INTERNATIONAL TELECOMMUNICATION UNION

CCITT

THE INTERNATIONAL
TELEGRAPH AND TELEPHONE
CONSULTATIVE COMMITTEE

RED BOOK

VOLUME IV – FASCICLE IV.1

GENERAL MAINTENANCE PRINCIPLES

MAINTENANCE OF INTERNATIONAL TRANSMISSION SYSTEMS AND TELEPHONE CIRCUITS

RECOMMENDATIONS M.10-M.762

VIII[TH] PLENARY ASSEMBLY
MALAGA-TORREMOLINOS, 8-19 OCTOBER 1984

Geneva 1985

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ISBN 92-61-02091-7

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APPLICABLE AFTER THE EIGHTH PLENARY ASSEMBLY (1984)

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MODIFICATIONS TO THE SERIES M RECOMMENDATIONS

Reorganization within Volume IV of the CCITT Book

Due to certain rearrangements within Volume IV of the CCITT Yellow Book, some existing Recommendations have been moved (or renumbered) and appear now in other sections of the Volume.

For the convenience of the reader of Volume IV of the CCITT Red Book, these changes are listed below:

CCITT Yellow Book (Geneva, 1980)	*CCITT Red Book* (Malaga-Torremolinos, 1984)
M.82	M.1012
M.92	M.1013
M.95	M.1014
M.97	M.93
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M.640	M.560, M.565
M.728	M.710, M.93

PRELIMINARY NOTES

1 The Questions entrusted to each Study Group for the Study Period 1985-1988 can be found in Contribution No. 1 to that Study Group.

2 Supplements to the Series M and N Recommendations can be found in Fascicle IV.3 and those to the Series O Recommendations in Fascicle IV.4.

3 In this fascicle, the expression "Administration" is used for shortness to indicate both a telecommunication Administration and a recognized private operating agency.

FASCICLE IV.1

Recommendations M.10 to M.762

GENERAL MAINTENANCE PRINCIPLES
AND
MAINTENANCE OF INTERNATIONAL TRANSMISSION SYSTEMS AND TELEPHONE CIRCUITS

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INTRODUCTION

Recommendation M.10

GENERAL RECOMMENDATION CONCERNING MAINTENANCE

To enable Administrations to cooperate effectively in maintaining the characteristics required for the international telecommunication service, the relevant CCITT Recommendations, which are based on long experience, should be applied.

Recommendation M.15

MAINTENANCE CONSIDERATIONS FOR NEW SYSTEMS

1 General

To ensure that new systems are implemented so as to permit compatible international operation and maintenance in the most effective manner, the following guiding principles are indicated.

2 Principles

2.1 When a new system is being studied, early consideration should be given to operational and maintenance requirements.

2.2 The maintenance organization and maintenance facilities (including test equipment) should be considered early enough to ensure their availability when the new system is introduced.

2.3 In order to reduce total (lifetime) costs and to improve the efficiency of maintenance, new systems should be provided with internal supervision and fault localization functions. Such functions reduce the number and type of external test equipment to a minimum, and make it possible to omit most external routine tests.

2.4 Where existing maintenance procedures, for example fault reporting, are not appropriate, alternative procedures should be considered early enough to ensure their application when the new system is introduced. However, any new procedures should consider established maintenance principles accepted by the CCITT.

Recommendation M.20

MAINTENANCE PHILOSOPHY FOR ANALOGUE, DIGITAL AND MIXED NETWORKS

1 General

1.1 The major aim of a general maintenance philosophy for analogue, digital and mixed networks is both to minimize the occurrence of failures and to ensure that in case of failure:

- the right personnel can be sent to
- the right place with
- the right equipment at
- the right time to perform
- the right actions.

1.2 To apply this philosophy in a network, the following principles can be used:

Preventive maintenance

The maintenance carried out at predetermined intervals or according to prescribed criteria and intended to reduce the probability of failure or the degradation of the functioning of an item.

Corrective maintenance

The maintenance carried out after fault recognition and intended to restore an item to a state in which it can perform a required function.

Controlled maintenance

A method to sustain a desired quality of service by the systematic application of analysis techniques using centralized supervisory facilities and/or sampling to minimize preventive maintenance and to reduce corrective maintenance.

1.3 In general for all three types of network (analogue, digital and mixed), the use of controlled maintenance principles is recommended, i.e., the maintenance actions are determined on the basis of information generated in the maintained system or coming from auxiliary supervision systems.

1.4 The advantages of the controlled maintenance approach are that it directs future maintenance activity to those areas where a known improvement in service to the customer will be achieved. The monitoring techniques which are inherent in controlled maintenance provide data which simplify the identification of hidden faults by using statistical analysis.

1.5 The smaller the portion of the network which is affected by a failure, the more difficult and/or less economic it may be to detect it using controlled maintenance techniques. In these cases corrective and/or preventive maintenance techniques may have to be employed.

1.6 In analogue and mixed networks, a mixture of the above-mentioned principles are used, depending on the existing equipment included in the network (see Recommendations M.710, M.715 to M.725).

1.7 The maintenance philosophy and fundamental principles are closely linked to:

- availability performance
- network technical performance
- network economics.

2 Maintenance objectives

2.1 *Purpose*

The main purpose of a general maintenance philosophy for analogue, digital and mixed networks is to accomplish the aims defined in § 1.1.

In addition the following objectives should be fulfilled:

- For a defined level of service the total costs should be kept to a minimum by the use of appropriate methods (e.g. centralized operation and maintenance).
- The same maintenance philosophy should be applied to exchanges, transmission equipment, data equipment, subscriber terminals, etc., wherever possible.

2.2 *Economics*

New technology provides new possibilities for low cost maintenance not only for individual exchanges, but for the whole network, e.g. using the same technology for both transmission and switching.

The operation and maintenance functions in a network should be planned in such a way that the life cost will be a minimum. For a defined level of service the total cost consists of:

- investment cost
- operations cost
- maintenance cost
- cost for loss of traffic.

2.3 *Transition from analogue to digital networks*

The basic philosophy, as described in this Recommendation, is valid in principle, for analogue, mixed and digital networks. However, many digital network parts are more suited to the implementation of controlled maintenance than are analogue network parts. Due to new technological developments maintenance functions can be incorporated within the digital equipment. Analogue equipment often requires additional external maintenance systems in order to permit controlled maintenance, e.g. ATME No. 2 (Recommendation O.22 [1]).

3 Overall maintenance philosophy

3.1 *Maintenance entity concept*

In the maintenance philosophy, it is assumed that the different equipments of a telecommunication network are interconnected at easily identifiable points at which the interface conditions defined for these equipments apply.

3.1.1 The equipments which occur between two consecutive interface points constitute a maintenance entity (ME).[1] In an integrated digital network, for example, such points may be provided by digital distribution frames. Even in a location where no digital distribution frame is provided, an equivalent point, where defined interface conditions apply, will normally be identifiable.

3.1.2 The choice of maintenance entities should be compatible with the maintenance organization of an Administration (Recommendations M.710, M.715 to M.725). Examples of MEs are given in Figure 1/M.20.

Note – Several MEs can be assembled into a maintenance entity assembly (MEA) for operational and maintenance reasons. Typical applications are digital exchanges, digital circuits and facilities. MEs can also be subdivided into maintenance sub-entities (MSE) for operational and maintenance reasons. A typical example is a digital line system consisting of line terminals, repeaters and cable sections. Both the MEA and MSE concepts are under study.

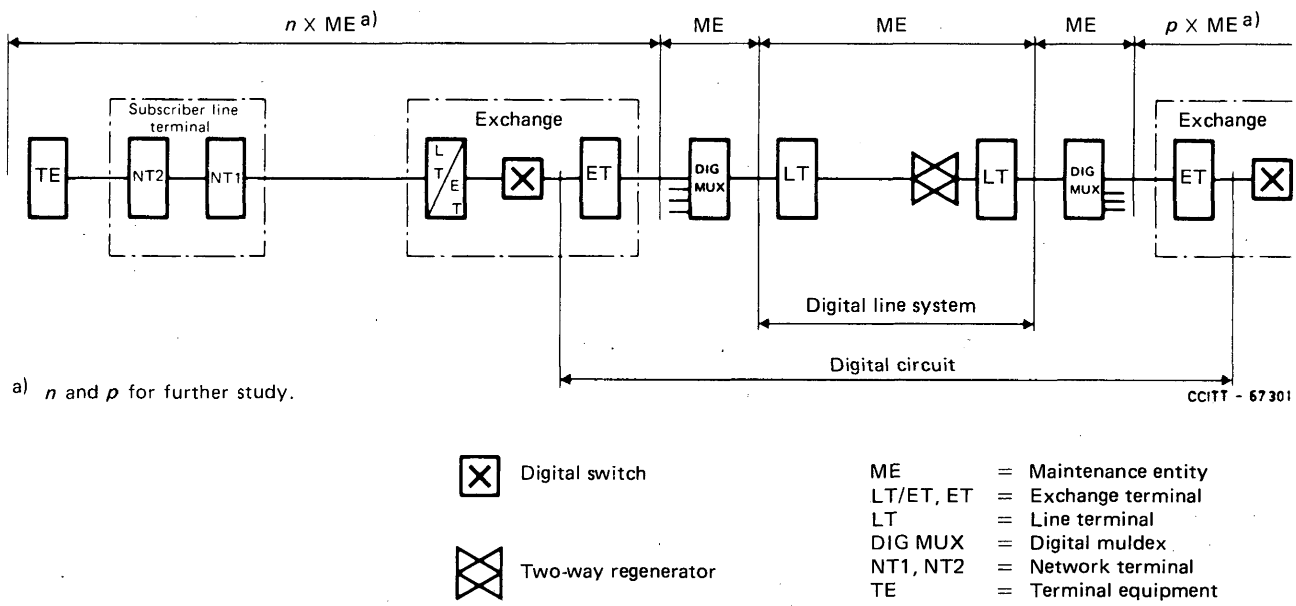

FIGURE 1/M.20

Maintenance entity concept for digital networks

1) While maintenance entities are currently defined by CCITT only for digital equipments in Recommendation G.803 [2], the philosophy set forth here can also be applied to analogue equipments and exchanges, although the detailed application has not yet been considered.

3.1.3 In defining the maintenance entities the following aspects are taken into account:

i) When a failure occurs within a network, it is desirable that a maintenance alarm indication appear at the failed maintenance entity. When this is not practical, the alarm indication should appear at the closest possible entity.

ii) A further important principle is that, where possible, a maintenance alarm indication in an entity should not cause a related alarm indication at other entities. In the event that such alarm indications are permitted to occur, they should clearly indicate that the failure lies upstream, and not in the other entities displaying the indications.

Meeting these two principles ensures that the responsible maintenance personnel are called into action, and that usually no unnecessary maintenance activity is initiated elsewhere.

3.2 *Classification of failures*

3.2.1 Recommendation G.106 [3] defines a failure as the termination of the ability of an item to perform a required function.

The severity of the failure depends on the failure effect. This effect can be related to:

- the network service performance requirements as experienced by the subscribers;
- the probability that multiple failures will occur, thus resulting in a deteriorating performance as seen by the customer;
- the probable loss of revenue to the Administration.

3.2.2 The failures can be classified according to their importance and consequences to the quality of service provided to the subscribers and to the network technical performance:

- failures which give a complete interruption of service(s) for one or several subscribers;
- failures which give a partial interruption of service(s) (e.g. degradation of transmission quality) to one or several subscribers;
- failures which decrease the availability performance of the equipment and/or the network, but do not affect the subscribers.

3.2.3 Another classification distinguishes between permanent and intermittent failures.

3.2.4 The severity of a failure can be determined by measuring the down time, up time and failure rate of the ME. These terms are defined in Recommendation G.106 [3].

3.3 *Network supervision*

Supervision is a process in which the functions of the various MEs in a network are checked (supervised). This is applicable for operational as well as maintenance matters.

For maintenance this supervision process has to include the following actions:

a) Locating "failed" equipment, or the equipment in which a failure is suspected or is believed to be imminent. It is generally carried out by analytical or statistical identification processes.

b) Reporting of failures to operating personnel.

c) Transmission of data to the operating personnel, relating to specific functional features of the network (traffic, state of equipment, particular malfunctions, etc.). This information can be transmitted systematically or on demand.

d) Protecting the system by transmitting to all concerned network equipment the necessary information for automatic initialization of internal or external protection mechanisms, e.g. reconfiguration, traffic rerouting, etc.

4 Maintenance phases

After the occurrence of a failure in the network, a number of maintenance phases are required to correct the failure and to protect, when possible, the traffic affected by the failure if it has been interrupted.

As an example, Figure 2/M.20 lists the maintenance phases which are involved after a failure occurrence in a maintenance entity (ME). The parameters determining the different phases are indicated in the figure. It is intended to characterize different maintenance strategies with the aid of the maintenance phases. The maintenance phases are described below in more detail.

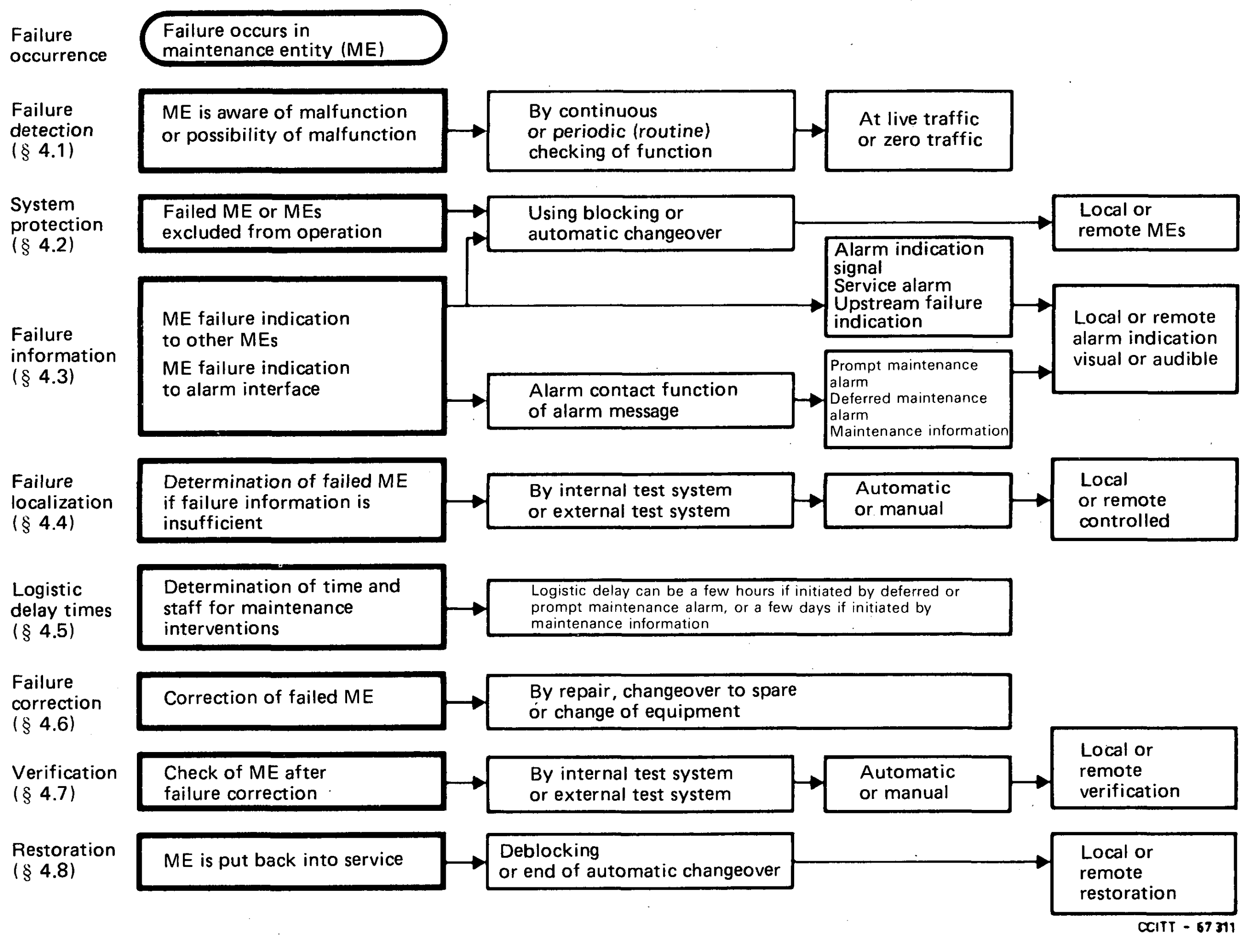

FIGURE 2/M.20

Example of maintenance phases

4.1 *Failure detection*

Failures should be discovered by the Administration independently of, and preferably before, the subscriber, i.e. the majority of failures are both detected and remedied without the subscriber having been aware of them.

Failures are classified depending on their nature, see § 3.2 and may be categorized depending on their severity. Different types of failure detection mechanisms can be used:

a) continuous checking

b) routine or periodic testing

c) checking of behaviour in live traffic

d) checking of behaviour in the absence of live traffic.

The rules governing the detection mechanisms are defined when conceiving the systems; no intervention of the operating personnel is necessary. Under some conditions, however, the personnel can control some operations which may prove necessary for periodic or casual checking, such as:

– modifying the priority level of a checking process

– modifying the nominal period in the case of periodical checking

– carrying out some partial or recurrent checks (e.g. test on demand).

