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MAINTENANCE: INTERNATIONAL TRANSPORT NETWORK

OPERATIONAL PROCEDURES IN LOCATING AND CLEARING TRANSMISSION FAULTS

Recommendation M.2130

FOREWORD

The CCITT (the International Telegraph and Telephone Consultative Committee) is a permanent organ of the International Telecommunication Union (ITU). CCITT is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The Plenary Assembly of CCITT which meets every four years, establishes the topics for study and approves Recommendations prepared by its Study Groups. The approval of Recommendations by the members of CCITT between Plenary Assemblies is covered by the procedure laid down in CCITT Resolution No. 2 (Melbourne, 1988).

Recommendation M.2130 was revised by Study Group IV and was approved under the Resolution No. 2 procedure on the 5th of October 1992.

CCITT NOTE

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

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Recommendation M.2130

OPERATIONAL PROCEDURES IN LOCATING AND CLEARING TRANSMISSION FAULTS

(Published as M.12 in 1960; renumbered as M.13 in 1964 and as M.130 in 1976; revised and renumbered as M.2130 in 1992)

Abstract

This Recommendation provides a guide to the location and clearance of transmission faults in the network, and circuits routed over circuit multiplication systems. It defines the basic principles used in fault location, provides flowcharts of actions required, and identifies cases of special faults, and the need to invoke escalation procedures.

Keywords

– channel;

– circuit;

– escalation:

– faults;

– group;

– maintenance;

– path;

– procedure;

– restoration.

1 The reporting of faults on automatic circuits is dealt with in Recommendations M.715 [5] and M.716 [6]; for leased and special circuits in Recommendations M.1012 [1], M.1013 [2] and M.1014 [3], for CCSS No. 6 in Recommendation M.762 [7] and for CCSS No. 7 in Recommendation M.4100 [4]. These principles should likewise be applied to the reporting of faults on groups, supergroups, etc., to the *fault report point* in a repeater station.

2 Basic principles for locating a fault on a circuit

2.1 The following principles apply to all types of circuit, however constituted:

i) The fault report is received by the relevant fault report point and passed on to the circuit control station.

ii) The circuit control station should immediately arrange for the circuit to be withdrawn from service.

iii) Appropriate overall measurements and tests should be made to verify the existence of the fault.

iv) Measurements should be made on the sections of the circuit between the *end* of the circuit (circuit access point, voice-frequency telegraph terminal or renter's termination, etc.) and the international line access point at the terminal international centre to find whether the fault is on these sections in either of the terminal countries concerned.

v) If the fault is proved in these sections, national practices should be applied to locate and clear the fault.

vi) If the fault is proved to be on the international line, maintenance personnel at the terminal international centres involved should make tests and measurements appropriate to the type of fault in cooperation with any intermediate sub-control station until the fault has been located between two adjacent sub-control stations, that is, to a circuit section. These two stations should then control the detailed location of the fault and its subsequent clearance within their section.

Note – Some types of circuit may be routed via a circuit multiplication system. The terminal Administrations must bilaterally agree on a detailed fault localization procedure for circuits routed via the particular circuit multiplication system in use between them. Annex A to this Recommendation contains an outline of a fault location procedure upon which detailed arrangements could be based.

vii) As soon as possible, the use of any permitted rerouting possibilities that there may be for the line or sections thereof should be made, in order to restore service on the circuit.

viii) If the circuit section is routed on the channel of an FDM group or a primary digital block, the group *or* digital block control should be informed of the fault in order to take the necessary action.

ix) When the fault has been cleared the sub-control station in whose country the fault was located should immediately notify the control station either directly or via the appropriate maintenance unit of the nature of the fault and the time and details of its clearance.

x) The controlling end should cooperate with the noncontrolling end and should make overall measurements, requesting further adjustments if necessary.

xi) When the circuit meets the specified requirements, the control station arranges to restore the circuit to service.

2.2 Figure 1/M.2130 shows a sequence of operations that may be followed applying the principles given in § 2.1.

2.3 A typical sequence of operations covering transmission faults on transfer links of CCSS No. 6 is shown in Figure 2/M.760 [8].

2.4 When a fault in a circuit section is proved to be due to an analogue group or a digital block fault, the basic fault procedures for the group or block are the same as those given for faults on an international line [see § 2.1 vi) and vii)].

