THE INTERNATIONAL TELEGRAPH AND TELEPHONE CONSULTATIVE COMMITTEE

CCITT

SIXTH PLENARY ASSEMBLY

GENEVA, 27 SEPTEMBER - 8 OCTOBER 1976

ORANGE BOOK

VOLUME VII

TELEGRAPH TECHNIQUE

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

ORANGE BOOK

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

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PRELIMINARY NOTE

In this Volume, 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)

a) 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) 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).

For these reasons, the CCITT *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.

Note. – See also Definition No. 52.28/53.30 in the 2nd Supplement to Part 1 of the *List of Definitions of Essential Telecommunication Terms* (Data Transmission).

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)

For separate measurements of the degrees of characteristic distortion, bias distortion and fortuitous distortion affecting a telegraph modulation or restitution, the following is recommended:

1. Measure the degree of overall distortion (at the actual mean modulation rate) on text, for instance on the text of Recommendation R.51 (**Q.95** text). Let Δ be the measurement obtained.

2. Measure the degree of distortion on reversals at the modulation rate used in measurement 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 (**Q.95** 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, and Mar del Plata, 1968)

The CCITT

in view of Recommendations R.51, R.54 and R.55,

considering

a) 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;

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

c) 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;

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;

5. that the observation time 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)

a) 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) 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.

For these reasons, the CCITT *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)

1. In general the isochronous standardized test distortion δ (Definitions 33.07 and 33.12 of the *List of Definitions of Essential Telecommunication Terms*) 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

$\delta_{inherent}$ = 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),

$\delta_{irreg.}$ = 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 $\delta_{inherent}$ and δ_{text} calculated with the aid of the above formulae is $(20/100)p$.

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SECTION 2

VOICE-FREQUENCY TELEGRAPHY

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 following capacities of telegraph channels:

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.

7. PCM (pulse code modulation) channels complying with Recommendation G.712 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.

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.

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 new 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 ± 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%.

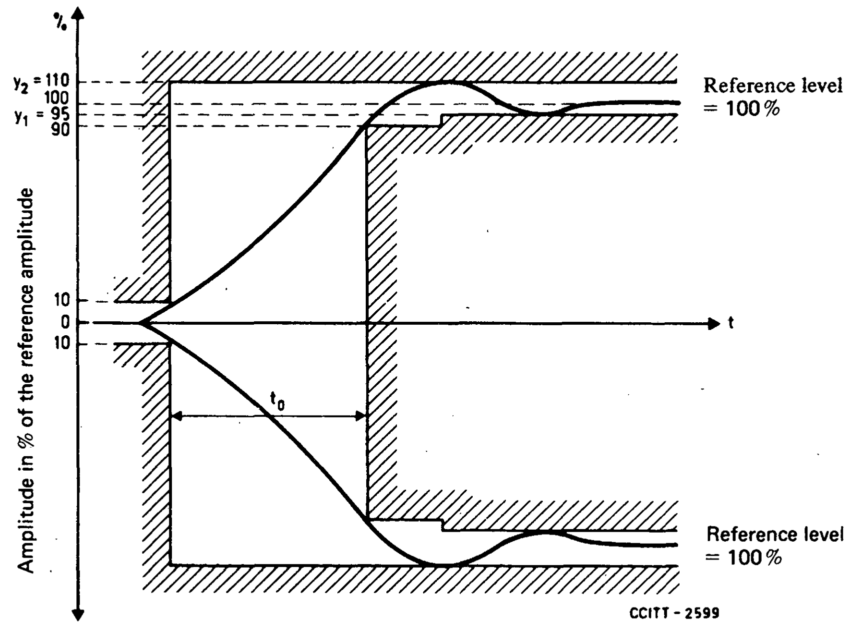


FIGURE 1/R.31 – **Diagram of tolerances to assess the waveform of the sent signals in AMVFT systems**

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 of frequency F_0 and the voltage at the frequencies $F_0 \pm 5 f_p$ must not exceed 0.4% of the nominal voltage of 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 Supplements Nos. 11 and 12 of the *Blue Book*, Volume VII). 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 1/R.31.

TABLE 1/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.

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 and 1976)

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 new 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 by more than 2 Hz from their nominal value.

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.

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, although a difference of 70 Hz may be used by agreement between the Administrations concerned. In this latter case, the absolute value of the unbalance δ due to the modulation process must be less than 3%.

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

7. The total average power transmitted to the telephone-type circuit by all the channels of a system is normally limited to 135 microwatts 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.

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.

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.

TABLE 1/R.35 – **Normal limits for the power per telegraph channel in frequency-modulated voice-frequency telegraph (FMVFT) systems**

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	11.25	−19.5
18	7.5	−21.25
24	5.6	−22.5

Note. – Some Administrations have bilateral agreements to reduce the power level of FMVFT aggregates to −13 dBm0 (50 μW0 instead of 135 μW0), provided the bearer circuit meets certain limits, see Recommendation H.23.

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.

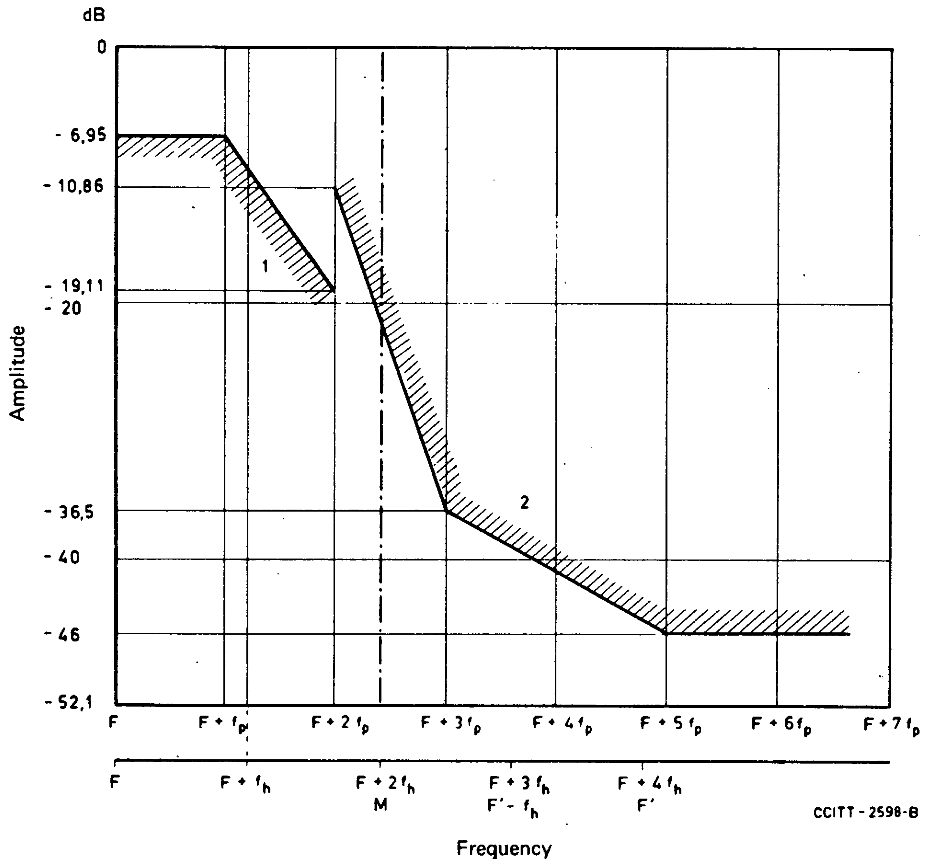
12. The receiving equipment should operate satisfactorily when the receiving level falls to 17.4 dB below the nominal level. The receiving equipment should have been restored to start polarity when the receiving level has fallen to 23.5 dB below the nominal level. The nominal level is the level resulting from the choice of power per channel (see Table 1/R.35) 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 ± 2 Hz 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.

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).



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**

d) By introducing a frequency drift (Δf Hz) of the signals, during transmission through the artificial line, Δf being not more than 5, and the initial condition of the test otherwise being preserved: (5 + 2.5 Δf 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, 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. 3300 Hz or, preferably, 300 Hz are 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 modulation conditions is fixed at two; this number may be increased, if necessary, by agreement between the Administrations concerned.

Recommendation R.35 *bis*

50-BAUD WIDEBAND VFT SYSTEMS

(Geneva, 1964)

a) 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) 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) In particular, if telephone-type circuits carrying VFT systems are unstable, the use of wideband channels together with frequency modulation is recommended.

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

For these reasons, the CCITT *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 MORE THAN 50 BAUDS

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

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

1. The CCITT has examined characteristics for telegraph circuits for more than 50 bauds. It noted that modulation rates of 75, 100, 150 and 200 bauds had been envisaged. The CCITT considers that the types of channels to be provided should not correspond to such a detailed subsidivison, for two reasons:

a) the rate of 75 bauds can obviously be used over a 100-baud channel and, in some cases, over a 50-baud channel; similarly, the rate of 150 bauds can obviously be used over a 200-baud channel and, in some cases, over a 100-baud channel;

b) the lease rates envisaged are such that differences in tariffs between 75-baud and 100-baud channels or between 150-baud and 200-baud channels will be relatively slight.

2. The CCITT therefore proposes to create so-called 100-baud channels and 200-baud channels, in addition to the 50-baud channels that have already been standardized.

Note. – The channel performance at the modulation rate of 75 bauds on one link of the standardized 120-Hz spacing system (Recommendation R.35) is quite satisfactory. 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 refer to

Recommendation R.57 and to assume that the limit values that appear in this Recommendation are applicable to the use of 50-baud channels for 75 bauds. However, the CCITT confirms the basic principle that the standard transmission channel for the rate of 75 bauds is a 100-baud channel, which is standardized in Recommendation R.37, and not a 50-baud channel. Such a use of 50-baud channels is recommended only in a special case, due to bandwidth economy, use of long-distance submarine cables, other line conditions, etc.

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 will not be constituent elements of the channel, for their presence prevents any flexibility as regards assignment of the channel for various uses.

5. With regard to channels for 200 bauds, it has been agreed that the spacing of 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 Administrations, which will generally be the case for 3-kHz band circuits on long submarine cables, the use of 360-Hz spacing between 200-baud telegraph channels is justified.

6. For that reason the four Recommendations following (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, R.38 B to homogeneous systems.

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

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

Distortion (%)	Recommendation				
	R.35 (50 bauds 120 Hz)	R.35*bis* (50 bauds 240 Hz)	R.37 (100 bauds 240 Hz)	R.38 A (200 bauds 480 Hz)	R.38 B (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	($5+2.5\ \Delta f$)		($5+1.3\ \Delta f$)	($5+0.7\ \Delta f$)	($6+1.2\ \Delta f$)

Recommendation R.36

CO-EXISTENCE 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)

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 point 13.a) of Recommendations R.37, R.38 A, or R.38 B respectively.

1.4 The mean power transmitted in the line at a point of zero relative level is normally limited to 135 microwatts for all the channels in the system. The mean normal power for each channel should not exceed:

9 μW for a 50-baud/120-Hz channel operated with amplitude modulation;

5.6 μW for a 50-baud/120-Hz channel operated with amplitude modulation (see Table 1/R.35);

11.25 μW for a 100-baud/240-Hz channel, provided the condition mentioned under 1.2 above is respected;

19.2 μW for a 200-baud/360-Hz channel, provided the condition mentioned under 1.2 above is respected;

22.4 μW for a 200-baud/480-Hz channel, provided the condition mentioned under 1.2 above 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.

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

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 and 1976)

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 new 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 by more than ± 3 Hz from their nominal value.

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;

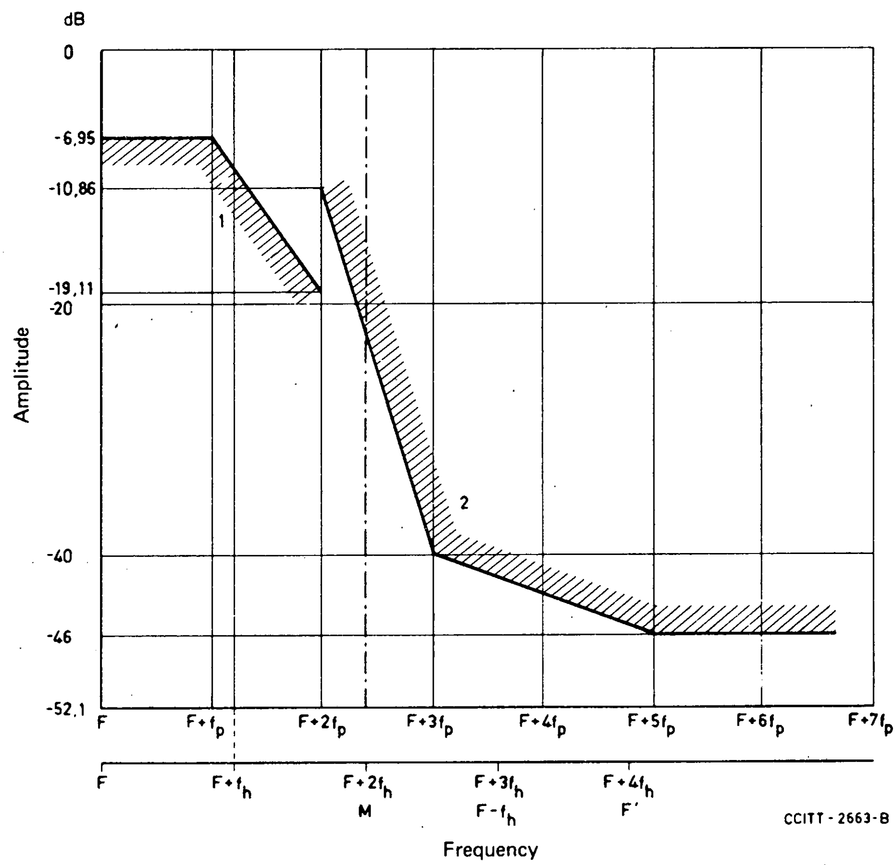
$$\delta = 2\frac{|F'_0 - F_l|}{F'_A - F'_Z} = 4\frac{|F'_0 - F_m|}{F'_A - F'_Z}$$

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 mean power per channel at relative zero level should not be more than 11.25 microwatts.



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**

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.

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 artifical 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 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, and the initial condition of the test otherwise being preserved: (5 + 1.3 Δf 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. 3300 Hz or, preferably, 300 Hz are 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.

Recommendation R.38 A

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

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

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

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 new numbering of channels that has been adopted in the international service see Recommendation R.70 *bis*.

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

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.

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 mean power per channel at relative zero level should not be more than 22.4 microwatts.

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).

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 $2\,f_r$ (f_r = 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 ± 4 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.

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. 3300 Hz or, preferably, 300 Hz are 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.

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 and 1976)

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

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).

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 $\pm$ 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 Δf 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 $\pm$ 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 $\pm$ 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.

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.

A. RADIO CIRCUITS THE FREQUENCY OF WHICH IS BELOW APPROXIMATELY 30 MHz

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.).

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.

3. *Synchronous telegraphy operating at approximately 100 bauds* (see CCIR Recommendation 436-1)

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

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

B. RADIO CIRCUITS WHOSE FREQUENCY IS GREATER THAN APPOXIMATELY 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.

SECTION 3

SPECIAL CASES OF ALTERNATING CURRENT TELEGRAPHY

Recommendation R.40

CO-EXISTENCE 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.

Recommendation R.42

NON-SIMULTANEOUS TRANSMISSION OF TELEPHONY AND TELEGRAPHY ON LEASED INTERNATIONAL TELEPHONE-TYPE CIRCUITS

(former CCIT Recommendation B.19, Geneva, 1951; amended at Arnhem, 1953, and at Geneva, 1956 and 1964)

Note. – This Recommendation applies to telegraphy using amplitude or frequency modulation. The modulation rate may be 50 bauds or more.

The CCITT,

considering

that the CCITT has issued Recommendations on the subject of alternate transmission of telegraphy or telephony on leased international telephone-type circuits (see former Recommendation H.31, *Green Book*, Volume III-2),

unanimously declares the following view:

1. The mean frequency of 1500 Hz is recommended for private telegraph transmissions between telephone stations permanently connected by leased international circuits.

2. For the steady telegraph emission of a continuous tone, a maximum power of 0.3 mW (corresponding to an absolute power level of about −5 dB) at a point of zero relative level is allowed. When leasing an international circuit that might be used for such telegraph transmissions, it is advisable to ensure, by measurements, that this limit is not exceeded.

3. Administrations and private operating agencies concerned are responsible, as regards their own national networks, for taking the necessary precautions to avoid interference to their domestic telephone services from such telegraph transmissions. Such precautions may consist in limiting the telegraph transmission power or the duration of use of telegraphy, or may concern the method of telegraph transmission.

4. Voice-frequency ringing sets on circuits leased for private telegraph transmissions between two permanently connected telephone stations must be insensitive to telegraph signals. It has been observed that one existing type of ringing set is sensitive to them, but measures may be taken to correct such ringing sets so that there is no great difficulty for the frequency chosen.

5. The maximum limit of 250 milliseconds adopted for the hangover time of echo suppressors on international telephone circuits does not appear long enough to suppress (even partially) the transmission of the answer-back signals when start-stop apparatus reply.

Secretarial Note. – Since the VIth Plenary Assembly of the CCITT agreed to delete former Recommendation H.31 *(Private telegraph transmission on leased international circuit with alternative private telephone service)* on the advice of Joint Working Party LTG, Study Group IX may need to consider whether Recommendation R.42 should be deleted or amended.

Recommendation R.43

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

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

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 and H.32 of the CCITT;

b) that standardization of the characteristics of apparatus 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 circuit;

c) 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 multiplied,

unanimously declares the view

1. that, in the case of the simultaneous use of a telephone- type circuit for telephony and telegraphy, the telegraph signal, if continuously transmitted, should be maintained at or below a level of -13.0 dB at a point of zero relative level;

2. that not more than three such circuits should be included in any one primary group of 12 telephone-type circuits nor more than 15 in any one coaxial cable system;

3. that the telegraph signals transmitted must not interfere with any signalling apparatus that may remain connected to the circuit,

and notes

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

Recommendation R.44

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 Supplement No. 8 to Volume VII of the *White Book*, 1968).

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 (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 the Annex to this Recommendation.

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

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

(1B4, phasing control only)

1B1/3, 2B1/3, 3B1/3, 4B1/3, 5B1/3, 6B1/3	half rate
– , 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	

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) or 2 elements (48 11/18 ms)	For Z polarity, 33 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
(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 the *List of Definitions of Essential Telecommunication Terms* (Definition 31.38).

Note 2. – See Recommendation S.4.

Recommendation R.49

INTERBAND TELEGRAPHY OVER OPEN-WIRE 3-CHANNEL CARRIER SYSTEMS

(New Delhi, 1960)

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.

For these reasons, the CCITT *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 B. of Recommendation G.361.

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*:

2.2.1 telephone channels occupying the frequency band 18 and 30 kHz:

30.42 – 30.54 – 30.66 and 30.78 kHz;

2.2.2 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*:

3.2.1 telephone channels occupying the frequency band 18 and 30 kHz:

30.18 and 30.30 kHz;

3.2.2 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 2.2.2 and 3.2.2 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 $\pm$ 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.

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SECTION 4

TRANSMISSION QUALITY

Recommendation R.50

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

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

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%.

Recommendation R.51

DETERMINATION OF THE STANDARDIZED TEXT FOR DISTORTION TEST OF THE ELEMENTS OF A COMPLETE CIRCUIT

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

The CCITT,

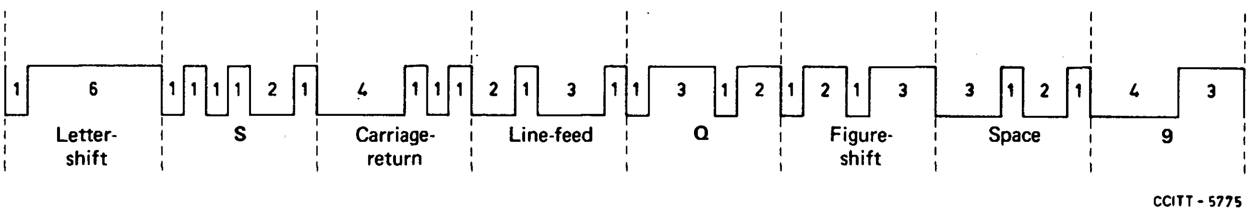
considering

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 the following:



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:

2.1 the specified text for the measurement of the degree of distortion;

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

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

2.4 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.

Recommendation R.52

STANDARDIZATION OF AN INTERNATIONAL TEXT FOR THE MEASUREMENT OF THE MARGIN OF START-STOP EQUIPMENT

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

The CCITT *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 it would be of interest to recommend to the operating Administrations the use of either of the following texts according to choice:

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)

a) 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.

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

c) 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) 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) 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.

For these reasons, the CCITT *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 Supplements No. 4 and No. 5 in the *Blue Book*, Volume VII, and the annex to Question 7/IX in the same Volume.

Recommendation R.55

CONVENTIONAL DEGREE OF DISTORTION

(Geneva, 1964)

a) The conventional degree of distortion is (Definition 33.14 from the *List of Definitions of Essential Telecommunication Terms*) 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) For standardized start-stop 50-baud systems, the assigned value is 1 per 100 000 (Recommendation R.54).

c) 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.

For these reasons, the CCITT *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 TO BE APPLIED IN PLANNING 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)

a) 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) 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) 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) On well-maintained channels, with modulation at the standard rate of 50 bauds, the following values 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.

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%

For the above reasons, the CCITT *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.

1.1 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%

1.2 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

1.3 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 1.2 and 1.3 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).

1.4 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 of the *List of Definitions of Essential Telecommunication Terms*) 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)

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

d) 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.

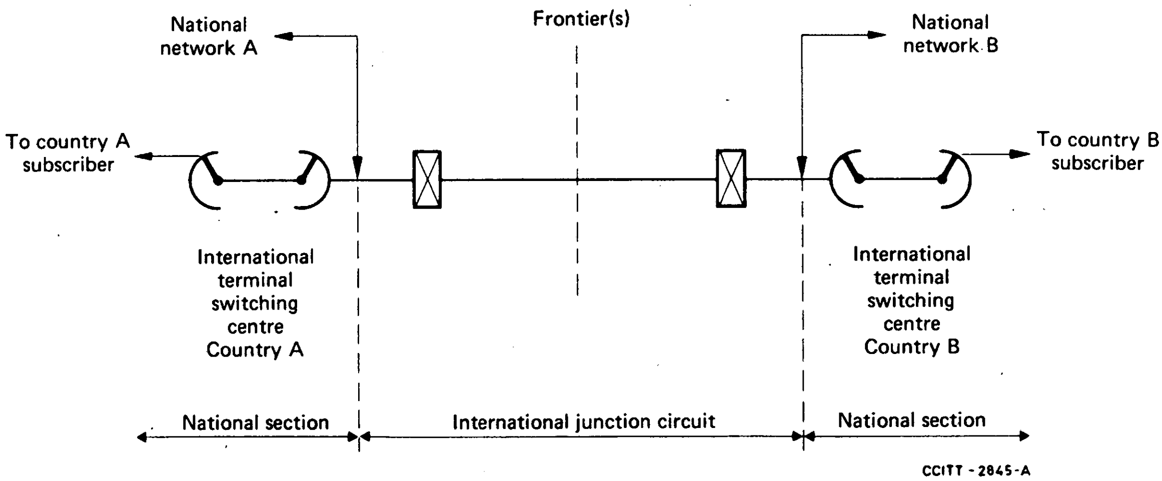


FIGURE 1/R.58 – Network diagram

For the above reasons, the CCITT *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):

1.1 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.

1.2 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 1.1 and 1.2 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 1.1 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 1.1 above.

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

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 (EXCEPT WHERE RECOMMENDATION R.61 IS APPLICABLE)

(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 of the *List of Definitions of Essential Telecommunication Terms*) 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).

Recommendation R.61

CONDITIONS TO BE FULFILLED BY REGENERATIVE REPEATERS EMPLOYED FOR 7-UNIT START-STOP TRANSMISSION WITH A MODULATION RATE OF 50 BAUDS

(former CCIT Recommendation B.21, 1951; amended at Geneva, 1956)

The CCITT,

in view of Recommendation R.62 regarding the siting of regenerative repeaters in international telex circuits and of Recommendation S.3 on the transmission cycle of start-stop apparatus;

considering

a) that, as there are at present large numbers of start-stop intstruments having a 7-unit transmission cycle, it is necessary to define the conditions to be satisfied by 7-unit regenerative repeaters;

b) that, since it is unlikely that the growth of the international telex network will demand the use of regenerative repeaters on transit international trunk circuits for some years, the regeneration of 7-unit signals need only concern those Administrations having start-stop instruments that transmit 7-unit signals,

Note. – Administrations are recommended to withdraw any apparatus that does not transmit at the rate of 7.5 (or a minimum of 7.4) units for the international service as far as possible, owing to the difficulty of regenerating 7-unit start-stop signals when they are sent automatically.

unanimously declares the view

1. that the duration of the stop element should never be less than 18 milliseconds, and consequently the mean speed must be:

   a) either the theoretical speed, with a tolerance of ± 0.1% in which case it is necessary to employ a device to control the duration of the stop signal;

   b) or the mean speed of the transmitter, with a suitable tolerance, in which case such a device is unnecessary;

2. that the degree of gross start-stop distortion of the retransmitted signals, including the stop signal, should be less than 10%;

3. that the synchronous margin should not be less than 40%;

4. that it seems desirable to permit dialling pulses to bypass the regenerative repeater when the transmission of these pulses has to be envisaged, but that the study of this question should, however, continue;

5. that the arrangements to be adopted for the present for the transmission of dialling pulses should be bilaterally agreed between the Administrations concerned;

6. that the regenerative repeaters should be capable of retransmitting the various supervisory signals employed in switching systems (except that when arrangements are made for the dialling pulses to bypass the regenerative repeater it could equally be unnecessary for certain of the supervisory signals to be transmitted by the regenerative repeater).

Recommendation R.62

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), 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.

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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:

2.1 general telegraph service circuit (the general telegraph service, Definition 01.14 of the *List of Definitions of Essential Telecommunication Terms*);

2.1.1 point-to-point circuit or circuit used for messages switching: TG

2.1.2 trunk circuit (Definition 35.12) of the public switching network (gentex): TGX

2.1.3 subscriber's line (Definition 35.11) from a telegraph office to its switching equipment: TGA

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

2.3 special circuits for private or special services:

2.3.1 point-to-point circuit or circuit used for message switching: TGP

2.3.2 switched circuit or multi-point network circuit [broadcasting network, conference, omnibus (Definiton 32.44) circuits]: TXP

2.4 service circuits:

2.4.1 point-to-point circuit: TS

2.4.2 omnibus or selective ringing circuit section: TXS

2.4.3 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.

Recommendation R.70 *bis*

NUMBERING OF INTERNATIONAL VFT CHANNELS

(Mar del Plata, 1968)

a) 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) 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.

The CCITT therefore *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
Channel No.	101	102	103	104	105	106	107	108	403	404	117	118	210	211	212	2 channels-200 bauds/480 Hz 3 channels-100 bauds/240 Hz 10 channels-50 bauds/120 Hz

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.

Recommendation R.74

CHOICE OF TYPE OF TELEGRAPH DISTORTION-MEASURING APPARATUS

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

The CCITT,

in view of Recommendation R.90,

considering

a) that measurements of isochronous distortion made with the text specified in Recommendation R.51 are normally applied only to 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 telegraph channels, isochronous distortion measuring sets should normally be used;

2. that Administrations may nevertheless, by common consent, use for this purpose start-stop distortion measuring sets;

considering also

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

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,

unanimously declares the view

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

Recommendation R.75

MAINTENANCE MEASUREMENTS ON INTERNATIONAL SECTIONS OF INTERNATIONAL TELEGRAPH CIRCUITS

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

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) with standard text according to Recommendation R.51;

3. that the following values for the inherent distortion in service (extracted from Recommendation R.57) must not be exceeded on the international section of a telegraph circuit:

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 inserting regenerative repeaters 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.

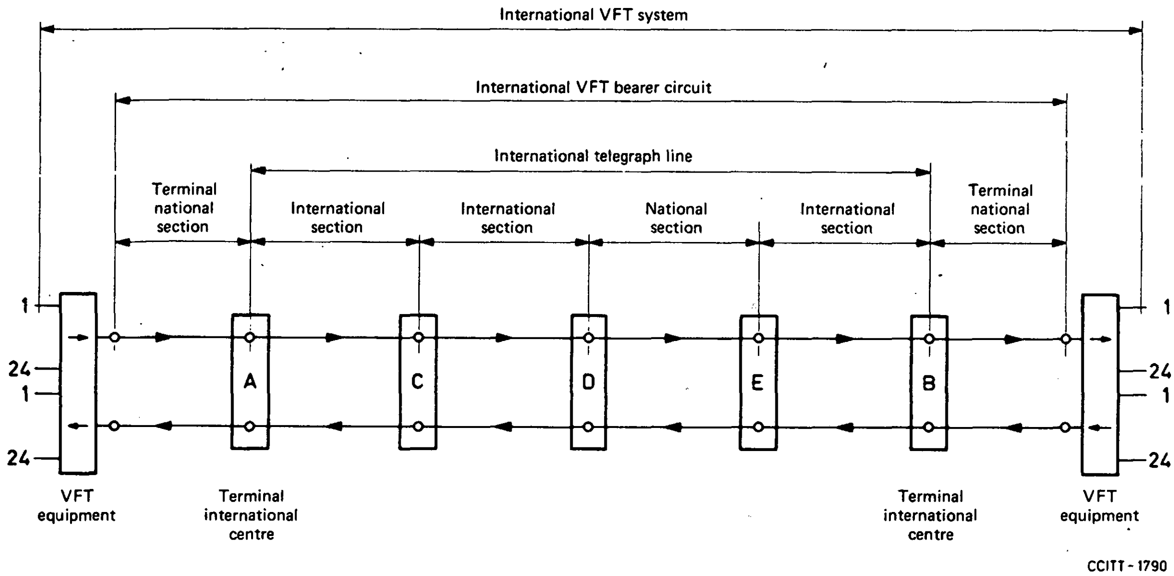
Recommendation R.77

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)

A. COMPOSITION AND NOMENCLATURE

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



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**

B. THE INTERNATIONAL VOICE-FREQUENCY TELEGRAPH SYSTEM

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. *The international VFT bearer circuit*

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 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.

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

3. *The international line of a VFT bearer circuit*

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 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.

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.

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.

C. RESERVE ARRANGEMENTS FOR INTERNATIONAL VFT BEARER CIRCUITS

1. *General*

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.

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.

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.

2. *Reserve international lines*

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).

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.

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.

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

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.

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

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 preface to *White Book,* Volume IV).

5. *Changeover arrangements from normal to reserve lines*

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 C 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.

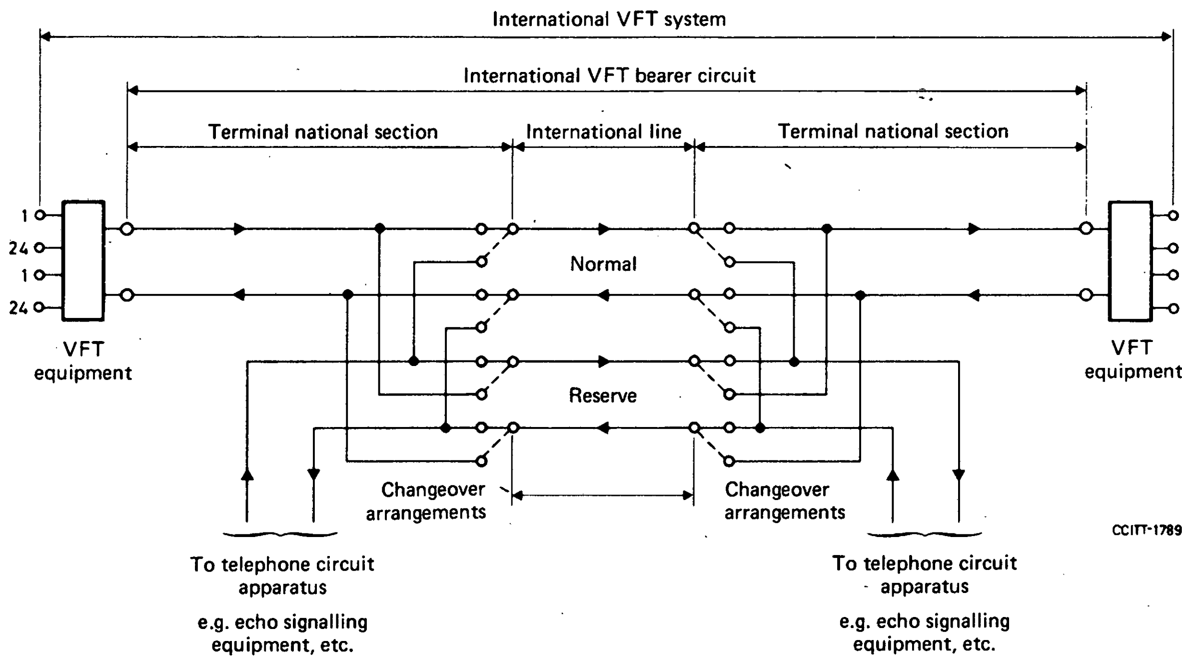


FIGURE 2/R.77 – **An example of how an international telephone line can be used as the reserve for the international line of an international VFT bearer circuit**

5.2 The changeover arrangements shown in Figure 2/R.77 could be applied to sections of the international line mentioned under C 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.

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.

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.

6. *Designation and marking*

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) and marking (see Recommendation M.10).

Recommendation R.78

PILOT CHANNEL FOR AMVFT SYSTEMS

(former CCIT Recommendation B.43, Arnhem, 1963; amended at New Delhi, 1960)

a) 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) 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.

For these reasons, the CCITT *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 and 1976)

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

a) *Purpose of automatic tests*

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.

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.

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.

b) *Circuits tested*

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. 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.

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.

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.

c) *Test station equipment*

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

1.1 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.)

1.2 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.

d) *Test text: decision levels and decision signals*

1. The text chosen for the tests is given in Recommendation R.51, i.e. the Q9S text emitted in the start-stop mode, with a stop element lasting at least 1.4 unit intervals.

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, thare 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).

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

3.1 8% for a switched network circuit consisting of a single VFT channel;

3.2 13% for a switched network circuit consisting of two VFT channels.

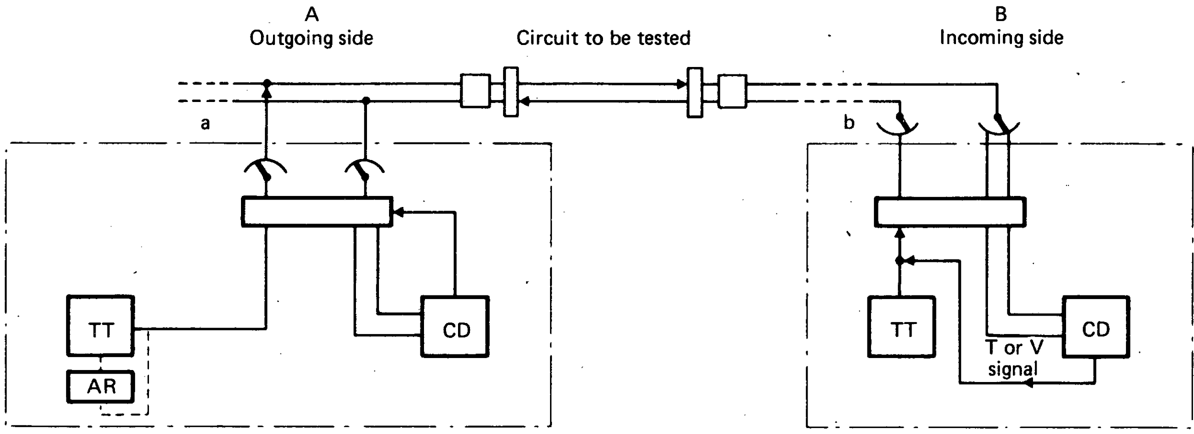
4. Two decision levels are recommended, one corresponding to 3.1 above and the other to 3.2. Since automatic measurements are more stringent than measurements made on an oscilloscope by an operator, who might fail to notice a brief peaking in the degree of distortion, and since automatic tests are meant to detect genuinely doubtful circuits, it is recommended that the following decision levels should be adopted: 10% for 3.1 and 14% for 3.2 above.

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.

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.

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

- combination No. 20 (letter T) of International Telegraph Alphabet (ITA) No. 2 for an affirmative reply (satisfactory channel AB of the circuit);
- combination No. 22 (letter V) for an negative reply (doubtful channel AB of the circuit).



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**

e) *Method of access*

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).

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.

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.

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. 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.

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.

7. Network B will indicate that it is ready to accept test signals **Q9S** by sending the ready-for-test (RFT) signal consisting of 4 × combination No. 11(**K**) of ITA No. 2.

f) *Test procedure*

1. The transmission tests will be carried out with six cycles of **Q9S** signals. If use is made of predistortion at the active station, the tests on the forward path will be made with three early and three late distortion cycles.

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 checing 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.

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.

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 of Recommendation R.51 (the **Q9S** text):

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

the duration of the stop element in each of these combinations being equal to at least 1.4 unit intervals. This will normally be transmitted with zero distortion (see also 16. below).

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, 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 **Q9S** 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 **Q9S** signals, station B shall begin to transmit six cycles of **Q9S** 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 **Q9S** 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 in three **Q9S** cycles with early transmission distortion followed by three **Q9S** cycles with late transmission 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*.

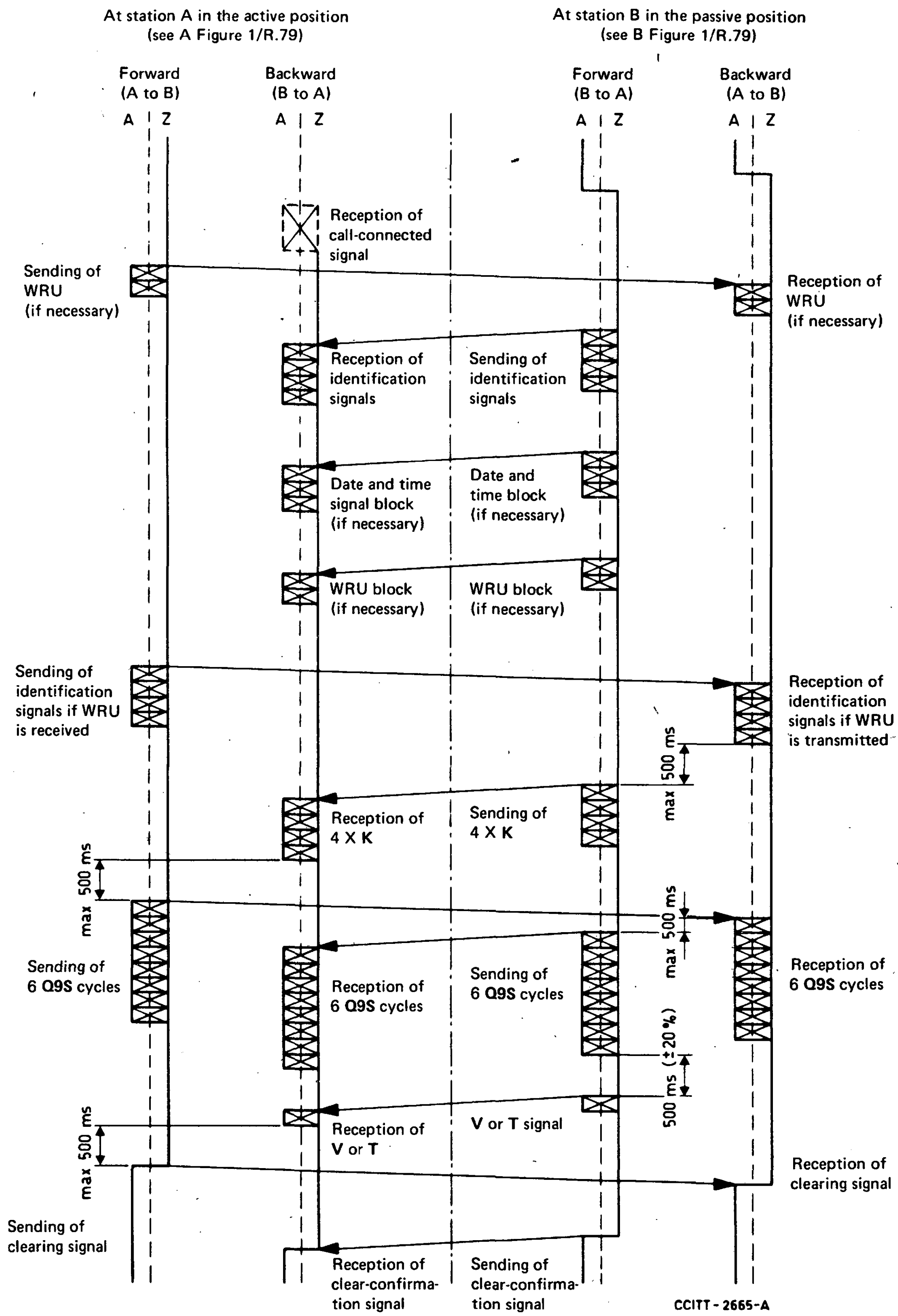


FIGURE 2/R.79 – **Timing diagram for automatic maintenance test (applicable to Recommendations R.79 and R.79*bis*)**

Recommendation R.79 *bis*

AUTOMATIC TESTS OF TRANSMISSION QUALITY OF TELEGRAPH CIRCUITS BETWEEN SWITCHING CENTRES WHERE REGENERATION IS INVOLVED

(Geneva, 1976)

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 Q9S 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:

1.1 26% where two VFT links exist before the point of regeneration;

1.2 30% where one VFT link exists before the point of regeneration;

1.3 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 1.1, 1.2 and 1.3 above may be found in Table 1/R.79 *bis*.

2. The format of the test signal block will follow the Q9S text described in Recommendation R.51, which will commence with the letter-shift and will be completed six times. The stop element for each code combination of this Q9S text will be of at least 1.4 units' duration.

3. The required degree of start-stop predistortion will be introduced on a block of six cycles of Q9S signals by lengthening the start elements of all characters in the first three Q9S cycles and shortening the length of the start elements in the remaining three cycles. The nominal duration of the transmitting cycle will be at least 7.4 units for all characters before predistortion is applied.

TABLE 1/R.79*bis* – **Test combinations**

Identification of test combination	Active station: Transmit pre-distortion %	Active station: Receive decision level %	Passive station: Transmit pre-distortion %	Passive station: Receive decision level %	Transmission and switching configuration
					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 14	0 0	10 14	0 0	10 14	} Non-regenerated as described in Recommendation R.79

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 **Q9S** text signals:

4.1 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;

4.2 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, 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.

8.1 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, the requisite additional letter shifts will be added.

8.2 The passive station shall then transmit the *Who are you?* (WRU) block to the active station.

8.3 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.

8.4 The passive station, on receipt of this identification, shall adapt itself to the required received decision level and transmit distortion.

8.5 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*

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) Abrubt 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.

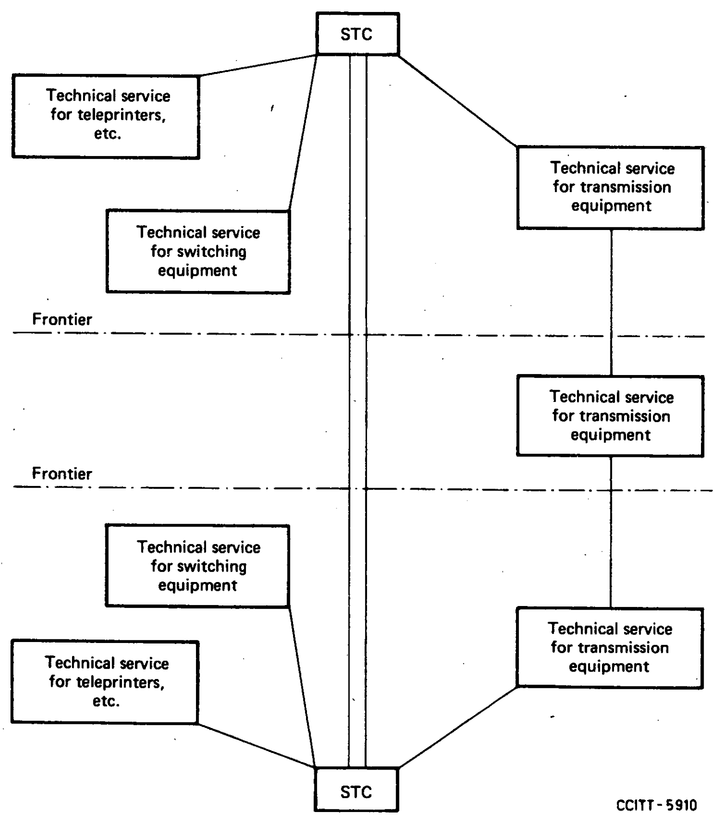


FIGURE 1/R.90 – Maintenance organization

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

(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 ...

No.	*Abbreviation*	*Meaning*
28	**OCC OCC ...**	Permanent busy signal from ...
29	**PERC ...**	Permanent call on ...
30	**BL ... SVP**	Please hold ...
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

No.	*Abbreviation*	*Meaning*
57	**ZYM**	Change from single printer to multiplex
58	**ZYP**	Change from multiplex to single printer
59	**RS ...**	Reception switched over to ...
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.101

CODE AND SPEED DEPENDENT TDM SYSTEM FOR ANISOCHRONOUS TELEGRAPH AND DATA TRANSMISSION USING BIT INTERLEAVING

(Geneva, 1976)

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.

Alternative A

1.2.1 Channels at 75 bauds (7.5 units including a stop element of 1.5 units) shall be accommodated. See Alternative A, 5.6 below.

1.2.2 Further study is needed to accommodate other modulation rates.

Alternative B

1.2.1 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 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 maximum speed tolerance that shall be accepted on continuous incoming 50- and 75-baud start-stop signals where a stop element of 1.4 units is employed shall be ± 2%.

2.2 The system shall accept isolated incoming 50- or 75-baud start-stop signals that have a 1-unit stop element.

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 To be recognized as valid, an input character start element shall be of at least 0.4 units' duration at the nominal modulation rate of the input channel.

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 speed tolerance for speeds 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 speeds.

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 50- or 75-baud characters 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. For all speeds other than 50 and 75 bauds, the minimum duration of the last stop element of the characters at the output shall be 0.8 units.

3.4 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);

b) Loss of aggregate signal;

c) Loss of synchronization.

3.5 Within 280 ms after failure (defined as the time when the last effective aggregate element is received) the following shall occur to channel outputs of the affected TDM:

3.5.1 leased channels – two options shall be possible on a per channel basis:

a) set to steady start polarity,

b) set to steady stop polarity;

3.5.2 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 nominal interval of up to 5 seconds, after which channel outputs shall revert to steady start polarity. Additionally for Alternative B the traffic path shall be maintained towards the distant muliplexer terminal during this loopback interval.

3.6 The failure of a terminal shall be signalled to the distant terminal. The distant terminal shall control its start-stop output channels in accordance with 3.5 above. The delay in initiating these functions shall not exceed 600 ms (measured from the instant of failure), ignoring the progagation time of the bearer circuit. Additionally, for Alternative B, leased channels have the option of taking no action and 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.

