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SERIES M: TMN AND NETWORK MAINTENANCE: INTERNATIONAL TRANSMISSION SYSTEMS, TELEPHONE CIRCUITS, TELEGRAPHY, FACSIMILE AND LEASED CIRCUITS

International data transmission systems

Maintenance of international data transmission systems

ITU-T Recommendation M.1375

(Previously CCITT Recommendation)

ITU-T M-SERIES RECOMMENDATIONS

TMN AND NETWORK MAINTENANCE: INTERNATIONAL TRANSMISSION SYSTEMS, TELEPHONE CIRCUITS, TELEGRAPHY, FACSIMILE AND LEASED CIRCUITS

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ITU-T RECOMMENDATION M.1375

MAINTENANCE OF INTERNATIONAL DATA TRANSMISSION SYSTEMS

Summary

This Recommendation describes the procedures and tests for the maintenance of international data transmission systems with a PDH presentation.

Source

ITU-T Recommendation M.1375 was revised by ITU-T Study Group 4 (1997-2000) and was approved under the WTSC Resolution No. 1 procedure on the 26th of June 1998.

Keywords

Fault information exchange, fault localization, fault reporting procedure, in-service monitoring, international data transmission link, international data transmission system, international leased circuit, maintenance, planned Maintenance.

FOREWORD

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The approval of Recommendations by the Members of the ITU-T is covered by the procedure laid down in WTSC Resolution No. 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

NOTE

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

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As of the date of approval of this Recommendation, the ITU had not received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementors are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database.

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Recommendation M.1375

MAINTENANCE OF INTERNATIONAL DATA TRANSMISSION SYSTEMS

(Published in 1984; revised in 1988, 1993, 1996 and 1998)

1 Scope

The requirements of this Recommendation are intended to ensure effective maintenance of international data transmission systems. The aim of this Recommendation is to minimize the number and duration of any interruptions to the customer's international leased circuit.

2 References

The following ITU-T Recommendations contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; all users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations listed below. A list of the currently valid ITU-T Recommendations is regularly published.

[1] ITU-T Recommendation M.60 (1993), *Maintenance terminology and definitions.*

[2] CCITT Recommendation M.80 (1988), *Control stations.*

[3] CCITT Recommendation M.90 (1988), *Sub-control stations.*

[4] CCITT Recommendation M.1012 (1988), *Circuit control station for leased and special circuits.*

[5] CCITT Recommendation M.1013 (1988), *Sub-control station for leased and special circuits.*

[6] ITU-T Recommendation M.1045 (1996), *Preliminary exchange of information for the provision of international leased circuits and international data transmission systems.*

[7] ITU-T Recommendation M.1300 (1997), *Maintenance of international data transmission systems operating in the range 2.4 kbit/s to 140 Mbit/s.*

[8] ITU-T Recommendation M.1340 (1996), *Performance allocations and limits for international data transmission links and systems.*

[9] ITU-T Recommendation M.1370 (1993), *Bringing-into-service of international data transmission systems.*

[10] ITU-T Recommendation M.1385 (1993), *Maintenance of international leased circuits that are supported by international data transmission systems.*

[11] ITU-T Recommendation M.1400 (1997), *Designations for international network.*

[12] ITU-T Recommendation M.1540 (1994), *Exchange of information for planned outages of transmission systems.*

[13] CCITT Recommendation M.1560 (1992), *Escalation procedure for international leased circuits.*

[14] ITU-T Recommendation M.2100 (1995), *Performance limits for bringing-into-service and maintenance of international PDH paths, sections and transmission systems.*

[15] ITU-T Recommendation M.2110 (1997), *Bringing-into-service of international PDH paths, sections and transmission systems and SDH paths and multiplex sections.*

[16] ITU-T Recommendation M.2120 (1997), *PDH path, section and transmission system and SDH paths and multiplex section fault detection and localization procedures.*

[17] ITU-T Recommendation G.701 (1993), *Vocabulary of digital transmission and multiplexing, and Pulse Code Modulation (PCM) terms.*

