5i’

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.

FIGURE 5/Q.257, p. 6

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, p. 7

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 |** (bits 1-2);

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

The heading codes are allocated as follows:

0 | Subsequent signal unit

0 | | | |

0 | | | |

Spare (reserved for regional and/or national use)

0 | | | |

0 | | | |

0 | | Acknowledgement signal unit

1 | | | | Initial signal unit of an initial address message (or of a multi-unit message)

1 | | | |

1 | | | |

1 | | | |

1 | | | | Subsequent address message (one-unit message or multi-unit message)

1 | | | |

1 | | | |

1 | | | |

1 | | | |

1 | | | |

International telephone signals

1 | | | |

1 | | | |

1 | | | | Spare (reserved for regional and/or national use)

?04

1 | | | | ?05

⌡

–v’1P’ –v’8p’ Signalling-system-control signals (except

acknowledgement signal unit) and management signals

1 | | | | ?04

?05 Spare (reserved for regional and/or national use)

1 | | | | ⎭

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 | | |** is used except with heading code **1 | | | |** 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).

TABLE [2/Q.257], p. 8

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], p. 9

The length indicator **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.

The subsequent signal units of an initial address message do not require the 5-bit heading or 11-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 | | | |** is used.

— The signal information code **0 | | |** is used.

— The assigned label code is used.

b) *Subsequent signal unit (number 1)*

— The heading code **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

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

— Bit 8: spare (reserved for international use)

— Bits 9-12: spare (reserved for regional and/or national use)

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

0 | | | spare

0 | | | operator, language French

0 | | | operator, language English

0 | | | operator, language German

0 | | | operator, language Russian

0 | | | operator, language Spanish

0 | | |

0 | | |

1 | | |

–v’2P’ –v’1p’ available to Administration

for selecting a particular language provided by mutual agreement

1 | | | reserved (see Recommendation Q.104)

1 | | | ordinary calling subscriber

1 | | | calling subscriber with priority

1 | | | data call

1 | | | test call

1 | | | spare

1 | | | spare (reserved for regional and/or national use)

— Bits 17-20: spare (reserved for regional and/or national use)

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

— The heading code **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 | | | filler (no information)

0 | | | digit 1

0 | | | digit 2

0 | | | digit 3

0 | | | digit 4

0 | | | digit 5

0 | | | digit 6

0 | | | digit 7

1 | | | digit 8

1 | | | digit 9

1 | | | digit 0

1 | | | code 11

1 | | | code 12

1 | | | spare

1 | | | spare

1 | | | ST

The filler code **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 |** 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 | | | system No. 6 continuity check

0 | | | ATME 2 — signalling check and transmission test

0 | | | ATME 2 — signalling check only

0 | | | quiet termination test line

0 | | | echo suppressor test system

0 | | | loop around test line

0 | | | transmission access test line

0 | | | transmission access test line

1 | | | transmission access test line

1 | | | echo canceller test line

1 | | | spare

1 | | | spare

1 | | | spare

1 | | | spare

1 | | | spare

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.

FIGURE 7/Q.258, p.10

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 | | | | -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 | | | |** , the second **1 | | | |**, the third **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 | | | |** .

Subsequent signal units of subsequent address messages use the heading code **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 | | | digit 1

0 | | | digit 2

0 | | | digit 3

0 | | | digit 4

0 | | | digit 5

0 | | | digit 6

0 | | | digit 7

1 | | | digit 8

1 | | | digit 9

1 | | | digit 0

1 | | | ST

Codes **1 | | |** , **1 | | |** , **1 | | |** , **1 | | |** and **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 | | |**

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

0 | | | filler (no information)

0 | | | digit 1

0 | | | digit 2

0 | | | digit 3

0 | | | digit 4

0 | | | digit 5

0 | | | digit 6

0 | | | digit 7

1 | | | digit 8

1 | | | digit 9

1 | | | digit 0

1 | | | ST

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

The filler code **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 | | | |**

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

0 | | | initial signal unit of an initial address message (see Recommendation Q.258, § 3.2.1.2)

0 | | | spare (reserved for international use)

0 | | | spare

0 | | | spare

0 | | | spare

0 | | | spare

0 | | | spare

0 | | | spare

1 | | | spare

1 | | | spare –v’5p’ (reserved for regional and/or national use)

1 | | | spare

1 | | | spare

1 | | | spare

1 | | | spare

1 | | | spare

1 | | | spare

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

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

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

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

0 | | | release-guard

0 | | | answer, charge (priority)

0 | | | answer, no charge (priority)

0 | | | clear-back No. 1

0 | | | reanswer No. 1

0 | | | clear-back No. 2

0 | | | reanswer No. 2

1 | | | clear-back No. 3

1 | | | reanswer No. 3

1 | | | spare

1 | | | spare

1 | | | spare

1 | | | spare

1 | | | spare

1 | | | spare

Signal information code **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 | | | |**

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

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

0 | | | spare

0 | | | spare

0 | | | switching-equipment-congestion

0 | | | circuit-group-congestion

0 | | | national-network-congestion

0 | | | spare

0 | | | spare

1 | | | call-failure

1 | | | spare

1 | | | spare

1 | | | spare

1 | | | spare

1 | | | spare

1 | | | confusion

1 | | | spare

Signal information code **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 | | | |**

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

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

0 | | | continuity

0 | | | clear-forward sent in the forward direction

0 | | | forward-transfer

0 | | | spare

0 | | | spare

0 | | | spare

0 | | | spare

1 | | | spare

1 | | | spare

1 | | | reset-circuit

1 | | | blocking

1 | | | unblocking

sent in either direction

1 | | | blocking-acknowledgement

1 | | | unblocking-acknowledgement

1 | | | message-refusal

Signal information code **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 | | | |**

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

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

0 | | | address-complete, subscriber-free, charge

0 | | | address-complete, subscriber-free, no charge

0 | | | address-complete, subscriber-free, coin-box

0 | | | subscriber-busy (electrical)

0 | | | unallocated-number

0 | | | line-out-of-service

0 | | | send-special-information tone

1 | | | spare

1 | | | spare

1 | | | address-complete, charge

1 | | | address-complete, no charge

1 | | | address-complete, coin-box

1 | | | address-incomplete

1 | | | spare

1 | | | spare

Signal information code **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 | | | |**, **0 | | | |** , **0 | | | |** , **0 | | | |** , **1 | | | |**, **1 | | | |** and **1 | | | |** are reserved for regional and/or national use.

Signal information code **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.

3.2.4.1 *Transit call* | rom 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*

1 | | | | | | | | | | | | | | | |fR |
| | | | | | | | |

0 | | | | | | | | | |fR |
| | | | |fR |
| | | | |fR |
| | | |

0 | | | | | | | | | | | | | | | | | | | | | | | | |

0 | | | | | | | | | | | | | | | | | | | | | | | | |

0 | | | | | | | | | | | | | | | | | | | | | | | | |

b) *Address message London-Amsterdam*

1 | | | | | | | | | | | | | | | | |fR |
| | | | | | | | |

0 | | | | | | | | | |fR |
| | | | |fR |
| | | | |fR |
| | | |

0 | | | | | | | | | | | | | | | | | | | | | | | |

0 | | | | | | | | | | | | | | | | | | | | | | | |

0 | | | | | | | | | | | | | | | | | | | | | | | |

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 | 01 | 49 | 813.