Alternative A

4.4 Multiplexing details for higher modulation rates remain for study.

Alternative B

4.4 The maximum transfer delay for all other permitted channel speeds for back-to-back terminals shall not exceed 3.5 units.

4.5 110-baud characters are conveyed on a 100 bit/s bearer channel by transmitting at least one stop element in the aggregate signal.

4.6 134.5-baud characters are conveyed on a 150 bit/s bearer channel by transmitting filling bits at the end of each character 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.

Alternative A

5.5 Two scrambling techniques are used:

5.5.1 Alternate frame slots have inverted signal polarity. The following chart of frame structure (Table 2/R.101) indicates the pattern used. Channels not equipped are transmitted as A (start) polarity.

5.5.2 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.

5.6 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 slots 2 and 25 are replaced by a 75-baud channel, the 75-baud channel should be known as channel 2.

TABLE 2/R.101 – **Frame for 46 50-baud channels with provision for 75-baud channels** (alternative A)

Sub-frame slot	Channel number	Aggregate polarity corresponding to Z polarity on low-speed channel	Channel speed	Sub-frame slot	Channel number	Aggregate polarity corresponding to Z polarity on low-speed channel	Channel speed
1	not applicable		SYNC	25	4	A	50[a]
2	2	A	50[a]	26	3	Z	50
3	1	Z	50	27	7	A	50
4	5	A	50	28	8	Z	50
5	6	Z	50	29	11	A	50
6	9	A	50	30	12	Z	50
7	10	Z	50	31	16	A	50
8	14	A	50	32	15	Z	50
9	13	Z	50	33	19	A	50
10	17	A	50	34	20	Z	50
11	18	Z	50	35	23	A	50
12	21	A	50	36	24	Z	50
13	22	Z	50	37	27	A	50
14	25	A	50	38	28	Z	50
15	26	Z	50	39	32	A	50
16	30	A	50	40	31	Z	50
17	29	Z	50	41	35	A	50
18	33	A	50	42	36	Z	50
19	34	Z	50	43	39	A	50
20	37	A	50	44	40	Z	50
21	38	Z	50	45	43	A	50
22	41	A	50	46	44	Z	50
23	42	Z	50	47	46	A	50
24	45	Z	50				

[a] Any horizontal pair, such as 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 Recommendation F.1, C.8).

Alternative B

5.5 The channel allocation in the fundamental frame is shown in Table 3/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.

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 Substitution of higher speed channels into a homogeneous 50-baud system configuration shall be made as follows:

2 × 75-baud channels	replace 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

5.7 All bits from groups 3 and 4 shall give inverted polarity.

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.

Alternative A

6.3 The synchronizing bits shall be alternated between 1 and 0 in successive sub-frames during normal traffic periods.

6.4 The system shall declare loss of synchronism when 7 synchronizing bits are detected in error during a period of 1.5 to 2 seconds.

6.5 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.

6.6 Under the conditions in 6.1 above, after loss of synchronism has been recognized and the receive aggregate signals have been restored, the maximum 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 900 ms.

6.7 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.

TABLE 3/R.101 – **Channel allocation for each speed within the 47-bit subframe** (alternative B)

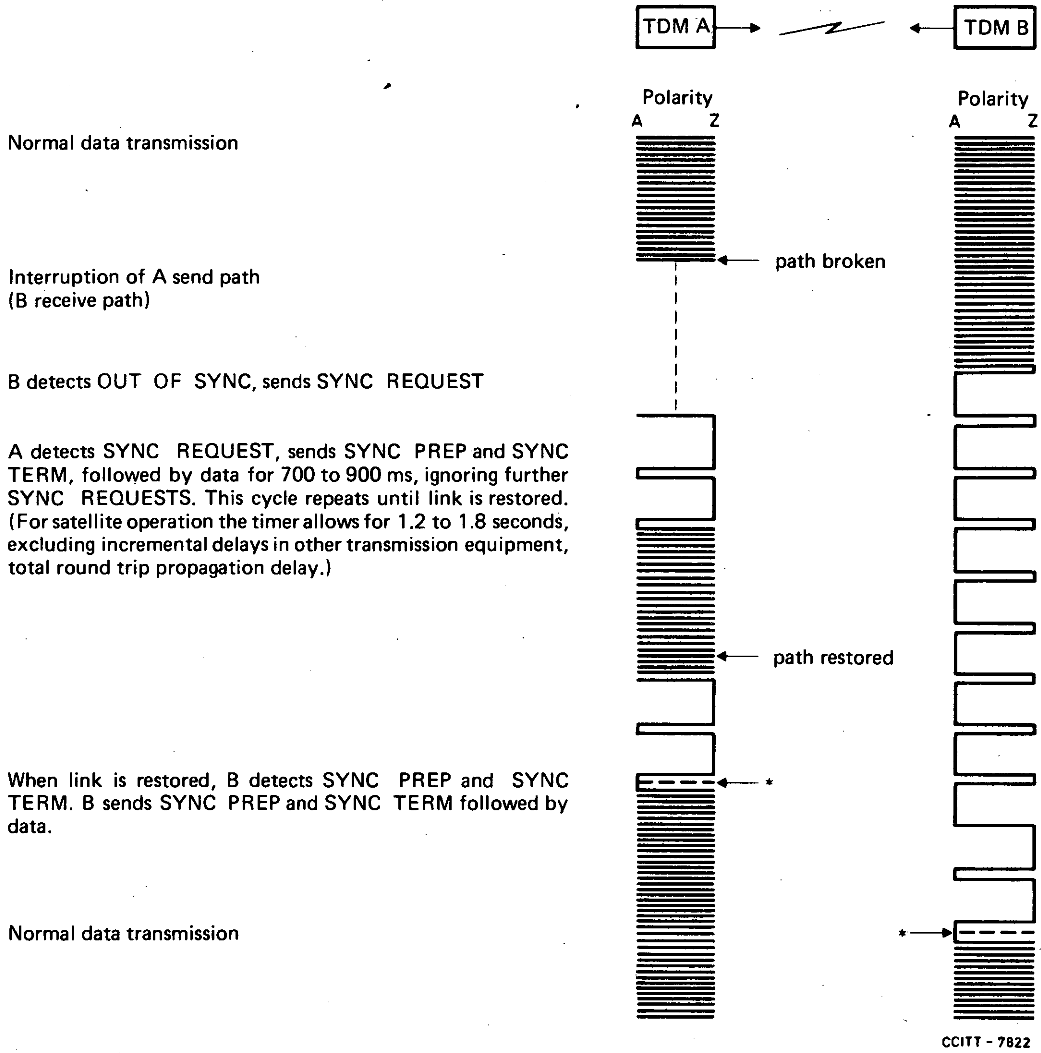
		Bit number	Channel number Group 1						Bit number	Channel number Group 2						Bit number	Channel number Group 3						Bit number	Channel number Group 4					
Channel speed			50	100	200	75	150	300		50	100	200	75	150	300		50	100	200	75	150	300		50	100	200	75	150	300
Fundamental frame	First subframe	1	S	S	S	S	S	S	2	1	1	1	1	1	1	3	2	2	2	2	2	2	4	3	3	3	3	3	3
		5	4	4	4	4	4	4	6	5	5	5	5	5	5	7	6	6	6	6	6	6	8	7	7	7	7	7	7
		9	8	x	x	8	8	x	10	9	8	8	9	9	1	11	10	9	9	10	10	2	12	11	10	10	11	11	3
		13	12	11	x	12	12	4	14	13	12	1	13	13	5	15	14	13	2	14	14	6	16	15	14	3	15	15	7
		17	16	15	4	x	x	x	18	17	16	5	16	1	1	19	18	17	6	17	2	2	20	19	18	7	18	3	3
		21	20	19	x	19	4	4	22	21	20	8	20	5	5	23	22	21	9	21	6	6	24	23	22	10	22	7	7
		25	24	x	x	23	8	x	26	25	1	1	24	9	1	27	26	2	2	25	10	2	28	27	3	3	26	11	3
		29	28	4	4	27	12	4	30	29	5	5	28	13	5	31	30	6	6	29	14	6	32	31	7	7	30	15	7
		SKIPPED							33	32	8	8	1	1	1	34	33	9	9	2	2	2	35	34	10	10	3	3	3
		36	35	11	x	4	4	4	37	36	12	1	5	5	5	38	37	13	2	6	6	6	39	38	14	3	7	7	7
		40	39	15	4	8	8	x	41	40	16	5	9	9	1	42	41	17	6	10	10	2	43	42	18	7	11	11	3
		44	43	19	x	12	12	4	45	44	20	8	13	13	5	46	45	21	9	14	14	6	47	46	22	10	15	15	7
	Second subframe	48				S			49				16			50				17			51				18		
		52				19			53				20			54				21			55				22		
		56				23			57				24			58				25			59				26		
		60				27			61				28			62				29			63				30		
		64				x			65				1			66				2			67				3		
		68				4			69				5			70				6			71				7		
		72				8			73				9			74				10			75				11		
		76				12			77				13			78				14			79				15		
		SKIPPED							80				16			81				17			82				18		
		83				19			84				20			85				21			86				22		
		87				23			88				24			89				25			90				26		
		91				27			92				28			93				29			94				30		

Notes

S = sync bit;

x = bit not available for corresponding channel speed;

110 and 134.5-baud signals shall be transmitted on 100 and 150-bit/s bearer channels respectively and restituted with appropriate speed at the channel output. See also 4.5 and 4.6 (alternative B).



*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 2/R.101.

FIGURE 1/R.101 – **TDM synchronization procedure** (alternative A)

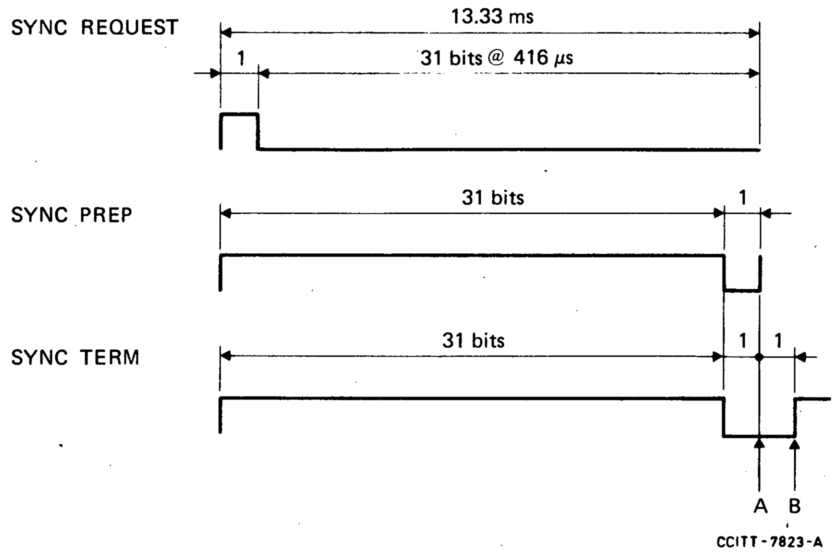
Alternative B

6.3 A sync frame is defined as a sequence of 3 consecutive fundamental frames (i.e. 6 consecutive subframes) containing a synchronization word which consists of 6 equidistantly spaced bits.

6.4 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 6.7 below). The changeover shall only occur at the end of a sync frame.

6.5 Loss of synchronism is defined when three consecutive synchronization patterns are received in error.

6.6 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.



Note. – 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.

FIGURE 2/R.101 – **Synchronization signals** (alternative A)

6.7 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 above).

6.8 Synchronism is defined as achieved when two identical synchronization patterns have been consecutively received without any error.

6.9 After loss of synchronism is recognized and the received aggregate signal is restored, the average time for the terminal concerned to resynchronize and connect through normal data to the output shall be les than 300 ms.

7. *Telex signalling*

7.1 Transmission of type A (control) signals shall be accomplished within the tolerances specified in Table 4/R.101.

7.2 Transmission of type B (control) signals shall be accomplished within the tolerances specified in Table 5/R.101.

7.3 Transmission of type C signals shall be accomplished in accordance with Table 6/R.101.

7.4 Transmission of type D signals shall be accomplished in accordance with Recommendation U.12.

7.5 Each of the following modes of both-way 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.

7.6 A single terminal shall be capable of handling any of the signalling combinations shown in 7.5 above and at least five of them simultaneously.

7.7 The nominal pulse duration (other than dial pulses) shown in Tables 4 to 6/R.101 for *Signal transmitted to telex* have a ± 3 ms tolerance except where otherwise indicated.

TABLE 4/R.101 – **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 seconds of Z polarity on the backward path	Teleprinter signals or 7 or 8 bits of A polarity followed by a minimum of 100 bits of Z polarity	Teleprinter signals or 140 or 160 ms pulse of A polarity followed by a minimum of 2 seconds 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 ± 20% followed by A polarity for 58 s ± 20%, continuously repeated	80-120 bits of Z polarity followed by 2320-3480 bits of A polarity	1.6-2.4 s of Z polarity followed by 46.4-69.6 s of A polarity

TABLE 5/R.101 – **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 seconds minimum, possibly followed by teleprinter signals)	Continuous Z polarity (2 seconds minimum, possibly followed by teleprinter signals)	Continuous Z polarity (2 seconds 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 52-97 bits of A polarity continuously repeated or 8-14 bits of Z polarity followed by teleprinter signals followed by 60-90 bits of A polarity, continuously repeated	156-275 ms of Z polarity followed by A polarity of minimum duration 1040 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

TABLE 6/R.101 – **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 140-320 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 400-520 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 4/R.101, 5/R.101 and 6/R.101

1. Actual polarity of each channel on the aggregate path will conform to 5.5.1 (alternative A) or 5.7 (alternative B).
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.

8. *Aggregate signals and interface*

8.1 The speed tolerance 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% provisionally.

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 voice-grade circuit, it is preferred that a modem complying with 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 .01%.

10. *System control and alarms*

10.1 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.

10.2 It shall be possible to reallocate individual start-stop channels for different services without removing the TDM terminal from service.

Recommendation R.111

CODE AND SPEED INDEPENDENT TDM SYSTEM FOR ANISOCHRONOUS TELEGRAPH AND DATA TRANSMISSION

(Geneva, 1976)

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 and X.51 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 Recommendation V.36 (application *f* in 1.). The nominal data signalling rate is 64 000 bit/s with a tolerance of ± 1 kbit/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 the Annex 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 or 1000 bit/s corresponding to one, two or four 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 channels*

1.6.1 The nominal modulation rates are 50, 100, 200 and 300 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).

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

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.

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 following interchange circuits should be provided (10. of Recommendation V.36).

Circuit Number (cf. Recommendation V.24)	Function
102 [1]	Signal ground or common return
102 b [2]	DCE common return
103 [3]	Transmitted data
104 [3]	Received data
109	Data channel received line signal detector
113 [3,4]	Transmitter signal element timing (DTE source)
114 [3,4]	Transmitter signal element timing (DCE source)
115 [3]	Receiver signal element timing

Note 1. – The provision of this conductor is optional.

Note 2. – This conductor is used in conjunction with interchange circuit 109.

Note 3. – The electrical characteristics of the interchange circuits marked with a 3 should be in accordance with Recommendation X.27. The circuits not so marked should be in accordance with Recommendation X.26.

Note 4. – Either circuit 113 or 114 is to be used.

1.10 *Telegraph interface*

1.10.1 The interface between the multiplexer and the telegraph circuits should be in accordance with national requirements.

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 or X.51.

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 above should be used (250, 500 and 1000 bit/s).

2.5.2 Table 2/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 2/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

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, 2 and 3/R.111 for illustration purposes only.

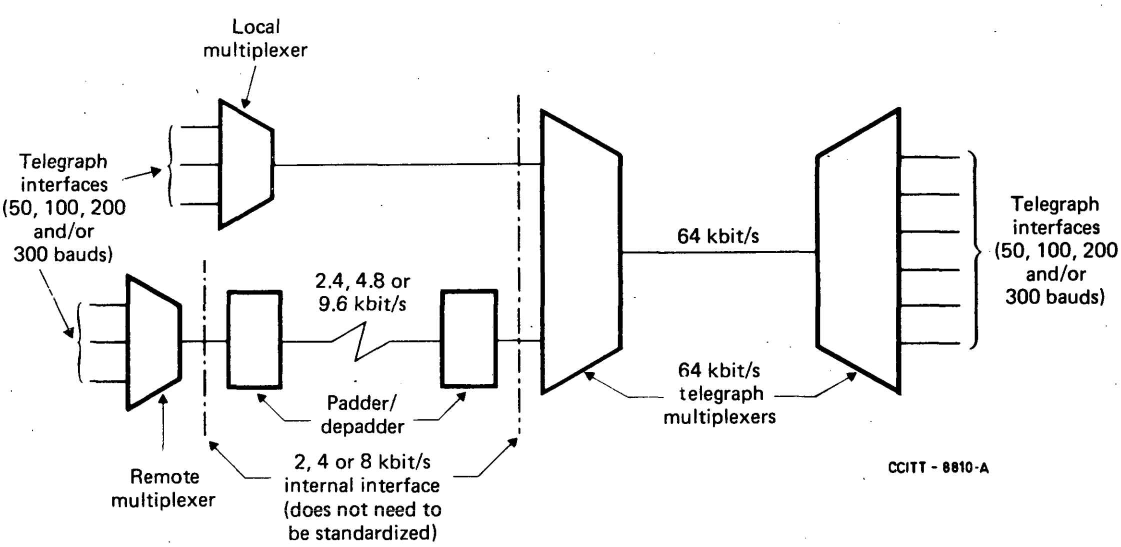


FIGURE 1/R.111 – **Integration of the lower aggregate rates defined in 2. using a 64 kbit/s telegraph multiplexer with a compatible frame structure**

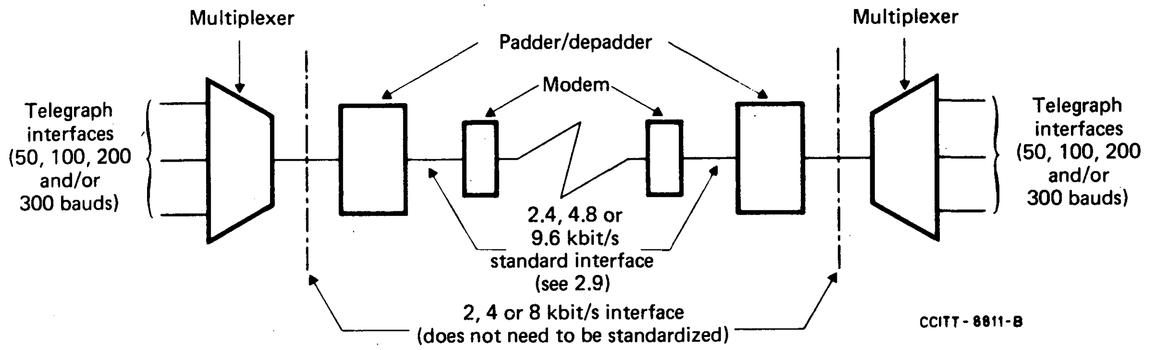


FIGURE 2/R.111 – **Routing of the lower aggregate rates by means of modems**

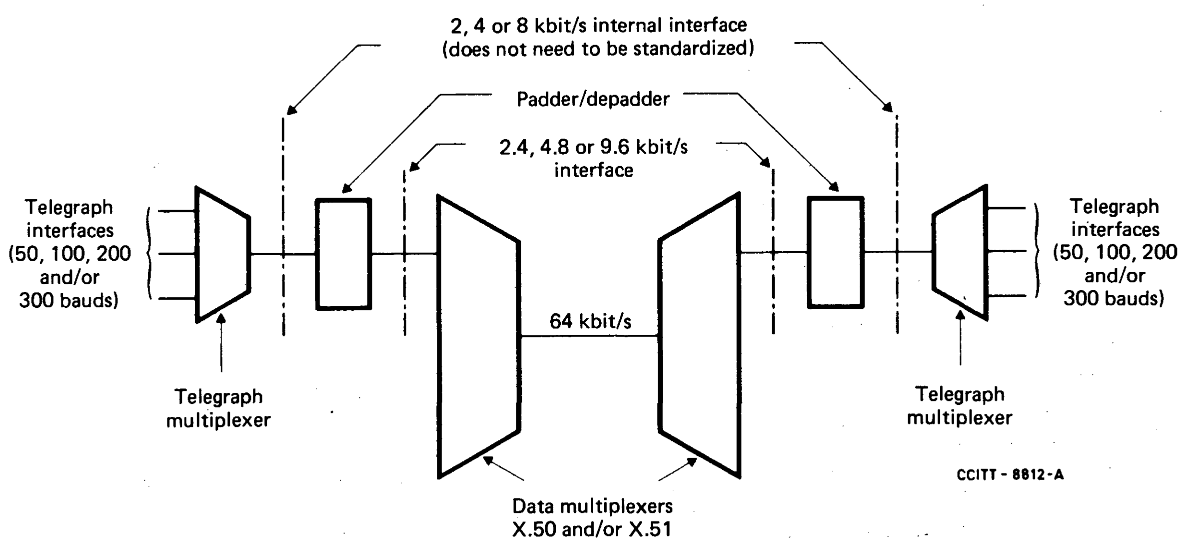


FIGURE 3/R.111 – **Routing of the lower aggregate rates over data multiplexers**
(Recommendation X.50 and/or X.51)

ANNEX

(to Recommendation R.111)

Transition coding process

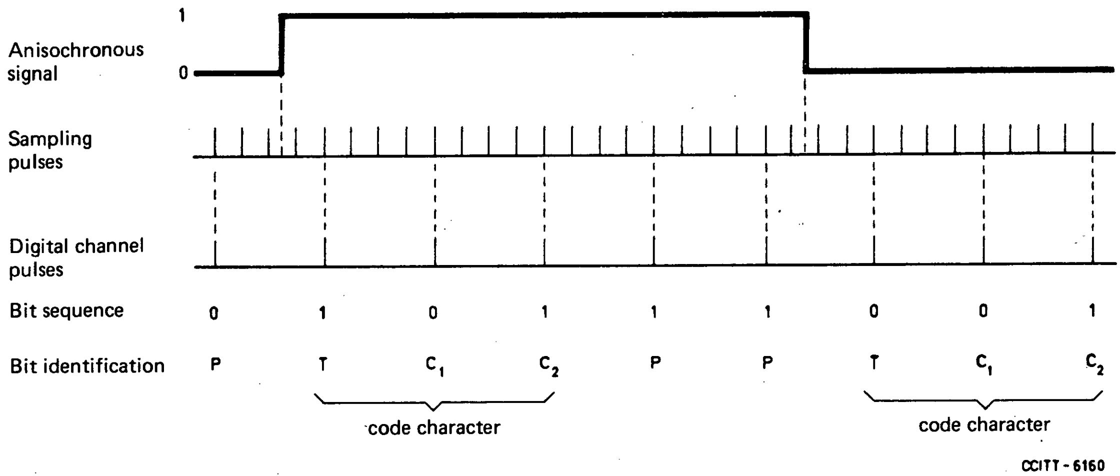


FIGURE 4/R.111

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.

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.

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 3/R.111.

TABLE 3/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

SECTION 8

TRANSMISSION QUALITY ABOVE 50 BAUDS

Recommendation R.120

TOLERABLE LIMITS FOR THE DEGREE OF ISOCHRONOUS DISTORTION OF TELEGRAPH CIRCUITS OPERATING AT MODULATION RATES OF 75, 100 AND 200 BAUDS

(Geneva, 1976)

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%.

Recommendation R.121

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, 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 (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.

PART II

Series S Recommendations

ALPHABETICAL TELEGRAPH AND DATA TERMINAL EQUIPMENT

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Recommendation S.3

TRANSMISSION CHARACTERISTICS OF THE LOCAL END WITH ITS TERMINATION (ITA No. 2)

(based on former Recommendations S.3, S,3 bis *and S.3* ter; *Geneva, 1976)*

a) This Recommendation defines the characteristics, from the transmission point of view, of the local end with its termination when start-stop equipment uses International Telegraph Alphabet No. 2 (see Recommendation S.4 and Division C of Recommendation F.1).

b) This Recommendation applies – except where otherwise specified (for example, the case of regenerative repeaters, which is covered by Recommendations R.60 and R.61) – to start-stop apparatus in the wide sense of the terms as defined in 34.14 of the *List of Definitions of Essential Telecommunication Terms,* Part I: i.e. it includes reperforators, service signals sent by switching equipment, the signals from answer-back units, automatic transmitters, etc.

c) Some equipment (for single current working, for instance) cannot be separated during operation from its supply and repeater devices; hence the measurements under operating conditions must apply to the *local end with its termination* (see Definition No. 34.025).

d) The characteristics laid down below are those that should be evident in service conditions on local ends with their terminations that are likely to be connected to the international network. It should be noted, however, that they apply to such local ends with their terminations only if the influence of the line in the local end produces negligible distortion.

The CCITT *unanimously declares the view*:

1. *General characteristics*

1.1 The nominal modulation rate should be 50, 75 or 100 bauds.

1.2 The difference between the real mean modulation rate of the signals when in service and the nominal rate should not exceed ± 0.75%.

1.3 For 50-baud working, the nominal duration of the transmitting cycle should be at least 7.4 units (preferably 7.5), the stop element lasting for at least 1.4 units (preferably 1.5).

Note. – Administrations are recommended to withdraw from the international service equipment not meeting this Recommendation. If this cannot be done immediately then, in view of the special difficulties that are encountered in the regeneration of automatically transmitted 7-unit start-stop signals, it is recommended that urgent attention should be given to the replacement of 7-unit automatic transmitters by 7.5- (or 7.4 minimum) unit automatic transmitters.

1.4 For 75-baud working, the nominal duration of the transmitting cycle should be at least 7.4 units (preferably 7.5) the stop element lasting for at least 1.4 units (preferably 1.5). Administrations should not authorize the use of terminal machines with a cycle of less than that value.

1.5 For 100-baud working, the nominal duration of the transmitting cycle should be at least 7.5 units, the stop element lasting for at least 1.5 units.

1.6 To accommodate the shortest signal that may be emitted by, for example, a regenerative repeater (see Recommendation R.60), the receiver must be able to translate correctly in service the signals coming from a source that appears to have a nominal transmit cycle equal to or greater than:

- 7 units at 50 or 75 bauds; or
- 7.2 units at 100 bauds.

2. *Transmitter characteristics*

2.1 The degree of gross start-stop distortion of transmitted signals, measured at the output of the local end with its termination, must not exceed 10%. This value applies to all working conditions of the equipment under consideration encountered during normal service, whether the signals are transmitted separately or whether they succeed one another at the maximum rate compatible with the modulation speed.

2.2 It is recommended that the measurement should be made with a start-stop distortion measuring set for two consecutive periods, each of about 15 seconds (corresponding to about 300, 450 or 600 transitions at 50, 75 or 100 bauds respectively). Early distortion should be observed during one period and late distortion during the other.

3. *Receiver characteristics*

3.1 For signals corresponding to a nominal transmit cycle equal to or greater than 7 units at 50 or 75 bauds or 7.2 units at 100 bauds, the effective net margin measured at the input of the local end with its terminations should not be less than:

- 35% at 50 or 75 bauds; or
- 30% at 100 bauds.

3.2 It is recommended that the measurement should be made under the following conditions, in service:

- 7.5-unit cycle for the signals transmitted by the measuring equipment;
- use of some of the signal trains specified in Recommendation R.52;
- first test with an identical distortion rate on all the transitions of the signal train, obtained by lengthening the start element;
- a second test with the same rate of identical distortion on all the transitions of the signal train, but obtained in this case by shortening the start element;
- reading the margin when less than one error per sentence of Recommendation R.52 is obtained. (The margin is the lesser of the two values of the degree of distortion obtained from the two measurements.)

Note. – It will be up to Administrations using some other measuring method to work out for their own use figures to give equivalent results to those that would have been obtained by the recommended method.

Recommendation S.4

USE OF INTERNATIONAL TELEGRAPH ALPHABET No. 2

(former CCIT Recommendations C.7, C.8 and C.12; modified at New Delhi, 1960, Geneva, 1964, 1972 and 1976)

A. *Secondaries of letters F, G, H – combinations Nos. 6, 7 and 8*

Since, in accordance with provision C.8 of Recommendation F.1, some Administrations and recognized private operating agencies assign the secondaries of letters F, G and H for internal use whereas others do not, it is desirable to avoid varying interpretations of these combinations that might result if they were used freely in international services.

The CCITT *unanimously declares the view*

1. that the use of secondaries of F, G and H should be prohibited in international services, except by direct agreement between Administrations;

2. that, in all services, the secondaries of F, G and H should be shown in some special manner on the keyboard;

3. that services in which these secondaries are not used should place on the secondary position on the printing blocks of the letters F, G and H an arbitrary sign, such as, for instance, a square, the appearance of such sign on the paper to indicate an abnormal impression.

B. *Control symbols*

The CCITT *unanimously declares the view*

that Administrations who wish to indicate the reception or transmission of certain combinations effect this using the symbols shown in Table 1/S.4.

Note. – The < symbol differs from that specified for CR in IA No. 5 in ISO Standard 2047 (←). The alignment of these graphic symbols is under study.

TABLE 1/S.4 – **Control characters**

Combination Number	Case	Symbol
4	figure	✠
10	figure	⍾
27	either	<
28	either	≡
29	either	↓
30	either	↑

C. *Sequences of combinations used for special purposes*

As quoted in Recommendations F.1, F.30, R.79, R.79 *bis*, S.11, S.15, U.21 and U.22, certain sequences of combinations from International Telegraph Alphabet No. 2 are devoted to special purposes and they should not be used for other purposes when the equipment on such networks introduces special facilities for which these sequences are reserved. These are:

1. ZCZC start-of-message signal in retransmission systems using perforated tape or equivalent devices;

2. + + + + end-of-telegram signal in retransmission systems using perforated tape or equivalent devices;

3. NNNN end-of-message signal, a switching signal in switching systems using perforated tape or equivalent devices for retransmission; also used for restoring the waiting signal device in accordance with Recommendation U.22;

4. CCCC for switching into circuit, by remote control, a reperforator (or equivalent device);

5. SSSS for switching into circuit data transmission equipment, in accordance with Recommendation S.15;

6. FFFF for switching out of circuit, by remote control, a reperforator (or equivalent device);

7. KKKK ready-for-test signal, for automatic tests of transmission quality, in accordance with Recommendations R.79 or R.79 *bis*;

8. XXXXX error signal when using automatic error correction devices (see Recommendation F.1, C.165);

TABLE 2/S.4 – Combinations in International Telegraph Alphabet No. 2 referred to in Recommendation S.4

Combination number	Start	Element number					Stop	Indication	
		1	2	3	4	5		Letter case	Figure case
3	A	A	Z	Z	Z	A	Z	C	:
6	A	Z	A	Z	Z	A	Z	F	Note 1
8	A	A	A	Z	A	Z	Z	H	Note 1
11	A	Z	Z	Z	Z	A	Z	K	((L. H. bracket)
14	A	A	A	Z	Z	A	Z	N	, (comma)
19	A	Z	A	Z	A	A	Z	S	' (apostrophe)
24	A	Z	A	Z	Z	Z	Z	X	/ (fraction bar or division sign)
26	A	Z	A	A	A	Z	Z	Z	+

Note 1. – The figure case indication of this code combination is available for the internal service of each Administration or recognized private operating agency.

Note 2. – Symbols A and Z have the meanings defined in the *List of Definitions of Essential Telecommunication Terms*, Part I, Definition 31.38. For punched tape working, A represents no perforation, Z represents a perforation.

Note. – The sequences of secondaries of these combinations – although they are not to be used for the purposes devoted to these sequences – are subject to the same restrictions in use, the equipment having to recognize only the sequence of combinations. In international services these sequences are:

+ : + :	corresponding to ZCZC	(combinations Nos. 26, 3, 26, 3),
ZZZZ	corresponding to + + + +	(combinations Nos. 26, 26, 26, 26),
, , , ,	corresponding to NNNN	(combinations Nos. 14, 14, 14, 14),
: : : :	corresponding to CCCC	(combinations Nos. 3, 3, 3, 3),
' ' ' '	corresponding to SSSS	(combinations Nos. 19, 19, 19, 19),
((((	corresponding to KKKK	(combinations Nos. 11, 11, 11, 11),
/ / / / /	corresponding to XXXXX	(combinations Nos. 24, 24, 24, 24, 24).

9. the line-feed signal (combination No. 28) followed by 4 carriage-return signals (combination No. 27) for the operator-recall signal on a telex connection made over a radiotelegraph circuit (see Recommendation U.21);
10. **HHHH** to prevent transmission of the delay signals described in Recommendation U.22 made up from combination No. 32 as described in D. below.

D. *Use of combination No. 32*

1. Combination No. 32, repeated at intervals of 1.2 seconds, can be used as a delay signal to indicate that the error-correcting is controlling a repetition.

2. Combination No. 32, repeated at intervals of 5 seconds, can be used as a delay signal to indicate that the storage device is not yet empty.

3. The reception of combination No. 32 shall not cause any spacing of the paper on tape-printing or page-printing teleprinters.

Note. – 9. and 10. in section C and 1. and 2. in section D apply directly only to start-stop equipment operating at 50 bauds, since this is the modulation rate for telex. However, in the event of suitable synchronous error-correcting systems' being used for the interconnection of start-stop circuits that operate at higher modulation rates, similar facilities might be desirable and could be provided by similar means.

TABLE 3/S.4 **The use of various sequences of combinations for special purposes**

Purpose of sequence	Sequence of combinations recommended	Method of operation		
		Message switching (including storage)	Through switching (without message storage)	Point-to-point operation
Start of message	26 3 26 3	Required in most systems	Could be useful in special cases	Not ordinarily required
Suppression of delay signals	8 8 8 8	Not required (delay signal not envisaged)	Required for some types of message (e.g. cypher) when routed over synchronous error-corrected radio-telegraph channels	Not required on public systems (delay signal not envisaged)
End of telegram	26 26 26 26	Could be useful in special cases	Could be useful in special cases	Not ordinarily required
End of message	14 14 14 14	Essential in most systems to separate individual message at relay centres and to control message switching	Required only when it is necessary positively to reconnect delay signal facility after use of suppression of delay signals facility	Not ordinarily required
Connection of reperforator (or equivalent device)	3 3 3 3	Not normally used (as storage is incorporated in the system); could be used for connection and disconnection of a supplementary storage device	Could be useful for special purposes; requires special equipment at point of reception	Could be useful for special purposes; requires special equipment at point of reception
Disconnection at distance of reperforator (or equivalent device)	6 6 6 6			
Connection of data equipment	19 19 19 19	Not normally used	Used for switching into data transmission equipment in association with telex networks	Could be useful for special purposes
Ready for test	11 11 11 11	Nor normally used	Used for automatic maintenance of telex circuits	Could be useful for special purposes
Error signal	24 24 24 24 24	Not required	Used for automatic correction of operator errors	Could be useful for special purposes; requires special equipment at point of reception

Recommendation S.5

STANDARDIZATION OF PAGE-PRINTING START-STOP EQUIPMENT AND COOPERATION BETWEEN PAGE-PRINTING AND TAPE-PRINTING START-STOP EQUIPMENT (ITA No. 2)

(Brussels, 1948; amended at New Delhi 1960, Geneva, 1964 and 1976)

The CCITT,

unanimously declares the view

1. that the number of characters that the line of text in page-printing equipment may contain should be fixed at 69;

2. that tape- or page-printing start-stop equipment should, with a view to interworking, be fitted with:

a) two keys for the transmission of the carriage-return and line-feed signals;

Note. – New equipment may, in addition, be fitted with a single key for both carriage-return and line-feed, in accordance with the procedures described in Recommendation F.60.

b) means to draw attention of the operator to the need to transmit carriage-return and line-feed signals in time to prevent overprinting on the 69th character;

Note. – New equipment may, in addition, be fitted with means preventing the input of any printing character after the 69th character of a line. This condition is signalled to the operator optically and/or acoustically. The carriage-return function cancels the signal and releases the input of characters.

3. that for controlling the alarm, several "figures J" signals, one carriage-return signal and one line-feed signal should be transmitted in the order indicated;

4. that such Administrations as are desirous of confirming on a tape machine the reception or transmission of the carriage-return and line-feed signals shall effect this confirmation by printing:

a) the symbol < for the carriage-return signal;

b) the symbol ≡ for the line-feed signal;

5. that, if the printing of the symbols indicated in 4. above is not desired, the reception of at least one of these signals shall nevertheless cause the paper to move forward. When only one of these signals causes the paper to move forward, it should preferably be the line-feed.

Recommendation S.6

CHARACTERISTICS OF ANSWER-BACK UNITS (ITA No. 2)

(based on former Recommendations S.6, S.6 bis *and S.6* ter *as shown in Volume VII of the Green Book; Geneva, 1976)*

The CCITT,

considering

a) Recommendations F.60 and F.21 concerning the telex and gentex services respectively;

b) that start-stop equipment is capable of receiving communications without the help of an operator;

c) that this advantage is useful to users of the international telegraph services that employ International Telegraph Alphabet No. 2 (ITA No. 2);

d) that it is therefore desirable that the identity of either the calling or the called party should be capable of being checked;

e) that it may be necessary to verify the correct functioning of the line and of the distant terminal equipment;

f) that it is desirable to give confidence to the calling party that the reception of the called station's answer-back code is related to the proper working of that station as a whole,

unanimously declares the view

1. that a code transmitter filling the requirements specified below is supplied for the subscribers' sets taking part in the international telex and gentex services and, upon request, for other telegraph services using start-stop equipment and ITA No. 2;

2. that operation of the code transmitter should be effected by the sequence of signals figure-shift **D** (combinations Nos. 30 and 4) in ITA No. 2;

3. that, for services [1] other than gentex, the answer-back code emission should be composed of a series of 20 signals, as follows:

1 letter-shift or figure-shift;

1 carriage-return;

1 line-feed;

16 signals chosen by each Administration for the subscriber's code signal;

1 letter-shift;

4. that, for the gentex service [1], the answer-back code emission should be composed of a series of 20 signals, as follows:

1 carriage-return,

1 line-feed,

1 figure-shift,

16 signals chosen by each Administration in accordance with Recommendation F.21,

1 letter-shift;

5. that, when a telex or gentex answer-back code includes less than 16 significant characters chosen by the Administration, the necessary number of filling characters should be inserted in accordance with Recommendation F.60 or F.21 respectively;

6. that, for services other than telex and gentex, when the answer-back code includes less than 16 significant characters, to distribute them by inserting as many letter-shifts as are necessary to make up the total of 16 signals. This would give the calling subscriber the chance of noting clearly the end of the requested code transmission;

7. that the answer-back signals should comply with the transmission characteristics specified in Recommendation S.3;

8. that the delay between the beginning of reception of the start unit of combination No. 4 by the equipment in the "figures" position and the beginning of the start unit of the first signal in the answer-back sent by this equipment should lie between:

- 150 and 600 ms for 50-baud equipment;
- 100 and 600 ms for 75-baud equipment;
- 75 and 600 ms for 100-baud equipment;

[1] As regards the information to be conveyed by answer-back codes and the order of presentation of that information, reference should be made to Recommendation F.60, 3.4.2 for the telex service or to Recommendation F.21 for the gentex service.

9. that the start-stop equipment in the telex service should be designed so that reperforators should not perforate the *Who are you?* (WRU) signal (figure-shift **D**);

10. that manufacturers should be informed that the answer-back mechanism should preferably be constructed so that the 20 positions in the answer-back code may be freely used for any combination in ITA No. 2.

Recommendation S.7

CONTROL OF TELEPRINTER MOTORS

(former CCIT Recommendation C.13; amended at Arnhem, 1953, and Geneva, 1976)

The CCITT,

considering

a) that, in the case of public and private point-to-point circuits, it is desirable that the teleprinter motors should be started with the commencement of traffic signalling and stopped with the cessation of such signalling;

b) that the general practice on such circuits is to utilize a time-delay device associated with the teleprinter which allows of such operation,

unanimously declares the view

1. that, in the case of public and private point-to-point circuits, the terminal apparatus shall be so equipped as to allow of the starting and stopping of the teleprinter motors with the commencement and completion respectively of the traffic;

2. that these facilities shall normally be provided by means of a time-delay device incorporated in the teleprinter, whereby the teleprinter motor is started immediately upon commencement of the signalling of traffic and is stopped within a time not less than 45 seconds after the last traffic signal;

considering

c) that more strict unification of the delay-time of these automatic devices might give rise to serious technical complications;

d) that precautions should thus be taken lest an operator, the motor of whose apparatus is still rotating, should transmit signals to an apparatus in which the motor has just stopped,

unanimously declares the view

3. that, in the case of a pause in transmission for a period equal to or longer than 30 seconds, operators or subscribers are recommended to send a letter-shift (combination No. 29 in International Telegraph Alphabet No. 2) and to wait at least 2 seconds after the emission of this signal before recommencing transmission;

considering

e) that, for reasons associated with the unification of terminal apparatus and for others, certain Administrations have expressed a preference for the utilization of a method whereby calling and clearing signals are used, as in the telex service, to effect the starting and stopping of the teleprinter motors,

unanimously declares the view

4. that, notwithstanding 2. above, Administrations can, if they find it convenient, arrange between themselves to use an alternative method whereby the teleprinter motor is started by the use of a call signal, and stopped by the use of a clearing signal. In such cases the calling and clearing signals employed should conform to those standardized for the telex service, namely Recommendation U.1.

Recommendation S.8

INTERCONTINENTAL STANDARDIZATION OF THE MODULATION RATE OF START-STOP APPARATUS AND OF THE USE OF COMBINATION No. 4 IN FIGURE CASE

(former CCIT Recommendations C.5 and C.11, Arnhem, 1953)

The CCITT,

considering

a) that the standardized modulation rate recommended for start-stop apparatus employed in international (including intercontinental) service is 50 bauds, in accordance with Recommendation S.3;

b) that there are nevertheless certain areas (notably in the U.S.A) in which a different modulation rate for start-stop apparatus is employed;

c) that, even though it is recognized that universal adoption of a standardized modulation rate would be advantageous in the intercontinental service, it is not possible at present to secure universal adoption of a standard;

d) that it is essential to do everything possible to facilitate the establishment of intercontinental services, notwithstanding differences in modulation rates that may exist between the start-stop apparatus employed;

e) that there are in existence methods, employing automatic storage equipment in the circuit, that enable start-stop apparatus having different modulation rates to interwork;

f) that, furthermore, on certain intercontinental circuits, e.g. radio circuits, the employment of special forms of synchronous equipment in association with storage equipment is sometimes essential and is already in use in the intercontinental sections of start-stop circuits.

unanimously declares the view

1. that, when it is necessary in the intercontinental service to operate between start-stop apparatus having a modulation rate of 50 bauds and start-stop apparatus having a non-standard modulation rate, then conversion equipment, for example automatic storage and retransmission equipment must be inserted in the international circuits concerned in a manner to be agreed bilaterally between the Administrations and/or private recognized operating agencies concerned;

considering

g) that the use of different signs or functions for combination No. 4 in the figure case of International Telegraph Alphabet No. 2 on start-stop apparatus having to work together in the same system leads to operational difficulties that ultimately amount to rendering the use of this combination impossible;

h) that the use of this combination to operate the answer-back unit, by allowing the caller to check the connection and the satisfactory working of his correspondent's apparatus, results in a considerable reduction in the time of establishing the communication, thereby facilitating operation of the service,

unanimously declares the view

2. that combination No. 4 (figure case) of International Telegraph Alphabet No. 2 should be reserved exclusively, both in international service and in intercontinental service, for operating the answer-back unit;

3. that, in intercontinental service, when apparatus not permitting the use of the answer-back unit is being operated, the methods of using combination No. 4 (figure case), should be the subject of bilateral agreement between the Administrations and/or private recognized operating agencies concerned.

Recommendation S.9

SWITCHING EQUIPMENT OF START-STOP APPARATUS

(former CCIT Recommendation F.60; modified at New Delhi, 1960)

The CCITT,

considering Recommendation U.1 relative to signalling conditions to be applied in the international telex service and Recommendation F.60 relative to operational provisions for the international telex service,

unanimously declares the view

1. that start-stop apparatus used in the telex service should be so equipped, or provided with the necessary devices, to permit of operation in accordance with Recommendations U.1 and F.60;

2. that, if a subscriber's apparatus is such that he can use his teleprinter outside communication periods in order to prepare perforated tapes, for local checking of those tapes, for staff training, etc., the possibility of taking the answer-back may be delayed for a period not exceeding 3 seconds after connection is established with the called subscriber.

Recommendation S.10

TRANSMISSION AT REDUCED CHARACTER TRANSFER RATE OVER A STANDARDIZED 50-BAUD TELEGRAPH CHANNEL

(Geneva, 1972)

The CCITT,

considering

a) that there is a requirement for transmission at reduced character transfer rates on leased telegraph circuits;

b) that the cost of devices to subdivide a standardized 50-baud telegraph channel for simultaneous use by a number of users is relatively high;

c) that a number of Administrations meet the demand for transmission at reduced character transfer rates by providing a separate standardized 50-baud telegraph channel for each user and that the number of transmitted characters per minute is then limited by controlling the operation of the telegraph machine;

d) that, in the case of a pause in transmission for a period equal to or longer than 30 seconds, operators or subscribers are recommended to send a letter-shift (combination No. 29 in International Telegraph Alphabet No. 2) and to wait at least 2 seconds after the emission of this signal before recommencing transmission (Recommendation S.7, 3.),

unanimously declares the view

1. that the preferred method of providing transmission at reduced character transfer rate on standardized 50-baud telegraph channels is an arrangement that employs one transmitted character followed by a period of stop polarity, the duration of which is determined in accordance with 2. and 3. below,

2. for quarter-speed operation (100 characters per minute), the duration of the period of stop polarity required is equivalent to 3 character periods.

3. for half-speed operation (200 characters per minute) the duration of the period of stop polarity required is equivalent to 1 character period.

Recommendation S.11

USE OF START-STOP REPERFORATING EQUIPMENT FOR PERFORATED TAPE RETRANSMISSION

(former CCIT Recommendation C.19, Arnhem, 1953; amended at New Delhi, 1960)

a) When a station is equipped with receiving reperforating equipment, it is often necessary to clear the perforated tape of the perforator to ensure transmission of the last characters of a message received during the perforation of the first characters of the next message.

b) This operation of clearing the tape may lead to mutilation of the beginning of the message that is being perforated (particularly if insufficient message separation signals have been transmitted).

For these reasons, the CCITT

unanimously declares the view:

1. It is recommended that arrangements be made to avoid the mutilation of signals transmitted at the head of a message and received on start-stop reperforating equipment.

2. If the reperforator is provided with local means for feeding the paper, not more than one multilated signal should be tolerated. The wording of the message must make allowances for this fact.

3. It is recommended that *message separation* signals should be sent at the end of a batch of telegrams following a given route at centres equipped with receiving reperforators. The choice of the type and number of signals to be sent for this purpose is left for agreement between the Administrations concerned. Use of a series of letter-shifts appears particularly desirable for this purpose.

4. If the reperforator is to be switched into circuit and out of circuit under control of the transmitting station, the following sequences of signals should be used:

combination No. 3 repeated 4 times (CCCC) for switching the reperforator into circuit by remote control;

combination No. 6 repeated 4 times (FFFF) for switching the reperforator out of circuit by remote control.