The choice of a detection mechanism depends on the requirements for the "quality of service" as seen by the subscribers, and on the technical network performance and the nature of the equipment. In addition, several mechanisms may be operated in the same item of equipment.

Typical detection mechanisms are listed below.

4.1.1 *Continuous checking*

All the time an item is active, it is being checked for good performance. If the item does not fulfill the test requirements, it is considered to have failed.

4.1.2 *Routine or periodic testing*

Items are tested periodically, initiated either by the system or by the maintenance staff.

The frequency of the test depends on the importance of the item, the failure rate and the number of items of that type present in the element.

4.1.3 *Checking in live traffic*

Checking behaviour in live traffic can be done directly or statistically.

Direct checking exists if the ME itself indicates a faulty performance.

Statistical checking leads to failure decisions on statistical grounds:

- the number of times in which the item performs its function "normally" is compared with the number of times the performance of the item does not fulfill the requirements
- the average time of functioning is compared with standard values
- the number of times an item performs its function during a certain period is compared to normal values.

4.1.4 *Checking in the absence of live traffic (traffic is zero)*

Checking of system internal functions is done once a process is over, or when a process has been initiated several times. Examples are operational checks which start when a customer initiates an action to use the network.

4.2 *System protection*

When a failure has been detected, the following functions must be performed:

- transmission to all the concerned network equipment of any necessary information for automatic initialization of internal or external protection mechanisms, e.g., reconfiguration, traffic rerouting, etc.
- decision on any necessary actions, e.g. putting an item "out of service" or "in testing condition", changing to a configuration with minimal or degraded service.

A specific protection method is recommended for transmission systems using manual or automatic restoration on a maintenance entity basis:

a) If a fault occurs either in maintenance entities without automatic changeover capabilities or with automatic changeover capabilities but no standby available, the following actions should be executed:

   1) initiate a prompt maintenance alarm indication at the maintenance entity containing the failed equipment;

   2) transmit an alarm indication signal (AIS) in the direction affected (downstream direction) or give an upstream failure indication (UFI) at equipment which has not failed;

   3) initiate a service alarm indication at the appropriate entities, e.g. primary PCM multiplex or digital switch interfaces. (As a consequence the circuits may be removed from service.)

b) If a fault occurs in a maintenance entity having automatic changeover capability with a standby available, the following actions should be automatically executed:

1) changeover to the standby;

Note – Whether or not connections are released as a result of automatic changeover depends on the service performance objectives assigned to each maintenance entity.

2) initiate a deferred maintenance alarm indication at the maintenance entity containing the failed equipment.

4.3 *Failure information*

The failure information consists of alarm information transmitted to alarm interfaces for use by the maintenance staff and failure indications transmitted to other parts of the network.

4.3.1 *Failure categories*

An ME has to perform a determined function between an input and output port, see Figure 3/M.20. The performance quality, if checked by internal failure detection, is conveyed to the alarm interface either automatically after a failure occurrence or after a request for alarm information.

The alarm interface is for further study.

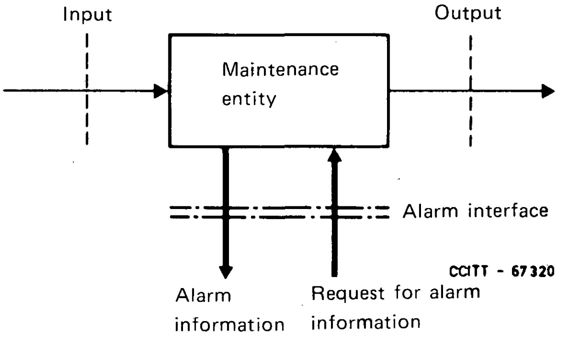

FIGURE 3/M.20

Maintenance entity interfaces

Alarm information may be categorized as follows:

a) Prompt maintenance alarm (PMA)

A prompt maintenance alarm is generated at maintenance entities in order to initiate maintenance activities (normally immediately) by maintenance personnel to remove from service a defective maintenance entity for the purpose of restoring good service and effecting repair of the failed maintenance entity.

The standard for activating the prompt alarm indication at a maintenance entity will generally be based on the requirements of the telephony service.

b) Deferred maintenance alarm (DMA)

A deferred maintenance alarm is generated when immediate action is not required by maintenance personnel, e.g. when performance falls below standard but the effect does not warrant removal from service, or if automatic changeover to standby equipment has been used to restore service.

c) Maintenance information (MI)

This information has to be generated as a consequence of events within a maintenance entity when no immediate actions by the maintenance staff are required because the total performance is not endangered. The maintenance actions can be performed according to scheduled maintenance or after the accumulation of maintenance information indications.

4.3.2 *Failure indication to other MEs and users*

In order to avoid unnecessary maintenance actions, MEs adjacent to the failing ME should receive failure indication, such as:

- Alarm indication signal (AIS)

  An alarm indication signal is a signal associated with a prompt maintenance alarm of a defective maintenance entity and is, when possible, transmitted in the direction affected (downstream direction) as a substitute for the normal signal, indicating to other nondefective entities that a failure has been identified and that other maintenance alarms consequent to this failure should be inhibited. The AIS is different from the "alarm indication to the remote end"; see for example Recommendation G.732, § 3.2.3 [4].

- Service alarm (SA)

  A service alarm is generated at maintenance entities at which the service originates and/or terminates to indicate that the particular service is no longer available (e.g. when a primary block is no longer available for setting up connections, the PCM muldex will extend a service alarm indication to the exchange equipment).

  The service alarm should be generated when performance falls below a level specified for a particular service. This level may coincide with that for initiating also a prompt maintenance alarm.

- Upstream failure indication (UFI)

  The upstream failure indication given by a maintenance entity indicates that the signal arriving at that maintenance entity is defective. The UFI indicates that the fault has occurred upstream of this point, and no unnecessary maintenance activities are initiated.

  The appearance of an alarm indicates either a failure in the equipment generating the alarm or a failure of the incoming signal (an upstream failure). To distinguish between these two possibilities it is necessary to provide an independent test, either of the input signal, or of the equipment generating the alarm. The input signal can be checked for proper parity, for example, by a monitor included in the protection switching equipment. A defective input signal indicates an upstream failure. Alternatively, the equipment generating the alarm can be tested independently, by looping, for example, and if the equipment operates correctly, an upstream failure is indicated.

Note – For a multiple destination maintenance entity (e.g. in networks with TDMA/DSI satellite systems) alarm indication signals on a circuit basis may be useful. This subject is under study.

4.3.3 *Transmission and presentation of alarm information*

The failure information at the alarm interface is used to determine the faulty ME or part of ME. The information can be presented either locally, or remotely via an alarm collection system.

The alarms may be presented as:

- an indication at an alarm interface (e.g. contact function, d.c. signal)
- an alarm message on the man-machine interface.

4.4 *Failure localization*

Where the initial failure information is insufficient for failure localization within a failing ME, it has to be augmented with information obtained by additional failure localization routines. The routines can employ ME internal or external test systems, initiated manually or automatically, at the local and/or remote end.

A test system, serving one or more MEs could have the following functions:

- alarm collection, e.g. by sampling of alarm interfaces and assembling of alarm messages,
- request for failure information, e.g. by addressing different MEs,
- test programs, e.g. for selection of essential alarms, editing, etc.,
- control of special devices, e.g. for looping measurement of electrical characteristics,
- display of results, e.g. for all MEs within a network region.

It should be particularly noted that:

- the corrective maintenance action time and the activity of repair centres (these repair centres may receive unfailed items or sub-items) are strongly conditioned by the localization efficiency (not yet defined);
- for interchangeable items, the failed item must be identified uniquely.

4.5 *Logistic delay*

4.5.1 The logistic delay is the period of time between the failure localization and arrival of the maintenance staff of site. In the case of an ISDN, the logistic delay will depend on the type of failures and how they are reported, i.e. by PMA, DMA or MI.

4.5.2 Following a PMA or DMA alarm, failure correction will be performed normally in the course of a specific trip of the maintenance staff. The logistic delay may vary from a few hours in the case of PMA alarms, to a few days in the case of DMA alarms.

4.5.3 Following an MI, which indicates that no immediate actions are necessary, the maintenance action can be postponed until the next scheduled maintenance visit unless an accumulation of MIs demands earlier action.

4.6 *Failure correction*

Failure correction normally requires change or repair of an ME or a part of an ME. One or more failure corrections can be performed in the course of a maintenance visit. It is desirable that strategies be developed to accomplish failure correction satisfying overall maintenance objectives with a minimum number of visits, using the concept of logistic delay.

Failed interchangeable items will be sent to a specialized repair centre, where appropriate test equipment is available (the system itself should not act as a test machine).

4.7 *Verification*

After the failure has been corrected, checks must be made to assure the ME is working properly. The verification can be made locally or remotely.

4.8 *Restoration*

The corrected part of the ME is restored to service. Blocked MEs are deblocked and changeover to spare may be terminated.

5 Additional maintenance activities

Besides the above-mentioned phases, the following activities may be required.

5.1 *Maintenance support*

Maintenance support covers the functions identified below:

- management of information of network equipment in operation,
- management of operating data (routing data mainly),
- correction instruction for hardware and software,
- repairing of removable items,
- management of maintenance stocks,
- network and equipment documentation.

The quantity of spare parts held depends on:

- organization of maintenance entities,
- failure rate of an item,
- turn around time (actual repair time, transport),
- number of items in operation,
- risk that no spare part is available.

5.2 *Failure statistics*

If all failures are recorded, this information, after processing, can serve the following organizational fields:

a) management, e.g. evaluating system performance,

b) organization of maintenance, e.g. use of test equipment, subscriber complaints versus test results, amount of spare parts,

c) maintenance activities, e.g. identifying weak components where preventive maintenance actions are necessary.

5.3 *Preventive maintenance actions*

Mechanical parts (such as magnetic equipment heads) have to be cared for periodically.

After analysing failure statistics, decisions can be made to interchange items even before failures have occurred, if they seem to be weak items.

References

[1] CCITT Recommendation *Specification for CCITT automatic transmission measuring and signalling testing equipment ATME No. 2*, Vol. IV, Rec. O.22.

[2] CCITT Recommendation *Maintenance of digital networks*, Vol. III, Rec. G.803.

[3] CCITT Recommendation *Concept, terms and definitions related to availability and reliability studies*, Vol. III, Rec. G.106.

[4] CCITT Recommendation *Characteristics of primary PCM multiplex equipment operating at 2048 kbit/s*, Vol. III, Rec. G.732.

Recommendation M.22

PRINCIPLES FOR USING ALARM INFORMATION FOR MAINTENANCE OF INTERNATIONAL TRANSMISSION SYSTEMS AND EQUIPMENT

1 General

1.1 This Recommendation presents the general principles for employing those maintenance features and capabilities of international transmission systems and equipment which are based on alarm information.

It describes a set of strategies, in addition to the maintenance philosophy in Recommendation M.20, to use these alarm-based features and capabilities in an effective and efficient manner. This Recommendation is also intended to address the interactions between alarms of digital and analogue transmission systems and equipments.

Alarm interactions for mixed analogue/digital transmission systems and equipment are under study.

1.2 While this Recommendation discusses the strategy to employ these features and capabilities, the actual arrangements to provide and use them are left to the discretion of the Administrations.

2 Types of alarms and related messages

Alarm information may be categorized as follows:

a) Prompt maintenance alarm (PMA);

b) Deferred maintenance alarm (DMA);

c) Maintenance information (MI).

Definitions of PMA, DMA and MI are found in Recommendation M.20, § 4.3.1.

3 Guidance for using alarm information

3.1 *Hierarchy*

The alarm information from transmission systems and equipment is based on a hierarchy of:

a) alarms and indications displayed on failed equipment or systems,

b) office audible/visual alarms which alert local staff, and

c) remote information which appears on a display monitored by centralized maintenance staff which is not collocated with the failed equipment or systems.

This alarm hierarchy is used in failure localization, either for a maintenance entity, or for specific equipment within a maintenance entity.

3.2 *Display*

Alarm information can be displayed to help in localization in different ways, such as:

a) locally – on the equipment,

b) on site – in the same building as the equipment, or

c) remotely – at a building not collocated with the equipment.

Both localized and on-site displays are used by on-site maintenance staff. Remote displays are normally used either for coverage during periods when a building is not staffed or to obtain a wider maintenance perspective from a single location on a possibly large number of systems.

For example, the remote maintenance strategy of § 3.5 can be used first to localize a trouble to a maintenance entity. Then, maintenance staff can obtain further remote (or otherwise made available) information to localize the failure to specific equipment. After this, the maintenance staff can use the local alarm maintenance strategy of § 3.7 to isolate and correct the failure.

3.3 *Considerations for local or remote alarm monitoring*

Alarm information may be displayed locally on equipment, or on-site in the same building as the monitored equipment using external monitoring equipment. Use of such displays implies that maintenance staff must be present or visit the site to observe the information.

Remote alarm monitoring provides a means for staff at a centralized location, not collocated with the transmission systems and equipment, to monitor them.

The choice between local and remote monitoring and the degree of centralization and automation employed depends on a number of factors, including the type of maintenance organization, the expected failure rates and the physical locations involved.

3.4 *Reducing unnecessary maintenance activity*

When an equipment failure requiring some maintenance activity occurs, alarms should, if possible, be generated by the maintenance entity in which the equipment is part. The basic philosophy is that maintenance activities should be directed only at the maintenance entity in which the failure exists. Thus, techniques should be used which prevent unwanted alarms (and the resulting unnecessary maintenance activity) beyond the maintenance entity in which a failure exists. Also, maintenance entities downstream of the failed maintenance entity should have a means of recognizing that a failure has occurred upstream, as part of the philosophy of reducing maintenance activity. Provision may be made at a maintenance entity to indicate an upstream failure and/or inhibit unnecessary actions. For example, in digital transmission systems and equipment, this may be accomplished by the use of:

- alarm indication signal (AIS);
- service alarm (SA);
- upstream failure indication (UFI).

For definition of AIS, SA and UFI see Recommendation M.20, § 4.3.2.

3.5 *Considerations for remote maintenance alarm information*

Remote maintenance alarm information provides a means for staff not collocated with transmission systems and equipment to nonetheless monitor and control them. The monitored equipment may be located in unstaffed locations. This section recommends the principles which should be followed if remote alarm information is provided.

3.5.1 Identification and localization are required to determine what the response should be: start restoration of service by using alternate routes, dispatch for maintenance of failed equipment, or wait and gather further information to better identify the nature and/or seriousness of the problem.

3.5.2 The decision to send maintenance staff is based upon the maintenance philosophy in Recommendation M.20, § 1.1.

3.6 *Maintenance alarm arrangements*

Maintenance alarm arrangements are based on the use of audible/visual alarm systems. These systems provide alarms which direct on-site staff to the location of the failed equipment. The principle for providing audible/visual alarm indications is such that they should ensure that on-site maintenance staff can detect and locate the source of failure in a timely fashion in line with other priorities. Note that distinctive sounds may be used to differentiate audible alarms. Also, visual signals should be able to direct maintenance staff to the failed equipment or to a point where the location of the failure can be determined.

3.7 *Use of local alarm information*

3.7.1 Local alarm information is concerned with alerting on-site maintenance staff to equipment failures. The local maintenance activities usually entail the location and correction of the failure. To carry this out effectively and efficiently, information which helps direct the maintenance staff to the failure should be provided directly from the failed equipment.

3.7.2 Local alarm information is derived from local failure indications, together with the maintenance staff use of tests and relevant documentation. This should be sufficient to localize the failure within the failed equipment.

3.7.3 Note that a further purpose of local failure indications is to provide a backup for remote indications, in the event that there is a failure in communications between monitored equipment and a central monitoring location.

4 General strategies for alarms

4.1 *Monitoring*

In general, failures of equipment should be detected by continuous (or nearly continuous) automatic monitoring, as opposed to monitoring or testing involving human intervention. Note that shared, but automatic, monitoring is considered nearly continuous. Continuous (or nearly continuous) monitoring is often made feasible by virtue of advances in technology, and by virtue of the large number of circuits affected or jeopardized by a transmission system failure. In addition, continuous (or nearly continuous) monitoring is faster, more reliable, and less labor intensive than alternative monitoring strategies.

4.2 *Uses of PMA, DMA and MI*

4.2.1 When reporting or displaying alarms either locally or remotely, it is important to distinguish between PMA/DMA indications and MI indications. PMA/DMA indications are those which cause maintenance staff to be alerted (e.g., by ringing a bell), and MI indications are those which are displayed in response to staff interrogations or in conjunction with other indications (e.g., alarms) which are spontaneously generated.

4.2.2 These distinctions should be defined for each transmission system and equipment in order for alarm indications to be properly processed. These distinctions may be of particular importance when using remote alarm surveillance systems, where large numbers of PMA, DMA and MI indications must be dealt with by maintenance staff.

4.2.3 MI indications may be used as aids in failure localization or verification of remote operations (such as remote control of protection switching) under manual control. The information conveyed by MI indications may also be used to supplement that conveyed by PMA/DMA indications.

4.2.4 Note that detection of failures is accomplished by having suitable monitors associated with each maintenance entity. The criteria for activating alarm indications at a maintenance entity should generally be based on limits on the maintenance entities, which will generally be related to the performance objectives of the transmission systems.

4.2.5 To aid in the dispatch decision, remote indications should include the following information:

a) identification of the failed transmission system or equipment and nature of trouble condition,

b) distinction between service-affecting failures and non-service-affecting failures where such a distinction is possible, and

c) the severity of the failure which has occurred.