— Overlap with subscribers' dialling operation.

a) *Address messages Amsterdam-London*

1 | | | | | | | | | | | | | | | | |fR |
| | | | | | | | |

0 | | | | | | | | | |fR |
| | | | |fR |
| | | | |fR |
| | | |

Initial address message

0 | | | | | | | | | | | | | | | | | | | | | | | |

0 | | | | | | | | | | | | | | | | | | | | | | | |

1 | | | | | | | | | | | | | | | | |fR |
| | | | | | | | | — First subsequent address message

1 | | | | | | | | | | | | | | | | |fR |
| | | | | | | | | — Second subsequent address message

1 | | | | | | | | | | | | | | | | |fR |
| | | | | | | | | — Third subsequent address message

1 | | | | | | | | | | | | | | | | | | | | | | | | | | — Fourth subsequent address message

1 | | | | | | | | | | | | | | | | | | | | | | | | | | * — 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.

Recommendation Q.259

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, p.11

3.3.2.2 *Codes for the ACU parts*

a) *Heading*

The heading code **0 | |** 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* **|** ondition 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 | |** , **1 | |** , **1 | |** , **1 | |** , **1 | |** , **0 | |** . | |

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, p.12

3.3.3.2 *Codes for the SYU parts*

a) *Synchronization pattern*

This pattern is coded as: **1 | | | | | | | | | | | | | | | |**

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

The heading code **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 | | |** up to **1 | | |** 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 | | |** to **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, p.13

3.3.4.2 *Codes for the SCU parts*

a) *Heading*

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

The heading code **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 | | |** is used.

c) *Control information*

— bits 10-12 are coded as **0 | |** . The other codes are spare.

— bits 13-16 are coded as **0 | | |** . The other codes are spare.

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

0 | | | spare

0 | | | changeover

0 | | | manual-changeover

0 | | | spare

0 | | | standby-ready

0 | | | spare

0 | | | load-transfer

0 | | | emergency-load-transfer

1 | | | spare

1 | | | spare

1 | | | manual-changeover-acknowledgement

1 | | | spare

1 | | | standby-ready-acknowledgement

1 | | | spare

1 | | | load-transfer-acknowledgement

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, p.14

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

a) *Heading*

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

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

b) *Signal information*

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

c) *Control information*

— bits 10-12 are coded as follows:

0 | | multi-block monitoring signal

1 | | 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 | | | |**, . | | ,

1 | | | | , **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].

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, p.15

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 | | |** in the signal information field (bits 6-9) distinguishes an initial signal unit from a one-unit management message.

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

FIGURE 13/Q.260, p.16

3.4.1.3 *Codes for management signals*

a) *Heading*

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

b) *Signal information*

Signal information codes are assigned as follows:

0 | | | network-management and network-maintenance signal units

0 | | | spare

0 | | | spare

0 | | | spare

0 | | | signalling-network-management signal unit

0 | | | spare (reserved for regional and/or national use)

0 | | | spare (reserved for regional and/or national use)

1 | | | spare

1 | | | spare

1 | | | spare

1 | | | MBS (see Recommendation Q.259)

1 | | | SCU (see Recommendation Q.259)

1 | | | SYU (see Recommendation Q.259)

1 | | | spare (reserved for regional and/or national use)

1 | | | spare (reserved for regional and/or national use)

Signal information code **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 | | | |** . Signal information fields are coded **0 | | |** for multi-unit management messages and **0 | | |** 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 estab lished in three categories:

1) destination hard to reach,

2) all circuits busy, and

3) switching centre congestion.

For coding see § 3.4.2.4 |).

3.4.2.2 *Network maintenance signals*

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

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

a) *Heading*

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

b) *Signal information*

The signal information code **0 | | |** 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 | | | spare

0 | | | spare

0 | | | spare

0 | | | spare

0 | | | spare

0 | | | spare

0 | | | spare

0 | | | spare

1 | | | spare

1 | | | spare

1 | | | spare

1 | | | spare

1 | | | spare

1 | | | spare

1 | | | reset-band-acknowledgement, all circuits idle

1 | | | reset-band

3.4.2.4 *Codes used in multi-unit management messages*

a) *Initial signal unit*

— The five-bit heading code **1 | | | |** is used.

— The signal information code **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 | | | destination hard to reach

0 | | | all circuits busy

0 | | | switching centre congestion

0 | | | spare

0 | | | spare

0 | | | spare

0 | | | spare

0 | | | spare

1 | | | spare

1 | | | spare

1 | | | spare

1 | | | spare

1 | | | spare

1 | | | spare

1 | | | spare

1 | | | reset-band acknowledgement

c) *Subsequent signal unit*

— The heading code **0 |** is used.

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

— The management information is inserted.

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 | | | 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 Reason D1 D2 D3 D4 D5 D6

Code

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 | | | ABR (Answer/Bid Ratio) below arbitrary threshold

0 | | | ABR below high threshold

0 | | | ABR below medium threshold

0 | | | ABR below low threshold

0 | | | -1 | | | spare

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 Reason D1 D2 D3 D4 D5 D6

Code

Reasons are as follows:

0 | | | all circuits busy threshold exceeded

0 | | | low congestion

0 | | | medium congestion

0 | | | high congestion

0 | | | -1 | | | spare

0 | | | XXXX XXXX **1 | | | 1 | | |**

(5-8) (9-12) (13-16) (17-20)

ISC Reason Not Not

Code used used

Reasons are as follows:

0 | | | moderate congestion — level 1

0 | | | serious congestion — level 2

0 | | | unable to process calls — level 3

0 | | | -1 | | | spare

0 | | | spare

0 | | | spare

0 | | | spare

0 | | | spare

0 | | | spare

1 | | | spare

1 | | | spare

1 | | | spare

1 | | | spare

1 | | | spare

1 | | | spare

1 | | | spare

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 | | |**), and so on to bit 20 which refers to circuit No. **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 |) 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, p.17

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

a) *Heading*

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

b) *Signal information*

The signal information code **0 | | |** 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 | | | spare

0 | | | spare

0 | | | spare

0 | | | spare

0 | | | spare

0 | | | transfer-prohibited

0 | | | transfer-allowed

0 | | | spare

1 | | | transfer-allowed-acknowledgement

1 | | | spare

1 | | | spare

1 | | | spare

1 | | | spare

1 | | | spare

1 | | | spare

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* | rovides 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* | rovides 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* | rovides 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* | s 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* | ill 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.

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* | ay 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)].

