The mean normal power for each channel should not exceed the values specified in Table 1/R.36, for cases a) and b) above.

TABLE 1/R.36

VFT channel power levels

VFT channel power level (µW)		Relevant Recommendation	VFT channel characteristics		
Bearer case a)	Bearer case b)		Modulation rate (bauds)	Bandwidth (Hz)	Type of modulation
—	9	R.31	50	120	AM
2.0	5.6	R.35	50	120	FM
4.0[a]	10.8[a]	R.37	100	240	FM
—	19.2[a]	R.38B	200	360	FM
8.0[a]	21.6[a]	R.38A	200	480	FM

[a] Provided that the condition mentioned under § 1.2 is respected.

2 Combined use of channels with 240-Hz spacing and channels with 120-Hz spacing

2.1 Channels with 240-Hz spacing should be installed in the following preferred order: 12 (if possible), 11, 10, 9, 8, 7, . . . The channel numbers [1] are in accordance with Recommendation R.37 (100-baud channels with 240-Hz spacing).

3 Combined use of 200-baud channels with 360-Hz spacing and channels with 120-Hz or 240-Hz spacing

3.1 The characteristics of these channels with high modulation rates are defined in Recommendations R.37 on 100-baud channels with 240-Hz spacing and R.38 B on 200-baud channels with 360-Hz spacing.

3.2 The 200-baud/360-Hz channels should be installed in the following preferred order: 5, 4, 6, 3, 2, 1 instead of the corresponding 50-baud channels. The channel numbers [1] are in accordance with Recommendation R.38 B.

3.3 In combined systems using channels with three different modulation rates, the order indicated in § 3.2 above should be used in preference to that indicated in § 2.1 above.

4 Combined use of 200-baud channels with 480-Hz spacing and channels with 120-Hz or 240-Hz spacing

4.1 For a combination of channels with 240-Hz spacing and channels with 480-Hz spacing, the channels with 480-Hz spacing should be installed in the following preferential order: 4, 3, 5, 2, 6 [1].

4.2 For a combination of channels with 120-Hz spacing and channels with 480-Hz spacing, the order indicated in § 4.1 above is applicable.

Note – In cooperation with a system using 6-channel group modulation, the preferred order would be: 4, 3, 6 (if possible), 1 [1].

4.3 In combined systems using channels with three different modulation rates, the order indicated in § 4.1 above should be used in preference to that indicated in § 2.1 above.

Recommendation R.37

STANDARDIZATION OF FMVFT SYSTEMS FOR A MODULATION RATE OF 100 BAUDS

(Geneva, 1964; amended at Mar del Plata, 1968, Geneva, 1972, 1976 and 1980)

Note – In this Recommendation frequency-modulated voice-frequency telegraph (FMVFT) equipment with and without crystal control are distinguished. In order to improve the quality of transmission and to minimize maintenance costs, the application of equipment with crystal control is recommended.

1 The nominal modulation rate is standardized at 100 bauds.

2 The nominal mean frequencies are $480 + (n - 1)\ 240$ Hz, n being the channel position number. The mean frequency is defined as half the sum of the characteristic frequencies corresponding to the start polarity and stop polarity. For the numbering of channels that has been adopted in the international service see Recommendation R.70 *bis.*

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[1] For the numbering of channels that has been adopted in the international services see Recommendation R.70 *bis.*

3 The mean frequencies at the sending end should not deviate from their nominal value by more than:

a) for equipment without crystal control 3 Hz;

b) for equipment with crystal control 0.5 Hz [1].

4 The difference between the two characteristic frequencies in the same channel is fixed at 120 Hz.

5 The maximum tolerance on this difference should be ± 4 Hz.

6 The unbalance due to the modulation process $\delta = 2\frac{|F'_0 - F_l|}{F'_A - F'_Z}$, should not exceed 2%,

where

F'_A and F'_Z are the two characteristic frequencies measured over a period of 10 seconds;

F'_0 is the mean static frequency measured $= \frac{F'_A + F'_Z}{2}$;

F_l is the mean dynamic frequency measured with 1:1 rectangular signals during 10 seconds.

Measurement should be made applying to the input of the transmitter 1:1 rectangular signals with the build-up and hangover time below 1 µs and with the unbalance below 0.1%. In the event that in service the transmitter is controlled by an electro-mechanical relay (with a certain transit time), the measurement should also be made with that type of relay inserted between the 1:1 signal generator and the input to the transmitter. Both forms of measurement need not necessarily be included in the maintenance procedure but should be included in laboratory type tests.

Note – To determine the unbalance due to the modulation process by the method indicated above, it is necessary to measure the frequencies F'_A, F'_Z and F_l and to calculate the mean frequency F'_0 and the unbalance

$$\delta = 2\frac{|F'_0 - F_l|}{F'_A - F'_Z}.$$

A more rapid method for checking whether or not the unbalance is less than the limit fixed is to measure:

– the mean dynamic frequency F_l with 1:1 signals during 10 seconds;

– the mean dynamic frequency F_m with 2:2 signals during 10 seconds;

$$\delta = 2\frac{|F'_0 - F_l|}{F'_A - F'_Z} = 4\frac{|F'_0 - F_m|}{F'_A - F'_Z}$$

or to subtract:

$$|F_l - F_m| = \frac{1}{4}(F'_A - F'_Z)\,\delta \approx \frac{1}{4}(F_A - F_Z)\,\delta \leq 0.9 \text{ Hz}.$$

The absolute value of the difference between the two frequencies measured, F_l and F_m, must be less than 0.9 Hz.

7 The total average power transmitted to the telephone-type circuit is normally dependent on the transmission characteristics of the circuit as follows:

a) For circuits with characteristics not exceeding the limits given in Annex A to Recommendation R.35, the mean power per channel at a point of relative zero level should not be more than 4.0 µW (–24.0 dBm0). The pilot channel, where employed, should have a level of not more than 2.0 µW (–27.0 dBm0);

b) for other circuits, the mean power per channel at a point of relative zero level should not be more than 10.8 µW (–19.7 dBm0). The pilot channel, where employed, should have a level of not more than 5.4 µW (–22.7 dBm0).

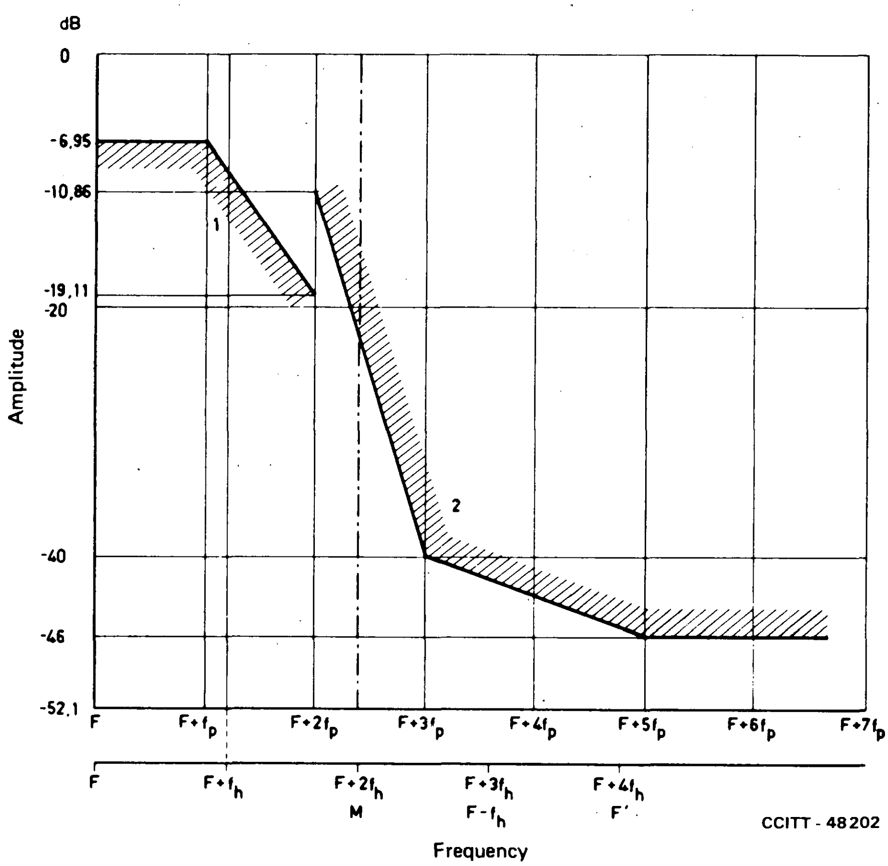
[1] The tightening of this tolerance is for further study.

8 In service, the levels of signals corresponding to continuous stop polarity and continuous start polarity should not differ by more than 1.7 dB in the same channel. Both of these levels must lie between ± 1.7 dB with reference to the level in § 7 above.

9 The frequency for the transmitted condition corresponding to the start polarity is the higher of the two characteristic frequencies and that corresponding to the stop polarity is the lower.

10 In the absence of a channel-modulator control telegraph current, a frequency shall be transmitted that shall be within ± 10 Hz of the frequency normally transmitted for the start polarity. It is not necessary for this transmission to take place immediately after the control current has been cut.

11 The frequency spectrum of the emitted signal, when transmitting 1:1 signals at the modulation rate of $2 f_p$ (f_p = frequency of modulation), should be in accordance with the limits specified in Figure 1/R.37, which shows the levels of the spectra of different components with respect to the amplitude of the non-modulated carrier as ordinates and the frequencies as abscissae.



F = carrier frequency of a channel
f_p = frequency of modulation = 100 Hz
f_h = frequency shift = 120 Hz

M = centre line between adjacent channels
F' = carrier frequency of the adjacent channel

Curve 1 = lower limit in the pass band
Curve 2 = upper limit in the stop band

Note — The reference level (0 dB) is the mean value of the levels of the signals corresponding to continuous stop and continuous start polarity, which are measured at the characteristic frequencies F_Z and F_A.

FIGURE 1/R.37

Frequency spectrum for 1:1 signals in 100-baud/240-Hz and 200-baud/480-Hz frequency-modulated voice-frequency telegraph (FMVFT) systems

12 The receiving equipment should operate satisfactorily when the receiving level falls to 17.4 dB below the nominal level. The receiving equipment should have been restored to start polarity when the receiving level has fallen to 23.5 dB below the nominal level. The alarm-control level is left to the choice of each Administration.

13 On delivery by the manufacturer of 100-baud FMVFT equipment, the following values must not be exceeded for the degree of distortion on a telegraph channel. These values correspond to closed circuit measurements, made with the audio-frequency line terminals of the sending and receiving equipments connected together through an artificial line. Before the series of measurements taken in accordance with Recommendation R.51, the levels are adjusted to their normal values, the mean frequencies are checked to see whether they are within:

1) for equipment without crystal control ± 3 Hz;

2) for equipment with crystal control ± 0.1 Hz [1],

of their nominal value (see § 3 above) and the difference between the two characteristic frequencies is within the permitted tolerance of less than 4 Hz (see § 5 above). Bias distortion is eliminated by adjustment in the channel receivers. The other channels of the system are modulated with unrelated signals when the effect of interchannel interference is to be included in the measurement. These "unrelated signals" can conveniently be 1:1 signals from different generators at approximately 100 bauds but not synchronous to each other or to the signal on the channel under test.

a) The transmission levels being normal, the artificial line introducing no frequency drift, but the measured channel being subject to fortuitous distortion due to interchannel interference: 5% for the degree of inherent isochronous distortion.

b) The level being maintained constant, but at a value different from the normal level, for all constant levels between 8.7 dB above the normal reception level and 17.4 dB below the normal reception level, the other conditions being the original measurement conditions: 7% for the degree of inherent isochronous distortion.

c) In the presence of interference by a single sine-wave frequency equal first to one and then to the other characteristic frequency, with a level of 20 dB below the signal level, the other conditions for the start of measurements being maintained: 12% for the degree of inherent isochronous distortion (i.e. total distortion including the increase due to the interfering frequency, not distortion due to the interfering frequency alone).

d) By introducing a frequency drift (Δf Hz) of the signals during transmission through the artificial line, Δf being not more than 5 Hz and the initial condition of the test otherwise being preserved:

   – for equipment without crystal control
   – for equipment with crystal control but without compensation for frequency drift
   } (5 + 1.3 Δf Hz) %

   – for equipment with crystal control and compensation for frequency drift 7%

   for the degree of inherent isochronous distortion.

   By introducing a frequency drift (Δf Hz) of the signals during transmission through the artificial line, Δf being more than 10 Hz, and the initial conditions of the test otherwise being preserved:

   – for equipment with crystal control and compensation for frequency drift 10%

   for the degree of inherent isochronous distortion. The measurements shall be made after the transient effects of changing frequency have ceased.

e) Equipment with crystal control, with any climatic conditions specified for the tested equipment, the initial condition of the test otherwise being preserved: 8% for the degree of inherent isochronous distortion. The bias distortion caused by changes of climatic conditions should not be eliminated.

[1] The tightening of this tolerance is for further study.

14 Frequency drifts on modern telephone-type circuits are generally less than 2 Hz. Hence it is not necessary to recommend frequency drift control. For circuits on which a maximum frequency drift of not greater than ± 2 Hz cannot be guaranteed, and on which the distortion resulting from the frequency drift is not acceptable, compensation seems necessary. Two methods can be used:

a) compensation for each channel up to about 15 Hz;

b) compensation for all the channels by using a pilot. In this case, the receiving end must be able to request and obtain a pilot frequency. Administrations should agree among themselves on the advisability of sending the pilot and the choice of frequency. The frequencies 3300 Hz or, preferably, 300 Hz are recommended for this pilot, with a tolerance of:

   1) for equipment without crystal control ± 1 Hz

   2) for equipment with crystal control ± 0.2 Hz.

   The mean power emitted at the relative zero point on this frequency should not exceed −27.0 dBm0 or −22.7 dBm0 as appropriate (see § 7 and Tables 1/R.35 and 2/R.35 in Recommendation R.35, which are also applicable to equipment to this Recommendation).

15 The number of significant conditions of the modulation is fixed at two; this number may be increased, if necessary, by agreement between the Administrations concerned.

Recommendation R.38 A

STANDARDIZATION OF FMVFT SYSTEM FOR A MODULATION RATE OF 200 BAUDS WITH CHANNELS SPACED AT 480 Hz

(Geneva, 1964; amended at Mar del Plata, 1968, Geneva, 1972, 1976 and 1980)

Note 1 — This is the standardized system for operation at 200 bauds.

Note 2 — In this Recommendation frequency-modulated voice-frequency telegraph (FMVFT) equipment with and without crystal control are distinguished. In order to improve the quality of transmission and to minimize maintenance costs, the application of equipment with crystal control is recommended.

1 The nominal modulation rate is fixed at 200 bauds.

2 The nominal mean frequencies are 600 + (n − 1) 480 Hz, n being the channel position number. The mean frequency is defined as half the sum of the characteristic frequencies corresponding to the start and stop polarities. For the numbering of channels that has been adopted in the international service see Recommendation R.70 *bis*.

3 The mean frequencies at the sending end should not deviate from their nominal value by more than:

a) for equipment without crystal control 4 Hz;

b) for equipment with crystal control 0.8 Hz [1].

4 The difference between the two characteristic frequencies in the same channel is fixed at 240 Hz.

5 The maximum tolerance on this difference should be ± 6 Hz.

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[1] The tightening of this tolerance is for further study.

6 The unbalance due to the modulation process $\delta = 2\frac{|F'_0 - F_l|}{F'_A - F'_Z}$ should not exceed 2%,

where

F'_A and F'_Z are the two characteristic frequencies measured over a period of 10 seconds;

F'_0 is the mean static frequency measured $= \frac{F'_A + F'_Z}{2}$;

F_l is the mean dynamic frequency measured with 1:1 rectangular signals during 10 signals.

Measurement should be made applying to the input of the transmitter 1:1 rectangular signals with the build-up and hangover time below 1 μs and with the unbalance below 0.1%. In the event that in service the transmitter is controlled by an electro-mechanical relay (with a certain transit time), the measurement should also be made with that type of relay inserted between the 1:1 signal generator and the input to the transmitter. Both forms of measurements need not necessarily be included in the maintenance procedure but should be included in laboratory type tests.

Note – To determine the unbalance due to the modulation process by the method indicated above, it is necessary to measure the frequencies F'_A, F'_Z and F_l and to calculate the mean frequency F'_0 and the unbalance

$$\delta = 2\frac{|F'_0 - F_l|}{F'_A - F'_Z}.$$

A more rapid method for checking whether or not the unbalance is less than the limit fixed is to measure:

– the mean dynamic frequency F_l with 1:1 signals during 10 seconds;

– the mean dynamic frequency F_m with 2:2 signals during 10 seconds;

$$\delta = 2\frac{|F'_0 - F_l|}{F'_A - F'_Z} = 4\frac{|F'_0 - F_m|}{F'_A - F'_Z}$$

or to subtract:

$$|F_l - F_m| = \frac{1}{4}(F'_A - F'_Z)\,\delta \approx \frac{1}{4}(F_A - F_Z)\,\delta \leq 1.8 \text{ Hz.}$$

The absolute value of the difference between the two frequencies measured, F_l and F_m, must be less than 1.8 Hz.

7 The total average power transmitted to the telephone-type circuit is normally dependent on the transmission characteristics of the circuit as follows:

a) For circuits with characteristics not exceeding the limits given in Annex A to Recommendation R.35, the mean power per channel at a point of relative zero level should not be more than 8.0 μW (−21.0 dBm0). The pilot channel, where employed, should have a level of not more than 2.0 μW (−27.0 dBm0).

b) For other circuits, the mean power per channel at a point of relative zero level should not be more than 21.6 μW (−16.7 dBm0). The pilot channel, where employed, should have a level of not more than 5.4 μW (−22.7 dBm0).

8 In service, the levels of the signals corresponding to continuous stop polarity and continuous start polarity should not differ by more than 1.7 dB in the same channel. Both of these levels must lie between ± 1.7 dB with reference to the level in § 7 above.

9 The start polarity frequency is the higher of the two characteristic frequencies, and the stop polarity frequency is the lower one (see Recommendation V.1 [1]).

10 In the absence of a channel-modulator control telegraph current, a frequency shall be transmitted that shall be within ± 20 Hz of the frequency normally transmitted for the start polarity. It is not necessary for this transmission to take place immediately after the control current has been cut.

11 The frequency spectrum of the emitted signal, when transmitting 1:1 signals at the modulation rate of $2 f_p$ (f_p = frequency of modulation) should be in accordance with the limits specified in Figure 1/R.37, which shows the levels of the spectra of different components with respect to the amplitude of the non-modulated carrier as ordinates and the frequencies as abscissae.

12 The receiving equipment should operate satisfactorily when the receiving level falls to 17.4 dB below the nominal level. The receiving equipment should have been restored to start polarity when the receiving level has fallen to 23.5 dB below the nominal level. The alarm-control level is left to the choice of each Administration.

13 On delivery by the manufacturer of 200-baud/480-Hz frequency-modulated voice-frequency telegraph (FMVFT) equipment, the following values must not be exceeded for the degree of distortion on a telegraph channel. These values correspond to closed circuit measurements, made with the audio-frequency line terminals of the sending and receiving equipments connected together through an artificial line. Before the series of measurements taken in accordance with Recommendation R.51, the levels are adjusted to their normal values, the mean frequencies are checked to see whether they are within:

1) for equipment without crystal control ± 4 Hz;

2) for equipment with crystal control ± 0.8 Hz,

of their nominal value (see § 3 above) and the difference between the two characteristic frequencies is within the permitted tolerance of less than 6 Hz (see § 5 above). Bias distortion is eliminated by adjustment in the channel receivers. The other channels of the system are modulated with unrelated signals when the effect of interchannel interference is to be included in the measurement. These "unrelated signals" can conveniently be 1:1 signals from different generators at approximately 200 bauds but not synchronous to each other or to the signal on the channel under test.

a) The transmission levels being normal, the artificial line introducing no frequency drift, but the measured channel being subject to fortuitous distortion due to interchannel interference: 5% for the degree of inherent isochronous distortion.

b) The level being maintained constant, but at a value different from the normal level, for all constant levels between 8.7 dB above the normal reception level and 17.4 dB below the normal reception level, the other conditions being the original measurement conditions: 7% for the degree of inherent isochronous distortion.

c) In the presence of interference by a single sine-wave frequency equal first to one and then to the other characteristic frequency, with a level of 20 dB below the signal level, the other conditions for the start of measurements being maintained: 10% for the degree of inherent isochronous distortion (i.e. total distortion including the increase due to the interfering frequency, not distortion due to the interfering frequency alone).

d) By introducing a frequency drift (Δf Hz) of the signals during transmission through the artificial line, Δf in Hz being not more than 10, and the initial conditions of the test otherwise being preserved: ($5 + 0.7\ \Delta f$ Hz)% for the degree of inherent isochronous distortion; the measurements shall be made after the transient effects of changing frequency have ceased.

e) Equipment with crystal control, with any climatic conditions specified for the tested equipment, the initial condition of the test otherwise being preserved: 8% for the degree of inherent isochronous distortion. The bias distortion caused by changes of climatic conditions should not be eliminated.

14 Frequency drifts on modern telephone-type circuits are generally less than 2 Hz. Hence it is not necessary to recommend frequency drift control. For circuits on which a maximum frequency drift of not greater than ± 2 Hz cannot be guaranteed, and on which the distortion resulting from the frequency drift is not acceptable, compensation seems necessary. Two methods can be used:

a) compensation for each channel up to about 15 Hz;

b) compensation for all the channels by using a pilot. In this case, the receiving end must be able to request and obtain a pilot frequency. Administrations should agree among themselves on the advisability of sending the pilot and the choice of frequency. The frequencies 3300 Hz or, preferably, 300 Hz are recommended for this pilot, with a tolerance of:

   1) for equipment without crystal control ± 1 Hz

   2) for equipment with crystal control ± 0.2 Hz.

   The mean power emitted at the relative zero point on this frequency should not exceed −27.0 dBm0 or −22.7 dBm0 as appropriate (see § 7 and Tables 1/R.35 and 2/R.35 in Recommendation R.35, which are also applicable to equipment to this Recommendation).

15 The number of significant conditions of the modulation is fixed at two; this number may be increased, if necessary, by agreement between the Administrations concerned.

Reference

[1] CCITT Recommendation *Equivalence between binary notation symbols and the significant conditions of a two-condition code*, Vol. VIII, Fascicle VIII.1, Rec. V.1.

Recommendation R.38 B

STANDARDIZATION OF FMVFT SYSTEMS FOR A MODULATION RATE OF 200 BAUDS WITH CHANNELS SPACED AT 360 Hz USABLE ON LONG INTERCONTINENTAL BEARER CIRCUITS GENERALLY USED WITH A 3-kHz SPACING

(Geneva, 1964; amended at Geneva, 1972, 1976 and 1980)

1 Frequency-modulated voice-frequency telegraph (FMVFT) systems, with a spacing of 360 Hz between the mean frequencies, can accommodate seven channels. In the case of telephone bearer channels with 4-kHz spacing, channel position 8 can be used.

2 The nominal modulation rate is fixed at 200 bauds.

3 The nominal mean frequencies are 540 + (n − 1) 360 Hz, n being the channel position number. The mean frequency is defined as half the sum of the characteristic frequencies corresponding to the start and stop polarities. For the numbering of channels that has been adopted in the international service see Recommendation R.70 *bis*.

4 The mean frequencies at the sending end must not deviate by more than ± 3 Hz from their nominal value.

5 The difference between the two characteristic frequencies in the same channel is fixed at 180 Hz.

6 The maximum tolerance on this difference should be ± 4 Hz.

7 The unbalance due to the modulation process $\delta = 2\dfrac{|F'_0 - F_l|}{F'_A - F'_Z}$ should not exceed 2%,

where

F'_A and F'_Z are the two characteristic frequencies measured over a period of 10 seconds;

F'_0 is the mean static frequency measured $= \dfrac{F'_A + F'_Z}{2}$;

F_l is the mean dynamic frequency measured with 1:1 rectangular signals during 10 seconds.

Measurements should be made applying to the input of the transmitter 1:1 rectangular signals with the build-up and hangover time below 1 μs and with the unbalance below 0.1%. In the event that in service the transmitter is controlled by an electro-mechanical relay (with a certain transit time), the measurement should also be made with that type of relay inserted between the 1:1 signal generator and the input to the transmitter. Both forms of measurements need not necessarily be included in the maintenance procedure but should be included in laboratory type tests.

Note – To determine the unbalance due to the modulation process by the method indicated above, it is necessary to measure the frequencies F'_A, F'_Z and F_l and to calculate the mean frequency F'_0 and the unbalance

$$\delta = 2\frac{|F'_0 - F_l|}{F'_A - F'_Z}.$$

A more rapid method for checking whether or not the unbalance is less than the limit fixed is to measure:

- the mean dynamic frequency F_l with 1:1 signals during 10 seconds;
- the mean dynamic frequency F_m with 2:2 signals during 10 seconds;

$$\delta = 2\frac{|F'_0 - F_l|}{F'_A - F'_Z} = 4\frac{|F'_0 - F_m|}{F'_A - F'_Z}$$

or to subtract:

$$|F_l - F_m| = \frac{1}{4}(F'_A - F'_Z)\delta \approx \frac{1}{4}(F_A - F_Z)\delta \leq 1.3 \text{ Hz}.$$

The absolute value of the difference between the two frequencies measured, F_l and F_m, must be less than 1.3 Hz.

8 The mean power per channel at relative zero level should not be more than 19.2 microwatts.

9 In service, the levels of the signals corresponding to continuous stop polarity and continuous start polarity should not differ by more than 1.7 dB in the same channel. Both of these levels must lie between ± 1.7 dB with reference to the level in § 8 above.

10 The start polarity frequency is the higher of the two characteristic frequencies, and the stop polarity is the lower one (see Recommendation V.1 [1]).

11 In the absence of a channel-modulator control telegraph current, a frequency shall be transmitted that shall be within ± 10 Hz of the frequency normally transmitted for the start polarity. It is not necessary for this transmission to take place immediately after the control current has been cut.

12 The receiving equipment should operate satisfactorily when the receiving level falls to 17.4 dB below the nominal level. The receiving equipment should have been restored to start polarity when the receiving level has fallen to 23.5 dB below the nominal level. The alarm-control level is left to the choice of each Administration.

13 On delivery by the manufacturer of 200-baud/360-Hz FMVFT equipment, the following values must not be exceeded for the degree of distortion on a telegraph channel. These values correspond to closed circuit measurements, made with the audio-frequency line terminals of the sending and receiving equipments connected together through an artificial line. Before the series of measurements taken in accordance with Recommendation R.51, the levels are adjusted to their normal values, the mean frequencies are checked to see whether they are within ± 3 Hz of their nominal value (see § 4 above) and the difference between the two characteristic frequencies is within the permitted tolerance of less than 4 Hz (see § 6 above). Bias distortion is eliminated by adjustment in the channel receivers. The other channels of the system are modulated with unrelated signals when the effect of interchannel interference is to be included in the measurement. These "unrelated signals" can conveniently be 1:1 signals from different generators at approximately 200 bauds but not synchronous to each other or to the signal on the channel under test.

a) The transmission levels being normal, the artificial line introducing no frequency drift, but the measured channel being subject to fortuitous distortion due to interchannel interference: 6% for the degree of inherent isochronous distortion.

b) The level being maintained constant, but at a value different from the normal level, for all constant levels between 8.7 dB above the normal reception level and 17.4 dB below the normal reception level, the other conditions being the original measurement conditions: 8% for the degree of inherent isochronous distortion.

c) In the presence of interference by a single sine-wave frequency equal first to one and then to the other characteristic frequency, with a level of 20 dB below the signal level, the other conditions for the start of measurements being maintained: 15% for the degree of inherent isochronous distortion (i.e. total distortion including the increase due to the interfering frequency, not distortion due to the interfering frequency alone).

d) By introducing a frequency drift (Δf Hz) of the signals during transmission through the artificial line, Δf being not more than 10; and the initial conditions of the test otherwise being preserved: $(6 + 1.2\ \Delta f\ \text{Hz})$% for the degree of inherent isochronous distortion: the measurements shall be made after the transient effects of changing frequency have ceased.

14 Frequency drifts on modern telephone-type circuits are generally less than 2 Hz. Hence, it is not necessary to recommend frequency drift control. For circuits on which a maximum frequency drift of not greater than ± 2 Hz cannot be guaranteed, and on which the distortion resulting from the frequency drift is not acceptable, compensation seems necessary. Two methods can be used:

- compensation for each channel up to about 15 Hz;
- compensation for all the channels by using a pilot. In this case, the receiving end must be able to request and obtain a pilot frequency. Administrations should agree among themselves on the advisability of sending the pilot and the choice of frequency. The frequency 300 Hz is recommended, with a tolerance of ± 1 Hz. The mean power emitted at the relative zero point on this frequency should not exceed that recommended for a telegraph channel in the case of a 24-channel group, i.e. −22.5 dBm0.

15 The number of significant conditions of the modulation is fixed at two; this number may be increased, if necessary, by agreement between the Administrations concerned.

Reference

[1] CCITT Recommendation *Equivalence between binary notation symbols and the significant conditions of a two-condition code*, Vol. VIII, Fascicle VIII.1, Rec. V.1.

Recommendation R.39

VOICE-FREQUENCY TELEGRAPHY ON RADIO CIRCUITS

(former CCIT Recommendation B.49, Geneva, 1956; amended at Geneva, 1964, Mar del Plata, 1968 and Geneva, 1976)

It is necessary to distinguish between the case in which the radio frequency used is below approximately 30 MHz, and the case in which the radio frequency used is greater than approximately 30 MHz.

1 Radio circuits the frequency of which is below approximately 30 MHz

1.1 In the case of radio circuits whose frequency is less than approximately 30 MHz, it appears that the use of amplitude-modulated voice-frequency telegraph systems, as defined by Recommendation R.31, cannot be recommended. In such a case, the nature of the telephone-type circuits available for telegraph operation may vary widely according to the radio system used, and several systems of telegraph transmission are available (e.g. two- or four-tone telegraph systems, frequency modulated systems, etc.).

1.2 However, frequency-shift systems are in use on many routes and the frequency-exchange method of operation is in use on long routes suffering from severe multipath distortion.

1.3 *Synchronous telegraphy operating at approximately 100 bauds* (see CCIR Recommendation 436-2 [1])

Radiotelegraph channels that operate synchronously at a modulation rate of 96 bauds and employ automatic error correction are being increasingly used. The channel arrangement shown in Table 1/R.39 is preferred for voice-frequency multi-channel frequency-shift systems operating at a modulation rate of approximately 100 bauds over HF radio circuits. For frequency-exchange systems, the central frequencies of Table 1/R.39 should be used, and should be paired in the manner found to be best suited to the propagation conditions of the route. (A typical arrangement would take alternate pairs giving 340 Hz between tones.)

TABLE 1/R.39

Central frequencies of voice-frequency frequency-shift telegraph channels with a channel separation of 170 Hz and a modulation index of about 0.8

(Frequency shift: ± 42.5 Hz or ± 40 Hz)

Channel position	Central frequency (Hz)	Channel position	Central frequency (Hz)
1	425	8	1615
2	595	9	1785
3	765	10	1955
4	935	11	2125
5	1105	12	2295
6	1275	13	2465
7	1445	14	2635
		15	2805

1.4 *Start-stop telegraphy at 50 bauds*

For several years, various Administrations have had in service, on certain selected circuits, equipment with a channel spacing of 120 Hz, the central frequencies and frequency deviations of which are in agreement with Recommendation R.35. The central frequencies of these systems are given in Table 2/R.39.

TABLE 2/R.39

Central frequencies of voice-frequency frequency-shift telegraph channels with a channel separation of 120 Hz and a modulation index of about 1.4

(Frequency shift: ± 35 Hz or ± 30 Hz)

Channel position	Central frequency (Hz)	Channel position	Central frequency (Hz)
1	420	11	1620
2	540	12	1740
3	660	13	1860
4	780	14	1980
5	900	15	2100
6	1020	16	2220
7	1140	17	2340
8	1260	18	2460
9	1380	19	2580
10	1500	20	2700

2 Radio circuits whose frequency is greater than approximately 30 MHz

The use of voice-frequency telegraphy on line-of-sight radio-relay links and on trans-horizon radio-relay systems is under study.

Reference

[1] CCIR Recommendation *Arrangement of voice-frequency telegraph channels working at a modulation rate of about 100 bauds over HF radio circuits*, Vol. III, Rec. 436-2, ITU, Geneva, 1978.

SECTION 3

SPECIAL CASES OF ALTERNATING CURRENT TELEGRAPHY

Recommendation R.40

COEXISTENCE IN THE SAME CABLE OF TELEPHONY AND SUPRA-ACOUSTIC TELEGRAPHY

(former CCIT Recommendation B.17, Brussels, 1948; amended at Geneva, 1951)

The CCITT,

considering

(a) that this process provides only one telegraph channel, in addition to the telephone channel, and that it can be applied only in comparatively few cases (lightly loaded or unloaded circuits, which cannot be used for multi-channel carrier telephony);

(b) that in such cases, the Administrations and private operating agencies concerned could in most cases by common agreement contemplate the possibility of making use of some other more suitable process that would provide, in addition to the audio telephone channel, more than one telegraph channel;

unanimously declares the view

that the use of supra-acoustic telegraphy should not prejudice the quality of transmission over the adjacent telephone channel and that, in particular, it should not limit the band of frequencies necessary for good speech reproduction (300 to 3400 Hz at least).

Recommendation R.41

UTILIZATION OF THE INTERCHANNEL FREQUENCY BAND OF TELEPHONE CARRIER CIRCUITS FOR TELEGRAPH TRANSMISSION

(former CCIT Recommendation B.18, Geneva, 1951; amended at New Delhi, 1960)

The CCITT,

unanimously declares the view

that in the present state of technical development the utilization for telegraph communication of the interchannel frequency band of telephone channels on cable carrier systems is neither technically nor economically desirable.

SIMULTANEOUS COMMUNICATION BY TELEPHONE AND TELEGRAPH ON A TELEPHONE-TYPE CIRCUIT

(former CCIT Recommendation B.50, Geneva, 1956; amended at Geneva, 1964 and 1980)

The CCITT,

considering

(a) that the use of a leased telephone-type circuit for simultaneous communication by telephone and telegraph is envisaged in Recommendations D.1 [1] and H.32 [2];

(b) that the CCITT has indicated conditions under which the simultaneous use of telephone-type circuits for telephony and telegraphy is technically tolerable;

(c) that standardization of the characteristics of equipment permitting simultaneous use of a telephone-type circuit for telephony and telegraphy is not justified, but that it is necessary to limit the power of the signals transmitted and to avoid the use of frequencies that will interfere with any telephone signalling equipment that may remain connected to the telephone-type circuit;

(d) that new demands for the allocation of particular frequencies for special purposes frequently arise and the number of frequencies used for any one purpose should not be unnecessarily extended;

(e) that the systems described below may be useful when the more modern systems advocated in Recommendation H.34 [3] are not feasible;

unanimously declares the view

(1) that in the case of the simultaneous use of a telephone-type circuit for telephony and telegraphy, the resulting maximum permissible 1-minute mean power loading shall not exceed 50 μW0 (i.e. −13 dBm0);

(2) that where frequency division multiplexing is employed, the general principle concerning the allocation of level to each type of service should be that the allowable mean signal power is proportional to the bandwidth assigned. This case is considered in more detail in Recommendation H.34 [3], resulting in the aggregate power of the telegraph signals being set a level not exceeding 10 μW0 (i.e. approximately −20 dBm0);

(3) that there should not be more than three circuits of this type in a frequency-division multiplexed group of 12 telephone-type circuits and that the number of circuits of this type set up on a wideband carrier system should not exceed the number of supergroups in the system;

(4) that the telegraph signals transmitted must not interfere with any signalling equipment that may remain connected to the telephone-type circuit,

and notes

that some Administrations have permitted the use, for simultaneous telephony and telegraphy of the frequencies 1680 Hz and 1860 Hz both for amplitude and for frequency modulation.

Note – If circuits equipped in accordance with the present Recommendation are used in a private network, it will be impossible to use push-button telephone sets or multifrequency signalling (e.g. Signalling System R2) in the network.

References

[1] CCITT Recommendation *General principles for the lease of international (continental and intercontinental) private leased telecommunication circuits*, Vol. II, Fascicle II.1, Rec. D.1.

[2] CCITT Recommendation *Simultaneous communication by telephony and telegraphy on a telephone-type circuit*, Vol. III, Fascicle III.4, Rec. H.32.

[3] CCITT Recommendation *Subdivision of the frequency band of a telephone-type circuit between telegraphy and other services*, Vol. III, Fascicle III.4, Rec. H.34.

6-UNIT SYNCHRONOUS TIME-DIVISION 2-3-CHANNEL MULTIPLEX TELEGRAPH SYSTEM FOR USE OVER FMVFT CHANNELS SPACED AT 120 Hz FOR CONNECTION TO STANDARDIZED TELEPRINTER NETWORKS

(Mar del Plata, 1968)

The CCITT,

considering

(a) that synchronous modulation enables a larger number of telegraph channels to be constituted by time-subdivision of a standardized telegraph channel (Recommendation R.35);

(b) that such an increase may be of interest in the case of long submarine cables of the telephone type in view of the resulting economies;

(c) that, in addition to the signals of International Telegraph Alphabet No. 2, transmission of the selection and supervisory signals is essential when incorporating the telegraph channels thus provided into the international switching network;

(d) that it is desirable to allow for the provision of half-rate and quarter-rate channels;

(e) that correct phase-relationship should be established and also maintained automatically;

(f) that systems using 5- and 6-unit codes have been proposed,

unanimously declares the view

that, where the synchronous multiplex system uses a 6-unit binary code, the equipment should be constructed to the following standards (Administrations may of course by mutual agreement use a different system with a 5-unit code such as that described in [1].

1 Telegraph modulation

1.1 The character period should be 145 5/6 ms.

1.2 The multiplexing should provide for the derivation of either 2 or 3 time-division channels from each voice-frequency telegraph (VFT) channel. The aggregate modulation rate will be 82 2/7 bauds for a 2-channel multiplex and 123 3/7 bauds for a 3-channel multiplex. Generally it is found that VFT systems conforming to Recommendation R.35 will operate satisfactorily at 82 2/7 bauds, but to ensure satisfactory operation at 123 3/7 bauds, it is necessary to employ characteristic distortion compensation (CDC) at the receiving end of the VFT channel.

1.3 The time derived channels shall be interleaved element by element to form the aggregate signal.

2 Connection to start-stop circuits

2.1 The channel inputs shall be capable of accepting signals from start-stop equipment conforming to Recommendation S.3 [2] (except § 1.6 of S.3). The channel output should be start-stop with a modulation rate of 50 bauds. Standards of performance are given in § 9 below.

3 Alphabet

3.1 Combinations 1 to 31 of the 5-unit International Telegraph Alphabet No. 2 shall each be preceded by an A-condition element, while the continuous start and continuous stop conditions shall utilize the 6-unit combinations AAAAAA and ZZZZZZ respectively. The remaining combination No. 32 shall be preceded by a Z element.

3.2 The alphabet should be as shown in Annex A.

4 Grouping of multiplex systems

4.1 A common phasing control can be used for a number of multiplex systems carried by different channels of the same VFT system. A group of multiplexes shall comprise a maximum of six systems. Some time-derived channels shall be capable of being further divided to provide sub-channels. The various channels should be identified by a figure denoting the number of the multiplex system within the group of six, i.e. 1-6 followed by a letter denoting the channel within that system, i.e. A, B or C. Thus the complete channel numbering will be as follows:

Multiplex system/channel

1A, 2A, 3A, 4A, 5A, 6A –, 2B, 3B, 4B, 5B, 6B 1C, 2C, 3C, 4C, 5C, 6C	full rate

(1B is not available as a full-rate channel – see § 7 below.)

4.2 Each A channel should be full character rate only.

4.3 Each B channel should be capable of full character rate and subdivision (except 1B, which is permanently subdivided).

4.4 The full-rate channels A and B in the case of 2-channel multiplexing, or A, B and C in the case of 3-channel, should be multiplexed on an element-interleaved basis in the following sequence:

A1, B1, A2, B2, etc. for 2-channel operation (where A1 is the first element of channel A etc.);

A1, B1, C1, A2, B2, C2, etc. for 3-channel operation.

5 Subdivision of channels

5.1 All full character-rate channels B (except B1) and C should be capable of subdivision into quarter character-rate channels, and into multiples of quarter-rate, i.e. one half-rate, using two quarter-rate channels. (Although theoretically three-quarter rate channels could be provided, controlled by means of pulses from the multiplex equipment, provision of this facility is not recommended.)

5.2 The sub-channels should be identified basically in the same manner as the full-rate channels with the addition of a numeral denoting the quarter-rate channel, i.e. 1-4. In the case of half-rate channels, the numbers of the two quarter-rate channels used for it should be shown, i.e. 1/3 or 2/4. Thus the complete sub-channel numbering will be as follows:

Multiplex system/channel/sub-channel

1B1, 2B1, 3B1, 4B1, 5B1, 6B1. 1B2, 2B2, 3B2, 4B2, 5B2, 6B2. 1B3, 2B3, 3B3, 4B3, 5B3, 6B3. –, 2B4, 3B4, 4B4, 5B4, 6B4.	1C1, 2C1, 3C1, 4C1, 5C1, 6C1 1C2, 2C2, 3C2, 4C2, 5C2, 6C2 1C3, 2C3, 3C3, 4C3, 5C3, 6C3 1C4, 2C4, 3C4, 4C4, 5C4, 6C4	quarter rate

(1B4, phasing control only)

1B1/3, 2B1/3, 3B1/3, 4B1/3, 5B1/3, 6B1/3 –, 2B2/4, 3B2/4, 4B2/4, 5B2/4, 6B2/4 (1B2/4 not available) 1C1/3, 2C1/3, 3C1/3, 4C1/3, 5C1/3, 6C1/3 1C2/4, 2C2/4, 3C2/4, 4C2/4, 5C2/4, 6C2/4	half rate

5.3 The sub-channels 1, 2, 3 and 4 shall be operated in the following character sequence:

A B1 A B2 A B3 A B4 A B1, etc. for 2-channel operation,

A B1 C1 A B2 C2 A B3 C3 A B4 C4 A B1 C1, etc. for a 3-channel operation.

5.4 All the sub-channels shall be transmitted with the same polarity except those of channel 1B, which should be inverted.

6 Transposition pattern

6.1 To avoid inadvertent cross-connections between channels when the system is out of phase, element transpositions should be allocated to the channels and sub-channels as follows:

Channel A	1 2 3 4 5 6	sub-channel 1
Channel B	1 3 2 4 5 6	
Channel C	1 2 4 3 5 6	
Channel A	1 2 3 5 4 6	sub-channel 2
Channel B	1 2 3 4 6 5	
Channel C	1 4 3 2 5 6	
Channel A	1 2 5 4 3 6	sub-channel 3
Channel B	1 2 3 6 5 4	
Channel C	1 5 3 4 2 6	
Channel A	1 2 6 4 5 3	sub-channel 4
Channel B	1 6 3 4 5 2	
Channel C	1 6 5 4 3 2	

6.2 Full character-rate and half character-rate channels should take that sequence which is allocated to their lowest-numbered sub-channel, i.e. a full character-rate channel should take the sequence for its sub-channel 1, a half character-rate sub-channel using sub-channels 1 and 3 should take the sequence for its sub-channel 1, and a half character-rate sub-channel using sub-channels 2 and 4 should take the sequence for its sub-channel 2.

6.3 The element transpositions shall be carried out in the permanent wiring to the start-stop input and output units so that each of these units may be used in any position without alteration.

7 Phasing

7.1 Provision should be made for:

a) automatic phasing, automatically initiated (normal working condition);

b) automatic phasing, manually initiated;

c) manual phasing.

7.2 One quarter-rate channel of the group (1B4) should be permanently allocated for phasing control purposes, and should continuously send the character ZZAAZZ (the phasing signal).

7.3 Automatic initiation of phasing should occur when three successive phasing signals have not been recognized.

7.4 Automatic phasing may be in steps of one element per expected reception of the phasing signal, i.e. every four transmission cycles (583 ms), or alternatively a method that will carry out rephasing in one operation thus reducing the time spent on phasing. Phasing shall automatically cease when the phasing signal is recognized on the phasing sub-channel receiving unit.

7.5 Visual indication of the correct reception of the phasing signal should be given.

8 Telex and gentex signalling

8.1 The multiplex equipment should be capable of accepting CCITT types A, B and C signals and shall sensibly reproduce them with minimum delay or change.

8.2 It is especially desirable to transmit the signals used for calling and call confirmation with the minimum delay in order to minimize the probability of simultaneous seizure from both ends where circuits are used for both-way working.

8.3 To meet this requirement of minimum delay it is necessary that both the normal character storage inherent in a random arrival system should be bypassed during the free-line condition and the incoming signal from telex should be inspected at the most frequent intervals possible, with element interleaving between channels. Thus effectively the line input circuit is connected directly to the multiplex aggregate, and is inspected at intervals of 24 11/36 ms causing an element of this length and input polarity to be transmitted over the aggregate signal path. At the receiving end this element would be distributed to the appropriate channel and produce an element of like polarity at the output. The result of this is to transmit elements of 24 11/36 ms of a polarity determined by the channel input.

8.4 With the character store bypassed in this way the transmission of pulse signals, which may be signalling or dialling, during the setting up of a telex call is also permitted. The character store must, however, be switched into use prior to the transmission of teleprinter characters whether these are signalling or traffic.

8.5 The method of switching start-stop stores into the connection depends on the type of signalling and it may vary with the direction of calling. Normally each direction of signalling may be considered separately and the stores can be switched into the connection within a period less than one character length of the inversion to stop polarity's being recognized, but with calls to type B dial selection systems switching must be deferred until such conversion has occurred on both signalling paths.

8.6 It seems desirable to guard against reproduction of short spurious pulses on the input line as full elements. Pulses of up to 8-10 ms should therefore be rejected. Thus pulses would result as follows:

Input to system	*Multiplex aggregate*	*Output from system*
0-9 (± 1) ms of either polarity	No pulse	No pulse
9 (± 1)-33 11/36 ms	1 element (24 11/36 ms)	For A polarity 45 ms For Z polarity 33 ms
33 11/36-57 11/18 ms	2 elements (48 11/18 ms)	Both polarities 48 11/18 ms

8.7 An alternative method of producing pulses, as follows, would be acceptable:

0-9 (± 1) ms	No pulse	
9 (± 1)-24 11/36 ms	1 element (24 11/36 ms)	For A polarity, 45 ms
24 11/36-48 11/18 ms	1 element (24 11/36 ms)	For Z polarity, 33 ms
	or 2 elements (48 11/18 ms)	Both polarities 48 11/18 ms
48 11/18-72 11/12 ms	2 elements (48 11/18 ms)	
	or 3 elements (72 11/12 ms)	Both polarities 72 11/12 ms

8.8 Dial pulse trains when received within the speed and ratio limits specified in Recommendation U.2 should be regenerated within the bypass unit, to be retransmitted by the multiplex equipment when the store is bypassed with a minimum duration of Z polarity of 32-34 ms and that of A polarity of 44-46 ms. Two or more elements of either A or Z polarity should be transmitted as multiples of 24 11/36 ms and within the ratio limits specified should not exceed 73 ms for Z polarity and 98 ms for A polarity.

8.9 The type B call confirmation or proceed-to-select signal when received by the multiplex equipment within the limits specified by Recommendation U.1 should, on retransmission by the multiplex equipment, fall within the limits of 32-50 ms. The interval of A polarity between call-confirmation and proceed-to-select signals should be not less than 60 ms.

8.10 In order to discriminate between the various type B backward path signals and to preserve their duration within acceptable limits it may be necessary to delay their transmission. This delay should be kept to a minimum in all cases.

9 Standards of performance

9.1 The stability of the master oscillator controlling the timing of each group should not be worse than ± 1 part in 10^6.

9.2 The degree of isochronous distortion of the aggregate output should not exceed 3%. The degree of synchronous start-stop distortion of the channel output should not exceed 3%.

9.3 The receiving input margin for both the aggregate and start-stop channel input should not be less than ± 45%.

9.4 The maximum speed error for the start-stop output signals should not be greater than ± 0.5%.

10 Miscellaneous facilities

10.1 It should be arranged that when phase is lost the output of the multiplex channels becomes a continuous condition. When a channel is used for telex, the continuous condition should be A. When a channel is used for other services the condition may be Z if required.

10.2 With the exception of combination No. 32, the 6-unit equivalents to the combinations of International Telegraph Alphabet No. 2 have the first element of condition A. If the first element is received erroneously as condition Z, the character need not be rejected but may be passed to the channel output.

Note — The requirements to be met by synchronous multiplex equipment for telex and gentex operation are defined in Recommendation U.24.

ANNEX A

(to Recommendation R.44)

Code conversion table

Combination No. in International Telegraph Alphabet No. 2	Letter case	Figure case	Code in International Telegraph Alphabet No. 2 (see Note 1)	Code in International Telegraph Alphabet No. 4 (see Note 1)
1	**A**	–	ZZAAA	AZZAAA
2	**B**	?	ZAAZZ	AZAAZZ
3	**C**	:	AZZZA	AAZZZA
4	**D**	Note 2	ZAAZA	AZAAZA
5	**E**	3	ZAAAA	AZAAAA
6	**F**	Note 2	ZAZZA	AZAZZA
7	**G**	Note 2	AZAZZ	AAZAZZ
8	**H**	Note 2	AAZAZ	AAAZAZ
9	**I**	8	AZZAA	AAZZAA
10	**J**	Note 2	ZZAZA	AZZAZA
11	**K**	(	ZZZZA	AZZZZA
12	**L**	)	AZAAZ	AAZAAZ
13	**M**	.	AAZZZ	AAAZZZ
14	**N**	,	AAZZA	AAAZZA
15	**O**	9	AAAZZ	AAAAZZ
16	**P**	0	AZZAZ	AAZZAZ
17	**Q**	1	ZZZAZ	AZZZAZ
18	**R**	4	AZAZA	AAZAZA
19	**S**	'	ZAZAA	AZAZAA
20	**T**	5	AAAAZ	AAAAAZ
21	**U**	7	ZZZAA	AZZZAA
22	**V**	=	AZZZZ	AAZZZZ
23	**W**	2	ZZAAZ	AZZAAZ
24	**X**	/	ZAZZZ	AZAZZZ
25	**Y**	6	ZAZAZ	AZAZAZ
26	**Z**	+	ZAAAZ	AZAAAZ
27	carriage-return		AAAZA	AAAAZA
28	line-feed		AZAAA	AAZAAA
29	letter-shift		ZZZZZ	AZZZZZ
30	figure-shift		ZZAZZ	AZZAZZ
31	space		AAZAA	AAAZAA
32	not normally used		AAAAA	ZAAAAA
–	phasing signal		–	ZZAAZZ
–	signal α		permanent A polarity	AAAAAA
–	signal β		permanent Z polarity	ZZZZZZ

Note 1 — Symbols A and Z have the meanings defined in Definition 31.38 of Recommendation R.140.
Note 2 — See Recommendation S.4 [3].

References

[1] *Report on synchronous telegraphy over standardized telegraph channels*, White Book, Vol. VII, Supplement No. 8, ITU, Geneva, 1969.

[2] CCITT Recommendation *Transmission characteristics of the local end with its termination (ITA No. 2)*, Vol. VII, Fascicle VII.2, Rec. S.3.

[3] CCITT Recommendation *Use of International Telegraph Alphabet No. 2*, Vol. VII, Fascicle VII.2, Rec. S.4.

Recommendation R.49

INTERBAND TELEGRAPHY OVER OPEN-WIRE 3-CHANNEL CARRIER SYSTEMS

(New Delhi, 1960)

The CCITT,

considering

(a) It is considered necessary to introduce, for international traffic, an open-wire carrier system that uses common line repeaters for telephone and interband telegraph channels.

(b) This is important for some Administrations that desire to have a small number of telegraph channels (up to six) without having to use a *standard* voice-frequency telegraph system on one of the telephone circuits, thereby effecting an economy, as all the telephone circuits are retained entirely for telephone traffic.

(c) The arrangement of line frequencies as far as the telephone channels are concerned should be as specified in Recommendation G.361 [1].

unanimously declares the following view:

1 Four interband telegraph channels, for a modulation rate of 50 bauds, can be set up over an open-wire carrier system by the use of line repeaters common to the telephone channels and the telegraph channels provided that the system in question conforms to the Recommendation cited in [2].

2 The nominal frequencies of these four telegraph channels are as follows:

2.1 *Low-frequency direction of transmission*:

3.22 – 3.34 – 3.46 and 3.58 kHz.

2.2 *High-frequency direction of transmission*:

a) telephone channels occupying the frequency band 18 and 30 kHz:
30.42 – 30.54 – 30.66 and 30.78 kHz;

b) telephone channels occupying the frequency band 19 and 31 kHz:
18.22 – 18.34 – 18.46 and 18.58 kHz.

3 When in-band signalling is employed on the telephone channels (as opposed to out-band signallng outside the 4-kHz bandwidth), it becomes possible to provide two additional telegraph channels having the following nominal frequencies:

3.1 *Low-frequency direction of transmission*: 3.70 and 3.82 kHz.

3.2 *High-frequency direction of transmission*:

a) telephone channels occupying the frequency band 18 and 30 kHz: 30.18 and 30.30 kHz;

b) telephone channels occupying the frequency band 19 and 31 kHz: 18.70 and 18.82 kHz.

4 In those cases where, as a result of agreement between the Administrations concerned, the system employs an upper pilot of 17.800 kHz, the following frequencies may be used as alternatives to those specified in § 2.2 b) and § 3.2 b) above. This alternative arrangement permits, in certain types of systems, a more economical modulation process: 31.42 – 31.54 – 31.66 and 31.78 kHz, instead of 18.22 – 18.34 – 18.46 and 18.58 kHz, also 31.18 and 31.30 kHz instead of 18.70 and 18.82 kHz.

5 This Recommendation applies to amplitude-modulated telegraphy and to frequency-modulated telegraphy.

6 It is not considered desirable to standardize absolutely the power transmitted to the line as this may be dependent upon the conditions on the open-wire route. Under favourable conditions a recommendable value for the power on each telegraph channel would be – 20 dBm0 (referred to one milliwatt at a point of zero relative level).

7 For amplitude modulation the tolerance on the sent frequency will be ± 6 Hz and for frequency modulation the tolerances given in Recommendation R.35 will apply.

8 In tests made on the local end, equipments should meet the distortion conditions described in § (2) of Recommendation R.50 for amplitude modulation, and those described in § 13 of Recommendation R.35 for frequency modulation.

9 The correspondence between the significant conditions described in § 15 of Recommendation R.31 and § 9 of Recommendation R.35 applies to these channels for interband telegraphy.

References

[1] CCITT Recommendaion *Systems providing three carrier telephone circuits on a pair of open-wire lines*, Vol. III, Fascicle III.2, Rec. G.361.

[2] *Ibid.*, § 2.

SECTION 4

TRANSMISSION QUALITY

Recommendation R.50

TOLERABLE LIMITS FOR THE DEGREE OF ISOCHRONOUS DISTORTION OF CODE-INDEPENDENT 50-BAUD TELEGRAPH CIRCUITS

(former CCIT Recommendation B.24, Arnhem, 1953; amended at Geneva, 1976 and 1980)

The CCITT,

considering

(a) that, to facilitate the study of plans for the establishment of international telegraph circuits, it is convenient to set limits for the degree of isochronous distortion of the telegraph circuits and channels;

(b) that, for whatever purpose normally used, these circuits should be capable of use with start-stop equipment;

(c) that, in certain cases, limits have been set by Recommendations R.57 and R.58 for the isochronous distortions of the trunk sections of circuits and for that of voice-frequency telegraph channels;

(d) that the limits laid down are those that should be evident in service conditions on telegraph circuits, excluding the local lines and terminal equipment;

unanimously declares the view

(1) that circuits (excluding local lines and terminal equipment) should be established and maintained in such a manner that the degree of isochronous distortion will not exceed 28% whether they are equipped with regenerative repeaters or not;

(2) that the degree of isochronous distortion of each channel that may form part of a circuit should be as small as possible, and should not in any case exceed 10%.

STANDARDIZED TEXT FOR DISTORTION TESTING OF THE CODE-INDEPENDENT ELEMENTS OF A COMPLETE CIRCUIT

(former CCIT Recommendation B.32, Warsaw, 1936; amended at Geneva, 1956 and 1980)

The CCITT,

considering

(a) that, for a precise definition of the degree of distortion in service permitting the comparison of results of measurements obtained under similar conditions in different places, it is advisable to standardize the wording of the text that should be transmitted for the test;

(b) that it is best to choose a text that can be received directly by start-stop equipment and that also presents a sequence of the combinations recognized as those that generally cause the maximum distortion;

unanimously declares the view

(1) that the text to transmit in the course of measurements of the degree of distortion in service should be as shown in Figure 1/R.51;

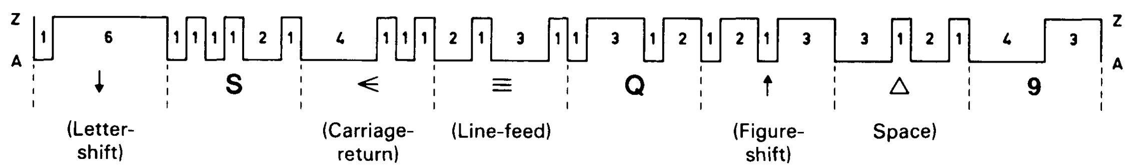


FIGURE 1/R.51

CCITT - 48211

this text corresponds to the following sequence of signals emitted by start- stop equipment:

letter-shift **S** carriage-return line-feed **Q** figure-shift space **9**,

and considering, on the other hand,

(c) that, in maintenance adjustments and in the various distortion measurements that may arise in the study of lines and equipment, it would be necessary to make use of a single apparatus offering the possibility of transmitting the different combinations of signals recognized as the most practical for this purpose;

(d) that the unification of the list of these combinations would permit comparison of results obtained in various places;

unanimously declares the view

(2) that it is appropriate to recommend the construction of special transmitters for distortion measurements, which could transmit with one or the other polarity:

i) the specified text for the measurement of the degree of distortion;

ii) a continuous sequence of reversals, the duration of each element being that of the unit interval corresponding to the anticipated telegraph modulation rate;

iii) a continuous sequence of reversals, the duration of each element being double the unit interval corresponding to the anticipated telegraph modulation rate;

iv) a continuous sequence of signals, each formed by an emission of a duration equal to that of the unit interval, followed by an emission of a kind distinct from the first and of equal duration to that of six unit intervals;

(3) that for all new test equipment, the text specified in Recommendation R.51 *bis* (**QKS**) is preferred. In the interim, either text may be used for tests on code-indepedent systems. For tests on routes where code-dependent systems may be included, a text having characters with a mean length of at least 7.4 units must be used.

Recommendation R.51 *bis*

STANDARDIZED TEXT FOR TESTING THE ELEMENTS OF A COMPLETE CIRCUIT

(Geneva, 1980)

The CCITT,

considering

(a) that, for testing telegraph transmission equipment it is advisable to standardize the wording of the text that should be transmitted for the test;

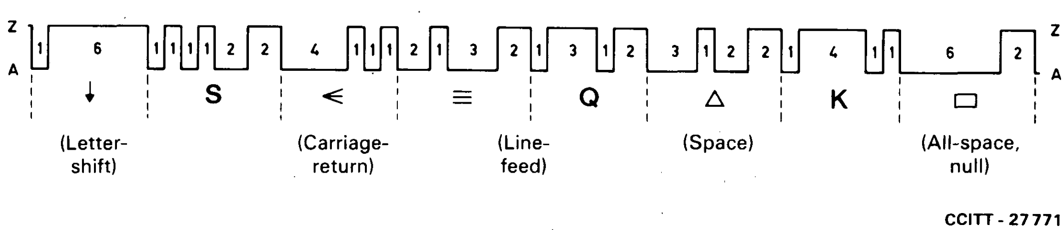
(b) that the text should form a short repetitive test message suitable for conducting routine tests on circuits that include code-dependent channels (International Telegraph Alphabet No. 2) and/or code-independent channels;

(c) that it is best to choose a text that can be received directly by start-stop equipment and that also presents a sequence of the combinations recognized as those that generally cause the maximum distortion;

(d) that the text should contain an equal number of unit elements of each binary condition and that it should be suitable for start-stop or isochronous measurement of distortion when used with code-independent transmission equipment;

unanimously declares the view

(1) that the text to transmit in the course of tests on telegraph transmission equipment should be as shown in Figure 1/R.51 *bis*;



Note — The stop element length alternates between 1 unit and 2 units on successive characters.

FIGURE 1/R.51 *bis*

QKS test message

(2) that when equipment capable of generating the foregoing text is not available, it is acceptable to use the text given in Recommendation R.51 for testing code-independent systems only.

Note – Test equipment capable of generating the text in Figure 1/R.51 *bis* should also be capable of generating 1:1, 2:2, 1:6 and 6:1 patterns for testing code-independent systems only (see § 2 in Recommendation R.51).

Recommendation R.52

STANDARDIZATION OF INTERNATIONAL TEXTS FOR THE MEASUREMENT OF THE MARGIN OF START-STOP EQUIPMENT

(former CCIT Recommendation B.33, Brussels, 1948; amended at Geneva, 1964 and 1980)

The CCITT,

considering

(a) that to test the effective margin of the receiver of a start-stop teleprinter it is desirable to standardize the content of the transmitted sequence of signals;

(b) that there is advantage in choosing a short text that can be directly printed within a single line by start-stop terminal equipments;

(c) that preferably the composition of the text used should include all alpha characters of the basic alphabet employed and be arranged in a format that is easy to read and to understand;

(d) that comparison of the margin measurements obtained would be facilitated by such arrangements;

unanimously declares the view

(1) that it is not necessary to standardize an international text for the measurement of the margin of a teleprinter;

(2) that, nevertheless, where teleprinters are required to receive information in languages based on the Latin alphabet, either of the following texts may be used:

VOYEZ LE BRICK GEANT QUE J'EXAMINE PRES DU WHARF

THE QUICK BROWN FOX JUMPS OVER THE LAZY DOG

Recommendation R.53

PERMISSIBLE LIMITS FOR THE DEGREE OF DISTORTION ON AN INTERNATIONAL 50-BAUD/120-Hz VFT CHANNEL (FREQUENCY AND AMPLITUDE MODULATION)

(former CCIT Recommendation B.36, 1951; amended at Arnhem, 1953, Geneva, 1964 and Mar del Plata, 1968)

The CCITT,

considering

(a) that the numerous tests made on voice-frequency telegraph (VFT) equipment in service now make it possible to establish limits for the degree of distortion outside which a VFT channel must be regarded as being out of order;

(b) that these tests should be made with reversals and with standard text at the modulation rate used for adjustment;

(c) that, when equipment is put into service and when it is adjusted, the minimum distortion should be sought and therefore limits for the degree of distortion need not be established in this case;

unanimously declares the view

(1) that the degree of bias distortion of reversals on an international VFT channel at the modulation rate employed for adjustment should not exceed a value corresponding to 4% at the standard modulation rate of 50 bauds;

(2) that the degree of isochronous distortion in service of an international VFT channel on the standardized text should not exceed 10%, and that the degree of inherent start-stop distortion, in service conditions, on standardized text, should not exceed 8%.

Note – These limits, except where otherwise stated, apply to a modulation rate of 50 bauds and take account of the accuracy of the measuring equipment. They are provisional and may be amended according to the technical development of voice-frequency telegraphy and of studies of telegraph distortion.

Recommendation R.54

CONVENTIONAL DEGREE OF DISTORTION TOLERABLE FOR STANDARDIZED START-STOP 50-BAUD SYSTEMS

(former CCIT Recommendation B.51, Geneva, 1956; amended at Geneva, 1964, and at Mar del Plata, 1968)

The CCITT,

considering

(a) that in telegraph communications used in the public telegram service, in the telex service and for leased circuits, over land lines and submarine cables, using 5-unit start-stop equipment at the modulation rate of 50-bauds, a maximum admissible rate of error of 3 per 100 000 alphabetic telegraph signals transmitted is recommended by Recommendation F.10 [1].

(b) that at present, interruptions of the telephone-type circuit account for a much higher error rate than that recommended by the CCITT.

(c) that to fix the objectives to be reached to curb interruptions and noise in telephone-type bearer circuits, it is of interest to indicate how this tolerable error rate of 3 per 100 000 telegraph signals can be distributed among the telegraph equipment and the circuits bearing the telegraph systems.

(d) that telegraph apparatus, particularly the transmitter and the receiver, is itself liable to fortuitous failures and it is difficult to distinguish between errors due to these causes and errors due to the probability that the degree of telegraph distortion can exceed the receiver margin, which cannot be ignored.

(e) But in planning telegraph circuits, it may be convenient to limit the conventional degree of gross start-stop distortion of complete circuits (including telegraph transmitting apparatus) to the nominal margin of the receiving apparatus.

(f) that moreover, if the individual degree to distortion at apparatus input exceeds the margin by about once in 100 000, the measurements show that the combined effect of telegraph distortion and fortuitous apparatus failures is manifested by an error rate of about 2 per 100 000 telegraph signals.

Note – The result is that the error rate due to interruptions and noise on telephone-type circuits carrying telegraph systems should not exceed 1 per 100 000.

unanimously declares the view

(1) that the conventional degree of distortion should be the individual degree of distortion whose probability of being exceeded is 1 in 100 000;

(2) that theoretical and planning studies should be carried out in such a way that the conventional degree of distortion at the receiver input is not more than the nominal margin.

Note 1 – The notion of conventional degree of distortion is useful above all for theoretical studies and planning.

Note 2 – For the relation between conventional degree of distortion and practical measurements, reference should be made to [2], [3] and [4].

References

[1] CCITT Recommendation *Character error rate objective for telegraph communication using 5-unit start-stop equipment*, Vol. II, Fascicle II.4, Rec. F.10.

[2] *Conventional degree of distortion*, Blue Book, Vol. VII, Supplement No. 4, ITU, Geneva, 1964.

[3] *Relation between the results of routine measurements of distortion and the conventionl degree of distortion*, Blue Book, Vol. VII, Supplement No. 5, ITU, Geneva, 1964.

[4] CCITT – Question 7/IX, Annex, Blue Book, Vol. VII, ITU, Geneva, 1964.

Recommendation R.55

CONVENTIONAL DEGREE OF DISTORTION

(Geneva, 1964)

The CCITT,

considering

(a) that the conventional degree of distortion is (Definition 33.14, Recommendation R.140) the degree of distortion the probability of exceeding which, during a prolonged observation, equals a very small assigned value.

Note – The assigned value should be specified for each case of utilization.

(b) that for standardized start-stop 50-baud systems, the assigned value is 1 per 100 000 (Recommendation R.54).

