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PUBLIC DATA NETWORKS

TRANSMISSION, SIGNALLING AND SWITCHING

TERMINAL AND TRANSIT CONTROL SIGNALLING SYSTEM FOR START - STOP SERVICES ON INTERNATIONAL CIRCUITS BETWEEN ANISOCHRONOUS DATA NETWORKS

ITU-T Recommendation X.70

(Extract from the *Blue Book*)

NOTES

1 ITU-T Recommendation X.70 was published in Fascicle VIII.3 of the *Blue Book*. This file is an extract from the *Blue Book*. While the presentation and layout of the text might be slightly different from the *Blue Book* version, the contents of the file are identical to the *Blue Book* version and copyright conditions remain unchanged (see below).

2 In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

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Recommendation X.70

TERMINAL AND TRANSIT CONTROL SIGNALLING SYSTEM FOR START - STOP SERVICES ON INTERNATIONAL CIRCUITS BETWEEN ANISOCHRONOUS DATA NETWORKS

(Geneva, 1972, amended at Geneva, 1976 and 1980; Malaga-Torremolinos, 1984)

With the appearance of public data networks in various countries it becomes necessary to establish the appropriate international control signalling schemes for interworking in order to facilitate the introduction of such networks as much as possible. The main objective of public data networks is to offer to the user a great range of data signalling rates with a minimum of restrictions, very short call set-up and clear-down times and a variety of new service facilities. These requirements can be fulfilled only by a specially conceived signalling system which caters for all foreseeable needs and which is flexible enough to provide also for new, not yet defined services.

For these reasons, the CCITT,

unanimously recommends

for interworking between anisochronous data networks the control signalling scheme given below should be used on international circuits.

Note 1 - The start-stop user classes of service are specified in Recommendation X.1.

Note 2 - The signalling for synchronous user classes of service provided on anisochronous networks is the subject of further study.

Note 3 - The signalling on links between synchronous and anisochronous networks is the subject of further study.

Scope

This Recommendation defines a decentralized terminal and transit control signalling system for start-stop services on international circuits between anisochronous data networks.

1 General switching and signalling principles

1.1 The two classes, namely user class 1 and user class 2, which are considered applicable to anisochronous types of data network require a control signalling rate of 300 bit/s and 200 bit/s respectively.

Telex service based upon 50-baud trunks does not form part of this Recommendation[1)] .

1.2 Decentralized signalling will apply, the same channel being used for control signalling and data transmission.

1.3 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.

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.

1) See Recommendation U.12 for telex and similar telegraph services.

Selection signals will be transmitted by the originating country at automatic speed in a single block.

1.4 The numbering scheme that will be applied to networks accessed by this signalling system is defined in Recommendation X.121.

The data network identification code (DNIC) (see Recommendation X.121), and network or service identification signals will be transmitted on both transit and terminal calls. However, the data country code (DCC) portion of the DNIC may be suppressed in the *selection* signals and only the network or service digit forwarded on terminal calls if requested by the incoming network.

1.5 Alternative routing will be permitted. The principle of high-usage circuits will be adopted, with overflow on to adequately provided routes between centres. Overflow on to higher speed circuits will not be permitted.

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.

1.6 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.

1.7 It is assumed that the gathering of information required for charging and accounting should normally be the responsibility of the originating Administration (see Recommendation D.10). Other arrangements for gathering information are for further study.

1.8 The grade of service to apply for the provision of circuits for links between public data networks of anisochronous type which carry traffic overflowed from other routes or from which overflow was not permitted would not be worse than one lost call in 50.

For high-usage direct links, circuits would be provided at a grade of service of not worse than one lost call in 10.

1.9 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.

1.10 The target setting-up time for the user classes of service applicable to these types of data networks will be one second.

2 Specific signalling characteristics

Notes applicable to § 2.

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.

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 from the originating terminal.

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).

Note 4 - For user class 1 the control signalling code (CSC) will employ 7-unit signalling characters with one parity bit, one start and two stop elements (see Table 8/X.70). The parity of the characters will be even and hence will be consistent with Recommendation X.4. The individual bits should be transmitted at the nominal modulation rate (300 bit/s) with the low order bit (i.e. b_1) first and completed by the parity bit (b_8).

The *end-of-selection* signal will be the International Alphabet (IA5) character 2/11(+). The reception confirmation will use IA5 character 2/10 (*). All other signals will be characters chosen from column 3 of IA5 (see Table 1/X.70). This choice helps ensure that the end of selection and reception confirmation signals are uniquely separable from the other signalling characters.

For user class 2 the CSC will employ 4-unit signalling characters with one parity bit, one start and two stop elements (see Table 8/X.70). The parity of the characters will be even with regard to elements of Z polarity. The individual bit should be transmitted at the nominal modulation rate (200 bit/s) with the low order bit (i.e. b_1) first and completed by the parity bit (b_5).

2.1 The signalling system between two data networks of anisochronous type is described in Table 1/X.70.

2.2 The incoming equipment may release the connection if the *calling* signal exceeds the specified maximum period (see Remarks column of Table 1/X.70). Start polarity will be maintained on the backward signalling path from centre Y to centre X.

2.3 The first forward path signal following the *calling* signal (class-of-traffic character) 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* signal 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 facilities for alternative routing exist and there are no free circuits on the primary route. In the event of a further head-on collision on the second attempt, no further attempt will be made and the call will be cleared down. In the case of a transit centre, the *call progress* signal No. 20 followed immediately by the *clearing* signal will be returned to the preceding centre after the *reception-confirmation* signal and the *network* or *service identification* signals.

2.4 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 characters 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 *call progress* signal No. 20 followed immediately by the *clearing* signal, will be returned to the preceding centre after the *reception-confirmation* signal and the *network* or *service identification signals.*

2.5 *Selection* signals can be divided into two parts. The first part, designated as the *network selection* signals, contains information regarding network and user requirements and may be composed of one to nine (or possibly more) characters (see Tables 2/X.70, 3/X.70, 4/X.70, 4a/X.70, 5/X.70 and 5a/X.70). The second part comprises the *address* signals (the called network terminal number which is preceded by the DNIC always in the case of a transit call and also for terminal calls unless the destination country requests omission of the data country code portion, see Tables 6/X.70 and 6a/X.70).

The *network selection* signals used in the forward direction (see also Appendix II) are further subdivided and assembled as follows (see §§ 2.5.1 to 2.5.4 below) for signalling purposes.

Note that the term "user class of service" is abbreviated in the following to "user class".

2.5.1 *First class-of-traffic character* (see Table 2/X.70)

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 (see § 2.5.3) may be used. Whether a second class-of-traffic or user class characters follow or not, will be indicated by the bits b_3 and b_4 of the first class-of-traffic character.

TABLE 1/X.70

Decentralized signalling between anisochronous data networks

Signal or function	Forward path (X towards Y)	Backward path (Y towards X)	Remarks
Free line	Start polarity (polarity A)	Start polarity (polarity A)	
Calling signal	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 should be ready to receive *selection* signals within one character period. The minimum and consequently the maximum periods will be lengthened at the request of the incoming country. (*Note* - The duration of the *calling* signal may require review in the light of false calling signals.)
Reception confirmation signal		Stop polarity followed by CSC character No. 14 (user class 2) or by IA5 character No. 2/10 (user class 1)	Stop polarity returned within three character periods after the end of receipt of the first class-of-traffic character. The return of CSC character No 14 or IA5 character No 2/10 shall be commenced 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 signals	At least one (first class-of-traffic character only) or possibly several network selection signals depending on the network requirement (see Appendix I), the digits of the DNIC of the called network, the digits of the called terminal number, and an *end-of-selection* signal		These signal are transmitted immediately after the *calling* signal without awaiting the reception at X of the *reception-confirmation* signal. The selection signals are transmitted according to the control signalling code at the appropriate data signalling rate for the user class-of-service concerned and at automatic speed in a single block which included an *end-of-selection* signal. For the user class 1 the *end-of-selection* signal will be IA5 character No 2/11 . For user class 2 the *end-of-selection* signal will be CSC character No. 11. The data country code (DCC) may be omitted on terminal calls at the request of the incoming country.

TABLE 1/X.70 *(continued)*

Signal or function	Forward path (X towards Y)	Backward path (Y towards X)	Remarks
Network or service identification signals		CSC No. 12 followed by the data network identification code (DNIC) of the network	The character CSC No. 12 and DNIC follow the *reception-confirmation* signal at automatic speed within one to two character periods. These signals must go through centre X and arrive at the originating network. In all cases, the country or network identity shall consist of four decimal digits. The value of the fourth digit should, in the case when it is not explicity defined by the numbering plan, be at the discretion of the country in question within the limits allowed by the numbering plan.
Reception-congestion signal		Stop polarity for a period of one or two characters followed by the *clearing* signal	This signal is returned within 0-5 character periodsafter the start of receipt of the *calling* signal when the selection signal cannot be received. This signal should be absorbed by centre X and not allowed to be received by a preceding exchange.
Call progress signals without clearing		CSC No. 11 followed by 2 digits (see Table 7d/X.70)	Examples would be *redirected call* or *terminal-called call progress* signal (for further details see Appendix III.)
Call connected signal		One CSC character (see Table 7/X.70)	See § 2.14 of the text and for further details see Appendix III.
Strat of transit through-connect signal (STTC)		CSC No. 15 (see Table 7/X.70)	The signal always precedes the *transit through-connect* signal.
Transit through-connect signal (TTC)		One CSC character (see Table 7b/X.70)	This signal will always be prefaced by the *start of transit through-connect* signal and will be returned preceding a *call progress* signal without clearing when this has to be sent. It will also be transmitted when the *calling* and/or *called line identification* is required (for further details see Appendix III).
Transit centres through-connected signal (TTD)	CSC No. 11 (see Table 6/X.70)		The signal will be transmitted within 40 to 120 ms after the receipt of the *transit through-connect* signal (TTC) when no calling line identification is required (for further details see Appendix III).
Called line identification (if applicable)		Combinations of the *called line identification* signals transmitted at automatic speed within 120 ms of the receipt of the TTD signal or the first character of the *calling line identification* signals	The *called line identification* signal consists of the data network or service identification code (DNIC) followed by the digits of the network terminal number and CSC No. 12. Where no identification is available, only No. 12 is sent (for further details see Appendix III).

