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OF ITU

SERIES Q: SWITCHING AND SIGNALLING

Specifications of Signalling System No. 6

ITU-T Recommendations Q.251-Q.300

(Formerly CCITT Recommendations)

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ITU-T Q-SERIES RECOMMENDATIONS

SWITCHING AND SIGNALLING

SIGNALLING IN THE INTERNATIONAL MANUAL SERVICE	Q.1–Q.3
INTERNATIONAL AUTOMATIC AND SEMI-AUTOMATIC WORKING	Q.4–Q.59
Basic Recommendations	Q.4–Q.9
Numbering plan and dialling procedures in the international service	Q.10–Q.11
Routing plan for international service	Q.12–Q.19
General Recommendations relative to signalling and switching systems (national or international)	Q.20–Q.34
Tones for use in national signalling systems	Q.35–Q.39
General characteristics for international telephone connections and circuits	Q.40–Q.47
Signalling for satellite systems	Q.48–Q.49
Signalling for circuit multiplication equipment	Q.50–Q.59
FUNCTIONS AND INFORMATION FLOWS FOR SERVICES IN THE ISDN	Q.60–Q.99
Methodology	Q.60–Q.67
Basic services	Q.68–Q.79
Supplementary services	Q.80–Q.99
CLAUSES APPLICABLE TO ITU-T STANDARD SYSTEMS	Q.100–Q.119
General clauses	Q.100–Q.109
Transmission clauses for signalling	Q.110–Q.114
Control of echo suppressors	Q.115
Abnormal conditions	Q.116–Q.119
SPECIFICATIONS OF SIGNALLING SYSTEMS No. 4 AND No. 5	Q.120–Q.249
Specifications of Signalling System No. 4	Q.120–Q.139
Specifications of Signalling System No. 5	Q.140–Q.179
SPECIFICATIONS OF SIGNALLING SYSTEM No. 6	**Q.250–Q.309**
SPECIFICATIONS OF SIGNALLING SYSTEM R1	Q.310–Q.399
SPECIFICATIONS OF SIGNALLING SYSTEM R2	Q.400–Q.499
DIGITAL EXCHANGES	Q.500–Q.599
INTERWORKING OF SIGNALLING SYSTEMS	Q.600–Q.699
SPECIFICATIONS OF SIGNALLING SYSTEM No. 7	Q.700–Q.799
Q3 INTERFACE	Q.800–Q.849
DIGITAL SUBSCRIBER SIGNALLING SYSTEM No. 1	Q.850–Q.999
PUBLIC LAND MOBILE NETWORK	Q.1000–Q.1099
INTERWORKING WITH SATELLITE MOBILE SYSTEMS	Q.1100–Q.1199
INTELLIGENT NETWORK	Q.1200–Q.1699
SIGNALLING REQUIREMENTS AND PROTOCOLS FOR IMT-2000	Q.1700–Q.1799
SPECIFICATIONS OF SIGNALLING RELATED TO BEARER INDEPENDENT CALL CONTROL (BICC)	Q.1900–Q.1999
BROADBAND ISDN	Q.2000–Q.2999

For further details, please refer to the list of ITU-T Recommendations.

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ITU-T Recommendations Q.251-Q.300

Specifications of Signalling System No 6

Summary

Signalling System No. 6 could be used to control the switching of all types of international circuits, including TASI-derived circuits and satellite circuits. It is designed for both-way operation of the speech circuits. The system can also be used for regional and national applications, and a large part of the signal code capacity is reserved for this purpose.

The system features are obtained by entirely removing the signalling from the speech paths and introducing the concept of a separate common signalling link over which all signals for a number of speech circuits are transferred. A number of these common signalling links interconnected by a number of transit centres and signal transfer points will form a coherent signalling network which can transfer all signals for all speech circuit groups within that network area.

The separate common signalling link is capable of operation over both analogue and digital circuits. Signalling information is transmitted in the serial data mode on a link-by-link basis – i.e. the signals are transferred from one link to the next only after processing.

Source

ITU-T Recommendations Q.251-Q.300 were prepared by CCITT Study Group XI (1985-1988) and approved by WTSC in Melbourne on 25 November 1988. Those texts were originally published in Blue Book, Fascicle VI.3.

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The World Telecommunication Standardization Conference (WTSC), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSC Resolution 1.

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CONTENTS

Part I – Specifications of Signalling System No. 6

Rec. No.			Page
INTRODUCTION			1
SECTION 1 –	*Functional description of the signalling system*		
Q.251	1.1	General	3
Q.252	1.2	Signal transfer time definitions	6
Q.253	1.3	Association between signalling and speech networks	7
SECTION 2 –	*Definition and function of signals*		
Q.254	2.1	Telephone signals	10
Q.255	2.2	Signalling-system-control signals	14
Q.256	2.3	Management signals	15
SECTION 3 –	*Signal unit formats and codes*		
Q.257	3.1	General	16
Q.258	3.2	Telephone signals	20
Q.259	3.3	Signalling-system-control signals	28
Q.260	3.4	Management signals	31
SECTION 4 –	*Signalling procedures*		
Q.261	4.1	Normal call set-up	36
Q.262	4.2	Analysis of digital information for routing	42
Q.263	4.3	Double seizing with both-way operation	42
Q.264	4.4	Potential for automatic repeat attempt and re-routing	43
Q.265	4.5	Speed of switching and signal transfer in international exchanges	44
Q.266	4.6	Blocking and unblocking sequences and control of quasi-associated signalling	44
Q.267	4.7	Unreasonable and superfluous messages	46
Q.268	4.8	Release of international connections and associated equipment	49
SECTION 5 –	*Continuity check of the speech path*		
Q.271	5.1	General	54
	5.2	Reliability of the speech path across the exchange	54
	5.3	Continuity check of the speech circuit between exchanges	54
	5.4	Loop checking method	54
	5.5	Transmission requirements for the continuity check	54
	5.6	Continuity signal	55
	5.7	Timing considerations for the continuity check	55

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Rec. No.			Page
SECTION 6 – *Signalling link*			
Q.272	6.1	Requirements for the signalling data link	57
Q.273	6.2	Data transmission rate	62
Q.274	6.3	Transmission methods	63
	6.4	Modem and interface requirements	64
Q.275	6.5	Data channel failure detection	71
Q.276	6.6	Service dependability	71
Q.277	6.7	Error control	72
Q.278	6.8	Synchronization	75
Q.279	6.9	Drift compensation	78
SECTION 7 – *Signal traffic characteristics*			
Q.285	7.1	Signal priority categories	79
Q.286	7.2	Signalling channel loading and queueing delays	80
Q.287	7.3	Signal transfer time requirements	84
SECTION 8 – *Security arrangements*			
Q.291	8.1	General	87
	8.2	Basic security arrangements	87
	8.3	Types of failure, recognition of failure and abnormal error rates	88
Q.292	8.4	Reserve facilities provided	90
Q.293	8.5	Intervals at which security measures are to be invoked	92
	8.6	Changeover and changeback procedures	93
	8.7	Emergency restart procedure	96
	8.8	Full-time synchronized reserve links	98
	8.9	Load sharing method	99
SECTION 9 – *Testing and maintenance*			
Q.295	9.1	Overall tests of Signalling System No. 6	100
	9.2	Signalling data link	101
	9.3	(Reserved)	102
	9.4	(Reserved)	102
	9.5	Network maintenance	102
Q.296	9.6	Monitoring and maintenance of the common signalling channel	105

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Rec. No. Page

SECTION 10 – *Network management*

Q.297 10. Network management 112

10.1 General 112

10.2 Information categories 112

Annex – The application of network management signals transported by System No. 6 113

Annex A to Signalling System No. 6 specifications 115

Annex B to Signalling System No. 6 specifications 121

Part II – Interworking between CCITT Signalling System No. 6 and national common channel signalling systems

Q.300 Interworking between CCITT Signalling System No. 6 and national common channel signalling systems 127

Glossary of terms specific to Signalling System CCITT No. 6 132

Abbreviations specific to Signalling System No. 6 136

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PART I – SPECIFICATIONS OF SIGNALLING SYSTEM No. 6

Preamble

This specification of Signalling System No. 6 represents an evolution originating with the *Green Book* text and proceeding through the *Yellow Book* revision to the present text. It is intended that new or modernized application of System No. 6 should be based on this text. Updating of earlier versions is encouraged with the caution that careful coordination is called for.

INTRODUCTION

General

Signalling System No. 6 can be used to control the switching of all types of international circuits to be used in a worldwide connection, including TASI-derived circuits and satellite circuits.

The system meets all requirements defined by the CCITT concerning the service features for world-wide international semi-automatic and automatic telephone traffic. It is designed for both-way operation of the speech circuits.

The system can also be used for regional and national applications, and a large part of the signal code capacity is reserved for this purpose.

Moreover, a large unused signal code capacity will allow the addition of new signals to cater for some unknown future requirements. This spare capacity may be used for increasing the number of telephone signals as well as for introducing other signals, e.g. network-management signals and network-maintenance signals.

The system features are obtained by entirely removing the signalling from the speech paths and introducing the concept of a separate common signalling link over which all signals for a number of speech circuits are transferred. A number of these common signalling links interconnected by a number of transit centres and signal transfer points will form a coherent signalling network which can transfer all signals for all speech circuit groups within that network area.

Modes of operation

The signalling system may be operated both in an associated *mode* and in a non-associated mode. In the associated mode of operation, the signals are transferred between the two exchanges which are the end points of a group of speech circuits over a common signalling link terminating at the same exchanges. In the non-associated mode of operation, the signals are transferred via two or more common signalling links in tandem associated with other groups of circuits, the signals being processed and forwarded through one or more intermediate exchanges acting only as signal transfer point.

The associated mode of operation is suited for use with large circuit groups, while a non-associated mode makes the signalling system economically suitable for use with small circuit groups by sharing the capacity of a signalling link among several groups.

A signalling link may be operated in the associated mode for one circuit group and in a non-associated mode for other circuit groups, either under normal or under breakdown conditions.

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Common signalling link

The separate common signalling link is capable of operation over both analogue and digital circuits. Signalling information is transmitted in the serial data mode on a link-by-link basis – i.e. the signals are transferred from one link to the next only after processing.

Analogue signalling links are capable of operations over standard international voice bandwidth channels including the 3-kHz spaced telephone channels used for some intercontinental circuits. Over voice-frequency channels the stream of pulses is normally transmitted at a rate of 2400 bit/s using the four-phase modulation method.

With respect to digital signalling links, the 1544 kbit/s and 2048 kbit/s internationally standardized PCM primary multiplexes (Recommendation Q.47 and Recommendation Q.46) are treated differently. In the case of 1544 kbit/s a channel is derived over which the stream of pulses is transmitted at 4 kbit/s. Signalling information is also transmitted at 4 kbit/s. In the case of 2048 kbit/s, a channel is derived over which the stream of pulses is transmitted at 64 kbit/s. Signalling information may be sent over such a channel at specified rates of either 4 kbit/s or 56 kbit/s. Other bit rates may have application in the future and other provisions for channel derivation may also prove useful, but neither are included in the present specification.

In both analogue and digital channels the pulse stream is divided into signal units of 28 bits each and into blocks of 12 signal units each.

The error control necessary for a common signalling link is based on error detection by coding and on error correction by retransmission. Error detection is based on decoding of checking bits included in each signal unit and on data carrier failure detection. This provides the desired system reliability. Error-free signal messages are used without delay. Provision is made for automatic transfer to an alternative link in the event of failure caused by breakdown or excessive error rate.

Signal messages

Signal messages carry information to identify the telephone circuit concerned. Since the circuit identity, i.e. the *label*, requires a large proportion of the bits (11 out of the 20 available information bits), provision is made for sending *multi-unit messages* consisting of several signal units under one label. A single digit or a random telephone signal will normally be transferred in a one-unit message while several or even all digits may be transferred in a multi-unit message.

Signal processing

All signals are processed at each transit centre or signal transfer point which has to be passed.

The processing of messages at a signal transfer point is minimal and includes label translation, if necessary, and the sending of signal messages within the proper priority category. In addition to the processing required at a signal point, a transit centre examines sufficient signal information to perform proper switching action.

Signalling equipment

Because of the new technique based on a separate common signalling link, on data type transmission and on central processing of the signalling information, Signalling System No. 6 will be used in general between exchanges of the stored programme control type.

