INTERNATIONAL TELECOMMUNICATION UNION

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THE INTERNATIONAL
TELEGRAPH AND TELEPHONE
CONSULTATIVE COMMITTEE

Recommendations provisionally adopted

X.75 Terminal and transit call control procedures and data transfer system on international circuits between packet-switched data networks

X.121 International numbering plan for public data networks

Geneva 1979

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Note. – Recommendations contained in this publication are those provisionally approved in September, 1978 in accordance with Resolution No. 2 of the VIth Plenary Assembly of the CCITT (Geneva, 1976).

TERMINAL AND TRANSIT CALL CONTROL PROCEDURES AND DATA TRANSFER SYSTEM ON INTERNATIONAL CIRCUITS BETWEEN PACKET-SWITCHED DATA NETWORKS

(Geneva, 1978)

The establishment in various countries of public data networks providing packet-switched data transmission services creates a need to standardize international interworking.

The CCITT,

considering

a) that Recommendation X.1 includes specific user classes of service for data terminal equipments operating in the packet mode, Recommendation X.2 defines user facilities, Recommendations X.25 and X.29 define DTE/DCE interface characteristics, Recommendation X.95 defines network parameters and Recommendation X.96 defines call progress signals;

b) that the logical Links A1 and G1 in an international connection are defined in Recommendation X.92 for packet-switched data transmission services;

c) the desirability of being able to use Links A1 and G1 for all user facilities;

d) the urgent need to standardize an international signalling Recommendation to allow interworking between gateway/transit data switching exchanges as defined in Recommendation X.92;

e) that the necessary elements of the signalling terminal (STE) interface Recommendation at the gateway/transit data switching exchange should be defined independently as:

Level 1 – The physical, electrical, functional and procedural characteristics to establish, maintain and disconnect the physical link at the signalling terminal interface

Level 2 – The packet transfer procedures for data interchange across the interface between the signalling terminals

Level 3 – The packet format and signalling procedures for the exchange of packets containing control information and user data at the signalling terminal interface;

unanimously declares the view

1. that the basic system structure of the signalling and data transfer procedures in terms of elements, should be as specified in the Introduction, *Basic system structure*;

2. that the physical, electrical, functional and procedural characteristics to establish, maintain and disconnect the physical link at the signalling terminal interface should be as specified in 1. below, *Level 1 – Characteristics of the signalling terminal physical circuit interface*;

3. that the packet transfer procedures which operate over the physical circuits and provide a mechanism for reliable transport of packets at the signalling terminal interface should be as specified in 2. below, *Level 2 – Packet transfer procedures between signalling terminals*;

4. that the packet signalling procedures for the exchange of call control information and user data at the signalling terminal interface should be as specified in 3. below, *Level 3 – Packet signalling procedures between signalling terminals*;

5. that the packet format for packets exchanged at the signalling terminal interface should be as specified in 4. below, *Packet formats for virtual call*;

6. that the procedure and formats for user facilities and network utilities at the signalling terminal interface should be as specified in 5. below, *Procedure and formats for user facilities and network utilities.*

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INTRODUCTION

General

This Recommendation defines the characteristics and operation of an Interexchange Signalling System for international packet-switched data transmission services.

The signalling system defined in this Recommendation is intended to be used for the transfer of information between two signalling terminals each within a packet-mode data network and directly connected by an international link.

Each signalling terminal (STE) will be located at a network node and be associated with, or part of, an exchange or exchange function at that node. The nodes may be part of separate packet-mode data networks.

The information transferred will consist of call control and network control information and user traffic.

The link connecting the two signalling terminals will comprise one or a number of circuits.

Elements

The system is made up of communicating elements which function independently and are therefore defined separately. These elements are:

a) the physical circuits which comprise Links A1 or G1, and a set of physical, electrical, functional and procedural interface characteristics between the transmission media and the signalling terminals and which provide a mechanism for information transfer between two signalling terminals;

b) the packet transfer procedures which operate over the physical circuits and provide a mechanism for reliable transport of packets between the two signalling terminals independently of the particular types of physical circuit in use;

c) the packet signalling procedures which use the packet transfer procedures and provide a mechanism for the exchange of call control information and user traffic between the two signalling terminals.

Basic system structure

The basic system structure of the signalling and data transfer procedures, in terms of the elements, is shown in Figure 1/X.75.

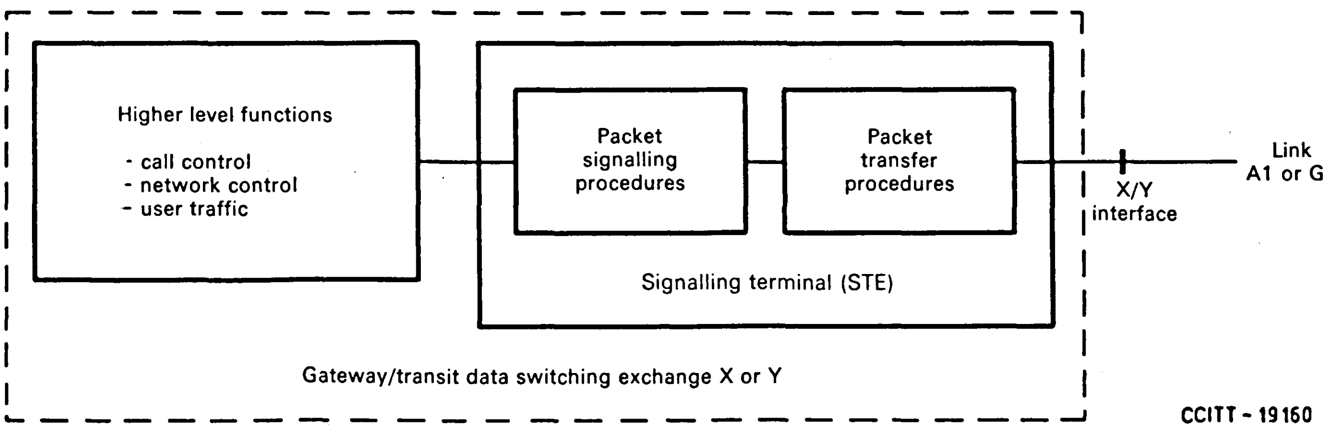


FIGURE 1/X.75 – **Basic system structure of signalling and data transfer procedures**

Note. – Applicable to this Recommendation:

a) STE-X denotes the STE of the international exchange under consideration on the international link concerned;

b) STE-Y denotes the STE of the other international exchange under consideration on the international link;

c) the STE-X/STE-Y interface is abbreviated to the X/Y interface.

1. LEVEL 1 – CHARACTERISTICS OF THE SIGNALLING TERMINAL/ PHYSICAL CIRCUIT INTERFACE

The characteristics of the signalling terminal/physical circuit interface, defined as the level 1 element, shall be in accordance with Recommendation G.703, for physical circuits having a bearer rate of 64 kbit/s. Optionally Administrations may adopt, for digital circuits, a data transfer rate at the link level of 48 kbit/s or any other internationally recognized rate by bilateral agreement.

However, for an interim period by bilateral agreement, any other internationally recognized rates could be used for analogue circuits, in which case the characteristics of the signalling terminal/physical circuit interface shall be in accordance with the appropriate V-Series Recommendation.

The international link should be capable of supporting duplex operation.

The international link is assumed to be data Link A1 and/or data Link G1 in terms of the hypothetical reference connections defined in Recommendation X.92.

2. LEVEL 2 – PACKET TRANSFER PROCEDURES BETWEEN SIGNALLING TERMINALS

2.1 *Scope and field of application*

2.1.1 In order to provide a mechanism for the reliable transport of packets between two signalling terminals, it is necessary to define a procedure which can accept and deliver packets to level 3 when either single or multiple physical circuits are employed. A multiplicity of physical circuits is required if the effects of circuit failures are not to disrupt the level 3 operation.

Note. – At this time the multiple line transfer procedure is for urgent further study. Also for further study is the possibility that compatibility between the procedures for the single and multiple line cases can be achieved.

2.1.2 Considering the urgent need for a packet transfer procedure to be provided at level 2, a procedure applicable over a single physical circuit is specified in 2.2 to 2.4 below.

2.1.3 The transmission facility is duplex.

2.1.4 The Packet Transfer Procedure is based upon thé Link Access Procedure (LAP B) described in 2, of Recommendation X.25. The procedure uses the principle and terminology of the High Level Data Link Control (HDLC) procedure specified by the International Organization for Standardization (ISO).

2.1.5 Either extended mode (modulo 128) or non-extended mode (modulo 8) may be used. The choice of the mode employed for level 2 is a matter for bilateral agreement and is independent of the choice of mode for the corresponding level 3 procedures.

2.2 *Frame structure*

2.2.1 All transmissions are in frames conforming to one of the formats of Tables 1/X.75 and 2/X.75. The flag preceding the address field is defined as the opening flag.

TABLE 1/X.75 – **Frame formats (modulo 8)**

Bit order of transmission	12345678	12345678	1 to 8	16 to 1	12345678
	Flag	Address	Control	FCS	Flag
	F 01111110	A 8-bits	C 8-bits	FCS 16-bits	F 01111110

FCS = frame checking sequence

Bit order of transmission	12345678	12345678	1 to 8		16 to 1	12345678
	Flag	Address	Control	Information	FCS	Flag
	F 01111110	A 8-bits	C 8-bits	I N-bits	FCS 16-bits	F 01111110

FCS = frame checking sequence

TABLE 2/X.75 – **Frame formats (modulo 128)**

Bit order of transmission	12345678	12345678	1 to 16	16 to 1	12345678
	Flag	Address	Control	FCS	Flag
	F 01111110	A 8-bits	C 16-bits	FCS 16-bits	F 01111110

FCS = frame checking sequence

Bit order of transmission	12345678	12345678	1 to 16		16 to 1	12345678
	Flag	Address	Control	Information	FCS	Flag
	F 01111110	A 8-bits	C 16-bits	I N-bits	FCS 16-bits	F 01111110

FCS = frame checking sequence

2.2.2 *Flag sequence*

All frames shall start and end with the flag sequence consisting of one 0 followed by six contiguous 1s and one 0. A single flag may be used as both the closing flag for one frame and the opening flag for the next frame.

2.2.3 *Address field*

The address field shall consist of one octet. The coding of the address field is described in 2.4.1 below.

2.2.4 *Control field*

The control field shall consist of one or two octets. The content of this field is described in 2.3.2 below.

2.2.5 *Information field*

The information field of a frame is unrestricted with respect to code or grouping of bits.

See 2.3.4.7 and 2.4.7.3 with regard to the maximum information field length.

2.2.6 *Transparency*

The STE, when transmitting, shall examine the frame content between the two flag sequences including the address, control, information and FCS sequences and shall insert a 0 bit after all sequences of five contiguous 1 bits (including the last five bits of the FCS) to ensure that a flag sequence is not simulated. The STE, when receiving, shall examine the frame content and shall discard any 0 bit which directly follows five contiguous 1 bits.

2.2.7 *Frame checking sequence (FCS)*

The FCS shall be a 16-bit sequence. It shall be the ones complement of the sum (modulo 2) of:

1) the remainder of $x^k(x^{15} + x^{14} + x^{13} + ... + x^2 + x + 1)$ divided (modulo 2) by the generator polynomial $x^{16} + x^{12} + x^5 + 1$, where k is the number of bits in the frame existing between, but not including, the final bit of the opening flag and the first bit of the FCS, excluding bits inserted for transparency, and

2) the remainder after multiplication by x^{16} and then division (modulo 2) by the generator polynomial $x^{16} + x^{12} + x^5 + 1$ of the content of the frame, existing between but not including, the final bit of the opening flag and the first bit of the FCS, excluding bits inserted for transparency.

As a typical implementation, at the transmitter, the initial remainder of the division is preset to all 1s and is then modified by division by the generator polynomial (as described above) on the address, control and information fields; the 1s complement of the resulting remainder is transmitted as the 16-bit FCS sequence.

At the receiver, the initial remainder is preset to all 1s, and the serial incoming protected bits and the FCS when divided by the generator polynomial will result in a remainder of 0001110100001111 (x^{15} through x^0, respectively) in the absence of transmission errors.

2.2.8 *Order of bit transmission*

Addresses, commands, responses and sequence numbers shall be transmitted with the low order bit first (for example, the first bit of the sequence number that is transmitted shall have the weight 2^0).

The order of transmitting bits within the information field is not specified under 2. of this Recommendation. The FCS shall be transmitted to the line commencing with the coefficient of the highest term.

Note. – The low order bit is defined as bit 1, as depicted in Tables 3/X.75, 4/X.75, 5/X.75, 6/X.75, 7/X.75 and 8/X.75.

2.2.9 *Invalid frames*

A frame not properly bounded by two flags, or having fewer than 32 bits (modulo 8) or 40 bits (modulo 128) between flags, is an invalid frame.

2.2.10 *Frame abortion*

Aborting a frame is performed by transmitting at least seven contiguous 1s (with no inserted 0s).

2.2.11 *Interframe time fill*

Interframe time fill is accomplished by transmitting contiguous flags between frames.

2.2.12 *Link channel states*

2.2.12.1 *Active channel state*

A channel is in an active condition when the STE is actively transmitting a frame, an abortion sequence or interframe time fill.

2.2.12.2 *Idle channel state*

A channel is defined to be in an idle condition when a contiguous 1s state is detected that persists for at least 15 bit times.

Note 1. – The action to be taken upon detection of the idle channel state is a subject for further study.

Note 2. – A link channel as defined here is the means of transmission for one direction.

2.3 *Elements of procedure*

2.3.1 The elements of procedure are defined in terms of actions that occur on receipt of frames.

A procedure is derived from these elements of procedure and is described in 2.4 below. Together, 2.2 and 2.3 form the general requirements for the proper management of the link.

2.3.2 *Control field formats and state variables*

2.3.2.1 *Control field formats*

The control field contains a command or a response, and sequence numbers where applicable.

Three types of control field formats (see Tables 3/X.75 and 4/X.75) are used to perform numbered information transfer (I frames), numbered supervisory functions (S frames) and unnumbered control functions (U frames).

TABLE 3/X.75 – **Control field formats (modulo 8)**

Control field bits	1	2	3	4	5	6	7	8
I frame	0	N(S)			P/F	N(R)		
S frame	1	0	S	S	P/F	N(R)		
U frame	1	1	M	M	P/F	M	M	M

N(S) = transmitter send sequence number (bit 2 = low order bit)
N(R) = transmitter receive sequence number (bit 6 = low order bit)
S = supervisory function bits
M = modifier function bits
P/F = poll bit when issued as a command, final bit when issued as a response.

Note. – Distinction between command and response, and therefore, distinction between P bit and F bit are made by the addressing rules.

TABLE 4/X.75 – **Control field formats (modulo 128)**

Control field bits	1st Octet								2nd Octet							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
I frame	0	N(S)							P/F	N(R)						
S frame	1	0	S	S	X	X	X	X	P/F	N(R)						
U frame	1	1	M	M	U	M	M	M	P/F	X	X	X	X	X	X	X

N(S) = transmitter send sequence number (bit 2 = low order bit)
N(R) = transmitter receive sequence number (bit 10 = low order bit)
S = supervisory function bits
M = modifier function bits
X = reserved and set to 0
U = unspecified
P/F = poll bit when issued as a command, final bit when issued as a response.

Note. – Distinction between command and response, and therefore, distinction between P bit and F bit are made by the addressing rules.

Information transfer format – I

The I format is used to perform an information transfer. The functions of N(S), N(R) and P/F are independent; i.e., each I frame has an N(S), an N(R) which may or may not acknowledge additional frames received by the STE, and a P/F bit.

Supervisory format – S

The S format is used to perform link supervisory control functions such as acknowledge I frames, request retransmission of I frames, and to request a temporary suspension of transmission of I frames.

Unnumbered format – U

The U format is used to provide additional link control functions. This format contains no sequence numbers. The encoding of the unnumbered commands and responses is as defined in Tables 5/X.75 and 6/X.75.

2.3.2.2 *Control field parameters*

The various parameters associated with the control field formats are described below.

2.3.2.3 *Modulus*

Each I frame is sequentially numbered and may have the value 0 through modulus – 1 (where "modulus" is the modulus of the sequence numbers). The modulus equals 8 or 128 and the sequence numbers cycle through the entire range.

2.3.2.4 *Frame variables and sequence numbers*

2.3.2.4.1 *Send state variable V(S)*

The send state variable denotes the sequence number of the next in-sequence I frame to be transmitted. The send state variable can take on the value 0 through modulus – 1. The value of the send state variable is incremented by 1 with each successive I frame transmission, but cannot exceed N(R) of the last received I or S frame by more than the maximum number of outstanding I frames (k). The value of k is defined in 2.4.7.4 below.

2.3.2.4.2 *Send sequence number N(S)*

Only I frames contain N(S), the send sequence number of transmitted frames. Prior to transmission of an in-sequence I frame, the value of N(S) is updated to equal the value of the send state variable.

2.3.2.4.3 *Receive state variable V(R)*

The receive state variable denotes the sequence number of the next in-sequence I frame to be received. This receive state variable can take on the values 0 through modulus – 1. The value of the receive state variable is incremented by the receipt of an error free, in-sequence I frame whose send sequence number N(S) equals the receive state variable.

2.3.2.4.4 *Receive sequence number N(R)*

All I frames and S frames contain N(R), the expected sequence number of the next received I frame. Prior to transmission of a frame of the above types, the value of N(R) is updated to equal the current value of the receive state variable. N(R) indicates that the STE transmitting the N(R) has correctly received all I frames numbered up to N(R) – 1.

