5i’

SECTION 9

TESTING AND MAINTENANCE

Recommendation Q.295

9.1 OVERALL TESTS OF SIGNALLING SYSTEM No. 6

9.1.1 *Automatic operational tests of circuits served*

Information can be gained on faulty operation of System No. 6 from overall operational tests of international circuits served by the system. Such tests can be performed by the use of the automatic transmission measuring and signalling testing equipment (ATME 2 — Recommendation O.22). In accordance with Recommendation Q.258, the information to be transmitted in the IAM is the following:

Country-code indicator No country code included
Nature-of-circuit indicator As appropriate
Echo suppressor indicator Outgoing half-echo suppressor not included
Calling-party’s category indicator Test call
Address signals **X** + **ST**

This format allows 16 types of tests, both for transmission and signalling. If more are required, an additional address signal can be used.

The following **X** address signal codes are assigned:

0 | | | System No. 6 continuity check, see Recommendation Q.261, § 4.1.4

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

All test calls are completed with the clear-forward and release-guard sequence regardless of the outcome of the test.

All test calls must be allowed to be completed (for example to the responding equipment of ATME 2), even if there is a failure of the continuity check. On test calls, therefore, the continuity signal will be sent irrespective of the result of the continuity check of the speech path.

9.1.2 *Signal unit error rate monitor*

The signal unit error rate monitor, which is described in Recommendation Q.291, § 8.3.2, also provides a means of detecting deterioration of the data link. When the error rate exceeds 0.2% for a period of 6 to 10 minutes, an alarm should be given to alert maintenance personnel.

9.2 SIGNALLING DATA LINK

The data link is composed of two one-way data channels. In general, the maintenance functions are performed independently for each direction of transmission.

For maintenance purposes each data channel may be considered to be composed of the following elements:

— Analogue version

a) a voice frequency channel ;

b) the modulator and demodulator ;

c) a data carrier failure detector

— Digital version

a) a digital channel ;

b) the digital interface adaptor at each end;

c) a loss of frame alignment detector

The data channel and its constituent parts must be tested to ensure that they meet the requirements of Recommendation Q.272.

9.2.1 *Maintenance safeguard*

Since interruptions of the data link will affect many speech circuits, the data channels must be treated with the utmost care. Appropriate special measures should be taken to prevent unauthorized maintenance access which could result in interruptions to service. These special measures may include marking or flagging the equipment and appearances on distribution frames or test bays where access is possible (see Recommendation M.1050).

9.2.2 *Voice-frequency channel line-up and maintenance*

The recommendations for the line-up and maintenance of the voice-frequency channel are taken from Recommendation M.1050, taking also into account Recommendation Q.272, § 6.1.3.

9.2.2.1 *Line-up*

The voice-frequency channel line-up must be done in such a way as to ensure that the attenuation/frequency and delay/frequency distortions meet the requirements of Recommendation Q.272, § 6.1.3, within the frequency band 1000 to 2600 Hz. In addition, the uniform spectrum random noise and impulsive noise requirements of Recommendation Q.272 must be met at the receiving end.

9.2.2.2 *Maintenance*

To ensure proper operation of the common channel signalling system, it will be necessary to schedule preventive maintenance for the voice-frequency channel. The tests to be made as a routine measure are:

Test Periodicity

a) Overall loss at 800 Hz See Table 1/M.610, column 3

b) Attenuation frequency distortion Annually

c) Delay/frequency distortion Annually

d) Noise See Table 1/M.610, column 3

9.2.3 *Digital channel line-up and maintenance*

Tests should be applied to ensure that the digital channel meets the requirements given in Recommendation Q.46 or Q.47.

9.2.4 *Data carrier failure and loss of frame alignment detector tests*

Local tests should be applied to ensure that the data carrier failure detector and the loss of frame alignment detector meet the requirements given in Recommendation Q.275.

9.2.5 *Modem tests*

Modems should be tested locally to ensure that the requirements of Recommendation Q.274 are met. Appropriate arrangements should be provided so that tests may be made independently of the voice-frequency channel and other equipment.

9.2.6 *Interface adaptor tests*

The interface adaptors used in the digital version of System No. 6 should be tested locally to ensure that the requirements of Recommendation Q.274 are met.

9.2.7 *Data channel line-up and maintenance*

9.2.7.1 *Line-up*

After verifying that the transmission path meets the requirements (§§ 9.2.2.1, 9.2.3 above), the data channel error rate should be checked for a period of 15 minutes (without interruption) using the equipment described in § 9.2.8 below. The error rate requirements are given in Recommendation Q.272, § 6.1.2.

9.2.7.2 *Routine maintenance*

The checks described in § 9.2.7.1 above should be made each time routine noise tests of the voice-frequency channel (see § 9.2.2.2 above) or tests (see § 9.2.3 above) of the digital channel are required.

9.2.8 *Data test equipment*

The equipment for testing the data channel error rate consists of a pseudo-random bit stream generator to be connected to the input of the transmitting end of the data channel and a monitor to be connected to the output of the corresponding receiving end.

The bit stream to be generated, as specified in Recommendation V.52, is reproduced in Annex A to this Recommendation.

9.3 (Reserved)

9.4 (Reserved)

9.5 NETWORK MAINTENANCE

Network maintenance signals relate to the maintenance of the telephone network. They refer normally to groups of circuits, exchanges, etc., rather than to individual circuits and relate to maintenance activity rather than the rerouting of traffic to provide continuing service.

9.5.1 *Reset-band signal*

In systems which maintain circuit status in software, there may be very rare occasions when large blocks of memory are erased during an emergency action or are accidentally mutilated. In these cases, the sending of the reset-circuit signal would be too laborious during recovery procedures, and two reset-band signals will be sent for each affected group or subgroup of circuits (label band number). The memory should be reconstructed according to the response received in the reset-band-acknowledgement message. Any interconnected circuits may be cleared by the use of an appropriate signal.

The unaffected exchange receiving a reset-band signal twice within a period of 5 seconds will:

1) make the circuits idle in the designated band, except those circuits at the receiving end that have imposed a blocked condition on the sending end,

2) send the appropriate clearing signal (clear-forward, clear-back) on any tandem-connected circuits, and

3) respond with a reset-band-acknowledgement message for the designated band coded as follows:

— *band number:* same band number as received reset-band signal

— *circuit status indicators:* i) for all circuits idle, coded as describedin § 3.4.2.3 |) in an LSU; ii) for any other status condition, coded as described in the last (1 | | |) entry of § 3.4.2.4 |), with 0 to indicate available for service, 1 to indicate unavailable for service due to blocked condition. In this case a two unit message results.