(c) that to facilitate the use of the conventional degree of distortion and the comparison of studies and plans that have been established with the aid of the conventional degree, it is useful for the probability of being exceeded assigned to the conventional degree to be the same for all telegraph systems (including data transmissions), unless another probability of being exceeded has been assigned to the conventional degree of distortion for special studies.

unanimously declares the view

(1) that, unless otherwise specified by the Administrations and recognized private operating agencies concerned, the conventional degree of distortion is the degree of distortion whose probability of being exceeded is 1 in 100 000;

(2) that the conventional degree of distortion applies to individual distortion.

Recommendation R.57

STANDARD LIMITS OF TRANSMISSION QUALITY FOR PLANNING CODE-INDEPENDENT INTERNATIONAL POINT-TO-POINT TELEGRAPH COMMUNICATIONS AND SWITCHED NETWORKS USING 50-BAUD START-STOP EQUIPMENT

(former CCIT Recommendation B.25, 1951; amended at Arnhem, 1953, and New Delhi, 1960; see also Recommendation R.58)

The CCITT,

considering

(a) that Administrations must agree on the composition of the international section and the national sections before setting up an international point-to-point telegraph circuit,

(b) that for the interconnection of switched public or private national networks a plan for distributing telegraph distortion between national networks and international circuits connecting the international terminal exchanges is required,

(c) that for this purpose, provisional standards, based on the results of practical experience and on studies of the composition of telegraph distortion, should be laid down for Administrations,

(d) that on well-maintained channels, with modulation at the standard rate of 50 bauds, the values in Table 1/R.57 should not normally be exceeded on the trunk sections (see Recommendations R.53 and R.75). These values are valid whether the channels are amplitude or frequency modulated,

TABLE 1/R.57

Number of channels in tandem within the trunk circuit (excluding the local section at each end)	The limit of bias distortion on reversals at the modulation rate employed for adjustment shall be equivalent to the following values at 50 bauds	Limit of the degree of isochronous distortion on standardized text	Limit of the degree of inherent start-stop distortion, in service on standardized text
1	4%	10%	8%
2	7%	18%	13%
3	10%	24%	17%
4	12%	28%	21%
5	–	–	25%

unanimously declares the following view:

1 In planning international point-to-point and switched telegraph communications, Administrations should use the following standard limits valid for start-stop equipment and for 50-baud channels conforming to CCITT Recommendations and set up by amplitude-modulation or frequency-modulation.

Note – Although the figures in Recommendation R.57 are for planning purposes, they do not correspond to conventional degrees of distortion but to routine measurements.

a) Limit of the degree of gross start-stop distortion, measured by a start-stop distortion measuring set at the beginning of the trunk section of the circuit (i.e. at the point where the circuit enters the long-distance line telegraph equipment) and including the effect of the emission distortion of the transmitting apparatus 12%

b) Limit of the degree of isochronous distortion on standardized text in the trunk section of the connection:

When one voice-frequency telegraph (VFT) channel is used for the communication 10%

When two VFT channels are used for the communication 18%

When three VFT channels are used for the communication 24%

When four VFT channels are used for the communication 28%

or

c) Limit of degree of inherent start-stop distortion on standardized text of the trunk section of the connection:

When one voice-frequency (VF) channel is used for the communication 8%

When two VF channels are used for the communication 13%

When three VF channels are used for the communication 17%

When four VF channels are used for the communication 21%

When five VF channels are used for the communication 25%

Note – The limits for the degrees of isochronous and start-stop distortions indicated under b) and c) above do not establish a law of correspondence between the degree of isochronous distortion and the degree of start-stop distortion; this law of correspondence depends on the composition of the distortion (relative magnitudes of characteristic and fortuitous distortion).

d) Limit of the degree of the gross start-stop distortion, measured by a start-stop distortion measuring set, which can be present in signals at the input of the extension circuit of the connection 30%

Note – The (physical) extension circuit (tail) (Definition 32.04, Recommendation R.140) is the permanent connection extending a telegraph station to a nearby centre, giving access to the long-distance network.

2 These standards take no account of the possibility of including regenerative repeaters in circuits.

3 These standards presuppose that the distortion introduced by the local section of the circuit is negligible, and that, should that not be so, Administrations should agree amongst themselves on the degree of distortion admissible in the various sections of the communication, and on the number of VFT channels that can be used.

4 Administrations should use them, in order to agree on the maximum number of VFT channels that may compose the international section of a circuit and in order to determine the characteristics of their national networks due to be connected to the networks of other countries, on the understanding that the isochronous distortion in service, originated by the trunk section, may not in any circumstances exceed 28%.

Recommendation R.58

STANDARD LIMITS OF TRANSMISSION QUALITY FOR THE GENTEX AND TELEX NETWORKS

(New Delhi, 1960; amended at Geneva, 1964)

The CCITT,

considering

(a) that to permit the sharing of responsibility for the maintenance of a high-standard of transmission between countries participating in the establishment of switched connections, it is necessary to specify limiting values of distortion at the international terminal exchanges,

(b) that on the other hand, to enable national switched networks to be interconnected, it is necessary to have a distribution plan of the telegraph distortion between national networks and the international junction circuits connecting up the international switching centres (international terminal switching centres),

(c) that Figure 1/R.58 shows the points of entry and exit of the national network and the ends of the international junction circuit,

(d) that it is difficult to lay down standards applicable both to small and to large national networks. However, it has been possible to fix limit values for large countries and they could apply to the great majority of telex subscriber stations or gentex stations taking part in the international service,

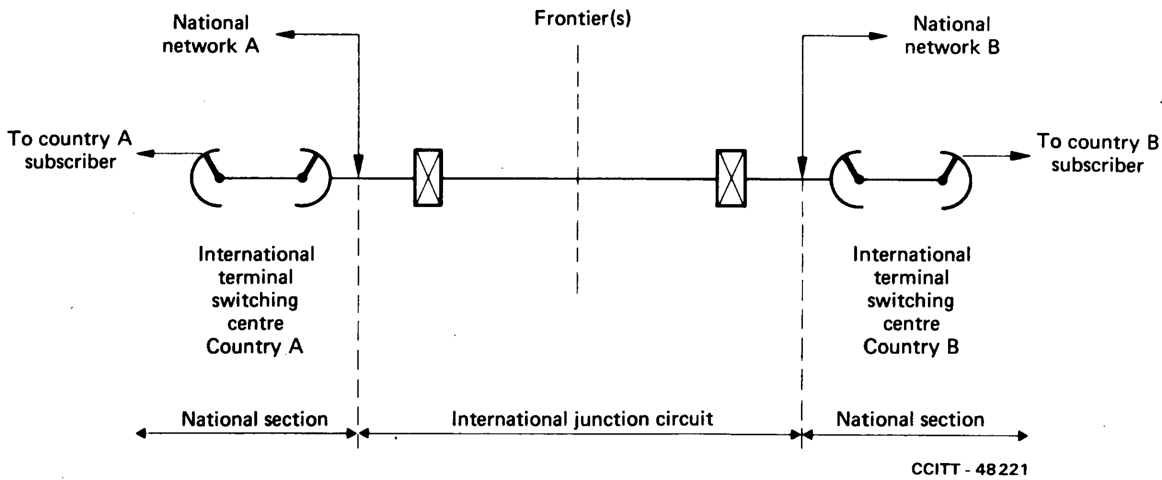


FIGURE 1/R.58

Network diagram

unanimously declares the following view:

1 The following standards of transmission quality are observed for the interconnection of 50-baud national networks set up by means of telegraph channels and start-stop equipment in accordance with CCITT Recommendations (national gentex or telex networks):

a) Degree of gross start-stop distortion in service (i.e. including the effect of distortion due to the sending equipment and the exchanges) at the point of exit of the national network: not more than 22%.

Note – When a terminal country of an international connection possesses an intercontinental transit centre, that transit centre is considered as forming part of the national network.

b) Degree of inherent start-stop distortion of the international junction circuit: not more than 13%.

Note 1 – In establishing the 13% limit for the degree of start-stop distortion in the international junction circuit, account has been taken of the fact that, in a world telex or gentex chain, the junction circuit might quite often consist of two VFT channels in tandem. If the international junction circuit is established on a single channel, the 8% limit mentioned in Recommendation R.57 is applicable to that circuit.

Note 2 – No limit for distortion on the entry of the national network at the receiving end has been indicated in Recommendation R.58. The values mentioned in § 1 a) and § 1 b) above are adequate for planning purposes.

2 Although the degrees of distortion to be inserted in the Recommendations relative to the planning of networks are normally conventional degrees of distortion, the maximum values mentioned under § 1 above correspond to the results that would be provided by the routine measurements carried out in accordance with Recommendation R.5.

3 These limit values are applicable to large countries that are directly connected without switching in a transit country. The stations taking part in the international service that cannot satisfy condition § 1 a) above will have to be specially equipped, for example with distortion correctors.

4 Small countries (defined as countries in which all stations can be reached with not more than one long-distance telegraph circuit in the national network) will have to try to obtain values less than the maximum of 22% for the measurements corresponding to § 1 a) above.

5 The standard limits mentioned under § 1 above can also apply to private switched networks.

INTERFACE REQUIREMENTS FOR 50-BAUD START-STOP TELEGRAPH TRANSMISSION IN THE MARITIME MOBILE SATELLITE SERVICE

(Geneva, 1980)

The CCITT,

considering

(a) that proper interworking with the international telegraph services must be ensured;

(b) that the coast-earth station equipment will interface with the international terrestrial telegraph networks and will therefore need to conform to CCITT Recommendations where applicable;

(c) that the ship station will include a local end with its termination consisting of start-stop equipment using International Telegraph Alphabet No. 2;

unanimously recommends

(1) that the coast earth station equipment interfacing with terrestrial telegraph channels should conform to Recommendation R.101 as applicable to 50-baud services:

a) for signals from the terrestrial network entering the coast earth station, the relevant points are given in Table 1/R.59;

b) for signals from the coast earth station entering the terrestrial network, the relevant points are given in Table 2/R.59;

(2) that the transmission characteristics of the ship terminal start-stop equipment should conform to Recommendation S.3 [1] as applicable to 50-baud services.

Note – This Recommendation corresponds to CCIR Recommendation 553 [2].

TABLE 1/R.59

Parameter	Recommendation R.101
Input modulation rate	§ 2.1
Isolated character stop elements	§ 2.2
Minimum interval between start elements	§ 2.3
No restrictions on the use of combinations of International Telegraph Alphabet No. 2	§ 2.4
Effective net margin	§ 2.5
Minimum input start element duration	§ 2.6

TABLE 2/R.59

Parameter	Recommendation R.101
Output distortion	§ 3.1
Output modulation rate	§ 3.2
Minimum output stop element	§ 3.3

References

[1] CCITT Recommendation *Transmission characteristics of the local end with its termination (ITA No. 2)*, Vol. VII, Fascicle VII.2, Rec. S.3.

[2] CCIR Recommendation *Interface requirements for 50-baud start-stop telegraph transmission in the Maritime Mobile Satellite Service*, Vol. VIII, Rec. 553, ITU, Geneva, 1978.

SECTION 5

CORRECTION OF SIGNALS

Recommendation R.60

CONDITIONS TO BE FULFILLED BY REGENERATIVE REPEATERS FOR START-STOP SIGNALS OF INTERNATIONAL TELEGRAPH ALPHABET No. 2

(former CCIT Recommendation B.20, 1952; amended at Geneva, 1956 and 1964, and at Mar del Plata, 1968)

The CCITT,

considering

(a) that the duration of the transmitting cycle of terminal start-stop apparatus should be at least 7.4 units for appartus operating at 50 and 75 bauds, 7.5 units for apparatus operating at 100 bauds;

(b) that the effective net margin should be greater than:

– 35% for signals sent by a transmitter having a nominal cycle equal to or greater than 7 units (for operation at 50 or 75 bauds),

– 30% for signals sent by a transmitter having a nominal cycle equal to or greater than 7.2 units (for operation at 100 bauds),

unanimously declares the view

(1) that regenerative repeaters for start-stop signals should operate at the nominal modulation rate of the signals that they are required to regenerate with a speed tolerance in service of ± 0.5%;

(2) the effective synchronous margin should be at least 40%;

(3) that the degree of synchronous start-stop distortion (see Definition 33.10, Recommendation R.140) of the retransmitted signals should not exceed 5%;

(4) that the significant instants corresponding to the beginning of the start signals emitted by the regenerative repeater should in no case be separated by less than 7 unit intervals (for operation at 50 or 75 bauds) or 7.2 unit intervals (for operation at 100 bauds).

SITING OF REGENERATIVE REPEATERS IN INTERNATIONAL TELEX CIRCUITS

(former CCIT Recommendation B.26, 1951; amended at Geneva, 1956 and 1964, and Mar del Plata, 1968)

The CCITT,

considering

(a) that insufficient experience has been acquired in the use of regenerative repeaters;

(b) that it nevertheless seems desirable to lay down a provisional rule governing the siting of regenerative repeaters, with a view to the preparation of plans for international telegraph communications by switching;

(c) that it would also appear desirable that the signals transmitted by an international terminal exchange should not be affected by a higher degree of distortion than those recommended in Recommendations R.57 and R.58,

unanimously declares the view

(1) that, when the transmission quality demands it, Administrations agree with one another on the necessity for inserting regenerative repeaters and for taking the necessary steps so that the location chosen ensures that the expenses are equally shared between the Administrations and is appropriate to the organization of their telex and general switching networks and to the quality of transmission that it is possible to provide on complete connections;

(2) that in the automatic intercontinental telex and gentex transit network (see Recommendation F.68 [1]), where regeneration is not inherently provided by time-division multiplex equipment, start-stop regenerative repeaters shall be provided in the receive path of the connection at the intercontinental transit centre.

Note – Start-stop regenerative repeaters and time-division multiplex equipment in accordance with CCITT Recommendations are generally suitable only for normal (50-baud, 5-unit code) telex and gentex operation. Special uses of the automatic intercontinental transit network (cf.§ 7 of Recommendation U.11), involving other codes and speeds, raise problems that have to be investigated.

Reference

[1] CCITT Recommendation *Establishment of the automatic intercontinental telex network*, Vol. II, Fascicle II.4, Rec. F.68.

SECTION 6

TELEGRAPH MAINTENANCE

Recommendation R.70

DESIGNATION OF INTERNATIONAL TELEGRAPH CIRCUITS

(former CCIT Recommendation B.29, 1951;
amended at Arnhem, 1953 and Mar del Plata, 1968)

The CCITT,

unanimously declares the view

that international telegraph circuits should be designated:

(1) first, by the localities of terminal offices, arranged in alphabetical order according to the spelling of the country;

(2) by an indication of the service using the circuit according to the following table:

a) public telegram service circuit:

- i) point-to-point circuit or circuit used for messages switching: TG
- ii) trunk circuit of the public switching network (gentex): TGX
- iii) subscriber's line from a telegraph office to its switching equipment: TGA

b) telex circuit (including circuits common to the telex and gentex services): TX

c) special circuits for private or special services:

- i) point-to-point circuit or circuit used for message switching: TGP
- ii) switched circuit or multi-point network circuit [broadcasting network, conference, omnibus (Definiton 32.44, Recommendation R.140) circuits]: TXP

d) service circuits:

- i) point-to-point circuit: TS
- ii) omnibus or selective ringing circuit section: TXS
- iii) pilot channel for voice-frequency telegraph systems: TT

(3) by a serial number, using a separate continuous series for each group of circuits.

Note – To avoid confusion in the case of TGP and TXP circuits, the designation originally assigned to a leased circuit should not be re-assigned to a new circuit until a period of at least two years has elapsed.

NUMBERING OF INTERNATIONAL VFT CHANNELS

(Mar del Plata, 1968)

The CCITT,

considering

(a) that in view of the introduction in the international service of voice-frequency telegraph (VFT) channels operated at various nominal modulation rates and having different pass-band spacing, and since the same (heterogeneous) system may include channels with different characteristics, it has become necessary to evolve a method of numbering VFT channels;

(b) that this numbering method must make it possible to recognize:

– the type of modulation (amplitude or frequency) on the channel,

– the nominal modulation rate and average channel spacing,

– the position of the channel in the frequency range;

(c) it must also be such that, in a heterogeneous system, any change in the composition of the channels does not change the numbers of the channels already set up in the system. The transformation of a homogeneous system into a heterogeneous one should not alter the numbers of the channels that are retained,

unanimously declares the view

(1) that the channels in an international VFT system should be numbered as shown in Table 1/R.70 *bis*;

TABLE 1/R.70 *bis*

Number allocation

Channel numbers	Channel spacing (Hz)	Type of modulation
001 - 024	120	amplitude
101 - 124	120	frequency
151 - 165	170	frequency
201 - 212	240	frequency
301 - 307	360	frequency
401 - 406	480	frequency

(2) that the number assigned to a channel should be selected from the series applicable to the type of channel and should correspond to its position in the multiplex table;

(3) An example of this procedure is given in Table 2/R.70 *bis.*

TABLE 2/R.70 *bis*

Numbering scheme

Mean frequency (Hz)	420	540	660	780	900	1020	1140	1260	1380	1500	1620	1740	1860	1980	2100	2220	2340	2460	2580	2700	2820	2940	3060	3180	In accordance with Recommendation R.31 } 50 bauds/ Recommendation R.35 } 120 Hz
Channel No.	001 101	002 102	003 103	004 104	005 105	006 106	007 107	008 108	009 109	010 110	011 111	012 112	013 113	014 114	015 115	016 116	017 117	018 118	019 119	020 120	021 121	022 122	023 123	024 124	

Mean frequency (Hz)	480	720	960	1200	1440	1680	1920	2160	2400	2640	2880	3120	Recommendation R.37 50 bauds } 240 Hz 100 bauds }
Channel No.	201	202	203	204	205	206	207	208	209	210	211	212	

Mean frequency (Hz)	600	1080	1560	2040	2520	3000	Recommendation R.38 A 200 bauds/480 Hz
Channel No.	401	402	403	404	405	406	

Mean frequency (Hz)	540	900	1260	1620	1980	2340	2700	3060	Recommendation R.38 B 200 bauds/360 Hz
Channel No.	301	302	303	304	305	306	307	308	

Mean frequency (Hz)	420	540	660	780	900	1020	1140	1260	1560	2040	2340	2460	2640	2880	3120	One example of the application of Recommendation R.36 2 channels-200 bauds/480 Hz 3 channels-100 bauds/240 Hz 10 channels-50 bauds/120 Hz
Channel No.	101	102	103	104	105	106	107	108	403	404	117	118	210	211	212	

Recommendation R.71

ORGANIZATION OF THE MAINTENANCE OF INTERNATIONAL TELEGRAPH CIRCUITS

(former CCIT Recommendation B.30, Brussels, 1948; amended 1951 and at Geneva, 1956)

The CCITT,

considering

that, in order to ensure satisfactory cooperation between Administrations and private telegraph operating agencies interested in the maintenance of international telegraph circuits, and in order to ensure the maintenance of satisfactory transmission in the international telegraph service, it is necessary to unify the essential action to be taken for the establishment and maintenance of international telegraph circuits,

unanimously declares the view:

1 Periodical maintenance measurements should be taken on international voice-frequency telegraph (VFT) systems, and documents relating to such measurements should be exchanged.

2 The responsibilities for the maintenance of satisfactory transmission, and (as and when necessary) the removal of faults on an international VFT system should be assumed by one of the terminal stations of the system to be known as the *system control station*. The said station is to be appointed for the purpose by the Administrations and private telegraph operating agencies concerned on the occasion of the establishment of the VFT system concerned. The system control station is to be entrusted with coordination of the execution of the maintenance measurements to which § 1 above relates.

3 The responsibilities for the maintenance of satisfactory transmission, and (as and when necessary) the removal of faults on an international telegraph system should be allocated between the different stations concerned as indicated below.

3.1 One station of the circuit should assume the principal responsibility for the maintenance of satisfactory service on the circuit. The station in question should be known as the *control station*.

3.2 This station should be equipped with testing equipment to enable it to make telegraph transmission measurements and in this connection it exercises an executive control over all the other stations on the circuit.

3.3 It should be appointed by agreement between the Administrations concerned on the occasion of the establishment of the telegraph circuits concerned. It should be, wherever possible, one of the terminal stations of the circuit, save in so far as otherwise agreed by the services concerned. For example, in the case of VFT circuits, the control station should be one of the terminal VFT stations as nominated by common agreement between the Administrations concerned.

3.4 The control station is responsible for coordinating all operations required when there is a breakdown in the circuit. It keeps a record of all circuit breakdowns. To facilitate supervision, a reference number must be allocated to each breakdown reported.

3.5 When a fault comes to the notice of another station on the circuit, this station should take steps to secure suitable action on the part of other stations concerned; but the control station is nevertheless responsible for ensuring that the fault is cleared as soon as possible.

3.6 The control station should be in a position to furnish all requisite information in reply to inquiries on the subject of faults – e.g. in regard to the time of any fault, the location of the fault, the orders given for dealing with it and the times of restoration of the circuit.

3.7 In order, however, to increase the flexibility of the organization and the rapidity of the removal of faults, the control station will confine itself in each foreign country to securing the cooperation of a station to be known as the *sub-control station* of the circuit. The sub-control station should assume, within its own territory, the responsibilities indicated above in the case of the control station and should therefore be equipped with testing equipment to enable it to make telegraph transmission measurements. Such delegation of responsibility shall not affect the authority of the control station, with which the primary responsibility for the maintenance of satisfactory service on the circuit will continue to rest.

3.8 The sub-control station shall be appointed by the technical service of the Administration concerned. It shall furnish detailed information to the control station regarding faults occurring in its own country.

4 Administrations or private recognized telegraph operating agencies shall be free to organize the maintenance measurements on those portions of international point-to-point circuits and switched connections (including apparatus) that lie wholly within their control, but the methods adopted should be not less efficacious than those recommended for international circuits.

5 To facilitate the control of tests, circuits shall be divided into *test sections* (parts of a circuit between two telegraph stations). Each section shall be under the control of a *testing station* responsible for the localization and removal of faults on the section concerned. The testing station shall furnish detailed information as to the faults occurring in the section under its control to the sub-control station (or, if necessary, the control station).

6 In the case of VFT channels, each channel shall constitute a test section. The testing station will in this case be the principal VFT station at the end of the section concerned.

Recommendation R.72

PERIODICITY OF MAINTENANCE MEASUREMENTS TO BE CARRIED OUT ON THE CHANNELS OF INTERNATIONAL VFT SYSTEMS

(former CCIT Recommendation B.34, 1951; amended at New Delhi, 1960 and Geneva, 1964)

The CCITT,

considering

that, for technical supervision of operations, maintenance measurements on international voice-frequency telegraph (VFT) channels are necessary,

unanimously declares the view

(1) that maintenance measurements be carried out on international VFT channels once every three months (once every six months for 50-baud channels spaced at 240 Hz conforming to Recommendation R.35 *bis*;

(2) that there is no need to carry out measurements more frequently on channels making up long circuits or circuits used in a switched network;

(3) that, when it is observed that the number of maladjustments is too high, supplementary measurements should be performed by agreement between the Administrations concerned.

Recommendation R.73

MAINTENANCE MEASUREMENTS TO BE CARRIED OUT ON VFT SYSTEMS

(former CCIT Recommendation B.35, 1951; amended at New Delhi, 1960; Geneva, 1964 and Mar del Plata, 1968)

The CCITT,

in view of

Recommendation R.72 on the periodicity of maintenance measurements to be made on international voice-frequency telegraph (VFT) channels, *considering*

that it should be clearly laid down what maintenance measurements are indispensable to ensure the correct operation of VFT channels,

unanimously declares the view

(1) that maintenance measurements and any necessary adjustments of *amplitude-modulated* VFT channels should be made in the following order:

a) the power supply voltages;

b) the value of the frequency transmitted to line by the channel;

c) the output level of each send filter in condition Z and in condition A;

d) the output level of each send filter after the control current has been interrupted;

e) the output level of each receive filter in condition Z;

f) the degree of distortion with symmetrical 1:1 or 2:2 signals. (It would be advisable for this measurement to be made at normal, maximum and minimum levels. All the modifications of level should be made after the receive filter.) The measurement and adjustments may be first carried out on local and then on line, or on line only, so as to minimize the degree of distortion;

g) the receiving relay if any (if the results obtained at point f should make this desirable);

h) the threshold of the receiver;

i) the degree of distortion, in accordance with the method described in Recommendation R.5 and bearing in mind § (1) and § (2) of Recommendation R.74;

(2) that maintenance measurements and any necessary adjustments of *frequency-modulated* VFT channels should be made in the following order:

a) the power supply voltages;

b) the values of the frequencies transmitted to line by the channel;

c) the frequency emitted after the control current has been interrupted;

d) the output levels of each send filter for the characteristic frequencies A and Z;

e) the output levels of each receive filter for the characteristic frequencies A and Z, if possible;

f) the frequency drift, if the channel is used for this measurement (see below);

g) the degree of distortion with symmetrical 1:1 or 2:2 signals; the measurement and adjustment should be first carried out on local and then on line, or on line only, so as to minimize the degree of distortion;

h) the receiving relay, if any;

i) the threshold of the receiver (at blocking);

j) the degree of distortion, in accordance with the method described in Recommendation R.5 and bearing in mind § (1) and § (2) of Recommendation R.74.

The measurement referred to in f) above must be carried out to check, where necessary, whether there is any frequency drift on the VFT bearer circuit by measuring the pilot frequency when the system is operated with one; otherwise, Administrations should agree to measure a characteristic frequency at the output of the line for a mutually determined channel. The result of this measurement will be compared with the result of the measurement made when this frequency is sent; the difference will show any drift due to transmission on the VFT bearer circuit;

(3) that, unless otherwise specified, the measurements should be effected at the nominal modulation rate of the channel (50, 100 or 200 bauds). However, if a 100-baud channel is operated with a rate of 50 bauds, in accordance with Recommendation R.35 *bis*, the measurements should be effected at the rate of 50 bauds and adjustments made if the limits mentioned for 50 bauds in Recommendation R.57 are no longer respected;

(4) that the results of the measurements made on the international channels should be exchanged directly by telegraph or telephone between the measuring stations, at the request of one of these stations;

(5) that, since maintenance work is a cause of interference on circuits in service, maintenance measurements should be made outside busy hours as far as possible;

(6) that, when maintenance measurements are carried out on circuits in operation, every precaution should be taken in accordance with Recommendation R.76 to avoid disturbances.

CHOICE OF TYPE OF TELEGRAPH DISTORTION-MEASURING EQUIPMENT

(former CCIT Recommendation B.52, Geneva, 1956;
amended at Geneva, 1964 and 1980)

The CCITT,

in view of

Recommendation R.90,

considering

(a) that measurements of isochronous distortion made with the text specified in Recommendation R.51 *bis* should normally be applied to code-independent telegraph channels;

(b) that it may in principle be desirable to measure the distortion of telegraph channels in terms of start-stop distortion;

(c) that all important terminals of voice-frequency telegraph systems are equipped with isochronous distortion-measuring equipment and that their replacement by start-stop instruments would be expensive,

unanimously declares the view

(1) that, for the maintenance of code-independent telegraph channels, isochronous distortion measuring equipment should normally be used;

(2) that Administrations may nevertheless, by common consent, use for this purpose start-stop distortion measuring equipment,

considering also

(d) that measurements of the quality of start-stop signals cannot normally be made without start-stop distortion measuring equipments;

(e) that the planning and establishment of telegraph networks are to be judged in terms of conventional degrees of start-stop distortion, and that degrees of start-stop distortion may also prove to be the best basis for calculations of the summation of degrees of distortion and for calculation of conventional start-stop distortion;

(f) that, for the maintenace of telegraph channels incorporating code-dependent systems, start-stop test equipment is essential,

unanimously declares the view

(3) that all international switching and testing centres (ISTCs) should be equipped with start-stop distortion-measuring equipment.

MAINTENANCE MEASUREMENTS ON CODE-INDEPENDENT INTERNATIONAL SECTIONS OF INTERNATIONAL TELEGRAPH CIRCUITS

(former CCIT Recommendation B.44, Arnhem, 1953; amended at New Delhi, 1960, and at Geneva, 1980)

The CCITT,

in view of

Recommendations R.50, R.57 and R.90,

considering

(a) that, for the technical supervision of international telegraph circuits, it is necessary to make periodic measurements of distortion on their international sections when they are made up of two or more channels;

(b) that certain Administrations consider it desirable to have available apparatus for making simple measurements automatically and periodically, giving an indication of the performance rating and transmitting an alarm when this rating exceeds the limits permitted for automatic switched channels,

unanimously declares the view

(1) that it is desirable to make distortion measurements every three months on the international sections of international telegraph circuits made up of at least two channels;

(2) that these measurements should be made at a modulation rate of 50 bauds;

a) with reversals,

b) preferably with the standardized text specified in Recommendation R.51 *bis*;

(3) that the values shown in Table 1/R.75 for the inherent distortion in service (extracted from Recommendation R.57) must not be exceeded on the international section of a telegraph circuit;

TABLE 1/R.75

Number of channels in tandem within international section	The limit of bias distortion on reversals at the modulation rate employed for adjustment shall be equivalent to the following values at 50 bauds	Isochronous distortion with standardized text	Inherent start-stop distortion with standardized text
2	7%	18%	13%
3	10%	24%	17%
4	12%	28%	21%
5	–	–	25%

Note 1 — The above values are valid whether the channels are amplitude-modulated or frequency-modulated.

Note 2 — The columns giving the limits for degrees of isochronous distortion and start-stop distortion on the text are not intended to establish a law relating the degree of start-stop distortion to the degree of isochronous distortion; this law of relationship depends on the constitution of the distortion (relative magnitudes of characteristic and fortuitous distortion).

(4) that these values do not take into account the possibility of regenerative repeaters or other code-dependent systems in the international section;

(5) that these values can be regarded only as provisional and the study of them should be continued;

(6) that, in future, measurements made with the apparatus mentioned in b) above will no doubt make it possible to eliminate the maintenance measurements referred to above.

Recommendation R.76

RESERVE CHANNELS FOR MAINTENANCE MEASUREMENTS ON CHANNELS OF INTERNATIONAL VFT SYSTEMS

(former CCIT Recommendation B.38, 1951; amended at Geneva, 1964)

The CCITT,

considering

that it is desirable that maintenance measurements on the channels of international voice-frequency telegraph (VFT) systems should disturb communications as little as possible,

unanimously declares the view

(1) that, whenever possible, measurements on a working channel of a VFT system should be carried out only after the channel concerned has, if necessary, been replaced by a spare channel;

(2) and to this end, the CCITT considers that it is desirable that one channel should be reserved for this purpose in each VFT system.

(3) When this change is not possible, the channel user will be informed in advance that measurements or tests are about to be carried out on his circuit.

Recommendation R.77 [1)]

USE OF BEARER CIRCUITS FOR VOICE-FREQUENCY TELEGRAPHY

(former CCIT Recommendation B.39, Brussels, 1948; amended at New Delhi, 1960 and Mar del Plata, 1968)

1 Composition and nomenclature

Figure 1/R.77 illustrates the composition of an international voice-frequency telegraph (VFT) system and the nomenclature used.

2 The international voice-frequency telegraph system

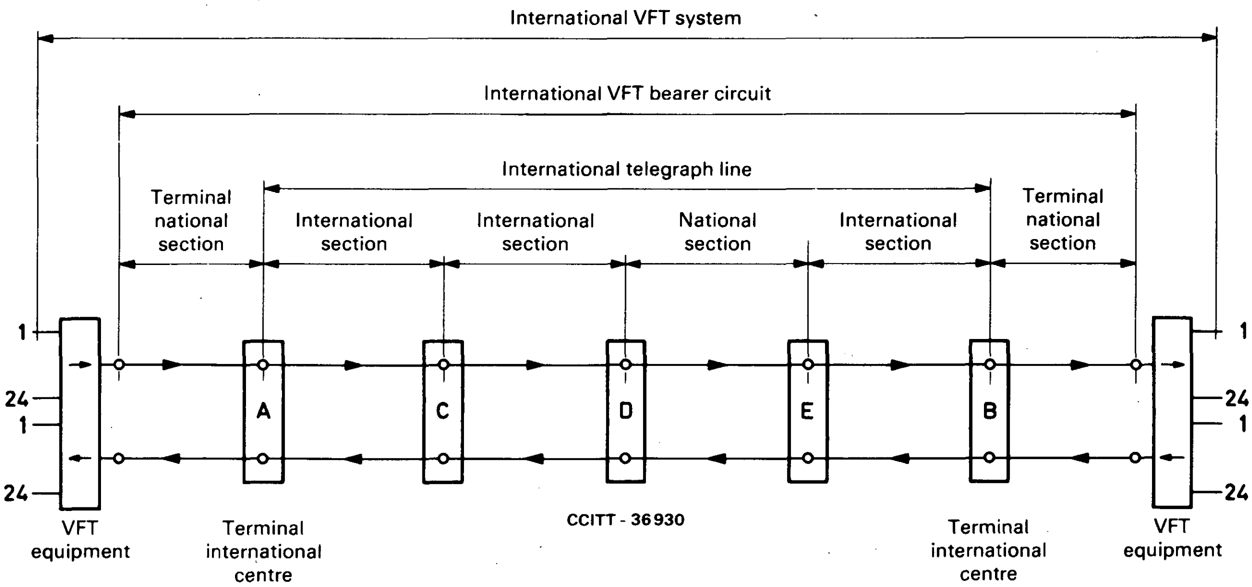
2.1 This is the whole of the assembly of apparatus and lines, including the terminal VFT equipment. In Figure 1/R.77 the system illustrated provides 24 duplex international telegraph circuits but other numbers of telegraph circuits can be provided.

2.2 *The international VFT bearer circuit*

2.2.1 Four-wire telephone-type circuits are used as VFT bearer circuits. The circuit comprises two unidirectional transmission paths, one for each direction of transmission, between the terminal VFT equipments.

2.2.2 The VFT bearer circuit consists of an international line together with any terminal national sections connecting the international line to the VFT terminal equipment and may be constituted entirely on carrier channels (on symmetric pair, coaxial pair or radio-relay systems) or an audio-frequency lines or combinations of such lines.

1) See also Recommendation M.800 [1].



Note — At the intermediate centres C, D and E and at the terminal international centres A and B, the signals transmitted are at audio frequencies. At these points it is possible to make measurements.

FIGURE 1/R.77

The components of an international VFT system

2.2.3 VFT bearer circuits have no terminating units, signalling equipment or echo suppressors.

2.3 *The international line of a VFT bearer circuit*

2.3.1 The internaional line of a VFT bearer circuit may be constituted by using a channel in a carrier group or channels in tandem on a number of groups. National and international sections can be interconnected to set up an international line. See Figure 1/R.77 but note that § 2.3.2 below details the preferred method. The international line could equally well be set up between, for example, only A and C or between C and D, in which case A and C, or C and D would be the terminal international centres.

2.3.2 Wherever possible an international line for a VFT bearer circuit should be provided on channels of a single carrier group, thereby avoiding intermediate audio-frequency points. In some cases, such a group may not exist or, for special routing reasons, it may not be possible to set up the international line in the preferred way. In such cases, the international line will consist of channels in tandem on two or more groups with or without audio sections, depending on the line available and the routing requirements.

2.4 *Terminal national sections connected to the international line of a VFT bearer circuit*

In many cases the VFT terminal equipment is remote from the terminal international centre of the international line (Figure 1/R.77), and such cases necessitate the provision of terminal national sections in order to establish international VFT bearer circuits. These sections may be in short-distance local audio cables, amplified or unamplified, or may be routed in long-distance carrier groups or amplified audio plant as available.

3 Reserve arrangements for international VFT bearer circuits

3.1 *General*

3.1.1 All necessary action should be taken to enable the duration of interruptions on international VFT bearer circuits to be reduced to a minimum and, for this purpose, it is expedient to standardize some of the methods to be adopted for replacing defective portions of the circuit.

3.1.2 Although it does not appear necessary for these methods to be the same in detail in every country, it would be advisable to reach agreement regarding the general directives to be followed.

3.1.3 The make-up of the reserve VFT bearer circuits will in general be similar to that of the normal VFT bearer circuits. However, if the VFT terminal equipment is not located at the terminal international centres, the line portion of an international telephone circuit can be used to replace only the international line of the VFT bearer circuit.

3.2 *Reserve international lines*

3.2.1 Wherever possible a reserve international line should be provided between the two terminal international centres by means of the international line of an international telephone circuit (between A and B in Figure 1/R.77).

3.2.2 The telephone circuit used as a reserve should be chosen wherever possible so as to follow a different route from that of the normal international line. Where this cannot be done, as much as possible of the circuit or its sections should be alternatively routed.

3.2.3 If there is a choice, the use of manually-operated circuits as reserve lines for VFT is technically and operationally preferable to the use of automatic circuits. It should be possible after prior agreement between the controlling officers at the international terminal exchanges concerned for an operator to break into a call in progress to advise the correspondents that the circuit is required and that the call should be transferred to another circuit if it lasts longer than six minutes.

3.2.4 If the reserve telephone circuit is automatic or semi-automatic a direct indication should be given at the changeover point. If it is not available when needed the reserve circuit should be blocked against any further call.

3.3 *Reserve sections for the sections of the international VFT bearer circuit*

3.3.1 Where it is not possible to provide reserve international circuits either because there are no suitable telephone circuits or because the number of telephone circuits does not permit the release of a circuit for reserve purposes, reserve sections should be provided wherever possible for each of the component sections. For these sections, national or international telephone lines or, where they exist, spare channels, circuits, etc., should be used.

3.4 *Reserve arrangements for the terminal national sections connecting the VFT terminal equipment to the international line*

3.4.1 Reserve sections should be provided by means of national telephone circuits or by the use of spare channels, particularly in the case of long sections and of sections forming part of a category B VFT bearer circuit (see [2]).

3.5 *Changeover arrangements from normal to reserve lines*

3.5.1 When an international telephone line (i.e. part of an international telephone circuit) is used to provide a reserve for the international line (or for one of its sections as mentioned in § 3.3 above), there should be changeover arrangements to enable the changeover from the normal line to the reserve line to be made as rapidly as possible. The changeover arrangements (Figure 2/R.77) should be such that on changeover, all signalling equipment, echo suppressors, etc., associated with the telephone circuit that is used as a reserve for the international line, are disconnected on the line side. When the fault is cleared on the normal line, it should be possible to join it to the signalling equipment, echo suppressors, etc., and put it into service as part of the telephone circuit until the agreed time for the restoration of the line to the normal routing. It is desirable to introduce as little disturbance as possible when changing back from reserve to normal. Arrangements of cords and parallel jacks can be devised to achieve this.

3.5.2 The changeover arrangements shown in Figure 2/R.77 could be applied to sections of the international line mentioned under § 3.3 above when it is not possible to obtain an overall reserve for the international line. Normal sections and the corresponding reserve sections should be routed via suitable changeover arrangements at the stations concerned.

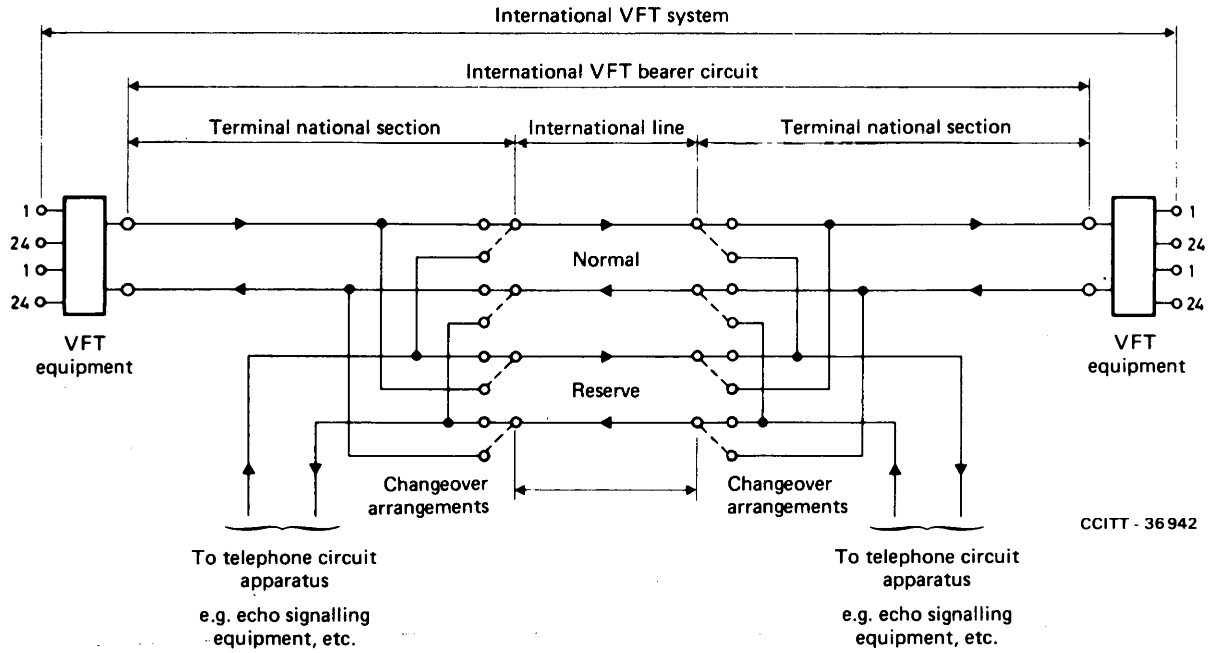


FIGURE 2/R.77

An example of how an international telephone line can be used as the reserve for the international line of an international VFT bearer circuit

3.5.3 Should the alarm indicating that the VFT bearer circuit is faulty be received by a station other than the group control station, this other station shall interrupt the return direction of the alarm channel towards the group control station in order to advise the latter to take the necessary action.

3.5.4 Making manual, automatic or semi-automatic international telephone circuits available for reserve circuits for voice-frequency telegraphy should be in accordance with the instructions issued and the arrangements made by the respective Administrations. Should the normal and reserve lines both be faulty, the technical services of the Administration concerned should take immediate joint action to find a temporary remedy.

3.6 *Designation and marking*

3.6.1 Normal and reserve circuits, etc., should be clearly distinguishable from other circuits both from the point of view of designation (see Recommendation M.140 [3]) and marking (see Recommendation M.810 [4]).

References

[1] CCITT Recommendation *Use of circuits for voice-frequency telegraphy*, Vol. IV, Fascicle IV.2, Rec. M.800.

[2] CCITT. White Book, Preface to Vol. IV, ITU, Geneva, 1969.

[3] CCITT Recommendation *Designation of international circuits, groups, etc.*, Vol. IV, Fascicle IV.1, Rec. M.140.

[4] CCITT Recommendation *Setting-up and lining-up an international voice-frequency telegraph link for public telegraph circuits (for 50, 100 and 200 baud modulation rates)*, Vol. IV, Fascicle IV.2, Rec. M.810.

Recommendation R.78

PILOT CHANNEL FOR AMVFT SYSTEMS

(former CCIT Recommendation B.43, Arnhem, 1953; amended at New Delhi, 1960)

The CCITT,

considering

(a) that use of a pilot channel is suggested to give an alarm in the case of an abnormal drop in the receiving level of the bearer circuit in amplitude-modulated voice-frequency telegraph (AMVFT) systems;

(b) that service channels could have been used as pilot channels for this alarm signal, but since there is not always a service channel in each VF group, it is suggested that channels be chosen for the alarm signal,

unanimously declares the view

(1) that it is advisable to use a pilot channel to give an alarm in the case of an abnormal drop in the receiving level of the bearer circuit carrying an AMVFT system;

(2) that the level at which the alarm should work should be fixed by the Administration at the receiving end;

(3) that the pilot channel frequency should, as far as possible, be 300 Hz, transmitted with a power level corresponding to that of a frequency-modulated channel in accordance with Table 1/R.35;

(4) that, if such an arrangement cannot be adopted, the Administrations concerned should agree on the use of one of the standardized frequencies for the pilot channel used for alarm purposes.

Note – The case of 50-baud frequency-modulated systems is dealt with Recommendation R.35.

Recommendation R.79

AUTOMATIC TESTS OF TRANSMISSION QUALITY ON TELEGRAPH CIRCUITS BETWEEN SWITCHING CENTRES WHERE NO REGENERATION IS INVOLVED

(Mar del Plata, 1968; amended at Geneva, 1972, 1976 and 1980)

Note – Where regeneration is involved, the automatic test arrangements are as described in Recommendation R.79 *bis*.

1 Purpose of automatic tests

1.1 A maintenance measurement on a telegraph circuit made in the course of routine maintenance measurements takes a relatively long time to carry out and occupies staff at both ends of the circuit. This applies as much to circuits in a satisfactory condition (the majority of cases) as to faulty circuits.

1.2 The purpose of automatic testing is to make it possible to perform rapid tests; circuits found to be "satisfactory" in the course of these will not be subjected to full maintenance tests and the maintenance staff can thus concentrate on making full tests of circuits identified as "doubtful" during the rapid tests.

1.3 Automatic tests should be organized in such a way that at one end at least of the group of circuits under test, no staff is required. This end of the circuit will then be said to be "in the passive position", while the end initiating the tests will be said to be "in the active position".

Note – Unless stated otherwise, the end of the circuit in the active position will be denoted by the letter A and the end of the circuit in the passive position by the letter B throughout this Recommendation.

2 Circuits tested

2.1 It must be possible for the end of the circuit in the active position to be connected up automatically with the automatic testing equipment at the passive end. Rapid automatic tests should therefore only be envisaged over circuits connected at the incoming end to an automatic circuit switching centre, i.e. on circuits of the telex and gentex networks.

2.2 For practical reasons, which will be explained later, tests are limited to circuits connecting two international switching centres. No tests are envisaged for the time being on chains of circuits set up through a transit switching centre.

2.3 If a trunk circuit system between two centres A and B is divided into groups of circuits made up, say, of a group of circuits confined to traffic from A to B, a group of circuits confined to traffic from B to A and a group of both-way circuits, station A can be in the active position only for the both-way circuits and the circuits confined to traffic from A to B; and, vice versa, station B will be active for tests concerned with traffic from B to A and may also be active on both-way circuits. Both-way circuits will therefore be tested twice as often as one-way circuits.

2.4 Separate tests must be made in each direction of transmission of the circuit being tested since, if tests are made in the two directions in tandem, an inadmissible bias distortion on the forward path can be masked by a bias distortion of opposite sense on the backward path.

3 Test station equipment

3.1 An automatic measurement station will consist of two main groups of equipment:

a) A transmission unit consisting of a text transmitter TT and a distortion monitor CD. The distortion monitor will be adjusted to a particular degree of distortion, called the decision level, in such a way that if the latter value is exceeded in the signals received during the measurement, the transmission channel being tested will be classified as "doubtful"; otherwise it will be classified as "satisfactory". (To allow for very occasional distortion of a fortuitous nature, a channel will be classified "doubtful" only if the decision level is exceeded *twice* during the measurement.)

b) A switching unit for access operations; selection and signalling on the A-to-B circuit to be operated in accordance with the characteristics of switching centre B, checking at station A the call-connected signal originating at station B; receiving the call, transmitting the call-connected signal and the identification signals when the station is in the passive position.

4 Test text: decision levels and decision signals

4.1 The text chosen for the tests is given in Recommendation R.51 *bis* (**QKS**). [See, however, § (2) below].

4.2 The choice of the decision level is complicated by the fact that, while most international telex or gentex circuits are made up of a single voice-frequency telegraph (VFT) channel, there are also links in which these circuits consist of two VFT channels in tandem. International circuits consisting of three inter-connected VFT channels in tandem are very rare and can be ignored as far as the organization of automatic maintenance tests is concerned (which means that these circuits can only with difficulty be subjected to automatic maintenance tests).

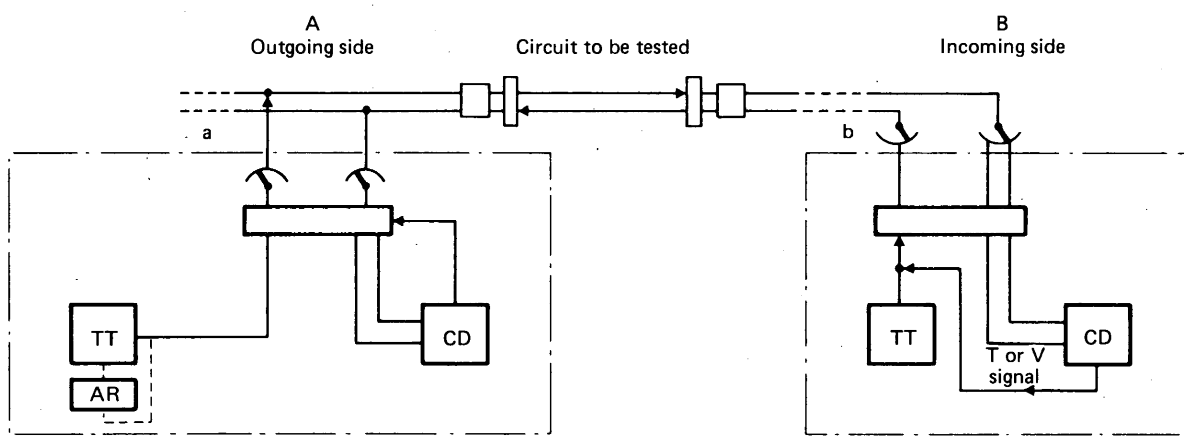
4.3 Recommendations R.57 and R.58 specify the following values for the limit of inherent start-stop distortion on standardized texts:

a) 8% for a switched network circuit consisting of a single VFT channel;

b) 13% for a switched network circuit consisting of two VFT channels.

4.4 Two decision levels are recommended, one corresponding to § 4.3 a) above and the other to § 4.3 b). Since automatic measurements are more stringent than measurements made on an oscilloscope by an operator, who might fail to notice a brief peaking in the degree of distortion, and since automatic tests are meant to detect genuinely doubtful circuits, it is recommended that the following decision levels should be adopted: 10% for § 4.3 a) and 14% for § 4.3 b) above.

4.5 However, on certain circuits set up in modern multi-channel VFT systems, the degrees of distortion normally prescribed can be less than the limits specified in Recommendations R.57 and R.58. A test carried out with decision levels of 10% (or 14%) could indicate that a circuit is "satisfactory" whereas in fact it is "doubtful". In such circuits, measurements may be made with artificial distortion of the signals. The equipment of the text transmitter should include an AR device (see Figure 1/R.79) that introduces an adjustable artificial degree of distortion on the signals transmitted on the forward path. In the active station the decision level in the distortion monitor CD situated on the backward path would then be reduced by the same value as that introduced in the transmission of the signals on the forward path. This device can be used to make more precise tests with the automatic testing device if this should prove to be necessary.



A = station in active position
AR = device for adding an adjustable degree of artificial distortion
B = station in passive position

CD = distortion monitor
T = channel AB "satisfactory"
TT = text transmitter
V = channel AB "doubtful"

FIGURE 1/R.79

Typical equipment block diagram for automatic testing of transmission quality on telegraph circuits

4.6 Distortion tests on the backward signalling path will commence as soon as possible after the start of the test signals on the forward signalling path.

4.7 The test check results made at the passive station will be sent to the active station by means of the following decision signals:

a) combination No. 20 (letter **T**) of International Telegraph Alphabet (ITA) No. 2 for an affirmative reply (satisfactory channel AB of the circuit);

b) combination No. 22 (letter **V**) for a negative reply (doubtful channel AB of the circuit).

5 Method of access

5.1 The circuits to be tested will be seized at the output of the switching equipment of A. A seized circuit will be marked "busy" at switching unit A (and at switching equipment B in the case of a both-way circuit). Station A will call test station B on the circuit seized for the tests in accordance with the selection and signalling system applicable to calls from A to B (indications given by country B).

5.2 In choosing between measurements with a decision level of 10% and measurements with a decision level of 14%, the simplest procedure is to give a station two access codes, one for access to the 10% measuring equipment and the other for access to the 14% measuring equipment. These access codes must be as short as possible and they should if possible be chosen from among the service position numbers. The codes for access to the distortion monitor should if possible be the same for both telex and gentex circuit tests.

5.3 Safeguards against seizure of test stations by telex subscribers are recommended. It is also recommended that calls made in connection with automatic tests should not be recorded by the traffic meters operating on the international circuits.

5.4 It would be useful if the outgoing access could be so arranged as to include the supervisory and other elements normally associated with the trunk circuits used for calls to make sure that these elements are not subject to faults liable to have an adverse effect on transmission. It is considered that normal switching equipment should be used to permit access to the testing equipment at the incoming end of the circuits. This will obviate the need for special access equipment and enable normal signalling functions to be tested in addition to transmission performance.

5.5 The identification of the station obtained should be indicated by the return of an answer-back code consisting of:

- one or two letters representing the telex network identification code of the country of the station,
- the letters **MAT**,
- the figures **10** or **14** depending on whether equipment with a 10% or a 14% decision-level adjustment is involved.

Depending on the characteristics of network B, transmission of the answer-back code will be initiated directly by the incoming call or by automatic command sent by A.

5.6 After the actual call-connected signal, calling station A will [after sending the *Who are you?* (WRU) code if necessary] receive one, two or three blocks of signals sent by network B: identification block, date and hour block, WRU block. The number of blocks depends on the characteristics of network B.

5.7 Network B will indicate that it is ready to accept test signals **QKS** by sending the ready-for-test (RFT) signal consisting of 4 × combination No. 11 (**K**) of ITA No. 2.

6 Test procedure

6.1 The transmission tests will be carried out with 6 cycles of **QKS** signals. If use is made of predistortion at the active station, the tests on the forward path will be made with early and late distortion on alternate characters. The first character of each cycle (combination No. 29, letter-shift) will have early (short-start) distortion.

6.2 After verification of the RFT signal, the active equipment sends the cycles of test signals. On reception of the first of these signals, the passive station begins sending the test cycles. The passive station sends the decision signal after receiving and checking the test signals received and following the transmission of the test signals to the active station. On receiving signal **V** or **T**, the active station sends the clearing signal.

6.3 The automatic tests should take place in a slack period. To prevent collision between two international centres A trying to seize the same passive station B at the same time, a timetable for the automatic tests should be established by the Administrations concerned to enable Administrations to have access to a particular passive station one after the other.

6.4 To make sure that circuits that are busy when due to be tested, or on which busy conditions from the distant network are encountered when testing, are not overlooked during automatic testing, the Administrations concerned shall agree on when new attempts should be carried out on these circuits.

The CCITT therefore

declares the view

(1) that Administrations (or recognized private operating agencies) may organize between international switching and testing centres (ISTCs) an automatic maintenance test service for testing the international trunk circuits of telex and gentex networks with automatic switching consisting of one or two multi-channel VFT links connected in tandem. In those cases where regeneration is involved in the transmission or switching equipment, Recommendation R.79 *bis* should apply.

(2) The tests shall consist of measurements of the degree of gross start-stop distortion made independently in each direction of transmission of the trunk circuit with the test text specified in Recommendation R.51 *bis* (the **QKS** text). This will normally be transmitted with zero distortion [see also § (16) below]. It should be noted that there is equipment in use that applies the test text specified in Recommendation R.51 (the **Q9S** text).

(3) The tests shall check that, on each transmission direction of the circuit, the degree of gross start-stop distortion measured does not exceed a level called the "decision level", which is established at 10% if the channel consists of a single VFT channel or at 14% if the channel consists of two VFT channels in tandem. The tolerance for the degree of gross start-stop distortion at the transmission end shall be 0.5% and the tolerance for the decision level shall be ± 0.5%. A circuit shall be considered doubtful in the rapid tests if the degree of distortion measured on each transmission direction has more than once exceeded the appropriate decision level; otherwise it shall be considered satisfactory.

(4) Each test station shall have two access codes, one for access to measurements with a decision level of 10% and another if necessary for access to measurements with a decision level of 14%. These access codes shall be as short as the switching equipment to which the testing station is connected will permit.

(5) Each station shall have two identification groups as follows:

a) letter-shift carriage-return line-feed one or two letters representing the telex network identification code space **MAT** figure-shift **10** to identify 10% decision level equipment;

b) as above, but with **14** instead of **10** to identify 14% decision level equipment.

For networks that have to send an answer-back in accordance with Recommendation S.6 [1], the requisite additional letter-shifts will be added.

(6) In an ISTC, a station is normally in the passive condition. In this condition it can be seized by an incoming call for automatic tests and can participate in these tests without the intervention of an operator.

(7) If it wishes to initiate automatic tests on an AB circuit (i.e. one permitting a call from centre A to centre B), station A:

i) goes into the active position;

ii) checks that the AB circuit to be tested is not being used for a call and, if it is free, seizes this circuit on the outgoing side of switching equipment A. This seizure of the AB circuit marks the latter as busy at switching centre A;

iii) calls the automatic testing station B in accordance with the selection and signalling system to be used on circuit AB.

(8) As soon as station B, in the passive position, is seized by the call, it sends the call-connected signal. This will be followed by the identification code (either automatically returned or returned in response to the WRU sent by station A) and then by the RFT signal [consisting of 4 × combination No. 11 (**K**) of ITA No. 2] with a delay not exceeding 500 ms after the end of the preceding block.

(9) Station A will receive the call-connected signal, the identification code and the RFT signal. It may be necessary either as part of the normal signalling requirements of network B or for maintenance purposes for network B to send the WRU signal to network A. Station A will always return its identification in response to the WRU signal. Station B will delay transmission of the RFT signal until the identification code has been received in response to the WRU signal. The RFT signal will be sent with a delay not exceeding 500 ms after the last character of this block has been received.

(10) The identification code returned by station A will correspond to that returned by station B with the exception that the characters indicating the decision level will be replaced by figure-shifts. In this case the identification code returned by station A will correspond to a total of 20 characters.

(11) Having verified that the RFT signal is correct, station A will then send six cycles of **QKS** signal with a delay not exceeding 500 ms from the end of the reception of the RFT signal. In the event that the block of signals representing the RFT signal proves to be erroneous or the signal was not received in the time permitted the circuit under test will be indicated as doubtful.

(12) As soon as it receives the first **QKS** signals, station B shall begin to transmit six cycles of **QKS** signals on the BA channel.

(13) The distortion monitor of station B will check whether or not the degree of distortion on the text signals received at B has more than once exceeded the decision level. If it has not, station B will send the signal **T** of ITA No. 2 over channel BA. If it has, station B will send signal **V** of ITA No. 2 over the BA channel. 500 ms (± 20%) shall elapse between the end of the reception at B of the last **QKS** cycle and the beginning of decision signal **V** or **T**.

(14) The distortion monitor of station A will check whether the degree of distortion of the test signals received at A exceeds the decision-level more than once. The decision will be indicated locally at A.

(15) After receiving signal **V** or signal **T**, station A will send the clearing signal to B within 500 ms. Any call set up for the automatic testing of a circuit shall be automatically cleared if it lasts longer than 30 s. The circuit on which a call has been released in this manner will be marked doubtful for further examination.

(16) Administrations may, if they wish, make use of automatic maintenance testing equipment for finer distortion measurements. For this purpose, they may, with a station in the active position, artificially predistort the signals sent (transmission distortion). The decision level in the distortion monitor of the active station will be reduced by the value of this predistortion. The station in the passive position will not have to intervene. In a test of this sort, the sending of the test text by the A station will be effected with early transmission distortion on alternate characters for the full duration of the 6 **QKS** cycles. The first character of each cycle (combination No. 29, letter-shift) will have early (short-start) distortion.

(17) Figure 1/R.79 shows a typical block diagram for the equipment. Figure 2/R.79 is a typical timing diagram for one test, showing the optional and mandatory signals. This timing diagram is common to Recommendations R.79 and R.79 *bis*.

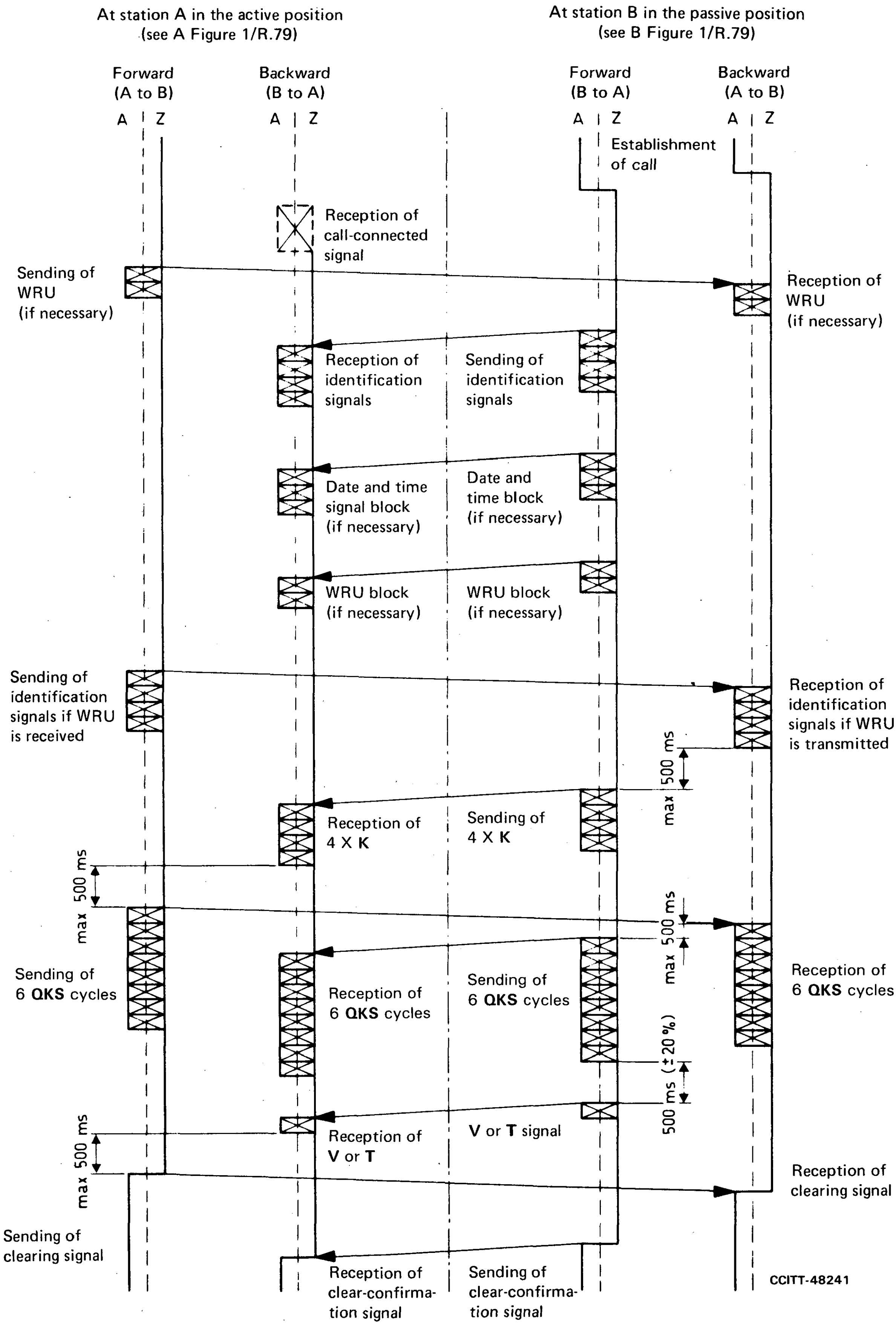


FIGURE 2/R.79

Timing diagram for automatic maintenance test
(applicable to Recommendations R.79 and R.79 *bis*)

Reference

[1] CCITT Recommendation *Characteristics of answer-back units (ITA No. 2)*, Vol. VII, Fascicle VII.2, Rec. S.6.

AUTOMATIC TESTS OF TRANSMISSION QUALITY OF TELEGRAPH CIRCUITS BETWEEN SWITCHING CENTRES WHERE REGENERATION IS INVOLVED

(Geneva, 1976; amended at Geneva, 1980)

The CCITT,

considering

(a) that Recommendation R.79 describes automatic maintenance tests of transmission and switching equipment on circuits where no regeneration is involved and that may consist of one or two tandem-connected voice-frequency telegraph (VFT) links;

(b) that the transmission path of switched telegraph circuits may include forms of start-stop regeneration such as regenerative repeaters, time division multiplex (TDM) systems or regenerative switching equipment and therefore Recommendation R.79 needs to be extended to permit the automatic testing of switched telegraph circuits with regeneration;

(c) that regenerative repeaters, if any, are provided at (one or both) receiving ends of the international circuit only;

(d) that the correct operation of regenerative equipment may be tested by applying at the input a test message of predetermined format and at a level of predistortion equal to the effective in-service margin of the equipment; the signals retransmitted by the regenerator may be checked to ensure that the distortion level and speed tolerance are satisfactory, and as an additional precaution the format of the regenerated test message may be checked against that of the message intended to be used;

unanimously declares the view

that, where automatic tests of transmission quality are required on telegraph circuits between switching centres where regeneration is involved, the facilities described below may be made available to extend the functions of the test equipment described in Recommendation R.79.

1 The **QKS** test signal blocks transmitted by the test stations will be predistorted depending on the number of tandem links (maximum 2) in the circuit and their type (i.e., VFT or TDM conforming typically to Recommendation R.44) and the relative location of the regenerative devices, including the switching equipment. The levels of predistortion to be applied in each direction independently will be:

a) 26% where two VFT links exist before the point of regeneration;

b) 30% where one VFT link exists before the point of regeneration;

c) 40% where the transmission link is TDM conforming typically to Recommendation R.44 or no significant distortion is introduced prior to the point of regeneration.

Further information concerning the combinations of §§ 1 a), b) and c) above may be found in Table 1/R.79 *bis*.

2 The format of the test signal block will follow the **QKS** text described in Recommendation R.51 *bis*, which will commence with the letter-shift and will be completed six times. The stop element for each code combination of this **QKS** text will be as shown in Figure 1/R.51 *bis*.

TABLE 1/R.79 *bis*

Test combinations

Identification of test combination	Active station		Passive station		Transmission and switching configuration
	Transmit pre-distortion %	Receive decision level %	Transmit pre-distortion %	Receive decision level %	
					Symmetrical
11	26	8	26	8	2 VFT links followed by regeneration in each direction
12	30	8	30	8	1 VFT link followed by regeneration in each direction
13	40	6	40	6	TDM conforming typically to Recommendation R.44
					Non-symmetrical
15	0	8	30	10	1 VFT link, regeneration only at receive end at active terminal
16	0	8	26	14	2 VFT links, regeneration only at receive end at active terminal
17	30	10	0	8	1 VFT link, regeneration only at receive end at passive terminal
18	26	14	0	8	2 VFT links, regeneration only at receive end at passive terminal
10	0	10	0	10	Non-regenerated as described in Recommendation R.79
14	0	14	0	14	

3 The required degree of start-stop predistortion will be introduced on a block of 6 cycles of **QKS** signals by shortening or lengthening the start elements of alternate characters. The first character of each cycle (combination No. 29, letter-shift) will have a shortened start element. After predistortion is applied, the nominal duration of each character will be maintained as shown in Figure 1/R.51 *bis* by means of complementary changes in stop lengths.