4.3 *Transmission and presentation of alarm information*

4.3.1 There are two basic interface arrangements for transferring alarm information between monitored and monitoring equipment:

a) discrete, parallel, and

b) serial data.

The parallel method of data gathering and control uses discrete wires for implementing each function. The serial data method of gathering and control uses a single pair of wires to carry serial (in time) data points, rather than individual wires for each point. Much new telecommunications equipment is "intelligent", that is, it employs microprocessor circuit design, which lends itself more readily to serial data transfer rather than to parallel interfaces.

4.3.2 The presentation of alarm information can be:

a) visual (lamp, LED, printer or display indication), and/or

b) audible (bell, tones or voice).

The alarm information may be presented as:

a) an indication at an alarm interface (e.g., contact function, d.c. signal) and/or

b) an alarm message on the man-machine interface.

This alarm message may contain:

i) heading (name of maintenance entity, date, time, etc.),

ii) category of failure (PMA, DMA, MI),

iii) description of failure, which may include the cause of failure, location of the failed item(s) and other information which can be useful in locating the failed item(s),

iv) possible consequences of the failure, and

v) the automatic actions performed by the network (internal protection and service actions).

4.4 *Possible use of MIs*

Those Administrations using MIs may desire to alert maintenance staff by means of a PMA or DMA. The criteria and arrangements[1] for generating PMA or DMA based on analysis of MIs are left to the discretion of the Administration.

[1] The arrangements to generate such information may take place in the transmission system or in auxiliary supervision systems.

4.5 *Considerations for protection switching and control*

To meet transmission system availability objectives or maintenance criteria, transmission systems may be provided with protection (hot standby) equipment. Such equipment, if provided, may have the following capabilities:

a) automatic protection switching of service from failed regular equipment to working standby equipment,

b) automatic protection switching of service to overcome transmission degradation caused by, for example, radio path fading,

c) remotely controllable protection switching of service between regular equipment and standby equipment, and/or

d) locally controllable protection switching of service between regular equipment and standby equipment.

Recommendation M.24

PRINCIPLES FOR APPLICATION OF MAINTENANCE INFORMATION FOR PERFORMANCE MONITORING ON INTERNATIONAL TRANSMISSION SYSTEMS AND EQUIPMENT

1 General

1.1 This Recommendation presents the general principles for employing performance monitoring features and capabilities on international transmission systems and equipment for maintenance purposes. Performance monitoring data is one category of maintenance information as described in Recommendation M.20, § 4.3.1. It describes strategies for using these features and capabilities in an effective and efficient manner.

1.2 As an example, the need for performance monitoring may be seen by considering a defective transmission system or equipment which will increasingly degrade for a period of time prior to total failure. In the early stages, the ailing system or equipment generates errors over isolated short duration intervals, possibly causing short losses of frame alignment. As the severity of the degradation increases with time, the quantities and densities of errors and losses of frame alignment increase to more severe levels. Since these error bursts and losses of frame alignment are usually too short in duration to initiate automatic protection switching or to generate alarms, they will propagate through the network unchecked and affect customers. The degradation process may last for days, weeks or even months if not corrected before a detectable failure occurs. In many cases, the defective equipment will never completely fail, but continually generate errors and losses of frame alignment.

1.3 This Recommendation describes a possible strategy to employ performance monitoring features and capabilities. The choice of applying this strategy and the actual arrangements to provide it are left to the discretion of the Administrations.

2 General strategy for using performance monitoring data

2.1 *General*

Performance monitoring is generally used to collect data which may identify degrading systems before they fail and cause alarms. The maintenance staff response to performance monitoring data does not usually require the same priority as that of other alarm information.

2.2 *Consideration for local or remote performance monitoring*

Performance data may be displayed locally on equipment, or on-site in the same building as the monitored equipment using external monitoring equipment (for example, portable test sets). Use of such displays implies that maintenance staff must visit the site at least periodically to retrieve the data.

Remote performance monitoring provides a means for staff at a centralized location, not collocated with the transmission systems and equipment, to monitor them.

The choice between local and remote monitoring and the degree of centralization and automation employed depends on a number of factors, including the type of maintenance organization, the expected failure rates and the physical locations involved.

2.3 *Monitoring strategies*

In general, failures of equipment should be detected by continuous (or nearly continuous) automatic monitoring, as opposed to monitoring or testing involving human intervention. Note that shared, but automatic, monitoring is considering nearly continuous. Continuous (or nearly continuous) monitoring is often made feasible by virtue of advances in technology, and by virtue of the large number of circuits affected or jeopardized by a transmission system failure. In addition, continuous (or nearly continuous) monitoring is faster, more reliable, and less labor intensive than alternative monitoring strategies.

2.3.1 *Uses of performance monitoring data*

Three general ways in which performance monitoring data may be used for maintenance purposes are:

a) for routine monitoring of transmission systems and equipment,

b) for demand monitoring initiated by staff,

c) for initiating a deferred maintenance alarm when performance has degraded beyond pre-determined limits.

2.3.2 For routine monitoring, performance data which may be useful in predicting degrading systems is routinely collected and reported to a person on a scheduled or periodic basis. The reporting of data may provide, for example, daily, weekly or monthly summaries of performance.

As an example, remotely located monitoring equipment may continuously observe the performance of a collocated transmission system and store the significant data until a central computer requests the remote monitoring equipment to report the data. The central computer may routinely request data once every day. Then the central computer would convert the data into a report format useful for maintenance staff. Maintenance staff may use this routine data to determine trends in performance and schedule preventive maintenance or repairs before a failure has occurred. Or it may use the data to verify that transmission objectives are being met.

2.3.3 For demand monitoring, the staff requests performance data on an essentially real-time basis from a monitored entity. This type allows the staff to retrieve detailed information from the monitored entity.

The main uses of demand monitoring are repair verification, installation and acceptance testing. However, for some transmission systems (for example, a radio system), demand monitoring may be used with other test equipment or signal generators to perform fault localization.

2.3.4 A deferred maintenance alarm is initiated if performance has degraded so much that it is important for the staff to be alerted independently of the routine reporting of performance data. The deferred maintenance alarm should be indicated to the staff as soon as practical. It would be expected that maintenance staff would respond relatively quickly to this alarm for restoration and correction.

2.3.5 *Criteria for selection of performance monitoring data*

The general criteria for selection of performance monitoring data are as follows:

a) the data should be chosen depending on their use; i.e., maintenance (§ 2), verification (§ 3.1) or characterization (§ 3.2);

b) the amount of data and their resolution should be adjusted so as to minimize the amount of data collected, stored and reported consistent with the uses of performance monitoring data in § 2.3.1;

c) the data should be of a form which allows comparison of performance among different transmission systems and equipment;

d) for each data element it is important to select an appropriate measurement time interval.

2.4 *Types of interfaces to monitoring equipment*

2.4.1 For specific applications, Administrations should consider using a serial interface for transfer of performance monitoring data between the monitored entity and the equipment which is monitoring it. To derive maximum benefit in using the performance monitoring data, very fine resolution for representing each data element may be necessary. This may imply that an impractically large number of wires may be required if a serial interface were not used. For other applications where little performance data is transferred or where each performance data element can be represented with few levels of coarse resolution, a discrete interface may be appropriate (see § 4.3 of Recommendation M.22).

2.4.2 It is recommended that Administrations evaluate both interface arrangements using the above considerations and use the one which is most economical and feasible for the specific application.

2.5 *Data collection and report screening*

2.5.1 Performance monitoring implies the collection of data from transmission systems and equipment which may be performing satisfactorily a large portion of the time they are monitored. To meet the objectives for performance monitoring, a means of screening the data is desirable so that only useful information is provided. Administrations should base the amount of screening on the desired maintenance staff responses and the processing, storage and communications needs related to the data quantities.

2.5.2 As an example of screening, consider the case where there are two thresholds available in a remotely located performance monitoring equipment. For a particular monitored entity, a storage threshold may be used such that performance data for that entity measured over a given time interval need not be stored or reported unless the threshold is exceeded. Then a deferred maintenance alarm threshold may be used such that when the performance data exceeds this threshold, the monitoring equipment will not only store the data but also generate a deferred maintenance alarm.

2.5.3 Note that in a system in which processing is shared between remotely located monitoring equipment and a central processor, the central processor may contain thresholds which may be used to further screen or process information reported to the maintenance staff.

3 Other possible uses of performance monitoring data

In addition to maintenance, performance monitoring data may be used for:

a) verification of transmission system or equipment performance objectives,

b) characterization of transmission systems and equipment.

3.1 The verification of objectives is concerned with the transmission systems and equipment as a whole and how well the analogue or digital signal streams are being delivered to the aggregate of customers using these systems and equipment. Thus, even if a particular regular equipment is operating poorly, when a protection equipment is operating properly, signal streams are still being delivered to customers intact. Thus, monitoring for verification of objectives should usually be done only when the equipment which is the object of the verification is carrying live traffic. The monitored verification data can be used to give a general picture of the performance of the transmission system and equipment, construct network measures, and verify that transmission objectives are being met.

3.2 Characterization includes collection of data that may be used by transmission system and equipment designers. This type of data is often very specialized, and often must be collected in very large quantities in order to do an appropriate system characterization. It is also often collected with monitoring equipment specifically designed for the purpose.

Recommendation M.25

LINE-UP AND MAINTENANCE LIMITS

The following principles have been adopted in respect of line-up and maintenance action limits for analogue and digital international circuits, links and lines:

i) There should be separate limits for line-up and maintenance action.

ii) There should be a single limit specified for maintenance action, and this limit should be chosen such that, if exceeded, a fault would be considered to exist. (However, the subject of prompt and deferred maintenance action requirements is under study and the result of this study may reflect on the number of limits required for maintenance action.)

iii) After clearance of a fault, an international circuit, link or line should be returned to service within the line-up limit or, in the circumstances where this is not practical, as close as possible to the line-up limit. In all cases, the circuit, link or line should be returned to service within the maintenance action limit.

It is intended that, wherever practical, these principles be embodied in new M and N Recommendations, and be taken into account when the M and N Recommendations have cause to be reviewed or amended.

Recommendation M.50

VOCABULARY

For their dealings with their colleagues in other countries, personnel at repeater stations and other maintenance units will find it helpful to refer to the *Vocabulary of basic terms used in line transmission* published by the CCITT for their benefit.

This *Vocabulary* gives transmission terms in the following languages: English, French, Spanish, Russian, German, Italian, Polish, Dutch, Portuguese and Swedish.

The terms of telecommunication used in the CCITT Books have been collected in the volume *Terms and Definitions* of this Book. This vocabulary gives the terms in English, French and Spanish.

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SECTION 1

GENERAL PRINCIPLES OF MAINTENANCE AND MAINTENANCE ORGANIZATION

Recommendation M.70

GUIDING PRINCIPLES ON THE GENERAL MAINTENANCE ORGANIZATION FOR TELEPHONE-TYPE INTERNATIONAL CIRCUITS

1 General

In order to furnish guiding principles to Administrations, the CCITT recommends the following principles for the general maintenance organization for international circuits.

1.1 Definitions relating to the various maintenance elements, each representing a set of functions, are given in Recommendations M.700 to M.725 for automatic circuits, and in Recommendations M.1012 [1], M.1013 [2], M.1014 [3] for leased and special circuits.

1.2 The size and complexity of the maintenance organization will depend on the particular case and the particular country concerned. In some instances it may be possible to carry out all sets of functions from a single location; in others only some of the functions might be combined and carried out from one location. The precise arrangement will depend on the Administration concerned, and the CCITT limits itself to defining the functions of the separate elements, leaving the manner in which the elements are grouped to be determined by the Administration.

1.3 If a country so desires and/or if it judges that the complexity of its international telecommunications so requires, the international maintenance organization can be responsible for all types of circuit for which Study Group IV makes recommendations.

2 Types of circuits to be catered for

The types of circuits to be catered for are as follows:

public circuits:

- telephone circuits,
- voice-frequency telegraph circuits,
- phototelegraph circuits,
- sound-programme circuits, etc.;

leased circuits:

- telephone circuits: point-to-point and multiterminal,
- voice-frequency telegraph circuits,
- data circuits: point-to-point and multiterminal,
- multi-facility circuits, that is, phototelegraph plus voice-frequency telegraph; speech plus voice-frequency telegraph; simultaneous or alternative transmission,
- phototelegraph circuits,
- sound-programme circuits, etc.

3 Maintenance organization

The maintenance of international public telephone circuits relies upon the ability of each Administration to fulfil the various functions and responsibilities noted in the Series M Recommendations. Where such circuits are manual, as opposed to automatic, it is assumed that the Administration will select and provide the relevant elements such as the *fault report point (circuit)* and the *testing point (transmission)* together with *circuit control* and *sub-control station* assignments as appropriate.

For automatic circuits all the elements noted in Recommendation M.710 apply.

Leased and special international circuits require the services of a Transmission Maintenance Point (International Line) (TMP-IL) which is described in Recommendation M.1014 [3]. The circuit control and sub-control functions and responsibilities on leased and special international circuits are noted in Recommendations M.1012 [1] and M.1013 [2] and include a close cooperation with the TMP-IL.

For operations at other levels (group, supergroup, etc.), specific responsibilities are allotted to particular repeater stations. At each level, maintenance is based on the appointment of a *control station* and one or more *sub-control stations* Additional information concerning control and sub-control stations follows in Recommendations M.80 and M.90 and is supplemented by that contained in Recommendations M.1012 [1] and M.1013 [2], M.723, M.724, N.5 [4] and N.55 [5].

The attention of Administrations is drawn to the need for exchanging contact forms (similar to those for maintenance units for automatic circuits as described in Recommendation M.93) which give telephone numbers, staffing hours, etc. for units involved in the maintenance of leased circuits and the higher order transmission systems.

References

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

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

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

[4] CCITT Recommendation *Sound programme control, sub-control and send reference stations*, Vol. IV, Rec. N.5.

[5] CCITT Recommendation *Organization, responsibilities and functions of control and sub-control stations for international television connections, links, circuits and circuit sections*, Vol. IV, Rec. N.55.

Recommendation M.75

TECHNICAL SERVICE

1 General

1.1 The term "technical service" (sometimes "technical services") is used throughout the Series M Recommendations. The term is used to indicate the appropriate authorities within an Administration which have responsibility for: making international agreements on technical and engineering aspects of provision and maintenance, allocating responsibilities to maintenance units within the same Administration, specifying provision and maintenance facilities, and determining provision and maintenance policy and overseeing its implementation. Thus it can be seen that the responsibilities of the technical service are at a higher administrative level than those of the staff concerned with day-to-day operation of international services.

1.2 The staff of the technical service is generally part of the central headquarters of the Administration. However, Administrations sometimes delegate some or all of their technical service responsibilities to regional centres or even operational maintenance units. In such cases the technical service remains responsible for ensuring that the delegated responsibilities are satisfactorily carried out.

2 Outline of responsibilities

As far as international cooperation and coordination are concerned, the responsibilities of the technical service are specified in various Series M Recommendations. The following list, which is not exhaustive, serves to illustrate the type of functions normally performed by the technical service of an Administration:

- making international agreements on the appointment of control and sub-control stations, and ensuring that the stations so appointed are advised accordingly;
- reaching international agreements on all matters relating to the engineering provision of new and rearranged telephone circuits, leased, circuits, etc.; digital blocks, paths, etc.; groups, supergroups, etc.; and so on;
- exchanging contact point and other maintenance information between Administrations;
- acting as a centralized escalation point for those faults and problems which cannot be cleared by staff at maintenance units, even after discussions between the managers of such units. (For example, escalation may be required where special test equipment or specialized expertise is needed);
- ensuring the satisfactory preparation and execution of routine maintenance schedules;
- developing and keeping up to date plans for the restoration of service in the event of the failure of international transmission systems;
- ensuring that other Administrations are advised of planned interruptions to transmission systems in its own country, and ensuring that steps are taken to minimize their effect on international services.

The functions mentioned above are based on responsibilities imposed on the technical service by Series M Recommendations.

3 Contact point information

Contact point information for the technical service should be exchanged between Administrations in accordance with Recommendation M.93. If the responsibilities of the technical service have been split on a functional basis, contact point information for each separate function should be exchanged. If technical service responsibilities have been delegated (as envisaged in § 1.2 above), contact point information for the responsible central headquarters staff should be exchanged.

Recommendation M.80

CONTROL STATIONS

1 Definition of control station

A control station is that point within the general maintenance organization which fulfils the control responsibilities for the circuit, group, supergroup, digital section, etc., assigned to it.

2 Appointment of control stations

The following principles for control stations apply to:

- every international circuit (circuit control station),
- every international group, supergroup, digital block, digital path, etc. (group control station, supergroup control station, digital block control station, digital path control station, etc.),
- every line link, every regulated line section and every digital section (line link control station, regulated line section control station, digital section control station) using a symmetric pair line, a coaxial line, an optical fibre or a radio-relay link.

2.1 *Circuit control station*

A circuit control station is nominated for each international circuit used for public telephony or for leased or special purposes in accordance with Recommendations M.723 and M.1012 [1] as appropriate. In the case of sound-programme or television circuits, the terminal ISPC (International Sound-Programme Centre) or ITC (International Television Centre) at the receiving end should be nominated as the control station. (See Recommendations N.1 [2], N.5 [3] and N.55 [4].)