The sequence of operations followed by the group control station and the group sub-control station in locating faults on a group is shown in Figure 2/M.2130. Associated operations by other control and sub-control functions are shown in Figures 3/M.2130 and 4/M.2130.

2.5 The operations mentioned above can sometimes be modified according to special circumstances. For example, if there is a cable fault in a terminal country and if this fault affects a large number of circuits, it will not generally be necessary to carry out all the operations given in § 2.1 and Figure 1/M.2130 in the order shown.

3 Faults observed at repeater stations as a result of local or extended alarms

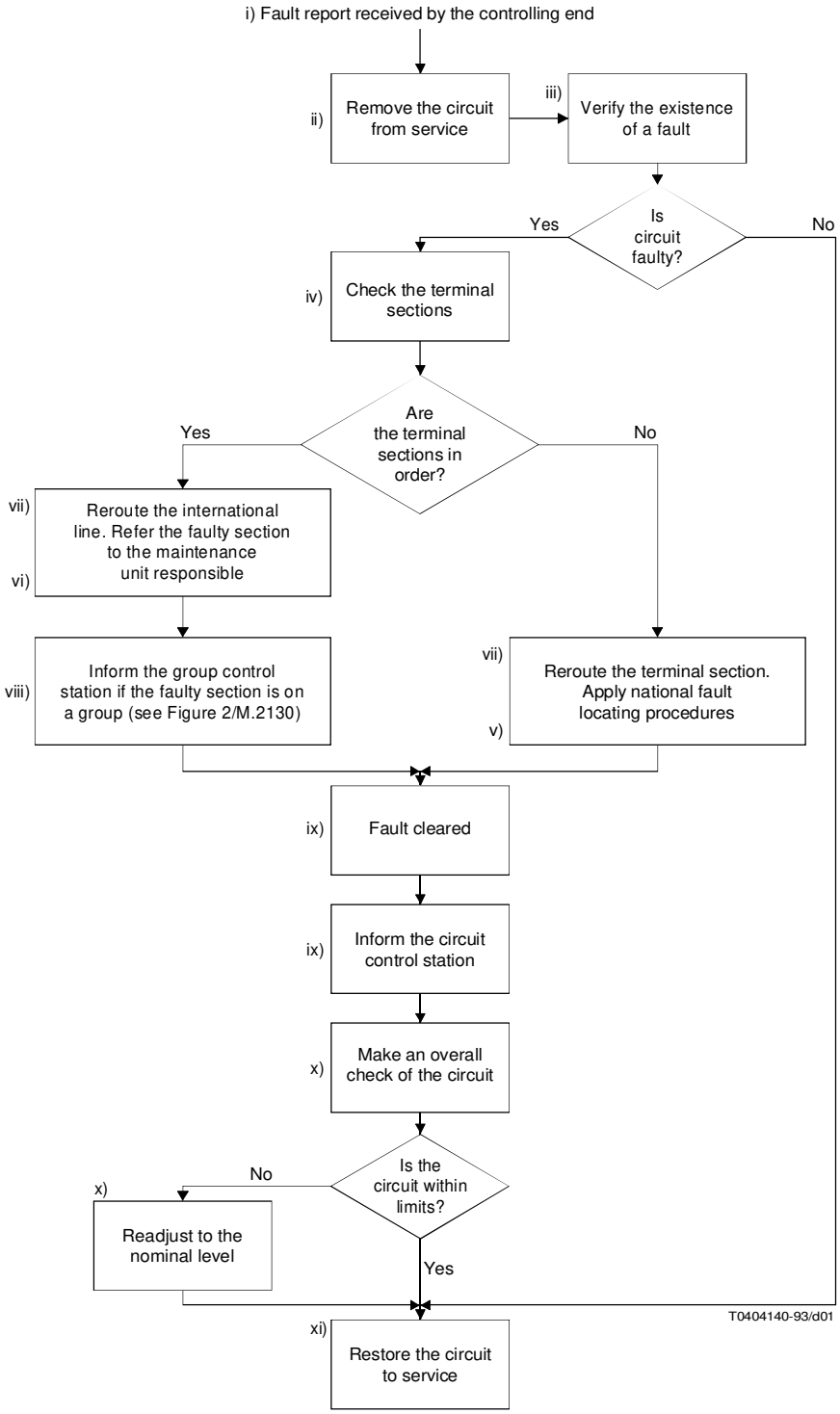
All fault conditions affecting transmission that are observed at repeater stations as a result of local or extended alarms should be reported to the relevant fault report points of the country concerned, so that arrangements can be made to apply the fault clearing procedure.