The first System No. 6 exchange will send forward the *continuity signal* after completion of the following conditions:

— the continuity check performed on the outgoing circuit is completed,

— the speech path across the exchange has been checked and found correct (Recommendation Q.271, § 5.2), and

— if the preceding link is a common link, receipt of a continuity signal from the preceding exchange.

Succeeding intermediate System No. 6 exchanges will send forward the continuity signal after the completion of the three following conditions:

— a continuity signal is received from the preceding link,

— the speech path across the exchange has been checked and found correct (Recommendation Q.271, § 5.2), and

— the continuity check performed on the outgoing circuit is completed.

The speech path may be switched through at an international exchange and the transceiver disconnected after the continuity check of the circuit has been successfully completed. However, the switching through of the speech path should be delayed until the residual check tone has propagated through the return path of the speech circuit. This determination may be made by timing, or by using the check-tone receiver to test for the removal of the check-tone or other appropriate means.

On receipt of the continuity signal in the following international exchange, the continuity-check loop will be removed. Also, any digits of the national number which were withheld may be released (see § 4.1.2 above).

At the System No. 6 exchange, on failure of the outgoing circuit to satisfy the continuity check:

— the continuity-check transceiver will be removed and an automatic repeat attempt will be made on another circuit,

— the outgoing terminal of the faulty circuit will be removed from service,

— a blocking signal will be sent to the following exchange, and

— after receipt of the blocking-acknowledgement signal, a clear-forward release-guard sequence will take place.

A *repeat of the continuity check* | f the speech path will be made on the failed outgoing circuit within 1 to 10 seconds of receipt of the release-guard signal.

The second continuity check will be initiated by the System No. 6 exchange detecting the failure, using the test call procedure specified in Recommendation Q.295, § 9.1.1. The address information shall contain the code **0 | | |** to notify the incoming exchange that the test call is not to be switched through.

If the repeated check passes on this test call, the speech circuit will be unblocked and returned to service. If the check fails, the maintenance staff will be alerted that a failure has occurred and the circuit has been blocked. The check may be repeated at intervals of 1-3 minutes using the test call procedure. The repeated continuity check procedure will be finished and the circuit unblocked and returned to service when continuity is detected. Each repeated continuity check test call will be terminated using the clear-forward release-guard sequence.

The repeated continuity check test cycle may at any time be inhibited, either manually or automatically, in order to prevent its use in an inappropriate situation.

According to transmission maintenance requirements, System No. 6 should provide for:

a) a print-out each time a second continuity check is started. In such cases, the circuit involved should be identified;

b) a print-out each time a continuity check results in a warning being given to maintenance personnel.

Continuity check by means of the test call procedure may be performed at any time as required under the control of the maintenance staff. In these circumstances, although the test call is always terminated by the clear-forward signal, the blocking and unblocking signals are sent only at the discretion of the maintenance staff.

The second continuity check is not performed in the case of check failure in test calls (see Recommendation Q.295, § 9.1.1).

Since a continuity check failure can be caused by a faulty transceiver, precautions should be taken to ensure a low probability of selecting a faulty one for both the initial continuity check and the second check, e.g. by ensuring the selection of a different transceiver for each of the checks.

4.1.5 *Address-complete signals*

The address-complete signals should be originated either in or as close as possible to the called-party's-exchange since they imply that no further electrical called-party's-line-condition signals or congestion signals (see, however, § 4.1.7 below) will be sent. An address-complete signal will not be sent until the continuity signal has been received and the cross-office check made, if applicable.

If the succeeding network does not provide electrical called-party's-line-condition signals, the last No. 6 exchange shall originate and send an address-complete signal when the end of address signalling has been determined:

a) by receipt of an end-of-pulsing (ST) signal ;

b) by receipt of the maximum number of digits used in the national numbering plan;

c) by analysis of the national (significant) number to indicate that a sufficient number of digits has been received to route the call to the called party;

d) by receipt of an end-of-selection signal from the succeeding network (e.g. number received signal in System No. 4); or

e) exceptionally, if the succeeding network uses overlap pulsing and number analysis is not possible, by observing that 4 to 10 (for new equipment 4 to 6) seconds have elapsed since the last digit was received, and that no fresh information has been received; in such circumstances, transmission to the national network of the last digit received must be prevented until the end of the waiting period which causes an address-complete signal to be sent over the international circuit. In this way, it is ensured that no national answer signal can arrive before an address-complete signal has been sent.

If the succeeding circuit in a connection utilizes System No. 5, the last System No. 6 exchange shall originate and send an address-complete signal whenever the conditions for sending the end-of-pulsing (ST) signal over the No. 5 circuit have been met as specified in Recommendation Q.152.

When the last System No. 6 (common channel) exchange receives an address-complete or equivalent signal, it will release routing and address

information from memory and transmit the address-complete signal over the preceding link after receipt of the continuity signal.

If in normal operation delay in the receipt of an address-complete or equivalent signal from the succeeding network is expected, the last common channel exchange will originate and send an address-complete signal 15 to 20 seconds after receiving the latest address message. This time-out condition is an upper limit considering the clauses of 4.8.5.1 a) of Recommendation Q.268 (20 to 30 seconds for outgoing international exchanges in abnormal release conditions).

An intermediate System No. 6 exchange which receives an address-complete signal will release routing and address information from memory and transmit the signal over the preceding link.

On receipt of an address-complete signal, the first System No. 6 exchange will release registers and through-connect the speech path of the interconnected circuit, release address and routing information from memory and transmit the same or an equivalent signal over the preceding link.

When interworking from System No. 4 to System No. 6, the number-received signal will be sent over the System No. 4 link on receipt of the end-of-pulsing signal (ST) from the System No. 4 link or an address-complete signal from the System No. 6 link. However, the number-received signal will also be sent on failure to receive one of those signals within 4 to 6 seconds after reception of the latest digit.

Unless the exchange originating an address-complete signal has the ability to determine that a called number is a coin-box or a no charge number, the address-complete charge signal will be sent.

After an address-complete signal, only the following signals relating to the call may be sent:

a) in normal operation, one of the answer signals, clear-back or release-guard signals;

b) call-failure signal (§ 4.8.3 below), message-refusal signal (§ 4.6.2.3 below); or

c) when interworking with Systems No. 4 and No. 5, one of the congestion signals derived from busy-flash signals (§ 4.1.7 below).

Any further information about the called-party's line condition or congestion will be transmitted to the calling subscriber or operator as audible tones or announcements.

The appropriate address-complete, subscriber-free signal is sent as an alternative to the address-complete signals given above when it is known that the called subscriber's line is free (not busy). It must be originated in the called subscriber's exchange, and therefore cannot be followed by the busy-flash signal. The procedures for handling the address-complete, subscriber-free signals are the same as for the other address-complete signals when generated in the called subscriber's exchange.