4 After transmission and verification of the ready-for-test (RFT) signal (4 × combination No. 11), each test station shall check that, during reception of the block of six cycles of the **QKS** text signals:

a) The degree of gross start-stop distortion of the regenerated output signals does not exceed 8%. This limit can be reduced to not more than 6% where TDM equipment conforming typically to Recommendation R.44, is employed. It is assumed that the regenerative device is located at the incoming end of the channel;

b) Each received character is verified as being without error against the format of the correct character sequence of the test message intended to be used.

5 The performance of a circuit will be considered satisfactory when checks on both directions of the circuit reveal that

- no character errors are detected, and
- the appropriate received distortion level is not exceeded more than once.

Circuits that fail to meet either of these checks will be considered doubtful.

6 Preferably each test station should have a number of access codes in addition to those described in § (4) of Recommendation R.79, when it is desired to test regenerated circuits automatically. This would involve a separate code's being allocated to each test combination required from this indicated in Table 1/R.79 *bis*.

7 For each access code provided at a test station, an individual identification group is required. The format of the identification group should be as follows:

letter-shift carriage-return line-feed one or two letters representing the telex network identification code space **MAT** figure-shift two digits identifying the test combination.

For networks that have to send an answer-back in accordance with Recommendation S.6 [1], the requisite additional letter-shifts will be added.

8 When only one access code in addition to those specified in Recommendation R.79 can be provided to gain access to the passive station, the following procedure would need to be adopted to enable the passive station to cooperate in the desired test.

a) The format of the passive station's identification group will be as follows:

letter-shift carriage-return line-feed one or two letters representing the telex network identification code space **MAT** figure-shift **00**.

For networks that have to send an answer-back in accordance with Recommendation S.6 [1], the requisite additional letter shifts will be added.

b) The passive station shall then transmit the *Who are you?* (WRU) block to the active station.

c) The active station shall reply to the WRU block by transmitting its identification in accordance with Table 1/R.79 *bis*, as required by the composition of the circuit.

d) The passive station, on receipt of this identification, shall adapt itself to the required received decision level and transmit distortion.

e) On completion of this action, the passive station shall transmit the RFT signal.

9 The active station will automatically verify that the appropriate identification group returned by the passive station corresponds to the test number required. In the event of an incorrect identification signal's being received, the active station will clear down the call and mark the circuit as doubtful.

10 The typical timing diagram of the test procedure appears as Figure 2/R.79. The intention is that the timing arrangements for the test procedure should apply to both Recommendations R.79 and R.79 *bis*.

Reference

[1] CCITT Recommendation *Characteristics of answer-back units (ITA No. 2)*, Vol. VII, Fascicle VII.2, Rec. S.6.

Recommendation R.80

CAUSES OF DISTURBANCES TO SIGNALS IN VFT CHANNELS AND THEIR EFFECT ON TELEGRAPH DISTORTION

(former CCIT Recommendation B.41, 1951; amended at Arnhem, 1953 and Geneva, 1956 and 1964)

The CCITT,

considering

(a) that the great majority of international telegraph circuits are routed on voice-frequency telegraph (VFT) channels;

(b) that VFT channels are liable to disturbance from the following causes:

i) variations in the voltage and frequency of the source of telegraph carrier frequency due to variations in the power supply, and variations in the signalling load in the case where the carrier source supplies several channels;

ii) abrupt or gradual changes in the transmission equivalent of the telephone-type circuit;

iii) intelligible crosstalk from other telephone-type circuits, particularly near-end crosstalk;

iv) unintelligible crosstalk resulting from the cross-modulation of telephone-type circuits when operated by carrier currents;

v) noise induced from electrical power and traction systems;

vi) telegraph crosstalk from other telegraph channels, e.g. production of odd harmonics of the telegraph carrier frequencies in certain channels falling within the passband of other channels, intermodulation in filter coils, etc.;

vii) variations of power supplies affecting the amplifier and detector of the VFT channel and sometimes the receiving relay;

viii) the effects of mechanical vibration upon valves (microphonics) and relays;

ix) bad contacts (e.g. test points and valve bases) and badly soldered joints;

x) deterioration of component parts, e.g. ageing valves;

xi) failure of power supplies, e.g. on changeover from main to reserve supply;

xii) accidental disconnections made during the course of maintenance and construction work;

xiii) on overhead lines, effects of atmospheric electricity, frost, etc.;

(c) that the disturbances account for practically all the distortion in telegraph channels, except for characteristic distortion (which is chiefly a function of filter and amplifier-detector design), some bias (due to misadjustment of controls and relays, etc.) and, in the case of the lower frequency channels, the distortion that arises from the low ratio of carrier frequency to signalling frequency;

(d) that many of the causes of disturbance are individually negligible and the more important of the others have been found, in the experience of several Administrations, to be capable of elimination by careful maintenance both on the VFT equipment and at all points on the bearer circuit;

(e) that the CCITT is also studying the causes of disturbance in telephone circuits and the precautions to be taken to minimize their occurrence;

(f) that the results of the CCITT study will be of great importance to telegraphy;

(g) that, as a result of the considerable investigations already made by certain Administrations on the causes of disturbances in telephone and telegraph circuits, the relative order of importance of these causes appears to be approximately as follows:

i) *in the case of telephone circuits*:

- high resistance and unsoldered connections;
- noisy and microphonic valves, and poor contact between valve pins and valve holders;
- working parties engaged on cable operations;
- noisy and high-resistance U-links;
- changes in line level not compensated at the detector input;
- crosstalk;
- errors in setting up, for example incorrect equalization, line transformers incorrectly connected, faulty components;

ii) *in the case of VFT equipment*

- high resistance and unsoldered connections;
- valves deteriorated beyond permissible limits;
- bad contacts;
- faults on power changeover equipment;
- frequency error of the carrier supply;

unanimously declares the view

(1) that it is desirable for Administrations to undertake investigations of the causes, and frequency of occurrence of disturbances of VFT channels routed on the various types of bearer circuit likely to be employed for international telegraph circuits;

(2) that in doing these tests and in order that the results may be of the greatest use to telegraphy and telephony, the incidence of disturbances should be measured according to their duration as follows: less than 1 ms, 1 to 5 ms, 5 to 10 ms, 10 to 20 ms, 20 to 100 ms, 100 to 300 ms and those more than 300 ms;

(3) that the results should be classified according to the type of bearer circuit, viz. audio or carrier, cable or overhead line.

(4) Measurements of disturbances should be made at the direct current output of the VFT channel that is under observation.

Recommendation R.81

MAXIMUM ACCEPTABLE LIMIT FOR THE DURATION OF INTERRUPTION OF TELEGRAPH CHANNELS ARISING FROM FAILURE OF THE NORMAL POWER SUPPLIES

(former CCIT Recommendation B.40, 1951)

The CCITT,

considering

that in switched telegraph networks a 300-millisecond interruption of the telegraph current would be translated into a release of switches, and that the relays controlling the release are arranged to operate in slightly less than 300 ms,

unanimously declares the view

(1) that it is desirable that no interruption of the telegraph current should occur as a result of failure of a normal power supply.

(2) If, however, it is impracticable to avoid an interruption, then its duration should in no case exceed 150 ms.

Recommendation R.82

APPEARANCE OF FALSE CALLING AND CLEARING SIGNALS IN CIRCUITS OPERATED BY SWITCHED TELEPRINTER SERVICES

(former CCIT Recommendation B.42, 1951;
amended at Arnhem, 1953 and Geneva, 1964)

The CCITT,

in view of

Recommendation R.80, on the causes of disturbances affecting signals in telegraph channels, and their effect on the distortion of telegraph signals;

considering

(a) that precautions should be taken with circuits used in switched teleprinter services to prevent the appearance of parasitic signals that would give rise to false calling and clearing signals;

(b) that special monitoring or indicating devices should be provided on voice-frequency telegraph (VFT) systems, the channels of which are used for international switched circuits;

(c) that special steps might well be taken to discover the causes of false signals due to transient changes in transmission level or momentary increases in noise level, on VFT circuits;

(d) that it would be desirable to draw up operating standards in this connection,

unanimously declares the view

(1) that the following precautions should be taken to avoid false calling and clearing signals:

– the security and stability of power supplies and of sources of carrier frequencies, both telegraph and telephone, should be ensured;
– a characteristic marking should be used to denote telegraph and telephone-type circuits used for the operation of switched teleprinter circuits, both in terminal and intermediate stations;
– precise instructions should be given to staff in order that false entry into the above-mentioned circuits may be avoided;
– the number of non-soldered connections should be reduced as much as possible, together with the number of break points; unsoldered connections, e.g. U-links and screw terminals, etc., should be checked with particular care. In this connection, attention is drawn to the methods of inspection by vibration tests;
– the amplitude of level variations in VFT bearers should be limited, and abrupt variations in the level should be particularly avoided;
– limit the crosstalk mentioned in Recommendation R.80;
– limit induced voltage caused by electric power and traction systems;
– limit the microphonics of valves in repeaters and of valves used in VFT;
– reduce the sensitivity of voice-frequency modulators to disturbing signals;
– avoid, in switched teleprinter services, the use of supervision signals having a short duration in relation to the transitory phenomena due to filters and time-constants in the level-regulators of VFT systems.

(2) These precautions, inasmuch as they concern telephone-type circuits used for voice-frequency telegraphy, must be taken simultaneously on normal and reserve circuits.

(3) For the permanent monitoring of VFT systems the channels of which are used for international switched circuits, it is advisable to use a pilot channel. An alarm should be given to indicate when either the system or the pilot channel is out of order (see Recommendation R.78).

(4) It would be advisable to record the transmission level, in order to discover and localize the causes of the false signals on circuits behaving particularly badly.

(5) It is not yet possible to lay down operating standards in this connection.

Recommendation R.83

CHANGES OF LEVEL AND INTERRUPTIONS IN VFT CHANNELS

(former CCIT Recommendation B.53, Geneva, 1956;
amended at Geneva, 1964)

The CCITT,

considering

(a) that an alarming situation for the telegraph service has been created by interruptions on voice-frequecy telegraph (VFT) channels, and by changes of level that have the same effect as interruptions;

(b) that the consequences are such that, at present, the error rate that is attributed to VFT channels is still very far above the tolerable limit fixed by considerations of operational requirements (see Recommendation R.54, a) and f);

(c) that certain Administrations have observed an improvement in the situation, and that this improvement seems to result from the measures taken by the telephone services, for instance, symmetric percussion tests, precautions in the switching or power supplies, etc.;

(d) that it has been confirmed that the number of interruptions increases markedly during the normal hours when maintenance staff are present, and is reduced when, despite very heavy traffic, maintenance is suspended, so that telegraph Administrations are now convinced that one of the principal causes of interruptions on telegraph channels is intervention by maintenance personnel and perhaps by operating personnel;

(e) that it has also been observed that the number of interruptions appears greater on international circuits than on national circuits;

unanimously declares the view

that the drive against interruptions should be continued vigorously and that, in order to observe the progress of this drive, Administrations should continue to make symmetric observations of the frequency and duration of interruptions on voice-frequency telegraph channels;

and draws the attention

of the maintenance Study Group especially to the study of practical measures to remedy the situation.

Recommendation R.90

ORGANIZATION FOR LOCATING AND CLEARING FAULTS IN INTERNATIONAL TELEGRAPH SWITCHED NETWORKS

(former CCIT Recommendation B.55, Geneva, 1956; amended at New Delhi, 1960)

The CCITT,

considering

(a) that it is desirable that faults affecting communication between stations on international switching networks (e.g. telex and gentex service) should be reported and cleared as quickly as possible;

(b) that it is necessary to unify the essential action to be taken and methods to be employed for locating and clearing faults;

(c) that, for this purpose, it is necessary to determine the essential testing equipment that is to be provided at the switching centres responsible for locating and clearing faults;

unanimously declares the view

1 that it is necessary to set up switching and testing centres (STCs), defined as switching centres equipped with measuring equipment for testing telex subscribers' and public station lines and equipment and also telegraph channels.

2 Each telex subscriber and each public station in the general switching service should have access to an STC for the purpose of reporting faults and cooperating in tests.

3 International switching and testing centres (ISTCs) are the STCs that are also international line-head offices.

4 All STCs should be subscribers to the telex network, both for the purpose of receiving fault reports and for communication for maintenance purposes. They should also be provided with a telephone subscriber's line.

5 Each STC should be responsible for coordinating action in locating and clearing faults on all station lines connected to the exchange and on all trunk circuits for which it is nominated as the controlling office. It should also cooperate with other STCs in locating faults on connections established through two or more exchanges.

5.1 It should carry out a preliminary location of faults by finding out whether they affect channels, switching gear or apparatus. The faults are then accurately located by the engineers responsible for each part of the circuit and the STC cooperates with them for this purpose. It may assume the direction of the fault-locating procedure should there be disagreement between these services. Internationally, it is responsible to the STCs of other countries with which it has telex connections.

5.2 The organization of the liaison between the STC and the different technical services is shown in Figure 1/R.90. The STCs must check that the performance given by the equipment involved in the switching service, i.e. VF channels, switching equipment and apparatus, is satisfactory.

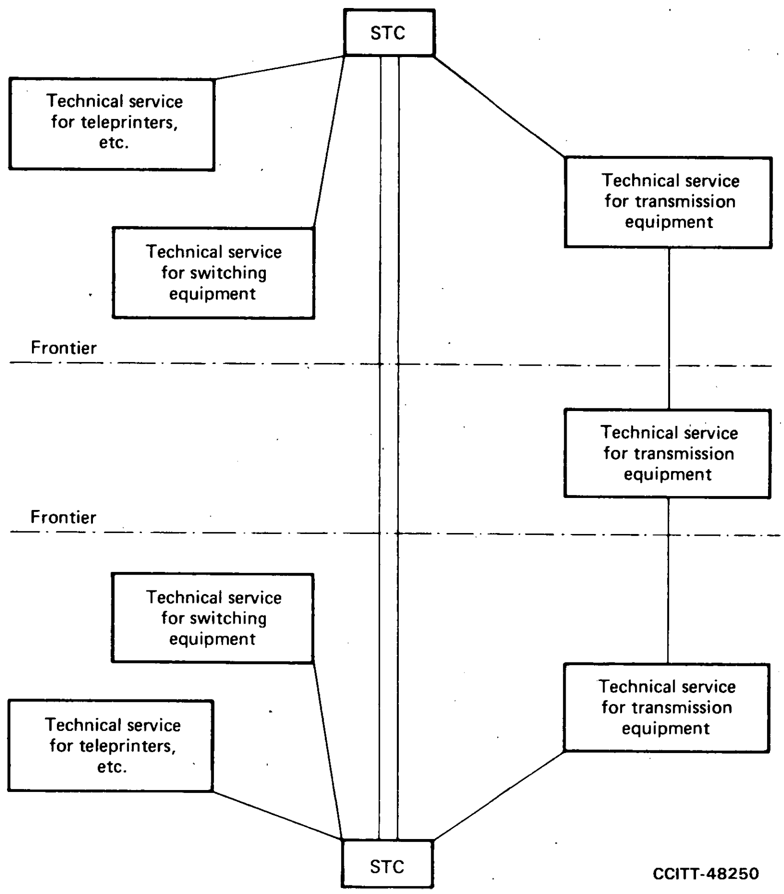


FIGURE 1/R.90

Maintenance organization

6 The staff employed at STCs should be selected with a view to avoiding language difficulties and should be conversant with all types of telegraph equipment used in the switching network, i.e. automatic or manual switching equipment, VFT equipment, telegraph machines and regenerative repeaters. The staff need not necessarily be fully competent to maintain all these items of equipment, but should have sufficient knowledge of them to be able to form an appreciation of the effect that faults on any of them may have on a switched connection. In addition, the staff of ISTCs should have some general knowledge of the types of equipment used in the countries to which they are connected, particularly of the signalling conditions that will be encountered.

7 Each STC should be provided with the following measuring equipment:

a) 50-baud start-stop distortion meter;

b) test transmitter for generating undistorted 50-baud start-stop signals;

c) apparatus to measure the modulation rate of teleprinters at a distance;

d) apparatus for measuring the speed and pulse ratio of dials, where appropriate;

e) apparatus for measurement of the condition of direct current lines; for example, continuity, resistance, insulation.

7.1 The arrangements for access to established connections for making test measurements should be such as not to cause interruptions or reduce the quality of transmission.

7.2 Considering that some Administrations have found it desirable to have available at the STC other items of apparatus to expedite the clearing of faults, all Administrations are invited to consider the utility of these devices, namely:

a) apparatus for measuring teleprinter margin;

b) recording distortion meters for testing established connections;

c) apparatus for measuring continuously, periodically and automatically, the distortion on subscribers' lines and apparatus.

8 The following procedure for reporting, locating and clearing faults should be adopted.

8.1 Faults should be reported to the STC concerned by the subscribers or operators who have experienced difficulty in operation. In the same way, it would be useful, in order to give the STCs a full picture of the situation, that the maintenance engineers should inform them of faults noted during the periodic maintenance operations. Faults should preferably be signalled by teleprinter, if their nature does not preclude this procedure.

8.2 A reference number should be given by the STC to the subscriber or service notifying the fault. This number can then be quoted in any subsequent inquiries as to the progress of fault clearance.

8.3 On account of the difficulties that may arise in the detection of faults on the international section of a communication (due to lack of knowledge of languages, etc.), care should be taken in each country to see that the national sections of the communication, including subscribers' lines and apparatus, are not involved before approaching the STC of the corresponding country.

8.4 Complete holding of a connection that is reported to be faulty should be avoided.

8.5 The STC notified of a fault should therefore begin by ascertaining that it is not located in the national section of the communication and for this purpose should, if necessary, approach the other STCs of its country concerned in the circuit. The STC of the distant country is then advised and, in turn, checks the national section routed over its network. The international section of the communication is not checked until the terminal national sections of telegraph circuits have been definitely exonerated. The STCs in different countries will communicate with one another, either directly or via their ISTCs, as determined by the Administrations concerned.

8.6 If the tests of the two local ends fail to reveal any fault conditions, the STC should report the fault to its ISTC, which will decide what further action, if any, is necessary. As a rule, isolated fault reports would not justify a test of all trunk circuits on a route, and it would be assumed that the condition giving rise to the fault would be cleared on the next routine adjustment. If however, several fault reports were received, some of which might have been due to a faulty circuit on a particular route, then a special routine test of all the circuits on the route might be justified.

8.7 In general, it is considered that the procedure will be broadly the same for manual, semi-automatic and automatic systems.

9 The abbreviations annexed below should be used in calls exchanged between services responsible for the maintenance of telegraph equipment.

ANNEX A

(to Recommendation R.90)

List of service abbreviations for maintenance of telegraph circuits

I. *General service*

No.	*Abbreviation*	*Meaning*
1	**ICI . . .**	Here is . . .
2	**BR TR . . .**	Bad transmission on . . .
3	**QREF**	Please give reference number
4	**QRES**	Please report result
5	**REF . . .**	Reference number is . . .
6	**RES . . .**	Here is result of test on . . .
7	**DERA**	Machine faulty
8	**DER CCT**	Circuit faulty
9	**DERPS**	Position equipment faulty
10	**DERR**	Fault now cleared
11	**NDER**	No fault found
12	**TESTD . . . SVP**	Please send test message with . . . % distortion on . . .
13	**QDIS . . .**	Please measure distortion on . . . and report result
14	**RAP . . . MNS SVP**	Please call me in . . . minutes
15	**RAP . . . MNS**	I shall recall you in . . . minutes
16	**. . . DIS . . .**	The distortion on . . . is . . . %
17	**ZSU**	Your signals are unreadable
18	**MEET . . .**	Meet me on circuit No. . . .
19	**VERX . . .**	Please check subscriber No. . . .
20	**VERS**	Please check the speed
21	**VERED**	Please check the transmitter distortion
22	**VERM**	Please check the margin
23	**DEVS . . .**	Speed deviation is . . . %
24	**MAR . . .**	The margin is . . . %
25	**EDIS . . .**	The transmitter distortion is . . . %
26	**NCS . . .**	No call-connected signal from . . .
27	**NCFM . . .**	No call-confirmation signal on . . .
28	**OCC OCC . . .**	Permanent busy signal from . . .
29	**PERC . . .**	Permanent call on . . .
30	**BL . . . SVP**	Please hold . . .

No.	*Abbreviation*	*Meaning*
30 *bis*	**BL**	Holding
31	**NBL . . . SVP**	Please clear . . .
31 *bis*	**NBL . . .**	Clearing
32	**ZOK**	I am receiving correctly
33	**DER VF . . .**	Fault on voice-frequency system . . .
34	**ZKWA . . .**	The received signals have . . . % bias (start polarity prolonged)
34 *bis*	**Q DIS A**	Is there bias distortion (prolonged start polarity) on the received signals?
35	**ZKWZ . . .**	The received signals have . . . % bias (stop polarity prolonged)
35 *bis*	Q DIS Z	Is there bias distortion (prolonged stop polarity) on the received signals?
36	ZYN	Reduce the bias
37	QRCS	Are you receiving my calling signal?
37 *bis*	CSR	I am receiving your calling signal
38	CCT . . . OUT SVP	Please take circuit No. . . . out of service
38 *bis*	**CCT . . . OUT**	I have taken circuit No. . . . out of service
39	**CCT . . . IN SVP**	Please restore circuit No. . . .
39 *bis*	**CCT . . . IN**	I have restored circuit No. . . .
40	**N PER A**	I am not receiving your permanent start polarity signal
41	**N PER Z**	I am not receiving your permanent stop polarity signal
42	**NPS**	I am not receiving your proceed-to-select signal
43	**CRD . . .**	The connection is released after selection on circuit No. . . .
44	**SIG 1/1 SVP**	Please send 1 : 1 signals
45	**SIG 2/2 SVP**	Please send 2 : 2 signals
46	**PER A . . .**	Permanent start polarity on . . .
47	**PER Z . . .**	Permanent stop polarity on . . .
48	**PER A . . . SVP**	Please send permanent start polarity on . . .
49	**PER Z . . . SVP**	Please send permanent stop polarity on . . .
50	**N IND**	I am not receiving your answer-back code
51	**DER REG**	Register does not operate
52	**DER TAPE**	Your perforated tape is faulty
53	**LOOP . . . SVP**	Please loop circuit . . .
53 *bis*	**LOOP . . .**	I have looped circuit . . .

II. *Multiplex service*

54	**RQFS . . .**	Your repetition cycle transmission contains 7-unit code faults. Please check channel No. . . .
55	**RFC . . .**	I am receiving errors in 5-unit code. Please check channel No. . . .
56	**ZYK . . .**	Your keying on channel . . . is affected; please check
57	**ZYM**	Change from single printer to multiplex
58	**ZYP**	Change from multiplex to single printer
59	**RS . . .**	Reception switched over to . . .

No.	*Abbreviation*	*Meaning*
60	**TRS** ...	Transmission switched over to ...
61	**SS** ...	Storage switched over to ...
62	**DS** ...	Distribution switched over to ...
63	**PH** ...	Please phase system ...
64	**DEVD**	Deviation of distributor speed at your end
65	**OPH** ...	Out of phase on system ...
66	**NARQ** ...	Multiplex ... unprotected; please re-establish automatic request for repetition (ARQ)
67	**TRAS** ...	Please send alpha signal on multiplex channel ...
68	**TRBS** ...	Please send beta signal on multiplex channel ...
69	**ZYC**	Your transmitter is sending permanent ARQ
70	**RMUT** ...	I am receiving garbled signals on multiplex channel ... please check your 7-unit code
71	**ZYA**	Cease traffic on all channels; send **As** on A channel for line-up

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SECTION 7

TIME DIVISION MULTIPLEXING

Recommendation R.100

TRANSMISSION CHARACTERISTICS OF INTERNATIONAL TDM LINKS

(Geneva, 1980)

Note – The application of TDM systems providing code- and speed-independent channels in addition to code- and speed-dependent channels is a subject for further study.

1 Analogue path links

1.1 Standard telephone carrier systems with 4-kHz and 3-kHz spaced channels permit homogeneous time division multiplex (TDM) telegraph systems, operated in association with 2400-bit/s data modems, to provide the capacities of telegraph channels shown in Table 1/R.100.

TABLE 1/R.100

Channel capacities of homogeneous TDM systems

TDM system type (see Note 1)	Quantity of channels provided by homogeneous system					
	50 baud	75 baud	100 baud	150 baud	200 baud	300 baud
Recommendation						
R.101, Alternative A	46	22	–	–	–	–
R.101, Alternative B	46	30	22	15	10	7
R.111	8	(see Note 2)	4	(see Note 2)	2	2

Note 1 – TDM systems complying with Recommendation R.101 provide code- and speed-dependent channels involving inherent regeneration of output signals. The provision of channels above 75 bauds for Recommendation R.101, Alternative A systems is the subject of further study.

TDM systems complying with Recommendation R.111 provide code- and speed-independent channels by a transition coding process that does not include regeneration of the output signals. Furthermore, these systems may have aggregate signalling rates of either 2.4, 4.8, 9.6 or 64 kbit/s.

Note 2 – The Recommendation R.111 homogeneous system configurations shown involve an aggregate rate of 2400 bit/s and 5% maximum isochronous distortion per channel due to sampling. 75- and 150-baud signals may be carried on nominal 100- and 200-baud channels respectively with proportionally less distortion.

1.2 A 4-wire link is required in association with the data modem employed to provide satisfactory transmission for the 2400-bit/s duplex aggregate signals of an international TDM system.

1.3 The data modem employed should preferably comply with the appropriate aspects of the Series V Recommendations. Multiple 2400-bit/s aggregates may be multiplexed onto the same 4-wire link using the appropriate internal multiplexing facilities of a Recommendation V.29 [1] modem. The reliability and availability of derived telegraph channels will, however, be highly dependent on the stability and characteristics of the bearer, modem and system arrangements adopted.

1.4 The conditions of use of international TDM links are generally similar to those for VFT links, described in Recommendation H.22 [2]. The requirements of the actual V-Series modem employed however, should be additionally respected.

Note – This subject is under study in Joint Working Party LTG, Study Group IV and Study Group IX.

1.5 PCM (pulse code modulation) telephone channels complying with Recommendation G.712 [3] are also generally suitable as bearers for TDM telegraph systems associated with modems complying with the Series V Recommendations. However, possible transmission arrangements involving tandem connection of a number of PCM channels require further study.

1.6 Recommendation R.111, in § 1.2.1, provides for the use of modems complying with the Recommendation cited in [4].

2 Digital path links

Note 1 – An international 64-kbit/s digital path using first-order 1544 or 2048 kbit/s multiplexers (Recommendations G.736 [5], G.737 [6], G.738 [7], G.739 [8]) can be used for routing:

– aggregate signals from telegraph TDM systems at 64 kbit/s (Recommendation R.111, § 1.2), and

– after time division multiplexing (Recommendations X.51 [9] and X.51 *bis* [10]), aggregate signals from telegraph TDM systems at 2.4 kbit/s (Recommendation R.101, § 8.4 and Recommendation R.111, § 2.2.1) and at 4.8 or 9.6 kbit/s (Recommendation R.111, § 2.2.1).

Note 2 – The maximum telegraph channel capacities for homogeneous systems and other parameters for such 64-kbit/s digital international links are the subject of further studies.

References

[1] CCITT Recommendation *9600 bits per second modem standardized for use on point-to-point 4-wire leased telephone-type circuits*, Vol. VIII, Fascicle VIII.1, Rec. V.29.

[2] CCITT Recommendation *Transmission requirements of international voice-frequency telegraph links (at 50, 100 and 200 bauds)*, Vol. III, Fascicle III.4, Rec. H.22.

[3] CCITT Recommendation *Performance characteristics of PCM channels at audio frequencies*, Vol. III, Fascicle III.3, Rec. G.712.

[4] CCITT Recommendation *Modems for synchronous data transmission using 60-108 kHz group band circuits*, Vol. VIII, Fascicle VIII.1, Rec. V.36, § 1, f).

[5] CCITT Recommendation *Characteristics of synchronous digital multiplex equipment operating at 1544 kbit/s*, Vol. III, Fascicle III.3, Rec. G.736.

[6] CCITT Recommendation *Characteristics of primary PCM multiplex equipment operating at 2048 kbit/s and operating synchronous 64 kbit/s digital access options*, Vol. III, Fascicle III.3, Rec. G.737.

[7] CCITT Recommendation *Characteristics of a synchronous digital multiplex equipment operating at 2048 kbit/s*, Vol. III, Fascicle III.3, Rec. G.738.

[8] CCITT Recommendation *Characteristics of an external access equipment operating at 2048 kbit/s and offering synchronous digital access at 64 kbit/s*, Vol. III, Fascicle III.3, Rec. G.739.

[9] CCITT Recommendation *Fundamental parameters of a multiplexing scheme for the international interface between synchronous data networks using 10-bit envelope structure*, Vol. VIII, Fascicle VIII.3, Rec. X.51.

[10] CCITT Recommendation *Fundamental parameters of a 48-kbit/s user data signalling rate transmission scheme for the international interface between synchronous data networks using 10-bit envelope structure*, Vol. VIII, Fascicle VIII.3, Rec. X.51 *bis*.

CODE AND SPEED DEPENDENT TDM SYSTEM FOR ANISOCHRONOUS TELEGRAPH AND DATA TRANSMISSION USING BIT INTERLEAVING

(Geneva, 1976; amended at Geneva, 1980)

The CCITT,

considering

(a) that the economic transmission of large numbers of anisochronous telegraph and data services over a single telephone-type circuit may be achieved by using time-division multiplexing (TDM) techniques;

(b) that the multiplexing system should be capable of operating as a sub-multiplexer within a higher order TDM hierarchy as well as on an analogue telephone-type circuit in association with standard data modems;

(c) that the codes and speeds used for anisochronous telegraph and data transmission are well defined, permitting the application of simple code-dependent multiplexing techniques;

(d) that code-dependent multiplexing provides inherent regeneration of start-stop signals carried by the system;

(e) that, while it is foreseen that the main application would be for telex traffic, the multiplexing system should be capable of simultaneously transmitting the complete range of standard anisochronous speeds and codes likely to be required by users;

(f) that the multiplexing system should be capable of accepting for transmission all types of telex signals and of regenerating those signals at the channel outputs within the tolerances specified in the relevant CCITT Recommendations;

(g) that the multiplexing system should permit the efficient mixing of various combinations of anisochronous speeds, codes and signalling types in the same transmission system;

(h) that the minimum duration of signal transfer delay through the TDM system could be achieved by the transmission of interleaved elements;

unanimously declares the view

that, where bit-interleaved code and speed dependent TDM systems are used for anisochronous telegraph and data transmission with an aggregate bit rate of 2400 bit/s carried either by an analogue telephone-type circuit or by a higher order TDM, the equipment shall be constructed to comply with the following standard:

1 System capacity

1.1 The capacity of the system shall be 46 channels at 50 bauds (7.5 units including a stop element of 1.5 units).

1.2 For other modulation rates two alternatives are allowed.

1.2.1 *Alternative A*

1.2.1.1 Channels at 75 bauds (7.5 units including a stop element of 1.5 units) shall be accommodated. See § 5.5.2 below.

1.2.1.2 Further study is needed to accommodate other modulation rates.

1.2.2 *Alternative B*

1.2.2.1 The modulation rates and character structures shown in Table 1/R.101 shall be accommodated with the capacities indicated for homogeneous configurations.

1.2.2.2 The TDM system shall be capable of multiplexing the eight modulation rates shown in Table 1/R.101 simultaneously.

TABLE 1/R.101

System capacity (alternative B)

Modulation rate (bauds)	Character structure		Number of channels (homogeneous configuration)
	Character length (units)	Stop element (units)	
50	7.5	1.5	46
75	7.5	1.5	30
100	7.5 or 10	1.5 1	22
110	11	2	22
134.5	9	1	15
150	10	1	15
200	7.5, 10 or 11	1.5 1 2	10
300	10 or 11	1 2	7

2 Start-stop channel inputs

2.1 The modulation rate tolerance that shall be accepted on continuous incoming 50- and 75-baud start-stop signals with a stop element of 1.4 units shall be at least ± 1.4%.

2.2 When receiving characters at 50 or 75 bauds having nominally 1.5-unit stop elements, the system shall be capable of transmitting without error, isolated incoming characters that have a one-unit stop element, occurring at a maximum rate of one per second.

2.3 The minimum interval between start elements of undistorted successive continuous characters that may be presented at the channel input when the nominal modulation rate is 50 or 75 bauds shall be 145 5/6 or 97 2/9 ms respectively.

2.4 There shall be no restriction on the continuous transmission of all characters specified in § 1 above (e.g. combination No. 32 of International Telegraph Alphabet No. 2) when they are presented at the maximum permitted rate.

2.5 The effective net margin on all channel inputs when undistorted signals are received from a transmitter having a nominal character length and rate shall be at least 40%.

2.6 At the nominal signalling rate, an input character start element shall be rejected if equal to or less than 0.4 units duration and shall be accepted if equal to or more than 0.6 units duration.

2.7 Elements corresponding to start polarity (at the distant multiplexer output) shall be inserted in the aggregate stream in the case of:

a) unequipped channels;

b) equipped but unallocated channels;

c) open-circuit line condition at the local start-stop channel input.

2.8 The maximum tolerance on modulation rates other than 50 and 75 bauds shall be 1.8%.

3 Start-stop channel outputs

3.1 The maximum degree of gross start-stop distortion shall be 3% for all permitted modulation rates.

3.2 The maximum difference possible between the mean modulation rate of the channel output signals and the nominal modulation rate shall be 0.2%.

3.3 When characters having a nominal 1.5-unit stop element are presented at any input rate within the specified range of this Recommendation, the minimum stop element duration released at the output shall be 1.25 units.

3.4 When characters having a nominal 1- or 2-unit stop element are presented at any input rate within the specified range of this Recommendation, the minimum stop element duration released at the output shall be 0.8 or 1.8 units respectively.

3.5 Channel output shall be controlled as specified below in the event of recognition of any of the following failure conditions:

a) carrier loss signalled by the modem (OFF condition of received line signal detector - circuit CT109, Recommendation V.24 [1]);

b) loss of aggregate signal (defined as a period of 280 ms without a transition on the aggregate);

c) loss of synchronization.

3.6 Within 4 ms of the recognition of the failures described in § 3.5, the following shall occur to the channel outputs of the affected TDM:

3.6.1 Leased channels - two options shall be possible on a per channel basis:

a) set to steady start polarity;

b) set to steady stop polarity;

3.6.2 Circuit-switched service - two options shall be possible on a per channel basis:

a) steady start polarity at the channel output;

b) loopback of the channel towards the local end for a period of 5 ± 1 seconds, after which channel outputs shall revert to steady start polarity. Additionally for Alternative B, the traffic path shall be maintained towards the distant multiplexer terminal during this loopback interval.

Note – The actions taken in case 3.6.2 a) shall ensure that, after recognition of failure, no 50-baud channel used for circuit-switched service shall produce an output pulse of stop polarity of longer than 20 ms or a series of 20-ms pulses of stop polarity. It should be noted that 20-ms pulses can cause difficulty with some switching equipment. The loopback option in 3.6.2 b) is provided in order to avoid clearance of established connections during short breaks and thus avoid excessive recall attempts.

3.7 The affected terminal shall signal its synchronization status to the distant terminal in accordance with §§ 6.3.5 for Alternative A and 6.4.2 for Alternative B. The distant terminal shall control its channel outputs in accordance with § 3.6 above with a delay that shall not exceed 600 ms (measured from the instant of failure), ignoring the propagation time of the bearer circuit. Alternatively, for Alternative B, leased channels have the option, at the customer's request, of maintaining the traffic path in the unaffected direction.

4 Multiplexing details

4.1 Channel interleaving shall be on a bit basis.

4.2 Both start and stop elements of each input character shall be transmitted through the aggregate.

4.3 The transfer delay for 50- and 75-baud signals through a pair of terminals connected back-to-back (excluding the modems) shall not exceed 2.5 units. This delay shall be measured from the reception of the start element of a character at an input channel of one terminal until the corresponding start element is delivered from the output channel of the second terminal.

4.4 *Alternative A*

4.4.1 Multiplexing details for higher modulation rates remain for study.

4.5 *Alternative B*

4.5.1 The maximum transfer delay for all other permitted channel speeds for back-to-back terminals shall not exceed 3.5 units.

4.5.2 110-baud characters are conveyed on a 100-bit/s bearer channel by transmitting at least one stop element in the aggregate signal.

4.5.3 134.5-baud characters are conveyed on a 150-bit/s bearer channel by transmitting the necessary filling bits of stop polarity before the character start elements in the aggregate signal.

5 Frame structure

5.1 A unique subframe of 47 bits shall be used.

5.2 A 47-bit subframe shall consist of one synchronization bit in the first bit position and 46 traffic bits.

5.3 A fundamental frame consisting of two consecutive subframes shall be used.

5.4 Two alternative framing arrangements are allowed; however, the channel numbers used throughout this Recommendation represent the last two digits of a 4-digit numbering scheme - the first two digits being the subject of further study. This channel numbering scheme (see Tables 3/R.101, 4/R.101 and 5/R.101) covers both framing arrangements.

5.5 *Alternative A*

5.5.1 Two scrambling techniques are used:

5.5.1.1 Alternate frame slots have inverted signal polarity. The chart of frame structure (see Table 2/R.101) indicates the pattern used. Channels not equipped are transmitted as A (start) polarity.

5.5.1.2 The channels are arranged for external interconnection with assignment of a sequence of channel numbers (channel 1 through channel 46). These channel numbers are distinct from frame slot assignment. (This is comparable to a VFT's having both a frequency assignment and a channel number.) The channel numbering sequence is scrambled with respect to the frame slot sequence. This technique is useful not only for ensuring a good distribution of transitions, but also for simplifying mixed speed programming.

TABLE 2/R.101

Frame for forty-six 50-baud channels with provision for 75-baud channels (Alternative A)

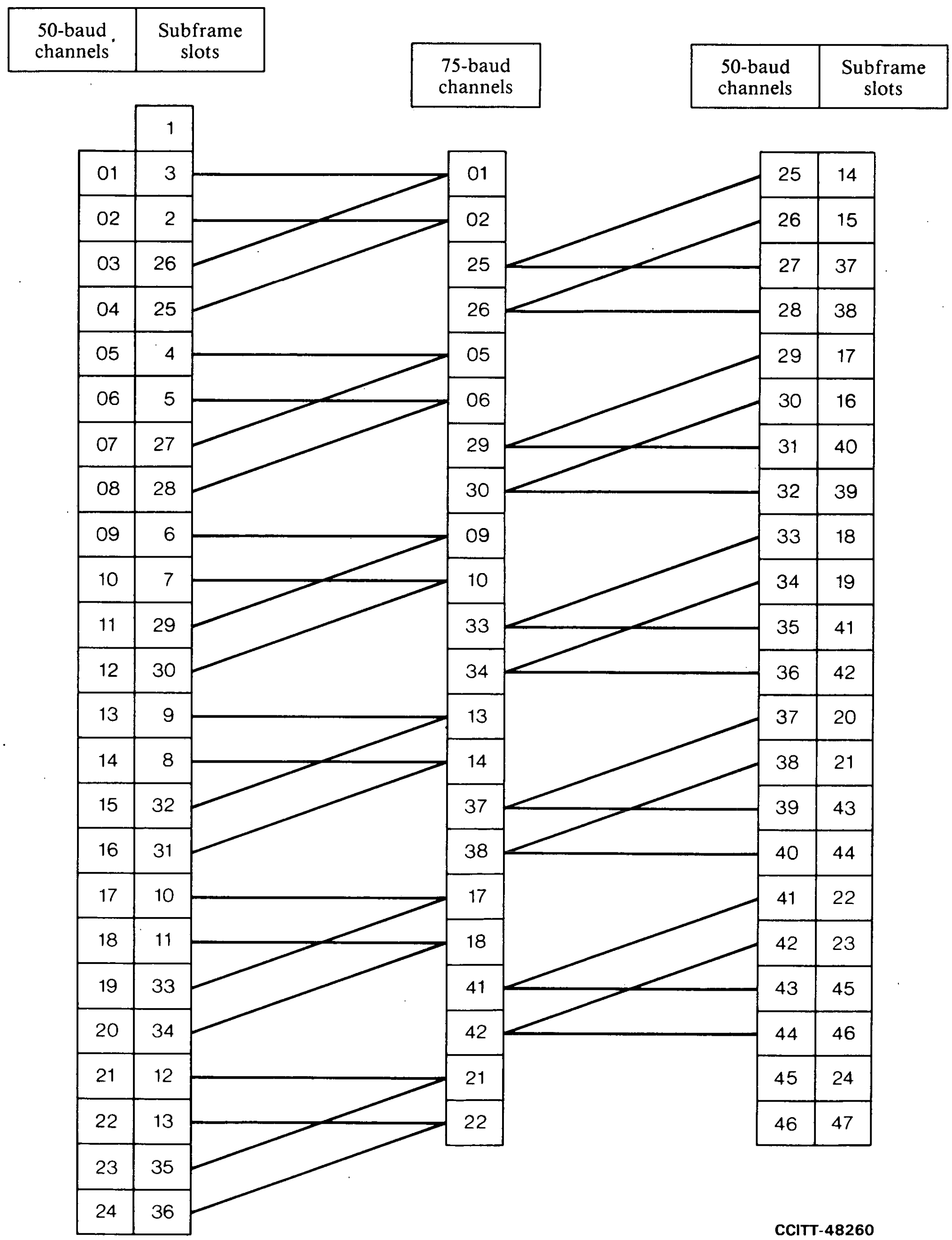
Subframe slot	Channel number	Aggregate polarity corresponding to Z polarity on low-speed channel	Channel speed
1	Not applicable		SYNC
2	02	A	50 a)
3	01	Z	50
4	05	A	50
5	06	Z	50
6	09	A	50
7	10	Z	50
8	14	A	50
9	13	Z	50
10	17	A	50
11	18	Z	50
12	21	A	50
13	22	Z	50
14	25	A	50
15	26	Z	50
16	30	A	50
17	29	Z	50
18	33	A	50
19	34	Z	50
20	37	A	50
21	38	Z	50
22	41	A	50
23	42	Z	50
24	45	Z	50
25	04	A	50 a)
26	03	Z	50
27	07	A	50
28	08	Z	50
29	11	A	50
30	12	Z	50
31	16	A	50
32	15	Z	50
33	19	A	50
34	20	Z	50
35	23	A	50
36	24	Z	50
37	27	A	50
38	28	Z	50
39	32	A	50
40	31	Z	50
41	35	A	50
42	36	Z	50
43	39	A	50
44	40	Z	50
45	43	A	50
46	44	Z	50
47	46	A	50

a) Any horizontal pair, such as channels 02 and 04 (i.e. subframe slots 2 and 25), may be replaced by a 75-baud channel. (Slots 1, 24 and 47 excepted.) In this case "fill" pulses of A polarity must be inserted in each character following element numbers 2 and 5 (see the Recommendation cited in [2] for element numbers with International Telegraph Alphabet No. 2).

5.5.2 In Table 2/R.101, higher speed channels may be substituted for multiple low-speed channels. The resulting channel should bear the number of the lowest channel replaced. For example, when channels 02 and 04 are replaced by a 75-baud channel, the 75-baud channel should be known as channel 02. (See Table 3/R.101 for the relative numbering of 50- and 75-baud channels.)

TABLE 3/R.101

Channel numbering scheme for Alternative A



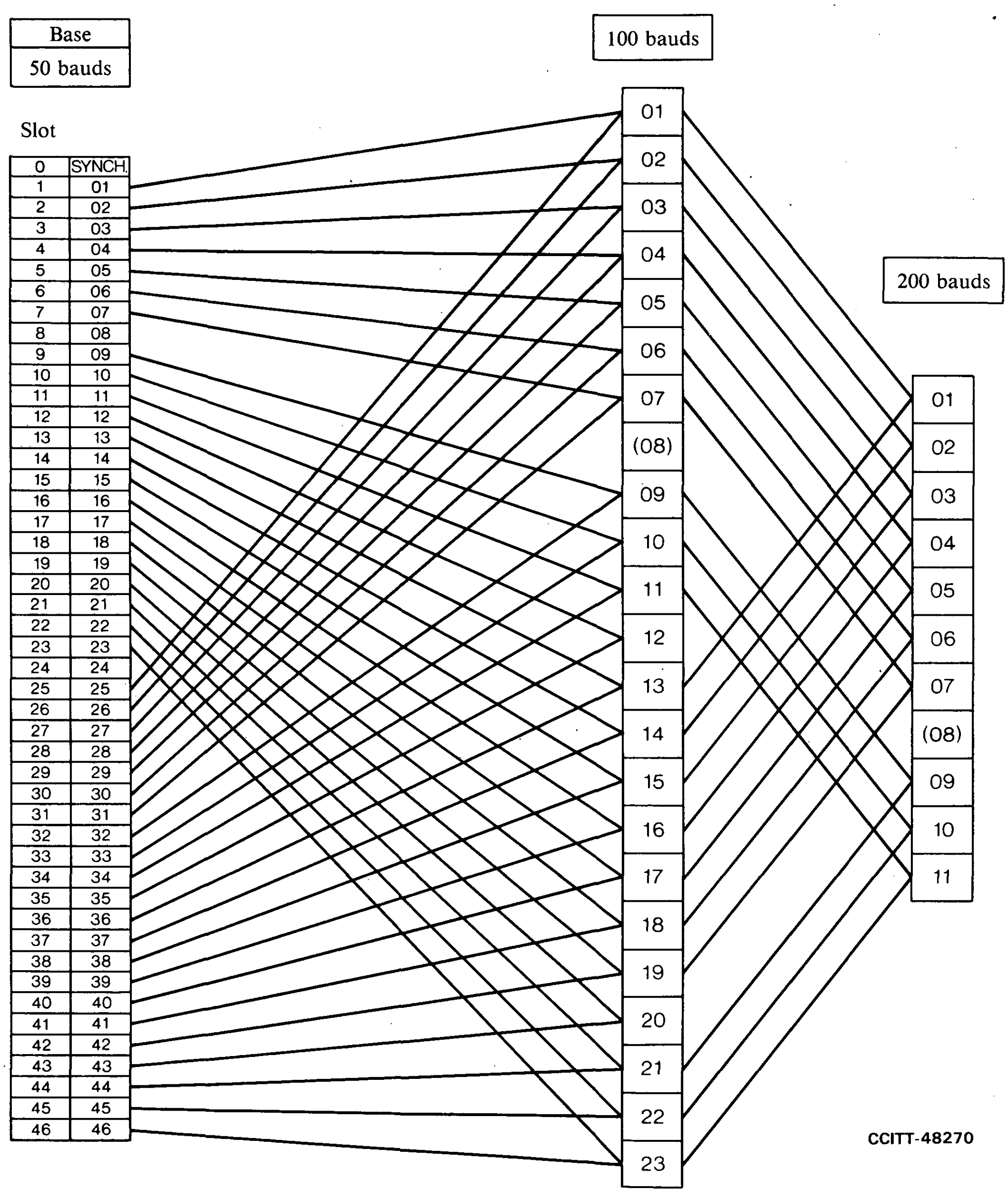
CCITT-48260

5.6 *Alternative B*

5.6.1 The channel allocation in the fundamental frame is shown in Table 6/R.101 in matrix form giving the relationship between individual low-speed channels and the corresponding traffic bits. The fundamental frame is represented as divided into four groups of 24 positions. The correspondence between positions in the matrix structure and bit numbers within the fundamental frame is shown in the bit number columns. The table also shows the distribution of positions within the specific groups for channels of different speeds and the corresponding channel numbering. (See also Tables 4/R.101 and 5/R.101.)

TABLE 4/R.101

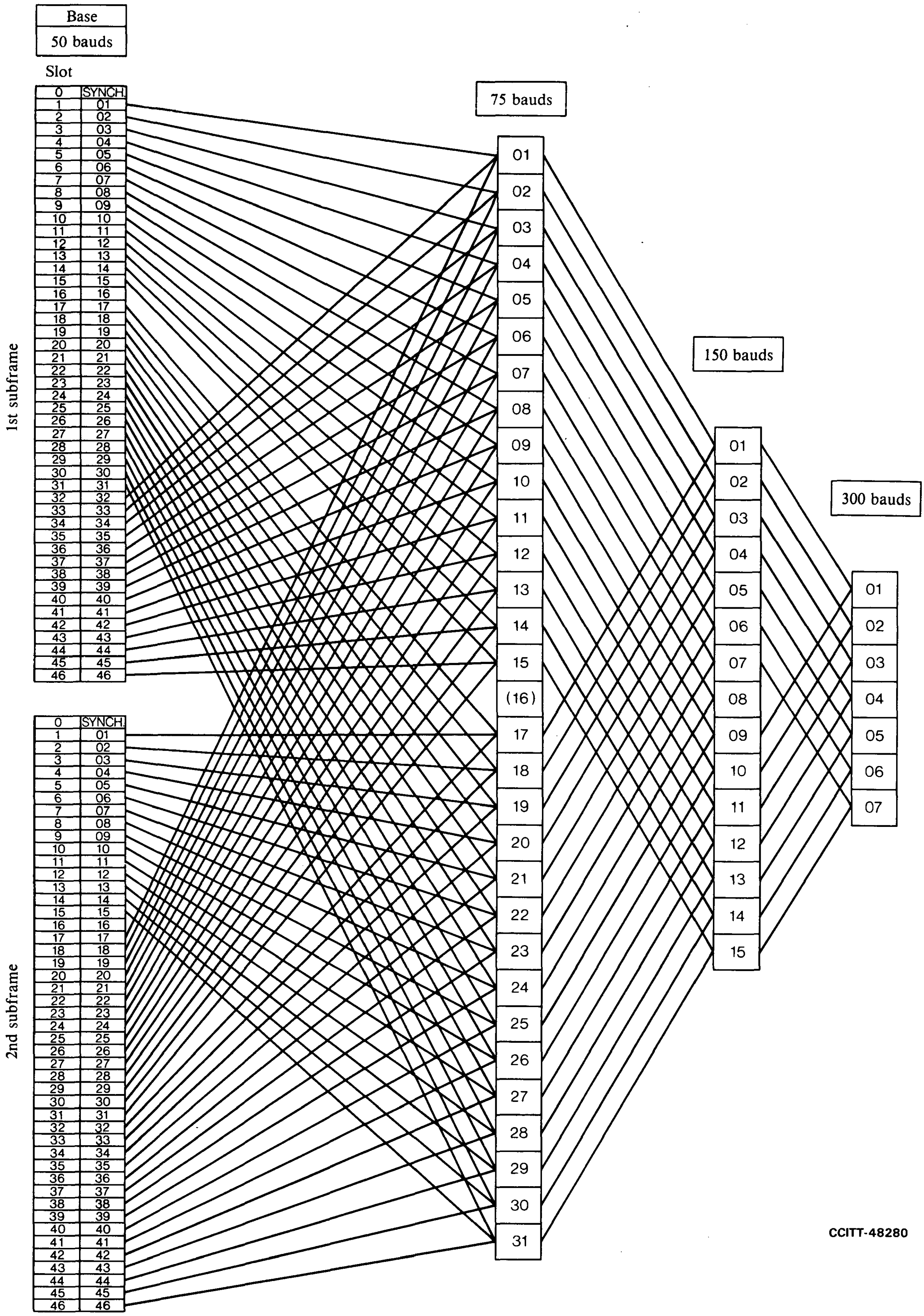
TDM channel numbering for Alternative B (50, 100 and 200 bauds)



Note – A higher rate channel cancels the use of all other channel numbers connected across to that channel number.

TABLE 5/R.101

TDM channel numbering for Alternative B (50, 75, 150 and 300 bauds)



Note – A higher rate channel cancels the use of all other channel numbers connected across to that channel number.

TABLE 6/R.101

Frame structure for Alternative B

		Subframe slot	Group one channel number						Subframe slot	Group two channel number						Subframe slot	Group three channel number						Subframe slot	Group four channel number					
Channel rate (bauds)			50	100	200	75	150	300		50	100	200	75	150	300		50	100	200	75	150	300		50	100	200	75	150	300
Fundamental frame	First subframe	0	Synchronization bit						1	01	01	01	01	01	01	2	02	02	02	02	02	02	3	03	03	03	03	03	03
		4	04	04	04	04	04	04	5	05	05	05	05	05	05	6	06	06	06	06	06	06	7	07	07	07	07	07	07
		8	08	x	x	08	08	x	9	09	09	09	09	09	01	10	10	10	10	10	10	02	11	11	11	11	11	11	03
		12	12	12	x	12	12	04	13	13	13	01	13	13	05	14	14	14	02	14	14	06	15	15	15	03	15	15	07
		16	16	16	04	x	x	x	17	17	17	05	17	01	01	18	18	18	06	18	02	02	19	19	19	07	19	03	03
		20	20	20	x	20	04	04	21	21	21	09	21	05	05	22	22	22	10	22	06	06	23	23	23	11	23	07	07
		24	24	x	x	24	08	x	25	25	01	01	25	09	01	26	26	02	02	26	10	02	27	27	03	03	27	11	03
		28	28	04	04	28	12	04	29	29	05	05	29	13	05	30	30	06	06	30	14	06	31	31	07	07	31	15	07
			Skipped						32	32	09	09	01	01	01	33	33	10	10	02	02	02	34	34	11	11	03	03	03
		35	35	12	x	04	04	04	36	36	13	01	05	05	05	37	37	14	02	06	06	06	38	38	15	03	07	07	07
		39	39	16	04	08	08	x	40	40	17	05	09	09	01	41	41	18	06	10	10	02	42	42	19	07	11	11	03
		43	43	20	x	12	12	04	44	44	21	09	13	13	05	45	45	22	10	14	14	06	46	46	23	11	15	15	07
	Second subframe	0	Synchronization bit						1				17			2				18			3				19		
		4				20			5				21			6				22			7				23		
		8				24			9				25			10				26			11				27		
		12				28			13				29			14				30			15				31		
		16				x			17				01			18				02			19				03		
		20				04			21				05			22				06			23				07		
		24				08			25				09			26				10			27				11		
		28				12			29				13			30				14			31				15		
			Skipped						32				17			33				18			34				19		
		35				20			36				21			37				22			38				23		
		39				24			40				25			41				26			42				27		
		43				28			44				29			45				30			46				31		

Note 1 – Blank slots in second subframe are as first subframe.

Note 2 – x = bit not available for corresponding channel bit rate.

Note 3 – 110- and 134.5-baud signals shall be transmitted on 100 and 150 bit/s bearer channels respectively and restituted with appropriate rate at the channel output. See also §§ 4.5.2 and 4.5.3 (Alternative B).

TABLE 7/R.101

Alternative B channel numbering

Channel rate (bauds)	Range of channel number n	Subframe slot(s) allocated to channel number n	
50	01 – 46	n	
75	01 – 15	n and $(n + 31)$ from first subframe and $(n + 16)$ from second subframe	See Notes 1 and 2
	17 – 31	n from first subframe and $(n - 16)$ and $(n + 15)$ from second subframe	
100	01 – 07	n and $(n + 24)$	See Note 3
	09 – 23	n and $(n + 23)$	
150	01 – 15	n and $(n + 16)$ and $(n + 31)$	
200	01 – 07	n and $(n + 12)$ and $(n + 24)$ and $(n + 35)$	See Note 3
	09 – 11	n and $(n + 12)$ and $(n + 23)$ and $(n + 35)$	
300	01 – 07	n and $(n + 8)$ and $(n + 16)$ and $(n + 24)$ and $(n + 31)$ and $(n + 39)$	

Note 1 – At 75 bauds, channel number n and $n + 16$ are interdependent, i.e. when channel n is used for 75 baud traffic, channel $n + 16$ must also be used for 75 bauds or remain unallocated.

Note 2 – Channel number 16 not used.

Note 3 – Channel number 08 not used.

Note 4 – 110- and 134.5-baud signals shall be transmitted on 100 and 150 bit/s bearer channels respectively and restituted with appropriate rate at the channel output. See also §§ 4.5.2 and 4.5.3 (Alternative B).

Note 1 – For all speeds other than 75 bauds, the second subframe in the fundamental frame is a repetition of the first subframe.

Note 2 – In each subframe one position within group 1 is skipped, i.e. allocated zero time in the aggregate signal.

5.6.2 Substitution of higher speed channels into a homogeneous 50-baud system configuration shall be made as follows:

2 × 75-baud channels	replaces 3 × 50-baud channels
1 × 100- or 110-baud channel	replaces 2 × 50-baud channels
1 × 150- or 134.5-baud channel	replaces 3 × 50-baud channels
1 × 200-baud channel	replaces 4 × 50-baud channels
1 × 300-baud channel	replaces 6 × 50-baud channels

5.6.3 All bits from groups 3 and 4 shall give inverted polarity.

5.6.4 The first, third and fifth bits of the synchronization pattern are contained in the first subframe. The second, fourth and sixth bits are contained in the second subframe (see § 6.4.2).

6 Synchronizing

6.1 The system shall not lose synchronism more than once per hour for a randomly distributed error rate of one part in 10^3.

6.2 Two synchronizing arrangements are allowed as follows on §§ 6.3 and 6.4.

6.3 *Alternative A*

6.3.1 The synchronizing bits shall be alternated between 1 and 0 in successive subframes during normal traffic periods.

6.3.2 The system shall declare loss of synchronism when 7 synchronizing bits are detected in error during a period of 1.5 to 2 seconds.

6.3.3 With two terminals connected back-to-back (excluding the modems), one terminal shall be capable of detecting loss of synchronism within 280 ms when its received aggregate signals are replaced by either steady start or steady stop polarity.

6.3.4 Under the conditions in § 6.1 above, after loss of synchronism has been recognized and the receive aggregate signals have been restored, the average time that may be taken for the terminal concerned to resynchronize and to connect normal data through to the low-speed channel outputs shall be less than 900 ms.

6.3.5 When one terminal recognizes loss of synchronism:

a) traffic transmitted to the other terminal shall be interrupted immediately;

b) the changes shown in Figures 1/R.101 and 2/R.101 shall occur in the synchronizing pattern.

6.4 *Alternative B*

6.4.1 A sync frame is defined as a sequence of three consecutive fundamental frames (i.e. six consecutive subframes) containing a synchronization word that consists of six equidistantly spaced bits.

6.4.2 The normal sync pattern transmitted when the TDM terminal receiver is correctly synchronized will be 100010. When the receiver is out of synchronism the transmitted pattern shall be 011101 (see § 6.4.5 below). The changeover shall only occur at the end of a sync frame.

6.4.3 Loss of synchronism is defined when three consecutive synchronization patterns are received in error.

6.4.4 When the received aggregate signal is replaced by steady start or steady stop polarity, the receiver terminal shall be capable of detecting loss of synchronism within 280 ms.

6.4.5 With two terminals connected back-to-back, loss of synchronism in one terminal shall be indicated at the other terminal within 240 ms, by inversion of the normal synchronization pattern. (See § 6.4.2 above.)

6.5 Receipt of the inverted sync pattern shall cause the terminal to force the aggregate traffic bits to the polarities corresponding to:

a) steady start at the start-stop channel input for channels that are used for circuit-switched service and that are in the free-line condition;

b) steady stop at the start-stop channel input for all other channels,

that is, both transmitted in accordance with § 5.6.3 above.

Normal data transmission

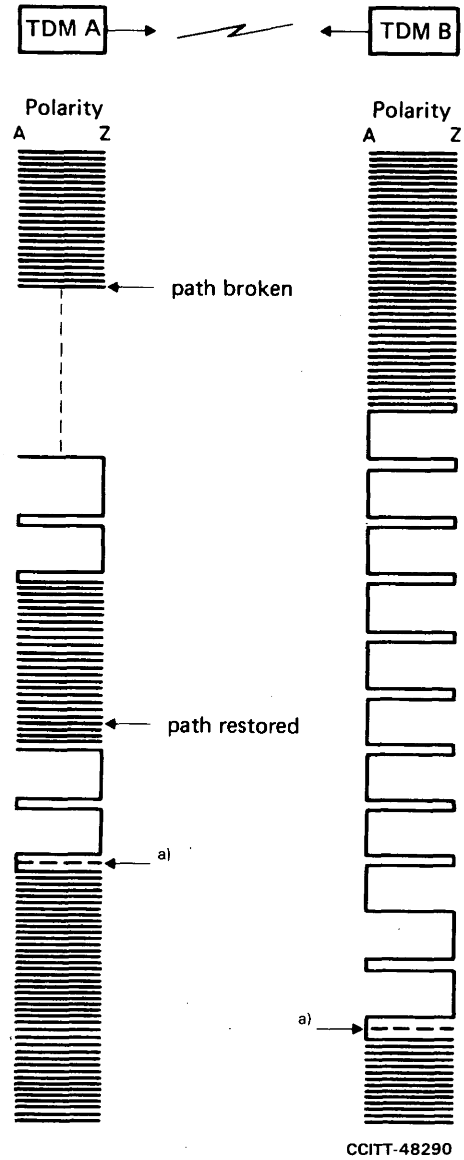
Interruption of A send path
(B receive path)

B detects OUT OF SYNC, sends SYNC REQUEST

A detects SYNC REQUEST, sends SYNC PREP and SYNC TERM, followed by data for 700 to 900 ms, ignoring further SYNC REQUESTS. This cycle repeats until link is restored. (For satellite operation the timer allows for 1.2 to 1.8 seconds, excluding incremental delays in other transmission equipment, total round trip propagation delay.)

When link is restored, B detects SYNC PREP and SYNC TERM. B sends SYNC PREP and SYNC TERM followed by data.

Normal data transmission

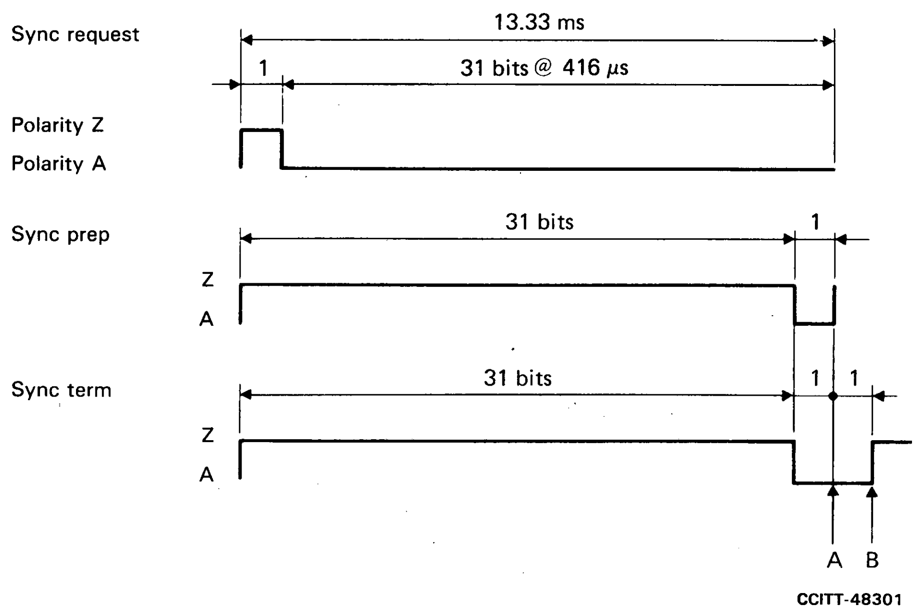


a) Aggregate time slot counters are reset to zero upon receipt of SYNC TERM. FRAME SYNC is the next bit transmitted. See description of SYNC TERM, which follows in Figure 2R/101.

Note – It should be noted that there is equipment (corresponding to Alternative A) in use that applies SYNC signals that are of inverted polarity to those shown in this Recommendation.

FIGURE 1/R.101

TDM synchronization procedure (Alternative A)



Note 1 – When synchronization is achieved, point A represents the time when aggregate time slot counters are reset to zero. The interval from A to B represents the frame SYNC pulse of the first subframe to be released after synchronization.

Note 2 – It should be noted that there is equipment (corresponding to Alternative A) in use that applies SYNC signals that are of inverted polarity to those shown in this Recommendation.

FIGURE 2/R.101

Synchronization signals (Alternative A)

6.6 Synchronism is defined as achieved when:

a) six identical synchronization patterns (i.e. six normal or six inverted synchronization patterns) have been consecutively received on a single bit position without error; and

b) within the same period, two or more consecutive identical synchronization patterns (i.e. normal or inverted sense) have not been received on any of the other bit positions in the 47-bit subframe.

The sense of the patterns in a) and b) may be different.

6.7 If condition a) in § 6.6 above is fulfilled while condition b) is not:

a) the search for synchronism is continued in the terminal concerned; and

b) this terminal shall force the transmitted aggregate traffic bits to the polarities indicated in § 6.5 above.

6.8 Under the conditions in § 6.1 above, after loss of synchronism has been recognized and the aggregate signals have been restored, the average time that may be taken for the terminal concerned to resynchronize and to connect normal data through to the low-speed channel outputs shall be less than 960 ms, excluding all transmission delays external to the R.101 TDM terminal equipment.

7 Telex signalling

7.1 Specifications for the signals used to establish, to clear and to control telex calls are laid down in Recommendations U.1 (Types A and B), U.11 (Type C) and U.12 (Type D). Recommendation U.25 lists the modes of both-way telex signalling on a single circuit and the signalling combinations on a given aggregate that a TDM terminal shall be capable of handling.

7.2 Recommendation U.25 also lays down the tolerances on the control signals from a TDM terminal to telex and vice versa.

8 Aggregate signals and interface

8.1 The tolerance on the modulation rate of the send aggregate signals of the TDM system shall be ± 0.01%.

8.2 The maximum degree of isochronous distortion of the send aggregate signals of the TDM system shall be 4%.

8.3 The effective net margin of the aggregate receiver of the TDM system shall be at least 40%.

8.4 When the TDM system is operated with an aggregate speed of 2400 bit/s over an international analogue telephone-type circuit, it is preferred that a modem complying with the appropriate aspects of the Series V Recommendations be employed.

8.5 The electrical interface conditions and control signals between the TDM system and the bearer circuit shall comply with the appropriate Recommendations in the V and X Series.

9 System clock arrangements

9.1 The TDM system shall be capable of operating with either an internal or external transmit clock.

9.2 In the event of the failure of an external clock that may be used for the TDM transmit, the TDM shall continue to function locally for maintenance purposes using its own internal clock.

9.3 The receive clock for the TDM terminal shall be provided by the bearer circuit or higher order multiplex.

9.4 In the event of the failure of an external clock that may be used for the TDM receive, the TDM shall continue to function locally for maintenance purposes using its own internal clock.

9.5 The internal clock provided in the TDM terminal should have an accuracy of 0.01%.

10 System maintenance, control and alarms

10.1 One 50-baud channel may be allocated (on an optional basis) for maintenance purposes, where possible on a separate system using a parallel route. Where this option is exercised, channels 16 or 24 (subframe slots 16 or 24) in Alternative B equipment or channel 45 (subframe slot 24) in Alternative A equipment are preferred to minimize the effect on the derivation of higher-rate channels.

10.2 If the internal (logic) power supply of the TDM terminal fails and an external telegraph battery supply is employed, all local start-stop channel outputs shall be controlled to start polarity.

10.3 It shall be possible to reallocate individual start-stop channels for different services without removing the TDM terminal from service.

References

[1] CCITT Recommendation *List of definitions for interchange circuits between data terminal equipment and data circuit terminating equipment*, Vol. VIII, Fascicle VIII.1, Rec. V.24.