2.2 *Group, supergroup, digital block, etc. control stations*

For each international group, supergroup, digital block, etc., the terminal repeater station is a control station for its incoming direction of transmission. There are thus two control stations, one for each direction of transmission.

2.3 *Regulated line section control station*

The procedure is the same as for groups, supergroups, digital blocks, etc., that is to say, each of the terminal repeater stations is a control station for the incoming direction of transmission.

2.4 *Digital path control station*

For each digital path, each terminal station is a control station for its incoming direction of transmission. There are thus two control stations, one for each direction of transmission.

3 **Responsibilities of circuit control stations**

See Recommendations M.723 and M.1012 [1] concerning public automatic telephone circuits, leased circuits and special circuits, respectively. See Recommendations N.5 [3] and N.55 [4] in connection with sound-programme and television circuits.

4 **Responsibilities of control stations for groups, supergroups, digital paths, etc.**

4.1 Group, supergroup, digital block, digital path, regulated line section, line link, etc. control stations are responsible for the incoming direction of transmission only.

4.2 Each control station is responsible for ensuring that the group, supergroup, digital block, digital path, link, line, etc. with which it is concerned is set up and maintained to the required standards. In particular, it is responsible for:

a) controlling lining-up measurements to within the recommended limits and keeping records of reference measurements (initial measurements) for *analogue transmission systems*;

b) ensuring that the performance of digital transmission systems is kept within recommended limits and keeping records of initial measurements;

c) ensuring that routine maintenance measurements are carried out on the due dates, using the specified methods and in such a way that interruptions to service are limited to the shortest possible duration;

d) ensuring that the stations concerned take action when a fault occurs, and controlling the various tests or investigations necessary in clearing the fault. It must be possible to report faults discovered at any time of the day or night;

e) informing the circuit control station of any condition which might affect the operation of the circuits under its control;

f) seeking the authority of the circuit control station for any action which will take a circuit, or circuits, out of service;

g) knowing what are the possibilities of rerouting any faulty groups, supergroups, etc.;

h) recording, on forms provided for the purpose, all incidents which arise, giving the time of occurrence of the incident, the exact location if known, the action taken if any, and the time of restoration to service.

4.3 Thus, for technical purposes (maintenance, lining-up) the control function for digital paths, groups, supergroups, mastergroups, supermastergroups and regulated line sections are divided between the two directions of transmission, the station at the incoming end being the control station in each case. However, it is considered desirable to have a single routing form for each, giving information about both directions of transmission, and in order that this and similar documentation may be prepared and distributed on a methodical basis, these documentary functions shall be added to the responsibilities of one of the control stations, this *control station for documentary purposes* being chosen by agreement between the Administrations concerned.

References

[1] CCITT Recommendation *Circuit control station for leased and special circuits*, Vol. IV, Rec. M.723.

[2] CCITT Recommendation *Definitions for application to international sound-programme transmissions*, Vol. IV, Rec. N.1.

[3] CCITT Recommendation *Control and subcontrol stations for sound-programme circuits, connections, etc.*, Vol. IV, Rec. N.5.

[4] CCITT Recommendation *Organization, responsibilities and functions of control and sub-control ITCs and control and sub-control stations for international television connections, links, circuits and circuit sections*, Vol. IV, Rec. N.55.

Recommendation M.90

SUB-CONTROL STATIONS

1 Definition of sub-control station

A sub-control station is a point within the general maintenance organization which fulfils the sub-control responsibilities of the circuit, group, supergroup, etc. digital section, assigned to it.

2 Appointment of sub-control stations

The following principles apply to:

- every international circuit (circuit sub-control station), for whatever purpose (telephony, telegraphy, sound-programme, data transmission, etc.). (See in particular Recommendations N.5 [1] in connection with sound-programme circuits and N.55 [2] in connection with television circuits);
- every international digital block, digital path, group, supergroup, mastergroup or supermastergroup (digital block sub-control station, digital path sub-control station, group sub-control station, supergroup sub-control station, etc.);
- every line link, every regulated line section and every digital line section (line link sub-control station, regulated line section sub-control station, digital line section sub-control station) using a symmetric pair line, a coaxial line, an optical fibre or a radio-relay link.

The technical service of the Administration concerned designates the station that is to act as a sub-control station in its country and informs the technical service of the country responsible for the control station accordingly.

2.1 *Terminal sub-control stations*

2.1.1 *Terminal sub-control stations for circuits*

For each circuit a terminal circuit sub-control station is appointed in accordance with Recommendations M.724 and M.1013 [3] as appropriate.

For unidirectional constituted circuits the terminal station at the sending end should be the terminal circuit sub-control station. In particular, in the case of sound-programme or television circuits, the terminal ISPC or ITC at the sending end should be the terminal sub-control station. (See Recommendations N.5 [1] and N.55 [2].)

2.1.2 *Terminal sub-control stations for digital blocks, digital paths, groups, supergroups, etc.*

At the two ends of a digital block, digital path, group, supergroup, etc., the terminal stations are designated as terminal digital block, digital path, group, supergroup, etc., sub-control stations for the direction of transmission for which they are not the digital block, digital path, group, supergroup, etc., control station.

2.1.3 *Terminal sub-control station for a digital section, line link or a regulated line section*

At the two ends of a digital section, line link or a regulated line section, the terminal stations are designated as terminal digital section, line link or regulated line section sub-control station for the direction of transmission for which they are not the digital section, line link or regulated line section control station.

2.2 *Intermediate sub-control stations*

2.2.1 *Intermediate sub-control stations for circuits*

In transit countries in which a circuit is brought to audio frequencies or 64 kbit/s, etc., an intermediate circuit sub-control station is appointed at a suitable point for each direction of transmission. It is left to the country concerned to choose:

- where this point shall be;
- whether the sub-control functions for the two directions of transmission are vested in one station or two stations (see Figure 1/M.90);
- whether, as may be desirable in the case of a large country, each direction of transmission has more than one circuit sub-control station per transit country.

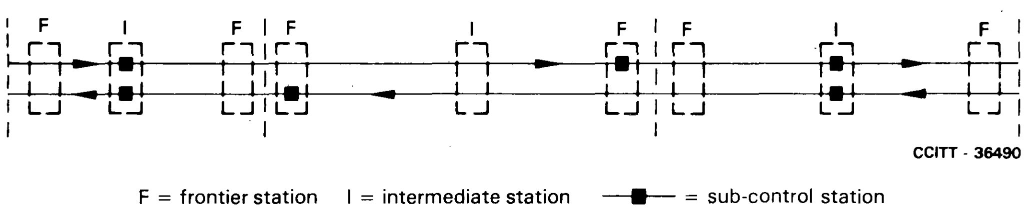


FIGURE 1/M.90

Possible choice for sub-control stations in a transit country

2.2.2 *Intermediate sub-control stations for paths and links*

In general, for digital paths and analogue links, in transit countries in which the path or link concerned appears in its characteristic bit rate or in its basic frequency range, an intermediate sub-control station is appointed for each direction of transmission. The countries concerned have the same prerogatives as those indicated above for circuits (see § 2.2.1 and Figure 1/M.90).

2.2.3 *Intermediate sub-control stations for regulated line sections*

In transit countries, a regulated line section intermediate sub-control station is appointed for each direction of transmission, the same discretion as for circuits being given to the country concerned (see § 2.2.1 above and Figure 1/M.90).

2.3 *Combination of functions*

Any, or all, of the above functions may be vested in one station, depending on the arrangements in the country concerned.

3 Responsibilities of sub-control stations for circuits

See Recommendations M.724 and M.1013 [3] concerning automatic public telephone circuits, leased circuits and special circuits, respectively. See also Recommendations N.5 [1] and N.55 [2] in connection with sound-programme and television circuits.

4 Responsibilities of sub-control stations for groups, supergroups, digital blocks, digital paths, etc.

The responsibilities of sub-control stations are, for the sections which they control, similar to those given in Recommendation M.80 for control stations, but in addition they include:

- cooperating with the control stations and other sub-control stations in locating and clearing faults;
- setting up and maintaining that part of the digital path, group link, supergroup link, mastergroup link, or regulated line link between the through-connection stations nearest to the two frontiers;
- seeing that the transmission on the national section with which they are concerned is within the prescribed limits;
- reporting to the control station all relevant details concerning the location and subsequent clearance of faults;
- keeping the necessary records on lining-up (analogue transmission) or initial measurements (digital transmission), fault location and fault clearing for the section for which they are responsible.

In addition to the above responsibilities, an intermediate sub-control station (in a transit country) is responsible for initiating fault localization tests on the sections it controls in response to reports from other control or sub-control stations.

References

[1] CCITT Recommendation *Control and sub-control stations for sound-programme circuits, connections, etc.*, Vol. IV, Rec. N.5.

[2] CCITT Recommendation *Organization, responsibilities and functions of control and sub-control ITCs and control and sub-control stations for international television connections, links, circuits and circuit sections*, Vol. IV, Rec. N.55.

[3] CCITT Recommendation *Circuit sub-control station for leased and special circuits*, Vol. IV, Rec. M.1013.

Recommendation M.93

EXCHANGE OF CONTACT POINT INFORMATION FOR THE MAINTENANCE OF INTERNATIONAL SERVICES AND THE INTERNATIONAL NETWORK

1 General

The attention of Administrations is drawn to the need of exchanging information about telephone numbers, telex numbers, staffing hours, etc., for units involved in the maintenance of international services and the international network. The exchange of such information is of great assistance to international cooperation and has an important bearing on maintenance efficiency.

2 Aspects to be covered by the exchange of information

2.1 *Technical service*

The general functions and responsibilities of the "technical service" are given in Recommendation M.75.

Where technical service responsibility within an Administration has been divided on a functional basis, contact point information relating to each function (for example, maintenance of telephone circuits, provision of leased circuits) should be supplied.

2.2 *Automatic and semi-automatic telephone service*

For each international centre, contact point information for each of the maintenance elements in Recommendations M.715 to M.725 should be exchanged.

2.3 *Manual telephone circuits*

For each international centre which has responsibility for manually operated international telephone circuits, appropriate maintenance contact point information should be exchanged.

2.4 *Signalling System No. 6 (SS No. 6)*

For each international centre where SS No. 6 is employed, contact point information should be exchanged for the maintenance units which have responsibility for the following:

- SS No. 6 transfer link (Recommendation M.760);
- signalling system administrative control (Recommendation M.762).

Where an Administration has subdivided the maintenance functions of the SS No. 6 transfer link (for example, into fault reporting, control station, etc.), appropriate contact point information should be supplied.

2.5 *Leased and special circuits*

For each international centre which has responsibility for leased and special circuits, contact point information should be exchanged for the following:

- fault report point;
- testing point;
- transmission maintenance point (international line) (Recommendation M.1014 [1]);
- circuit control/sub-control station (Recommendations M.1012 [2] and M.1013 [3]);
- restoration point for individual circuits.

2.6 *Sound programme and television*

Contact point information for the following centres concerned with sound and television should be exchanged:

- international sound-programme centre (ISPC) (Recommendation N.1 [4]);
- international television centre (ITC) (Recommendation N.51 [5]);
- programme booking centre (PBC) (Recommendation D.180 [6]).

2.7 *Groups, supergroups, etc., digital paths and blocks and transmission systems*

For each international centre, contact point information should be exchanged for the following:

- fault report point (Recommendation M.130);
- testing point (for routines, functional tests and fault localization);
- control/sub-control station (Recommendations M.80 and M.90);
- restoration control point (Recommendation M.725);
- restoration implementation point.

2.8 *Setting-up and lining-up activities*

Where staff separate from those concerned with day-to-day maintenance are used for setting-up and lining-up new or rearranged telephone circuits, leased circuits, groups, supergroups, etc., relevant contact point information should be exchanged.

3 Exchange and distribution of contact point information

Annexes A, B, C, D and E to this Recommendation contain "forms" to be used for the purpose of exchanging contact point information.

For convenience, the form in Annex B covers contact points for the automatic, semi-automatic and manual telephone service, and SS No. 6.

Each form provides for specific telephone numbers, telex numbers and answerback codes, together with the hours of staffing for each contact point and the name[1] of the maintenance unit involved. The *remarks* columns on the forms should be used to supply other useful information, such as languages spoken, telephone number of the supervising officer of the maintenance unit.

Each contact point is afforded two horizontal lines. If the maintenance unit normally responsible for a particular contact point is staffed during restricted hours only, alternative contact point information should be supplied in the lower line for use outside those hours.

In some situations a single telephone number, telex number, etc., will cover all contact points for, say, leased and special circuits at an international centre. In other situations, each contact point may have its own number. The actual arrangements will depend upon the particular organization existing within the Administration concerned.

Each Administration should distribute completed forms (Annexes A to E) to all Administrations likely to have use of the contact point information involved. Furthermore, revised issues of the forms should be distributed as required, for example, to reflect organizational changes, because a new international centre has been put into service.

Copies of contact point information distributed to, and received from, other Administrations should be made readily available to all staff at maintenance centres involved in international services or the international network. In this way, such staff are made aware of both their own functions and responsibilities and those of the maintenance organizations of other Administrations.

ANNEX A

(to Recommendation M.93)

COUNTRY:

ADMINISTRATION OR PRIVATE OPERATING AGENCY:

Contact point of the Technical Service:

Postal address:
Telephone No.:
Telex No. and answerback:
Office hours (UTC):

International centres:

Further information:

(e.g. contact points common for more than one international centre, or principal contact points for certain traffic relations or where more than one technical service applies.

FIGURE A-1/M.93

Form for contact points for the technical service

[1] The name to be used is that by which the maintenance unit is known within the Administration and should ideally be the name used by maintenance staff when answering the telephone.

ANNEX B

(to Recommendation M.93)

CONTACT POINTS FOR THE INTERNATIONAL TELEPHONE SERVICE

COUNTRY: INTERNATIONAL CENTRE:

DATE OF ISSUE: POSTAL ADDRESS:

Contact point			Telephone No.	Telex No. Answerback code	Service hours (UTC)	Name of unit responsible	Remarks[1]
Automatic and semi-automatic telephone service	Fault report point (circuit)						
	Fault report point (network)						
	Testing point (transmission)						
	Testing point (line signalling)						
	Testing point (switching and interregister signalling)						
	Network analysis point						
	System availability information point)						
	Network management	Planning + liaison point					
		Implement + control point					
		Development point					
	Circuit control station subcontrol						
	Restoration control point						
Signalling System No. 6	SS No. 6 transfer link						
	SS No. 6 administrative control						
Manual telephone service	Manual telephone circuits						

1) Language information may be included.

FIGURE B-1/M.93

Form for the contact points for the international telephone service

ANNEX C

(to Recommendation M.93)

CONTACT POINTS FOR INTERNATIONAL LEASED AND SPECIAL CIRCUIT MAINTENANCE

COUNTRY:

DATE OF ISSUE:

INTERNATIONAL CENTRE:

POSTAL ADDRESS:

Contact point	Telephone No.	Telex No. and answerback code	Service hours (UTC)	Name of unit responsible	Remarks [1]
Fault report point					
Testing point					
Transmission maintenance point – international line (TMP-IL)					
Circuit Control/sub-Control station					
Restoration of individual circuits					

[1] Language information may be included.

FIGURE C-1/M.93

Form for the contact points for international leased and special circuit maintenance

ANNEX D

(to Recommendation M.93)

CONTACT POINTS FOR GROUP, SUPERGROUP, ETC., DIGITAL PATH, BLOCK, AND TRANSMISSION SYSTEM MAINTENANCE

COUNTRY:

INTERNATIONAL REPEATER STATION (IRS):

INTERNATIONAL CENTRES SERVED BY THIS IRS:

DATE OF ISSUE:

POSTAL ADDRESS:

Contact point	Telephone No.	Telex No. and answerback code	Service hours (UTC)	Name of unit responsible	Remarks [1]
Fault report point					
Testing point					
Control/sub-Control station					
Restoration implementation point					
Restoration control point (Recommendation M.725)					

[1] Language information may be included.

FIGURE D-1/M.93

Form for the contact points for group, supergroup, etc., digital path, block, and transmission system maintenance

ANNEX E

(to Recommendation M.93)

CONTACT POINTS FOR INTERNATIONAL SOUND-PROGRAMME AND TELEVISION TRANSMISSIONS

COUNTRY: DATE OF ISSUE:

Contact point	Telephone No.	Telex No. and answerback code	Service hours (UTC)	Postal address	Remarks [1]
ISPC					
ITC					
PBC					

[1] Language information may be included.

FIGURE E-1/M.93

Form for the contact points for international sound-programme and television transmissions

References

[1] CCITT Recommendation *Transmission maintenance point international line (TMP-IL)*, Vol. IV, Rec. M.1014.

[2] CCITT Recommendation *Circuit control station for leased and special circuits*, Vol. IV, Rec. M.1012.

[3] CCITT Recommendation *Sub-control station for leased and special circuits*, Vol. IV, Rec. M.1013.

[4] CCITT Recommendation *Definitions for application to international sound-programme transmissions*, Vol. IV, Rec. N.1.

[5] CCITT Recommendation *Definitions for application to international television transmissions*, Vol. IV, Rec. N.51.

[6] CCITT Recommendation *International sound- and television-programme transmissions*, Vol. II, Rec. D.180.

Recommendation M.100

SERVICE CIRCUITS

To facilitate the general maintenance of the international telephone network, *service circuits* should be set up as may be necessary between relevant maintenance units taking part in the international service.