5. These operations may equally well be controlled by the secondaries of CCCC and FFFF but, for convenience in operating the primary signals, CCCC or FFFF only should be used by operating staff.

6. If the sequence four times combination No. 6 has not been received before the arrival of the clearing signal (or the end-of-message signal), receipt of the clearing signal (or end-of-message signal) should cause disconnection of the reperforator.

Recommendation S.12

CONDITIONS THAT MUST BE SATISFIED BY SYNCHRONOUS SYSTEMS OPERATING IN CONNECTION WITH START-STOP TELEPRINTER SYSTEMS

(former CCIT Recommendation C.23, Geneva, 1956; amended at New Delhi, 1960)

The CCITT,

considering, on the one hand,

a) that the receiving portion of the sending end of the synchronous system can be linked to a start-stop receiver,

unanimously declares the view

1. that the receiving portion of the sending end termination shall satisfy the conditions laid down in points 1.1, 1.2, 1.3 and 1.6 of Recommendation S.3,

considering, on the other hand,

b) that the retransmitting portion of the receiving end of the synchronous system can be linked to a start-stop transmitter having special characteristics, because of the high speed stability of synchronous systems,

unanimously declares the view

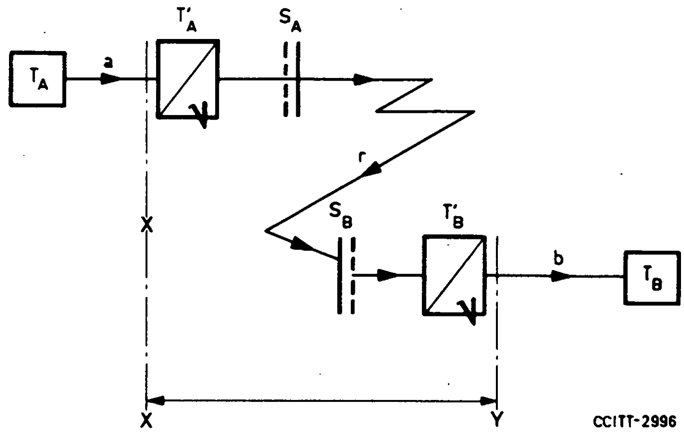
2. that the start-stop signals provided by the retransmitting portion of the receiving termination of the synchronous system shall have the following characteristics:

2.1 nominal modulation rate, 50-bauds;

2.2 gross start-stop distortion of the signals, less than 5%;

2.3 interval between the beginning of successive start elements, 145 $^{5}/_{6}$ milliseconds with a tolerance of $\pm 1/10^{6}$.

Note. – For a better understanding of the Recommendation, the general arrangement of a communication system involving transmission over a synchronous channel is shown in Figure 1/S.12.



In this diagram:

T_A and T_B are start-stop teleprinters.

T'_A and T'_B are repeaters with or without storage.

a and *b* represent the networks connecting teleprinters T_A and T_B to the repeaters T'_A and T'_B. These networks may comprise any number of channels in tandem, relays or regenerative repeaters.

S_A and S_B are the distributors of the synchronous system, the complexity of which it is not necessary to state.

r denotes a synchronous radiotelegraph channel.

It is agreed that, for the study of this question, the synchronous system includes all the equipment shown between lines X and Y on the diagram.

The input and output of the synchronous system are thus directly connected to the start-stop networks.

FIGURE 1/S.12 – **Synchronous system**

Recommendation S.13

USE ON RADIO CIRCUITS OF 7-UNIT SYNCHRONOUS SYSTEMS GIVING ERROR CORRECTION BY AUTOMATIC REPETITION

(former CCIT Recommendation C.24, Geneva, 1956; amended at New Delhi, 1960, Geneva, 1964, Mar del Plata, 1968, and Geneva, 1972)

(This Recommendation corresponds to CCIR Recommendation 342-2, New Delhi, 1970)

The CCITT,

considering

a) that it is essential to be able to interconnect terminal start-stop apparatus employing International Telegraph Alphabet No. 2 by means of radiotelegraph circuits;

b) that radiotelegraph circuits are required to operate under varying conditions of radio propagation, atmospheric noise and interference, which introduce varying degrees of distortion that may at times exceed the margin of the receiving apparatus;

c) that, in consequence, the transmission of 5-unit code signals over radio circuits is liable to errors and that such errors are not automatically detectable by the receiving apparatus;

d) that an effective means of reducing the number of wrongly printed characters is the use of codes permitting the correction of errors by detecting the errors and automatically causing repetition;

e) that the method using synchronous transmission and automatic repetition (ARQ) is now well proven;

f) that it is desirable to permit the correct phase to be established automatically on setting up a circuit;

g) that certain circumstances can occur that result in a loss of the correct phase relationship between a received signal and the receiving apparatus;

h) that it is desirable to permit the correct phase relationship to be re-established automatically after such a loss, without causing errors;

i) that to avoid misrouting of traffic, it is essential to prevent phasing to a signal that has been unintentionally inverted;

j) that in certain cases there is a need to subdivide one or more channels in order to provide a number of services at a proportionately reduced character rate;

k) that the method of automatically achieving the correct phase relationship between the received signal and the sub-channelling apparatus should be an integral part of the phasing process;

l) that compatibility with existing equipment designed in accordance with the former Recommendation S.13 (New Delhi, 1960) is a requirement,

unanimously declares the view

1. that, when the direct use of a 5-unit code on a radio circuit gives an intolerable error rate and there is a return circuit, a 7-unit ARQ system using International Telegraph Alphabet No. 3 should be used;

2. when automatic phasing of such a system is required, the system described in the Annex should be adopted as a preferred system;

3. that equipment, designed in accordance with 2. above, should be provided with switching, to permit operation with equipment designed in accordance with Recommendation S.13, New Delhi, 1960;

4. that the start-stop sections of the receiving and transmitting portions of the radiotelegraph circuit, points x and y in Figure 1/S.12, should satisfy the conditions of Recommendations S.3 and S.12. In conformity with Recommendation S.12, the aggregate modulation rate for a 2-channel time-division multiplex system will be 96 bauds and for a 4-channel system will be 192 bauds;

5. that if such systems are used in establishing telex connections, the signalling position should conform to the arrangements shown in Recommendations U.11, U.20, U.21, U.22.

5.1 For circuits on switched telegraph networks, the conditions of Recommendation U.20 should apply. In this usage the polarity retransmitted by the terminal of the radio channel towards the start-stop section of the circuit during a repetition cycle shall be start polarity when the circuit is in the "free line" condition and stop polarity when the circuit is in the "busy circuit" condition.

5.2 For point-to-point circuits, Administrations may adopt, at the terminal equipment under their jurisdiction, their own method of stopping and starting the motors of the receiving machines, based on Recommendation S.7. Signal β should normally be transmitted to indicate the idle circuit condition. However, for signalling purposes, the signals α and β may be employed.

ANNEX

(to Recommendation S.13)

1. *Conversion table*

1.1 Table 1/S.13 shows the correspondence between International Telegraph Alphabet No. 3 used in 7-unit ARQ systems and International Telegraph Alphabet No. 2 (defined in Recommendation F.1, C.8).

TABLE 1/S.13 – 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. 3 (see Note 1)
1	A	–	ZZAAA	AAZZAZA
2	B	?	ZAAZZ	AAZZAAZ
3	C	:	AZZZA	ZAAZZAA
4	D	Note 2	ZAAZA	AAZZZAA
5	E	3	ZAAAA	AZZZAAA
6	F	Note 2	ZAZZA	AAZAAZZ
7	G	Note 2	AZAZZ	ZZAAAAZ
8	H	Note 2	AAZAZ	ZAZAAZA
9	I	8	AZZAA	ZZZAAAA
10	J	Note 2	ZZAZA	AZAAAZZ
11	K	(	ZZZZA	AAAZAZZ
12	L	)	AZAAZ	ZZAAAZA
13	M	.	AAZZZ	ZAZAAAZ
14	N	,	AAZZA	ZAZAZAA
15	O	9	AAAZZ	ZAAAZZA
16	P	0	AZZAZ	ZAAZAZA
17	Q	1	ZZZAZ	AAAZZAZ
18	R	4	AZAZA	ZZAAZAA
19	S	'	ZAZAA	AZAZAZA
20	T	5	AAAAZ	ZAAAZAZ
21	U	7	ZZZAA	AZZAAZA
22	V	=	AZZZZ	ZAAZAAZ
23	W	2	ZZAAZ	AZAAZAZ
24	X	/	ZAZZZ	AAZAZZA
25	Y	6	ZAZAZ	AAZAZAZ
26	Z	+	ZAAAZ	AZZAAAZ
27	Carriage-return		AAAZA	ZAAAAZZ
28	Line-feed		AZAAA	ZAZZAAA
29	Letter-shift		ZZZZZ	AAAZZZA
30	Figure-shift		ZZAZZ	AZAAZZA
31	Space		AAZAA	ZZAZAAA
32	Not normally used		AAAAA	AAAAZZZ
–	Signal repetition		–	AZZAZAA
–	Signal α		(permanent A polarity)	AZAZAAZ
–	Signal β		(permanent Z polarity)	AZAZZAA

Note 1. – Symbols A and Z have the meanings defined in the *List of Definitions of Essential Telecommunication Terms* (Definition 31.38).

Note 2. – See Recommendation S.4.

2. *Repetition cycles*

2.1 Four characters for normal circuits that are not subject to excessive propagation time. The cycle should comprise one signal repetition and three stored characters.

2.2 Eight characters on circuits for which the four-character repetition cycle is inadequate. The cycle should comprise one signal repetition, three signals β and four stored characters, or one signal repetition and seven stored characters.

3. *Channel arrangement*

3.1 *Channel A*

3.1.1 For equipments employing a 4-character repetition cycle: one character inverted followed by three characters erect [see Figure 1(a)/S.13].

3.1.2 For equipments employing an 8-character repetition cycle: one character inverted followed by seven characters erect [see Figure 2(a)/S.13].

3.2 *Channel B*

3.2.1 For equipments employing a 4-character repetition cycle: one character erect followed by three characters inverted [see Figure 1(b)/S.13].

3.2.2 For equipments employing an 8-character repetition cycle: one character erect followed by seven characters inverted [see Figure 2(b)/S.13].

3.3 *Channel C*

As for Channel B [see Figures 1(c) and 2(c)/S.13].

3.4 *Channel D*

As for Channel A [see Figures 1(d) and 2(d)/S.13].

3.5 *Order of transmission*

3.5.1 Characters of Channels A and B are transmitted consecutively [see Figures 1(e) and 2(e)/S.13].

3.5.2 Elements of Channel C are interleaved with those of Channel A [see Figures 1(g) and 2(g)/S.13].

3.5.3 Elements of Channel D are interleaved with those of Channel B [see Figures 1(g) and 2(g)/S.13].

3.5.4 In the aggregate signal, A elements precede those of C, and B elements precede those of D [see Figures 1(g) and 2(g)/S.13].

3.5.5 The first erect character on A, transmitted after the inverted character on A, is followed by the erect character on B [see Figures 1(e) and 2(e)/S.13].

3.5.6 The erect character on C is followed by the inverted character on D [see Figures 1(f) and 2(f)/S.13].

3.5.7 The inverted character on A is element-interleaved with the erect character on C [see Figures 1(g) and 2(g)/S.13].

4. *Sub-channel arrangement*

4.1 The character transmission rate of the fundamental sub-channel should be a quarter of the standard character rate.

4.2 Sub-channels should be numbered 1, 2, 3 and 4 consecutively.

4.3 Where a 4-character repetition cycle is used, sub-channel 1 should be that sub-channel which has opposite keying polarity to the other three sub-channels of the same main channel [see Figures 3(a), 3(b), 3(c), 3(d)/S.13]. When an 8-character repetition cycle is used, sub-channel 1 should be that sub-channel which has alternately erect and inverted keying polarity [see Figures 3(a), 3(b), 3(c), 3(d)/S.13].

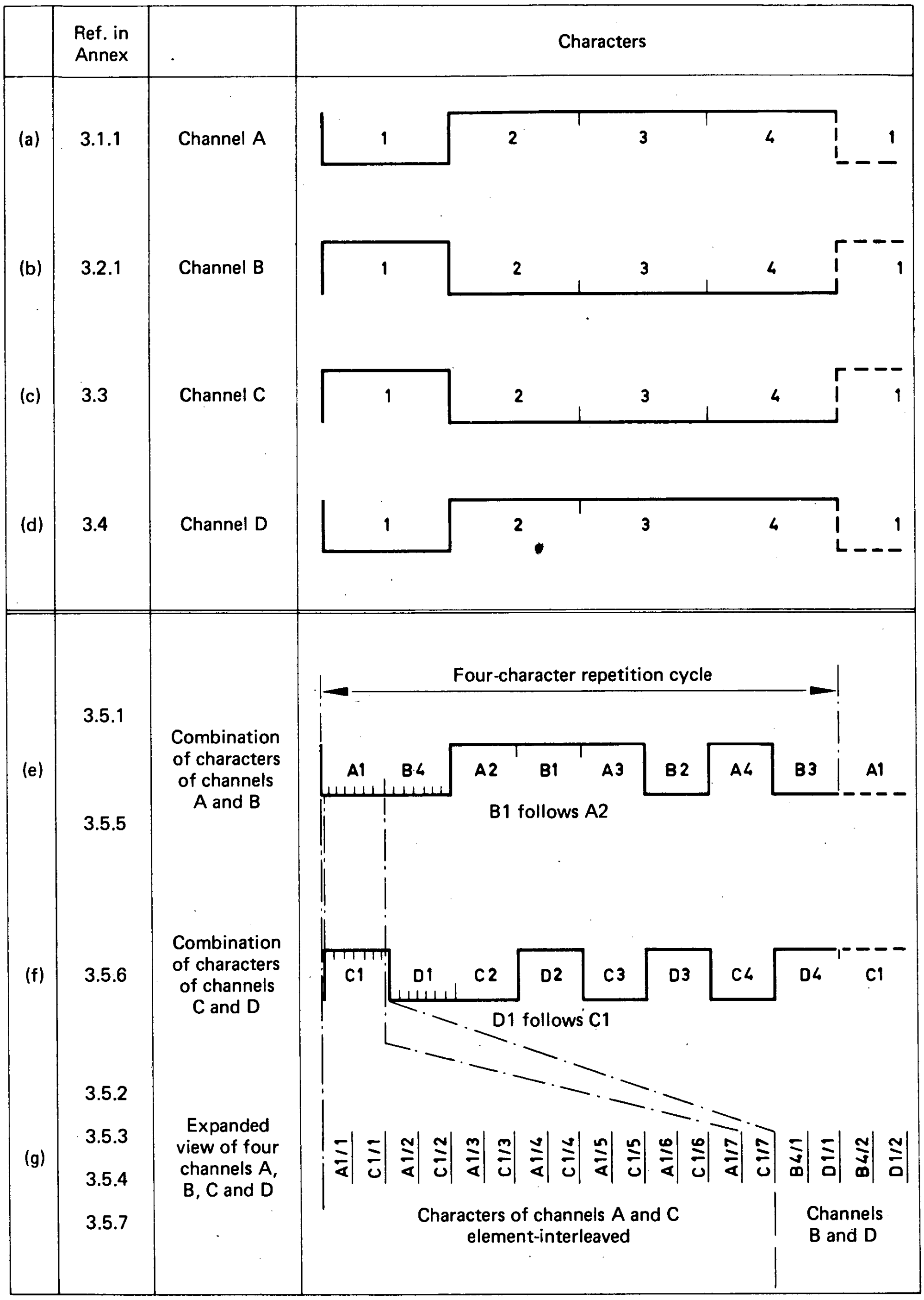


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FIGURE 1/S.13 – **Channel arrangement for a four-character repetition cycle**

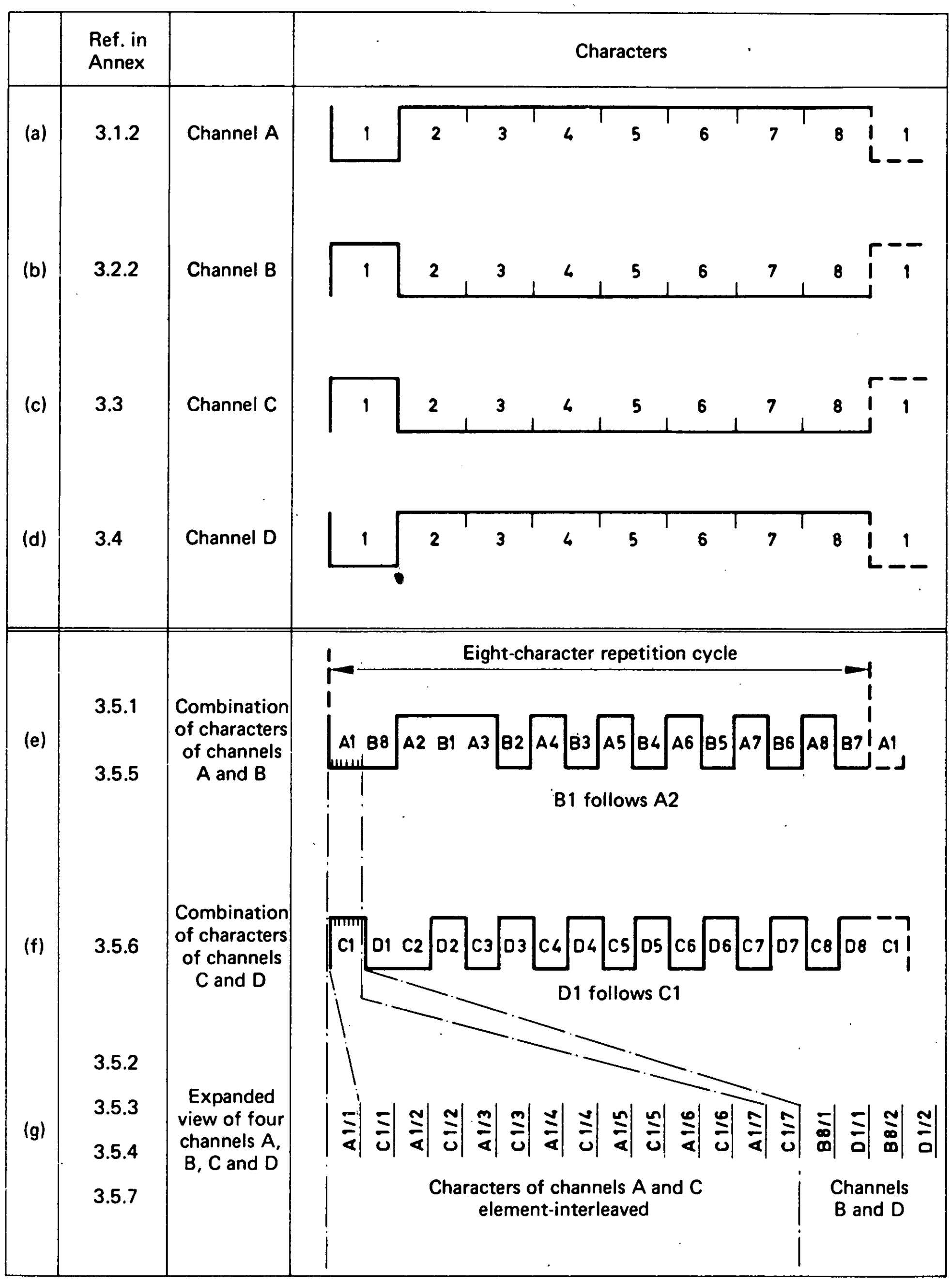

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FIGURE 2/S.13 – Channel arrangement for an eight-character repetition cycle

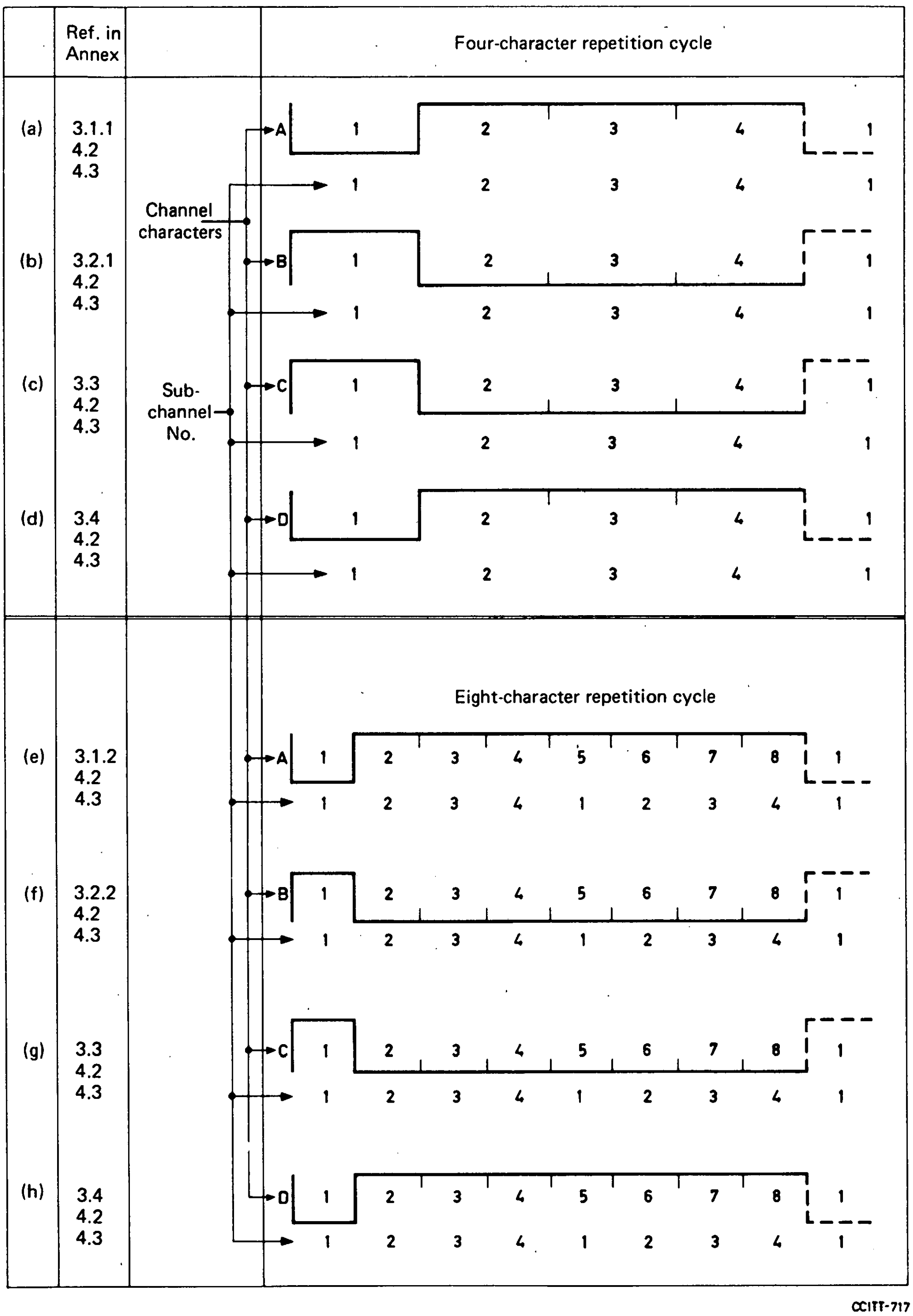

FIGURE 3/S.13 – Sub-channelling arrangements for a four- and eight-character repetition cycle

4.4 When sub-channels of half-character rate, or three-quarter-character rate are required, combinations of the fundamental sub-channels should be arranged as shown in Table 2/S.13.

TABLE 2/S.13

Proportion of full-channel character rate	Combination of fundamental sub-channels
(1) quarter (2) quarter (3) half	No. 1 No. 3 Nos. 2 and 4
(1) half (2) half	Nos. 1 and 3 Nos. 2 and 4
(1) quarter (2) three-quarters	No. 1 Nos. 2, 3 and 4

5. *Designation of aggregate signal*

To assist in identifying the signal condition when applying the aggregate telegraph signal to modulate the radio channel, the designation for the aggregate signal should be used as shown in Table 3/S.13.

TABLE 3/S.13

Seven-unit code condition	Aggregate signal condition	
	Erect character	Inverted character
A	B	Y
Z	Y	B

Note. – With a frequency shift system, the higher frequency should correspond to aggregate condition B and the lower frequency should correspond to aggregate condition Y.

6. *Diagrams*

As a result of the characteristics specified in 2., 3. and 4. above, the transmission of characters will be as shown in Figures 1/S.13, 2/S.13 and 3/S.13.

7. *Automatic phasing*

7.1 Automatic phasing should normally be used. It should be initiated either:

7.1.1 after a waiting period during which cycling due to the receipt of errors has occurred continuously on both channels on a 2-channel system, or on at least two main channels of a 4-channel system;

7.1.2 after equal counts of A and Z elements have been made over at least two consecutive system cycles whilst continuous cycling due to the receipt of errors is occurring on all main channels.

7.2 When the slave station is phasing, it should transmit in each channel, in place of the signal repetition, a 7-element signal in which all seven elements are of the same polarity, all other characters in the repetition cycle being transmitted unchanged.

Recommendation S.14

SUPPRESSION OF UNWANTED RECEPTION IN RADIOTELEGRAPH MULTI-DESTINATION TELEPRINTER SYSTEMS

(former CCIT Recommendation C.22, Geneva, 1956; amended at New Delhi, 1960)

The CCITT,

considering

a) that in a radiotelegraph system in which a radio teleprinter transmitter broadcasts messages simultaneously to a number of receiving stations, this broadcast is sometimes required only by a restricted number of these stations;

b) that it is desirable in such cases to prevent the reception of the message at the other offices to avoid wastage of paper;

c) that such wastage can be avoided by the use of selective calling systems whereby only those stations required to receive the transmission are connected whilst it is in progress;

d) that various technical methods are available for achieving this, using either pulse signalling (e.g. by dial), or signalling with 5-unit signals;

e) that a wide variety of systems may be devised based upon the methods in d) above;

f) that such systems are normally used only for special services in which agreement can be reached on the particular type of system to be adopted,

unanimously declares the view

1. that, when it is desired to avoid wastage of paper at receiving stations in radiotelegraph multi-destination teleprinter systems, a selective calling system should be used;

2. that it is neither necessary nor desirable to recommend the use of any particular type of system for international use.

Recommendation S.15

USE OF THE TELEX NETWORK FOR DATA TRANSMISSION AT 50 BAUDS

(former Recommendation V.10, Geneva, 1964; amended at Mar del Plata, 1968)

a) The telex network is well adapted for the economical transmission of data at fairly slow speeds, for the equipment required for binary transmission of data by telex stations, over and above the normal equipment, is relatively simple.

b) But some limits have to be imposed on data transmission codes used in the telex network because of:

- the need to make sure that telex calls will not be abruptly released;
- exaggerated distortion that may be introduced by amplitude-modulation voice-frequency telegraph systems when an excessively long-duration start (condition A) modulation element appears in a signal;
- the fact that in some networks there is regenerative repetition of start-stop signals, which can be handled only as if they were constructed like five-unit start-stop information signals;
- the possibility that certain long-distance calls may be established over synchronous systems that can handle only five-unit start-stop signals.

c) The limitation due to regenerative repeaters and synchronous systems imposes the use of a five-unit start-stop code for information, hence Division A of the Recommendation (the more general procedure) deals with data transmission with a five-unit code on start-stop systems. But in certain circumstances alphabets with more than five units can be used for data transmission; hence Division B of the Recommendation.

For these reasons, the CCITT *unanimously declares the following view:*

A. DATA TRANSMISSION WITH A FIVE-UNIT CODE ON START-STOP SYSTEMS

1. Telex calls for data transmission may be set up in the international telex network, subject to the following provisions:

2. The call shall be set up between the caller and the called subscriber in accordance with the procedure recommended for the setting-up of a telex call and its supervision by exchange of answer-back codes (Recommendations F.60 and U.1).

3. When one of the subscribers concerned wishes to introduce data transmission equipment into the connection, he shall transmit the sequence SSSS (or ' ' ' ') of combination No. 19 from International Telegraph Alphabet No. 2 (signal for transfer to data). Upon reception of this sequence of combinations, the data transmission or reception equipment, as the case may be, shall be connected to the line. This changeover to the data position may be effected:

a) manually at both terminals;

b) automatically at both terminals;

c) manually at one terminal and automatically at the other.

In order to avoid any misunderstanding between the stations concerned, the calling operator should first check the equipment of the distant station (whether manual changeover or automatic changeover).

3.1 *Manual changeover at both terminals*

3.1.1 Once the connection has been set up, the following procedure should be followed.

3.1.2 The operator of the calling station sends the sequence of four combinations No. 19. This sequence should not connect the data equipment locally.

3.1.3 Upon reception of the SSSS (or ' ' ' ') sequence, the operator of the called station likewise sends the sequence of four combinations No. 19, and then connects his data equipment to the line.

3.1.4 Upon reception of this answer sequence, the calling operator connects his data equipment to the line.

3.2 *Automatic changeover at both terminals*

3.2.1 Once the connection has been set up, the following procedure should be followed:

3.2.2 The calling station sends the sequence of four combinations No. 19 and must connect its data equipment to the line automatically within less than 500 milliseconds, starting from the end of transmission of the last signal of this sequence.

3.2.3 Reception of the sequence at the other terminal of the connection connects the called station to the data equipment line automatically within less than 500 milliseconds, starting from the end of reception of the last signal of this sequence.

3.2.4 The data transmission should not commence before the end of the 500-millisecond delay.

3.3 *Calling station with manual changeover and called station with automatic changeover*

3.3.1 Once the connection has been set up, the following procedure is followed:

3.3.2 The operator of the calling station sends the sequence of four combinations No. 19, and then immediately connects his data equipment to the line.

3.3.3 Upon reception of the sequence of four combinations No. 19 at the called station, the data equipment must be connected to the line within less than 500 milliseconds, starting from the end of reception of this sequence.

3.3.4 The data signals should not be transmitted before the end of the 500-millisecond delay.

3.4 *Calling station with automatic changeover and called station with manual changeover*

3.4.1 Once the connection has been set up, the following procedure should be followed:

3.4.2 The calling station invites its called correspondent, by a brief preliminary message, to send the sequence of four combinations No. 19. This message must not include within itself the sequence of four combinations No. 19. If the calling station is not equipped with a teleprinter attended by an operator, this preliminary message must be sent automatically.

3.4.3 The operator of the called station then sends the sequence of four combinations No. 19 and immediately connects his data equipment to the line.

3.4.4 Upon reception of this sequence at the calling station, connection of the data equipment to the line must be effected within less than 500 milliseconds, starting from the end of reception of the last combination No. 19 of the sequence.

3.4.5 Transmission of the data signals should not begin before the end of the 500-millisecond delay.

Note. – The arrangements envisaged throughout 3. above run counter to the inclusion of the sequence of four combinations No. 19 in the answer-back code of telex lines equipped with a simulator and at the same time in the answer-back of teleprinters equipped with an automatic device for changeover to data transmission. (This fact should be borne in mind in the further study of this Recommendation.)

4. The sequence of four combinations No. 19 will make ineffective, where necessary:

- devices that might conceivably emit signals disturbing to data transmissions, in particular the answer-back or, possibly, the delay signal used in connection with error-correcting synchronous radio systems (Recommendation U.22);
- devices that might be falsely operated by data signals, such as devices for operator-recall (Recommendation U.21).

5. Data transmission should be made by means of start-stop formed according to the structure of International Telegraph Alphabet No. 2 (ITA No. 2). Users should be left free to decide how combinations should be allocated to the various components of the alphabet (of course ITA No. 2 itself may be used).

6. When error control is necessary, one of the following methods of error control may be used:

- return of information to the transmitting station (information feedback system);
- block tansmission with check characters at the end of the block;
- character-by-character transmission with check bits (in the case of five-unit signals with redundancy).

7. Unless the exception stated in 8. below is employed at the end of the data transmission, the telex clearing signal described in Recommendation U.1 shall be emitted. This will cause the call to be cleared down and the terminal equipment to return to the telex position, and will cause the devices that might have been rendered inoperative on certain special circuits (see 4. above) to go back to normal. This clearing signal must set off the clear-confirmation (see Recommendation U.1).

Note. – Users may expect that some combinations No. 32, possibly followed by other combinations, may be received before the connection is cleared.

8. As soon as the telex connection has been transferred to the data transmission equipment, the transmission must be controlled by the data equipment at each terminal. If it is useful, for some reason, to return to telex operation, the data terminal equipment must control the transfer back to telex. This possibility of returning to the telex condition is used by a subscriber who considers it useful, after a data transmission, to return to teleprinter operation for a telex connection, instead of sending the clearing signal as mentioned in 7. above. This return should be accompanied by the re-entry into service of the answer-back device. This control may be caused:

a) by the transmission of a special data signal over the line, causing the receiving installation to return to the telex position. The received data terminal equipment must send the same signal in the reverse direction to the opposite terminal before it causes transfer to the telex condition. This mutual signalling identifies the situations at the two terminals;

b) by a local control causing return to the telex situation, set off if no data or supervisory signal is transmitted or received during a given time interval agreed upon by the users.

Note. – Telex connections that include error-correcting synchronous radio systems often insert long pauses into the message and due attention should be paid to this in selecting the agreed interval.

For these control operations, a special circuit should be set aside in the interface connecting the data terminal equipment to the transfer device.

Note. – The provisions of 8. above could be applied with advantage to the case of telex lines not equipped with teleprinter equipment but simply with answer-back unit simulators.

9. The signals transmitted by the data transmission devices must meet the requirements of 1.1, 1.2, 1.3 and 2.1 in Recommendation S.3. The receiving equipment of the data reception devices must meet the requirements of 1.1, 1.2, 1.6 and 3.1 in Recommendation S.3.

B. DATA TRANSMISSION WITH CODES DIFFERENT FROM THE START-STOP CODE OF ITA No. 2

1. The attention of Administrations is drawn to the fact that it is impossible to send signals other than those of a five-unit start-stop code over international connections via time-division multiplex sections specially designed for a five-unit code. However, telex connections for data transmission may be set up over such relations in the conditions set out in Division A of this Recommendation for the transmission of messages composed of signals different from those of the five-unit start-stop code. A service of this nature may be obtained by regrouping the units of these signals in the form of five-unit signals. Such regrouping calls for the use of additional code converters at the sending and receiving terminals.

2. Between telex networks that can take signals different from those of the five-unit start-stop code (that is to say, when telex calls between such networks do not call for regenerative repeaters, or for certain synchronous systems that would clash with them), by agreement between the Administrations concerned, data transmission with data transmission alphabets using these signals may be made, subject to the following:

2.1 Application of the procedure described under A 2.;

2.2 Application of the procedure described under A 3.;

2.3 Application of the procedure described under A 4.;

2.4 Use of a code with a modulation rate of 50 bauds should avoid composition of signals having more than seven consecutive elements of start polarity. (This limit is imposed to avoid clearing the connection unexpectedly in the exchanges as well as not to introduce excessive distortion on AMVFT channels.) Data may be transmitted by start-stop, or isochronously;

2.5 When error control is necessary, one of the following methods of error control may be used:

- return of information to the transmission station (information feedback system);
- block transmission with check characters at the end of the block;
- character-by-character protection by means of a parity check or a constant ratio code, for example the seven-unit code standardized in Recommendation S.13 (ITA No. 3).

In all cases 2.4 above should be taken into consideration;

2.6 Application of the procedure described under A 7.;

2.7 Application of the procedure described under A 8.

Recommendation S.16

AUTOMATIC CALLING AND/OR ANSWERING ON THE TELEX NETWORK

(former Recommendation V.11, Mar del Plata, 1968)

1. *General*

1.1 This Recommendation provides a method of automatically originating and answering calls on the telex network. Manual calling or answering with automatic facilities is also provided. At this stage the application of that part of this Recommendation for automatic origination of calls is limited to those networks where selection is by means of dial pulses. The automatic answering procedure, however, is generally applicable.

1.2 In order to simplify and reduce the costs of overall data terminal systems in the particular cases where calls are originated for data transmission over the telex as well as the switched telephone networks, the interface and data terminal procedures have been arranged to be similar (see Recommendation V.25 for automatic calling and/or answering on the general switched telephone network).

1.3 The object is to standardize the call establishment and answering procedures between the data terminal equipment (DTE) and the data circuit-terminating equipment (DCE). In addition, the essential interchange circuits, in accordance with Recommendation V.24, have been defined between the two equipments.

1.4 It is recognized that other simpler methods may be possible for automatic calling by data terminals connected only to the switched telegraph networks, and these are still under study. Ultimately it may be technically possible to extend the application of this Recommendation to selection signals of the telegraph character type (commonly known as keyboard selection). This requires further study.

2. *Interchange circuits*

2.1 *Automatic answering*

The following circuits are required to be connected between the DTE and the control unit within the DCE (see Figure 1/S.16).

Circuit numbers

CT 101	Protective ground (may be excluded if so required by local safety regulations)
CT 102	Signal ground
CT 103	Transmitted data
CT 104	Received data
CT 106	Ready for sending (see Note)
CT 107	Data set ready (see Note)
CT 108/2	Data terminal ready
CT 109	Data channel received line signal detector (see Note)
CT 125	Calling indicator
CT 132	Return to non-data mode

Note. – In as far as the operation of the DCE is concerned, circuits CT 106 and CT 109 are not required. But to provide an interface common to that for the telephone case these two circuits are included and are both coupled to CT 107 at the DCE.

2.2 *Automatic calling*

For automatic calling by data terminals connected to telex networks with dial selection, in addition to the above circuits, the following circuits should also be employed between the DTE and the automatic calling equipment within the DCE.

Circuit numbers

CT 201	Signal ground
CT 202	Call request
CT 203	Data line occupied
CT 204	Distant station connected
CT 205	Abandon call
CT 206	Binary digit signal 1
CT 207	Binary digit signal 2
CT 208	Binary digit signal 4
CT 209	Binary digit signal 8
CT 210	Present next digit
CT 211	Digit present
CT 212	Protective ground (may be excluded if so required by local safety regulations)
CT 213	Power indication

The above sets of interface circuits are applicable only to a single DTE connected to a single telex terminal. The impedances of these interface circuits and the signals (voltages, etc.) on the circuits must be as specified in Recommendation V.28.

Note 1. – The use of a common auto-calling equipment for the connection of several DTEs to one, or more, telex lines and any additional interchange circuits thus required remains for further study.

Note 2. – It may be technically possible to extend the application of this automatic calling interface for keyboard selection. This possibility requires further study.

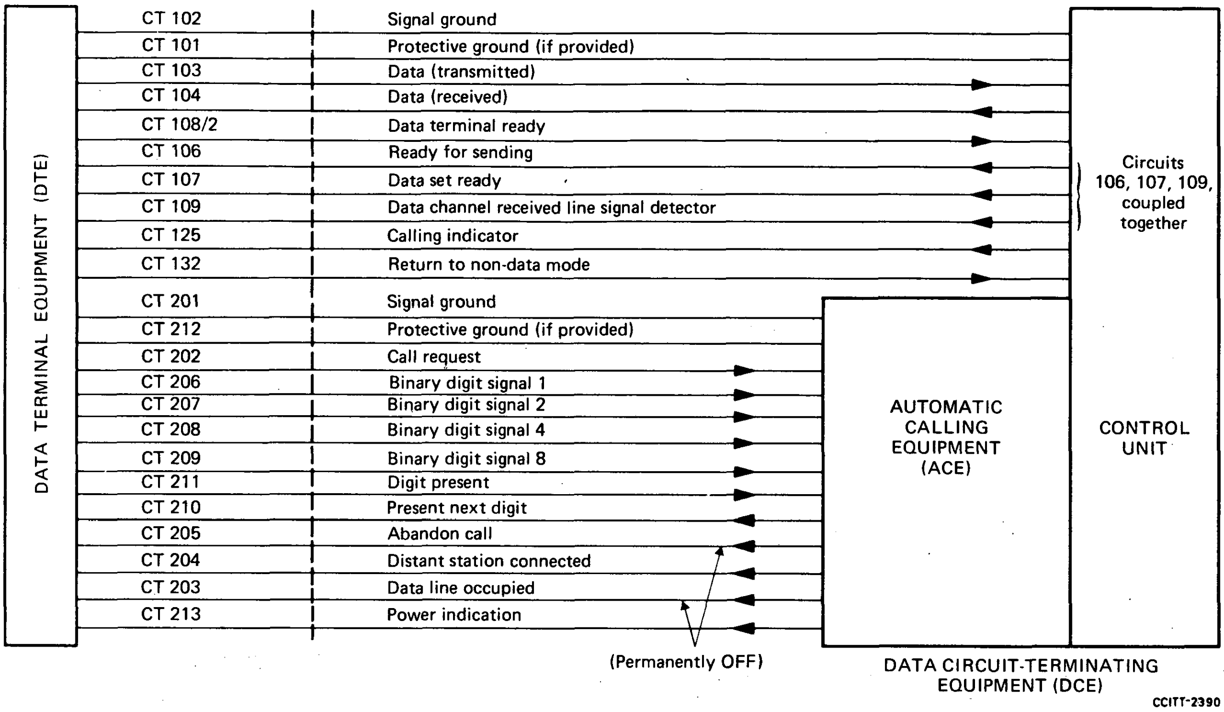

FIGURE 1/S.16 – **Proposed interface for telex ACE**

3. *Procedures*

The connections between various types of terminals covered by the following recommended procedures are:

I	Telex terminal, with manual calling	Data terminal, with automatic answering
II	Telex and data terminal, with manual calling, manual or automatic changeover to data	Data terminal, with automatic answering
III	Data terminal, with automatic calling	Telex terminal, with teleprinter answering
IV	Data terminal, with automatic calling	Telex and data terminal, with teleprinter answering, automatic changeover
V	Data terminal, with automatic calling	Data terminal with automatic answering

The recommended procedures are: CASE I

A Station (calling)	B Station (answering)
Telex terminal: *Manual calling* 1.A Call telex exchange. 2.A Operator dials or keys selection signals and establishes connection in normal way. 3.A Receives A/B signals, either automatically or after the operator sends WRU signal. 4.A Data exchange may commence.	Data terminal: *Automatic answering* 1.B Incoming call indication at control unit switches CT 125 to on and call-connected signal is transmitted. 2.B If DTE is going to accept incoming call, CT 108/2 must be switched on within 2 seconds after CT 125 is on. 3.B Upon receipt of WRU signal, then a) if CT 108/2 is off, control unit sends A/B signals followed by the service signal **ABS** and then the clearing signal, b) if CT 108/2 is on, control unit sends A/B signals. It then connects CT 103 and CT 104 to line; CT 106, CT 107, CT 109 are switched on. (A/B unit simulator remains enabled.) 4.B Data exchange may commence.
Telex operator clears 5.A i) If the operator requires to clear down, he initiates clearing signal in the normal telex manner.	5.B i) Upon receipt of the clearing signal, the DCE returns the clearing signal, switches CT 125, CT 106, CT 107 and CT 109 to off. The line is disconnected from CT 103 and CT 104. 6.B i) DTE might or might not switch CT 103/2 to off.
5.A ii) Clearing signal received, terminal clears down automatically in normal telex manner.	Data terminal clears 5.B ii) DTE switches CT 108/2 to off. 6.B ii) The control unit switches CT 106, CT 107, CT 109 and CT 125 to off. 7.B ii) The control unit disconnects the line from CT 103 and CT 104; transmits the clearing signal. 8.B ii) DTE might or might not switch CT 108/2 to on.

Abbreviations

A/B = answer-back
DCE = data circuit-terminating equipment
DTE = data terminal equipment
ITA No. 2 = International Telegraph Alphabet No. 2
WRU = *Who are you?*

CASE II

A Station (calling)	B Station (answering)
Telex and data terminal: *Manual calling – Manual or automatic changeover* 1.A Call telex exchange.	Data terminal: *Automatic answering*

CASE II *(continued)*

A Station (calling)	B Station (answering)
2.A Operator dials or keys selection signals and establishes connection in normal way.	1.B Incoming call indication at control unit switches CT 125 to on and call-connected signal is transmitted. 2.B If DTE is going to accept incoming call, CT 108/2 must be switched on within 2 seconds after CT 125 is on. 3.B Upon receipt of WRU signal, then a) if CT 108/2 is off, control unit sends A/B signals followed by the service signal **ABS** and then the clearing signal, b) if CT 108/2 is on, control unit sends A/B signals. It then connects CT 103 and CT 104 to line; CT 106, CT 107, CT 109 are switched on. (A/B unit simulator remains enabled.)
3.A Receives A/B signals, either automatically or after the operator sends WRU signal. 4.A Operator transmits four combinations No. 19 of ITA No. 2 and: a) immediately switches the line manually to the DTE, or b) (With automatic changeover.) The transfer of the line from the teleprinter to CT 103 and CT 104 is effected automatically within the control unit by the transmission of the last signal of the sequence four combinations No. 19. Control unit switches CT 106, CT 107 and CT 109 to on. A/B unit disabled.	4.B The receipt of the sequence four combinations No. 19 of ITA No. 2 indicates to the DTE that the data equipment at the A station is connected to line. DCE disables the A/B unit simulator.
5.A Data exchange may commence.	5.B Data exchange may commence.
Telex operator clears: *Manual changeover only* 6.A i) Operator manually switches the line to the telex terminal. 7.A i) Operator initiates clearing signal in the normal telex manner and A/B unit is re-enabled.	6.B i) Upon receipt of the clearing signal, the DCE returns the clearing signal, switches CT 125, CT 106, CT 107 and CT 109 to off. The line is disconnected from CT 103 and CT 104. 7.B i) DTE might or might not switch CT 108/2 to off. 8.B i) A/B unit simulator is re-enabled by DCE.
Data terminal clears 6.A ii) DTE switches CT 108/2 to off. 7.A ii) The DCE control unit switches CT 106, CT 107 and CT 109 to off, transfers the line from CT 103 and CT 104 to the telex terminal and transmits the clearing signal. A/B unit is re-enabled.	6.B ii) Upon receipt of the clearing signal, the DCE returns the clearing signal, switches CT 125, CT 106, CT 107 and CT 109 to off. The line is disconnected from CT 103 and CT 104. A/B unit simulator is re-enabled. 7.B ii) DTE might or might not switch CT 108/2 to off.

CASE II *(concluded)*

A Station (calling)	B Station (answering)
	Data terminal clears
	6.B iii) DTE switches CT 108/2 to off.
	7.B iii) The control unit switches CT 106, CT 107, CT 109 and CT 125 to off.
6.A iii) Clearing signal received, terminal clears down automatically in normal telex manner. A/B unit is re-enabled.	8.B iii) The control unit disconnects the line from CT 103 and CT 104; transmits the clearing signal. A/B unit simulator is re-enabled.

