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## **Information processing systems — Data communication — Automatic fault isolation procedures using test loops**

*Systemes de traitement de l'information — Communication de données — Procédures  
automatiques de localisation des défauts utilisant des boucles de test*

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## Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 9067 was prepared by Technical Committee ISO/TC 97, *Information processing systems*.

Users should note that all International Standards undergo revision from time to time and that any reference made herein to any other International Standard implies its latest edition, unless otherwise stated.

# Information processing systems — Data communication — Automatic fault isolation procedures using test loops

## 0 Introduction

When transmission failures of a repetitive or continuing nature occur in a data communication system, fault isolation, or the identification of the faulty equipment or faulty portion of line included in the system, could be achieved by operating test loops implemented in DTEs and DCEs. This International Standard describes how automatic fault isolation can be achieved by the DTE by the use of loop test procedures.

Control of test loops via an operator console is also dealt with in this International Standard.

## 1 Scope and field of application

This International Standard describes fault isolation procedures using test loops and applies to DTEs which are connected to DCEs with the automatic test loop facility, standardized in the V-series or X-series CCITT<sup>1)</sup> Recommendations.

In the V-series, the means for DTE control of test loops via interchange circuits in the DTE/DCE interface are specified in CCITT Recommendations V.24 and V.54.

In the X-series, the means for DTE control of test loops via interchange circuits or signals in the DTE/DCE interface are specified in CCITT Recommendations X.24, X.150 and the individual DTE/DCE Interface CCITT Recommendations X.20, X.20 *bis*, X.21, X.21 *bis* and X.22.

### NOTES

1 CCITT Recommendation X.150 specifies the definition of test loops, the principles for the control of test loops and the principles for the indications to be presented. Specific details concerning the implementation of these principles are contained in the individual DTE/DCE Interface Recommendations.

2 The inclusion of test procedures covered by the I-series Recommendations is for further study.

## 2 References

CCITT Recommendation V.24, *List of definitions for interchange circuits between data terminal equipment and data circuit-terminating equipment.*

CCITT Recommendation V.52, *Characteristics of distortion and error-rate measuring apparatus for data transmission.*

CCITT Recommendation V.54, *Loop test devices for modems.*

CCITT Recommendation X.20, *Interface between data terminal equipment (DTE) and data circuit-terminating equipment (DCE) for start-stop transmission services on public data networks.*

CCITT Recommendation X.20 *bis*, *Use on public data networks of data terminal equipment (DTE) which is designed for interfacing to asynchronous duplex V-series modems.*

CCITT Recommendation X.21, *Interface between data terminal equipment (DTE) and data circuit-terminating equipment (DCE) for synchronous operation on public data networks.*

CCITT Recommendation X.21 *bis*, *Use on public data networks of data terminal equipment (DTE) which is designed for interfacing to synchronous V-series modems.*

CCITT Recommendation X.22, *Multiplex DTE/DCE interface for user classes 3-6.*

CCITT Recommendation X.24, *List of definitions for interchange circuits between data terminal equipment (DTE) and data circuit-terminating equipment (DCE) on public data networks.*

CCITT Recommendation X.150, *Principles of maintenance testing for public data networks using data terminal equipment (DTE) and data circuit-terminating equipment (DCE) test loops.*

1) International Telegraph and Telephone Consultative Committee.

### 3 Definition and control of test loops

#### 3.1 CCITT Recommendations — V-series

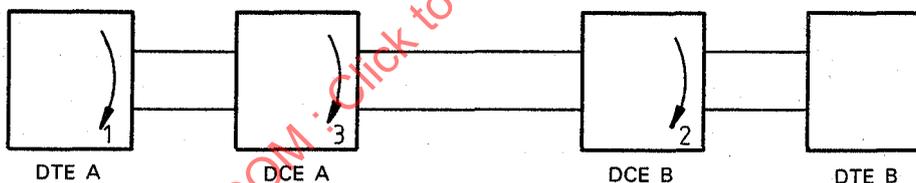
##### 3.1.1 Definition of test loops

For the purpose of fault isolation by the DTE (DTE A) three test loops numbered 1 to 3 are defined. Their location as seen from DTE A is shown in figure 1. Test loops 2 and 3 conform to CCITT Recommendation V.54. Test loop 1 is designed to permit DTE A to check itself for satisfactory operation. Since test loop 1 is completely inside the DTE, its implementation is not subject to standardization.