For the purposes of this Recommendation, a distinction is made between the following types of service circuit:

- **Direct service circuit**: a telephone or teleprinter (teletypewriter) service circuit serving only two stations and linking them directly.

  Note – It will also be necessary to consider the communications required by technical staff for setting up and maintaining very long circuits routed over a number of major systems in tandem, e.g. London – Singapore circuits. These may require service circuits to be interconnected.

- **Omnibus service circuit** (see Figure 1/M.100 below): a telephone or teleprinter (teletypewriter) service circuit serving more than two stations connected in series, any or all of which may make connection to the service circuit simultaneously.

- **Multiterminal service circuit** (see Figure 2/M.100 below): a telephone or teleprinter (teletypewriter) service circuit serving more than two stations and having at least one branching point. On each *branch* of this circuit a certain number of stations can be connected in series. Every station served can enter the circuit individually.

  Note – Attention is drawn to the possible use of selective signalling on omnibus and multiterminal service circuits and to the problems that may arise in achieving the necessary stability on such circuits.

It is recommended that for the maintenance of international circuits:

1) all attended stations should be connected direct to the public telephone network;

2) the terminal stations of an international system should be provided with a direct telephone service circuit;

3) terminal and intermediate stations on an international system should be provided with an omnibus telephone service circuit;

4) where the provision of direct teleprinter (teletypewriter) service circuits is impracticable or uneconomical, important repeater stations on international routes should be provided with international telex facilities;

   The equipment of the telegraph local end used on service telegraph circuits must be capable of transmitting and receiving signals conforming to International Telegraph Alphabet No. 2 and must be in accordance with the provisions of CCITT Recommendations;

5) maintenance staff responsible for international circuits should have authority to make priority calls in the international service [1];

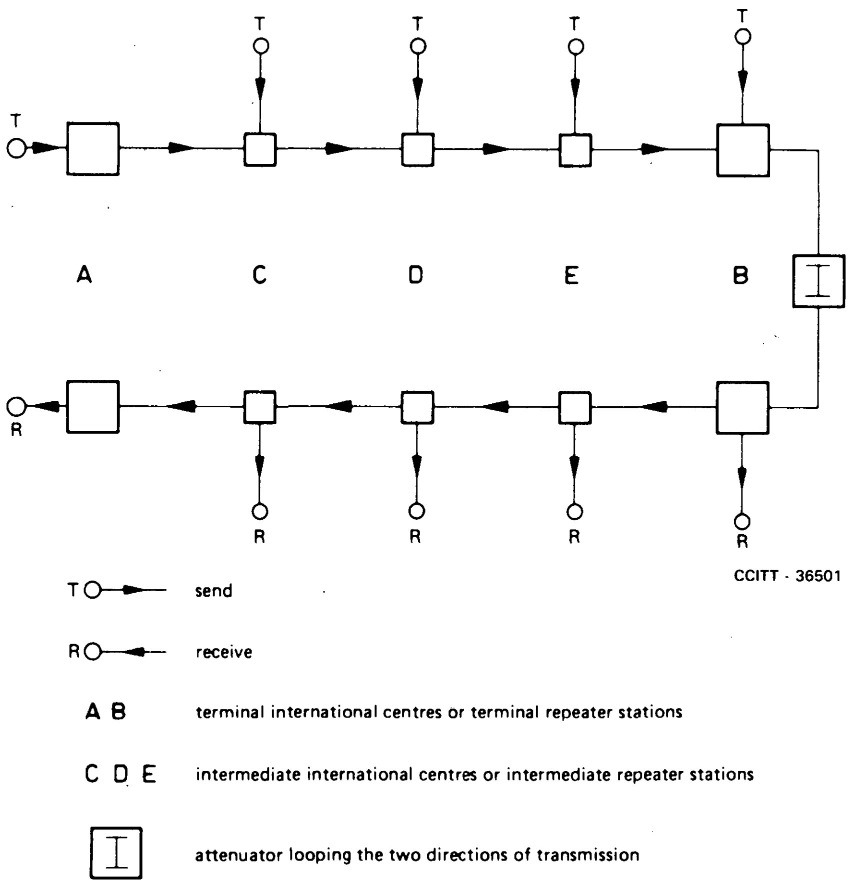
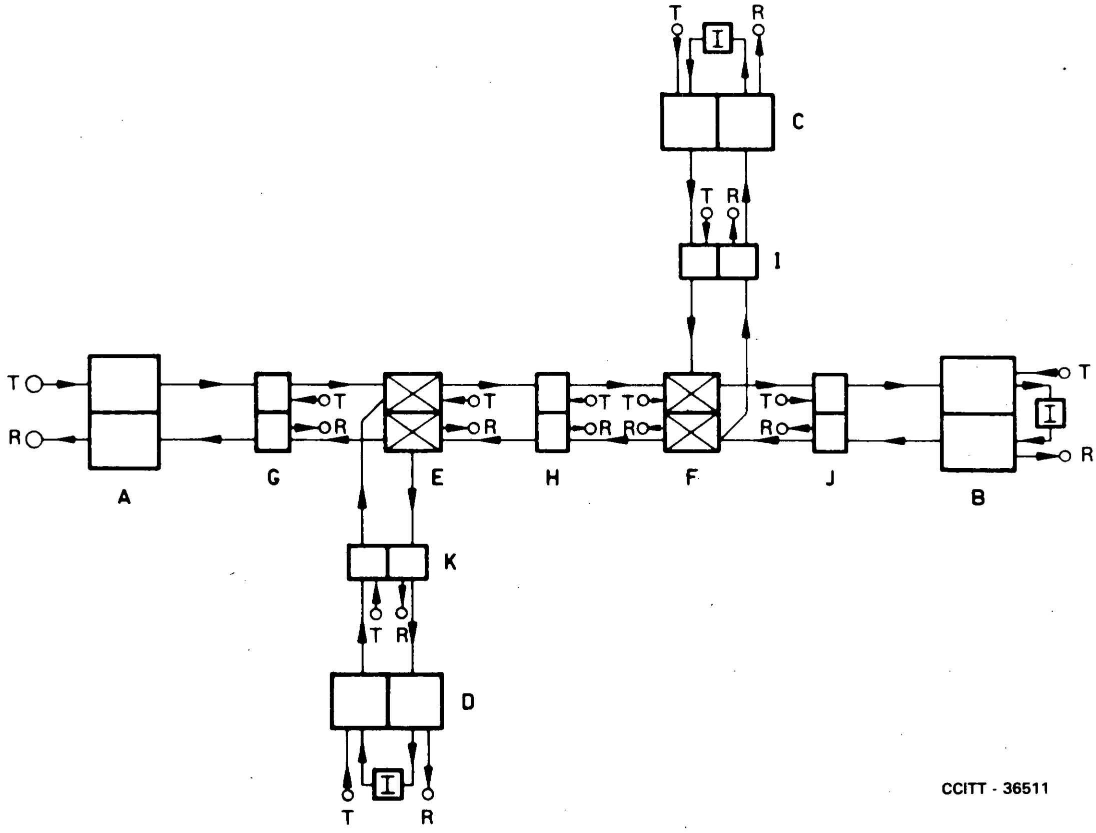


FIGURE 1/M.100

Example of an omnibus service circuit



T o→ send

R o← receive

A B C D terminal international centres or terminal repeater stations

E F international centres (or repeater stations) with branching facilities

G H I J K intermediate international centres or intermediate repeater stations

I attenuator looping the two directions of transmission

FIGURE 2/M.100

Multiterminal service circuit

6) all service circuits should in general conform to the Recommendations of the CCITT in respect of their quality and maintenance. However, service circuits may have a restricted quality which must nevertheless be such as to provide efficient communication when maintenance personnel have to use languages other than their mother tongue;

7) in the event of a major interruption involving service circuits, these should be accorded priority in restoration;

8) the terminal stations of a long international submarine cable system should be provided with a direct teleprinter (teletypewriter) service circuit;

9) terminal and intermediate stations on a long international submarine cable system should be provided with an omnibus teleprinter (teletypewriter) service circuit.

The CCIR has issued Recommendation 400-2 (Geneva, 1982) concerning service circuits for radio-relay links. (For the convenience of readers, this Recommendation is reproduced below. CCIR Report 444-1 [2] also applies.)

CCIR RECOMMENDATION 400-2[1]

SERVICE CHANNELS TO BE PROVIDED FOR THE OPERATION AND MAINTENANCE OF RADIO-RELAY SYSTEMS

(Question 4/9)

(1956 - 1959 - 1963 - 1966 - 1970)

The CCIR,

CONSIDERING

a) that service channels are required for the maintenance, supervision and control of radio-relay systems;

b) that if, for any reason, the radio-relay system itself fails to function, communication between various stations along the route, and from those stations to other points is likely to assume special importance;

c) that agreement is desirable on the number and function of the service channels to facilitate the planning of radio-relay systems;

d) that service channels will be used to provide:

- omnibus voice circuits,
- express voice circuits,
- supervisory circuits,
- control and operational circuits;

e) that service channels will not be connected to the public telephone network,

UNANIMOUSLY RECOMMENDS

that, on international radio-relay systems:

1. all staffed stations should be connected directly to the public telephone network;

2. when a radio-relay link is extended by means of short cable sections, and these cable sections and the radio-relay link taken together constitute a regulated line section, the terminal stations of the radio-relay link itself should have speaker circuits to the stations at the ends of the regulated line section;

3. a telephone service channel (omnibus voice circuit) should be set up to connect together all the stations on the system, whether staffed or not;

4. a second telephone service channel (express voice circuit) should be provided for direct telephonic communication between the staffed stations receiving supervisory signals;

5. provisions for the transmission of supervisory and control signals should be subject to agreement between the Administrations concerned;

6. the telephone service channels should possess, whenever possible, the characteristics (excluding noise power) recommended by the CCITT for international telephone circuits and, in particular, should be able to transmit the frequency band 300 to 3400 Hz;

7. all telephone service channels (including those used for supervisory and control circuits) up to a length of 280 km should, whenever possible, not exceed a mean noise power in any hour of 20 000 pW0p psophometrically weighted, at a point of zero relative level.

Note – Service channels may be provided over an auxiliary radio-relay system, over the main radio-relay system, or by other unrelated means, either on a primary or stand-by basis. In the case of express voice circuits, the use of regular multiplex channels within the telephony baseband is acceptable, where this is possible.

References

[1] CCITT, *Instructions for the International Telephone Service,* Articles 46 to 49, ITU, Geneva, 1985.

[2] CCIR Report *Service channels for analogue radio-relay systems*, Vol. IX, Report 444-1, ITU, Geneva, 1982.

[1] This Recommendation applies to radio-relay systems which will transmit at least 60 telephone channels or a television signal and comprise two staffed terminal stations, in which the signals are demodulated to baseand, and any number of unstaffed intermediate stations. This Recommendation applies, where appropriate, to trans-horizon radio-relay systems.

CIRCUIT TESTING

1 Access points for testing purposes

Access points are required to enable lining-up and subsequent maintenance operations to be performed on international circuits. The required access points are as follows:

1.1 Recommendation M.565 describes and defines the access points needed for international public telephone circuits, these points being referred to as "circuit access points" and "line access points".

Line access points and circuit access points (or appropriate means for reaching the circuit access points) should be provided for testing all circuits in the public service.

1.2 Test access points should also be provided for circuits connected through a repeater station in transit from one country to another. Such access points are known as "intermediate access points".

1.3 On a leased circuit, the circuit access points are regarded as being located in the renter's premises, at the demarcation point where connections are made to the terminal equipment used on the circuit [1)].

1.4 Test access points should also be available at the terminal international centre for circuits terminating within the country at a place remote from the international centre, for example, in the premises of the users of leased circuits or in a voice-frequency telegraph terminal station, etc. Such access points, known as line access points, should be available directly or indirectly to the transmission maintenance point (international line) as defined in Recommendation M.1014 [1] for such circuits.

1.5 In addition to those mentioned in §§ 1.1 to 1.4 above, access points should be provided on the audio input and output of FDM channel multiplex and primary PCM multiplex equipments.

1.6 Access points for testing purposes should be provided on all primary order digital paths. Such access points, known as digital path access points, should be located as near to the ends of the digital path as possible. With suitable digital test equipment, such digital path access points enable circuit testing to be carried out when, for example, digital paths are directly interfaced with digital exchanges or transmultiplexers.

1.7 Figure 1/M.110 shows an example of the basic access points for international telephone circuits terminated on an analogue exchange, and for a variety of other telephone-type circuits. Figure 2/M.110 shows the basic access points for telephone circuits terminated on a digital exchange. Figures 1/M.110 and 2/M.110 both show that remote access has been provided to the "circuit access points" of automatic telephone circuits.

1.8 Series M Recommendations relating to the various types of international circuits specify how the above-mentioned access points should be used for line-up and maintenance purposes.

2 Measuring and testing equipment

2.1 The basic types of measuring equipment needed in an analogue environment are:

- signal generators (fixed and variable frequency oscillators and calibrated sending units),
- level-measuring sets,
- calibration units,
- psophometers,
- standard frequency source (or access to such a source),
- equipment for signalling tests.

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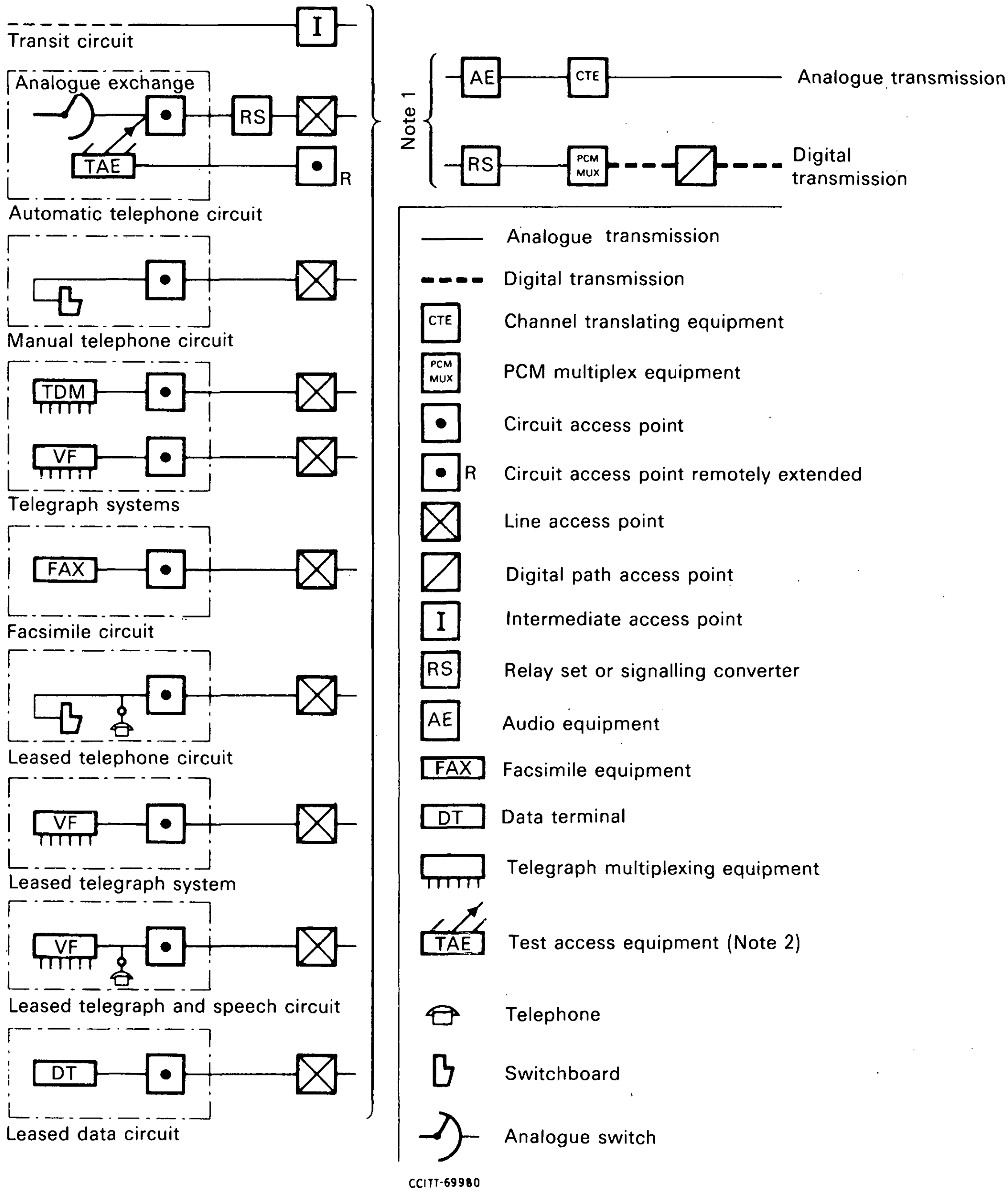
1) The access points required for digital leased circuits have yet to be specified. This matter is for further study by Study Group IV.