2.3.3 *Functions of the poll/final bit*

The poll/final (P/F) bit serves a function in both command frames and response frames. In command frames the P/F bit is referred to as the P bit. In response frames it is referred to as the F bit.

The use of the P/F bit is described in 2.4.2 below.

2.3.4 *Commands and Responses*

The following commands and responses will be used by the STE and are represented in Tables 5/X.75 and 6/X.75.

TABLE 5/X.75 – **Commands and responses (modulo 8)**

Format	Command	Response	1	2	3	4	5	6	7	8
Information transfer	I (information)		0	N(S)			P	N(R)		
Supervisory	RR (receive ready)	RR (receive ready)	1	0	0	0	P/F	N(R)		
	RNR (receive not ready)	RNR (receive not ready)	1	0	1	0	P/F	N(R)		
	REJ (reject)	REJ (reject)	1	0	0	1	P/F	N(R)		
Unnumbered	SABM (set asynchronous balanced mode)		1	1	1	1	P	1	0	0
	DISC (disconnect)		1	1	0	0	P	0	1	0
		FRMR (frame reject)	1	1	1	0	F	0	0	1
		UA (unnumbered acknowledgement)	1	1	0	0	F	1	1	0
		DM (disconnected mode)	1	1	1	1	F	0	0	0

Note. – The need for, and use of, additional commands and responses are for further study.

TABLE 6/X.75 – **Commands and responses (modulo 128)**

Format	Command	Response	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
			Encoding															
Information transfer	I (information)		0	N(S)							P	N(R)						
Supervisory	RR (receive ready)	RR (receive ready)	1	0	0	0	0	0	0	0	P/F	N(R)						
	RNR (receive not ready)	RNR (receive not ready)	1	0	1	0	0	0	0	0	P/F	N(R)						
	REJ (reject)	REJ (reject)	1	0	0	1	0	0	0	0	P/F	N(R)						
Unnumbered	SABME (set asynchronous balanced mode extended)		1	1	1	1	U	1	1	0	P	0	0	0	0	0	0	0
	DISC (disconnect)		1	1	0	0	U	0	1	0	P	0	0	0	0	0	0	0
		FRMR (frame reject)	1	1	1	0	U	0	0	1	F	0	0	0	0	0	0	0
		UA (unnumbered acknowledgement)	1	1	0	0	U	1	1	0	F	0	0	0	0	0	0	0
		DM (disconnected mode)	1	1	1	1	U	0	0	0	F	0	0	0	0	0	0	0

Note 1. – Bit 5 of unnumbered frames is unspecified.
Note 2. – The need for, and use of, additional commands and responses are for further study.

The commands and responses are as follows:

2.3.4.1 *Information (I) command*

The function of the information (I) command is to transfer across a data link sequentially numbered frames containing an information field.

2.3.4.2 *Receive ready (RR)*

The receive ready (RR) supervisory frame is used by the STEs to:

1) indicate it is ready to receive an I frame;

2) acknowledge previously received I frames numbered up to N(R) – 1.

RR may be used to clear a busy condition that was initiated by the transmission of RNR. The RR command with the P bit set to 1 may be used by the STE to ask for the status of the other STE.

2.3.4.3 *Reject (REJ)*

The reject (REJ) supervisory frame is used by the STE to request retransmission of I frames starting with the frame numbered N(R). I frames numbered N(R) – 1 and below are acknowledged. Additional I frames pending initial transmission may be transmitted following the retransmitted I frame(s).

Only one REJ exception condition for a given direction of information transfer may be established at any time. The REJ exception condition is cleared (reset) upon the receipt of an I frame with an N(S) equal to the N(R) of the REJ.

2.3.4.4 *Receive not ready (RNR)*

The receive not ready (RNR) supervisory frame is used by the STE to indicate a busy condition; i.e., temporary inability to accept additional incoming I frames. I frames numbered up to N(R) – 1 are acknowledged. I frame N(R) and any subsequent I frames received, if any, are not acknowledged; the acceptance status of these I frames will be indicated in subsequent frames.

An indication that the busy condition has cleared and I frames will now be accepted is communicated by the transmission of a valid UA, RR, REJ, or SABM/SABME (modulo 8/modulo 128: SABM for modulo 8 and SABME for modulo 128).

The RNR command with the P bit set to 1 may be used by the STE to ask for the status of the other STE.

2.3.4.5 *Set asynchronous balanced mode (SABM) command and set asynchronous balanced mode extended (SABME) command*

The SABM unnumbered command is used to place the addressed STE in the asynchronous balanced mode (ABM) information transfer phase, where all command/response control fields will be one octet in length.

The SABME unnumbered command is used to place the addressed STE in the asynchronous balanced mode extended (ABME) information transfer phase, where all command/response control fields will be two octets in length.

No information field is permitted with the SABM and SABME command. The STE confirms acceptance of SABM/SABME (modulo 8/modulo 128) by the transmission at the first opportunity of a UA response. Upon acceptance of this command both the send state variable and the receive state variable are set to 0.

Previously transmitted frames that are acknowledged when this command is actioned remain unacknowledged.

2.3.4.6 *Disconnect (DISC) command*

The DISC unnumbered command is used to terminate the mode previously set. No information field is permitted with the DISC command. Prior to actioning the DISC command, the addressed STE confirms the acceptance of DISC by the transmission of a UA response. The STE sending the DISC enters the disconnected phase when it receives the acknowledging UA response.

Previously transmitted frames that are unacknowledged when this command is actioned remain unacknowledged.

2.3.4.7 *Frame reject (FRMR) response*

The FRMR unnumbered response is used by the STE to report an error condition not recoverable by retransmission of the identical frame, i.e., one of the following conditions resulted from the receipt of a frame without FCS error:

1) the receipt of a command or a response that is invalid or not implemented;

2) the receipt of an I frame with an information field which exceeded the maximum established length;

3) the receipt of an invalid N(R);

4) the receipt of a supervisory or unnumbered frame with an information field which is not permitted or has an incorrect length;

5) the receipt of a supervisory frame with the final bit set to 1, except during a timer recovery condition as described in 2.4.4.9 or except as a reply to a command sent with the poll bit set to 1;

6) the receipt of an unexpected UA or DM response;

7) the receipt of an invalid N(S).

With reference to the note of 2.4.5 below, the conditions 4 to 7 above are for further study.

An invalid N(R) is defined as one which points to an I frame which has previously been transmitted and acknowledged or to an I frame which has not been transmitted and is not the next sequential I frame pending transmission.

An invalid N(S) is defined as an N(S) which is equal to the last transmitted N(R) + k and is equal to the received state variable V(R), where k is the maximum number of outstanding information frames (see 2.4.7.4 below).

An invalid/not implemented command or response is defined as a frame with a control field that is unknown to the receiver of this frame.

Note. – Subjects for further study are: the three foregoing definitions, as well as the coding in the information field of the FRMR response for the four conditions listed for further study above.

An information field which immediately follows the control field, and consists of 3 octets (modulo 8) or 5 octets (modulo 128), is returned with this response and provides the reason for the FRMR response. This format is given in Tables 7/X.75 and 8/X.75.

TABLE 7/X.75 – **FRMR field format (modulo 8)**

Information field bits

1 2 3 4 5 6 7 8	9	10 11 12	13	14 15 16	17	18	19	20	21	22	23	24
Rejected frame control field	0	V(S)	C/R	V(R)	W	X	Y	Z	0	0	0	0

- Rejected frame control field is the control field of the received frame which caused the frame reject.
- V(S) is the current send state variable value at the STE reporting the rejection condition (Bit 10 = low order bit).
- C/R set to 1 indicates the rejected frame was a response.
  C/R set to 0 indicates the rejected frame was a command.
- V(R) is the current receive state variable at the STE reporting the rejection condition (Bit 14 = low order bit).
- W set to 1 indicates the control field received and returned in bits 1 through 8 was invalid.
- X set to 1 indicates the control field received and returned in bits 1 through 8 was considered invalid because the frame contained an information field which is not permitted with this command. Bit W must be set to 1 in conjunction with this bit.
- Y set to 1 indicates that the information field received exceeded the maximum established capacity. This bit is mutually exclusive with bit W above.
- Z set to 1 indicates the control field received and returned in bits 1 through 8 contained an invalid N(R). This bit is mutually exclusive with bit W above.
- Bits 9 and 21 through 24 shall be set to 0.

TABLE 8/X.75 – **FRMR field format (modulo 128)**

Information field bits													
1 to 16	17	18 to 24	25	26 to 32	33	34	35	36	37	38	39	40
Rejected frame control field	0	V(S)	C/R	V(R)	W	X	Y	Z	0	0	0	0

- Rejected frame control field is the control field of the received frame which caused the frame reject.
- V(S) is the current send state variable value at the STE reporting the rejection condition (Bit 18 = low order bit).
- C/R set to 1 indicates the rejected frame was a response.
  C/R set to 0 indicates the rejected frame was a command.
- V(R) is the current receive state variable at the STE reporting the rejection condition (Bit 26 = low order bit).
- W set to 1 indicates the control field received and returned in bits 1 through 16 was invalid.
- X set to 1 indicates the control field received and returned in bits 1 through 16 was considered invalid because the frame contained an information field which is not permitted with this command. Bit W must be set to 1 in conjunction with this bit.
- Y set to 1 indicates that the information field received exceeded the maximum established capacity. This bit is mutually exclusive with bit W above.
- Z set to 1 indicates the control field received and returned in bits 1 through 16 contained an invalid N(R). This bit is mutually exclusive with bit W above.
- Bits 17 and 37 through 40 shall be set to 0.

2.3.4.8 *Unnumbered acknowledge (UA) response*

The UA unnumbered response is used by the STE to acknowledge the receipt and acceptance of the U format commands. Received U format commands are not actioned until the UA response is transmitted. The UA response is transmitted as directed by the received U format command. No information field is permitted with the UA response.

2.3.4.9 *Disconnected mode (DM) response*

The DM unnumbered response is used to report a status where the STE is logically disconnected from the link, and is in the disconnected phase. The DM response is sent in this phase in response to the reception of a set mode command, to inform the STE that the STE is still in disconnected phase and cannot action and set mode command. No information field is permitted with the DM response.

2.3.5 *Exception condition reporting and recovery*

The error recovery procedures which are available to effect recovery following the detection/occurrence of an exception condition at the link level are described below. Exception conditions described are those situations which may occur as the result of transmission errors, STE malfunction or operational situations.

2.3.5.1 *Busy condition*

The busy condition results when an STE is temporarily unable to continue to receive I frames due to internal constraints, e.g., receive buffering limitations. In this case an RNR frame is transmitted from the busy STE. I frames pending transmission may be transmitted from the busy STE prior to or following the RNR. Clearing of the busy condition is indicated as described in 2.3.4.2 above.

2.3.5.2 *N(S) sequence error*

The information field of all I frames whose N(S) does not equal the receive state variable V(R) will be discarded.

An N(S) sequence exception condition occurs in the receiver when an I frame received error-free (no FCS error) contains an N(S) which is not equal to the receive state variable at the receiver. The receiver does not acknowledge (increment its receive state variable) the I frame causing the sequence error, or any I frame which may follow, until an I frame with the correct N(S) is received.

An STE which receives one or more valid I frames having sequence errors but otherwise error-free shall accept the control information contained in the N(R) field and the P bit to perform link control functions; e.g., to receive acknowledgement of previously transmitted I frames. Therefore, the retransmitted frame may contain an N(R) and a P bit that are up-dated from, and therefore different from, the ones contained in the originally transmitted I frame.

2.3.5.3 *REJ recovery*

The REJ is used to initiate an exception recovery (retransmission) following the detection of a N(S) sequence error.

Only one "sent REJ" exception condition from an STE is established at a time. A "sent REJ" exception condition is cleared when the requested I frame is received.

An STE receiving REJ initiates sequential (re-)transmission of I frames starting with the I frame indicated by the N(R) obtained in the REJ frame.

2.3.5.4 *Time-out recovery*

If an STE, due to a transmission error, does not receive (or receives and discards) a single I frame or the last I frame in a sequence of I frames, it will not detect an out-of-sequence exception condition and therefore will not transmit an REJ. The STE which transmitted the unacknowledged I frame(s) shall, following the completion of a system specified time-out period, (see 2.4.4.9 and 2.4.7.1 below) take appropriate recovery action to determine at which I frame retransmission must begin.

2.3.5.5 *Invalid frame and FCS error*

Any invalid frame (see 2.2.9 above) or any frame received with an FCS error will be discarded and no action is taken as the result of that frame.

2.3.5.6 *Frame rejection condition*

A frame rejection condition is established upon the receipt of an error-free frame with one of the first three conditions listed in 2.3.4.7 above.

This exception is reported by sending an FRMR.

Once an STE has established an FRMR exception, no additional I or S frames are accepted, except for examination of the P bit.

2.4 *Description of the procedure*

2.4.1 *Procedure for addressing*

Commands are sent with the remote STE address and responses are sent with the local STE address. These STE addresses are coded as follows:

Address	1 2 3 4 5 6 7 8
A	1 1 0 0 0 0 0 0
B	1 0 0 0 0 0 0 0

A and B are assigned by bilateral agreement between the Administrations.

2.4.2 *Procedure for the use of the poll final bit*

The next response frame returned by the STE to an SABM/SABME or DISC command with poll bit set to 1 will be a UA or DM response with the final bit set to 1. The next response frame returned to an I frame with the poll bit set to 1, received during the information transfer phase, will be an RR, REJ or RNR response in supervisory format with the final bit set to 1.

The next response frame returned to a supervisory command frame with the poll bit set to 1, received during the information transfer phase, will be an RR, REJ or RNR response with the final bit set to 1.

The response frame returned to an S or I frame with the poll bit set to 1, received in the disconnected phase, will be a DM with final bit set to 1.

The P bit is used by the STE in conjunction with the time-out recovery condition (see 2.4.4.9 below).

When not used the P/F bit is set to 0.

Note. – Other use of the P bit by the STE is a subject for further study.

2.4.3 *Procedures for link set-up and disconnection*

The STE will indicate that it is able to set up the link by transmitting contiguous flags (active channel state).

2.4.3.1 *Link set-up*

Either STE may initialize the link by sending SABM/SABME (modulo 8/modulo 128) and starting Timer T1. The opposite STE, upon receiving SABM/SABME correctly, sends UA and resets both its state variables to 0. If UA is received correctly, then the link is set up and the initiating STE resets both its state variables to 0 and stops Timer T1.

If, upon receipt of SABM/SABME correctly, the STE determines that it cannot enter the indicated phase, it sends the DM response.

When receiving the DM response, the STE which has transmitted an SABM/SABME stops its Timer T1 and does not enter the information transfer phase.

The STE sending SABM/SABME will ignore and discard any frames except SABM/SABME, DISC, UA and DM from the other STE.

Frames other than UA and DM in response to a received SABM/SABME will be sent only after the link is set up and if no outstanding SABM/SABME exists.

If an SABM/SABME or DISC command, UA or DM response is not received correctly, the result will be that the Timer T1 will run out in the STE which originally sent the SABM/SABME and that the STE may re-send SABM/SABME and restart Timer T1.

After transmission of SABM/SABME N2 times by the STE, appropriate recovery action will be initiated.

The value of N2 is defined in 2.4.7.2 below.

2.4.3.2 *Information transfer phase*

After setting up the link, in this phase the STE will accept and transmit I and S frames according to the procedures described in 2.4.4 below.

When receiving an SABM/SABME (modulo 8/modulo 128) command while in the information transfer phase, the STE will conform to the resetting procedure described in 2.4.6 below.

2.4.3.3 *Link disconnection*

During the information transfer phase either STE shall indicate a request for disconnecting the link by transmitting a DISC command and it shall start Timer T1 (see 2.4.7 below).

The STE, on correctly receiving a DISC command, will send a UA response and enter the disconnected phase. The STE, on receiving a UA or DM response to a sent DISC command, stops its timer, and enters the disconnected phase. If a UA or DM response is not received correctly, this will result in the expiration of the Timer T1 in the STE which originally sent the DISC command. If Timer T1 runs out, this STE will retransmit a DISC command and restart Timer T1. This action will continue until a UA response or a DM response is correctly received or until recovery takes place at a higher level after transmission of DISC N2 times. The value of N2 is defined in 2.4.7.2 below.

2.4.3.4 *Procedures in a disconnected phase*

2.4.3.4.1 The STE in the disconnected phase will monitor received commands and will react to the receipt of an SABM/SABME (modulo 8/modulo 128) as described in 2.4.3.1 above and will transmit a DM response in answer to a received DISC command.

When receiving any other command frame with the poll bit set to 1, the STE will transmit a DM response with the final bit set to 1. Other frames in the disconnected phase will be ignored.

2.4.3.4.2 After recovery from an internal malfunction, the STE may either initiate a resetting procedure (see 2.4.6.2 below) or disconnect the link (see 2.4.3.3 above) prior to a link set-up procedure (see 2.4.3.1 above).

2.4.3.5 *Collision of unnumbered commands*

Collision situations shall be resolved in the following way:

2.4.3.5.1 If the sent and received U commands are the same, each STE shall send the UA response at the earliest possible opportunity. Each STE shall enter the indicated phase after receiving a UA response.

2.4.3.5.2 If the sent and received U commands are different, each STE shall enter the disconnected phase and issue a DM response at the earliest possible opportunity. However, the actions to be taken by each STE on collision of an SABM and SABME command are for further study.

2.4.4 *Procedures for information transfer*

The procedures which apply to the transmission of I frames in each direction during the information transfer phase are described below.