##### 3.1.2 Control of test loops

Test loops 2 and 3 can be formed by automatic control via signals in the DTE/DCE Interface. Automatic control of these test loops through the interface is achieved by using interchange circuits 140, 141 and 142 as defined in CCITT Recommendation V.24.

Circuit 140 is used to control test loop 2 and circuit 141 is used to control test loop 3. Circuit 142 is used to indicate the establishment of the test mode. Specific details concerning automatic loop control using circuits 140, 141, 142 are specified in CCITT Recommendation V.54 and also in CCITT Recommendations X.20 *bis* and X.21 *bis* (see 3.2.2).



NOTE — Each DCE will implement two loops, i.e. test loop 2 for testing from the line side, and test loop 3 for testing from the local end.

Figure 1 — Location of test loops (V-series)

NOTE — The following cases of automatic loop control are specified in CCITT Recommendation V.54:

##### Synchronous DCE

- simple multipoint duplex leased circuits;
- point-to-point duplex leased circuits and switched connections;
- tandem duplex leased circuits.

##### Asynchronous DCE

- point-to-point duplex leased circuits and switched connections.

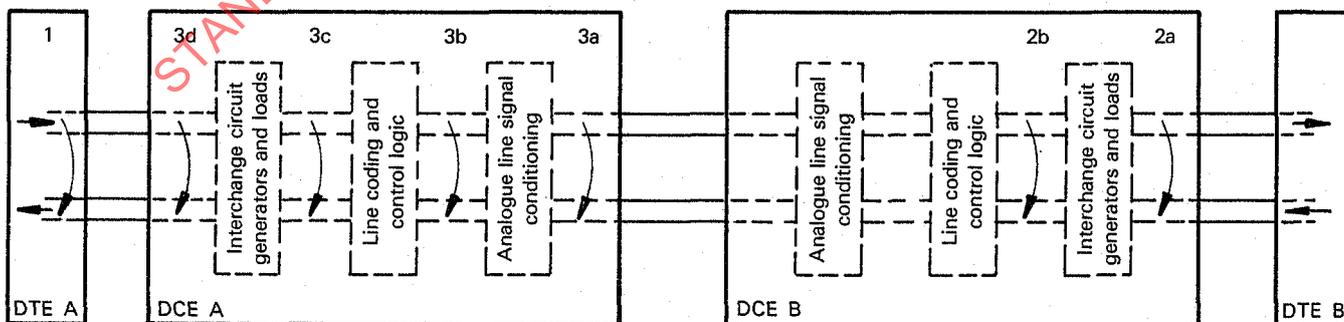
#### 3.2 CCITT Recommendations — X-series

##### 3.2.1 Definition of test loops

For the purpose of fault isolation by the DTE the six test loops of types 2 and 3 shown in figure 2 are defined in CCITT Recommendation X.150. Their location as seen from DTE A is shown in figure 2. Since test loop 1 is completely inside the DTE, its implementation is not subject to standardization.

##### 3.2.2 Control of test loops

For CCITT Recommendation X.21, the test loops 2 and 3 can be established automatically via signals in the DTE/DCE Interface. This is achieved by using the loop commands on inter-



NOTE — Each DCE will implement at least one of the two loops of type 2 (loop 2a or 2b) for testing from the line side and at least one of the four loops of type 3 (loop 3a, 3b, 3c or 3d) for testing from the local end.

If more than one loop of a type is implemented, one of them shall be selected at installation time.

Figure 2 — Location of test loops (X-series)

change circuit T. It is recommended that DCE Controlled-Not-Ready (CNR) is used as the test indicator in order to avoid ambiguity with the DCE inoperative state.