TABLE 1/X.70 *(continued)*

Signal or function	Forward path (X towards Y)	Backward path (Y towards X)	Remarks
Calling line identification (if applicable)	Combinations of the *calling line identification* signals transmitted at automatic speed within 40 to 120 ms of receipt of the *transit through-connect* signal (TTC).		The *calling line identification* signal consists of the data network or service identification code (DNIC) followed by the digits of the network terminal number and CSC No. 12 Where no identification is available only the DNIC and CSC No. 12 is sent (for further details, see Appendix III).
Originating through-connection signal	ACK character (combination 0/6 of IA5)		For definition see § 2.14 of the text and for further details see Appendix III).
Call progress signals with clearing		CSC No. 11 followed by 2 digits (see Table 7d/ X.70) followed by the *clearing* signal	
Waiting signal	Stop polarity	Stop polarity	
Clearing signal	Inversion to start polarity in the direction of clearing. The minimum recognition time is 210 ms and the maximum time is 420 ms		The minimum period of start polarity on one signalling path which in itself ensures the complete release of the connection is 420 ms.
Clear confirmation signal	Inversion to continuous start polarity in the opposite direction after a minimum duration of 210 ms of clearing signal and a maximum duration of 490 ms		The minimum and maximum periods for the release of the international circuit by an exchange are 210 ms and 490 ms respectively.
Incoming guard delay	Period of 390-420 ms 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		A new incoming call shall not be accepted until this guard period has elapsed.
Outgoing guard delay	Period of 840 ms 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		A new outgoing, call shall not be originated until this guard period has elapsed.

TABLE 1/X.70 *(concluded)*

Signal or function	Forward path (X towards Y)	Backward path (Y towards X)	Remarks
Automatic retest signal	Stop polarity for 1-2 character periods followed by CSC No. 13 stop polarity for 4 seconds and then start polarity for a period of 56 seconds and the signal sequence is then repeated		See § 2.17 of the text.
Backward busy signal		Continuous stop polarity for a maximum period of 5 minutes	

Note - For the control signalling code (CSC) numbers mentioned, refer to Table 8/X.70.

TABLE 2/X.70

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 (see Table 4/X.70) [b]
Z	A			User class character follows (see Table 3/X.70) [b]
		A		Alternative routing not allowed [b]
		Z		Alternative routing allowed [b]
			A	Transit traffic [b]
			Z	Terminal traffic [b]
Z	Z	A	A	Retest signal [b]
Z	Z	A	Z	Reception confirmation for user class 2 only [c]
Z	Z	Z	A	Not allocated
Z	Z	Z	Z	Not allocated

a) CSC = Control signalling code (see Table 8/X.70).
For user class 1 all characters are in column 3 ($b_5 = 1$, $b_6 = 1$, $b_7 = 0$) of International Alphabet No. 5. The eight bit (b_8) is chosen to give even parity over the character.

b) First class-of-traffic character.

c) For user class 2 only. The reception confirmation signal for user class 1 will be IA5 character No. 2/10.

2.5.2 *User class character (indication of speed and code* (see Table 3/X.70))

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.

As eight user classes in Table 3/X.70 are not sufficient, a second user class character may be added by means of an escape character. 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. Whether a second class-of-traffic character follows or not will be indicated by bit b_4 of the first user class character.

TABLE 3/X.70

First user class character [a]

Combination				Condition signalled from X to Y [b]
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/X.70)
	A	A	A	Reserve
	A	A	Z	300 bit/s (user class 1)
	A	Z	A	50 bit/s (user class 2)
	A	Z	Z	100 bit/s (user class 2)
	Z	A	A	110 bit/s (user class 2)
	Z	A	Z	134.5 bit/s (user class 2)
	Z	Z	A	200 bit/s (user class 2)
	Z	Z	Z	A second user class character follows [c]

a) For user class 1 all characters are in column 3 ($b_5 = 1$, $b_6 = 1$, $b_7 = 0$) of International Alphabet No. 5. The eighth bit (b_8) is chosen to give even parity over the character.

b) The user class character may be omitted if, for example, the information can be derived from the incoming line.

c) For future extension.

2.5.3 *Second and subsequent class-of-traffic characters* (see Tables 4/X.70 and 4a/X.70)

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 indicate whether another class-of-traffic character follows or not.

TABLE 4/X.70

Second class-of-traffic character [a]

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 (see Table 4a/X.70)
	A			No closed user group sequence follows
	Z			Closed user group sequence follows (see Table 5/X.70)
		A		Called line identification not required
		Z		Called line identification required
			A Z	reserved for national use [b]

a) For user class 1 all characters are in column 3 ($b_5 = 1$, $b_6 = 1$, $b_7 = 0$) of International Alphabet No. 5. The eighth bit (b_8) is chosen to give even parity over the character.

b) On international circuits bit b_1 should be set to A polarity.

TABLE 4a/X.70

Third class-of-traffic character [a]

Combination				Condition signalled from X to Y
b_4	b_3	b_2	b_1	
A				No fourth class-of-traffic character follows
Z				Fourth class-of-traffic character follows [b]
	A			Redirection not allowed [c]
	Z			Redirection allowed [c]
		A		Not multiple address call [c]
		Z		Multiple address call [c]
			A Z	Not allocated

a) For user class 1 all characters are in column 3 ($b_5 = 1$, $b_6 = 1$, $b_7 = 0$) of International Alphabet No. 5. The eighth bit (b_8) is chosen to give even parity over the character.

b) Reserved for future needs.

c) The international use of this signal requires further study.

2.5.4 *Closed user group characters* (see Tables 5/X.70 and 5a/X.70)

These characters are only used in conjunction with the second and possibly subsequent class-of-traffic characters which may follow.

The start of closed user group (CUG) character would precede the closed user group number which would be coded into a number of hexadecimal characters up to a maximum of four (see Table 5/X.70).

TABLE 5/X.70

Start of closed user group character[a) b)]

Combination				Condition signalled from X to Y
b_4	b_3	b_2	b_1	
A				Without outgoing access
Z				With outgoing access
	A			No DNIC [c)] follows
	Z			DNIC [c)] follows
		A	A	1 } Number of hexadecimal CUG characters which follow
		A	Z	2
		Z	A	3
		Z	Z	4

a) For user class 1 all characters are in column 3 ($b_5 = 1$, $b_6 = 1$, $b_7 = 0$) of International Alphabet No. 5. The eighth bit (b_8) is chosen to give even parity over the character.

b) The start of closed user group character shall precede the DNIC of the representative user followed by the closed user group number which would be coded into a number of hexadecimal characters up to a maximum of four, as indicated. The closed user group number would be transmitted with the least significant bit of the least significant character first.

c) On international circuits, bit 3, should be set to Z polarity.

TABLE 5a/X.70

Closed user group characters [a)]

Combination				Condition signalled from X to Y	
b_4	b_3	b_2	b_1		
A	A	A	A	0	Hexadecimal closed user group character
A	A	A	Z	1	
A	A	Z	A	2	
A	A	Z	Z	3	
A	Z	A	A	4	
A	Z	A	Z	5	
A	Z	Z	A	6	
A	Z	Z	Z	7	
Z	A	A	A	8	
Z	A	A	Z	9	
Z	A	Z	A	A	
Z	A	Z	Z	B	
Z	Z	A	A	C	
Z	Z	A	Z	D	
Z	Z	Z	A	E	
Z	Z	Z	Z	F	

a) For user class 1 all characters are in column 3 ($b_5 = 1$, $b_6 = 1$, $b_7 = 0$) of International Alphabet No. 5. The eighth bit (b_8) is chosen to give even parity over the character.

2.5.5 The numerical characters used for the second part of the selection signals are shown in Table 6/X.70. When the first class-of-traffic character indicates a terminal call, the incoming country can adopt the option not to receive the data country code portion of the DNIC. The complete selection block is terminated by an *end-of-selection* signal which is different for user classes 1 and 2. They are shown in Tables 6/X.70 and 6a/X.70.

TABLE 6/X.70

Miscellaneous forward path signals[a)]

Comlbination				Conditions 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
				Digits for: – data network identification code (DNIC) – called network terminal number – calling line identification signal
Z	A	Z	A	End-of-selection signal for user class 2 only [b)] Transit centres through connected signal (TTD)
Z	A	Z	Z	End-of-calling line identification signal [c)]
Z	Z	A	A	Not allocated
Z	Z	A	Z	
Z	Z	Z	A	
Z	Z	Z	Z	

a) For user class 1 all characters are in column 3 ($b_5 = 1$, $b_6 = 1$, $b_7 = 0$) of International Alphabet No. 5. The eighth bit (b_8) is chosen to give even parity over the character.

b) For user class 2 only. The end-of-selection signal for user class 1 will be IA5-character No. 2/11.

c) This signal follows the DNIC when the calling line identification is not available. See § 2.13.