[18] ITU-T Recommendation G.704 (1995), *Synchronous frame structures used at 1544, 6312, 2048, 8448 and 44 736 kbit/s hierarchical levels.*

[19] CCITT Recommendation G.706 (1991), *Frame alignment and Cyclic Redundancy Check (CRC) procedures relating to basic frame structures defined in Recommendation G.704.*

[20] ITU-T Recommendation G.736 (1993), *Characteristics of a synchronous digital multiplex equipment operating at 2048 kbit/s.*

[21] ITU-T Recommendation G.783 (1997), *Characteristics of Synchronous Digital Hierarchy (SDH) equipment functional blocks.*

[22] CCITT Recommendation G.796 (1992), *Characteristics of a 64 kbit/s cross-connect equipment with 2048 kbit/s access ports.*

[23] CCITT Recommendation X.50 (1988), *Fundamental parameters of a multiplexing scheme for the international interface between synchronous data networks.*

3 Terminology and definitions

Recommendation M.1300 [7] provides general descriptions of international data transmission links and international data transmission systems.

Terminologies and definitions relating to this Recommendation are provided in Recommendations M.60 [1] and G.701 [17].

For the purposes of this Recommendation the following definition applies:

The term **"structured" (sometimes known as "framed")** indicates that a frame structure such as those defined in Recommendation G.704 [18] is used.

4 Abbreviations

This Recommendation uses the following abbreviations:

CRC Cyclic Redundancy Check

CSES Consecutive Severely Errored Seconds

DXC Digital Cross-Connect

ES Errored Second

SDH Synchronous Digital Hierarchy

SES Severely Errored Second

TMN Telecommunications Management Network

UTC Coordinated Universal Time

5 Performance limits and objectives

Recommendation M.1340 [8] covers all performance limits and objectives associated with this Recommendation. For all performance tests described in this Recommendation, the Errored Second (ES) and Severely Errored Second (SES) limits should be met simultaneously for the test result to be considered acceptable.

Additionally, periods of Consecutive Severely Errored Seconds (CSES) should be avoided as these can cause a severe impact on some customers' applications that are supported by international data transmission systems, (see clause 5/M.1385 [10]).

6 Maintenance records

Network Operators/Service Providers should ensure that up-to-date information is held on file to assist with maintenance activities. In particular, Network Operators/Service Providers should aim to hold all information highlighted in clause 6/M.1370 [9].

7 Fault reporting procedures

7.1 Control and sub-control status

At the bringing-into-service stage, Network Operators/Service Providers will have agreed on a dual control or on a control and sub-control relationship for the terminal stations of an international data transmission system (see clause 10/M.1300 [7]).

Where a control and sub-control relationship exists, responsibilities will be as described in Recommendations M.80 [2], M.90 [3], M.1012 [4] and M.1013 [5].

Where a dual control relationship has been established, Network Operators/Service Providers should have agreed an effective mechanism for coordinating maintenance activities. Under this arrangement, to avoid confusion, it is essential that the terminal stations inform each other of maintenance activities as rapidly as possible.

7.2 Fault information exchange

In general, fault information relating to an international data transmission system can originate from four sources:

– a customer (due to the failure or poor performance of an international leased circuit);

– a lower order system[1] operator (due to the failure or poor performance of a lower order system that is supported as a channel on this system);

– the system itself (through alarms or distant operator);

– a network or higher order system[1] operator (with notification of the failure or poor performance of the higher order network that supports this system or recognition of a transmit problem from this system).

Where fault information is received directly from a customer, reference should additionally be made to Recommendation M.1385 [10].

During fault localization and clearance, fault information exchange should be as indicated in Figure 1.

Where a fault is passed from one operator to another, or between Network Operators/Service Providers, as much information as possible should be exchanged including:

– the name, title and contact details for the person reporting the fault;

– time of fault report, recorded in UTC;

– designation of the faulty system (see Recommendation M.1400 [11]);

– symptoms of the fault;

– the observed duration of the fault prior to a report being made;

– fault reference numbers;

– any associated information that may assist with fault clearance.