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SECTION 1

FUNCTIONAL DESCRIPTION OF THE SIGNALLING SYSTEM

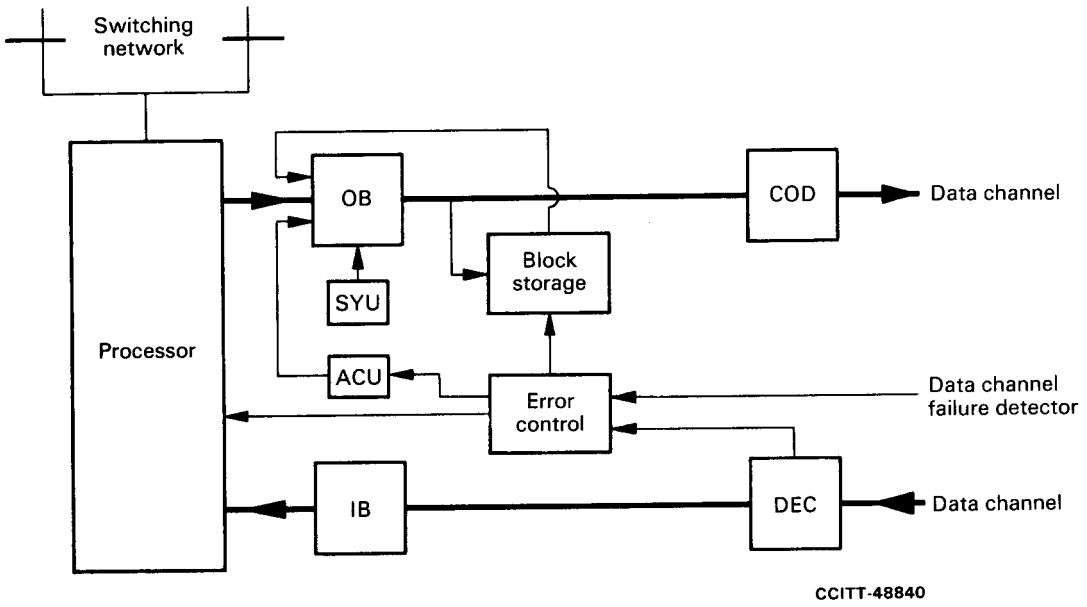
Recommendation Q.251

1.1 GENERAL

1.1.1 *Block diagrams*

Because common channel signalling, used in conjunction with exchanges having stored programme control, allows a wide latitude in the distribution of signalling functions between the processor and peripheral equipment, and because common channel signalling is not limited to exchanges of this type, it is not practicable to specify well-defined equipment interfaces.

The major signal transfer functions are shown in Figures 1/Q.251, 2/Q.251 and Table 1/Q.251 for both the analogue version and the digital version. The blocks are functional blocks and should not be construed as depicting equipment arrangements.



OB output buffer
IB input buffer
SYU synchronization signal unit generator
ACU acknowledgement signal unit generator
COD coder
DEC decoder

FIGURE 1/Q.251

Functional block diagram of a System No. 6 terminal

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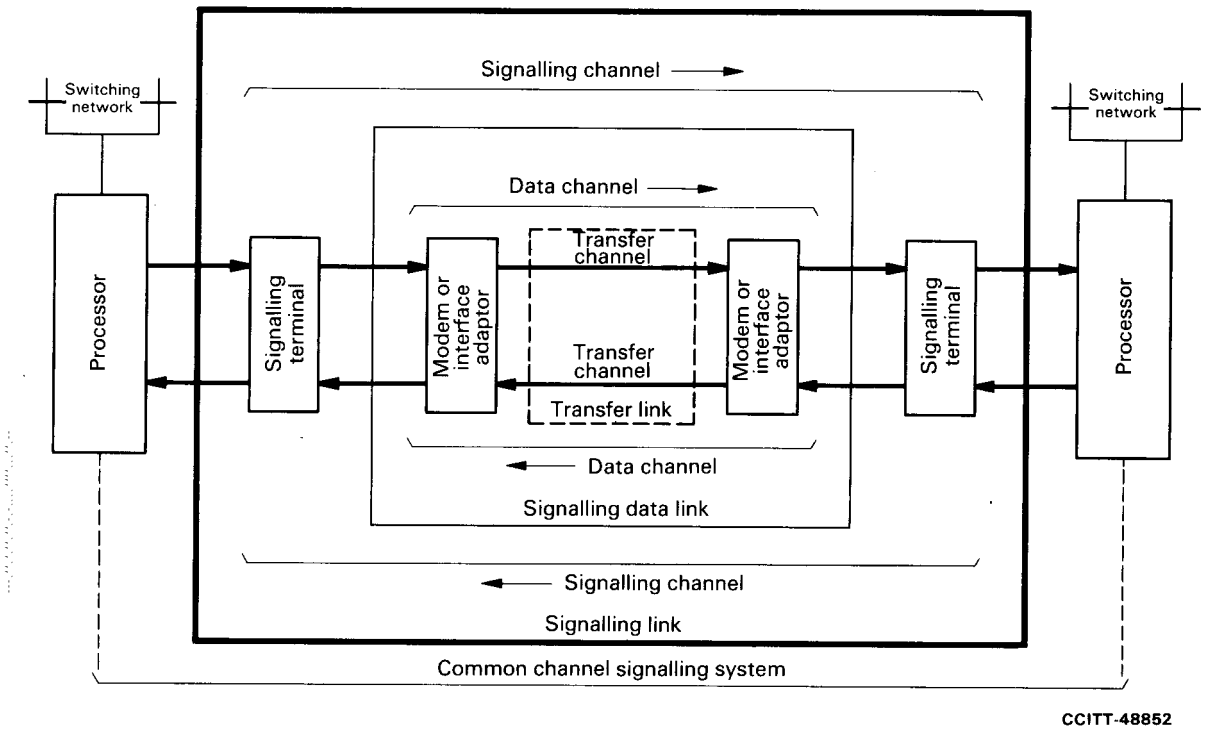

FIGURE 2/Q.251

Basic diagram of the common channel signalling system

TABLE 1 /Q.251

	Analogue version	Digital version
Data transceiver	Modem	Interface adaptor
Transfer channel	(Voice-frequency channel) a one-way voice-frequency transmission path from the output of a data modulator to the input of a data demodulator, made up of one or more voice-frequency channels in tandem.	(Digital channel) a one-way digital transmission path, from the output of the interface adaptor to the input of the interface adaptor, made up of one or more digital channels in tandem.
Transfer link	(Voice-frequency link) a two-way voice-frequency transmission path between two data modems, made up of one voice frequency channel in each direction.	(Digital link) a two-way digital transmission path between two interface adaptors, made up of one digital channel in each direction.
Data channel	a one-way data transmission path between two points, made up of a modulator, a voice-frequency channel and a demodulator.	a one-way data transmission path between two points, made up of a digital channel terminating on an interface adaptor at each end.
Signalling data link	a two-way data transmission path between two points, made up of one data channel in each direction.	
Signalling channel	a one-way signalling path from the processor of one switching machine to the processor of another switching machine.	
Signalling link	a two-way direction signalling path from processor to processor made up of one signalling channel in each direction.	

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1.1.2 *Signal unit and block structure*

Each signalling channel of the system (shown in Figure 2/Q.251) is operated synchronously: that is, a continuous stream of data flows in both directions. The data stream is divided into signal units of 28 bits each, of which the last 8 are check bits, and these signal units in turn are grouped into *blocks* of 12 signal units. The 12th and last signal unit of each block is an acknowledgement signal unit coded to indicate the number of the block being transmitted, the number of the block being acknowledged and whether or not each of the I 1 signal units of the block being acknowledged was received without detected errors.

Eight consecutive blocks form a *multi-block.* Since the system allows for up to 32 multi-blocks, the maximum number of blocks in the error control loop is 256.

In normal operation, the first 11 signal units within a block will consist of signal units carrying either telephone signals or management signals, or of synchronization signal units. Synchronization signal units, which are transmitted only in the absence of other signalling traffic, are coded to indicate the number of the position they occupy within the block to facilitate locating the acknowledgement signal unit. Their format has been chosen to produce a large number of dibit transitions to facilitate achieving or maintaining bit synchronism in the analogue version.

During system-synchronizing procedures, only synchronization and acknowledgement signal units are transmitted until bit, signal unit, and block synchronism has been achieved at both ends of the signalling system.

1.1.3 *Transmitting terminal*

The transmission of a signal in System No. 6 starts in the processor as shown in Figure 1/Q.251. Signals corresponding to the information to be transmitted are formed in accordance with the format specified and delivered to the output buffer. These signals, which may be one-unit messages or multi-unit messages, are stored in this buffer according to their priority level. The output buffer delivers the highest priority signal awaiting transmission to the coder in serial form in the next available time slot. In the coder, each signal unit is encoded by the addition of check bits in accordance with the check bit polynomial.

In the analogue version of the signalling system the signal is then modulated and delivered to the outgoing voice frequency channel for transmission to the distant receiving terminal. In the digital version of the signalling system the signal is passed through the interface adaptor before entering the outgoing digital channel.

1.1.4 *Receiving terminal*

The receiving function starts with the acceptance of the serial data from the transmission path. The output of the demodulator or the interface adaptor is delivered to the decoder where each signal unit is checked for errors on the basis of the associated check bits. Signal units received with detected errors are discarded. Signal units carrying telephone signals or management signals which are error-free are transferred to the input buffer after deletion of the check bits. The input buffer delivers the signal units to the processor where the processor analyzes the signals and takes appropriate action.

1.1.5 *Error control*

Error control is based on error detection by redundant coding and on error correction by retransmission of those signal messages found to be in error. This procedure requires that each transmitted signal message be stored until acknowledged as being received correctly. In the case of multi-unit messages, each signal unit of the message must be stored until all units of the message are acknowledged as being received correctly. When an acknowledgement signal unit is received, it is analyzed in the box marked *error control* in Figure 1/Q.251. If an acknowledgement bit indicates that a signal unit being acknowledged was received in error, the retransmission process is started. Request for retransmission of a synchronization signal unit is ignored. If any unit of a multi-unit message is in error, the entire multiunit message must be retransmitted in its initial order.

The data channel failure detector complements the decoder for longer error bursts. When activated it gives an indication to the box marked *error control* in Figure 1/Q.251. An error indication from either the decoder or the data

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channel failure detector is associated with the position of the erroneous signal unit(s) within the block. This information is used by the acknowledgement signal unit generator to control the marking of the acknowledgement bits.

As shown in Figure 1/Q.251, the processor may also be notified whenever an error is detected in a signal unit. This information may be used by the processor to erase the memory of any signal unit(s) of a multi-unit message received which is associated with the one found in error, since this entire message will be retransmitted.

Recommendation Q.252

1.2 SIGNAL TRANSFER TIME DEFINITIONS

1.2.1 *Functional reference points*

The major functional reference points are as indicated in Figure 3/Q.252, i.e. points A, B, C and D, which are defined below:

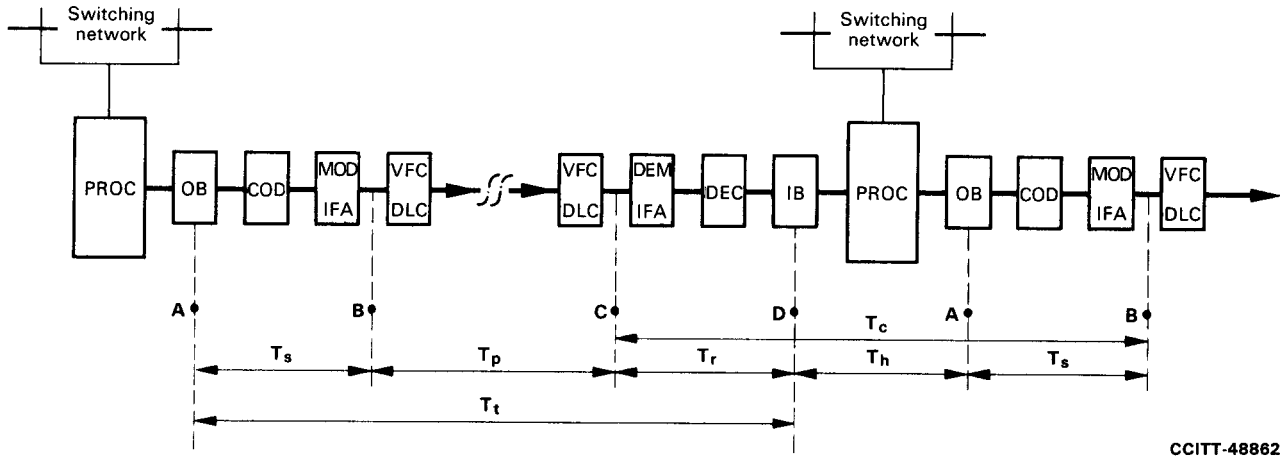
Point A. – That point in a switching centre where the signal as a signal unit, before being coded (check bits added), is delivered from the processor to an output buffer store.