Should a reset-band signal be received after sending a reset-band signal, but before receiving a reset-band-acknowledgement message indicating that both exchanges have lost memory, the response should be a reset-band-acknowledgement, all circuits idle LSU. If the exchange has not been arranged to avoid all-zero signal units by recourse to the LSU established to supersede the prior RBA coding, the original two-unit message remains applicable. Although the new LSU is recommended, no time has been set to remove the validity of the reset-band-acknowledgement as originally coded.

Maintenance status should then be established manually by maintenance personnel especially for those circuits in the installation and testing process. Faulty circuits will be detected during the continuity check on the first call attempt.

When both exchanges are arranged to handle reset-circuit and band signals, if no reset-band acknowledgement is received before 4-15 seconds after sending the second reset-band signal, the reset-circuit signal should be sent for each affected circuit. If an acknowledgement signal for the reset-circuit signal is not received within a period of one minute after the sending of the initial reset signal, maintenance personnel should be notified to facilitate manual restoration procedures. The sending of the reset-circuit signal should continue at one 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 for either signal, the signalling procedure should be ceased and maintenance personnel notified to facilitate manual restoration of affected circuits. Although the indicated signals are optional, the ability to cooperate with exchanges transmitting them should be regarded as the preferred status.

To the extent that selective use of the reset-band signal improves recovery from other fault situations, its use for this purpose is permitted.

In the event that reset signals are received at an STP, the following procedures apply:

1) An STP receiving a reset-band, reset-band-acknowledgement or reset-circuit signal will forward the signal on the opposite signalling route in the normal manner, after band number translation (if required);

2) If an STP transmits a Transfer Prohibited Signal (TFP) and subsequently receives:

a) a reset-circuit signal: a message-refusal signal shall be returned;

b) a reset-band signal: the TFP signal shall be repeated;

c) a reset-band-acknowledgement: the TFP signal shall be repeated.

Actions b) and c) allow the failed exchange to reconstruct its transfer status information. It is assumed that any re-initialization should cause all connected STPs to appear to have transfer status ‘‘Allowed’’.

ANNEX A

(to Recommendation Q.295)

Pseudo-random test pattern

In order to test circuits for data transmission on an international basis, it is necessary to standardize the test patterns to be used. Such a pattern should be a pseudo-random one having the following characteristics:

1) it should contain all or at least the majority of eight-bit sequences likely to be met in the transmission of actual data;

2) it should contain sequences of **0** s and **1** s as long as possible compatible with ease of generation;

3) the pattern should be of sufficient length such that at data transmission rates higher than 1200 bits per second its duration is significant compared with line noise disturbances.

Accordingly, a 511-bit test pattern is chosen. The pattern is generated in a nine-stage shift register whose fifth and ninth stage outputs are added together in a modulo-two addition stage, and the result is fed back to the input of the first stage.The modulo-two adder is such that the output produces an output **0** when the two inputs are similar and an output **1** when the two inputs are dissimilar.

Table 11/Q.295 shows the state of each stage of the shift register during the transmission of the first 15 bits. The pattern over a longer period is

1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

It is clear from the table that this pattern is the sequence of bits in stage 9 of the shift register but it also represents the sequence in any other stage shifted in time. The choice of stage to be connected to the output is therefore a matter of circuit convenience.

TABLE [11/Q.295], p.

Recommendation Q.296

9.6 MONITORING AND MAINTENANCE

OF THE COMMON SIGNALLING CHANNEL

9.6.1 *General*

The purpose of the facilities and equipment described in this Recommendation is as follows:

i) To enable, by means of independent equipment connected directly to the No. 6 transfer link , the observation by maintenance staff of any or all signals on the link for reasons of maintenance on the common channel signalling system itself. (Telephony maintenance observations in general should be performed by the same means as utilized by maintenance staff for the other signalling system types implemented in the switching centre.)

ii) To enable, by means of independent equipment connected in tandem with the No. 6 transfer link, the generation of signals in connection with pre-service testing according to the CCITT No. 6 Test Schedule, published as an ITU Manual. (*Note* — use of this equipment requires the breaking of the transfer link, and is not appropriate in a maintenance environment).

iii) To enable, by means of facilities which may be included in the System No. 6 implementation, the recording and mutual exchange by Administrations of an effective but economical set of performance statistics for the signalling link network and for individual signalling links.

9.6.2 *Signalling monitor*

9.6.2.1 *General requirements for signal monitoring equipment*

The Signalling System No. 6 Data Link Monitor shall be independent of the signalling equipment, to ensure that the performance of the monitor is independent of any fault in the equipment being tested. The monitor should allow full access to the data on a Number 6 transfer link as well as facilities for selecting particular signals under operator control. As it is considered necessary under some conditions to observe signals in both directions on both a regular and one reserve link, as well as signals entering and leaving an STP function, the monitor should be capable of simultaneously monitoring at least two transfer links (i.e. four transfer channels).

9.6.2.2 *Monitor configuration*

The monitoring system would consist of three basic subsystems: the demodulation equipment (or digital interface for the digital version of System No. 6), the Computer, and I/O Equipment.

The demodulation equipment for analogue data (or the corresponding digital interface adaptor) must be of a high impedance type so as not to present a load when connected to the transfer link.

The Computer Subsystem will perform the majority of logic and processing functions in the system. The implementation chosen must, however, allow the repertoire of signals the monitor can handle to be updated as additions are made to the Specification of Signalling System No. 6 (refer § 9.6.2.7). The functions required of the Computer Subsystem include the following:

— interfacing to the demodulation equipment (or digital interface) and receiving the signal units;

— storage for signal units (with check bits) to be processed;

— processing functions;

— the man-machine interface (I/O subsystem).

The I/O subsystem consists of a hard copy output device. As an option a visual display unit could be provided to allow higher output speeds and the ability to avoid large amounts of hard copy.

9.6.2.3 *Functional specification*

a) *Synchronism*

The system must be capable of attaining signal unit synchronism regardless of the signal units on the data link. Since this synchronism will be attained by the detection of SYUs, the system must be capable of maintaining synchronism in the event of sustained absence of SYUs (e.g. during changeovers).

Bit, Block and multi-block synchronism should be constantly monitored and suitable messages stored and/or displayed to inform the operator.

The check bits of each signal unit should be verified as soon as the signal is received to allow special treatment of signals units received in error.