4.1.6 *Address-incomplete signal*

The address-incomplete signal is sent whenever it can be determined that the proper number of digits has not been received. This determination can

be made at once if the end-of-pulsing (ST) signal is received or by receipt of an address-incomplete signal (or equivalent) from the national network. When overlap working is used, and the end-of-pulsing (ST) signal has not been received, the address-incomplete signal will be sent by the last common channel exchange 15 to 20 seconds after receipt of the latest digit.

If the incoming international exchange has already generated and sent an address-complete signal as described in § 4.1.5 above, and address-incomplete signal received from the succeeding network will be suppressed and the suitable tone or announcement sent.

Each System No. 6 exchange on receipt of the address-incomplete signal will send the signal to the preceding System No. 6 (common channel) exchange, if any, clear forward the connection, and remove the record of the call from memory. The first common channel exchange will send the appropriate tone or announcement, if any, for the national network concerned to the calling party.

4.1.7 *Congestion signals*

The three types of congestion signals are defined in Recommendation Q.254, §§ 2.1.12 to 2.1.14. The congestion signals may be sent without waiting for the completion of the continuity-check sequence. Reception of a congestion signal at any System No. 6 exchange will cause the clear-forward signal to be sent and cause either:

a) re-routing of the call or an automatic repeat attempt to be made (§ 4.4 below); or

b) the appropriate attempt signal or the appropriate audible tone or announcement to be sent to the preceding international exchange or to the national network.

Because receipt of congestion signal CGC by an outgoing international exchange may initiate repeat attempt or re-routing, it is possible to transmit congestion signal NNC from international exchanges where repeat attempt or re-routing may be expected to be useless.

If a busy-flash signal is received from a succeeding international link which uses another signalling system, it shall be coded as a circuit-group-congestion signal on System No. 6. Any of the congestion signals from System No. 6 — i.e. switching equipment, circuit group, national network — will be converted to a busy-flash signal for transmission over a preceding link using System No. 4 or System No. 5.

If a signal equivalent to a busy-flash signal is received by an incoming international exchange from a national network, it should be coded as a national-network-congestion signal to be transmitted on System No. 6.

4.1.8 *Called-party's-line-condition signals*

The following signals will be sent when the appropriate electrical signals are received at the incoming international exchange from the national networks:

— subscriber-busy signal (electrical) ,

— line-out-of-service signal ,

— unallocated-number signal ,

— send-special-information tone signal

These signals will be sent without waiting for the completion of the continuity check.

On receipt of one of these signals, the first common channel exchange (or the outgoing international exchange) will clear forward the connection and cause an appropriate indication to be given to the originating subscriber or operator.

Each System No. 6 exchange on receipt of a subscriber-busy, line-out-of-service, unallocated-number or send-special-information tone signal can clear forward the connection. Preceding links using System No. 4 or System No. 5 will be able to transmit only the busy-flash signal. This signal shall be returned when a subscriber busy signal is received. For the other three signals named above, a special information tone shall be applied when interworking with System No. 4 or System No. 5.

4.1.9 *Answer signals*

The signals answer, charge and answer, no charge are sent as received from the national network or from the succeeding international link.

The answer, no charge signal shall be used when:

a) an answer, no charge signal is received from a succeeding link; or

b) an answer signal is received and an address-complete, no charge or equivalent signal has been sent to a preceding link.

The answer, no charge signal will be translated to a normal answer signal when the preceding signalling system does not include a no-charge signal, either address-complete, no charge, answer, no charge or equivalent.

The signals answer, charge and answer, no charge are used only as a result of the first off-hook signal from the called party and are priority signals.

4.1.10 *Clear-back signals*

A clear-back signal is sent when the called party clears before a clear-forward signal has been received. A clear-back signal must not disconnect the speech path at a System No. 6 international exchange. The requirements for the release of a connection in the event that a clear-forward signal is not received are given in Recommendation Q.118.

4.1.11 *Reanswer and clear-back sequences*

Subsequent off-hook, on-hook signals from the called party, such as will result from switch-hook flashing, will cause the following sequence of signals to be sent:

Clear-back No. 1

Reanswer No. 1

Clear-back No. 2

Reanswer No. 2

Clear-back No. 3

Reanswer No. 3

Clear-back No. 1

etc.

In contrast to the answer signal, the reanswer signal has no special priority. The sequence numbering of the clear-back and reanswer signals makes it possible for the first System No. 6 exchange to reassemble the sequence in proper order in the event that the original sequence is disturbed as a result of retransmission of one or more of the signals. It is necessary, however, that a flashing sequence be retransmitted to the operator (or the preceding link) and that the final condition of the circuit represents the final position of the called party’s switch hook. A reanswer signal is transmitted as an answer signal over a preceding link using System No. 4 or System No. 5.

4.1.12 *Forward-transfer signal*

The forward-transfer signal may be sent in semi-automatic working in either of the following two cases:

a) following a call switched automatically to a subscriber, or following a call established via a special operator, the controlling

operator wishes to call in an assistance operator. On receipt of the forward-transfer signal at the incoming international exchange, an assistance operator is called in;

b) following a call via code 11 or code 12, the controlling operator wishes to recall the incoming operator at the incoming international exchange. Receipt of the forward-transfer signal at the incoming international exchange recalls the incoming operator on calls completed via the operator positions at the exchange.

4.1.13 *Clear-forward and release-guard sequence*

The clear-forward signal is overriding and all international exchanges must be in a position to respond by releasing the circuit and sending a release-guard signal at any time during the progress of a call and even if the circuit is in the idle condition. The clear-forward signal is sent only after all equipment has been released, information concerning the call has been released from memory and the circuit is available for a new incoming call. Receipt of a clear-forward signal will cause all associated equipment to be returned to the idle condition and all information concerning the call to be

released from memory. If sent while a circuit is blocked, however, it will *not* result in unblocking the circuit concerned (see Recommendation Q.266, § 4.6.1).

The release-guard signal is sent in response to the clear-forward signal, but not until the circuit is available for a new call. The fact that the circuit is blocked will not delay the transmission of the release-guard signal.

4.1.14 *Diagrams showing signal sequence*

The normal call set-up sequences are shown diagrammatically in Annex A to these Specifications.

Recommendation Q.262

4.2 ANALYSIS OF DIGITAL INFORMATION FOR ROUTING

Refer to Recommendation Q.107 | fIbis .

Recommendation Q.263

4.3 DOUBLE SEIZING WITH BOTH-WAY OPERATION

4.3.1 *Double seizing*

Since System No. 6 circuits have the capability of both-way operation, it is possible that the two exchanges will attempt to seize the same circuit at approximately the same time.

4.3.2 *Unguarded interval*

Considering that with Signalling System No. 6:

a) circuit propagation time may be relatively long,

b) the initial address message may consist of up to six signal units,

c) there may be a significant queueing delay, and

d) quasi-associated operation may add extra cross-office delay(s),

the unguarded interval during which double seizing can occur may be relatively long in some instances. The exchange must therefore detect double seizing and take action as defined in § 4.3.5.