In the following "number 1 higher" is in reference to a continuously repeated sequence series, i.e. 7 is 1 higher than 6 and 0 is 1 higher than 7 for modulo 8 series, and 127 is 1 higher than 126 and 0 is 1 higher than 127 for modulo 128 series.

2.4.4.1 *Sending I frames*

When the STE has an I frame to transmit (i.e. an I frame not already transmitted, or having to be retransmitted as described in 2.4.4.6 below), it will transmit it with an N(S) equal to its current send state variable V(S), and an N(R) equal to its current receive state variable V(R). At the end of the transmission of the I frame, it will increment its send state variable V(S) by 1.

If the Timer T1 is not running at the instant of transmission of an I frame, it will be started.

Note. – It is for further study to determine whether Timer T1 will be restarted or not influenced if it is running at the instant of transmission of an I frame.

If the send state variable V(S) is equal to the last value of N(R) received plus k (where k is the maximum number of outstanding frames – see 2.4.7.4) the STE will not transmit any new I frames, but may retransmit an I frame as described in 2.4.4.6 or 2.4.4.9 below.

When the STE is in a busy condition, it may still transmit I frames provided that the other STE is not busy itself. When in the frame rejection condition, the STE will stop transmitting I frames.

2.4.4.2 *Receiving an I frame*

2.4.4.2.1 When the STE is not in a busy condition and receives with correct FCS an I frame whose send sequence number is equal to the STE receive state variable V(R), the STE will accept the information field of this frame, increment by 1 its receive state variable V(R), and act as follows:

i) If an I frame is available for transmission by the STE, it may act as in 2.4.4.1 above and acknowledge the received I frame by setting N(R) in the control field of the next transmitted I frame to the value of the STE receive state variable V(R). The STE may also acknowledge the received I frame by transmitting an RR with the N(R) equal to the value of the STE receive state variable V(R).

ii) If no I frame is available for transmission by the STE, it will transmit an RR with the N(R) equal to the value of the STE receive state variable V(R).

2.4.4.2.2 When the STE is in a busy condition, it may ignore N(S) and the information field contained in any received I frame.

2.4.4.3 *Reception of out of sequence frames*

When the STE receives with correct FCS an I frame whose send sequence number is incorrect, i.e. not equal to the current STE receive state variable V(R), it will discard the information content of the frame and transmit an REJ response with the N(R) set to 1 higher than the N(S) of the last correctly received I frame. The STE will then discard the information content of all frames until the expected frame is correctly received. When receiving the expected frame, the STE will then acknowledge the frame as described in 2.4.4.2 above. The STE will use the N(R) and P bit indications in the discarded I frames.

2.4.4.4 *Reception of incorrect frames*

When the STE receives a frame with incorrect FCS, an invalid frame (see 2.2.9 above) or a frame with an address other than A or B, this frame will be discarded.

2.4.4.5 Receiving acknowledgement

When correctly receiving an I or S frame (RR, RNR or REJ), except in the frame rejection condition, the STE will consider the N(R) contained in this frame as an acknowledgement for all I frames it has transmitted with an N(S) up to the received N(R) − 1. The STE will reset Timer T1.

If there are outstanding I frames still unacknowledged, it will restart Timer T1. If the Timer then runs out, the STE will follow the retransmission procedure (in 2.4.4.9 below) in respect of the unacknowledged frames.

2.4.4.6 *Receiving reject*

When receiving an REJ, the STE will set its send state variable V(S) to the N(R) received in the REJ control field. It will transmit the corresponding I frame as soon as it is available or retransmit it. Retransmission will conform to the following procedure:

i) If the STE is transmitting a S or U command or response when it receives the REJ, it will complete that transmission before commencing transmission of the requested I frame.

ii) If the STE is transmitting an I frame when the REJ is received, it may abort the frame and commence transmission of the requested I frame immediately after abortion.

iii) If the STE is not transmitting any frame when the REJ is received, it will commence transmission of the requested I frame immediately.

In all cases, if other unacknowledged I frames have already been transmitted following the one indicated in the REJ, then those I frames will be retransmitted by the STE following the retransmission of the requested I frame.

If the REJ frame was received from the other STE as a command with the P bit set to 1, the STE will transmit an RR, RNR or REJ response with the F bit set to 1 before transmitting or retransmitting the corresponding I frame.

2.4.4.7 *Receiving RNR*

After receiving an RNR, the STE may transmit or retransmit the I frame with the send sequence number equal to the N(R) indicated in the RNR. If Timer T1 runs out after the reception of RNR, the STE will follow the procedure described in 2.4.4.9 below. In any case the STE will not transmit any other I frame before receiving an RR or REJ, or the completion of a resetting procedure.

2.4.4.8 *STE busy condition*

When the STE enters a busy condition, it will transmit an RNR response at the earliest opportunity. While in the busy condition, the STE will accept and process supervisory frames and return an RNR response with the F bit set to 1 if it receives a S frame or an I frame with the P bit set to 1. To clear the busy condition, the STE will transmit either an REJ or an RR with N(R) set to the current receive state variable V(R) depending on whether or not it discarded information fields of correctly received I frames.

2.4.4.9 *Waiting acknowledgement*

The STE maintains an internal retransmission count variable which is set to 0 when the STE receives a UA or RNR or sends a UA response, or when the STE correctly receives an I or S frame with the N(R) higher than the last received N(R) (actually acknowledging some outstanding frames).

If Timer T1 runs out, the STE will enter the timer recovery condition, add 1 to its retransmission count variable and set an internal variable *x* to the current value of its send state variable.

The STE will restart Timer T1, set its send state variable to the last N(R) received from the opposite STE and retransmit the corresponding I frame with the P bit set to 1.

If, while in the timer recovery condition, the STE correctly receives an S frame with the F bit set to 1 and with an N(R) within the range from its current send state variable to *x* included, it will clear the timer recovery condition and set its send state variable to the received N(R).

If, while in the timer recovery condition, the STE correctly receives a frame with the F bit set to 0 and with an N(R) within the range from its current send state variable to *x* included, it will not clear the timer recovery condition. The received N(R) may be used to update the send state variable. However, the STE may decide to keep the last transmitted I frame in store (even if it is acknowledged) in order to be able to retransmit it with the P bit set to 1 when Timer T1 expires at a later time.

If Timer T1 runs out in the timer recovery condition, the STE will add 1 to its retransmission count variable.

If the retransmission count variable is equal to N2, the STE initiates a resetting procedure for both directions of transmission as described in 2.4.6.2 below. N2 is a system parameter (see 2.4.7.2 below).

Note. – Although the STE will implement the internal variable *x*, other mechanisms do exist that achieve the identical functions.

2.4.5 *Frame rejection condition*

2.4.5.1 Frame rejection conditions are established when receiving, during the information transfer phase, a frame with correct FCS and with one of the first three conditions listed in 2.3.4.7 above.

Under these conditions, the STE will ask the other STE to reset the link by transmitting an FRMR response as described in 2.4.6.3 below.

Note. – It is for further study to decide whether for the conditions 4 to 7 in 2.3.4.7 above, the STE will ask the other STE to reset the link by transmitting an FRMR response as described in 2.4.6.3 or send an SABM/SABME command to reset the link according to 2.4.6.2 below.

2.4.6 *Procedures for resetting*

2.4.6.1 The resetting procedures are used to initialize both directions of information transmission. The procedures only apply during the information transfer phase.

2.4.6.2 The STE shall indicate a resetting of both directions of transmission by sending an SABM/SABME (modulo 8/modulo 128) command and starting Timer T1. After receiving an SABM/SABME command, the STE will return, at the earliest opportunity, a UA response and reset its send and receive state variable V(S) and V(R) to 0 and stop Timer T1 unless it has sent an SABM/SABME or DISC itself. If the UA is received correctly by the initial STE, it resets its send and receive state variables to 0 and stops Timer T1.

This also clears one and/or both STEs busy condition if present.

If a DM response is received, the STE will enter the disconnected phase and stop its Timer T1. If Timer T1 runs out before a UA or DM response is received, the SABM/SABME command will be retransmitted and Timer T1 will be started. After Timer T1 runs out N2 times, appropriate recovery action will be initiated and the STE will enter the disconnected phase. The value of N2 is defined in 2.4.7.2 below.

The reaction of an STE in the case of collision of SABM, SABME or DISC command is described in 2.4.3.5 above.

Other commands or responses received by the STE before completion of the reset procedure will be discarded.

2.4.6.3 Under certain rejection conditions listed in 2.3.4.7 above, one STE may ask the other STE to reset the link by transmitting an FRMR response.

After transmitting an FRMR response, the STE will enter the frame rejection condition. The frame rejection condition is cleared when the STE receives an SABM/SABME (modulo 8/modulo 128) or DISC command. Any other frame received while in the frame rejection condition will cause the STE to retransmit the FRMR response with the same information field as originally transmitted.

In the frame rejection condition additional I frames will not be transmitted and received I frames and S frames will be discarded by the STE.

The final bit in an FRMR frame has no significance and therefore it will not be checked by the receiving STE.

Note. – Timer T1 may be started on transmission of the FRMR response and the STE may then, after Timer T1 has run out N2 times, reset the link as described in 2.4.6.2 above.

2.4.7 *List of system parameters*

The system parameters are as follows:

2.4.7.1 *Timer T1*

Timer T1, at the end of which retransmission of a frame may be initiated, is a system parameter agreed for a period of time between the Administrations.

The period of Timer T1 will take into account whether the timer is started at the beginning or end of transmission of the frame in the STE.

The proper operation of the procedure requires that Timer T1 be greater than the maximum time between transmission of a command frame and reception of the corresponding frame returned as an answer to this frame.

2.4.7.2 *Maximum number of transmissions N2*

The value of the maximum number N2 of transmission and retransmissions of a frame following the running out of Timer T1 is a system parameter agreed for a period of time between Administrations.

2.4.7.3 *Maximum number of bits in a frame N1*

The maximum number of bits in a frame (excluding flags and 0 bits inserted for transparency) is a system parameter which depends upon the maximum length of the information fields transferred across the X/Y interface.

2.4.7.4 *Maximum number of outstanding frames k*

The maximum number (k) of sequentially numbered I frames that the STE may have outstanding (i.e. unacknowledged) at any given time is a system parameter which can never exceed 7/127 (modulo 8/modulo 128). It shall be agreed for a period of time between Administrations and shall have the same value for both the STEs.

3. LEVEL 3 – PACKET SIGNALLING PROCEDURES BETWEEN SIGNALLING TERMINALS

General Principles

This section of the Recommendation relates to the transfer of packets at the STE-X/STE-Y (X/Y) interface. The procedures apply to packets which are successfully transferred across the X/Y interface.

Each packet to be transferred across the X/Y interface shall be contained in the information field of an I frame in the link access procedure. The number of packets contained in the information field of an I frame is to be decided and until this study is completed only one packet is contained in the information field of an I frame.

To enable simultaneous virtual calls, a logical channel group number (in the range 0 to 15 inclusive) and a logical channel number (in a range 0 to 255 inclusive) are assigned to the virtual call during the call set-up phase. The range of logical channels and logical channel groups that are available for assignment to virtual calls is agreed bilaterally for a period of time.

The combination of logical channel number 0 and logical channel group number 0 will not be used for virtual calls.

During the existence of a particular virtual call, each packet related to that call uses the STEs selected at call set-up.

The accounting principle which assumes that in all cases, including that of transit switching, the originating country or network will be responsible for recording accounting information, will apply to public packet-switched data networks.

The following text together with Annexes 1, 2 and 3 specifies for each logical channel the states, received packets and consequent actions in an STE. Packet formats are defined and explained in 4. of this Recommendation.

Note. – The need for any procedures, particularly for permanent virtual circuit, other than the switched virtual circuit procedures specified is for further study.

3.1 *Procedure for virtual call set-up and clearing*

Virtual calls will be set up and cleared according to the procedures described hereunder. The procedures for call set-up and clearing are only applicable when a logical channel is in the *Level 3 ready* state (r1). In all other *r* states these procedures are not applicable.

3.1.1 *Ready state*

If there is no call or call attempt in existence and if call set-up is possible, the logical channel is in the *Ready* state (p1), within the *Level 3 ready* state (r1).

3.1.2 *Call request packet*

An STE indicates a call request by transferring a *call request* packet which specifies a logical channel in the *Ready* state (p1) across the X/Y interface. The logical channel selected by the calling STE is then in the STE *Call request* state (p2/3). If this state persists for more than *y* minutes the calling STE will clear the call. The value of *y* is for further study.

3.1.3 *Call connected packet*

The called STE will indicate acceptance of the call by the called DTE by transferring across the X/Y interface a *call connected* packet specifying the same logical channel as that of the *call request* packet. This places the specified logical channel in the *Flow control ready* state (d1) within the *Data transfer* state (p4). The procedure applying to the *Data transfer* state is specified in 3.3 below.

3.1.4 *Call collision*

Call collision occurs when the STE – X receives a *call request* packet when it is in state *p2* or if the STE – Y receives a *call request* packet when it is in state *p3.* In these cases, both calls shall be cleared. The clearing cause field shall be coded *network congestion.*

In order to reduce the occurrence of this situation, inverse order testing of logical channels will be used. The *call request* packet of one STE will use the logical channel in the *Ready* state with the lowest number; the *call request* packet of the other STE will use the logical channel in the *Ready* state with the highest number. Which STE will use the lowest number and which the highest number will be agreed bilaterally.

3.1.5 *Clear request packet and call progress signals*

An STE may request clearing of a logical channel in any state by transferring across the X/Y interface a *clear request* packet specifying the logical channel. If the *STE Clear request* state persists for more than three minutes, the STE may again request clearing. This may be continued and indicated by an alarm at an appropriate time. This procedure may be discontinued at any stage.

The clearing cause field will be coded according to the reason for clearing. Each STE shall be capable of generating the distinct codes for all of the call progress signals specified in Recommendation X.96 for the packet-switched data transmission service.

Note. – When *network congestion* occurs, it may be necessary to signal additional network-related information across the X/Y interface as to why the call is being cleared. The manner in which this is done is for further study.

3.1.6 *Clear confirmation packet*

When an STE-X or STE-Y (STE X/Y) has received a *clear request* packet, it will free the logical channel, whatever the state of the logical channel except the *STE X/Y Clear request* state (p6 or p7 respectively), and transfer across the X/Y interface a *clear confirmation* packet specifying the same logical channel. The logical channel is placed in the *Ready* state (p1) within the *Level 3 ready* state (r1). The receipt of a *clear confirmation* packet cannot be interpreted as an indication of the remote DTE being cleared.

3.1.7 *Clear collision*

If a logical channel is in the *STE X/Y Clear request* state (p6 or p7 respectively) and the STE X/Y receives a *clear request* packet specifying the same logical channel, this STE will consider the clearing completed and will not transmit a *clear confirmation* packet. This logical channel is now in the *Ready* state (p1) within the *Level 3 ready* state (r1).

3.2 *Procedure for permanent virtual circuits*

This procedure remains for further study.

3.3 *Procedure for data and interrupt transfer*

The data transfer procedure described below applies independently to each logical channel existing at the X/Y interface.

Normal network operation dictates that user data in *data* packets and interrupt data are all passed transparently, unaltered through the network. The order of bits in *data* packets is preserved. A packet sequence received by an STE is always delivered as a complete packet sequence. Diagnostic codes are treated as described in 4.2.3 and 4.4.3 below.

3.3.1 *States for data transfer in virtual calls*

Data, interrupt, flow control and *reset* packets may be transmitted and received by an STE in the *Data transfer* state (p4) of the *Level 3 ready* state (r1) of a logical channel at the X/Y interface. Only in this state, do the flow control and reset procedures described in 3.4 below apply to data transmission on that logical channel to and from the STE. In all other *r* or *p* states the data and interrupt transfer, flow control, and reset procedures are not applicable.

3.3.2 *Numbering of data packets*

Each *data* packet transmitted at the X/Y interface for each direction of transmission in a virtual call is sequentially numbered. This sequential numbering is performed regardless of the level of data [value of the qualifier (Q) bit].

The sequence numbering scheme of the packets is performed modulo 8 or 128. This modulo is common to all logical channels at the X/Y interface. The packet sequence numbers cycle through the entire range 0 to 7 or 0 to 127 respectively. The selection of modulo 8 or 128 is done by bilateral agreement.

Only *data* packets contain this sequence number called the *packet send sequence number* P(S).

After the virtual call has been established or reset, the first *data* packet to be transmitted across the X/Y interface for a given direction of data transmission has a *packet send sequence number* equal to 0.

3.3.3 *Data field length of data packets*

The maximum data field length is 128 octets. The data field may contain any number of bits from 0 up to 1024 (128 octets).

If an STE receives a *data* packet having a data field exceeding 128 octets, it will clear the virtual call indicating the cause *network congestion.*

Note. – The use of other maximum data field lengths is for further study.

3.3.4 *More data bit and qualifier bit*

A packet sequencing method is provided to enable coherent transmission of data longer than 128 octets. Each packet sequence consists of any number (including 0) of full *data* packets (full means that the data field contains 1024 bits) followed by one other packet of any length up to (and including) the maximum. All of the packets in the complete packet sequence except the last packet will have the more data bit set to 1 and the last packet will have the more data bit set to 0. If an STE receives a packet which is not full but which has the more data bit set to 1, it may reset the virtual circuit; the resetting cause shall be *network congestion.*

The value of the Q bit should not change within a packet sequence. If an STE detects that the value of this bit has changed within a packet sequence, it may reset the virtual circuit; the resetting cause shall be *network congestion.*

Note. – It is left for further study if a means should be provided for conveying more explicit, network related, resetting cause information in *reset* packets.