In the event of a carrier failure a suitable indication must be given to the operator. Similarly, when the carrier is restored, the operator must be informed.

b) *Signal types*

No. 6 signals are categorized in Recommendations Q.257 to Q.260 into the following types: Telephony, Control and Management. The majority of signal processing functions shall be based upon specifying any combination of these signal types. Signals received in error are treated as another signal type. Each signal type has particular processing requirements as detailed in the following section.

i) *Telephone signals*

To monitor a call, a facility is required to be able to store or display signal units which relate to a specific band and telephone circuit. Since an SSU which contains the information field in a MUM carries no label field it cannot be detected by scanning label fields only. Thus special account must be taken of SSUs.

ii) *Signalling-system-control signals*

Control signals have no label field and therefore cannot be further processed. As an option, the facility may be provided to suppress output of changeover signal units under the control of the operator to reduce the number of signal units which must be stored or displayed during a changeover.

iii) *Management signals*

The label field of some management signals contains a band number. A facility should be provided to allow only signals relating to a selected band or bands to be stored or displayed. The SSUs contained in a MUM must be handled as previously detailed in 9.6.2.3, b), i).

c) *Modes of operation*

Three distinct modes of operation shall be provided to allow the operator to view the type of information required at the rate required.

— A ‘‘ Statistics’’ mode capable of quickly gathering specified information relating to the status and behaviour of the link itself. It is expected that this mode will be used for the following purposes:

i) to obtain a quick indication of the error rate on the link, and the condition of the link (bit signal unit or multi-block synchronism achieved);

ii) to assist investigation into why a link between two No. 6 signalling terminals will not synchronize;

iii) to demonstrate that the monitor can achieve signal unit synchronism, so that output in the other modes can be used with confidence;

iv) to determine the average signal unit loading on the link.

— An ‘‘ Immediate Mode ´operator in a quickly readable form some or all of the signals passing on the link. In this mode it is expected that behaviour of the link at a bit level is not of interest, and in order to reduce the quantity of information displayed, no ACUs, SYUs or information in binary form (including check bits) would be displayed.

— A ‘‘ Deferred Mode received on the link for a period of time, to allow later investigation of link behaviour at bit level. (*Note* — This does not preclude the use of compression techniques for storage of SYUs, ACUs and check bits, as long as validity checks are performed before compression.) In this mode storage will be necessary, since the rate of receipt of information will be too great for an operator to handle in real time, and therefore facilities must be provided to allow the operator to recover and examine stored data.

d) *Statistics mode*

During periods of link instability, it is desirable to obtain statistics relating to the behaviour and synchronization status of the link. It is also desirable to be able to measure the average loading of the link. The following should be counted for a time specified by the operator:

— signal units;

— signal units received in error;

— number of signal units retransmitted;

— ACUs;

— sequence errors;

— carrier failures (the duration of the carrier-off condition should also be measured);

— zero signal units;

— undersized/oversized blocks;

— block acknowledge/complete skips/repeats;

— average valid signal units per block, between 0 to 11 excluding ACUs. (*Note* — From this it is possible to calculate loading in Erlangs or as a percentage.)

As an option the facility to allow continuous monitoring of link performance with periodic production of hard copy results could be provided.

e) *Immediate mode*

The Immediate mode allows the display immediately upon receipt of specified signal types with specified labels if desired. The output must be presented in chronological order so that the operator is in no confusion over the order of occurrence of the signals. The signals on each link shall be displayed simultaneously and in clear time relationship with each other.

A time stamp of the time each signal unit was received should be displayed alongside each signal unit if possible. Otherwise IAM and SAM signals should be time stamped, and further time stamps given at regular intervals if signals are being displayed.

Facilities must be provided to allow the operation to vary the output speed of each signal unit on the display to ensure that the output is not too fast to read on a visual display output terminal.

f) *Deferred mode*

The Deferred mode is used to closely analyse signals on a link or links for a period not less than 2 minutes, to allow storage of all signals exchanged (including check bits) during the 60 second ‘‘Normal Proving Period’’ (see Recommendation Q.278).

Efficient and flexible scanning facilities shall be provided to allow the operator to locate signals of interest easily. The signals shall be stored on a block basis, with time stamp identifying each block. All scanning and display can then be performed on a block basis.

9.6.2.4 *Triggering for immediate and deferred modes*

The display or storage processes in the Immediate and Deferred Modes require some form of trigger event to allow them to begin or end. The provision of a wide range of trigger events adds considerable power to the monitor.

A suitable trigger event is the reception by the signalling monitor of a specific signal unit or signal type specified by the operator, or an appropriate operator command. When the operator specifies a trigger event, it also should be specified whether the trigger event will be used to start or stop the recording, and whether the monitor will record the data received

before the trigger event, after the trigger event, or both immediately before and after the trigger event.

9.6.2.5 *Output forms*

Signal Units shall be displayed as mnemonics in abbreviated form (e.g. CLF B = 5, C = 6 for a clear forward on Band 5, Circuit 6) with all the data in the information field in a suitable form. A command shall be provided to enable the output of the mnemonic and a bit representation of the signal unit.

The output shall distinguish betweeen signals received in error, unrecognized signals and reserved signals. Unrecognized and reserved signals shall be categorized as belonging to all signal types to ensure that they are always displayed.

Hard copy output shall include a page header with the time/date and mode of operation.

9.6.2.6 *Operator facilities*

The operator shall be able to perform all functions with the minimum of keystrokes. There must be facilities to set the current time and to initialize and/or restart the system.

9.6.2.7 *Addition of signals*

Since new No. 6 signals are defined by Study Group XI from time to time, the facility must exist to allow easy additions to the repertoire of signals. This could be achieved by decoding signals using a look-up table which is stored in Read-Only-Memory, which can be modified if necessary.

9.6.3 *Signal manipulator* | see Figure 25/Q.296)

9.6.3.1 *Preamble*

During pre-service testing of Signalling System No. 6 between Administrations, in order to execute certain tests specified in the ITU Manual entitled ‘‘CCITT Signalling System No. 6 Test Schedule’’, it is necessary to inject messages out of sequence, and to withhold certain signals. It is preferable for these actions to be performed by separate test equipment. Advantages of economy may be obtained by realizing such an interactive signalling system No. 6 link test set as part of the signalling system No. 6 link monitor, described previously.

9.6.3.2 *Functional description*

The interactive test set should be equipped with two modems (or the corresponding digital interfaces) and inserted serially in one transfer channel of the data link (Figure 25/Q.296 refers). While the data flows through the set in one direction, the data that flows in the other direction in the other transfer channel should be uninterrupted. After insertion into the transfer channel, the test set should synchronize automatically and give an indication once system synchronization has been achieved. Upon achieving syncronization, the system must continually check each block, to ensure that synchronism still exists. If block synchronism is subsequently lost, automatic resynchronization should be initiated and an indication of loss of synchronization be given. Operator commands should be accepted only when synchronization exists.