Point B. – That point where the signal unit (check bits included) in serial form will be delivered to the transmission path.

Point C. – That point where the signal unit (check bits included) in serial form will be delivered to the demodulator or interface adaptor.

Point D. – That point in a switching centre where the signal unit, after being decoded (check bits deleted), will be presented from an input buffer store to the processor.

The functional reference points B and C are typically those points which define the transmission path used for common channel signalling. In the analogue version this transmission path is provided by a voice frequency channel and in the digital version by a digital channel.



PROC	processor
OB	output buffer
IB	input buffer
COD	coder
DEC	decoder
MOD	modulator
DEM	demodulator
VFC	voice-frequency channel
IFA	interface adaptor
DLC	digital channel

T_c	cross-office transfer time
T_h	processing (handling) time
T_p	voice-frequency or digital channel propagation time
T_r	receiver transfer time
T_s	sender transfer time
T_t	total signal transfer time

FIGURE 3/Q.252

Functional signal transfer time diagram

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1.2.2 *Signal transfer time components*

The various components of signal transfer time between two switching centres are defined as follows:

T_c = cross-office transfer time,

T_e = emission time of a signal unit (included in T_s),

T_h = processing (handling) time,

T_p = transfer channel propagation time,

T_q = queueing delay in the output buffer store (included in T_s),

T_r = receiver transfer time,

T_s = sender transfer time,

T_t = total signal transfer time.

T_h is that period from the moment the signal is available for acceptance by the processor to the moment the signal is placed in the output buffer and is available for transmission.

T_r is that period of time from the moment when the last bit of the signal unit leaves the transfer channel to that time when the signal is completely in the input buffer and is available for acceptance by the processor. T_r, thus includes the following actions: demodulation, decoding (error detection) and, where present, serial to parallel conversion.

T_s is that period of time from the moment when the signal enters the output buffer store to that time when the last bit of the signal unit passes into the transfer channel. T_s thus includes the following times and actions: emission time of signal unit(s) (one-unit or multi-unit message), queueing delay in the output buffer store, encoding (adding check bits), parallel to serial conversion where present, modulation in the analogue version and clock and data rate conversion where applicable in the digital version.

The definitions of signal transfer times give rise to the following time relationships:

$$T_c = T_r + T_h + T_s$$

$$T_t = T_s + T_p + T_r$$

In the case when an error is detected, retransmission will occur and the above time relationships are not valid. Rather, the time involved in retransmission and the extra queueing delays, which may occur on a retransmitted signal, must be taken into consideration.

Recommendation Q.253

1.3 ASSOCIATION BETWEEN SIGNALLING AND SPEECH NETWORKS

1.3.1 *Definitions*

The signals pertaining to a given group of speech circuits between two exchanges utilizing a common channel signalling system can be transferred in the following ways:

1.3.1.1 **associated mode of operation**

In the associated mode of operation, the signals are transferred between the two exchanges over a common signalling link which terminates at the same exchanges as the group of speech circuits to which the signalling link has been assigned.

1.3.1.2 **non-associated mode of operation**

In a non-associated mode of operation, the signals are transferred between the two exchanges over two or more common signalling links in tandem, the signals being processed and forwarded through one or more intermediate *signal transfer points* (see § 1.3.3 below). Following this definition, there may be a range of non-associated modes of operation.

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which vary in the degree of rigidity imposed on the choice of the path utilized by the signals pertaining to the speech circuit. The ends of this range can be described as fully dissociated mode and quasi-associated mode of operation.

a) **fully dissociated mode of operation**

The fully dissociated mode of operation is the extreme case of the non-associated mode. It is assumed that there is an established network of common signalling links and signal transfer points which may have its own routing principles.

In the fully dissociated mode of operation, the signals are transferred between the two exchanges via any available path in the signalling network according to the rules of that network.

b) **quasi-associated mode of operation**

The quasi-associated mode of operation is the limited form of the non-associated mode. The common signalling links to be used are generally each operating in the associated mode with a group of circuits.

In the quasi-associated mode of operation the signals are transferred between the two exchanges over two or more common signalling links in tandem, but only over certain predetermined paths and through predetermined signal transfer points.

1.3.2 *Association methods provided by the System No. 6*

Signalling System No. 6 is designed to provide associated and quasi-associated modes of operation as defined in §§ 1.3.1.1 and 1.3.1.2, b) above, e.g. as shown in Figure 4/Q.253.

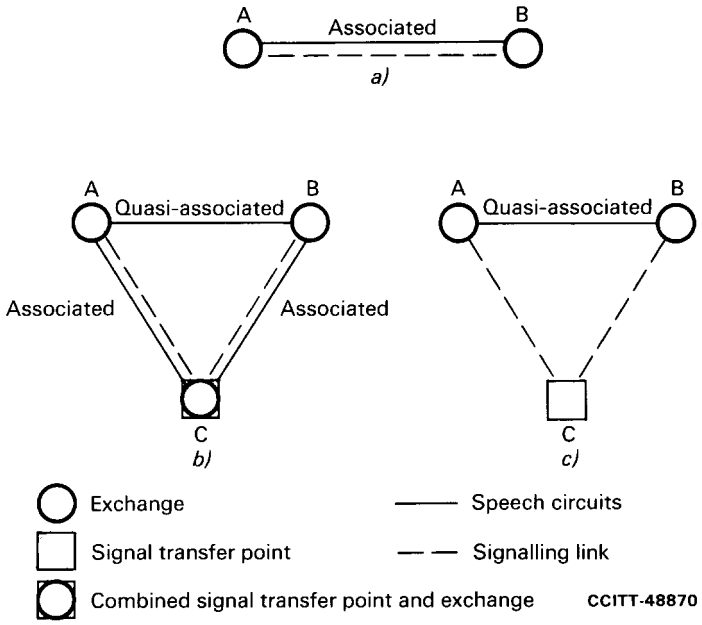

FIGURE 4/Q.253

Example of associated and quasi-associated modes of operation

As far as quasi-associated structures are concerned, the number of signal transfer points in the signalling path for a group of speech circuits between the two System No. 6 exchanges should be kept as low as practicable. Normally, one such signal transfer point should suffice. However, there may be groups of circuits without associated common signalling links which will need more than one signal transfer point to handle the signalling traffic.

Attention is drawn to the fact that the addition of a signal transfer point involves the handling time at that point and one additional signal transfer time. Extensive use of signal transfer points will reduce some of the advantages of the signalling speed of System No. 6.

Note – It should be noted that where a speech circuit group has an associated signalling link, dependability requirements may be met with economically, by using quasi-associated operation under breakdown condition when the associated signalling link is non-operative.

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1.3.3 **signal transfer point**

1.3.3.1 *Definition*

A signal transfer point is a signal relay centre handling and forwarding telephone signals from one signalling link to another in case of signalling in a non-associated mode of operation as defined in § 1.3.1.2 above.

Note – Following this definition there is no need for a signal transfer point to have any connection with, or relation to, a switching centre.

However, in the case of a quasi-associated mode of operation as defined in § 1.3.1.2 b) above, it is obvious that a signal transfer point may coincide with the System No. 6 exchange where the signalling links terminate and that the equipment may be incorporated into the signalling equipment of that System No. 6 exchange.

1.3.3.2 *Functions of a signal transfer point*

a) The equipment at a signal transfer point has to analyze the label and telephone signal information of every telephone signal message received in order to offer the message to the proper outgoing signalling channel, taking account of its priority, if any.

b) In doing so, it may be necessary to change the label of the received telephone signal message according to some preset rules. However, the telephone signal information included in the message will never be changed by the equipment of a signal transfer point.

c) If for some reason a signal transfer point is unable to transfer signal messages, a procedure is provided to notify the preceding exchange(s) so that signal messages may be sent via reserve routes if available.

Note – The fact mentioned under b) above and the fact that the analysis of the received message will never be accompanied by the switching of speech circuits provide a distinction between a signal transfer point and a transit exchange. In general, a transit exchange will be designed to perform both the normal transit exchange functions and the signal transfer point functions.

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SECTION 2

DEFINITION AND FUNCTION OF SIGNALS

Recommendation Q.254[1)]

2.1 TELEPHONE SIGNALS

Signals concerning a particular call or a particular speech circuit.

2.1.1 address signal

A call set-up signal sent in the forward direction containing one element of information (digit 1, 2, ... 9 or 0, code 11 or code 12) about the called party's number or the end-of-pulsing (ST) signal.

For each call, a succession of address signals is sent.

2.1.2 country-code indicator

Information sent in the forward direction indicating whether or not the country code is included in the address information.

2.1.3 nature-of-circuit indicator

Information sent in the forward direction about-the nature of the circuit or any preceding circuit(s) already engaged in the connection:

– *satellite circuit*, or

– *no satellite circuit*.

An international exchange receiving this information will use it (in combination with the appropriate part of the address information) to determine the nature of the outgoing circuit to be chosen.

2.1.4 echo suppressor indicator

Information sent in the forward direction indicating whether or not an outgoing half-echo suppressor is included in the connection.

2.1.5 calling-party's-category indicator

Information sent in the forward direction about the *category of the calling party* and, in case of semi-automatic calls about the *service language* to be spoken by the incoming, delay and assistance operators.

The following categories are provided:

– operator,

– ordinary calling subscriber,

– calling subscriber with priority,

– data call,

– test call.

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1) Some section numbers have been reserved for future use.

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2.1.6 **end-of-pulsing (ST) signal**

An address signal sent in the forward direction indicating that there are no more address signals to follow.

2.1.10 **continuity signal**

A signal sent in the forward direction indicating continuity of the preceding No. 6 speech circuit(s) as well as of the selected speech circuit to the following international exchange, including verification of the speech path across the exchange with the specified degree of reliability.

2.1.12 **switching-equipment-congestion signal**

A signal sent in the backward direction indicating the failure of the call set-up attempt due to congestion encountered at international switching equipment.

2.1.13 **circuit-group-congestion signal**

A signal sent in the backward direction indicating the failure of the call set-up attempt due to congestion encountered on an international circuit group or on the outgoing links of a terminal international exchange.

2.1.14 **national-network-congestion signal**

A signal sent in the backward direction indicating the failure of the call set-up attempt due to congestion encountered in the national destination network (excluding the busy condition of the called party's line(s)).

2.1.15 **address-incomplete signal**

A signal sent in the backward direction indicating that the number of address signals received is not sufficient for setting up the call. This condition may be determined in the incoming international exchange (or in the national destination network):

– immediately after the reception of an ST signal, or

– on time-out after the latest digit received.

2.1.16 **address-complete signal, charge**

A signal sent in the backward direction indicating that all the address signals required for routing the call to the called party have been received, that no called-party's-line-condition signals (electrical) will be sent, and that the call should be charged on answer.

2.1.17 **address-complete signal, no charge**

A signal sent in the backward direction indicating that all the address signals required for routing the call to the called party have been received, that no called-party's-line-condition signals (electrical) will be sent, and that the call should not be charged on answer.

2.1.18 **address-complete signal, coin-box**

A signal sent in the backward direction indicating that all the address signals required for routing the call to the called party have been received, that no called-party's-line-condition signals (electrical) will be sent, that the call should be charged on answer, and that the called number is a coin (box) station.

2.1.19 **address-complete, subscriber-free signal, charge**

A signal sent in the backward direction as an alternative to the address-complete, charge signal indicating that the called party's line is free, and that the call should be charged on answer.

2.1.20 **address-complete, subscriber-free signal, no charge**

A signal sent in the backward direction as an alternative to the address-complete, no charge signal indicating that the called party's line is free, and that the call should not be charged on answer.

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2.1.21 **address-complete, subscriber-free signal, coin-box**

A signal sent in the backward direction as an alternative to the address-complete, coin-box signal indicating that the called party's line is free, that the call should be charged on answer, and that the called number is a coin (box) station.

2.1.23 **unallocated-number signal**

A signal sent in the backward direction indicating that the received number is not in use (for example spare level, spare code, vacant subscriber's number).

2.1.24 **subscriber-busy signal (electrical)**

A signal sent in the backward direction indicating that the line(s) connecting the called party with the exchange is (are) engaged. The subscriber-busy signal will also be sent in case of complete uncertainty about the place where the busy or congestion conditions are encountered and in the case where a discrimination between subscriber-busy and national-network congestion is not possible.