TABLE 6a/X.70

Other forward path signal

IA5-character	Condition signalled from X to Y
0/6	Originating through-connection
2/11	End-of-selection signal for user class 1
2/15	Start of extended address

2.6 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 first valid class-of-traffic character. 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 character), the incoming equipment should return the *call progress* signal No. 20 to the preceding centre, immediately followed by the *clearing* signal after the *reception-confirmation* signal and the *network* or *service identification signals.*

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 character. In this event, the *call progress* signal No. 20 is returned to the preceding centre, immediately followed by the *clearing* signal after the *reception-confirmation* signal and the *network* or *service identification signals.*

2.7 The address signal may consist of the international data number and an address extension.

The international data number may have a maximum number of 14 digits comprising the 4 digit data network identification code and a 10 digit maximum network terminal number. Alternatively the 14 digits can be considered as the 3 digit data country code followed by a national number of 11 digits maximum (see Recommendation X.121).

The possible address extension may either be included in the 14 digit international data number or may be separated from the international data number by a start-of-extension address-signal (2/15). In that case the extended address provisionally consists of up to 32 decimal digits. The network shall not be required to look at or operate on a network extension address. However some networks may look at the network address extension if they wish.

Note - The maximum length of 32 decimal digits is derived from the provisional maximum length of the OSI Network Service Access Point (NSAP) address defined in Recommendation X.213.

2.8 In the case of receipt of *the reception-congestion* signal at a transit centre, the *call progress* signal No. 61 should be returned to the preceding centre (after the *reception-confirmation* and *network* or *service identification* signals) and followed by the *clearing* signal.

2.9 The *network* or *service identification* signals shall be sent following the *reception-confirmation* signal in all cases. In all cases the country or network identity shall consist of four decimal digits. The value of the fourth digit should, in the case when it is not explicitly defined by the numbering plan, be at the discretion of the country in question within the limits allowed by the numbering plan.

If several transit networks are involved in setting up a call, the calling network will receive the network identifications one after the other. If a transit centre fails to receive the first character of the *network* or *service identification* signals within two seconds of the *reception-confirmation* signal, it will return to the preceding centre the *call progress* signal No. 20 (after the *reception-confirmation* and *network* or *service identification signals),* followed by the *clearing signal.*

The *network* or *service identification* signals could be useful for retracing the route followed by a call (for traffic statistics, international accounts, analysis of unsuccessful calls and the clearing of faults).

It is possible for a transit centre to receive backward path signals such as the *network* or *service identification signals, call connected* signal or *call progress* signals from subsequent centres, while the backward path signals originated locally are still being sent. It is necessary for the transit centre to ensure that the received signals are passed to the preceding centre without mutilations or loss.

2.10 The backward path signals indicating effective and ineffective call conditions are scheduled in Tables 7/X.70, 7a/X.70, 7b/X.70, 7c/X.70 and 7d/X.70.

TABLE 7/X.70

Miscellaneous backward path signal [a]

Combination				Condition signalled from X to Y	
b_4	b_3	b_2	b_1		
A	A	A	A	0	Digits for: – network or service identification signals – called line identification signals – call progress signals
A	A	A	Z	1	
A	A	Z	A	2	
A	A	Z	Z	3	
A	Z	A	A	4	
A	Z	A	Z	5	
A	Z	Z	A	6	
A	Z	Z	Z	7	
Z	A	A	A	8	
Z	A	A	Z	9	
Z	A	Z	A		Start of call progress signal (see Table 7d/X.70)
Z	A	Z	Z		End-of-called line identification signal [b] Start of network or service identification signal
Z	Z	A			Call connected signal
			A		Call metering
			Z		No call metering
Z	Z	Z	A		Start of transit through-connect signal (STTC)
Z	Z	Z	Z		Further backward path signal follows (see Table 7a/X.70)

a) For user class 1 all characters are in column 3 ($b_5 = 1$, $b_6 = 1$, $b_7 = 0$) of International Alphabet No. 5. The eighth bit (b_8) is chosen to give even parity over the character.

b) This signal is also used alone when the called line identification is not available.

TABLE 7a/X.70

Further miscellaneous backward path signals [a) b)]

Combination				Condition signalled from Y to X
b_4	b_3	b_2	b_1	
A Z				Reserved for national use
	A A A A Z Z Z Z	A A Z Z A A Z Z	A Z A Z A Z A Z	Not allocated

a) For user class 1 all characters are in column 3 ($b_5 = 1$, $b_6 = 1$, $b_7 = 0$) of International Alphabet No. 5. The eighth bit (b_8) is chosen to give even parity over the character.

b) These signals follow combination ZZZZ in Table 7/X.70.

TABLE 7b/X.70

Transit through-connect signals a) b)

Combination				Condition signalled from Y to X
b_4	b_3	b_2	b_1	
A	A	A	A	Not allocated
A	A	A	Z	
A	A	Z	A	
A	A	Z	Z	
A	Z	A	A	
A	Z	A	Z	
A	Z	Z	A	
A	Z	Z	Z	
Z	A	A	A	
Z	A	A	Z	
Z	A	Z	A	
Z	A	Z	Z	
Z	Z			Transit through connect signal (TTC)
		A		Calling line identification not required
		Z		Calling line identification required
			A	Call metering
			Z	No call metering

a) For user class 1 all characters are in column 3 ($b_5 = 1$, $b_6 = 1$, $b_7 = 0$) of International Alphabet No. 5. The eighth bit (b_8) chosen to give even parity over the character.

b) These signals follow the start of transit through-connect signal (STTC) in Table 7/X.70.

TABLE 7c/X.70

Other backward path signals

IA5-character	Condition signalled from Y to X
2/10	Reception-confirmation for user class 1

TABLE 7d/X.70

Call progress signals [a) g)]

Numerical code first/second digit	Category	Significance
01 02 03	Without clearing	Terminal called Redirected call Connect when free
20 21 22 23	With clearing due to subscriber - short term [b)]	Network failure [c)] Number busy d) d)
41 42 43 44 45 46 47 48 49 51 52	With clearing, due to subscriber - long term [b)]	Access barred Changed number Not obtainable Out of order Controlled not ready Uncontrolled not ready DCE power off d) Network fault in local loop Call information service Incompatible user class service
61	With clearing due to network -short term [b)]	Network congestion
71 72	With clearing, due to network -long term [b)]	Degradated service e)
81 82 83	With clearing due to DTE-network procedure	Registration/cancellation confirmed [f)] d) d)

a) For user class 1 all characters are in column 3 ($b_5 = 1$, $b_6 = 1$, $b_7 = 0$) of International Alphabet No. 5. The bit (b_8) is chosen to give even parity over the character.

b) "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.

c) At the originating exchange, this results in sending a call progress signal "no connection" to the calling customer and clearing the call.

d) These signals are normally only utilized between first centre and subscriber and are not signalled on inter-network links.

e) Only utilized within national networks.

f) Not yet included. To be studied in relation to Recommendation X.300 on network call-control procedures.

g) A *call progress* signal without clearing should precede the *called line identification* signal. A *call progress* signal with clearing could precede or follow the *called line identification signal.*

2.11 If any *call progress* signal or the *call connected* signal are not received within 30 seconds from the end of the selection, then the *call progress* signal No. 20 will be returned to the preceding centre (after the *reception-confirmation* and *network* or *service identification* signals), followed by the *clearing* signal.

2.12 If the called station is not able to receive information immediately, the return of the *call connected* signal should be delayed accordingly. This point is left for further study.

2.13 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.

If the *called line identification* has been requested but is not available, the terminating centre in this connection should send only the *end-of-line identification* signal (CSC-character No. 12). If the *calling line identification* has been requested but is not available, the originating centre in this connection should send only the data network identification code (DNIC) signals followed by the *end-of-line identification* signal (CSC-character No. 12).

2.14 The *call connected* signal confirms that the call is accepted by the called subscriber and, if applicable, the *calling line identification* has been completely received by the terminating centre and passed to the called subscriber and, when applicable, that the *called line identification* has been completely transmitted to the originating centre (see Appendix III).

The originating *through-connection* signal confirms that the *call connected* signal has been received by the originating centre and, when applicable, that a *call progress* signal without clearing has been completely received by the originating centre and passed to the calling subscriber or, when applicable, that the *called line identification* has been completely received by the originating centre and passed to the calling subscriber (see Appendix III).

The *call connected* signal is sent on the backward path by the terminating centre. The originating *through-connection* signal is sent by the originating centre both to calling and called subscribers.

The connection must be switched through in the originating centre within 20 ms after transmission of the originating *through-connection* signal (see Appendix III). This limit follows from the condition given in Recommendation X.20 for the beginning of data transmission.

The connection must be switched through in the terminating centre within 40 ms after transmission of the *call connected* signal (see Appendix III).

The connection must be switched through in the transit centres within 40 ms after transmission of the *call connected* or *transit through-connect* signal (see Appendix III).

If a transit centre has a character orientated switch, the connection may be switched through within 40 ms after transmission of the *call connected* signal for user class 2 service.

Complete network through-connection is assured when the originating *through-connection* signal is received by the data terminals.

2.15 If the terminating centre fails to receive the *transit centres through-connected* signal (TTD) or, if applicable, the first character of the *calling line identification* signals within 4 seconds after having sent the *transit through-connect* signal (TTC), it will return to the preceding centre the *call progress* signal No. 20 followed by the *clearing* signal.

2.16 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.

For incoming calls this guard period shall be 390-420 ms. A new incoming 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.

The guard period on clearing for outgoing calls should be a period of at least 840 ms. A new outgoing call shall not be originated until this guard period has elapsed.

If exchanges are able to distinguish between the different clearing conditions, shorter periods may be introduced accordingly.

2.17 The automatic *retest* signal will be initiated as indicated in § 2.4.

This signal transmitted over the forward signalling path is composed of a maximum of five successive cycles, each cycle incorporating:

- stop polarity for 1-2 character periods (see Note) followed by CSC No. 13, followed by stop polarity for a maximum period of 4 seconds;

- start polarity for a period of 56 seconds.

Note - The minimum and consequently the maximum periods will be lengthened at the request of the incoming country Y (see Remarks column of Table 1/X.70).