When the set is in the idle state, it should appear completely transparent to the two system No. 6 exchanges between which it is inserted, except for a maximum propagation of the order of one block time.

It is recommended that the interactive test set contain the following minimum functions, which should be executed upon operator command.

a) *Display signal unit*

A specified signal unit combined with a specified mask is searched for, and once a match is found, a specified number of successive signal units are displayed. This function enables monitoring of a sequence of events commencing with a specified trigger event.

b) *Replace signal unit*

A specified signal unit combined with a mask is searched for, and once found, is replaced by a second specified signal unit. There must be an automatic function for calculating and adding the 8 check bits to the specified 20 bits prior to the insertion of the signal unit in the output buffer. Furthermore, if the signal unit is to be replaced by an SYU, the last 4 bits specified in the SYU should be ignored and the sequence number recalculated automatically to reflect its position in the block.

This function may be used to delete, insert or replace signal units.

c) *Delay signal unit*

A specified signal unit is delayed by a variable time interval. A search is initiated for a specified signal unit combined with the mask, and once found, is automatically replaced by a SYU. After the specified interval of time has elapsed, the next received SYU should be replaced by the original SYU. The specified time should be taken as a minimum time interval since the time of arrival of an SYU is uncertain.

d) *Skip*

The sequence number in the SYU is incremented by a specified number. It may be useful to specify how many successive (if more than one) SYUs are to be affected by this skip function.

e) *Corrupt signal unit*

A specified number of signal units in a block are corrupted by inverting all 8 check bits in the signal unit. The inversion of check bits should begin with the first signal unit in the next block. It should also be possible to specify the number of blocks that are to be affected.

This function is useful in simulating a given error rate on the link.

f) *Manipulate ACU*

A number of functions to manipulate an ACU should be provided. One function should be provided that would modify the position of the ACU such that it is moved to a position other than the 12th position. It should be possible to specify the number of blocks to be modified in this manner. A second function should serve to replace a specified number of successive ACUs by SYUs (sequence number 0). A third function to be provided would cause the next ACU to contain a specified block completed number. It should be possible to specify the number of successive ACUs to be transmitted with this same number.

g) *Suppress transmit carrier*

The transmit carrier on the output side of the test set is interrupted by a specified time interval.

9.6.4 *Measurement of signalling data link network performance*

9.6.4.1 *Preamble*

Recommendation Q.272 specifies the transmission characteristics of both analogue and digital channels suitable for use as signalling data links. However, it is expected that the error performance and availability of circuits conforming to Recommendation Q.272 will be variable, and at present no performance limits have been specified except the 15 minute bit error rate described in Recommendation Q.295.

Therefore acceptability of a particular voice channel for use as a signalling data link is a matter for bilateral agreement by the administrations concerned.

To assist with the longer term maintenance of the common signalling channel network, it is recommended that facilities be provided to record the basic signalling data link performance supervision statistics specified below.

Deterioration in the performance supervision statistics (see Note 1) may indicate a need for maintenance staff to investigate in more detail the performance of a particular link, in which case the link maintenance statistics listed in § 9.6.4.3 below may be useful.

(*Note* — For these statistics to be useful in the maintenance environment, provision is required for corrections to be automatically made to the statistics in the event of an outage of the whole or a part of the common channel signalling equipment, or where this is not possible, a clear indication to maintenance staff that the recorded statistics are incomplete.)

9.6.4.2 *Signalling performance supervision statistics*

The following indicators shall be computed for the duration of a standard Measurement Period, for purposes of comparison. The Measurement Period is seven days. The indicators may be recorded in hard copy form automatically or by operator command at the end of the Measurement Period, or may be output in a coded form for further computer analysis.

a) *Signalling route set performance supervision statistics*

— Signalling route set unavailability, expressed as a percentage of the Measurement Period (see Note 2);

— The number of outages (that is, the number of times the signalling route set enters a state of unavailability (see Note 2)).

b) *Signalling data link supervision statistics*

— Signalling data link unavailability, expressed as a percentage of the Measurement Period;

— The number of changeovers caused by overflow of the error rate monitor (Note 3);

— The number of changeovers which occur as a result of COV received from the distant end of the link (Note 3);

— The number of reserve link failures (Note 3);

— The number of times block synchronism is lost;

— The number of times multi-block synchronism is lost.

Note 1 — No supervision statistics on a link set basis are recommended for measurement, because although it may be convenient to measure these, the availability of a complete signalling route set (which itself may consist of a link set) is a direct measure of the ability of the signalling data link network to be available to carry signals from one System No. 6 terminal to another. Emergency Restarts on a link set are not recommended for measurement because in some configurations, emergency restart may occur even when a link in the signalling route set is still available (e.g. a triangular network with exchanges conforming to the 1980 Yellow Book Q-recommendations).

Note 2 — Unavailability of the signalling route set is defined as the condition in which no signalling data link in the signalling route set is in service.

Note 3 — A link may be simultaneously both regular in one signalling relation and reserve in another.

9.6.4.3 *Link maintenance statistics*

[*Note* — The following list of indicators is not yet considered to be complete and is for further study.]

The following indicators shall be computed for a duration of time determined by the operator. The indicators may be recorded in hard copy automatically or by operator command, at the end of the Measurement Period or may be output in a coded form for further computer analysis:

a) the number of losses of block synchronism;

b) the number of occurrences of high error rate (reception of 30 consecutive signal units in error or detection of error rate over 2% in 30 seconds);

c) the number of failures detected during a one minute proving period;

d) the number of signal units received in error;

e) the number of skipped or repeated ACUs;

f) the number of signal units transmitted;

g) the number of telephone signal units.

FIGURE 25/Q.296, p.

MONTAGE: PAGE 116 = PAGE BLANCHE

SECTION 10

NETWORK MANAGEMENT

Recommendation Q.297

10. NETWORK MANAGEMENT

10.1 *General*

The application of Signalling System No. 6 for network management purposes was anticipated in the original coding structure of the signal units fundamental to the system. Specific coding was deferred until studies and understandings of intent were well established. The revision to the Red Book specification, of which this section is a part, makes a significant advance in extending the general utility of the system.

The expanded specification enables System No. 6 to fill the role of a transport mechanism for network management information passing System No. 6 equipped exchanges for which a network management band assignment has been made by bilateral agreement (or multilateral agreement). The information need not be limited to System No. 6 circuits nor to the two System No. 6 equipped exchanges.

The means of obtaining the requisite information to be transported, and the ability to respond to information received, must be provided by each Administration involved. Bilateral, or multilateral agreements are expected to clarify the inputs to and outputs from System No. 6 whilst the system will provide the capability to pass all signals allocated to Network Management information, including currently spare codes.

