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TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

**SPECIFICATIONS OF SIGNALLING SYSTEM No. 6
TESTING AND MAINTENANCE**

**MONITORING AND MAINTENANCE
OF THE COMMON SIGNALLING CHANNEL**

ITU-T Recommendation Q.296

(Extract from the *Blue Book*)

NOTES

1 ITU-T Recommendation Q.296 was published in Fascicle VI.3 of the *Blue Book*. This file is an extract from the *Blue Book*. While the presentation and layout of the text might be slightly different from the *Blue Book* version, the contents of the file are identical to the *Blue Book* version and copyright conditions remain unchanged (see below).

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

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" capable of presenting to the 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", capable of storing all bits 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 between 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 synchronization, 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.

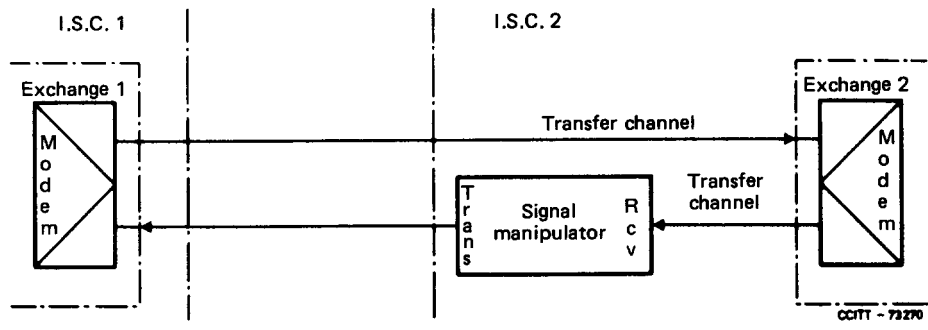


FIGURE 25/Q.296