The above fault information may be exchanged electronically, for example, using a TMN X interface.

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[1] The terminology covering lower order systems and higher order systems relates to the hierarchical transmission data rate of the terminal multiplexing equipments that are interconnected to support service. A typical lower and higher order system relationship would exist where a 64 kbit/s international data transmission system (see Recommendation X.50 [23]) is supported as a channel on a 2048 kbit/s international data transmission system (see Recommendation G.736 [20]).

When a fault is cleared, appropriate clearance information should be passed to stations that had been involved with initial fault reporting and localization.

8 Fault localization

Figure 1 provides a systematic and coordinated procedure for efficient fault localization.

Initial localization should aim to identify as quickly as possible whether the fault is due to the international data transmission link or the terminal multiplexing equipment[2]. Subsequent localization should aim to identify the specific link section or equipment that has failed.

Where the TMN methodology is used, automatic identification of the exact cause of problems may greatly simplify fault monitoring and localization.

Where fault localization is not achieved in a reasonable time, Network Operators/Service Providers shall invoke the agreed escalation procedure (see Recommendation M.1560 [13]) to assist progress.

9 Maintenance tests

9.1 General

Existing maintenance records should provide details of test equipment, test points, test patterns and performance limits that are to be used for the maintenance of specific international data transmission systems. Where information is incomplete or out of date, reference should be made to Recommendations M.1340 [8] and M.1370 [9] as appropriate.

Maintenance tests should be kept as short as possible to avoid significantly extending out-of-service time. Care must be taken to avoid the use of loopbacks to localize system faults, as this may disrupt one or more customers' circuits on the same system.

Where an international data transmission system has yet to be fully utilized, that is, where it has spare capacity, it may be possible to connect test equipment to monitor the performance of one channel. The data from such tests may provide a useful indication of the overall performance of the international data transmission system.

9.2 Maintenance intervention tests

Several test measurement configurations are possible; see Figure 1/M.2110 [15] for guidance. Maintenance intervention testing should be of a duration that is appropriate to the nature of the fault report that has been received.

Where a report suggests that a system has failed completely, a short test of basic integrity should be performed. Such tests, which are interpreted on a simple pass or fail basis, should normally be limited to a duration of 15 minutes with no Severely Errored Seconds (SES) being observed.

Where a fault report suggests that there is an overall degradation of service, but that the system has not failed completely, longer duration tests (1 hour or 24 hours) should be performed as appropriate. It may be possible for some tests to be performed via protected monitoring points with the system still in service. This may be particularly useful when the fault is believed to be in the data receive direction. Where an out-of-service test is necessary, full account should be taken of the traffic that is being supported. On some occasions, it may be appropriate to defer testing until such time as it is most convenient for customers.

9.3 Returning to service tests

Returning to service tests should be of a duration that is appropriate to the nature of the fault that has been cleared and should include observation of any network alarm facilities that may be available. Where a fault had caused a general degradation of performance, a returning to service test with a short duration (e.g. 15 minutes) may not be appropriate, and a longer-term test (e.g. 1 hour or 24 hours) should be used.

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2 The term "multiplexing equipment", as defined in Recommendation M.60 [1], includes digital cross-connect equipment.