Two other understandings support the specification revision:

i) the signals represent advice and do not constitute directives;

ii) any screening of output signals by an originator is assumed to have taken place before the signals appear on the common channel.

Thus, an Administration may:

i) choose to inspect information before allowing it to be sent;

ii) send information automatically;

iii) screen selected signals while sending others automatically.

10.2 *Information categories*

10.2.1 It has been found useful to define basic information categories. Those now recognized are:

i) destinations hard to reach;

ii) all circuits busy;

iii) switching centre congestion.

Coding is shown in § 3.4.2.4 b). Introductory text appears in § 3.4.2.1. The annex to this Recommendation contains a summary of the application of these information categories.

10.2.2 *Destination Hard to Reach*

A indicated in the SSU format structure, it is possible to report on a number of traffic streams defined by up to 6 destination code digits at each of up to 16 ISCs through the same transport arrangements. This general purpose reason code covers Answer Bid Ratio (ABR) and can be set for up to 16 separate levels. Not all the destination code digits or the reason codes need be used, this being specified as part of the bilateral arrangements between Administrations which would also include assignment of the ISC code to which the information relates. The binary code assignment should conform to those listed in § 3.2.1.2 c) with filler digits and ST as appropriate.

10.2.3 *All circuits busy*

The same approach is followed for All Circuits Busy as for Destination Hard to Reach in § 10.2.2. Again, 16 circuit group conditions, specified by the reason code, can be catered for. Circuit groups are identified by up to a 6-digit code, and the information can relate to any of up to 16 ISCs. The parameter values of the reason codes will be assigned by bilateral agreement and may relate to the full occupancy condition or percentage

occupancy conditions. Circuit group identities and ISC codes will also be bilaterally agreed.

10.2.4 *Switching Centre Congestion*

This information is coded compactly into one SSU in all cases. The ISC code again permits the condition reported to be related to any of up to 16 ISCs. The reason code covers up to 16 congestion levels although three levels are thought to be sufficient for most contingencies. Again, bilateral agreements will be necessary to assign congestion levels and ISC codes.

10.2.5 *Operational concerns*

Details relating to operational matters are covered in the E.410 series Recommendations. See especially Recommendation E.411. A related issue concerns false signals. A review of error correction measures incorporated in the design of System No. 6 concluded that no significant difficulty need be anticipated. The adoption of a rule whereby signals will be disregarded if not confirmed periodically should afford added protection. A time interval of 30 seconds, for example, could be adopted. The expiration of such an interval should affect signal processing external to the No. 6 transport system.

Thus, a rare signal arising inadvertently could affect traffic for at most one such time interval. Regulation of signal volume is a similar concern. Even though management signals are of a lower priority than telephone signals, administrative avoidance of queueing extremes should be part of an operating plan.

ANNEX
(to Recommendation Q.297)

The application of network management signals

transported by System No. 6

Section 10 of the System No. 6 specification identifies three information categories of Network Management Signals (NMS) which may be transported by System No. 6. Provision is made for each information category to transmit information relating to one of up to 16 reason codes. However, it is not envisaged that all 16 reason codes will be allocated during the initial applications of this capability. Following the experience gained from initial applications, however, a move towards a standardized range of reason codes for all users is likely to take place. In the intervening period, some guidance as to the allocation of reason codes is given in order to assist Administrations in making bilateral arrangements. Coding allocation of the reason codes is contained in § 3 of this specification whilst operational guidance for network management actions is contained in the E.410 series of Recommendations. A summary of the application of reason codes which have been initially allocated for each of the information categories, is as follows:

a) Destination Hard to Reach NMS : This information relates to the performance of traffic to a destination. A destination is said to be Hard-to-Reach (HTR) when the Answer-Bid-Ratio (ABR) to the destination is abnormally low.

A HTR code can be a country code, an area (or city) code or an exchange code. Initially, four reason codes have been allocated. One general purpose reason code covers ABR values below an arbitrary level whilst the other three reason codes relate to the level of ABR (High, Medium, Low) and could be used to identify the type and degree of network management action required.

b) All Circuits Busy NMS : This information relates to the availability of circuits. A signal should indicate when all circuits in a route or to a destination are busy, or (preferably) when the remaining idle circuits in a route (or to a destination) are less than a specified number, or when occupancy of a route has exceeded the desired threshold. As with the Destination Hard to Reach NMS, four reason codes have been allocated initially. One reason code is allocated to ‘‘All Circuits Busy threshold’’ and will indicate that a predetermined number of circuits are busy or that the occupancy of a particular circuit group has exceeded a certain level. The

threshold level would be set by bilateral agreement. Three other reason codes have been allocated to indicate Low, Medium and High Congestion levels. Each reason code, or combination of reason codes, could be used to identify the type, degree and duration of network management action required.

c) Switching Centre Congestion NMS : This information relates to the Switching congestion of an ISC. Three reason codes have been allocated to indicate ‘‘moderate congestion’’, ‘‘serious congestion’’ and ‘‘unable to process calls’’. The function of this signal is to warn other Switching Centres that this particular ISC is experiencing overload. Appropriate Network Management actions can then be taken depending upon the degree of the problem identified by the particular reason code.

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ANNEX A TO SIGNALLING SYSTEM No. 6 SPECIFICATIONS

(see Recommendation Q.261)

TABLE [A-1], p.

TABLE [A-2], p.

TABLE [1-A-2] p.

TABLE [2-A-2], p.

TABLE [3-A-2], p.

ANNEX B TO SIGNALLING SYSTEM No. 6 SPECIFICATIONS

(see Recommendation Q.267)

Reasonableness check tables

1 The following tables are provided:

Table B-1 refers to signal reception for an incoming call or an idle circuit or an undefined state of the circuit,

Table B-2 refers to signal transmission for an incoming call or an idle circuit or an undefined state of the circuit,

Table B-3 refers to signal reception for an outgoing call or for restoring circuits to service,

Table B-4 refers to signal transmission for an outgoing call or for restoring circuits to service,

Table B-5 contains the actions to be taken for blocking and unblocking sequences,

Table B-6 deals with timing intervals.

The *abbreviations* | sed for the signals in these tables are explained in the *List of abbreviations* following the glossary.

2 The reasonableness check tables consist of rows and columns.

The row on top of the table contains the telephone signals which may be received or transmitted.

The first and second columns from the left indicate the state of the circuit.

The first column contains the Circuit State Sequence Number (CSSN) and, in the second column, the state of the circuit is detailed by the signals already received (R) or sent (S).