The circuit should be tested up to 5 times at nominal intervals of one minute and a check made to confirm the receipt of the *reception-confirmation* signal on the backward path in response to each test. If the *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 nominal intervals. If 5-minute intervals are used and the *reception-confirmation* signal has not been received at the end of this second group of tests, further 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.

If, however, during the above sequence of retests, the *reception-confirmation* signal is received, a *clearing* signal will be transmitted in 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. An Administration may, however, ignore such calls which occur during the incoming guard delay period.

The interval between the tests at the two ends of the trunk circuit should be made different by increasing the nominal interval by 20% at one end, to be sure that successive retests do not overlap at both ends. In general, the intercontinental transit centre having the higher DNIC 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.

Where an exchange has knowledge of a transmission system failure it is desirable that the *retest* signals shall not be applied to the circuits affected.

In order to avoid simultaneous seizure of too many registers at the distant centre, it is advisable that the *retest* signals, which may be sent simultaneously on various circuits subjected to this test, should be out of phase with one another.

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.

2.18 If at the receiving end, parity does not check during the establishment of the connection, provisionally the connection should be cleared down unless otherwise specified. However, the possibility of different actions remains open for further study.

TABLE 8/X.70

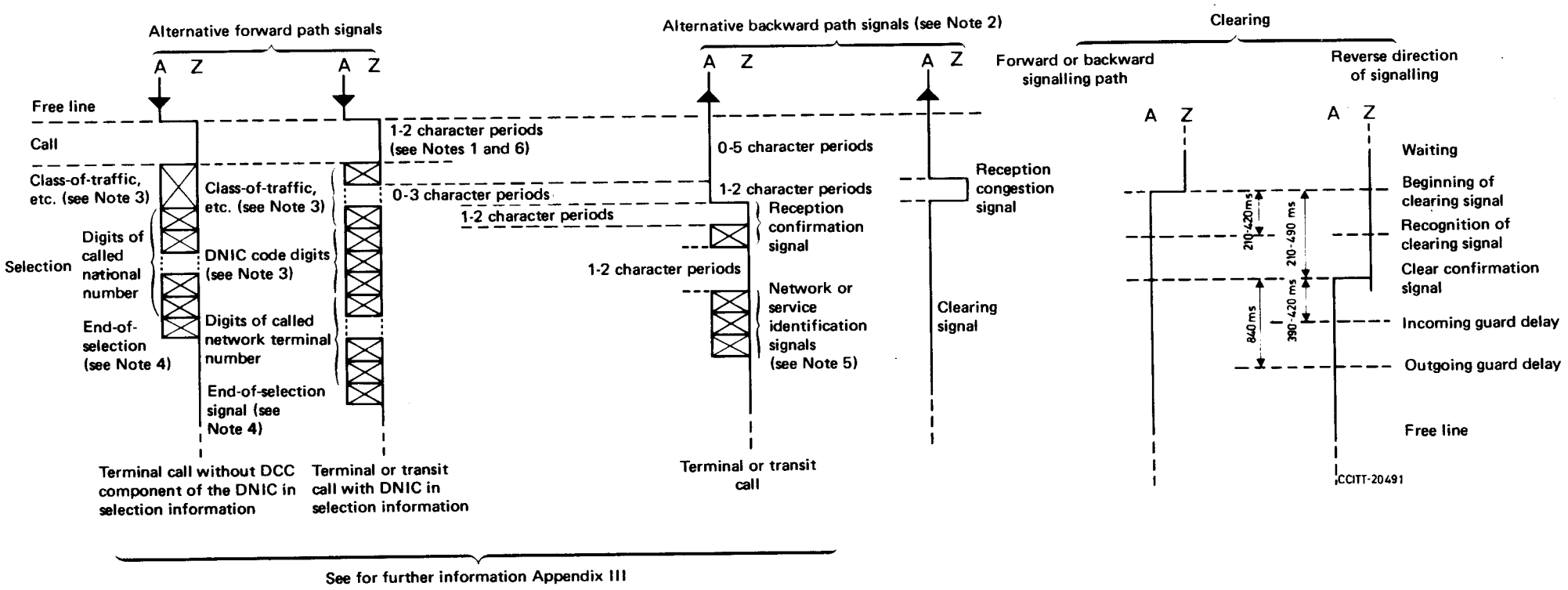
Control signalling code (CSC)

CSC character number	CSC character structure			
	b_4	b_3	b_2	b_1
1	A	A	A	A
2	A	A	A	Z
3	A	A	Z	A
4	A	A	Z	Z
5	A	Z	A	A
6	A	Z	A	Z
7	A	Z	Z	A
8	A	Z	Z	Z
9	Z	A	A	A
10	Z	A	A	Z
11	Z	A	Z	A
12	Z	A	Z	Z
13	Z	Z	A	A
14	Z	Z	A	Z
15	Z	Z	Z	A
16	Z	Z	Z	Z

Note 1 - The 7-unit code with one parity check bit, 1-unit start and 2-unit stop elements for user class 1 and the 4-unit code with 1 parity check bit, l-unit start and 2-unit stop elements for user class 2 used in this control signalling system are listed in the table. As the bits b_5, b_6 and b_7 of the 7-unit code have a permanent pattern (1,1,0) only the bits b_1, b_2, b_3 and b_4 are shown.

Note 2 - The parity bit of the signal should correspond to even parity with regard to unit elements of Z polarity. The individual bits should be transmitted at the nominal data signalling rate of 200 bit/s (user class 2) and 300 bit/s (user class 1) with the low order bit (b_1) first and completed by the parity check bit (b_5 or b_8).

Note 3 - The transmitting part of the signalling device shall send the control character at the nominal modulation rate (300 bauds for user class 1 and 200 bauds for user class 2) of ± 0,2% with a maximum degree of gross start-stop distortion of 5%. The receiving part of the signalling device shall have an effective net margin of not less than 40%.



Note 1 – Timings shown as character periods refer to the complete control character of user class (11 units at 300 bits/s) and user class 2 (8 units at 200 bit/s). Switching and propagation delays are not included.

Note 2 – *Forward path* signals may also appear in the backward path, indicating a head-on collision on both-way circuits.

Note 3 – *Network selection* signals (class-of-traffic, user class characters, etc.). See Tables 2-5/X.70. DNIC comprises 4 digits.

Note 4 – *Selection* signals will always be sent as a single block by the originating network with and *end-of-selection* signal in all cases.

Note 5 – The *network* or *service identification* signals comprise a distinctive character followed by the DNIC of the network concerned.

Note 6 – The minimum and consequently the maximum periods will be lengthened at the request of the incoming country Y.

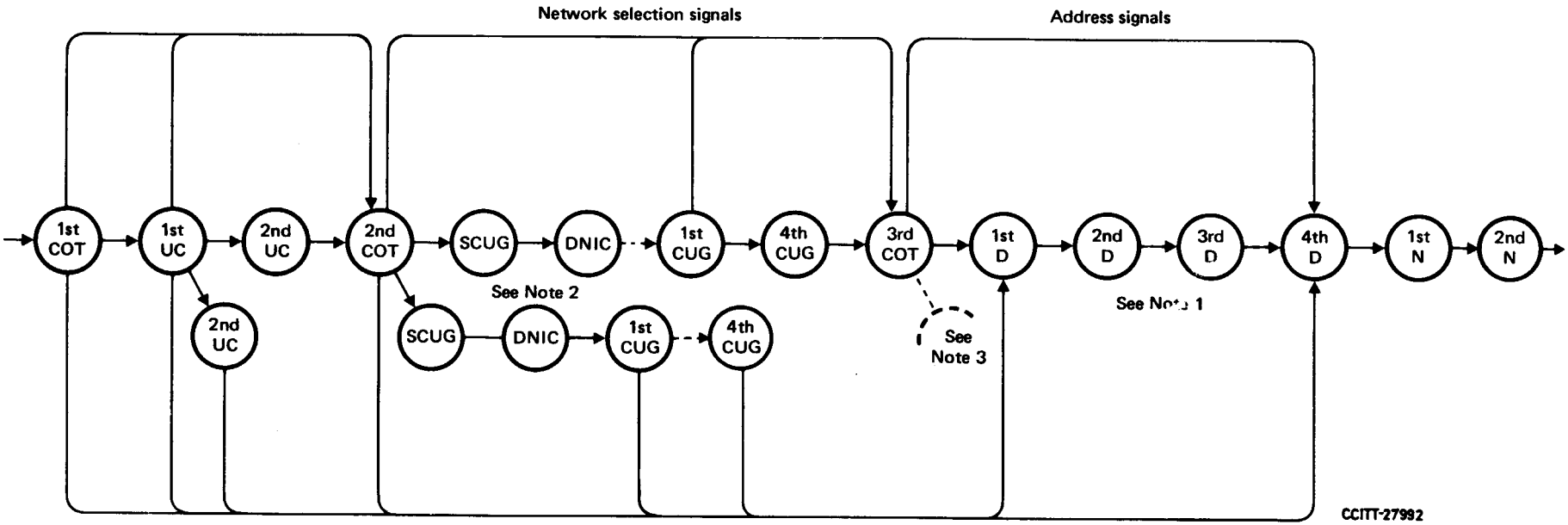
FIGURE 1/X.70

Decentralized signalling between data networks of anisochronous type

APPENDIX I

(to Recommendation X.70)

Possible sequences of network selection signals



COT	Class-of-traffic character
UC	User class character
SCUG	Start of closed user group character
DNIC	Data network identification code
CUG	Closed user group character
D	Data network (or service) identification code digit
N	Called number digit

Note 1 – The first three digits D_1, D_2 and D_3, form the data country code (DCC) component of the data network identification code (DNIC). The fourth digit (D_4) is the network or service digit of the DNIC.