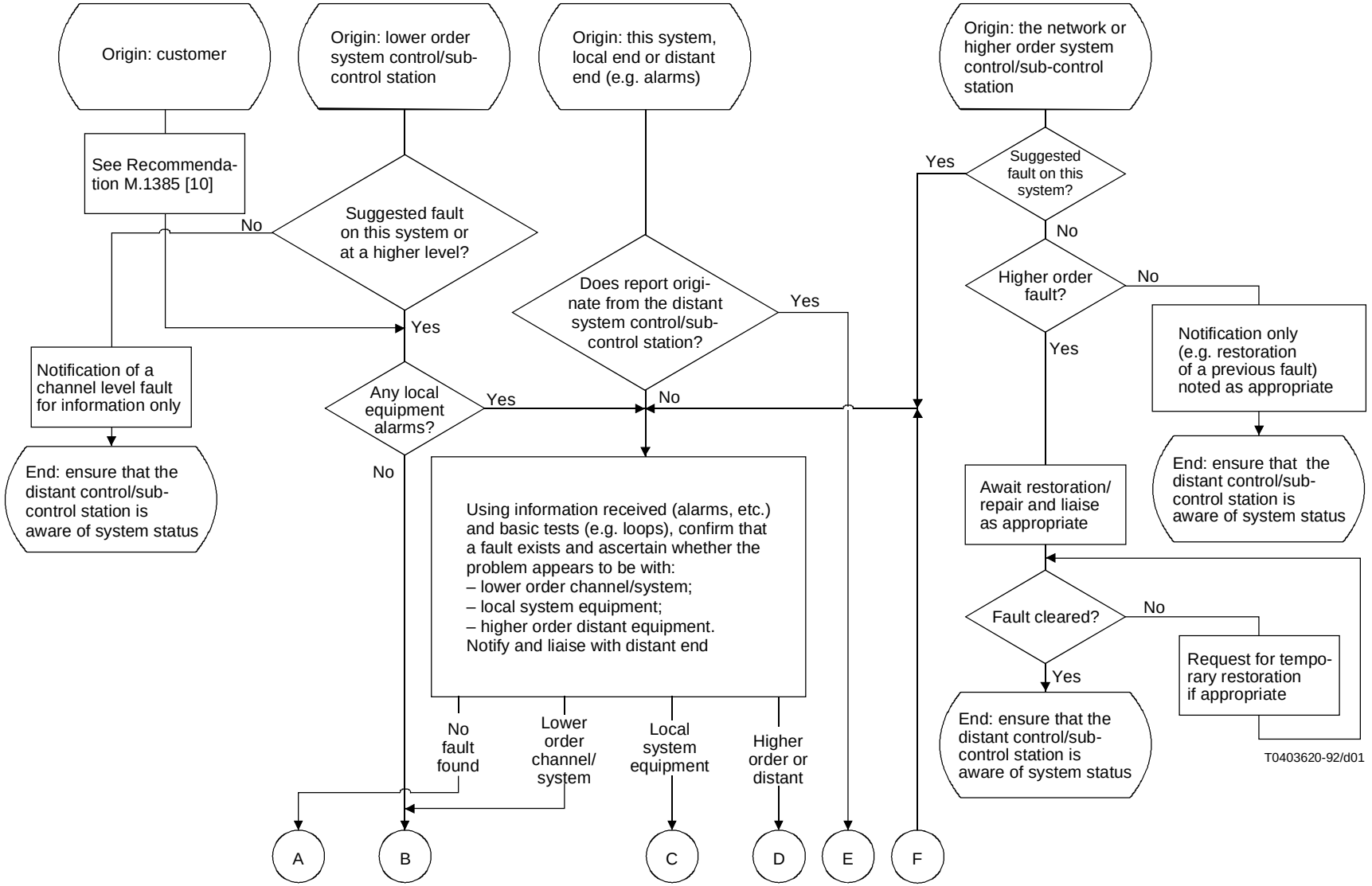