CASE III

A Station (calling)	B Station (answering)
Data terminal: *Automatic calling*	Telex terminal: *Teleprinter answering – No data equipment*
1.A DTE checks CT 213 is on and CT 203 is off.	
2.A DTE switches CT 202 to on.	
3.A DTE switches CT 108/2 to on.	
4.A DCE (auto-calling equipment and control unit) calls telex exchange and switches CT 203 to on.	
5.A Proceed-to-select signal is received from telex exchange.	
6.A DCE switches CT 210 to on.	
7.A DTE presents first digit on CT 206, CT 207, CT 208, CT 209.	
8.A DTE switches CT 211 to on.	
9.A DCE sends the selection signal for the first digit, then switches CT 210 to off.	
10.A DTE switches CT 211 to off.	
11.A The sequence of steps 6.A-10.A is repeated for each digit, including the last to be transmitted.	
12.A DCE switches CT 210 to on.	1.B Call received in normal way.
13.A DTE presents the "end of number" (EON) signals on CT 206, CT 207, CT 208 and CT 209, then switches CT 211 to on.	2.B Call-connected signal sent.
14.A DCE switches CT 210 to off and holds it in this condition for the remainder of call.	
15.A DTE switches CT 211 to off.	
16.A Call-connected signal received, DCE connects CT 103 and CT 104 through to line and switches CT 106, CT 107 and CT 109 to on. (A/B unit simulator in DCE still connected.)	
17.A If A/B signals are not automatically received within 3 seconds (see Notes 1, 2 and 5), DTE transmits combinations No. 30 and No. 4 of ITA No. 2 (WRU). The A/B unit simulator of the DCE must not respond to this WRU signal.	3.B Upon receipt of the WRU signal, the A/B signals are transmitted.

CASE III *(concluded)*

A Station (calling)	B Station (answering)
18.A The A/B signals having been received by the DTE data exchange may commence.	4.B Data exchange may commence.
Data terminal clears 19.A i) DTE switches CT 108/2 and CT 202 to off. 20.A i) CT 108/2 being switched off, the DCE control unit switches CT 106, CT 107 and CT 109 to off. Disconnects CT 103 and CT 104 from the line. Transmits the clearing signal.	5.B i) Clearing signal received, telex terminal clears down in normal telex way.
19.A ii) On receipt of clearing signal monitored from line by control unit, DCE switches CT 106, CT 107 and CT 109 to off, disconnects CT 103 and CT 104 from the line and returns the clearing signal to line. 20.A ii) DTE switches CT 202 and CT 108/2 to off.	Telex operator clears 5.B ii) If operator requires to clear down, he initiates the clearing signal in the normal telex way.

CASE IV

A Station (calling)	B Station (answering)
Data terminal: *Automatic calling*	Telex + data terminal: *Automatic changeover*
1.A CTE checks CT 213 is on and CT 203 is off.	
2.A DTE switches CT 202 to on.	
3.A DTE switches CT 108/2 to on.	
4.A DCE (auto-calling equipment and control unit) calls telex exchange and switches CT 203 to on.	
5.A Proceed-to-select signal is received from telex exchange.	
6.A DCE switches CT 210 to on.	
7.A DTE presents first digit on CT 206, CT 207, CT 208, CT 209.	
8.A DTE switches CT 211 to on.	
9.A DCE sends the selection signal for the first digit, then switches CT 210 to off.	
10.A DTE switches CT 211 to off.	
11.A The sequence of steps 6.A-10.A is repeated for each digit, including the last to be transmitted.	
12.A DCE switches CT 210 to on.	1.B Incoming call indication received, DCE switches CT 125 to on.
13.A DTE presents the "end of number" (EON) signals on CT 206, CT 207, CT 208 and CT 209, then switches CT 211 to on.	2.B Call-connected signal sent.

CASE IV *(continued)*

A Station (calling)	B Station (answering)
14.A DCE switches CT 210 to off and holds it in this condition for the remainder of call.	
15.A DTE switches CT 211 to off.	
16.A Call-connected signal received, DCE connects CT 103 and CT 104 through to line and switches CT 106, CT 107 and CT 109 to on. (A/B unit simulator in DCE still connected.)	
17.A If A/B signals are not automatically received within 3 seconds (see Notes 1, 2 and 5), DTE transmits combinations No. 30 and No. 4 of ITA No. 2 (WRU). The A/B unit simulator of the DCE must not respond to this WRU signal.	3.B Upon receipt of the WRU signal, the A/B signals are transmitted.
18.A Upon receipt of A/B signals (in ITA No. 2), the DTE transmits over CT 103 the signal sequence of four combinations No. 19 of ITA No. 2.	
19.A Upon recognition of the sequence of four combinations No. 19 by the DCE the A/B unit simulator is disabled.	4.B Upon receipt of the sequence of four combinations No. 19: a) If CT 108/2 is on, DCE transfers the line from the telex terminal to CT 103 and CT 104; CT 106, CT 107 and CT 109 are switched on. A/B unit is disabled. b) If CT 108/2 is off, the call is cleared by DCE.
20.A After a minimum delay of 500 ms data exchange may commence.	5.B Data exchange may commence.
21.A If the DTE requires to communicate with the telex terminal at the B station after data have been exchanged a special data signal should be sent from the DTE to effect this.	6.B Upon receipt of the appropriate data signal, DTE switches CT 132 to on.
22.A After 2 seconds "telegraph" characters, encoded in accordance with ITA No. 2, may now be exchanged.	7.B The control unit of the DCE restores the line connection to the telex terminal and switches CT 106, CT 107, CT 109 and CT 125 to off.
	8.B Normal telegraph transmission may commence.
	9.B DTE switches CT 132 to off.
Data terminal clears	Data terminal still connected
23.A i) DTE switches CT 108/2 and CT 202 to off.	
24.A i) CT 108/2 being switched off, the DCE control unit switches CT 106, CT 107 and CT 109 to off, disconnects CT 103 and CT 104 from the line, and transmits the clearing signal. A/B unit simulator is re-enabled.	10.B i) On receipt of the clearing signal monitored from the line by the DCE control unit, CT 106, CT 107, CT 109 and CT 125 are switched off. Line is transferred from CT 103 and CT 104 to the telex terminal and the clearing signal is returned to line in the normal telex manner. A/B unit is re-enabled.

CASE IV *(concluded)*

A Station (calling)	B Station (answering)
Data terminal clears 23.A ii) DTE switches CT 108/2 and CT 202 to off. 24.A ii) CT 108/2 being switched off, the DCE control unit switches CT 106, CT 107 and CT 109 to off, disconnects CT 103 and CT 104 from the line. Transmits the clearing signal. A/B unit simulator is re-enabled.	Telex terminal reconnected 10.B ii) Clearing signal received, terminal clears down in normal telex manner. A/B unit is re-enabled.
23.A iii) On receipt of the clearing signal monitored from line by control unit, DCE switches CT 106, CT 107 and CT 109 to off, disconnects CT 103 and CT 104 from the line and returns the clearing signal to line. A/B unit simulator is re-enabled. 24.A iii) DTE switches CT 202 and CT 108/2 to off.	Data terminal clears (not having returned to telex terminal) 10.B iii) DTE switches CT 108/2 to off. 11.B iii) The control unit switches CT 106, CT 107, CT 109 and CT 125 to off. 12.B iii) The control unit transfers the line from CT 103 and CT 104 to the telex terminal and transmits the clearing signal. A/B unit is re-enabled.
23.A iv) On receipt of the clearing signal monitored from line by control unit, DCE switches CT 106, CT 107 and CT 109 to off, disconnects CT 103 and CT 104 from the line and returns the clearing signal to line. A/B unit simulator is re-enabled. 24.A iv) DTE switches CT 202 and CT 108/2 to off.	Telex operator clears (having returned to telex terminal) 10.B iv) If operator requires to clear down, he initiates the clearing signal in the normal telex way.

CASE V

A Station (calling)	B Station (answering)
Data terminal: *Automatic calling* 1.A DTE checks CT 213 is on and CT 203 is off. 2.A DTE switches CT 202 to on. 3.A DTE switches CT 108/2 to on. 4.A DCE (auto-calling equipment and control unit) calls telex exchange and switches CT 203 to on.	Data terminal: *Automatic answering*

CASE V *(continued)*

A Station (calling)	B Station (answering)
5.A Proceed-to-select signal is received from telex exchange.	
6.A DCE switches CT 210 to on.	
7.A DTE presents first digit on CT 206, CT 207, CT 208, CT 209.	
8.A DTE switches CT 211 to on.	
9.A DCE sends the selection signal for the first digit, then switches CT 210 to off.	
10.A DTE switches CT 211 to off.	
11.A The sequence of steps 6.A-10.A is repeated for each digit, including the last to be transmitted.	
12.A DCE switches CT 210 to on.	
13.A DTE presents the "end of number" (EON) signals on CT 206, CT 207, CT 208 and CT 209, then switches CT 211 to on.	1.B Incoming call indication at control unit switches CT 125 to on and call-connected signal is transmitted.
14.A DCE switches CT 210 to off and holds it in this condition for the remainder of call.	2.B If DTE is going to accept incoming call, CT 108/2 must be switched on within 2 seconds after CT 125 is on.
15.A DTE switches CT 211 to off.	
16.A Call-connected signal received, DCE connects CT 103 and CT 104 through to line and switches CT 106, CT 107 and CT 109 to on. (A/B unit simulator in DCE still connected.)	
17.A If A/B signals are not automatically received within 3 seconds (see Notes 1, 2 and 5), DTE transmits combinations No. 30 and No. 4 of ITA No. 2 (WRU). The A/B unit simulator of the DCE must not respond to this WRU signal.	3.B Upon receipt of WRU signal, then: a) if CT 108/2 is off, control unit sends A/B signals followed by the service signal **ABS** and then the clearing signal. b) if CT 108/2 is on, control unit sends A/B signals. It then connects CT 103 and CT 104 to line; CT 106, CT 107, CT 109 are switched on. (A/B unit simulator remains enabled.)
18.A Upon receipt of A/B signals (all in ITA No. 2), the DTE transmits over CT 103 the signal sequence of four combinations No. 19 of ITA No. 2.	
19.A Upon recognition of the sequence of four combinations No. 19 by the DCE the A/B unit simulator is disabled.	4.B The receipt of the sequence four combinations No. 19 of ITA No. 2 indicates to the DTE that the data equipment at the A station is connected to line. DCE disables the A/B unit simulator.
20.A After a minimum delay of 500 ms data exchange may commence.	5.B Data exchange may commence.

CASE V *(concluded)*

A Station (calling)	B Station (answering)
Data terminal clears 21.A i) DTE switches CT 108/2 and CT 202 to off. 22.A i) CT 108/2 being switched off, the control unit of DCE switches CT 106, CT 107 and CT 109 to off, disconnects CT 103 and CT 104 from the line and transmits the clearing signal. A/B unit simulator is re-enabled.	6.B i) Upon receipt of the clearing signal, the DCE returns the clearing signal, switches CT 125, CT 106, CT 107 and CT 109 to off. The line is disconnected from CT 103 and CT 104. A/B unit simulator is re-enabled. 7.B i) DTE might or might not switch CT 108/2 to off.
21.A ii) On receipt of the clearing signal monitored from the line by control unit, DCE switches CT 106, CT 107 and CT 109 to off, disconnects CT 103 and CT 104 from the line and returns the clearing signal to line. A/B unit simulator is re-enabled. 22.A ii) DTE switches CT 202 and CT 108/2 to off.	Data terminal clears 6.B ii) DTE switches CT 108/2 to off. 7.B ii) The control unit switches CT 106, CT 107, CT 109 and CT 125 to off. 8.B ii) The control unit disconnects the line from CT 103 and CT 104; transmits the clearing signal. A/B unit simulator is re-enabled.

Note 1. – In some national telex systems the answer-back from the A station is automatically tripped by a WRU signal from the telex exchange. Therefore the DTE at both A and B stations must be prepared for these signals to be transmitted before data can be reliably exchanged. The telex operator at the A station in cases I and II above must also be prepared for these signals to be transmitted before attempting to send the sequence of four combinations No. 19.

Note 2. – This is a provisional time of three seconds. It is considered that a finally agreed figure may be in excess of this.

Note 3. – On the occasions when a call, for various reasons, is not connected through to a B station, a service signal (e.g. OCC, DER) will be sent from the telex exchange to the A station. Since those service signals are always prefixed by continuous stop polarity for a minimum duration of 200 milliseconds, the lines at the A station will have been extended to the DTE and the service signal will pass straight to the DTE. The call will be cleared automatically by the telex exchange. The general question of service signals and the responses that the DTE should make to them (e.g. number of attempts to establish the call and timing between successive attempts) is to be studied.

Note 4. – The particular case of a data terminal with automatic calling working into a telex + data terminal with manual changeover has not been included as the indefinite delay of an operator in switching to data could be unacceptable.

Note 5. – Because of the possible reception by data terminal equipments of normal telegraph supervisory and/or service signals (see Notes 1 and 3) it might be advisable for the data terminal equipments at either end of the connection to exchange "message prefix" signals before commencing to exchange data. The coding and decision to use such message prefixes remain the responsibility of the data user.

Recommendation S.17

ANSWER-BACK UNIT SIMULATORS

(former Recommendation V.13, Mar del Plata, 1968)

1. The answer-back code must be released by a device capable of recognizing the *Who are you?* signal in International Telegraph Alphabet No. 2 (five-unit code). Hence, this device must keep in a store unit the *figures* situation indicated by combination No. 30 received before combination No. 4 of this alphabet.

2. In view of the procedure adopted for the use of the sequence of four No. 19 combinations as the signal for passage from the telex position to the data position in terminal equipment, the introduction of this sequence (four times combination No. 19) in the 20 signals of the simulator answer-back code is to be avoided, since it is incompatible with the procedure already adopted.

Note. – It should be noted that, for the same reason of procedure, this four times combination No. 19 sequence should not be introduced in the answer-back code signals of a teleprinter associated with a manual or automatic call-transfer device.

3. The composition of the signals of the answer-back unit simulator can obviously be used for identification of the station obtained by the station that requests the call. If the identification is negative, it is up to this calling station to interrupt the unwanted connection.

Note. – On the other hand, it was agreed that identification in the opposite direction could not be achieved in a simple way by the answer-back unit simulator, since the answer-back code to be checked in this direction is that of the opposite station, which is normally the one that has requested the connection.

4. In a telex installation intended for data transmission and equipped with an answer-back unit simulator instead of a teleprinter, the device for changeover from telex to data working – by the passage of the sequence of four combinations No. 19 – must be automatic.

5. The characteristics of the answer-back unit simulator should conform with Recommendation S.6.

Recommendation S.30

STANDARDIZATION OF BASIC MODEL PAGE-PRINTING MACHINE USING INTERNATIONAL ALPHABET No. 5

(Geneva, 1972; amended at Geneva, 1976 – identical to Recommendation X.30)

The CCITT,

considering

a) that the basic model page-printing machine is defined as having certain basic features for receiving (including printing) and/or transmitting;

b) Recommendations V.3, V.4 and X.4;

unanimously declares the view

1. the sets of graphics to be used should be either:

- a set of 95 characters consisting of columns 2 to 7 in the code table of International Alphabet No. 5 excluding the character DEL; or
- a smaller set of 64 characters consisting of columns 2 to 5 of the code table of International Alphabet No. 5.

If the machine is designed only for the smaller set of characters, the logic of the machine must be such that it prints the appropriate capital letters even when it receives a code combination for small letters;

Note. – The interpretation, by 64-character machines, of other than alphabetic characters in columns 6 and 7 of the code table is at the discretion of Administrations for the time being.

2. the number of characters that the line of text of the basic model page-printing machine may contain should be fixed at 80;

3. To ensure the new-line function on direct printing machines:

– the transmitter must send at least *n* characters;

– the receiver must operate correctly on receipt of *n* characters.

For speeds up to and including 20 characters per second, $n = 4$. At 27.3 (corresponding to 300 bauds) and 30 characters per second, $n = 6$. The *n* characters consist of:

– one format effector CR (position 0/13 in International Alphabet No. 5);

– one format effector LF (position 0/10 in International Alphabet No. 5);

– the appropriate remaining number of non-printing and non-carriage moving characters (but the CR character is allowed);

4. the time elapsing between the application of power to the motor of a machine and the machine's running up to speed and being ready to receive or send characters should not exceed 600 ms. Where the machine is used in a switched network, this elapsed time shall start from the instant when an incoming call is received at the interface.

Note. – Manufacturers should endeavour to minimize this time.

Recommendation S.31

TRANSMISSION CHARACTERISTICS FOR START-STOP DATA TERMINAL EQUIPMENT USING INTERNATIONAL ALPHABET No. 5

(Geneva, 1972; amended at Geneva, 1976 – identical to Recommendation X.31)

a) Taking into account Recommendations V.3 and X.4, this Recommendation applies to the characteristics, from the transmission point of view, at the interchange point between data circuit-terminating equipment and start-stop data terminal equipment using International Alphabet No. 5. Except where otherwise specified, *data terminal equipment* in this Recommendation should be understood to mean *start-stop apparatus* in the wide sense of the term, as defined in 34.14 of the *List of Definitions of Essential Telecommunication Terms*, Part I, i.e. it includes reperforators, service signals sent by switching equipment, signals from answer-back units, automatic transmitters, etc.

b) Bearing in mind the definition of User Class of Service 1 in Recommendation X.1, where it is specified that a signalling rate of 300 bit/s, a structure of 11 units per character and start-stop operation shall be used for address selection, call progress signals and data transfer.

c) The characteristics laid down below are those that should be evident in service conditions at the interchange point between data terminal equipment and data circuit-terminating equipment.

The CCITT *unanimously declares the view:*

1. *Equipment characteristics*

1.1 The nominal modulation rate should be:

a) 300 bauds; or

b) 200 bauds.

1.2 The difference between the real mean modulation rate of the signals when in service and the nominal rate should not exceed ± 0.1%.

1.3 The nominal duration of the transmitting cycle should be at least 11 units, the stop element lasting for at least 2 units.

1.4 The receiver must be able to translate correctly in service the signals coming from a source that appears to have a nominal transmit cycle equal to or greater than 10 units.

2. *Transmitter characteristics*

2.1 The degree of gross start-stop distortion of transmitted signals, measured at the interchange point between data terminal equipment and data circuit-terminating equipment, must not exceed 5%. This value applies to all working conditions of the equipment under consideration encountered during normal service, whether the signals are transmitted separately or whether they succeed one another at the maximum rate compatible with the modulation rate.

2.2 It is recommended that the measurement should be made with a start-stop distortion measuring set for two consecutive periods, each of about 15 seconds (corresponding to about 1200 transitions at 200 bauds or 1800 transitions at 300 bauds). Early distortion should be observed during one period and late distortion during the other.

3. *Receiver characteristics*

3.1 The effective net margin measured at the interchange point between data terminal equipment and data circuit-terminating equipment should not be less than 40% for signals corresponding to a nominal transmit cycle equal to or greater than 10 units.

3.2 It is recommended that the measurement should be made under the following conditions, in service:

- 11-unit cycle for the signals transmitted by the measuring apparatus;
- use of one of the signal trains specified in Recommendation S.33;
- first test with an identical distortion rate on all transitions of the signal train, obtained by lengthening the start element;
- a second test with the same rate of identical distortion on all the transitions of the signal train, but obtained in this case by shortening the start element;
- reading the margin when one error per test sentence is obtained. (The margin is the lesser of the two values of the degree of distortion obtained from the two measurements);
- the length of the start element or of any data element must in no case be less than 50% of the theoretical unit element.

Note. – It will be up to Administrations using some other measuring method to work out for their own use figures to give equivalent results to those which would have been obtained by the recommended method.

Recommendation S.32

ANSWER-BACK UNITS FOR 200- AND 300-BAUD START-STOP MACHINES IN ACCORDANCE WITH RECOMMENDATION S.30

(Geneva, 1972; amended at Geneva, 1976 – identical to Recommendation X.32)

The CCITT,

considering

a) that start-stop machines are capable of receiving communications without the aid of an operator;

b) that it may be necessary to verify the correct functioning of the line and of the distant terminal equipment, *unanimously declares the view* that if the use of an automatic answer-back unit is requested, it would be advisable:

1. to effect the operation of the code transmitter by the control character ENQ, position 0/5 in the code table of International Alphabet No. 5 (Recommendation V.3);

2. to compose the code-emission by a series of 20 signals, as follows:

   1 CR (position 0/13 in the code table),

   1 LF (position 0/10 in the code table),

   2 non-printing, non-carriage moving signals (but which may include CR),

   16 signals chosen for the subscriber comprising the identification of the machine;

3. when the code signal does not comprise 16 characters, to distribute them by inserting at the beginning as many fill signals (such as DEL or NUL) as are necessary to make up the total of 16 signals;

4. that the answer-back signals follow Recommendations X.4 and S.31;

5. that the delay between the reception of the beginning of the start unit of control character ENQ and the beginning of the start unit of the first signal of the answer-back sent by the machine should lie between one and four character periods.

Recommendation S.33

STANDARDIZATION OF AN INTERNATIONAL TEXT FOR THE MEASUREMENT OF THE MARGIN OF START-STOP MACHINES USING INTERNATIONAL ALPHABET No. 5

(Geneva, 1972 – identical to Recommendation X.33)

The CCITT

unanimously declares the view

1) that it is not necessary to standaridize a single international text for the measurement of the margin of a teleprinter;

2) that nevertheles it would be of interest to recommend to the operating Administrations the use of one or other of the following texts (based on the international reference version of International Alphabet No. 5):

a) in case of application of the 95-character set (columns 2 to 7 in the code table):

VoyeZ Le BricK GeanT QuE J'ExaminE PreS Du WharF 123 456 7890 + – × : = ¤ % ( )

ThE QuicK BrowN FoX JumpS OveR ThE LazY DoG 123 456 7890 + – × : = ¤ % ( )

b) in case of application of the 64-character set (columns 2 to 5 in the code table):

VOYEZ LE BRICK GEANT QUE J'EXAMINE PRES DU WHARF 123 456 7890 + – × : = ¤ % ( )

THE QUICK BROWN FOX JUMPS OVER THE LAZY DOG 123 456 7890 + – × : = ¤ % ( )

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PART III

Series T Recommendations

APPARATUS AND TRANSMISSION FOR FACSIMILIE TELEGRAPHY

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APPARATUS AND TRANSMISSION FOR FACSIMILE TELEGRAPHY

Recommendation T.0

CLASSIFICATION OF FACSIMILE APPARATUS FOR DOCUMENT TRANSMISSION OVER TELEPHONE-TYPE CIRCUITS

(Geneva, 1976)

1. For document facsimile transmission by international communications carried on telephone-type circuits there is a need for providing sufficient operating speeds to meet users' requirements.

2. Users' requirements may best be served at the present time by classifying the following three basic categories of document facsimile service:

Group 1 (See Note 1)

Apparatus which uses double sideband modulation without any special measures to compress the bandwidth of the transmitted signal and which is suitable for the transmission of documents of ISO A4 size at nominally 4 lines per mm in about six minutes via a telephone-type circuit.

Apparatus in this group may be designed to operate at a lower definition suitable for the transmission of documents of ISO A4 size in a time between three and six minutes.

Group 2 (See Note 2)

Apparatus which exploits bandwidth compression techniques in order to achieve a transmission time of about three minutes for the transmission of an ISO A4 size document at nominally 4 lines per mm via a telephone-type circuit. Bandwidth compression in this context includes encoding and/or vestigial sideband working but excludes processing of the document signal to reduce redundancy.

Group 3 (See Note 3)

Apparatus which incorporates means for reducing the redundant information in the document signal prior to the modulation process and which can achieve a transmission time of about 1 minute for a typical typescript document of ISO A4 size via a telephone-type circuit. The apparatus may incorporate bandwidth compression of the line signal.

3. The users will choose among these apparatus, in accordance with their needs and the facilities afforded by the connection.

4. Procedures for document facsimile transmission in the general switched telephone network should be in accordance with Recommendation T.30.

Note 1. – This apparatus has been standardized in Recommendation T.2.

Note 2. – This apparatus has been standardized in Recommendation T.3.

Note 3. – This apparatus is under study in Questions 2/XIV and 3/XIV.

Recommendation T.1

STANDARDIZATION OF PHOTOTELEGRAPH APPARATUS

(former CCIT Recommendation D.1; amended at New Delhi, 1960, Geneva, 1964, and Mar del Plata, 1968)

The CCITT,

considering

that the transmission of pictures is possible only if certain characteristics of the transmitting and receiving equipments are identical,

unanimously declares the view

that phototelegraph apparatus and the associated modulating and demodulating equipment should be constructed and employed according to the following standards:

1. *Scanning track*

At the transmitting apparatus the message area should be scanned in a "negative" direction. The orientation of the document in relation to the scanning plane will depend upon its dimensions and is of no consequence.

At the receiving apparatus scanning takes place in a "negative" direction for "positive" reception and in a "positive" direction for "negative" reception.

2. *Index of cooperation*

The normal index is 352 (corresponds to a factor of cooperation of 1105).

The preferred alternative index, for use when less dense scanning is required, or when the characteristics of circuits (and particularly combined radio and metallic circuits) so demand, is 264 (a factor of cooperation of 829). The admissible tolerances on the above-mentioned values are ± 1%.

3. *Dimensions of apparatus*

3.1 *Apparatus with drum scanning*

The most currently used drum diameters are 66, 70 and 88 mm.

The drum factor of the sending apparatus shall not be more than 2.4.

The drum factor of the receiving apparatus shall not be less than 2.4.

The width of the picture-retaining device (dead sector) may not exceed 15 mm. An allowance of 3% of the total length of a scanning line is also made for phasing. Thus, since the total circumference of a drum of the diameter of 66 mm is about 207 mm, the usable circumference will be at least 186 mm.

3.2 *Apparatus with flat-bed scanning*

The total lengths of the most current scanning lines are 207, 220 and 276 mm of which 15 mm are not used for effective transmission, because of the possibility that the receiving station may use a drum apparatus.

Before transmitting a picture to a receiving station using a drum apparatus, it is necessary to ensure that the value of ratio:

$$\frac{\text{length of document to be transmitted}^{1)}}{\text{total length of a scanning line}} \times \pi$$

is less or at most equal to the drum factor of the receiver used.

3.3 Table 1/T.1 gives corresponding values of index of cooperation M, factor of cooperation C, drum diameter D, total length of scanning line L, scanning pitch P and scanning density F for apparatus in most common use.

TABLE 1/T.1

M	C	D (mm)	L (mm)	P (mm)	F (lines/mm)
264	829	66	207	1/4	4
264	829	70	220	1/3.77	3.77
264	829	88	276	1/3	3
350	1099	70	220	1/5	5
352	1105	66	207	3/16	16/3
352	1105	88	276	1/4	4

Note. – The maximum dimensions of the pictures to be transmitted result from the parameters given in the table.

4. *Reproduction ratio*

In the case where apparatus working with different lengths of scanning line (but with the same index of cooperation) are interconnected, there will be a slight change in size and the reproduction will bear the same proportion as the original, the ratio being that of the total lengths of the scanning lines.

5. *Drum rotation speed – scanning line frequency*

5.1 Table 2/T.1 gives the normal and approved alternative combinations of drum rotation speeds or of scanning line frequencies and indices of cooperation.

TABLE 2/T.1

	Drum rotation speed in r.p.m. or scanning line frequency	Index of cooperation	
		Metallic circuits	Combined metallic and radio circuits
Normal conditions	60 90	352	352 264
Alternatives for use when the phototelegraph apparatus and metallic circuits are suitable	90 120 150	264 and 352 264 and 352 264	

Note 1. – In the case of transmitters operating on metallic circuits, the index 264 is not intended to be used with an 88-mm drum. In the case of transmitters operating on combined metallic and radio circuits, the index 264 associated with a drum diameter of 88 mm is intended to be used only exceptionally.

Note 2. – The provisions given in the table are not intended to require the imposition of such standards on users who use their own equipment for the transmission of pictures over leased circuits. However, the characteristics of the apparatus used should be compatible with the characteristics of the circuits used.

1) Measured in the direction perpendicular to the scanning line.

5.2 The speed of transmitters must be maintained as nearly as possible to the nominal speed and in any case within ± 10 parts in 10^6 of the nominal speed. The speed of receivers must be adjustable and the range of adjustment should be at least ± 30 parts in 10^6 from the nominal speed. After regulation, the speeds of the transmitting and receiving sets should not differ by more than 10 parts in 10^6.

6. *Judder*

The stability of the speed during one rotation should be such that the maximum shift of the drum surface from the average position should not exceed one quarter of the scanning pitch *P* at normal index 352, which means that the maximum angle of the oscillations should not exceed 0.08 degree measured from the average position.

7. *Synchronization*

When phototelegraph stations have available a standard of frequency which is better than ± 5 parts in 10^6, verification of the synchronism between the two stations may be dispensed with. In view of the saving of time, this method should be adopted wherever possible.

To compare the speeds of a transmitter and a receiver, an alternating current whose frequency bears an unvarying relationship to the transmitter speed and has a nominal value of 1020 Hz is used.

Where there is the possibility that the transmitter and receiver may be connected by a circuit liable to introduce frequency drifts, for example, by a carrier telephone circuit, the use of the simple 1020-Hz synchronizing tone is unsatisfactory. The preferred method of overcoming this difficulty is to transmit the phototelegraph carrier (of about 1900 Hz) modulated by the 1020-Hz synchronizing tone.

At the receiving end, the 1020-Hz synchronizing frequency is restored by detection and can then be used in the normal manner.

8. *Phasing*

Phasing is performed after the speeds of the transmitter and receiver drums have been equalized.

For phasing purposes, the transmitter sends a series of alternating white and black signals in such a way that the black lasts 95% and the white 5% of the total scanning line period (admissible tolerance: ± 0.5% of the total duration of a scanning line). The apparatus must be so adjusted that the pulses corresponding to the signal for white are transmitted:

- during scanning of the "dead sector", when drum apparatus is used,
- during "lost time", when flat-bed apparatus is used,

and that they are placed at the middle of the dead sector (or of the interval corresponding to the lost time).

(Tolerance admitted in the position of the "white" pulses: $\Delta_E = \pm 1\%$ of a "total scanning line length".)

At the receiving station, phasing signals are used to start the apparatus so that short white pulses occur in the middle of the "lost time" (tolerance admitted: $\Delta_R = \pm 2\%$ of a "total scanning line length").

Note. – These tolerances allow for the fact that the restitution of the original may deviate from its nominal position by 3% of a "total scanning line length", when the sending and receiving stations are operating with the maximum authorized drift in the same direction.

9. *Contrast*

The transmitter must transmit the original document without changing the contrast of the tone scales of the picture to be transmitted.

10. *Modulation and demodulation equipment*

10.1 *Amplitude modulation*

Phototelegraph equipment shall normally provide for transmission and reception of an amplitude-modulated audio-frequency carrier, which is the normal mode of transmission for international metallic circuits.

The level of the output signal of the transmitter shall be greatest for white and least for black. It is desirable that the ratio of nominal white signal to nominal black signal should be approximately 30 decibels.

To simplify multi-destination operation and AM/FM conversion for radio operation it is desirable that the amplitude of the transmitted signal should vary linearly with the photocell voltage and that no corrections for tone scale should be made at the phototelegraph transmitting station.

For audio-frequency telephone circuits, the frequency of the picture carrier-current is fixed at about 1300 Hz. This frequency gives the least delay distortion on lightly loaded underground cables.

In the case of carrier telephone circuits providing a transmission band from 300 to 3400 Hz, a carrier-current frequency of about 1900 Hz is recommended.

10.2 *Frequency modulation*

Preferably phototelegraph apparatus should also provide for transmission and reception of a frequency-modulated audio-frequency carrier for use when necessary:

a) on combined metallic and radio circuits;

b) on wholly metallic circuits.

In such a case, the characteristics of the frequency-modulated output should be:

mean frequency	1900 Hz
white frequency	1500 Hz
black frequency	2300 Hz

The deviation of frequency should vary linearly with photocell voltage or, in the case of conversion from amplitude modulation to frequency modulation, with the amplitude of the amplitude-modulated carrier.

The stability of the transmission must be such that the frequency corresponding to a given tone does not vary by more than 8 Hz in a period of 1 second and by more than16 Hz in a period of 15 minutes.

The receiving apparatus must be capable of operating correctly when the drift of black and white frequencies received does not exceed their nominal value by more than ± 32 Hz.

11. *Positive or negative reception*

Selection of positive or negative reception should be made by adjustment at the receiver. The adaptation of the transmitted signals to the characteristics of the photographic materials must also be effected at the receiving end according to the type of reproduction, negative or positive.

Recommendation T.2

STANDARDIZATION OF GROUP 1 FACSIMILE APPARATUS FOR DOCUMENT TRANSMISSION

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

The CCITT,

considering

a) that there is a requirement for Group 1 facsimile apparatus which enables an ISO A4 document to be transmitted over a telephone-type circuit in approximately six minutes;

b) that document facsimile transmission may be requested alternately with telephone conversation or when either or both stations are unattended; in both cases the facsimile operation should conform to Recommendation T.30,

unanimously declares the view

that Group 1 facsimile apparatus for use on the general switched telephone network and international leased circuits should be designed and operated according to the following standards:

1. *Scanning track*

The message area should be scanned in the same direction in the transmitter and receiver. Viewing the message area in a vertical plane, the scanning direction should be from left to right, and subsequent scans should be adjacent and below the previous scan.

2. *Index of cooperation*

The nominal index of cooperation is 264. In cases where a lower vertical resolution is acceptable, and by agreement between the users, an optional index of cooperation of 176 may be used.

These values should be observed with a nominal tolerance of $\pm$ 1% for each equipment.

3. *Dimensions of apparatus*

3.1 The apparatus should accept documents up to a minimum of ISO A4 size (nominally 210 mm $\times$ 297 mm).

3.2 The total scanning line length (active sector plus dead sector) should be nominally 215 mm. Nominally 200 mm should be available for scanning or recording, the remainder being the dead sector.

3.3 For any one document the nominal number of scans should be 1144 for an index of cooperation of 264 (762 scans for an index of 176). The receiver should be capable of recording nominally 1144 scans per document for an index of cooperation of 264 (or 762 scans for an index of 176).

3.4 Apparatus with other dimensions may be used provided that the index of cooperation is respected, that the total scanning line length lies between 210 and 250 mm and the usable recording line length retains the same ratio to the total scanning line length.

4. *Scanning density*

Scanning density is normally 3.85 lines per mm.

5. *Scanning line frequency*

In the subscriber-to-subscriber service via the general switched telephone network, the scanning line frequency should be 180 lines per minute (see Note).

For leased circuits operation the best line frequency, which may be higher or lower than 180 lines per minute, may be chosen according to the circuit characteristics.

The scanning line frequency during the transmission should be kept within ± 10 parts in 10^6 of the nominal value.

Note. – With manual control at the two ends of connection set up over the general switched telephone network, another scanning line frequency (e.g. 240 per minute) may be chosen by agreement between the two operators.

6. *Phasing*

The duration of the phasing signal for transmitters should be 15 ± 1 seconds.

In a preferred method of phasing (see Note 1), the transmitter sends a series of alternating white and black signals in such a way that the white pulse (phasing pulse) is 4 to 6% of the total scanning line length and the leading edge is 2 to 3% in advance of the middle of the dead sector.

Receiving apparatus should synchronize the middle of its dead sector 0.5 to 4.5% lagging the leading edge of the received phasing pulse (see Note 2).

Note 1. – In a permitted method of phasing for present generation machines, the transmitter sends a series of white and black signals in such a way that the white pulse is 2 to 12% of the total scanning line length and the leading edge is 2 to 3% in advance of the middle of the dead sector.

Note 2. – Maximum reduction of recorded scanning line length due to synchronizing misalignment should not exceed 3% of total scanning line length. Maximum reduction of recorded scanning line length due to the combined effect of deviations of the transmitter and receiver scanning line frequencies should not exceed 4% of total scanning line length. The effect of these reductions of recorded scanning line length may cause it to be less than the nominal 200 mm.

7. *Modulation and demodulation equipments*

7.1 *Amplitude modulation* (for leased circuits only)

The facsimile signal level is higher for black and lower for white.

The carrier frequency should range between 1300 and 1900 Hz and will depend upon the characteristics of the circuits used.

7.2 *Frequency modulation* (for leased circuits and for switched connections)

The frequency corresponding to black will normally be f_0 + 400 Hz and the frequency corresponding to white will normally be f_0 – 400 Hz (see Note).

For switched connections f_0 = 1700 Hz (provisional). For leased circuits f_0 should range between 1300 and 1900 Hz: the choice of the centre frequency f_0 will depend upon the circuit characteristics. However, if the user, in some cases, wishes to use the apparatus on switched connections, f_0 = 1700 Hz.

The stability of the transmitter must be such that the significant frequencies do not vary by more than 32 Hz from their nominal value in a period of 15 minutes.

Note. – Attention is drawn to the fact that there are some equipments currently in operation for which black and white elements are represented in the opposite sense, but the preferred standard for new equipment is as indicated above.

7.3 *Power at the transmitter output*

When amplitude modulation is used, the power of black at the transmitter output must be able to be adjusted between −7 dBm and 0 dBm. The white level must be approximately 15 dB below the black level.

In frequency-modulated systems, the level at the output of the facsimile apparatus must be able to be adjusted between −15 dBm and 0 dBm.

The equipment should be so designed that there is no possibility of this adjustment being tampered with by an operator.

7.4 *Power at the receiver input*

The facsimile receiver must be so designed that it functions correctly when the input power ranges between 0 dBm and −40 dBm, the latter value being considered provisional. In the case of amplitude modulation, this concerns the power of the black signal. No control of receiver sensitivity should be provided for operator use.

Recommendation T.3

STANDARDIZATION OF GROUP 2 FACSIMILE APPARATUS FOR DOCUMENT TRANSMISSION

(Geneva, 1976)

The CCITT,

considering

a) that Recommendation T.2 refers to Group 1 type apparatus for ISO A4 document transmission in approximately six minutes;

b) that there is a demand for Group 2 apparatus which enables an ISO A4 document to be transmitted over a telephone-type circuit in approximately three minutes;

c) that the Group 2 apparatus reproduces document quality similar to Group 1 apparatus;

d) that such a service may be requested either alternatively with telephone conversation, or when either or both stations are not attended; in both cases, the facsimile operation will follow Recommendation T.30;

unanimously declares the view

that Group 2 facsimile apparatus for use on the general switched telephone network and international leased circuits should be designed and operated according to the following standards:

1. *Scanning track*

The message area should be scanned in the same direction in the transmitter and receiver. Viewing the message area in a vertical plane, the scanning direction should be from left to right and subsequent scans should be adjacent and below the previous scan.

2. *Dimensions of apparatus*

The following dimensions are recommended but apparatus with other dimensions may be used provided that the factor of cooperation is respected and that the total scanning line length lies between 210 and 250 mm.

Factor of cooperation	829 ± 1%
Total scanning line-length	215 mm
Usable scanning line-length	200 mm
Input document size	Up to a minimum of ISO A4 size (nominally, 210 × 297 mm)

Note. – Drum-type receivers may not be able to receive longer documents.

The foregoing dimensions give rise to the following approximate secondary dimensions.

Index of cooperation	264
Scanning density	3.85 line/mm
Number of scanning lines in a document 297 mm long	1145

3. *Scanning line frequency*

3.1 The scanning line frequency should be 360 lines per minute.

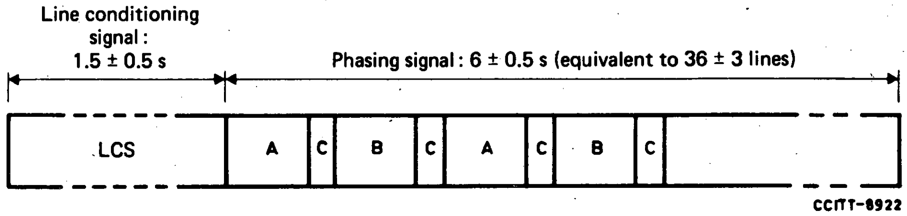
Note. – Another scanning line frequency (e.g. 300 lines per minute) may be chosen by agreement between the two stations.

3.2 The scanning line frequency during the transmission should be kept within ± 10 parts in 10^6 of the nominal value.

4. *Phasing*

For phasing prior to transmission of document information the transmitter sends a signal as shown in Figure 1/T.3. The start of the carrier indicates the end of the lost time. Both transmitter and receiver should phase the end of lost time with an accuracy of ± 2% of the total scanning line length.

Note. – In the case of the multiple page transmission the phasing procedure may need to be repeated between pages.



LCS = line conditioning signal: 1100 ± 50 Hz. Transmission of this signal is optional
A = carrier in 0° phase for 94-96 % of total scanning line length
B = as A but may be in 180° phase
C = no signal (at least 26 dB below the carrier) for the remaining 6-4 % of scanning line length

FIGURE 1/T.3 – **Structure of line conditioning and phasing signal**

5. *Synchronization*

5.1 During transmission of document information the transmitter should transmit full amplitude carrier during the lost time. The phase of the carrier may be reversed at the end of this signal. Both transmitter and receiver should align the end of lost time to this phase reversal with an accuracy of ± 2% in this case.

5.2 This signal may be used at the receiver as an amplitude reference independent of the document signal and also to indicate to the receiver that document transmission is still in progress.

6. *Modulation and demodulation*

6.1 Equivalent modulated waveforms with vestigial sideband amplitude modulation – phase modulation characteristics should be used for Group 2 apparatus operated on leased circuits and on the general switched telephone network. The carrier frequency should be 2100 ± 10 Hz (see Note). A white signal should be represented by maximum carrier and a black signal by minimum (at least 26 dB below white) or no carrier. The phase of the carrier representing white may be reversed after each transition through black.

Note. – It should be noted that there are equipments in service using, inter alia, a carrier frequency of 2048 Hz. The arrangement of interworking between equipment conforming to Recommendation T.3 and these existing equipments is subject to further study.

6.2 The facsimile transmission could contain a limited range of half-tones represented by a carrier amplitude less than that sent during the lost time.

6.3 A vestigial sideband filter symmetrical about the 2100 Hz carrier frequency should be provided at the transmitter. The response of this filter should conform to Figure 2/T.3. The accuracy of this filter is not critical but the relative transmittance at the carrier frequency should be 0.5 with a tolerance of ± 0.05 and the characteristic should be sensibly symmetrical about the carrier frequency.

Tome VII – Partie III – Anglais – Ms p. 196 – Figure 2/T.3

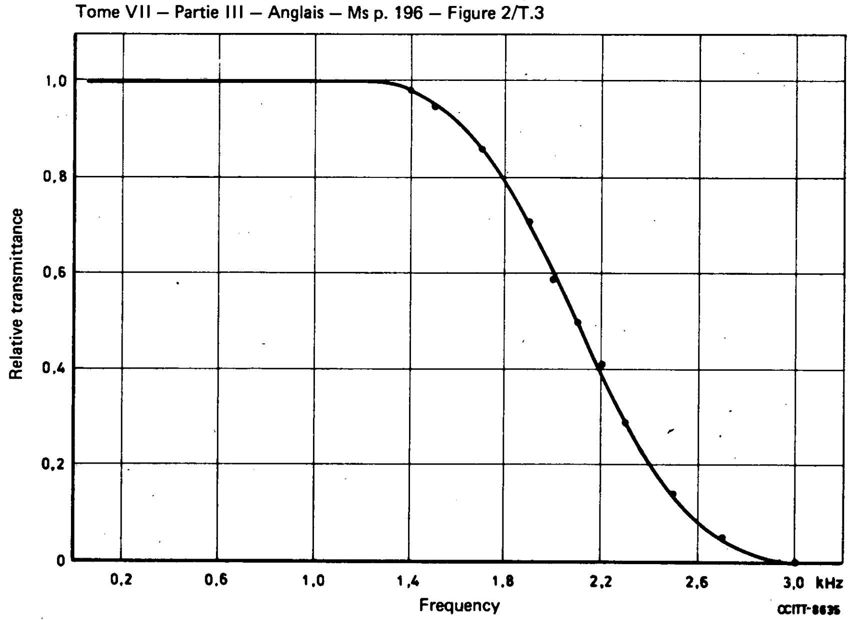


FIGURE 2/T.3 – Frequency response of the vestigial sideband filter

6.4 The receiving apparatus must be capable of operating correctly when the drift of carrier frequency does not exceed its nominal value by more than ± 16 Hz.

6.5 A fixed compromise equalizer, an automatic equalizer or an adaptive equalizer may be provided in the receiver but this should be a matter for further study.

7. *Power at the transmitter output*

The power of the white signal should be adjustable from −15 dBm to 0 dBm but the equipment should be so designed that there is no possibility of this adjustment being tampered with by an operator. The black level should be at least 26 dB below the white level.

8. *Power at the receiver input*

The receiving apparatus should be capable of functioning correctly when the received signal level for white is within the range 0 dBm to −40 dBm, the latter value being considered provisional. No control of receiver sensitivity should be provided for operator use.

Recommendation T.10

DOCUMENT FACSIMILE TRANSMISSIONS ON LEASED TELEPHONE-TYPE CIRCUITS

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

1. *Type of circuits to be used*

The telephone-type circuits used should have characteristics as recommended in Recommendation H.12.

Note. – If the leased circuit is used alternately for telephone conversation and facsimile transmission and if the latter is unidirectional, it is not necessary to provide for disabling echo-suppressors located on the long-distance leased circuit. However, when such circuit is used for the simultaneous operation in both directions appropriate measures should be taken to disable echo-suppressors before the actual facsimile transmission takes place.

2. *Modulation*

Equipment conforming to Recommendation T.2 or Recommendation T.3 may be used. In the case of Recommendation T.2 equipment, either amplitude or frequency modulation may be chosen.

3. *Power*

The maximum power output of the transmitting apparatus into the line shall not exceed 1 mW whatever the frequency.

For frequency-modulation equipment conforming to Recommendation T.2 and equipment conforming to Recommendation T.3 the level at the transmitter output shall be so adjusted that the level of the facsimile and control signals on the trunk circuit does not exceed −13 dBm0 regardless of the type of operation, duplex or simplex.

For amplitude-modulation equipment conforming to Recommendation T.2, higher black levels may be used provided the mean power in any hour, in both directions considered together, does not exceed 64 microwatts at a zero relative level point of the trunk circuit.

4. *Multipoint transmission*

If facsimile transmissions take place simultaneously from a transmitting station to several receiving stations, arrangements shall be made at the junction points so that, on the circuits following the junction points, the same power levels are maintained as those prescribed for individual transmissions.

5. *Phase distortion*

Equipment conforming to Recommendation T.2 should not require any special treatment. However, equipment conforming to Recommendation T.3 may require phase distortion correction in some cases.

Recommendation T.10 *bis*

DOCUMENT FACSIMILE TRANSMISSIONS IN THE GENERAL SWITCHED TELEPHONE NETWORK

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

1. *Type of circuits to be used*

Since circuits of the general telephone network and the station lines of telephone subscribers should be capable of being used for document facsimile transmissions on the general network, the circuits to be used are those of the general switched network which have 2-wire terminals at both ends of the facsimile station.

Note. – For the actual document transmission, which is one-way, there is no need to cater for the disabling of echo-suppressors. Compandors do not seem detrimental to document facsimile transmission.

2. *Overall loss*

The conditions for overall transmission loss are the same as those for circuits of the general switched telephone network.

3. *Modulation*

Equipment conforming to Recommendation T.2 or Recommendation T.3 may be used. In the case of Recommendation T.2 equipment, frequency modulation shall be used.

4. *Sent signal power*

In order to avoid the risk that facsimile signals be disturbed, e.g. by dial pulses transmitted over adjacent channels or by noise, it is important that the sending level should be as high as possible, provided, however, that it shall not exceed – 13 dBm0 on the multi-channel system and also that the power at the output of the sending apparatus shall not exceed 1 mW.