Note 2 – The DNIC comprises four digits as defined in Note 1.

Note 3 – Reserved for future extension.

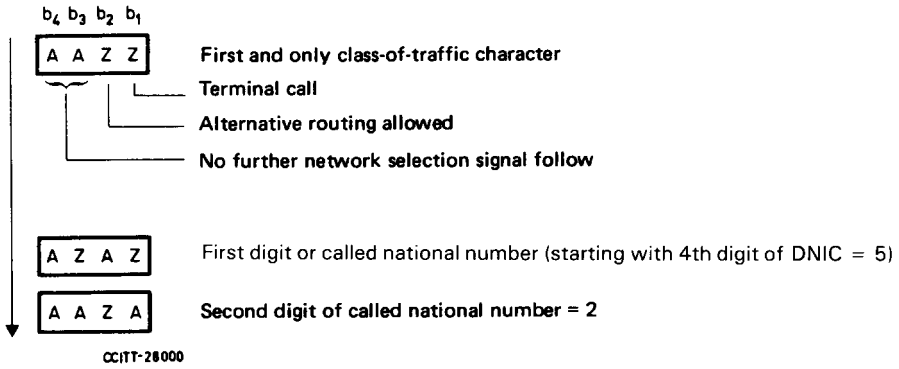
APPENDIX II

(to Recommendation X.70)

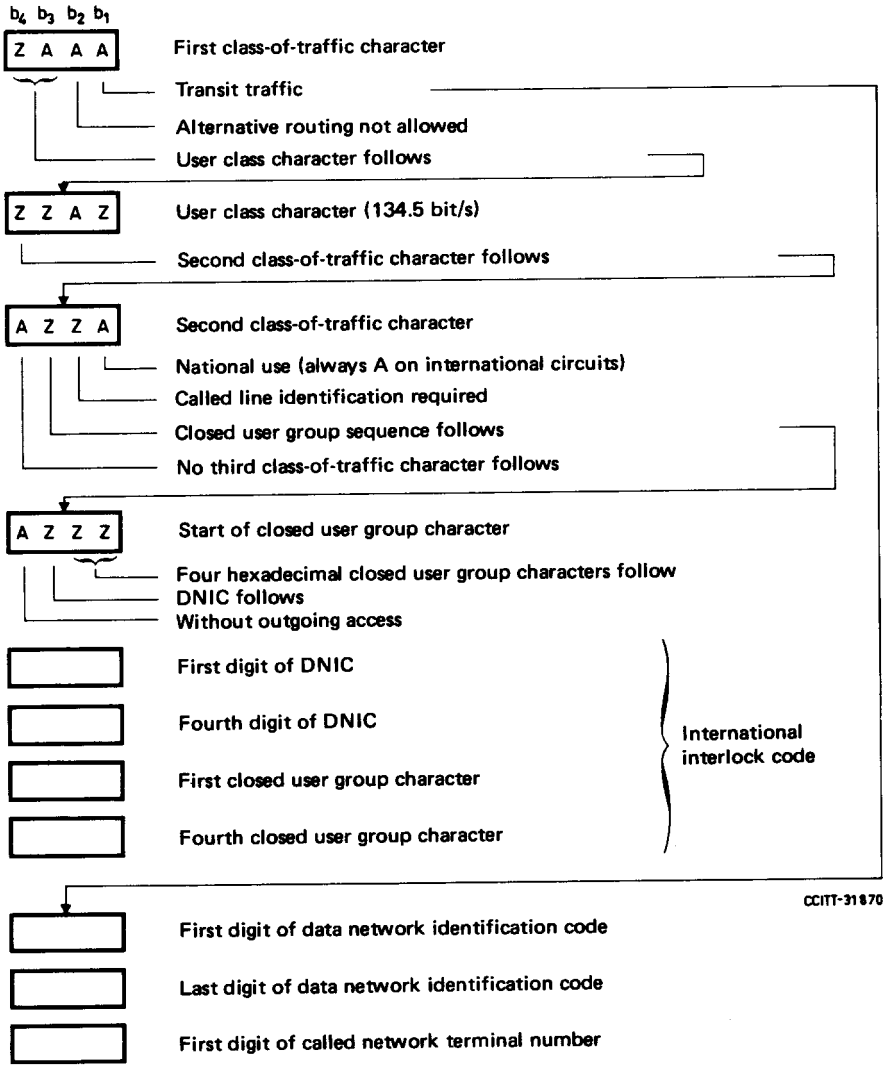
Examples of network selection signals

II.1 *First example* (minimum sequence of network selection signals)

This example shows a sequence of minimal length. The country of destination has indicated that it does not wish to receive the DCC component of the DNIC. (The preceding *calling* signal, start and stop elements, possible stuffing bits and the parity bit are not shown. The bits are shown in the order of b_4, b_3, b_2 and b_1).



II.2 *Second example* (a sequence of *network selection* signals including closed user group characters)

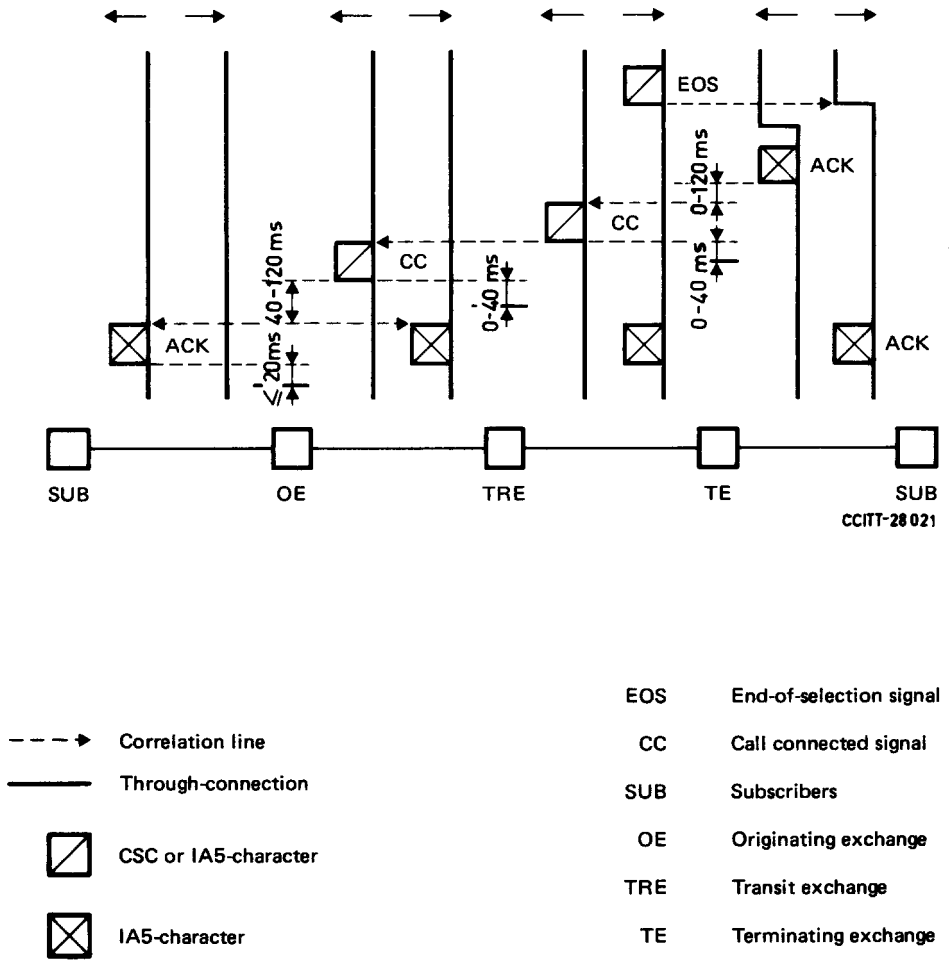


APPENDIX III (A)

(to Recommendation X.70)

Through-connection procedure

Called and calling line identification not required (no *connect-when-free* facility)



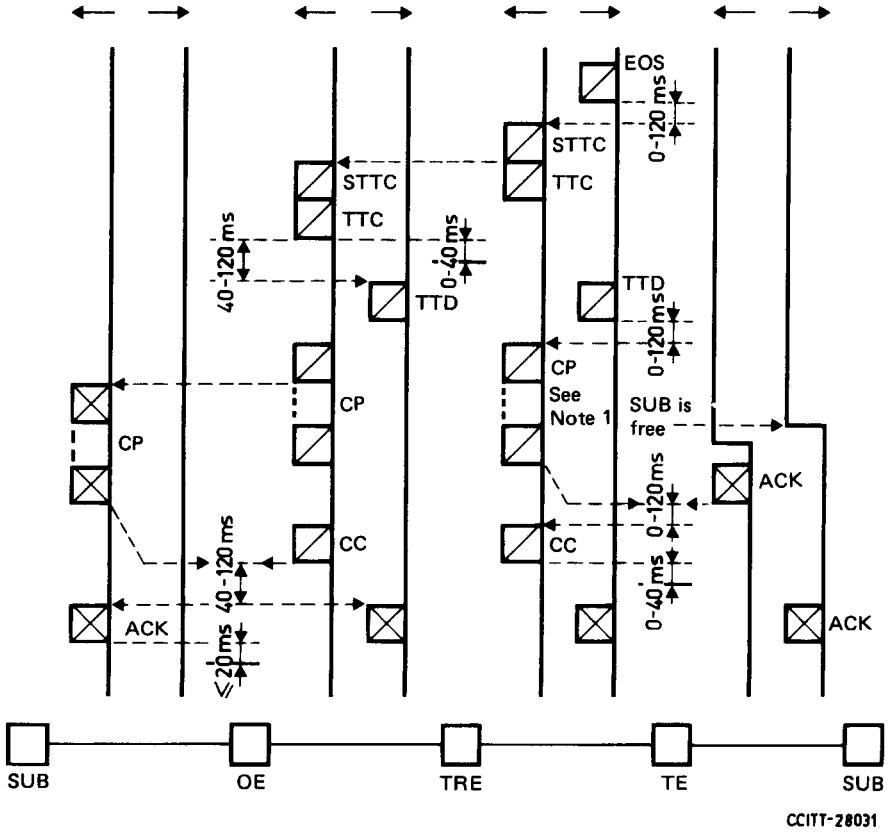
Note - Timings shown are worst case figures and design objectives should be to keep them as short as possible.