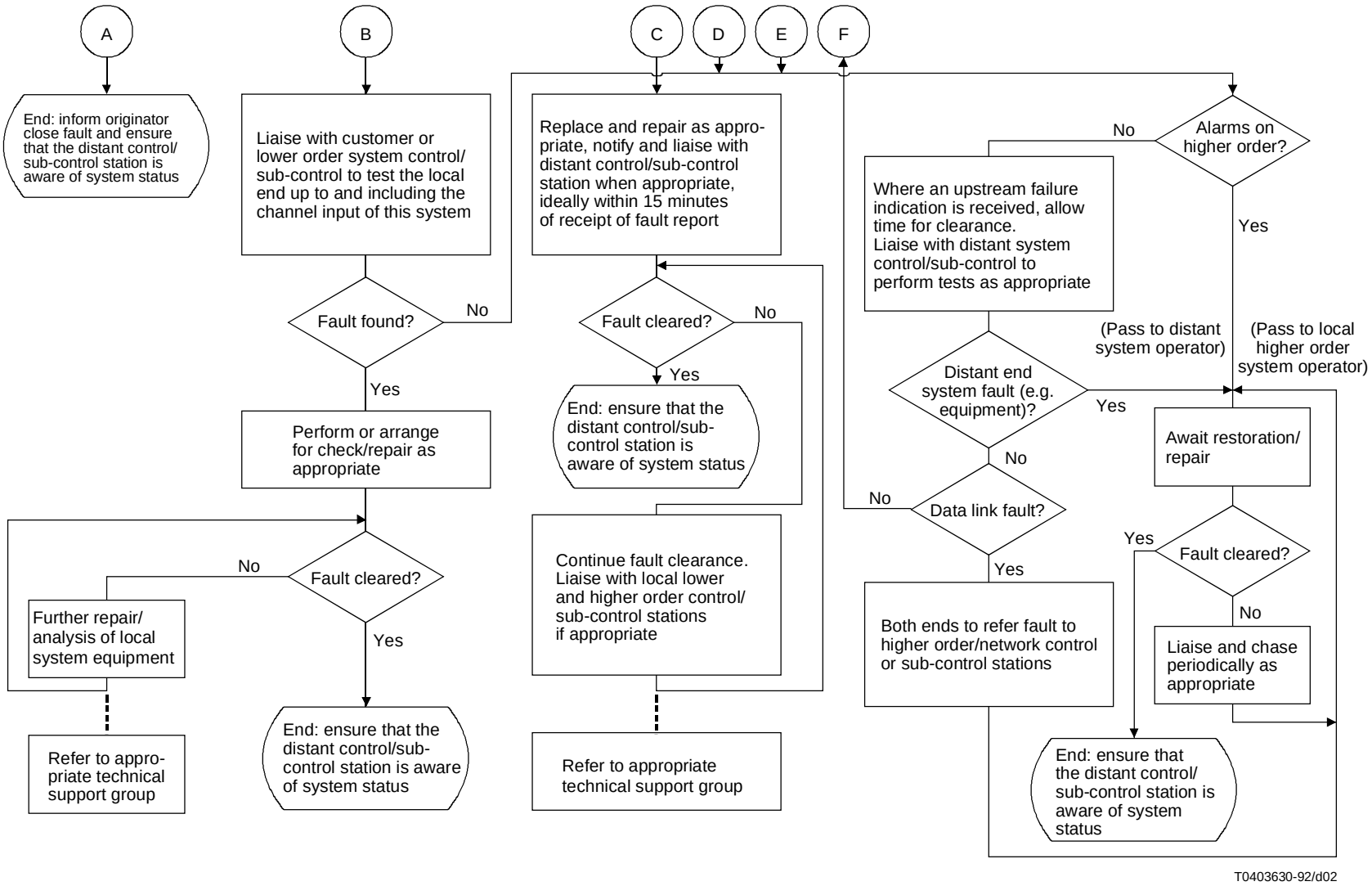