CSSN 00 represents the idle condition of the circuit,

CSSN 01 represents an undefined state of the circuit (e.g. by memory mutilation),

CSSN 11 to 17 represent possible states for an incoming call,

CSSN 51 to 62 represent possible states for an outgoing call,

CSSN 63 and 64 represent possible states in restoring circuits to service,

CSSN 91 to 98 represent possible states for blocking and unblocking sequences.

In the intersections of rows and columns (small rectangles), the actions to be taken are shown. The *symbols* used are explained at the end of the reasonableness check tables. If the codes at the intersection require advance to another CSSN, the necessary actions must be taken to achieve the new CSSN. See example 2 below.

3 *Examples*

Example 1:

On receipt of an IAM (first signal column, Table B-1) at CSSN 11 (the state at which an IAM is received, or an IAM and one or more SAMs are received), the state is maintained (CSSN 11) and the new IAM is discarded if it is identical to the one previously received, or a confusion signal is sent backwards if the new IAM differs from the previous one.

Example 2:

If the circuit is idle (CSSN 00, Table B-1), and a confusion signal (COF) is received, the code 62 and PS appear at the intersection. In order to advance to CSSN 62 (Table B-4), it is necessary to send a clear-forward signal. The PS indicates that the selection of the circuit must be prevented until the requirements of CSSN 62 are met [receipt of release-guard signal (RLG)] to allow the circuit to return to idle (CSSN 00).

Table B-1 p.

Table B-2 p.

Table [B-3] p.

Table [B-4] p.

Table [B-5] p.

Table [B-6] p.

GLOSSARY OF TERMS

SPECIFIC TO SIGNALLING SYSTEM CCITT No. 6

acknowledgement signal unit (ACU) : The twelfth signal unit of a block, which carries information as to whether or not the signal units in the block indicated were received correctly.

associated signalling : A mode of operation of System No. 6 in which the signals carried by the system relate to a group of speech circuits which terminate in the same System No. 6 exchanges as the signalling system.

block : A group of 12 signal units on the signalling channel.

block-acknowledged counter : A cyclic counter provided within the signalling terminal to count the number of blocks acknowledged as received at the distant end.

block-completed counter : A cyclic counter provided within the signalling terminal to count the number of completed blocks transmitted.

changeback : The procedure of transferring signalling traffic from a reserve signalling link to the regular signalling link, when the regular link is again serviceable.

changeover : The procedure of transferring signalling traffic from one signalling link to another, when the link in use fails or is required to be cleared of traffic.

check loop : A device which is attached to interconnect the GO and RETURN paths of a circuit at the incoming end of a circuit to permit the outgoing end to make a continuity check on a loop basis.

common channel exchange : An exchange utilizing a common channel signalling system, which has the facilities of System No. 6 from an interworking standpoint.

common channel exchange, first : The exchange closest to the calling party in each common channel section of a connection where, unless it is the calling party's exchange, interworking with other signalling systems takes place.

common channel exchange, intermediate : A transit exchange where interworking between common channel signalling system takes place.

common channel exchange, last : The exchange closest to the called party in each common channel of a connection where, unless it is the called party's exchange, interworking with other signalling systems takes place.

common channel signalling : A signalling method, using a signalling link common to a number of speech circuits, for the transmission of all signals necessary for the traffic via these circuits.

continuity check : A check made of the circuit or circuits in a connection to verify that a speech path exists.

continuity check transceiver : A combination of the check-tone transmitter and receiver.

cross-office check : A check made across the exchange to verify that a speech path exists.

data carrier failure detector : A monitoring unit designed to indicate that the level of the data carrier on a voice-frequency channel is below the minimum sensitivity of the receiver.

data channel, analogue : A one-way path for data signals which includes a voice-frequency channel and an associated data modulator and demodulator.

data channel, digital : A one-way path for data signals which includes a digital channel and associated interface adaptors at each end.

data channel failure detector : A data carrier failure detector or loss of frame alignment detector.

drift compensation : The process of adjusting for the difference in relationship of the backward acknowledgement information contained in the ACU to the forward signal units it acknowledges which occurs as a result of drift in the bit rates of the data channels.

emergency restart : The procedure of re-established signalling communication, when the regular and all reserve signalling links fail.

error control loop : The number of signal units transmitted on the signalling link between the time a particular signal unit is sent and the time that the acknowledgement of that signal unit is recognized.

error rate monitor : A device which receives an indication for each signal unit found in error and which measures the rate of occurrence of errors according to a prescribed rule.

faulty link information : Information sent on a signalling link to indicate a failure of that link. The information consists of alternate blocks of changeover signals and of synchronization signal unit.

field : A subdivision of a signal unit, which carries a certain type or classification of information — e.g. label field, signal information field, etc.

fully dissociated signalling : A form of non-associated signalling in which the path that signals may take through the network is only restricted by the rules and configuration of the signalling network.

initial address message (IAM) : A multi-unit message which is sent as the first message in a call set-up, consisting of a minimum of three and a maximum of six signal units, and containing enough information to route the call through the international network.

initial signal unit (ISU) : The first signal unit of a multi-unit message.

interface adaptor : A unit required between the signalling terminal and the digital channel to provide for hold-over clock, loss of frame alignment indication and where necessary, for clock and data rate conversion.

label : The 11-bit binary code within a signal message used to identify the particular speech circuit with which the message is associated. The label is subdivided into a band number and a circuit number.

load transfer : The transfer of signalling traffic from one signalling link to another.

lone signal unit (LSU) : A signal unit carrying a one-unit message.

loss of frame alignment detector : A monitoring unit, designed to indicate to the signalling terminal that frame alignment of the PCM system has been lost.

management signals : Signals concerning the management or maintenance of the speech circuit network and the signalling network.

multi-block : A group of 8 blocks or 96 signal units on the signalling channel.

multi-block synchronization signal unit (MBS) : A signal unit carrying a signal concerning the multi-block synchronization of the signalling system.

multi-unit message (MUM) : A signal message which consists of more than one signal unit.

non-associated signalling : A mode of operation in which the signals for a group of speech circuits are sent over two or more common signalling links in tandem. The signals being processed and forwarded to the next link by equipment at one or more signal transfer points.

one-unit message : A signal message which is transmitted entirely within one signal unit.

quasi-associated signalling : A form of non-associated signalling in which the route the signals may take through the network is prescribed.

queueing delay : The delay incurred by a signal message as a result of the sequential transmission of signal units on the signalling channel.

reasonableness check tables : Tables which define procedures used to avoid or resolve ambiguous call situations.

security arrangements : The measures provided to ensure continuity of service of the signalling system in the event of the failure of one or both of the data channels.

signalling channel : A data channel in combination with the associated signalling terminal equipment at each end.

signalling data link : A combination of two data channels operating together in a single signalling system.

signalling link : A combination of two signalling channels operating together in a single signalling system.

signalling system : The combination of all of the equipment and channels necessary to provide signalling for one or more groups of circuits between two No. 6 exchanges. It thus includes a data link, signalling terminal equipment, and necessary portion of the processor at each No. 6 exchange.