NOTE — Control of the test loops 2 and 3 in CCITT Recommendation X.20 depends on automatic loop control facilities within the DCE.

For CCITT Recommendations X.20 *bis* and X.21 *bis*, operation of the test loop 3 is performed by using the V.24 circuit 141 for control and circuit 142 for test indication. Operation of the test loop 2 in CCITT Recommendation X.21 *bis* is performed by using the V.24 circuit 140 for control and circuit 142 for test indication.

NOTE — Use of the test loop 2 by the DTE in CCITT Recommendation X.20 *bis* and control of the test loops 2 and 3 in CCITT Recommendation X.22 is for further study.

## 4 Fault isolation

Using the test loops described in clause 3, fault isolation is performed by repeating, as necessary, the following procedure:

- a) selection and establishment of a test loop;
- b) loop testing;
- c) evaluation of whether or not the faulty part is within the loop tested.

The following principles apply when testing:

- 1) the test loops specified are transparent;
- 2) loop testing is a disruptive type of testing;
- 3) loop testing shall commence from the data transfer phase;
- 4) loop test initiation procedures involving local and remote data stations shall be specified so that head-on collisions are avoided.

Since the remote DTE is disabled when a loop 2 test is set up, the total test time shall be limited in order to avoid excessive disruption of the data transfer. Although the total test time depends to a large extent on the data signalling rate, a single time-out shall be used. Its value should be 30 s. This value may be extended under special conditions, if necessary.

### 4.1 Loop selection

Loop testing may start with the loop which includes the minimum number of elements and end with the loop which includes the maximum number. However, as establishment of loops 1 and 3 may, in a switched connection, release the line,

such a sequence should be reversed. Where it is desired to keep the procedure the same for leased circuits and switched connections, the sequence for a simple point-to-point connection shall be

- 1: test loop 2;
- 2: test loop 3;
- 3: test loop 1.

In this case the evaluation test flow of figure 3 applies.

### 4.2 Loop establishment and termination

The test loops shall be established and terminated in accordance with the procedures specified in the relevant CCITT Recommendation.

### 4.3 Test phase

In the test phase, a test message shall be transmitted and compared with the one returned.

Since the test loops are transparent, any test signal may be used.

It is recommended that these signals incorporate the 511-bit pseudo-random pattern specified in CCITT Recommendation V.52. In the case of synchronous transmission, the test signal may be a long sequence of the repeating 511-bit pattern. In the case of asynchronous transmission, the test signal may be composed of the 511-bit pattern segmented into a sequence of characters each with start and stop elements added.

Special test patterns, not incorporating the 511-bit pattern, may be used when experience indicates that the 511-bit pattern would not be adequate to detect certain faults or equipment limitations.