Figure 1/M.1375 – Actions on receipt of fault information



NOTE – The fault-finding procedure outlined should be followed, as far as is possible, by lower order system control/sub-control stations prior to passing faults onto higher order system control/sub-control stations.

Figure 1/M.1375 *(concluded)* **– Actions on receipt of fault information**

9.4 Loopback tests

On certain occasions, it may be possible to perform a data transmission performance test by utilizing a loopback. However, it should be appreciated that the results of such tests are not directly comparable with any previous measurements made in a single direction of transmission.

Care must be taken to avoid the simultaneous operation of loopbacks if the system configuration is such that erroneous results would occur. Once the need for a loopback no longer exists, then care should be taken to ensure that it is removed.

9.5 Test access at Digital Cross-Connect (DXC) equipment

An increasing number of international data transmission systems are configured using Digital Cross-Connect (DXC) equipment within transmission stations (e.g. see Recommendation G.796 [22]). These equipments are used to switch faulty digital paths over to standby paths when necessary. They also often provide the capability to divert data transmission systems and circuits to test ports to which test equipment can be connected and used to measure performance and diagnose faults.

Furthermore, this test equipment may be remotely controlled, preferably by the same management system that controls the DXC equipment. In any event, control of the two must be carefully synchronized. In some cases, simultaneous multiple access to test equipment ("remote test head") is possible by multiple operators.

It is desirable that DXC equipment is capable of providing monitoring of selected digital paths before taking the path out of service. This allows in-service performance assessment and/or confirmation that a fault exists before breaking the path. Most DXC equipment provides both a monitor and a split and terminate functionality on the test ports. While the digital path is being monitored in-service, no interruption is experienced. Once a fault has been confirmed, the faulty path is split and the fault diagnosed.

10 In-service monitoring

On some international data transmission systems, it may be possible to assess overall performance by implementing a cyclic redundancy check within certain nominally spare bits of a frame alignment signal (e.g. CRC4 and CRC6 – see Recommendation G.706 [19]) or by monitoring an additional dedicated service channel. The system is then referred to as "structured" (or "framed").

The criteria for the evaluation of the Errored Second (ES) and Severely Errored Second (SES) parameters in relation to in-service performance monitoring are given in Annex B/M.2100 [14]. Where in-service monitoring is using an additional dedicated service channel, the results obtained may not reflect the true performance experienced by the customer’s traffic. However, it is likely that the SES performance results will be correct.

There is a need for further study of many issues relating to the support of in-service performance monitoring for international data transmission systems. However, degraded and unacceptable performance limit thresholds have been derived and are presented in Recommendation M.1340 (see Tables 4/M.1340 and 5/M.1340) [8]. The degraded performance limit threshold relates to a 24-hour monitoring period and the unacceptable performance limit threshold to a 15-minute monitoring period.

The action to be taken in the event that a threshold is exceeded remains for further study. However, in general, where the unacceptable performance limit threshold is exceeded, immediate corrective action should be taken (e.g. temporary service restoration). Where the degraded performance limit threshold is exceeded, immediate corrective action may not be appropriate. However, the performance of the affected international data transmission system should be reviewed on a regular basis to establish whether a fault exists. See also 2.3/M.2120 [16] for further guidance with respect to performance limit thresholds.

Where an international data transmission link is comprised of a number of discrete monitored link sections, the degraded and unacceptable performance limit thresholds should apply to that part of the international data transmission link that is actually monitored. In this case, the allocation for a particular monitored path element will be less than the allocation for the overall international data transmission link.

The use of DXC equipment enables in-service observation, in the receive direction, on structured data transmission systems. For loopback observations, the agreement and cooperation of the foreign DXC authority is required. In some countries, observations via DXCs may be centralized by the TMN.

In cases of complaints relating to intermittent faults on a leased circuit supported by a data transmission system, it may often be advisable for Network Operators/Service Providers to compare records of interruptions on the link, at DXC level.

Comparison of regular records among Network Operators/Service Providers also provides a means of evaluating routings and thus of detecting those prone to frequent ES and SES.

In-service monitoring may not be possible where the circuit is deemed to be transparent.

11 Temporary service restoration

Temporary service restoration may be utilized when a network failure is localized to the international network and this is affecting circuits supported by an international data transmission system. Typical international network failures that may require the use of temporary service restoration include the loss of an undersea cable system or satellite system.

Temporary service restoration should only be used when it is clear that normal international network restoration or repair will not be achieved in a reasonable time (see Annex D/M.1560) [13].