(signal) message : Signal information pertaining to a call, management action, etc., sent at one time on the signalling channel. A message may consist of one or more signals transmitted in one or more signal units.

signal transfer point : A signal relay centre handling and transferring signals from one signalling link to another in a non-associated mode of operation.

signal unit (SU) : The smallest defined group of bits on the signalling channel (28 bits), used for the transfer of signal information.

subsequent address message (SAM) : An address message, which may be either a one-unit or a multi-unit message, sent following the initial address message.

subsequent signal unit (SSU) : A signal unit of a multi-unit message other than the initial signal unit.

synchronization signal unit (SYU) : A signal unit containing a bit pattern and information designed to facilitate rapid synchronization and which is sent on the signalling channel when synchronizing or when no signal messages are available for transmission.

system control signal unit (SCU) : A signal unit carrying a signal concerning the operation of the signalling system — e.g. changeover, load-transfer.

system No. 6 exchange : An exchange utilizing Signalling System No. 6.

system No. 6 exchange, first : The exchange closest to the calling party in each No. 6 section of a connection where, unless it is the calling party's exchange, interworking with other signalling systems takes place.

system No. 6 exchange, intermediate : A transit exchange where interworking to and from Signalling System No. 6 takes place.

system No. 6 exchange, last : The exchange closest to the called party in each No. 6 section of a connection where, unless it is the called party's exchange, interworking with other signalling systems takes place.

telephone signal : Any signal which pertains to a particular telephone call or to a particular speech circuit.

transfer channel : A voice-frequency channel or a digital channel.

transfer link : A combination of two transfer channels operating together in a single signalling system.

unreasonable message : A message with an inappropriate signal content, an incorrect signal direction, or an inappropriate place in the signal sequence.

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ABBREVIATIONS SPECIFIC TO SIGNALLING SYSTEM No. 6

ACU Acknowledgement signal unit

ADC Address-complete signal, charge

ADI Address-incomplete signal

ADN Address-complete signal, no charge

ADX Address-complete signal, coin-box

AFC Address-complete signal, subscriber-free, charge

AFN Address-complete signal, subscriber-free, no charge

AFX Address-complete signal, subscriber-free, coin-box

ANC Answer signal, charge

ANN Answer signal, no charge

BLA Blocking-acknowledgement signal

BLO Blocking signal

CB1-3 Clear-back signal No. 1-No. 3

CFL Call-failure signal

CGC Circuit-group-congestion signal

CLF Clear-forward signal

COF Confusion signal

COT Continuity signal

COV Changeover signal

CSSN Circuit state sequence number

ELT Emergency-load-transfer signal

FOT Forward-transfer signal

IAM Initial address message

ISU Initial signal unit

LOS Line-out-of-service signal

LSU Lone signal unit

LTA Load-transfer-acknowledgement signal

LTR Load-transfer signal

MBS Multi-block synchronization signal unit

MCA Manual-changeover-acknowledgement signal

MCO Manual-changeover signal

MMM Multiunit network management and maintenance message

MRF Message-refusal signal

MUM Multi-unit message

NMM Network-management and maintenance signal

NNC National-network-congestion signal

RA1-3 Reanswer signal No. 1-No. 3

RBA Reset-band-acknowledgement message

RBI Reset-band-acknowledgement, all circuits idle signal

RLG Release-guard signal

RSB Reset-band signal

RSC Reset-circuit signal

SAM1-7 Subsequent address message No. 1-No. 7

SBR Standby-ready signal

SCU System-control signal unit

SEC Switching-equipment-congestion signal

SNM Signalling-network-management signal

SRA Standby-ready-acknowledgement signal

SSB Subscriber-busy signal (electrical)

SST Send-special-information tone signal

SSU Subsequent signal unit

SU Signal unit

SYN Synchronization signal unit

TAA Transfer-allowed-acknowledgement signal

TFA Transfer-allowed signal

TFP Transfer-prohibited signal

UBA Unblocking-acknowledgement signal

UBL Unblocking signal

UNN Unallocated-number signal

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ALPHABETICAL INDEX FOR SYSTEM No. 6

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PART II

Recommendation Q.300

INTERWORKING BETWEEN CCITT SIGNALLING SYSTEM No. 6

AND NATIONAL COMMON CHANNEL SIGNALLING SYSTEMS

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Recommendation Q.300

INTERWORKING BETWEEN CCITT SIGNALLING SYSTEM No. 6

AND NATIONAL COMMON CHANNEL SIGNALLING SYSTEMS

1 Introduction

This Recommendation deals with the philosophy that can provide for simplification of interworking between the CCITT Signalling System No. 6 employed in the international network and national common channel signalling systems for use in national networks. Three categories of such national signalling systems can be identified and are:

i) Signalling System No. 6;

ii) signalling system(s) derived from Signalling System No. 6;

iii) other common channel signalling systems.

These are defined in § 3.2 below.

Through the aim of simplification, optimal operating conditions for the overall network are envisaged and thus an economic, high quality of service can be achieved. This is a matter for which all countries are interdependent.

The rapid introduction at all levels in the hierarchy of national networks can be avantageous in order to make full use of additional services and facilities of common channel signalling systems from the beginning and to facilitate the interworking problem.

2 Definitions of items concerning general principles

2.1 **signalling interworking**

Signalling interworking is the controlled transfer of signalling information across the interface between signalling systems where the significance of the transferred information is identical or where the significance is translated in a defined manner.

2.2 **commonality**

The degree to which the basic features employed in two systems are identical.

2.3 **transparency**

A transparent state may be said to exist between two defined points when a signal which exists at one point can be transmitted to the second point without any loss or change of information. Signal is understood here in the sense the word has in signalling systems, i.e. a piece or item of information with a standardized meaning.

Transparency of the network of signalling channels would ensure that transfer of signalling information from one link to another is always achieved on a signal-per-signal basis. Thus, laborious analysis of several received signals for deciding which signal to transmit could be avoided.

Transparency is facilitated by the use of Signalling System No. 6 or a system derived from Signalling System No. 6, in national networks.

2.4 **compatibility**

Compatibility with respect to interworking implies a degree of transparency sufficient to support an acceptable grade of service with respect to a connection which transits the interworking office. Full compatibility implies full transparency.

2.5 **basic features**

The essential prime constituent characteristics on which a system is founded.