4 Special faults

In the case of unusual faults, or faults which are difficult to locate with the testing equipment that is available, or faults of a similar kind occurring very frequently on a particular section, the appropriate control station should inform its technical service without delay. This service, in cooperation with other technical services involved, will take the necessary action to locate such faults or, where appropriate, prevent such faults in the future by rearrangement of the circuit layout or equipment involved. The circuit control station should be kept informed of the progress of the action taken or proposed, the prospects of clearance and other pertinent details.

5 Escalation procedure

Normally cooperation between maintenance elements in different Administrations will result in the satisfactory identification and correction of faults. There may be circumstances, however, where fault escalation procedures defined in Recommendations M.1550 [9] and M.1560 [10] may be required.



Note – The Roman numbers correspond to those § 2.1 of this Recommendation.

FIGURE 1/M.2130

Example of possible action following a circuit fault report

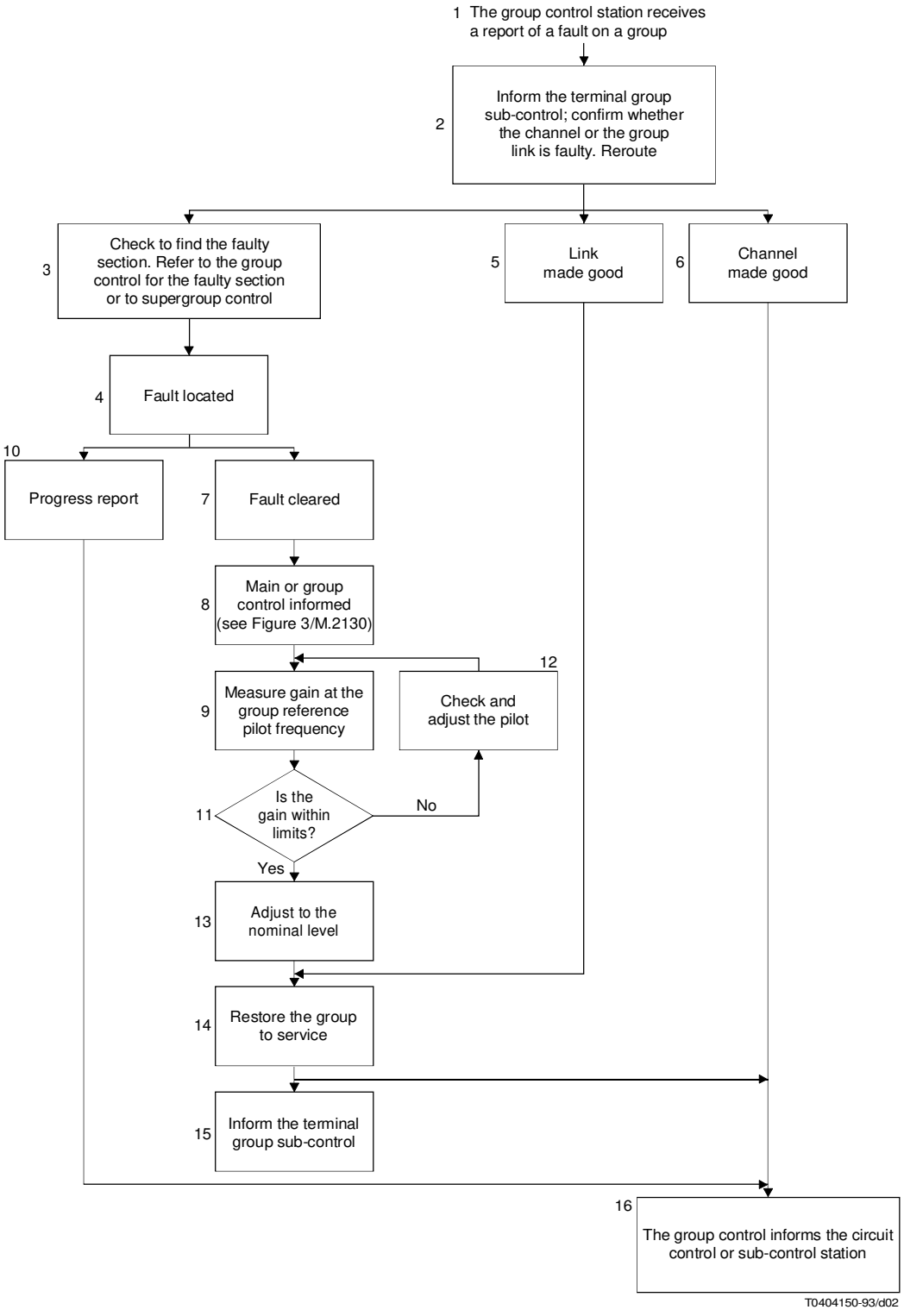


FIGURE 2/M.2130

Example of possible action by a group control station following a fault report

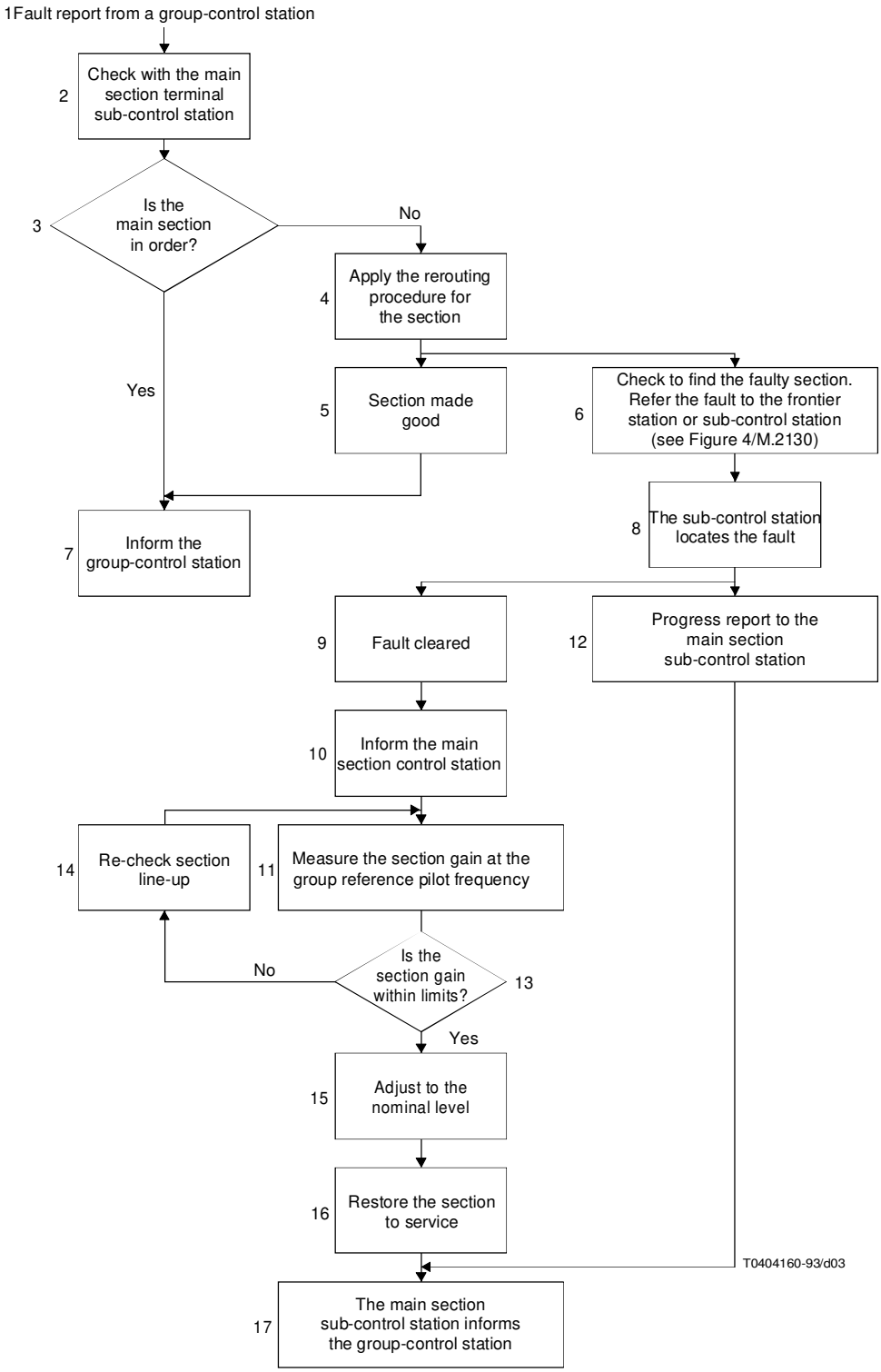


FIGURE 3/M.2130

Example of possible action by main section control station following a fault report