[2] CCITT Recommendation *Operational provisions for the international public telegram service*, Vol. II, Fascicle II.4, Rec. F.1, § C8.

CODE AND SPEED INDEPENDENT TDM SYSTEM FOR ANISOCHRONOUS TELEGRAPH AND DATA TRANSMISSION

(Geneva, 1976; amended at Geneva, 1980)

The CCITT,

considering

(a) that the use of voice-frequency telegraph (VFT) equipment on voice channels provided by frequency division multiplexing of a primary group or by time slots in a pulse code modulation (PCM) transmission system may not always be the optimum solution for telegraph and low-speed data transmission, if aspects of transmission quality, equipment complexity, technological progress, miniaturization, power consumption and overall cost are globally considered;

(b) that the economic transmission of telegraph and low-speed anisochronous data signals requiring code- and speed-independent channels may be achieved by using time division techniques;

(c) that a relatively simple TDM (time division multiplex) system, even if less efficient in bandwidth utilization, might be preferred in some (e.g. short-haul) applications;

(d) that Administrations might be interested in conserving code and speed independence inherent in VFT systems when replacing them by TDM systems;

(e) that code and speed independent transmission systems are capable of transmitting any type of digital signal (anisochronous, isochronous, telegraph, data, signalling for switching purposes);

(f) that a code and speed independent TDM system can adapt its inherent telegraph distortion to the needs of a network, depending on the number of circuits connected in tandem;

(g) that a code and speed independent TDM system can adapt to a number of different types of channels (each being defined by its maximum modulation rate and inherent distortion);

(h) that a basic 64 kbit/s telegraph multiplexer may provide interfaces for remote submultiplexers if required. The submultiplexers may be associated in some applications with Recommendations X.50 [1] and X.51 [2] data multiplexers and with telephone channel modems and/or baseband modems;

unanimously declares the following views

1 64 kbit/s aggregate

1.1 *General*

1.1.1 Where code and speed independent TDM systems for transmission of telegraph and low-speed anisochronous data signals utilize the whole 64 kbit/s capacity (e.g. provided by a PCM time slot or a primary group), the equipment shall be manufactured to comply with the following standards.

1.2 *Aggregate bearer channel*

1.2.1 The aggregate bearer channel may be a 64 kbit/s PCM time slot or a 64 kbit/s synchronous data modem in accordance with the Recommendation cited in [3]. The nominal data signalling rate is 64 000 bit/s with a tolerance of ± 1 bit/s.

1.3 *Frame structure*

1.3.1 The frame consists of 240 bits for information plus 16 symmetrically distributed service bits for framing and other purposes. The 16th bit of the frame is the first service bit. The frame synchronization pattern comprises the first 12 service bits in the sequence 101001010101.

1.3.2 The 13th service bit is used to inform the opposite multiplexer terminal of bearer failure as follows: 1 = no bearer failure; 0 = bearer failure. A minimum of three consecutive 0 conditions is the criterion for an alarm indication.

1.3.3 The 14th service bit is used to inform the opposite multiplexer terminal of frame alignment loss as follows: 1 = no loss of frame alignment; 0 = frame alignment loss (this may be accompanied by bearer failure). A minimum of three consecutive 0 conditions is the criterion for an alarm indication.

1.3.4 The time delay between detection of a bearer failure or frame alignment loss and the sending of the 0 condition is for further study.

1.3.5 The 15th service bit is provisionally fixed to 1 and its use is left for further study.

1.3.6 The 16th service bit (last bit of the frame) may be used for possible justification and is fixed to 1. However, the justification strategy, if used, must be agreed bilaterally.

1.4 *Type of multiplexing*

1.4.1 Channel interleaving shall be on a bit basis.

1.4.2 The coding method shall be the transition coding process in accordance with Annex A below.

1.5 *Allocation of information bits*

1.5.1 The data signalling rate on the bearer for each multiplexed channel should be 250, 500, 1000, 2000 or 4000 bit/s corresponding to one, two, four, eight or sixteen bits per frame (symmetrically distributed) respectively.

1.5.2 The 64 kbit/s aggregate stream is divided into 60 kbit/s for information and 4 kbit/s for framing and other purposes.

1.5.3 The 60 kbit/s information bit stream may be subdivided into five bit streams of 12 kbit/s or, for national use or by bilateral agreement, into twenty bit streams of 3 kbit/s.

1.6 *Telegraph and data channels*

1.6.1 The nominal modulation rates are 50, 100, 200, 300, 600 and 1200 bauds. A mixture of these rates should be possible.

1.6.2 The maximum degree of inherent isochronous distortion due to the sampling process is 2.5, 5 or 7.5% according to the application as shown in Table 1/R.111, which gives the channel characteristics and full system capacity for various telegraph channel rates and for aggregate signalling rates of 64 kbit/s and below (see § 2 below).

1.7 *Frame alignment*

1.7.1 Frame realignment is ensured within three correct consecutive frame synchronization patterns, i.e. within 12 to 16 ms. In the absence of frame realignment, the telegraph channel outputs of the demultiplexer should be locked in their start polarity state for switched applications.

Note – Stop polarity might be required by some Administrations on a per channel basis for leased applications.

TABLE 1/R.111

Channel characteristics and system capacities

Nominal modulation rate (bauds)	Maximum degree of isochronous distortion due to sampling (%)	Theoretical maximum modulation rate (bauds)	Data signalling rate on the bearer per channel (bit/s)	Shortest isolated element (ms)	Maximum number of channels for an aggregate system of			
					64 kbit/s	9.6 kbit/s	4.8 kbit/s	2.4 kbit/s
50	5	83	250	4	240	32	16	8
	2.5	167	500	2	120	16	8	4
100	5	167	500	2	120	16	8	4
	2.5	333	1000	1	60	8	4	2
200	5	333	1000	1	60	8	4	2
300	7.5	333	1000	1	60	8	4	2
600[a)]	7.5	666	2000	0.5	30	4	2	–
1200[a)]	7.5	1333	4000	0.25	15	2	–	–

[a)] The number of channels indicated for modulation rates of 600 and 1200 bauds is for information only (homogeneous aggregates at these rates are not contemplated).

1.7.2 Three consecutive erroneous frame synchronization patterns should be regarded as the criterion for loss of frame alignment.

1.8 *Loss of telegraph input*

1.8.1 In the absence of any signal at a telegraph channel input, the multiplexer system should reproduce start polarity at the corresponding output.

Note – Stop polarity might be required by some Administrations on a per channel basis for leased applications.

1.9 *Bearer interface*

1.9.1 For the interface between the aggregate bearer and a PCM time slot, either a codirectional or contradirectional 64 kbit/s interface with the PCM equipment could be accepted. Even for a codirectional interface no stuffing device would be provided in the telegraph multiplexer, which would loop back the 64 kHz clock.

1.9.2 For the interface to a 64 kbit/s modem the interchange circuits of Table 2/R.111 should be provided (see the Recommendation cited in [4]).

1.10 *Telegraph interface*

1.10.1 The interface between the multiplexer and the telegraph circuits should be in accordance with national requirements.

TABLE 2/R.111

Circuit Number (cf. Recommendation V.24 [5])	Function
102 a)	Signal ground or common return
102b b)	DCE common return
103 c)	Transmitted data
104 c)	Received data
109	Data channel received line signal detector
113 c) d)	Transmitter signal element timing (DTE source)
114 c) d)	Transmitter signal element timing (DCE source)
115 c)	Receiver signal element timing

a) The provision of this conductor is optional.

b) This conductor is used in conjuntion with interchange circuit 109.

c) The electrical characteristics of the interchange circuits marked with a c) should be in accordance with Recommendation X.27 [6]. The circuits not so marked should be in accordance with Recommendation X.26 [7].

d) Either circuit 113 or 114 is to be used.

2 Aggregate bearer rates lower than 64 kbit/s

2.1 *General*

2.1.1 Where code and speed independent TDM systems for transmission of telegraph and low speed anisochronous data signals make use of capacities lower than 64 kbit/s, the equipment shall be manufactured to comply with the following standards:

2.2 *Aggregate bearer channels*

2.2.1 Aggregate rates of 2.4, 4.8 and 9.6 kbit/s shall be used. These rates can be provided either using modems in accordance with the Series V Recommendations or using data multiplexers in accordance with Recommendations X.50 [1] or X.51 [2].

2.3 *Frame structure*

2.3.1 The frame structure is independent of the frame structure of the 64 kbit/s data multiplexer or of the 64 kbit/s telegraph multiplexer. However, it must be designed to allow easy insertion of the carried telegraph channels on to the multiplexer defined in § 1 above (see also § 3 below).

2.3.2 For that purpose, one bit out of every six bits will carry framing information and other functions, which will result in effective binary rates of 2, 4 or 8 kbit/s with actual aggregate rates of 2.4, 4.8 and 9.6 kbit/s respectively.

2.3.3 The frame consists of 160 information bits plus 32 symmetrically distributed service bits for framing and other purposes. The sixth bit of the frame is the first service bit.

2.3.4 This frame is subdivided into two subframes each consisting of 80 information bits plus 16 symmetrically distributed service bits.

2.3.5 The subframe synchronization pattern comprises the first 12 service bits in the sequence 101001010101.

2.3.6 For the allocation of the 13th, 14th and 15th service bits, see §§ 1.3.2 to 1.3.5 above. The 16th service bit is set at 0 for the first subframe and at 1 for the second subframe.

2.4 *Type of multiplexing*

2.4.1 See § 1.4 above.

2.5 *Allocation of information bits*

2.5.1 The same data signalling rates as defined in § 1.5 should be used (250, 500 and 1000 bit/s and, where applicable, 2000 and 4000 bit/s).

2.5.2 Table 3/R.111 shows the number of information bits per frame for the different data signalling rates on the bearer channel. These information bits are symmetrically distributed among the 160 information bits of the frame.

TABLE 3/R.111

Number of information bits per frame

Data signalling rate on the bearer per channel (bit/s)	Number of information bits per frame for each channel in an aggregate system of		
	9.6 kbit/s	4.8 kbit/s	2.4 kbit/s
250	5	10	20
500	10	20	40
1000	20	40	80
2000	40	80	–
4000	80	–	–

2.6 *Telegraph and data channels*

2.6.1 See § 1.6 above.

2.7 *Frame alignment*

2.7.1 Frame realignment time is ensured within three correct consecutive subframe synchronization patterns. This frame realignment will be ensured within 40, 80 and 160 ms for aggregate rates of 9.6, 4.8 and 2.4 kbit/s respectively. In the absence of frame realignment the telegraph channel outputs of the demultiplexer should be locked in their start polarity state for switched applications.

Note – Stop polarity might be required by some Administrations on a per channel basis for leased applications.

2.7.2 See § 1.7.2 above.

2.8 *Loss of telegraph input*

2.8.1 See § 1.8 above.

2.9 *Bearer interface*

2.9.1 The interface between the telegraph aggregate and higher aggregate bearer channels should be as laid down in the relevant Recommendations for modems and data multiplexers.

2.10 *Telegraph interface*

2.10.1 See § 1.10 above.

3 Compatibility

3.1 For the different subrates of 2, 4 and 8 kbit/s, there should be 8, 16 and 32 information bits respectively distributed symmetrically within the 64 kbit/s aggregate frame.

3.2 The 160 information bits of the 2.4, 4.8 and 9.6 kbit/s aggregate rates should correspond to 20 groups of 8 bits, 10 groups of 16 and 5 groups of 32 bits respectively. These 8, 16 and 32 information bits should be made to correspond to the 8, 16 and 32 information bits of the 64 kbit/s frame by means of a special padding/depadding unit.

3.3 Some examples of possible implementations are given in Figures 1/R.111, 2/R.111 and 3/R.111 for illustration purposes only.

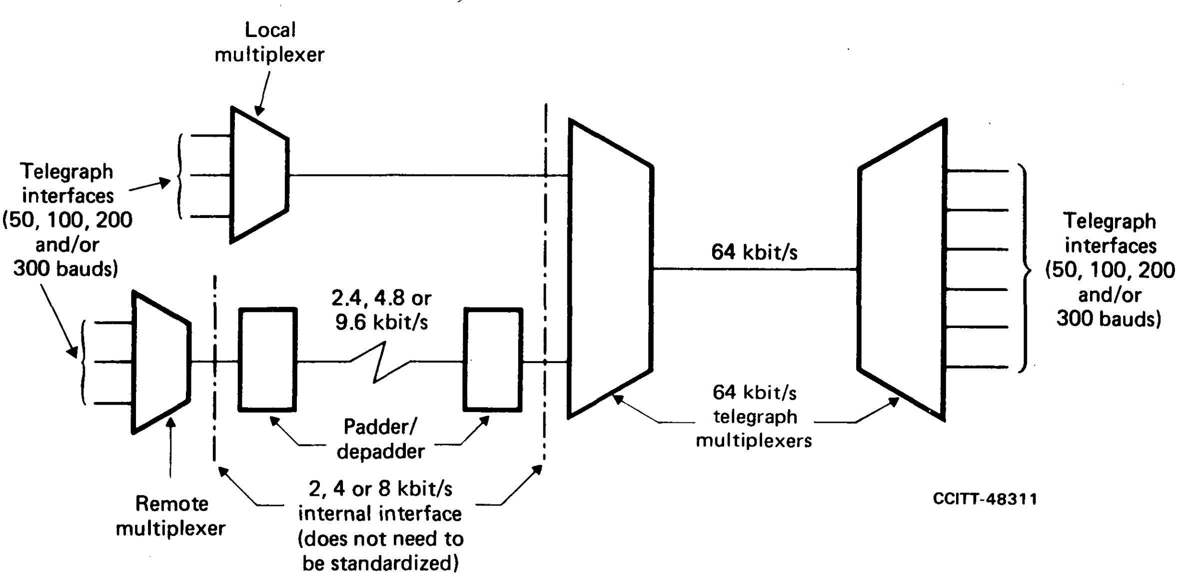


FIGURE 1/R.111

Integration of the lower aggregate rates defined in § 2 using a 64 kbit/s telegraph multiplexer with a compatible frame structure

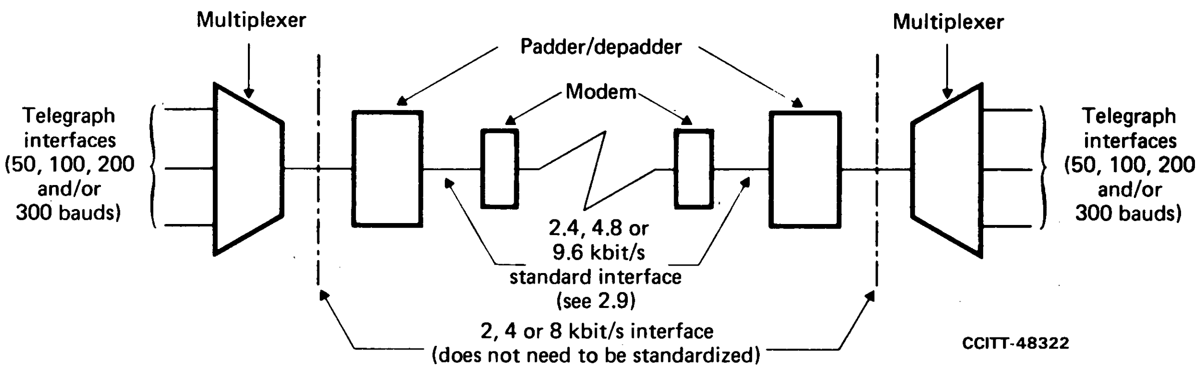


FIGURE 2/R.111

Routing of the lower aggregate rates by means of modems

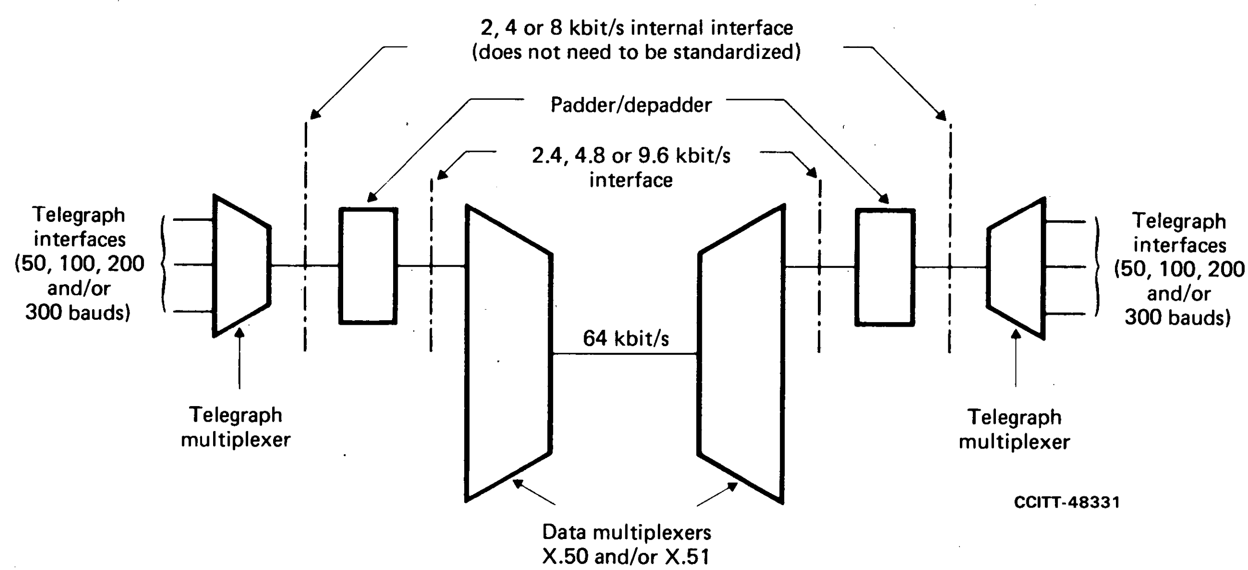


FIGURE 3/R.111

Routing of the lower aggregate rates over data multiplexers
(Recommendation X.50[1] and/or X.51[2])

ANNEX A

(to Recommendation R.111)

Transition coding process

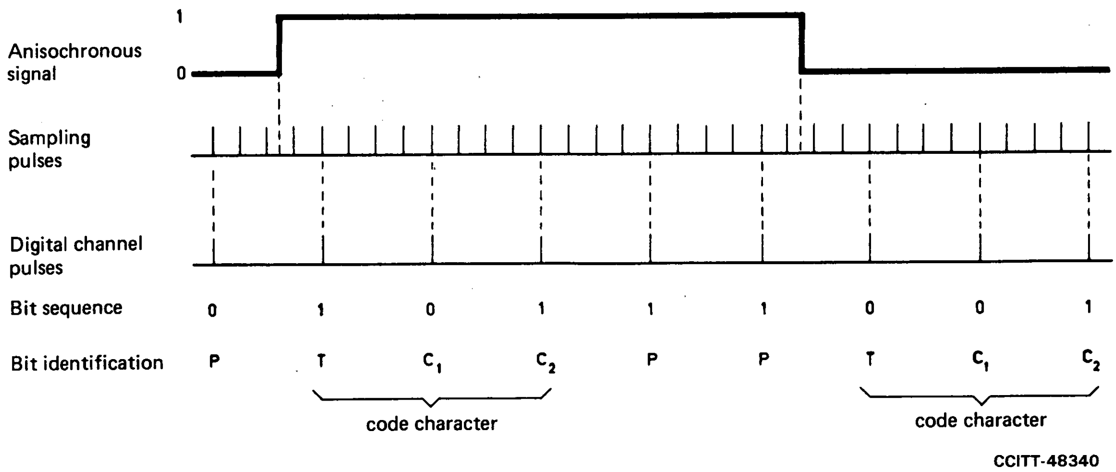


FIGURE A-1/R.111

Transition coding process

A.1 The sampling pulses are divided into groups of four and each transition of the anisochronous signal causes a code character of 3 bits to be generated at the rate of one bit for a group of 4 samples. The first T bit of this code character indicates the sense of transition while the two bits C_1 and C_2 translate into binary code the position of the transition in the relevant group.

A.2 The code characters are transmitted over the digital channel at a rate of 1 bit per group of 4 sampling pulses and the subsequent bits P between the code characters confirm the polarity of the anisochronous signal at the relevant instant. The minimum number of P bits may be zero, so the maximum code character rate equals 1/3 of the maximum modulation rate allowed.

A.3 When the anisochronous signal has a permanent polarity, an error of one bit will never entail a continuous inversion of the decoded signal, but will cause a mutilation of this signal during a limited time. The duration of these mutilations is reduced to a minimum when the code characters are formed as shown in Table A-1/R.111.

TABLE A-1/R.111

Code character for a transition from 1 to 0 in the anisochronous signal			Code character for a transition from 0 to 1 in the anisochronous signal			Position of the transition in a group of four sampling pulses
T	C_1	C_2	T	C_1	C_2	
0	0	0	1	1	1	first quarter
0	0	1	1	1	0	second quarter
0	1	0	1	0	1	third quarter
0	1	1	1	0	0	fourth quarter

References

[1] CCITT Recommendation *Fundamental parameters of a multiplexing scheme for the international interface between synchronous data networks*, Vol. VIII, Fascicle VIII.3, Rec. X.50.

[2] CCITT Recommendation *Fundamental parameters of a multiplexing scheme for the international interface between synchronous data networks using 10-bit envelope structure*, Vol. VIII, Fascicle VIII.3, Rec. X.51.

[3] CCITT Recommendation *Modems for synchronous data transmission using 60-108 kHz group band circuits*, Vol. VIII, Fascicle VIII.1, Rec. V.36, § 1 f).

[4] *Ibid.*, § 10.

[5] CCITT Recommendation *List of definitions for interchange circuits between data terminal equipment and data circuit terminating equipment*, Vol. VIII, Fascicle VIII.1, Rec. V.24.

[6] CCITT Recommendation *Electrical characteristics for balanced double-current interchange circuits for general use with integrated circuit equipment in the field of data communications*, Vol. VIII, Fascicle VIII.2, Rec. X.27.

[7] CCITT Recommendation *Electrical characteristics for unbalanced double-current interchange circuits for general use with integrated circuit equipment in the field of data communications*, Vol. VIII, Fascicle VIII.2, Rec. X.26.

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SECTION 8

TRANSMISSION QUALITY ABOVE 50 BAUDS

Recommendation R.120

TOLERABLE LIMITS FOR THE DEGREE OF ISOCHRONOUS DISTORTION OF CODE-INDEPENDENT TELEGRAPH CIRCUITS OPERATING AT MODULATION RATES OF 75, 100 AND 200 BAUDS

(Geneva, 1976; amended at Geneva, 1980)

The CCITT,

considering

(a) that, to facilitate the study of plans for the establishment of international telegraph circuits, it is convenient to set limits for the degree of isochronous distortion of telegraph circuits and channels;

(b) that, for whatever purposes normally used, these circuits should be capable of use with start-stop equipment;

(c) that, until detailed transmission planning standards are established for the trunk sections of international telegraph circuits operating at modulation rates of 75, 100 and 200 bauds, the distortion limits mentioned below should be regarded as provisional standards;

(d) that the limits laid down are those that should be evident in service conditions on telegraph circuits, excluding the local lines and terminal equipment,

unanimously declares the view

(1) that circuits (excluding local lines and terminal equipment) should be established and maintained in such a manner that the degree of isochronous distortion will not exceed the limits shown in Table 1/R.120, irrespective of whether any form of regeneration is provided in the circuit or not;

TABLE 1/R.120

Modulation rate (bauds)	Maximum degree of isochronous distortion permitted
75	28 %
100	24 %
200	32 %

(2) that the degree of isochronous distortion of each channel that may form part of a circuit should be as small as possible, and should not in any case exceed 10%.

STANDARD LIMITS OF TRANSMISSION QUALITY FOR START-STOP USER CLASSES OF SERVICE 1 AND 2 ON ANISOCHRONOUS DATA NETWORKS

(Geneva, 1976)

The CCITT,

considering

(a) that, to permit the sharing of responsibility for the maintenance of a high standard of transmission quality on switched connections between anisochronous data networks referred to in Recommendation X.1 [1], it is necessary to specify limiting values of distortion on signals leaving the international gateway centre of each network;

(b) that, on the other hand, to enable national switched networks to be interconnected, it is necessary to have a distribution plan of the telegraph distortion between national networks and the international junction circuits connecting the international gateway switching centres;

(c) that it is difficult to lay down standards applicable both to small and to large national networks;

(d) that it should be possible to fix limit values for large countries and they should apply to the great majority of user locations taking part in the international service;

unanimously declares the view

1 The following standards of transmission quality should be observed for the interconnection of national anisochronous data networks set up by means of transmission channels and start-stop terminal equipment in accordance with CCITT Recommendations to provide service for user classes of service 1 and 2 to Recommendation X.1 [1] (up to and including 300 bit/s).

1.1 The degree of gross start-stop distortion in service (i.e. including the effect of distortion due to the sending terminal equipment and the switching centres) at the point of exit of the national network should provisionally not exceed 22%.

Note – The international gateway exchange of a country is considered as forming part of the national network of that country.

1.2 The degree of inherent start-stop distortion of the international junction circuit should provisionally not exceed 13%.

Note 1 – In establishing the provisional 13% limit for the degree of start-stop distortion in the international junction circuit account has been taken of the fact that in a global connection, the international junction circuit might consist of 2 channels in tandem. If the international junction circuit is established on a single channel, an 8% provisional limit would be applicable to that circuit.

Note 2 – No limit for distortion on the entry to an international gateway centre at the receiving end has been indicated in this Recommendation. The values mentioned in §§ 1.1 and 1.2 above are adequate for planning purposes.

2 The provisional limit values mentioned above are applicable to large countries that are directly interconnected without switching in a transit country. Where national networks are unable to satisfy § 1.1 above, signal regeneration will be required.

3 Small countries (defined as countries in which all user terminal equipment can be reached via not more than one carrier channel in the national network) will have to try to obtain values less than the maximum 22% distortion mentioned in § 1.1 above.

4 The provisional standard limits mentioned under § 1 above can also apply to private switched telegraph and anisochronous data networks.

Reference

[1] CCITT Recommendation *International user classes of service in public data networks*, Vol. VIII, Fascicle VIII.2, Rec. X.1.

SECTION 9

DEFINITIONS

Recommendation R.140

DEFINITIONS OF ESSENTIAL TECHNICAL TERMS IN THE FIELD OF TELEGRAPH TRANSMISSION

(Geneva, 1980)

Note – Except for 31.381, the definitions given below were originally published in the *List of Definitions of Essential Telecommunication Terms* [1] or, in the case of definitions 02.09, 31.011, 32.01, 32.02, 32.021, 33.02 and 33.04, in [2] the CCITT *Green Book.* These definitions have been identified as necessary for studies in the field of telegraph transmission. In a number of cases minor amendments have been made to the earlier texts already, but study is continuing under Question 11/IX [3].

02 SERIES – GENERAL TRANSMISSION PROCESSES

02.02 **channel**

F: voie de transmission

S: canal

A means of oneway transmission.

Several channels may share a common path as in multi-channel systems; in this case each channel is allotted a particular frequency band or time slot which is reserved to it.

Note – See also 32.01 for telegraph channel.

02.07 **telegraph circuit**

F: circuit télégraphique

S: circuito telegráfico

A permanent connection between two instrument rooms or switching centres, or a permanent connection between a subscriber and a switching centre, without intermediate switching.

02.08 **hypothetical reference circuit**

F: circuit fictif de référence

S: circuito ficticio de referencia

A hypothetical circuit having a defined length and a defined amount of terminal and intermediate equipment, these quantities being reasonably large but not extreme. Such a conception is of value in the study of certain characteristics (noise, for example) of long-distance circuits.

02.081 **hypothetical reference connection**

F: communication fictive de référence

S: conexión ficticia de referencia

A hypothetical connection (in a telecommunication network) of defined structure, length and performance. Such a concept is of value to the study of certain aspects (noise, transmission quality) of multilink long-distance connection.

02.09 **line**

F: ligne

S: línea

1) The portion of a circuit external to the apparatus, consisting of the conductors connecting a telegraph set or telephone set or data circuit-terminating equipment to the exchange or connecting two exchanges.

2) The group of conductors on the same overhead route or in the same cable.

02.20 **passband**

F: bande passante

S: banda de paso

A band of frequencies in which the attenuation (or gain) is less than (or greater than) a specified value.

02.21 **spectrum**

F: spectre

S: espectro

1) A continuous range of frequencies, usually wide in extent, within which waves have some specific common characteristic.

2) A graphical representation of the distribution of the amplitude (and sometimes phase) of the components of a wave as a function of frequency.

A spectrum may be continuous or, on the contrary, contain only points corresponding to certain discrete values.

02.23 **telephone frequency**

F: fréquence téléphonique

S: frecuencia telefónica

Any frequency within that part of the audio-frequency range essential for the transmission of speech of commercial quality, i.e. 300-3400 Hz.

02.24 **subtelephone frequency**

F: fréquence infra-téléphonique

S: frecuencia infraacústica

A frequency below that part of the audio range usually employed in telephone transmission.

02.25 **super-telephone frequency**

F: fréquence supra-téléphonique

S: frecuencia supraacústica

A frequency above that part of the audio range usually employed in telephone transmission.

02.26 **frequency translation**

F: transposition en fréquence

S: transposición (traslación) de frecuencia

The transfer en bloc of signals occupying a definite frequency band (such as a channel or group of channels) from one position in the frequency spectrum to another, in such a way that the arithmetic frequency difference of signals within the band is unaltered.

02.27 **signal** (general sense)

F: signal

S: señal

Aggregate of waves carrying information and along a transmission channel and intended to act on a receiving unit.

02.28 **modulation**

F: modulation

S: modulación

Process by which certain characteristics of a wave (modulated or carrier wave) are modified in accordance with a characteristic of another wave representing a *signal.*

02.29 **modulation products**

F: produits de modulation, modulats

S: productos de modulación

A wave or a number of waves resulting from *modulation* perhaps followed by additional operations such as filtering.

02.30 **carrier wave**

F: onde porteuse

S: onda portadora

A wave, usually sinusoidal, which is modulated to transmit signals.

The frequency of the wave is called the "carrier frequency".

02.31 **sideband**

F: bande latérale

S: banda lateral

The frequency band on either the upper or lower side of the carrier frequency within which fall the frequencies produced by the process of modulation.

02.32 **modulating frequency**

F: fréquence de modulation

S: frecuencia de modulación

The frequency of the modulating wave.

02.38 **demodulation**

F: démodulation

S: demodulación

An operation, the reverse of *modulation*, in which the *modulation products* are used to reproduce the modulating signal.

02.44 **frequency deviation**

F: déviation de fréquence

S: desviación máxima de frecuencia

For the case of a frequency modulated wave, the maximum value of the *frequency swing* corresponding to the maximum modulation.

02.46 **deviation ratio**

F: rapport de déviation

S: relación de desviación

For the case of a frequency modulated wave, the ratio of the *frequency deviation* to the maximum modulation frequency.

02.66 **bearer channel**

F: voie porteuse

S: canal soporte

A channel used for the transmission of the aggregate signal generated by multi-channel transmission equipment.

07 SERIES – COMMON UNITS TUBES, RELAYS, AMPLIFIERS, ETC.

07.11 **relay**

F: relais

S: relé

A device, operated electrically, and causing by its operation abrupt changes in an electrical circuit (e.g. breaking the circuit, changing the circuit connections or variations in the circuit characteristics).

07.14 **electronic relay**

F: relais électronique

S: relé electrónico

A relay without moving parts, the operation of which is based upon electronic principles.

07.16 **polarized relay**

F: relais polarisé

S: relé polarizado

Relay of which the final condition at a sufficiently high value of the actuating quantity is dependent on the direction of this quantity.

07.58 **response curve**

F: courbe de réponse

S: curva de respuesta

A curve showing the variation of the output signal (power or voltage) as a function of a characteristic of the input signal (level, frequency, etc.), all other characteristics remaining constant.

31 SERIES – GENERAL ALPHABETIC TELEGRAPHY

31.01 **code character**

F: caractère (télégraphique)

S: carácter de código

The set of conventional elements established by the code to enable the transmission of a written character (letter, figure, punctuation sign, arithmetical sign, etc.) or the control of a particular function (spacing, shift, line-feed, carriage return, phase correction, etc.); this set of elements being characterized by the variety, the duration and the relative position of the component elements (or by some of these features).

31.011 **telegraph signal**

F: signal télégraphique

S: señal telegráfica

A signal representing all or part of one or more telegraph messages.

31.02 **(telegraph) signal element** (general sense)

F: élément de signal (télégraphique)

S: elemento de señal (telegráfica)

Each of the parts constituting a telegraph signal and distinguished from the others by its nature, magnitude, duration and relative position (or by one or some of these features only).

31.03 **telegraph signal element** (in alphabetic systems)

F: élément de signal télégraphique

S: elemento de señal telegráfica

Any of the elements constituting the signal according to the code, distinguished from the others by its variety, duration and relative position (or by some of these features only).

31.04 **alphabetic signal**

F: signal alphabétique, signal d'alphabet

S: señal alfabética; señal de alfabeto

Group of signal elements serving to distinguish amongst particular characters or functions in a telegraph alphabet.

Note – An alphabetic signal may be accompanied by auxiliary signals such as the start and stop signal in a start-stop system.

31.05 **start signal** (in a start-stop system)

F: signal de départ

S: señal de arranque

Signal serving to prepare the receiving mechanism for the reception and registration of a character, or for the control of a function.

31.06 **stop signal** (in a start-stop system)

F: signal d'arrêt

S: señal de parada

Signal serving to bring the receiving mechanism to rest in preparation for the reception of the next telegraph signal.

31.07 **telegraph code**

F: code télégraphique

S: código telegráfico

A system of rules and conventions according to which the telegraph signals corresponding to a text should be formed, transmitted, received and translated, in alphabetic telegraphy.

31.08 **telegraph alphabet**

F: alphabet télégraphique

S: alfabeto telegráfico

A table of correspondence between the written characters together with some of the functions (e.g. spacing, line-feed, inversion, etc.) and the telegraph signals which represent them.

31.09 **character**

F: caractère (d'écriture)

S: carácter

Letter, figure, punctuation or other sign contained in a text to be transmitted by alphabetic telegraphy.

31.10 **equal-length code**

F: code à moments

S: código de igual longitud

Code, the alphabetic signals of which are composed of the same number of unit elements, each having the same duration.

31.11 **n-unit code**

F: code à cinq moments; code à cinq éléments (unitaires)

S: código de n unidades

Equal-length code according to which the modulation is binary and the alphabetic signals are composed of *n*-unit telegraph signals of the same duration.

31.12 **code conversion**

F: conversion de code

S: conversión de código

Automatic conversion of telegraph signals or groups of telegraph signals in one code into corresponding signals or groups of signals in another code.

31.13 **modulation** (sense appropriate to the purpose of telegraphy) **keying** (Am)

F: modulation

S: modulación

Variation in time of one or more given characteristics of an electromagnetic wave or of a direct current brought about directly (in the case of facsimile telegraphy), or by means of an appropriate code (in the case of alphabetic telegraphy), according to the contents of the document to be transmitted.

31.14 **telegraph modulation** (special term for alphabetic telegraphy)

F: modulation télégraphique

S: modulación telegráfica

1) Succession in time of distinct conditions assumed by the appropriate device in the sending apparatus for the purpose of forming telegraph signals, each condition being associated with the time interval that corresponds to its duration *(outgoing signal-train).*

2) The act making the appropriate device in the sending apparatus assume such series of distinct conditions *(formation of outgoing signal-train).*

31.15 **restitution**

F: restitution

S: restitución

Series of conditions assumed, as a consequence of a telegraph modulation, by the appropriate device of a receiving apparatus, each condition being associated with the interval of time corresponding to its duration.

31.16 **"semator"** (no equivalent in English)

F: sémateur

S: semator

The appropriate device of the transmitter (or receiver) which, assuming definite conditions in succession, forms a telegraph modulation (or restitution).

Note – The "appropriate device of the transmitter (or receiver)", which is mentioned in several recommendations of the CCITT, can be called an *outgoing semator* in the case of a sender, and an *incoming semator* in the case of a receiver.

31.17 **signal-train** ("semateme" not used in English)

F: sématème

S: tren de señales; sematema

Succession in time of distinct conditions taken by a "semator".

Note 1 – The *conventional signal-train* is derived from a signal-train as defined above, by assuming that the significant condition is maintained until the following significant condition is attained.

Note 2 – The signal-train is designated "*outgoing*" or "*incoming*" according to whether the "semator" of a transmitting or receiving device is under consideration.

31.18 **sémation** (no equivalent in English)

F: sémation

S: formación de un sematema; semación

Formation of a signal-train.

31.19 **modulation (restitution signal) element**

F: élément de modulation (signal de restitution)

S: elemento de modulación (restitución, señal)

A distinct condition assumed by the appropriate device in the transmitting of receiving apparatus or by the signal, associated with the interval of time corresponding to its duration.

31.20 **significant conditions of a modulation**

F: états significatifs d'une modulation

S: estados significativos de una modulación

Distinct conditions assumed by the appropriate device of the sending apparatus that serve to characterize the variety of the elements of the alphabetic telegraph signals to be transmitted.

31.21 **significant conditions of a restitution**

F: états significatifs d'une restitution

S: estados significativos de una restitución

Distinct conditions assumed by the appropriate device of the receiving apparatus that serve to characterize the variety of the elements of the alphabetic telegraph signals received.

31.211 **significant conditions of a signal**

F: états significatifs d'un signal

S: estados significativos de una señal

Distinct conditions assumed by the telegraph signal that correspond to its discrete values and serve to characterize the variety of its elements.

31.22 **significant interval**

F: intervalle significatif

S: intervalo significativo

A time interval during which a given significant condition to be transmitted is, or should be, maintained.

31.23 **theoretical duration of a significant interval**

F: durée théorique d'un intervalle significatif

S: duración teórica de un intervalo significativo

Duration corresponding exactly to the duration prescribed by the code for a significant interval, taking into account the average modulation rate or, when necessary, the standardized modulation rate.

31.24 **significant instants**

F: instants significatifs

S: instantes significativos

Instants limiting significant intervals.

31.25 **restitution delay**

F: délai de restitution [retard à la restitution]

S: retardo de restitución; retardo en la restitución

The delay between a significant instant of modulation and the corresponding significant instant of restitution.

31.26 **unit interval**

F: intervalle unitaire

S: intervalo unitario

In a system using an equal-length code, or in a system using an isochronous modulation, the maximum interval of time such as the theorical durations of the significant intervals of a telegraph modulation (or restitution) are whole multiples of this interval.

31.27 **modulation rate**

F: rapidité de modulation

S: velocidad de modulación

Reciprocal of the unit interval measured in seconds. (This rate is expressed in *bauds.*)

31.28 **baud**

F: baud

S: baudio

The unit of modulation rate. It corresponds to a rate of one unit interval per second. Example: if the duration of the unit interval is 20 milliseconds, the modulation rate is 50 bauds.

31.29 **isochronous modulation (restitution, signal)**

F: modulation (restitution, signal) isochrone

S: modulación (restitución, señal) isócrona

Modulation (restitution, signal) in which the time interval separating any two significant instants is theoritically equal to the unit interval or to a multiple of this.

31.30 **start-stop modulation (restitution, signal)**

F: modulation (restitution, signal) arythmique

S: modulación (restitución, señal) arrítmica

Modulation (restitution, signal) characteristic of start-stop systems.

31.31 **auxiliary conditions of a modulation**

F: états auxiliaires d'une modulation

S: estados auxiliares de una modulación

Conditions, other than the significant conditions, that the appropriate device of the transmitting apparatus is caused to assume in order to facilitate the passage of the appropriate device in the receiving apparatus to the correct significant conditions and possibly to maintain it there.

31.32 **curbed modulation**

F: modulation fragmentée

S: modulación fraccionada

Modulation in which auxiliary conditions occur.

31.34 **marking percentage**

F: taux de travail

S: índice de trabajo

The percentage of a unit interval used for marking in cable code systems.

31.35 **number of significant conditions**

F: valence

S: valencia (número de estados significativos)

Number of distinct significant conditions employed to characterize the signal elements to be transmitted or received.

31.37

(For the countries of English language: the English and French terminologies do not correspond.)

marking; spacing (see also Definition 31.38)

mark; space

F: travail; repos

S: trabajo, reposo

Designation of the two significant conditions of a binary modulation (or restitution).

	The English term "marking" or "mark"	*French term*
1.	In Morse, corresponds to those portions of dot and dash signals that, for example, when actuating a Morse inker, will cause the inker to mark the paper.	**1. Travail**
2.	In printing telegraphy, corresponds to the significant condition the results in an active selecting operation in a receiving apparatus.	**2. Repos** or **travail** according to the system
	Note 1 – In start-stop automatic transmission, the term corresponds to the perforation of a hole in the tape.	idem
	Note 2 – In standardized start-stop telegraphy, the term corresponds to the "stop" element.	**Repos**
3.	In isochronous systems, the term that is arbitrarily assigned to one or the other of the two signalling conditions.	**3. Repos** or **travail** according to the system

	The English term "spacing" or "space"	
1.	In Morse, corresponds to the spaces separating marking signals and to the spaces separating complete characters.	**1. Repos**

2.	In printing telegraphy, corresponds to the significant condition that results in a passive selecting operation in a receiving apparatus.	**2. Travail** or **repos** according to the system
	Note 1 – In start-stop automatic transmission the term corresponds to the absence of perforation in the tape.	**Travail** or **repos** according to the system
	Note 2 – In standardized start-stop telegraphy the term corresponds to the "start" element.	**Travail**
3.	In isochronous systems, the term that is assigned to the non-marking signalling condition.	**3. Travail** or **repos** according to the system

The CCITT has recommended that those terms should not be used in telegraph circuit diagrams, but that the letters A and Z should be used to represent the two significant conditions of a binary modulation (see Definition 31.38).

The French term "travail"

	applies to the significant condition that:	*English term*
1.	In Morse corresponds to the recording of an impression on the paper;	**1. Mark**
2.	In International Telegraph Alphabet No. 2, corresponds to the "start" element of a start-stop signal and to the absence of perforation in the tape in start-stop automatic transmission.	**2. Space**

The French term "repos"

	applies to the significant condition that:	
1.	In Morse corresponds to spaces;	**1. Space**
2.	In International Telegraph Alphabet No. 2, corresponds to the "stop" element of a start-stop signal and to the perforation of the tape in start-stop automatic transmission.	**2. Mark**

31.38 **position A, position Z**

F: position A, position Z

S: posición A, posición Z

Representation of the positions occupied by the moving parts (for example, relay armatures) in a circuit diagram.

1 In a diagram representing a complete telegraph connection, operated by binary modulation, the positions that all the moving parts in the connection should simultaneously occupy, so that the electro-magnet of the receiver shall be in a given position (A or Z), should be designated in the same way as this position.

2 Position A is that which corresponds to the start signal of a standardized start-stop apparatus; position Z is that which then corresponds to the stop signal.

3 In the case of a point-to-point start-stop circuit, the moving parts should all be shown in position Z.

4 In the case of a diagram of a switched connection, the moving parts should all be shown in the position corresponding to the free condition of the circuits. Thus, for example, in the standardized international telex system, the position in question is A.

31.381 **condition A, condition Z**

F: condition A, condition Z

S: estado A, estado Z

The two significant conditions of a binary signal, modulation or restitution. In start-stop transmission condition A corresponds to the start- element and condition Z to the stop-element. For other representations see the table of equivalence in Recommendation V.1 [4].

31.39 **unit element**

F: élément unitaire

S: elemento unitario

Alphabetic signal element having a duration equal to the unit interval.

31.40 **unit**

F: éléments de code

S: unidad

The signal element in an equal-length multi-unit telegraph code from the arrangements of which the alphabet is formed.

31.41 **sequential . . . ; coincident (signal elements)**

F: . . . à moments successifs; à moments simultanés

S: (elementos de señal) sucesivos, simultáneos

In an equal length code system, if the signal elements are transmitted successively in time over a channel, the transmission is said to be "sequential", if the signal elements are transmitted at the same time over a multiwire circuit, the transmission is said to be "coincident".

31.42 **Morse code**

F: code Morse

S: código Morse

A two-condition telegraph code in which characters are represented by groups of dots and dashes, these groups being separated by spaces.

31.43 **Morse dot**

F: point Morse

S: punto Morse

A unit element of marking condition followed by a unit element of spacing condition, used in the formation of signals in accordance with the Morse code.

31.44 **Morse dash**

F: trait Morse

S: raya Morse

A signal element of marking condition equal in duration to three unit elements, followed by a unit element of spacing condition, used in the formation of signals in accordance with the Morse code.

31.45 **Morse space**

F: espace Morse

S: espacio Morse

1) Between characters: two unit elements of spacing condition.

2) Between words: normally six unit elements of spacing condition.

Note – These unit elements of spacing condition are in addition to the one unit element of spacing condition which forms part of the Morse dot and Morse dash signal.

31.46 **cable code**

F: code pour câble

S: código-cable

A variation of the Morse code, commonly used on submarine cables, in which cable code dots, dashes and letter spaces all have equal durations in time.

31.47 **two-condition cable code** (see Figure 1/R.140)

F: code bivalent pour câble

S: código-cable bivalente (de dos estados)

A code in which dots, dashes and letter spaces are equal in length and are formed from the arrangements of two unit elements, each of which may be one of the two conditions, e.g. positive current or negative current.

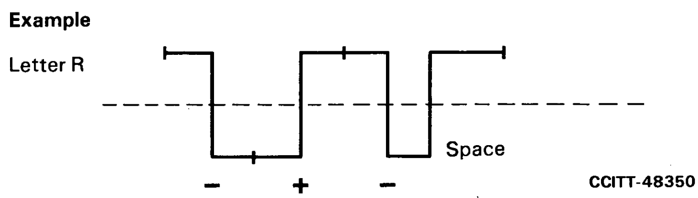

FIGURE 1/R.140

31.48 **three-condition cable code** (see Figure 2/R.140)

F: code trivalent pour câble [code recorder]

S: código-cable trivalente (de tres estados)

A code in which dots, dashes and letter spaces are equal in length and are represented by unit elements of three different conditions, e.g. positive current, negative current and zero current.

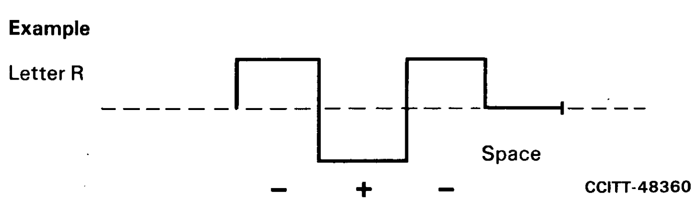

FIGURE 2/R.140

32 SERIES – TELEGRAPH CHANNELS

32.01 **(telegraph) channel**

F: voie de transmission (télégraphique)

S: canal (telegráfico)

The transmission media and intervening apparatus involved in the transmission of telegraph signals in a given direction, between two terminal sets or, more generally, between two intermediate telegraph installations.

A means of one-way transmission of telegraph signals.

A telegraph channel is characterized by the number of significant conditions and by the modulation rate it is designed to transmit.

Example: a 50-baud channel for two-condition modulation.

Note 1 – Separate telegraph channels can have common constituent parts (e.g. side and phantom circuits) or share a common path (as in the case of a multiplex).

Note 2 – When it is a question of a channel between two terminal sets, it can be referred to as a complete telegraph channel.

Note 3 – A retransmitter with storage of signals is considered a terminal set and terminates a complete channel.

Note 4 – A complete channel may include regenerative repeaters (without storage).

A channel not including any regenerative repeater is called an ordinary channel.

32.02 **(telegraph) circuit**

F: voie de communication (télégraphique) (bilatérale)

S: circuito (telegráfico) (bidireccional)

A means of both-way communication between two points comprising associated "send" and "receive" channels.

The two associated channels may be symmetrical (that is to say, they may offer users the same possibilities in either direction of transmission), or, on the other hand, asymmetrical.

Example of a symmetrical telegraph channel: the two channels together making one standardized voice-frequency telegraph circuit.

Example of an asymmetrical telegraph circuit: for data transmission, a channel offering a rate of 1200 bauds in one direction, associated with a channel offering only 100 bauds in the other direction.

Note 1 – The circuit includes the signal conversion equipment in the case of data transmission.

Note 2 – Notes 1, 2, 3 and 4 of Definition 32.01 apply to Definition 32.02, *mutatis mutandis.*

32.021 **frequency channel**

F: voie de fréquences

S: canal de frecuencias

A channel essentially characterized by its passband.

This passband is designated by its upper and lower frequencies. Should the channel be made up by joining several sections in tandem, its passband is that which will result from the whole.

Several frequency channels may share a common path, as in carrier systems; in which case each frequency channel is characterized by a particular frequency band reserved to it.

32.03 **(transmission) link**

F: chaînon de voie (de transmission, ou de communication)

S: enlace (de transmisión)

A section of a channel (or circuit) between:

a) a transmitting station and the following telegraph repeater;

b) two successive telegraph repeaters;

c) a receiving station and the preceding telegraph repeater.

32.04 **extension circuit**

F: section locale

S: circuito de prolongación sección local

The permanent connection extending a telegraph station to a nearby centre, giving access to the long distance network.

Note – Depending upon the organization of the national network, an extension circuit may comprise metallic conductors or a radio circuit, etc.

32.05 **local line**

F: raccordement

S: línea local

The line between a station and a nearby exchange.

32.06 **telegraph repeater**

F: translation (télégraphique)

S: repetidor (traslator) telegráfico

A device that receives telegraph signals and automatically retransmits corresponding signals.

32.07 **telegraph converter**

F: translation convertisseuse télégraphique

S: convertidor telegráfico

A telegraph repeater in which the input and output signals are formed according to the same code, but not according to the same type of electrical modulation.

32.08 **code converter**

F: convertisseur de code

S: convertidor de código

A repeater that converts the code.

32.09 **broadcast repeater**

F: translation pour diffusion

S: repetidor de difusión

A repeater connecting several channels, one incoming and the others outgoing.

32.10 **conference (telegraph) repeater**

F: translation (télégraphique) pour conférence

S: repetidor (telegráfico) para conferencias

A repeater connecting several circuits, which receives signals from any one of the circuits and automatically retransmits them over all the others.

32.11 **regenerative repeater**

F: translation régénératrice [translation rectificatrice] [régénérateur]

S: repetidor regenerativo

A repeater in which signals retransmitted are practically free from distortion.

32.12 **direct-current transmission**

F: transmission par courant continu

S: transmisión en corriente continua

A form of telegraphy in which transmission is effected by a direct current applied to the line under the control of the sending apparatus.

32.13 **single-current transmission**

F: transmission par simple courant

S: transmisión a simple polaridad (por corriente simple)

A form of telegraph transmission effected by means of unidirectional currents.

32.14 **double-current transmission**

F: transmission par double courant

S: transmisión a doble polaridad (por corriente doble)

A form of binary telegraph transmission in which positive and negative direct currents denote the significant conditions.

32.15 **closed-circuit working**

F: transmission par fermeture de circuit ou par envoi de courant

S: funcionamiento en circuito cerrado

A method of single-current operation in which a current flows in the circuit while the transmitting device is at rest.

32.16 **open-circuit working**

F: transmission par ouverture (rupture) de circuit ou par interruption de courant (par batterie centrale)

S: funcionamiento en circuito abierto

A method of single-current operation in which no current flows in the circuit while the transmitting device is at rest.

32.17 **simplex (circuit)**

F: (communication) simplex

S: (circuito) símplex

Permitting the transmission of signals in either direction, but not simultaneously.

32.18 **duplex (circuit, connection)**

F: ligne, liaison duplex; ligne, liaison duplexée

S: (circuito, conexión) dúplex

A circuit equipped with balancing devices permitting simultaneous both-way transmission of telegraph signals by the modulation of a continuous current.

32.23 **half duplex circuit (or connection)**

F: communication ou circuit semi-duplex

S: circuito (o conexión) semidúplex

A circuit (or connection) capable of duplex operation, but which, on account of the nature of its termination, can be operated alternately only.

32.24 **diplex . . .**

F: . . . diplex

S: . . . dúplex

Permitting simultaneously and in the same direction, the transmission or reception of two signals over a circuit or channel.

32.25 **two way simplex . . .**

F: . . . conjugués

S: símplex bidireccional

In telegraphy, term applied to channels or installations consisting of two unilateral channels or two installations, one for transmission in one direction, the other for transmission in the other direction, grouped to serve a single connection. Such grouping allows for duplex operation.

32.26 **unidirectional connection**

F: communication unilatérale

S: conexión unidireccional

A connection between telegraph sets, one of which is a transmitter and the other a receiver.

32.27 **duplex, two way simplex (connection)**

F: (communication) bilatérale

S: (conexión) dúplex, símplex bidireccional

A circuit permitting the exchange of signals in both directions.

32.28 **carrier current telegraphy**

F: télégraphie par courant porteur

S: telegrafía por corriente portadora

A method of transmission in which the signals from a telegraph transmitter modulate an alternating current.

32.29 **amplitude modulation**

F: modulation d'amplitude

S: modulación de amplitud

A telegraph signalling method in which the modulating conditions of the telegraph code are represented by currents alternating or direct of different amplitude.

32.30 **frequency modulation**

F: modulation de fréquence (ou modulation en fréquence)

S: modulación de frecuencia

A telegraph signalling method in which one or more particular frequencies correspond to each desired signalling condition of a telegraph code. The transition from one set of frequencies to the other may be either a continuous or a discontinuous change in frequency or in phase.

32.31 **frequency-shift keying (F.S.K.)**

F: modulation par déplacement de fréquence

S: modulación por desplazamiento de frecuencia (MDF)

A frequency modulation method, in which the frequency or frequencies are made to vary in accordance with the telegraphs signals and characterized by continuity of phase during the transition from one signalling condition to another.

32.32 **frequency-exchange signalling**

F: modulation par mutation de fréquences

S: modulación por cambio de frecuencias

A frequency modulation method in which the change from one signalling condition to another is accompanied by decay in amplitude of one or more frequencies and by build-up in amplitude of one or more other frequencies.

32.33 **subcarrier frequency modulation**

F: modulation en fréquence d'un sous-porteur

S: modulación de frecuencia de una subportadora

A method mainly employed in facsimile transmission over radio channels in which the picture intelligence is used to frequency-modulate a low-frequency carrier wave (the subcarrier) and this modulated wave is used to modulate the higher frequency carrier wave of the radio circuit, which may use any system of modulation (for example, amplitude modulation or frequency modulation).

32.34 **multiplex**

F: multiplex

S: múltiplex

Use of a common channel in order to make two or more channels, either by splitting of the frequency band transmitted by the common channel into narrower bands, each of which is used to constitute a distinct channel (frequency-division multiplex), or by allotting this common channel in turn, to constitute different intermittent channels (time-division multiplex).

32.35 **time-division multiplex (TDM)**

F: multiplexage par répartition dans le temps (MRT)

S: multiplexación por división en el tiempo (MDT)

A method in which a channel is established in connecting intermittently, at regular intervals and by means of an automatic distribution, its terminal equipment to a common channel.

Outside the times during which these connections are established, the section of the common channel between the distributors can be utilized in order to establish other similar channels, in turn.

32.36 **frequency-division multiplex**

F: multiplexage par répartition en fréquence (MRF)

S: multiplexación por división de frecuencia (MDF)

A multiplex in which the available transmission frequency range is divided into narrower bands, each used for a separate channel.

32.37 **voice-frequency telegraphy (VFT)**

F: télégraphique harmonique; télégraphie à fréquences vocales

S: telegrafía armónica

Telegraphy using one or more carrier currents the frequencies of which are within the voice-frequency range.

32.38 **voice-frequency telegraph (VFT system)**

F: faisceau de système de télégraphie harmonique

S: sistema de telegrafía armónica (sistema TA)

The aggregate of voice-frequency telegraph circuits carried on a single telephone circuit.

32.40 **multitone system**

F: multivoie (de transmission)

S: sistema multifrecuencia

A telegraph transmission system in which it is necessary to use two or more channels simultaneously in the same direction for transmitting a signal between the same two points.

32.44 **omnibus system**

F: (système à postes) embrochés

S: sistema con estaciones en serie (sistema ómnibus)

A system in which a number of stations are permanently connected in series, the signals transmitted by any one station being received by all.

32.45 **echelon telegraphy**

F: (communication, installation, faisceau) échelonné

S: telegrafia escalonada

An arrangement by which a part of the traffic capacity of a route provided between two points A and B is allocated to provide also direct circuits linking an intermediate point C with either or both of the points A and B.

32.46 **forked working**

F: (communication) bifurquée

S: funcionamiento con bifurcación

A circuit arrangement designed for direct communication between a point A and two points B and C, using a common path AT for part of the route, extended from the point T by two paths in parallel, one serving B and the other serving C.

32.47 **superposed circuit**

F: circuit superposé [circuit virtuel]

S: circuito superpuesto

An additional circuit obtained from one or more wires, provided primarily for other circuits, and arranged so that other circuits may be used simultaneously without mutual interference.

32.49 **phantom telegraph circuit** (see Figure 3/R.140)

F: circuit télégraphique fantôme

S: circuito telegráfico fantasma

A telegraph circuit superimposed on two physical circuits reserved for telephony.

32.50 **earth-return phantom circuit** (see Figure 3/R.140)

F: circuit approprié; circuit télégraphiquè fantôme avec retour par la terre

S: circuito telegráfico fantasma con vuelta por tierra

A superposed earth return telegraph circuit derived from a pair of line conductors used in parallel.

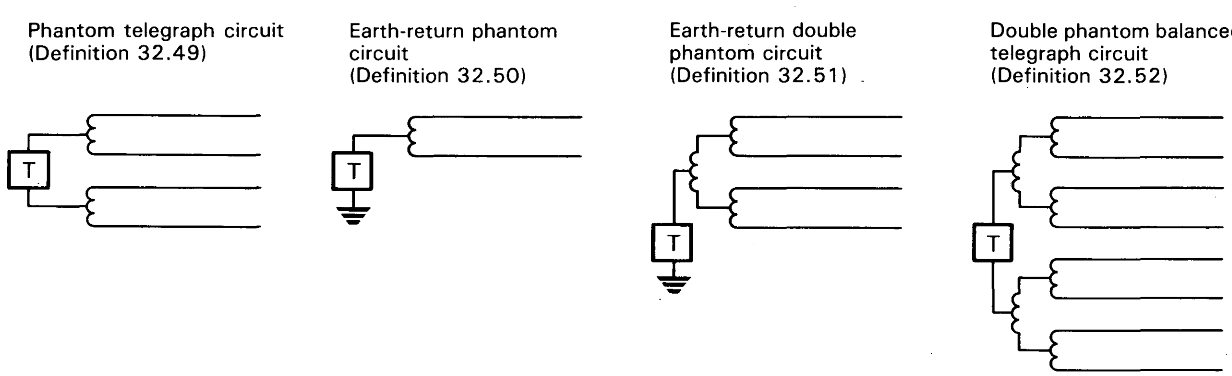

FIGURE 3/R.140

Arrangement for phantom and double phantom telegraph circuits

32.51 **earth-return double phantom circuit** (see Figure 3/R.140)

F: (circuit) approprié de fantôme; (circuit) approprié de combiné; circuit télégraphique superfantôme avec retour par la terre

S: circuito superfantasma con vuelta por tierra

A superposed earth-return telegraph circuit derived from two pairs of line conductors used in parallel.

32.52 **double phantom balanced telegraph circuit** (see Figure 3/R.140)

F: circuit télégraphique superfantôme

S: circuito telegráfico superfantasma

A double phantom telegraph circuit derived from four pairs of line conductors and without earth return.

32.53 **subtelephone telegraphy**

F: télégraphie infra-téléphonique

S: telegrafía infraacústica

A form of telegraphy using a frequency band below the voice-frequency range, e.g. below 300 Hz.

32.54 **super-telephone telegraphy**

F: télégraphie supra-téléphonique

S: telegrafía supraacústica

A form of telegraphy using a frequency band above the voice-frequency range, e.g. above 3400 Hz.

32.55 **interband telegraphy**

F: télégraphie inter-bandes

S: telegrafía interbanda

A form of carrier telegraphy in which the channel is constituted in a narrow frequency band included between two wider bands used to constitute telephone channels.

32.56 **intraband telegraphy**

F: télégraphie intrabande

S: telegrafía intrabanda

A process involving the appropriation of a band of frequencies from a telephone channel in order to form a carrier-current telegraph channel and so permit simultaneous telegraph and telephone communication.

32.57 **speech plus simplex (equipment)**

F: (équipement) univocal

S: (equipo) telefónico, más símplex

Equipment for simultaneous telegraphy and telephony providing a simplex telegraph circuit by the use of a single telegraph carrier frequency.

32.58 **speech plus duplex (equipment)**

F: (équipement) bivocal

S: (equipo) telefónico, más dúplex

Equipment for simultaneous telegraphy and telephony providing a duplex telegraph circuit by the use of two telegraph carrier frequencies.

32.61 **reserve circuit**

F: circuit de secours

S: circuito de reserva

A circuit, normally available for telephone traffic, that is allocated for the operation of a multi-channel telegraph system when the main, or primary, circuit becomes faulty.

32.62 **speaker circuit**

F: circuit de service

S: circuito de servicio

Circuit reserved for messages that relate to the operation of the service.

33 SERIES – QUALITY OF TELEGRAPH TRANSMISSION

33.01 **perfect modulation (restitution, signal)**

F: modulation (restitution, signal) parfaite

S: modulación (restitución, señal) perfecta

Modulation (restitution, signal) such that all the significant intervals are associated with correct significant conditions and conform accurately to their theoretical durations.

33.02 **ideal instants**

F: instants idéals

S: instantes ideales

Instants with which the significant instants would coincide in certain conditions.

It will be necessary to indicate, in each particular case, how these ideal instants are determined.

a) *Start-stop modulation*

The ideal instant of a start element is the instant at which this element begins. The ideal instant of each of the other elements is *n* times the theoretical unit interval later than the ideal instant of the start element of the same signal, *n* being the rank of this element in the signal.

The standardized unit interval should be taken as the theoretical unit interval. The interval corresponding to the real mean modulation rate can also be taken, provided that it is specified.

The instant corresponding to the beginning of the start element of a signal should be known as the reference ideal instant for this signal.

b) *Isochronous modulation*

An ideal reference instant can be chosen arbitrarily. All the others are deduced from it by intervals equal to the corresponding theoretical significant intervals.

In the absence of any other deciding reason, the reference ideal instant shall be chosen so that the mean value of the deviations with respect to it is equal to zero.

33.03 **incorrect modulation (restitution, signal)**

F: modulation (restitution, signal) incorrecte

S: modulación (restitución, señal) incorrecta

Modulation (restitution, signal) containing one or more elements, the significant condition of which differs from that corresponding to the kind prescribed by the code.

33.04 **telegraph distortion**

F: distorsion télégraphique

S: distorsión telegráfica

1 A modulation, restitution or signal suffers from telegraph distortion when the significant intervals have not all exactly their theoretical durations.

2 A modulation, restitution or signal is affected by telegraph distortion when significant instants do not coincide with the corresponding theoretical instants.

33.05 **spread**

F: (zone d') empiètement

S: desplazamiento

Time interval at either side of an ideal instant of modulation, restitution or signal, in which occur the actual significant instants of the modulation, restitution or signal.

33.06 **individual distortion**

F: distorsion individuelle

S: distorsión individual

Ratio to the unit interval of the displacement, expressed algebraically, of this significant instant from an ideal instant.

This displacement is considered positive when the significant instant occurs after the ideal instant.

The degree of individual distortion is expressed as a percentage.

33.07 **degree of isochronous distortion**

F: degré de distorsion isochrone

S: grado de distorsión isócrona

Ratio to the unit interval of the maximum measured difference, irrespective of sign, between the actual and the theoretical intervals separating any two significant instants, these instants not necessarily being consecutive.

The degree of distortion expressed as a percentage.

Note – The result of the measurement should be completed by an indication of the period, usually limited, of the observation. For a prolonged modulation (or restitution) it will be appropriate to consider the probability that an assigned value of the degree of distortion will be exceeded.

33.08 **degree of start-stop distortion**

F: degré de distorsion arythmique

S: grado de distorsión arrítmica

In start-stop transmission the ratio to the unit interval of the maximum measured difference, irrespective of sign, between the actual and theoretical intervals separating any significant instant from the significant instant of the start element immediately preceding it.

The degree of distortion of a start-stop modulation, restitution or signal is usually expressed as a percentage.

Note 1 – As for Definition No. 33.07.

Note 2 – Distinction can be made between the degree of *late* (or positive) distortion and the degree of *early* (or negative) distortion.

33.09 **degree of gross start-stop distortion**

F: degré de distorsion arythmique global

S: grado de distorsión arrítmica global

Degree of start-stop distortion determined when the unit interval and the theoretical intervals assumed are exactly those apropriate to the standardized modulation rate.

Note – As for Definition No. 33.07.

33.10 **degree of synchronous start-stop distortion**

F: degré de distorsion arythmique au synchronisme

S: grado de distorsión arrítmica en el sincronismo

Degree of distortion determined when the unit interval and the theoretical intervals assumed are those appropriate to the actual mean rate.

Note 1 – As for Definition No. 33.07.

Note 2 – For the determination of the actual mean modulation rate, account is only taken of those significant instants of modulation (or restitution) that correspond to a change of condition in the same sense as that occurring at the beginning of the start element.

33.11 **degree of distortion in service**

F: degré de distorsion en service

S: grado de distorsión en servicio

Degree of distortion of a modulation (restitution signal), measured when the telegraph apparatus is in service.

Note – The duration of the measurement may be quoted in each particular case.

33.12 **degree of standardized test distortion**

F: degré de distorsion d'essai normalisé

S: grado de distorsión normalizado de prueba

Degree of distortion of the restitution measured during a specified period of time when the modulation is perfect and corresponds to a specific text.

33.13 **degree of inherent distortion**

F: degré de distorsion propre

S: grado de distorsión propia

Degree of output distortion when the applied input signal is undistorted.

Note 1 – By inherent distortion is meant the combination of the different types of distortion caused by the channel (bias, characteristic, etc.).

Note 2 – This notion may be extended to the constituent elements of a channel, such as a telegraph relay.

Note 3 – It will be necessary to specify in what conditions the channel is used (type of apparatus, modulation rate, manual or automatic keying, etc.) and to effect the modulation under these conditions.

In particular the point of entry at which the distortionless modulation is applied and the terminal point where the distortion is measured should be defined.

33.14 **conventional degree of distortion**

F: degré conventionnel de distorsion

S: grado convencional de distorsión

The degree of distortion the probability of exceeding which, during a prolonged observation, equals a very small assigned value.

Note – The assigned value should be specified for each case of utilization.

33.15 **characteristic distortion**

F: distorsion caractéristique

S: distorsión característica

Distortion caused by transients that, as a result of the modulation, are present in the transmission channel and depend on its transmission qualities.