5. *Signal reception power*

Receiving apparatus should be designed to operate when the input level is in the range – 40 dBm to 0 dBm.

6. *Amplitude and phase distortion*

Equipment conforming to Recommendation T.2 should not require any special treatment. However equipment conforming to Recommendation T.3 may require both amplitude and phase distortion correction on certain connections.

Recommendation T.11

PHOTOTELEGRAPH TRANSMISSIONS ON TELEPHONE-TYPE CIRCUITS

(former CCIT Recommendation D.3, amended at New Delhi, 1960, Geneva, 1964 and 1972)

Note. – In the case of carrier circuits, this Recommendation applies only to systems established on the basis of 12-channel group links. Systems using 16-channel group links will be the subject of subsequent study.

Both audio-frequency telephone circuits and carrier circuits can be used for phototelegraphy.

When normal audio-frequency circuits or carrier circuits are used, amplitude modulation offers some advantages over frequency modulation [2] and is therefore to be preferred for phototelegraph transmissions on circuits set up from end to end on cable or line-of-sight radio-relay links [3].

However, in the case of circuits subject to sudden level variations or to noise, frequency modulation may be preferable to amplitude modulation; Administrations could in this case come to an agreement to use frequency modulation for phototelegraph calls over such circuits; the provisions of Recommendation T.1 relative to the frequency-modulation characteristics should then be applied.

For these reasons, the CCITT *unanimously declares the view*

that phototelegraph transmissions over telephone circuits require that the following conditions be observed, according to the way in which the circuits are used for phototelegraphy:

A. CIRCUITS PERMANENTLY USED FOR PHOTOTELEGRAPHY

It seems that these circuits are few. In any case, they should even more easily meet the characteristics given in B. below.

B. CIRCUITS USED NORMALLY (AND PREFERENTIALLY) FOR PHOTOTELEGRAPHY

a) *Types of circuit to be used*

Two-wire circuits have no practical value for phototelegraphy because of feedback phenomena.

For the same reason, 4-wire circuits should be extended to the phototelegraph stations on a 4-wire basis at the appropriate amplifier stations, the terminating units and echo-suppressors always being disconnected.

b) *Overall loss*

The same conditions apply to the overall transmission loss of 4-wire circuits used for phototelegraphy as apply, in general, for telephony.

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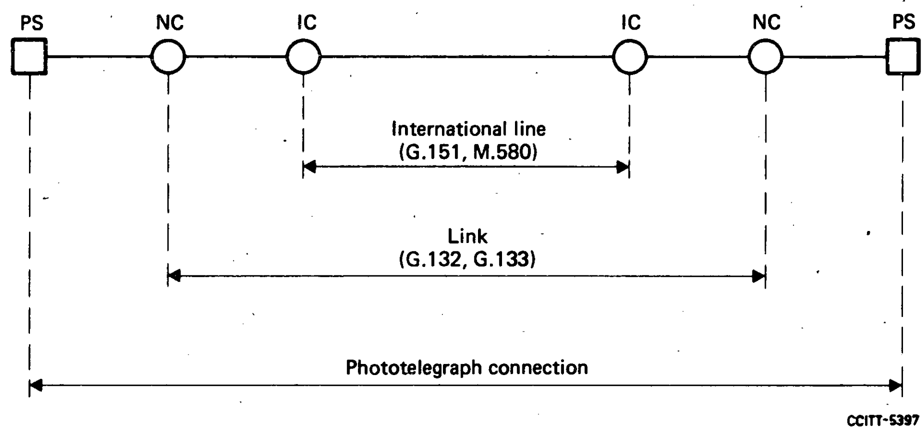
[2] In particular, with the same index of cooperation and speed, frequency-modulation necessitates a wider frequency range than that of amplitude-modulation to obtain a picture of the same quality.

[3] See Recommendation T.15 for phototelegraph transmissions over combined radio and metallic circuits.



IC = international centre NC = national centre PS = phototelegraph station

Note. – The connection is not set up on a chain of switched circuits but on lines according to the terminology used by Study Group IV.

FIGURE 1/T.11 – **Constitution of a phototelegraph connection**

c) *Sent signal power*

The emission voltage for the phototelegraph signal corresponding to maximum amplitude should be so adjusted that the power level of the signal is 0 dBm0 for amplitude-modulation phototelegraph transmission and – 10 dBm0 for frequency-modulation phototelegraph transmissions. In the case of amplitude-modulation the level of the signal corresponding to black is usually about 30 dB lower than that of the signal corresponding to white.

d) *Relative levels*

If phototelegraph transmissions take place simultaneously from a transmitting station to several receiving stations, arrangements shall be made at the junction point so that, on the circuits following the junction point, the same power levels are maintained as those prescribed for individual transmissions.

e) *Attenuation distortion*

The limits for attenuation distortion on international circuits used for phototelegraphy are given in Recommendation G.151 concerning telephone circuits. The attenuation distortion between two terminal national centres shall therefore not exceed the limits indicated in Recommendation G.132 and it will not normally be necessary to compensate the distortion of the lines linking the phototelegraph stations to the terminal national centres in order to obtain, for amplitude-modulated phototelegraph transmission, an attenuation distortion between phototelegraph stations of less than 8.7 dB in the wanted band.

f) *Variation of circuit overall loss with time* (See Notes 1 and 2)

1. The objective is that:

1.1 The difference between the mean value and the nominal value of the transmission loss value should not exceed 0.5 dB.

1.2 The standard deviation from the mean value should not exceed 1 dB.

However, in the case of circuits set up wholly or partly on older-type equipment, where the international line consists of two or more circuit sections, a standard deviation not exceeding 1.5 dB may be admitted.

2. The method for achieving the above objective values is left to the discretion of Administrations (better maintenance, fitting of automatic regulators, etc.).

3. The assumption is made that these limits for the variation of loss with time of a single circuit may be compared to limits for loss measurements made on a set of circuits at a given time. Experience indicates that such a comparison has a practical validity although it has not been fully demonstrated at this time. Administrations are encouraged to use this Recommendation as giving currently practical limits for sets of circuits. This does not preclude the application of these limits to single circuits, should this prove practical at any time.

Note 1. – See Recommendation M.160 and Supplement No. 1.6 of Volume IV of the *Green Book*.

Note 2. – The provisions specified in f) are provisional and need further study from the facsimile transmission point of view.

g) *Phase distortion* (see also Recommendation T.12)

Phase distortion limits the range of satisfactory phototelegraph transmissions. Differences between the group delays of a telephone circuit, in the interval of the phototelegraph transmission, should not exceed

$$\Delta t \leqslant \frac{1}{2 f_p}$$

f_p = maximum modulation frequency corresponding to the definition and scanning speed.

h) *Interference*

Interfering currents, whatever their nature, should not exceed the CCITT recommended limits for telephone circuits.

C. TELEPHONE CIRCUITS RARELY USED FOR PHOTOTELEGRAPHY

a) *Transmission characteristics*

It seems that the majority of the characteristics specified by the CCITT for modern telephone circuits are sufficient to permit phototelegraph transmissions on a circuit chosen at random in a group of circuits normally used for telephone working. However, it is not certain that such a circuit would have a sufficiently low phase distortion for such use, particularly channels 1 and 12 of a 12-circuit group, use of which is not advised. The influence of phase distortion is more noticeable in frequency modulation.

With amplitude modulation there is a further risk that phototelegraph transmissions will be subject to faulty modulation because the special precautions applied to circuits regularly used for phototelegraphy [see B. f) above] cannot be applied to circuits taken at random.

b) *Precautions concerning signalling*

As long as automatic switching for phototelegraph circuits is not envisaged, the signal receiver can be disconnected so that no signalling disturbances can occur even when frequency modulation is used. However, if frequency modulation is used for phototelegraph transmission and if it is impracticable to disconnect the signal receiver, then it would be desirable, in the case of the single-frequency system, that a blocking signal be transmitted along with the picture signal to operate the guard circuit and render the receiver inoperative.

It is also apparent that the frequency of such a blocking signal should lie well outside the range of frequencies involved in the picture transmission.

The frequency and the level of the blocking signal must depend on the characteristics of the VF receiver (or receivers in the case of a tandem international connection), as designed by different Administrations to meet the specification to be prescribed for international signalling.

In the case of the two-frequency international signalling system, the CCITT has indicated its view that no interference will take place.

Recommendation T.12

RANGE OF PHOTOTELEGRAPH TRANSMISSIONS ON A TELEPHONE-TYPE CIRCUIT

(former CCIT Recommendation D.3; amended at New Delhi, 1960 and Geneva, 1964)

Note. – In the case of carrier circuits, this Recommendation applies only to systems established on the basis of 12-channel group links. Systems using 16-channel group links will be the subject of subsequent study.

1. The differences between the delays of the various frequencies and the width of the transmission band actually usable on a circuit for telephony give rise, when phototelegraph signals are started or stopped, to transient phenomena which limit the phototelegraph transmission speed.

2. The range of phototelegraph calls of satisfactory quality, for a given transmission speed, depends especially on the constitution of the circuit, i.e. on:

- the loading and length, in the case of audio-frequency circuits;
- the number of 12-channel group links used in tandem in the case of carrier circuits,

and on the choice of the carrier frequency for amplitude-modulated photograph transmission, or on the mean frequency in the case of frequency modulation.

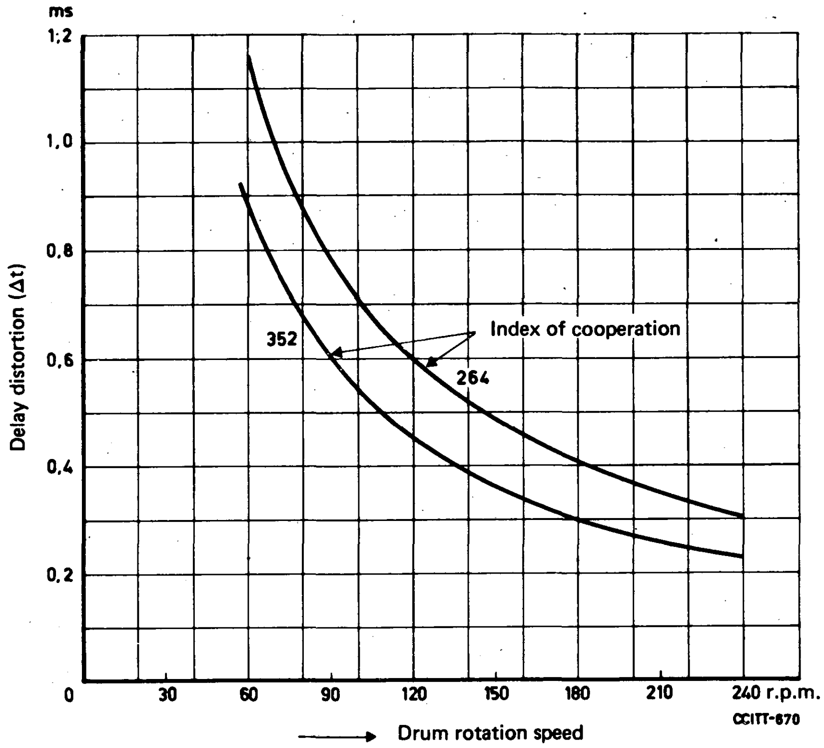
3. Phototelegraph transmission of satisfactory quality requires that the limits of differences between the group delays in the transmitted frequency band, as shown in Figure 1/T.12, are not to be exceeded.

4. The CCITT has recommended the following for international telephone circuits:

The permissible difference for a worldwide chain of twelve circuits, each set up on a single group link between the minimum group delay throughout the frequency band transmitted and the group delay at the upper and lower limits of this band are given in the Table 1/T.12.

TABLE 1/T.12

	Lower limit of the frequency band	Upper limit of the frequency band
International chain	30 ms	15 ms
Each of the national 4-wire extensions	15 ms	7.5 ms
On the whole 4-wire chain	60 ms	30 ms



Note. – The scanning spot is assumed to have the same dimensions in both directions (square or circular).

FIGURE 1/T.12 – **Permissible delay distortion in the transmitted frequency band as a function of the phototelegraph transmission speed**

For these reasons, the CCITT *unanimously declares the following view:*

As regards the effect of phase distortion on phototelegraph transmission quality, the carrier frequency (where amplitude modulation is used) or the mean frequency (when frequency modulation is used) must be chosen in such a way that it is as near as possible to the frequency which has the minimum group delay on the telephone circuit.

A. CIRCUITS PERMANENTLY USED FOR PHOTOTELEGRAPHY

1. It will generally be possible, by agreement between Administrations, to choose a circuit satisfying stricter limits than those specified above from the point of view of phase distortion.

2. Moreover, it will be possible to compensate phase distortions by inserting phase equalizers and to effect phototelegraph transmissions occupying the whole nominal band of the circuit.

B. CIRCUITS USED NORMALLY (OR PREFERENTIALLY) FOR PHOTOTELEGRAPHY

1. The greater the differences between the delays in the transmission intervals, the narrower should be the bandwidth chosen (leading to a lower phototelegraph definition or transmission speed).

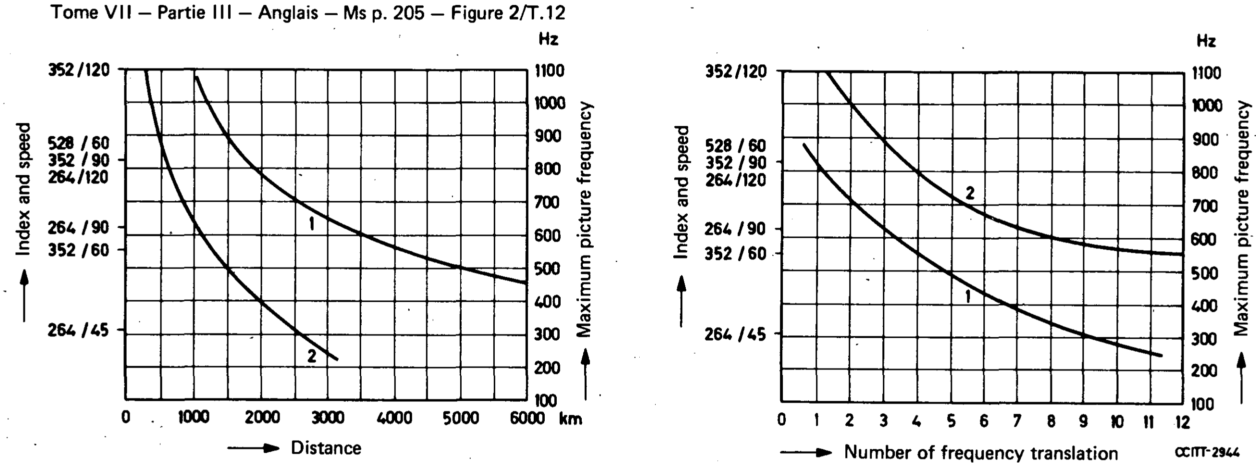
2. Hence, audio-frequency circuits should in any case be lightly loaded circuits.

3. Phase distortion is well within the limits indicated above, in the case of carrier circuits, if a single modern-type carrier system is considered (and considering especially the telephone channels in the middle of a 12-channel group of such a system).

4. Nevertheless, it would be unjustifiable from the financial point of view to make the aforementioned recommendation concerning phase distortion stricter simply with a view to the occasional use of only a few circuits for high-speed phototelegraph transmissions.

5. The curves of Figure 2/T.12 give information on the relative performances of amplitude- and frequency-modulated phototelegraph transmissions on audio-frequency and carrier telephone circuits.

Tome VII – Partie III – Anglais – Ms p. 205 – Figure 2/T.12



a) Audio-frequency circuits

b) Carrier frequency channels

Curve 1 : AM carrier = 1300 Hz.
Curve 2 : FM = 1900 ± 400 Hz
AM carrier = 1900 Hz

FIGURE 2/T.12 – **Range of phototelegraph transmission**

C. TELEPHONE CIRCUITS RARELY USED FOR PHOTOTELEGRAPHY

If phototelegraph connections are set up on circuits selected at random from modern-type groups of telephone circuits (for example, by automatic switching), a circuit may be taken which has too high a degree of phase distortion, particularly if it has been set up on channels 1 or 12 of a 12-channel group, use of which is deprecated. It is impossible, in this case, to draw up general information on the range of phototelegraph transmissions; however, it will be possible to meet the conditions for a transmission of adequate quality if the phototelegraph connection comprises only one 12-channel group link and if transmission is effected in normal conditions as outlined in Recommendation T.1.

Recommendation T.15

PHOTOTELEGRAPH TRANSMISSION OVER COMBINED RADIO AND METALLIC CIRCUITS [4)]

(former CCIT Recommendation D.4; amended at New Delhi, 1960 at Geneva, 1964, Mar del Plata, 1968 and Geneva, 1976)

The CCITT,

considering

a) that, to facilitate interworking, it is desirable to standardize the characteristics of systems employed for phototelegraph transmission over long-distance HF (decametric) circuits [5)];

b) that it is desirable to standardize certain characteristics of the systems in such a way as to make them equally suitable for transmission over metallic circuits;

c) that the transmission system using direct amplitude modulation is generally unsatisfactory over HF (decametric) radio circuits, because of the intolerable fading ratio usually encountered;

d) that the system of sub-carrier frequency modulation has proved satisfactory, but requires standardization in respect of the centre frequency and shift frequencies, taking into account the values of the picture-modulation frequencies to be transmitted;

e) that, when a direct frequency-modulation system is employed, the terminal equipment normally used for a sub-carrier modulation system should be usuable without serious modifications;

f) that, taking into account the quality necessary for reproduction of the picture received, the effect of multipath echoes on long-distance HF (decametric) radio circuits normally limits the maximum admissible picture-modulation frequency to approximately 600 Hz,

unanimously declares the following view

that phototelegraph transmissions over combined radio and metallic circuits should conform to the following provisions:

1. *Characteristics of radio circuits*

1.1 When a sub-carrier frequency-modulation system is used, the following characteristics should be observed:

centre frequency	1900 Hz
frequency corresponding to white	1500 Hz
frequency corresponding to black	2300 Hz

(the 1500-Hz frequency is also used for the phasing signal)

1.2 When a direct frequency-modulation system is employed, the following characteristics should be observed:

centre frequency (corresponding to assigned frequency)	f_0
frequency corresponding to white	f_0 – 400 Hz
frequency corresponding to black	f_0 + 400 Hz

(the frequency f_0 – 400 Hz is also used for the phasing signal)

1.3 In both systems the stability of frequencies should be such that the variations are less than:

8 Hz during a period of 1 second,
16 Hz during a period of 15 minutes.

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4) This Recommendation corresponds to CCIR Recommendation 344-2.
5) The transmission over communication-satellite systems will be the subject of later study.

2. *Characteristics of equipment and metallic circuits*

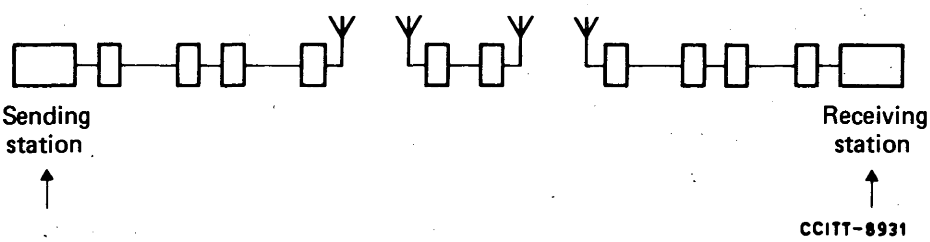
The standards for phototelegraph apparatus and the specifications for transmission on metallic circuits are given in Recommendations T.1 and T.11.

On the metallic sections connected to both ends of the radio path, frequency modulation can be used whatever type of modulation is used over the radio circuits. However, amplitude modulation should preferably be used (see Recommendation T.11 on this subject).

3. *Typical circuit*

In principle, a worldwide hypothetical connection consisting of combined radio and wire channels may involve a maximum of two radio circuits with two metallic circuits at either end. Another metallic circuit may be required in the radio channel link if, in a country, the receiving and transmitting radio stations are at a distance from each other or if the two radio circuits terminate in neighbouring countries. The typical circuit for this connection is shown in Figure 1/T.15.

The frequency tolerances on each of the various sections of this connection should be no greater than those proposed by the CCITT (see Recommendations G.225 and T.1) as shown in Figure 1/T.15.



Frequency tolerances (Hz) for short-term (1 s)

8 2 2 8 2 8 2 2

Frequency tolerances (Hz) for long-term (15 min)

16 2 2 16 2 16 2 2

FIGURE 1/T.15 – **Typical circuit in a worldwide phototelegraph connection**

If it is assumed that these deviations are distributed at random and if we take the standard deviation, we shall obtain the values 15 and 28 Hz respectively, which are not harmful for satisfactory reception, since CCITT Recommendation T.1 admits a maximum deviation of 32 Hz.

4. *Modulation conversion*

When conversion from amplitude modulation to frequency modulation (or vice versa) is required, the conversion should be such that the deviation of the frequency-modulated carrier varies linearly with the amplitude of the amplitude-modulated carrier.

Each Administration will decide, when the question arises, on the location of modulation converters. They may be placed either at the terminal phototelegraph station or at the control station associated with the radio station, to facilitate speech on the circuit used for phototelegraphy, if the radio channel will carry speech.

Recommendation T.16

FACSIMILE TRANSMISSION OF METEOROLOGICAL CHARTS OVER RADIO CIRCUITS [6)]

(former CCIT Recommendation D.7, Geneva, 1956; amended by CCIR, Los Angeles, 1959, Geneva, 1963, and Oslo, 1966)

The CCIR and the CCITT,

considering

a) that increasing use is being made of facsimile telegraphy for the transmission of meteorological charts for reception on direct-recording apparatus;

b) that it is desirable to standardize certain characteristics of the radio circuits for this purpose,

unanimously declare the view

1. that when frequency modulation of the sub-carrier is employed for the facsimile transmission of meteorological charts over radio circuits, the following characteristics should be used:

centre frequency	1900 Hz
frequency corresponding to black	1500 Hz
frequency corresponding to white	2300 Hz

2. that when direct frequency modulation is employed on radio circuits the following characteristics should be used:

2.1 *HF (decametric) circuits*

centre frequency (corresponding to the assigned frequency)	f_0
frequency corresponding to black	f_0 − 400 Hz
frequency corresponding to white	f_0 + 400 Hz

2.2 *LF (kilometric) circuits*

centre frequency (corresponding to the assigned frequency)	f_0
frequency corresponding to black	f_0 − 150 Hz
frequency corresponding to white	f_0 + 150 Hz

Recommendation T.20

STANDARDIZED TEST CHART FOR FACSIMILE TRANSMISSIONS

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

It will be a great advantage to use a standardized test chart to check the quality of facsimile transmissions. Such a chart would provide the receiving office with a reliable and rapid means of checking the quality of test transmissions according to uniform principles and of making comparisons between different transmission results in a precise way. The chart has been designed for measuring the quality of both picture and black-and-white transmissions and it enables the apparatus used and the communication channels to be judged by means of objective measurements, the results of which may be expressed in code.

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6) This Recommendation corresponds to CCIR Recommendation 343-1.

For the above reasons, the CCITT *unanimously declares the following view:*

1. Tests of facsimile transmission quality will be carried out in the international service with the aid of the "CCITT standardized test chart".

2. This test chart is made by the ITU under the supervision of the CCITT and should be offered for sale by the ITU. There are two editions:

- test charts sold before the IVth Plenary Assembly of the CCITT (October 1968) are of the first edition;
- test charts sold since the IVth Plenary Assembly of the CCITT are of the second edition.

These test charts are described in the annex to this Recommendation; the specimens printed in the annex cannot be used for measurements.

3. These two test charts are compatible and a test chart of either the first edition or the second can be used in the international service.

ANNEX

Description of the standardized test chart

1. The test chart has the following dimensions:

- length: 250 mm,
- width: 110 mm.

The lateral margin is some 10 mm wide on either side. The margin at top and bottom is 20 mm wide, approximately. The chart is divided into sections marked on the transparent paper delivered with every chart.

2. Sections 1 and 2 contain two tone scales, each having 15 density steps, varying from black and white and vice versa. Nos. 1, 4, 8, 11, and 15 bear their numbers on them, the number 1 always betokens white and the number 15 black.

3. Section 3 is occupied by a group of black lines on a white background, in the form of hyperbolae. The thickness of the lines and the distances between them diminish regularly from left to right, from 1 mm to 1/6 mm.

If a vertical line be drawn through the hyperbolae, the lines therein will subtend distances on the vertical line equal to the inverse of the figures on the scale graduated from 1 to 6 at the bottom of Section 3.

4. Section 4 contains two groups of hyperbolae similar to those of Section 3 but limited to the scanning densities lying between 3 and 6. One group is made up of grey lines on a white ground, the other by grey lines on a black ground.

5. Section 5 contains three patterns.

a) *First edition:*

The first pattern is made up of five black lines on a white background, the lines being 0.25 mm thick, arranged in one group of two lines and another of three lines. These lines are 0.25 mm apart, and the two groups are separated by 1.5 mm.

The second pattern is the same as the first, but the lines are white on a black background.

The third pattern consists of two similar groups of black lines on a white background, as follows:

- line, thickness . . . . 1 mm
- separation . . . . 0.25 mm
- line, thickness . . . . 0.25 mm
- separation . . . . 1 mm
- line, thickness . . . . 0.25 mm
- separation . . . . 0.25 mm
- line, thickness . . . . 1 mm

The two groups are separated by 1 mm.

b) *Second edition:*

The first pattern is made up of eight black lines on a white background, separating into three groups:

- one group of two black lines being 0.25 mm thick and 0.25 mm apart;
- one group of three black lines being 0.25 mm thick and 0.25 mm apart;
- one group of three black lines being 0.1 mm thick and 0.25 mm apart.

These groups are separated by 1.5 mm.

The second and third patterns are respectively the same as those of Section 5 of the first edition.

6. Section 6 contains a tapering black line on a white background, and a tapering white line on a black background. The maximum width of the tapering lines is 0.7 mm.

At the top of the section is a scale in millimetres, showing the width of the tapering lines.

7. Section 7 contains a strip of tone equivalent to that in Section 1, step 11, on a background of Section 1, step 5.

8. In the first edition, Section 8 accommodates a photograph of UNESCO House in Paris.

In the second edition, Section 8 accommodates a portrait of an Argentine boy.

9. Section 9 contains two concentric circles, the radii of which differ by 1 mm. A square, with its diagonals, is inscribed in the inner circle.

In the second edition the radii of the two circles are bigger than those of the first edition and the exterior circle is osculating with the limits of Section 9.

10. There are two Sections numbered 10 which contain adjustment lines.

In the first edition, these lines are numbered from 1 to 6 and these figures are placed in the central part of the left half of Section 10.

In the second edition, only the even adjustment lines are numbered and these figures are placed at the left of the prolongation of the line separating Sections 3 and 12, 7 and 12 respectively.

11. Section 11 contains a pattern of lines, with a spacing of 2.5 mm. It is divided into two equal parts by a vertical line. The column on the right contains white rectangles, while that on the left contains alternate white and black rectangles.

In the second edition Section 11 is so cut that the parts adjacent to Sections 10 are kept in white. These parts are used for extension of the adjustment lines of Sections 10.

To indicate the centre of the test charts of the second edition, a line in the right column of Section 11 which is the prolongation of the line separating the density steps 8 and 9 of Section 1 is 0.5 mm thick.

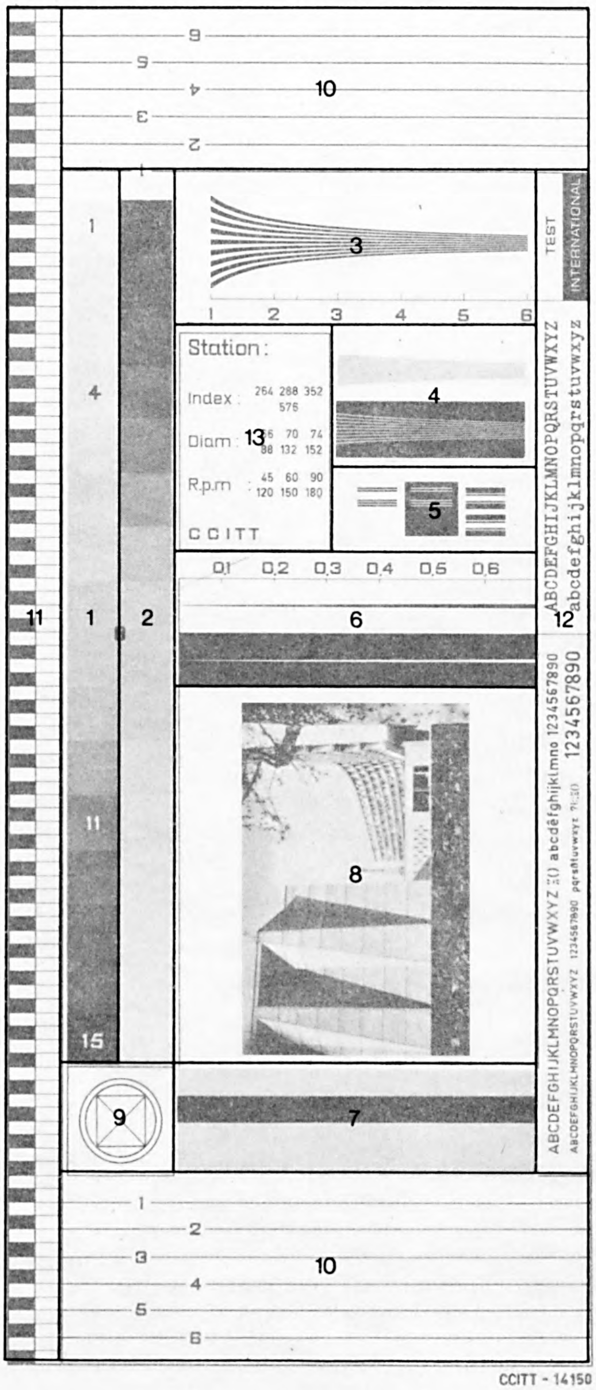
12. Section 12 contains letters, digits, and punctuation marks printed in various styles, and arranged so that they can be read sideways.

Section 12 is divided into three parts:

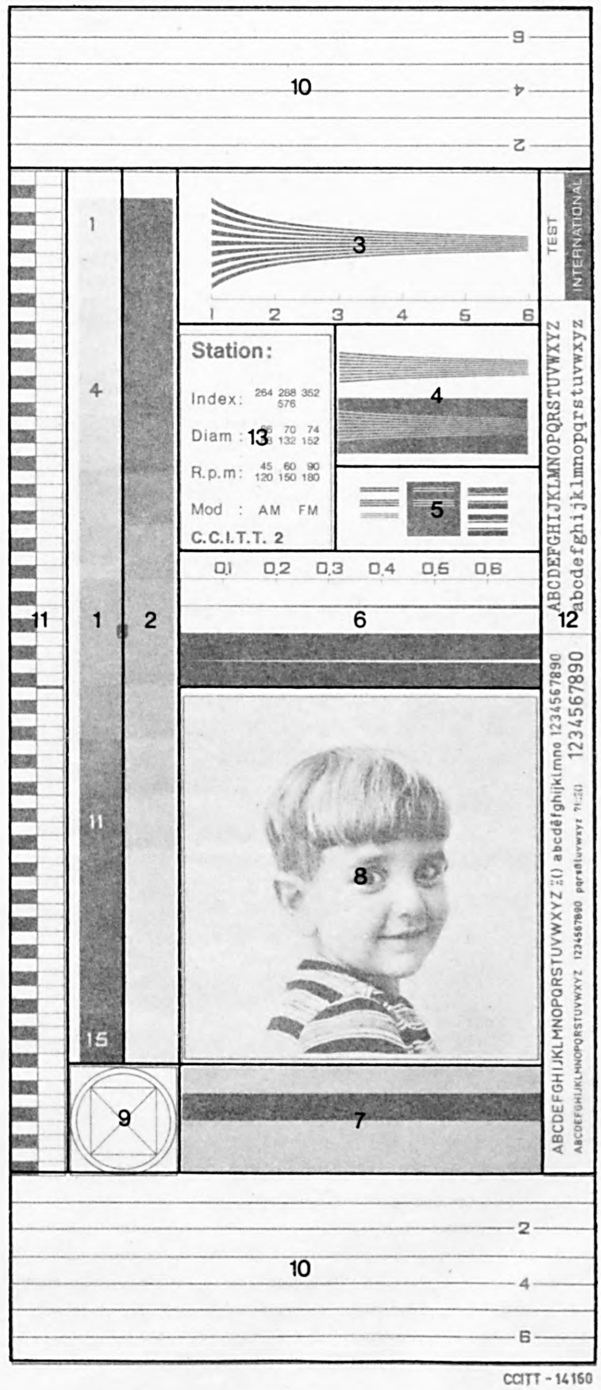
- the bottom part contains typographical signs (letters, figures, and a few punctuation marks), printed in various styles.
- the middle part contains signs in typewritten characters 2.3 mm high.
- the top part contains two words: "TEST" and "INTERNATIONAL" one above the other. "TEST" is black on a white background, while "INTERNATIONAL" is white on a black background.

13. Section 13 contains

- space for the name of the transmitting station;
- the cooperation indices most often used;
- the diameters in millimetres of the drums most often used;
- the r.m.p. of the drums;
- "Mod.: AM FM" to indicate either amplitude modulation or frequency modulation (the second edition only);
- the indication "CCITT" in the test charts of the first edition is replaced by "CCITT 2" for the test charts of the second edition.



Test chart (first edition)



Test chart (second edition)

Recommendation T.30

PROCEDURES FOR DOCUMENT FACSIMILE TRANSMISSION IN THE GENERAL SWITCHED TELEPHONE NETWORK

(former Recommendation T.4, Mar del Plata, 1968; amended and renumbered at Geneva, 1976)

Introduction

i) This Recommendation is intended to apply to all document facsimile apparatus covered by CCITT Recommendations. It describes the procedures and signals to be used where facsimile equipments are operated over the general switched telephone network.

ii) Arrangements for automatic calling/answering on the general switched telephone network have been aligned as closely as possible with those described in the Series V Recommendations for data terminal equipment.

iii) Whilst there are eight possible operating methods (see Table 1/T.30) each may be described by five separate and consecutive phases:

Phase A Call set up

Phase B Pre-message procedure for identifying and selecting the required facilities

Phase C Message transmission (includes phasing and synchronization where appropriate)

Phase D Post-message procedure including end-of-message and confirmation and multi-document procedures

Phase E Call release

iv) Two separate signalling systems are described; first a simple system using single frequency tones and second a binary coded system which offers a wide range of signals for more complex operational procedures. Thus tonal signalling is restricted to manual operation at both stations or where a manually operated station intends to transmit to a called station equipped as an automatic answering receiver. Facsimile machines conforming to Recommendations T.2 and T.3 will normally use the tonal signalling system although the binary coded system may be provided in addition where complex procedures are required, e.g. comprehensive automatic functions.

v) For digital document facsimile apparatus it is intended that the binary coded system shall be the standard signalling arrangement, but additionally a tonal signalling capability may be provided where the digital facsimile apparatus has a fallback capability to apparatus conforming to Recommendations T.2 and T.3. The binary coded signalling has priority and should be tried first; if this fails to elicit a response, tonal signalling should be attempted.

vi) The binary coded signalling system is based on a high level data link control (HDLC) format developed for data transmission procedures. The basic HDLC structure consists of a number of frames each of which is sub-divided into a number of fields. It provides for frame labelling, error checking and confirmation of correctly received information and the frames can be easily extended if this should be required in the future.

vii) The transmission of the facsimile message itself (phase C) will be according to the modulation system described in the appropriate Recommendation for the facsimile apparatus.

CONTENTS

The CCITT

considering

a) that facilities exist for facsimile transmission over the general switched telephone network;

b) that such facsimile transmission may be requested either alternatively with telephone conversation, or when either or both stations are not attended;

c) that for this reason the operations involved in establishing and/or releasing a facsimile call should be capable of automatic operation,

unanimously declares the view

that the facsimile apparatus should be designed and operated according to the following standards:

1. *Scope*

1.1 *General*

1.1.1 This Recommendation is concerned with the procedures which are necessary for document transmission between two facsimile stations in the general switched telephone network.

These procedures essentially comprise the following:

- call establishment and call release,
- compatibility checking, status and control command,
- checking and supervision of line conditions,
- control functions and facsimile operator recall.

1.1.2 Only the procedures with their corresponding signals are specified in this Recommendation.

1.1.3 This Recommendation includes all groups of machines as described in Recommendation T.0.

1.2 *Classification of operating methods*

1.2.1 This Recommendation regulates the operational sequence of manually operated facsimile stations as well as of automatic stations.

The automtic facsimile station is understood to be a station which is capable of performing all procedures (listed in 1.1. above) automatically. In this case, an opertor is not necessary.

If, however, an operator is required for any of these procedures, the station must be regarded as a manually operated station.

1.2.2 Based upon all combinations which may result from the fact that there are manually operated stations and automatic facsimile stations, the operating methods shown in Table 1/T.30 are possible.

TABLE 1/T.30

Method No.	Description of operating method	Direction of facsimile transmission	Overall designation
1	*Manual* operation at calling station and	Calling station *transmits to* called station	1-T
	Manual answering at called station	Calling station *receives from* called station	1-R
2	*Manual* operation at calling station and	Calling station *transmits to* called station	2-T
	Automatic answering at called station	Calling station *receives from* called station	2-R
3	*Automatic* operation at calling station and	Calling station *transmits to* called station	3-T
	Manual answering at called station	Calling station *receives from* called station	3-R
4	*Automatic* operation at calling station and	Calling station *transmits to* called station	4-T
	Automatic operation at called station	Calling station *receives from* called station	4-R

Note. – There may also be operating methods which will allow messages to be received by more than one station (multipoint connection).

1.3 *Station identification*

1.3.1 For the purpose of classifying an automatic facsimile station as a non-speech terminal, a tone must be transmitted to line. As both automatic calling and called facsimile stations transmit tones to line during call establishment, a normal telephone user who becomes inadvertently connected to one will receive tone signals for a period of sufficient duration to indicate clearly to him that he is incorrectly connected.

1.3.2 Additionally an automtic verbal announcement may be used which can provide station identification.

1.4 *General provisions*

1.4.1 The control signals specified in this Recommendation have been chosen in such a way that the telephone service is not affected.

1.4.2 If any malfunction of the facsimile procedures described in this Recommendation is detected, the call should be released.

1.4.3 Where the called station has automatic facsimile apparatus which is not ready or not able to operate, the call should not be answered automatically.

1.4.4 This Recommendation includes procedures for switching from facsimile to speech. However, speech facilities may be omitted if this is permitted by the regulations of the Administrations.

1.5 *Optional provisions*

1.5.1 The operator at each station may have the possibility of calling the other station at any time during the progress of the facsimile procedure (see 2.2 below).

1.5.2 The procedures in this Recommendation allow a facsimile station to transmit and/or receive several documents successively without the aid of an operator.

1.5.3 This Recommendation includes procedures for incorporating a unique station identification command if required to prevent unauthorized stations from demanding a message.

2. *Explanation of terms used*

2.1 *Facsimile station main functions*

One or more equipments at the end of the line providing three main functions.

2.1.1 *Call establishment and call release*

The establishment and release of a connection according to the normal rules of using the general switched telephone network.

2.1.2 *Procedure*

To identify, to supervise and to control the facsimile transmission according to protocol.

2.1.3 *Message transmission*

To transmit and/or receive the facsimile message.

2.2 *Time sequence of facsimile call*

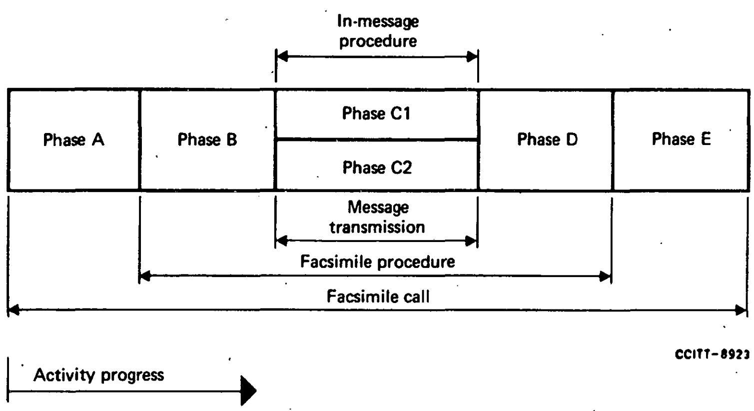


FIGURE 1/T.30

2.3 *Description of phases*

2.3.1 *Phase A – Call establishment*

Call establishment can be realized manually and/or automatically.

2.3.2 *Phase B – Pre-message procedure*

The pre-message procedure consists of the identification of capabilities and the commanding of the chosen conditions as well as the confirmation of acceptable conditions.

2.3.2.1 *Identification section*

- group identification,
- confirmation for reception,
- station identification (option),
- non-standard facilities identification (option).

2.3.2.2 *Command section*

- group command,
- phasing, synchronization, as well as the following optional commands:
  - non-standard facilities command,
  - station identification command,
  - polling (send) command,
  - line conditioning,
  - echo-suppressor disabling.

2.3.3 *Phase C1 – In-message procedure*

The in-message procedure takes place at the same time as message transmission and controls the complete signalling for in-message procedure, e.g., in-message synchronization, error detection and correction, line supervision, and multipage signalling.

2.3.4 *Phase C2 – Message transmission*

Message transmission procedure is covered by the appropriate Recommendation for the equipment.

2.3.5 *Phase D – Post-message procedure*

Post-message procedure includes information of end of message, confirmation, transmission of further messages:

- end of message signalling,
- confirmation signalling,
- multipage signalling,
- end of facsimile procedure signalling.

2.3.6 *Phase E – Call release*

Call release shall be realized manually and/or automatically.

3. *Description of a facsimile call* [7)]

3.1 *Phase A – Call establishment*

The establishment of a facsimile call may be realized either manually, if an operator is in attendance, or automatically. To accomplish this, four operating methods have been defined.

[7)] See Appendix 2 for abbreviations used in this Recommendation.

3.1.1 *Operating method 1*

Manual operation at both the calling and called station, Diagram 1/T.30 indicates the operator's action required to establish a call.

Call event No.	Calling station	Called station
1	Operator hears dial tone and dials desired number	
2	Operator hears ringing tone	Call rings and operator answers the call
3	Verbal identification	Verbal identification
4	Facsimile machine is switched to line	Facsimile machine is switched to line
5	Begin facsimile procedure (see 4. and/or 5. of this Recommendation)	Begin facsimile procedure (see 4. and/or 5. of this Recommendation)

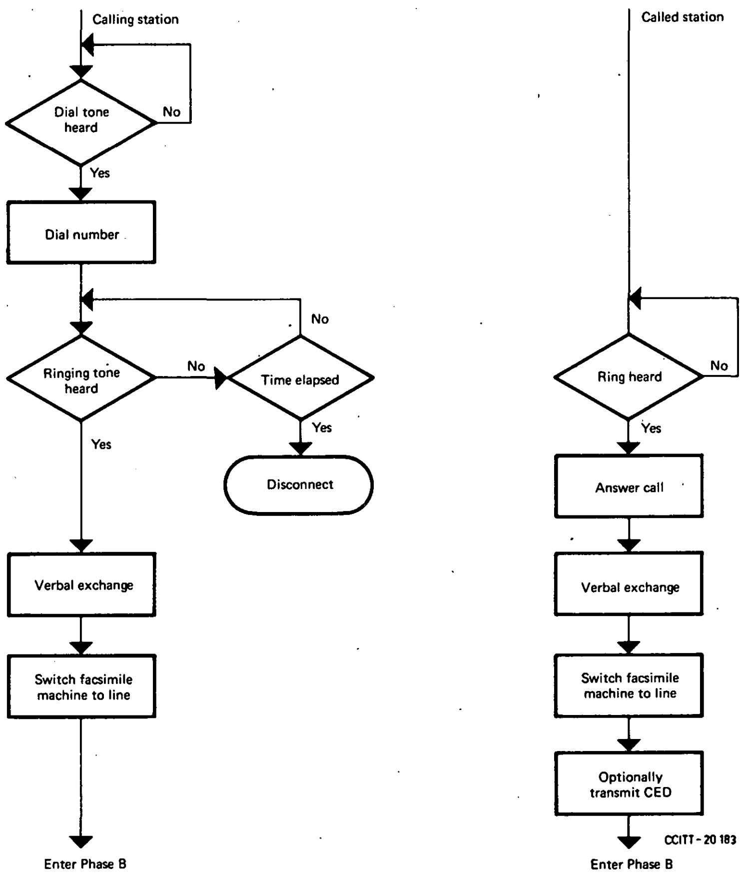


DIAGRAM 1/T.30 – **Call establishment, operating method 1**

3.1.2 *Operating method 2*

Manual operation at the calling station and automatic operation at the called station. Diagram 2/T.30 indicates the operator and apparatus actions required to establish a call.

Call event No.	Calling station	Called station
1	Operator hears dial tone and dials desired number	
2	Operator hears ringing tone	Equipment detects ring and answers the call
3		Optionally, a recorded verbal announcement may be transmitted
4	Operator hears CED and facsimile machine is switched to line	Transmit CED
5	Begin facsimile procedure (see 4. and/or 5. of this Recommendation)	Begin facsimile procedure (see 4. and/or 5. of this Recommendation)

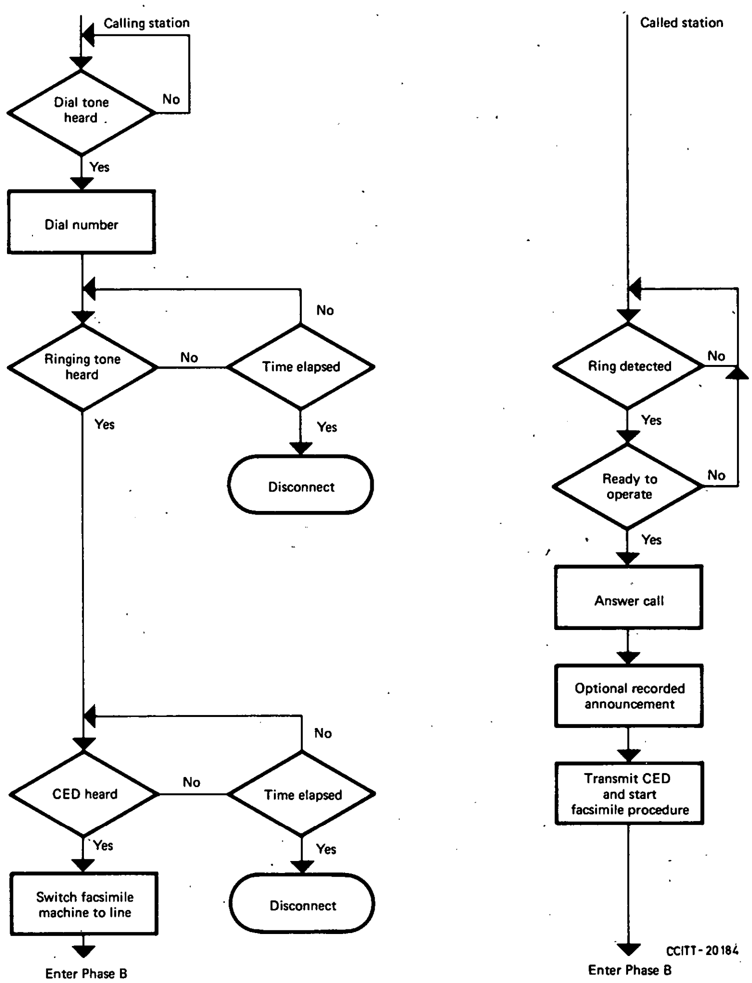


DIAGRAM 2/T.30 – **Call establishment, operating method 2**

3.1.3 *Operating method 3*

Automatic operation at the calling station and manual operation at the called station. Diagram 3/T.30 indicates the operator and apparatus actions required to establish a call.