APPENDIX III (B)

(to Recommendation X.70)

Through-connection procedure

Called and calling line identification not required (subscriber is busy, *connect-when-free* facility)



Correlation line

Through-connection

CSC or IA5-character

IA5-character

EOS End-of-selection signal

STTC Start-of-transit through-connect signal

TTC Transit through-connect signal

TTD Transit centres through-connected signal

CP Call progress signals (without clearing)

CC Call connected signal

SUB Subscribers

OE Originating exchange

TRE Transit exchange

TE Terminating exchange

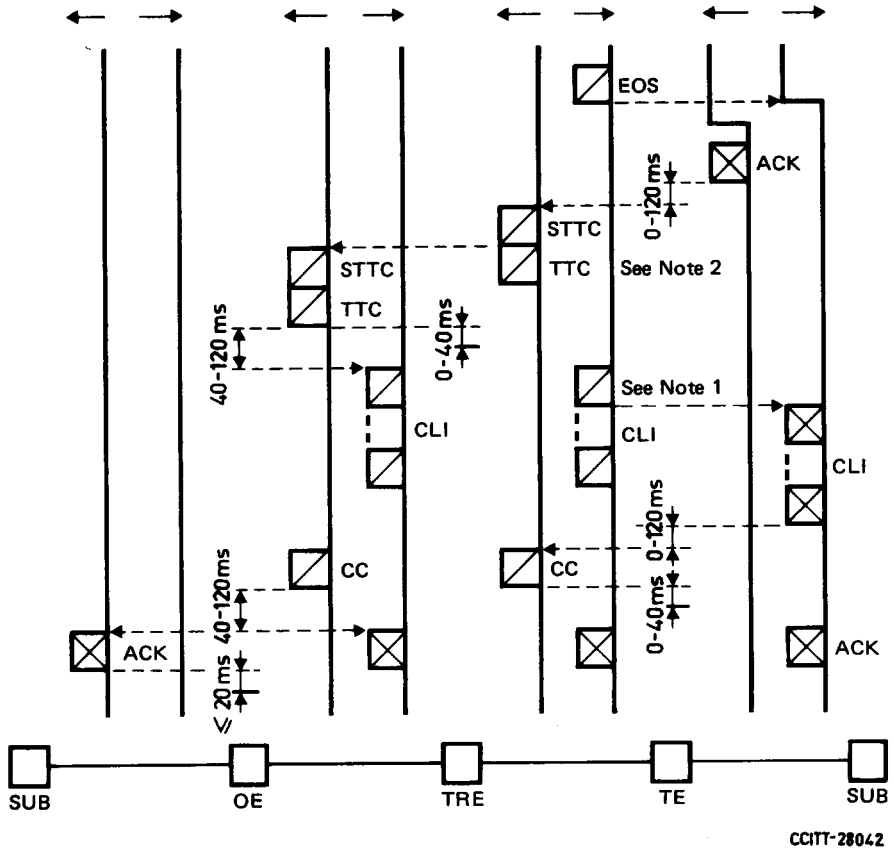
Note 1 - *Call progress* signals comprise a distinctive character followed by a 2-digit number.
Note 2 - See Note in Appendix III (A).

APPENDIX III (C)

(to Recommendation X.70)

Through-connection procedure

Called line identification not required, calling line identification required (no *connect-when-free facility*)



Correlation line		TTC	Transit through-connect signal
Through-connection		CLI	Calling line identification signals
CSC or IA5-character		CC	Call connected signal
		SUB	Subscribers
IA5-character		OE	Originating exchange
EOS	End-of-selection signal	TRE	Transit exchange
STTC	Start-of-transit through-connect signal	TE	Terminating exchange

Note 1 - The *calling line identification* signal consists of the DNIC followed by the digits of the subscriber number and CSC No. 12. Where no identification is available, only the DNIC followed by CSC No. 12 is sent.

Note 2 - In this example, it is assumed that the *STTC* signal is sent after the receipt of the *call accepted* signal (ACK). However, some countries may decide to return this signal following a positive subscriber cheek state (not busy), at the same time as the subscriber call set-up is initiated.

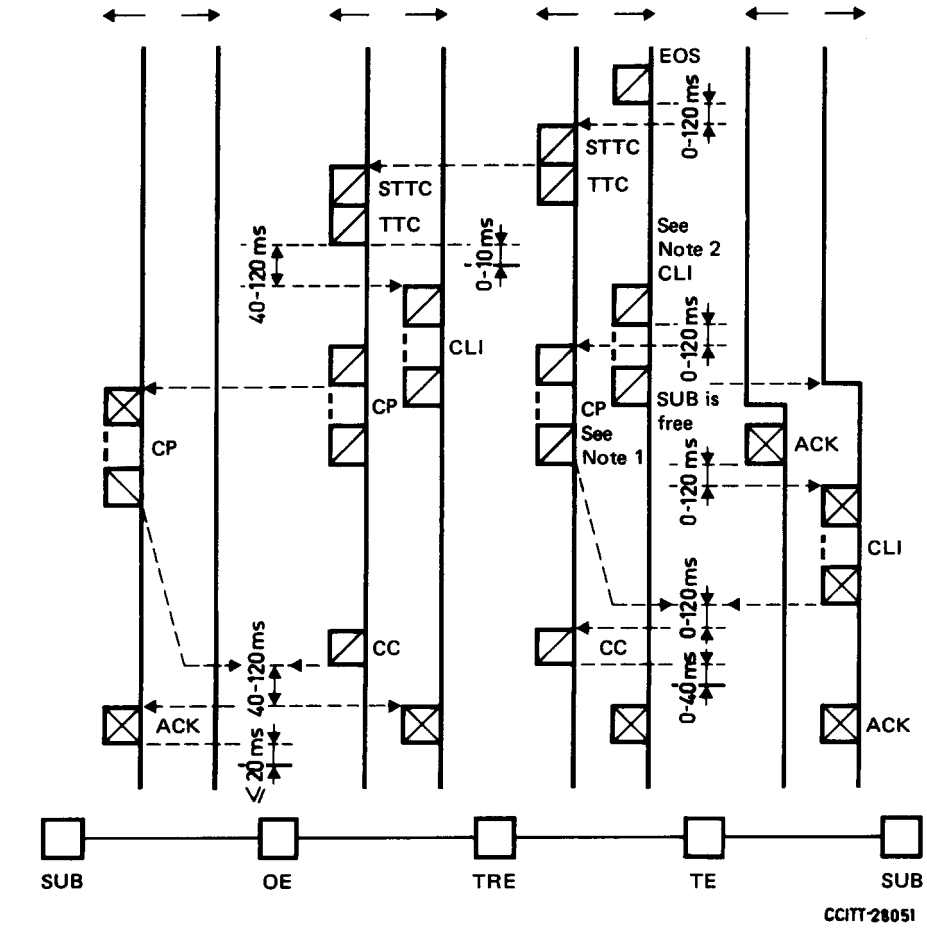
Note 3 - See Note in Appendix III (A).

APPENDIX III (D)

(to Recommendation X.70)

Through-connection procedure

Called line identification not required, calling line identification required (subscriber is busy, *connect-when-free* facility)



- - - →	Correlation line	EOS	End-of-selection signal
———	Through-connection	STTC	Start-of-transit through-connect signal
⊘	CSC or IA5-character	TTC	Transit through-connect signal
⊠	IA5-character	CLI	Calling line identification signals
		CP	Call progress signals
		CC	Call connected signal
		SUB	Subscribers
		OE	Originating exchange
		TRE	Transit exchange
		TE	Terminating exchange

Note 1 - *Call progress* signals comprise a distinctive character followed by a 2-digit number.

Note 2 - The *calling line identification* signal consists of the DNIC followed by the digits of the subscriber number and CSC No. 12. Where no identification is available, only the DNIC followed by CSC No. 12 is sent.

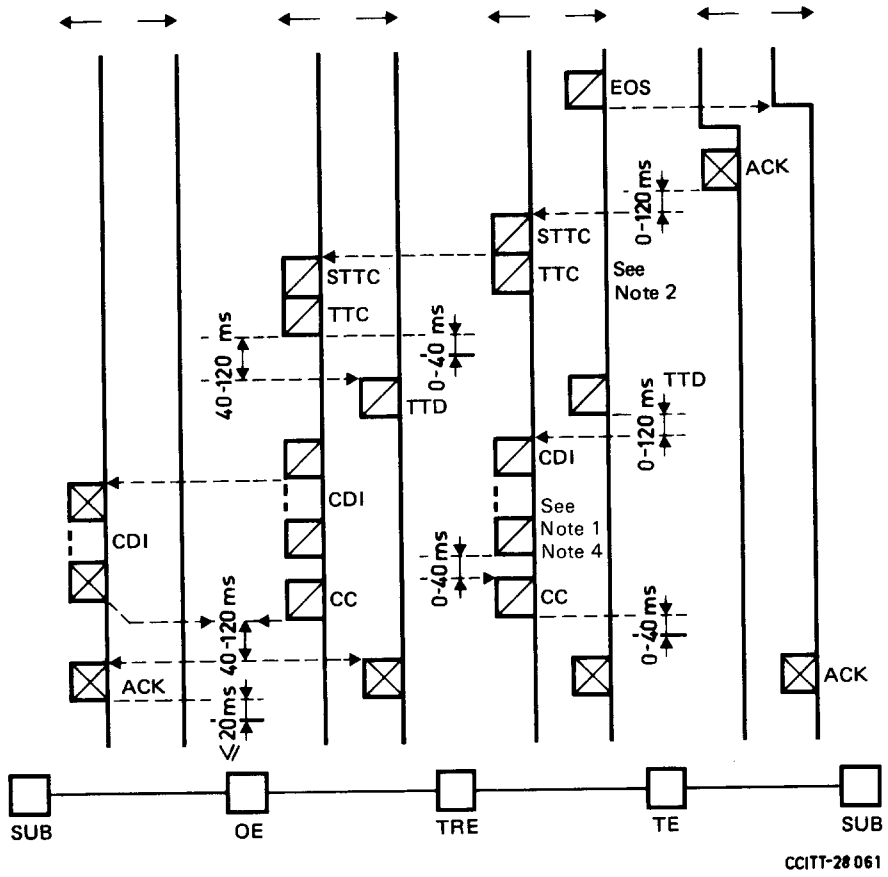
Note 3 - See Note in Appendix III (A).