33.16 **fortuitous distortion**

F: distorsion fortuite; [distorsion irrégulière]; [distorsion accidentelle]

S: distorsión fortuita

Distortion resulting from causes generally subject to random laws (accidental irregularities in the operation of the apparatus and of the moving parts, disturbances affecting the transmission channel, etc.).

33.17 **asymmetrical distortion**

F: distorsion biaise; distorsion dissymétrique

S: distorsión asimétrica

Distortion affecting a two-condition (or binary) modulation (or restitution) in which all the significant intervals corresponding to one of the two significant conditions have longer or shorter durations than the corresponding theoretical durations.

33.18 **cyclic distortion**

F: distorsion cyclique

S: distorsión cíclica

Distortion that is due to a cause having a periodic character (for example, irregularities in the duration of contact time of the brushes of a transmitter distributor, interference from alternating currents, etc.).

33.19 **error rate of a telegraph communication**

F: taux d'erreur d'une communication télégraphique

S: tasa de errores de una comunicación telegráfica

Ratio of the number of alphabetic signals of a message incorrectly received (after automatic translation, where applicable) to the number of alphabetic signals of the message, the keying being correct.

Note 1 – A telegraph communication may have a different error rate for the two directions of transmission.

Note 2 – The notion of error rate could be applied to any operation taking place in a telegraph communication (e.g. keying, translation, etc.).

Note 3 – The statement of the error rate will be accompanied by that of the time interval, generally limited, during which the observation was made. For a communication established for a sufficiently long time, the probability of exceeding an assigned value of error rate could be considered.

33.20 **error rate of keying**

F: taux d'erreur d'une manipulation

S: tasa de errores de una modulación

Ratio of the number of alphabetic signals incorrectly transmitted to the number of alphabetic signals of the message.

33.21 **error rate of a translation**

F: taux d'erreur d'une traduction

S: tasa de errores de una traducción

Ratio of the number of alphabetic signals incorrectly translated to the number of alphabetic signals in the message, the restitution at the input of the receiving apparatus being without distortion.

33.22 **quality index of a channel**

F: indice de qualité d'une voie de transmission

S: índice de calidad de un canal

The probability of exceeding an assigned value of the degree of inherent distortion of a channel, or of a section of a channel, or of a telegraph repeater, etc.

33.23 **efficiency factor in time** (of a telegraph communication with automatic repetition for the correction of errors)

F: facteur d'efficacité dans le temps

S: factor de eficacia en el tiempo

Ratio of the time necessary to transmit a text automatically without repetition, at a specified modulation rate, to the time actually taken to receive the same text with a given error rate.

Note 1 – The whole of the apparatus comprising the communication is assumed to be in the normal conditions of adjustment and operation.

Note 2 – A telegraph communication may have a different efficiency factor in time for the two directions of transmission.

Note 3 – The actual conditions in which the measurement is made should be specified, in particular the duration of the measurement.

33.24 **mutilation**

F: mutilation

S: mutilación

A transmission defect in which a signal element becomes changed from one significant condition to another.

33.25 **transposition**

F: transposition

S: transposición

A transmission defect in which, during one character period, one or more signal elements are changed from one significant condition to the other, and an equal number of elements are changed in the opposite sense.

33.26 **controlling testing station (on a circuit)**

F: station directrice (sur un circuit)

S: estación directora (de un circuito)

A station located on the circuit and having the responsibility for the quality of transmission on the circuit.

33.27 **sub-control station**

F: station sous-directrice

S: estación subdirectora

Station, located on the circuit, responsible to the controlling testing station, and having responsibility for the quality of transmission on the section of the circuit within its territory.

33.28 **system control station**

F: station de contrôle (d'un faisceau)

S: estación de control de un sistema

Terminal station of a voice-frequency telegraph system responsible for the maintenance and the removal of faults on the system.

33.29 **test section**

F: section d'essais

S: sección de pruebas

The section of a channel that is contained between two stations having measuring equipment enabling tests of telegraph transmission to be made.

33.30 **principal test section**

F: section principale d'essais

S: sección principal de pruebas

The longest test section that can be obtained from a complete channel.

33.31 **automatic repetition**

F: répétition automatique

S: repetición automática

A system in which each signal is automatically sent more than once, the duplicated signal being separated from the initial transmission by a constant delay.

33.32 **precorrection**

F: précorrection

S: precorrección

Application of artificial telegraph distortion to signals at the sending end of a channel.

33.33 **error-detecting telegraph code**

F: code détecteur d'erreurs

S: código detector de errores

A telegraph code in which each telegraph signal conforms to specific rules of construction, so that departures from this construction in the received signals can be automatically detected. Such codes necessarily require more signalling elements than are required to convey the basic information.

33.34 **error-correcting telegraph system**

F: système correcteur d'erreurs

S: sistema corrector de errores

A system employing an error-detecting code and so conceived that any false signal initiates a repetition of the transmission of the character incorrectly received.

33.35 **error-correcting telegraph code**

F: code correcteur d'erreurs

S: código corrector de errores

An error-detecting code incorporating sufficient additional signalling elements to enable the nature of some or all of the errors to be indicated and corrected entirely at the receiving end.

References

[1] *List of Definitions of Essential Telecommunication Terms*, Part I, and 1st and 2nd Supplements, ITU, Geneva, 1961.

[2] CCITT *Green Book*, Vol. VII, ITU, Geneva, 1973.

[3] CCITT - Question 11/IX, Contribution COM IX-No. 1, Study Period 1981-1984, Geneva, 1981.

[4] CCITT Recommendation *Equivalence between binary notation symbols and the significant conditions of a two-condition code*, Vol. VIII, Fascicle VIII.1, Rec. V.1.

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PART II

Series U Recommendations

TELEGRAPH SWITCHING

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SECTION 1

GENERAL

Recommendation U.1

SIGNALLING CONDITIONS TO BE APPLIED IN THE INTERNATIONAL TELEX SERVICE

(former CCIT Recommendation E.1, Arnhem, 1953; amended at Geneva, 1956, New Delhi, 1960, Geneva, 1964, Mar del Plata, 1968, Geneva, 1972, 1976 and 1980)

The CCITT,

considering

(a) that signalling conditions in the international telex service require accurate definition of the signals to be used on international telex circuits in putting through, supervising, clearing, and charging for international telex calls;

(b) that these signals must be such as to take into account that there are some fairly important differences in make-up between the telex networks of different countries. In some countries, selection is done by dialling, in others by means of start-stop signals. Some networks use direct selection while others use register translators. Between some networks, subscriber automatic selection is used whilst, in relations with other networks, semi-automatic or manual selection is still being used;

(c) that hence it has not been possible to lay down uniform signals for all international telex relations. While, for certain signals, it has been possible to lay down rules valid for all relations, for others the choice has been left between two types of signals known as type A and type B, within each type it has sometimes been necessary to provide alternative forms for certain signals. The signals with regard to which there is a choice are described in Tables 1a/U.1, 1b/U.1 and 2/U.1 below;

(d) that it is intended that the signalling with which this Recommendation deals should apply as far as possible when telex circuits make use of transmission devices having multiplex and signal regeneration facilities. In the case of operation over error-corrected radio circuits, Recommendaton U.20 lays down the conditions for adapting the signalling defined in Recommendation U.1. In the case of operation over channels using synchronous multiplex equipment in accordance with Recommendation R.44, Recommendation U.24 lays down the conditions for adapting the signalling defined in Recommendation U.1. When the signals defined in Recommendation U.1 are transmitted via regenerative repeaters the signals received from these transmission devices may lie outside the tolerances stated in this Recommendation, and the permitted variations are shown in Recommendation U.5;

(e) that it has also been necessary to define an additional signalling standard (type C signalling) for use on the intercontinental telex transit network. Details of this method of signalling are laid down in Recommendation U.11,

unanimously declares the view

1 Signalling types

1.1 In general, as far as signalling over international telex circuits is concerned, the outgoing country should conform to the signalling requirements of the incoming country. Nevertheless, when in the case of fully automatic service this requirement would entail considerable difficulty, alternative arrangements may be adopted by agreement between the two Administrations concerned.

1.2 The signals shown in §§ 2 to 10 below shall be employed under the conditions indicated.

Note – Both the forward and backward path signals are described at the moment of their emission on the international circuit.

1.3 The characteristics of the signals defined in §§ 4, 5, 7 and 10 below can be divided into two basic groups – type A and type B – as given in Tables 1a/U.1, 1b/U.1 and 2/U.1.

TABLE 1a/U.1

International telex circuits terminated on distant automatic switching equipment with semi-automatic working to subscribers

Signal	Type A	Type B
Call-confirmation (see §§ 4 and 5.1 of the text)	Permanent stop polarity	25-ms pulse of stop polarity (between 17.5 and 35 ms)
Proceed-to-select (see § 5.1 of the text)	Teleprinter signal(s)	25-ms pulse of stop polarity (between 17.5 and 35 ms)
Selection (see § 6 of the text)	Teleprinter signals	Dial pulses, or teleprinter signals
Call-connected (see § 7 of the text)	Teleprinter signals *Note* – The teleprinter signals may be preceded by a 150-ms (± 11 ms) pulse of start polarity	Stop polarity for at least two seconds
Busy (see § 10.1 of the text)	Teleprinter signals followed by clearing signal	i) 165-260-ms pulse of stop polarity followed by start polarity for 1500 ms (tolerance: ± 30%) (See Note) ii) 165-260-ms pulse of stop polarity followed by teleprinter signals and start polarity for 1500 ms (tolerance: ± 20%) (See Note)
Out-of-order, number changed and number unobtainable (see § 10.1 of the text)	Clearing signal normally preceded by teleprinter signals	i) Permanent start polarity ii) 165-260-ms pulse of stop polarity followed by start polarity for 1500 ms (tolerance: ± 30%) (See Note) iii) 165-260-ms pulse of stop polarity followed by teleprinter signals and start polarity for 1500 ms (tolerance: ± 20%) (See Note)

Note – This sequence of signals may be repeated until a clearing signal is sent over the forward signalling path. However, with transmission systems having significant propagation delay, e.g. satellite or multiplex systems, it may be preferable to prevent such repetitions.

TABLE 1b/U.1

International telex circuits terminated on distant automatic switching equipment with fully automatic working between subscribers

Signal	Type A	Type B
Call-confirmation (see §§ 4 and 5 of the text)	Permanent stop polarity	25-ms pulse of stop polarity (between 17.5 and 35 ms)
Proceed-to-select (see § 5.1 of the text)	40-ms (± 8 ms) pulse of start polarity	25-ms pulse of stop polarity (between 17.5 and 35 ms)
Selection (see § 6 of the text)	Teleprinter signals	Dial pulses, or teleprinter signals
Call-connected (see § 7 of the text)	150 ms (± 11 ms) pulse of start polarity followed by stop polarity for at least 2 seconds and possibly by teleprinter signals	Stop polarity for at least 2 seconds
Busy (see § 10.1 of the text)	Teleprinter signals followed by clearing signal	i) 165-260-ms pulse of stop polarity followed by start polarity for 1500 ms (tolerance: ± 30%) (See Note 1) ii) 165-260-ms pulse of stop polarity followed by teleprinter signals and start polarity for 1500 ms (tolerance: ± 20%) (See Note 1)
Out-of-order, number changed and number unobtainable (see § 10.1 of the text)	Clearing signal normally preceded by teleprinter signals	i) Permanent start polarity (See Note 2) ii) 165-260-ms pulse of stop polarity followed by start polarity for 1500 ms (tolerance: ± 30%) (See Note 1) iii) 165-260-ms pulse of stop polarity followed by teleprinter signals and start polarity for 1500 ms (tolerance: ± 20%) (See Note 1)

Note 1 – This sequence of signals may be repeated until a clearing signal is sent over the forward signalling path. However, with transmission systems having significant propagation delay, e.g. satellite or multiplex systems, it may be preferable to prevent such repetitions.

Note 2 – The use of this signal should be avoided if possible.

TABLE 2/U.1

International telex circuits terminated on distant manual switching equipment

Signal	Type A	Type B
Call-confirmation (see § 4 of the text)	Permanent stop polarity	25-ms pulse stop polarity (between 17.5 and 35 ms)
Proceed-to-transmit (see § 5.2 of the text)	Teleprinter signals	Stop polarity followed by teleprinter signals
Call-connected (see § 7 of the text)	Teleprinter signals	Teleprinter signals
Busy, out-of-order, number changed and number unobtainable (see § 10.1 of the text)	Teleprinter signals	Teleprinter signals

2 Free line condition

2.1 The *free line* is characterized by a permanent signal corresponding to the start impulse in accordance with International Telegraph Alphabet No. 2 (see the Recommendation cited in [1]) on the forward and backward signalling paths.

3 Call

3.1 The *call* is characterized by the inversion of the condition specified in § 2.1 above on the forward signalling path.

4 Call-confirmation signal

4.1 A *call-confirmation* signal shall be returned over the backward signalling path following the initiation of a call to prove the continuity of the line and the response of the distant terminal equipment.

4.2 The call-confirmation signal shall be returned by the receiving end as quickly as possible and in any event with a delay not exceeding 150 milliseconds after the arrival of the calling signal at the receiving end.

5 Signals preceding selection

5.1 *Proceed-to-select signal*

5.1.1 In the case of international telex circuits terminated on distant automatic switching equipment that cannot accept the selection information immediately (either after the reception of the calling signal or after the sending of the call-confirmation signal), a distinct *proceed-to-select* signal shall be returned over the backward signalling path after the call-confirmation signal, to indicate that the selection information may be transmitted.

5.1.2 For type A signalling, the sending duration of the stop polarity, from the beginning of the call confirmation signal until the moment when the proceed-to-select signal begins to be sent, should be at least 100 milliseconds.

5.1.3 For type B signalling, the time interval between the end of the call-confirmation signal pulse and the moment when the proceed-to-select signal begins to be sent, during which the start polarity is sent, should be at least 100 milliseconds.

5.1.4 During the busy hour, for 99 calls in 100, the delay in the return by the receiving system of the proceed-to-select signal must not exceed 3 seconds after the reception of the calling signal. (In certain existing networks, this time may be 4 seconds.)

5.1.5 If the automatic switching equipment at the receiving end can receive the selection information immediately after the sending of the call-confirmation signal, the call-confirmation signal shall constitute the proceed-to-select signal.

5.1.6 If the automatic switching equipment at the receiving end can receive the selection information at the time of receiving the call signal, there shall be no proceed-to-select signal.

5.2 *Proceed-to-transmit signal*

5.2.1 In the case of international telex circuits terminated on a distant manual switchboard, a *proceed-to-transmit* signal shall be returned over the backward signalling path following the initiation of a call, to indicate that the teleprinter of the distant operator has been connected to the international circuit.

6 Selection signals

6.1 The selection signals should be in conformity with International Telegraph Alphabet No. 2 or dial signals in conformity with Recommendation U.2.

6.2 In the case of dial selection into a system employing letters in the national numbering scheme, figures only will be used on international circuits, because of the difficulty in transmitting signals other than figures from dials.

6.3 In the case of selection into a keyboard selection system, the *prepare-for-digits* signal will be combination No. 30 (figure-shift).

6.4 In those cases where an *end-of-selection* signal is required, this signal shall be combination No. 26 (+), possibly followed by another combination characterizing the class of traffic in the incoming country.

6.5 In systems that use keyboard selection and that require an end-of-selection signal, it is preferable that the subscriber's number consist of a uniform number of characters.

6.6 To avoid undue occupation of lines and equipment, Administrations should take all reasonable steps to ensure that the transmission of selection signals over international circuits is completed without undue delay. In particular, where excessive delays are encountered, the incoming country may cause the connection to be cleared. When selection signals are sent by a subscriber, or by an operator, from country A towards a register in country B, country B may disconnect itself from the call if the time interval between two successive selection signals (either pulse trains or teleprinter characters) exceeds 5 seconds.

7 Call-connected signal

7.1 A *call-connected* signal shall be returned over the backward signalling path to indicate that the call has been extended to a called subscriber. In the case of fully automatic switching between subscribers, this signal will start the equipment for determining the charge for the call. For administrative purposes (accounting between Administrations), the conventional start of the chargeable duration is fixed at 6 ± 1 seconds after the start of the call-connected signal (see Recommendation F.61 [2]). For the same purposes, the end of the chargeable duration will be between 300 and 1000 milliseconds after the start of the clearing signal.

7.2 Switching systems not giving an automatic return of answer-back signals over the international telex circuits shall be arranged to be ready to respond to WRU signals (transmitted from the calling country) with a delay not exceeding two seconds from the beginning of the call-connected signal. To meet this requirement in the case of *in-local* working, the return of the call-connected signal has to be delayed until the moment when the teleprinter of the obtained subscriber has in effect been connected to line (see Recommendation S.9 [3]).

7.3 If the incoming country automatically returns the obtained subscriber's answer-back, the interval between the start of the call-connected signal and the start of the answer-back signals (or, if applicable, of other signal sequences, such as date and time signals) should be at least two seconds to allow satisfactory reception of teleprinter signals by the calling subscriber. In order to restrict charging on unsatisfactory calls, the particular interval should be kept as short as possible and should not exceed 3 seconds for new networks or 6 seconds for existing networks.

7.4 If the call has been routed via a transit centre the two-second minimum period for the call-connected signal, which is transmitted by the destination network, may have been reduced on signalling conversion and the answer-back signals may be received at the originating network after a minimum duration of 1050 milliseconds.

7.5 If the incoming country normally returns the obtained subscriber's answer-back code automatically, and the answer-back transmission fails to appear for some reason, the signal **DER** followed by the clearing signal should be transmitted to the country of origin within 6 seconds from the start of the call-connected signal.

7.6 In the case of a call to a switchboard or service point the call-connected signal shall be returned as soon as the call reaches the terminal equipment even though it may be required to wait before being switched to the service position.

7.7 If the answer-back is preceded by a sequence of signals, such as date, time or identity signals, this sequence should be limited to not more than 12 characters and it should be followed within 1100 milliseconds by the answer-back code.

7.8 If the answer-back of the obtained subscriber is followed by a sequence or sequences of signals, the interval between the end of the answer-back and the completion of the sequence (excluding the answer-back of the calling subscriber if taken automatically) should be as short as possible and should not exceed 4 seconds.

7.9 For future networks the sending of date, time and other signals (excluding however WRU signals to the calling subscriber) that are additional to the obtained subscriber's answer-back (either preceding or following it) should be avoided on international calls.

8 Idle circuit condition

8.1 On an established connection, the *idle circuit* is characterized by a permanent signal corresponding to the stop impulse, in accordance with International Telegraph Alphabet No. 2, on the forward and backward signalling paths.

9 Clearing

9.1 *Clearing signal*

9.1.1 The clearing signal is characterized by a reversion to the condition specified in § 2.1 above on either signalling path maintained until the complete release of the circuit..

9.1.2 The supervisory equipment of the international connection shall be arranged to interpret a signal of start polarity as a clearing signal within 300 to 1000 milliseconds.

9.2 *Clear-confirmation signal*

9.2.1 The clear-confirmation signal is a reversion to the condition specified in § 2.1 above on the other signalling path in response to the clearing signal. When a clearing signal transmitted on an international circuit has reached the receiving end of that circuit the clear-confirmation signal must be sent back in the other direction within 350 to 1500 milliseconds after the initial start polarity begins.

9.2.2 The minimum period will be increased to 400 milliseconds for future systems.

9.3 *Guard delay*

9.3.1 Guard arrangements at the ends of an international telex circuit should be such that the circuit cannot be used for a new call until the distant equipment is free to accept another call.

9.3.2 A guard delay of 1 second will be maintained during which incoming calls will not be accepted and a guard delay of 2 seconds will be maintained during which outgoing calls will not be offered, from the moment when start polarity appears on both signalling paths. This start polarity shall be maintained throughout the guard period on both signalling paths of the international circuit.

10 Service signals

10.1 *Signals for ineffective calls*

10.1.1 If a *busy, out of order, absent subscriber/office closed, number changed,* or *number unobtainable* (i.e. not connected, service ceased or barred access) condition is encountered in the distant network, this shall be indicated by the return of a signal to the calling end. This signal shall cause the connection to be cleared.

10.1.2 In printed service signal sequences the code expressions mentioned in the Recommendation cited in [4] should be used. In this case the code expression should be preceded by the carriage-return, line-feed and letter-shift signals and followed by carriage-return and line-feed and then immediately by the clearing signal in all cases. Where additional information is transmitted, the long-term objective should be to standardize strictly the format of service signals. Such additional information should consist of four characters (α, β, γ, δ) and be sent before the service signal at maximum speed. The composition of the complete service signal train should then be:

$$\alpha\ \beta\ \gamma\ \delta\ < \ \equiv\ \downarrow \text{ service code } < \ \equiv$$

where α may be a letter-shift ($\downarrow$) or figure-shift ($\uparrow$).

10.1.3 Ineffective telex calls should not be charged for. With this in view printed service signal sequences returned on ineffective calls should never be preceded by the call-connected signal; however, under faulty conditions that can be detected only after the call has been put through, it may be impossible to prevent the return of the call-connected signal and subsequent charging of the call.

10.2 *Waiting signals*

10.2.1 Should a call be routed to a point in the system where it is required to wait before connection can be made to the requested service, a *waiting signal* (**MOM**) should be sent back automatically in accordance with Table 3/U.1.

10.2.2 The *waiting signal sequence* should include the carriage-return, line-feed and letter-shift signals followed by the characters **MOM**. It may be useful in some instances to include characters to indicate the date and/or time and also characters indicating the identity of the switchboard or service point returning the signals. In some existing systems, however, the waiting signal sequence consists only of a group of characters indicating the date and/or time.

10.2.3 The first character of the waiting signal sequence shall be transmitted within 8 seconds of the commencement of the call-connected signal.

10.2.4 The **MOM** signal sequence shall be followed by stop polarity until the service-connected signal is returned.

10.2.5 In some systems, however, arrangements are provided so that the transmission by the caller of suitable teleprinter characters causes the return of a further sequence of the **MOM** signal. Where such a facility is provided attention is drawn to the need for the Administrations returning the signal to make arrangements to ensure that the signal sequence can be correctly received without mutilation in the calling system. For this purpose it is acceptable to include one or two letter-shift signals at the beginning of the **MOM** signal sequence.

10.2.6 It is desirable that when connection is established to the requested service the service-connected signal should be returned as quickly as possible.

10.2.7 The equipment must be arranged so that a caller in the waiting condition can be released.

TABLE 3/U.1

Access to switchboards and service points

Signal	Type A	Type B
Call-confirmation (see §§ 4 and 5.1 of the text)	Permanent stop polarity	25-ms pulse of stop polarity (between 17.5 and 35 ms)
Proceed-to-select (see § 5.1 of the text)	40-ms pulse (± 8 ms) of start polarity	25-ms pulse of stop polarity (between 17.5 and 35 ms)
Selection (see § 6 of the text)	Teleprinter signals	Dial pulses or teleprinter signals
Call-connected (see § 7 of the text)	150-ms pulse (± 11 ms) start polarity followed by stop polarity for a period between 2 and 8 seconds	Stop polarity for a period between 2 and 8 seconds
Waiting signals (see § 10.2 of the text)	Teleprinter signals which may interrupt the stop polarity period of the call-connected signal, in which case the initial period of stop polarity should not be less than 2 seconds	Teleprinter signals which may interrupt the call-connected signal, in which case the initial period of stop polarity should not be less than 2 seconds
Service-connected (see § 10.3 of the text)	Teleprinter signals indicating the identification of the switchboard or service point	Teleprinter signals indicating the identification of the switchboard or service point
Busy (see § 10.1 of the text)	Teleprinter signals followed by clearing signal	i) 165-260-ms pulse of stop polarity followed by start polarity for 1500 ms (tolerance ± 30%) (See Note) ii) 165-260-ms pulse of stop polarity followed by teleprinter signals and then by start polarity for 1500 ms (tolerance ± 20%) (See Note)

Note – This sequence of signals may be repeated until a clearing signal is sent over the forward signalling path.

10.3 *Service-connected signal*

10.3.1 A *service-connected* signal shall be returned over the backward signalling path to indicate that the call has been extended to the teleprinter, or equivalent, of the requested service point. This signal may comprise the answer-back code of the teleprinter or a group of teleprinter characters identifying the service point or switchboard position. The service-connected signal may also include characters indicating date and/or time.

10.3.2 Where waiting signals are not provided the first character of the service-connected signal shall be returned within 8 seconds of the commencement of the call-connected signal.

10.4 *Backward busying signal*

10.4.1 To facilitate routine tests of the switching equipment connected at the incoming end of an international telex circuit, a backward busying signal might be sent on the return signalling channel to show, at the other end, that the circuit is occupied.

10.4.2 With fully-automatic operation, on one-way circuits as well as on both-way circuits, the signal would take the form of permanent stop polarity for not more than 5 minutes.

10.4.3 In semi-automatic working, the signal would be either permanent start polarity, or permanent stop polarity, lasting not more than 5 minutes; the particular polarity chosen would be that requested by the outgoing country.

10.4.4 If the outgoing equipment is designed to block the outgoing end of the circuit in the busy position after receipt of the permanent stop polarity, stop polarity would be used for preference. In some instances, use of stop polarity could give rise to difficulties. It might, for example, cause a call signal to appear in the outgoing manual switching equipment. In such circumstances, recourse will have to be had to permanent start polarity.

10.4.5 As to tests made at the outgoing end of one-way circuits, there will be no call for a forward busying signal. The blocking of these circuits is locally done, on the outgoing side.

10.5 *Retest signal*

10.5.1 When the call-confirmation is not returned over the backward signalling path within the delay indicated in § 4.2 above, Administrations may apply a *retest signal*, which automatically provides for the test of the circuit in such a way that the international circuit is marked *unavailable* for outgoing traffic and may be restored to service if the fault disappears in the course of this test.

10.5.2 This signal transmitted over the forward signalling path should be composed of:

- a stop polarity period of 2 seconds duration;
- a start polarity period of 58 (or 70) seconds, 4 minutes 58 seconds (or 5 minutes 58 seconds) or 29 minutes 58 seconds (or 35 minutes 58 seconds) duration.

10.5.3 For the fault to be regarded as cleared, the return of stop polarity should occur during the stop period of a retest.

10.5.4 The circuit should be tested up to five times at nominal intervals of 1.0 minute or 1.2 minutes and a check should be made to confirm the receipt of a call-confirmation signal in response to each test. If a valid call-confirmation signal has not been received at the end of this first group of tests, the retest will continue with a further group of up to five tests at either 5.0/6.0-minute or 30/36-minute intervals. If 5.0- or 6.0-minute intervals are used and a valid call-confirmation signal has not been received at the end of this second group of tests, a further group of up to nominally five retests will be made at 30- or 36-minute intervals. An alarm will be given at an appropriate time. However, this retest procedure may be discontinued at any stage at the discretion of the outgoing Administration.

10.5.5 If, however, during the above sequence of retests, a valid call-confirmation signal is received, a clearing signal shall be transmitted in the place of the retest signal. Following a valid clear-confirmation signal, the incoming and the outgoing sides of the trunk circuit should not be returned to service until after expiry of the appropriate guard delay time.

10.5.6 In order to cater for the possibility that a faulty circuit may be seized at both ends, the automatic retest equipment should be arranged to allow an incoming call to be received during the start polarity period of the automatic retest signals. Administrations may, however, ignore such calls which occur during the incoming guard delay period.

10.5.7 Where an exchange has knowledge of a transmission system failure, it is desirable that retest signals shall not be applied to the circuits affected.

10.5.8 In order to avoid simultaneous seizure of too many registers at the distant centre, it is advisable that the retest signals, which might be sent simultaneously on various circuits subjected to this test, should be out of phase with one another.

10.5.9. The intervals between the tests at the two ends of the trunk route should be made different to be sure that successive retests do not overlap at both ends. In general, the international/intercontinental transit centre having the higher F.69 [5] telex destination code should take the longer interval (i.e. 1.2, 6 and 36 minutes). The tolerance on all above time intervals is ± 10%. Nevertheless, when this requirement would entail considerable difficulty, alternative arrangements may be adopted by agreement between the two Administrations concerned.

11 Setting-up time

11.1 The setting-up time is defined as the period of time from the initiation of the call on the international circuit until the initiation of the return of either the call-connected signal or a service signal indicating that the call has been unsuccessful, provided the selection signals have been transmitted at the maximum speed.

11.2 For new networks, the objectives are as follows:

- an average of 8 seconds;
- a maximum of 15 seconds with a probability of 1% exceeding this value.

12 Both-way working

12.1 For both-way cable circuits used in the fully automatic telex service, the following action to minimize the incidence of head-on collision is recommended:

a) that inverse order testing, or a close approximation to it by testing the route in small groups of circuits in fixed order, always starting the search from the same initial positions, should be adopted at opposite ends of a group of both-way trunk circuits;

b) that calls should be offered in such a way that each circuit is treated once only for the minimum period of time necessary to ascertain whether it is free or busy, and the outgoing selectors should not have facilities for delayed hunting.

12.2 The absence of the proceed-to-select signal in type A signalling or the substitution of call signal for the call-confirmation signal in type B signalling will serve respectively to detect a head-on collision when the group of circuits is totally occupied or very nearly totally occupied. The two calls will then be cleared down unless there are still free circuits in the route.

13 Transit working

13.1 It is noted that a number of Administrations use signalling systems in accordance with Recommendation U.1 to provide international transit facilities. Whilst Recommendation U.11 (type C) is intended for signalling between telex transit centres, nevertheless transit operation using type A or B signalling is feasible. To provide guidance for this specific application, the following general rules should apply.

13.2 Circuits provided for terminal calls will normally also be used to carry transit calls.

13.3 The signalling conditions for transit calls between the originating centre and the transit centre should, as far as possible, be the same as those used for terminal calls to subscribers in the transit network.

13.4 The signalling conditions for transit calls between the transit centre and the terminating centre should, as far as possible, be the same as those used for terminal calls to subscribers in the terminating network.

13.5 Any signal conversion to meet the requirements of the distant terminal network is the responsibility of the transit centre.

13.6 An appropriate numbering scheme should either:

a) include F.69 [5] destination codes on both terminal and transit calls; or

b) use 0 as a standard transit prefix. Should 0 be precluded by the national numbering plan in the transit network, another digit might be agreed with the transit Administration.

Either way the originating centre should bar irregular routing, by discriminating the digits transmitted by calling subscribers.

13.7 A single stage of selection in which all the selection digits are transmitted as a single block should be employed over the circuit from the outgoing centre to the transit centre.

References

[1] CCITT Recommendation *Operational provisions for the international public telegram service*, Vol. II, Fascicle II.4, Rec. F.1, § C.8.

[2] CCITT Recommendation *The chargeable duration of a telex call*, Vol. II, Fascicle II.4, Rec. F.61.

[3] CCITT Recommendation *Switching equipment of start-stop apparatus*, Vol. VII, Fascicle VII.2, Rec. S.9.

[4] CCITT Recommendation *Operational provisions for the international telex service*, Vol. II, Fascicle II.4, Rec. F.60, § 4.1.

[5] CCITT Recommendation *Plan for telex destination codes*, Vol. II, Fascicle II.4, Rec. F.69.

Recommendation U.2

STANDARDIZATION OF DIALS AND DIAL PULSE GENERATORS FOR THE INTERNATIONAL TELEX SERVICE

(former CCIT Recommendation E.2, 1951; amended at Arnhem, 1953 and Geneva, 1956)

The CCITT,

considering

(a) that, when dials and dial pulse generators are used for the process of automatic selection by subscribers to the international telex network, it is advantageous to standardize as far as possible the characteristics of such dials and dial pulse generators;

(b) that the standardization of the dialling speed and lost motion periods of dials presents no technical difficulty;

(c) that, for the satisfactory working of certain automatic systems, the time between successive pulse trains should not be less than 500 milliseconds, but that experience has shown that the minimum time taken by an experienced operator to rotate the dial is of the order of 300 milliseconds;

(d) that pulse ratios from 1.2:1 to 1.9:1 will ensure the satisfactory working of existing automatic switching systems;

(e) that these pulse ratios can be usefully adopted with a view to simplifying direct calling between subscribers,

unanimously declares the view

(1) that in the international telex service, when dials or dial pulse generators are used for the automatic selection of subscribers:

a) the dialling speed shall be standardized at 10 pulses per second with a tolerance of ± 10%;

b) the lost motion period of dials shall be not less than 200 milliseconds nominal value;

c) the inter-digit pause of dial pulse trains generated by dial pulse generators shall not be less than 600 milliseconds;

(2) a) that the pulse ratio must be between 1.2:1 and 1.9:1, the nominal ratio may be chosen as lying between 1.5:1 or 1.6:1;

b) that when the selection signals pass through a regenerative repeater it may be advantageous to use a nominal ratio of 1.5:1.

Recommendation U.3

ARRANGEMENTS IN SWITCHING EQUIPMENT TO MINIMIZE THE EFFECTS OF FALSE CALLING SIGNALS

(former CCIT Recommendation E.3, Geneva, 1956)

The CCITT,

considering

(a) that transmission systems at present in use for international telex trunks are liable to generate false calling signals;

(b) that such false calling signals can seize and engage switching equipment, thereby reducing the grade of service. This is of particular importance with systems in which common equipment normally used only to set up calls is seized by false calling signals;

(c) that the ill effects of false calling signals can be minimized by delaying the operation of the calling relay at the termination of the international telex trunk circuit;

(d) that, however, when direct dial selection is employed over an international trunk line, unless it is a manually selected circuit not preceded by a stage of automatic selection, there is normally insufficient time available between successive digits to permit the use of slow operating relays;

(e) that, nevertheless, Administrations may agree among one another to use digit storage at the outgoing end of the circuit so that the inter-train pause can be increased to permit the calling relays to be made slow to operate,

unanimously declares the view

(1) that the design and maintenance of transmission systems should be such as to reduce to a minimum the number and duration of false calling signals. In this connection attention is drawn to the merits of frequency-modulated voice-frequency telegraph systems, particularly with long overhead lines;

(2) that, wherever possible, calling relays on international telex trunk circuits should have an operation lag of at least 100 milliseconds. Administrations using circuits on lines prone to long-duration false calling signals may agree to use calling relays with longer operation lags.

Recommendation U.4

EXCHANGE OF INFORMATION REGARDING SIGNALS DESTINED TO BE USED OVER INTERNATIONAL CIRCUITS CONCERNED WITH SWITCHED TELEPRINTER NETWORKS

(former CCIT Recommendation E.4, Geneva, 1956; modified at New Delhi, 1960 and Geneva, 1972)

The CCITT,

considering

(a) that certain signals and certain characteristics of signals used in the international telex service have been standardized in Recommendation U.1;

(b) that certain Administrations have introduced automatic telex transit switching facilities based upon the signalling standards shown in Recommendation U.1;

(c) that standardized signals for the European switched network for the public telegram service (gentex network) are advocated in Recommendation U.30;

(d) that in view of the foregoing an exchange of information regarding the precise nature of the signals proposed to be used in the above-mentioned services by interested Administrations would be very useful;

(e) that certain Administrations have already supplied such details regarding their telex services in a useful form (see supplements to the documents of the VIIIth Plenary Assembly of the CCIT, and subsequent Plenary Assemblies of the CCITT),

unanimously recommends

that Administrations concerned in the international telex service and gentex network be invited to supply to the CCITT time-sequence diagrams showing in each case the signals at present transmitted or proposed to be transmitted over the international circuit for incoming calls. The diagrams should show not only the sequence and characteristics of the signals, but also the timing tolerances to be expected. The diagrams should show the signalling conditions applicable to transit as well as to terminal calls, including any conversion of the signals that are received from the destination network.

Recommendation U.5

REQUIREMENTS TO BE MET BY REGENERATIVE REPEATERS IN INTERNATIONAL CONNECTIONS

(former CCIT Recommendation E.5, Geneva, 1956; amended at Geneva, 1964, Mar del Plata, 1968 and Geneva, 1976)

The CCITT,

considering

(a) that it may be desirable to include regenerative repeaters in teleprinter switching networks;

(b) that the only signals other than teleprinter signals that must be transmitted by a regenerative repeater are the clearing signal and the call-connected signal (see § 3.1.3 below), since all other signals can be bypassed;

(c) that other signals may be transmitted by regenerative repeaters,

unanimously declares the view

1 that, when regenerative repeaters are used in switching systems, the clearing signal should be retransmitted with a minimum of delay. This delay is of course the same as for the transmission of teleprinter signals;

2 that to ensure the correct retransmission of the call-connected signal (see § 3.1.3 below) and the clearing signal, the regenerative repeater must not automatically insert the stop element in either of these signals;

3 that for other signals that may pass through regenerative repeaters, the tolerances at the origin and after retransmission through the regenerative repeaters are as stated below.

Note – The characteristics and tolerances quoted are for the signals at the origin. The tolerances at the input to the regenerative repeater will depend on the degree of distortion in the transmission path from the origin to the input of the regenerative repeater. The tolerances at the output will depend on the normal tolerances for the regenerative repeater.

3.1 *Pulse signals*

3.1.1 *Call-confirmation (proceed-to-select) signal.* Type B signalling

A pulse of stop polarity of duration from 17.5 to 35 milliseconds. The nominal duration of the pulse after retransmission through the regenerative repeater should not be less than 20 milliseconds or more than 40 milliseconds.

Note – This signal will be transmitted over only one international trunk circuit and should thus normally pass through not more than one regenerative repeater.

3.1.2 *Dial selection signals.* Type B signalling

These signals have been standardized (Recommendation U.2) at a dial speed of 10 pulses per second ± 10%, and a pulse ratio (start/stop) between the tolerance of 1.2:1 and 1.9:1 with a nominal ratio lying between 1.5:1 and 1.6:1. Such signals after retransmission through several regenerative repeaters should not fall outside the tolerances stated above.

3.1.3 *Call-connected signal.* Type A signalling

A pulse of start polarity lasting 150 ± 11 milliseconds. The nominal duration of the pulse after retransmission through several regenerative repeaters should be within the limits of 140 to 160 milliseconds.

3.1.4 *Busy signal.* Type B signalling

Pulses of stop polarity lasting 165-260 milliseconds, separated by intervals of start polarity lasting 1.5 seconds ± 30%. After retransmission through several regenerative repeaters neither the pulses nor the intervals should be shortened by more than 10%.

3.2 *Sequence signals (involving a single change of polarity)*

3.2.1 *Calling signal.* Types A and B signalling

3.2.2 *Call-connected signal.* Type B signalling

These signals (inversion from start to stop polarity) have no timing tolerances as such. It is, however, essential that they should be retransmitted by a regenerative repeater with a minimum of delay which in no case should exceed 20 milliseconds.

Recommendation U.6

PREVENTION OF FRAUDULENT TRANSIT TRAFFIC IN THE FULLY AUTOMATIC INTERNATIONAL TELEX SERVICE

(New Delhi, 1960; amended at Geneva, 1964)

The CCITT,

considering

(a) that, with fully automatic working in the international telex service, the possibility of fraudulent routing by subscribers of international calls involving tandem connection of international telex trunks might arise whenever subscribers are given automatic access to international telex trunk circuits that have, at their incoming ends, automatically switched access to other international telex trunk circuits;

(b) that, by the adoption of a systematic plan, such traffic can be barred without involving either expensive or elaborate equipment arrangements;

(c) that, to be effective, such a plan would need to be adopted by all Administrations and recognized private operating agencies since failure to provide barring facilities on the traffic between two countries could open the way for irregular routings at the expense of a third country,

unanimously declares the view

(1) that national telex systems shall be so arranged that the first digit of the selection signals transmitted over incoming international telex trunks will indicate whether an automatic transit call is concerned;

Note – The use of a common first digit to indicate access to both international telex trunk circuits and manual switchboards leads to complication in the barring arrangements and should therefore be avoided as far as possible.

(2) that where an international telex trunk carrying fully automatic traffic also carries traffic requiring access at the incoming end to outlets selected by means of the digit characterizing an automatic transit call, the country of origin will bar irregular routings by discriminating on the digits transmitted by calling subscribers;

(3) that where an international telex trunk carrying fully automatic traffic does not carry traffic requiring access at the incoming end by means of the digit characterizing an automatic transit call, the incoming equipment shall be so arranged that the corresponding outlets are not accessible and that when access is attempted the *number unobtainable* signal is returned;

(4) that it is not admitted that two Administrations can agree to omit the provision of barring facilities on traffic between their respective countries. However, where the incoming country has an existing network in which considerable difficulty would be experienced in barring in accordance with § 3 above, the responsibility for barring may, by agreement, be assumed by the country of origin in the manner specified in § 2.

Recommendation U.7

NUMBERING SCHEMES FOR AUTOMATIC SWITCHING NETWORKS

(former CCIT Recommendation E.7, Geneva, 1956)

The CCITT,

considering

that with fully automatic working between subscribers in the international telex service it is desirable to envisage the possibility:

a) of routing traffic over the appropriate international trunk route where more than one such route exists between two countries;

b) of enabling the appropriate tariff to be determined automatically (in the originating country), even if the destination country is divided into several tariff zones,

unanimously declares the view

(1) that subscribers' national numbering plans should be systematically arranged;

(2) that, where more than one international trunk route exist between two countries, the corresponding geographical division and hence the appropriate point of entry should be identifiable by examination of the initial digits of the called subscriber's national number;

(3) that, where a multiple tariff scale exists, the different tariff zones should be identifiable in the originating country by the initial digits of the called subscriber's national number;

(4) that the number of initial digits to be examined should be limited, preferably to one, but in any case should not exceed two. When a single digit provides the discrimination it will usually be the first digit, but, where the subscribers' national numbers have a uniform initial digit (usually 0) to permit discrimination on internal calls, the following (second) digit should be used.

Note – The attention of Administrations (and recognized private operating agencies) is drawn to the considerable technical advantage that would result from the adoption of a single tariff between two countries.

EQUIPMENT OF AN INTERNATIONAL TELEX POSITION

(former CCIT Recommendation F.60; modified at New Delhi, 1960)

The CCITT,

considering

that an international telex position that is a manual position in an international telex exchange and is used to set up international telex calls should be so equipped as to permit satisfactory operation in conformity with Recommendation F.60 [1],

unanimously declares the following view

(1) An international telex position must be equipped in such a way as to receive the clearing signal from both sides.

(2) It should not be possible to recall the operator of that position by a signal to an established connection, except if Recommendation U.21 is applied.

(3) Precaution must be taken that, in the event of the operator of the international telex position's delaying to remove the plug on reception of the clearing signals, a new call from a subscriber on one network cannot pass to the other network.

(4) When the call has been established, the answer-back signals of equipment used at the intermediate telex positions must not be sent to line when figure-shift D is received.

(5) The international telex position must be provided with equipment to determine the chargeable time of calls controlled by these positions, this timing equipment to be brought into operation in accordance with the Recommendation cited in [2] but to be stopped on receipt of the first clearing signal.

References

[1] CCITT Recommendation *Operational provisions for the international telex service*, Vol. II, Fascicle II.4, Rec. F.60.

[2] *Ibid.*, § 3.3.

SECTION 2

SPECIFIC SIGNALLING SCHEMES

Recommendation U.11

TELEX AND GENTEX SIGNALLING ON INTERCONTINENTAL CIRCUITS USED FOR INTERCONTINENTAL AUTOMATIC TRANSIT TRAFFIC (TYPE C SIGNALLING)

(Geneva, 1964; amended at Mar del Plata, 1968, Geneva, 1972 and 1976)

The CCITT,

considering

(a) that it is necessary to standardize an intercontinental signalling system to be used between intercontinental transit centres, as the present standard systems A and B, in the limits of CCITT Recommendations, do not comply with all the requirements of an intercontinental signalling system;

(b) that the intercontinental links that are used and could be used in the future for telex and gentex operation use various transmission systems, including not only the standard voice-frequency telegraph channels – normally used in the continental field – but also 7-unit error-proof multiplex systems over radio circuits and 6-unit or 5-unit multiplex systems over VFT channels. Other transmission systems will perhaps be used in the future. Therefore, it seems necessary that the intercontinental signalling system should be suitable for as wide a variety of transmission systems as possible;

(c) that this signalling system must enable the channels to be operated on a both-way basis. This type of operation can produce collisions; therefore it was noted that the intercontinental signalling system must provide for limiting collisions, or at least for simple facilities to detect head-on collisions and for taking appropriate action after their detection;

(d) that another important feature of the intercontinental signalling system should concern the automatic testing of the ability of the multiplex equipment to transmit teleprinter characters, before establishing a call to the distant subscriber, through an intercontinental transit centre. The class-of-traffic signal, the class-of-traffic-check signal, and the transmission-confirmation signal in the form proposed, can provide an efficient and simple method of meeting this requirement. The signals provided also check the functioning of the FRXD when used. It is important that the correct class-of-traffic and class-of-traffic-check signals be transmitted for the required category;

(e) that the use of teleprinter characters, for selection information and other signalling functions, appears to be most advantageous, as they can be transmitted over the error-proof radio circuits, which undoubtedly will be part of the intercontinental transit network;

(f) that it is emphasized that the signals, in the form proposed, simplify interconnection of the intercontinental transit network to the terminal networks, in the outgoing and in the incoming countries;

(g) that as regards the method of transmission of selection information, it has been decided that the selection by complete block will be adopted on intercontinental routes. Under this arrangement, the telex destination code and the national number of the called subscriber will be signalled as a single group of characters without awaiting backward path signals. There may be some advantage with regard to reducing the occupancy of intercontinental trunks and equipment and in preventing the mutilation of signals if the complete group of selection signals is assembled, preferably by the originating country, before commencing to route the call. However, the retransmission of selection signals from one switching centre to the next may start even before the block has been completely received;

(h) that exemption from selection by complete block is permissible for manual testing of intercontinental links. The receiving centre should take account of this and also of the fact that calls via an error-proof multiplex radio channel may prevent selection signals' being received as a complete block;

unanimously declares the view

1 The signalling system between two intercontinental transit centres will be as described in Table 1/U.11.

Note 1 – In this Recommendation:

X denotes the intercontinental transit centre that originates the call under consideration on the intercontinental circuit;

Y denotes the intercontinental transit centre that receives the call considered on the intercontinental circuit.

Both the forward and backward path signals are described at the moment of their emission on the intercontinental circuit. It should be noted that the signals in Tables 1/U.11, 2/U.11 and 3/U.11 are those transmitted by the switching equipment irrespective of the type of transmission used for the intercontinental trunk circuit. It is possible that the teleprinter signals, although transmitted at automatic speed, may be delayed or separated by periods of stop polarity after transmission via multiplex systems and that the original periods of start and stop polarity may be either lengthened or shortened by the incidence of error-correction on radio circuits.

The circuits between X and Y may transmit calls in both directions.

Note 2 – For the description of the combinations of International Telegraph Alphabet No. 2, see Table 1/S.13 [1] or the Recommendation cited in [2].

2 For new exchanges introduced into the intercontinental transit network, intercontinental circuits should be searched in a fixed order, always starting the search from the same initial position. The order of search should be inverse to the order used at the distant end.

A head-on collision is provisionally assumed if centre X receives combination No. 20 (100 ms pulse of polarity A) instead of combination No. 22 (40 ms pulse of polarity A). When this combination No. 20 has been detected, centre X checks receipt of the second combination No. 20 to establish whether a head-on collision or a signal mutilation due to faulty transmission has occurred. During this time, centre X continues signalling towards centre Y, until both combinations No. 20 of the calling signal have been transmitted. The clearing signal is then sent and the trunk is released.

When a head-on collision has been assumed upon receipt of a single combination No. 20, the switching equipment may make another attempt to select a free circuit either on the same group of circuits or on a group of overflow circuits, if they exist. In the event of a further head-on collision on the recall or on the call attempt via the overflow route, no further recall will be made and the call will be cleared down after returning the transit failure signal.

Should the second combination No. 20 not have arrived in the five seconds following the commencement of receipt of the first combination No. 20, centre X will put into operation the automatic retest procedure on the circuit concerned.

3 There is no need to distinguish on a circuit XY whether a call is to terminate in centre Y or if it is to pass in transit via Y to a country other than the country (or network) of Y. The advantage of not having to transmit on circuit XY the digits of the destination code in the case of a call termination in Y is offset by the complication of the registers and the necessity for an additional discrimination in the class-of-traffic signal.

4 The transit centre will be provided with an identification code consisting of seven characters, of which the uniform format is:

- combination No. 29;
- either one letter combination and combination No. 29 or two letter combinations designating the transit Administration;
- combination No. 30;
- a one-, two- or three-digit number identifying the centre and/or equipment in the transit Administration's network.

If the numerical portion of the transit centre identification code comprises one or two digits, two or one combinations No. 30 should be added to maintain the seven-character format. The letter (or two letters) designating the transit Administration shall be the letter (or two letters) of the telex network identification code as far as possible.

The transit centre identification code will be returned automatically in all cases and will continue as far as the calling country. If several transit centres are involved in setting up a call, the calling network will receive the codes of these transit centres one after the other. This information is useful for retracing the route followed by a call (for traffic statistics, international accounts and the clearing of faults).

5 To simplify the solution of problems raised by overflow (increased congestion of systems, risk that the call may return back to the original exchange) overflow for each call will be allowed at only one centre.

Note – The rigour of this rule could be eased by admitting alternative (2nd choice) routings in certain traffic relations. This question will be discussed when the routing plans are established.

6 A transit centre will have to be advised:

1) that an incoming call is :
   a) a telex call (between telex subscribers),
   b) a gentex call (between gentex stations),
   c) a call, generally originating from a switchboard operator or from maintenance staff, to a manual switchboard or service point. This class-of-traffic signal is to be used if signalling conditions for calls to manual switchboards or other service points in the destination network are different from those returned on calls to subscribers,
   d) a special category call (see §§ 7.1 and 7.2 below);
2) that the call concerned has already been subjected to overflow.

Other possibilities must be reserved, such as routing via telegraph circuits for 100 or 200 bauds, and a reserve supply of class-of-traffic signals has been envisaged to this end.

7 Class-of-traffic signal

7.1 The class-of-traffic signals are divided into two categories:

Category A: Signals for transmission at 50 bauds, the utilization of which is allocated as shown in Tables 4/U.11 and 5/U.11.

Category B: Signals reserved to meet future uses, not yet defined, such as use of circuits for more than 50 bauds.

7.1.1 The signals of category A are characterized by Z polarity of the first element; the signals under category B are characterized by A polarity of the first element.

7.1.2 For category A signals the second and third elements are associated to discriminate the four following categories: telex, gentex, service traffic and a special category (see Note under § 7.2).

7.1.3 For the signals of category A as well as for those of category B, the polarity of the fourth element indicates whether or not the call has already been overflowed.

7.1.4 For the signals of category A as well as for those of category B, the fifth element must always have an A polarity in order to avoid the use as a class-of-traffic signal of the special signals, combination No. 20 (calling signal) and combination No. 30 (special pre-signal).

7.2 Table 5/U.11 indicates the combinations used for class-of-traffic and class-of-traffic-check signals.

Note – For 50-baud transmissions during which an alphabet with a non-5-unit code could be used, to avoid routing through time-division multiplex channels see the Recommendation cited S.15 [3].

7.3 The class-of-traffic combination for a previously alternatively routed call shall be inserted by the switching equipment in the centre at which overflow occurs.

8 The ability of the forward signalling path of the trunk to transmit 5-unit signals is checked by using complementary class-of-traffic and class-of-traffic-check signals. The two combinations of the transmission-confirmation signal are also complementary and provide a similar check of the backward signalling path. Failure to receive the reception-confirmation and transmission- confirmation signals correctly within 5 seconds from the start of the calling signal, or receipt of the transmission-failure signal, should initiate the automatic retest signal on the circuit concerned.

9 The equipment of centre Y should preferably begin the forward selection as soon as the first digit of the called number has been registered, but in the case of 2-digit destination codes forward selection may be postponed until the second digit of the called number has been registered.

If D1, D2 and D3 are the destination code digits of the called country (or network), and if N1, N2, N3, etc., are the digits of the called number, on any intercontinental circuit XY the sequence of selection signals, including those for calls terminating in the country Y, will be as follows:

Case of a called country having a 2-digit destination code

Class-of-traffic

Class-of-traffic check

D1
D2
N1
→ } start of forward selection
N2
→
N3
.
.
N*n*

Combination No. 26

Case of a called country having a 3-digit destination code

Class-of-traffic

Class-of-traffic check

D1
D2
D3
N1
→ start of forward selection
N2
.
.
N*n*

Combination No. 26

The maximum number of digits to be expected in the sum of the destination code and national number is 12.

10 Retest signal

10.1 The automatic retest signal should be initiated on the circuit concerned as indicated in §§ 2 and 8 above, another attempt to select a circuit should be made (once only) and, if unsuccessful, the transit failure signal should be returned to the preceding exchange. The circuit should be marked *unavailable* for outgoing traffic and the retest signal should be transmitted over the forward signalling path as shown in Table 1/U.11.

10.2 The circuit should be tested up to five times at nominal intervals of 1.0 or 1.2 minutes and a check should be made to confirm the receipt of backward path signals up to and including the transmission-confirmation signal in response to each test. If a valid transmission-confirmation signal has not been received at the end of this first group of tests, the retest will continue with a further group of up to five tests at either 5.0/6.0- or 30/36-minute intervals. If 5.0- or 6.0-minute intervals are used and a valid transmission-confirmation signal has not been received at the end of this second group of tests, a further group of up to nominally five retests will be made at 30- or 36-minute intervals. An alarm will be given at an appropriate time. However, this retest procedure may be discontinued at any stage at the discretion of the outgoing Administration.

10.3 If, however, during the above sequence of retests a valid transmission-confirmation signal is received, a clearing signal shall be transmitted in the place of the retest signal. Following a valid clear-confirmation signal, the incoming and the outgoing sides of the trunk circuit should not be returned to service until after expiry of the appropriate guard delay time.

10.4 In order to cater for the possibility that a faulty circuit may be seized at both ends, the automatic retest equipment should be arranged to allow an incoming call to be received during the start polarity period of the automatic retest signals. Administrations may however ignore such calls which occur during the incoming guard delay period.

10.5 Where an exchange has knowledge of a transmission system failure, it is desirable that retest signals shall not be applied to the circuits affected.

10.6 The intervals between the tests at the two ends of the trunk route should be made different to be sure that successive retests do not overlap at both ends. In general, the intercontinental transit centre having the higher F.69 [4] telex destination code should take the longer interval (i.e. 1.2, 6 and 36 minutes). Nevertheless, when this requirement would entail considerable difficulty, alternative arrangements may be adopted by agreement between the two Administrations concerned.

11 A guard delay of 1 second will be maintained during which incoming calls will not be accepted, and a guard delay of 2 seconds will be maintained during which incoming calls will not be accepted, and a guard delay of 2 seconds will be maintained during which outgoing calls will not be offered, from the moment when start polarity appears on both signalling paths. This start polarity should be maintained throughout the guard period, on both signalling paths of the international circuit.

Note – In the case of error-corrected radiotelegraph systems the guard period should be measured from the moment that the appropriate number of α signals has been transmitted and received in accordance with Recommendation U.20, § 8.3.

12 The receiving equipment congestion signal should be returned on not more than 0.4% of calls in the busy hour and the equipment should ensure that this signal is returned only when receiving equipment congestion is positively identified, and not in the case of a fault in the register access equipment.

Receipt of a receiving equipment congestion signal by a transit centre either on the first attempt or after a single recall (either on the same route or on an alternative route) should cause the transit failure signal to be returned to the calling network.

13 The incoming equipment should be arranged to maintain start polarity on the backward path if the first character of the selection signal is spurious as indicated either by a character other than a class-of-traffic signal or the pre-signal combination No. 30 (see Note to Table 2/U.11).

The incoming equipment may release the connection if any of the consecutive combinations of the calling and selection signals is delayed for five or more seconds. In this case the transit failure signal should be returned after the reception confirmation, the transmission confirmation and transit centre identification code signals; and be followed by the clearing signal.

An Administration may release the connection or recall if the transit centre identification code from the next transit centre has not been returned within three seconds after the receipt of the transmission confirmation signal.

14 The normal time (i.e. without taking account of the supplementary delay which could be introduced by operation of ARQ equipment) required to switch through a transit centre measured from the beginning of the receipt of the calling signal to the offering of the calling signal on the outgoing route varies from 1200 to 1500 milliseconds (according to the number of digits to be examined), plus the time required to position the selectors. (This time is independent of the transmission delay of the transmission system.) The time required to position the selectors should not exceed 800 milliseconds.

15 For signalling purposes on international circuits that will be used between the international exchange of the terminal country and an intercontinental transit centre, several solutions are available to the Administrations concerned. The choice between the solutions must be the subject of agreement between the terminal country and the country handling the intercontinental transit. These solutions will result from the following considerations:

a) Whether the routing towards the intercontinental transit centre (or from the intercontinental transit centre) would be made through the continental centre adjacent to the intercontinental transit centre in the transit country (in this case the access prefix 00 should be used).

b) Alternatively, whether the routing would be made directly from the international terminal centre towards the intercontinental centre and vice versa.

c) Whether the international circuits between the terminal country and the transit country would be operated only as outgoing or incoming circuits or whether it would be possible to operate them in both directions for setting up calls.

d) Whether the signalling system on these circuits would be the one that is used for automatic traffic between the terminal country and the transit country, the transit country being responsible for making the conversion of this signalling system according to type C, Table 1/U.11 signals on the intercontinental circuits and vice versa.

e) Alternatively, whether this signalling would be established according to type C signalling.

f) It is permitted to transmit over the intercontinental transit network the digits of the called station number (except the first one or two digits) as and when received from the calling subscriber. It is to be noted, however, that in that case backward path signals may be received by the calling subscriber or operator during his selection. This may prevent correct printing of the forward and backward path signals and even lead to mutilation of the forward selection signals. This difficulty, as well as unnecessary loading of the intercontinental transit network by selection faults and slow selection can be avoided by assembling the subscriber's selection information, preferably in the originating network.

To give some guidance to Administrations Tables 2/U.11 and 3/U.11 below have been set up. Table 2/U.11 corresponds to the case of access to the intercontinental transit centre through the adjacent continental centre. Table 3/U.11 corresponds to the case of direct access to the intercontinental transit centre with unidirectional circuits. In the case of direct access to the intercontinental transit centre using both-way circuits, type C signalling indicated in Table 1/U.11 could be applied.

TABLE 1/U.11

Signalling between the two intercontinental transit centres

Signal or function	Forward path (X towards Y)	Backward path (Y towards X)	Remarks
Free line	Start polarity (polarity A)	Start polarity (polarity A)	
Call	Stop polarity (polarity Z) for 150-300 ms followed by 2 combinations No. 20 (2 polarity A pulses of 100 ms duration) and then followed immediately by the selection signals		The Y incoming register must be connected and ready to receive selection signals within 425 ms of the commencement of the inversion to stop polarity; the combinations No. 20 do not need to be detected as part of the signal for calling purposes. The Y register must be able to absorb any combination No. 20 or portion of a combination No. 20 that may precede the selection signals. *Note* – It is necessary for the transmission system to be capable of transmitting the combinations No. 20 of the calling signal before reception of the reception-confirmation signal. In the case of error-corrected radio circuits the radio equipment must ensure that the period of stop polarity preceding the first combination No. 20 is transmitted as four consecutive β signals, and that at the Y end the inversion to stop polarity is transmitted when two consecutive β signals have been received. The radio equipment at the Y end must also ensure that the first combination No. 20 is preceded by at least 140 ms of stop polarity.
Reception confirmation		Stop polarity followed by combination No. 22 (40-ms pulse of A polarity)	Stop polarity is returned 450 ms ($\pm$ 10%) after the end of receipt of the class-of-traffic signal. Combination No. 22 is returned 450 ms ($\pm$ 10%) after the inversion to stop polarity on the backward path.
Selection signals	Class-of-traffic signal Class-of-traffic-check signal The 2 or 3 digits of the destination code of the called country The digits of the called station number Combination No. 26		These signals are transmitted immediately after the calling signal, without awaiting the reception at X of the reception confirmation signal. These signals are transmitted according to the code of International Telegraph Alphabet No. 2 at the normal modulation rate of 50 bauds; the digits of the destination code and the first two digits of the called station are transmitted at automatic speed [see § 15*f)*.]
Transmission confirmation		Combination No. 29 (20-ms pulse of A polarity) Combination No. 32 (120-ms pulse of A polarity)	Transmitted after the reception-confirmation signal on condition that the class-of-traffic check signal has been correctly received. This signal and the reception-confirmation signal will have to be absorbed by the switching equipment of X and should not be able to go through that equipment to arrive at the preceding centre.
Transit centre identification		Combination No. 29 Either 1 letter and Combination No. 29 or 2 letters to identify transit centre Y Combination No. 30 1, 2 or 3 digits followed by 2, 1 or 0 combinations No. 30 respectively	Teleprinter signals immediately following the transmission-confirmation signal at automatic speed. These signals must go through centre X and arrive at the originating country.

TABLE 1/U.11 *(continued)*

Signal or function	Forward path (X towards Y)	Backward path (Y towards X)	Remarks
Call connected		Combination No. 32 (120-ms pulse of A polarity) followed by 8 combinations No. 29 (20-ms pulses of A polarity) transmitted at automatic speed	As soon as it is possible, at the last transit centre, to discriminate that the signal received is the call-connected signal from the destination network, it should be returned immediately to the calling network, in type C format, by the last transit centre. In the case of type A signalling in the destination network the format of the type C call-connected signal is either *a)* combination No. 32 and 8 combinations No. 29 transmitted at automatic speed but then preceded by the type A call-connected signal (150 ms ± 11 ms) followed by 150-300 ms stop polarity, or *b)* combination No. 32 followed by 0-300 ms stop polarity and 8 combinations No. 29 transmitted at automatic speed. In the case of type B signalling in the destination network the format of the type C call-connected signal will always be combination No. 32 and 8 combinations No. 29 transmitted at automatic speed. In the event of non-receipt of a call-connected or service signal from the destination network within 60 seconds of the transmission of the end-of-selection signal, the last transit centre will return an appropriate service signal and release the connection. Non-receipt of the call-connected or service signal at the first transit centre within approximately 60 seconds of transmission of the end-of-selection signal will cause this transit centre to return the **NC** service signal and release the connection.
Answer-back signals			Where the destination system returns the answer-back automatically, the answer-back and any associated signals (e.g. date and time) should be extended to the calling network as and when received. Where the destination system does not return the answer-back automatically, the last transit centre in the connection will make a request for the return of the answer-back code of the obtained teleprinter.
Teleprinter service signals from type A or B systems		Teleprinter signals as returned from the called system, followed by the clearing signal	
Non-printing service signals from type B systems *a)* Spare line of permanent start polarity		Combination No. 27 Combination No. 28 Combination No. 31 Combination No. 29 Combination No. 4 **(D)** Combination No. 5 **(E)** Combination No. 18 **(R)** Combination No. 27 Combination No. 28 followed by the clearing signal	These signals *a)*, *b)* or *c)* should be transmitted by the last transit centre in the connection. In order to reduce the ineffective time of trunk circuits to a minimum the service signal in *a)* should be returned not later than 15 sec. from the end of the last selection signal transmitted to the terminal system and in *c)* should be returned within 6 sec. from the inversion to stop polarity from the terminal system.

TABLE 1/U.11 *(continued)*

Signal or function	Forward path (X towards Y)	Backward path (Y towards X)	Remarks
b) Busy or similar signals		Combination No. 27 Combination No. 28 Combination No. 31 Combination No. 29 Combination No. 15 **(O)** Combination No. 3 **(C)** Combination No. 3 **(C)** Combination No. 27 Combination No. 28 followed by the clearing signal	
c) Station faulty permanent stop polarity		Combination No. 27 Combination No. 28 Combination No. 31 Combination No. 29 Combination No. 4 **(D)** Combination No. 5 **(E)** Combination No. 18 **(R)** Combination No. 27 Combination No. 28 followed by the clearing signal	
Idle circuit	Stop polarity	Stop polarity	
Clearing	Inversion to continuous start polarity in the direction of clearing		The recognition time for this signal is 450 ± 150 ms.
Clear confirmation	Inversion to continuous start polarity in the opposite direction within 500 ± 100 ms of the commencement of the clearing signal		
Automatic re-test	Stop polarity for 300 ms Combination No. 20 Combination No. 20 Combination No. 21 Combination No. 15 Combination No. 16 Combination No. 16 Combination No. 16 Stop polarity for 2 seconds Start polarity for 1.0 or 1.2 minutes, 5 or 6 minutes, 30 or 36 minutes (repeated; see § 10 of the text)		3 combinations No. 16 correspond to a spare destination code 000, allocated for re-test purposes. 1.0, 5 and 30 minute periods of start polarity for one centre. 1.2, 6 and 36 minute periods of start polarity for the other centre. The automatic re-test signal is initiated: – in the case of a head-on collision, on failure to receive the second combination No. 20, – or on failure to receive the reception-confirmation and transmission-confirmation signals correctly, – or on receipt of the transmission failure signal. *Note* – Tolerance on all timings is ± 10%.
Backward busy	Continuous stop polarity for a maximum of 5 minutes		
Receiving equipment congestion		Stop polarity for 450 ms followed by clearing signal	This signal is returned not more than 500 ms after the start of the calling signal when there is no receiving equipment free to be connected to receive the selection signals within 425 ms of the start of the calling signal. This signal will have to be absorbed by the switching equipment at X and should not be able to go through that equipment to arrive at the preceding centre.

TABLE 1/U.11 *(concluded)*

Signal or function	Forward path (X towards Y)	Backward path (Y towards X)	Remarks
Transit failure		Combination No. 27 Combination No. 28 Combination No. 31 Combination No. 29 Combination No. 14 (N) Combination No. 3 (C) Combination No. 27 Combination No. 28 followed by clearing signal	This signal is returned as soon as possible following the transit centre identification code signal: *a)* when there is no free trunk outgoing from transit centre, *b)* when the three digits following the class-of-traffic check signal do not correspond to an allocated code, *c)* any of the consecutive incoming Y selection signals is delayed for 5 seconds or more, *d)* when a call fails owing to a head-on collision, *e)* when the class-of-traffic signal received does not correspond to an authorized type of call, or *f)* when the receiving equipment congestion signal is received from another transit centre.
Transmission failure		Combination No. 15 Combination No. 15 (two 80-ms pulses of A polarity) followed by clearing signal	Returned after the reception-confirmation signal as soon as the class-of-traffic check signal has been found to be incorrect. This signal and the reception-confirmation signal will have to be absorbed by the switching equipment of X and should not be able to go through that equipment to arrive at the preceding centre.