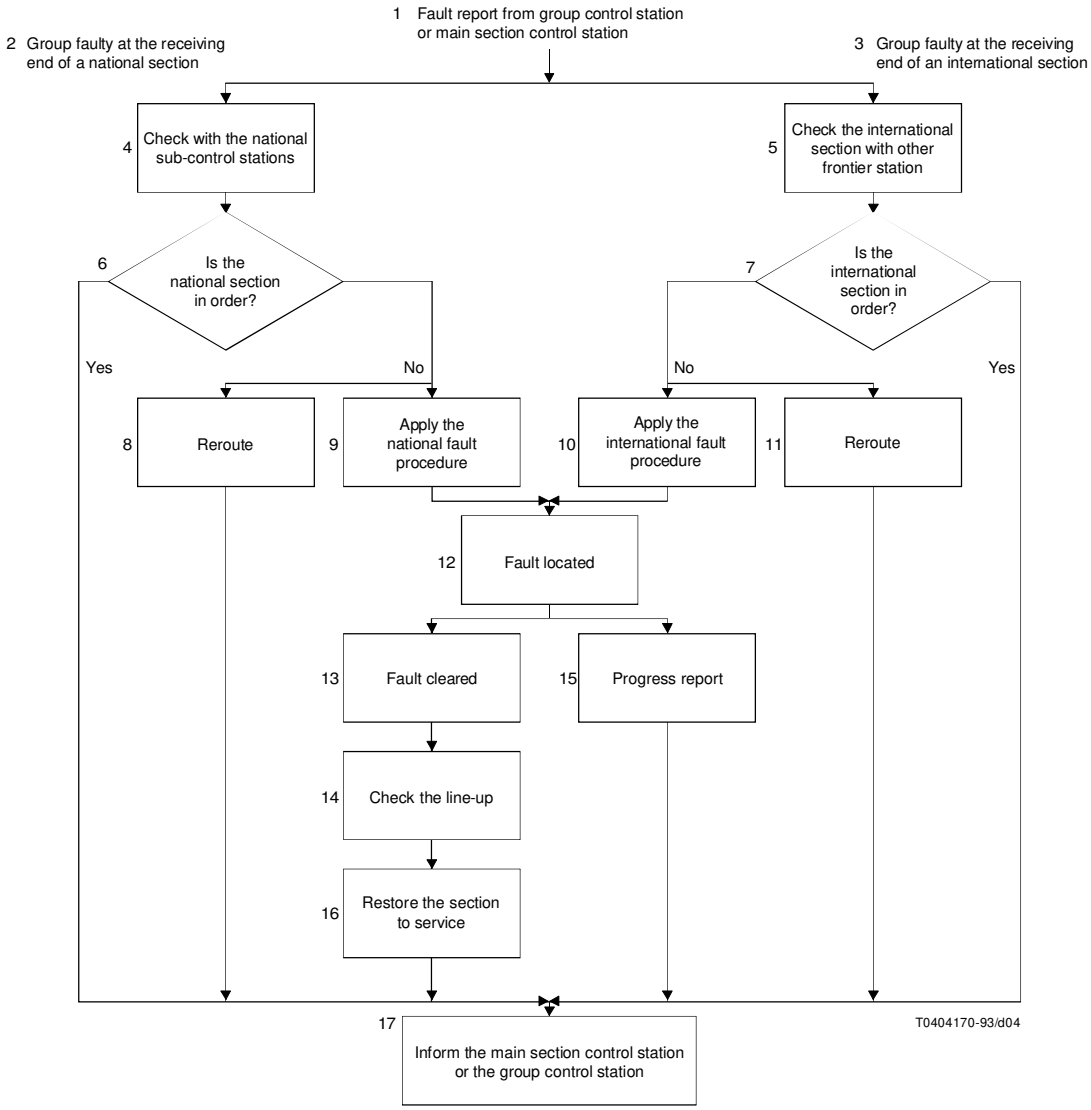


FIGURE 4/M.2130

Example of possible action by a frontier station following a fault report

ANNEX A

(to Recommendation M.2130)