2.1.25 **line-out-of-service signal**

A signal sent in the backward direction indicating that the called party's line is out-of-service or faulty.

2.1.26 **send-special-information tone signal**

A signal sent in the backward direction indicating that the special information tone should be returned to the calling party. This tone indicates that the called number cannot be reached for reasons not covered by other specific signals and that the unavailability is of a long term nature. (See also Recommendation Q.35.)

2.1.27 **confusion signal**

Signal sent in the backward direction indicating that an exchange is unable to act upon a message received from the preceding exchange because the message is considered unreasonable.

2.1.28 **call-failure signal**

A signal sent in the backward direction indicating the failure of a call set-up attempt due to the lapse of a time-out or a fault not covered by specific signals and where the congestion tone is the appropriate tone to be returned to the calling party.

2.1.29 **message-refusal signal**

A signal sent by a signal transfer point in response to the reception of a telephone signal which it is unable to deal with as a consequence of the transfer-prohibited situation.

2.1.31 **forward-transfer signal**

A signal sent in the forward direction on semi-automatic calls when the outgoing international exchange operator wants the help of an operator at the incoming international exchange. The signal will normally serve to bring an assistance operator (see Recommendation Q.101) into the circuit if the call is automatically set up at that exchange. When a call is completed via an operator (incoming or delay operator) at the incoming international exchange, the signal should preferably cause this operator to be recalled.

2.1.32 **answer signal, charge**

A signal sent in the backward direction indicating that the call is answered and subject to charge.

In semi-automatic working, this signal has a supervisory function. In automatic working, the signal is used:

– to start metering the charge to the calling subscriber (Recommendation Q.28), and

– to start the measurement of call duration for international accounting purposes.

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2.1.33 **answer signal, no charge**

A signal sent in the backward direction indicating that the call is answered but is not subject to charge. it is used for calls to particular destinations only.

In semi-automatic working, this signal has a supervisory function. In automatic working, the reception of this signal shall not start the metering to the calling subscriber.

2.1.34 **clear-back signals**

Signals sent in the backward direction, the first of which indicates that the called party has cleared. Subsequent clear-back signals indicate that the called party has cleared following a reanswer, e.g. switch-hook flashing.

In semi-automatic working, they perform a supervisory function. In automatic working, the arrangements specified in Recommendation Q.118 apply.

2.1.35 **reanswer signals**

Signals in the backward direction indicating that the called party, after having cleared, again lifts his receiver or in some other way reproduces the answer condition, e.g. switch-hook flashing.

2.1.36 **clear-forward signal**

A signal sent in the forward direction to terminate the call or call attempt and release the circuit concerned. This signal is normally sent when the calling party clears but also may be a proper response in other situations, as for example, when reset circuit is received.

2.1.37 **release-guard signal**

A signal sent in the backward direction in response to a clear-forward signal, or if appropriate to the reset-circuit signal, when the circuit concerned has been brought into the idle condition.

2.1.38 **reset-circuit signal**

A signal that is sent to release a circuit when, due to memory multilation or other causes, it is unknown whether, for example, a clear-forward or clear-back signal is appropriate. If at the receiving end the circuit is blocked, this signal should remove that condition.

2.1.41 **blocking signal**

A signal sent for maintenance purposes to the exchange at the other end of a circuit to cause engaged conditions of that circuit for subsequent calls outgoing from that exchange. An exchange receiving the blocking signal must be capable of accepting incoming calls on that circuit unless it also has sent a blocking signal. Under conditions covered later, a blocking signal is also a proper response to a reset-circuit signal.

2.1.42 **unblocking signal**

A signal sent to the exchange at the other end of a circuit to cancel in that exchange the engaged conditions of that circuit caused by an earlier blocking signal.

2.1.43 **blocking-acknowledgement signal**

A signal sent in response to a blocking signal indicating that the speech circuit has been blocked.

2.1.44 **unblocking-acknowledgement signal**

A signal sent in response to an unblocking signal indicating that the speech circuit has been unblocked.

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2.2 SIGNALLING-SYSTEM-CONTROL SIGNALS

Signals used for the proper functioning of the signalling system via the common signalling link.

2.2.1 **acknowledgement indicator**

Information indicating whether or not an error has been detected in a received signal unit.

2.2.2 **synchronization signal**

A signal sent in order to establish and maintain synchronization between the two ends of a signalling channel.

2.2.3 *System-control signals*

2.2.3.1 **changeover signal**

A signal sent to indicate a failure on a synchronized signalling link. If this signal is sent on a link carrying signalling information, it also indicates that a changeover to the next reserve signalling link is required.

2.2.3.2 **manual-changeover signal**

A signal sent to initiate a changeover to a reserve signalling link or to initiate the removal of full-time synchronized reserve link from service availability because of need for rearrangements, changes, maintenance, etc.

2.2.3.3 **manual-changeover-acknowledgement signal**

A signal sent in response to a manual-changeover signal to indicate that manual changeover can take place.

2.2.3.4 **standby-ready signal**

A signal sent on a standby reserve link to indicate that the error rate on that link has met the requirements of the *one-minute proving period.*

2.2.3.5 **standby-ready-acknowledgement signal**

A signal sent on the standby reserve link in response to a standby-ready signal and indicating that the error rate on that link has met the requirements of the *one-minute proving period.*

2.2.3.6 **load transfer signal**

A signal sent on a link to indicate that the error rate on that link has met the requirements of the *one-minute proving period* and that signalling traffic should be transferred to that particular link.

2.2.3.7 **emergency-load-transfer signal**

A signal sent on as many links as possible to indicate that the error rate on those links has met the requirements of the *emergency proving period,* and that emergency transfer can take place to one of these links.

2.2.3.8 **load-transfer-acknowledgement signal**

A signal sent on a link in response to a load-transfer signal or to an emergency-load-transfer signal to indicate that the load-transfer will take place to that particular link.

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2.2.4 *Multi-block synchronization signals*

2.2.4.1 **multi-block monitoring signal**

A signal, required on links where the number of blocks in the error control loop exceeds 8, and sent to check multi-block synchronism.

2.2.4.2 **multi-block acknowledgement signal**

A signal sent on a link in response to a multi-block monitoring signal and used by the receiving terminal to verify multi-block synchronism.

Recommendation Q.256

2.3 MANAGEMENT SIGNALS

Signals concerning the management of the speech circuit network and the signalling network. The three following categories of signals are distinguished:

2.3.1 **network-management signals**

Information regarding the conditions of circuit groups or equipment sent from one point in the network to one or more other points. This excludes information relevant to individual calls or individual speech circuits.

2.3.2 **network-maintenance signals**

Management signals used for maintenance purposes.

2.3.2.1 **reset-band signal**

A signal sent by a failed exchange during recovery to request that all circuits in the band be put in the idle state except those circuits at the receiving end that have imposed a blocked condition on the sending end. If at the receiving end the circuit is blocked, the reset-band signal should remove that condition.

2.3.2.2 **reset-band-acknowledgement signal**

A signal sent in response to the reset-band signal to indicate whether a circuit is available for use or should be blocked in the failed exchange.

2.3.2.3 **reset-band-acknowledgement signal, all circuits idle**

A signal sent in response to the reset-band signal to indicate that all circuits in the band are available for use.

2.3.3 **signalling-network-management signals**

Information regarding the conditions of signalling links which may be required to modify signal routings. This excludes information relevant to the signals concerned with individual calls or speech circuits.

2.3.3.1 **transfer-prohibited signal**

A signal sent by a signal transfer point when it is unable to transfer signals for a particular group of circuits.

2.3.3.2 **transfer-allowed signal**

A signal sent by a signal transfer point when it is once again ready to transfer signals for the particular group of circuits.

2.3.3.3 **transfer-allowed-acknowledgement signal**

A signal sent in response to the reception of a transfer-allowed signal.

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SECTION 3

SIGNAL UNIT FORMATS AND CODES

Recommendation Q.257

3.1 GENERAL

3.1.1 *Types of message and signal unit (SU)*

Signalling and other information carried by the common signalling link is transferred by means of messages consisting of one or more signal units.

A **signal unit (SU)** is the smallest defined group of bits on the signalling channel and contains 28 bits.

Dependent upon the number of signal units necessary to transmit one message, the message is called a one-unit message or a multi-unit message.

3.1.1.1 *One-unit message, lone signal unit (LSU)*

A **one-unit message is** a message which is transmitted entirely within one signal unit, Such a signal unit is called a lone signal unit (LSU). It is designed to transmit either:

a) a single telephone signal,

b) a signalling-system-control signal, or

c) a management signal.

3.1.1.2 *Multi-unit message (MUM)*

A **multi-unit message (MUM)** consists of 2, 3, 4, 5 or 6 signal units in tandem. It is designed to transmit a number of related signals (e.g. address signals) in an efficient way. A special case of the multi-unit messages is the initial address message, which is the only one which can have six signal units in tandem and has a minimum of three signal units.

3.1.1.3 **initial signal unit (ISU)**

The first signal unit of a multi-unit message is called the initial signal unit (ISU).

3.1.1.4 **subsequent signal unit (SSU)**

The second and any following signal unit of a multi-unit message are called subsequent signal units (SSU).

3.1.2 *Basic formats*

3.1.2.1 *Basic format of a lone signal unit*

The basic format of a lone signal unit is shown in Figure 5/Q.257.

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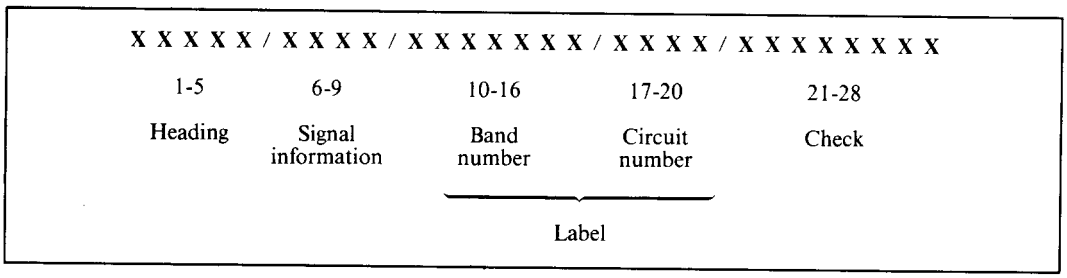

FIGURE 5/Q.257

Basic format of : – a lone signal unit
– an initial signal unit of a multi-unit message

The basic format of a lone signal unit is not used in all cases. Where a different format is used it is shown in the sections relating to individual signal units.

3.1.2.2 *Basic format of a multi-unit message*

The format of the initial signal unit of a multi-unit message is shown in Figure 5/Q.257. The use of a special code in the signal information field (bits 6-9) distinguishes an initial signal unit from a lone signal unit. See 3.1.2.1 above.

The format of a subsequent signal unit of a multi-unit message is shown in Figure 6/Q.257.

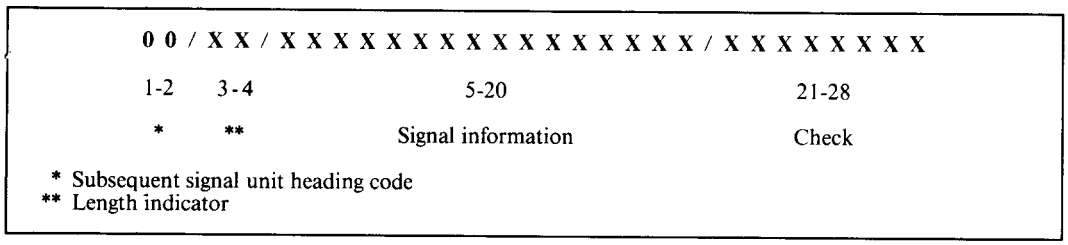

FIGURE 6/Q.257

Format of a subsequent signal unit of a multi-unit message

For some messages, the signal information field of a subsequent signal unit (bits 5-20) can be sub-divided, notably in address messages where the field is divided into four 4-bit parts.

3.1.3 *Codes for the general parts of signal units*

The interpretation of a message depends upon a system of codes in various parts of the message.

3.1.3.1 *Heading*

The heading is used to identify the type of:

a) group of signals,

b) message, or

c) signal.

The heading generally consists of the first five bits of the signal units (bits 1-5). There are two exceptions to this rule, viz.:

– all subsequent signal units are identified by the same 2-bit heading code **0 0** (bits 1-2);

– the acknowledgement signal unit is identified by a 3-bit heading code **0 1 1** (bits 1-3).