TABLE 2/U.11

Signalling between the calling international system and the intercontinental transit system (using code 00 for access via the international exchange of the transit Administration)

Function	Forward path	Backward path	Remarks
Call			These are signalled in accordance with the type of signalling used on terminal calls into the national system of the transit Administration.
Call confirmation			
Proceed-to-select			
Selection	Digits 00		
Transit proceed-to-select		Stop polarity for at least 450 ms followed by combination No. 22 (40-ms pulse of A polarity)	In the case where the transit Administration uses type A signalling for terminal calls to its national network, the inversion to stop polarity on the backward signalling path takes place when the incoming trunk circuit is seized. Where the transit system uses type B signalling for this traffic the inversion to stop polarity on the backward signalling path occurs after the transit access code digits 00 have been selected. The transit access code is selected in accordance with the same signalling arrangements as those used for the terminal traffic into the national network.
Selection signals [a)]	Combination No. 30 Class-of-traffic 2 or 3 digit destination code Digits of called number Combination No. 26		
Transit centre identification code signals		As in Table 1/U.11. Returned within 150 ms of recognition of the class-of-traffic signal (or the end-of-selection signal if the method using assembling of selection signals [see § 15*f*) of the text] is adopted)	
Call connected		As in Table 1/U.11	
Service signals		As in Table 1/U.11	
Clear			These are signalled in accordance with the type of signalling used on terminal calls into the national system of the transit Administration.
Clear confirmation			

a) The pre-signal combination No. 30 indicates a call without class-of-traffic check facilities, which are considered unnecessary for circuits of this type.

TABLE 3/U.11

Signalling between the calling international system and the first transit exchange (when access to this is by direct connection to the transit switching equipment)

Function	Forward path	Backward path	Remarks
Free line	As in Table 1/U.11		
Call	Inversion to stop polarity for 450 ms		The incoming register must be connected and ready to receive selection signals within 425 ms of the commencement of the inversion to stop polarity.
Reception confirmation		As in Table 1/U.11	
Selection signals	As in Tables 1/U.11 and 2/U.11		As in Table 1/U.11
Transmission confirmation		Combination No. 29 (20-ms pulse of A polarity) Combination No. 32 (120-ms pulse of A polarity)	Transmitted only on receipt of selection signals in accordance with Table 1/U.11 and then as soon as the class-of-traffic check combination has been correctly received.
Transit centre identification code signals		As in Table 1/U.11	
Call connected		As in Table 1/U.11	
Service signals		As in Table 1/U.11	
Idle circuit	As in Table 1/U.11		
Clearing	As in Table 1/U.11		
Clear confirmation	As in Table 1/U.11		
Automatic re-test	As in Table 1/U.11		As in Table 1/U.11
Backward busy	As in Table 1/U.11		
Receiving equipment congestion		As in Table 1/U.11	
Transit failure		As in Table 1/U.11	
Transmission Failure		As in Table 1/U.11	

Note 1 – Working over these circuits is on a unidirectional basis and there is therefore no requirement for the inclusion of combinations No. 20 in the calling signal.

Note 2 – In the case of both-way working the use of the signalling system of Table 1/U.11 is recommended.

TABLE 4/U.11

Class-of-traffic signals

Category	Element number					Condition signalled
	1	2	3	4	5	
A	Z					Category A (50 bauds)
B	A					Category B (reserved)
A		A	A			Special category (see Note under § 7.2)
A		A	Z			Gentex
A		Z	A			Service traffic
A		Z	Z			Telex
A and B				A		Not previously overflowed
A and B				Z		Previously overflowed
A and B					A	Permanent polarity

TABLE 5/U.11

Combinations used for class-of-traffic and class-of-traffic check signals

Category	Class-of-traffic						Class-of-traffic check						Function	
	Combination number	Element number 1	2	3	4	5	Combination number	Element number 1	2	3	4	5	Gentex, telex, telex and gentex combined, or special category	Previously alternatively routed (overflowed)
A	11	Z	Z	Z	Z	A	20	A	A	A	A	Z	Telex	yes
A	21	Z	Z	Z	A	A	15	A	A	A	Z	Z	Telex	no
A	10	Z	Z	A	Z	A	8	A	A	Z	A	Z	Service traffic	yes
A	1	Z	Z	A	A	A	13	A	A	Z	Z	Z	Service traffic	no
A	6	Z	A	Z	Z	A	12	A	Z	A	A	Z	Gentex	yes
A	19	Z	A	Z	A	A	7	A	Z	A	Z	Z	Gentex	no
A	4	Z	A	A	Z	A	16	A	Z	Z	A	Z	Special category (see Note under § 7.2)	yes
A	5	Z	A	A	A	A	22	A	Z	Z	Z	Z	Special category (see Note under § 7.2)	no
B	3	A	Z	Z	Z	A	26	Z	A	A	A	Z		yes
B	9	A	Z	Z	A	A	2	Z	A	A	Z	Z		no
B	18	A	Z	A	Z	A	25	Z	A	Z	A	Z		yes
B	28	A	Z	A	A	A	24	Z	A	Z	Z	Z		no
B	14	A	A	Z	Z	A	23	Z	Z	A	A	Z		yes
B	31	A	A	Z	A	A	30	Z	Z	A	Z	Z		no
B	27	A	A	A	Z	A	17	Z	Z	Z	A	Z		yes
B	32	A	A	A	A	A	29	Z	Z	Z	Z	Z		no

References

[1] CCITT Recommendation *Use on radio circuis of 7-unit synchronous systems giving error correction by automatic repetition*, Vol. VII, Fascicle VII.2, Rec. S.13, Table 1/S.13.

[2] CCITT Recommendation *Operational provisions for the international public telegram service*, Vol. II, Fascicle II.4, Rec. F.1, § C8.

[3] CCITT Recommendation *Use of the telex network for data transmission at 50 bauds*, Vol. VII, Fascicle VII.2, Rec. S.15, § 2.

[4] CCITT Recommendation *Plan for telex destination codes*, Vol. II, Fascicle II.4, Rec. F.69.

Recommendation U.12

TERMINAL AND TRANSIT CONTROL SIGNALLING SYSTEM FOR TELEX AND SIMILAR SERVICES ON INTERNATIONAL CIRCUITS (TYPE D SIGNALLING)

(Geneva, 1972; amended at Geneva, 1976 and 1980)

The CCITT,

considering

(a) that new networks are being introduced based upon stored programme control techniques;

(b) that these networks, which may be synchronous or anisochronous, are being provided to carry either telex and similar services or these services in combination with data traffic;

(c) that the equipment provided for these networks facilitates an enhanced range of facilities compared with those available on existing types of telex network;

(d) that these factors justify the establishment of a new type of signalling, enabling both telex and other traffic to be handled, as far as practicable, by common processes;

(e) that, for interworking between these anisochronous networks for telex and similar switched telegraph services, a signalling standard (designated type D) has been adopted, based upon that described in Recommendation X.70 [1] for start-stop data services on anisochronous networks;

(f) that at this stage priority has been given to signalling in an all-type D environment and a Recommendation agreed. Further detailed study is required of interworking between type D and other existing signalling standards that might reflect on these agreements;

(g) that the decentralized signalling to apply on connections between synchronous public data networks is described in Recommendation X.71 [2];

unanimously declares the view

1 Signal conversion

1.1 Recommendation U.1, § 1.1 concerning the responsibility for signal conversion, should be the ultimate aim for interworking between networks using type D signalling on the one hand and type A, B or C signalling on the other hand.

1.2 However, in order to avoid unnecessary inconvenience during the introductory stages of the new signalling system, it is recommended that countries employing type D signalling systems should provide for incoming international traffic type A or B signalling and possibly for transit working type C signalling. The question as to when Recommendation U.1, § 1.1 will become fully effective is yet to be resolved.

2 General switching and signalling principles

2.1 Decentralized signalling will apply, the same channel being used for control signalling and information transfer.

2.2 Both terminal and transit operation will be required. Due to the inclusion of transit operation, link-by-link signalling control of calls will be adopted.

2.3 Onward selection from transit and incoming terminal centres should be arranged to overlap the receipt of selection signals, this in order to minimize call set-up times. Selection signals will be transmitted by the originating country at automatic speed in a single block that includes an end-of-selection signal.

2.4 The schedule of telex destination codes laid down in Recommendation F.69 [3] will apply. The same numerical codes will be used for network identification purposes.

2.5 Alternative routing will be permitted. The principle of a few high usage circuits will be adopted, with overflow on to adequately provided routes between centres. In order to prevent repeated alternative routing causing traffic to circulate back to the originating point, alternative routing will be restricted to once per call.

2.6 Both-way operation will be assumed and inverse order testing of circuits on both-way routes, or a close approximation to it by testing the route in small groups in fixed order always starting the search from the same position, will be specified in order to minimize head-on collisions.

2.7 In all cases (including transit switching) the originating network will be responsible for recording accounting information.

2.8 The grade of service for the provision of circuits should not be worse than one lost call in 50 for routes carrying overflow traffic or from which overflow is not permitted. For high-usage direct links, circuits would be provided at a grade of service to be agreed bilaterally, but should not be worse than one lost call in ten.

2.9 Sufficient switching equipment will be provided to ensure that congestion will not be signalled on more than 0.4% of calls in the busy hour, and only then when congestion has been positively identified.

3 Specific signalling characteristics

Notes applicable to § 3

Note 1 – X denotes the international centre that originates the call under consideration on the international link concerned. Y denotes the international centre that receives the call under consideration on the international link.

Centre X and centre Y will provide any necessary signalling conversion to the type of signalling employed on the preceding and succeeding links if these do not use type D signalling.

Note 2 – Timings shown are within the centre concerned with no allowance being made for propagation and other delays, such as slow sending of selection signals by the originating subscriber.

Note 3 – The times for permanent start polarity (A) and stop polarity (Z) are generally indicated in the following signal descriptions as integral multiples of a character (see Note 4). Compared with Recommendation X.70 [1], some other multiples are selected in order to enable simpler interworking with systems operating in accordance with Recommendations U.1 and U.11.

Note 4 – The control signalling code (CSC) used in this signalling system is described in Table 8/U.12.

3.1 The signalling system for telex and similar services between two anisochronous networks using type D signalling is described in Table 1/U.12.

3.2 The incoming equipment may release the connection if the calling signal exceeds the maximum period of two characters, or of four characters in exceptional cases where extension of call signals has been requested by centre Y. Start polarity will be maintained on the backward signalling path from centre Y to centre X.

3.3 The first forward path signal following the calling signal (class-of-traffic signal) is distinctive from the first backward path signal to provide a guard against head-on collisions in the case of bothway operation. A head-on collision is detected by the fact that centre X receives a first class-of-traffic character instead of the reception-confirmation or reception-congestion signal.

When a head-on collision is detected, the switching equipment at each end of the circuit should make another attempt to select a free circuit, either on the same group of circuits or on a group of overflow circuits, if they exist and there are no free circuits on the primary route. In the event of a further head-on collision on the recall, or on the call attempt via the overflow route, no further recall will be made and the call will be cleared down. In the case of a transit centre, the service signal No. 20 (**NC**) followed immediately by the clearing signal will be returned to the preceding centre after the reception-confirmation signal and the network identification signal (Recommendation F.69 [3]).

3.4 If there is failure to receive the reception-confirmation or reception-congestion signal within 4 seconds from the start of the calling signal or receipt of a spurious signal, as indicated by a character other than a first class-of-traffic character, the reception-confirmation signal or reception-congestion signal, should initiate the automatic retest signal on the circuit concerned.

In the case of failure to receive the correct reception-confirmation or reception-congestion signal, another attempt to select a circuit should be made (once only). If the second attempt is unsuccessful, the service signal No. 20 (**NC**) followed by the clearing signal will be returned to the preceding centre after the reception-confirmation signal and the network identification signal (Recommendation F.69 [3]).

3.5 Selection signals can be divided into two parts. The first part, designated as the network selection signals, contains information regarding network and subscriber requirements and may be composed of one to nine (or possibly more) characters (see Tables 2/U.12, 3/U.12, 4/U.12, 5/U.12 and 5a/U.12). The second part comprises the address signals (the called subscriber number, which is preceded by the destination code in the case of a transit call). The network selection signals used in the forward direction (see also Appendix II) are further subdivided and assembled as follows (§§ 3.5.1 to 3.5.4 below) for signalling purposes:

3.5.1 *First class-of-traffic character* (see Table 2/U.12)

The calling signal is always followed by at least one class-of-traffic character. The bit functions of this character were so chosen that no further characters are needed for most connections. If there is a need for indication of further requirements, a second class-of-traffic character may be used. Whether the second class-of-traffic and user-class characters follow or not will be indicated by the bits b_3 and b_4 of the first class-of-traffic character.

3.5.2 *User-class character* (see Table 3/U.12)

This character, if used, will follow the first class-of-traffic character and will be required when, for example, this information cannot be derived from the incoming line. Whether a second user-class character follows or not will be indicated by the bits b_1, b_2 and b_3 of the first user-class character. When seven user classes in Table 3/U.12 are not sufficient, a second user-class character may be added by means of an escape character. Whether a second class-of-traffic character follows or not will be indicated by bit b_4 of the first user-class character.

3.5.3 *Second and subsequent class-of-traffic characters* (see Table 4/U.12)

These characters follow any user-class characters required. The number of these class-of-traffic characters depends on the number of user facilities available. The bit b_4 of the second or subsequent class-of-traffic characters will indicate whether another class-of-traffic character follows or not.

3.5.4 *Closed user group character* (see Table 5/U.12)

closed user group is defined as follows : A number of users of a public switched communication service who have the facility that they can communicate with each other but access is barred to and from all other users of the service.

Note 1 – A special facility, permitting a user in a closed group to call any other user connected to a public switched communication service or to any other network with which interworking is permitted, may be offered. This is termed *Closed user group with outgoing access*. Access to users of this facility is restricted to other members of the closed user group.

The start of closed user group character would precede the closed user group number which would be coded into a number of hexadeciml characters up to a maximum of four (see Table 5/U.12).

Note 2 – Further study is required concerning administrative aspects of the method to provide the closed user group facility.

3.5.5 The numerical characters used for the second part of the selection signals are shown in Table 6/U.12. When the first class-of-traffic character indicates a terminal call, the Recommendation F.69 [3] telex destination code will be omitted.

3.6 The incoming equipment should maintain start polarity on the backward signalling path by releasing the connection if the first received character is spurious, as indicated by a character other than a valid first class-of-traffic signal. This procedure prevents the possibility of regarding a second selection signal as a first class-of-traffic character and provides a further safeguard against false calls.

In the case of receipt of a spurious signal as indicated by a parity error or by a character other than a valid selection signal (with the exception of the first class-of-traffic signal), the incoming equipment should return the service signal No. 20 (**NC**) to the preceding centre – after the reception-confirmation and the network identification signal (F.69 [3]) – followed by the clearing signal.

The incoming equipment may release the connection if all of the selection signals are not correctly received within a period of 15 seconds from the reception of the first class-of-traffic signal. In this event, the **NC** service signal is returned to the preceding centre, followed by the clearing signal.

3.7 For the address signals, i.e. the destination code and the national number, the maximum number of digits to be expected is 12.

3.8 In the case of receipt of the reception-congestion signal at a transit centre, the service signal No. 61 (**NC**) should be returned to the preceding centre (after the reception-confirmation and the network identification signal) and followed by the clearing signal.

3.9 The network identification signal shall be sent following the reception-confirmation signal.

If several networks are involved in setting up a call, the calling network will receive the network identification signals one after the other. If a transit centre fails to receive the first character of a network identification signal within two seconds of the reception-confirmation signal, it will return the service signal No. 20 (**NC**) to the preceding centre, followed by the clearing signal. The network identification signals could be useful for retracing the route followed by a call (for traffic statistics, international accounts, analyses of unsuccessful calls and the clearing of faults).

It is possible for a transit centre to receive backward path signals, such as network identification signals, a call-connected signal or service signals, from subsequent centres whilst the backward path signals originated locally are still being sent. It is necessary for the transit centre to ensure that the received signals are retransmitted to the preceding centre without mutilation or loss.

3.10 The backward path signals indicating effective and ineffective call conditions are scheduled in Tables 7/U.12, 7a/U.12 and 7b/U.12.

3.11 If the last backward path signalling character, call-connected, or service signal is not received within 90 seconds from the end of selection, then the service signal No. 20 (**NC**) will be returned to the preceding centre and followed by the clearing signal.

3.12 If the called station is not able to receive information immediately, the return of the start-of-transit-through-connect or call-connected signals to the calling station should be delayed accordingly (up to a maximum of 3 seconds for telex in accordance with Recommendation S.9 [4]).

3.13 In this type of signalling, originating and terminating national centres contain the identification of the calling or called subscribers respectively. These identifications may be exchanged within the network as an optional subscriber's feature.

In the case of a call terminating in a network with a signalling standard other than type D, and hence called line identification is not available, the last type D centre in the connection should send only the end-of-line-identification signal (CSC character No. 12) in response to a request for the line identification. The last type D centre may be either the international gateway or a national type D centre.

In the case of a call originating in a network with a signalling standard other than type D, and hence the calling line identification is not available, the first type D centre in the connection should send only the end-of-line-identification signal (CSC character No. 12) in response to a request for the line identification. The corresponding printed service signal to indicate this condition to the calling or called subscriber as appropriate is **NI**.

Regardless of the action taken on calling and/or called line identifications, tripping of the called subscriber's answerback is required. Normally this is initiated by the originating type D centre; the exception being where the terminating or transit network uses a different signalling system, in which case that network sends the WRU to the called subscriber. Return of the answer-back code is supervised by the originating centre. If it does not arrive within 6 seconds of the commencement of the WRU sequence (or in the above exceptional case, the instant when the WRU sequence would have commenced), the originating centre returns the **DER** signal in International Telegraph Alphabet No. 2 to the calling subscriber and clears the connection.

3.14 The call connected signal confirms that the call is extended to the called subscriber and, if applicable, that the calling line identification has been completely received by the terminating centre and passed to the called suscriber and, when applicable, that the called line identification has been completely transmitted to the originating centre (see Appendix III).

The WRU signal confirms that the call-connected signal has been received by the originating centre and, when applicable, that the called line identification has been completely received by the originating centre and passed to the calling subscriber (see Appendix III).

The call-connected signal is sent on the backward path by the terminating centre, the WRU signal is sent by the originating centre to the called subscriber, but not before the calling subscriber is ready to receive the answer-back signal.

The connection must be switched through in the originating centre and in the terminating centre within the timings shown in Appendix III.

In transit centres the connection can be switched through earlier provided that losses and mutilations of characters are avoided.

Complete network through-connection is assured when the called subscriber's answerback is received by the calling terminal.

3.15 The guard delays on clearing are measured from the moment when start polarity has been established on both signalling paths by:

– either recognizing or transmitting the clearing signal on one signalling path, and

– either transmitting or recognizing the clear-confirmation signal on the other signalling path.

On all type D signalling paths the guard period for incoming calls should be a period of 3-4 characters. A new call shall not be accepted until this guard period has elapsed. This is on the assumption that the terminating centre will be able to accept the first selection signal after a negligible period of stop polarity and will also be able to return the reception-confirmation signal within a negligible delay after the receipt of the first class-of-traffic character.

On all type D signalling paths the guard period for outgoing calls should be a period of at least eight characters. If centres are able to distinguish between the different clearing conditions, shorter periods may be introduced accordingly.

For interworking between type D signalling standards, the incoming and outgoing guard delay periods referred to above are changed to 1 second and 2 seconds respectively.

3.16 The automatic retest signal will be initiated as indicated in § 3.4 above.

The circuit should be marked *unavailable* for outgoing traffic and should be tested up to five times at nominal intervals of 1.0 minute or 1.2 minutes and a check made to confirm the receipt of a reception-confirmation signal in response to each test. If a valid reception-confirmation signal has not been received at the end of this first group of tests, the retest will continue with a further group of up to five tests at either 5.0/6.0- or 30/36-minute intervals. If 5.0 or 6.0-minute intervals are used and a valid reception-confirmation signal has not been received at the end of this second group of tests, a further group of up to nominally five retests will be made at 30- or 36-minute intervals. An alarm will be given at an appropriate time. However, this retest procedure may be discontinued at any stage at the discretion of the outgoing Administration.

If, however, during the above sequence of retests, a valid reception-confirmation signal is received, a clearing signal will be transmitted in the place of the retest signal. Following a valid clear-confirmation signal, the incoming and the outgoing sides of the trunk circuit should not be returned to service until after expiry of the appropriate guard delay time. In order to cater for the possibility that a faulty circuit may be seized at both ends, the automatic retest equipment should be arranged to allow an incoming call to be received during the start polarity period of the automatic retest signals. Administrations may, however, ignore such calls that occur during the incoming guard delay period. Where an exchange has knowledge of a transmission system failure, it is desirable that retest signals shall not be applied to the affected circuits.

The intervals between the tests at the two ends of the trunk circuit should be made different to be sure that successive retests do not overlap at both ends. In general, the international/intercontinental transit centre having the higher F.69 [3] teles destination code should take the longer interval (i.e. 1.2, 6 and 36 minutes). The tolerance on all above time intervals is ± 10%. Nevertheless, when this requirement would entail considerable difficulty, alternative arrangements may be adopted by agreement between the two Administrations concerned.

The use of a special first class-of-traffic character for retest permits the incoming centre to be informed about retests on its incoming circuits.

3.17 If at the receiving end parity does not check, provisionally the connection should be cleared down unless otherwise specified. However, the possibility of different actions remains open for further study.

TABLE 1/U.12

Signalling for telex and similar services between anisochronous networks

Note – For the Control Signalling Code (CSC) numbers mentioned refer to Table 8/U.12.

Signal or function	Forward path (X towards Y)	Backward path (Y towards X)	Remarks
Free line	Start polarity (polarity A)	Start polarity (polarity A)	
Call	Stop polarity (polarity Z) for a minimum period of one character and a maximum period of two characters followed immediately by selection signals		The equipment at centre Y must be connected and ready to receive selection signals within one character period. Exceptionally the minimum and consequently the maximum period may be lengthened to no more than four characters at the request of the incoming country (Y).
Reception-confirmation		Stop polarity followed by CSC No. 14	Stop polarity returned within three character periods after the end of receipt of the first class-of-traffic signals. The return of CSC No. 14 shall commence within one to two character periods after the inversion to stop polarity. The reception-confirmation signal will have to be absorbed by the switching equipment of X and should not be able to go through that equipment to arrive at the preceding centre.
Selection	At least one (first class-of-traffic signal only) or possibly several network selection signals depending on the network requirement (see Appendix I), the two or three digits of the F.69 [3] telex destination code of the called country, the digits of the called station number and an end-of-selection signal (CSC No. 11)		These signals are transmitted immediately after the calling signal without awaiting the reception at X of the reception-confirmation signal. The destination code will be omitted for terminal calls. The selection signals will be transmitted in a single group at automatic speed.
Network identification		CSC No. 12 followed by the F.69 [3] code for the network concerned	The CSC No. 12 follows the reception confirmation signal at automatic speed after one to two character periods. These signals must go through centre X and arrive at the originating country.
Reception-congestion		Stop polarity for a period of one or two characters followed by the clearing signal	When selection signals cannot be accepted (refer to § 2.9 of the text) this signal should be returned as soon as possible and in any event within three character periods (exceptionally five character periods where centre X sends prolonged call signals) after the start of receipt of the call signal. The reception-congestion signal should be absorbed by centre X and not allowed to be received by a preceding country.
Service signal without clearing		CSC characters (see Table 7b/U.12) followed by the idle circuit condition	Service signals consist of CSC No. 11 followed by two characters from Table 7b/U.12.

TABLE 1/U.12 *(continued)*

Signal or function	Forward path (X towards Y)	Backward path (Y towards X)	Remarks
Call connected		One CSC character (see Table 7/U.12)	See Appendix III.
Start of transit through-connect signal (STTC)		CSC No. 15 (see Table 7/U.12)	This signal always precedes the transit through-connect signal.
Transit through-connect signal (TTC)		One CSC character (see Table 7a/U.12)	This signal will always be prefaced by the start of transit through-connect signal and will be returned preceding a service signal without clearing when this has to be sent. It will also be transmitted when the calling and/or called line identification is required (for further details see Appendix III).
Transit centres through-connected signal (TTD)	CSC No. 11 (see Table 6/U.12)		This signal will be transmitted within one to two character periods after the receipt of the transit through-connect signal (TTC) when no calling line identification is required (for further details see Appendix III).
Called line identification (if required)		The called line identification signal transmitted at automatic speed commencing within one character period of the receipt of the TTD signal or the first character of the calling line identification signals.	The called or calling line identification signal consists of the F.69 [3] code followed by the digits of the subscriber's number and then the end-of-identification character (CSC No. 12). Where no identification is available, only CSC No. 12 is sent. (For further study in a mixed signalling situation.) For further details see Appendix III.
Calling line identification (if required)	The calling line identification transmitted at automatic speed commencing within one to two character periods of receipt of the transit through-connect signal (TTC)		
WRU *(Who are you?)*	WRU characters (combinations Nos. 30 and 4) of ITA2		For definition see § 3.14 of the text and for further details see Appendix III.
Service signal with clearing		CSC characters (see Table 7b/U.12), followed by clearing signal	The service signal consists of CSC No. 11 following by two characters of Table 7b/U.12.
Idle circuit	Stop polarity	Stop polarity	
Clearing	Inversion to start polarity in the direction of clearing. The minimum recognition time is 2 characters and the maximum time is 4 characters		The minimum period of start polarity on one signalling path that in itself ensures the complete release of the connection is 4 characters.
Clear confirmation	Inversion to continuous start polarity in the opposite direction after a minimum duration of 2 characters of clearing signal and a maximum duration of 7 characters		The minimum and maximum periods for the release of the international circuit by a centre are 2 and 7 characters respectively.

TABLE 1/U.12 *(concluded)*

Signal or function	Forward path (X towards Y)	Backward path (Y towards X)	Remarks
Incoming guard delay	Period of 3-4 characters measured from the appearance of start polarity on both signalling paths		A new incoming call shall not be accepted until this guard period is elapsed. For further details see § 3.15 of the text.
Outgoing guard delay	Period of 8 characters measured from the appearance of start polarity on both signalling paths		The outgoing equipment should not open the trunk circuit for service until this guard period has elapsed. For further details see § 3.15 of the text.
Automatic retest	Stop polarity for 1-2 (exceptionally 4) character periods followed by CSC No. 13, stop polarity for 4 seconds and then start polarity, repeated		For further details on the repetition periods see § 3.16 of the text.
Backward busy		Continuous stop polarity for a maximum of 5 minutes	

TABLE 2/U.12

First CSC[a] character on the forward and backward paths

Combination				Condition signalled
b_4	b_3	b_2	b_1	
A	A			No further network selection signal follows[b]
A	Z			Second class-of-traffic character follows[b] (see Table 4/U.12)
Z	A			User-class character follows[b] (see Table 3/U.12)
		A		Alternative routing not allowed[b]
		Z		Alternative routing allowed[b]
			A	Transit traffic[b]
			Z	Terminal traffic[b]
Z	Z	A	A	Retest signal[b]
Z	Z	A	Z	Reception-confirmation
Z	Z	Z	A	Not allocated
Z	Z	Z	Z	Not allocated

[a] CSC = control signalling code.
[b] First class-of-traffic character.

TABLE 3/U.12

First user-class character

Combination				Condition signalled from X to Y[a]
b_4	b_3	b_2	b_1	
A				No second class-of-traffic character follows
Z				A second class-of-traffic character follows (see Table 4/U.12)
	A	A	A	Reserve
	A	A	Z	Reserve
	A	Z	A	Service
	A	Z	Z	Telex
	Z	A	A	Gentex
	Z	A	Z	Reserve
	Z	Z	A	Reserve
	Z	Z	Z	A second user-class character follows[b]

[a] The user-class character may be omitted, if, for example, the information can be derived from the incoming line.
[b] Reserve for future needs.

TABLE 4/U.12

Second class-of-traffic character

Combination				Condition signalled from X to Y
b_4	b_3	b_2	b_1	
A				No third class-of-traffic character follows
Z				Third class-of-traffic character follows [a]
	A			No closed user group sequence follows
	Z			Closed user group sequence follows (see Table 5/U.12)
		A		Called line identification not required
		Z		Called line identification required
			A Z	Reserved for national use [b]

[a] Reserve for future needs. If implemented, the allocations should be the same as in Table 4a/X.70 [5].

[b] On international circuits b_1 should be set to A-polarity.

TABLE 5/U.12

Start of closed user group character [a) b)]

Combination				Condition signalled from X to Y
b_4	b_3	b_2	b_1	
A				Without outgoing access
Z				With outgoing access
	A			No DNIC follows [c]
	Z			DNIC follows [c) d)]
		A	A	1
		A	Z	2
		Z	A	3
		Z	Z	4

(1–4: Number of hexadecimal closed user group characters that follow)

[a] The application of closed user groups is provisional and for further study in the telex service.

[b] The start of closed user group character shall precede the data network identification code (DNIC – Recommendation X.121 [6]) of the representative user (see Recommendation X.87 [7]) followed by the closed user group number, which would be coded into a number of hexadecimal characters up to a maximum of four, as indicated. The closed user group number would be transmitted with the least significant bit of the least significant character first.

[c] For further information, see Recommendation X.121 [6].

[d] On international circuits b_3 should be set to Z-polarity.

TABLE 5a/U.12

Closed user group characters

Combination				Condition signalled from X to Y	
b_4	b_3	b_2	b_1		
A	A	A	A	0	Hexadecimal closed user group character
A	A	A	Z	1	
A	A	Z	A	2	
A	A	Z	Z	3	
A	Z	A	A	4	
A	Z	A	Z	5	
A	Z	Z	A	6	
A	Z	Z	Z	7	
Z	A	A	A	8	
Z	A	A	Z	9	
Z	A	Z	A	A	
Z	A	Z	Z	B	
Z	Z	A	A	C	
Z	Z	A	Z	D	
Z	Z	Z	A	E	
Z	Z	Z	Z	F	

TABLE 6/U.12

Miscellaneous forward path signals

Combination				Condition signalled from X to Y
b_4	b_3	b_2	b_1	
A	A	A	A	0
A	A	A	Z	1
A	A	Z	A	2
A	A	Z	Z	3
A	Z	A	A	4
A	Z	A	Z	5
A	Z	Z	A	6
A	Z	Z	Z	7
Z	A	A	A	8
Z	A	A	Z	9
				0–9: Digits for: – telex destination code; – called subscriber's number; – calling line identification; – DNIC.
Z	A	Z	A	End-of-selection signal and transit centres through-connected signal (TTD)
Z	A	Z	Z	End-of-calling-line-identification signal [a]
Z	Z	A	A	Not allocated
Z	Z	A	Z	Not allocated
Z	Z	Z	A	Not allocated
Z	Z	Z	Z	Not allocated

[a] This signal is also used without any pre-service signal when the calling line identification is not available.

TABLE 7/U.12

Miscellaneous backward path signals

Combination				Condition signalled from Y to X
b_4	b_3	b_2	b_1	
A	A	A	A	0
A	A	A	Z	1
A	A	Z	A	2
A	A	Z	Z	3
A	Z	A	A	4
A	Z	A	Z	5
A	Z	Z	A	6
A	Z	Z	Z	7
Z	A	A	A	8
Z	A	A	Z	9
				0–9: Digits for: – network identification signal (Recommendation F.69[3]), – called line identification, – service signals.
Z	A	Z	A	Start-of-service signal (see Table 7a/U.12)
Z	A	Z	Z	End-of-called-line identification [a] Start-of-network identification signal
Z	Z	A		Call connected signal
			A	Call metering
			Z	No call metering
Z	Z	Z	A	Start of transit through-connect signal (STTC)
Z	Z	Z	Z	Further backward path signal follows [b]

[a] This signal is also used without any pre-service signal when the called line identification is not available.

[b] Use of this combination is for future need.

TABLE 7a/U.12

Transit through-connect signals [a]

Combination				Condition signalled from Y to X
b_4	b_3	b_2	b_1	
A	A	A	A	Not allocated
A	A	A	Z	
A	A	Z	A	
A	A	Z	Z	
A	Z	A	A	
A	Z	A	Z	
A	Z	Z	A	
A	Z	Z	Z	
Z	A	A	A	
Z	A	A	Z	
Z	A	Z	A	
Z	A	Z	Z	
Z	Z			Transit through-connect signal (TTC)
		A		Calling line identification not required
		Z		Calling line identification required
			A	Call metering
			Z	No call metering

[a] These signals follow the start of transit through-connect signal (STTC) in Table 7/U.12.

TABLE 7b/U.12

Service signals on the backward path

Numerical code, first/second digit	Category	Signifiance	Equivalent alphabetical code
01	Without clearing	[a]	–
02		Redirected call [b]	**RDI**
03		Connect when free [c]	**MOM**
20	With clearing, due to subscriber – short term [d]	Network failure	**NC**
21		Number busy	**OCC**
22		[a]	–
23		[a]	–
41	With clearing, due to subscriber – long term [d]	Access barred	**NA**
42		Changed number	**NCH**
43		Not obtainable	**NP**
44		Out of order (general)	**DER**
45		Controlled not ready	**ABS**
46		Uncontrolled not ready	**DER**
47		(Answerback failure)	–
48		[a]	–
49		Network fault in local loop	**DER**
51		Call information service	**INF**
52		[a]	–
61	With clearing, due to network – short term [d]	Network congestion	**NC**
71	With clearing, due to network – long term [d]	[a]	–
72		[a]	–
81	With clearing, due to subscriber – network procedure	[a]	–
82		[a]	–
83		[a]	–

[a] Used in data networks. Not applicable to telex.

[b] Procedures concerning the use of this signal are left for further study (see Recommendation U.41).

[c] Only utilized within national networks.

[d] "Short-term" in this context approximates to the holding time of a call, whilst "long-term" implies a condition that can persist for some hours or even days.

TABLE 8/U.12

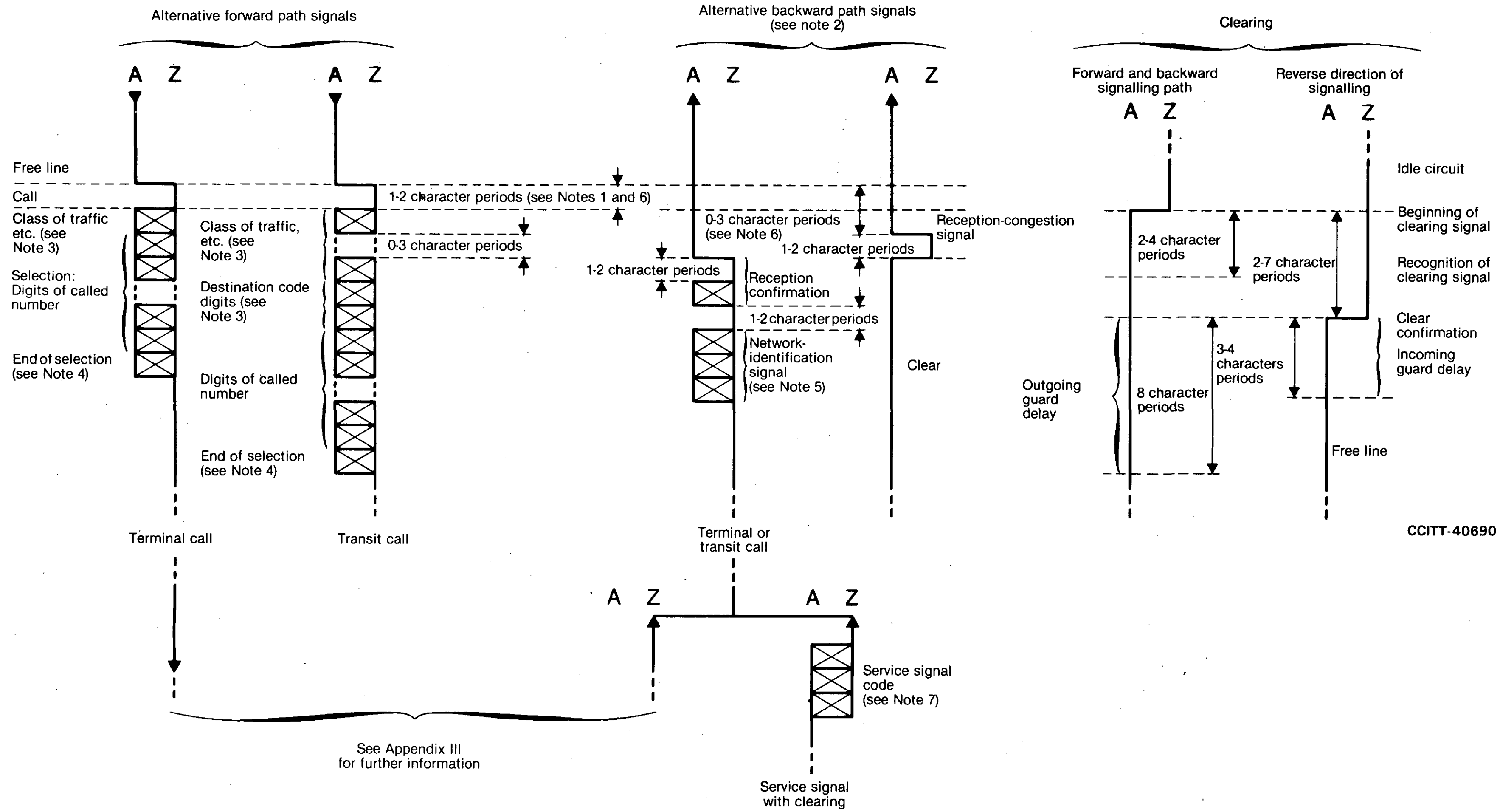
Control signalling code (CSC)

CSC character number	CSC character structure				
	b_5	b_4	b_3	b_2	b_1
1	A	A	A	A	A
2	Z	A	A	A	Z
3	Z	A	A	Z	A
4	A	A	A	Z	Z
5	Z	A	Z	A	A
6	A	A	Z	A	Z
7	A	A	Z	Z	A
8	Z	A	Z	Z	Z
9	Z	Z	A	A	A
10	A	Z	A	A	Z
11	A	Z	A	Z	A
12	Z	Z	A	Z	Z
13	A	Z	Z	A	A
14	Z	Z	Z	A	Z
15	Z	Z	Z	Z	A
16	A	Z	Z	Z	Z

Note 1 – The 4-unit code with one parity check bit used in this control signalling system is listed in the table. A complete control signalling code (CSC) character consists of a one-unit start element, four information bits (b_1, b_2, b_3 and b_4), a parity check bit (b_5) and a stop element of nominally one and a half units.

Note 2 – The parity bit of the signal should correspond to even parity with regard to unit elements of Z polarity. The individual bits should be transmitted at the nominal modulation rate of 50 bauds with the low order bit (b_1) first and completed by the parity check bit (b_5).

Note 3 – The transmitting part of the signalling device shall send the control characters at the nominal modulation of 50 bauds ± 0.5% with a maximum degree of gross start-stop distortion of 5%. The receiving part of the signalling device shall have an effective margin of not less than 40%.



Note 1 – Timings are shown as character periods of the 4 (+ 1 parity) bit code. Switching and propagation delays are not included.

Note 2 – Forward path signals may also appear on the backward path, indicating a head-on collision on both-way circuits.

Note 3 – Network selection signals (class-of-traffic), user-class signals, etc.: see Tables 2-5/U.12. Destination codes may comprise two or three digits.

Note 4 – Selection signals will always be sent as a single block by the originating country. An end-of-selection signal must be included.

Note 5 – The network identification signal comprises a distinctive character followed by the destination code of the network concerned.

Note 6 – The minimum and consequently the maximum periods will be lengthened at the request of the incoming country.

Note 7 – Service signals comprise a distinctive character followed by a 2-digit number.

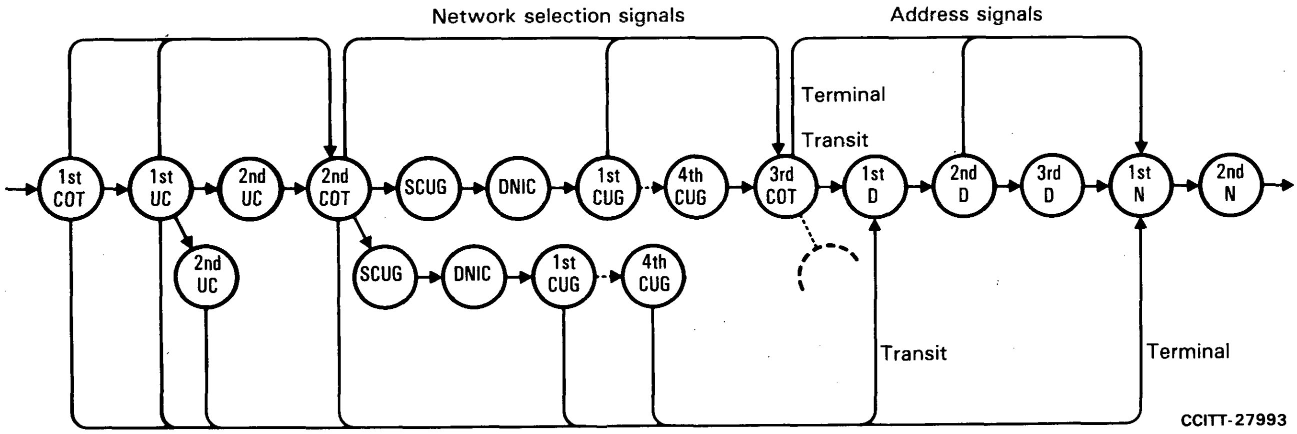
FIGURE 1/U.12

Signalling system type D

APPENDIX I

(to Recommendation U.12)

Possible sequences of network selection signals



COT Class-of-traffic character
UC User-class character
SCUG Start of closed user group sequence
DNIC Data network identification code (see Recommendation X.121 [6])
CUG Closed user group character
D Destination code digit
N Called number digit

Dotted lines reserved for further extension

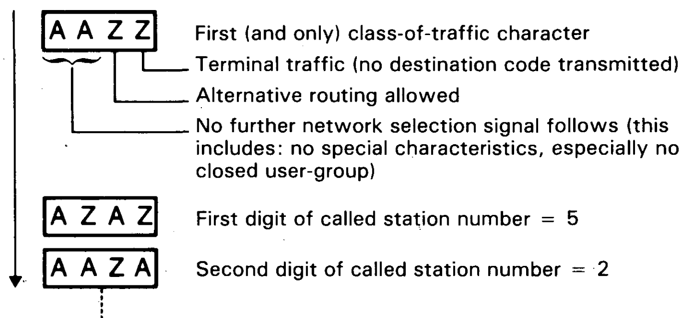
APPENDIX II

(to Recommendation U.12)

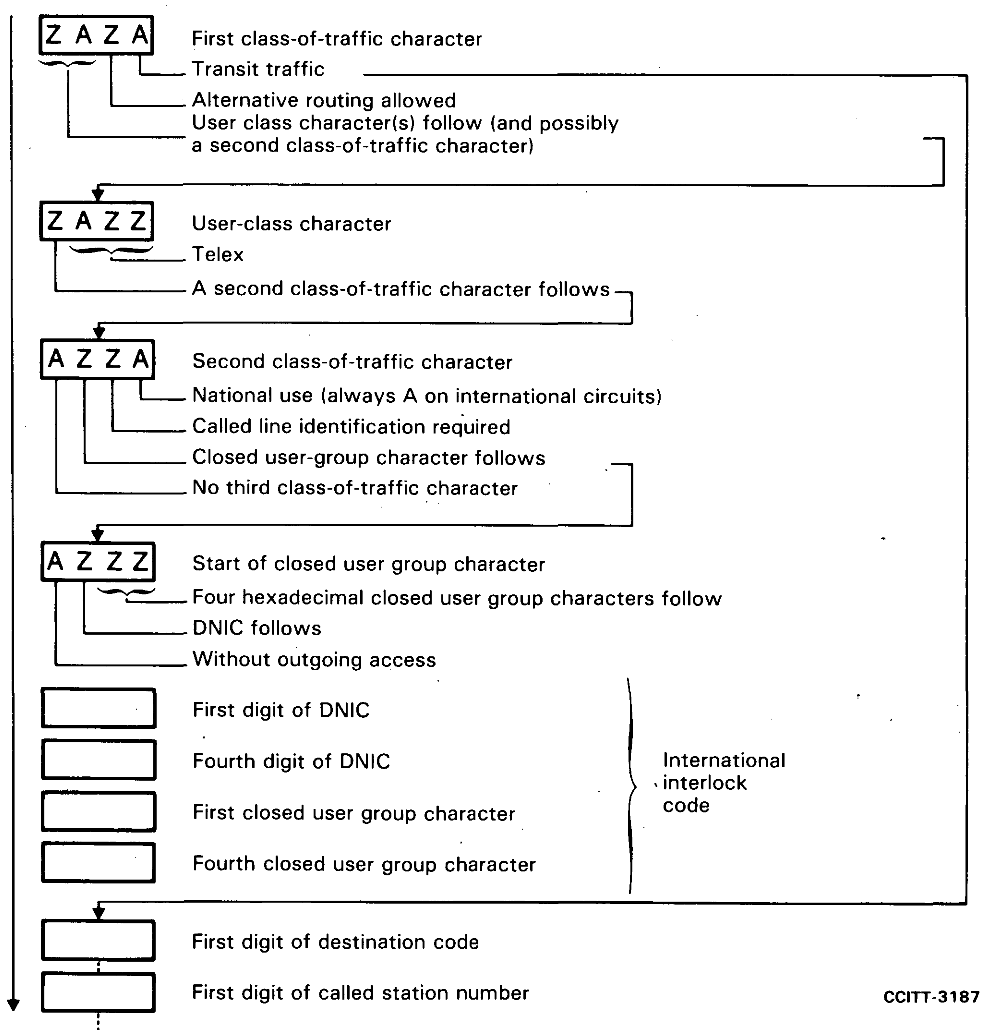
Examples of network selection signals

II.1 *First example* (minimum sequence of network selection signals)

This example shows a sequence of minimal length. (The preceding calling signal, the start and stop elements and the parity bit are not shown. The bits are shown in the order b_4, b_3, b_2 and b_1.)



II.2 *Second example* (a sequence of network selection signals including closed user-group characters)

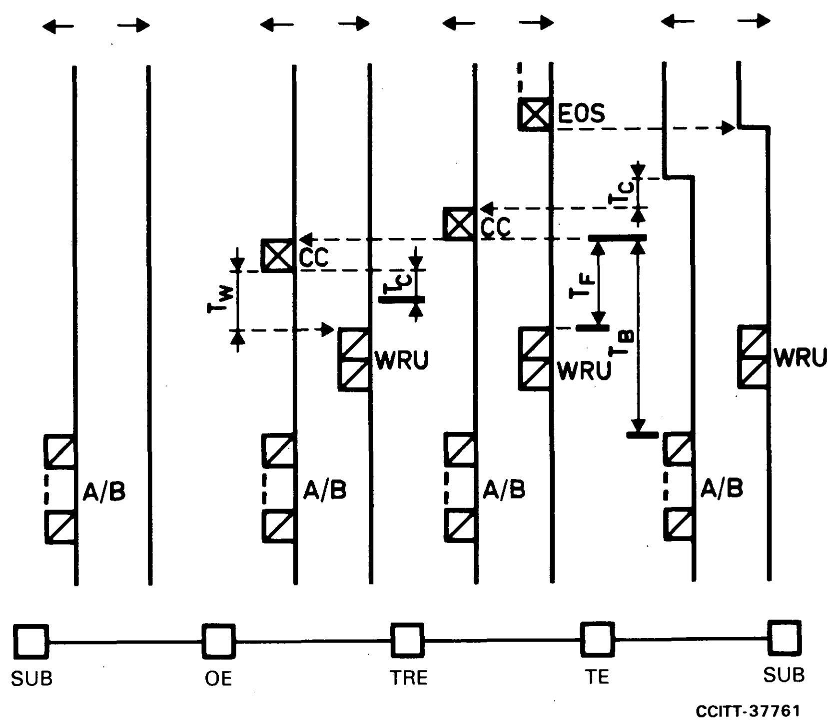


APPENDIX IIIa

(to Recommendation U.12)

Through-connection procedure

Called and calling line identification not required



Legends to Appendices IIIa to IIId

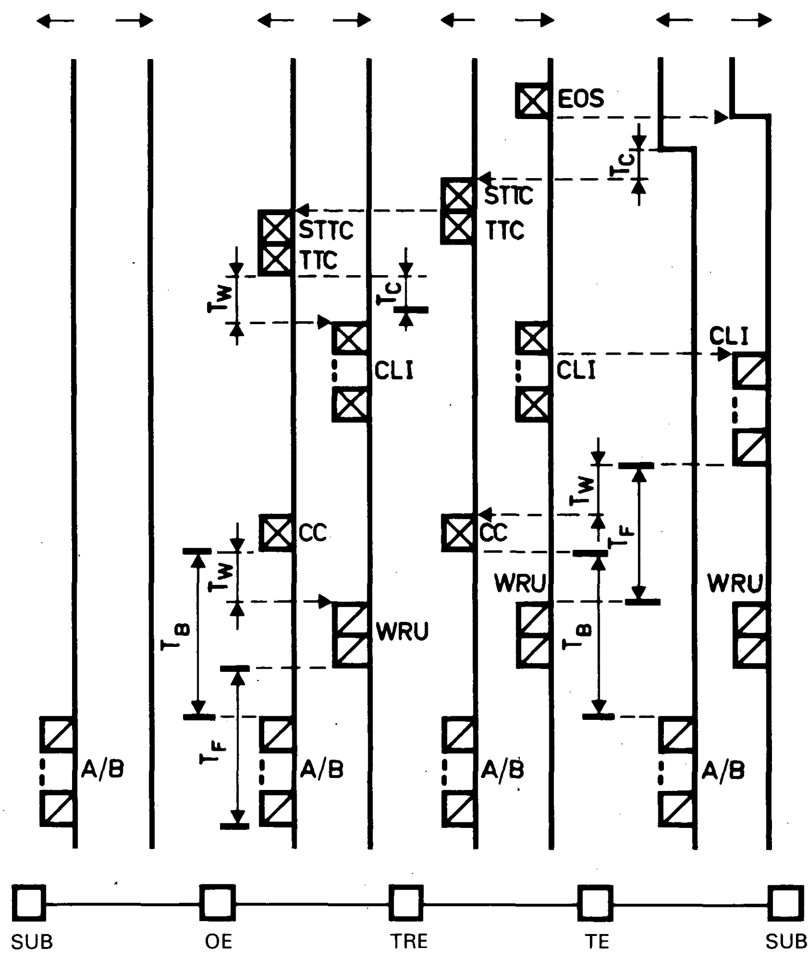
- - - - ▶	Correlation line	CDI	Called line identification signals
▬	Through-connection	CC	Call connected signal
T_B	Upper and lower limits for through-connection of backward path	WRU	Who are you?
T_F	Upper and lower limits for through-connection of forward path	A/B	Answerback
⧄	ITA2 character	SUB	Subscribers
⊠	CSC character	OE	Originating exchange
EOS	End of selection signal	TRE	Transit exchange
STTC	Start of transit through-connect signal	TE	Terminating exchange
TTC	Transit through-connect signal	C	Character period
TTD	Transit centres through-connected signal	T_C	0 to 1 C, see also § 3.12
CLI	Calling line identification signals	T_W	1 to 2 C, see also § 3.14

APPENDIX IIIb

(to Recommendation U.12)

Through-connection procedure

Called line identification not required,
calling line identification required



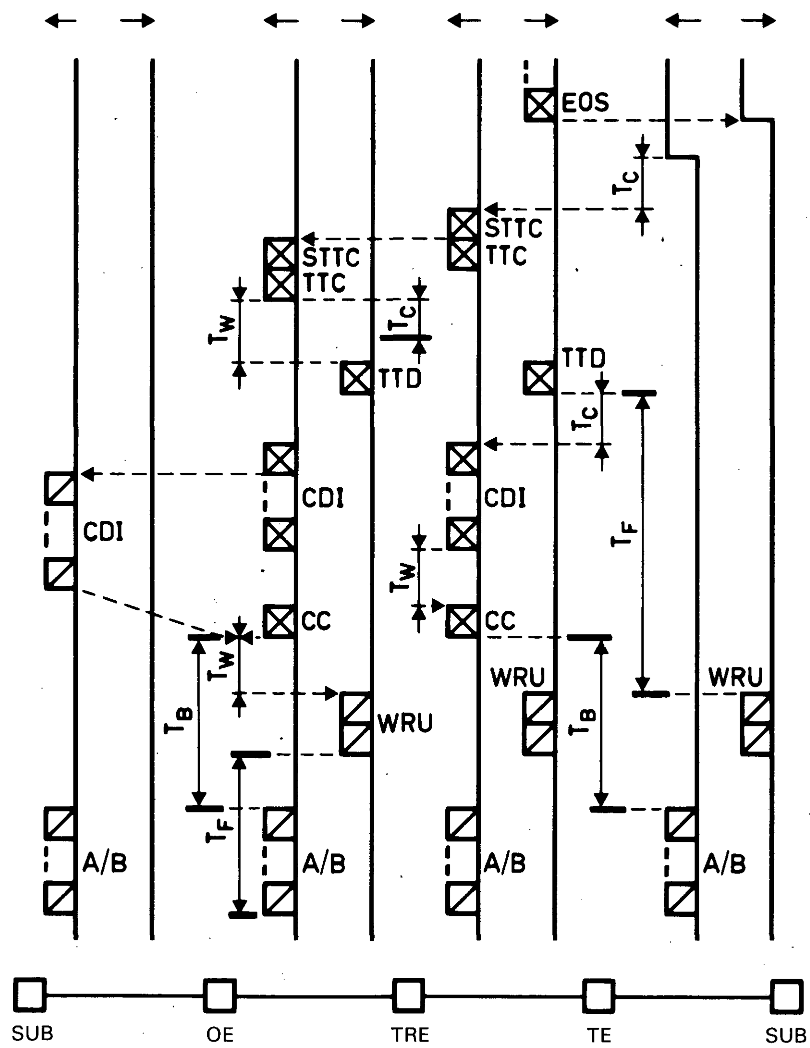
CCITT-37741

APPENDIX IIIc

(to Recommendation U.12)

Through-connection procedure

Called line identification required,
calling line identification not required



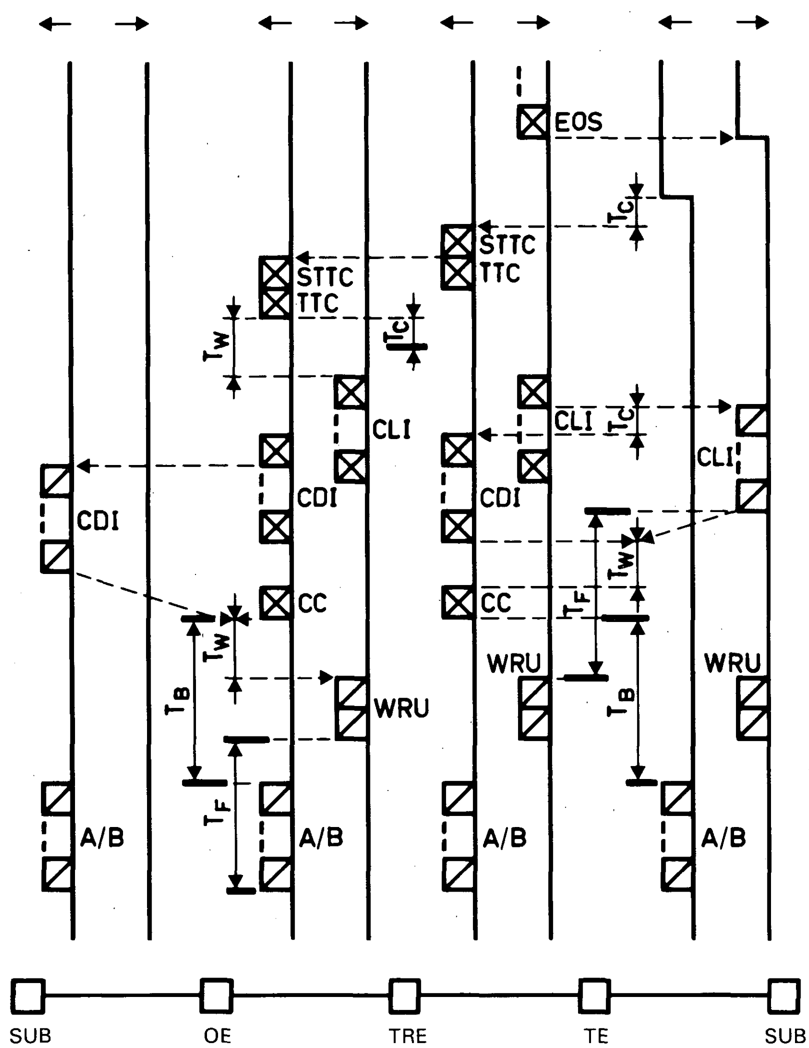
CCITT-37731

APPENDIX IIId

(to Recommendation U.12)

Through-connection procedure

Called and calling line identification required



References

[1] CCITT Recommendation *Terminal and transit control signalling system for start-stop services on international circuits between anisochronous data networks*, Vol. VIII, Fascicle VIII.3, Rec. X.70.

[2] CCITT Recommendation *Decentralized terminal and transit control signalling system on international circuits between synchronous data networks*, Vol. VIII, Fascicle VIII.3, Rec. X.71.

[3] CCITT Recommendation *Plan for telex destination codes*, Vol. II, Fascicle II.4, Rec. F.69.

[4] CCITT Recommendation *Switching equipment of start-stop apparatus*, Vol. VII, Fascicle VII.2, Rec. S.9.

[5] CCITT Recommendation *Terminal and transit control signalling system for start-stop services on international circuits between anisochronous data networks*, Vol. VIII, Fascicle VIII.3, Rec. X.70, Table 4a/X.70.

[6] CCITT Recommendation *International numbering plan for public data networks*, Vol. VIII, Fascicle VIII.3, Rec. X.121.

[7] CCITT Recommendation *Principles and procedures for realization of international user facilities and network utilities in public data networks*, Vol. VIII, Fascicle VIII.3, Rec. X.87.

SECTION 3

SIGNALLING OVER RADIO AND MULTIPLEXED CHANNELS

Recommendation U.20

TELEX AND GENTEX SIGNALLING ON RADIO CHANNELS (SYNCHRONOUS 7-UNIT SYSTEMS AFFORDING ERROR CORRECTION BY AUTOMATIC REPETITION)

(Geneva, 1956; amended at New Delhi, 1960, Geneva, 1964, Mar del Plata, 1968, and Geneva, 1972)

The CCITT,

considering

(a) that numerous radiotelegraph circuits working in association with 5-unit start-stop apparatus make use of error-correcting synchronous systems having a special error-detecting 7-unit code enabling errors to be corrected by a request for a repetition (ARQ system);

(b) that when they are usable for switched communications, on the radio section these synchronous systems use two combinations α and β, which characterize the permanent conditions of start polarity and stop polarity respectively in the start-stop part of the connection (see Recommendation S.13 [1]);

(c) that the special make-up of these systems is such that a change in the significant condition at the input to the system is not reproduced at the output with a constant delay;

(d) that the experience acquired with telex and gentex switching through these radiotelegraph systems seems sufficient to justify the laying down of general rules specifying signalling arrangements for manual, semi-automatic and automatic working in such international radio channels.

unanimously declares the view

that the signals, enumerated in Recommendation U.1, to be used in setting up international telex and gentex calls over radio channels comprising synchronous systems with error correction by automatic repetition should be characterized as follows:

1 Free line condition

1.1 Successive α combinations on the forward and backward paths.

2 Call

2.1 Transition from combination α to combination β on the forward signalling path. Reception of two consecutive β signals over the forward signalling path shall be interpreted as a calling signal.

2.2 On circuits automatically operated in both directions, reception of a single β signal at the end of the circuit remote from the calling subscriber must cause the outgoing equipment on this circuit at that end to be marked busy immediately. This busy condition must be applied until two α signals are received.

2.3 If the motor of the FRXD (fully automatic reperforator transmitter distributor) or equivalent motor-driven storage device is not already running, it must be started without delay, in order to accept the subsequent selection signals. Furthermore, if the motor of the storage device at the called end is not already working, it must be started.

2.4 It is desirable that, in the busy hour at least, the starting of the motor of the storage device should not be dependent on the calling signal for each call. One simple method of meeting this requirement is to provide a device that delays the switching off of the motor until about 5 minutes after the call has been cleared.

3 Call-confirmation signal

3.1 Transition from combination α to combination β on the backward signalling path. The reception of two consecutive β signals over the backward signalling path shall be interpreted as a call-confirmation signal.

3.2 The return of this signal can be initiated either by the switching equipment or by the radio equipment. Not more than one second shall elapse at the incoming end between the moment when two β signals have been received and the return of the first β signal of the call-confirmation signal.

3.3 With manual switching the call-confirmation signal shall be returned independently of the operator's answer.

3.4 For retest purposes radio circuits may be considered faulty when the call-confirmation signal is not received within three seconds.

4 Signals preceding selection

4.1 *Proceed-to-select signal*

4.1.1 *Semi-automatic working*

4.1.1.1 If the automatic switching equipment at the receiving end can receive the selection information immediately after the sending of the call-confirmation signal, the call-confirmation signal shall constitute the proceed-to-select signal.

4.1.1.2 If the automatic switching equipment at the receiving end cannot receive the selection information immediately after the sending of the call-confirmation signal, a distinct *proceed-to-select* signal, combination No. 22, shall be returned over the backward signalling path after the call-confirmation signal. For 99% of calls in the busy hour, this signal must be returned not more than 3 seconds after the transmission of the call-confirmation signal begins. (For some existing systems this delay will be 4 seconds.)

4.1.2 *Fully-automatic working*

4.1.2.1 The proceed-to-select signal, combination No. 22, returned over the backward signalling path shall always be distinct from the call-confirmation signal and should be returned within the limits specified under semi-automatic working.

4.2 *Proceed-to-transmit signal*

4.2.1 On the backward signalling path teleprinter signals indicating the called operator's position.

4.2.2 The sending of the proceed-to-select or the proceed-to-transmit signal should be delayed until two consecutive β signals have been correctly received over the backward signalling path. Two consecutive β signals can be presumed to have been or to be received when four β signals have been accepted by the storage of the error-correcting equipment at the sending end. (This allows for the loss of one β signal as an undetected error.)

4.2.3 The receiving equipment shall be arranged so that when two β signals are received and followed immediately by teleprinter signals [representing the call-confirmation and proceed-to-select (or proceed-to-transmit) signals in rapid succession] the recognition of the two β signals as the call-confirmation signal will allow the teleprinter signals to be preceded by 140 ms (minimum) of stop polarity.

4.2.4 Measures should be taken so that, if proceed-to-select or proceed-to-transmit signals are relayed by the FRXD (or equivalent storage device), the switching equipment does not return these signals until the motor has reached its full speed.

5 Selection signals

5.1 For manual working, teleprinter signals over the forward signalling path.

5.2 For semi-automatic working, teleprinter signals over the forward signalling path, as follows:

- the prepare-for-digits signal shall be combination No. 30 (figure-shift);
- digits of the called subscriber's number (preceded by transit access codes, if required) in International Telegraph Alphabet No. 2;
- end-of-selection signal, combination No. 26. This may be followed by another combination characterizing the class of traffic in the incoming country.

5.3 For fully-automatic working: teleprinter signals over the forward signalling path, as follows:

- the prepare-for-digits signal shall be combination No. 30 (figure-shift);
- digits of the called subscriber's number (preceded by transit access codes, if required) in International Telegraph Alphabet No. 2;
- if an end-of-selection signal is required, this should be combination No. 26. This may be followed by another combination characterizing the class of traffic in the incoming country.

5.4 The transmission of the selection signals should be delayed if the motor of the FRXD has not yet gained speed.

5.5 Where the incoming system uses a uniform numbering plan so that the number of digits in the number can be determined from the initial digit, the outgoing Administration must transmit an end-of-selection signal if this is required by the incoming country. Where the incoming system has a non-uniform numbering scheme the end-of-selection signal cannot be made obligatory. However, for such a system it may be advantageous to use this signal subject to the agreement of the outgoing Administration, in those cases where the outgoing system can readily insert the signal. To avoid undue occupation of trunks and equipment, Administrations should take all reasonable steps to ensure that selection signals are transmitted over radio circuits without undue delay.

6 Call-connected signal

6.1 Manual working: the code **DF** over the backward signalling path.

6.2 Semi-automatic working: either answer-back signals or the signals defined for fully-automatic working below.

6.3 Fully-automatic working: combination No. 32, followed by 11 to 13 combinations No. 29 (letter-shift) followed by the obtained subscriber's answer-back code. The insertion of the combinations No. 29 must not cause mutilation of the subsequent signals in the sequence.

6.4 In the case of transit operation where the first circuit in the connection is an ARQ radio circuit and the second circuit in the connection uses Type A or B signalling to a country that returns the answer-back automatically, the number of combinations No. 29 of the radio call-connected signal may be reduced to eight to avoid mutilating the answer-back.

7 Idle circuit condition

7.1 Combinations β on the forward and backward signalling paths.

8 Clearing

8.1 *Clearing signal*

8.1.1 The appearance of α combinations in the direction in which the clearing signal is sent. Reception of two consecutive α signals will have to be interpreted as a clearing signal.

8.1.2 On recognition of the clearing signal received over the radio circuit any text remaining in the store, at the point where the clearing signal is recognized, must be destroyed.

8.1.3 On recognition of the clearing signal received over the land line, any text remaining in store, at the point where the clearing signal is recognized, must be transmitted before the α signals are sent over the radio path.

8.2 *Clear-confirmation signal*

8.2.1 The appearance of α combinations in the direction opposite to that from which the clearing signal was sent. Reception of two consecutive α signals will be interpreted as a clear-confirmation signal when a clearing signal of 7 α signals has been accepted by the storage of the radio equipment without a request for repetition. The transmission of 7 α signals in this way ensures that, allowing for the loss of one α signal as an undetected error, the clearing signal can be presumed to have been received and recognized at the distant end.

8.2.2 For radio circuits using an eight-character cycle with four characters stored, a sequence of 8 α signals shall be used in place of the above sequence of 7 α signals. For radio circuits using an eight-character cycle with seven characters stored, a sequence of 11 α signals shall be used in place of the above sequence of 7 α signals.

8.2.3 It is desirable that the equipment shall be arranged so that the clearing and clear-confirmation signals do not cause spurious characters (including combinations No. 32) to be transmitted over the radio path. Where electronic storage devices are used it is possible to arrange for these spurious characters to be suppressed in the storage device. Where electro-mechanical storage devices are used, the generation of spurious characters by the clear-confirmation signal can be minimized by arranging that when the clearing signal is received over the radio circuit, the input to the storage device is blocked.

8.2.4 In order to ensure that, on transit calls, switching equipment and possibly the subscriber's teleprinter set are not unnecessarily held because of delay in transmitting the clearing and clear-confirmation signals over the radio path, the radiotelegraph equipment should return the clear-confirmation signal to the switching equipment without waiting for the exchange of clearing and clear confirmation signals over the radio path.

8.3 *Guard delay*

8.3.1 The circuit shall be guarded on release as specified in Recommendation U.1 except that the delay shall be measured from the moment when the equipment has both:

a) transmitted 7 α signals over the radio path without request for repetition;

b) has received two consecutive α signals over the other signalling path.

8.3.2 During the guard period the free line condition shall be maintained on both signalling paths of the international circuit.

8.3.3 Because it is possible for the circuit to be opened for traffic at one end before the equipment at the other end has completed the transmission of the 7 α signals, it is possible that an incoming call may be received before the 7 α signals have been transmitted. Where this occurs, the call should be accepted but the call-confirmation signal should not be returned until the transmission of the 7 α signals has been completed. (See § 8.2.2 above.)