Outline procedure for locating faults on circuits routed via a circuit multiplication system

Introductory Notes

In this annex, the term circuit multiplication system (CMS) is used for convenience. It is intended to cover all systems which increase the number of circuits available from a transmission link by taking advantage of the fact that only one direction of transmission is used at any one time in a telephone conversation (one talker and one listener), and that normal speech patterns involve pauses, hesitations and silent intervals. Examples of such systems are TASI-E and CELTIC.

Reduced bit rate coding systems, e.g. transcoders, are not presently included in the description of CMSs found in this Recommendation.

A.1 *General*

A circuit multiplication system consists of a transmit and receive equipment for each direction of transmission, interconnected by a number of "channels" (sometimes known as connect- or connection-channels).

Inputs and outputs of the CMS take the form of "trunks", the number of which typically exceeds the number of channels by a factor of two. That is, a typical CMS provides an advantage of two trunks (and therefore, two circuits) per CMS channel.

Figure A-1/M.2130 depicts a generalized CMS, in this case interfaced at basic circuit level. Other circuit multiplication systems are interfaced by primary order digital paths (operated at 1544 or 2048 kbit/s) on both trunk and channel sides of the CMS terminal equipment. Other interface arrangements are also possible.

When the CMS is taken out of service, due to a fault or on a planned basis, CMS trunks are switched through to CMS channels on a predetermined basis, one trunk per channel. The circuits routed on such trunks are called "CMS-and-through" circuits. The circuits routed on the additional trunks derived by the CMS are called "CMS-only" circuits.

A.2 *Fault localization procedure for circuits routed via CMS*

A.2.1 *Impact of CMS operation*

At the time a fault is detected on a circuit routed via a CMS, a particular CMS trunk-to-CMS channel association existed. The fault localization procedures must recognize that the probability of reproducing this trunk-channel association under testing conditions is very remote, particularly in modern circuit multiplication systems. In older systems (for example, those interfaced at basic circuit level), there is the possibility of reproducing the original trunk-channel association, especially if both fault detection and testing occur during light traffic periods. This possibility should not be overlooked in the fault localization procedures for circuits routed via such systems.

An important feature of many modern circuit multiplication systems is that they include self-diagnostic procedures which continuously switch trunk/channel connections even when the traffic load does not necessitate interpolation. Such self-diagnostic procedures include the monitoring of the transmission performance of CMS channels[1)]. When pre-set thresholds (for example, of loss and noise) are exceeded, the CMS establishes a permanent trunk/channel connection (a so-called "trunk/channel lock"), and alerts maintenance staff in a suitable manner.

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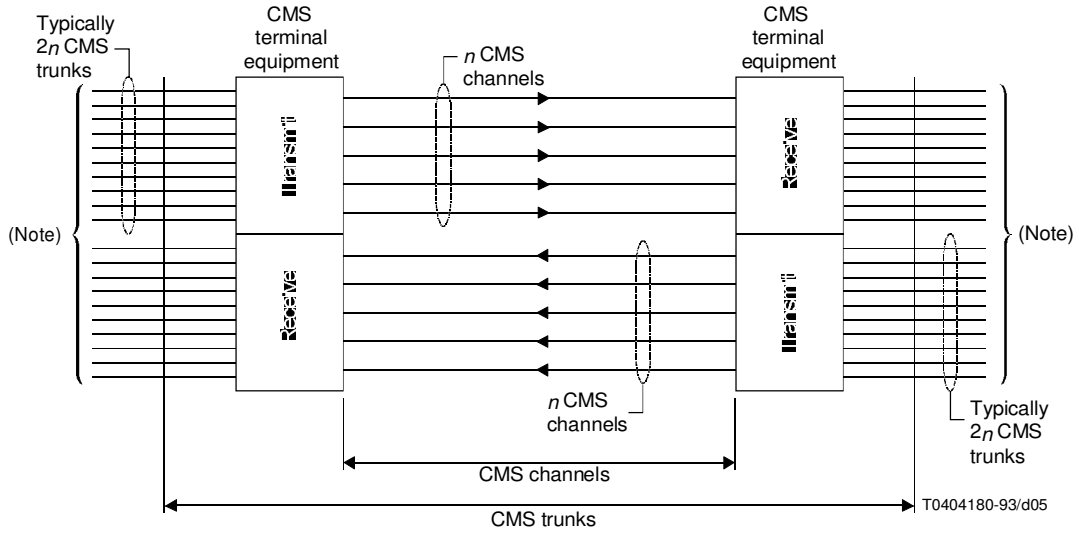
1) In some systens, minor loss variations are also automatically compensated for.