3 Items concerning signalling systems and interworking points

3.1 *Signalling System No. 6*

The specifications of System No. 6 are contained in Recommendations Q.251 to Q.295.

3.2 *National common channel signalling systems*

National common channel signalling systems may be used in:

a) analogue networks;

b) mixed analogue and digital networks;

c) digital networks with or without service integration.

In national networks the following national common channel signalling systems may be used:

1) Signalling System No. 6

Even when the signal units reserved for regional and/or national use are allocated in a different manner by various Administrations it is justified to consider this signalling system as Signalling System No. 6.

2) Signalling system(s) derived from Signalling System No. 6

A signalling system is considered to be derived from Signalling System No. 6 when typical basic features of Signalling System No. 6 are employed:

The following are typical basic features of Signalling System No. 6:

a) separate common signalling channel,

b) all inter-office signal transmission through the common signalling channel,

c) signal transfer on a link-by-link basis,

d) full duplex signal unit synchronous mode of transmission,

e) fixed signal unit length and block size,

f) error detection by check bits and error correction by retransmission,

g) continuity check on per-call basis,

h) quasi-associated signalling capability,

i) security arrangements for signalling channel,

3) Other common channel signalling system(s)

Although some similarity with Signalling System No. 6 may exist, basic features differ from the Signalling System No. 6 concept.

3.3 *Interworking point*

In Figure 1/Q.300, a signalling system *N* | etween exchanges *A* | nd *X* is a national common channel signalling system, while a system *IN* between exchanges *X* and *B* is System No. 6. All necessary interworking arrangements should be provided at exchange *X* (CT); thus interworking point is *X* .

With regard to the order of the systems mentioned no preference is expressed.

Use of this expression is recommended instead of the term *based in Signalling System No. 6* in order to avoid ambiguity.

FIGURE 1/Q.300, p.

In Figure 2/Q.300, a signalling system *N* | etween exchanges *A* | nd *Y* is a national common channel signalling system, while a signalling system *IN* between exchanges *Z* and *B* is System No. 6.

Figure 2/Q.300, p.

Signalling system *IW* | pplicable to the section between exchanges *Y* and *Z* (CT) can be any of

1) Signalling System No. 6,

2) national common channel signalling system,

3) signalling system for interworking use.

The interworking point is exchange Y for 1), and Z for 2). On the other hand, in the case of 3), the necessary interworking arrangement can be shared between exchanges Y and Z. Interworking point in this case is divided into two sub-interworking points, i.e. national side sub-interworking point (exchange Y) and international side sub-interworking point (exchange Z).

4 Signalling procedures

4.1 *Translation of signalling information*

It is to be expected that in the future the long-distance network in many areas will be a mesh network of high density. Intensive use of transversal routes can be foreseen which in many cases will be operated with common channel signalling in the non-associated mode. Essentially, then, an overall signalling channel network will exist representing a link-by-link message switching system with messages and transfer procedures between

different links due to the various national common channel signalling systems. In the nodes of that network, signal processing will be carried out, thereby including necessary signal translation operations if different common channel signalling systems are joining at the particular point.

Signal translation, however, may entail laborious processing procedures which require costly computer time likely to increase in proportion to telephone traffic. Evidently, it is desirable to reduce to a minimum such additional processing, which also may introduce faults.

Interworking is simplified if:

— supervisory signals have exactly the same meaning and the same function in both systems;

— the address information is sent in the same sequence in both systems;

— address-complete signal or its equivalent is used in the national system.

4.2 *Signal conversions and originations*

Some electrical signals in a national common channel signalling system may differ from the signals in the System No. 6. The international exchange or the national trunk exchange must convert such signals into corresponding signals according to the predetermined conversion table.

In order to provide for proper interworking between Signalling System No. 6 and national common channel signalling systems it is essential that a common channel exchange in the national network originates and sends on each connection one of the signals: address-complete, address-incomplete, congestion or called party's line condition. See also §§ 4.1.5 through 4.1.8 of Recommendation Q.261.

It is desired that some backward signals of System No. 6, which indicate conditions of an incoming national network or called subscribers, be converted, as directly as possible, into corresponding signals in the outgoing national network. If direct conversion is not possible, at least signals of the following two categories should be converted into relevant appropriate audible tones or recorded announcements at some appropriate interworking point:

1) In order to request that the calling subscriber re-dial:

switching-equipment-congestion signal (SEC)

circuit-group-congestion signal (CGC)

national-network-congestion signal (NNC)

subscriber-busy signal (SSB)

2) In order to send the information that the dialled telephone number is not available:

address-incomplete signal (ADI)

unallocated-number signal (UNN)

line-out-of-service signal (LOS)

subscriber-transferred signal (SST)

4.3 *Continuity check*

When no continuity check or a different continuity check from that in System No. 6 is applied in the national network, the transit exchange at the interworking point must be able to deal with both methods.

In a national network, a continuity check method differing from that of System No. 6 is necessary for the checking of two-wire circuits or circuits switched in two-wire exchanges.

An example of continuity check method for national use is as follows:

End-to-End continuity check facilities are provided on a pre-call basis between the first common channel signalling exchange and the last common channel signalling exchange. Two different tones (f_1 and f_2) are used for the checking.

The first exchange, on receipt of the backward tone f_2 from the last exchange, sends the tone f_1 forward. When the exchange detects the tone sent from the first exchange, the continuity check is successfully accomplished and Check-OK is sent backward to the first exchange to inform that the check was successful.

Another example employs link-by-link continuity check facilities on a per-call basis between the first common channel signalling exchange and the next common channel signalling exchange where the first exchange employs two-wire switching. Again, two frequencies f_1 and f_2 are employed, one in each direction of transmission and if a successful continuity check is

achieved a continuity signal is transmitted. A similar check would be used between the next to last and the last common channel signalling exchanges.

4.4 *Signals for national use*

Interworking of common channel signalling systems may require certain extra common channel signals which may be used exclusively in a national common channel signalling system.

A possible example is given below:

In order to avoid ineffective occupation of international circuits by unsuccessful calls, it is desired to send back relevant electrical signals to the preceding exchanges indicating that the call has not succeeded so that the connection may be cleared and an appropriate tone connected as close as possible to the calling subscriber.

When a national common channel signalling system is interworking with existing national signalling and switching systems, however, appropriate backward electrical signals that can indicate non-success of a call (e.g. national-network-congestion, etc.) may not always be available, and indications may be restricted to audible tones. In this case, an extra interworking signal, say *non-common-channel-connected* signal, may be provided. Such a signal would request the incoming interworking exchange to withhold the address-complete signal for a certain period of time so as to permit the audible tone sent back from beyond the last exchange of the national common channel signalling section to be received and converted into an appropriate electrical signal.