Call event No.	Calling station	Called station
1	Equipment detects dial tone and dials desired number (see Note). To clearly indicate to a called operator that he is connected to a facsimile machine or to a normal telephone user that he is inadvertently connected, CNG will be transmitted to line during the time that signals are attempted to be detected *Note.* – An alternative procedure may be specified by Administrations	
2		Call rings and operator answers the call
3		Operator detects CNG and switches facsimile machine to line (optionally CED may be generated)
4	Begin facsimile procedure (see 5. of this Recommendation)	Begin facsimile procedure (see 5. of this Recommendation)

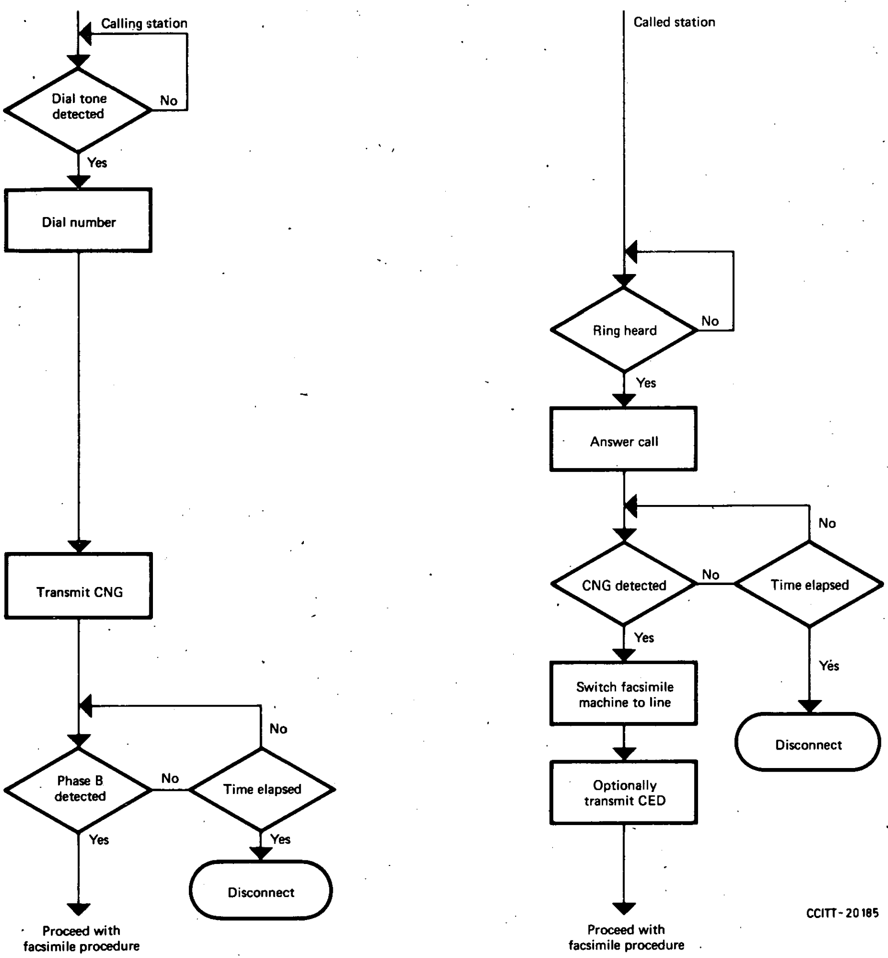


DIAGRAM 3/T.30 – **Call establishment, operating method 3**

3.1.4 *Operating method 4*

Automatic operation at both the calling and called stations, Diagram 4 indicates the actions required by the apparatus to establish a call.

Call event No.	Calling station	Called station
1	Equipment detects dial tone and dials desired number (see Note). To clearly indicate to a normal telephone user that he is inadvertently connected, CNG will be transmitted to line during the time that signals are attempted to be detected *Note.* – An alternative procedure may be specified by Administrations	
2		Equipment detects ring and answers the call
3		Optionally, a recorded verbal announcement may be transmitted
4		Transmit CED
5	Begin facsimile procedure (see 5. of this Recommendation)	Begin facsimile procedure (see 5. of this Recommendation)

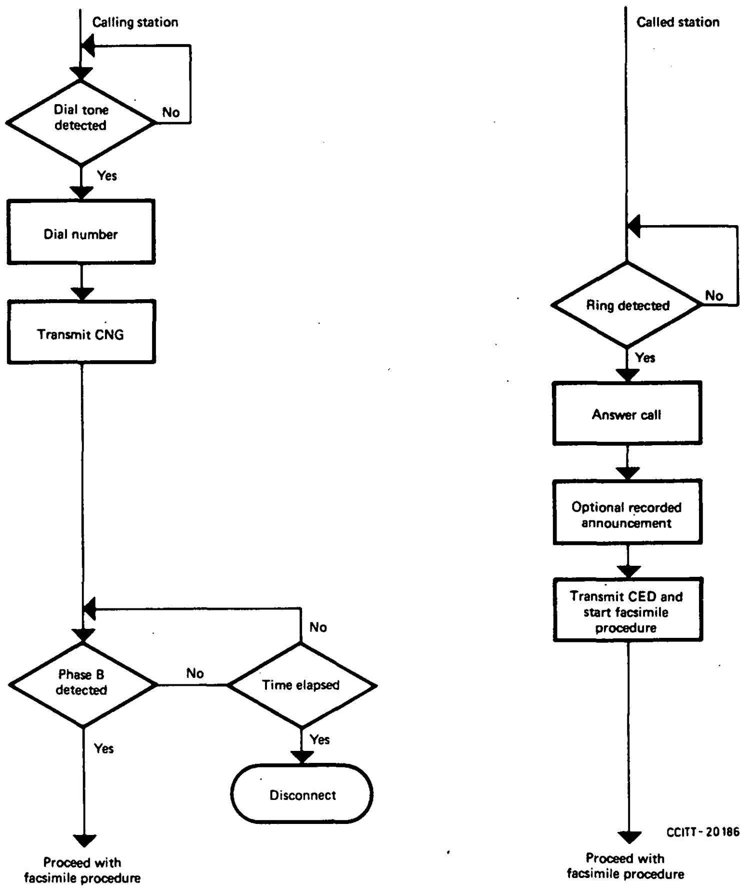


DIAGRAM 4/T.30 – **Call establishment, operating method 4**

3.2 *Phases B, C and D – Facsimile procedure*

The detailed information pertaining to the tonal and binary coded facsimile procedures is contained in 4. and 5. below. The relationship between these two procedures and an overview regarding the total system operation is given in the following :

3.2.1 *The interaction between tonal and binary-coded procedures*

Facsimile procedures, as described in this Recommendation, may be realized in two different ways:

– tonally, with a limited number of tones for simple procedures (see 4. below) and
– binary coded, for more comprehensive procedures (see 5. below).

Coded signalling is especially desirable for machines which use:

– comprehensive automatic functions;
– digital concepts internally (e.g. redundancy reduction techniques);
– fast transmission rates (in order to keep pre- and post-message time short compared to total transmission time);
– special safety features.

Recommendations concerning the interaction between tonal and binary coded signalling recognize the principle of the priority of coded procedures such that, when available, binary coded signalling shall be tried first. The interaction steps are as follows :

– The unattended called station shall answer a call with the CED signal.
– The unattended calling station shall indicate a call with the CNG signal.
– Whenever it is capable of binary-coded signalling, the called station will start with binary signalling.
– Facsimile stations being capable of tonal signalling only will start tonally.
– Facsimile stations being capable of both binary coded and tonal signalling will send a sequence of signals, the first being a binary coded signal and the second and all following signals being a composite of tonal and binary coded information.
– If the calling station reacts binary coded then the coded signalling goes on through all control procedures.
– If the calling station reacts tonally, then the tonal signalling goes on through all procedures.

An example of a station having both binary-coded and tonal capabilities is shown in Diagram 5/T.30 for further clarification.

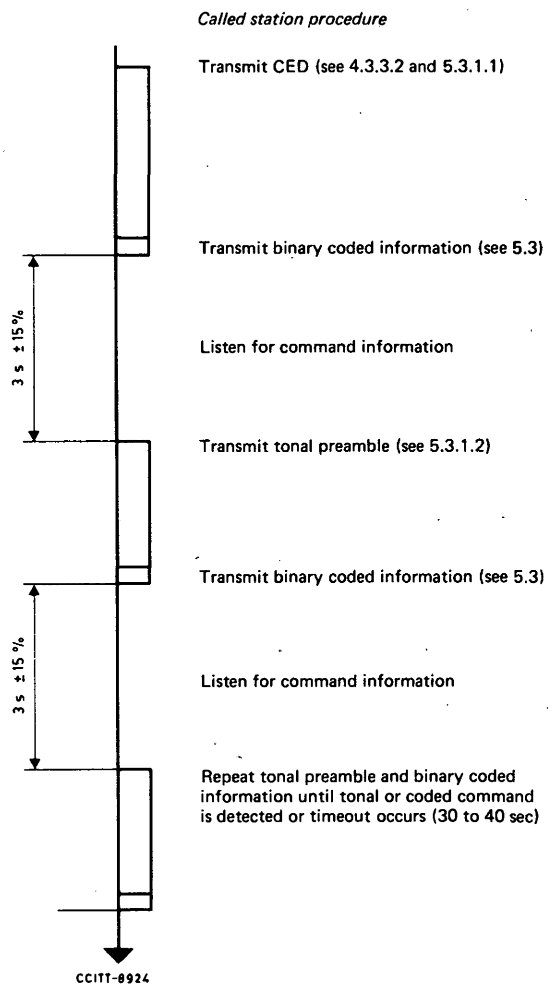


DIAGRAM 5/T.30 – **Binary-tonal identification signal**

3.2.2 *Signal sequences*

The recommended system utilizes the interchange of signals between the two equipments to verify compatibility and assure operation. To accomplish this end, the called station identifies its capabilities tonally (in the simplest configuration) and/or binary coded. The calling station responds to this accordingly with a command tonally or binary. Now the transmitter continues Phase B.

Following the transmission of the message, the transmitter sends an end-of-message signal and the receiver confirms reception. Multiple documents can then be transmitted by repeating this procedure.

The flow of signals is shown in Diagram 6/T.30 for the configuration where the calling station is transmitting. These signals may be tonal or binary-coded, subject to the conditions of 3.2.1 above.

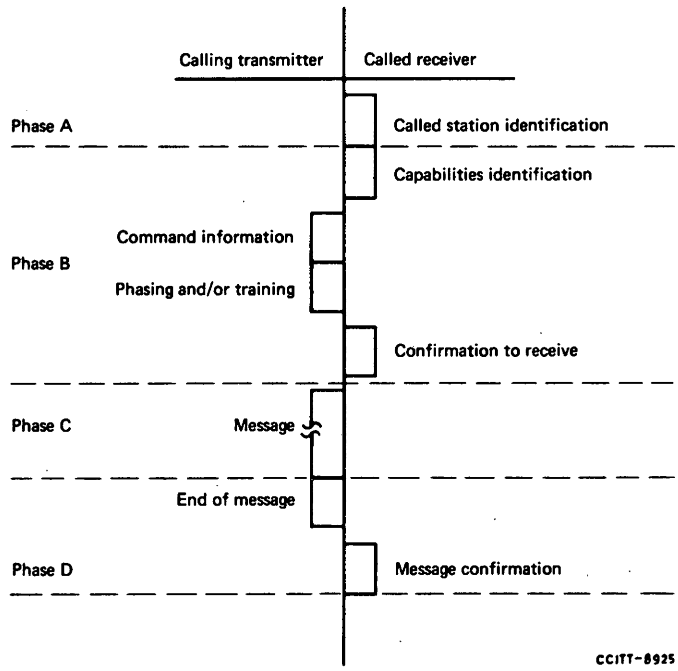


DIAGRAM 6/T.30 – Calling station transmitting

The condition where the calling station is to receive documents is shown in Diagram 7/T.30. The simple tonal systems do not provide this capability.

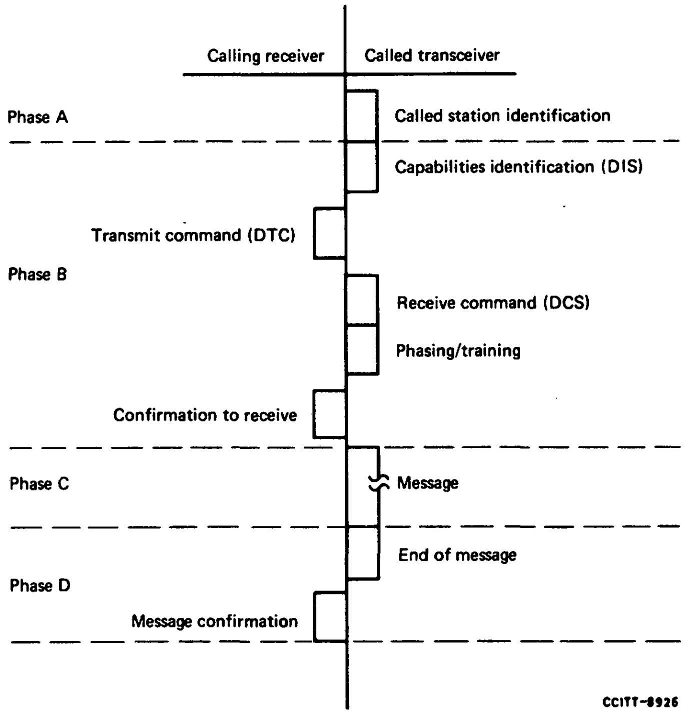


DIAGRAM 7/T.30 – **Calling station receiving**

3.3 *Phase E – Call release*

Call release occurs after the last post-message signal of the procedure or under certain conditions, e.g.:

3.3.1 *Timeout*

When a signal as specified by the facsimile procedure is not received within the specified timeout period, the apparatus may signal to operator (if one is in attendance) or disconnect the telephone connection. The appropriate timeout periods are specified in 4. and 5. below.

3.3.2 *Procedural interrupt*

If a malfunction in the facsimile procedure is detected by the apparatus, the facsimile procedure may be interrupted by sending a procedural interrupt signal, by notifying the attending operator or by disconnecting the connection. This signal is defined in 4. and 5. below.

3.3.3 *Command*

In the case where binary coded procedures are utilized, the call may be immediately terminated by the binary-coded system commands, as specified in 5. below.

4. *Tonal signalling for facsimile procedure*

This signalling system covers operating methods 1 and 2T and has to be implemented for apparatus operating according to Recommendations T.2 and T.3.

Note. – Further study is required to cover the other operating methods.

4.1 *Description*

Phases B and C

Transmitter	Receiver
	1. Transmit GI
2. GI detected	
3. Select appropriate Group	
4. Transmit GC	
5. Transmit Phasing	
	6. Detect GC and Phasing select group and phase
	7. Transmit CFR
8. Detect CFR	
9. Transmit Message	

Phase D

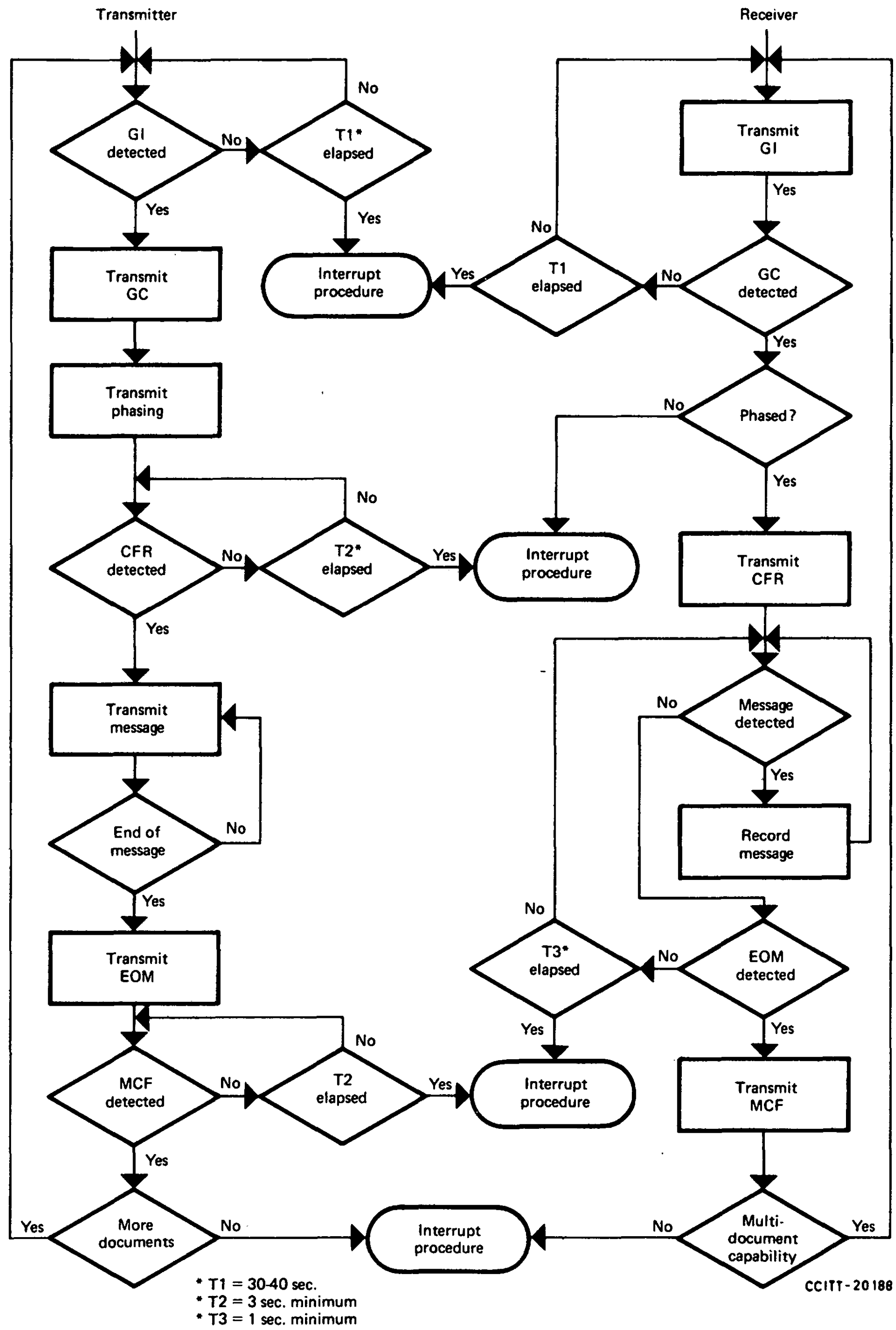
Single-document transmitter	Multi-document receiver
1. Transmit EOM	
	2. Detect EOM
	3. Transmit MCF
	4. Prepare for next document
5. Detect MCF Switch back to telephone Operator loads document	
	6. When ready to receive transmit GI
7. Operator hears GI and switches machine to line	
8. Detect GI	
9. Transmit GC	
Continue Phases B and C	

Multi-document transmitter	Single-document receiver
1. Transmit EOM	
	2. Detect EOM
	3. Transmit MCF
	4. Switch back to telephone Operator loads paper
5. Detect MCF and prepare for next document	
6. When ready to transmit, transmit SID (optional)	
	7. Operator hears SID and switches machine to line
	8. Transmit GI
9. Detect GI	
10. Transmit GC	
Continue Phases B and C	

Multi-document transmitter to multi-document receiver and single document facsimile apparatus operate accordingly.

Note. – It is acknowledged that there are existing equipments in the field that may not conform in all aspects to this Recommendation. Therefore, the decision may be made to go to a mode of operation other than specified herein. The diagram of Appendix 1 describes, as an example, one of these conditions. Other methods may be possible, as long as they do not interfere with the recommended operation.

4.2 *Flow diagram*



4.3 *Tonal signal functions and formats*

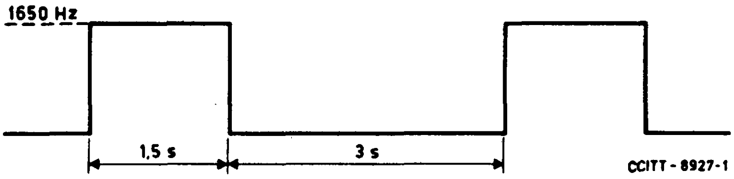
The signals used are single frequencies to line.

4.3.1 *Facsimile receiver signals* (signals transmitted by receiver)

4.3.1.1 *Group identification signals (GI)*

4.3.1.1.1 *GI 1*

Format



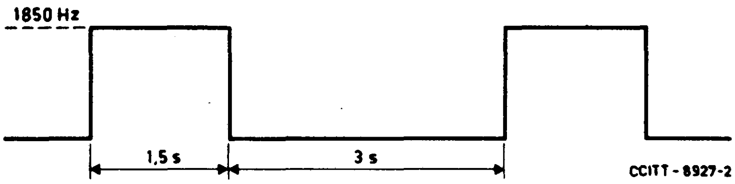
CCITT - 8927-1

Function

1. To indicate the apparatus is in the receive mode and capable of receiving at least one A4 page in the Group 1 mode.
2. The signal is repeated until detection of GC or timer T1 elapses.
3. Tolerances: Timing ± 15%; Frequency as in Recommendation V.21.

4.3.1.1.2 *GI 2*

Format



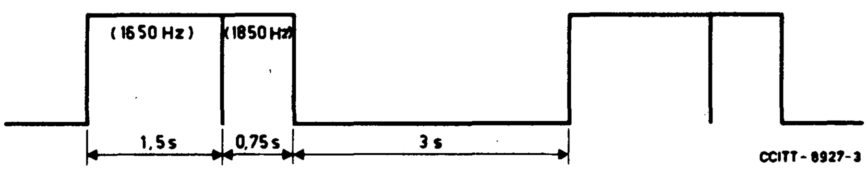
CCITT - 8927-2

Function

1. To indicate the apparatus is in the receive mode and capable of receiving at least one A4 page in the Group 2 mode.
2. The signal is repeated until detection of GC or timer T1 elapses.
3. Tolerances: Timing ± 15%; Frequency as in Recommendation V.21.

4.3.1.1.3 *GI 1/2*

Format



CCITT - 8927-3

Function

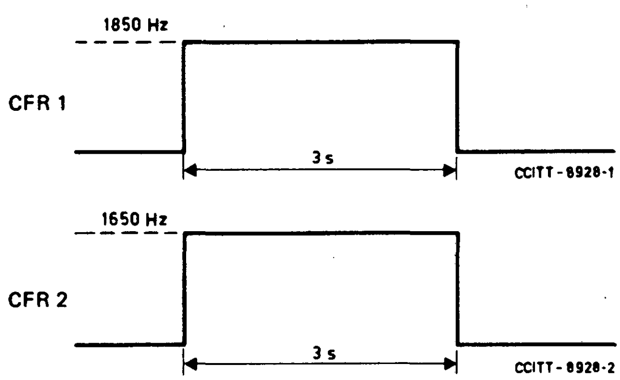
1. To indicate the apparatus is in the receive mode and is capable of receiving at least one A4 page in the Group 1 or Group 2 mode. The apparatus is capable of adjusting automatically to the speed of the transmitter.

2. The signal is repeated until detection of GC or timer T1 elapses.
3. Tolerances: Timing ± 15%; Frequencies as in Recommendation V.21.

Note. – To prevent confusing the repeating GI signal with the busy tone it may be required by certain Administrations that a delay be incorporated prior to answering the call.

4.3.1.2 *Confirmation to receive signals (CFR)*

Format



Function

1. To indicate that the receiver has phased and is ready to receive the document.
2. Tolerances: Timing ± 15%; Frequencies as in Recommendation V.21.

4.3.1.3 *Message confirmation signal (MCF)*

MCF 1 = the same frequency and duration as CFR 1.

MCF 2 = the same frequency and duration as CFR 2.

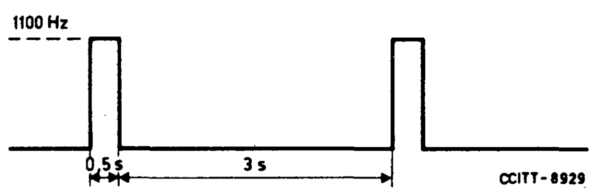
Function

To indicate that the receiver has received one page. The signal must start not later than 0.5 second after the completion of EOM at the receiver and continue for 3 seconds.

4.3.2 *Facsimile transmitter signals* (signals transmitted by transmitter)

4.3.2.1 *Send Identification Signal (SID)*

Format



Function

1. To indicate that the apparatus is in the transmit mode and is ready to transmit on the receipt of the appropriate GI.
2. This is an optional signal and would be transmitted whilst the transmitter was waiting for GI. It would indicate to an operator that the transmitter was still connected to line.
3. Tolerances: Timing ± 15%; Frequency ± 100 Hz.

4.3.2.2 *Group Command signals (GC)*

GC 1 = 1300 Hz ± 2.5% for 1.5 sec. minimum;

GC 2 = 2100 ± 10 Hz for 1.5 sec. minimum.

Function

To indicate to the receiver the group that the transmitter has chosen. GC signal starts at the recognition of the end of the GI signal with a maximum delay of 0.1 second.

4.3.2.3 *Line Conditioning Signals (LCS)*

Format

As in Recommendation T.3.

Function

1. To enable a receiver to equalize the line.
2. This is an optional signal and non-transmission should not affect compatibility.

4.3.2.4 *Phasing*

Format and function

As defined by Recommendations T.2 and T.3.

4.3.2.5 *End-of-Message signal (EOM)*

Format

1100 Hz ± 3.5% for 3 seconds immediately following the message.

Function

To indicate Phase C was completed.

4.3.3 *Common signals* (Applicable in both directions)

4.3.3.1 *Procedure Interrupt Signal (PIS)*

Format

462 Hz ± 1.5 Hz for 3 seconds minimum.

Function

1. To stop a distant machine.
2. May be used as operator recall.

Note 1. – This is an optional signal.

Note 2. – Some Administrations have in use obsolescent systems which may interpret this signal as a clearing signal. This may cause clear down of the connection.

4.3.3.2 *Called Station Identification (CED)*

At 1.8 to 2.5 seconds after the called station is connected to the line, it sends a continuous 2100 Hz answering tone for a duration of not less than 2.6 seconds and not more than 4.0 seconds.

The answering tone propagates towards the calling station and, during the course of one or two interruptions between bursts of calling tone, causes any echo suppressors in the circuit to disable. The answering station delays for a period of 75 ± 20 milliseconds after terminating the answer tone before transmitting further signals.

Function

To indicate a called non-speech terminal.

4.3.3.3 *Calling Tone (CNG)*

Format

1100 Hz, ON for 0.5 second, OFF for 3 seconds.

Tolerance: Timing ± 15%; Frequency ± 100 Hz.

Function

To indicate a calling non-speech terminal.

5. *Binary coded signalling for facsimile procedure*

Note. — The information contained under 5. is provisional and is the subject of continuing study. It is presented so that design and field testing of control procedures can proceed.

Binary coded procedures are used for Group 3 facsimile machines and also for Group 1 and Group 2 machines that require additional facilities to those provided by the procedures described in 4. above.

Except as otherwise noted, the binary coded control procedures should be transmitted in a synchronous mode on the general switched telephone network at 300 bits per second utilizing the characteristics of the Recommendation V.21, channel No. 2 modulation system. (For the tolerances, see 3. of Recommendation V.21.) Signal generators should have a distortion not exceeding 1% and the control signal receivers should accept signals with a distortion not exceeding 40%.

Note 1. — When binary coded control procedures are used in association with Group 3 machines on public data networks (in accordance with Recommendation X.1) it is intended that the normal facsimile message data rate should be used for the communication of the control procedure.

Note 2. — Optionally, a 75 bits per second backward channel may be provided. This channel should comply with the characteristics of the backward channel described in 4. of Recommendation V.23. This channel may be used for optional facilities as long as there is no interference with recommended operation.

Note 3. — It is acknowledged that existing equipments may not conform in all aspects to this Recommendation. Other methods may be possible as long as they do not interfere with the recommended operation.

5.1 *Description*

Phases B, C and D

Case 1: Calling station wishes to transmit (see Diagram 6/T.30).

Calling station	Called station
	1. Transmit DIS
2. DIS detected	
3. Transmit DCS	
	4. DCS detected
	5. Select mode
6. Transmit Phasing/Training	
	7. Phasing/Training
	8. Transmit CFR
9. Detect CFR	
10. Transmit message	
	11. Receive message
12. At end of message send either: a) EOM or b) EOP or c) MPS	
	13. Detect EOM, EOP or MPS
	14. Transmit one of the confirmation signals of post-message responses [see G.1)-G.5) of 5.3.5.1]

Note 1. – Binary coded signals must be preceded by a preamble (see 5.3.1 below).

Note 2. – In case of Group 3 machines training, in-message signals and post-message commands shall be sent at the modulation rate of message transmission.

Case 2: Calling station wishes to receive (see Diagram 7/T.30).

Calling station	Called station
	1. Transmit DIS
2. DIS detected	
3. Transmit DTC	
	4. DTC detected
	5. Transmit DCS
6. DCS detected	
7. Select mode	
	8. Transmit Training/Phasing
9. Training/Phasing	
10. Transmit CFR	
	11. Detect CFR
	12. Transmit message
13. Receive message	
	14. At end of message send either: a) EOM or b) EOP or c) MPS
15. Detect EOM, EOP or MPS	
16. Transmit one of the confirmation signals of post-message responses [see G.1)-G.5) of 5.3.5.1]	

Note 1. – Binary coded signals must be preceded by a preamble (see 5.3.1 below).

Note 2. – In case of Group 3 machines training, in-message signals and post-message commands shall be sent at modulation rate of message transmission.

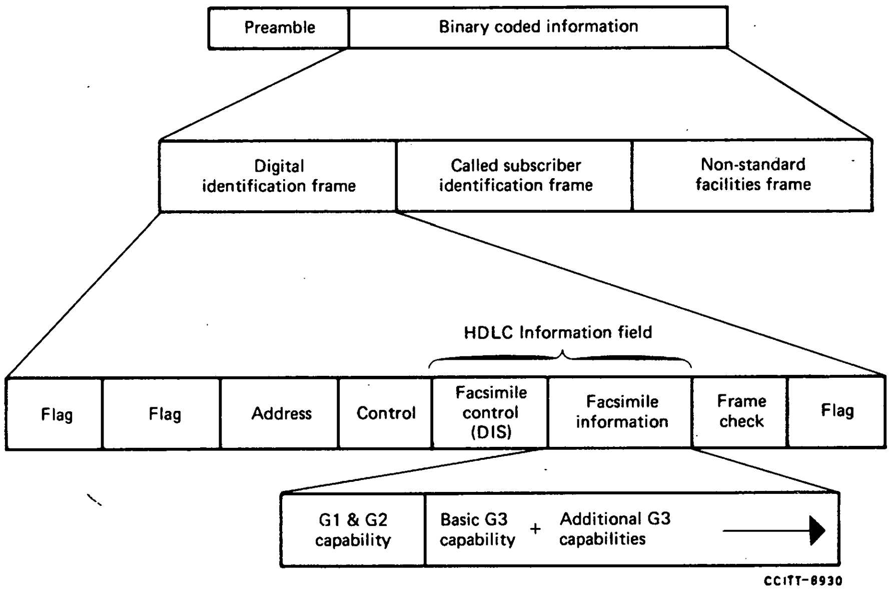
5.2 *Flow diagram*

Under study (to be inserted later).

5.3 *Binary coded signal functions and formats*

An HDLC frame structure is utilized for all binary coded facsimile control procedures accomplished at 300 bit/s. The basic HDLC structure consists of a number of frames, each of which is subdivided into a number of fields. It provides for frame labelling, error checking and confirmation of correctly received information.

More specifically, the following example of a format is used for binary coded signalling. This example shows an initial identification sequence (see 5.3.5.1 A. below).



In the following descriptions of the fields it is intended that the information bits be transmitted in the order as printed, i.e. from left to right.

The equivalence between binary notation symbols and the significant conditions of the signalling code should be in accordance with Recommendation V.1.

5.3.1 *Preamble*

The preamble shall precede all binary coded signalling whenever a new transmission of information begins in any direction (i.e. for each line turnaround). This preamble assures that all elements of the communication channel (e.g. echo suppressors) are properly conditioned so that the subsequent data may be passed unimpaired. This preamble shall, in all cases, be of one second minimum duration and may take the following forms:

5.3.1.1 *Initial identification*

For this case, the CED signal shall serve as the preamble. (see 4.3.3.2 above.)

5.3.1.2 *Subsequent identification*

Where the called station has tonal signalling capabilities, the preamble for the coded information shall be the appropriate GI signal (see 3.2.1, Diagram 5/T.30 and 4.3.1 above). In the case of binary coded signalling only the procedure in 5.3.1.4 below applies.

5.3.1.3 *Message/signalling delineation*

Where Group 1 or Group 2 modulation techniques are employed, the preamble for binary coded message signalling shall be the tonal EOM signal as defined in 4.3.2.5 above. This signals the T.2 or T.3 modulation system to drop off the line and be replaced by the T.30 binary coded modulation system.

5.3.1.4 *Others*

For all other conditions, the preamble for the binary coded information exchange shall be a series of HDLC flag sequences for the appropriate duration (see 5.3.2 below) except for an optional procedure interrupt signal from the receiver. If the transmitter is not expecting a signal the preamble must consist of a tonal PIS signal as defined in 4.3.3.1 above to ensure that the signalling modem on the transmitter is activated.

5.3.2 *Flag sequence*

The eight bit HDLC flag sequence is used to denote the beginning and end of the frame, as the HDLC procedure requires a "0" to be inserted in the data stream after any occurrence of five continuous "1"s. For facsimile procedure, the flat sequence is used to establish bit and frame synchronization. To facilitate this with simple machines a minimum of two flag sequences is specified for the first frame in any transmission. Subsequent frames need only one flag sequence as in the standard HDLC procedure.

Continued transmission of the flag sequence may be used to signal to the distant station that the machine remains on line but not presently prepared to proceed with the facsimile procedure.

Format : 0111 1110

5.3.3 *Address field*

The eight-bit HDLC address field is intended to provide identification for the secondary channel [8]. System planning may provide common secondary station [8] addresses for various purposes. In the case of point-to-point facsimile transmission on the general switched telephone network this field is not specifically required. It is reserved, however, for future use such as multipoint connections and use on data networks.

Format : 0000 0000

5.3.4 *Control field*

The eight-bit HDLC control field provides the capability of encoding the commands and responses to control the data link. A unique facsimile control field is identified to override the other commands identified in HDLC.

Format: 1100 X000

Notes. – The final format is to be decided in conjunction with ISO.

X = 0 for non-final frames within the procedure, X = 1 for final frames within the procedure. A final frame is defined as the last frame transmitted prior to an expected response from the distant station.

5.3.5 *Information field*

The HDLC information field is of variable length and contains the specific information for the control and message interchange between two facsimile stations. In this Recommendation it is divided into two parts, the Facsimile Control Field (FCF) and the Facsimile Information Field (FIF).

[8] The terminology used here is taken from the ISO description of HDLC procedures.

5.3.5.1 *Facsimile Control Field (FCF)*

The Facsimile Control Field is defined to be the first eights bits of the HDLC information field. This field is extremely important, as it contains the complete information regarding the type of information being exchanged and the position in the overall sequence. The first four bits of this field contain the sequencing information, whereas the last three pertain to specific conditions. The fifth bit is presently reserved for future expansion. At least one signal under each section must be sent. The bit assignments within the FCF are as follows:

A. *Initial identification* (from the called to the calling station)

Format: 0000 XXXX

1) *Digital Identification Signal (DIS)* – Characterizes the standard CCITT capabilities of the called apparatus.

Format: 0000 0001

2) *Called Subscriber Identification (CSI)* This optional signal may be used to provide the specific identity of the called station by (for example) a number assigned to it or its telephone number. Proposals for this signal are to be studied.

Format: 0000 0010

3) *Non-Standard Facilities (NSF)* – This optional signal may be used to identify specific user requirements which are not covered by the Series T Recommendations.

Format: 0000 0100

B. *Command to send* (from a calling station wishing to be a receiver to a called station which is capable of transmitting).

Format: 1000 XXXX

1) *Digital Transmit Command (DTC)* – The digital command response to the standard capabilities identified by the DIS signal.

Format: 1000 0001

2) *Calling Station Identification (CIG)* – This optional signal indicates that the following FIF information is an identification of that calling station. It may be used to provide additional security to the facsimile procedure.

The use of this signal is a matter for further study.

Format: 1000 0010

3) *Non-standard Facilities Command (NSC)* – This optional signal is the digital command response to the information contained in the NSF signal.

Format: 1000 0100

C. *Command to receive* (from the transmitter to the receiver)

Format: X100 XXXX

1) *Digital Command Signal (DCS)* – The digital set-up command responding to the standard capabilities identified by the DIS signal.

Format: X100 0001

2) *Non-standard facilities set-up (NSS)* – This optional signal is the digital command response to the information contained in the NSC or NSF signal.

Format: X100 0100

3) *Training Check (TCF)* – This optional signal may be sent through the Group 3 modulation system to verify training and to give a first indication of the acceptability of the channel for this speed communication.

Format to be determined.

Note. – A training signal may be required for Group 3 modulation systems.

D. *Pre-message response signals* (from the receiver to the transmitter)

Format: X010 XXXX

1) *Confirmation to Receive (CFR)* – A digital response confirming that the entire pre-message procedure has been completed and the message transmission may commence.

Format: X010 0001

2) *Failure to Train (FTT)* – An optional digital response rejecting all or part of the pre-message procedure and requesting a retraining of the Group 3 modulation system.

Format: X010 0010

E. *In-message procedure* (normally from the transmitter to the receiver. Optionally from the receiver to the transmitter as described under 5. above, Note 2. In case of Group 3 machines the in-message procedure formats and specific signals shall be consistent with the recommendation of Group 3 machines. In-message procedures for Group 1 and Group 2 are defined in Recommendations T.2 and T.3.)

F. *Post message commands* (From the transmitter to the receiver. Group 3 machines post message formats and specific signals shall be consistent with the recommendations for Group 3 machines.)

The post message commands for Group 1 and Group 2 machines are as follows:

Format: X111 XXXX

1) *End-of-Message (EOM)* – To indicate the end of a page of facsimile information and to return to the beginning of Phase B in the procedure.

Format: X111 0001

2) *Multipage Signal (MPS)* – To indicate the end of a page of facsimile information and to return to the beginning of Phase C upon receipt of a confirmation.

Format: X111 0010

3) *End of Procedure (EOP)* – To indicate the end of a page of facsimile information and to further indicate that no further documents are forthcoming and to proceed immediately to Phase E.

Format: X111 0100

G. *Post-message responses* (from the receiver to the transmitter. At least one of these signals must be used.)

Format: X011 XXXX

1) *Message Confirmation (MCF)* – To indicate that a complete message has been received and that additional messages may follow. (This is a positive response to MPS or EOM).

Format: X011 0001

2) *Retrain Positive (RTP)* – To indicate that a complete message has been received and that additional messages may follow after retransmission of training and/or phasing and CFR.

Format: X011 0011

3) *Retrain Negative (RTN)* – To indicate that the previous message has not been satisfactorily received. However, further receptions may be possible, provided training and/or phasing are retransmitted.

Format: X011 0010

4) *Procedural Interrupt Positive (PIP)* – To indicate that a message has been received but that further transmissions are not possible without operator intervention or a complete restart of the facsimile procedure.

Format: X011 0101

5) *Procedure Interrupt Negative (PIN)* – To indicate that the previous (or in-process) message has not been satisfactorily received and that further transmissions are not possible without operator intervention or a complete restart of the facsimile procedure.

Format: X011 0100

5.3.5.2 *Facsimile Information Field (FIF)*

In many cases the FCF will be followed by the transmission of additional information to further clarify the facsimile procedure. This information for the basic binary coded system would consist of an expansion of the information of the DIS, DCS and DTC signals.

5.3.5.2.1 *DIS standard capabilities* – Additional information fields will be transmitted immediately following the DIS Facsimile Control Field. The first 8 bits of this additional information relate to Group 1 and Group 2 apparatus, and subsequent bits relate to Group 3 apparatus. The bit assignment for this information is given in Table 2/T.30, where a "1" indicates the condition is valid.

TABLE 2/T.30

Bit numbers	Description
1	Transmitter (Group 1 or 2)
2	Receiver (Group 1 or 2)
3	Group 1 – Index of cooperation = 264 only
4	Group 1 – Index of cooperation = 264 and 176
5	Group 2
6-8	Reserved for future Group 2 features
9	Transmitter (Group 3) } Group 3 standard modem and resolution
10	Receiver (Group 3) } Group 3 standard modem and resolution
11 onwards	Additional Group 3 modem capabilities
	Additional horizontal resolution capabilities
	Additional vertical resolution capabilities
	Reserved for Group 3 machines as defined

5.3.5.2.2 *DCS Standard Commands* – The response commands to the DIS information is formatted in a manner identical to that shown in Table 2/T.30. It is obvious, however, that the command must indicate only the chosen alternative rather than the full range of capabilities.

5.3.5.2.3 *DTC standard command* – This response command to the DIS information is formatted in a manner identical to that shown in Table 2/T.30. It will contain a "0" in position 1 and/or 9 and a "1" in position 2 and/or 10. The remaining positions may command a particular configuration or leave that choice to the transmitter.

5.3.6 *Frame check sequences*

The 16-bit polynominal check sequence defined for the HDLC shall be transmitted as an integral part of each frame.

Note. – Further study is to be carried out regarding the use of the frame check.

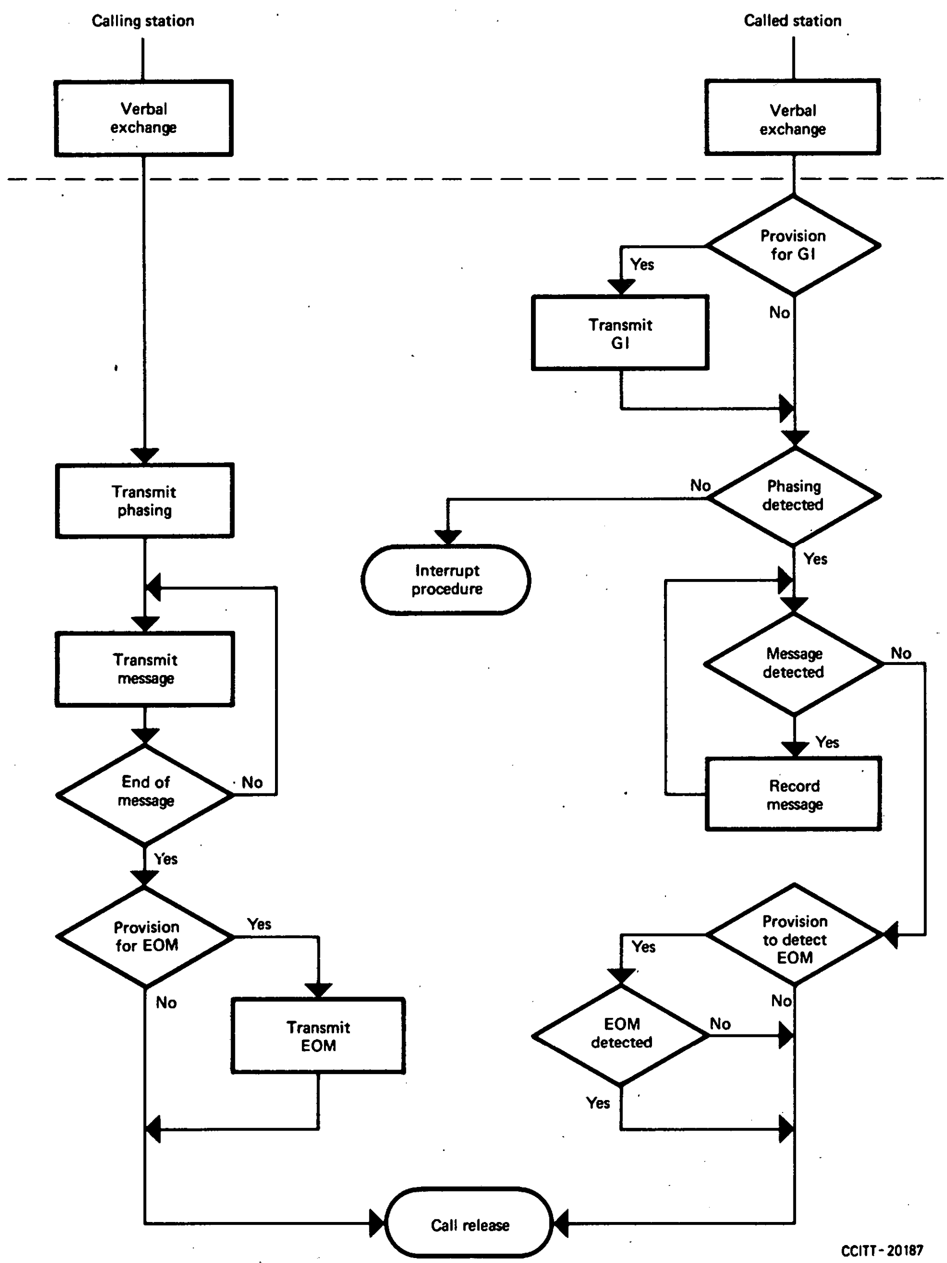
5.3.7 *Flag sequence* (see 5.3.2 above)

APPENDIX 1

(to Recommendation T.30)

Example of non-standard manual-to-manual basic facsimile operation

It is acknowledged that there are existing equipments in the field that may not conform in all aspects to this Recommendation. Therefore, the decision may be made to go to a mode of operation other than specified herein. This diagram describes, as an example, one of these conditions. Other methods may be possible, as long as they do not interfere with the recommended operation.