To take account of these operating characteristics, the localization of faults on circuits assigned to a CMS follows a technique that is different from that used for normal (non-CMS) circuits. Furthermore, the test procedures to be used differ slightly depending on whether the circuit under test is a CMS-and-through circuit or a CMS-only circuit.



Note – CMS trunks are extended, as appropriate, to circuit terminating equipment.

FIGURE A-1/M.2130

Generalized representation of a circuit multiplication system (CMS)

A.2.2 *CMS-and-through circuits*

If it is known that the CMS was out of service at the time the circuit fault was identified, and remains out of service during fault localization, the procedures employed for normal (non-CMS) circuits can be used.

Tests made when the CMS is in service are carried out without regard to the CMS channel used. The existence of a fault is first verified (or otherwise) by an initial test. If no fault is detected on the initial test, it is safe to assume that the fault may have been due to the CMS equipment or the interconnecting channel at the time the fault was observed. The circuit should be returned to service. A record of the fault should be given to the maintenance unit responsible for the CMS for their information and use when CMS and CMS channel tests are carried out. The fault report point (circuit) should keep a record of the fault and the action taken for future reference purposes.

If the fault is confirmed by the initial test and repeat tests, fault localization procedures depend upon the particular CMS involved. In modern systems, a check should be made for the existence of a trunk/channel lock. If such a lock exists, normal fault localization procedures used for non-CMS circuits may be used. On older systems, or if no trunk/channel lock exists on a modern system, it can be assumed the fault is external to the CMS and its interconnecting channels. Further tests should be made to identify the exact location of the fault, which should then be referred to the appropriate maintenance unit for attention.

When localizing faults on circuits routed via older CMSs, especially during periods of light traffic, there is a chance that the CMS channel is faulty if identical fault conditions are observed on initial and repeat tests – the CMS may not have switched channels. In this event, further localization tests must include the CMS channel associated with the circuit under test and the CMS terminal equipment.

A.2.3 *CMS-only circuits*

Again, tests are made on the circuit without regard to the CMS channel being used.

The procedures for dealing with verified and unverified faults specified in § A.2.2 can be used for CMS-only circuits. However, trunk/channel locks are not generally possible on CMS-only circuits, and thus verified faults can be assumed to be external to the CMS and its interconnecting channels. Similar precautions to those in § A.2.2 should be taken when localizing faults on circuits routed via older CMSs.

When CMSs are out of service, this type of circuit is removed from service and is not therefore available for testing purposes. Fault localization tests must await the return to service of the CMS.

A.3 *CMS signalling channel faults*

Faults and service problems observed on circuits routed via a CMS may be due to problems on the CMS signalling channel causing, for example, incorrect trunk-channel switching. Many CMSs monitor the performance of the signalling channel(s) continuously. The information made available by such monitoring should be used by maintenance staff to help eliminate signalling channel problems as a source of circuit faults.

References

[1] CCITT Recommendation M.1012 *Circuit control station for leased and special circuits*.

[2] CCITT Recommendation M.1013 *Sub-control station for leased and special circuits*.

[3] CCITT Recommendation M.1014 *Transmission maintenance point international line (TMP-IL)*.

[4] CCITT Recommendation M.4100 *Maintenance of CCSS No. 7*.

[5] CCITT Recommendation M.715 *Fault report point (circuit)*.

[6] CCITT Recommendation M.716 *Fault report point (network)*.

[7] CCITT Recommendation M.762 (will be M.4040 when revised) *Maintenance of CCSS No. 6*.

[8] CCITT Recommendation M.760 (will be M.4020 when revised) *Transfer link for CCSS No. 6*.

[9] CCITT Recommendation M.1550 *Escalation procedure*.

[10] CCITT Recommendation M.1560 *Escalation procedure for international leased circuaits*.