4.3.3 *Detection of double seizing*

A double seizure is detected by an exchange from the fact that it receives an initial address message for a circuit for which it has sent an initial address message. For detection of a double seizure when out of sequence messages are received, see *Reasonableness check tables* , Annex B to these Specifications.

4.3.4 *Preventive action*

Double seizing is minimized by the use of an opposite order of selection at each terminal exchange of a both-way circuit group. It is necessary to use this method of selection in cases where System No. 6 uses a voice-frequency link with long propagation time.

4.3.5 *Action to be taken on detection of double seizing*

It is expected that each exchange will control one-half of the circuits in a both-way circuit group. On detection of a double seizure, the call being processed by the control exchange for that circuit will be completed and the received initial address message will be disregarded. Under these conditions, the call being processed by the control exchange will be allowed to complete although the continuity of the circuit may have been checked in the direction from non-control to control only. The call being processed by the non-control exchange will be backed off, switches released, the continuity check transceiver removed, and the check loop connected unless or until a continuity signal has been received from the control exchange. A clear-forward signal will not be sent. The non-control exchange will make an automatic repeat attempt on the same or on an alternative route.

Recommendation Q.264

4.4 POTENTIAL FOR AUTOMATIC REPEAT ATTEMPT AND RE-ROUTING

4.4.1 *Automatic repeat attempt*

The potential for automatic repeat attempt as defined in Recommendation Q.12 is provided in System No. 6. Backward signals are included to provide information on which to base a decision as to whether or not it would be advantageous to invoke an automatic repeat attempt.

An automatic repeat attempt will be made:

— upon failure of the continuity check (§ 4.1.4 above),

— on receipt of the confusion signal (while setting up a call) (§ 4.7.6.4 below),

— on detection of double seizing (at the non-control exchange) (§ 4.3.5 above),

— in some cases on receipt of a message-refusal signal (§ 4.6.2.3 below), and

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For the purpose of resolution of double seizing on both-way circuits, a suitable method is that one exchange as determined by bilateral agreement will control *all* circuits with odd-numbered (binary numbers) labels and the other exchange those with even-numbered labels. This designation of control may also be used for maintenance control purposes (see Recommendation M.80).

— on receipt of a blocking signal after sending an initial address message and before any backward signals have been received (§ 4.6.1 below).

4.4.2 *Automatic repeat attempt and re-routing*

The potential for automatic repeat attempt or re-routing on receipt of the circuit-group-congestion, the switching-equipment-congestion or the call-failure signals is provided.

Recommendation Q.265

4.5 SPEED OF SWITCHING AND SIGNAL TRANSFER

IN INTERNATIONAL EXCHANGES

4.5.1 *General*

It is recommended that the equipment in the international exchanges (terminal or transit) shall have a high switching speed so as not to lose the advantage of the high speed of System No. 6.

Although the speech path of circuits served by System No. 6 is not split, the speech path of circuits using in-band line signalling is split during the transmission of line signals (see Recommendation Q.27). To avoid clipping the initial verbal response of the called party, it is necessary to

remove splits inserted during transmission of the answer signal as rapidly as possible. Consequently, the answer signal should be transferred across the System No. 6 exchange as rapidly as possible to avoid delaying removal of the splits in any interconnected circuits which utilize in-band line signalling.

The operation of switching devices to attach and disconnect continuity-check equipment must be as rapid as possible to minimize post-dialling delay.

The signals switching-equipment congestion or circuit-group congestion should be returned as soon as practicable following receipt of the information necessary to determine the routing.

4.5.2 *Outgoing international exchange*

At the outgoing international exchange:

— if overlap operation is used, the sending of the initial address message shall take place as soon as sufficient digits are received (normally a minimum of 4) and analyzed to permit the selection of an outgoing circuit;

— if *en bloc* | peration is used, the initial address message should be sent as soon as all the digits of the address including the end-of-pulsing (ST) signal are available and the outgoing circuit has been chosen.

4.5.3 *International transit exchange*

At the international transit exchange, the selection of an outgoing circuit should begin as soon as the digits necessary to determine the routing have been received and analyzed.

4.5.4 *Incoming international exchange*

At the incoming international exchange:

— if overlap operation is used in the national network, the setting-up of the national part of the connection should start as soon as a sufficient number of digits has been received for routing;

— if *en bloc* | peration is used in the national network, the setting-up of the national part of the connection should start as soon as all of the digits have been received (including signal ST).

Recommendation Q.266

4.6 BLOCKING AND UNBLOCKING SEQUENCES AND CONTROL

OF QUASI-ASSOCIATED SIGNALLING

4.6.1 *Blocking and unblocking sequences*

The blocking (unblocking) signal is provided to permit the switching equipment or maintenance personnel to remove from (and return to) traffic the distant terminal of a circuit because of a fault or to permit testing. It is also used in connection with the continuity check of the speech path as described in Recommendation Q.261, § 4.1.4, and in Recommendation Q.271.

Since the circuits served by System No. 6 have both-way capability, the blocking signal can be originated by either exchange. The receipt of the blocking signal will have the effect of prohibiting calls outgoing from that exchange until an unblocking signal is received, but will not in itself prohibit calls incoming to that exchange. Acknowledgement sequences are always required for both the blocking and unblocking signals , using the blocking-acknowledgement signal, and the unblocking-acknowledgement signal, respectively. The acknowledgement is not sent until the appropriate action, either blocking or unblocking, has been taken. The clear-forward signal should not override the blocking signal and return circuits to service which might be

faulty. The blocked circuit will be returned to service on transmission of the unblocking-acknowledgement signal at one exchange and on receipt of the unblocking-acknowledgement signal at the other exchange.

In the event of the receipt of a blocking signal :

— after an initial address message has been sent, and

— before a backward signal relating to that call has been received,

an automatic repeat attempt will be made on another circuit. The exchange receiving the blocking signal should clear forward the original attempt in the normal manner after sending the blocking-acknowledgement signal.

If the blocking signal is sent while the speech circuit is engaged on a call and after at least one backward signal relating to that call has been sent, steps will be taken by the exchange receiving the signal to prevent the circuit being seized for subsequent calls outgoing from that exchange.

The fact that the circuit is engaged on a call will not delay transmission of the blocking (unblocking)-acknowledgement signal

If a blocking signal is sent and subsequently an initial address message is received in the opposite direction, the following action is taken:

— for test calls, the call should be accepted, if possible. In the case where the test call cannot be accepted, the blocking signal must be repeated;

— for calls other than test calls, the blocking signal must be repeated.

Blocking of a circuit by use of the blocking signal should not exceed 5 minutes, after which an alarm should be given at each terminal of the circuit. Should a call be in progress on the circuit involved, the 5 minutes time will commence when that call is cleared. If the work on the circuit must exceed 5 minutes, the circuit should be withdrawn from service by the Circuit Control Station.

4.6.2 *Control of quasi-associated signalling*

4.6.2.1 *Transfer-prohibited signal*

When a signal transfer point is unable to transfer quasi-associated signals for a particular group of circuits, this signal transfer point sends a *transfer-prohibited signal* for each affected band to the exchange or signal transfer point concerned. Since this signal refers to a group of 16 circuits, the band number of the relevant group is sufficient. (See Recommendation Q.260, § 3.4.3.2.)