APPENDIX 2
(to Recommendation T.30)

Index of abbreviations used in Recommendation T.30

Abbreviation	Function	Signal format	Reference
CED	Called Station Identification	2100 Hz	4.3.3.2
CFR	Confirmation to Receive	X010 0001 1850 or 1650 Hz for 3 sec.	5.3.5.1 D1) 4.3.1.2
CIG	Calling Station Identification	1000 0010	5.3.5.1 B2)
CSI	Called Subscriber Identification	0000 0010	5.3.5.1 A2)
DCS	Digital Command Signal	X100 0001	5.3.5.1 C1)
DIS	Digital Identification Signal	0000 0001	5.3.5.1 A1)
DTC	Digital Transmit Command	1000 0001	5.3.5.1 B1)
EOM	End of Message	X111 0001 1100 Hz	5.3.5.1 F1) 4.3.2.5
EOP	End of Procedure	X111 0100	5.3.5.1 F3)
FCF	Facsimile Control Field	–	5.3.5.1
FIF	Facsimile Information Field	–	5.3.5
FTT	Failure To Train	X010 0010	5.3.5.1 D2)
GC	Group Command	1300 Hz for minimum 1.5 sec. 2100 Hz for minimum 1.5 sec.	4.3.2.2
GI	Group Identification	1650 or 1850 Hz	4.3.1.1
HDLC	High-level Data Link Control	–	5.3.1.4
LCS	Line Conditioning Signals	1100 Hz	4.3.2.3
MCF	Message Confirmation	X011 0001 1650 or 1850 Hz	5.3.5.1 G1) 4.3.1.3
MPS	Multi-Page Signal	X111 0010	5.3.5.1 F2)
NSF	Non-standard Facilities	0000 0100	5.3.5.1 A3)
PIN	Procedural Interrupt Negative	X011 0100	5.3.5.1 G5)
PIP	Procedural Interrupt Positive	X011 0101	5.3.5.1 G4)
PIS	Procedure Interrupt Signal	462 Hz for 3 sec.	4.3.3.1
RTN	Retrain Negative	X011 0010	5.3.5.1 G3)
RTP	Retrain Positive	X011 0011	5.3.5.1 G2)
SID	Send Identification Signal	1100 Hz for 500 ms	4.3.2.1
TCF	Training Check		5.3.5.1 C3)
CNG	Calling Tone	1100 Hz for 500 ms	4.3.3.3
NSC	Non-Standard Facilities Command	1000 0100	5.3.5.1 B3)
NSS	Non-Standard Facilities Set-Up	X100 0100	5.3.5.1 C2)

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PART IV

Series U Recommendations

TELEGRAPH SWITCHING

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TELEGRAPH SWITCHING

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 and 1976)

a) 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) 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) 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) 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) 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.

For these reasons, the CCITT *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.

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 (Recommendation F.1, C.8) 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.

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 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 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.

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 6. 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

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). 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).

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 Recommendation F.60, 4.1 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 1) ii) 165-260-ms pulse of stop polarity followed by teleprinter signals and then by 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.

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 seconds, 4 minutes 58 seconds or 29 minutes 58 seconds duration. (The tolerance on all above time intervals is ± 20%.)

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 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- or 30-minute intervals. If 5-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-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 or RPOA.

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 and RPOAs 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.

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 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.

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 outoing 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)

a) 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) By the adoption of a systematic plan, such traffic can be barred without involving either expensive or elaborate equipment arrangements.

c) 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.

The CCITT therefore *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 exist between two countries;

b) of enabling the appropriate tarrif 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 tarrif 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.

Recommendation U.10

EQUIPMENT OF AN INTERNATIONAL TELEX POSITION

(former CCIT Recommendation F.60; modified at New Delhi, 1960)

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.

For the above reasons, the CCITT *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 Recommendation F.60, 3.3, but to be stopped on receipt of the first clearing signal.

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)

a) 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) 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) 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) 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) 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) 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) 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) 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.

For these reasons, the CCITT *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, 2 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 or Recommendation F.1, C8.

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 or recognized private operating agency (RPOA);
- combination No. 30;
- a one-, two- or three-digit number identifying the centre and/or equipment in the transit Administration's (or RPOA'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 (or RPOA) 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 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 B. of Recommendation S.15.

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	*Case of a called country having a 3-digit destination code*
Class-of-traffic	Class-of-traffic
Class-of-traffic check	Class-of-traffic check
D1	D1
D2	D2
N1	D3
→ start of forward selection	N1
N2	→ start of forward selection
→	N2
N3	.
.	.
.	N*n*
N*n*	Combination No. 26
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 or RPOA.

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 and RPOAs 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 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 or RPOAs 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 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 retransmitted 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 (± 10 %) after the end of receipt of the class-of-traffic signal. Combination No. 22 is returned 450 ms (± 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.*)

TABLE 1/U.11 *(continued)*

Signal or function	Forward path (X towards Y)	Backward path (Y towards X)	Remarks
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.
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.

TABLE 1/U.11 *(continued)*

Signal or function	Forward path (X towards Y)	Backward path (Y towards X)	Remarks
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.
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.

TABLE 1/U.11 *(continued)*

Signal or function	Forward path (X towards Y)	Backward path (Y towards X)	Remarks
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.
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 the 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,

TABLE 1/U.11 *(concluded)*

Signal or function	Forward path (X towards Y)	Backward path (Y towards X)	Remarks
			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 or 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
	21	Z	Z	Z	A	A	15	A	A	A	Z	Z		no
	10	Z	Z	A	Z	A	8	A	A	Z	A	Z	Service traffic	yes
	1	Z	Z	A	A	A	13	A	A	Z	Z	Z		no
	6	Z	A	Z	Z	A	12	A	Z	A	A	Z	Gentex	yes
	19	Z	A	Z	A	A	7	A	Z	A	Z	Z		no
	4	Z	A	A	Z	A	16	A	Z	Z	A	Z	Special category (see Note under 7.2)	yes
	5	Z	A	A	A	A	22	A	Z	Z	Z	Z		no
B	3	A	Z	Z	Z	A	26	Z	A	A	A	Z		yes
	9	A	Z	Z	A	A	2	Z	A	A	Z	Z		no
	18	A	Z	A	Z	A	25	Z	A	Z	A	Z		yes
	28	A	Z	A	A	A	24	Z	A	Z	Z	Z		no
	14	A	A	Z	Z	A	23	Z	Z	A	A	Z		yes
	31	A	A	Z	A	A	30	Z	Z	A	Z	Z		no
	27	A	A	A	Z	A	17	Z	Z	Z	A	Z		yes
	32	A	A	A	A	A	29	Z	Z	Z	Z	Z		no

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)

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 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,

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 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 this section

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, some other multiples are selected in order to enable simpler interworking with systems operating in accordance with Recommendation U.1 (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 both-way 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 NC service signal followed immediately by the clearing signal will be returned to the preceding centre after the reception-confirmation signal and the network identification signal (F.69).

3.4 Failure to receive the reception-confirmation or reception-congestion signal within 4 seconds from the start of the calling signal or the reception 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). In the case of transit calls, if the second attempt is unsuccessful, the NC service signal followed by the clearing signal will be returned to the preceding centre after the reception-confirmation signal and the network identification signal (F.69).

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 seven (or possibly more) characters (see Tables 2/U.12, 3/U.12, 4/U.12 and 5/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 2) 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.

Note 2. – A closed user group may incorporate the direct call or abbreviated address calling facilities.

The closed user group characters are only used in conjunction with the second and possibly subsequent class-of-traffic signals that they follow. The closed user group characters required may vary in number. They are completed by an end-of-closed user group character signal.

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 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 NC service signal to the preceding centre [after the reception confirmation, and possibly the network identification signal (F.69)] 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 twelve.

3.8 In the case of receipt of the reception-congestion signal at a transit centre, the NC service signal should be returned to the preceding centre (after the reception-confirmation and possibly the network identification signal in the case of a transit centre) and followed by the clearing signal.

3.9 The network identification signal shall be sent following the reception-confirmation signal in all cases of transit calls but not for terminal calls. However, when a service signal is returned from the destination network for reasons other than failure or congestion of the called subscriber line, or the called number is spare, it should be followed by the network identification signal.

If several transit 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 NC service signal to the preceding centre, followed by the clearing signal (see exception for extension of the call to a terminal network in the preceding paragraph). 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 and 7a/U.12.

3.11 If the last backward path signalling character, call-connected, terminating-through-connection or service signal is not received within 90 seconds from the end of selection, then the NC service signal 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 call-connected and following signals to the calling station should be delayed accordingly (up to a maximum of 3 seconds for telex in accordance with Recommendation S.9).

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 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 answer-back 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 terminating-through-connection signal confirms that the identification of the calling subscriber has been completely received by the terminating centre, converted and retransmitted to the calling subscriber.

The WRU signal confirms that the call-connected signal has been received by the originating centre and when applicable that the identification of the called subscriber has been completely received by the originating centre, converted and retransmitted to the calling subscriber, and when applicable that the terminating-through-connection signal has been received.

The terminating-through-connection signal is sent on the backward path by the terminating centre. The WRU signal is sent by the originating centre to the called subscriber.

The connection must be switched through in the destination centre within one character period after transmission of the call-connected signal or the terminating-through-connection signal CSC No. 13 or completion of the transmission of the line identification to centre X. The appropriate condition is dependent on whether or not and in which direction a line identification has to be transmitted. The various situations are illustrated in Appendix 3.

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 answer-back 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 8 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 5 times at nominal intervals of 1.0 minute 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 5 tests at either 5- or 30-minute intervals. If 5-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 5 retests will be made at 30-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 or RPOA.

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.

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 signal. 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 1), the two or three digits of the F.69 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 code for the network concerned	For transit calls 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. For terminal calls CSC No. 12 follows the service signal character(s), when specified, at automatic speed after one to two character periods.
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

TABLE 1/U.12 *(continued)*

Signal or function	Forward path (X towards Y)	Backward path (Y towards X)	Remarks
			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 7A/U.12) followed by the idle circuit condition	Service signals consist of CSC No. 11 followed by two characters from Table 7A/U.12.
Call connected		One CSC character (see Table 7/U.12)	See Appendix 3.
Called line identification (if required)		The called line identification signal transmitted at automatic speed commencing within two character periods of the transmission of the call-connected signal	The called or calling line identification signal consists of the F.69 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.)
Calling line identification (if required)	The calling line identification transmitted at automatic speed commencing within one to two character periods of receipt of the call-connected signal		
Terminating through connection (if required)		CSC character No. 13	For definition see 3.14 of the text and for further details see Appendix 3.
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 3.
Service signal with clearing		CSC characters (see Table 7A/U.12), possibly followed by the network identification signals (see 3.9 of the text) followed by clearing signal	The service signal consists of CSC No. 11 followed by two characters of Table 7A/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.

TABLE 1/U.12 *(concluded)*

Signal or function	Forward path (X towards Y)	Backward path (Y towards X)	Remarks
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.
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 re-test	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	Re-test 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 character follows
	Z			Closed user group character follows (see Table 5/U.12)
		A		Called line identification not required
		Z		Called line identification required
			A	Not allocated
			Z	Not allocated

[a] Reserve for future needs. If implemented, the allocations should be the same as in Table 4a/X.70.

TABLE 5/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 Closed user group digits[a]
A	A	A	Z	1 Closed user group digits[a]
A	A	Z	A	2 Closed user group digits[a]
A	A	Z	Z	3 Closed user group digits[a]
A	Z	A	A	4 Closed user group digits[a]
A	Z	A	Z	5 Closed user group digits[a]
A	Z	Z	A	6 Closed user group digits[a]
A	Z	Z	Z	7 Closed user group digits[a]
Z	A	A	A	8 Closed user group digits[a]
Z	A	A	Z	9 Closed user group digits[a]
Z	A	Z	A	End-of-closed user group character
Z	A	Z	Z	Not allocated
Z	Z	A	A	No closed user group digit is included[b]
Z	Z	A	Z	Not allocated
Z	Z	Z	A	Not allocated
Z	Z	Z	Z	Not allocated

[a] The application and implementation of closed user groups is provisional and for further study in the telex service.

[b] Character sent to indicate that the closed user group validation check has been already performed in the originating centre (e.g. can be used if the call is a direct call).

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
Z	A	Z	A	End-of-selection signal
Z	A	Z	Z	End-of-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
				(digits 0–9:) Digits for: – network identification signal (F.69), – called line identification, – service signals
Z	A	Z	A	Start-of-service signal (see Table 7a/U.12)
Z	A	Z	Z	End-of-line identification [a] / Start-of-network identification signal
Z	Z			Call connected signal [b]
		A		Calling line identification not required
		Z		Calling line identification required
			A	Call metering
			Z [c]	No call metering

[a] This signal is also used without any pre-service signal when the called line identification is not available.
[b] CSC character No. 13 (ZZAA) is terminating through connection.
[c] b_1 may be used in the future to provide an escape possibility.

TABLE 7a/U.12 – **Service signals on the backward path** [a]

Equivalent numerical code [b]	Category	Meaning	Equivalent alphabetical code
00	Without clearing	Unallocated	–
01		Redirected call [c]	**RDI** [c]
02		Connect when free	**MOM**
03		No line identification	**NI**
10	With clearing, due to a short-term condition at the subscriber's station [d]	Number busy	**OCC**
11		Selection error [c] (procedure)	**FMT** [c]
12		Selection error [e] (transmission)	**NC**
20	With clearing, due to a long-term condition at the subscriber's station [d]	Not obtainable	**NP**
21		Access barred	**NA**
22		Controlled not ready	**ABS**
23		Out of order	**DER**
24		Number changed	**NCH**
25		Call information service	**INF**
30	With clearing, due to a network fault	Network congestion	**NC**
31		Trunk congestion	
32		Equipment congestion	
33		Network error	
34		Trunk error	
35		Equipment error	
36		Out of order	

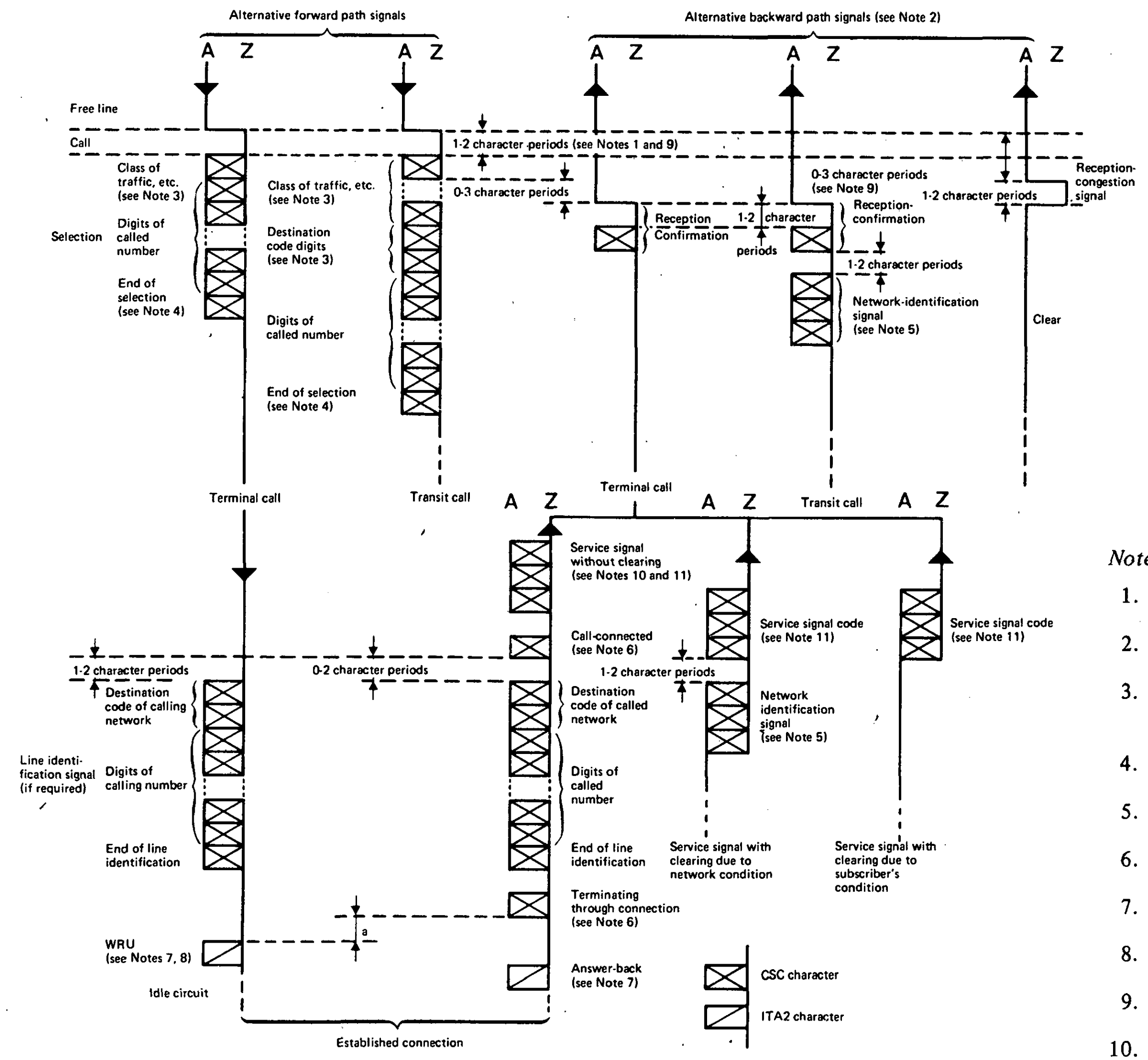
[a] The use of two CSC characters to indicate service signal codes is provisional and requires further study.
[b] Codes not allocated in the 00-79 range are reserved for international use. The remaining codes are available for national use.
[c] Not yet standardized in Recommendation F.60.
[d] *Short-term* 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.
[e] These signals are normally only utilized between the first exchange and the subscriber. They are not signalled on inter-exchange links.

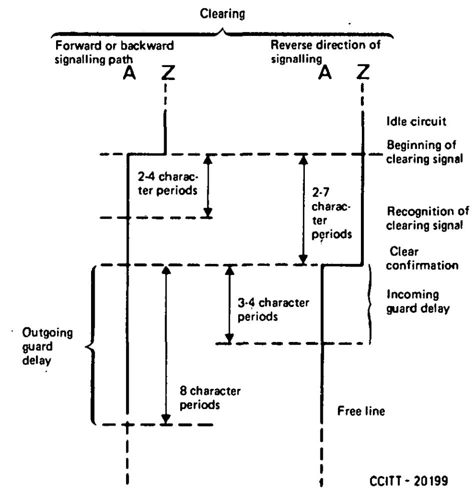
TABLE 8/U.12 – **Control signalling code (CSC)**

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

Notes

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.
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).
3. The transmitting part of the signalling device shall send the control characters at the nominal modulation rate 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 %.





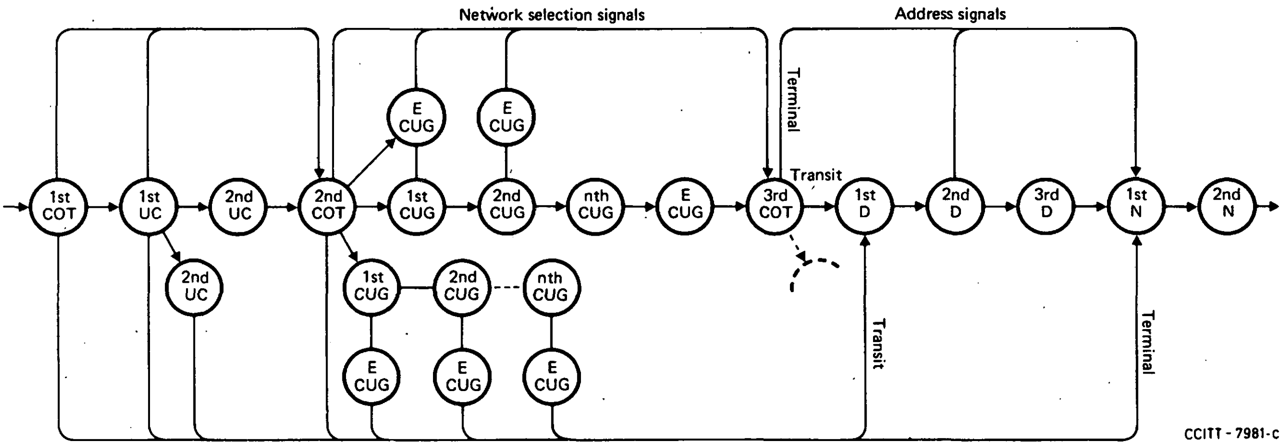
Notes

1. Timings are shown as character periods of the 4 (+ 1 parity) bit code. Switching and propagation delays are not included.
2. Forward path signals may also appear on the backward path, indicating a head-on collision on both-way circuits.
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.
4. Selection signals will always be sent as a single block by the originating country. An end-of-selection signal must be included.
5. The network identification signal comprises a distinctive character followed by the destination code of the network concerned.
6. For additional information regarding the call-connected and through-connection signals, see Appendix 3.
7. The WRU signal and answer-back signals shown for the established connection are characters of International Telegraph Alphabet No. 2.
8. For value of a and for further details, refer to 3.14 of the text and Appendix 3.
9. The minimum and consequently the maximum periods will be lengthened at the request of the incoming country.
10. Service signals without clearing may be introduced to indicate such facilities as call redirection.
11. Service signals comprise a distinctive character followed by a 2-digit number.

FIGURE 1/U.12 – **Signalling system type D**

APPENDIX 1
(to Recommendation U.12)

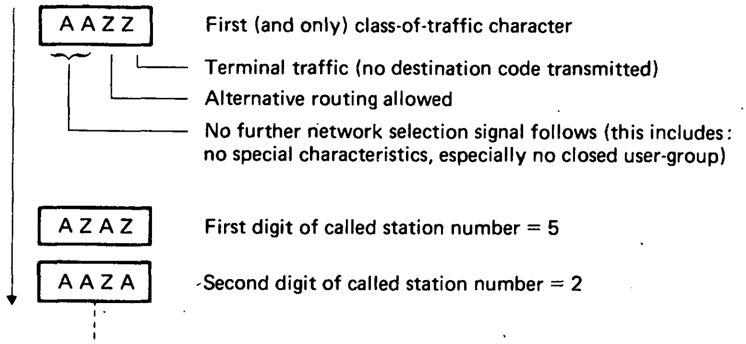
Possible sequences of network selection signals



COT = class-of-traffic character
UC = user class character
CUG = closed user group character
D = destination code digit
N = called number digit
E CUG = end of closed user group character
Dotted lines: reserved for further extension

APPENDIX 2
(to Recommendation U.12)

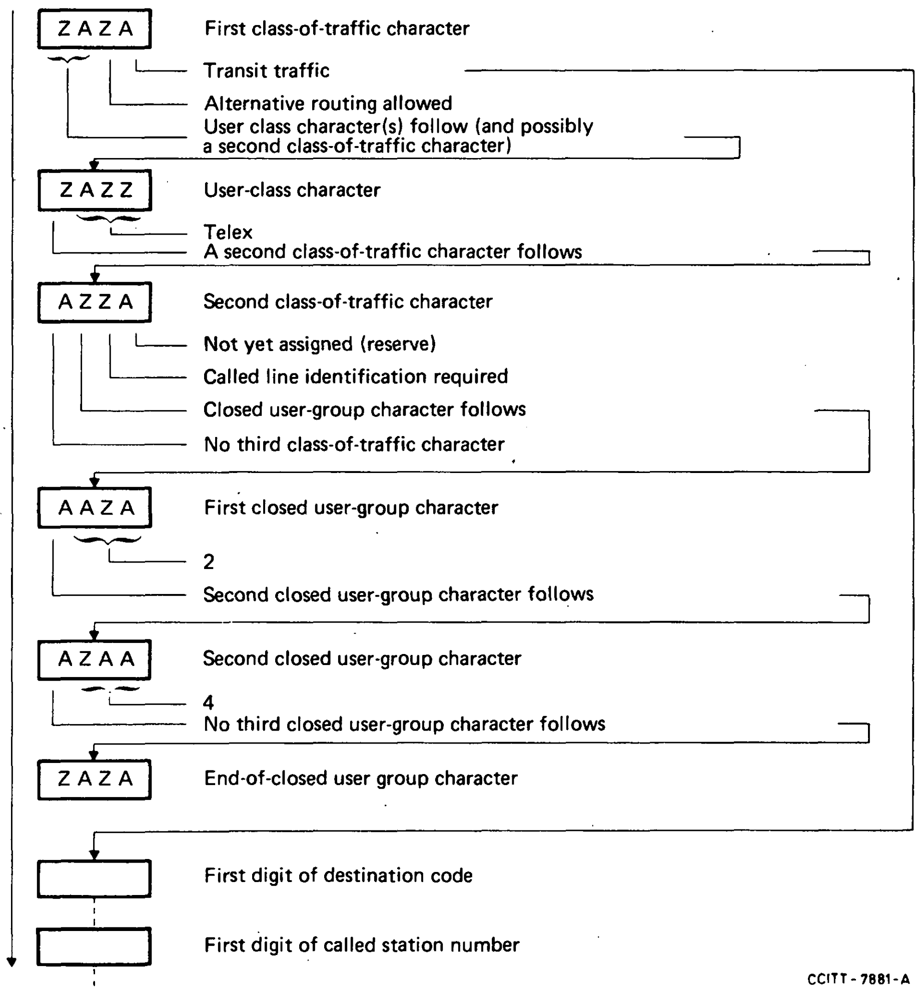
Examples of network selection signals



1. *First example* (minimum sequence of network selection signals)

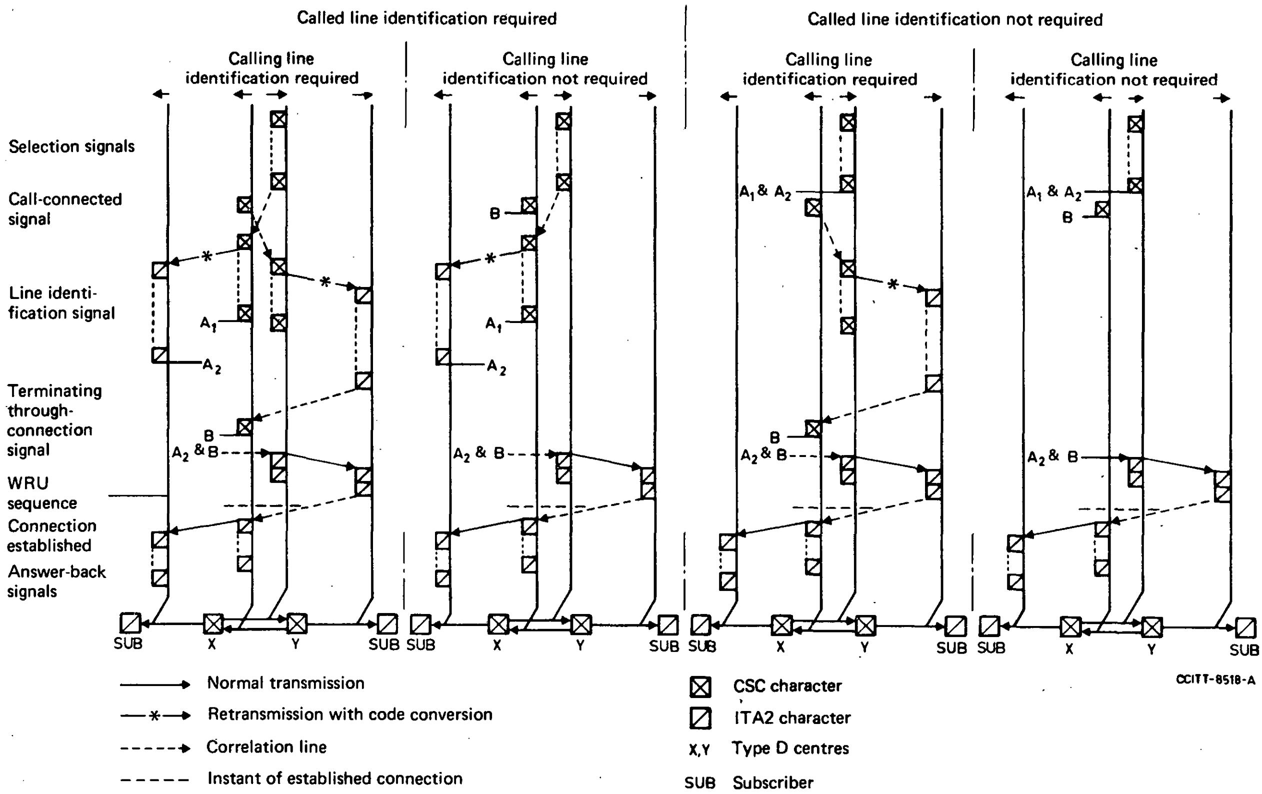
This example shows a sequence of minimal length. (The preceding calling signal, the start and stop elements and the parity bit are not shown. The bits are shows in the order b_4, b_3, b_2 and b_1.)

2. *Second example* (a sequence of network selection signals including closed user-group characters)



APPENDIX 3
(to Recommendation U.12)

Through-connection procedures



Conditions for termination through connection:

All type D network: at originating centre – with first answer-back signal
at transit centre – with call-connected signal
at terminal centre – with condition A_1 and B

Mixed signalling network: at first type D centre – with first answer-back signal
at last type D centre – dependent on destination with condition A_1 and B or after WRU received

Note. – The WRU sequence is generated by the originating or first type D centre within 1 to 2 character periods from condition A_2 and B.

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)

a) 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) 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).

c) 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) 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.

For these reasons, the CCITT

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*

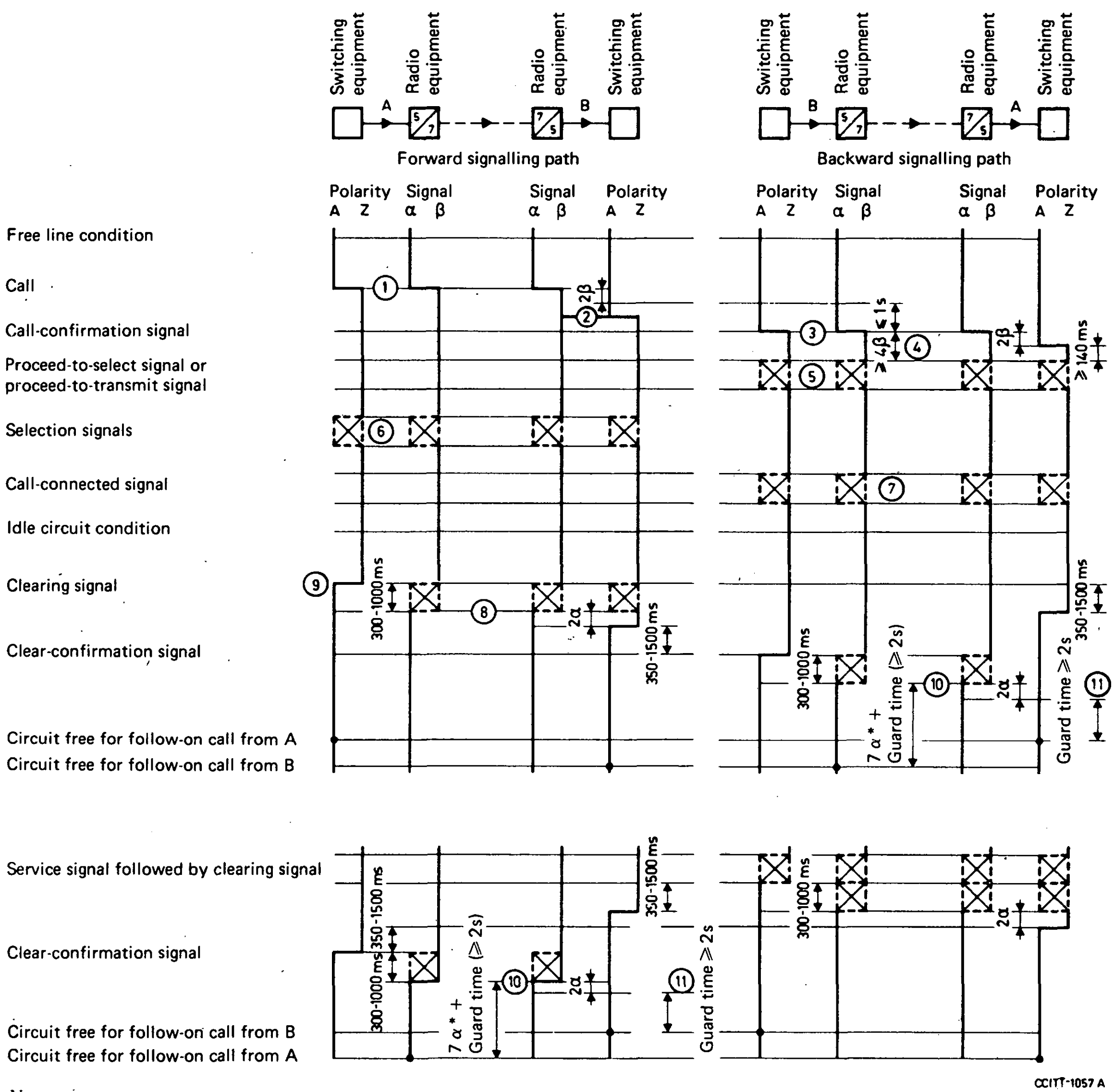
11.1 For both-way ARQ radio circuits used in the fully-automatic telex and gentex services, the following action to minimize the incidence of head-on collision is recommended:

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 of the text.
2. See 2.2 to 2.4 of the text.
3. See 3.3 of the text.
4. See 4.1 and 4.2.4 of the text.
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 of the text.
7. See 6.1 to 6.4 of the text.
8. See 8.1.3 of the text.
9. See 8.2.3 and 8.2.4 of the text.
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 of the text.

* See 8.2.2 of the text.

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**

Recommendation U.21

OPERATOR RECALL ON A TELEX CALL SET UP ON A RADIOTELEGRAPH CIRCUIT

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

a) 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) 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) 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.

The CCITT therefore *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).

Recommendation U.22

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)

a) 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) 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) 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) 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) 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) 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.

For these reasons, the CCITT *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)

A. *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.

B. *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.

C. *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 I. 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.

D. *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%.

E. *Practical application of busying*

For a radiotelegraph system corresponding to 50 bauds (see Recommendation S.13), the maximum number of transmissible elements in a 20-second period is 20 × 48 and the corresponding number of characters is (20 × 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.

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.

[1] This figure is 8 in the case of an 8-character-repetition cycle.

[2] 3.5 with an 8-character-repetition cycle.

F. *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.

G. *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.

H. *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.

I. *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 (or the RPOA) 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, 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 (or RPOAs) 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 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. (Definition of the efficiency factor (in time): Definition 33.23 of the *List of Definitions of Essential Telecommunications Terms.)*

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).

Recommendation U.24

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 (reference Recommendation S.3, 1.6), 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 :

10.1 *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.

10.2 *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.

10.3 *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.

10.4 *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 TO RECOMMENDATION U.24

TABLE 1 – **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 (± 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 (± 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 the end of the tables.

TABLE 2 – **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 the end of the tables.

TABLE 3 – **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

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.

Recommendation U.30

SIGNALLING CONDITIONS FOR USE IN THE INTERNATIONAL GENTEX NETWORK

(New Delhi, 1960)

a) 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) 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.

Hence, the CCITT *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.

Recommendation U.31

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.,

A. *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;

B. *unanimously declares the view*

1. 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);

2. 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;

3. 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.

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PART V

QUESTIONS ENTRUSTED TO STUDY GROUPS VIII, IX, X AND XIV FOR THE PERIOD 1977-1980

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

QUESTIONS CONCERNING TELEGRAPH AND DATA TERMINAL EQUIPMENT ENTRUSTED TO STUDY GROUP VIII FOR THE PERIOD 1977-1980

Chairman: Mr. W. Staudinger (Federal Republic of Germany)

Vice-Chairman: Mr. A. Dupont (France)

List of Questions

Note. – An asterisk (*) indicates an urgent Question.

Question No.	Title
1/VIII	Sequences of combinations
2/VIII	Telex terminals with both printing and visual display facilities
3/VIII	The *not-ready* condition in telex terminal equipment
4/VIII	Automated calling and clearing for teleprinters
5/VIII	Standardization of keyboard facilities for telex terminals
6/VIII	Formatting of telex messages
7/VIII	Speed and code conversion
8/VIII	Text communication service
9/VIII	Standardization of data terminal equipment
10/VIII *	Automatic originating and answering of calls in the telex network

Question 1/VIII – Sequences of combinations

(Geneva, 1976)

(interests Study Group I)

Standardization of new sequences of combinations form International Telegraph Alphabet No. 2 for special purposes (Recommendations S.4 and F.30 refer).

Question 2/VIII – Telex terminals with both printing and visual display facilities

(Geneva, 1976)

(interests Study Group I)

Is there a requirement to standardize the characteristics and mode of operation of visual display facilities supplementing the printer of a telex machine to facilitate local text preparation and editing? If so, to what extent should international standardization be sought?

Question 3/VIII – The *not-ready condition in telex terminal equipment*

(Geneva, 1976)

(interests Study Groups I and X)

considering

a) that one of the characteristics of the telex service is the continuous ready-to-receive condition;

b) that existing equipment already provides some features to support the aim of improving the service;

c) that with the introduction of new equipment more possibilities might be offered,

the action to be taken in each of the following cases should be studied with a view to modification of Recommendation S.9 :

1. maintenance of the terminal equipment, e.g. replacement of the ribbon or paper;
2. end of printing paper;
3. end of capacity of other storage media;
4. other failures, e.g. of the power supply.

Note. – The study of this Question should take into account the terminal's condition, i.e. in local operation, idle, etc., when the failure is detected.

Question 4/VIII – Automated calling and clearing for teleprinters

(Geneva, 1976)

(see also Question 10/VIII; interests Study Group X)

What means should be provided in start-stop teleprinters to automate further their operation in the international telex network?

The following particular aspects should be studied:

1. With automatic cleardown of the connection after automatic transmission from an unattended teleprinter, what length of time should be allowed between the end of the tape transmission and clearing by the calling teleprinter for the reception and printing of the called subscriber's answer-back code?

2. To simplify call repetition in the case of an unsuccessful call attempt, it might be useful to store the selection information for further attempts. In which case:

a) how many digits or selection characters must be stored?

b) what, if any, is the minimum waiting time between two selection attempts?

c) what should the maximum number of call attempts be?

d) when and how should the selection information be erased?

e) should the stored selection information be printed (or displayed) for each repeated attempt?

Question 5/VIII – Standardization of keyboard facilities for telex terminals

(Geneva, 1976)

(to be studied in collaboration with Study Group I – Question 13/I)

Considering the new operating facilities made possible by the evolving technology used in new-generation teleprinters, the following points should be studied:

1. Technical arrangements for and operating repercussions from automatic insertion of control characters (carriage-return, line-feed, letter-shift and figure-shift);

2. Simultaneous *local* and *on-line* use of a terminal.

Question 6/VIII – Formatting of telex messages

(Geneva, 1976)

(interests Study Group I)

Considering that the varying length of telex messages results in different lengths on the printed paper, leading to inconvenience in handling, the possibility of formatting messages should be studied.

The following questions are relevant:

1. What paper format is most suitable for the average length of a telex message?

2. Should formatting be controlled by the calling teleprinter or by the called and/or calling teleprinter in the local mode?

3. How should the teleprinter react in the event of an incoming call when additional time is required in the local mode to comply with the format (filling-up with lines) after clearing the previous connection?

Question 7/VIII – Speed and code conversion

(Geneva, 1976)

1. What rules should be recommended for conversion between International Telegraph Alphabet No. 2 and International Alphabet No. 5? (To be studied in cooperation with ISO.)

2. Is there a requirement for terminal equipment to provide for code and speed conversion between ITA No. 2 and IA No. 5? (This point is to be studied with a view to similar studies in Study Group VII on network facilities.)

3. If inclusion of such a facility into CCITT recommended technical equipment is required, what would be the mode of operation? In particular, what would be the end-to-end control procedures (e.g. remote character rate control of the faster machine)?

Question 8/VIII – Text communication service

(Geneva, 1976)

(to be studied in collaboration with Study Group I – Question 8/I)

Considering that there is an increasing interest in a new text communication service, which – in addition to the existing telex service – would offer more sophisticated features combining both certain office typewriter facilities including editing functions and transmission functions to remote stations via the public switched networks, the following aspects should be studied in particular:

1. technical characteristics of the terminal equipment; CCITT Recommendation S.30 should be taken as a basis for specifying the minimum requirements;
2. local mode operation without rejection of incoming calls;
3. interworking with the telex network.

Question 9/VIII – Standardization of data terminal equipment

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

What standards should be set for the characteristics of data terminal equipment, working at standardized rates above 50 bauds with International Alphabet No. 5, used by Administrations and recognized private operating agencies for services that they provide?

Question 10/VIII * – Automatic originating and answering of calls in the telex network

*(continuation of Question 1/A point F, Geneva, 1964; amended at Mar del Plata, 1968, transferred to Study Group X at Geneva, 1972, amended at Geneva, 1976 – see Question 1/X * – Study Group X coordinating)*

Apart form the case standardized in the existing Recommendation S.16 *(Automatic calling and/or answering on the telex network)* the following additional cases should be examined:

1. keyboard selection;
2. a simpler interface;
3. action to be taken on the receipt of each type of service signal.

QUESTIONS CONCERNING TELEGRAPH TRANSMISSION ENTRUSTED TO STUDY GROUP IX FOR THE PERIOD 1977-1980

Chairman: Mr. R.A. Brown (Australia)
Vice-Chairman: Mr. B. Kubin (Czechoslovakia)

List of Questions

Note. – An asterisk (*) indicates an urgent Question.

Question No.	Title
2/IX	Reduction of transmission levels in FMVFT systems
3/IX	Reliability of telegraph transmission
4/IX	Routing of FMVFT systems on PCM telephone-type circuits
6/IX	Transmission plans
7/IX	Revision of Recommendations
8/IX	Revision of the maintenance organization for international telegraph circuits and networks
9/IX	Maritime telegraph transmission standards
10/IX	Automatic identification and removal of faulty telegraph-type international circuits from service
11/IX	Definitions concerning telegraph transmission quality
13/IX	A new short test message
15/IX	Low-level telegraph transmission on subscriber lines
22/IX	Automatic maintenance tests of telegraph circuits
24/IX *	Code and speed dependent TDM systems
28/IX	Sudden phase changes
31/IX *	Code and speed independent TDM systems

Question 2/IX – Reduction of transmission levels in FMVFT systems

(Geneva, 1972; amended at Geneva, 1976)

(Joint Working Party LTG to be kept informed)

1. Noting that it is desirable, would it be possible to reduce the power level on bearer circuits for voice-frequency telegraphy to prevent overloading of carrier systems because of the increasing demand for non-telephone circuits to be routed over these systems?

2. Noting that a number of Administrations have already introduced reduced power levels for FMVFT (frequency-modulated voice-frequency telegraph) systems in their national networks and in certain international relations, what power levels could be recommended instead of those indicated in Recommendations R.35, R.37, R.38 A and R.38 B?

Notes

A. Field tests should be carried out, particularly on long-haul circuits, taking the following into account:

1) a reduction of 1.5, 3, 4.5 and 6 dB;

2) the following aspects, which may arise from such reductions:

- increase of inherent start-stop distortion;
- increase of inherent isochronous distortion;
- increase in the number of transitions exceeding the limit of 8% start-stop distortion in a single 50-baud channel;
- increase of bit-error rate;
- increase of character-error rate.

B. It is desirable to indicate all relevant circumstances of the performed tests, e.g.:

- noise in pW/km of the bearer circuit;
- unweighted noise voltage;
- weighted noise voltage;
- impulsive noise rate during a 15-minute interval at thresholds of −30, −33 and −36 dBm0 with a dead-time of 125 ms;
- routing, composition and length of the circuit;
- number and kinds of VFT systems and other non-speech systems in the primary group involved.

C. All measurements should be carried out during busy hours.

D. Reference should be made to the Annexes to Question 2/IX in the *Green Book* (1972) and to Figure 4/H.12.

Question 3/IX – Reliability of telegraph transmission

(Geneva, 1976)

What overall reliability and availability objectives should be established for telegraph transmission in the international telecommunication network?

1. The reliability and availability of the following types of items should be considered:

a) a telegraph channel (e.g. in a VFT or TDM system);

b) a telegraph circuit forming part of a switched network;

c) a point-to-point (leased) telegraph circuit without local ends and their terminations;

d) a complete connection in a switched network;

e) a complete point-to-point connection.

Figures 1 and 2 define these items. Figure 1 applies to the case of conventional switching systems where telegraph signals are repeated when entering an exchange and are repeated again when leaving it. For other cases Figure 1 will have to be modified.

2. Conditions to be considered for the definitions of reliability and availability of these items are for example:

a) the degree of inherent isochronous distortion not surpassing a certain limit [applies to 1 *a)* above];

b) the degree of inherent start-stop distortion not surpassing a certain limit [applies to 1 *b)* and 1 *c)* above];

c) modulation and character rates involved in transmission not surpassing limits given by tolerances in relevant Recommendations [applies to 1*a)*, 1 *b)* and 1 *c)* if code-dependent transmission is involved and to 1 *d)* and 1 *e)* in envery case];

d) the bit error rate not surpassing a certain limit [applies to items 1 *a)*, 1 *b)* and 1 *c)* above];

e) the character error rate not surpassing a certain limit [applies to points 1 *a)*, 1 *b)* and 1 *c)* above if code-dependent transmission is involved and to points 1 *a)*, and 1 *e)* in every case].

Note. – The conditions given under 2 *a)*, 2 *b)*, 2 *c)*, 2 *d)* and 2 *e)* have been drafted to suit probabilistic definitions of reliability and availability treated under Question 2/C.

3. Durations of unfavourable conditions beyond the limits under 2. should be assessed for defining the borderline between errors, transmission interruptions and service interruptions. Note should be taken of the occurrence of realignment periods in TDM systems.

4. A method of counting error bursts should be proposed, possibly based upon an investigation of their statistical characteristics.

5. A distinction should be made between reliability objectives for the design of new equipment and systems and the availability and reliability of the service provided to customers.

6. The study should take account of all the modulation rates for which Study Group IX is responsible.

7. The study should take account of the introduction of new multiplexing techniques.

Note. – Study of this Question is to be carried out by Study Group IX, but progress should be coordinated with Joint Special Study Group CMBD (refer Question 2/CMBD) for aspects affecting the overall telecommunication network, with Study Group I for aspects affecting operations and tarrifs, and with Study Groups VII and X for data and telegraph switching aspects respectively.

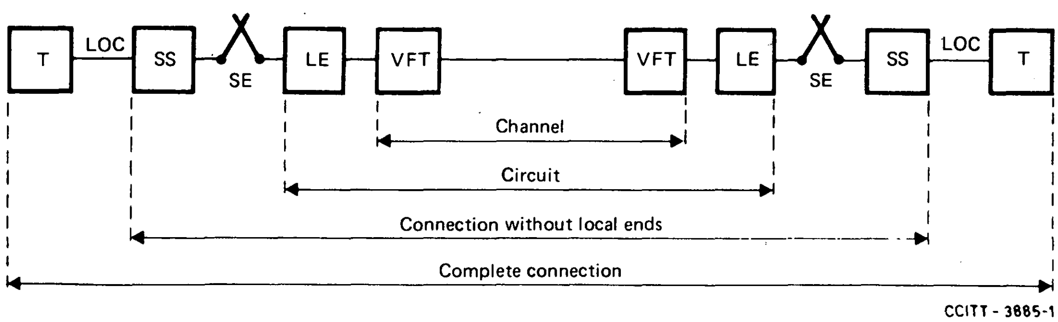
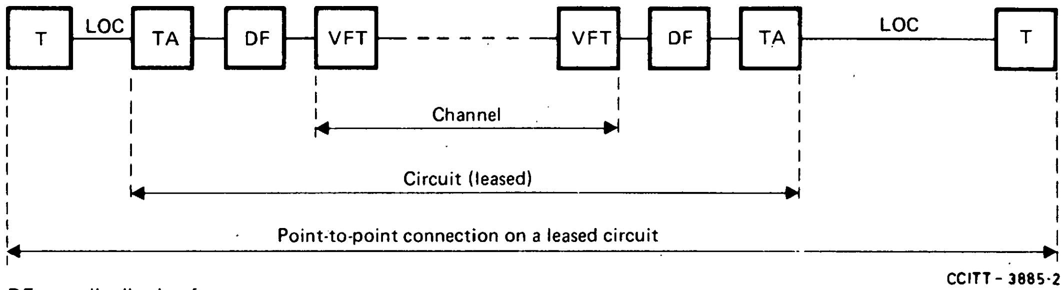


FIGURE 1 – **Connection in a switched network** (example)



DF = distribution frame
LE = line equipment
LOC = local end
SE = switching equipment
SS = subscriber's set
T = termination of local end
TA = terminal adapter
VFT = voice-frequency telegraph equipment

Note. – The terms used in these figures need to be defined.