3.3.5 *Interrupt procedure*

The interrupt procedure allows a DTE to transmit data to the remote DTE, without following the flow control procedure applying to *data* packets between STEs (see 3.4 below). The interrupt procedure can only apply in the *Flow control ready* state (d1) within the *Data transfer* state (p4).

The interrupt procedure has no effect on the transfer and flow control procedures applying to the *data* packets on the virtual call.

An STE conveys an interrupt by transferring across the X/Y interface an *interrupt* packet. The other STE will convey the interrupt confirmation by transferring an *interrupt confirmation* packet.

The receipt of an *interrupt confirmation* packet indicates that the interrupt has been confirmed by the remote DTE by means of a *DTE interrupt confirmation* packet.

A STE receiving a further *interrupt* packet in the time between receiving one *interrupt* packet and transferring the interrupt confirmation, may either discard this *interrupt* packet or reset the virtual circuit.

3.4 *Procedure for flow control and for reset*

The procedures for flow control of data packets and for reset only apply to the *Data transfer* state (p4) and are specified below.

3.4.1 *Procedure for flow control*

At the X/Y interface of each logical channel used for a virtual call, the transmission of *data* packets is controlled separately for each direction and is based on authorizations from the receiver.

3.4.1.1. *Window description*

At the X/Y interface of each logical channel used for a virtual call, a window is defined for each direction of data transmission as the ordered set of W consecutive *packet send sequence numbers* of the *data* packets authorized to cross the interface.

The lowest *sequence number* in the window is referred to as the lower window edge. When a virtual call at the X/Y interface has just been established or reset, the window related to each direction of data transmission has a lower window edge equal to 0. The *packet send sequence number* of the first *data* packet not authorized to cross the interface is the value of the lower window edge plus W (modulo 8 or 128).

The maximum value of the different window sizes at the X/Y interface is common to all the logical channels and is agreed for a period of time bilaterally. This value does not exceed 7 or 127.

For a particular virtual call two window sizes may be selected, one for each direction of transmission. These window sizes may be less than or equal to the above-mentioned maximum. The two sizes are selected by reference to a utility in the network utility field of the *call request* packet and the *call connected* packet, and, in some cases, by reference also to a correspondence table relating window size to throughput class. This table is agreed for a period of time between Administrations.

3.4.1.2 *Flow control principles*

A number modulo 8 or 128 referred to as a *packet receive sequence number* P(R), conveys across the X/Y interface information from the receiver for the transmission of *data* packets. When transmitted across the X/Y interface, a P(R) becomes the lower window edge. In this way, additional *data* packets may be authorized by the receiver to cross the X/Y interface.

When the *sequence number* P(S) of the next *data* packet to be transmitted by the STE is within the window, the STE is authorized to transmit this *data* packet to the other STE, which may then accept it. When the *sequence number* P(S) of the next *data* packet to be transmitted by the STE is outside the window, the STE shall not transmit a *data* packet to the other STE. Otherwise, the other STE will consider the receipt of this *data* packet as a procedure error and will reset the virtual call.

The *packet receive sequence number*, P(R), is conveyed in *data*, *receive ready* (RR) and *receive not ready* (RNR) packets, and implies that the STE transmitting the P(R) has accepted at least all *data* packets numbered up to and including P(R) – 1.

The value of a P(R) received by the STE must be within the range starting from the last P(R) received by the STE up to and including the *packet send sequence number* of the next *data* packet to be transmitted by the STE. Otherwise, the STE will consider the receipt of this P(R) as a procedure error and will reset the virtual call.

The only universal significance of a P(R) value is a local updating of the window across the packet level interface.

The P(R) value may be used within some Administrations' networks to convey an end-to-end acknowledgement.

3.4.1.3. *STE receive ready (RR) packet*

RR packets are used by the STE to indicate that it is ready to receive the W *data* packets within the window starting with P(R), where P(R) is indicated in the *RR* packet.

3.4.1.4 *STE receive not ready (RNR) packet*

RNR packets are used by the STE to indicate a temporary inability to accept additional *data* packets for a given virtual call. An STE receiving an *RNR* packet shall stop transmitting *data* packets on the indicated logical channel.

The receive not ready situation indicated by the transmission of an *RNR* packet is cleared by the transmission in the same direction of an *RR* packet or by a reset procedure being initiated.

The transmission of an *RR* after an *RNR* at the packet level is not to be taken as a demand for retransmission of packets which have already been transmitted but are still in the window indicated in the *RNR.*

3.4.2 *Procedure for reset*

The reset procedure is used to reinitialize the virtual call. The reset procedure only applies in the *Data transfer* state of the X/Y interface. In any other state of the interface the reset procedure is abandoned.

When a virtual call at the X/Y interface has just been reset, the window related to each direction of data transmission has a lower window edge equal to 0, and the numbering of subsequent *data* packets to cross the X/Y interface for that direction of data transmission shall start from 0.

3.4.2.1 *Reset request packet*

The STE shall indicate a request for reset by transmitting a *reset request* packet specifying the logical channel. This places the logical channel in the *Reset request* state (d2 or d3).

In this state, the STE will discard *data, interrupt, RR* and *RNR* packets.

3.4.2.2 *Reset collision*

Reset collision occurs when both STEs transfer a *reset request* packet. In this case both STEs shall consider that resetting is complete and shall not transfer a *reset confirmation* packet. The logical channel is then in the *Flow control ready* state (d1).

3.4.2.3 *Reset confirmation packet*

When the logical channel is in the *Reset request* state, the requested STE will confirm reset by transmitting to the requesting STE a *reset confirmation* packet. This places the logical channel in the *Flow control ready* state (d1).

The *reset confirmation* packet can only be interpreted universally as having local significance; however within some Administrations' networks, reset confirmation may have end-to-end significance. In all cases, the time spent in the *Reset request* state (d2 or d3) will not exceed a network dependent limit. The limit will be lower than *t* minutes. The value of *t* is for further study.

3.4.2.4 *Effect of reset procedure on data and interrupt packets*

Data and *interrupt* packets, transmitted by an STE before a reset procedure is initiated at its X/Y interface, will either be delivered before the corresponding reset procedure is completed at the remote DTE/DCE interface, or discarded.

The first *data* and *interrupt* packets transmitted by an STE after a reset procedure is completed at its interface will be the first packets delivered after the corresponding reset procedure is completed at the remote DTE/DCE interface.

Data and *interrupt* packets transmitted by an STE after a reset procedure has been initiated by the other STE will be discarded by the latter STE until the reset procedure has been completed at the X/Y interface.

3.5 *Procedure for restart*

The restart procedure is used to clear simultaneously all the virtual calls at the X/Y interface.

3.5.1 *Restart by the STE*

The STE may at any time request a restart by transferring across the X/Y interface a *restart request* packet. The interface for each logical channel is then in the *Restart request* state (r2 or r3).

In this state of the X/Y interface, the STE will discard all packet types except *restart request* and *restart confirmation* packets.

On receipt of a *restart request* packet, an STE shall clear all virtual calls and shall place all assigned logical channels in the *Ready* state (p1) within the *Level 3 ready* state (r1). The STE shall return a *restart confirmation* packet unless a collision has occurred.

The *restart confirmation* packet can only be interpreted universally as having local significance. The time spent in the *Restart request* state (r2 or r3) will not exceed a network dependent limit. The limit is for further study.

3.5.2 *Restart collision*

Restart collision can occur when both STEs transfer *restart request* packets. Under this circumstance, both STEs will consider that the restart is completed and will not expect a *restart confirmation* packet, neither will they transfer a *restart confirmation* packet.

3.6 *List of system parameters*

The system parameters applying to level 3 are for further study. This study should include considerations of timeouts, numbers of retries, and action to be taken when these maximum numbers are reached.

3.7 *Relationship between levels*

Changes of operational states of levels 1 and 2 of the X/Y interface do not implicitly change the state of each logical channel at level 3. Such changes, when they occur, are explicitly indicated at level 3 by the use of restart, clear or reset procedures as appropriate.

However, in the following cases it may be appropriate to initiate the restart procedure, and accept no more new calls:

a) level 1: circuit trouble duration exceeds predetermined time *T*,

b) level 2: N2-time-retries of link set-up or disconnection command.

4. PACKET FORMATS FOR VIRTUAL CALLS

4.1 *General*

The formats of X.75 packets are based on the general structure of packets in Recommendation X.25. It is anticipated that modification in X.25 control packet formats will also be adopted in X.75.

The possible extension of packet formats by the addition of new fields is for further study.

Bits of an octet are numbered 8 to 1 where bit 1 is the low order bit and is transmitted first. Octets of a packet are consecutively numbered starting from 1 and are transmitted in this order.

4.1.1 *General format identifier*

The general format identifier field is a four bit binary coded field which is provided to indicate the general format of the rest of the header. The general format identifier field is located in bit positions 8, 7, 6, and 5 of octet 1, and bit 5 is the low order bit (see Table 9/X.75).

Bit 8 of the general format identifier is used for the qualifier (Q) bit in *data* packets and is set to 0 in all other packet types. Two of the remaining eight possible codes are used to distinguish packets using modulo 8 sequence numbering from packets using modulo 128 sequence numbering. Other codes of the general format identifier are not assigned at present.

Note. – It is envisaged that unassigned codes could identify alternative packet formats associated with other services.

TABLE 9/X.75 – **General format identifier**

General format identifier		Octet 1 Bits 8	7	6	5
Data packets	Sequence numbering scheme modulo 128	X	0	1	0
	Sequence numbering scheme modulo 8	X	0	0	1
Call set-up and clearing, flow control, interrupt, reset and restart packets	Sequence numbering scheme modulo 128	0	0	1	0
	Sequence numbering scheme modulo 8	0	0	0	1

Note. – A bit which is indicated as X may be set to either 0 or 1 as specified in the text and in Figures 6/X.75 and 7/X.75.

4.1.2 *Logical channel group number*

The logical channel group number appears in every packet except in *restart* packets (see 4.5 below) in bit positions 4, 3, 2 and 1 of octet 1. This field is binary coded and bit 1 is the low order bit of the logical channel group number.

For each logical channel, this number has local significance at the X/Y interface.

4.1.3 *Logical channel number*

The logical channel number appears in every packet except in *restart* packets (see 4.5 below) in all bit positions of octet 2. This field is binary coded and bit 1 is the low order bit of the logical channel number.

For each logical channel, this number has local significance at the X/Y interface.

4.1.4 *Packet type identifier*

Each packet shall be identified in the octet 3 of the packet according to Table 10/X.75.

TABLE 10/X.75 – **Packet type identifier**

Packet type	Octet 3 Bits 8	7	6	5	4	3	2	1
Call set-up and clearing								
Call request	0	0	0	0	1	0	1	1
Call connected	0	0	0	0	1	1	1	1
Clear request	0	0	0	1	0	0	1	1
Clear confirmation	0	0	0	1	0	1	1	1
Data and interrupt								
Data	X	X	X	X	X	X	X	0
Interrupt	0	0	1	0	0	0	1	1
Interrupt confirmation	0	0	1	0	0	1	1	1
Flow control and reset								
Receive ready (modulo 128)	0	0	0	0	0	0	0	1
Receive ready (modulo 8)	X	X	X	0	0	0	0	1
Receive not ready (modulo 128)	0	0	0	0	0	1	0	1
Receive not ready (modulo 8)	X	X	X	0	0	1	0	1
Reset request	0	0	0	1	1	0	1	1
Reset confirmation	0	0	0	1	1	1	1	1
Restart								
Restart request	1	1	1	1	1	0	1	1
Restart confirmation	1	1	1	1	1	1	1	1

Note. – A bit which is indicated as X may be set either to 0 or 1 as specified in the text and in Figures 2/X.75 to 17/X.75.

4.2 *Call set-up and clearing packets*

4.2.1 *Call request packet*

Figure 2/X.75 illustrates the format of a *call request* packet. In this figure the user facility length field, user facilities field, and call user data field are as defined in Recommendation X.25.

4.2.1.1. *Address length field*

Octet 4 consists of field length indicators for the called and calling DTE addresses. Bits 4, 3, 2 and 1 indicate the length of the called DTE address in semi-octets. Bits 8, 7, 6, and 5 indicate the length of the calling DTE address in semi-octets. Each address length indicator is binary coded and bit 1 or 5 is the low order bit of the indicator.

4.2.1.2 *Address field*

Octet 5 and the following octets consist of the called DTE international data number followed by the calling DTE international data number.

Each digit of an address is coded in a semi-octet in binary coded decimal with bit 5 or 1 being the low order bit of the digit.

Starting from the high order digit, the address is coded in octet 5 and consecutive octets with two digits per octet. In each octet, the higher order digit is coded in bits 8, 7, 6 and 5.

The address field shall be rounded up to an integral number of octets by inserting 0s in bits 4, 3, 2, and 1 of the last octet of the field when necessary.

4.2.1.3. *Network utility length field*

Bits 6 through 1 of the octet following the address field indicate the length of the network utility field in octets.

The network utility length field indicator is binary coded and bit 1 is the low order bit.

Bits 8 and 7 of this octet are unassigned and set to 0.

4.2.1.4 *Network utility field*

The network utility field contains an integral number of octets. The length of this field depends on the utilities present. The maximum length of this field is 62 octets.

The coding of the network utility field is defined in 5. below.

4.2.1.5 *User facility length field*

Bits 6 through 1 of the octet following the network utility field indicate the length of the facility field in octets. The user facility length indicator is binary coded and bit 1 is the low order bit.

Bits 8 and 7 of this octet are set to 0.

4.2.1.6 *User facility field*

The user facility field contains an integral number of octets. The length of this field depends on the facilities present. The maximum length of this field is 62 octets. The coding of the facility field is dependent on the facility being requested as defined in Recommendation X.25.

4.2.1.7 *Call user data field*

Following the user facility field, user data may be present. The call user data field may contain any number of bits from 0 up to 128 (16 octets). The contents of the field are passed unchanged.

4.2.2 *Call connected packet*

Figure 3/X.75 illustrates the format of a *call connected packet.* Similarly to the *call request* packet, the *call connected* packet contains:

- an address length field,
- an address field,
- a network utility length field, and
- a network utility field.

The coding of these fields is the same as that in the *call request* packet (see 4.2.1 above). The address field may be empty.

Note. – The inclusion of the user facility length field and the user facility field is for further study.

4.2.3 *Clear request packet*

Figure 4/X.75 illustrates the format of a *clear request* packet.

Clearing cause field

Octet 4 is the clearing cause field and contains the reason for the clearing of the call.

The coding of the clearing cause field in a *clear request* packet is given in Table 11/X.75.

Diagnostic code

Octet 5 is the diagnostic code and may contain additional information on the reason for the clearing of the call.

The coding is for further study. However, this field is set to 0 when not used.

TABLE 11/X.75 – **Coding of clearing cause field in a clear request packet**

	Bits							
	8	7	6	5	4	3	2	1
DTE Clearing	0	0	0	0	0	0	0	0
Number busy	0	0	0	0	0	0	0	1
Out of order	0	0	0	0	1	0	0	1
Remote procedure error	0	0	0	1	0	0	0	1
Reverse charging not subscribed	0	0	0	1	1	0	0	1
Invalid call	0	0	0	0	0	0	1	1
Access barred	0	0	0	0	1	0	1	1
Network congestion	0	0	0	0	0	1	0	1
Not obtainable	0	0	0	0	1	1	0	1
DTE incompatible call	0	0	1	0	0	0	0	1

4.2.4 *Clear confirmation packet*

Figure 5/X.75 illustrates the format of the *clear confirmation* packet.

4.3 *Data and interrupt packets*

4.3.1 *Data packet*

Figures 6/X.75 and 7/X.75 illustrate the format of the *data* packets in the case of modulo 8 and modulo 128 respectively.

Qualifier

Bit 8 in octet 1 is used for the *qualifier.*

Packet receive sequence number

In Figure 6/X.75 bits 8, 7 and 6 of octet 3 are used for indicating the *packet receive sequence number* P(R). P(R) is binary coded and bit 6 is the low order bit. In Figure 7/X.75 bits 2 through 8 of octet 4 are used for the *packet receive sequence number* and bit 2 is the low order bit.

More data indication

In Figure 6/X.75, bit 5 in octet 3 is used for the More data indication. In Figure 7/X.75, bit 1 in octet 4 is used for the More data indication (0 for no more data and 1 for more data).

Packet send sequence number

In Figure 6/X.75, bits 4, 3 and 2 of octet 3 are used for indicating the *packet send sequence number* P(S). P(S) is binary coded and bit 2 is the low order bit. In Figure 7/X.75, bits 2 through 8 of octet 3 are used for the *packet send sequence number* and bit 2 is the low order bit.

User data field

The bits following octet 3 (modulo 8) or octet 4 (modulo 128) contain user data.

4.3.2 *Interrupt packet*

Figure 8/X.75 illustrates the format of the *interrupt* packet.

Interrupt user data field

Octet 4 contains user data.

4.3.3 *Interrupt confirmation packet*

Figure 9/X.75 illustrates the format of the *interrupt confirmation* packet.

4.4 *Flow control and reset packets*

4.4.1 *Receive ready (RR) packet*

Figures 10/X.75 and 11/X.75 illustrate the format of *receive ready* packets in the case of modulo 8 and modulo 128 respectively.

Packet receive sequence number

In Figure 10/X.75, bits 8, 7, and 6 of octet 3 are used for indicating the *packet receive sequence number* P(R). P(R) is binary coded and bit 6 is the low order bit. In Figure 11/X.75, bits 2 through 8 of octet 4 are used for the *packet receive sequence number* and bit 1 is the low order bit.