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The heading codes are allocated as follows:

0 0	Subsequent signal unit
0 1 0 0 0 **0 1 0 0 1** **0 1 0 1 0** **0 1 0 1 1**	Spare (reserved for regional and/or national use)
0 1 1	Acknowledgement signal unit
1 0 0 0 0	Initial signal unit of an initial address message (or of a multi-unit message)
1 0 0 0 1 **1 0 0 1 0** **1 0 0 1 1** **1 0 1 0 0** **1 0 1 0 1** **1 0 1 1 0** **1 0 1 1 1**	Subsequent address message (one-unit message or multi-unit message)
1 1 0 0 0 **1 1 0 0 1** **1 1 0 1 0** **1 1 0 1 1**	International telephone signals
1 1 1 0 0	Spare (reserved for regional and/or national use)
1 1 1 0 1	Signalling-system-control signals (except acknowledgement signal unit) and management signals
1 1 1 1 0 **1 1 1 1 1**	Spare (reserved for regional and/or national use)

The heading code allocation is also shown in Table 2/Q.257.

3.1.3.2 *Signal information*

Signal units with a 5-bit heading code have a signal information field of four bits (bits 6-9). The signal information field is used:

a) to define a particular signal within a group of signals being defined by the heading code,

b) to define a sub-group within a group of signals, or

c) to indicate that the signal unit is an initial signal unit and that the subsequent signal unit(s) contain(s) a number of signals belonging to the group of signals defined by the heading code.

For case c), the signal information code **0 0 0 0** is used except with heading code **1 0 0 0 0** which alone is sufficient to identify the signal unit as an initial signal unit.

The allocation of signal information codes is shown in Table 2/Q.257.

3.1.3.3 *Label*

Messages which relate to a speech circuit (or a group or sub-group of speech circuits) must carry a label to identify that circuit (or group of circuits). Only one label per message is used.

To identify a group of up to sixteen speech circuits, a 7-bit *band number* is used (bits 10-16).

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TABLE 2/Q.257

Allocation of heading and signal information codes

Bits 6-9 \ Bits 1-5	0000X	0001X	0010X	0011X	01000	01001	01010	01011	011XX	10000	10001	10010	10011	10100	10101	10110	10111	11000	11001	11010	11011	11100	11101	11110	11111	Bits 1-5 \ Bits 6-9
0000	SSU				ISU of MUM	ISU of MUM	ISU of MUM	ISU of MUM		ISU of IAM	ISU of SAM 1	ISU of SAM 2	ISU of SAM 3	ISU of SAM 4	ISU of SAM 5	ISU of SAM 6	ISU of SAM 7	ISU of MUM	ISU of MUM	ISU of MUM	ISU of MUM	ISU of MUM	ISU of MMM	ISU of MUM	ISU of MUM	0000
NOT 0000					LSU	LSU	LSU	LSU		ISU of MUM	Lone SAM 1	Lone SAM 2	Lone SAM 3	Lone SAM 4	Lone SAM 5	Lone SAM 6	Lone SAM 7	LSU	LSU	LSU	LSU	LSU	LSU	LSU	LSU	NOT 0000
0000	ONE SSU or FIVE SSUs (IAM only)	TWO SSUs	THREE SSUs	FOUR SSUs	RESERVED FOR REGIONAL and/or NATIONAL USE	RESERVED FOR REGIONAL and/or NATIONAL USE	RESERVED FOR REGIONAL and/or NATIONAL USE	RESERVED FOR REGIONAL and/or NATIONAL USE	ACU	RESERVED FOR REGIONAL and/or NATIONAL USE												RESERVED FOR REGIONAL and/or NATIONAL USE	NMM	RESERVED FOR REGIONAL and/or NATIONAL USE	RESERVED FOR REGIONAL and/for NATIONAL USE	0000
0001											1	1	1	1	1	1	1	RLG		COT	AFC		NMM			0001
0010											2	2	2	2	2	2	2	ANC		CLF	AFN					0010
0011											3	3	3	3	3	3	3	ANN	SEC	FOT	AFX					0011
0100											4	4	4	4	4	4	4	CB 1	CGC		SSB					0100
0101											5	5	5	5	5	5	5	RA 1	NNC		UNN		SNM			0101
0110											6	6	6	6	6	6	6	CB 2			LOS		REGIONAL and/or NATIONAL			0110
0111											7	7	7	7	7	7	7	RA 2			SST					0111
1000											8	8	8	8	8	8	8	CB 3	CFL							1000
1001											9	9	9	9	9	9	9	RA 3								1001
1010											0	0	0	0	0	0	0			RSC	ADC					1010
1011																				BLO	ADN		MBS			1011
1100																				UBL	ADX		SCU			1100
1101																				BLA	ADI		SYU			1101
1110																			COF	UBA			REGIONAL and/or NATIONAL			1110
1111											ST	ST	ST	ST	ST	ST	ST			MRF						1111

CCITT - 26110

Note – All unassigned codes are reserved for international use. The interpretation of the abbreviations for signals is given in the List of *Abbreviations Specific to Signalling System No. 6* at the end of Part I of this fascicle.

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To identify a circuit within a group of up to sixteen speech circuits, an additional 4-bit code (circuit number) is used (bits 17-20). See Figure 5/Q.257.

This provides a total of 11 bits which can be used to identify 2048 speech circuits.

Label codes will be assigned by the Administration concerned.

The label field position is in bits 10-20 of either a lone signal unit or an initial signal unit of a multi-unit message. Subsequent signal units of multi-unit messages do not require a label. Where a 7-bit band number alone is sufficient to identify the destination of a signal (e.g. some management signals), bits 17-20 can contain some further signalling information.

3.1.3.4 *Length indicator*

Subsequent signal units have a length indicator field of two bits (bits 3-4) to indicate the number of subsequent signal units contained in a multi-unit message. Each subsequent signal unit of a multi-unit message carries the same length indicator. The codes used are shown in Table 3/Q.257.

TABLE 3/Q.257

Number of subsequent signal units	Length indicator	
	Initial address message	Other multi-unit messages
1	**–**	**00**
2	**01**	**01**
3	**10**	**10**
4	**11**	**11**
5	**00**	**–**

The length indicator **0 0** has a different, but unambiguous meaning in the initial address message because the initial address message has a minimum requirement of two subsequent signal units.

3.1.3.5 *Check*

Every signal unit has a check field of eight bits (bits 21-28) for error detection purposes (see Recommendation Q.277).

Recommendation Q.258

3.2 TELEPHONE SIGNALS

3.2.1 *Initial address message (IAM)*

The initial address message (IAM) is the first message of a call. It is a special case of the multi-unit message as it consists of a minimum of three signal units and a maximum of six signal units. It can contain different types of information – address signals (including ST), other routing information, and the filler code – under the same heading code.

3.2.1.1 *Format of the initial address message*

The format of the initial signal unit is shown in Figure 5/Q.257.

The format of the subsequent signal units is shown in Figure 6/Q.257 except for the subsequent signal units numbers 2-5 in which the signal information field (bits 5-20) is sub-divided into four 4-bit parts so that four address signals can be carried in each of these subsequent signal units.

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The subsequent signal units of an initial address message do not require the 5-bit heading or 1l-bit label as this information is already contained in the initial signal unit.

The number of address signals available for transmission determines the length of the initial address message.

3.2.1.2 *Codes used in the initial address message*

a) *Initial signal unit*

– The 5-bit heading code **1 0 0 0 0** is used.

– The signal information code **0 0 0 0** is used.

– The assigned label code is used.

b) *Subsequent signal unit (number 1)*

– The heading code **0 0** is used.

– The length indicator is coded as appropriate (see Recommendation Q.257, 3.1.3.4).

– Bit 5: country code indicator:
  0 country code not included
  1 country code included

– Bit 6: nature of circuit indicator:
  0 no satellite circuit in the connection
  1 one satellite circuit in the connection

– Bit 7: echo-suppressor indicator:
  0 outgoing half-echo suppressor not included
  1 outgoing half-echo suppressor included

– Bit 8: spare (reserved for international use) [1)]

– Bits 9-12: spare (reserved for regional and/or national use) [1)]

– Bits 13-16: calling-party's-category indicator

0 0 0 0	spare
0 0 0 1	operator, language French
0 0 1 0	operator, language English
0 0 1 1	operator, language German
0 1 0 0	operator, language Russian
0 1 0 1	operator, language Spanish
0 1 1 0 **0 1 1 1** **1 0 0 0**	available to Administration for selecting a particular language provided by mutual agreement
1 0 0 1	reserved (see Recommendation Q.104)
1 0 1 0	ordinary calling subscriber
1 0 1 1	calling subscriber with priority
1 1 0 0	data call
1 1 0 1	test call
1 1 1 0	spare
1 1 1 1	spare (reserved for regional and/or national use)

– Bits 17-20: spare (reserved for regional and/or national use) [1)]

---

1) These bits are coded as **0** at present.

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c) *Subsequent signal units (numbers 2-5) – telephone call*

– The heading code **0 0** is used.

– The length indicator is coded as appropriate (see Recommendation Q.257, § 3.1.3.4).

– The four 4-bit parts of the signal information field contain address signals in sequence, bits 5-8, bits 9-12, etc., and are coded as follows:

0 0 0 0	filler	(no information)
0 0 0 1	digit	1
0 0 1 0	digit	2
0 0 1 1	digit	3
0 1 0 0	digit	4
0 1 0 1	digit	5
0 1 1 0	digit	6
0 1 1 1	digit	7
1 0 0 0	digit	8
1 0 0 1	digit	9
1 0 1 0	digit	0
1 0 1 1	code	11
1 1 0 0	code	12
1 1 0 1	spare	
1 1 1 0	spare	
1 1 1 1	ST	

The filler code **0 0 0 0** is used where needed to complete the signal information field of the last subsequent signal unit of the initial address message.

d) *Subsequent signal unit (number 2) – test call*

– The heading code **0 0** is used.

– The length indicator is coded as appropriate (see Recommendation Q.257, § 3.1.3.4).

– The first 4-bit part (bits 5-8) of the signal information field contains an address signal coded as follows:

0 0 0 0	system No. 6 continuity check
0 0 0 1	ATME 2 – signalling check and transmission test
0 0 1 0	ATME 2 – signalling check only
0 0 1 1	quiet termination test line
0 1 0 0	echo suppressor test system
0 1 0 1	loop around test line
0 1 1 0	transmission access test line
0 1 1 1	transmission access test line
1 0 0 0	transmission access test line
1 0 0 1	echo canceller test line
1 0 1 0	spare
1 0 1 1	spare
1 1 0 0	spare
1 1 0 1	spare
1 1 1 0	spare
1 1 1 1	spare

The codes used to complete the signal information field of the subsequent signal unit (number 2) test call are the end-of-pulsing (ST) and fillers.

3.2.1.3 *Example of an initial address message*

An example of a three-unit initial address message is shown in Figure 7/Q.258.

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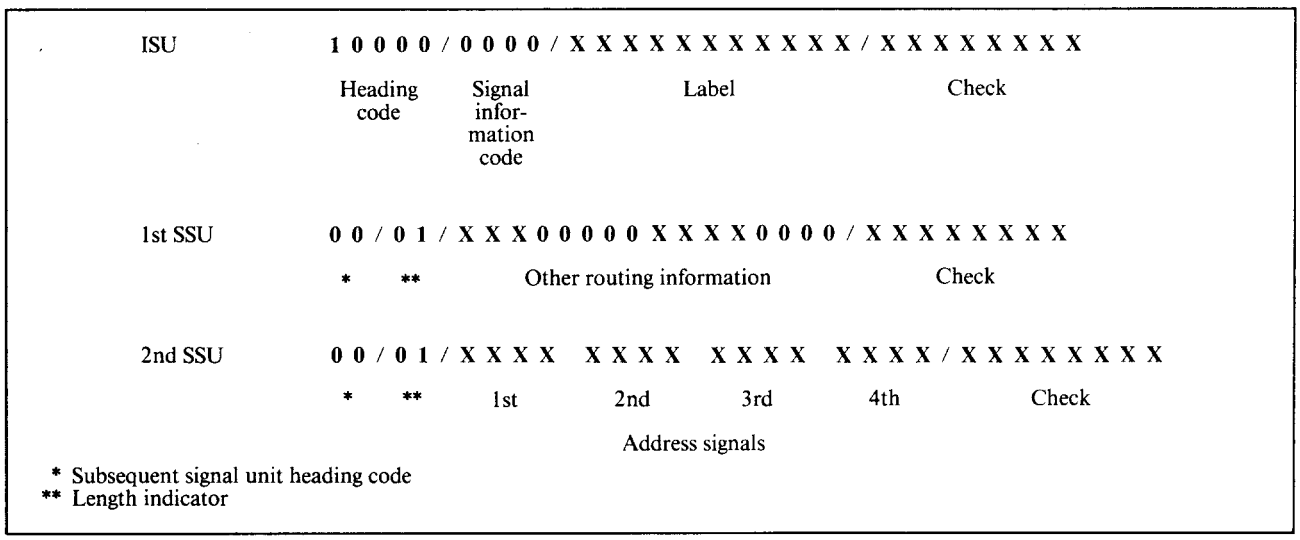

FIGURE 7/Q.258

Example of a three-unit initial address message

3.2.2 *Subsequent address message (SAM)*

A subsequent address message (SAM) is used to transmit additional address signals not available when the initial address message is formed.