FIGURE 2 – **Point-to-point connection on a leased circuit**

Question 4/IX – Routing of FMVFT systems on PCM telephone-type circuits

(Geneva, 1972; part of former Question 31/IX; amended at Geneva, 1976)

When PCM (pulse code modulation) channels are used as bearers for FMVFT (frequency-modulated voice-frequency telegraph) links, what is the increase in telegraph distortion in relation to the transmission level and the number of tandem-connected PCM channels?

Question 6/IX – Transmission plans

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

1. Study of transmission plans of networks composed of standard VFT (voice-frequency telegraph) channels and/or TDM (time division multiplex) channels of various types, which are operated at their nominal modulation rate.

2. Study of the limits of isochronous and start-stop distortion to be applied in planning international switched and point-to-point telegraph type communications at modulation rates up to and including 300 bauds.

3. Study of distortion as a function of modulation rate for VFT channels and the transmission plan for networks composed, for example, of

a) 50-baud VFT channels to Recommendations R.31 and R.35, operated at 75 bauds, and

b) 200-baud VFT channels to Recommendation 38 A, operated at 300 bauds.

4. Study of hypothetical reference connections (HRCs) for anisochronous public data networks convered by user classes of service 1 and 2 in Recommendation X.1.

a) What configuration(s) of transmission channels and switching equipment shoulb be adopted for the HRC(s)?

b) In addition to determining limits for isochronous and start-stop distortion, what other parameters (which may have a bearing on transmission, switching and/or signalling aspects) should be included in the HRC(s) for each of the user classes of service?

c) In relation to each parameter determined to be required in *b)* above, what limits should be applied to particular parameters within sections of an HRC or between international gateway centres?

Note. – See also Question 10/X *(Signal transfer delay in the telex network).*

5. Distortion measurements should be made in accordance with Recommendation R.51 or S.33 with suitable modulation rates. A particular point for study should be the effect of inter-channel interference.

Question 7/IX – Revision of Recommendations

(Geneva, 1976)

Study of possible amendments to the Recommendations within the purview of Study Group IX.

Question 8/IX – Revision of the maintenance organization for international telegraph circuits and networks

(Geneva, 1976)

[to be studied in collaboration with Study Group X (Question 9/X); Study Group IX coordinating]

Bearing in mind the increasing numbers and types of transmission channels employed to provide automatic telegraph and data services operating on a start-stop basis, is there a need to revise the telegraph maintenance organizations described in Recommendations R.71 and R.90?

In particular the revised maintenance organization for telephone-type international circuits described in Recommendations M.70 and M.700 may serve as a guide to consider what changes if any are desired to the existing maintenance organizations for the equivalent telegraph-type international circuits and services.

Question 9/IX – Maritime telegraph transmission standards

(Geneva, 1976)

What telegraph transmission standards should be met to permit interconnection with the fixed telegraph and data networks of start-stop telegraph circuits operating at modulation rates up to and including 300 bauds in the maritime mobile service (over HF or satellite links)? Possible points for study include:

1. tolerable distortion limits and error rates;
2. transmission aspects of signalling requirements;
3. maintenance procedures.

Note. – Recommendation Mar2 – 19 of the World Maritime Administrative Radio Conference (Geneva 1974) refers. See also Questions 7/I and 4/X.

Question 10/IX – Automatic identification and removal of faulty telegraph-type international circuits form service

(Geneva, 1976)

[to be studied in collaboration with Study Group X (Question 9/X); Study Group IX coordinating]

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

Note. – Useful background relating to consideration of this subject in the telephony service areas can be found in Recommendation G.732 (PCM multiplex, fault conditions) and the Annexes to Question 5/XV.

Question 11/IX – Definitions concerning telegraph transmission quality

(New Delhi, 1960; amended at Geneva, 1972 and 1976)

Revision of definitions relating to telegraph transmission:

1. to make them clearer and more coherent;
2. to render them applicable to higher speed start-stop transmissions;
3. to take account of the terms referred to Study Group IX by other Study Groups;
4. review of definitions for terms used in the study of transmission plans and also different types of connections considered in the study of reliability and availability.

Question 13/IX – A new short test message

(Geneva, 1976)

What would be the most suitable format of a short repetetive test message for conducting routing distortion measurements on circuits that include code dependent (International Telegraph Alphabet No. 2) and code transparent channels (e.g. TDM and VFT) in tandem?

Question 15/IX – Low-level telegraph transmission on subscriber lines

(Geneva, 1976)

Considerations

a) The commonly used high-level telegraph signalling with single current and double current frequently causes impulse noise in adjacent pairs. Low-level signalling with modems would substantially reduce this noise level. Further, the power consumption of the line drivers in the exchange would be decreased.

b) Several countries have shown interest in low-level signalling for telex subscriber lines. Different investigations have shown that frequency-shift keying is a suitable modulation method. Other methods may be considered.

Since there is no standardization of frequency-shift keying for this purpose, different frequencies have already been chosen by various Administrations. To prevent a large variety of standards in different countries a CCITT Recommendation would be very useful.

Question 22/IX – Automatic maintenance tests of telegraph circuits

(New Delhi, 1960; amended at Mar del Plata, 1968 and Geneva, 1972 and 1976)

1. Possible amendments to Recommendations R.79 and R.79 *bis* in the light of practical experience.
2. Expansion of Table 1 in Recommendation R.79 *bis* to take account of the introduction of:

a) TDM equipment conforming to Recommendation R.101 by themselves or in tandem with code-transparent channels (VFT or TDM) operating at 50 bauds;

b) stored-programme controlled switching equipment.

Note. – Study Group X is to be consulted on any switching aspects.

Question 24/IX * – Code and speed dependent TDM systems

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

Further development of Recommendation R.101, for example as regards:

1. the transmission of supervisory and control information relating to higher-speed traffic channels;
2. system control and alarms;
3. channel numbering schemes;
4. the accommodation of higher speeds in the system identified as Alternative A;
5. range of standard interchange circuits already defined by other Study Groups to be employed between the TDM (time division multiplex) system and data modems or other digital multiplex systems.

Question 28/IX – Sudden phase changes

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

(interests Study Group IV – see Question 4/IV)

1. What magnitude of phase change could have a noticeable influence on telegraph distortion?
2. What is the interrelation between sudden phase changes and the resulting error rate?

Note. – Study Group IV is studying the magnitude of phase changes that occur. Study Group IX will be informed of the results of the study.

Questions 31/IX * – Code and speed independent TDM systems

(Geneva 1972; formed from parts of former Questions 30/IX and 31/IX, amended at Geneva, 1976)

1. Further development of Recommendation R.111, in particular as regards:

a) time delays (1.3 of the Recommendation);

b) use of the 15th service bit (1.3 of the Recommendation);

c) standardization of the electrical characteristics of the interchange circuits (1.9 of the Recommendation).

2. Evaluation of the total distortion due to sampling and other influences.
3. Channel numbering scheme.
4. Evaluation of the time to recover synchronism in the encoder and decoder.

QUESTIONS CONCERNING TELEGRAPH SWITCHING ENTRUSTED TO STUDY GROUP X FOR THE PERIOD 1977-1980

Chairman: Mr. E.E. Daniels (United Kingdom)

Vice-Chairmen: Mr. P. Daude (France)
Mr. M. Matsubara (Japan)

List of Questions

Note. – An asterisk (*) indicates an urgent Question.

Question No.	Title
1/X *	Automatic originating and answering of calls in the telex network
2/X	Further standardization of telex and gentex signalling in accordance with Recommendation U.1 (type A and type B) and Recommendation U.20
3/X *	Terminal and transit control signalling system for telex and similar services in accordance with Recommendation U.12 (type D)
4/X	Interconnection of maritime satellite communication services and other mobile services with the international telex network
5/X *	New services and facilities for telex
6/X	Use of data networks in the international telex service
7/X	Revision of Recommendations
9/X	Revision of the maintenance organization for international telegraph circuits and networks
10/X	Signal transfer delay in the telex network
12/X	Automatic identification and removal of faulty telegraph-type international circuits from service
13/X	Integration of the telex and gentex networks with other networks that use common channel signalling

Question 1/X * – Automatic originating and answering of calls in the telex network

(Continuation of Question 1/A, point F, Geneva, 1964; amended at Mar del Plata, 1968, transferred to Study Group X at Geneva, 1972, amended at Geneva, 1976)

(to be studied in collaboration with Study Group VIII – see Question 10/VIII – Study Group X coordinating)

Apart from the case standardized in the existing Recommendation S.16 *(Automatic calling and/or answering on the telex network)*, the following additional cases should be examined:

1. keyboard selection;
2. a simpler interface;
3. action to be taken on the receipt of each type of service signal.

Question 2/X – Further standardization of telex and gentex signalling in accordance with Recommendation U.1 (type A and type B) and Recommendation U.20

(Geneva, 1972; amended at Geneva, 1976)

(also concerns Study Group I)

Points to be stressed in the study:

1. all aspects of transit working;
2. automatic restoration of service on the clearance of a fault that has caused the circuit to be made unavailable for outgoing traffic;
3. further standardization of printed service signals.

Question 3/X * – Terminal and transit control signalling system for telex and similar services in accordance with Recommendation U.12 (type D)

(Geneva, 1972; amended at Geneva, 1976)

In Recommendation U.12 itself, several points for further study are mentioned. These are included in the following, which should be stressed in the study:

1. transit working, in particular interworking with type A, B and C signalling systems;
2. calling or called line identifications;
3. action to be taken if a parity error is detected (see 2.17 of Recommendation U.12). Different actions may be required depending on the stage in the setting-up process or on the error's appearance on the forward or backward path;
4. allocation of reserve positions in the tables in Recommendation U.12;
5. allocation of user classes (Table 3/U.12);
6. application of closed user groups (Table 5/U.12);
7. allocation of service signals (Table 7A/U.12).

Note 1. – In the study of this Question, possible amendments by Study Group VII of Recommendations X.70 and X.71 should be taken into account in order to keep Recommendation U.12 in line with Recommendations X.70 and X.71 as far as possible.

Note 2. – Study of 2., 5., 6. and 7. above also interests Study Group I.

Question 4/X – Interconnection of maritime satellite communication services and other mobile services with the international telex network

(Geneva, 1976)

(to be studied in conjunction with Study Groups I and IX; see Questions 7/I and 9/IX)

Considering

a) Recommendation Mar2-19 of the World Maritime Administrative Radio Conference (Geneva 1974);

b) that several international organizations are considering maritime satellite communication systems for application on a worldwide basis and capable of carrying, inter alia, a telex service;

c) that such a service would be required to interwork with the international telex service and be correlated with, for example, the switching, signalling and numbering criteria of the international telex service,

what new Recommendations, if any, on network configuration, signalling and routing of telex calls are required and what additions and/or modifications to existing Recommendations are needed to provide for interconnection of the maritime satellite communication services and other mobile services with the international telex network?

Question 5/X * – New services and facilities for telex

(Geneva, 1972; amended at Geneva, 1976)

(to be studied in conjunction with Study Group I; see Question 12/I)

What new services and facilities are technically suitable for provision in the telex network and what technical conditions would need to be standardized concerning these services and facilities?

Questions 6/X – Use of data networks in the international telex service

(Geneva, 1976)

(to be studied in conjunction with Study Group VII, see Question 6/VII)

1. With the emergence of Recommendations for synchronous data networks, the possibility of providing the telex service over such a network is envisaged by some countries. In view of this, study should be made of the problems involved, particularly the signalling between the national data networks concerned.

2. Different methods of providing the telex service may be used in the future, for example, by conventional telex or public data networks. There are many possibilities, including the following, to be taken into account when studying the interworking problems that arise.

a) New public data networks in different countries may be based on synchronous or anisochronous procedures.

b) In some countries these networks will carry the telex service as well as data transmission services.

c) In most cases there will be a transitional period during which the telex service on a new public data network will be required to coexist with telex on an existing network.

d) New "defined" telex services may be introduced at a higher signalling rate than 50 bit/s with the possibility of interworking.

e) International telex gateway centres for any country may be part of an existing telex network or a public data network or in both during a transitional period.

f) International transit facilities for telex may be required on either public data networks or existing telex networks.

Question 7/X – Revision of Recommendations

(Geneva, 1976)

1. Study of possible amendments to the Recommendations within the purview of Study Group X.

2. There is a need for an overall review of the Series U Recommendations to take proper account of modern transmission and switching developments and to reappraise the presently recommended tolerances for the various signalling systems (both individually and in combination).

3. Any minor refinements to type C signalling and automatic maintenance might also be considered under this Question.

Question 9/X – Revision of the maintenance organization for international telegraph circuits and networks

(Geneva, 1976)

[to be studied in collaboration with Study Group IX (Question 8/IX); Study Group IX coordinating]

Bearing in mind the increasing complexity of the international telegraph network, is there a need to revise the telegraph maintenance organizations described in Recommendations R.71 and R.90?

Question 10/X – Signal transfer delay in the telex network

(Geneva, 1972; amended at Geneva, 1976)

Considering

a) that new exchanges based upon regenerative switching techniques are being introduced into the telex network;

b) that the transfer delay for transmission through an exchange using space switches is negligible and that the same delay of a frequency-division multiplex system with characteristics per Recommendation R.35 is typically in the range 22 to 30 milliseconds, depending on the design of the equipment; the variation from one channel to another in a particular design being approximately 2 milliseconds;

c) that, by comparison, the transfer delay associated with each time-division switch and with each time-division multiplex equipment in the telex system is of the order of 170 milliseconds for character-interleaved operation and 60 milliseconds with element-interleaved operation;

d) that the use of time-division equipment and systems in the telex network will probably increase in the future, thereby introducing significant additional transfer delays, to the extent that these may equal or exceed the component of overall path delay associated with operation via a telecommunications satellite;

e) that the overall transfer delay can be minimized by using interleaved elements rather than interleaved characters, by optimizing the design of the switching and multiplexing equipment and by coordination in the design and operation of time-division switches and multiplexing systems wherever they happen to interface with one another;

f) that Study Group IX is considering hypothetical reference connections for telex and other applications under Question 6/IX,

what should be the overall maximum delay for the hypothetical reference connection for the international telex network?

Question 12/X – Automatic identification and removal of faulty telegraph-type international circuits from service

(Geneva, 1976)

[to be studied in conjunction with Study Group IX (Question 10/IX); Study Group IX coordinating]

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

Question 13/X – Integration of the telex and gentex networks with other networks that use common channel signalling

(Geneva, 1976)

(to be studied in conjunction with Study Group VII; see Question 12/VII)

What signalling and switching requirements need to be specified for the telex and gentex networks prior to the inclusion of the services provided by these networks in integrated digital networks?

A point to be stressed is the user part aspect of specifications for common channel signalling systems.

Note. – Study Group X has agreed that responsibility for the inclusion of the signalling and switching requirements for the telex and gentex networks in integrated digital networks may be undertaken by Study Group VII, along with the requirements for data, following definition of the telex and gentex requirements by Study Group X.

QUESTIONS CONCERNING FACSIMILE TELEGRAPH TRANSMISSION AND EQUIPMENT ENTRUSTED TO STUDY GROUP XIV FOR THE PERIOD 1977-1980

Chairman: Mr. M. Blanc (France)

Vice-Chairman: Mr. W. Winogradov (Poland)

List of Questions

Question No.	Title	Remarks
1/XIV	Definitions for facsimile telegraphy	
2/XIV	Digital facsimile equipment	
3/XIV	Analogue facsimile equipment	
4/XIV	Standardized test chart(s) for facsimile transmissions	
5/XIV	Permissible power levels in facsimile transmission over telephone-type circuits	To be studied in conjunction with JWP/LTG; (Question 27/XV)
6/XIV	Studies concerning reliability objectives for facsimile telegraphy	To be studied in conjunction with CMBD (Question 2/CMBD)
7/XIV	Use of the public networks for facsimile telegraphy	Interests also Study Groups VII, XVII and XVIII.
8/XIV	Revision of the existing Series T Recommendations	
9/XIV	Technical implications of new facsimile services under study by Study Group I.	To be studied in conjunction with Study Group I (Question 11/I)

Question 1/XIV – Definitions for facsimile telegraphy

(Continuation of Question 10/XIV, Geneva, 1964, renumbered at Geneva, 1976)

Revision of the definitions for facsimile telegraphy in order to cover all facsimile equipment and circuits.

Question 2/XIV – Digital facsimile equipment

(Geneva, 1972, amended at Geneva, 1976)

A. *Considering* that the Study Group XIV has already agreed that Group 3 apparatus should work:

1. with a normal definition standard and an optional higher definition standard of 3.85 and 7.7 line/mm respectively in vertical direction;
2. with 1728 picture elements along the scanned line;
3. with a scanned line length of 215 mm. Other scanned line lengths may be employed in which case the scanning density should be changed to maintain the correct picture proportions;
4. with one dimensional run length encoding both in normal and high definition mode with an option for two dimensional coding;
5. with a modulation process still to be studied taking note of standardization by Study Group XVII, particularly at 2400 and 4800 bit/s.

B. Study of the following points to standardize Group 3 apparatus should be carried out:

1. definitions of redundancy reduction algorithms. For nominal and high definition modes taking into account vulnerability to and compensation of errors;
2. definitions of modems to be used;
3. compatibility with other facsimile groups.

Question 3/XIV – Analogue facsimile equipment

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

Study of points arising from the implementation of Recommendations T.2 and T.3.

1. *Points for further study in respect of Recommendation T.2*

   A general revision of Recommendation T.2 as necessary.

2. *Points for further study in respect of Recommendation T.3*

   a) A general revision of Recommendation T.3 as necessary.

   b) Means of interworking between Recommendation T.3 machines and equipments using a carrier frequency of 2048 Hz.

3. *Study of high speed machines*

   a) For use over telephone-type circuits.

   b) For use over wideband circuits.

Question 4/XIV – Standardized test chart(s) for facsimile transmissions

(Geneva, 1976)

Study is required of an extension of Recommendation T.20 to cater for document facsimile requirements. Recommendation T.20 provides a standardized test chart for checking the quality of document and picture facsimile transmission. With the increasing use of document facsimile throughout the world the present Recommendation has become inappropriate for document facsimile (Note 1). In order to become relevant to latest techniques the chart must provide for the requirements of:

– Group 1 and Group 2 machines including grey scale;

– Group 3 machines black and white (legibility tests with different kinds of characters, signs, ideographs, etc.).

If possible, design a single chart to cover all purposes.

Note 1. – An international test chart which incorporates as many scripts and ideographs as possible.

Note 2. – It is not intended to change Recommendation T.20 with regard to photograph or picture facsimile.

Question 5/XIV – Permissible power levels in facsimile transmission over telephone-type circuits

(Geneva, 1972, amended at Geneva, 1976)

(to be studied in conjunction with JWP/LTG, Question 27/XV)

Should the permissible levels for phototelegraph signals, as indicated in Recommendation T.11 (H.41), be modified?

Note. – In particular, one should consider whether it is possible to lower the level of the frequency modulated signal from –10 dBm0 to –15 dBm0. As concerns amplitude modulated phototelegraphing, the Annex to Question 5/XIV (*Green Book*, Volume VII, pages 305-307) describes test carried out by the IPTC and gives the opinion of this organization.

Question 6/XIV – Studies concerning reliability objectives for facsimile telegraphy

(Geneva, 1976)

A general study of reliability objectives is to be undertaken in conjunction with Joint Study Group CMBD (Question 2/CMBD).

Question 7/XIV – Use of the public networks for facsimile telegraphy

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

(interests also Study Groups VII, XVII and XVIII)

A. *Use of the general switched telephone network and leased telephone-type circuits*

1. Study of points arising from the implementation of Recommendations T.2 and T.3 as far as service between subscribers is concerned.

2. Study of points arising from the completion and implementation of Recommendation T30.

2.1 Completion of the binary coded system.

2.2 Implementation of the binary coded signalling system for Group 3 machines.

2.3 Study reports and tests of the implementation of Recommendation T.30.

B. *Study of points arising from the use of public data networks* (interests Study Group VII)

Taking account of the work being undertaken to standardize public data networks (Series X Recommendations) the following study points should be considered:

1. *Network and transmission considerations concerning public data networks*

1.1 Do digital document facsimile equipments have any special requirements on data networks and will the facilities provided by these networks impose any constraints on digital document facsimile equipments in respect of:

a) circuit switching;

b) packet switching;

c) leased circuits?

1.2 *Protocol*

In particular, the protocol for public data network should be considered.

1.3 *Reliability*

See Question 6/XIV.

2. *Consideration of the DTE/DCE interface to be used*

C. *High speed facsimile transmission on wideband or PCM circuits* (interests Study Groups XVII and XVIII)

1. Study of points arising from the use of PCM telephone links.
2. Study of points arising from the use of wideband analogue circuits.

Question 8/XIV – Revision of the existing Series T Recommendations

(Geneva, 1976)

Question 9/XIV – Technical implications of new facsimile services under study by Study Group I

(Geneva, 1976)

(to be studied in conjunction with Study Group I)

Which techniques are to be provided to implement new facsimile services under study by Study Group I (Question 11/I)?

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PART VI

DEFINITIONS

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DEFINITIONS

TERMS CONCERNING FACSIMILE TELEGRAPHY

The VIth Plenary Assembly of the CCITT has approved the following new and revised definitions of terms concerning facsimile telegraphy in Series 01 and 36.

Note. – For the definitions of terms in Series 01 and 36 other than those mentioned below, refer to Series 01 – *List of Definitions of Essential Telecommunication Terms* and "Series 36 – Systems of facsimile telegraphy", *Green Book*, Volume VII, pages 23-28.

1. *Series 01*

01.07 – **facsimile telegraphy** [1]

A system of telegraphy which allows the reproduction of fixed images (photographic or otherwise) in permanent form at a distance using a scanning technique. The reproduction may be in two significant states only, e.g. black and white, it may contain intermediate shades or it may be coloured.

01.07 *bis* – **telewriting** [2]

Telegraphy essentially intended for the immediate preparation at a distance of graphical documents by means of signals which represent progressively the positions of the succeeding elements of the lines to be traced on the document to be produced at the receiver.

01.08 *bis* – **document facsimile telegram** [2]

A telegram containing graphic material which would normally be transmitted by document facsimile telegraphy because it is unsuitable for transmission by alphabetic telegraphy and the use of photograph facsimile telegraphy is not necessary.

01.10 *bis* – **photograph facsimile telegram** [2]

A telegram containing continuous tonal densities which must be transmitted by photograph facsimile telegraphy because neither the use of alphabetic telegraphy nor of document facsimile telegraphy is suitable.

2. *Series 36*

36.101 – **photograph facsimile telegraphy** [1]

A system of telegraphy intended primarily for the transmission of photographs or documents containing continuous tonal densities which are reproduced as faithfully as possible.

Note. – This definition replaces both "36.101 : picture facsimile telegraphy" and "36.103 : phototelegraphy" defined in the *Green Book*, Volume VII, page 23.

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[1] Revised definition.
[2] New definition.

36.102 – **document facsimile telegraphy** [1)]

A system of telegraphy intended primarily for the transmission of documents other than photographs without guarantee of faithful restitution of the density scale.

Note. – The term "36.102 : black and white facsimile telegraphy" defined in the *Green Book*, Volume VII is replaced by this new term.

36.104 – **direct recording**

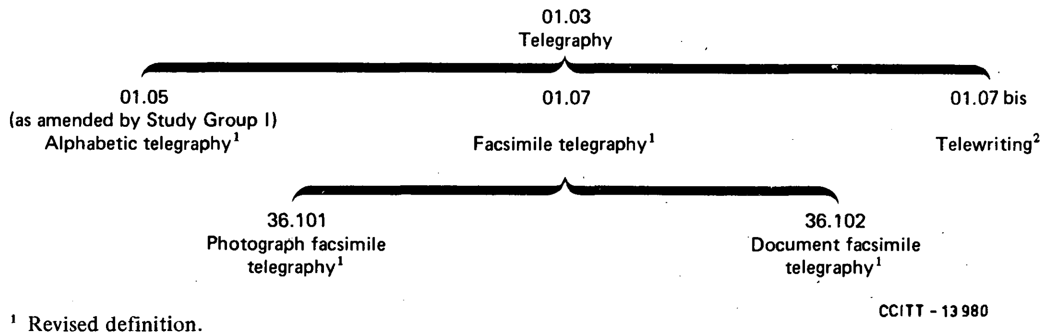
(Term and definition to be deleted.)

36.149 – **non-standard facilities equipment** [2)]

Facsimile machines for document transmission over the general switched telephone network and the public data network which have the facility that they can communicate with one another in a CCITT recommended mode (Recommendations T.2, T.3, etc.) but in addition are capable of offering modes other than the CCITT modes of operation, e.g. shorter or longer transmission time, higher or lower definition, etc.

Note. – Non-standard facilities equipment should incorporate the use of digital information to select the mode of non-standard operation for document transmission.

3. The relationship between terms is illustrated below:



[1] Revised definition.
[2] New definition.

PART VII

SUPPLEMENTS TO THE SERIES U RECOMMENDATIONS

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SUPPLEMENTS TO THE SERIES U RECOMMENDATIONS

Supplement No. 1

APPLICATION OF RECOMMENDATION U.4 – TELEX SIGNALLING ARRANGEMENTS IN THE TOKYO INTERNATIONAL EXCHANGE

(Source: Kokusai Denshin Denwa Co., Ltd. (KDD), Japan)

1. *Introduction*

1.1 In response to Recommendation U.4, this Supplement describes the signalling conditions of the CT-10 international gateway telex exchange in Tokyo, which also offers intercontinental transit switching facilities. This exchange, which employs character-switching controlled by stored programme, was put into service in 1976.

1.2 In this supplement the following notation is used :

X = the preceding switching centre;

Y = the Tokyo intercontinental transit centre;

Z = the succeeding switching centre.

2. *Selection methods*

There are two selection methods applied in centre X – selection by complete block or stage by stage – chosen according to the signalling arrangements in centre Z and the operating method for outgoing calls from subscribers in Japan. If Z provides fully-automatic or semi-automatic signalling and calls originating in Japan are handled on a fully-automatic basis, X would use selection by complete block. X would use stage-by-stage selection if Z provides manual signalling. Even where Z provides fully-automatic or semi-automatic signalling, if the outgoing calls from subscribers in Japan are handled on a semi-automatic or manual basis for some reason, X would also use stage-by-stage selection.

3. *Numbering plan*

KDD has introduced the Recommendation F.69 numbering plan for the international telex service in Japan. Thus X should send the F.69 destination code followed by a subscriber's national number for all calls, including terminal calls. This procedure is the same as is stipulated in Recommendation U.11 for type C signalling. For centres that cannot send 72 (the F.69 destination code for Japan) before the subscriber's number on calls terminating in Japan, KDD provides another method whereby the digit 9 may be used as a transit prefix followed by the F.69 destination code and the subscriber's national number for calls transiting Tokyo. KDD cannot use digit 0 for this transit prefix because 0 is used as the prefix for NTT's subscribers.

4. *Signalling*

4.1 KDD provides fully-automatic signalling for all type A and B variants stipulated in Recommendation U.1 (see timing diagrams in Figures 1 to 4). The Tokyo intercontinental transit centre has signalling conversion facilities for connecting transit calls between centres with different signalling arrangements. The characteristics of these facilities are described below.

4.2 *Fully-automatic signalling*

4.2.1 Call-confirmation and proceed-to-select signals are detected and eliminated at centre Y and hence do not go to centre X.

4.2.2 Selection signals to Z are sent by Y on request from Z. A class-of-traffic signal in the form of combination No. 1, 11 or 21 is inserted after the end-of-selection signals if required by centre Z. Where Z has a numbering plan other than F.69 for destination codes. Y converts the F.69 code sent from X into the numbers required by Z. This code conversion is limited to a range of 6 digits' addition and 6 digits' deletion.

4.2.3 Register codes sent from Z are deleted at Y and hence do not go to X.

4.2.4 The call-connected signal sent from Z is retransmitted in accordance with the type of signalling employed over the circuit from X to Y. The stop polarity period recommended as 2-3 seconds may be shortened.

4.2.5 Date and time signals, including the *Who are you?* signal where applicable, are passed to X when Z returns these signals.

4.2.6 Answer-back signals are passed on to X when Z returns the answer-back signals automatically. Otherwise a request for the answer-back is automatically made by Y.

4.2.7 Service signals in character codes are sent from Z before the call-connected signal are retransmitted to X; any additional digits or characters preceding the service code from Z are deleted. When service signals from Z do not include character codes, Y generates service signals as follows:

NC when Y recieves a busy pulse from Z during the transmission of selection signals towards Z;

OCC when Y receives a busy pulse from Z after the transmission of selection signals towards Z.

Service signals sent from Z after a call-connected signal are passed through Y to X without conversion.

4.2.8 The clearing signal from X is retransmitted to Z. However, a clear-confirmation signal is returned from Y to X without waiting for the clear-confirmation signal from Z.

4.3 *Semi-automatic signalling at Z*

4.3.1 Call-confirmation, proceed-to-select and selection signals are as mentioned in 4.2 above.

4.3.2 When Y receives a call-confirmation signal from Z, Y sends back a *preceding-call-connected* signal to X in accordance with the signalling type employed over the circuits from X to Y.

4.3.3 The proceed-to-transmit signal from Z is passed through Y to X; thereafter Y merely acts as a relay path without signal conversion.

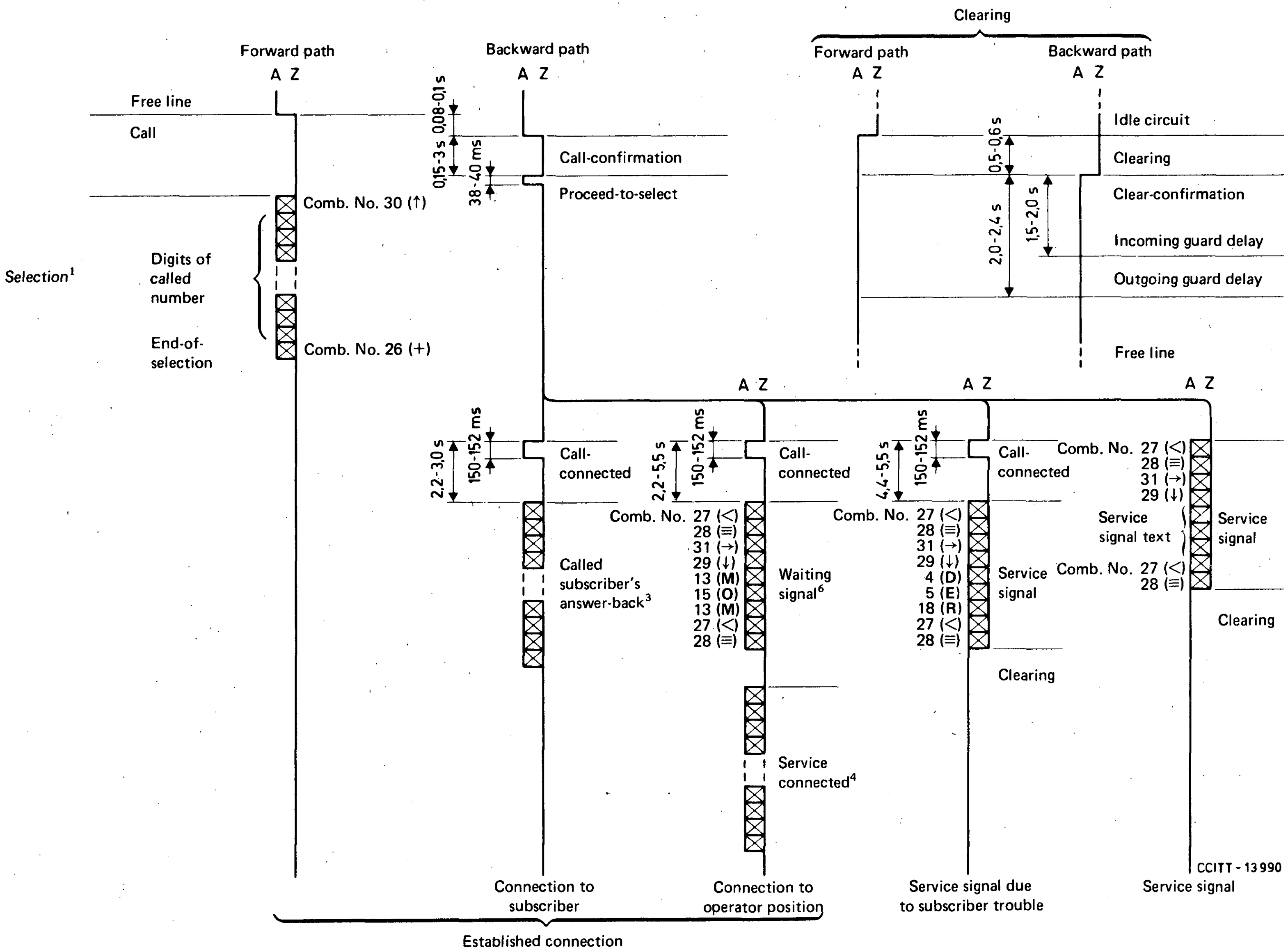

FIGURE 1 – **Automatic telex calls to Japan** (type A)

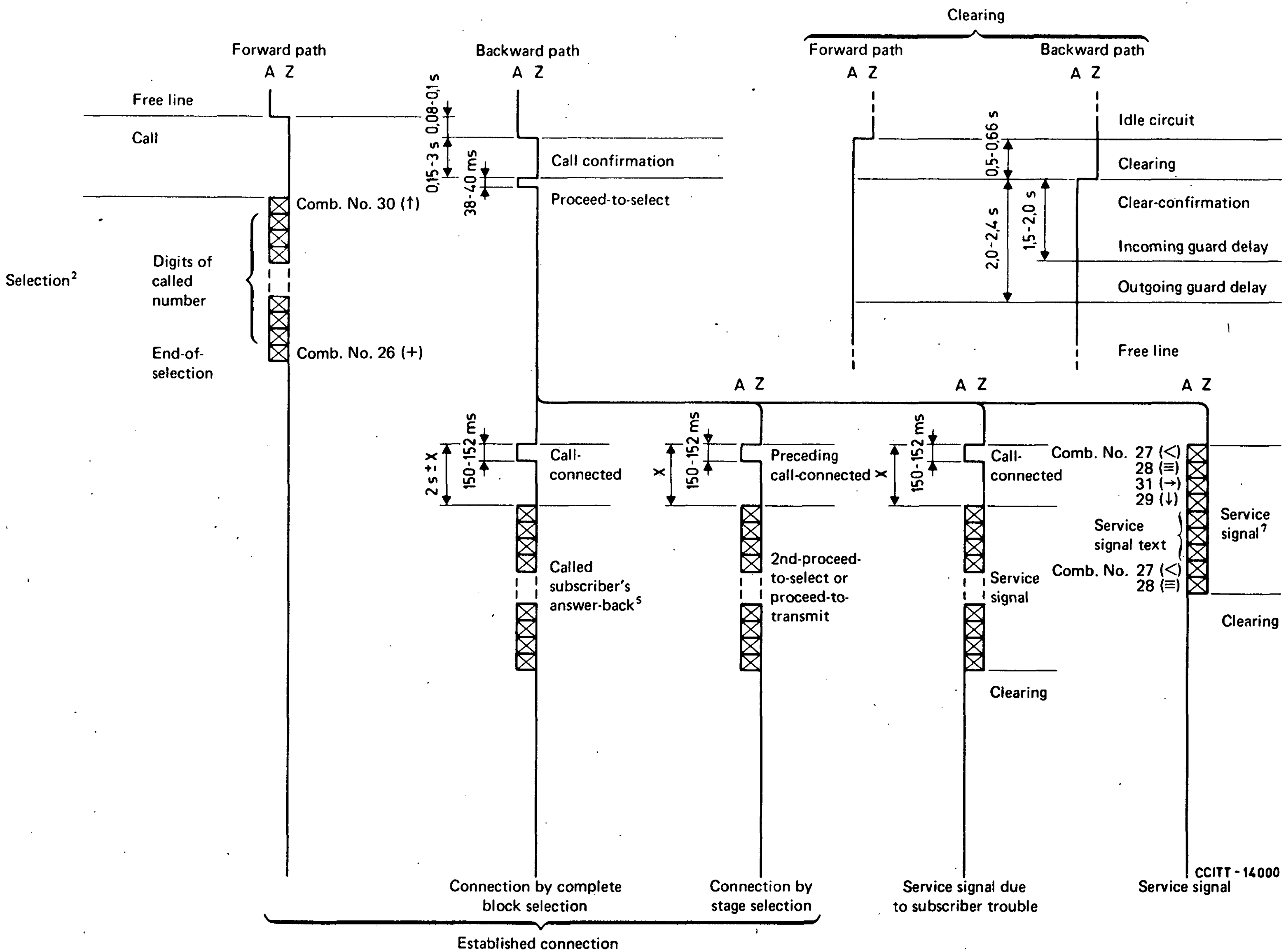

FIGURE 2 – **Automatic telex calls transiting Japan** (type A)

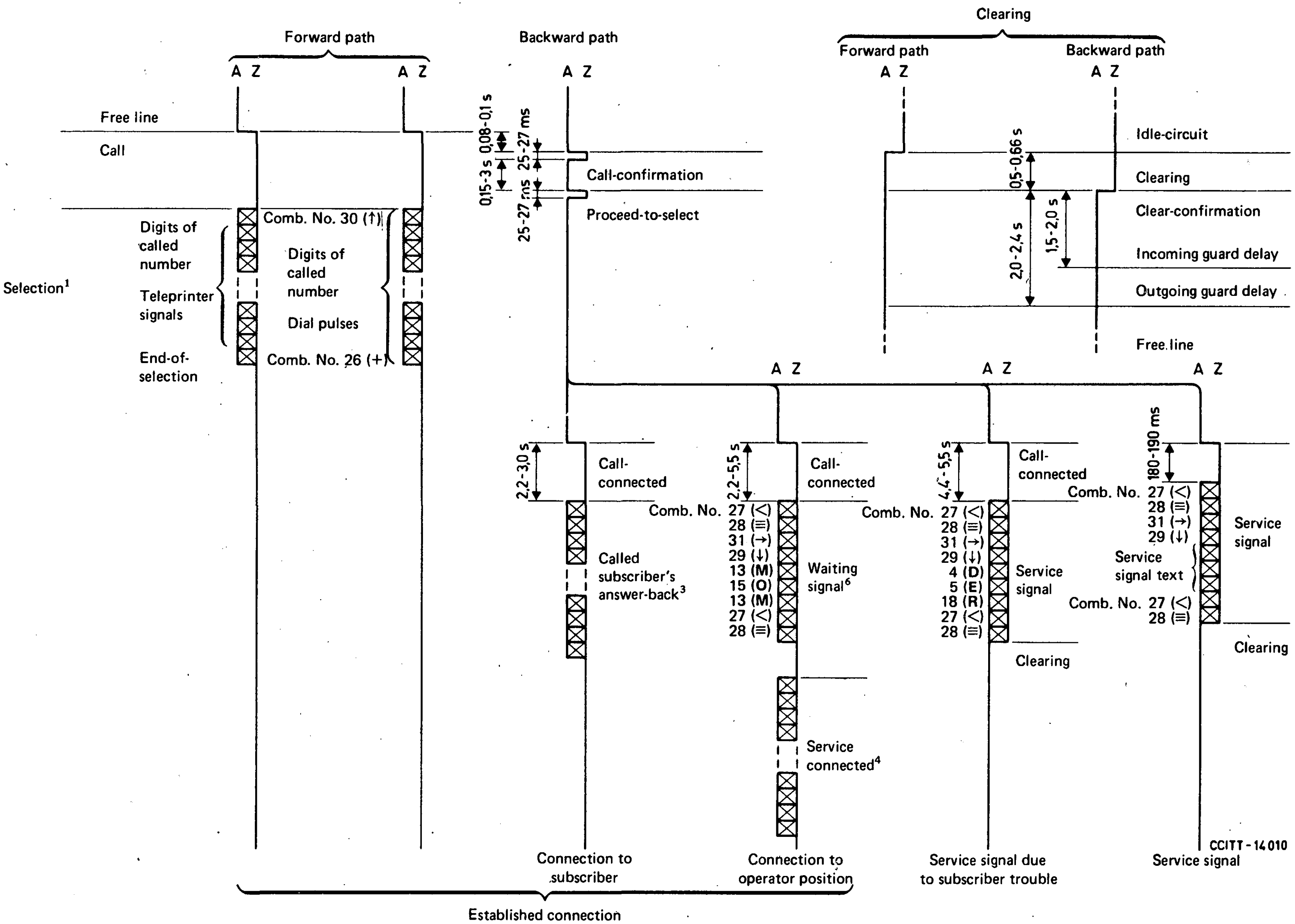

FIGURE 3 – **Automatic telex calls to Japan** (type B)

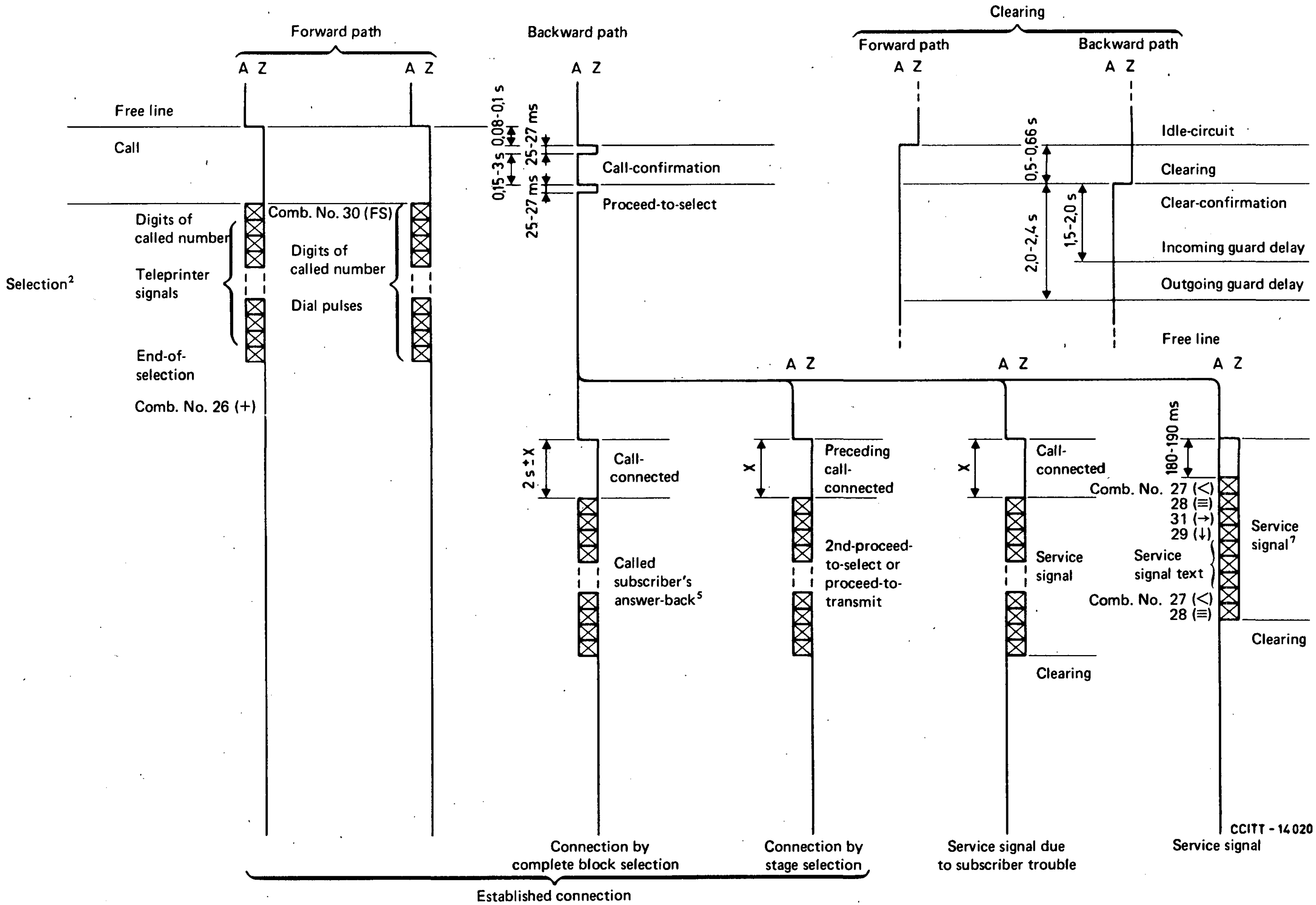

FIGURE 4 – **Automatic telex calls transiting Japan** (type B)

Notes to Figures 1-4

1. For connection to a KDD subscriber the selection signals consist of 72 and the subscriber's number. For connection to an NTT subscriber the selection signals consist of 720 and the subscriber's number. For connection to an operator's position the selection signals consist of 721xy. 72 is the destination code allocated to Japan in Recommendation F.69.

2. For complete block selection the selection signals consist of the F.69 destination code and the subscriber's number. For stage-by-stage selection the signals consist of the F.69 destination code only.

3. The composition of KDD subscribers' answer-back codes is as follows:

$$\downarrow < \equiv \text{eight letters} \rightarrow \text{J} \uparrow \text{five digits} \downarrow$$

The composition of NTT subscribers' answer-back codes is as follows:

$$\uparrow < \equiv \text{seven digits} \downarrow \text{six letters} \rightarrow \text{J} \downarrow$$

4. The composition of operator position answer-back codes is as follows:

$$\downarrow < \equiv \text{INTLX} \rightarrow \text{TOK} \rightarrow \uparrow \text{two digits} \downarrow < \equiv \downarrow$$

5. The Japanese exchange will automatically request an answer-back where the destination network does not return it automatically.

6. If the queue is empty the waiting signal will not be returned.

7. Printed service signals from the destination network are retransmitted. When the service signals sent from the destination network do not include character codes, the Japanese exchange generates and transmits service signals in character codes.

8. The value of X depends on the destination network.

9. In accordance with Recommendation F.1, the meaning of the symbols used above for functional characters in International Telegraph Alphabet No. 2 is as follows:

Combination Number	Symbol	Function
27	$<$	carriage-return
28	$\equiv$	line-feed
29	$\downarrow$	letter-shift
30	$\uparrow$	figure-shift
31	$\rightarrow$	space

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