11.1 Mechanisms for implementing temporary service restoration

Two basic mechanisms have been identified as follows:

1) To utilize a dedicated restoration facility

   The dedicated restoration facility will typically be an international data transmission system which may follow a different physical route. If both of the following criteria are met, the dedicated temporary restoration facility may be utilized:

   a) An international network failure has occurred and it is observed that normal restoration will not be achieved in a reasonable time.

   b) A dedicated restoration facility is available.

2) To utilize temporary restoration capacity

   The temporary restoration capacity would typically be found within other international data transmission systems that connect to the same destination, which may follow a different physical route within the international network. If each of the following criteria are met, the temporary restoration capacity may be utilized:

   a) An international network failure has occurred and it is observed that normal restoration will not be achieved in a reasonable time.

   b) Any dedicated restoration facility that may have been provided is not available.

   c) Spare restoration capacity is available.

   If the Network Operators/Service Providers involved have the technical capability and operating procedures to support the temporary switching of channels between international data transmission systems, reference should be made to clause 10/M.1385 [10].

11.2 Time to restore service

Network Operators/Service Providers should take into account the urgency for restoration for each particular international data transmission system as mentioned in the preliminary exchange of information for its provision (see Recommendations M.1045 [6] and M.1400 [11]). Where time to restore service seems to be unacceptable, Network Operators/Service Providers shall invoke the agreed escalation procedure (see Recommendation M.1560 [13]).

11.3 Restoration procedure

The following outline procedure is for guidance only. Detailed operating procedures will need to be agreed between the Network Operators/Service Providers involved taking account of the network infrastructure that is available. This may include the use of a TMN X interface.

When an international data transmission system failure occurs and the basic restoration criteria have been met (see 11.1 above), the Network Operators/Service Providers involved will confirm that some form of temporary service restoration is to be used and agree how this is to be achieved. Service can be restored using the following procedure:

a) Confirm that the international data transmission link is faulty.

b) Confirm that both Network Operators/Service Providers agree that the normal restoration time is unreasonable.

c) Implement restoration switching.

d) Confirm that the affected international data transmission system has been successfully restored.

11.4 Returning to normal routing

When service can be restored via its normal route, this should be done as soon as practically possible, or as a planned outage (see Recommendation M.1540 [12]).

11.5 Information that should be exchanged

Dependent upon the proposed restoration method that is to be used, Network Operators/Service Providers should ensure that suitable preliminary information has been exchanged (e.g. designations and routings for any international data transmission systems that may be used for dedicated or temporary service restoration).

12 Automatic rerouting of international data transmission links

For priority links, Network Operators/Service Providers may agree to fit the links with automatic rerouting switches, through requisite monitoring systems. These may be 1 + 1 or n + 1 rerouting systems.

For leased circuits supported on such links, the number of Consecutive Severely Errored Seconds (CSES) due to changeover of the data transmission system should be minimized in order to fulfil the requirements of the supported services (see clause 5/M.1385 [10]).