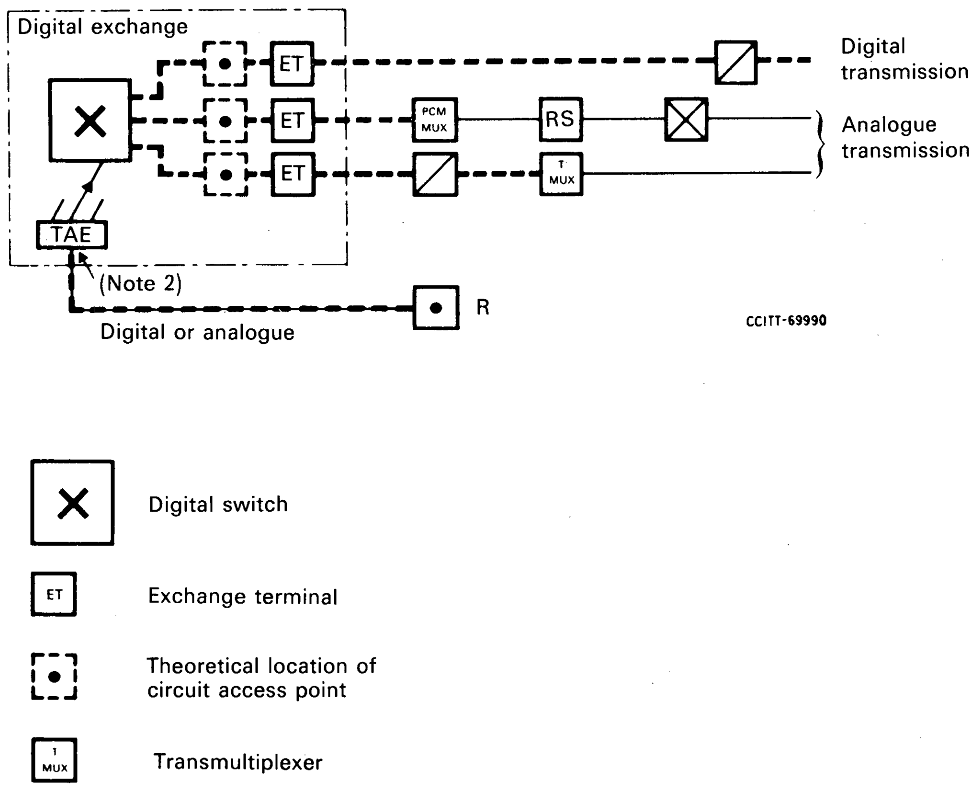
TDM = Time division multiplex
VF = Voice frequency multiplex

Note 1 – Circuits may be routed by analogue or digital transmission media.

Note 2 – Access may be provided by the normal exchange switching equipment, or by separately provided test access switching equipment.

FIGURE 1/M.110

Access points for analogue international telephone circuits and other telephone-type circuits



Note 1 — Other symbols are as indicated in Figure 1/M.110.

Note 2 — Access is normally provided by the exchange switching equipment.

FIGURE 2/M.110

Access points for digital international telephone circuits

In addition, delay distortion measuring equipment, frequency counters, interruption recorders, programme meters, impulsive noise counters, phase jitter meters, automatic transmission measuring equipment, and equipment for non-linear and total distortion measurement may be required.

2.2 The basic types of test and measuring equipment needed in a digital environment are as mentioned in § 2.1 above. This need can be met by equivalent digital test/measuring equipment, or by analogue equipment and the use of a "test coder/decoder" to convert digital access points to analogue access points. In some situations, testers for the following will prove useful:

- bit error ratio;
- error-free or errored seconds;
- code violations;
- timing jitter;
- frame alignment.

2.3 The actual requirements for a particular testing centre will depend upon the types of circuit existing at that centre, and the range of tests and measurements that are specified for those circuits in the relevant Series M Recommendations. Reference should also be made to the "facility" requirements specified for the testing points defined in Recommendations M.717, M.718 and M.719.

2.4 The implementation of the worldwide transmission and switching plans makes it necessary for international circuits to be lined up and maintained to a very high degree of accuracy.

It is essential, therefore, to use measuring equipment of high accuracy and stability in order that the maintenance requirements given in the relevant Series M Recommendations for circuits are met, and to ensure uniformity of measurement results.

To this end it is desirable that measuring equipment provided for lining-up and maintaining all classes of circuits should, wherever possible, conform to the measuring instrument specifications given in the Series O Recommendations. Where no CCITT specification is available, the best order of accuracy and stability should be provided, consistent with cost and type of measurement to be made.

Reference

[1] CCITT Recommendation *Transmission maintenance point international line (TMP-IL)*, Vol. IV, Rec. M.1014.

Recommendation M.120

ACCESS POINTS FOR MAINTENANCE

For lining-up and fault localization it is proposed to define access points at boundaries such as between switching and transmission. A division of maintenance repsonsibilities can be achieved with the aid of line access points, digital path access points and analogue link access points. The following concepts are compatible with the division shown in Recommendations Q.45 (Figure 1/Q.45) [1] and Q.502 (Figure 1/Q.502) [2].

a) A line access point separates an analogue exchange from analogue or digital transmission (see a) and b) of Figure 1/M.120).

   Location and interfaces of line access points are defined in Recommendation M.565.

b) A digital path access point separates a digital exchange from analogue or digital transmission (see c) and d) of Figure 1/M.120).

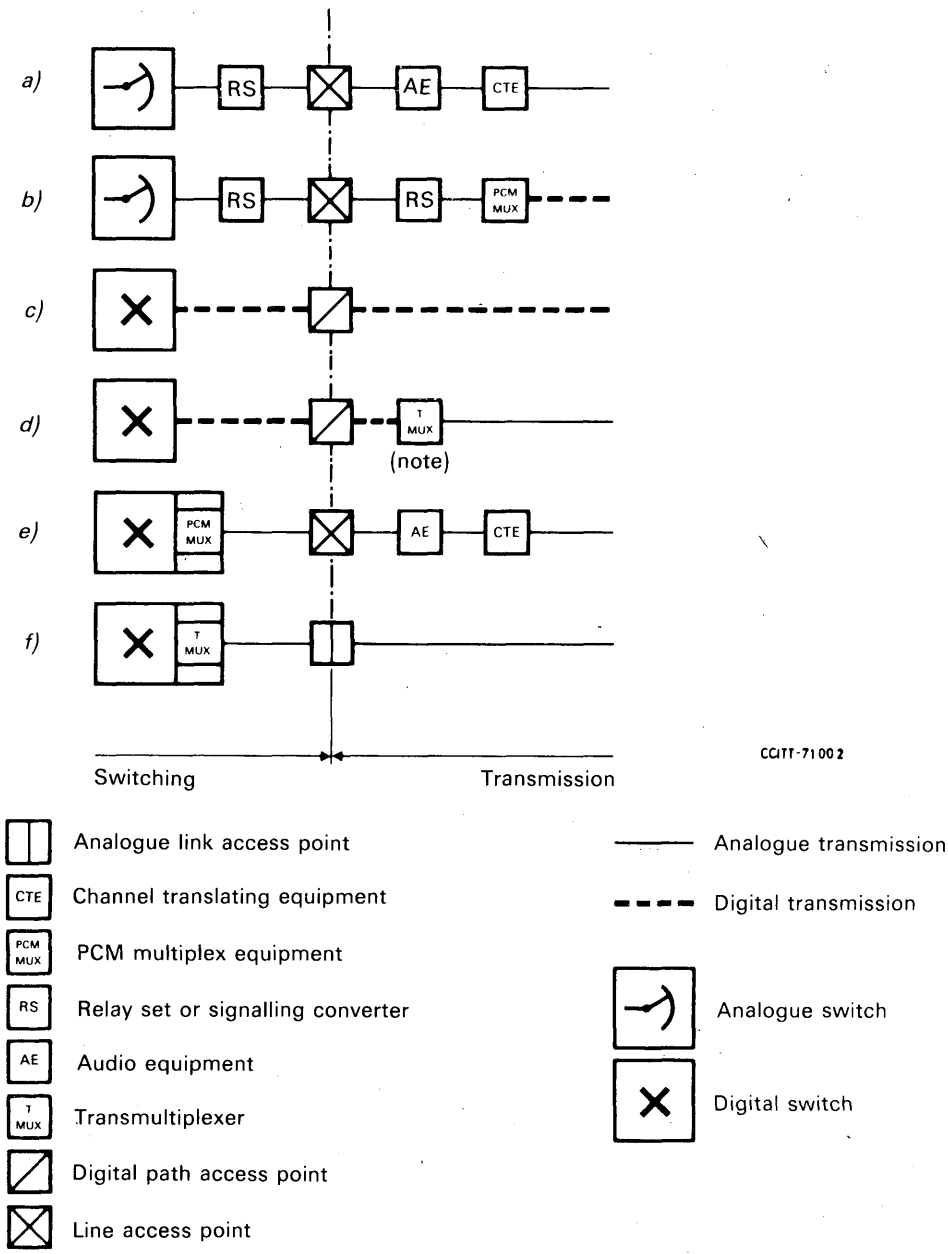
   Digital path access points are located at the input and output ports of digital paths. Interfaces are defined in Recommendation G.703 [3].

c) A line access point separates the digital exchange from the analogue transmission (see e) of Figure 1/M.120).

d) An analogue link access point separates a digital exchange from an analogue transmission if line access or digital path access is not provided. f) of Figure 1/M.120 shows as an example the collocation of a transmultiplexer with a digital exchange.

   Analogue link access points are located at the input and output ports of analogue links. Interfaces are defined in Recommendation G.233 [4].

Normally line access points, digital path access points and analogue link access points are provided as equipment interface, e.g. accessible at distribution frames.



Note – The transmultiplexer shown could also be a PCM multiplex equipment/channel translating equipment combination.

FIGURE 1/M.120

Access points for division of maintenance responsibilities

References

[1] CCITT Recommendation *Transmission Characteristics of an International Exchange*, Vol. VI, Rec. Q.45.

[2] CCITT Recommendation *Interfaces*, Vol.VI, Rec. Q.502.

[3] CCITT Recommendation *Physical/Electrical Characteristics of Hierarchical Digital Interfaces*, Vol. III, Rec. G.703.

[4] CCITT Recommendation *Recommendations Concerning Translating Equipment*, Vol III, Rec. G.233.

OPERATIONAL PROCEDURES IN LOCATING AND CLEARING TRANSMISSION FAULTS

1 The reporting of faults on automatic circuits is dealt with in Recommendations M.715 and M.716; for leased and special circuits in Recommendations M.1012 [1], M.1013 [2] and M.1014 [3] and for Signalling System No. 6 in Recommendation M.762. 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 (CMS). 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.

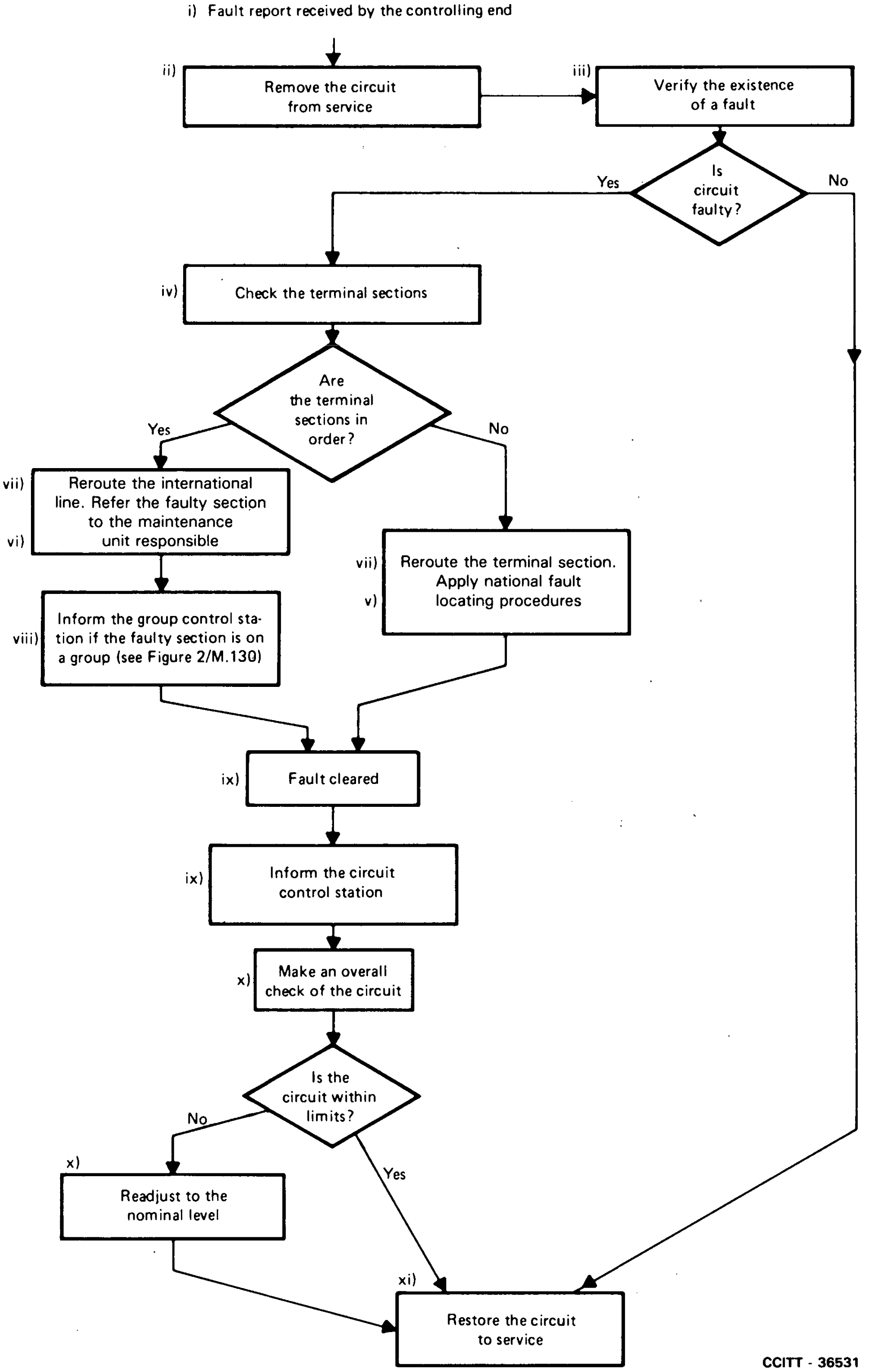
2.2 Figure 1/M.130 shows a sequence of operations that may be followed applying the principles given in § 2.1 above.

2.3 A typical sequence of operations covering transmission faults on transfer links of Signalling System No. 6 is shown in Figure 2/M.760.

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 above).

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.130. Associated operations by other control and sub-control functions are shown in Figures 3/M.130 and 4/M.130.

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 above and Figure 1/M.130 in the order shown.



Note – The Roman numbers correspond to those in § 2.1 of the text.