The transfer-prohibited signal may have the effect at the receiving exchange or signal transfer point of re-routing quasi-associated signals via another signalling path.

4.6.2.2 *Transfer-allowed signal*

When the signal transfer point is once more able to transfer signals, it sends a *transfer-allowed* signal to each exchange or signal transfer point concerned for each band that is allowed. The transfer-allowed signal will have the same band number as the transfer-prohibited signal. Following the transmission of the transfer-allowed signal, the signalling will be restored to the normal route.

On receipt of a transfer-allowed signal, the receiving exchange or signal transfer point will return a *transfer-allowed-acknowledgement* signal , and restore signalling for the circuits assigned to that band.

The signal transfer point will repeat the transfer-allowed signals at periods of 4 to 15 seconds until a transfer-allowed-acknowledgement signal is received. If a transfer-allowed-acknowledgement signal is not received within one minute of sending a transfer-allowed signal, the repetition of the transfer-allowed signal is ceased and maintenance personnel alerted.

4.6.2.3 *Message-refusal signal*

If a telephone message is received by a signal transfer point intended for a destination for which the signalling route set has failed, a *message-refusal signal* shall be returned to the exchange or signal transfer point from which this telephone message was received. The message-refusal signal uses the label of the circuit concerned. In addition a transfer-prohibited signal, using the same band number as that of the circuit label, is transmitted after the message-refusal and on the same link set.

On receipt of a message-refusal signal at a signal transfer point, the signal is passed on in the normal way.

On receipt of a message-refusal signal at the terminal exchange of the circuit identified in the label, that exchange will, if possible, retransmit the most recent signal message in memory associated with the affected circuit. In the case of an outgoing call in the process of being established, a clear forward should be sent and an automatic repeat attempt made. The repeated signal or call will be routed in the normal manner, except where a transfer-prohibited signal received from the signal transfer point has already indicated a permanent signalling reconfiguration.

4.6.3 *Signalling route set failure*

A signalling route set is considered to have failed when all signalling routes comprising the signalling route set have failed due to link set failure or receipt of transfer prohibited signals on the signalling routes for the band(s) concerned. Where the signalling route set terminates on the originating exchange, all free speech circuits should be removed from service. Where the signalling route set terminates on an STP or exchange acting as STP for the band(s) concerned, transfer prohibited signals should be sent on all signalling routes of the opposite signalling route set [see Recommendation Q.292, § 8.4.4 b)] as specified in § 4.6.2.1.

On restoration of the signalling route set, all free circuits may be returned to service and transfer allowed signals are sent on the opposite signalling route set as specified in § 4.6.2.2.

Recommendation Q.267

4.7 UNREASONABLE AND SUPERFLUOUS MESSAGES

4.7.1 *General*

The characteristics of the common channel signalling system may give rise to irregularities such as:

— *unreasonable messages* , i.e. messages with:

an inappropriate signal content,

an incorrect signal direction, or

an inappropriate place in the signal sequence;

— *superfluous messages* .

4.7.2 *Reasonableness check tables*

In order to resolve ambiguous situations which may arise from these irregularities, special procedures must be defined. These procedures, some of which are mandatory, are included in the reasonableness check tables given in

Annex B to these Specifications, which cover all possible stages in the signalling sequences.

The justification for using such tables follows from the dependability requirements in Recommendation Q.276, § 6.6.1.

4.7.3 *Retransmissions and undetected errors*

The following three cases may be considered as examples of the occurrence of unreasonable or superfluous messages:

— in case a signal unit received in error is retransmitted and the next signal unit of the same call is received in advance of the retransmitted signal unit, the signal units are received in reverse order and thus appear unreasonable;

— the incidence of an undetected error may alter the meaning of a signal unit, which then becomes unreasonable;

— in case the acknowledgement for a transmitted signal unit is not received (due to an ACU being received in error or drift compensation), this signal unit may be received twice, so that the second appearance of the signal unit is superfluous.

Examples:

a) *Disturbed signal sequence*

When a reanswer signal is received before a clear-back signal is retransmitted owing to a detected error:

Answer, charge

(retransmitted)

Reanswer 1

Clear-back 1

The reanswer signal is conditionally accepted pending receipt of the clear-back signal.

b) *Undetected error*

When a forward-transfer signal is received in an unreasonable place or direction in a call sequence owing to an undetected error:

Initial address message

Continuity

Forward-transfer (undetected error)

The forward-transfer signal is rejected.

c) *Superfluous message*

When two initial address messages are received owing to an ACU being received in error or to drift compensation:

Clear-forward (call 1)

Release-guard (call 1)

Initial address message (call 2)

Initial address message (call 2) (retransmitted)

The receipt of two initial address messages would call for the contents to be compared. Should the two be identical, one or the other is discarded.

4.7.4 *Spill-over of messages from one call sequence to another*

In the event of a new call following immediately after the completion of a previous call, there could be a spill-over of messages from the first call to the second, viz. if a signal unit of the first call is received correctly a second time owing to a retransmission. This could lead to ambiguous situations as illustrated in the following examples. The reasonableness check tables given in Annex B to these Specifications contain the procedures for these cases.

Examples:

a) Initial address message (call 1) (received correctly)

Clear-forward (call 1)

Release-guard (call 1)

Initial address message (call 1) (retransmitted)

Initial address message (call 2)

This sequence has a similar appearance to the one arising when an initial address message is received a second time owing to an ACU being received in error or to drift compensation without an intervening clear-forward signal; see example c) in § 4.7.3 above. The contents of the two initial address messages should be compared. Should the two be different, the call can be rejected by sending a *confusion signal* in the backward direction.

On receipt of the confusion signal, the System No. 6 exchange will send a clear-forward signal for the circuit in question, after which an automatic repeat attempt of the call will be made.

b) Another example of a spill-over could occur if an ACU acknowledging a clear-forward signal is received in error and another call is initiated on the circuit just cleared. The sequence would be:

Clear-forward (call 1)

Release-guard (call 1)

Initial address message (call 2)

Clear-forward (call 1) (retransmitted)

Release-guard (call 2)

The processor receiving the release-guard signal does not know whether it was generated in response to a retransmitted clear-forward signal or whether it was the result of an incoming undetected error.

In this case, the exchanges disagree as to the state of the circuit (seizure or release) and the specified procedure must be followed to remove the ambiguity.

4.7.5 *Other ambiguous situations*

Another ambiguous situation could arise for example if, after transmitting a clear-forward signal, an ACU is received in error resulting in the superfluous retransmission of the initial address message. If the latter is followed by a backward signal, for example the congestion signal, the sequence would be:

Initial address message (call 1)

Clear-forward (call 1)

Release-guard (call 1)

Initial address message (call 1) (retransmitted)

Congestion

The processor receiving the congestion signal will find the associated circuit in the idle condition and assume the signal to be invalid. The processor at the other end will keep the circuit busy while waiting for the clear-forward signal.