13 Precautions to be taken in the use of DXCs

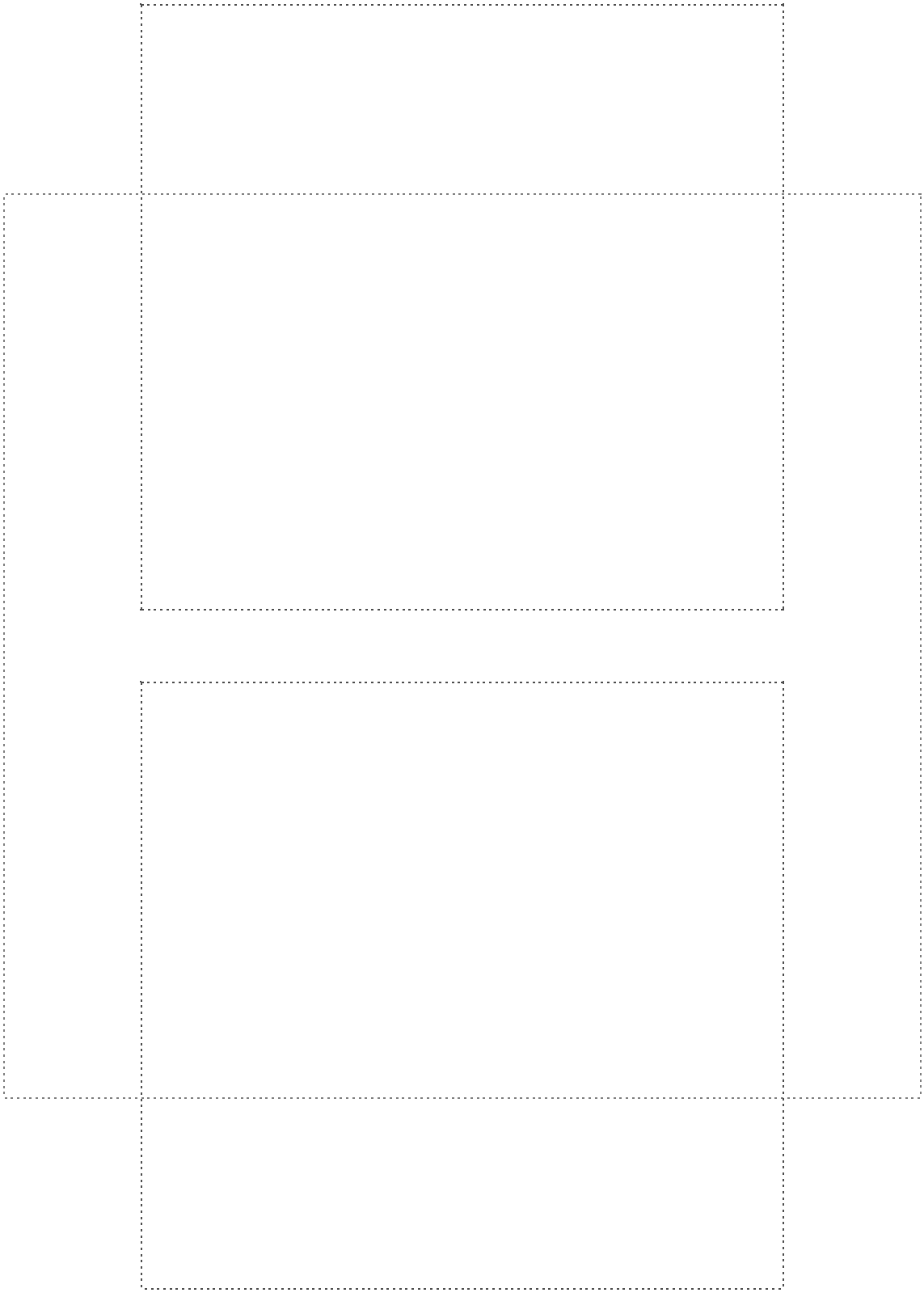
DXC equipment types vary. Some handle cross-connecting of low-speed (below primary rate) signals and have primary rate digital access ports. These are sometimes called "1/0 DXCs". Depending on the bit rate of the digital path to be monitored and tested, one or more timeslots of the test port are used for the signal. Other types of DXC equipment are used for higher bit rate signals, for example, cross-connecting primary rate digital paths and fitted with third level digital access ports. These are sometimes called "3/1 DXCs". Many SDH DXCs have considerably more flexibility. For further information on cross-connects, see Recommendations G.796 [22] for PDH and G.783 [21] for SDH.

For an international data transmission link, the DXC is typically the routing point, since it fulfils a switching function. The DXC must thus offer a very high degree of availability.

If a serious fault should nevertheless occur on a DXC, the Network Operator/Service Provider should have available sufficient alternative arrangements to relieve the faulty unit. At changeover, the databases may have to be loaded and it should be checked whether the software version is compatible if the DXC is a back-up for another.

14 Planned maintenance

In cases of planned maintenance on the Network Operator's/Service Provider's installations – transmission equipment, power equipment, cabling, etc. – which would cause or risk some performance degradation or unavailability of the international data transmission system, Recommendation M.1540 [12] procedures should be followed.



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