A subsequent address message may be either a one-unit message or a multi-unit message.

3.2.2.1 *Formats of subsequent address messages*

a) *Lone signal unit*

The format of the lone signal unit is shown in Figure 5/Q.257.

b) *Multi-unit message*

The format of the initial signal unit is shown in Figure 5/Q.257.

The format of the subsequent signal units is shown in Figure 6/Q.257. In this case, however, the signal information fields of every subsequent signal unit are sub-divided into four 4-bit parts.

3.2.2.2 *Codes used in subsequent address messages*

a) *Heading*

Heading codes in the range **1 0 0 0 1-1 0 1 1 1** are used in the lone signal unit or initial signal unit depending on the sequence number of the subsequent address message concerned. The first subsequent address message of a call uses heading **1 0 0 0 1**, the second **1 0 0 1 0**, the third **1 0 0 1 1**, etc. While it is preferred to limit the number of subsequent address messages, if more than seven are sent, the sequence is recycled so that the eighth uses heading code **1 0 0 0 1**.

Subsequent signal units of subsequent address messages use the heading code **0 0**.

b) *Signal information*

– *Lone signal unit*

In the case of a one-unit subsequent address message, the signal information field (bits 6-9) contains one of the address signals which are coded as follows:

0 0 0 1 digit 1
0 0 1 0 digit 2
0 0 1 1 digit 3

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0 1 0 0 digit 4
0 1 0 1 digit 5
0 1 1 0 digit 6
0 1 1 1 digit 7
1 0 0 0 digit 8
1 0 0 1 digit 9
1 0 1 0 digit 0
1 1 1 1 ST

Codes **1 0 1 1**, **1 1 0 0**, **1 1 0 1**, **1 1 1 0** and **0 0 0 0** are not used in the signal information field of a one-unit subsequent address message.

– *Multi-unit message*

The signal information field of the initial signal unit is coded as **0 0 0 0**.

The signal information field of the subsequent signal units contains the address signals which are coded as follows:

0 0 0 0 filler (no information)
0 0 0 1 digit 1
0 0 1 0 digit 2
0 0 1 1 digit 3
0 1 0 0 digit 4
0 1 0 1 digit 5
0 1 1 0 digit 6
0 1 1 1 digit 7
1 0 0 0 digit 8
1 0 0 1 digit 9
1 0 1 0 digit 0
1 1 1 1 ST

Signal information codes **1 0 1 1**, **1 1 0 0**, **1 1 0 1** and **1 1 1 0** are not used in multi-unit subsequent address messages.

The filler code **0 0 0 0** is used, where needed, to complete the signal information field of the last subsequent signal unit of the subsequent address message.

c) *Label*

The assigned label code is used.

3.2.3 *Other telephone signals*

3.2.3.1 *Telephone signals with heading code* **1 0 0 0 0**

The following signal information codes, in conjunction with heading code **1 0 0 0 0**, are allocated:

0 0 0 0 initial signal unit of an initial address message (see Recommendation Q.258, § 3.2.1.2)
0 0 0 1 spare (reserved for international use)
0 0 1 0 spare
0 0 1 1 spare
0 1 0 0 spare
0 1 0 1 spare
0 1 1 0 spare
0 1 1 1 spare
1 0 0 0 spare (reserved for regional and/or national use)
1 0 0 1 spare
1 0 1 0 spare
1 0 1 1 spare
1 1 0 0 spare
1 1 0 1 spare
1 1 1 0 spare
1 1 1 1 spare

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The formats for messages using signal information code **0 0 0 1** have not yet been decided. The formats for messages using signal information codes in the range **0 0 1 0** – **1 1 1 1** will be determined by regional organizations and/or national Administrations.

3.2.3.2 *Telephone signals with heading code* **1 1 0 0 0**

The format of one-unit telephone signals using heading code **1 1 0 0 0** is shown in Figure 5/Q.257.

Signals, sent in the backward direction, in lone signal units using heading code **1 1 0 0 0**, are allocated signal information codes as follows:

0 0 0 1 release-guard
0 0 1 0 answer, charge (priority)
0 0 1 1 answer, no charge (priority)
0 1 0 0 clear-back No. 1
0 1 0 1 reanswer No. 1
0 1 1 0 clear-back No. 2
0 1 1 1 reanswer No. 2
1 0 0 0 clear-back No. 3
1 0 0 1 reanswer No. 3
1 0 1 0 spare
1 0 1 1 spare
1 1 0 0 spare
1 1 0 1 spare
1 1 1 0 spare
1 1 1 1 spare

Signal information code **0 0 0 0** indicates that the signal unit is the initial signal unit of a multi-unit message. This facility is reserved for possible future expansion.

3.2.3.3 *Telephone signals with heading code* **1 1 0 0 1**

The format of one-unit telephone signals using heading code **1 1 0 0 1** is shown in Figure 5/Q.257.

Signals, sent in the backward direction, in lone signal units using heading code **1 1 0 0 1**, are allocated signal information codes as follows:

0 0 0 1 spare
0 0 1 0 spare
0 0 1 1 switching-equipment-congestion
0 1 0 0 circuit-group-congestion
0 1 0 1 national-network-congestion
0 1 1 0 spare
0 1 1 1 spare
1 0 0 0 call-failure
1 0 0 1 spare
1 0 1 0 spare
1 0 1 1 spare
1 1 0 0 spare
1 1 0 1 spare
1 1 1 0 confusion
1 1 1 1 spare

Signal information code **0 0 0 0** indicates that the signal unit is the initial signal unit of a multi-unit message. This facility is reserved for possible future expansion.

3.2.3.4 *Telephone signals with heading code* **1 1 0 1 0**

The format of a one-unit telephone signals using heading code **1 1 0 1 0** is shown in Figure 5/Q.257.

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Signals, in lone signal units using heading code **1 1 0 1 0**, are allocated signal information codes as follows:

0 0 0 1	continuity	sent in the forward direction
0 0 1 0	clear-forward	
0 0 1 1	forward-transfer	
0 1 0 0	spare	
0 1 0 1	spare	
0 1 1 0	spare	
0 1 1 1	spare	
1 0 0 0	spare	
1 0 0 1	spare	
1 0 1 0	reset-circuit	sent in either direction
1 0 1 1	blocking	
1 1 0 0	unblocking	
1 1 0 1	blocking-acknowledgement	
1 1 1 0	unblocking-acknowledgement	
1 1 1 1	message-refusal	

Signal information code **0 0 0 0** indicates that the signal unit is the initial signal unit of a multi-unit message. This facility is reserved for possible future expansion.

3.2.3.5 *Telephone signals with heading code* **1 1 0 1 1**

The format of one-unit telephone signals using heading code **1 1 0 1 1** is shown in Figure 5/Q.257.

Signals, sent in the backward direction, in lone signal units using heading code **1 1 0 1 1**, are allocated signal information codes as follows:

0 0 0 1 address-complete, subscriber-free, charge
0 0 1 0 address-complete, subscriber-free, no charge
0 0 1 1 address-complete, subscriber-free, coin-box
0 1 0 0 subscriber-busy (electrical)
0 1 0 1 unallocated-number
0 1 1 0 line-out-of-service
0 1 1 1 send-special-information tone
1 0 0 0 spare
1 0 0 1 spare
1 0 1 0 address-complete, charge
1 0 1 1 address-complete, no charge
1 1 0 0 address-complete, coin-box
1 1 0 1 address-incomplete
1 1 1 0 spare
1 1 1 1 spare

Signal information code **0 0 0 0** indicates that the signal unit is the initial signal unit of a multi-unit message. This facility is reserved for possible future expansion.

3.2.3.6 *Reserved heading codes*

The signal information codes under the heading codes **0 1 0 0 0**, **0 1 0 0 1**, **0 1 0 1 0**, **0 1 0 1 1**, **1 1 1 0 0**, **1 1 1 1 0** and **1 1 1 1 1** are reserved for regional and/or national use.

Signal information code **0 0 0 0** indicates that the signal unit is the initial signal unit of a multi-unit message. This facility is reserved for possible future expansion.

3.2.4 *Examples of address messages*

Examples of address messages are given below to elucidate the formats and codes adopted for address messages. As there is no telephone signal information contained in the check fields of the signal units, these fields are not shown in the examples.

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3.2.4.1 *Transit call* from USA (international exchange New York) to the Netherlands (international exchange Amsterdam) via the United Kingdom (transit exchange London).

Assumptions:
- Semi-automatic traffic, English language.
- The signalling links New York-London and London-Amsterdam are both associated with their respective speech circuit groups.
- Speech path New York-London is a satellite circuit equipped with echo suppressors, speech path London-Amsterdam is a cable circuit not equipped with echo suppressors (due to bilateral agreement between the Administrations concerned).
- Dialled information: 31 2150 43551.
- *En bloc* operation.

a) *Address message New York-London*

10000/0000/ 000 0101/0011
00/11/1110 0000 0010 0000
00/11/0011/0001/0010/0001
00/11/0101/1010/0100/0011
00/11/0101/0101/0001/1111

b) *Address message London-Amsterdam*

10000/ 0000/ 000 0000/1010
00/11 / 0100 0000 0010 0000
00/11 / 0010/0001/0101/1010
00/11 / 0100/0011/0101/0101
00/11 / 0001/1111/0000/0000

The intermediate CT London serves as a transit exchange.

3.2.4.2 *Direct call* from the Netherlands (international exchange Amsterdam) to USA (international exchange New York).

Assumptions:
- Automatic traffic, ordinary subscriber.
- Speech path Amsterdam-New York is a cable circuit equipped with echo suppressors.
- Speech circuit group Amsterdam-New York has no associated signalling link. Signal information will be transferred via the two signalling links Amsterdam-London and London-New York in tandem, thus using a quasi-associated mode of operation.
- Dialled information: 1 201 949 5813.
- Overlap with subscribers' dialling operation.

a) *Address messages Amsterdam-London*

10000/0000/ 001 0000/1001
00/ 10/0010 0000 1010 0000
00/ 10/0010/1010 / 0001/1001
00/ 10/0100/1001 / 0000/0000

Initial address message

10001/0101/ 001 0000/1001 – First subsequent address message
10010/1000/ 001 0000/1001 – Second subsequent address message
10011/0001/ 001 0000/1001 – Third subsequent address message
10100/0011/ 001 0000/1001 – Fourth subsequent address message
10101/1111/ 001 0000/1001* – Fifth subsequent address message

* ST-signal, sent if the end of the address has been recognized.

b) *Address messages London-New York*

Exactly the same messages are sent as under a).

The London exchange serves as signal transfer point only. It is assumed that by agreement between the Administrations concerned there is no need for a change of label at this signal transfer point.

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3.3 SIGNALLING-SYSTEM-CONTROL SIGNALS

3.3.1 *General*

The signalling-system-control signals are not related to telephone signal information. They are necessary for the proper functioning of the signalling system.

All signalling-system-control signals specified (see Recommendation Q.255) are transferred by means of lone signal units:

– acknowledgement signal unit,

– synchronization signal unit, and

– system-control signal unit.

3.3.2 *Acknowledgement signal unit (ACU)*

The function of the acknowledgement signal unit (ACU) is described in Recommendation Q.251.

3.3.2.1 *Format of the ACU*

The format of the ACU is given in Figure 8/Q.259.