4.4.2 *Receive not ready (RNR) packet*

Figures 12/X.75 and 13/X.75 illustrate the format of *receive not ready* packets in the case of modulo 8 and modulo 128 respectively.

Packet receive sequence number

In Figure 12/X.75, bits 8, 7 and 6 of octet 3 are used for indicating the *packet receive sequence number* P(R). P(R) is binary coded and bit 6 is the low order bit. In Figure13/X.75, bits 2 through 8 of octet 4 are used for the *packet receive sequence number* and bit 1 is the low order bit.

4.4.3 *Reset request packet*

Figure 14/X.75 illustrates the format of the *reset request* packet.

Resetting cause field

Octet 4 is the resetting cause field and contains the reason for the reset.

The coding of the resetting cause field in a *reset request* packet is given in Table 12/X.75.

TABLE 12/X.75 – **Coding of resetting cause field in reset request packet**

	Bits							
	8	7	6	5	4	3	2	1
DTE Reset	0	0	0	0	0	0	0	0
Out of order [a])	0	0	0	0	0	0	0	1
Remote procedure error	0	0	0	0	0	0	1	1
Network congestion	0	0	0	0	0	1	1	1
Remote DTE operational	0	0	0	0	1	0	0	1
Network operational	0	0	0	0	1	1	1	1

[a]) Applicability of out of order is for further study.

Diagnostic code

Octet 5 is the diagnostic code and may contain additional information on the reason for the reset.

The bits of the diagnostic code field are all set to 0 when no specific reason for the reset is supplied. Other values are not specified at this time.

4.4.4 *Reset confirmation packet*

Figure 15/X.75 illustrates the format of the *reset confirmation* packet.

4.5 *Restart packets*

4.5.1 *Restart request packet*

Figure 16/X.75 illustrates the format of the *restart request* packet. Bits 4, 3, 2 and 1 of the first octet and all bits of the second octet are set to 0.

Restarting cause field

Octet 4 is the restarting cause field and contains the reason for the restart.

The coding of the restarting cause field in the *restart request* packets is given in Table 13/X.75.

TABLE 13/X.75 – **Coding of restarting cause field in restart request packet**

	Bits							
	8	7	6	5	4	3	2	1
Network congestion	0	0	0	0	0	0	1	1
Network operational	0	0	0	0	0	1	1	1

Diagnostic code

Octet 5 is the diagnostic code and may contain additional information on the reason for the restart.

The bits of the diagnostic code field are all set to 0 when no specific reason for the restart is supplied. Other values are not specified at this time.

4.5.2 *Restart confirmation packet*

Figure 17/X.75 illustrates the format of the *restart confirmation* packet. Bits 4, 3, 2 and 1 of the first octet and all bits of the second octet are set to 0.

Number of octets	Bits 8	7	6	5	4	3	2	1
1	General format identifier (see Note)				Logical channel group number			
1	Logical channel number							
1	Packet type identifier 0	0	0	0	1	0	1	1
1	Calling DTE address length				Called DTE address length			
15 (max)	Called and calling DTEs addresses							
1	0	0	Network utility length					
62 (max)	Network utilities							
1	0	0	User facility length					
62 (max)	User facilities							
16 (max)	Call user data							

Note. – Coded 0001 (modulo 8) or 0010 (modulo 128).

FIGURE 2/X.75 – **Call request packet format**

Number of octets	Bits 8	7	6	5	4	3	2	1
1	General format identifier (see Note)				Logical channel group number			
1	Logical channel number							
1	Packet type identifier 0	0	0	0	1	1	1	1
1	Calling DTE address length				Called DTE address length			
15 (max)	Called and calling DTEs addresses							
1	0	0	Network utility length					
62 (max)	Network utilities							

Note. – Coded 0001 (modulo 8) or 0010 (modulo 128).

FIGURE 3/X.75 – **Call connected packet format**

Octets	Bits 8	7	6	5	4	3	2	1
1	General format identifier (see Note)				Logical channel group number			
2	Logical channel number							
3	Packet type identifier 0	0	0	1	0	0	1	1
4	Clearing cause							
5	Diagnostic code							

Note. – Coded 0001 (modulo 8) or 0010 (modulo 128).

FIGURE 4/X.75 – **Clear request packet format**

Octets	Bits 8	7	6	5	4	3	2	1
1	General format identifier (see Note)				Logical channel group number			
2	Logical channel number							
3	Packet type identifier							
	0	0	0	1	0	1	1	1

Note. – Coded 0001 (modulo 8) or 0010 (modulo 128).

FIGURE 5/X.75 – **Clear confirmation packet format**

Octets	Bits 8	7	6	5	4	3	2	1
1	General format identifier				Logical channel group number			
	Q	0	0	1				
2	Logical channel number							
3	P(R)			M	P(S)			0
	User data							

M = More data indication
Q = Qualifier

Note. – The figure assumes that the user data field does not contain an integral number of octets.

FIGURE 6/X.75 – **Data packet format (modulo 8)**

Bits

Octets	8	7	6	5	4	3	2	1
1	General format identifier				Logical channel group number			
	Q	0	1	0				
2	Logical channel number							
3	P(S)							0
4	P(R)							M
	User data							

M = More data indication
Q = Qualifier

Note. – The figure assumes that the user data field does not contain an integral number of octets.

FIGURE 7/X.75 – **Data packet format (modulo 128)**

Bits

Octets	8	7	6	5	4	3	2	1
1	General format identifier (see Note)				Logical channel group number			
2	Logical channel number							
3	Packet type identifier							
	0	0	1	0	0	0	1	1
4	Interrupt user data							

Note. – Coded 0001 (modulo 8) or 0010 (modulo 128).

FIGURE 8/X.75 – **Interrupt packet format**

Bits

Octets	8	7	6	5	4	3	2	1
1	General format identifier (see Note)				Logical channel group number			
2	Logical channel number							
3	Packet type identifier							
	0	0	1	0	0	1	1	1

Note. – Coded 0001 (modulo 8) or 0010 (modulo 128).

FIGURE 9/X.75 – **Interrupt confirmation packet format**

Octets	Bits 8	7	6	5	4	3	2	1
1	General format identifier 0	0	0	1	Logical channel group number			
2	Logical channel number							
3	P(R)			0	0	0	0	1

FIGURE 10/X.75 – **RR packet format (modulo 8)**

Octets	Bits 8	7	6	5	4	3	2	1
1	General format identifier 0	0	1	0	Logical channel group number			
2	Logical channel number							
3	0	0	0	0	0	0	0	1
4	P(R)							0

FIGURE 11/X.75 – **RR packet format (modulo 128)**

Octets	Bits 8	7	6	5	4	3	2	1
1	General format identifier 0	0	0	1	Logical channel group number			
2	Logical channel number							
3	P(R)			0	0	1	0	1

FIGURE 12/X.75 – **RNR packet format (modulo 8)**

Octets	Bits 8	7	6	5	4	3	2	1
1	General format identifier 0	0	1	0	Logical channel group number			
2	Logical channel number							
3	0	0	0	0	0	1	0	1
4	P(R)							0

FIGURE 13/X.75 – **RNR packet format (modulo 128)**

Octets	Bits 8	7	6	5	4	3	2	1
1	General format identifier (see Note)				Logical channel group number			
2	Logical channel number							
3	Packet type identifier 0	0	0	1	1	0	1	1
4	Resetting cause							
5	Diagnostic code							

Note. – Coded 0001 (modulo 8) or 0010 (modulo 128).

FIGURE 14/X.75 – **Reset request packet format**

Bits

Octets	8	7	6	5	4	3	2	1
1	General format identifier (see Note)				Logical channel group number			
2	Logical channel number							
3	Packet type identifier							
	0	0	0	1	1	1	1	1

Note. – Coded 0001 (modulo 8) or 0010 (modulo 128).

FIGURE 15/X.75 – **Reset confirmation packet format**

Bits

Octets	8	7	6	5	4	3	2	1
1	General format identifier (see Note)				0	0	0	0
2	0	0	0	0	0	0	0	0
3	Packet type identifier							
	1	1	1	1	1	0	1	1
4	Restarting cause							
5	Diagnostic code							

Note. – Coded 0001 (modulo 8) or 0010 (modulo 128).

FIGURE 16/X.75 – **Restart request packet format**

Bits

Octets	8	7	6	5	4	3	2	1
1	General format identifier (see Note)				0	0	0	0
2	0	0	0	0	0	0	0	0
3	Packet type identifier							
	1	1	1	1	1	1	1	1

Note. – Coded 0001 (modulo 8) or 0010 (modulo 128).

FIGURE 17/X.75 – **Restart confirmation packet format**

5. PROCEDURES AND FORMATS FOR USER FACILITIES AND NETWORK UTILITIES

5.1 *Description of optional user facilities*

User facilities signalled in the user facility field are described in 5.1 of Recommendation X.25. User facilities are conveyed through an STE which may examine and store them.

5.2 *Formats for optional user facilities*

The formats for optional user facilities are described in 5.2 of Recommendation X.25.

5.3 *Procedures for network utilities*

The network utility field is a network administrative signalling mechanism in the *call request* and *call connected* packets. The network utility field complements the user facility field and serves to separate user service signalling from network administrative signalling. The request for a service through an optional facility may, in certain instances, require the use of a network utility.

5.3.1 *Transit network identification* (mandatory in the *call request* and *call connected* packets)

The transit network identification is a mandatory utility in the *call request* and *call connected* packets that names a transit network controlling a portion of the (perhaps partially established) virtual circuit. A transit network is identified by the first 4 digits of the international data number.

In the *call request* packet, all transit networks controlling the virtual circuit up to this point of call set-up are signalled. When more than one transit network is identified, the order of identification in the network utility field is identical to the order of traversal of transit networks following the path being established from the calling DTE to the destination network.

In the *call connected* packet, all transit networks are identified. When there is more than one transit network, the identification order in the network utility field is identical to the order of traversal of transit networks following the path established from the calling to called DTE.

5.3.2 *Call identifier* (mandatory in the *call request* packet)

The call identifier is a mandatory network utility in the *call request* packet. The call identifier parameter is established by the originating network and is an identifying name for each virtual circuit established. The call identifier when used in conjunction with the calling DTE address, uniquely identifies the virtual call. The uniqueness is only guaranteed over a period of time. The duration of this time period is for further study.

The use of the call identifier in the *call connected* packet is for further study.

5.3.3 *Throughput class indication* (mandatory in the *call request* and in the *call connected* packets)

The throughput class indication is a network utility which specifies the actual data transfer rate in both directions that the STE does not need to exceed for this switched virtual circuit. This network utility allows an STE to operate with a specific window size for each direction of data transfer, depending on the throughput class indication. For each throughput class, a correspondence agreed between network Administrations for a period of time specifies the window size.

The throughput class indication is a mandatory network utility in the *call request* packet and its parameter values are derived from the calling DTE flow control parameter selection procedure. The throughput class is conveyed unaltered to the terminating network.

The throughput class indication is a mandatory network utility in the *call connected* packet and its parameter values are derived from the throughput classes indicated in the call request, and from the called DTE's characteristics.

5.3.4 *Traffic class indication* (for further study)

The traffic class utility indicates a service category for the virtual circuit being established. The traffic class signals service information (e.g. terminal, facsimile, maintenance) necessary for administering the call. Though their use is beyond the scope of this Recommendation, traffic class may have routing, tariff and other implications. The need for and definition of traffic classes are for further study.

5.3.5 *Window size selection* (for further study)

The window size selection is an optional network utility for selecting the window sizes on a specific logical channel between STEs. The use of this network utility is agreed for a period of time between network Administrations and in its absence, the window size is determined by the throughput class indication.

For each direction of data transfer, STE-X may indicate in the *call request* packet the window size for controlling the flow of data on the logical channel. Additionally, STE-Y may modify the window sizes in the *call connected* packet.

5.3.6 *Estimated transit delay* (for further study)

The estimated transit delay is a network utility that signals the transit delay of the virtual circuit. Packet delays occur at all points along the virtual circuit path. Some networks, such as those with a single node, will have small transit delays while others will have delays comparable to those of satellite channels. The use of satellite channels between STEs and their use internally by some networks will add additional delays to the virtual circuit. Thus, in order to determine expected performance, all sources of delay must be measured.

The procedures and use of the estimated transit delay are for further study.

5.3.7 *Tariffs* (for further study)

5.3.8 *Utility marker* (optional in the *call request* and the *call connected* packets)

A utility marker, consisting of a single octet pair, is used to separate X.75 utilities, as defined under 5. here, from non-X.75 utilities that may be agreed bilaterally by the Administrations.

5.4 *Formats for network utilities*

5.4.1 *General*

The network utility field is present in all *call request* and *call connected* packets exchanged between STEs.

The utility field contains a number of utility elements. Each utility element consists of a utility code followed by a utility parameter.

If multiple instances of a utility parameter are required in the utility field, such as the transit network identification, this information will be presented in multiple utility elements with an identical utility code.

The utility codes are divided into four classes, by the use of bits 7 and 8, in order to specify utility parameters consisting of 1, 2, 3, or a variable number of octets. The general class coding is shown in Table 14/X.75.

TABLE 14/X.75 – **General class coding for network utility field**

	Utility code field Bits 8	7	6	5	4	3	2	1	
Class A	0	0	X	X	X	X	X	X	for single octet parameter field
Class B	0	1	X	X	X	X	X	X	for double octet parameter field
Class C	1	0	X	X	X	X	X	X	for triple octet parameter field
Class D	1	1	X	X	X	X	X	X	for variable length parameter field

Note. – A bit which is indicated as X may be set either to 0 or 1 as discussed in the text.

For class D, the octet following the utility code indicates the length, in octets, of the utility parameter. The utility parameter length is binary encoded and bit 1 is the low order bit.

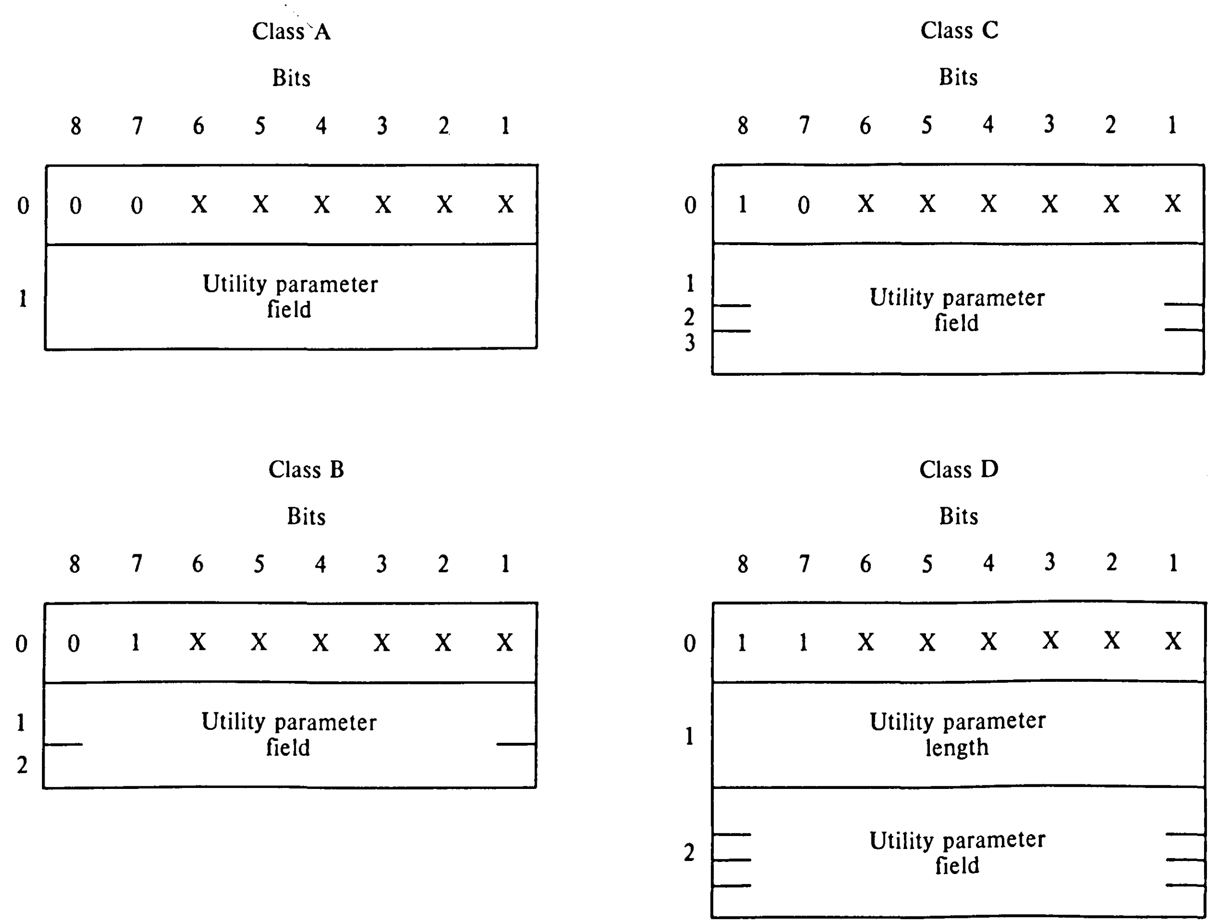


FIGURE 18/X.75 – **Utility code general formats**

The utility code field is binary coded and, without extension, provides for a maximum of 64 utility codes for classes A, B and C and 63 utility codes for class D giving a total of 255 utility codes (see Figure 18/X.75).