APPENDIX III (E)

(to Recommendation X.70)

Through-connection procedure

Called line identification required, calling line identification not required (no *connect-when-free* facility)



Correlation line

Through-connection

CSC or IA5-character

IA5-character

EOS End-of-selection signal

STTC Start-of-transit through-connect signal

TTC Transit through-connect signal

TTD Transit centres through-connected signal

CDI Called line identification signals

CC Call connected signal

SUB Subscribers

OE Originating exchange

TRE Transit exchange

TE Terminating exchange

Note 1 - The *called line identification* signal consists of the DNIC followed by the digits of the subscriber number and CSC No. 12. Where no identification is available, only CSC No. 12 is sent.

Note 2 - In this example, it is assumed that the *STTC* signal is sent after the receipt of the *call accepted* signal (ACK). However, some countries may decide to return this signal following a positive subscriber cheek state (not busy), at the same time as the subscriber call set-up is initiated.

Note 3 - See Note in Appendix III (A).

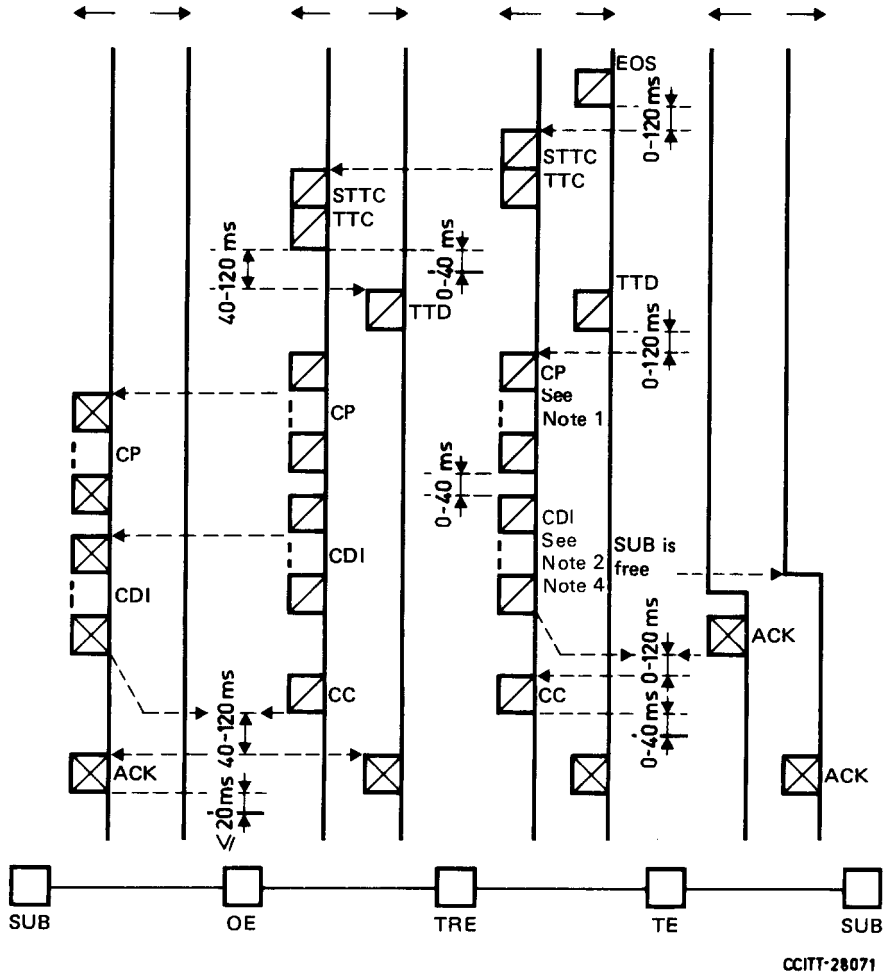
Note 4 - If the call is cleared the relevant *call progress* signal should be sent before or after the *called line identification* signal.

APPENDIX III (F)

(to Recommendation X.70)

Through-connection procedure

Called line identification required, calling line identification not required (subscriber is busy, *connect-when-free* facility)



----→	Correlation line	TTD	Transit centres through-connected signal
———	Through-connection	CP	Call progress signals
☒	CSC or IA5-character	CDI	Called line identification signals
☒	IA5-character	CC	Call connected signal
		SUB	Subscribers
EOS	End-of-selection signal	OE	Originating exchange
STTC	Start-of-transit through-connect signal	TRE	Transit exchange
TTC	Transit through-connect signal	TE	Terminating exchange

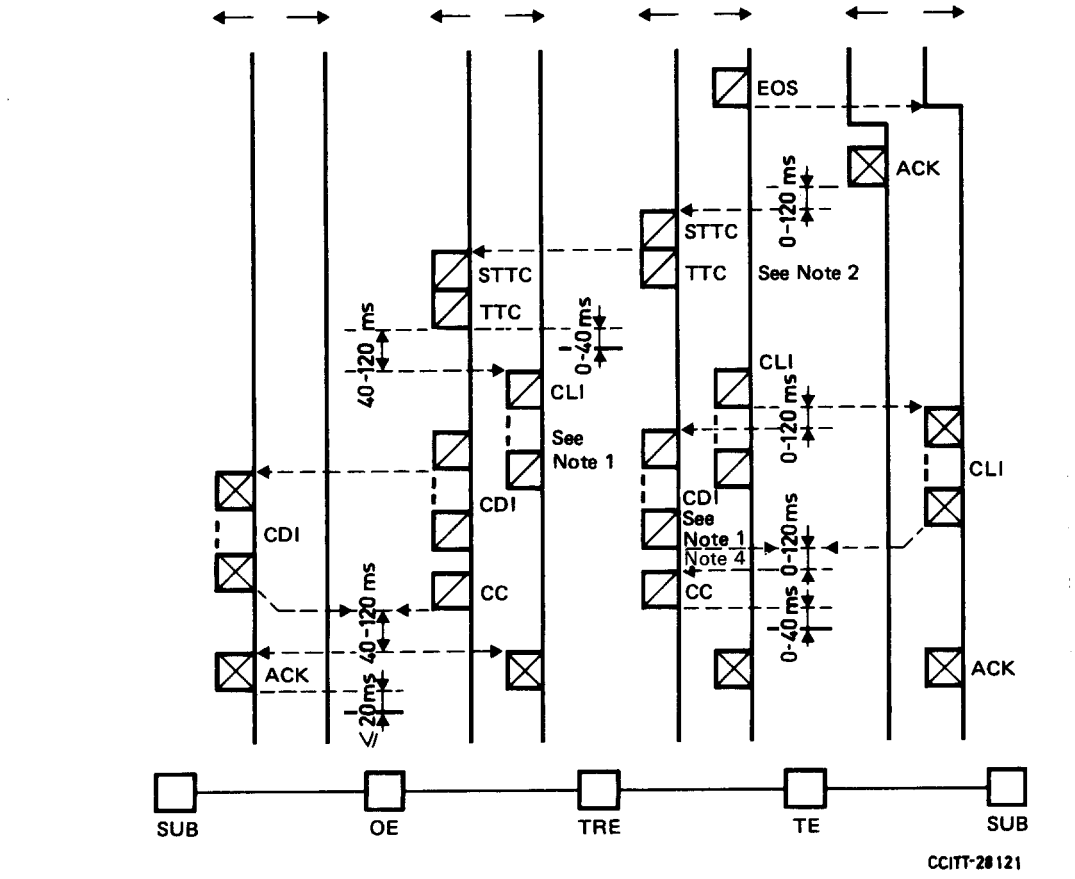
Note 1 - *Call progress* signals comprise a distinctive character followed by 2-digit number.
Note 2 - The *called line identification* signal consists of the DNIC followed by the digits of the subscriber number and CSC No. 12. Where no identification is available, only CSC No. 12 is sent.
Note 3 - See Note in Appendix III (A).
Note 4 - If the call is cleared after the sending of the *called line identification* signal, but before through-connection, a relevant *call progress* signal with clearing could be sent.

APPENDIX III (G)

(to Recommendation X.70)

Through-connection procedure

Called and calling line identification required (no *connect-when-free* facility)



---→	Correlation line	TTC	Transit through-connect signal
———	Through-connection	CLI	Calling line identification signals
▨	CSC or IA5-character	CDI	Called line identification signals
☒	IA5-character	CC	Call connected signal
		SUB	Subscribers
		OE	Originating exchange
EOS	End-of-selection signal	TRE	Transit exchange
STTC	Start-of-transit through-connect signal	TE	Terminating exchange

Note 1 - The *called line identification* signal consists of the DNIC followed by the digits of the subscriber number and CSC No. 12. Where no called line identification is available, only CSC No. 12 is sent.
The calling line identification signal consists of the DNIC followed by the digits of the subscriber number and CSC No. 12. Where no calling line identification is available, only the DNIC followed by CSC No. 12 is sent.