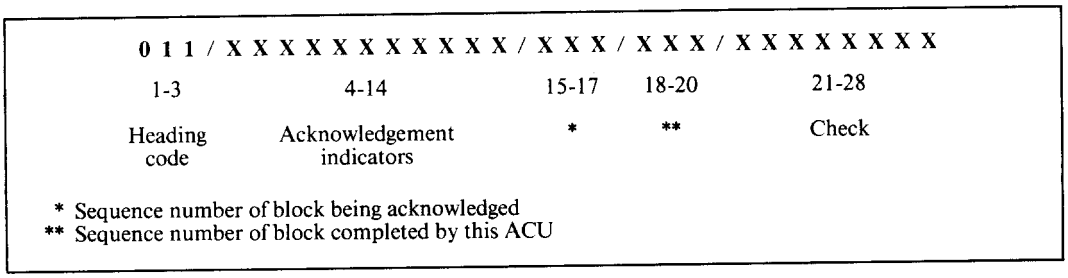

FIGURE 8/Q.259

Format of the acknowledgement signal unit

3.3.2.2 *Codes for the ACU parts*

a) *Heading*

The heading code **0 1 1** is used.

b) *Acknowledgement indicators*

The ACU contains 11 acknowledgement indicators to acknowledge sequentially the corresponding eleven signal units of a block received. That is, bit 4 refers to the first signal unit in the block being acknowledged, bit 5 refers to the second, etc. Each indicator will be coded in the following way:

0 no error detected,

1 error detected.

The error detected condition includes signals rejected by the terminal as covered in Recommendations Q.277, Q.278 and Q.293, § 8.6.1.

c) *Block sequence numbers*

Both the block being acknowledged and the block completed by the ACU are indicated by cyclic sequence numbers from the series **0 0 0**, **0 0 1**, **0 1 0**, **0 1 1**, **1 0 0**, **1 0 1**, **1 1 0**, **1 1 1**, **0 0 0** ...

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3.3.3 *Synchronization signal unit (SYU)*

The function of the synchronization signal unit (SYU) is described in Recommendation Q.251.

3.3.3.1 *Format of the SYU*

The format of the SYU is given in Figure 9/Q.259.

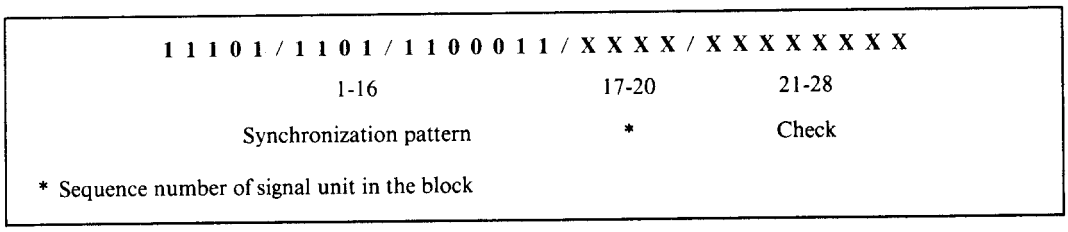

FIGURE 9/Q.259

Format of the synchronization signal unit

3.3.3.2 *Codes for the SYU parts*

a) *Synchronization pattern*

This pattern is coded as: **1 1 1 0 1 1 1 0 1 1 1 0 0 0 1 1**.

The first nine bits of the synchronization pattern may be considered to contain the heading and signal information fields which are coded **1 1 1 0 1** and **1 1 0 1** respectively.

The heading code **1 1 1 0 1** is used for signalling-system-control signals (except ACU) as well as for management signals. The spare signal information codes can be allocated either to system-control signals or to management signals.

b) *Signal unit sequence number*

The sequence number may have any code of the 4-bit binary code **0 0 0 0**, **0 0 0 1**, **0 0 1 0** up to **1 0 1 0** inclusive. The number chosen for a synchronization signal unit is determined by the position of that synchronization signal unit in the block of signal units.

The remaining codes **1 0 1 1** to **1 1 1 1** are not assigned.

3.3.4 *System-control signal units (SCU)*

The function of the system-control signal units is described in Recommendation Q.255.

3.3.4.1 *Format of an SCU*

The format of an SCU is given in Figure 10/Q.259.

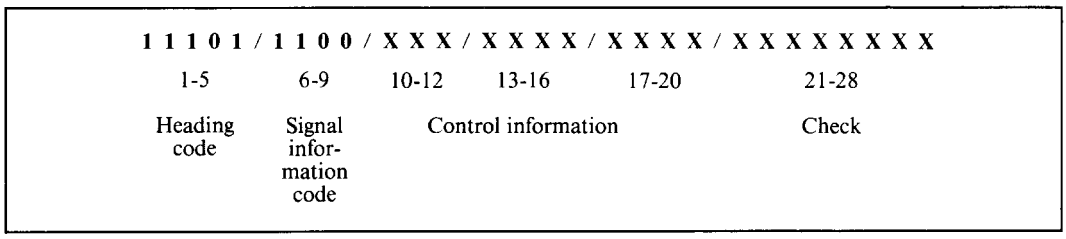

FIGURE 10/Q.259

Format of a system-control signal unit

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3.3.4.2 *Codes for the SCU parts*

a) *Heading*

The heading code **1 1 1 0 1** is used.

The heading code **1 1 1 0 1** is used for signalling-system-control signals (except ACU) as well as management signals. The spare signal information codes can be allocated either to system-control signals or to management signals.

b) *Signal information*

The signal information code **1 1 0 0** is used.

c) *Control information*

– bits 10-12 are coded as **0 0 1**. The other codes are spare.

– bits 13-16 are coded as **0 0 0 1**. The other codes are spare.

– bits 17-20 system-control signals, defined in Recommendation Q.255, are coded as follows:

0 0 0 0	spare
0 0 0 1	changeover
0 0 1 0	manual-changeover
0 0 1 1	spare
0 1 0 0	standby-ready
0 1 0 1	spare
0 1 1 0	load-transfer
0 1 1 1	emergency-load-transfer
1 0 0 0	spare
1 0 0 1	spare
1 0 1 0	manual-changeover-acknowledgement
1 0 1 1	spare
1 1 0 0	standby-ready-acknowledgement
1 1 0 1	spare
1 1 1 0	load-transfer-acknowledgement
1 1 1 1	spare

3.3.5 *Multi-block-synchronization signal units (MBS)*

The function of the multi-block-synchronization signal units is described in Recommendation Q.255.

3.3.5.1 *Format of an MBS*

The format of an MBS is given in Figure 11/Q.259.

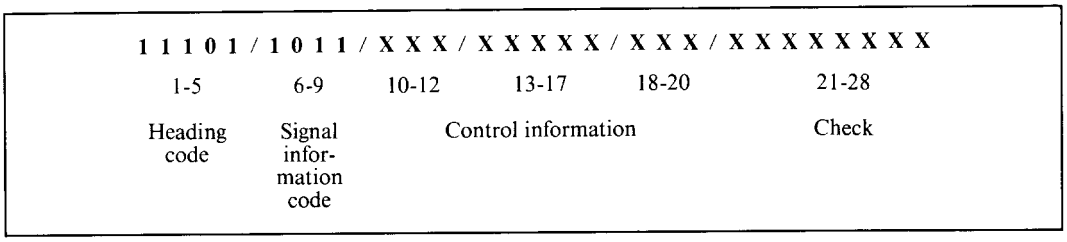

FIGURE 11/Q.259

Format of a multi-block-synchronization signal unit

3.3.5.2 *Codes for the multi-block-synchronization signal unit parts*

a) *Heading*

The heading code **1 1 1 0 1** is used.

The heading code **1 1 1 0 1** is used for signalling system control signals (except ACU) as well as management signals. See § 3.3.4.2.

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b) *Signal information*

The signal information code **1 0 1 1** is used.

c) *Control information*

– bits 10-12 are coded as follows:

0 0 0 multi-block monitoring signal

1 0 0 multi-block acknowledgement signal

The other codes are spare.

– bits 13-17 indicate the sequence number of the multi-block in which the multi-block monitoring signal is sent by a 5-bit binary code from the series **0 0 0 0 0**, **0 0 0 0 1**, **0 0 0 1 0**, . . ., **1 1 1 1 1**, **0 0 0 0 0**.

– bits 18-20 indicate the sequence number of the block in which the multi-block monitoring signal is sent (or placed into the output buffer) [see § 3.3.2.2, c) above].

Recommendation Q.260

3.4 MANAGEMENT SIGNALS

3.4.1 *General*

Management signals may include:

– network-management signals,

– network-maintenance signals,

– signalling-network-management signals,

i.e. signals concerned with the management of the signalling network and of the speech circuit network.

These signals may be transferred by means of one-unit messages or multi-unit messages.

3.4.1.1 *Basic format of management signals*

The basic format of a one-unit management message is shown in Figure 12/Q.260.

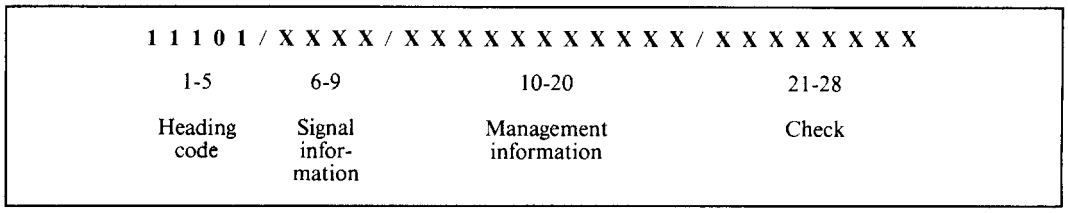

FIGURE 12/Q.260

Basic Format : a one-unit management message or an initial signal unit of a multi-unit management message

The management information field, bits 10-20, may be subdivided as required. When a band number is included in the management signal unit, it is placed in bits 10-16.

For some management signals which relate to a group or sub-group of circuits, the band number in bits 10 to 16 and the management information in bits 17-20. This is detailed under the type of signal.

3.4.1.2 *Format of a multi-unit management message*

The format of the initial signal unit of a multi-unit management message is given in Figure 12/Q.260. The use of a special code, **0 0 0 0** in the signal information field (bits 6-9) distinguishes an initial signal unit from a one-unit management message.

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The format of a subsequent signal unit of a multi-unit management message is shown in Figure 13/Q.260.

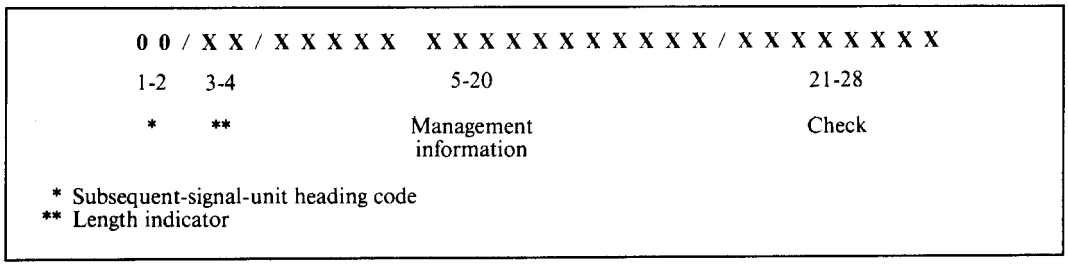

FIGURE 13/Q.260

Format of a subsequent signal unit of a multi-unit management message

3.4.1.3 *Codes for management signals*

a) *Heading*

The heading code **1 1 1 0 1** is used for one-unit management messages and for the initial signal unit of a multi-unit management message. The heading code **0 0** is used for subsequent signal units of multi-unit messages.

b) *Signal information*

Signal information codes are assigned as follows:

0 0 0 1	network-management and network-maintenance signal units
0 0 1 0	spare
0 0 1 1	spare
0 1 0 0	spare
0 1 0 1	signalling-network-management signal unit
0 1 1 0	spare (reserved for regional and/or national use)
0 1 1 1	spare (reserved for regional and/or national use)
1 0 0 0	spare
1 0 0 1	spare
1 0 1 0	spare
1 0 1 1	MBS (see Recommendation Q.259)
1 1 0 0	SCU (see Recommendation Q.259)
1 1 0 1	SYU (see Recommendation Q.259)
1 1 1 0	spare (reserved for regional and/or national use)
1 1 1 1	spare (reserved for regional and/or national use)

Signal information code **0 0 0 0** indicates that the signal unit is the initial signal unit of a multi-unit message.

The spare international signal information codes may be assigned to either management signals or signalling-system-control signals.

3.4.2 *Network-management and network-maintenance signals*

3.4.2.1 *Network-management signals*

The heading field is coded **1 1 1 0 1**. Signal information fields are coded **0 0 0 0** for multi-unit management messages and **0 0 0 1** for one unit network-management and network-maintenance signals. Figure 12/Q.260 and Figure 13/Q.260 apply. Multi-unit management messages and corresponding management information are established in three categories:

1) destination hard to reach,

2) all circuits busy, and

3) switching centre congestion.