Utility code 11111111 is reserved for extension of the utility code. The octet following this octet indicates an extended utility code having the format A, B, C or D as defined in Figure 18/X.75. Repetition of utility code 11111111 is permitted and thus additional extensions result.

The specific coding of the utility parameter field is dependent on the utility being requested.

5.4.2 *Coding of utility field*

Utility codings are the same for *call request* and *call connected* packets.

5.4.2.1 *Coding of transit network identification*

Utility code

The utility code for the transit network identification parameter (DNIC) is:

bit:	8 7 6 5 4 3 2 1
code:	0 1 0 0 0 0 0 1

Utility parameter

Each digit of the first four digits of the international data number is coded in a semi-octet in binary coded decimal with bits 5 and 1 being the low order bit of the digit. The high order digit is coded into bits 8 to 5 of the first octet of the parameter.

5.4.2.2. *Coding of the call identifier*

Utility codes

The call identifier has three octets of parameter data and they are assigned to the following utility code:

bit:	8 7 6 5 4 3 2 1
code:	1 0 0 0 0 0 0 1

Utility parameter

The call identifier consists of 24 bits of binary data.

5.4.2.3 *Coding of throughput class indication*

Utility code

The utility code field for throughput class indication is coded as follows:

bit:	8 7 6 5 4 3 2 1
code:	0 0 0 0 0 0 1 0

Utility parameter

The throughput class for transmission from the calling STE is indicated in bits 4, 3, 2 and 1. The throughput class for transmission from the called STE is indicated in bits 8, 7, 6 and 5.

The four bits indicating each throughput class are binary coded and express the logarithm base 2 of the number of octets per second defining the throughput class. Bit 1 or 5 is the low order bit of each throughput class indicator.

5.4.2.4 *Coding of traffic class indication*

Utility code

The coding of the utility code field for the traffic class indication, assuming a parameter one octet long, is:

bit:	8 7 6 5 4 3 2 1
code:	0 0 0 0 0 0 1 1

Utility parameter

The traffic class parameter is for further study.

5.4.2.5 *Coding of window size selection*

The coding of the window size selection utility is for further study.

5.4.2.6 *Coding of estimated transit delay*

The coding of the estimated transit delay utility is for further study.

5.4.2.7 *Coding of the tariffs*

The coding of the tariffs utility is for further study.

5.4.2.8 *Coding of the utility marker*

Utility code

bit:	8 7 6 5 4 3 2 1
code:	0 0 0 0 0 0 0 0

Utility parameter

bit:	8 7 6 5 4 3 2 1
code:	0 0 0 0 0 0 0 0

ANNEX 1

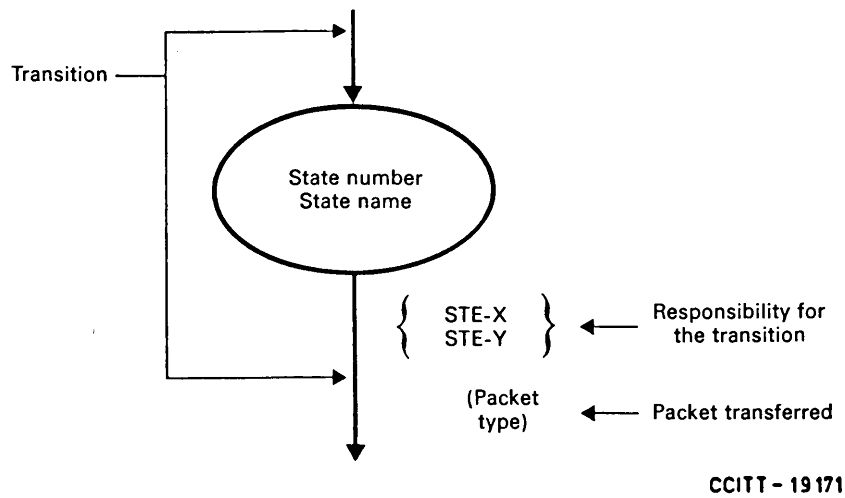
(to Recommendation X.75)

Definition of symbols for Annexes 2 and 3

1. *General*

This Annex contains the definitions for the symbols to be used in Annexes 2 and 3. Annex 2 defines the states of the X/Y interface and the transitions between states in the normal case, while Annex 3 contains the full definition of actions, if any, to be taken on the receipt of packets by an STE.

2. *Symbol definition of the state diagrams*



Note 1. – Each state is represented by an ellipse wherein the state name and number are indicated.

Note 2. – Each state transition is represented by an arrow. The responsibility for the transition (STE-X or STE-Y) and the packet that has been transferred are indicated beside that arrow.

FIGURE 19/X.75 – **Symbol definition of the state diagrams**

3. *Order definition of the state diagrams*

For the sake of clarity, the normal procedure at the interface is described in a number of small state diagrams. In order to describe the normal procedure fully it is necessary to allocate a priority to the different figures and to relate a higher order diagram with a lower one. This has been done by the following means:

– The figures are arranged in order of priority with Fig. 20/X.75 (Restart) having the highest priority and subsequent figures having lower priority. Priority means that when a packet belonging to a higher order diagram is transferred, that diagram is applicable and the lower order one is not.

– The relation with a state in a lower order diagram is given by including that state inside an ellipse in the higher order diagram.

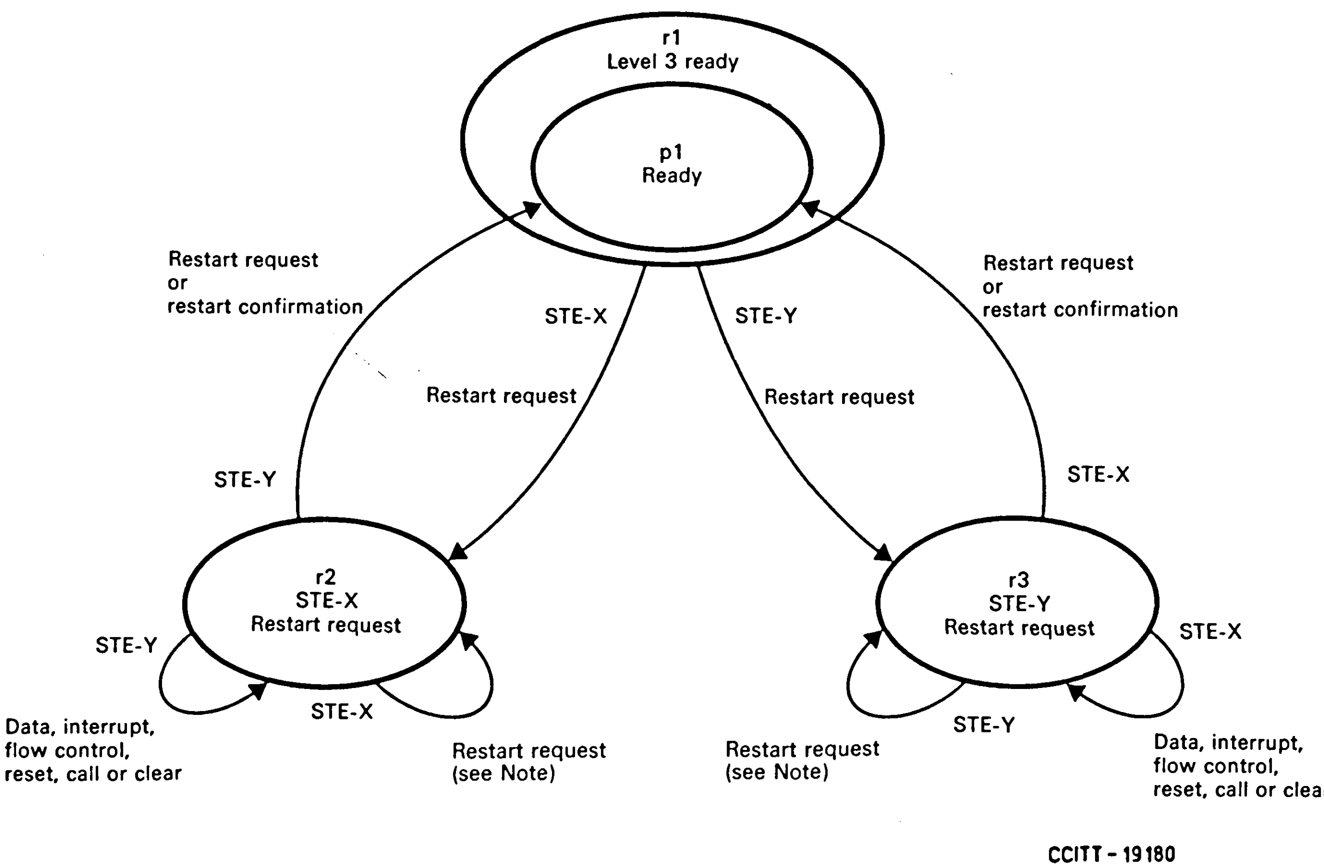
4. *Symbol definition of the action tables*

The entries given in Tables 15-19/X.75 (see Annex 3) indicate the action, if any, to be taken by an STE on receipt of any kind of packet, and the state the STE enters following the action taken which is given in brackets.

ANNEX 2

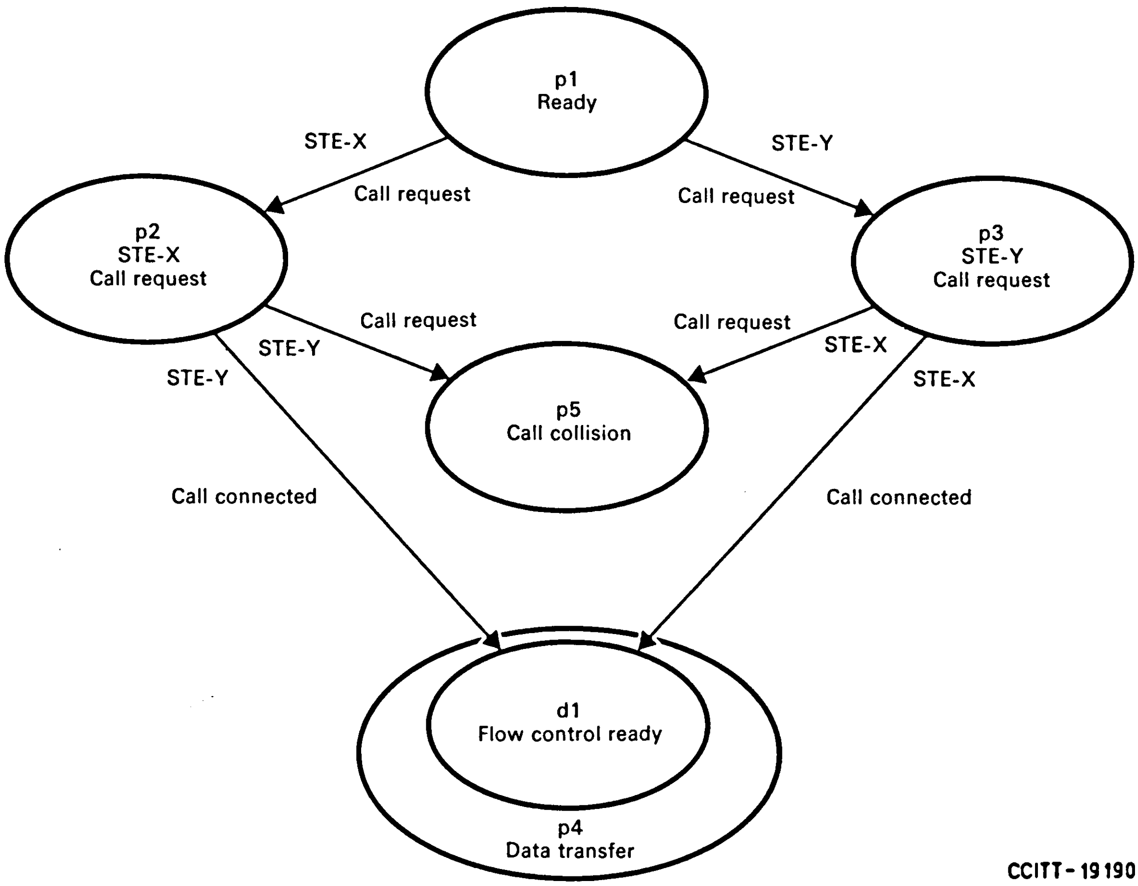
(to Recommendation X.75)

State diagrams for the packet level interface for a logical channel between STEs

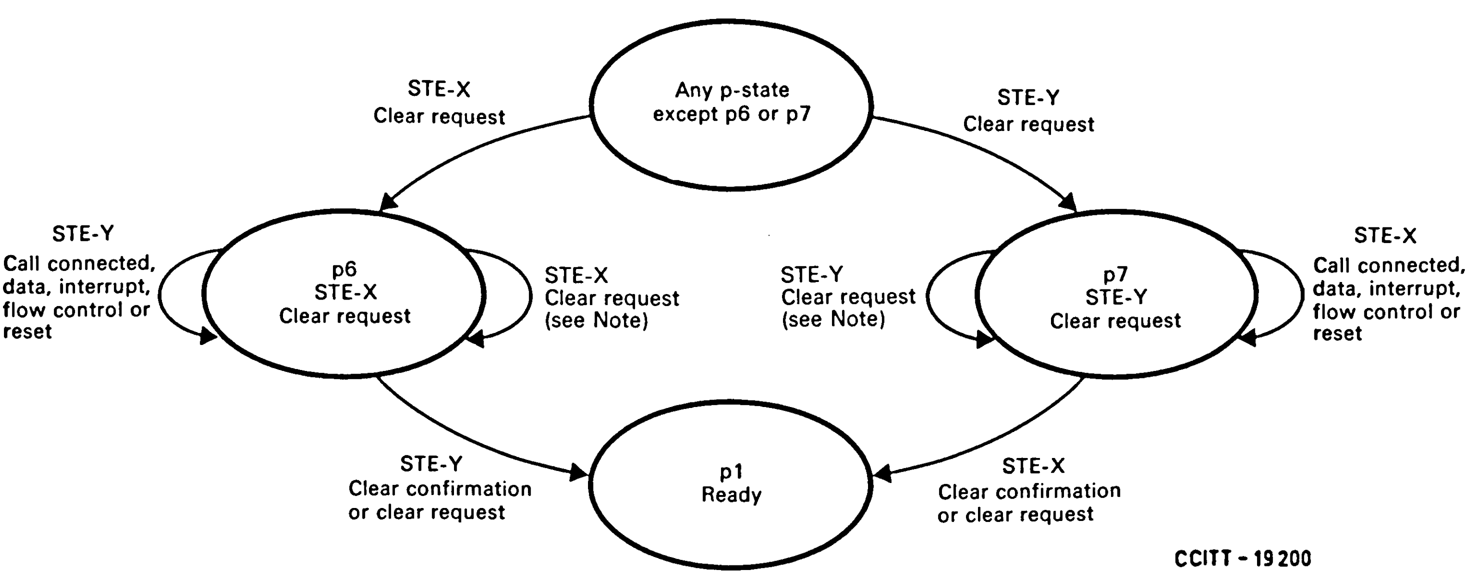


Note. – This transition may take place after a time-out.

FIGURE 20/X.75 – **Diagram of states for the transfer of restart packets**



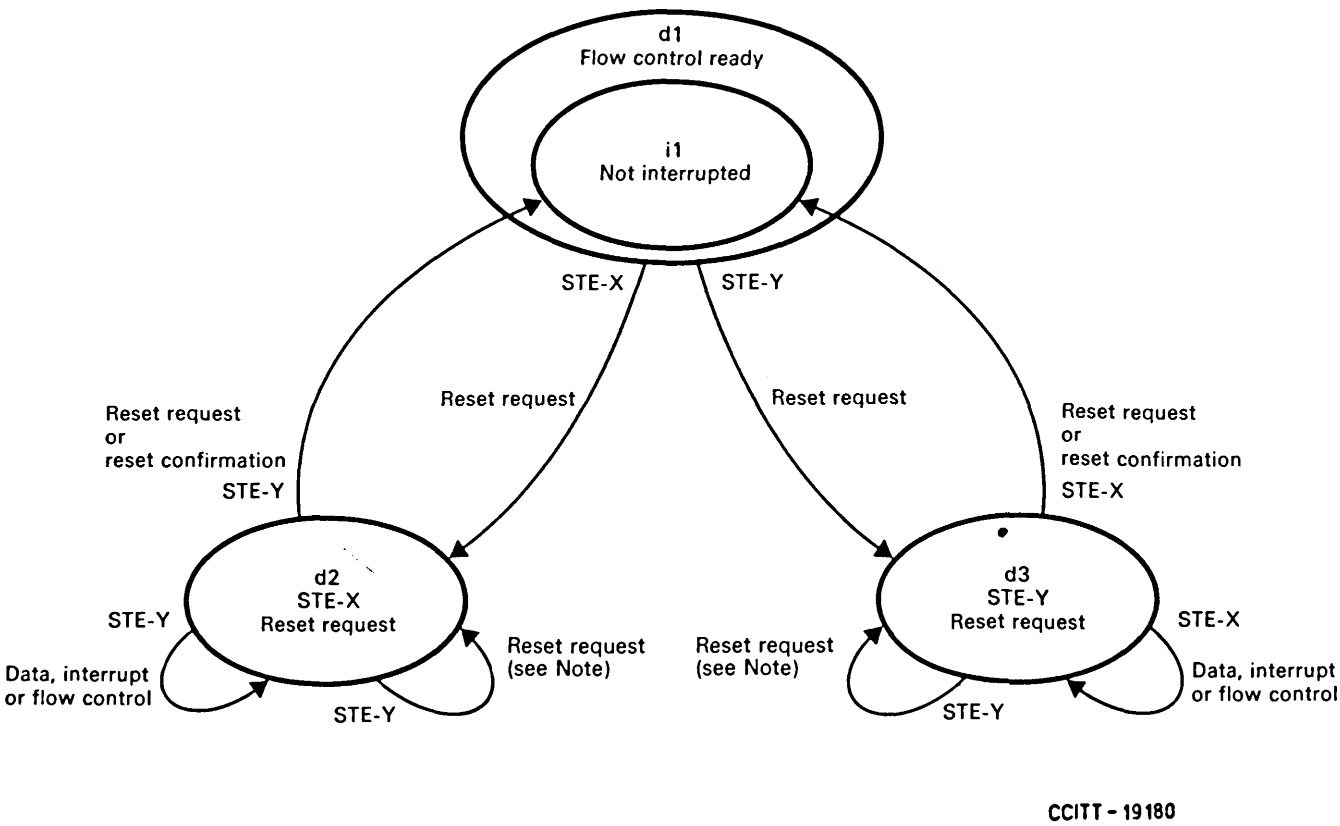
a) Transfer of call establishment packets



b) Transfer of call clearing packets

Note. – This transition may take place after a time-out.