9 Register congestion

9.1 Semi-automatic working: the return of a signal indicating congestion may be allowed; the **NC** sequence with the standard form of service signal should be used to indicate the situation.

9.2 Fully-automatic working: the return of a signal indicating congestion is prohibited.

10 Service signals

10.1 Teleprinter signals (**OCC**, **NC**, **NCH**, **NA**, **NP**, **DER**, **ABS**) preceded by the carriage-return, line-feed and letter-shift signals and followed by line-feed (preferably together with carriage-return) and then immediately by the clearing signal in all cases.

11 Both-way working

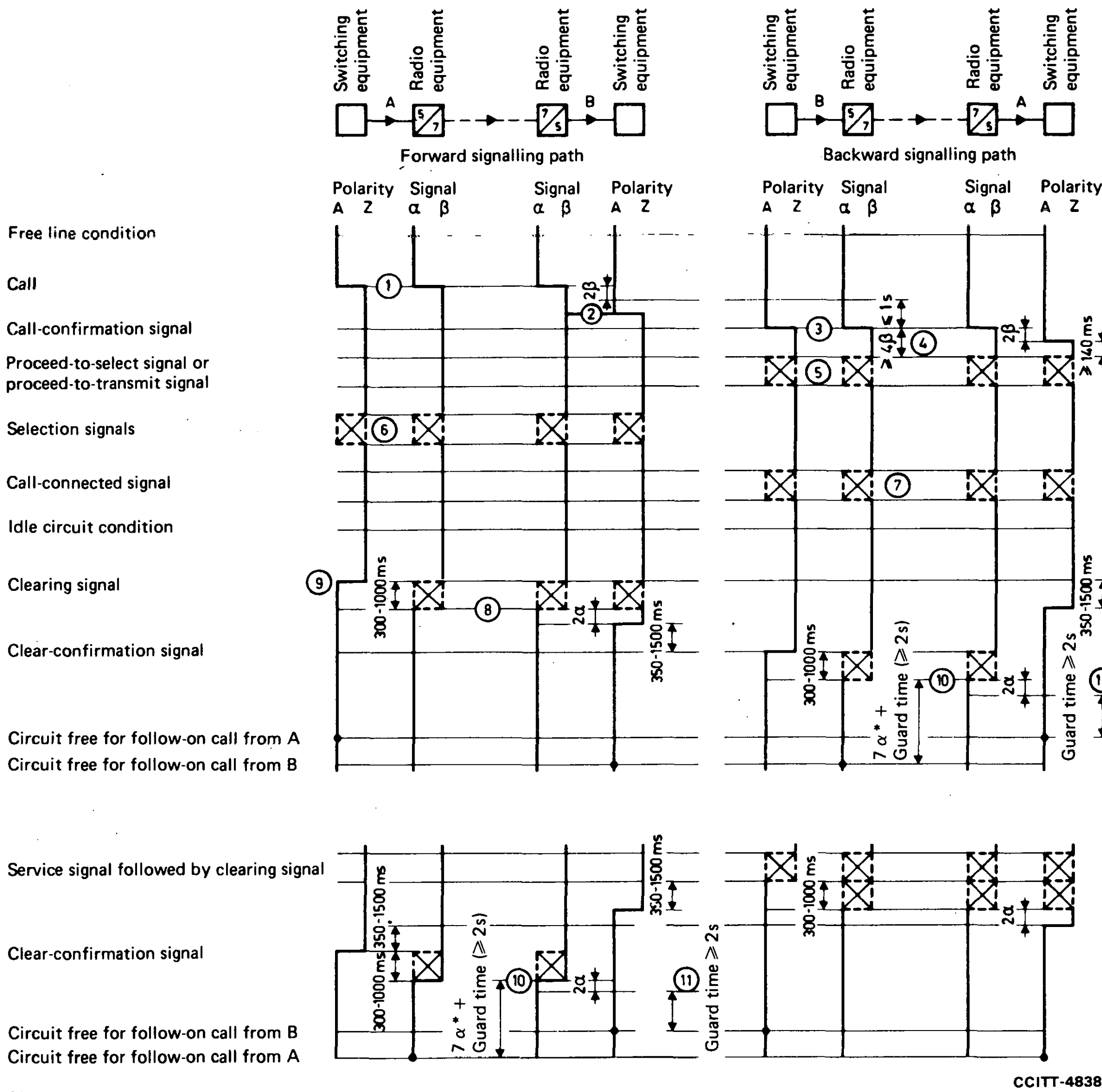
11.1 For both-way ARQ radio circuits used in the fully-automatic telex and gentex services, the following action to minimize the incidence of head-on collision is recommended:

a) that inverse order testing, or a close approximation to it by testing the route in small groups of circuits in fixed order, always starting the search from the same initial position, should be adopted at opposite ends of a both-way group of trunk circuits.

b) that calls should be offered in such a way that each circuit is tested once only for the minimum period of time necessary to ascertain whether it is free or busy, and the outgoing selectors should not have facilities for delayed hunting.

11.2 The absence of the proceed-to-select signal will serve to detect a head-on collision when the group of circuits is totally occupied or very nearly totally occupied. The two calls will then be cleared down unless there are still free circuits in the route.

Note – The recognition of the calling, call-confirmation, clearing and clear-confirmation signals requires the detection of two consecutive signals β or α as specified. The detection device should, in new equipment, be arranged to recognize two consecutive signals even though these may be separated by a period of automatic correction, i.e. the discrimination involves counting. In some existing equipments the detection device requires that the two signals to be recognized shall occur in consecutive character periods, i.e. the discrimination involves timing. The transmission of the call-confirmation, clearing and clear-confirmation signals requires that the appropriate number of β or α signals shall be offered to the storage of the radio equipment without a request for repetition, i.e. the control should be by a timing device that is reset when automatic correction occurs.



Notes

1. See § 2.3.
2. See §§ 2.2 to 2.4.
3. See § 3.3.
4. See § 4.1 and 4.2.4.
5. The letter V (combination No. 22 in ITA 2) shall be used for the proceed-to-select signal.
6. See §§ 5.1 to 5.5.
7. See §§ 6.1 to 6.4.
8. See § 8.1.3.
9. See §§ 8.2.3 and 8.2.4.
10. Should there still be text stored, this text must be destroyed. If an FRXD contains perforated tape that has not yet been transmitted, this tape should be fed out independently of possible requests for repetition. During the feeding out of the tape there shall be blocking with β-signals. The transmission of α-signals should be delayed until the perforated tape has been completely fed out.
11. See §§ 8.3.1 and 8.3.3.

* See § 8.2.2.

A = start polarity
Z = stop polarity
α = equivalent of permanent start polarity
β = equivalent of permanent stop polarity
⊠ = teleprinter signals
FRXD = fully-automatic reperforator transmitter distributor

This diagram does not show delays caused by propagation time, cooperation between start-stop and synchronous systems and possible repetitions.

FIGURE 1/U.20

Telex signalling on radio channels

Reference

[1] CCITT Recommendation *Use on radio circuits of 7-unit synchronous systems giving error correction by automatic repetition*, Vol. VII, Fascicle VII.2, Rec. S.13.

OPERATOR RECALL ON A TELEX CALL SET UP ON A RADIOTELEGRAPH CIRCUIT

(New Delhi, 1960; amended at Geneva, 1964)

The CCITT,

considering

(a) that experience has shown that, for telex calls set up over a radiotelegraph circuit, it was useful to enable the telex subscriber to cause an operator to re-enter on a call in progress without interrupting it;

(b) that such re-entry may be of interest in the following cases as well as in the case of a defective connection:

i) When a subscriber decides, in the course of a call, to change from a plain text to a cypher he can call the operators in the terminal radio exchanges and ask them to interrupt the delay signal, which might otherwise disturb the synchronism between the cyphering apparatus used at the two ends.

ii) When a subscriber has sent a message but waits a very long time for a reply from his correspondent, he can ask the operator whether his message is still being stored or whether it is expected that any interruption to the radio circuit will continue. If need be, he can then choose another means of communication (telegram or telephone call) to send an urgent message to its destination;

(c) that although it seems that re-entry by an operator will be limited mainly to national networks (for example by a subscriber calling the controlling telex operator on the radiotelegraph circuit), international standardization of an *operator recall* signal would be useful if the controlling telex operator on the radiotelegraph circuit is located in a transit country, and also for intermediate manual switches; this would no doubt prove to be a great advantage when this possibility is generally utilized,

unanimously declares the following view

(1) If the Administrations concerned agree on the use of a special signal enabling a subscriber to recall an international telex operator's position making use of radiotelegraph circuits, such a recall must not cause release of a call in progress.

(2) This *operator recall* signal will consist of the following sequence: combinations No. 28 (line-feed) followed by four combinations No. 27 (carriage-return).

(3) The detection device causing re-entry by the operator will be controlled by the receipt of four consecutive combinations No. 27; combinations No. 28 will only be used to avoid superposition of the text on the receiving teleprinter and will not have to be recognized by the detection device.

(4) The equipment for discriminating the operator recall signal will be switched off by a sequence of four consecutive combinations No. 19 (signal for transfer to data).

SIGNALS INDICATING DELAY IN TRANSMISSION ON CALLS SET UP BY MEANS OF SYNCHRONOUS SYSTEMS WITH AUTOMATIC ERROR CORRECTION BY REPETITION

(New Delhi, 1960; amended at Geneva, 1964)

The CCITT,

considering

(a) that traffic observations on radio telex channels have shown that the possible delay in the reception of text transmitted by one subscriber to another is a drawback from the operating point of view. The delay may be caused by repetitions and/or difference in the modulation rate of the teleprinters (traffic from Europe to the USA). In case of such delays a subscriber is left in doubt whether he simply has to await transmission of his message over the radio path or whether the delay is due to the tardy answering of his correspondent, for which he will have to pay. Furthermore, in the case of delays due to long repetition periods a receiving subscriber may be tempted to answer prematurely, which causes garbling of the text;

(b) that to a certain extent this drawback can be offset by the application of a strict operating procedure (**+?** signal to invite the correspondent to transmit). However, supplementary technical measures have proved to be desirable;

(c) that a good technical solution of this problem is to use combinations No. 32 as a delay signal in the following manner:

i) combinations No. 32 are returned to the transmitting subscriber at the rate of one every 5 seconds if he stops transmission during an interval of 10 seconds and the local storage device still contains untransmitted tape;

ii) combinations No. 32 are sent to a subscriber at the rate of one every 1.2 seconds if transmission is delayed by repetitions whenever condition i) does not apply;

(d) that the slow delay signals inform a sending subscriber that his message has not yet been received by his correspondent. The rapid delay signals inform a receiving subscriber that the received message is not yet complete and that he should not cut in;

(e) that in the case of cypher messages where combinations No. 32 may result from the coding procedure, delay signals should not be used. Also in the case of full duplex working, waiting signals cannot be used. Furthermore, it is desirable not to transmit waiting signals during the setting-up of semi- or fully-automatic calls, since interpolated waiting signals would complicate the discrimination of the selection signals and the call-connected signals. Therefore, the best solution seems to be to put the switching on and off of the delay signal facility under the control of the subscribers: four consecutive combinations No. 8 or No. 14 could be used for this purpose;

(f) that the transmission of these delay signals can obviously not be imposed on an Administration that makes an international connection by a landline and radio channel;

unanimously declares the view

(1) That, when the Administrations concerned agree that it is necessary to signal to telex subscribers about a delay in transmission over the radio telex channel, delay signals shall be used having the following characteristics:

i) combinations No. 32 at the rate of one every 5 seconds, returned to a sending subscriber when he has stopped transmission for a period of 10 seconds and if there is still text stored;

ii) combinations No. 32 at the rate of one every 1.2 seconds sent to a subscriber whenever transmission over the radio channel is delayed by repetitions and condition i) above does not apply.

(2) Sending of combinations No. 32 is cut off as soon as the subscriber starts to transmit again.

(3) No delay signal will be transmitted while the call is being put through.

(4) The calling and also the called subscribers can suppress sending of the waiting signal at the two ends of the radio circuit by transmitting four successive combinations No. 8. The waiting signal can also be started off again by transmitting four successive combinations No. 14.

(5) The delay signal should be switched off upon reception of four consecutive combinations No. 19 (signal for transfer to data) for the duration of the call.

Note – Administrations must take precautions to ensure that the reception of combinations No. 32 should not cause spacing of the paper on page-printing or tape-printing apparatus.

Recommendation U.23

USE OF RADIOTELEGRAPH CIRCUITS WITH ARQ EQUIPMENT FOR FULLY AUTOMATIC TELEX CALLS CHARGED ON THE BASIS OF ELAPSED TIME

(Mar del Plata, 1968; amended at Geneva, 1972)

1 Charging on the basis of elapsed time

Where a radiotelegraph circuit equipped with ARQ equipment forms part of an international telex network and can be engaged in a telex connection established by fully automatic switching, the Administrations are faced with a difficult problem regarding automatic charging of the calls. The difficulty arises from the fact that in case of bad transmission conditions on the radiotelegraph circuit, signals recognized as erroneous are repeated. These repetitions can be numerous at certain times. For manual or semi-automatic operation, in order to establish the basis for charging, the Administrations or recognized private operating agencies (RPOA) deduct the time during which the circuit has been transmitting repetitions from the elapsed duration of the connection.

The application of this method to fully automatic calls – although desirable – is made difficult by the fact that the charge for these calls is made in the originating country and by automatic methods. When the call is not established through the intermediary of radiotelegraph circuits incorporating ARQ equipment, the charge is made according to the elapsed time of the communication. It would then be necessary to advise the originating country that the call has involved a radiotelegraph circuit that incorporates ARQ equipment, and to advise what correction should be applied to the elapsed time of the communication in order to account for the periods of inefficiency of the radiotelegraph circuit.

Some study has been made for finding a solution that is both technically and economically acceptable for the transmission and use of information necessary for corrected charging as a function of the inefficiency of the radiotelegraph circuit. However, due to the declining importance of radio circuits incorporating ARQ equipment for fully automatic traffic in the telex network and the tendency for them to be relegated to the role of standby circuits, further study of the method of charging based upon efficient time has been abandoned.

The alternative solution of charges based upon elapsed time has now been adopted as the standard to be applied. It will then be necessary before incorporating a circuit with ARQ equipment in the fully automatic telex service to ensure that it meets with certain stability requirements. Safeguard measures designed to avoid, in certain cases, an excessive overcharge of the calling subscriber, as indicated in the present Recommendation, will be necessary.

2 Safeguard measures

When charges are to be based on elapsed time, the methods of safeguard are:

i) busying of an unoccupied radiotelegraph channel whenever transmission conditions on this channel are inadequate;

ii) forced release of an established connection on such a channel whenever transmission conditions are bad.

In the application of the latter type of safeguard (forced release of an established connection), there are two conflicting requirements:

i) the need to avoid substantial differences between the charged time and the time during which the connection was efficient;

ii) the need to avoid, as much as possible, forced release of established connections.

A reasonable compromise solution should achieve the following main objectives:

i) the percentage of forced releases must not exceed three;

ii) the average overcharge for a call must not exceed five per cent;

iii) the maximum overcharge for a call must not exceed twenty-five per cent.

3 Control of forced release

Administrations employing radiotelegraph circuits incorporating ARQ equipment should use the efficiency factor for controlling the forced release of an established connection. With this arrangement, an established connection will be cut whenever the efficiency factor, averaged over 60 consecutive seconds, falls below 80%. This form of control, especially if it is applied to circuits that conform to the stability requirements specified in § 9 below, ought not to result in more than two or three per cent of connections being interrupted; this figure is quite comparable with the number of fortuitous releases recorded in the use of cable circuits.

4 Control of busying

At those times when its efficiency factor is too low, a circuit that is not carrying traffic should be busied at both ends so that it cannot be seized by a call until such time as the efficiency factor reverts to an acceptable value. The circuit will be busied if the mean value of the efficiency factor, measured over an interval of 20 consecutive seconds, is less than 80%.

5 Practical application of busying

For a radiotelegraph system corresponding to 50 bauds (see Recommendation S.13 [1]), the maximum number of transmissible elements in a 20-second period is 20×48 and the corresponding number of characters is $(20 \times 48)/7$ i.e. 137. If r is the number of repetition cycles during 20 seconds, the efficiency factor is $(137 - 4$ [1] $r)/137$. Hence, it is sufficient to count the number of repetition cycles because if, in a period of 20 consecutive seconds, there are 7 [2] repetition cycles or more, then the mean efficiency factor is below 80% during that period.

The two most practical methods of dividing the time up into intervals of 20 seconds are the procedure of splitting the time into 20-second blocks and the method of using sliding periods of 20 seconds.

In the procedure of splitting the time into blocks, the time is divided into fixed intervals of 20 seconds. The repetition cycles are counted during each of these intervals and the count is recommenced for each interval, no account being taken of the result of the count for the preceding interval. In the sliding period method, the earliest count is eliminated and a new count added.

The block method uses simpler equipment than the sliding period method; it is a little less exact because of the fact that the influence of a bundle of repetitions arriving at about the same time as the division between successive blocks is spread over two successive and independent blocks.

After very close consideration of the discrepancies between the results given by the two methods, it was concluded that the effect of these discrepancies is small and of no practical importance as far as subscribers are concerned. Administrations may therefore select either method.

If, during a counting period, the number of repetition cycles has already reached a figure corresponding to a mean efficiency factor of lower than 80% over the 20-second period, the decision to order busying of the circuit will be made immediately, without waiting for the end of the current 20-second period.

The manner in which the order to busy the circuit is sent from the ARQ equipment to the switching centre is a matter that interests only the Administration that operates the centre and the ARQ equipment to issue an international recommendation on this matter.

The timing of intervals at the two ends of the same circuit is not synchronized, so that instants of busying or debusying a circuit at one end may differ from the corresponding instants at the other end by several seconds. As a result, while one end of the circuit is marked busy, a call can seize the circuit at the other end. This situation is considered as admissible, and the incoming call is accepted.

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[1] This figure is 8 in the case of an 8-character-repetition cycle.

[2] 3.5 with an 8-character-repetition cycle.

After a circuit is marked busy, the measurement of the efficiency factor proceeds in accordance with the same time-division process. If, during a 20-second period, the mean efficiency factor reaches or exceeds 80%, the busy marking is removed. It follows that, whenever the efficiency factor is varying at about 80%, periods of busying and of return to service can succeed one another at intervals of about 20 seconds. This effect was considered to be permissible.

6 Application of forced release

A call can seize the radiotelegraph circuit only during a period when the circuit is not marked busy. In the case of a call's arriving on the radiotelegraph circuit after the occurrence of the first marker denoting the termination of a 20-second period, the time division will proceed on the basis of 60-second intervals (instead of 20-second ones), and everything that has been said about 20-second periods applies equally to 60-second periods. In particular if, during a 60-second period, it is already evident that the efficiency factor cannot reach an average value of at least 80%, forced release of the connection shall be ordered without waiting for the end of the period.

If the efficiency falls so far that the connection must be cut at the calling end of the ARQ circuit, a long time could elapse, in the event of very adverse transmission conditions, before the release signal could be sent to the called subscriber. Consequently, the called subscriber (especially in stations not supervised by a receiving operator) remains engaged and cannot be reached by other subscribers. Also, the re-establishment of the call by way of another channel becomes impossible. Therefore, it is desirable to be able to effect a release at the receiving end in unfavourable conditions. The method of release employed at the receiving end, however, should not initiate release more easily than at the calling end. It is proposed for this purpose that, once there is evidence at the receiving end that the mean efficiency factor has remained lower than 80% for two successive 60-second periods, release at the receiving end should follow.

7 Elimination of signals still registered in the memory

Once the decision has been made to break the established connection at either end, the signals that are still recorded in the ARQ equipment memory must be destroyed. It must be pointed out that in this case the forced release signal has been due to the bad transmission conditions; it is very probable that the subscriber, at the receiving end, will be released by the auxiliary safeguard measures (two successive periods of 60 seconds with the efficiency factor below 80%); the signals that the memory would continue to dispose of in the forward direction will probably not reach the called subscriber. For this reason the elimination of the signals still registered in the memory has been decided.

8 Advising the calling subscriber

It has been proposed that the calling subscriber should be advised by a special service signal preceding the forced release signal; in this way the calling subscriber would know that he must reforward his whole message. This service signal would above all have the advantage of enabling the automatic charging device to recognize that it is dealing with a connection that has been interrupted as a result of operation of the safeguard feature of an ARQ equipment and that the call must not be charged.

Although the principle of this solution may have escaped critiscism, its application has provoked objections. The first would be the cost and complexity of equipment that would ultimately be used for only a very small proportion of calls. Another objection would be the fact that, in certain types of apparatus, automatic transmission could not be interrupted by the reception of signals; the only result would be mutilation on the local copy of the transmitted text and of the service code; the meaning of these mutilations could be obscure to the subscriber. The aspect of the other end of the communication, which could also have a message in the process of transmission to the calling subscriber, must also be taken into account. Finally, the use of the clearing signal only, without the use of a preliminary service signal, was proposed.

9 Precautions to be taken before incorporating circuits with ARQ equipment in automatic switching networks

In spite of these precautions, fully-automatic operation on a radiotelegraph circuit incorporating ARQ equipment can be considered only if this circuit possesses adequate stability.

Before incorporating a circuit with ARQ equipment in the fully-automatic switching network, the Administrations must carry out extended trials. These trials should be made under normal traffic conditions, over a minimum period of three consecutive hours chosen from the busy period (or periods), when heavy traffic is foreseen to occur on the route under consideration (allowing for the traffic, whether terminal or transit, that prevails on the route according to the season). The condition that must be fulfilled before a circuit can be accepted for use in the fully-automatic network is that its mean efficiency factor, measured over periods of 20 consecutive seconds each, shall not fall below 80% for more than 10% of the total time involved in the measurements. The measurements must be repeated as often as will be necessary for the Administration to have an assessment of the suitability of the circuit.

The attention of Administrations is drawn to the fact that, before offering fully-automatic transit working on a radio route incorporating ARQ equipment, the grade of service on the route under consideration must be in accordance with that proposed in Recommendation F.68 [2], i.e. only one call lost in 50.

If these conditions are not complied with, it would be better to retain semi-automatic operation.

For these reasons, the CCITT

unanimously declares the following view

(1) Administrations operating radiotelegraph circuits equipped with ARQ systems that may be engaged in a fully-automatic telex call, such that the charging of the subscriber is made automatically in the originating country according to the elapsed time of the connection, must take precautions to avoid too great a difference between the charged time and the time during which the radiotelegraph circuit was efficient.

(2) If, in the course of an established connection, the mean value of the efficiency factor [3)] is lower than 80% over a period of 60 consecutive seconds, the connection will be released and the clearing signal will be sent to the calling subscriber under the control of the ARQ equipment.

(3) For a circuit involved in a fully automatic telex network, measurements will be made, at those times when the circuit is not held by a call, in order to determine the mean efficiency factor based on periods of 20 consecutive seconds. If, during such a period, the mean efficiency factor falls below 80%, the circuit shall be marked busy on the first switching centre located backward of the ARQ equipment that assessed this situation. If, during a period of 20 consecutive seconds, the mean efficiency factor rises above 80%, the busy marking shall be removed and the circuit will be able to be seized by a call.

(4) Interruption of an established connection will occur, at the calling side when, during a 60-second period, it becomes apparent, without waiting until the end of the period, that the mean efficiency factor during the period will be lower than 80%. If, at the called side, the mean efficiency factor during two consecutive periods of 60 seconds is lower than 80%, the release of the connection will be given to the called end.

(5) In case of a forced release of the connection, the clearing signal will be sent to the calling end (and eventually to the receiving end) from the ARQ equipment. The signals that would still be stored in the memories at the moment of the sending of a forced release signal will be destroyed. Stop polarity will be transmitted across the radiotelegraph circuit while the store is being destroyed.

(6) In the case where two or more radio circuits using ARQ equipment would be used in tandem on a connection, each circuit will operate on its own, independently of the conditions on the other circuit(s).

References

[1] CCITT Recommendation *Use on radio circuits of 7-unit synchronous systems giving error correction by automatic repetition*, Vol. VII, Fascicle VII.2, Rec. S.13.

[2] CCITT Recommendation *Establishment of the automatic intercontinental telex network*, Vol. II, Fascicle II.4, Rec. F.68.

[3)] **efficiency factor in time** is defined as:

The ratio of the time necessary to transmit a text automatically without repetition, at a specified modulation rate, to the time actually taken to receive the same text with a given error rate.

Note 1 – The whole of the apparatus comprising the communication is assumed to be in the normal conditions of adjustment and operation.

Note 2 – A telegraph communication may have a different efficiency factor in time for the two directions of transmission.

Note 3 – The actual conditions in which the measurement is made should be specified, in particular the duration of the measurement.

REQUIREMENTS FOR TELEX AND GENTEX OPERATION TO BE MET BY SYNCHRONOUS MULTIPLEX EQUIPMENT DESCRIBED IN RECOMMENDATION R.44

(Mar del Plata, 1968)

The CCITT,

considering

(a) that it may be desirable to use synchronous systems described in Recommendation R.44 in the teleprinter switching networks;

(b) that it is essential to transmit the full range of telex signals for types A, B and C signalling;

unanimously declares the view

(1) that where it is necessary to receive signals with a nominal cycle of 7 units (see the Recommendation cited in [1]), it will be necessary to insert suitable storage to reconcile the two character rates (400 and 411 per minute);

(2) that type A and B signals in accordance with Recommendation U.1 and U.2 and type C signals in accordance with Recommendation U.11 should be accepted for transmission through the synchronous system. However, in the case of type A signalling, the delay between the start of the call-confirmation signal and the proceed-to-select signal should be increased to, at least, 150 ms;

(3) that the call signal should be transmitted through the synchronous system with the minimum delay obtainable with the particular method of multiplexing in use, e.g., element interleaving, in order to reduce the incidence of head-on collisions with both-way operation. The maximum delay due to the multiplex equipment should be limited to 60 ms;

(4) that the maximum delay on the call-confirmation signal due to the multiplex equipment should be 60 ms in the case of type A signalling, and 120 ms in the case of type B signalling;

(5) that the maximum delay on the start of the reception-confirmation signal due to the multiplex equipment should be 60 ms in the case of type C signalling;

(6) that the maximum delay on the proceed-to-select signal due to the multiplex equipment should be 450 ms in the case of type A signalling, and 120 ms in the case of type B signalling;

(7) that the maximum delay on the call-connected signal due to the multiplex equipment should be 450 ms (type A and type B signalling);

(8) that the maximum delay on a teleprinter character due to the multiplex equipment should be 450 ms;

(9) that the maximum delay on the clear and clear-confirmation signals due to the multiplex equipment should be 450 ms;

(10) that the tolerance of the type A and B pulse signals after retransmission through the synchronous multiplex system will be stated below:

a) *Call-confirmation and proceed-to-select signal – type B signalling*

The duration of the pulse after transmission through the synchronous system will not be less than 17.5 ms nor more than 50 ms.

b) *Dial pulses – type B signalling*

Speed – ± 3% of the mean speed of input measured for digit 0 (normally 9 to 11 pulses per second).

Ratio – The duration of stop polarity pulses will not be less than 32 ms; the duration of start polarity pulses will not be less than 44 ms.

Under certain circumstances the retransmitted dial signals may include pulses of stop polarity having durations of up to 73 ms and pulses of start polarity having durations of up to 98 ms. Where this is so and the incoming switching equipment cannot accept pulses with these characteristics a dial pulse regenerator should be inserted between the output of the multiplex circuit and the input of the switching equipment.

c) *Service signals for ineffective calls – type B signalling*

The duration of the period of stop polarity, whether followed by teleprinter signals or not, will, after transmissions through a synchronous system, be not less than 145 ms and not more than 292 ms.

If several synchronous systems are placed in tandem, the duration of the period of stop polarity of the service signal at the output of this group of systems should not exceed 440 ms.

At the input of a synchronous system, a type B service signal will cause the return of a clear-confirmation signal from the synchronous equipment without waiting for the return of the clear-confirmation signal from the distant end of the connection. Following the recognition of the clearing signal in the service signal, permanent start polarity will be transmitted over the synchronous system.

d) *Call-connect – type A signalling*

The duration of the pulse of start polarity after transmission through several synchronous systems will be within the limits 140 ms to 160 ms.

ANNEX A

(to Recommendation U.24)

TABLE A-1/U.24

Telex signalling through the multiplex equipment — Type A signalling

Signalling condition	Signal received from telex (Recommendation U.1)	Signal on channel aggregate path	Signal transmitted to telex
Free line	Continuous A polarity on both signalling paths	Continuous A polarity	Continuous A polarity
Call	Inversion to Z polarity on forward signalling path	Inversion to Z polarity (within 9-35 ms from inversion in column 2) (see Notes 1 and 2)	Inversion to Z polarity (maximum delay of 60 ms from inversion in column 2)
Call-confirmation	Inversion to Z polarity on backward path within 150 ms of receipt of calling signal	As for call	As for call
Proceed-to-select	Teleprinter signals or 40 ms pulse of A polarity ($\pm$ 8 ms) on backward path. Not to be returned within 150 ms of call-confirmation	Teleprinter signals or combination No. 22 (**V**)	Teleprinter signals or combination No. 22 (**V**) (see Note 3)
Selection	Teleprinter signals on the forward path	Teleprinter signals	Teleprinter signals (see Note 3)
Call-connect	Teleprinter signals or 150 ms ($\pm$ 11 ms) pulse of A polarity followed by continuous Z polarity for 2 seconds minimum on the backward path	Teleprinter signals or one α combination followed by continuous Z polarity for 2 seconds minimum	Teleprinter signals or 145 5/6 ms pulse of A polarity followed by continuous Z polarity for 2 seconds minimum (see Note 3)
Service signals	Teleprinter signals on the backward path followed by clearing signal (see Note 4)	Teleprinter signals followed by one or two α combinations and then continuous A polarity (see Note 5)	Teleprinter signals followed by continuous A polarity (see Note 3)
Clear	Inversion to continuous A polarity on either signalling path (see Note 4)	One or two α combinations followed by continuous A polarity (see Note 5)	Inversion to A polarity (see Note 3)
Clear-confirmation	Inversion to continuous A polarity in opposite direction to clearing after a delay of 350-1500 ms following receipt of clearing signal	As for clear	As for clear

For notes, see Table A-3/U.24.

TABLE A-2/U.24

Telex signalling through the multiplex equipment – Type B signalling

Signalling condition	Signal received from telex (Recommendations U.1 and U.2)	Signal on channel aggregate path	Signal transmitted to telex
Free line	As for type A	As for type A	As for type A
Call	As for type A	As for type A	As for type A
Call-confirmation	A 17.5-35 ms pulse of Z polarity on the backward signalling path, returned within 150 ms of receipt of calling signal	1 or 2 consecutive elements of Z polarity	32-50 ms pulse of Z polarity (see Note 7)
Proceed-to-select	As call-confirmation signal. The interval of A polarity separating the signals to be 100 ms minimum	As for call-confirmation	As for call-confirmation. The interval separating the pulses may be reduced to 60 ms minimum (see Note 7)
Selection signals	Teleprinter signals or dial pulses having the following limits: Speed: 9-11 p.p.s. Ratio: 1Z:1.9A	Teleprinter signals (see Note 2) or dial pulses, when each start polarity interval is transmitted as 1-4 elements of A polarity and each stop polarity interval is transmitted as 1-3 elements of Z polarity. The mean speed of pulsing will be the same (± 3 %) as the input signals (see Note 6)	Teleprinter signals (see Note 3) or dial pulses at the same mean speed of the input (± 3 %) and having the following ratio limits: A polarity intervals: 44-98 ms Z polarity intervals: 32-73 ms
Call-connect	Continuous Z polarity for 2 seconds minimum on the backward signalling path	One β combination followed by continuous Z polarity for 2 seconds minimum (see Note 6)	Continuous Z polarity for 2 seconds minimum (see Note 7)
Service signals (busy pulse)	165-260 ms of Z polarity on the backward path followed by A polarity for 1500 ms (± 30 %) continuously repeated. The Z polarity period may be followed by teleprinter signals when the tolerance of the A polarity period is reduced to ± 20 %	One or two β signals followed (possibly) by teleprinter signals, then by one α combination and A polarity as in the input signal (see Note 6)	145-292 ms Z polarity, followed (possibly) by teleprinter signals and then by A polarity of minimum duration 950 ms (see Note 7)
Clear and clear-confirmation	As for type A	As for type A	As for type A

For notes, see Table A-3/U.24.

TABLE A-3/U.24

Type C signalling effected by multiplex equipment

Signalling condition	Signal received from telex (Recommendation U.11)	Signal on channel aggregate path	Signal transmitted to telex
Free line	Continuous A polarity on both signalling paths	Continuous A polarity	Continuous A polarity
Call signal (or automatic retest signal)	Inversion to Z polarity on the forward path for 150-300 ms followed by teleprinter signals	Inversion to Z polarity (within 9-35 ms from inversion in column 2) (see Notes 1 and 2)	Inversion to Z polarity (maximum delay of 60 ms from inversion in column 2). The period of Z polarity may be lengthened by 450 ms maximum
Reception-confirmation (or receiving equipment congestion signal)	Inversion to Z polarity on the backward path for 450 ms (± 10 %) followed by teleprinter signals (or clearing signal)	As for call	As for call
Clear and clear-confirmation	As for type A	As for type A	As for type A

Notes concerning Tables A-1/U.24 to A-3/U.24

Note 1 — Pulses of Z or A polarity from 0-9 ms (± 1 ms) should be rejected by the multiplex equipment.

Note 2 — The start-stop stores of either signalling path should be switched into circuit after a maximum delay of one β combination for all types of signalling except type B with dial selection.

Note 3 — Recognition time of the clearing signal is 300-1000 ms.

Note 4 — The start-stop stores of either signalling path should be switched out of circuit after a maximum delay of two α combinations.

Note 5 — For type B signalling with dial selection the start-stop stores of both signalling paths will be switched into circuit after recognition of a maximum delay of one β combination on the backward path with Z polarity on the forward path.

Note 6 — In order to meet the timing requirements of the type B service signals it may be necessary to delay the initial inversion to Z polarity by an amount (450 ms maximum) corresponding to the delay with teleprinter signals. The call-connect signal may also be similarly delayed. However, reversion to A polarity within 50 ms indicating a type B call-confirmation or proceed-to-select signal should cancel any further delay on the transmission of these signals.

Note 7 — Delays given in these tables do not include the propagation time of voice-frequency telegraph channels.

Reference

[1] CCITT Recommendation *Transmission characteristics of the load end with its termination (ITA No. 2)*, Vol. VII, Fascicle VII.2, Rec. S.3, § 1.6.

REQUIREMENTS FOR TELEX AND GENTEX OPERATION TO BE MET BY CODE- AND SPEED-DEPENDENT TDM SYSTEMS CONFORMING TO RECOMMENDATION R.101

(Geneva, 1980)

The CCITT,

considering

(a) that it may be desirable to use code- and speed-dependent TDM systems described in Recommendation R.101 in the teleprinter switching networks;

(b) that it is essential to transmit the full range of telex signals for types A, B, C and D signalling;

unanimously declares

that the following requirements for telex and gentex operation should be met by code- and speed-dependent time division multiplex systems conforming to Recommendation R.101.

1 Transmission of type A (control) signals shall be accomplished within the tolerances specified in Table 1/U.25.

2 Transmission of type B (control) signals shall be accomplished within the tolerances specified in Table 2/U.25.

3 Transmission of type C signals shall be accomplished in accordance with Table 3/U.25.

4 Transmission of type D signals shall be accomplished in accordance with Recommendation U.12.

5 Each of the following modes of bothway telex signalling shall be capable of being accomplished on a single circuit:

a) type A in one direction and type B keyboard in the other;

b) type A in one direction and type B dial in the other;

c) type B keyboard in one direction and type B dial in the other;

d) type A in both directions;

e) type B dial in both directions;

f) type B keyboard in both directions;

g) type C to Table 1/U.11;

h) type C to Table 2/U.11;

i) type C to Table 3/U.11.

6 A single terminal shall be capable of handling any of the signalling combinations shown in § 5 above and at least five of them simultaneously.

7 The nominal pulse duration (other than dial pulses) shown in Tables 1/U.25, 2/U.25 and 3/U.25 for *Signal transmitted to telex* have a ± 3 ms tolerance except where otherwise indicated.

TABLE 1/U.25

Type A signalling

Signalling condition	Signal received from telex (Recommendation U.1)	Signal on aggregate path (Note 1)	Signal transmitted to telex
Free line	Continuous A polarity on both signalling paths	Continuous A polarity	Continuous A polarity
Call	Inversion to Z polarity on forward signalling path	Inversion to Z polarity	Inversion to Z polarity (within 50 ms of inversion in column 2) (Note 2)
Call-confirmation	Inversion to Z polarity on backward signalling path	As for call	As for call
Proceed to select	Teleprinter signals (semi-automatic) or an interval of Z polarity for not less than 100 ms followed by 40 ± 8 ms of A polarity on the backward path	Teleprinter signals (semi-automatic) or not less than 5 bits of Z polarity followed by 2 bits of A polarity	Teleprinter signals (semi-automatic) or Z polarity for not less than 97 ms followed by 40 ms of A polarity
Selection	Teleprinter signals on forward path	Teleprinter signals	Teleprinter signals
Call-connect	Teleprinter signals or 150 ms (± 11 ms) pulse of A polarity followed by a minimum of 2 s of Z polarity on the backward path	Teleprinter signals or 7 or 8 bits of A polarity followed by a minimum of 102 bits of Z polarity	Teleprinter signals or 140 or 157 ms pulse of A polarity followed by a minimum 1.997 s of Z polarity
Service signals	Teleprinter signals on backward path followed by a clearing signal	Teleprinter signals followed by continuous A polarity	Teleprinter signals followed by continuous A polarity
Clear	Inversion to A polarity on either signalling path	Inversion to A polarity	Inversion to A polarity
Clear-confirmation	Inversion to A polarity in opposite direction to clear after a delay of 350-1500 ms following receipt of the clear signal	As for clear	As for clear
Automatic retest	Z polarity for 2 s ± 10% followed by A polarity lasting at least 58 s ± 10% repeated	91-112 bits of Z polarity followed by at least 2665 bits of A polarity	1.782-2.194 s of Z polarity followed by at least 52.188 s of A polarity

For notes, see Table 3/U.25.

TABLE 2/U.25

Type B signalling

Signalling condition	Signal received from telex	Signal on aggregate path (Note 1)	Signal transmitted to telex
Free line	As for type A	As for type A	As for type A
Call	As for type A	As for type A	As for type A
Call confirmation	17-35 ms pulse of Z polarity on the backward path returned within 150 ms of receipt of the call signal	1-2 bits of Z polarity	20-40 ms pulse of Z polarity
Proceed-to-select	As for call-confirmation. The interval of A polarity separating the pulses will be 100 ms minimum	Interval of not less than 5 bits of A polarity followed by 1-2 bits of Z polarity	As for call-confirmation. The interval between the pulses to be nominally 100 ms minimum
Selection signals	Teleprinter signals or dial pulses having the following limits: Speed = 9-11 pps, Z: A ratio = 1:1.2 to 1:1.9 (Recommendation U.2)	Teleprinter signals or dial pulses, where each A polarity is transmitted as 2-4 bits and each Z polarity as at least 1 bit, the mean speed of pulsing being the same as the input	Teleprinter signals or dial pulses in accordance with Recommendation U.2
Call connected	Continuous Z polarity on the backward path (2 s minimum, possibly followed by teleprinter signals)	Continuous Z polarity (102 bits of Z polarity minimum, possibly followed by teleprinter signals)	Continuous Z polarity (1.997 s minimum, possibly followed by teleprinter signals)
Service signal (busy pulse)	165-260 ms of Z polarity on the backward path followed by A polarity for 1500 ms (± 30%) continuously repeated (the A polarity period may be preceded by teleprinter signals, in which case the tolerance of the A polarity is reduced to ± 20%)	8-14 bits of Z polarity followed by 53-100 bits of A polarity continuously repeated or 8-14 bits of Z polarity followed by teleprinter signals followed by 61-92 bits of A polarity continuously repeated	156-275 ms of Z polarity followed by A polarity of minimum duration 1037 ms (the A polarity period may be preceded by teleprinter signals)
Clear and clear-confirmation	As for type A	As for type A	As for type A
Automatic retest	As for type A	As for type A	As for type A

For notes, see Table 3/U.25.

TABLE 3/U.25

Type C signalling

Signalling condition	Signal received from telex (Recommendation U.11)	Signal on aggregate path (Note 1)	Signal transmitted to telex
Free line	Continuous A polarity on both signalling paths	Continuous A polarity	Continuous A polarity
Call or automatic retest	Inversion to Z polarity on forward path for 150-300 ms followed by teleprinter signals	Inversion to Z polarity for 7-16 bits followed by teleprinter signals	Inversion to Z polarity (within 50 ms of inversion in column 2) for 140-314 ms followed by teleprinter signals (Note 2)
Transit proceed to select	Z polarity for not less than 450 ms followed by code combination No. 22 (nominally 40 ms pulse of A polarity	Not less than 22 bits of Z polarity followed by 2 bits of A polarity	Not less than 430 ms of Z polarity followed by 40 ms of A polarity
Reception confirmation or equipment congestion	Inversion to Z polarity on backward path for 450 ms (± 10%) followed by teleprinter signals or clearing signal	Inversion to Z polarity for 20-26 bits followed by teleprinter signals or continuous A polarity	Inversion to Z polarity for 391-510 ms followed by teleprinter signals or continuous A polarity
Clear and clear-confirmation	As for type A	As for type A	As for type A

Notes concerning Tables 1/U.25 to 3/U.25

1. Actual polarity of each channel on the aggregate path will conform to § 5.5.1.1 (alternative A) or § 5.6.3 (alternative B) of Recommendation R.101.
2. The time delay of signals through the multiplex equipment shall not exceed 50 ms.
3. Pulses of Z or A polarity less than 10 ms shall be rejected by the multiplex equipment.
4. The tolerances shown for the *Signal transmitted to telex* shall not be exceeded when more than one pair of terminals are connected in tandem.
5. It is accepted that the *Signal transmitted to telex* may deviate from the tolerances given in the tables when the *Signal received from telex* conforms to Recommendation U.24 but not to Recommendation U.1 or U.11. In this event the *Signal transmitted to telex* shall not exceed the tolerances given in Recommendation U.24.

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SECTION 4

GENTEX SIGNALLING

Recommendation U.30

SIGNALLING CONDITIONS FOR USE IN THE INTERNATIONAL GENTEX NETWORK

(New Delhi, 1960)

The CCITT,

considering

(a) that the conditions in Recommendation U.1 concerning signalling in the international telex service, the specifications in Recommendation U.2 for standardization of dials and dial pulse generators in the international telex service, in Recommendation U.3 for the reduction of the effect of false calling signals, and in Recommendation U.5 on the characteristics of regenerative repeaters used in international calls, will hold good in the gentex network, except those referring specifically to manual or semi-automatic working. In some countries, indeed, no distinction is made between the gentex and the telex networks;

(b) that the differences between signalling conditions in the telex and the gentex networks are essentially due to the possibility of using overflow in the gentex network, and the absence of charges in it,

unanimously declares the following view

1 The recommendations in §§ 1 to 12 of Recommendation U.1 *(Signalling conditions to be applied in the international telex service)* shall also apply to the gentex network subject to the following changes:

1.1 *Proceed-to-transmit signal* (Recommendation U.1, § 5.2)

The proceed-to-transmit signal is not used in the gentex network, since switching is always automatic.

1.2 *Selection signals*

Recommendation U.1, § 6.3 should read as follows for the gentex network:

If there is selection towards a system in which selection is by teleprinter signal, the prepare-for-digits signal will normally be combination No. 30 (figure-shift). By agreement between the Administrations concerned, this combination could be replaced by another combination for gentex calls over circuits used for gentex and telex traffic simultaneously, if the network of the country of arrival can ensure barring between the two kinds of traffic.

2 Table 1b/U.1 (signal characteristics) applies to the gentex network.

3 Recommendation U.2 *(Standardization of dials and dial pulse generators for the international telex service)*, Recommendation U.3 *(Arrangements in switching equipment to minimize the effects of false calling signals)*, and Recommendation U.5 *(Requirements to be met by regenerative repeaters in international connections)*, apply to the gentex network.

PREVENTION OF CONNECTION TO FAULTY STATIONS AND/OR STATION LINES IN THE GENTEX SERVICE

(former CCIT Recommendation E.9, Geneva, 1956)

The CCITT,

considering

(a) that correct reception of the answer-back code at the beginning and end of a telegram should safeguard the correct transmission of the telegram;

(b) that it accordingly becomes essential to provide adequate signalling for cases when a teleprinter is temporarily unable to participate in the international service, on account of paper trouble, faults, etc.;

unanimously declares the view

(1) that faults during the transmission of a telegram shall be signalled as far as possible by the automatic transmission of a clearing signal;

recognizing, however,

that it will be impossible to signal all faults that may occur on an established connection,

unanimously declares the view

(2) that it is essential that absence of paper on a receiving teleprinter should be signalled by the clearing signal; and

unanimously declares the view

(3) that, since the receiving Administration is responsible for the receipt of the telegram when the answer-back signals have been correctly exchanged, it is responsible for making the necessary arrangements to ensure security of operation (for example, if the tape should break or become jammed);

(4) that in the case of a faulty station line or teleprinter at the moment of the call, the existing automatic switching networks use one or more of the following signalling conditions : no call-connected signal, busy signal, service code **DER** or no return of answer-back. All these signalling conditions ensure that a telegram is not transmitted over a faulty connection;

(5) that in the case of a faulty station line out of an office group it is essential that the faulty line should be busied out as quickly as possible so that traffic may be offered automatically to all the other lines in the group.

SECTION 5

PARTICULAR SIGNALLING FACILITIES

Recommendation U.40

REACTIONS BY AUTOMATIC TERMINALS CONNECTED TO THE TELEX NETWORK IN THE EVENT OF INEFFECTIVE CALL ATTEMPTS OR SIGNALLING INCIDENTS

(Geneva, 1980)

The CCITT,

considering

(a) that equipment capable of automatically originating calls in the telex network can repeat unsuccessful calls until the call has been set up;

(b) that unlimited repetition of call attempts may cause congestion in the telex network;

(c) that manufacturers of automatic terminals for connection to the telex network should be given guidance on tolerable numbers of repeated call attempts and simultaneous calls;

unanimously declares the following view:

1 Ineffective outgoing call

1.1 *Non-return of the call-confirmation and/or proceed-to-select signal(s)*

1.1.1 The call signal could be maintained for a maximum period of 20 s. If, within this period, the call-confirmation and/or the proceed-to-select signal(s) have not been received from the network, the terminal sends the clear signal.

1.1.2 A further call attempt must not be made within a minimum period of 20 s.

1.1.3 After three such ineffective attempts, the incident should be reported to the staff at the terminal installation, specifying the nature of the fault.

1.2 *Slow or incomplete selection*

1.2.1 Once the terminal has sent a call signal and has received the call-confirmation and/or proceed-to-select signal(s), transmission of the selection digits must commence within a period of between 0.5 and 7 s, depending on the national network. If this delay is exceeded, the network may clear.

1.2.2 The same procedure applies in the event of incomplete selection by the terminal or, if an interval longer than 7 s occurs, between two selection digits.

1.3 *No response after selection*

1.3.1 If, after selection has been completed (but before the call has been set up), the terminal receives no signals within 60 s, it may send the clear signal. This delay may be increased to 120 s for international calls.

1.3.2 Further attempts may be made in accordance with §§ 1.1.2 and 1.1.3 above.

1.4 *Ineffective attempts followed by service signals*

1.4.1 *OCC*

1.4.1.1 If, after initiating a call, the terminal receives an **OCC** service signal followed by clear, it must wait at least 60 s before repeating the attempt. If **OCC** is received again, then second, third and fourth attempts shall be permitted at 180-second intervals.

1.4.1.2 If the distant terminal is still unavailable after a maximum of four such reattempts, this should be reported to the staff at the terminal installation indicating the number called and the service code received. A further series of a maximum of four reattempts may be initiated after a delay of 20 minutes.

1.4.1.3 Should the distant terminal remain unavailable after these call series, this should be reported and the call abandoned as far as the automatic terminal is concerned.

1.4.2 *NC*

1.4.2.1 If, after initiating a call, the terminal receives an **NC** service signal followed by clear, it must wait at least 60 s before repeating the attempt.

1.4.2.2 If the distant terminal is still unavailable after a maximum of four such reattempts, this should be reported to the staff at the terminal installation indicating the number called and the service code received. A further series of a maximum of four reattempts may be initiated after a delay of 20 minutes.

1.4.2.3 Should this second series still fail to reach the distant terminal, this should be reported and the call abandoned as far as the automatic terminal is concerned.

1.4.3 *ABS, NA, NP, NCH, DER or the service code CI*

1.4.3.1 If, after initiating a call, the terminal receives an **ABS**, **NA**, **NCH**, **NP** or **DER** service signal followed by clear, only one reattempt may be made after a minimum period of 2 s.

1.4.3.2 In the event of a second failure due to a service signal specified in § 1.4.3.1, the terminal should abandon the call and report the incident to the staff at the terminal installation indicating the number called and the service code received.

1.4.3.3 If the terminal receives the service code **CI** followed by clear, the procedure described in §§ 1.4.3.1 and 1.4.3.2 should also be applied.

1.5 *Ineffective calls characterized by a clearing signal without a preceding service signal*

1.5.1 If after having made a call, the terminal equipment receives a clearing signal without previous reception of a service signal, it must wait 2 s before a second attempt.

1.5.2 If the same phenomenon occurs three times in succession, a second series of three calls may be made again after a delay of 15 minutes.

1.5.3 If the second series of calls produces the same result, the terminal equipment should definitively abandon the call and report the incident to the staff at the terminal installation indicating the number called and that no service code was received.

1.6 *Reception of an answer-back*

1.6.1 If, after having made a call, the terminal equipment receives an incorrect answer-back, it may send the clearing signal and repeat the call only once after a period of 2 s.

1.6.2 If the second attempt fails in the same way, the terminal should abandon the call and report the incident to the staff at the terminal installation, indicating the number called and the fact that the expected answer-back code was not received.

1.7 *Simultaneous calls*

1.7.1 If an automatic terminal equipment can initiate simultaneous call attempts on a number of outgoing lines, the number of such call attempts in progress at any one time shall not exceed a maximum prescribed by the Administration concerned.

1.7.2 In no case shall a multiple-line terminal equipment be allowed to present the same call simultaneously on more than one telex line. Moreover, the periodicity of a given repeated call and the number of attempts to be made in case of failure shall apply to this terminal equipment as indicated in Table 1/U.40, irrespective of whether the call is presented on the same line or on different lines.

2 Ineffective incoming calls

2.1 *False calls*

2.1.1 The terminal should disregard any "call" signal from the network that does not exceed 50 ms in duration.

2.1.2 If the terminal receives no signals within a period of up to 30 s after it has recognized a call signal from the network, it should return the clear signal to the network.

3 Incidents following call set-up

3.1 *Idle circuit without clearing signal*

3.1.1 Barring prior agreement to the contrary, if no signal is received after the beginning of the call or if the distant correspondent's transmission stops during an incoming call (i.e. steady stop polarity on the incoming path) for a period of more than 2 minutes, the receiving terminal may clear the call and report the incident to the staff at the terminal installation, indicating the nature of the suspected fault and, if possible, the number of the distant subscriber.

3.2 *No clear-confirmation*

3.2.1 Should the network fail to return the clear-confirmation signal after the terminal has been sending a clear signal for 10 s or more, the terminal should report the incident (giving the time at which it occurred) and withdraw the circuit from service until the necessary action has been taken.

TABLE 1/U.40

Summary of the required reactions to ineffective call attempts and signalling difficulties

Relevant point	Symptoms	Time-out or delay before clearing (seconds)	Maximum number of reattempts per series	Number of series	Minimum interval between series (seconds)	Minimum interval between attempts (seconds)
	Outgoing calls					
1.1	No call-confirmation and/or proceed-to-select	20	3	1	—	20
1.3	No response after selection:					
	national calls	60	3	1	—	20
	international calls	120	3	1	—	20
1.4.1	**OCC**	—	4	2	1200	60[a)] 180[a)]
1.4.2	**NC**	—	4	2	1200	60
1.4.3	**ABS, NA, NP, NCH, DER** or **CI**	—	1	1	—	2
1.5	Clearing without a service signal	—	3	2	900	2
1.6	Incorrect answer-back	0	2	1	—	2
	Incoming calls					
2.1	No signals after a "call" signal	30	—	—	—	—
	Conditions after call establishment					
3.1	Idle circuit (steady Z)	120	—	—	—	—
	Conditions after clearing					
3.2	No clear-confirmation	10	—	—	—	—

[a)] In the case of **OCC**, the period between the original attempt and the first reattempt should be 60 s. Between subsequent reattempts this period should be extended to 180 s.

Note 1 — Where various combinations of service signals are encountered, the equipment making the reattempts shall obey the rules appropriate to the last service signal encountered. In no case, however, shall the total number of reattempts on any one call exceed 12.

Note 2 — This Recommendation is subject to amendment in the light of traffic experiments undertaken by Administrations.

Recommendation U.41

CHANGED ADDRESS INTERCEPTION AND CALL REDIRECTION IN THE TELEX SERVICE

(Geneva, 1980)

The CCITT,

considering

(a) that, with fully automatic working between telex subscribers, it is desirable to envisage the possibility of:

- a fully automatic changed address interception facility;
- a fully automatic call redirection facility;

(b) that the operation of such facilities has an influence upon telex calls originated by other Administrations and therefore requires international standardization;

unanimously declares the following view

1 Changed address interception

1.1 In existing networks, in the case of a call to a subscriber whose number has been changed, the incoming network may return the service code **NCH** followed by the clearing signal in accordance with Recommendations F.60 [1] and U.1, § 10.1 and Table 1/U.1.

1.2 In new networks and as far as possible in existing networks, it would be desirable to inform the calling subscriber of the new number to be selected by means of a suitable sequence of signals, which should have the following format:

$<\equiv\downarrow$**NCH**$\uparrow$**:x. . .x**$+\downarrow$ (where **x. . .x** represents the figures of the new number),

followed by the clearing signal. This sequence may be preceded by the call-connected signal and every step should be taken to ensure that the period between the call-connected signal and the clearing signal does not exceed 5 seconds, in order to avoid accounting in accordance with Recommendations U.1 and F.61 [2].

1.3 Operating Administrations may optionally offer automatic redirection to the new number of a call to one of their subscribers whose number has been changed. This redirection will be in accordance with § 2 below, which treats this subject, and in particular the call-connected signal should be given once only at the moment when an effective call has been established. This supplementary service shall be available for a limited period only. It may not be offered beyond the time during which the Administration informs calling subscribers of the change in the call number.

2 Call redirection

2.1 In new networks and as far as possible in existing networks, a call redirection should be signalled by the return to the calling station of a sequence of signals constituted by the code **RDI** followed by the indication of the new number to which the call is redirected, in accordance with the following format:

$<\equiv\downarrow$**RDI**$\uparrow$**:x. . .x**$+\downarrow$ (where **x. . .x** represents the new number),

followed if necessary by further letter-shifts ($\downarrow$); the total number of characters in the sequence may in no case exceed 20.

Failing this, at least the code **RDI**, without any further indication, should be returned.

2.2 The signals indicated in § 2.1 above may be followed by other service signals employed in the signalling system applied in the network concerned. The call-connected signal should not be returned until the call has been extended to the station corresponding to the new number, in accordance with the procedure described in Recommendation U.1. It should be followed by the call-connected procedure for this station in accordance with the existing rules in the network in question.

2.3 Administrations offering call redirection facilities should take all necessary technical and administrative steps to ensure that the same call can in no circumstances give rise to more than one redirection and that the total number of circuits used to establish the call after redirection does not exceed the maximum tolerated in the transmission plan for the national network.

2.4 In the case described in § 1.3 above, where the calling station is connected to the new address, this address shall consist only of the national number.

2.5 With regard to the call redirection facility, redirection should not take place to addresses outside the jurisdiction of the Administration performing the redirection function.

References

[1] CCITT Recommendation *Operational provisions for the international telex service*, Vol. II, Fascicle II.4, Rec. F.60.

[2] CCITT Recommendation *The chargeable duration of a telex call*, Vol. II, Fascicle II.4, Rec. F.61.

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SECTION 6

RADIOTELEX INTERWORKING

Recommendation U.60

GENERAL REQUIREMENTS TO BE MET IN INTERFACING THE INTERNATIONAL TELEX NETWORK WITH MARITIME SATELLITE SYSTEMS [1)]

(Geneva, 1980)

The CCITT,

considering

(a) that, with fully automatic working between subscribers in the international telex service, it is desirable that the interface between the international telex network and maritime satellite systems be defined;

(b) that the CCIR is charged with the task of making Recommendations relating to the radio path of maritime satellite systems;

(c) that explanation of the detail of the interface between the internatonal telex network and maritime satellite systems would be of assistance to the CCIR;

unanimously recommends

1 that maritime satellite systems should be capable of interfacing the international telex network with one or more signalling systems in accordance with:

- Recommendation U.1: Signalling conditions to be applied in the international telex service (type A and type B signalling);
- Recommendation U.11 : Telex and gentex signalling on intercontinental circuits used for intercontinental automatic transit traffic (type C signalling);
- Recommendation U.12 : Terminal and transit control signalling system for telex and similar services on international circuits (type D signalling);

2 that type D signalling (Recommendation U.12) and, as a second choice, type C signalling (Recommendation U.11) are the preferred signalling systems, when they are available within the national boundaries, for the reasons given in Annex A;

3 that as the maritime signalling from the ship to the coast earth station is in the same relationship as the connection from the subscriber to the originating exchange in the international network, it is necessary that the transit delays inherent in the maritime system should be considered in conjunction with the standards recommended for the international network.

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1) See Recommendation U.61 for the detailed interface requirements.

ANNEX A

(to Recommendation U.60)

Signalling systems types C and D

A.1 These signalling systems have been developed in CCITT to permit the maximum utilization of the international telex network as well as to simplify the interface problems that exist between Administrations using different signalling systems within their national boundaries. In particular, types C and D signalling systems, which use telex destination codes in accordance with Recommendation F.69 [1], are of assistance in solving the problems of routing to and from maritime satellite systems where multiple access techniques are employed.

A.2 Type C signalling (Recommendation U.11) facilitates the use of improved techniques for switching traffic in the international network. In particular:

a) it permits any telegraph circuit capable of carrying International Telegraph Alphabet No. 2 (ITA 2) to be used without the need to convert supervisory signals to a form capable of being carried by the circuit;

b) it permits the automatic testing of the ability of the international circuit to transmit teleprinter characters before the call is established to the distant subscriber;

c) it permits the detection of head-on collision of calls and thus permits service protocols to be established in handling such collisions. It may be noted that head-on collisions may occur on telegraph circuits that are operated in the bothway mode due to the fact that the calling signal takes a finite time, depending upon the nature of the transmission path, before the receiving end of the circuit detects the seizure from the outgoing end;

d) it permits the efficient use of the international network with particular reference to the most economical use of automatic alternative routing and, by providing transit centre identification, permits full flexibility in routing as well as international accounting and subscriber billing.

A.3 Type D signalling (Recommendation U.12) facilitates the introduction into the international network of the following facilities (in addition to the advantages mentioned in § 2 above):

a) user groups;

b) network identification signals;

c) identification of the calling station without the necessity of using the WRU signal;

d) identification of a call relating to service matters, which the international network carries as a non-chargeable call.

Reference

[1] CCITT Recommendation *Plan for telex destination codes*, Vol. II, Fascicle II.4, Rec. F.69.

Recommendation U.61

DETAILED REQUIREMENTS TO BE MET IN INTERFACING THE INTERNATIONAL TELEX NETWORK WITH MARITIME SATELLITE SYSTEMS

(Geneva, 1980)

The CCITT,

considering

(a) that fully automatic working between subscribers in the international telex service and subscribers to a radiotelex service provided by a maritime satellite system is technically possible;

(b) Recommendation U.60, which gives the general requirements to be met in interfacing the international telex network with maritime satellite systems;

unanimously recommends

1 Maritime satellite systems should be capable of detecting the head-on collision condition at the coast earth station between a ship earth station request for call and a terrestrially originated call for that particular ship earth station and should:

– permit the ship-originated call to be connected to the international telex network; and

– terminate the call from the international telex network with an appropriate telex service signal (**OCC**) and a clear (Recommendation F.60 [1]).

2 Should the head-on collision condition occur in the connections in the terrestrial network between the coast earth station and the telex exchange, then the normal procedures in accordance with the appropriate Series U Recommendations (U.12, § 3.3, U.11, § 2, U.1 § 12.2) should prevail.

3 The return of a call-connected signal or a telex service signal and clear shall be returned as soon as possible after the receipt of the end-of-selection character at the coast earth station for shore-originated calls. The signal return delay shall not exceed 35 seconds.

Note – For type C signalling (Recommendation U.11) the end-of-selection (EOS) character is combination No. 26 (+) in International Telegraph Alphabet No. 2. For type D signalling (Recommendation U.12) the EOS is character No. 11 in the Control Signalling Code (CSC). For signalling to Recommendation U.1, this signal shall be combination No. 26 (+) in International Telegraph Alphabet No. 2.

4 The maritime satellite system returns to the subscriber in the terrestrial network the service signal **DER** (Recommendation F.60 [1]), followed by a clearing signal when the maritime satellite system detects:

– that the ship's station (teleprinter, control logic, radio equipment) is faulty;

– failure of the answer-back from the ship's teleprinter.

5 At the termination of the call the requirements of the clearing and clear-confirmation signals shall apply to and from the international network (Recommendations U.1, U.11, U.12); the maritime satellite system may use different timings in the directions to and from the ship. It is preferred that the total times for such signal exchanges should have a minimum time addition to that quoted for the international network.

Note – Automatic calling equipment and subscribers in the international telex network may attempt, under certain conditions, to place a follow-on call to the same ship. Under conditions of long clear and clear-confirmation cycle times, such calls will not be successful.

6 Where inherently in the maritime satellite system a period equal to one character period of Z polarity may be inserted in the data stream from the ship to shore, then the design of the equipment interfacing the international network should preferably ensure the following.

6.1 When type C signalling is employed to connect into the international network, either:

– the class-of-traffic and selection signals should all be transmitted into the international network at cadence speed without any periods of Z polarity between the 7 1/2-unit characters; or

– the class-of-traffic signal, the class-of-traffic-check signal, the 2 or 3 digits of the destination code of the called network and the first two digits of the called station should be transmitted as a complete block at cadence speed without any periods of Z polarity between the 7 1/2-unit characters. The remaining selection signals for the called number and the EOS signal (+) may be transmitted with periods of Z polarity, providing that the signals are not delayed by more than 4 seconds.

6.2 When type D signalling is employed to connect into the international network, the class-of-traffic signal(s) or network selection signals and selection signals should be transmitted as a complete block at cadence speed without periods of Z polarity between the Control Signalling Code (CSC) characters.

6.3 If these options cannot be exercised, then the provisions of Recommendation U.11, § 13, Recommendation U.12, § 3.6 or Recommendation U.1, § 6.6 shall apply.

7 Since, for automatic calls in the international telex service, there are no arrangements for call priorities such as are envisaged for maritime satellite systems and since it is a principle that a telex call should not be broken down without transmitting a service signal to the affected terminals, maritime satellite systems should, on exercising the maritime priority:

a) attempt to set up the priority call by cutting down a call that is in the process of being set up, i.e. the call-connected signal was not yet transmitted to the international network before cutting down an established call;

b) when a call in the process of being set up is cut down, transmit a service signal (**NC**) followed by a clear to the international network;

c) where it is unavoidable that an established call be cut down, clear the call using the standard international clearing procedure.

Note – Special signals could be used within the maritime satellite system to reduce the setting-up times of priority calls within that system. Such signals are not required to be related to the time scale of the cut-down of calls from or to the international network.

8 When the international network is used to permit an authorized telex terminal to access a coast earth station for the purpose of making a broadcast to ships, then such a service can be provided technically:

a) *when the originating network cannot apply selective barring to their subscribers*, providing that the coast earth station authenticates the calling terrestrial telex station by the transmission of the WRU signal and checks the status of the characters received from the calling terminal's answer-back;

It should be noted that the WRU should be transmitted after the call-connected signal and the coast earth station's answer-back has been transmitted to the calling terminal;

b) *when the originating telex network can apply selective barring to its subscribers*, providing that the telex selection received by the coast earth station is of the format:

$$D_1D_2D_3X_1X_2X_3 \ldots X_k \text{ EOS}$$

where $D_1D_2D_3$ is the appropriate telex destination code assigned to the Maritime Satellite Service in accordance with Recommendation F.69 [2], and $X_1X_2X_3 \ldots X_k$ is the telex number at the shore station defining the particular group call request, which, in association with the calling terminal, may be used to identify the appropriate listing of ships to receive the broadcast. The character X_1 in combination with the F.69 [2] code indicates to the international network that a maritime broadcast call is being made. The character X_1 shall be the character 0 (zero).

c) when type D systems exist in the connection to the calling telex terminal. In that case the "calling line identification" procedures of that system may be used during the setting-up phase of the connection to the coast earth station to authenticate the calling terminal's identity instead of the use of the WRU and answer-back. Where the calling link identification is not available in the terrestrial network the Control Signalling Code (CSC) No. 12 will be received. Under these circumstances the WRU/answer-back sequence should be used as detailed in § 7, a);

d) where the request for a maritime group call, from the international network, is rejected due to lack of authorization. In that case the international network should be cleared with a service signal (**NA**) followed by a clearing signal.

9 The composition of ship terminal's answer-back codes should conform to Recommendation F.130 [3].

References

[1] CCITT Recommendation *Operational provisions for the international telex service*, Vol. II, Fascicle II.4, Rec. F.60.

[2] CCITT Recommendation *Plan for telex destination codes*, Vol. II, Fascicle II.4, Rec. F.69.

[3] CCITT Recommendation *Maritime answer-back codes*, Vol. II, Fascicle II.4, Rec. F.130.

PART III

SUPPLEMENTS TO THE SERIES U RECOMMENDATIONS

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SIGNALLING CHARACTERISTICS AND TIMING OF THE MARISAT TELEX SERVICE

(*Source:* COMSAT)

1 Introduction

In response to Recommendation U.4, this Supplement describes the characteristics and time sequences of the international telex service operated over the MARISAT maritime satellite communication system.

2 Ship terminal originated telex call

Figure 1 shows the signalling sequence for a telex call originated from a ship terminal in the MARISAT system. Figure 2 illustrates the telex signalling and timing sequence. The following is a general description of the sequence of events in establishing a telex call from a ship terminal to a gateway switch.

2.1 To initiate a call, the ship terminal sends a telex request message in the *out of band* request channel. The coast earth station receiving the valid request message will send back an *out-of-band* assignment message instructing the ship terminal equipment to tune to the assigned channel.