In this case, the exchanges disagree as to the state of the circuit (idle or busy) and the specified procedure must be followed to remove the ambiguity.

4.7.6 *Procedures for the treatment of unreasonable and superfluous messages*

4.7.6.1 *Rejecting*

Messages or signal units recognized to be unreasonable or superfluous are discarded.

4.7.6.2 *Waiting*

Unreasonable messages or signal units which may become meaningful at a later stage of the signal sequence are provisionally held. The waiting time should be longer than the retransmission delay of the delayed message. The provisionally-held signal units are processed if the arrival of retransmitted signals within the waiting period makes them meaningful. Otherwise, if they are still meaningless at the end of the waiting period, they are rejected with the exception of the case where the held signal is a clear-forward signal. In this case, the release-guard signal must be sent.

4.7.6.3 *Clearing*

If due to an abnormal signal sequence an ambiguous situation arises, which would result in a circuit being held unduly for a prolonged time, the

circuit should be cleared in the normal way.

4.7.6.4 *Sending the confusion signal*

If none of the above procedures is suitable for resolving the situation created by the receipt of an unreasonable message (§ 4.7.1 above), the confusion signal is sent back to the preceding System No. 6 exchange. The confusion signal will not be sent subsequent to sending the address-complete signal or other signal causing the release of address and routing information at the preceding System No. 6 exchange (see § 4.8.1 below).

On receipt of the confusion signal , the preceding System No. 6 exchange will send the clear-forward signal, after which an automatic repeat attempt will be made of the call to be completed as in § 4.7.4, a) above, otherwise the clear-forward signal will be sent.

4.7.7 *Mandatory procedures*

Of the procedures contained in the reasonableness check tables, only those are mandatory which apply to situations in which:

— processors at either end of the link disagree as regards the state of a circuit, or

— cooperation between the processors at either end of the link is required to resolve the ambiguous situation.

Compelled sequences such as clear-forward release-guard must always be completed irrespective of whether the occurrence of the first signal appears reasonable or not.

Recommendation Q.268

4.8 RELEASE OF INTERNATIONAL CONNECTIONS

AND ASSOCIATED EQUIPMENT

4.8.1 *Normal release conditions*

Connections are normally released in the forward direction as a result of the receipt of a clear-forward signal from the preceding exchange. In addition, provision is made for the normal release of connections (or circuits) as follows:

— on the continuity check failure: Recommendation Q.261, § 4.1.4,

— on receipt of an address-incomplete signal: Recommendation Q.261, § 4.1.6,

— on receipt of one of the congestion signals: Recommendation Q.261, § 4.1.7,

— on receipt of one of the called-party’s-line-condition signals: Recommendation Q.261, § 4.1.8,

— on receipt of the blocking signal after sending an initial address message: Recommendation Q.266, § 4.6.1,

— in some cases, on receipt of the message-refusal signal: Recommendation Q.266, § 4.6.2.3,

— in some cases described under the treatment of unreasonable and superfluous messages: Recommendation Q.267, § 4.7.6.3, and Annex B to these Specifications,

— on receipt of a confusion signal: Recommendation Q.267, § 4.7.6.4.

If the conditions for the normal release of connections as described above are not fulfilled, release is provided as follows:

— in the release under abnormal conditions: § 4.8.5 below,

— on receipt of a call-failure signal: § 4.8.3 below,

— on failure to receive a clear-forward signal after receiving a clear-back signal: Recommendation Q.118, § 4.3.2,

— on failure to receive an answer signal: Recommendation Q.118, § 4.3.1,

— on failure to receive a clear-forward signal after sending a clear-back signal: Recommendation Q.118, § 4.3.3.

Address and routing information are released from memory in each of the exchanges of a connection as described in the following subsections:

4.8.1.1 *Outgoing international exchange*

Address and routing information stored at the outgoing international exchange can be erased on receipt of one of the following backward signals as covered in § 4.1 above:

a) one of the address-complete signals,

b) the address-incomplete signal,

c) one of the congestion signals (unless an automatic repeat attempt is to be made, see § 4.4 above),

d) one of the called-party's-line-condition signals, or

e) the answer signal (received out of sequence),

or when the connection is cleared earlier.

4.8.1.2 *Incoming international exchange*

Address and routing information stored at the incoming international exchange can be erased on receipt of one of the above backward signals (or equivalent) from a national common channel system, or when one of the following signals as covered in § 4.1 above has been originated and sent to the outgoing international exchange:

a) one of the address-complete signals,

b) address-incomplete signal, or

c) one of the congestion signals,

or on receipt of a clear-forward signal.

4.8.1.3 *International transit exchange*

Address and routing information stored at an international transit exchange can be erased on receipt of one of the backward signals, § 4.8.1.1, a) to e) above, on receipt of a clear-forward signal, or when one of the congestion signals is originated in that exchange. If the succeeding circuit in the connection utilizes System No. 5, the address and routing information can be released on sending the end-of-pulsing signal (ST) over the System No. 5 circuit as specified in Recommendation Q.152. Whenever one of the backward signals indicating an unsuccessful call is returned, the transit exchange connection and succeeding circuits shall be cleared.

4.8.2 *Abnormal release conditions — clear-forward, release-guard sequences*

4.8.2.1 *Inability to release in response to a clear-forward signal*

If an exchange is unable to return the circuit to the idle condition in response to a clear-forward signal, it should remove the circuit from service and send the blocking signal. Upon receipt of the blocking-acknowledgement signal, the release-guard signal is sent in acknowledgement of the original clear-forward signal.

4.8.2.2 *Inability to release in response to a backward signal*

If an exchange is unable to release a circuit in response to an address-incomplete, congestion, called-party's-line-condition, call-failure or confusion signal, it should remove the circuit from service by sending the blocking signal. Upon receipt of the blocking-acknowledgement signal, the clear-forward signal should be sent in reply to the original backward signal.

4.8.2.3 *Failure to receive a release-guard signal in response to a clear-forward signal*

If a release-guard signal is not received in response to a clear-forward signal before 4 to 15 seconds, the clear-forward signal will be repeated.

If, after sending a clear-forward signal , a release-guard signal is not received within a period of one minute after the first clear-forward signal, the maintenance personnel shall be alerted and a reset-circuit signal sent. The reset-circuit signal shall be repeated at one minute intervals until either an acknowledgement is received or maintenance intervention occurs. If there is no provision for sending reset-circuit signals, clear-forward signals shall be used instead.

4.8.3 *Call-failure signal*

The *call-failure signal* is sent as the result of time-out situations described in § 4.8.5 below. The call-failure signal is also sent whenever a call attempt fails and other specific signals do not apply, viz. :

— the confusion signal,

— the address-incomplete signal,

— the congestion signals, or

— the called-party's-line-condition signals.