Note 2 - In this example, it is assumed that the *STTC* signal is sent after the receipt of the call accepted signal (ACK). However, some countries may decide to return this signal following a positive subscriber check state (not busy), at the same time as the subscriber call set-up is initiated.

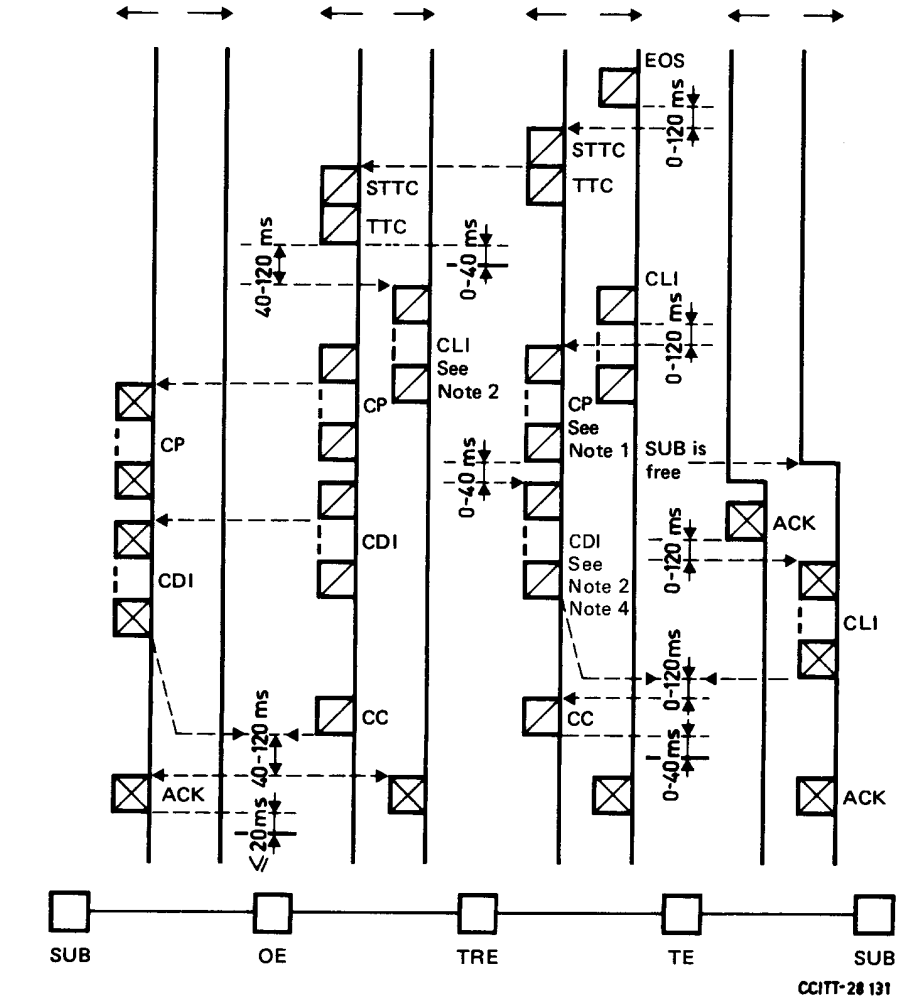
Note 3 - See Note in Appendix III (A).

Note 4 - If the call is cleared, the relevant *call progress* signal should be sent before or after the *called line identification* signal.

APPENDIX III (H)
(to Recommendation X.70)

Through-connection procedure

Called and calling line identification required (subscriber is busy, *connect-when-free* facility)



Correlation line	
Through-connection	
CSC or IA5-character	
IA5-character	

EOS	End-of-selection signal
STTC	Start-of-transit through-connect signal
TTC	Transit through-connect signal

CLI	Calling line identification signals
CP	Call progress signals
CDI	Called line identification signals
CC	Call connected signal
SUB	Subscribers
OE	Originating exchange
TRE	Transit exchange
TE	Terminating exchange

Note 1 - *Call progress* signals comprise a distinctive character followed by a 2-digit number.

Note 2 - The *called line identification* signal consists of the DNIC followed by the digits of the subscriber number and CSC No. 12. Where no called line identification is available, only CSC No. 12 is sent.
The *calling line identification* signal consists of the DNIC followed by the digits of the subscriber number and CSC No. 12. Where no calling line identification is available only the DNIC followed by CSC No. 12 is sent.

Note 3 - See Note in Appendix III (A).

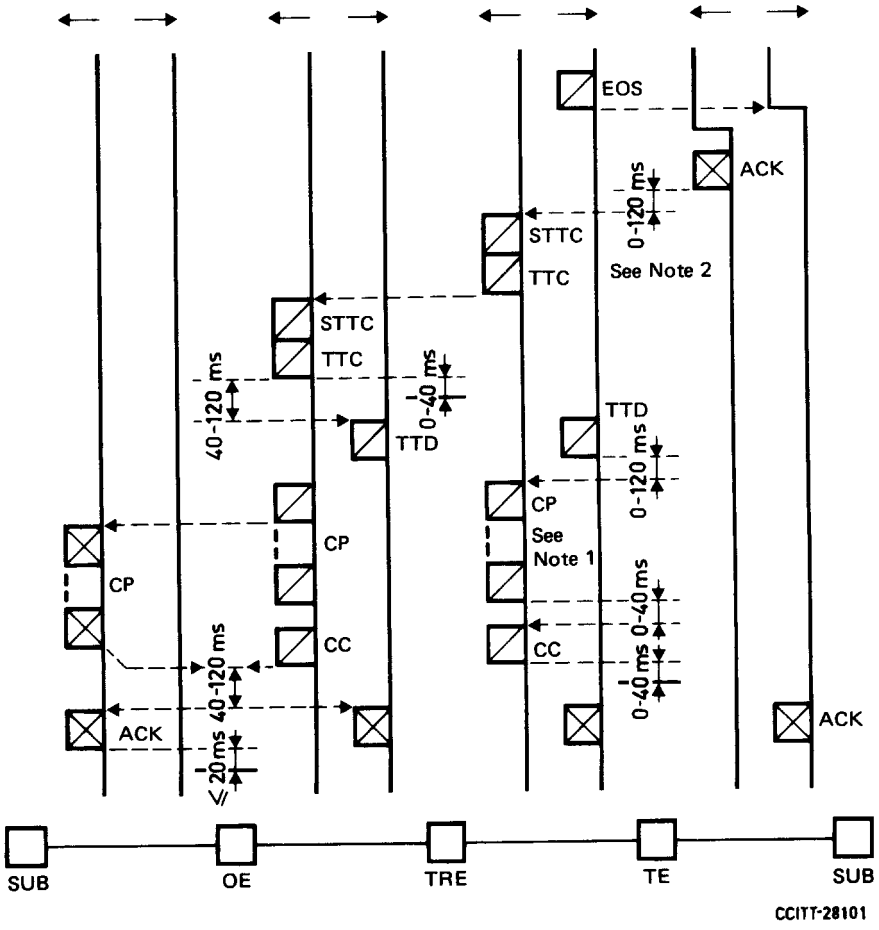
Note 4 - If the call is cleared after the sending of the *called line identification* signal, but before through-connection, a relevant *call progress* signal with clearing could be sent.

APPENDIX III (I)

(to Recommendation X.70)

Through-connection procedure

Called and calling line identification not required (call progress signal without clearing, e.g. redirected call)



Correlation line

Through-connection

CSC or IA5-character

IA5-character

EOS End-of-selection signal

STTC Start-of-transit through-connect signal

TTC Transit through-connect signal

TTD Transit centres through-connected signal

CP Call progress signal

CC Call connected signal

SUB Subscribers

OE Originating exchange

TRE Transit exchange

TE Terminating exchange

Note 1 Call progress signals comprise a distinctive character followed by a 2 digit number.

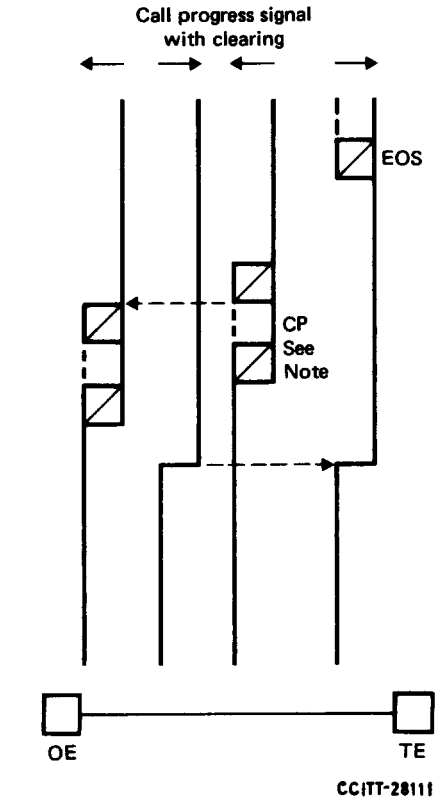
Note 2 - In this example, it is assumed that the *STTC* signal is sent after the receipt of the *call accepted* signal (ACK). However, some countries may decide to return this signal following a positive subscriber check state (not busy), at the same time as the subscriber call set-up is initiated.

Note 3 - See Note in Appendix III(A).

APPENDIX IV

(to Recommendation X.70)

Unsuccessful call



Note - Call progress signals comprise a distinctive character followed by a 2-digit number.