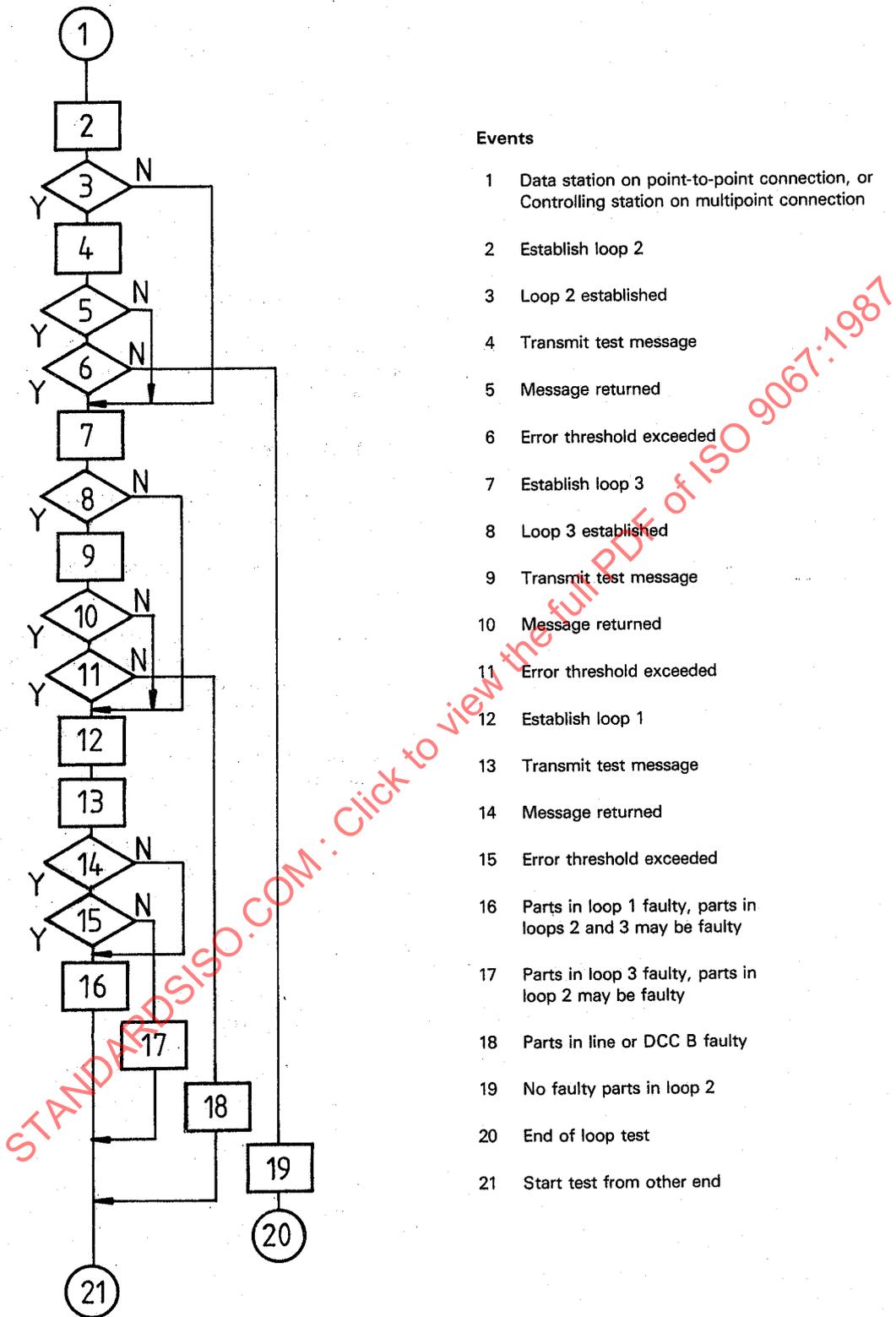
### 4.4 Evaluation of the test

The decision on whether or not a faulty element is included in the test loop is dependent on one of the following conditions:

- test loop could not be established;
- test message not returned;
- test message with an error rate exceeding a preset limit.

The use of preset limits requires knowledge of the normal transmission quality. Suitable limits shall be established in discussions with the network provider.

The evaluation test flow shall be as shown in figure 3.



Events

- 1 Data station on point-to-point connection, or Controlling station on multipoint connection
- 2 Establish loop 2
- 3 Loop 2 established
- 4 Transmit test message
- 5 Message returned
- 6 Error threshold exceeded
- 7 Establish loop 3
- 8 Loop 3 established
- 9 Transmit test message
- 10 Message returned
- 11 Error threshold exceeded
- 12 Establish loop 1
- 13 Transmit test message
- 14 Message returned
- 15 Error threshold exceeded
- 16 Parts in loop 1 faulty, parts in loops 2 and 3 may be faulty
- 17 Parts in loop 3 faulty, parts in loop 2 may be faulty
- 18 Parts in line or DCC B faulty
- 19 No faulty parts in loop 2
- 20 End of loop test
- 21 Start test from other end

NOTE — The evaluation test flow when a connection is not established starts at event 7.

Figure 3 — Evaluation test flow