FIGURE 21/X.75 – State diagrams for the transfer of call establishment and call clearing packets within the Level 3 ready (r1) state



Note. – This transition may take place after a time-out.

FIGURE 22/X.75 – **Diagram of states for the transfer of reset packets within the Data transfer (p4) state**

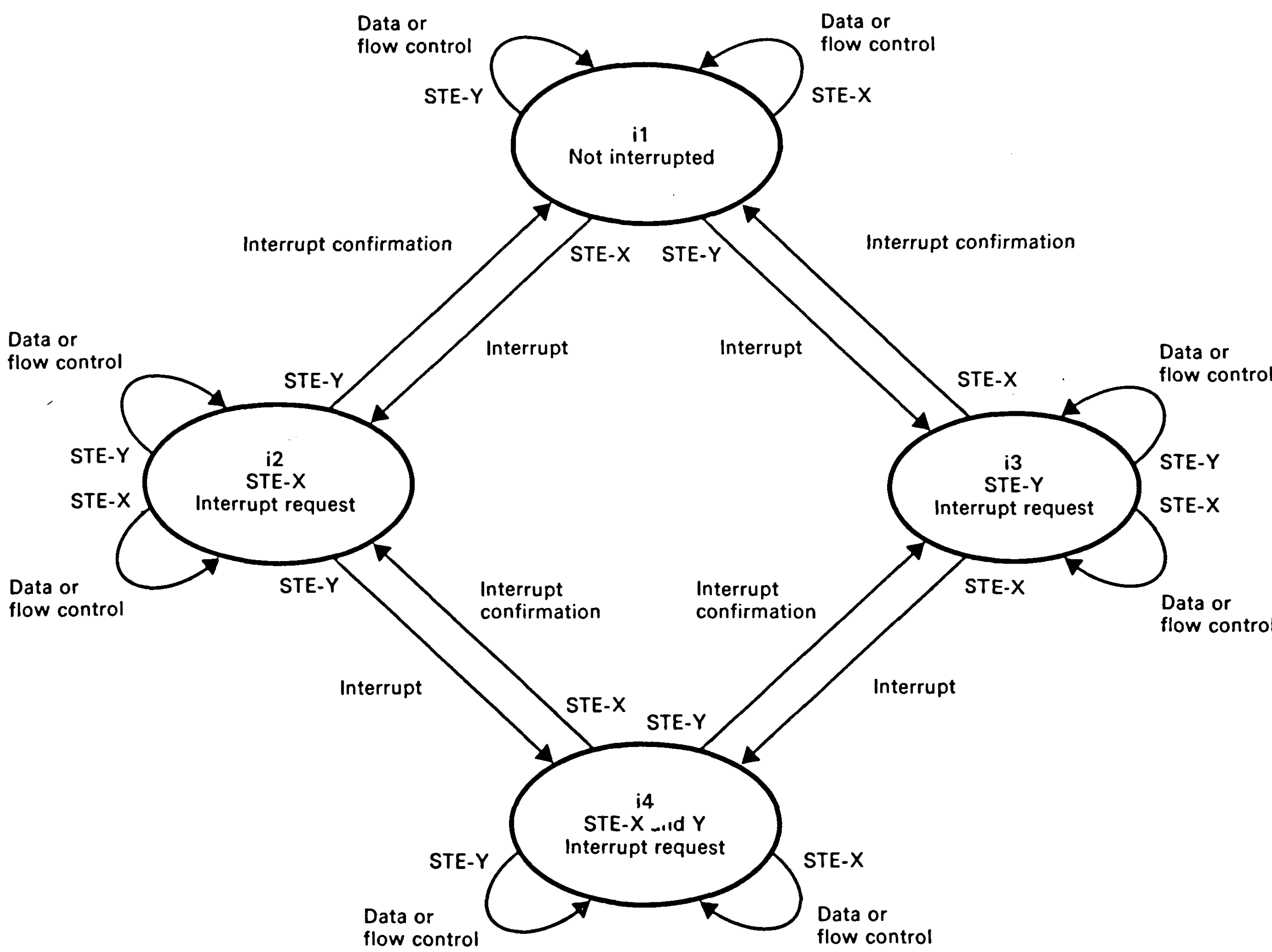


FIGURE 23/X.75 – **Diagram of states for the transfer of data, flow control and interrupt packets within the Flow control ready (d1) state**

ANNEX 3

(to Recommendation X.75)

Actions taken by the STE on receipt of packets in a given state of the packet level X/Y interface

TABLE 15/X.75 – **Action taken by STE-Y on receipt of packets not specifying an assigned logical channel**

State of the interface as perceived by STE-Y / Packet received by STE-Y	Not existent
Any packet with unassigned logical channel	DISCARD
Any packet with less than 2 octets	DISCARD

DISCARD: STE-Y discards the received packet and takes no subsequent action.

Note. – Actions are specified for STE-Y only. STE-X should follow the same procedure.

TABLE 16/X.75 – **Action taken by STE-Y on receipt of packets in a given state: restart**

State of the interface as perceived by STE-Y / F r. ..cd by STE-Y	Level 3 ready r1	STE-X Restart request r2	STE-Y Restart request r3
Restart request	NORMAL (r2)	NORMAL (r2)	NORMAL (r1)
Restart confirmation	ERROR (r3)	ERROR (r3)	NORMAL (r1)
Data, interrupt, flow control, reset, call or clear	See Table 17/X.75	ERROR (r3)	DISCARD (r3)
Restart request or confirmation with bit 1 to 4 of octet 1 or bit 1 to 8 of octet 2 $\neq 0$	ERROR (r3)	ERROR (r3)	ERROR (r3)

NORMAL: The action taken by STE-Y follows the normal procedures as defined in 3. of the text.
DISCARD: STE-Y discards the received packet and takes no subsequent action.
ERROR: STE-Y discards the received packet and indicates restarting with Network congestion cause.

TABLE 17/X.75 – **Action taken by STE-Y on receipt of packets specifying an assigned logical channel in a given state: call establishment and clearing**

Packet received by STE-Y \ State of the interface as perceived by STE-Y	Level 3 ready r1						
	Ready p1	STE-X Call request p2	STE-Y Call request p3	Data transfer p4	Call collision p5	STE-X Clear request p6	STE-Y Clear request p7
Call request	NORMAL (p2)	ERROR (p7)	NORMAL (p5)	ERROR (p7)	ERROR (p7)	ERROR (p7)	ERROR (p7)
Call connected	ERROR (p7)	ERROR (p7)	NORMAL (p4)	ERROR (p7)	ERROR (p7)	ERROR (p7)	DISCARD (p7)
Clear request	NORMAL (p6)	NORMAL (p6)	NORMAL (p6)	NORMAL (p6)	NORMAL (p6)	NORMAL (p6)	NORMAL (p1)
Clear confirmation	DISCARD (p1)	ERROR (p7)	ERROR (p7)	ERROR (p7)	ERROR (p7)	ERROR (p7)	NORMAL (p1)
Data, interrupt, flow control or reset	ERROR (p7)	ERROR (p7)	ERROR (p7)	See Table 18/X.75	ERROR (p7)	ERROR (p7)	DISCARD (p7)
Non-identifiable packet type	ERROR (p7)	ERROR (p7)	ERROR (p7)	ERROR (p7)	ERROR (p7)	ERROR (p7)	ERROR (p7)

NORMAL: The action taken by STE-Y follows the normal procedures as defined in 3. of the text.
DISCARD: STE-Y discards the received packet and takes no subsequent action.
ERROR: STE-Y discards the received packet and indicates clearing with Network congestion cause.

TABLE 18/X.75 – **Action taken by STE-Y on receipt of packets specifying an assigned logical channel in a given state: reset**

Packet received by STE-Y \ State of the interface as perceived by STE-Y	Data transfer p4		
	Flow control ready d1	STE-X Reset request d2	STE-Y Reset request d3
Reset request	NORMAL (d2)	NORMAL (d2)	NORMAL (d1)
Reset confirmation	ERROR (d3)	ERROR (d3)	NORMAL (d1)
Data, interrupt or flow control	see Table 19/X.75	ERROR (d3)	DISCARD (d3)

NORMAL: The action taken by STE-Y follows the normal procedures as defined in 3. of the text.
DISCARD: STE-Y discards the received packet and takes no subsequent action.
ERROR: STE-Y discards the received packet and indicates resetting with Network congestion cause.

TABLE 19/X.75 – **Action taken by STE-Y on receipt of packets specifying an assigned logical channel in a given state: data, interrupt or flow control**

State of the interface as perceived by STE-Y / Packet received by STE-Y	Flow control ready d1			
	Not interrupted i1	STE-X Interrupt request i2	STE-Y Interrupt request i3	STE-X and Y Interrupt request i4
Interrupt	NORMAL (i2)	DISCARD (i2) (see Note) or ERROR 1 (d3)	NORMAL (i4)	DISCARD (i4) (see Note) or ERROR 1 (d3)
Interrupt confirmation	DISCARD (i1)	DISCARD (i2)	NORMAL (i1)	NORMAL (i2)
Data with M or Q bit violation, out of sequence P(S), P(S) outside of window or Data or flow control with invalid P(R)	ERROR 1 (d3)	ERROR 1 (d3)	ERROR 1 (d3)	ERROR 1 (d3)
A first data packet after entering state d1 with P(S) ≠ 0 or A data packet with a too long data field	ERROR 2 (p7)	ERROR 2 (p7)	ERROR 2 (p7)	ERROR 2 (p7)
Valid data or flow control	NORMAL (i1)	NORMAL (i2)	NORMAL (i3)	NORMAL (i4)

NORMAL: The action taken by STE-Y follows the normal procedures as defined in 3. of the text.
DISCARD: STE-Y discards the received packet and takes no subsequent action.
ERROR 1: STE-Y discards the received packet and indicates reset with Network congestion cause.
ERROR 2: STE-Y discards the received packet and indicates clearing with Network congestion cause.

Note. – According to 3.3.5 of the text an STE receiving a further *interrupt* packet in the time between receiving one interrupt packet and transferring the Interrupt confirmation may either discard this *interrupt* packet or reset the virtual circuit.

INTERNATIONAL NUMBERING PLAN FOR PUBLIC DATA NETWORKS

(Geneva, 1978)

The purpose of this International Numbering Plan is to facilitate the introduction of public data networks and provide for their interworking on a worldwide basis.

1. *Design considerations*

The design considerations that form the basis of this Plan are as follows:

1.1 there could be a number of public data networks in a country [1];

1.2 where a number of public data networks are to be established in a country [1], it should not be mandatory to integrate the numbering plans of the various networks;

1.3 the International Numbering Plan should permit the identification of a called country [1] as well as a specific public data network in that country [1];

1.4 the number of digits comprising the code used to identify a country [1] and a specific public data network in that country [1] should be the same for all countries [1];

1.5 a national data number assigned to a data terminal should be unique within a particular national network. This national data number should form part of the international data number which should also be unique on a worldwide basis;

1.6 the number of digits to be used in an international data number should be governed by national and international requirements but a reasonable limit on the overall number of digits should be imposed;

1.7 the Numbering Plan should make provision for the interworking of data terminals on public data networks with data terminals on public telephone and telex networks;

Note. – The term "telex" employed in this Recommendation, includes TWX networks.

1.8 the International Numbering Plan should provide for substantial spare capacity to accommodate future requirements;

1.9 the Numbering Plan should not preclude the possibility of a single national network providing an integrated telecommunications system for services of all kinds;

1.10 where multiple RPOA facilities exist providing service to the same country [1], provision for the selection of a specific RPOA facility should be allowed for in the *facility request* part of the *selection signals.*

Note. – The term RPOA in this Recommendation refers to Recognized Private Operating Agency.

2. *Characteristics and application of the Numbering Plan*

2.1 *Number system*

2.1.1 The 10 digit numeric character set 0-9 should be used for numbers (or addresses) assigned to data terminals on public data networks. This principle should apply to both national and international data numbers.

[1] Country or geographical area.

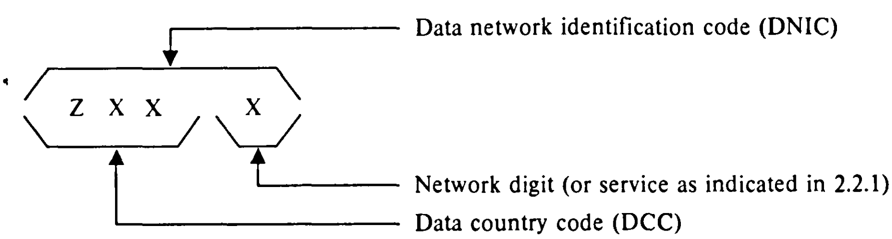
2.1.2 Use of the above number system will make it possible for data terminals on public data networks to interwork with data terminals on public telephone and telex networks.

2.2 *Data network identification codes*

2.2.1 A data network identification code (DNIC) should be assigned to each public data network or, possibly, where all networks are contained within an integrated numbering scheme, to each specific service.

2.2.2 All data network identification codes (DNIC) should consist of four digits. The first three digits should always identify a country [1] and could be regarded as a data country [1] code (DCC). The fourth, or network digit, should identify a specific data network or service in the country [1] as indicated in 2.2.1 above.

2.2.3 Each country [1] should be assigned at least one 3-digit data country [1] code (DCC). The data country [1] code (DCC) in conjunction with the fourth digit can identify up to 10 public data networks. The format for data network identification codes (DNIC) should be as indicated in Figure 1/X.121.



X - denotes any digit from 0 through 9
Z - denotes any digit from 2 through 7 as indicated in 2.2.4

FIGURE 1/X.121 – **Format for data network identification codes (DNIC)**

2.2.4 In the system of data network identification codes, the first digit of such codes should be in accordance with Table 1/X.121.

TABLE 1/X.121 – **First digit of data network identification code**

0 - 1 -	Reserved
2 - 3 - 4 - 5 - 6 - 7 -	For data network identification codes (DNIC)
8 -	For interworking with telex networks
9 -	For interworking with telephone networks

[1] Country or geographical area.

Note 1. – The allocation of codes for non-zoned services, such as the marine satellite services, is for further study. The following points could be considered:

– select a data country [1] code (DCC) in each zone to indicate the location, or

– use an escape DNIC such as 11XX.

Note 2. – Details on the Numbering Plan aspects of interworking between public data networks and public telephone and telex networks will be given in another Recommendation.

2.2.5 The system of data network identification codes (DNIC) indicated in 2.2.3 and 2.2.4 above will provide for 600 data country [1] codes (DCC) and a theoretical maximum of 6000 DNIC.

2.2.6 Should a country [1] have more than 10 public data networks, an additional data country [1] codes(s) (DCC) would be assigned to it.

2.2.7 A list of data country [1] codes (DCC) to be used in the development of data network identification codes (DNIC) is given in Annex 2 to this Recommendation. This list was prepared in accordance with the requirement that the first digit of a DNIC, which is also the first digit of the embedded data country [1] code (DCC) should be restricted to the digits 2-7 inclusive (see 2.2.4 above). As first digits of data country [1] codes (DCC) the digits 2-7 are arranged to represent world zones.

2.2.8 The assignment of data country [1] codes (DCC) is to be administered by the CCITT. The assignment of network digits will be made nationally and the CCITT Secretariat notified.

The Member countries of the International Telecommunication Union not mentioned in this list who wish to take part in the international data service or those Members who require an additional data country [1] code(s) (DCC) should ask the Director of the CCITT for the assignment of an available 3-digit data country [1] code(s) (DCC). In their request, they may indicate the available 3-digit code(s) preferred.

Assignments by the Director of the CCITT of data country [1] codes (DCC) as well as assignments by countries [1] of the network digits will be published in the Operational Bulletin of the International Telecommunication Union.

2.2.9 Examples indicating how data network identification codes (DNIC) could be developed, are given in Annex 1 to this Recommendation.

2.3 *International data number*

2.3.1 A data terminal on a public data network when called from another country [1] should be addressed by its international data number. The international data number should consist of the data network identification code (DNIC) of the called public data network, followed by the network terminal number (NTN) of the called data terminal, or, for example, where an integrated numbering scheme exists within a country [1], the data country [1] code (DCC) followed by the national number (NN) of the called terminal, i.e.:

International data number = DNIC + NTN, or, DCC + NN

2.3.2 The network terminal number (NTN) should consist of the full address that is used when calling the data terminal from within its serving public data network. The national number (NN) should consist of the full address used when calling the data terminal from another terminal within the national integrated numbering scheme. These numbers should consist of all the digits necessary to uniquely identify the data terminal within the serving network and should not include any prefix (or access code) that might be employed for such calling.