FIGURE 1/M.130

Exemple of possible action following a circuit fault report

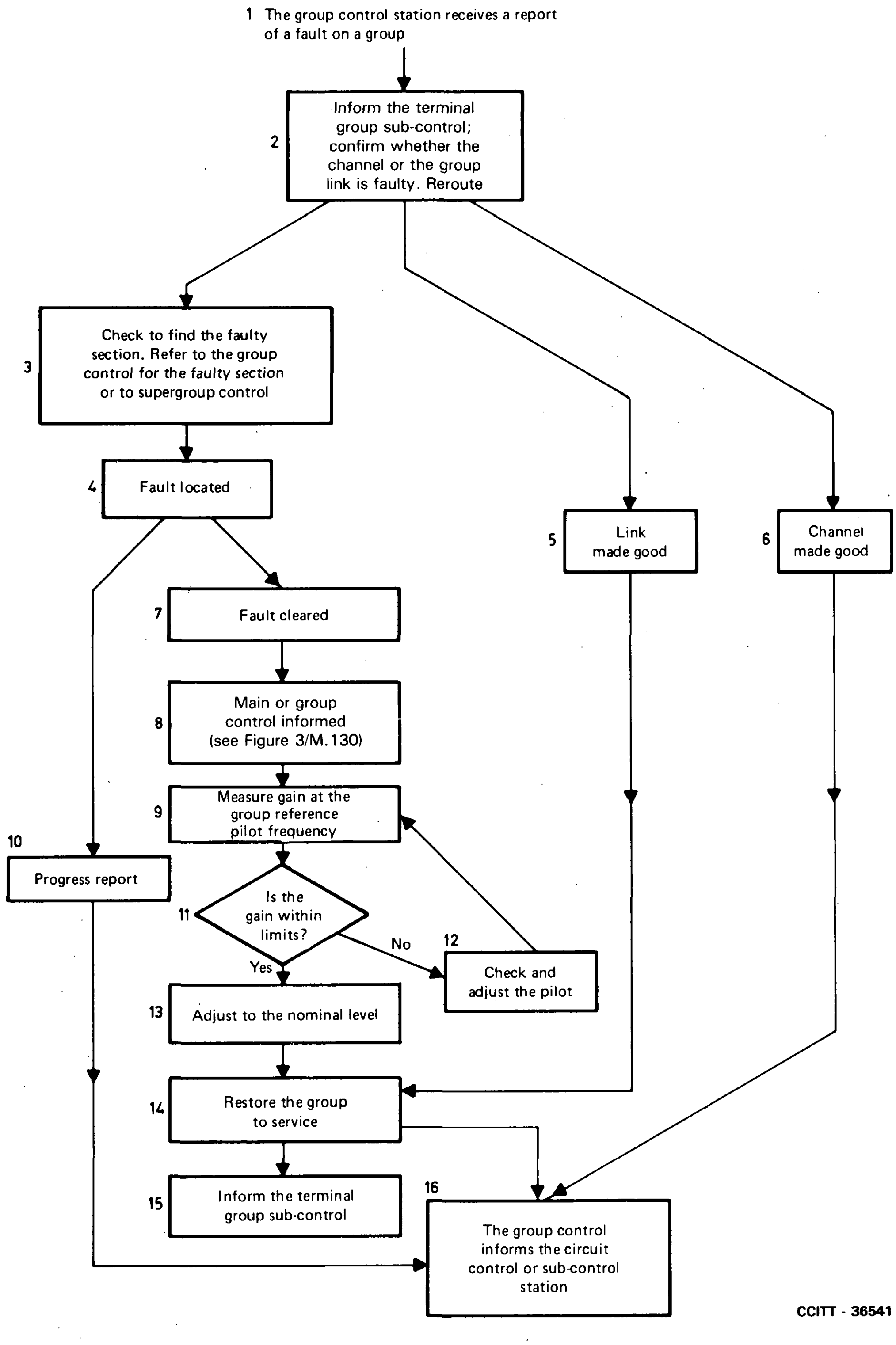


FIGURE 2/M.130

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

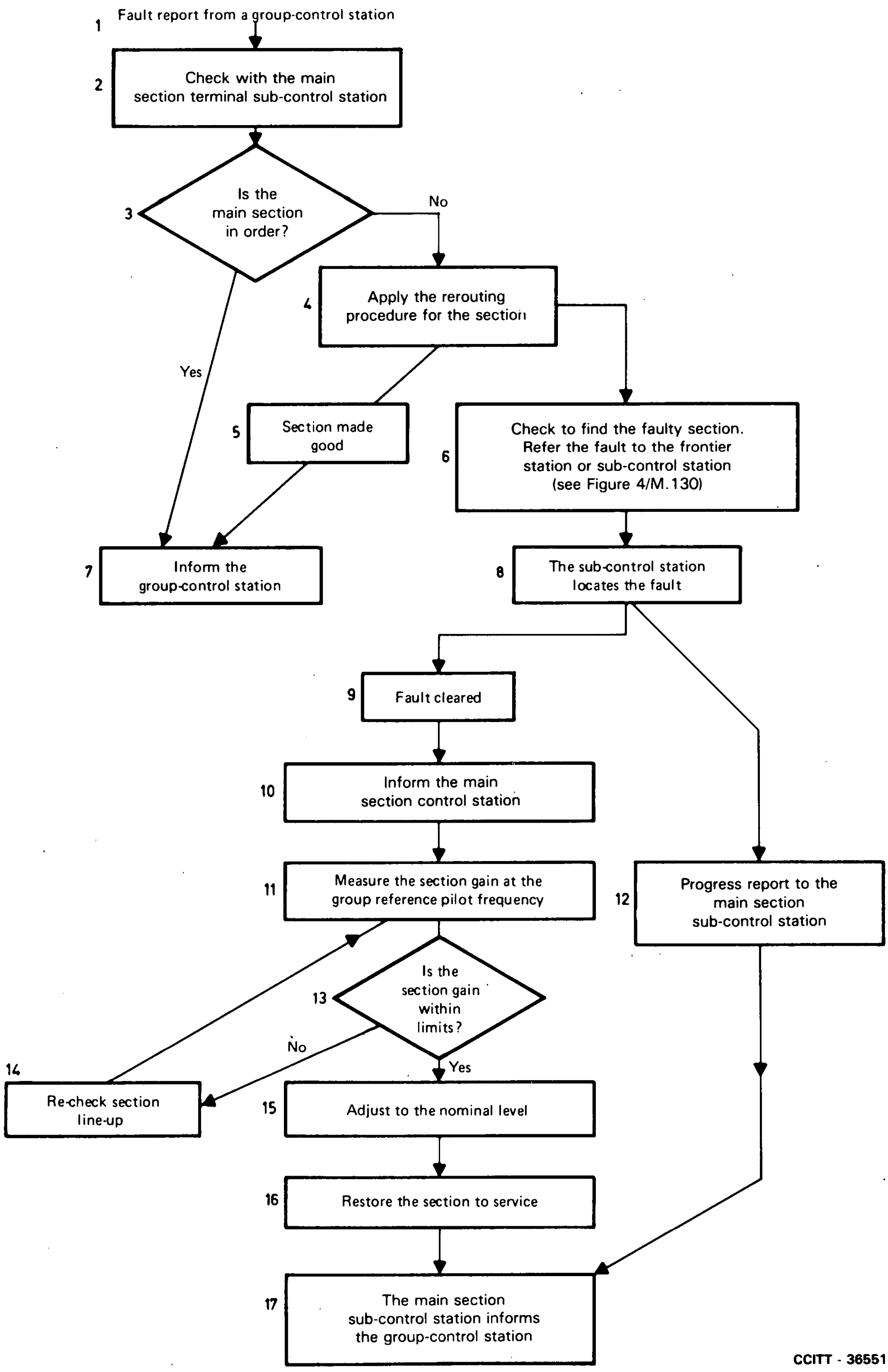


FIGURE 3/M.130

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

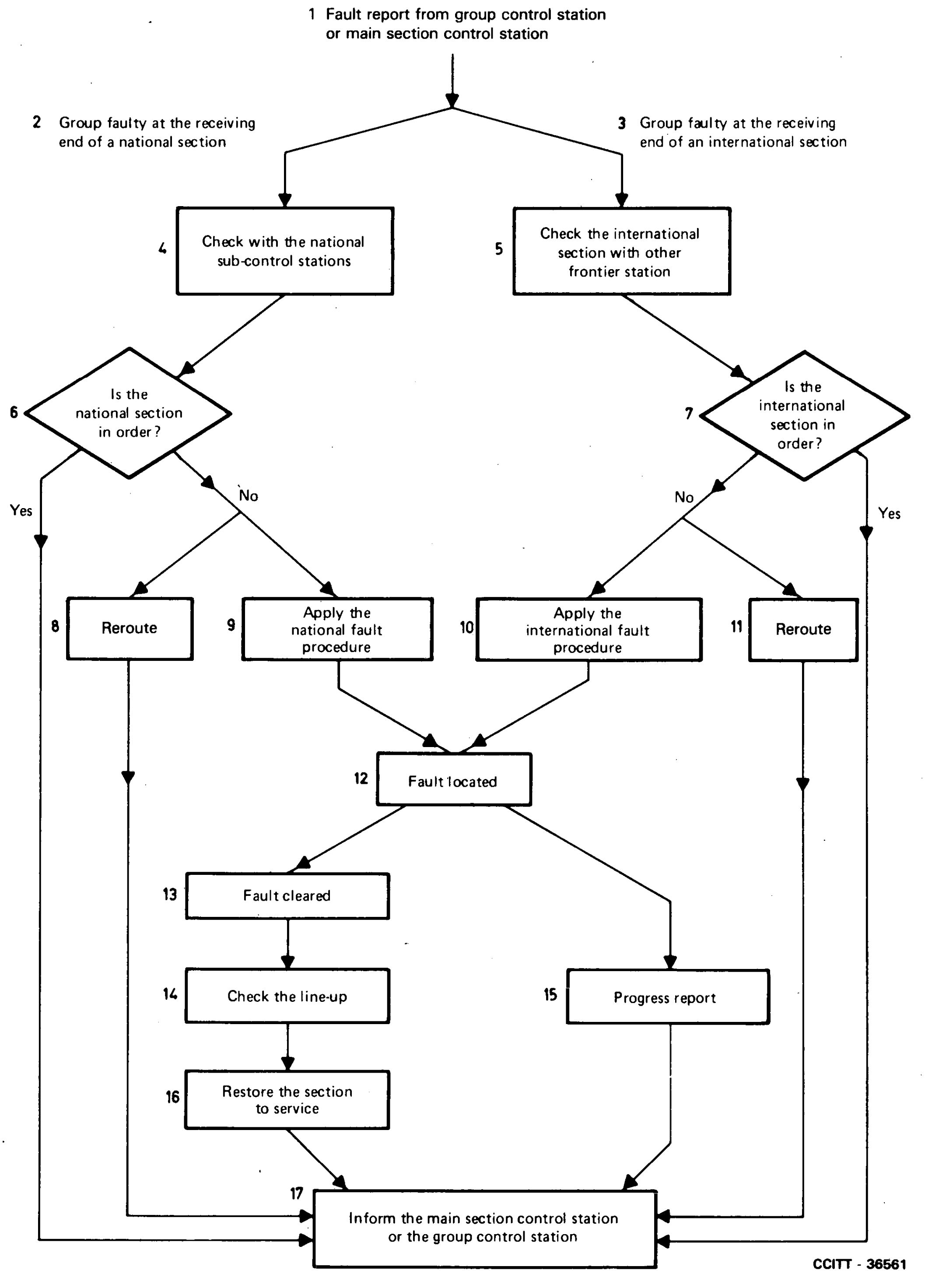


FIGURE 4/M.130

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

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.

ANNEX A

(to Recommendation M.130)

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; 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.

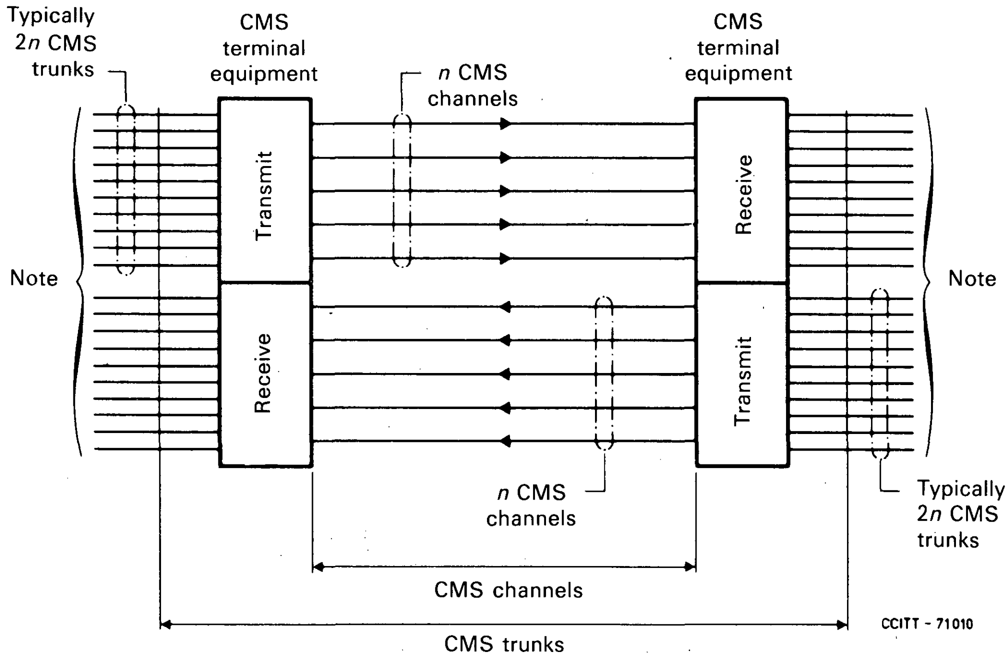
Figure A-1/M.130 depicts a generalized CMS, in this case interfaced at basic circuit level. Other circuit multiplication systems are interfaced by primary order digital paths (operated at 1544 or 2048 kbit/s) on both trunk and channel sides of the CMS terminal equipment. Other interface arrangements 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.



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

FIGURE A-1/M.130

Generalized representation of a circuit multiplication system (CMS)

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.

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.

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,

[1] In some systems, minor loss variations are also automatically compensated for.

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 above 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 *Circuit control station for leased and special circuits*, Vol. IV, Rec. M.1012.

[2] CCITT Recommendation *Sub-control station for leased and special circuits*, Vol. IV, Rec. 1013.

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

Recommendation M.140

DESIGNATION OF INTERNATIONAL CIRCUITS, GROUPS, DIGITAL BLOCKS, ETC.

The designations of international circuits specified in this Recommendation apply irrespective of the routing and constitution of the circuits. The designations should identify the two terminal points of a circuit and the circuit number. For switched circuits, the identification of a terminal point consists of the town name followed by a suffix indicating the international switching centre at which the circuit terminates if there is more than one switching centre in a town. In the case of non-switched circuits the designation should include the town name and, where necessary, a suffix to further identify the terminal point.

Similarly, the designation of international groups, supergroups, digital blocks, etc., should identify the terminal towns and international repeater stations (the latter by a suffix) where there is more than one international repeater station in a town.

The suffix can be the name of the terminal point (e.g. international switching centre) or may be in the form of a code such as letters and/or numerals. The suffix should be enclosed by parentheses.

Whatever scheme is adopted by an Administration for identifying its international switching centres and international repeater stations in such designations, it should be applied consistently and give a clear distinction between them.

To assist in circuit identification it is desirable that the numbering of circuits should be based on each town-to-town traffic relation. Thus each circuit in such a relation should have a unique number no matter where the circuits terminate in the towns. The same principle should also apply to the numbering of groups, supergroups, digital blocks, etc.[1], [2]

The place names should always be written in roman characters taking the official name of a town as used in the country to which it belongs. If identical place names occur in different countries, and if confusion is likely to arise, the Administrations concerned should agree to identify the country in the circuit designation by adding after the place name the telex network identification code. This code is given in [1].

If it is of interest to distinguish the private operating agency concerned, this may be done by inserting after the place name a suitable code identifying the agency.

The code for the country should be placed between fraction bars (division signs) / . . . . . /.

This is necessary to avoid any confusion either with the designatory letters assigned to the various types of circuit, or with the abbreviations used to designate private operating agencies or other recognized authorities.

1 Circuits in public service

1.1 *Telephone circuits*

1.1.1 *Telephone circuits used in manual operation*

The circuit number preceded by the prefix M follows immediately after the names of the two terminal exchanges arranged in alphabetical order.

Examples: London (Faraday) – Paris M1
Auckland – London (Faraday) M1

1.1.2 *One-way circuits used for semi-automatic or automatic operation*

These circuits are designated by the names of the two international terminal exchanges arranged in the order corresponding to the direction in which the circuit is operated and the number of the circuit is preceded by the letter Z.

The numbers of the two directions of operation of semi-automatic or automatic circuits must therefore be distinct. Circuits operated in the direction corresponding to the alphabetical order of the international terminal exchanges should have odd numbers. Circuits operated in the direction corresponding to an inverse alphabetical order of the international terminal exchanges should have even numbers.

Examples: for a circuit operated in the London – Montreal direction (alphabetical order):
London (Mollison) – Montreal Z21.

for a circuit operated in the Montreal – London direction (inverse alphabetical order):
Montreal – London (Mollison) Z18.

1.1.3 *Both-way circuits used for semi-automatic or automatic operation*

The circuit number follows immediately and without a letter prefix after the names of the two terminal exchanges arranged in alphabetical order.

Example: London (De Havilland) – New York (24) 1

1) However, some Administrations by bilateral agreement, may find it useful to allocate circuit serial numbers on the basis of one terminal international switching centre to another. This may give rise to serial numbers being duplicated between the same towns.

2) Some Administrations may also wish to number groups, supergroups, etc. serially in relation to stations rather than towns. This is to be agreed bilaterally where it is considered desirable.

1.2 *Circuits used to provide telegraph systems*

Note – Where necessary, the associated telegraph link should be identified by the designation of the overall telegraph system.

1.2.1 *Circuits used to provide voice-frequency telegraph links*

For the public service, these are distinguished by the letter T.

Example: Montreal – Zurich T1

In some cases the voice-frequency telegraph link terminates at one or both ends in the premises of a private operating agency. If it is of interest and useful to distinguish the private operating agency concerned, this may be done by inserting, after the place name, a suitable abbreviation in parentheses (. . . . .) to identify the agency.

Example: Bruxelles – New York (RCA) T1

In the case of telephone circuits used as *reserve circuits* for voice-frequency telegraph links, the telephone circuit designation for such a circuit (in accordance with the above) is followed by a supplementary indication, in parentheses, comprising the letters ST followed by the number of the voice-frequency telegraph link for which the circuit under consideration is normally used as a reserve.

Example: London (Faraday) – Montreal M10 (ST1)

describes the circuit designated as a reserve for the London – Montreal T1 voice-frequency telegraph link[3].

1.2.2 *Circuits used to provide TDM (time division multiplex) telegraph systems*

For the public service, these are distinguished by the letters TD.

Example: London – Montreal TD1

If it is of interest or useful to indicate that one or both ends of the TDM telegraph system are on the premises of a private operating agency, this may be done in a similar manner to voice frequency links.

Example: Bruxelles – New York (RCA) TD1

(The CCITT has not yet specified the transmission characteristics which should apply to TDM telegraph links. This is under study. Until such time as these characteristics are specified, Administrations should make bilateral arrangements between themselves. However, the designation "TD" will apply at this time whatever characteristic is used.)

1.3 *Circuits or links used for data transmission*

Data transmission circuits or links are characterized by the letter D.

Example: Frankfurt – Toronto D1

1.4 *Circuits specially designated for phototelegraphy or facsimile*

In the case of a circuit specially designated for phototelegraphy or facsimile, the designation of the circuit as a telephone circuit (in accordance with the above) is followed by a supplementary indication, in parentheses, comprising the letter F followed by the number of the circuit when it is used for phototelegraph transmissions.

Examples: London (Faraday) – Paris Z23 (F1)
London (Faraday) – Montreal M3 (F1)

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[3] It might happen that a telephone circuit, for example London – Oslo M9, is designated as a reserve section for a part of a voice-frequency telegraph link, for example, New York – Oslo T1. The complete designation of the telephony circuit to be used as a reserve section would then include an indication of the normal voice-frequency telegraph link concerned, that is, using the examples above, the London – Oslo telephone circuit would be designated "London – Oslo M9 (New York – Oslo ST1)" or, if it were a general reserve for a number of sections of voice-frequency telegraph links, it would be designated "London – Oslo M9 (ST)".