Reception of the call-failure signal at any No. 6 exchange will cause the clear-forward signal to be sent and:

a) an automatic repeat attempt to be made, or

b) the appropriate signal or the appropriate tone or announcement to be sent to the preceding international exchange or to the national network.

The call-failure signal from System No. 6 will be converted to a busy-flash signal for transmission over a preceding link using System No. 4 or System No. 5. If the preceding link uses System No. 6, the call-failure signal is passed back.

4.8.4 *Reset-circuit signal*

In systems which maintain circuit status in memory, there may be occasions when the memory becomes mutilated. In such a case, the circuits must be reset to the idle condition at both exchanges to make them available for new traffic. Since the exchange with the mutilated memory does not know whether the circuit is idle, busy outgoing, busy incoming, blocked, etc., a reset-circuit signal should be sent for each affected circuit. (If complete groups or subgroups of circuits are involved, the reset-band signal sequence described in Recommendation Q.295, § 9.5 should be used.) On receipt of a reset-circuit signal, the unaffected exchange will:

a) accept the signal as a clear-forward signal and respond by sending a release-guard signal, after the circuit has been made idle, if it is the incoming exchange on a connection in any state of call setup or during a call,

b) accept the signal as a clear-back or call failure, whichever is appropriate, and respond by sending a clear-forward signal if it is the outgoing exchange on a connection,

c) accept the signal as a clear-forward signal and respond by sending a release-guard signal if the circuit is in the idle condition,

d) if it has previously sent a blocking signal, or if it is unable to release the circuit as described above, respond with the blocking signal. If an incoming or outgoing call is in progress, this call should be disconnected and the circuit returned to the idle (blocked) state. A clear-forward or release-guard signal may be sent. The blocking signal should be acknowledged by the affected exchange. If the acknowledgement is not received, the repetition procedure in § 4.8.5.4 should be followed,

e) if it had previously received a blocking signal, respond by disconnecting any connected call, remove the blocked condition and restore the circuit to the idle state. If an outgoing call had been in progress, respond with a clear-forward signal or, in all other cases, a release-guard signal,

f) if a reset-circuit signal is received after the sending of an initial address message but before receipt of a backward signal relating to that call, clear the circuit and make a repeat attempt on another circuit if appropriate,

g) if a reset-circuit signal is received after having sent a reset-circuit signal, respond with a release-guard signal. The circuit should be restored to traffic,

h) send an appropriate clearing signal on an interconnected circuit (e.g., clear-forward, or a suitable backward signal).

The affected exchange will then reconstruct its memory according to the received acknowledgement to the reset-circuit signal, and respond to this signal in the normal way, i.e. release-guard in response to a clear-forward, blocking-acknowledgement in response to a blocking signal.

In addition, an interconnected circuit may be cleared by the use of an appropriate signal. When both exchanges are arranged to handle reset-circuit signals, if no acknowledgement to the reset-circuit signal is received before 4-15 seconds, the reset-circuit signal should be repeated. If an acknowledgement for the signal is not received within 1 minute after the sending of the initial reset-circuit signal, maintenance personnel should be notified to permit manual restoration procedures. However, the sending of the reset-circuit signal should continue at 1-minute intervals until maintenance intervention occurs.

The use of reset-circuit and reset-band signals is optional. Therefore, in the situation where only one exchange is arranged to handle these signals if no acknowledgement is received before 4-15 seconds, the signalling procedure should be ceased and maintenance personnel notified to facilitate manual restoration of affected circuits. To the extent that selective use of the reset-circuit signals improves recovery from other fault situations, their use for this purpose is permitted. Although the indicated signals are optional, the ability to cooperate with exchanges transmitting them should be regarded as the preferred status.

4.8.5 *Abnormal release conditions — other sequences*

If the conditions for normal release as covered in § 4.8.1 above are not fulfilled, release will take place under the following conditions:

4.8.5.1 *Outgoing international exchange*

An outgoing international exchange shall:

a) release all equipment and clear forward the connection on failure to meet the conditions for normal release of address and routing information as covered in 4.8.1.1 above before 20 to 30 seconds after sending the latest address message,

b) release all equipment and clear forward the connection on failure to receive a clear-forward signal from the national network after having received a clear-back signal as provided in Recommendation Q.118, or

c) release all equipment and clear forward the connection on failure to receive an answer signal within the interval specified in Recommendation Q.118.

4.8.5.2 *Incoming international exchange*

An incoming international exchange shall:

a) release all equipment, clear forward the connection into the national network and send back a call-failure signal in the following cases:

— on failure to receive a continuity signal before 10 to 15 seconds after receipt of the initial address message, or

— on failure to receive an address-complete or called-party's-line-condition signal from the national network (where expected) before 20 to 30 seconds after receipt of the latest address message, unless the timing for sending the address-incomplete signal (see § 4.1.6 above) is provided, or

b) send the call-failure signal on failure to receive a clear-forward signal for the incoming circuit before 4 to 15 seconds after sending an address-incomplete, congestion, call-failure,

confusion signal or a called-party's-line-condition signal indicating inability to complete the call. If a clear-forward signal is not received within a period of one minute after sending the call-failure signal, the maintenance personnel shall be alerted and a reset-circuit signal sent. The reset-circuit signal shall be repeated at one minute intervals until either an acknowledgement is received or maintenance intervention occurs. If there is no provision for sending reset-circuit signals, call-failure signals shall be used instead;

c) release all equipment and clear forward the connection on failure to receive a clear-forward signal after having sent a clear-back signal as provided in Recommendation Q.118.

4.8.5.3 *International transit exchange*

An international transit exchange shall:

a) release all equipment, clear forward the connection and send back the call-failure signal in the following cases:

— on failure to receive a continuity signal before 10 to 15 seconds after receipt of the initial address message, or

— on failure to meet the conditions for normal release as covered in § 4.8.1.3 above, before 20 to 30 seconds after sending the latest address message, or

b) send the call-failure signal on failure to receive a clear-forward signal for the incoming circuit before 4 to 15 seconds after sending an address-incomplete, congestion, call-failure, or confusion signal or a called-party's-line-condition signal indicating inability to complete the call. If a clear-forward signal is not received within a period of one minute after sending the call-failure signal, the maintenance personnel shall be alerted and a reset-circuit signal sent. The reset-circuit signal shall be repeated at one minute intervals until either an acknowledgement is received or maintenance intervention occurs. If there is no provision for sending reset-circuit signals, call-failure signals shall be used instead.

4.8.5.4 *Failure in the blocking/unblocking sequences*

An international exchange shall repeat the blocking or unblocking signal on failure to receive an acknowledgement signal in response to either the blocking or unblocking signals before 4 to 15 seconds. (See § 4.6.1 above for the blocking/unblocking sequence). If an acknowledgement signal is not received within a period of 1 minute after sending the initial blocking or unblocking signal, maintenance personnel should be alerted, and optionally the blocking or unblocking signal sent and repeated at one minute intervals until either an acknow ledgement is received or maintenance intervention occurs.

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