For coding see § 3.4.2.4 b).

3.4.2.2 *Network maintenance signals*

Network maintenance signals may be sent as one-unit or multi-unit messages under heading code **1 1 1 0 1**.

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3.4.2.3 *Codes for one-unit network-management and network-maintenance signals*

a) *Heading*

The heading code **1 1 1 0 1** is used.

b) *Signal information*

The signal information code **0 0 0 1** is used.

c) *Band number*

The band number (bits 10-16) indicates the group or subgroup of circuits to which the signal refers.

d) *Management or maintenance information is given in bits 17-20*

0 0 0 0	spare
0 0 0 1	spare
0 0 1 0	spare
0 0 1 1	spare
0 1 0 0	spare
0 1 0 1	spare
0 1 1 0	spare
0 1 1 1	spare
1 0 0 0	spare
1 0 0 1	spare
1 0 1 0	spare
1 0 1 1	spare
1 1 0 0	spare
1 1 0 1	spare
1 1 1 0	reset-band-acknowledgement, all circuits idle
1 1 1 1	reset-band

3.4.2.4 *Codes used in multi-unit management messages*

a) *Initial signal unit*

– The five-bit heading code **1 1 1 0 1** is used.

– The signal information code **0 0 0 0** is used.

– The band number is used to designate the group or subgroup of circuits to which the signals apply when appropriate. The remaining bits are used for management or maintenance information.

b) *Management information – initial signal unit*

Management or maintenance information is given in bits 17-20.

0 0 0 0	destination hard to reach
0 0 0 1	all circuits busy
0 0 1 0	switching centre congestion
0 0 1 1	spare
0 1 0 0	spare
0 1 0 1	spare
0 1 1 0	spare
0 1 1 1	spare
1 0 0 0	spare
1 0 0 1	spare
1 0 1 0	spare
1 0 1 1	spare
1 1 0 0	spare
1 1 0 1	spare
1 1 1 0	spare
1 1 1 1	reset-band acknowledgement

c) *Subsequent signal unit*

– The heading code **0 0** is used.

– The length indicator is coded as appropriate (see Recommendation Q.257, § 3.1.3.4).

– The management information is inserted.

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d) *Management information – subsequent signal units*

The format of subsequent signal units is determined by the management information coded in bits 17-20 in b) above.

e) *First subsequent signal unit*

ISU bits 17-20	*Bits 5-20 in first SSU*				*Bits 5-20 in second SSU*			
0 0 0 0	**XXXX**	**XXXX**	**XXXX**	**XXXX**	**XXXX**	**XXXX**	**XXXX**	**XXXX**
	(5-8)	(9-12)	(13-16)	(17-20)	(5-8)	(9-12)	(13-16)	(17-20)
	ISC Code	Reason	D1	D2	D3	D4	D5	D6

The digits shown as D1 to D6 represent destination code assignments which can follow address patterns or can be selected by bilateral agreement or both. The "reasons" given in the first SSU, bits (9-12) are:

0 0 0 0	ABR (Answer/Bid Ratio) below arbitrary threshold
0 0 0 1	ABR below high threshold
0 0 1 0	ABR below medium threshold
0 0 1 1	ABR below low threshold
0 1 0 0-1 1 1 1	spare

0 0 0 1	**XXXX**	**XXXX**	**XXXX**	**XXXX**	**XXXX**	**XXXX**	**XXXX**	**XXXX**
	(5-8)	(9-12)	(13-16)	(17-20)	(5-8)	(9-12)	(13-16)	(17-20)
	ISC Code	Reason	D1	D2	D3	D4	D5	D6

Reasons are as follows:

0 0 0 0	all circuits busy threshold exceeded
0 0 0 1	low congestion
0 0 1 0	medium congestion
0 0 1 1	high congestion
0 1 0 0-1 1 1 1	spare

0 0 1 0	**XXXX**	**XXXX**	**1 1 1 1**	**1 1 1 1**
	(5-8)	(9-12)	(13-16)	(17-20)
	ISC Code	Reason	Not used	Not used

Reasons are as follows:

0 0 0 0	moderate congestion – level 1
0 0 0 1	serious congestion – level 2
0 0 1 0	unable to process calls – level 3
0 0 1 1-1 1 1 1	spare

0 0 1 1	spare
0 1 0 0	spare
0 1 0 1	spare
0 1 1 0	spare
0 1 1 1	spare
1 0 0 0	spare
1 0 0 1	spare
1 0 1 0	spare

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1 0 1 1 spare
1 1 0 0 spare
1 1 0 1 spare
1 1 1 0 spare
1 1 1 1 circuit status indicators – codes to indicate for each circuit in the band the circuit status. Bit 5 refers to the first circuit, (circuit No. **0 0 0 0**), and so on to bit 20 which refers to circuit No. **1 1 1 1**, the last circuit. Code **0** indicates circuit available for service, **1** circuit should be blocked. However, if all circuits are idle (available), the LSU coding in § 3.4.2.3 d) for "all circuits idle" applies. Also see § 9.5.1.

3.4.3 *Signalling-network-management signals*

3.4.3.1 *Format of a signalling-network-management signal*

The format of a one-unit signalling-network-management message is given in Figure 14/Q.260.

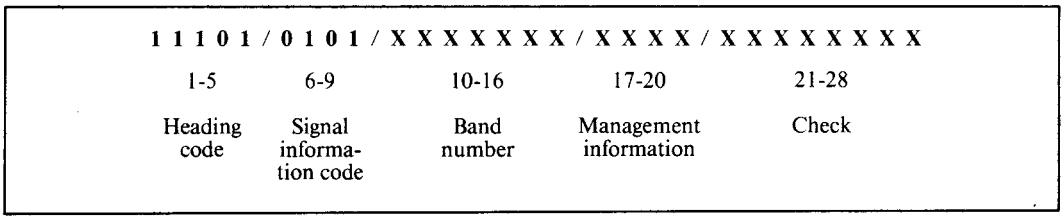

FIGURE 14/Q.260

Format of a one-unit signalling-network-management message

3.4.3.2 *Codes for the signalling network-management signal unit parts*

a) *Heading*

The heading code **1 1 1 0 1** is used.

b) *Signal information*

The signal information code **0 1 0 1** is used.

c) *Band number*

The band number (bits 10-16) indicates the group or sub-group of circuits to which the signal refers (see Recommendation Q.257, § 3.1.3.3).

d) *Management information*

The codes used in the management information field are allocated as follows:

0 0 0 0 spare
0 0 0 1 spare
0 0 1 0 spare
0 0 1 1 spare
0 1 0 0 spare
0 1 0 1 transfer-prohibited
0 1 1 0 transfer-allowed
0 1 1 1 spare
1 0 0 0 transfer-allowed-acknowledgement
1 0 0 1 spare
1 0 1 0 spare
1 0 1 1 spare
1 1 0 0 spare
1 1 0 1 spare
1 1 1 0 spare
1 1 1 1 spare

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SECTION 4

SIGNALLING PROCEDURES

(Including interworking with Signalling Systems No. 4 and No. 5)

Recommendation Q.261

4.1 NORMAL CALL SET-UP

4.1.1 *Initial address message*

An initial address message which is sent as the first message of a call set-up generally includes all of the information required by the next international exchange to route the call. The seizing function is implicit in the reception of this initial address message. The format of the initial address message is given in Recommendation Q.258.

The initial address message (IAM) will contain the following signalling information:

a) country-code indicator,

b) nature-of-circuit indicator,

c) echo-suppressor indicator,

d) calling-party's category,

e) address signals.

The *country-code indicator* provides information as to whether or not a country code is included in the address signals. It is necessary in System No. 6 as the country code is not sent to the incoming international exchange. This indicator must be translated to the appropriate signal for transmission over succeeding circuits using other signalling systems. Interworking with other systems is specified in the parts of the *Yellow Book* covering those systems.

The *nature-of-circuit indicator* provides information as to whether or not this circuit or any preceding circuit in the connection has traversed a high-altitude satellite, and makes it possible for an international transit exchange to ensure that a second high-altitude circuit is included only in known exceptional circumstances.

The *echo-suppressor indicator* provides information as to whether or not a standard outgoing half-echo suppressor (Recommendation G.161) has been included in the forward direction at a preceding international exchange. Receipt of this signal marked **1** indicates that a standard incoming half-echo suppressor should be included in the backward direction at the last four-wire exchange in the connection. Exceptionally, it is possible for the echo suppressors to be inserted at a point other than the last four-wire exchange on the basis of this signal.

The use of an echo suppressor at an international transit exchange must be by agreement and only in those connections which have been analyzed and where it has been found that the transmission requirements are fulfilled.

Recommendation Q.115 covers the arrangements for control of echo suppressors.

The *calling-party's-category indicator* is used to indicate the type of caller originating the call, e.g. ordinary caller, operator or data caller and may indicate that a special routing is required. The *language and discriminating information* is included in the calling-party's category. It will be necessary to translate the language digit received from an operator in semi-automatic working or a discriminating digit received from a preceding link to the appropriate calling-party's-category code. The language or discriminating information must be translated from the calling-party's-category indicator to the appropriate digit for transmission over a circuit using System No. 4 or System No. 5 in a succeeding link.

The *sending sequence of address information* will be the country code (not sent to an incoming international exchange) followed by the national (significant) number. For calls to code 11 and code 12, refer to Recommendation Q.107.

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All digits required for routing the call through the international network will be sent in the *initial address message.* On calls with a country code in the address (except in the case of calls to special operators), the initial address message will contain a minimum of four digits and should contain as many as are available. All digits of the address may be included. In a terminal link, the initial address may contain one digit. Thus, the initial address message could consist of as few as three signal units (one digit) or as many as six signal units. Although 15 digits and ST could be included in a six-unit message, the international numbering plan allows only 12 digits.

Selection of the outgoing national circuit normally can start at the incoming international exchange on receipt of the initial address message and signalling can proceed on the first national link.

Note – When interworking towards another signalling system with fewer facilities, it will be necessary to discard some of the signals, e.g. nature-of-circuit indicator and echo-suppressor indicator.

When no echo suppressor or nature-of-circuit indication is received from a preceding circuit using a signalling system with fewer facilities, the indicators will be considered as received *no* unless positive knowledge is available.

4.1.2 *Subsequent address messages*

The remaining digits, if any, of the address may be sent individually in one-unit messages or in groups in multi-unit messages. Efficiency can be gained by grouping together as many digits as possible. However, to prevent an increase in post-dialling delay in those cases where overlap operation with subscribers' dialling is used, it may be desirable to send the last few digits individually. The number of signal units used in a subsequent address message may be from one to four. If the outgoing circuit from an international transit exchange **is** equipped with System No. 5, any digits received in overlap must be grouped for *en bloc* sending.

Subsequent address messages can be sent on to the national network as they are received. Appropriate measures (e.g. by withholding the last digit(s) of the national number) must be taken at the last common channel exchange, to prevent ringing the called subscriber or alerting the operator until the continuity of the speech circuits served by the common channels has been verified.

The *sequence of address messages* may be disturbed in the event that one or more messages have been retransmitted because of an error. To prevent the assembly of digits in an incorrect sequence, the last System No. 6 or common channel exchange must examine the sequence number included in each address message and reassemble the digits if necessary. In some instances, intermediate common channel exchanges must also resequence address messages; refer to Recommendation Q.262, § 4.2.1.

4.1.3 *End-of-pulsing (ST) signal*

The ST signal is always sent in the following situations:

a) semi-automatic calls,

b) test calls, and

c) when the ST is received from a preceding circuit.

In automatic working, this signal will be sent whenever the outgoing international exchange is in a position to know, by digit analysis, that the final digit has been sent. Digit analysis may consist of an examination of the country code and counting of the maximum (or fixed) number of digits of the national number. In other cases, the ST signal is not sent and the end-of-address information is determined by the receipt of one of the address- complete signals from the incoming international exchange.

4.1.4 *Continuity check of the speech path*

The continuity check is described in § 5. The use of the loop method of continuity checking requires that any echo suppressors in the check loop be disabled. Each System No. 6 exchange must disable any echo suppressor in that exchange, which is required to be active for the speech connection, for the period of attachment of the *continuity-check loop* or *transceiver.*

Each System No. 6 exchange will connect the transceiver to the outgoing speech circuit when the initial address message is sent [see Recommendation Q.271, § 5.7.2, a)].

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