2.2 On the receipt of a valid *out-of-band* assignment message from the coast earth station, the ship terminal can then access its assigned channel. The terminal will normally achieve carrier and bit timing synchronization within 0.58 seconds after receipt of the assignment message. This time includes assignment message decoding, carrier recovery and clock recovery. Transmission will normally start upon frame synchronization, which occurs in less than 5.25 seconds.

Therefore, the normal ship terminal response time will be less than 5.8 seconds as seen at the ship or 6.6 seconds as seen at the coast earth sation. The time that the assignment message remains active in the coast earth station is in addition to this 6.6 seconds, allowing enough time for the ship terminal to start transmitting.

2.3 The coast earth station, which is continually transmitting a spacing signal, makes the transition space to mark indicating call confirmation within one character (150 milliseconds not counting framing delays) after the assignement message is formatted. In cases of heavy traffic, the assignment message may be delayed in queue until after the transition has occurred, i.e., it is possible for the space to mark transition to be received by the ship terminal before the assignment message.

2.4 The initial ship terminal transmission is in the spacing state. When a mark is received from the coast earth station, the terminal changes its transmission from space to mark. In the case when the space to mark transition on the coast earth station to ship terminal link reaches the terminal before the assignement message, the terminal inserts no more than two space characters in the initial burst.

2.5 Once the coast earth station has received the terminal's space to mark transition, it sends a WRU (figure case D) to the ship terminal. The coast earth station must receive a 20 character answerback within 7 seconds from the end of the WRU character sequence or it will clear the call. In addition, the coast earth station sends a *request not acceptable* assignment message (out-of-band) back to the terminal. The coast earth station does not check if the answerback code corresponds to the ship terminal's destination code (ID).

2.6 The received answerback is stored by the coast earth station. Call processing is now started between the coast earth station and the gateway switch. The coast earth station presents a mark to the gateway switch and the gateway responds with a *call confirmation* within 1 second. Within 3 seconds after the *call confirmation*, the gateway returns a *call connect.* The coast earth station then connects the gateway switch to the ship terminal. The gateway then sends its header (if any) and a WRU to the ship terminal. After transmission of these signals, the coast earth station disconnects the circuit and sends the ship's answerback in storage to the gateway switch within 850 milliseconds. The ship terminal will send an answerback in response to the WRU from the gateway switch. However, this second answerback is blocked by the coast earth station. The coast earth station will connect the circuit after the 19th character of the ship's answerback is received, and the ship terminal can then send selection digits to the gateway switch.

2.7 After this second connection, the coast earth station does not respond to any data on the line until it detects clearing.

2.8 The gateway switch, upon receipt of the selection sequence from the ship terminal, proceeds to process the call to the desired terrestrial subscriber. As the MARISAT system interfaces with various gateway switches, the signalling sequences proceed according to the protocol between the particular gateway switch and the terrestrial network.

Note — The signalling sequences shown between the gateway switch and terrestrial network in Figure 1 illustrates one method of signalling which can be employed.

3 Telex call originated by a coast earth station

3.1 Figures 3 and 4 illustrate the telex signalling and timing sequences for a telex call originated in a terrestrial network to a ship terminal via the MARISAT system. As the signalling sequences between the terrestrial networks and each gateway switch are not identical, that portion of the signalling sequences in Figure 3 are for illustrative purposes only and no attempt is made to describe all the possible sequences.

3.2 The following paragraphs provide a description of the sequence of events which occur between a gateway switch and a ship terminal for a telex call originated by a coast earth station.

3.2.1 Upon receit of the selection digits from the terrestrial network, the gateway switch starts the signalling sequence by sending a *call request* signal on an idle circuit to the coast earth station. Upon receipt, the coast earth station returns both a *call confirmation* and *proceed-to-select* signal within the proper intervals as shown in Figure 4. The gateway switch can then proceed to send the selection digits to the coast earth station.

3.2.2 The coast earth station checks the validity of the selection digits and if correct, sends an *out-of-band* assignment message to the ship terminal requested. When the assignment message has been transmitted, the signalling proceeds in the same manner as a call from a ship terminal to a coast earth station described in § 2. Once the ship has accessed its assigned channel, the coast earth station sends a WRU to the ship terminal. The terminal responds with its answerback which is stored by the coast earth station.

3.2.3 When the answerback is stored, the coast earth station sends a *call connect* signal to the gateway switch. The gateway then sends a WRU and its header toward the coast earth station. These signals are blocked at the coast earth station and prevented from going to the ship terminal. The coast earth station responds to the gateway's WRU with the ship terminal answerback it had previously stored. The coast earth station then interconnects the circuit between the gateway switch and the ship terminal. From this point, the coast earth station is essentially transparent to all data on the line until it detects a *clearing* signal.

4 Telex clearing sequence

4.1 The coast earth station recognizes a *clearing* signal as a spacing condition of 400 to 1000 milliseconds from either the gateway switch or a ship terminal. After recognition of the *clearing* signal, the coast earth station will disconnect the circuit and send a *clear confirmation* signal in both directions.

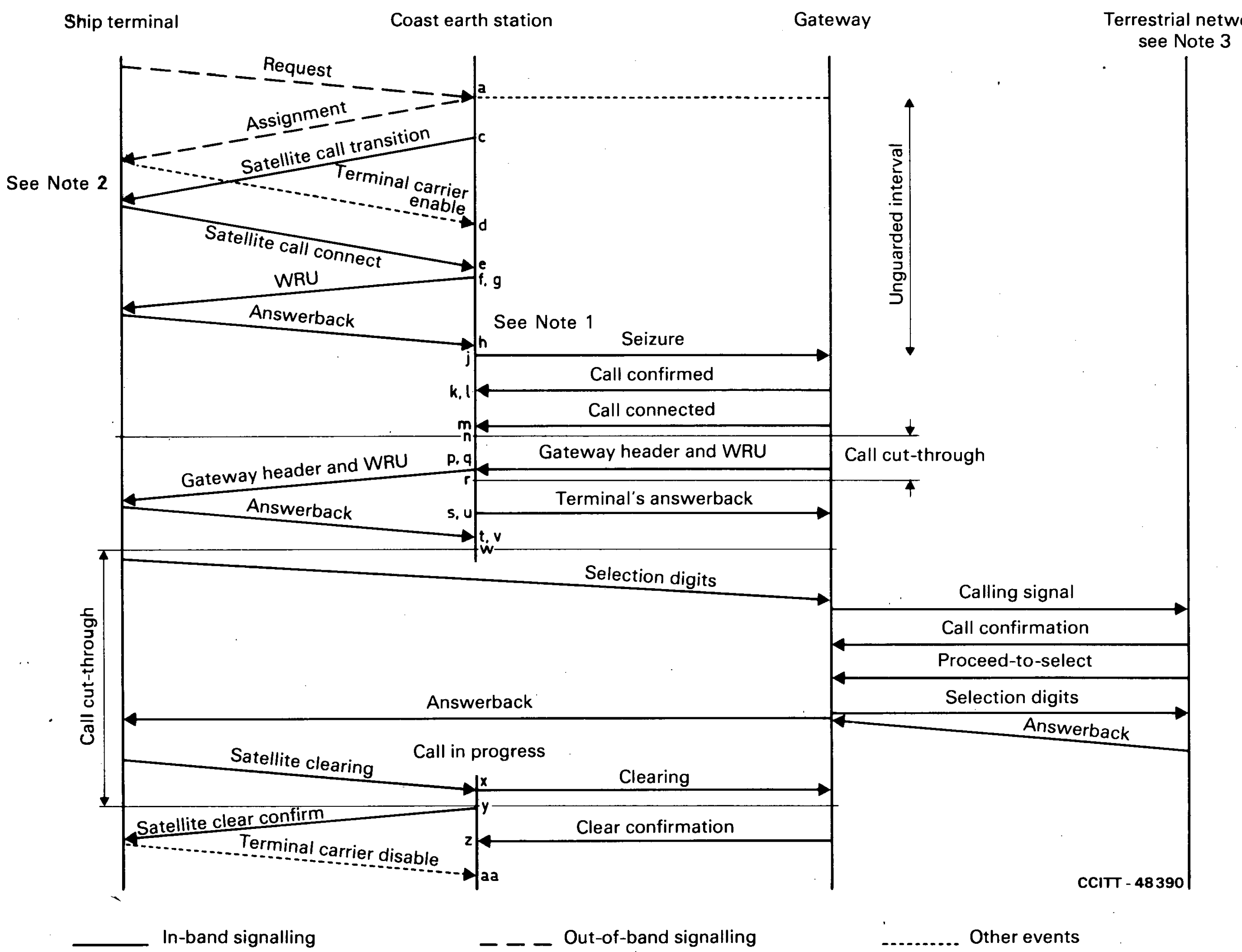
4.2 Release of the satellite circuit section is under the control of the coast earth station. The ship terminal does not stop transmission of its RF carrier until;

a) it has returned a *clear confirmation* signal following the receipt of a *clearing* signal from the coast earth station; or

b) a *clear confirmation* signal is received from the coast earth station.

In either case, the ship terminal maintains a spacing signal for a maximum of 3.09 seconds before transmission is terminated.

4.3 For 6 seconds after the successful receipt of the *clearing* and *clear confirmation* signals over a circuit section between the coast earth station and a gateway switch, the coast earth station will not process any calls on that circuit section. The ship terminal is also considered busy during this 6-second interval. This 6-second guard time is necessary to allow for proper clearing of the ship terminal over the satellite circuit section. If another telex call is received for that ship terminal during the 6-second guard time, the coast earth station will send back an **OCC** service signal.



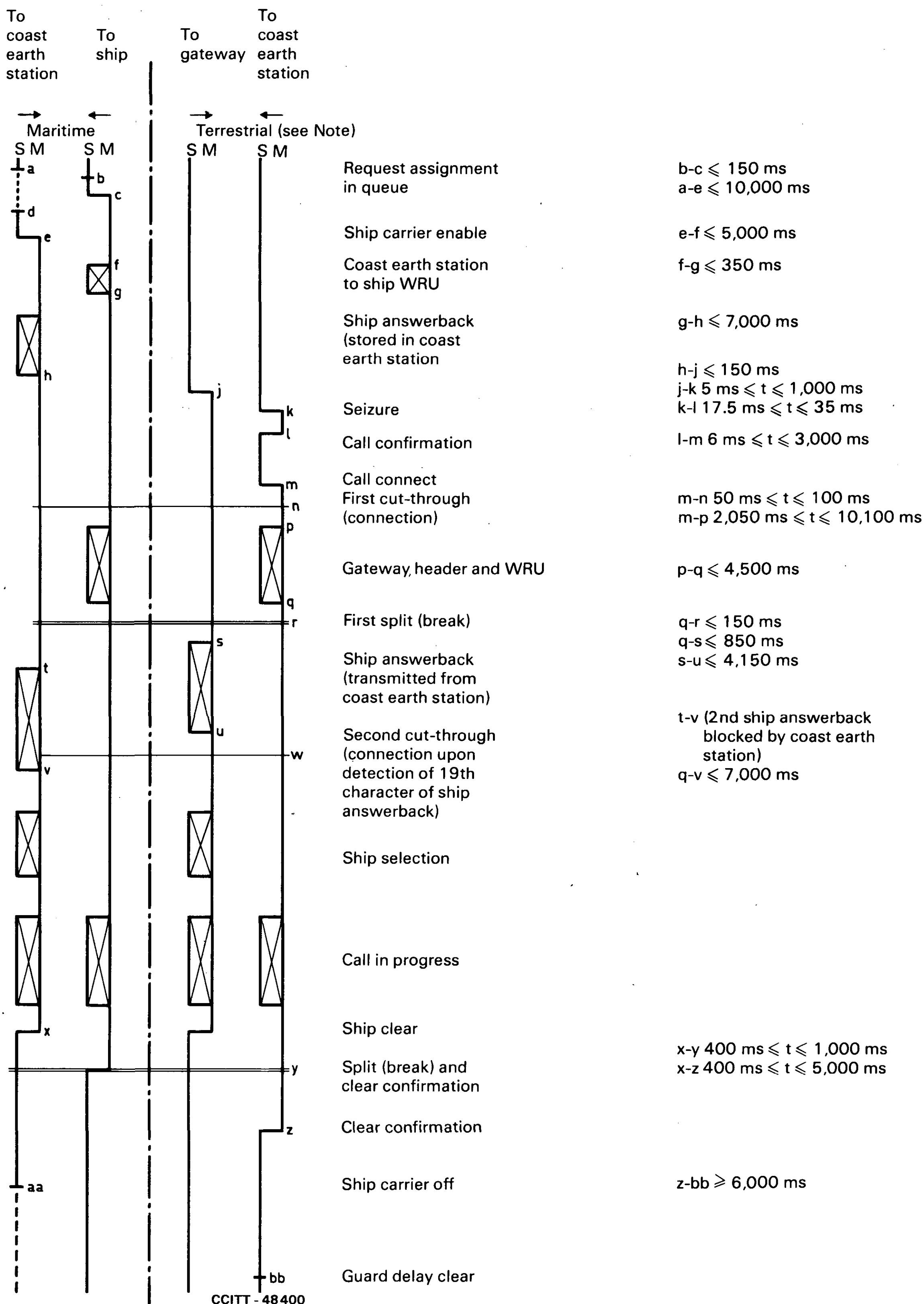
Note 1 — Answerback stored by coast earth station.

Note 2 — The assignment message and satellite call transition may arrive in either order.

Note 3 — Sequence between gateway and terrestrial network is for illustration only, as sequence can vary depending on the gateway involved.

FIGURE 1

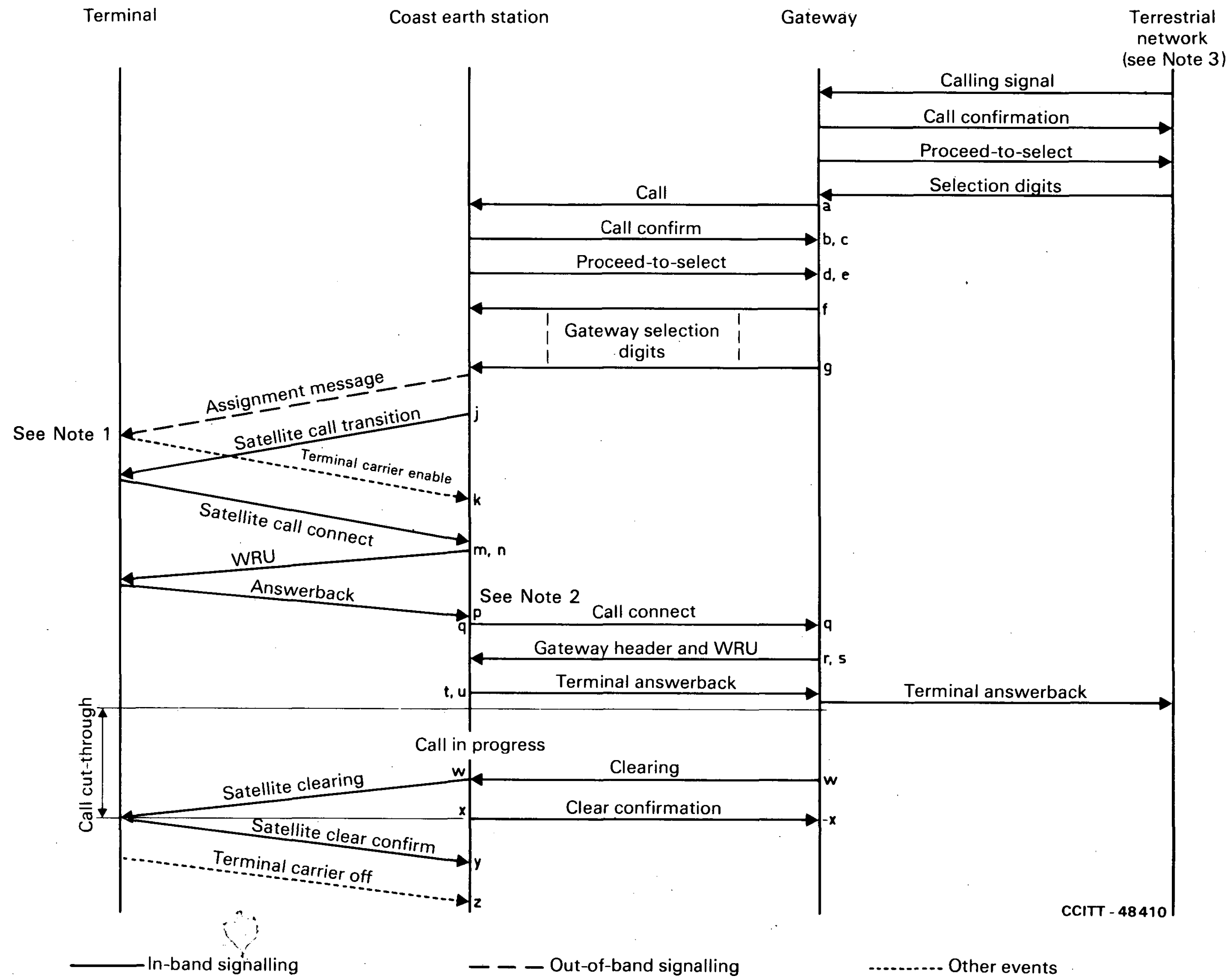
Signalling sequence for MARISAT telex calls (ship terminal-to-shore)



Note — U.S. coast earth station/gateway interface shown.

FIGURE 2

Timing sequence for a ship terminal originated MARISAT telex call



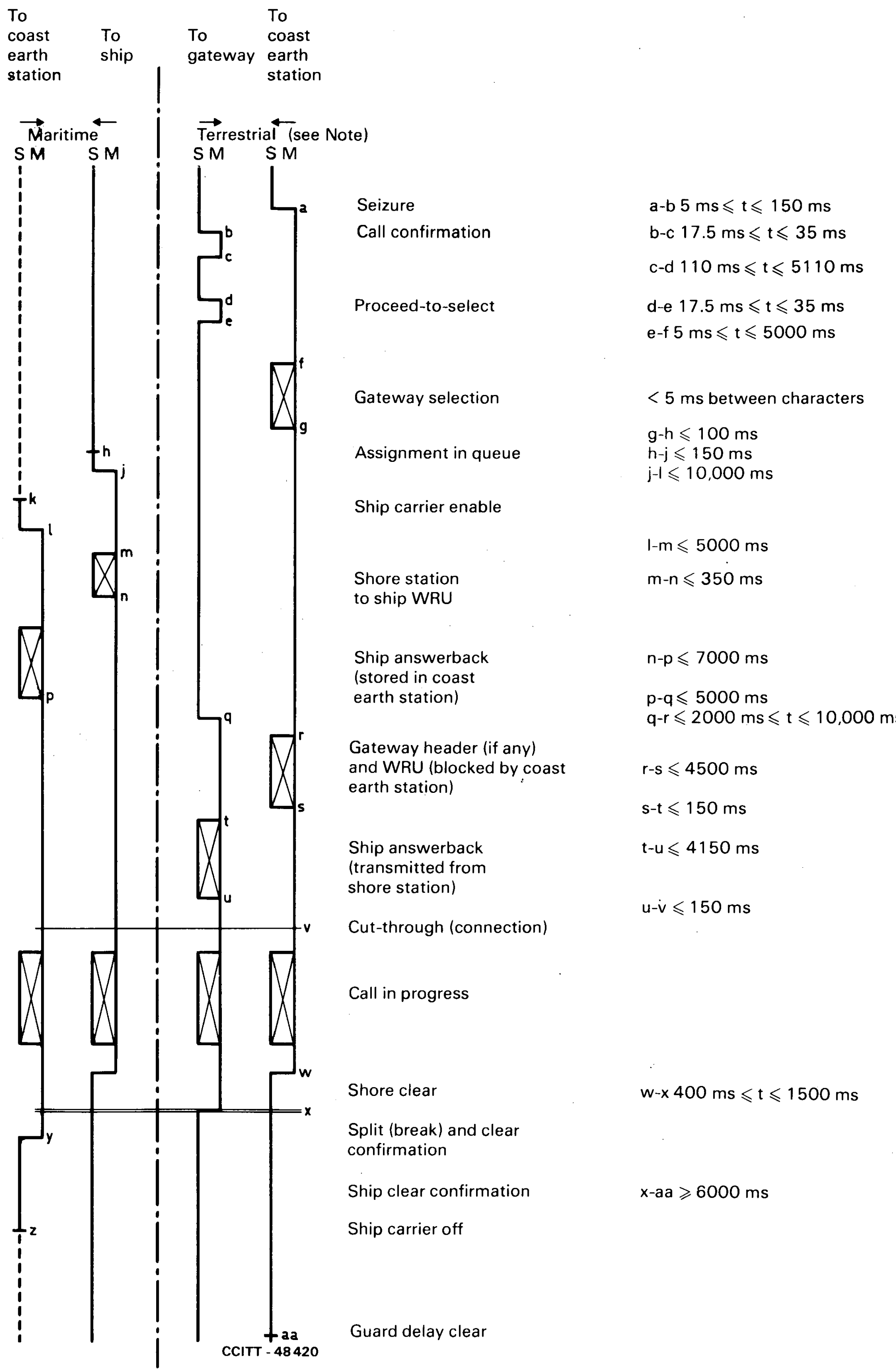
Note 1 — The assignment message and satellite call transition may arrive in either order.

Note 2 — Answerback stored by coast earth station.

Note 3 — Sequence between gateway and terrestrial network is for illustration only, as sequence can vary depending on the gateway involved.

FIGURE 3

Signalling sequence for MARISAT telex calls (shore-to-ship terminal)



Note — U.S. coast earth station/gateway interface shown.

FIGURE 4

Timing sequence for a shore originated MARISAT telex call

SIGNALLING ARRANGEMENTS IN THE MARITIME SATELLITE TELEX SERVICE VIA THE MARISAT SYSTEM

[*Source:* Kokusai Denshin Denwa Co., Ltd. (KDD)]

1 Introduction

In response to Recommendation U.4, this supplement describes the characteristics and signalling conditions of the Maritime Satellite Service being provided by KDD in Japan. The coast earth station at Yamaguchi was built by KDD to access the Indian Ocean MARISAT satellite.

Coast earth stations can be grouped into two types. As shown in Figure 1 *a)*, a coast earth station can be viewed as a gateway to accommodate international circuits directly by giving it routing, charging and other functions. On the other hand [Figure 1 *b)*] to simplify its functions the coast earth station can be regarded as a line concentrator, or local switch.

The Yamaguchi station is regarded as a local switch in the KDD telex network and uses domestic signalling, conforming to Recommendation U.1 (type B), between the station and a Tokyo gateway (CT10). Figure 1 shows the network configuration.

2 Numbering and routing

Ship stations are accessed by 3-digit destination codes of Recommendation F.69 [1] assigned to each maritime satellite (583 is assigned to the Indian Ocean satellite) and 7-digit ship numbers. Ship stations gain access by means of 2- or 3-digit destination codes of Recommendation F.69 [1] and subscriber numbers. When a ship station accesses a KDD operator for number inquiry, etc., the coast earth station converts the 2-digit number before sending it to the gateway.

Generally, maritime telex calls are connected automatically, while distress, urgent and safety calls have come to be operated manually.

3 Charging and accounting

At present, information, based on conversation time, about both subscribers' charging and international accounting is recorded onto the same toll ticket by transferring the originating subscriber's number to the gateway in the KDD network where it is recorded.

One of the tariff parameters in maritime satellite communications is space segment utilization. In order to base the accounting on holding times (including the time required for setting-up calls), recording at coast earth stations will be necessary. Fortunately, the MARISAT system has the same accounting structure as telex networks (i.e. based on conversation time). It is, therefore, possible to get charging and accounting information (including the space segment) from only one record, by transferring ship station numbers to gateways, and by utilizing the charging and accounting function of gateways.

Items recorded for ship originated calls are:

a) ship station number,

b) address number,

c) outgoing route information,

d) date and time at start of charging and accounting,

e) time at release of the connection.

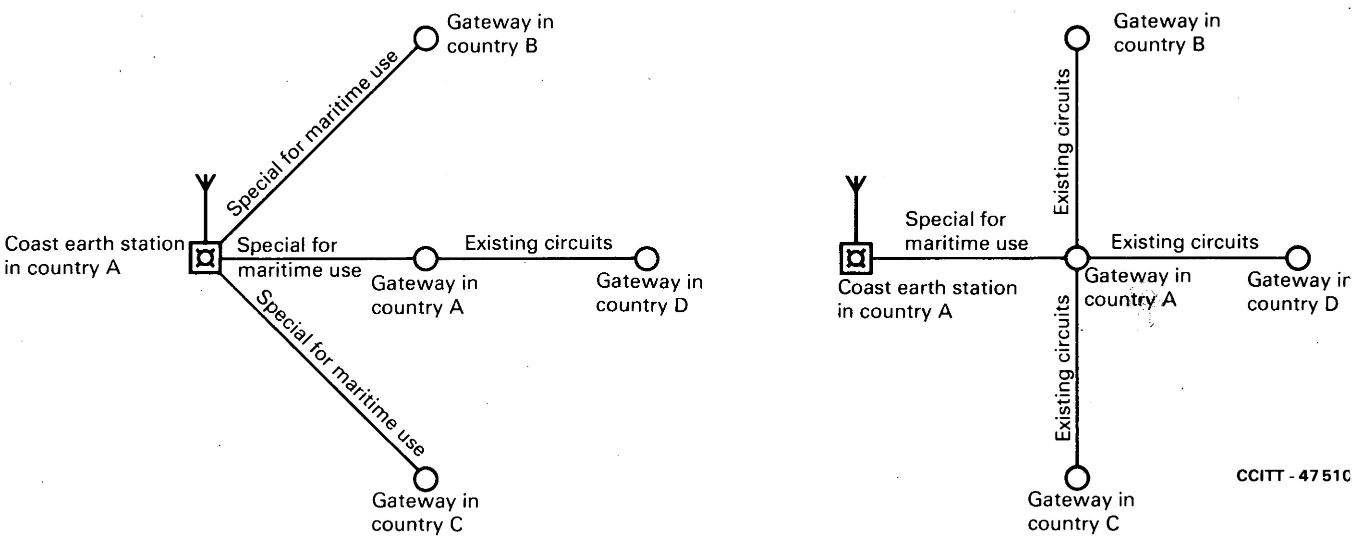
Items recorded for calls originated by domestic subscribers are:

a) domestic subscriber number,

b) ship station number,

c) date and time at start of charging and accounting,

d) time at release of the connection.



a) A coast earth station with *routing and charging functions*

b) A coast earth station without *routing and charging functions*

FIGURE 1

Connection between coast earth station and telex network

Items recorded for calls originated by foreign subscribers are:

a) incoming route information,

b) ship station number,

c) date and time at start of accounting,

d) time at release of the connection.

Ship station number up to nine digits can be handled. Time information is recorded in units of seconds.

The above information is recorded at the outgoing gateway, or at gateways which have operator positions. For ship originated calls, a reference number consisting of the date, time in Japanese Standard Time (JST), and circuit number is sent by the charging gateway to the ship station when calls are accepted. The chargeable duration of communications is sent when signals indicating the end of call are received.

4 Signalling

When introducing a new service, the first consideration must be to minimize the impact on the existing network. For example, a call setting-up procedure from a ship station meeting this objective must be like the one shown in Figure 2. However, considering that shipboard operators are already familiar with the procedure at the U.S. coast earth stations, the procedure shown in Figure 3 has been adopted to unify the call setting-up procedure.

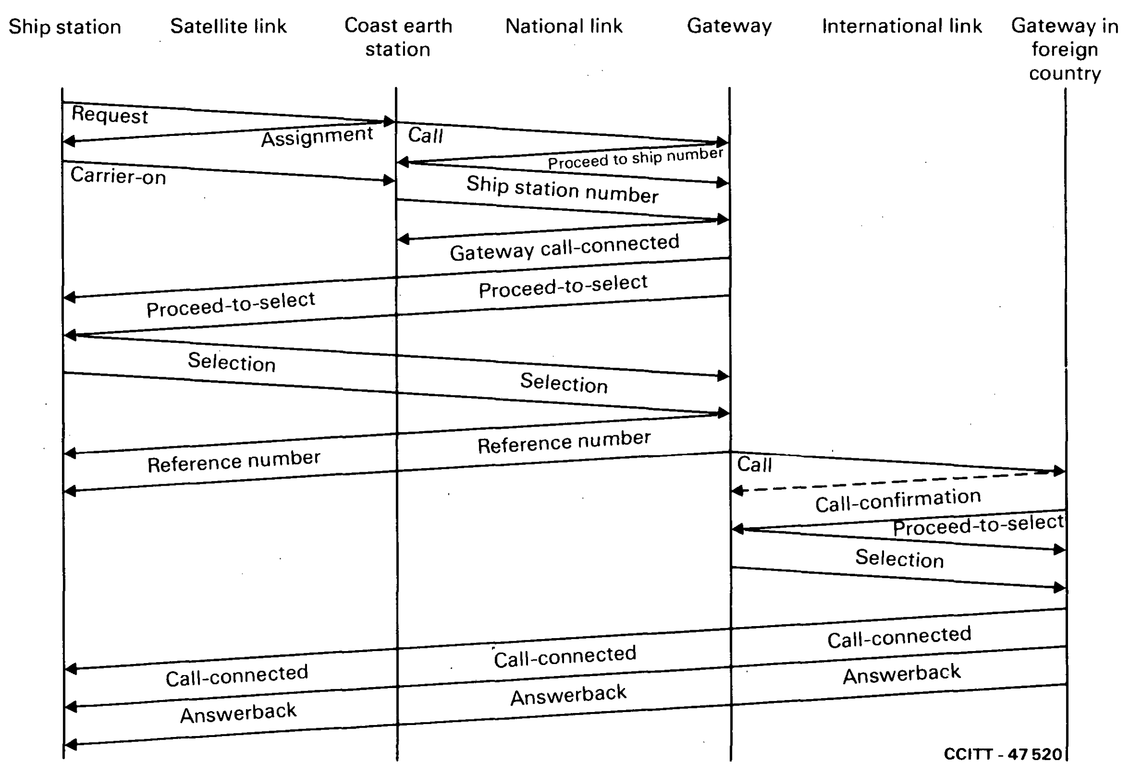


FIGURE 2

One example of a call setting-up procedure

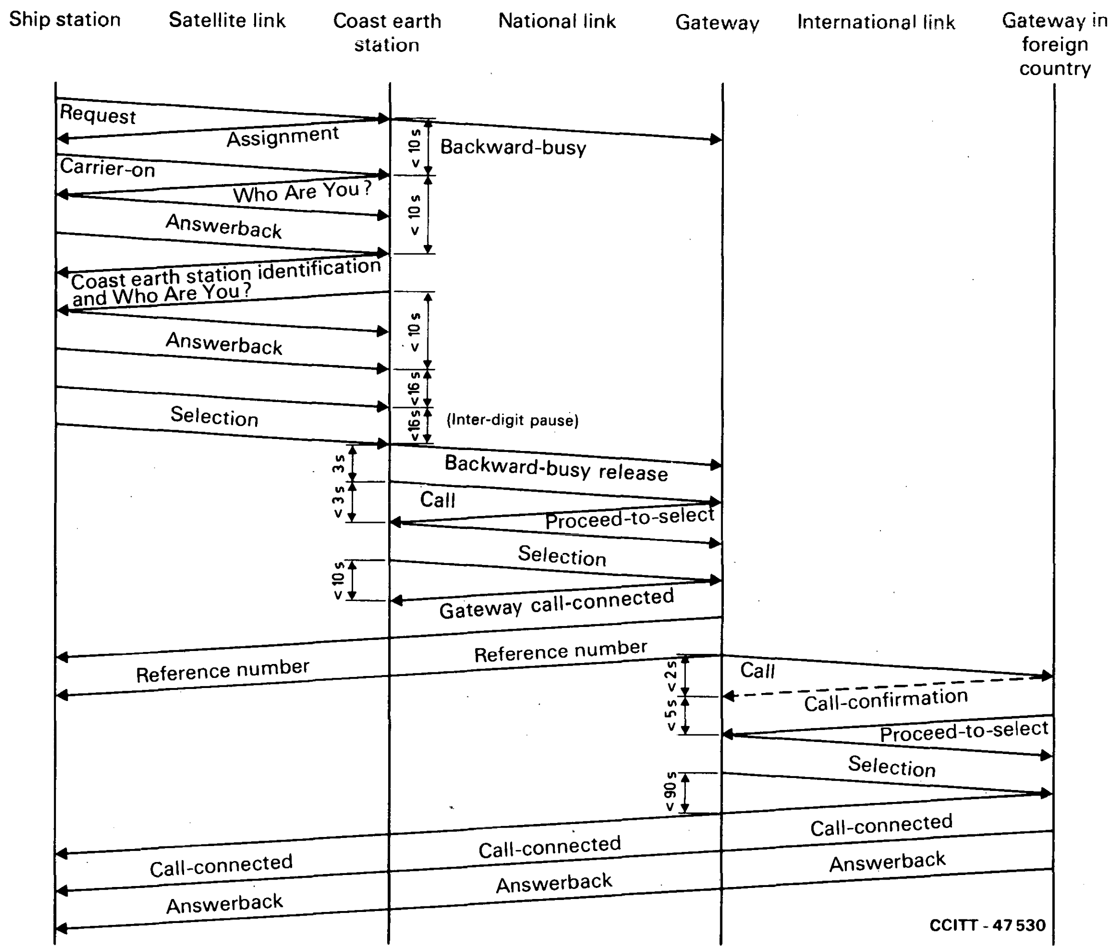


FIGURE 3

Ship originated call

4.1 *Ship originated call* (see Figure 2)

4.1.1 *Acceptance of requests*

Ship stations sending request signals are checked to determine whether or not they are authorized in the MARISAT system. Requests from ship stations that are not authorized are neglected. However, requests for distress calls are unconditionally accepted.

Request signals are of two types – release requests and assignment requests. On reception of a release request, a *channel release* is sent if a channel has already been assigned to that station; if an assignment request is waiting in a queue, it is deleted from that queue.

In the case of assignment requests, a *request not acceptable* is sent if assignment requests have already been accepted. Requests from ships to which the coast earth station is broadcasting are accepted. *Request not acceptable* is sent when request signals contain errors.

For routine requests, a circuit is assigned to the ship if there is an idle circuit. If there is no idle circuit, the request signal is put into the queue, and *acknowledged message (queue)* is sent. The length of a queue can vary up to a maximum size of 10.

In the case of distress requests, the request is handled in the same manner as for routine calls if there is an idle circuit. If there is no idle circuit, one circuit is pre-empted automatically. The priority order for this is as follows:

a) a circuit in setting-up procedure;

b) a circuit in progress.

For urgent or safety requests, the same procedure that is applied to routine calls is taken.

A circuit is selected from the higher order channel numbers.

After the request is accepted, the polarity of the transmission line on the gateway side is immediately inverted from an A polarity to Z polarity (backward busy). This backward busy signal is released on reception of the end-of-selection signal (**+**) from the ship station. However, in the case of distress, urgent, or safety requests, this signal is released after the second answerback is received from the ship.

During this time, the receive channel from the gateway is not monitored.

4.1.2 *Response to assignment*

If the carrier does not arrive at the coast earth station within ten seconds of sending the assignment signal, a second identical *assignment* signal is sent. The call is released if carrier is not received within a further ten seconds.

4.1.3 *Response to coast earth station identification*

The "Who are you?" signal is sent out after receiving a carrier, but the call is released unless a group of 20 characters (ship's answerback) is received within ten seconds. After receiving the answerback, the coast earth station identification (**<≡↓KDD↑→ xx→ xxxx↓Z→** where **xx** and **xxxx** are the date and time in UTC) and "Who are you?" are sent. Unless a further answerback is received within ten seconds, the call is released. Any characters received from ship stations while sending *Who are you*? or coast earth station identification signals are neglected, and character groups received are not checked as to whether answerbacks are those of eligible ship stations, or not.

4.1.4 *Processing of selection signals* (except distress, urgent and safety)

The numerical information received from the ship station between the end of the ship's answerback and the end-of-selection signal is stored. It is checked to see that the inter-digit pause does not exceed 16 seconds. The call is also released should the numerical information exceed 15 digits.

In cases where the first-digit numerical information is "1", the following conversion is performed:

a) Numbers 10 and 19 are converted to a number for the information position at the Tokyo gateway.

b) Number 18, to a number for the telephone booking position at the Tokyo international telephone office.

c) Numbers 17 and 16 are also accepted for the connection to the technical operator's position at the shore station and automatic test code sender respectively.

d) Any characters received from ships between the end-of-selection signal and connect-through are ignored.

4.1.5 *Transmission of a calling signal*

After releasing the backward-busy signal, reception of the clear-confirmation signal (A polarity for 450-600 ms) is confirmed. Three seconds later, a calling signal (inversion from A to Z polarity) is sent to the gateway. Unless the clear-confirmation signal is received within five seconds, the circuit is released after returning the service signal **NC** to ship station.

4.1.6 *Response to a calling signal*

Unless proceed-to-select (a Z polarity pulse for 20-40 ms followed by A polarity for 20 ms) is received from the gateway within three seconds of it sending a calling signal, the calling signal is repeated after sending an A polarity for three seconds. If no proceed-to-select signal is received in this time, the circuit is released after returning **NC** to the ship. The gateway side is cleared after detecting the clear confirmation signal and *carrier off* (three sequential TDMA bursts missing) from the ship. Three seconds thereafter, a retest signal (a Z polarity pulse for two seconds) is periodically sent to the gateway. If the proceed-to-select signal is received while sending the

Z polarity, the retest is stopped, and the circuit status is made idle three seconds after receiving a clear-confirmation signal from the gateway. If a calling signal is detected while sending the A polarity, retest is stopped and the call is accepted.

Failure to receive a proceed-to-select signal after making five retests at one-minute intervals and, thereafter, an additional five at 30-minute intervals, causes the circuit status to be changed to a fault condition.

A head-on collision is registered and the gateway side is released if Z polarity is received continuously for more than 40 ms against a calling signal. Three seconds after receiving a clear-confirmation signal, a calling signal is again sent out. Failure to receive a clear-confirmation signal within five seconds causes the ship station to be released after returning **NC**, and the gateway is released after detecting the clear-confirmation signal and *carrier off* condition from the ship station.

4.1.7 *Sending of selection signals*

After receiving a proceed-to-select signal from the gateway, the coast earth station sends a selection signal in one of the formats shown in Table 1. The numerical information is coded using a 2-out-of-5 code.

Priority calls are connected to a special operator position at the Tokyo gateway.

The class of calling party is used for barring and other uses in the KDD network. Number 02 is assigned to MARISAT ship stations, and number 21, to priority calls.

TABLE 1

Routine	↓ Start of selection	02 Class of calling party	xxxxxxx Ship station number in the out-of-band request signal	V Delimiter	xxx---x Numerical information from ship	E End of selection
Distress, urgent and safety	↓ Start of selection	21 Class of calling party	xxxxxxx Ship station number	V Delimiter	xxx Position's number	E End of selection

4.1.8 *Response to selection*

After sending the end-of-selection signal to the gateway, the coast earth station inspects the return channel for 10 seconds to detect the gateway call-connected signal (Z polarity for 100-150 ms). The circuit is connected through if this is successfully detected.

Failure to detect the call-connected signal results in the release of the ship station after returning **NC**, the channel to the gateway being released after receiving the clear-confirmation signal, and *carrier off* from the ship station.

4.1.9 *Monitoring after through-connection* (see Figure 4)

The circuit is monitored at the coast earth station. When a clearing signal (an A polarity for 450-600 ms) is detected, either from the ship station or the gateway, the circuit is split at this point.

When clearing from the ship station, the clear confirmation signal is returned to the ship station after splitting the circuits without waiting for a clear-confirmation signal from the gateway or a *carrier off* from the ship station.

The ship status is changed to the idle condition when *carrier off* has been detected, and the circuit's status is changed to the idle condition three seconds after a clear-confirmation signal has been received from the gateway and the conditions for the detection of *carrier off* have been fulfilled.

In the case of clearing from the gateway, the circuits are split when the clearing signal is detected. Then, the ship station status is changed to the idle condition when *carrier off* is detected after the arrival of a clear confirmation signal from the ship station. At the same time, the clear confirmation signal is returned to the gateway, and the circuits status changed to the idle condition after three seconds.

Unless a clear-confirmation signal and *carrier off* are received from the ship within 60 seconds of sending a clearing signal to the ship, or unless *carrier off* is received from the ship within 60 seconds of sending a clear-confirmation signal to the ship, a backward busy signal is sent to the gateway, and *channel release* command is sent to the ship, five times at intervals of one minute. *Carrier off* is then expected. Failure to detect *carrier off* causes the circuits and ship stations to be regarded as having failure status.

If *carrier off* is detected when release is not detected in both directions, the circuits are split, and clearing signals are sent to both the ship station and the gateway. A backward busy signal is sent to the gateway after receiving a clear-confirmation signal from the gateway. When *carrier off* is detected prior to a clear-confirmation signal after sending a clearing signal to the ship, an A polarity is sent for three seconds to the gateway, following which a backward busy signal is sent. In either case, a backward busy signal is sent for 50 seconds after receiving *carrier off*, and the circuits are made idle three seconds thereafter. The ship station is made idle when *carrier off* is detected.

If five continuous *full stops* (ITA 2 combination No. 13) or *commas* (ITA 2 combination No. 14) are received from the ship station together with release and *carrier-off*, the circuits are split for 600 ms. During this time, an A polarity is continuously sent to the gateway, and a Z polarity, to the ship stations.

For *carrier off* with less than three sequential TDMA bursts, the circuits are maintained in a condition of through-connection, and characters stored are sent to the ship station when the carrier recovers.

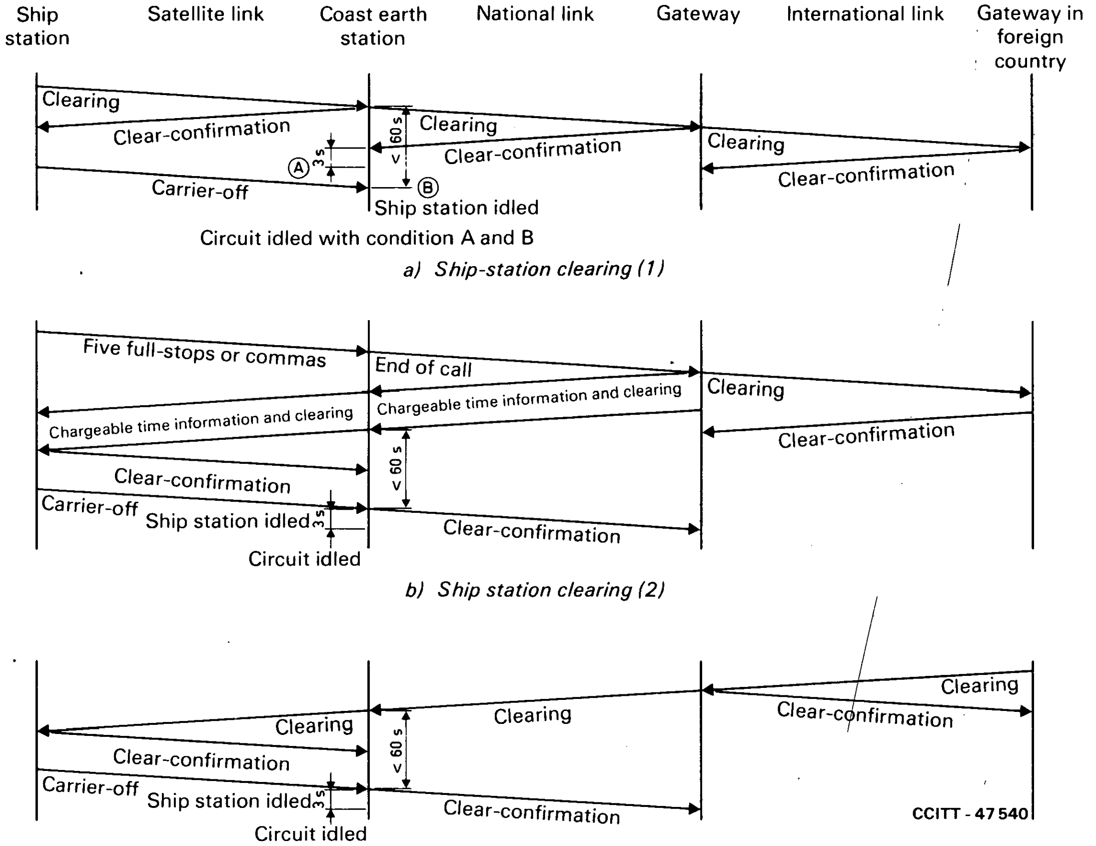
4.2 *Shore originated call* (See Figure 5)

4.2.1 *Sending of proceed-to-select signal*

When a calling signal from the gateway is detected (Z polarity for 100 ms), a proceed-to-select signal (Z polarity for 25 ms) is sent in response to it.

4.2.2 *Processing of selection signal*

After sending a proceed-to-select signal to the gateway, the coast earth station monitors the channel for 16 seconds to detect the start-of-selection signal (ITA 2 combination No. 29). If it fails to receive it, the circuit status is changed to a hold condition until the receiving line from the gateway is cleared. The characters received after receiving the start-of-selection signal are stored while performing inter-digit pause monitoring for 16 seconds, until an end-of-selection (ITA 2 combination No. 5) is received. Should a failure be detected the gateway is released after returning the service signal **NC**.



a) Ship-station clearing (1)

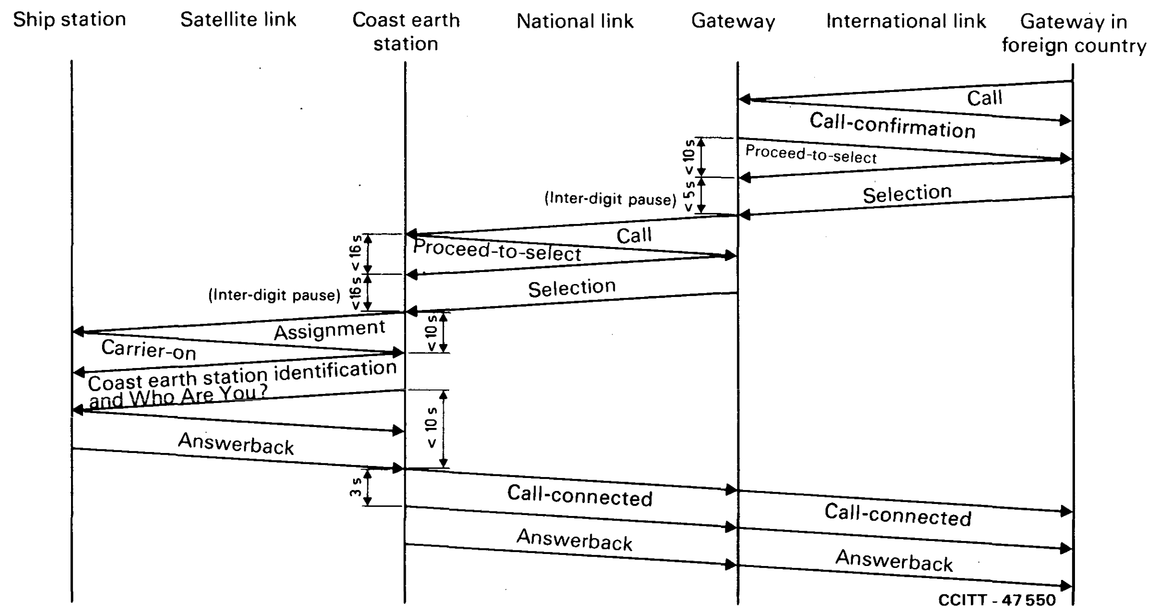
b) Ship station clearing (2)

c) Gateway clearing

Note — A detail interface between gateways is mentioned in Figures 2 and 4 of Supplement No. 1, CCITT Orange Book Volume VII.

FIGURE 4

Clearing



Note: A detail interface between gateways is mentioned in Figures 2 and 4 of Supplement No. 1, CCITT Orange Book Volume VII.

FIGURE 5

Shore originated call

The formats of selection signal received are as follows. Numerical information is coded using the 2-out-of-5 code.

↓	xx	V	xxxxxxx	E
Start of selection	Class of calling party	Delimiter	Ship station number	End of selection

Checks made to the ship station number and to the service signals returned to the gateway are given in Table 2.

TABLE 2

Checks	Service signal
Ship station is engaged	**OCC**
Ship station is not authorized	**NA**
Ship station is out of service (failure to stop carrier)	**DER**
Ship station number is other than seven digits	**NP**

Checks made to selection signals and service signals are given in Table 3.

TABLE 3

Checks	Service signal
Checking of 2-out-of-5 codes	**NC**
Checking of class of calling party for broadcast	**NA**

The kinds of class of calling party are: 1) foreign subscribers, 2) domestic subscribers and 3) service. At present, only service calls are accepted for broadcast calls.

4.2.3 *Response to assignment*

If a carrier is not received in the assigned channel within 10 seconds of sending an assignment, the call to the ship station is repeated by sending an assignment of the same content. If a carrier is not received within a further 10 seconds, the ship station is released, and the gateway is released by returning the service signal **ABS**.

4.2.4 *Response to coast earth station identification*

After receiving a carrier from the ship station, the coast earth station identification and "Who are you?" signal are sent. If the answerback sequence (group of 20 characters) is not received from the ship station within 10 seconds of the completion of the coast earth station identification, the gateway is released by returning **DER**. Characters from the ship other than the 20-character group are ignored until the sending of the station identification has been completed. Characters received between the end of the 20-character group and connect-through are returned to the ship station as they are received.

4.2.5 *Through-connection*

After receiving the answerback sequence from the ship station, a call-connected signal (a polarity inversion to a Z polarity) is sent to the gateway. Three seconds thereafter, the stored answerback sequence from the ship station is sent.

4.2.6 *Monitoring after through-connection*

This is the same as the procedure for a ship originated call.

4.3 *Broadcast* (See Figure 6)

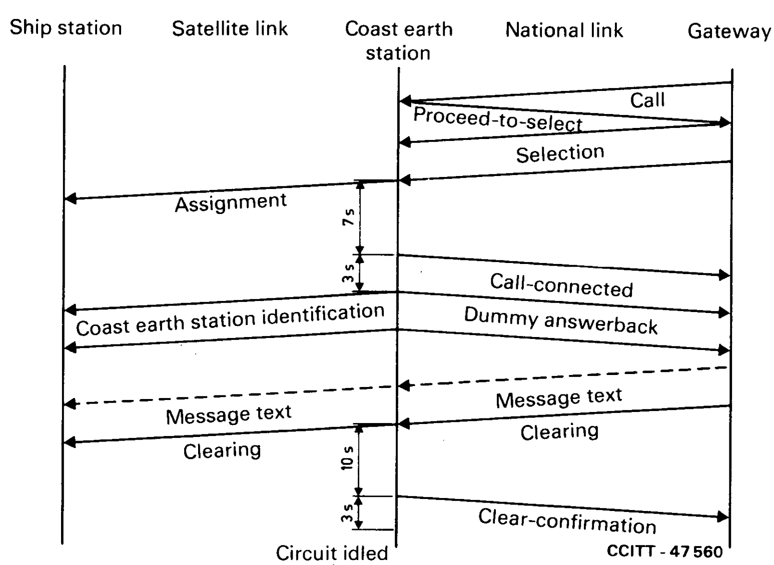


FIGURE 6

Broadcast call

4.3.1 *Call-connected signal*

Seven seconds after sending an assignment, a call-connected signal is returned to the gateway.

4.3.2 *Coast earth station identification and dummy answerback*

Three seconds after returning a call-connected signal, a dummy answerback in the following format is returned to the gateway, and coast earth station identification is returned to the ship:

$$\downarrow < \equiv \downarrow\downarrow \mathbf{GA} \rightarrow \uparrow \mathbf{xxxxxxx} \downarrow < \equiv \downarrow$$

Where **xxxxxxx** is the ship station number in the selection signals from the gateway.

The circuit is connected through after completing the return of the dummy answerback.

Reference

[1] CCITT Recommendation *Plan for telex destination codes*, Vol. II, Fascicle II.4, Rec. F.69.

Supplement No. 3

TELEX SIGNALLING ARRANGEMENTS IN THE NORDIC MARITIME SATELLITE COAST EARTH STATION

(*Source:* Norway)

1 Introduction

1.1 In response to Recommendation U.4, this supplement describes the signalling conditions of the Nordic maritime satellite coast earth station.

1.2 The coast earth station is planned to commence operation in the autumn of 1981. The station will be located at Eik in the south western part of Norway.

1.3 The station will provide fully automatic telex service to ships in the Maritime Satellite Service operating in the Indian Ocean region. The station will operate as an international gateway exchange connected to the international exchange in Oslo which for this purpose will act as a transit exchange.

Since the station has full switching capabilities for telex, it may also be connected to other international gateway exchanges but the traffic is expected to be too small at the outset to merit such a solution.

1.4 It should be noted that some of the timings required in order to interwork properly with the maritime satellite system will be different from those otherwise encountered towards the gateway exchange in Oslo.

2 Numbering and routing

2.1 At the outset the station will accept ship identities in accordance with the MARISAT numbering plan, i.e. seven digit octal numbers. The station is prepared for accepting six digit decimal numbers in accordance with Recommendation F.120/E.210 [1] and will furthermore be capable of operating with a mixed numbering plan during the period of transition from MARISAT numbers to CCITT numbers.

2.2 The F.69 [2] code to be used towards the coast earth station will be 583.

2.3 Provisions for group calls to ships will be made available. However, only calls to all ships in the ocean region will be provided at the outset (i.e. using MARISAT numbers 1 000 000 or CCITT numbers 000 000).

When the new numbering plan of Recommendation F.120/E.210 [1] is introduced, group calls to other groups of ships will also be provided for.

The procedure used for authorization of the calling subscriber is that defined in Recommendation U.61. At the outset a group call facility may be offered to 100 subscribers.

3 Operator facilities

No operator facilities will be provided at the coast earth station. However, such facilities will be offered at the gateway exchange in Oslo for traffic from other countries.

4 Telegram service

Telegrams to ships from telegram positions may be sent automatically using telex procedures.

5 Signalling

5.1 The timing diagrams for incoming traffic which is routed in transit via Oslo are shown in Figure 1. For completeness Figure 2 shows diagrams for traffic routed directly to the coast earth station. In both cases fully automatic working using type A signalling is provided for.

5.2 *Traffic via Oslo* (Figure 1)

5.2.1 The first selection signal (combination No. 30) should be received within 15 s after sending the proceed-to-select signal. All selection signals including the F.69 [2] code, 583, of the Maritime Satellite Service must be sent en bloc at machine speed. The selection signals must always include the end-of-selection signal, combination No. 26 (+).

The class-of-traffic signal must be one of the combinations, No. 1, 11 or 21.

Note – Since the gateway exchange in Oslo now will offer transit routing to the coast earth station, the selection signals for calls terminating in Norway must include the F.69 [2] code (56) allocated to Norway.

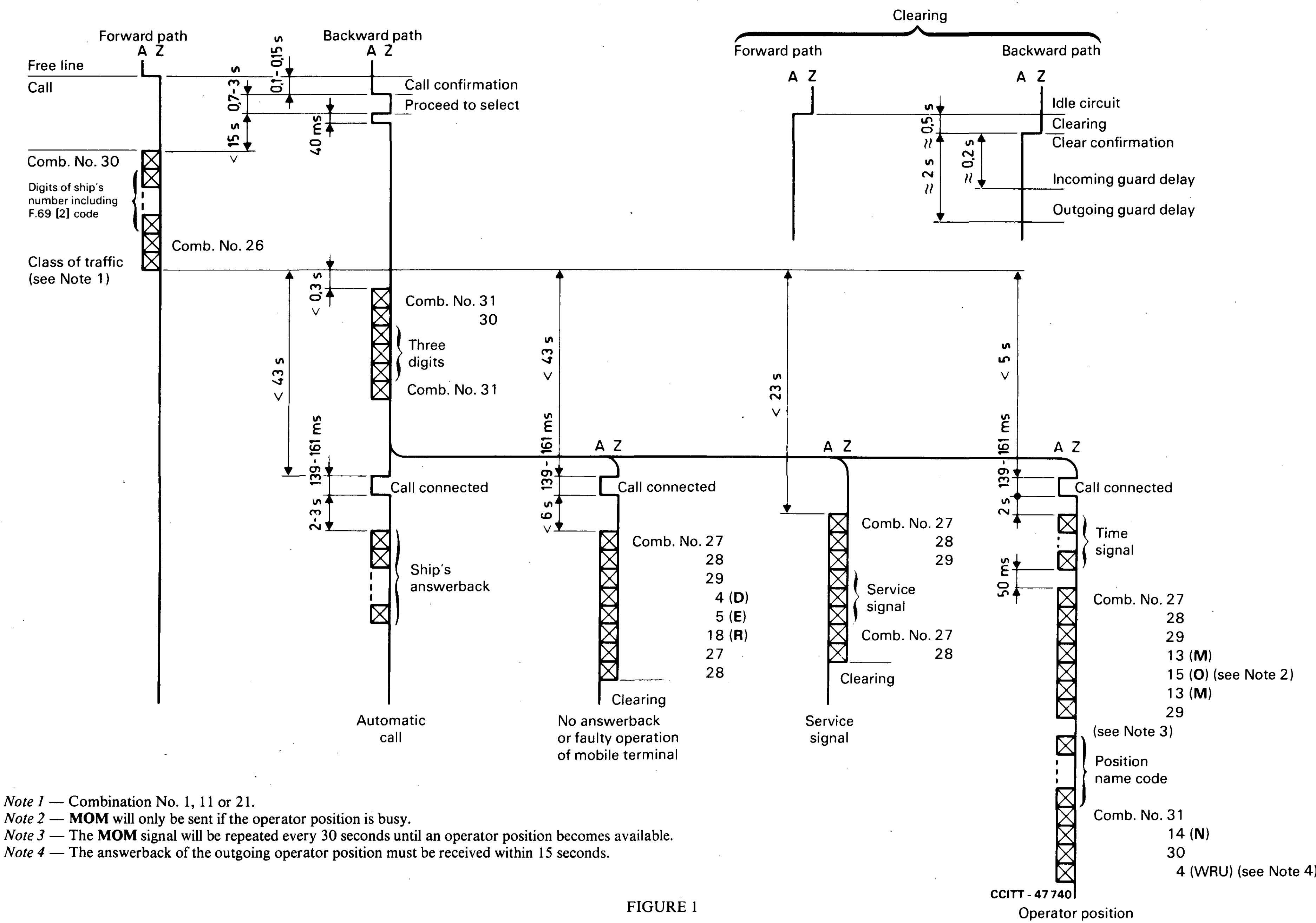
5.2.2 The selection signals are acknowledged by a group of three digits.

5.2.3 The call-connected signal is sent by the coast earth station when the first character of the ship's answerback has been received at the coast earth station. The call connected signal may in exceptional cases be delayed by as much as 43 seconds relative to the last selection signal. This delay takes into account maximum delays encountered in the various stages of connecting the maritime terminal, i.e.

- through-connection delay at the gateway exchange in Oslo,
- transmission delays,
- queuing delays at the coast earth station (number analysis, access to the assignment channel),
- framing delays of the satellite telex channels,
- delays in repeating the assignment message at the Network Coordinating Station (NCS),
- response time of the ship station to return the answerback.

5.2.4 The outgoing exchange must not send the WRU signal in order to obtain the ship's answerback because the answerback will be sent automatically by the coast earth station, 2 to 3 seconds after the call connected signal.

Note – The ship's answerback will be stored at the coast earth station so that it may be returned at the machine speed whenever a WRU signal is detected on the forward path during conversation. This has been done because the 20 characters of the answerback as received from the ship may contain intervals of Z polarity of one character duration due to speed differences between the synchronous satellite channel and the on-board teleprinter. This would avoid misoperation of automatic sending equipment at the outgoing end such as store-and-forward facilities. However, the WRU signal thus received will be sent to the ship so that the continuity the connection is verified before the answerback is returned.



Note 1 — Combination No. 1, 11 or 21.
Note 2 — **MOM** will only be sent if the operator position is busy.
Note 3 — The **MOM** signal will be repeated every 30 seconds until an operator position becomes available.
Note 4 — The answerback of the outgoing operator position must be received within 15 seconds.

FIGURE 1

Telex calls to Nordic maritime satellite coast earth station via Oslo

5.2.5 The coast earth station is capable of returning the service signals **OCC**, **NA**, **NP**, **NC**, **DER** and **ABS**.

The service signals are sent subject to the following conditions:

- **NA**: access barred (e.g. group call from nonauthorized subscriber or ordinary call to nonauthorized ship);
- **OCC**: ship terminal busy (in most cases this will imply that the ship is busy with either another telex call or a telephone call);
- **NC**: congestion at the coast earth station or at the network coordinating station;
- **NP**: nonallocated ship number (e.g. incomplete selection information);
- **ABS**: ship is unavailable (e.g. ship is not within the coverage area of the satellite or ship terminal is out of service);
- **DER**: ship terminal equipment out of order (e.g. call set-up failure or no response to WRU).

Service signals **OCC**, **NA**, **NP** or **NC** will in the worst case not be delayed by more than a few seconds. However, **ABS**, will always be delayed by at least 10 seconds.

5.3 *Calls to operator position* (Figure 1)

5.3.1 The selection signals must in this case be composed of the F.69 [2] code to Norway (56) followed by the three digits 000, the end-of-selection signal (combination No. 26) and a class of traffic signal which may be any of the combinations No. 1, 11 or 21. The selection signals must be sent en bloc at machine speed.

5.3.2 The call connected signal will be sent within 5 seconds after receipt of the last selection signal.

5.3.3 The call connected signal will be followed by a time signal within 2 seconds.

If the operator position is free, the position's name code followed by WRU will be sent immediately after the time signal.

5.3.4 If the position is busy, the call connected signal will be followed by a time signal and the **MOM** service signal. The **MOM** signal will be repeated every 30 seconds until an operator position becomes available. When the operator position is connected, the position's name code followed by Who Are You? will be sent.

5.3.5 The answerback of the outgoing operator position must be received within 15 seconds. Otherwise the call will be cleared without a service signal. (See Note 4 to Figure 1.)

5.4 *Direct connections to the coast earth station* (Figure 2)

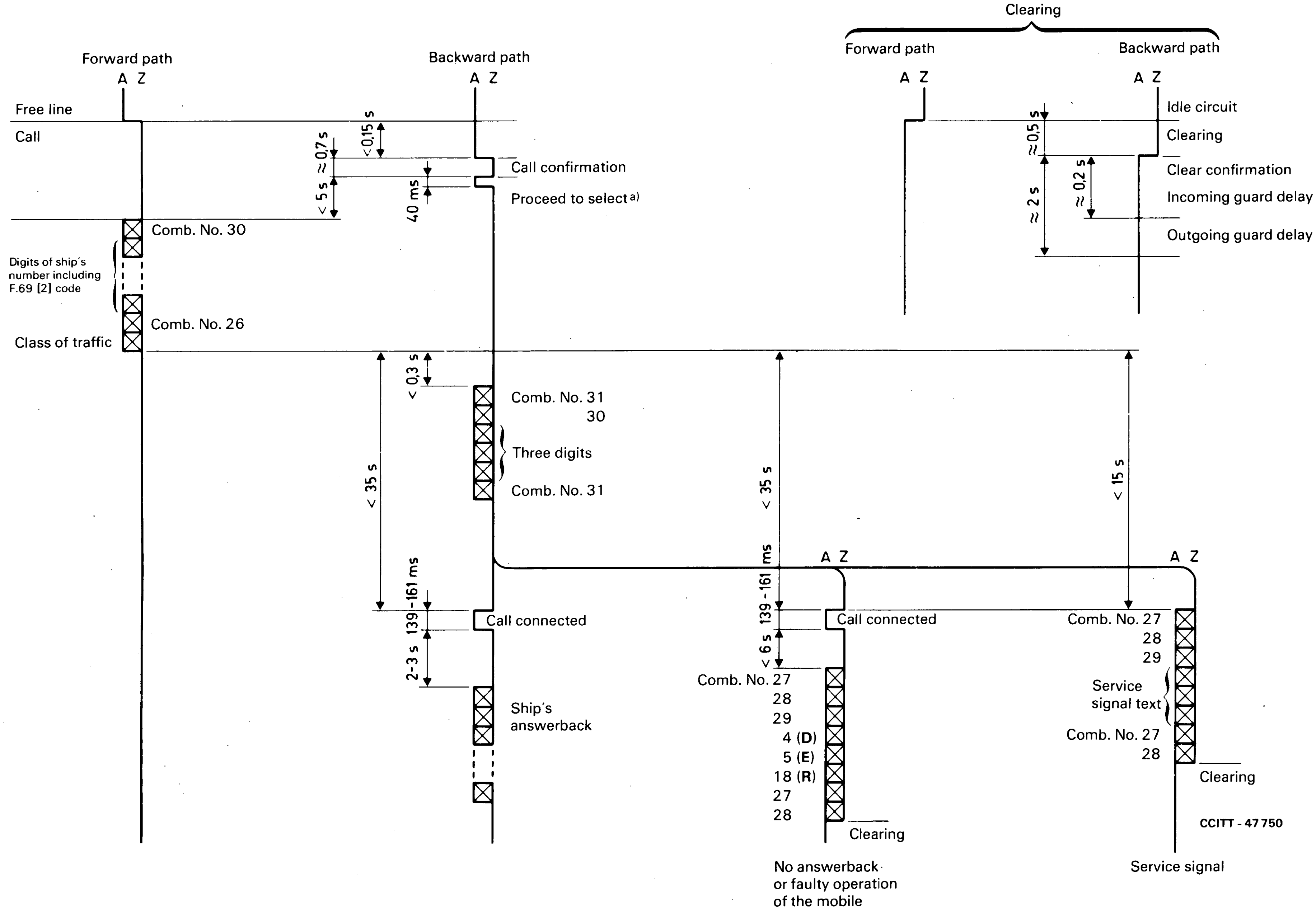
The same signalling procedures apply as for calls transitted through Oslo. However, the following should be noted:

5.4.1 The selection signals must in this case also be composed of the F.69 [2] code 583 followed by the ship's number, the end-of-selection signal combination No. 26 and a class of traffic signal which may be any of the combinations No. 1, 11 or 21. The selection signals must be sent en bloc at machine speed.

5.4.2 The proceed-to-select signal will be returned approximately 0.7 seconds after receipt of the call confirmation signal.

5.4.3 The first character of the selection signal must be received within 5 seconds relative to the proceed-to-select signal.

5.4.4. The time delay between the last character of the selection signal and the call connected signal will not exceed 35 seconds.



a) Comb. No. 22 is used as proceed to select signal.

FIGURE 2

Telex calls to Nordic maritime satellite coast earth station

References

[1] CCITT Recommendation *Ship station identification for VHF/UHF and maritime mobile-satellite services*, Vol. II, Fascicle II.4, Rec. F.120.

[2] CCITT Recommendation *Plan for telex destination codes*, Vol. II, Fascicle II.4, Rec. F.69.

Printed in Switzerland — ISBN 92-61-01131-4