---

[1] Country or geographical area.

2.4 *Maximum number of digits*

2.4.1 International data numbers could be of different lengths but should not consist of more than 14 digits. With the data network identification code (DNIC) fixed at 4 digits and the data country [1] code (DCC) fixed at 3 digits, it would, therefore, be possible to have a network terminal number (NTN) of 10 digits maximum, or, a national number (NN) of 11 digits maximum.

Note. – The limit of 14 digits specified above applies exclusively to the address information. Adequate register capacity should be made available at data switching exchanges to accommodate the above address digits as well as any additional digits that might be introduced for signalling, or other purposes.

2.5 *International prefix*

2.5.1 For outgoing international calls from a public data network, an international prefix (or access code) would generally be required to access appropriate facilities for international interworking. The composition of this prefix is a national matter as the prefix does not form part of the international data number. However, the possible need to accommodate such a prefix with regard to digit register capacity in the calling network should be noted.

2.6 *Number analysis – international calls between public data networks*

2.6.1 In the case of international calls between public data networks, provision should be made in originating countries [1] to interpret the first three digits of the international data number. These digits constitute the data country [1] code (DCC) component of the data network identification code (DNIC) and identify the terminal country [1]. This information is required in the originating country [1] for routing purposes.

2.6.2 In originating countries [1], it might also be necessary to interpret the fourth, or network digit, of a DNIC. Such interpretation would provide the identity of a specific network in a country [1] where several public data networks are in service. This information might be required for billing purposes or for the selection of specific routes to called networks.

Note. – With regard to RPOA selection, see 1.10 above.

2.6.3 Countries [1] receiving international calls for public data networks should receive the complete international data number including the data network identification code (DNIC). However, where a country [1] of destination indicates that it does not wish to receive the data country [1] code (DCC) component of the DNIC, arrangements should be made to suppress the DCC.

2.6.4 For destination countries [1] with more than ten public data networks, interpretation of the first three digits of the DNIC [i.e., the data country [1] code (DCC)] would identify the group of networks within which the called network is included. Interpretation of the fourth or network digit of the DNIC would identify the called network in that group. Interpretation of the first three digits would also make it possible to verify that an incoming call has in fact reached the correct country [1].

2.6.5 In the case of destination countries [1] where there are fewer than ten public data networks, the first three digits of the DNIC could provide the verification indicated in 2.6.4 above. Interpretation of the fourth, or network digit, of the DNIC would identify the specific network being called.

2.6.6 In transit countries [1] the complete international data number including the data network identification code (DNIC) must always be received. Interpretation of the first three digits would identify the called country [1]. Interpretation of the fourth or network digit would identify a specific data network or a service in the called country [1]. Interpretation of the fourth digit might be required for billing purposes or for route selection beyond the transit country [1].

2.6.7 Where a data call is to be routed beyond a transit country [1] through a second transit country [1], the complete international data number, including the data network identification code (DNIC) should always be sent to the second transit country [1]. Where the data call is to be routed by a transit country [1] to the country [1] of destination, the arrangements indicated in 2.6.3 above should apply.

---

[1] Country or geographical area.

2.7 *Directories and letterheads*

2.7.1 Directories for public data networks should include information on the procedures to be followed for making international data calls. A diagram, such as that of Figure 2/X.121 could assist the customer in these procedures.

2.7.2 With regard to the prefix (or access code) shown in Figure 2/X.121, it should be noted that the same prefix (designated P) could be used for all three types of calls. The choice of prefix is, however, a national matter.

2.7.3 With regard to RPOA selection (see 1.10 above) it should be noted that an RPOA facility request designator would be used only in international data calls. Provision of this facility as well as the designation of the RPOA facility selection designator is a national matter in the originating country [1].

2.7.4 With regard to the publication of international data numbers on letterheads or other written material, it is recommended that the network terminal number (NTN) or national number (NN) should be easily distinguished within the international number, i.e. that there be a space between the 4-digit DNIC and the network terminal number (NTN) or, between the 3-digit data country [1] code (DCC) and the national number (NN), where the fourth digit of the DNIC is included in the national number (NN).

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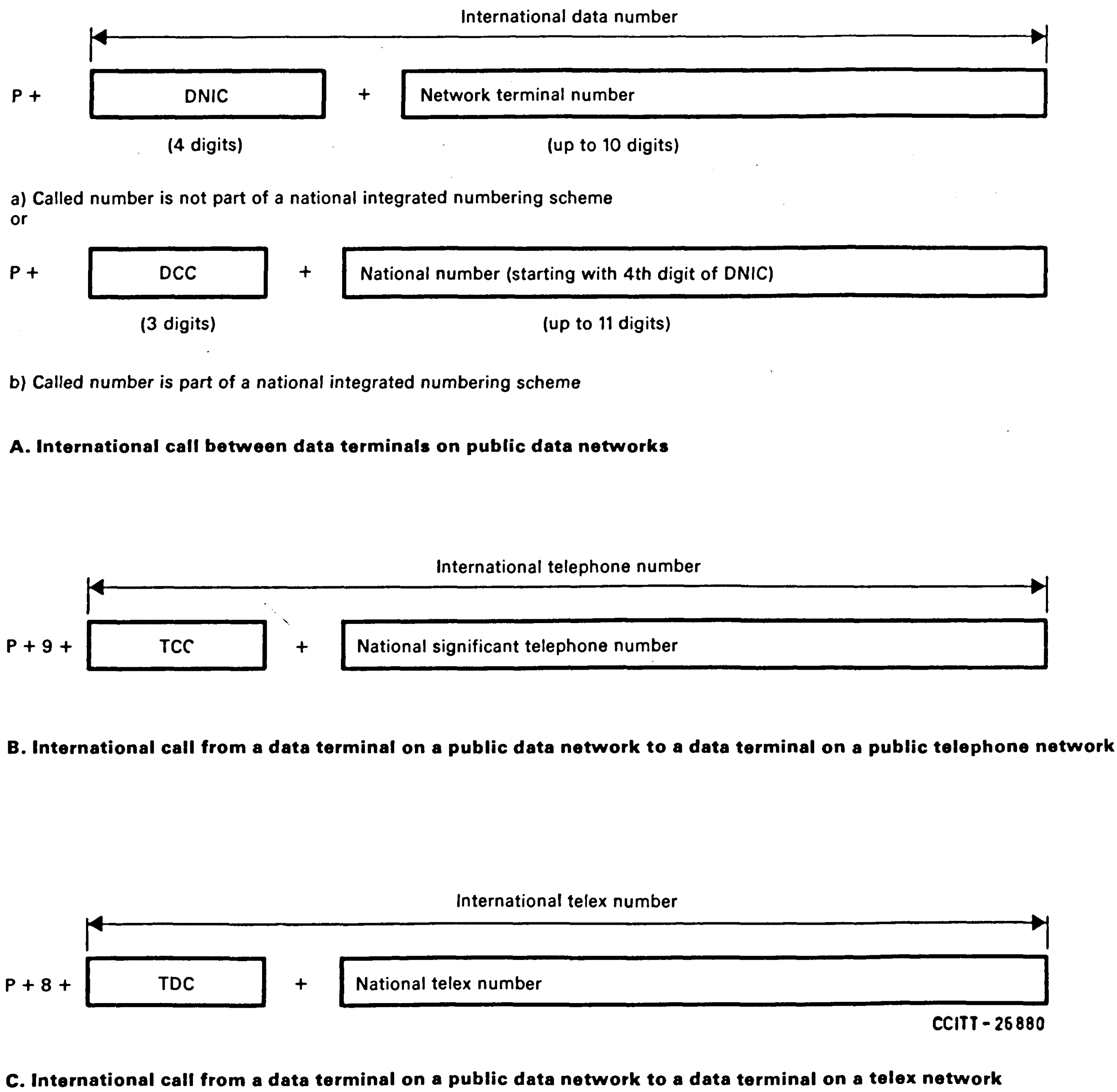
[1] Country or geographical area.



P = international prefix
DNIC = data network identification code
DCC = data country code
TCC = telephone country code
TDC = telex destination code

FIGURE 2/X.121 – **International calling format**

ANNEX 1

(to Recommendation X.121)

Development of Data Network Identification Codes (DNIC)

Example 1

In this example, it is assumed for illustrative purposes only, that the Netherlands has established its first public data network. To develop the data network identification code (DNIC) for this network, it would be necessary for the Netherlands to assign to it a network digit to follow the listed data country [1] code (DCC) 204 (see Annex 2). Assuming that the Netherlands selected the digit 0 as the network digit, the data network identification code (DNIC) for this initial network would be 2040.

Example 2

In this example, it is assumed for illustrative purposes only that five public data networks have been established in Canada. To develop the data network identification codes for these networks, it would be necessary for Canada to assign to each of these networks a network digit to follow the listed data country [1] code (DCC) 302 (See Annex 2). Assuming that Canada assigned the network digits 0-4 to the five networks, the resulting data network identification codes (DNIC) would be 3020, 3021, 3022, 3023 and 3024.

Example 3

In this example, it is assumed for illustrative purposes only that eight public data networks have been established in the United States of America. It is also assumed that network digits 0-7 would be assigned by the United States of America to follow the listed data country [1] code (DCC) 310 (see Annex 2). The data network identification codes (DNIC) thus formed for these eight networks would be 3100, 3101, 3102, 3103, 3104, 3105, 3106, and 3107.

If some time later, four additional public data networks were to be introduced in the United States of America, two of the four new networks could be assigned network digits 8 and 9 in association with data country [1] code (DCC) 310, to produce the data network identification codes (DNIC) 3108 and 3109.

For the remaining two public data networks, the United States of America would have to ask the CCITT for an additional data country [1] code (DCC). A request for a code next in sequence, i.e. 311, could be made if this code appeared to be spare. If code 311 could be made available it would be assigned to the United States of America. If it was not available, a spare code in the "300" series of data country [1] codes (DCC) would be assigned. Assuming data country [1] code (DCC) 311 was available and issued to the United States of America, the two remaining public data networks could be assigned network digits 0 and 1 in association with data country [1] code (DCC) 311, to produce the data network identification codes.(DNIC) 3110 and 3111.

The data network identification codes (DNIC) for the 12 public data networks would then be 3100, 3101, 3102, 3103, 3104, 3105, 3106, 3107, 3108, 3109, 3110 and 3111.

Example 4

In this example, it is assumed for illustrative purposes only that a public data network is to be established in each of two Caribbean islands that are part of the group of islands known as the French Antilles. The islands concerned are Guadeloupe and Martinique.

To develop the data network identification codes (DNIC) for these public data networks, it is assumed that the French Administration would assign network digit 0 to the network in Guadeloupe and network digit 1 to the network in Martinique and associate these network digits with the listed data country [1] code (DCC) 340 for the French Antilles (see Annex 2). The data network identification codes (DNIC) thus formed would be 3400 for Guadeloupe and 3401 for Martinique.

This example indicates that the system of data network identification codes (DNIC) is appropriate for application to groups of islands or regions of a country [1] since one data country [1] code (DCC) could provide for up to ten public data networks dispersed over several islands or regions. At the same time such island or regional networks would be distinguishable from each other.

[1] Country or geographical area.

ANNEX 2

(to Recommendation X.121)

List of data country or geographical area codes

Note. – The countries or geographical areas shown in this Annex include those that already have code assignments in the case of other public telecommunication networks.

Zone 2

Code	*Country or Geographical Area*
202	Greece
204	Netherlands (Kingdom of the)
206	Belgium
208	France
212	Monaco
214	Spain
216	Hungarian People's Republic
218	German Democratic Republic
220	Yugoslavia (Socialist Federal Republic of)
222	Italy
226	Roumania (Socialist Republic of)
228	Switzerland (Confederation of)
230	Czechoslovak Socialist Republic
232	Austria
234	United Kingdom of Great Britain and Northern Ireland
238	Denmark
240	Sweden
242	Norway
250	Union of Soviet Socialist Republics
260	Poland (People's Republic of)
262	Germany (Federal Republic of)
266	Gibraltar
268	Portugal
270	Luxembourg
272	Ireland
274	Iceland
276	Albania (Socialist People's Republic of)
278	Malta (Republic of)
280	Cyprus (Republic of)
282	Finland
284	Bulgaria (People's Republic of)
286	Turkey

Zone 2, Spare Codes: 68

Zone 3

Code	*Country or Geographical Area*
302	Canada
308	St. Pierre and Miquelon
310	United States of America
330	Puerto Rico
332	Virgin Islands (USA)
334	Mexico
338	Jamaica
340	French Antilles
342	Barbados
344	Antigua
346	Cayman Islands
348	British Virgin Islands
350	Bermuda
352	Grenada
354	Montserrat
356	St. Kitts
358	St. Lucia
360	St. Vincent
362	Netherlands Antilles
364	Bahamas (Commonwealth of the)
366	Dominica
368	Cuba
370	Dominican Republic
372	Haiti (Republic of)
374	Trinidad and Tobago
376	Turks and Calcos Islands

Zone 3, Spare Codes: 74

Zone 4

Code	*Country or Geographical Area*
404	India (Republic of)
410	Pakistan (Islamic Republic of)
412	Afghanistan (Democratic Republic of)
413	Sri Lanka (Democratic Socialist Republic of)
414	Burma (Socialist Republic of the Union of)
415	Lebanon
416	Jordan (Hashemite Kingdom of)
417	Syrian Arab Republic
418	Iraq (Republic of)
419	Kuwait (State of)
420	Saudi Arabia (Kingdom of)
421	Yemen (Arab Republic)
422	Oman (Sultanate of)
423	Yemen (People's Democratic Republic of)
424	United Arab Emirates
425	Israel (State of)
426	Bahrain (State of)
427	Qatar (State of)
428	Mongolian People's Republic
429	Nepal

Zone 4 *(cont'd)*

Code	*Country or Geographical Area*
430	United Arab Emirates (Abu Dhabi)
431	United Arab Emirates (Dubai)
432	Iran
440	Japan
450	Korea (Republic of)
452	Viet Nam (Socialist Republic of)
454	Hong Kong
455	Macao
456	Democratic Kampuchea
457	Lao People's Democratic Republic
460	China (People's Republic of)
470	Bangladesh (People's Republic of)
472	Maldives (Republic of)

Zone 4, Spare Codes: 67

Zone 5

Code	*Country or Geographical Area*
502	Malaysia
505	Australia
510	Indonesia (Republic of)
515	Philippines (Republic of)
520	Thailand
525	Singapore (Republic of)
528	Brunei
530	New Zealand
535	Guam
536	Nauru (Republic of)
537	Papua New Guinea
539	Tonga (Kingdom of)
540	Solomon Islands
541	New Hebrides
542	Fiji
543	Wallis and Futuna Islands
544	American Samoa
545	Gilbert & Ellice Islands
546	New Caledonia and Dependencies
547	French Polynesia
548	Cook Islands
549	Western Samoa

Zone 5, Spare Codes: 78

Zone 6

Code	*Country or Geographical Area*
602	Egypt (Arab Republic of)
603	Algeria (Algerian Democratic and Popular Republic)
604	Morocco (Kingdom of)
605	Tunisia
606	Libya (Socialist People's Libyan Arab Jamahiriya)
607	Gambia (Republic of the)
608	Senegal (Republic of the)
609	Mauritania (Islamic Republic of)
610	Mali (Republic of)
611	Guinea (People's Revolutionary Republic of)
612	Ivory Coast (Republic of the)
613	Upper Volta (Republic of)
614	Niger (Republic of the)
615	Togolese Republic
616	Benin (People's Republic of
617	Mauritius
618	Liberia (Republic of)
619	Sierra Leone
620	Ghana
621	Nigeria (Federal Republic of)
622	Chad (Republic of the)
623	Central African Empire
624	Cameroon (United Republic of)
625	Cape Verde (Republic of)
626	Sao Tome and Principe (Democratic Republic of)
627	Equatorial Guinea (Republic of)
628	Gabon Republic
629	Congo (People's Republic of the)
630	Zaire (Republic of)
631	Angola (People's Republic of)
632	Guinea-Bissau (Republic of)
633	Seychelles
634	Sudan (Democratic Republic of the)
635	Rwanda (Republic of)
636	Ethiopia
637	Somali Democratic Republic
638	Republic of Djibouti
639	Kenya (Republic of)
640	Tanzania (United Republic of)
641	Uganda (Republic of)
642	Burundi (Republic of)
643	Mozambique (People's Republic of)
645	Zambia (Republic of)
646	Madagascar (Democratic Republic of)
647	Reunion (French Department of)
648	Rhodesia
649	Namibia
650	Malawi
651	Lesotho (Kingdom of)
652	Botswana (Republic of)
653	Swaziland (Kingdom of)
654	Comoros (Federal and Islamic Republic of the)
655	South Africa (Republic of)

Zone 6, Spare Codes: 47

Zone 7

Code	*Country or Geographical Area*
702	Belize
704	Guatemala (Republic of)
706	El Salvador (Republic of)
708	Honduras (Republic of)
710	Nicaragua
712	Costa Rica
714	Panama (Republic of)
716	Peru
722	Argentine Republic
724	Brazil (Federative Republic of)
730	Chile
732	Columbia (Republic of)
734	Venezuela (Republic of)
736	Bolivia (Republic of)
738	Guyana
740	Ecuador
742	Guiana (French Department of)
744	Paraguay (Republic of)
746	Suriname (Republic of)
748	Uruguay (Oriental Republic of)

Zone 7, Spare Codes: 80

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