1.5 *Circuits for occasional sound-programme or television transmission*

The letter R is used in the case of a unidirectional sound-programme circuit and the letter V for a unidirectional television circuit. An additional letter H is used for designating the two circuits which form a stereophonic pair of circuits. The letters RK are used for a narrow-band circuit (e.g., telephone circuit) used for independent sound-programme transmissions in each direction or for a sound-programme transmission in one direction and a feedback path in the other direction.

The letters RR should be used in the case of a reversible sound-programme circuit and the letters VV for a reversible television circuit.

For a stereophonic pair of circuits the normal sound-programme circuit designation should be followed by the letter H and a number for the particular pair.

The names of the terminals in the designation for a unidirectional circuit (for sound or television) are placed in the order corresponding with the direction of transmission (instead of alphabetically). Telephone circuits taken from traffic for narrow band sound-programme transmissions should have the designation RK and ordinal number, all shown in parentheses, following the telephony circuit designation.

Examples: unidirectional sound-programme circuit transmitting in the direction Wellington – Montreal:
Wellington/NZ/ – Montreal R1

stereophonic pair of circuits:
London – Paris R1 H1
London – Paris R2 H1

telephone-type circuit set up permanently for narrow band sound-programme transmissions between Madrid and Milano:
Madrid – Milano RK1

telephone circuit taken from traffic for narrow-band sound-programme transmissions between Montreal and Wellington:
Montreal – Wellington/NZ/Z5 (RK2).

If it is of interest to distinguish any broadcasting organization, this may be done by inserting, after the place name, a suitable abbreviation in parentheses (. . . . .) to identify the organization.

Where it is necessary for sound-programme circuit designations to include an indication of the bandwidth, this is done by adding in parentheses the top nominal frequency in kHz, in which case it is to be assumed that the lower limit of the frequency band effectively transmitted is 50 Hz, or less.

Examples: London – Montreal R1 (10 kHz)
London – Sydney R1 (8 kHz)
Paris – London (Faraday) Z24 (RK1) (3.4 kHz)

Exceptionally, when the lowest frequency is above 50 Hz, a special mention of this should be made on the circuit record (circuit layout).

1.6 *Circuits used as transfer links for common channel signalling systems (No. 6)*

The circuit number preceded by the prefix DL follows immediately after the names of the two international terminal exchanges arranged in alphabetical order.

Example: Denver – Tokyo DL1

In the case of telephone circuits used as a nominated direct circuit reserve for transfer links, the telephone circuit designation for such a circuit is followed by a supplementary indication, in parentheses, comprising the letters SDL followed by the number of the circuit when it is used to replace a transfer link.

Example: Denver – Tokyo 5 (SDL1)

2 Leased circuits

Special circuits for private services or particular purposes (e.g. military, diplomatic, meteorological, civil aviation, electric power distribution, banks, permanent service circuits between repeater stations, permanently-used control circuits for sound or television broadcasting, etc.) are distinguished by the letter P.

The designations of the different categories of leased circuits are given in §§ 2.1 and 2.2 below. In special cases in which CCITT Recommendations cannot be followed, agreement should be reached between the Administrations involved (terminal and transit) concerning the designation.

If it is of interest or useful to distinguish any private operating agency, sound or television broadcasting organization that is involved, this may be done by inserting, after the place name, a suitable abbreviation in parentheses (. . . . .) to identify the agency. Examples of this are given in various places in this section.

The various categories of leased circuit are as follows:

2.1 *Leased circuits connecting only two locations*

2.1.1 *Leased circuit used wholly for telephony*

The circuit number preceded by the letter P follows immediately after the two terminal place names arranged in alphabetical order.

Example: Paris – Wellington P1

2.1.2 *Leased circuit used wholly for telegraphy*

2.1.2.1 *Voice-frequency telegraphy*

These are distinguished by the letters TP.

Example: Bern (RS) – New York (RCA) TP1

2.1.2.2 *TDM telegraphy*

These are distinguished by the letters TDP.

Example: London – Montreal TDP3

2.1.3 *Leased circuit used wholly for data transmission*

These are distinguished by the letters DP.

Examples: London – Paris DP3
New York (PAA) – Roma (PAA) DP1

2.1.4 *Leased circuit used wholly for phototelegraphy or facsimile*

These are distinguished by the letters FP.

Examples: London – Paris FP2
London – New York (AP) FP2

2.1.5 *Leased circuit used wholly for sound-programme transmission*

The letters RP are used in the case of a unidirectional sound-programme circuit and the letters RRP in the case of a reversible sound-programme circuit. The names of the terminals in the designation for a unidirectional circuit are placed in the order corresponding to the direction of transmission (instead of the alphabetical order if this is different).

Examples: circuit transmitting in the direction Montreal to Wellington:
Montreal – Wellington/NZ/RP1

circuit transmitting in the direction Wellington to Montreal:
Wellington/NZ/ – Montreal RP1

Where it is necessary for sound-programme circuit designations to include an indication of the bandwidth this is done by adding in parentheses the top nominal frequency in kHz, in which case it is to be assumed that the lower limit of the frequency band effectively transmitted is 50 Hz or less.

Examples: London – Montreal RP1 (10 kHz)
London – Sydney RP1 (8 kHz)

2.1.6 *Leased circuit used wholly for television transmission*

Similar in principle to the designations for sound-programme circuits except that the letters VP and VVP are used.

2.1.7 *Leased circuits connecting circuit multiplication terminal equipments at renters' premises* (Note 1)

Leased circuits used to connect circuit multiplication systems (CMSs) which have their terminal equipments located at renters' premises should be designated using the letters "CCP" (Note 2).

Example: Portsmouth – Boston CCP7; the seventh leased circuit used to connect circuit multiplication terminal equipment located at renters' premises in Portsmouth and Boston.

Note 1 – The designation of leased circuits connected to terminal equipment located at Administrations' premises is under study.

Note 2 – The circuit multiplication systems referred to involve (speech) interpolation processes. In assuming the designating letters "CCP", it is recognized that renters, on occasions, use connect channels for purposes other than speech (for example data, telegraphy).

2.1.8 *Leased circuit used for services other than those designated in §§ 2.1.1 to 2.1.6 above or used for combinations of services*

In this category are circuits used for different transmissions at different times or circuits in which the bandwidth is divided into two or more bands, thus providing two or more derived circuits which may be used for different types of transmission.

These specialized circuits are distinguished by the letters XP.

Example: Bruxelles – Paris XP8

2.2 *Leased circuits connecting three or more locations*

Into this category fall multiterminal circuits of various types and configurations. They are distinguished by the letter M (indicating the multiplicity of locations served) added to the designatory letters recommended in §§ 2.1.1 to 2.1.8 above.

This leads, in principle, to the categories PM, TPM, DPM, FPM, RPM, RRPM, VPM, VVPM and XPM.

The circuit number, preceded by the appropriate designatory letters follows immediately after the two place names which are at the end of the longest path provided by the circuit, the place names being arranged in alphabetical order.

Example: the designation of a telephone circuit interconnecting Aachen, Bruxelles, Edinburgh, Marseille and Paris would be:
Edinburgh – Marseille PM1.

The designation of a branch of such a circuit is the two terminal place names distinguishing the branch in alphabetical order placed in parentheses and preceded by the circuit designation.

Example: the Paris – Bruxelles branch of the example above would be:
Edinburgh – Marseille PM1 (Bruxelles – Paris).

3 International groups, supergroups, etc.

The numbering of a group, supergroup, etc., is applied between the point where it is assembled to the point where it is broken down, independently of the position it occupies in the band of line frequencies. Where group, supergroup, etc., links are directly interfaced by analogue to digital conversion equipment, reference should be made to § 8 below.

3.1 *Group* see the definitions in Recommendation M.300)

Groups should be designated by a number whose first figure(s) indicate(s) the number of channels in the groups, as follows:

Examples: 801, 802, 803, ... 898, 899, 8100, 8101, 8102, ... for 8 channel groups;
1201, 1202, 1203, ... 1298, 1299, 12100, 12101, 12102, ... for 12 channel groups;
1601, 1602, 1603, ... 1698, 1699, 16100, 16101, 16102, ... for 16 channel groups;

and in general:

*X*01, *X*02, *X*03, ... *X*98, *X*99, *X*100, *X*101, *X*102, ... for *X* channel groups.

3.2 *Supergroups* see the definitions in Recommendation M.300)

Supergroups should be designated by the numbers 6001, 6002, etc.

Example: Amsterdam – London (Stag Lane) 6001

3.3 *Mastergroups* see the definitions in Recommendation M.300)

Mastergroups should be designated by the numbers 30001, 30002, etc.

Example: Bruxelles – London (Mondial) 30001

3.4 *Supermastergroups* see the definitions in Recommendation M.300)

Supermastergroups should be designated by the numbers 90001, 90002, etc.

Example: Amsterdam – Paris 90001

3.5 *Other designations*

The designatory letters, T, D, F, R, V, and X as defined in §§ 2.1.1 to 2.1.7 above, placed immediately after the number, may be used to identify groups, supergroups, etc., used for purposes other than telephony. Such groups, supergroups, etc., take their place in the normal numbering sequence and do not constitute a numbering sequence of their own.

Examples: London (Wood Street) – Montreal 1201D
London (Stag Lane) – Paris 6001D

The above designations may be used in conjunction with the various designatory letters given in §§ 1.2, 1.3 and 1.4 above, as appropriate. If the group, supergroup, etc., is provided for private service then the letter P should additionally be used.

Example: A supergroup provided between renters' premises in London and Paris devoted to data transmission should be designated as shown below:
London (Mondial) – Paris 6001DP.

3.6 *Restoration groups and supergroups*

Groups and supergroups set up on restoration or spare group and supergroup links for restoration purposes should be designated by numbers taken from the following *800* series:

restoration groups		8899, 8898, 8897, etc., 12899, 12898, 12897, etc.,
	or	16899, 16898, 16897, etc. as appropriate
restoration supergroups		60899, 60898, 60897, etc.
Examples: London (Stag Lane) – Sydney		12898
Amsterdam – Bruxelles		60899

4 International group, supergroup and line links

4.1 *Group and supergroup links*

In practice it may be that terminal equipment is not connected to a group or supergroup link. Nevertheless, for designation purposes, the link will be numbered as though terminal equipment were connected.

4.1.1 *Conventional links not connected to their terminal equipment*

Such links are included in the normal numbering sequence of groups and supergroups and are not given a separate numbering sequence.

If the link is provided for private service then the letter P should additionally be used.

Example: A group link provided between renters' premises in London and Montreal devoted to data transmission should be designated as shown below:
London (Wood Street) – Montreal 1201DP.

When a group or supergroup link is used only part time with terminal translating equipment (to provide a conventional group or supergroup) it should also be designated in accordance with § 3 above followed by the letter X.

Examples: Amsterdam – London (Wood Street) 1206X
London (Stag Lane) – Paris 6003X

4.1.2 *Restoration links not connected to their terminal equipment*

Group and supergroup links nominated for restoration purposes should be designated by a number from the following *800* series:

restoration group links: 12801, 12802, 12803, etc.

restoration supergroup links: 60801, 60802, 60803, etc.

Examples: Hong Kong – Sydney 12802
Bruxelles – London (Wood Street) 60801

The first 2 digits *12* in the designation of a restoration group link do not necessarily indicate the number of channels in the group which is set up via the link. For example, a restoration group link London – Montreal 12801 might be used to restore the group London – Montreal 1605.

4.2 *Line links* (see definition in Recommendation M.300, § 1)

Line links should be designated by the names of the two terminals arranged in alphabetical order followed by a number part having the following form:

i) a number indicating the nominal telephone channel transmission capacity;

ii) the letter A;

iii) a two-digit serial number.

Examples: Beaver Harbour – Widemouth 1840A01
Etam – Pleumeur-Bodou 432A01

Note – Line links are sometimes characterized by having channel capacities not in accordance with normal group, supergroup, etc., alignments. Examples of these nonstandard capacities may often be found in submarine cable or satellite line links. These links will be numbered in accordance with the nominal channel capacity of the link.

5 Unidirectional groups and supergroups routed via multiple-access satellite systems

5.1 *Multiple destination unidirectional groups and supergroups*

The unidirectional path will be designated by the name of the sending terminal station followed by a dash and the letters MU (*M*ultiple destination *U*nidirectional) in parentheses. This will be followed by the number of the group or supergroup.

Examples: A supergroup from London to Bogota, Lusaka and Montreal, would be designated:
London (Stag Lane) – (MU) 6001

The next such supergroup from the same point of origin to whatever destinations would take the next number in the series; for example, the second supergroup from London would be designated:
London (Stag Lane) – (MU) 6002
but might go, for example, to Tokyo, Hawaii and Melbourne.

A supergroup from Montreal to London, Lusaka and Paris would be designated:
Montreal – (MU) 6001.

Note – Groups and supergroups routed via a multiple-access satellite system may be provided for exclusive use between two terminal stations only, in which case the normal designations given above in this Recommendation will apply.

5.2 *Single destination unidirectional groups and supergroups*

The unidirectional path will be designated by the name of the sending terminal station followed by a dash and the name of the receiving terminal station. This will be followed by the letter U (*U*nidirectional) in parentheses and the number of the group or supergroup.

Example: A unidirectional group transmitting in the direction from Paris to Etam, which, in the reverse direction of transmission is assigned to a multiple destination unidirectional (MU) group from Etam to Paris and Rio de Janeiro, would be designated as:
Paris – Etam (U) 1201.

The next group between these locations, Paris and Etam, if bidirectional, would be designated in the normal manner as:
Etam – Paris 1202.

Note – Groups and supergroups routed via a multiple-access satellite system may be provided on a bidirectional basis for exclusive use between two terminal stations only, and in this case the normal designations given above in this Recommendation will apply.

6 International digital blocks

The numbering of a digital block is applied between the point where it is assembled to the point where it is broken down independently of the position it occupies in the higher order bit stream.

6.1 *Digital blocks*

Digital blocks are designated by the names of the two terminals arranged in alphabetical order followed by a number part, having the following form:

i) a number indicating the nominal number of telephone channels in the block;

ii) the letter N;

iii) a 3-digit serial number of the block[4)].

Examples: London (Mondial) – Paris 120N004

The fourth secondary order block between London (Mondial) and Paris.

New York – Tokyo 24N10 (only after bilateral agreement).

The tenth primary order block between New York and Tokyo.

6.2 *Restoration digital blocks*

Digital blocks set up on restoration digital paths or spare digital paths for restoration purposes are designated by serial numbers taken from the 800 series. The serial numbering starts at 899 and blocks are numbered in descending order.

Example: København – Stockholm 1920N899

The first fourth order restoration block between København and Stockholm.

7 International digital paths

In practice it may be that terminal equipment is not connected to a digital path. Nevertheless, for designation purposes the digital path will be designated as though digital blocks had been set up.

7.1 *Conventional digital paths not connected to their terminal equipment*

Such digital paths are included in the normal serial numbering sequence of digital blocks and are not given a separate numbering sequence.

If the digital path is provided for private service then the letter P should additionally be used.

Example: A first order digital path between renters' premises in Amsterdam and Darmstadt should be designated as follows:
Amsterdam – Darmstadt 30N007P[4)]

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4) If bilaterally agreed between Administrations, the number may be given without the leading zeros.

7.2 *Restoration digital paths not connected to their terminal equipment*

Digital paths nominated for restoration purposes are designated by serial numbers taken from the 800 series. The serial numbering starts at 801 and paths are numbered in ascending order.

Restoration paths for first order digital blocks: 30N801, 30N802, etc.

Restoration paths for second order digital blocks: 120N801, 120N802, etc.

Examples: London (Mondial) – Paris 120N804
Amsterdam – Paris 480N801

8 Mixed analogue/digital transmission network

To be in accordance with the philosophy for lining-up and maintaining a mixed analogue/digital transmission network (Recommendation M.20), the analogue and digital parts of the network are designated separately. To indicate that the end-to-end transmission relies on a mixture of analogue and digital transmission systems, the letter C is included in both the analogue and digital designations.

Transmultiplexer equipment is included in the designation of the analogue part of the route.

8.1 *Transmission routes*[5] *with one analogue-to-digital conversion*

8.1.1 *Groups and supergroups etc., forming part of a mixed analogue/digital route*

Groups, supergroups, etc., which are converted into digital paths at some point are designated in the same way as conventional groups or supergroups but have a letter C placed between the parts of the designation which indicate the nominal number of channels and the serial number.

Examples:	Group:	London (Mondial) – Riyadh 12C02 Amsterdam – København 12C899 (restoration group)
	Supergroup:	Paris – Sydney 60C01
	Mastergroup:	Bruxelles – London (Mondial) 300C03
	Supermastergroup:	Amsterdam – Paris 900C04

When groups, supergroups, etc., are wholly used for purposes other than telephony, this may be indicated by suffix letters as shown in § 3.5 above.

Figure 1/M.140 shows a typical analogue/digital arrangement and how it would be designated.

8.1.2 *Digital blocks and paths forming part of a mixed analogue/digital transmission route*

Digital blocks and paths which are converted into analogue groups, supergroups, etc., at some point are designated in the same way as conventional digital blocks and paths but have an additional letter C placed after the letter N.

Example: Madrid – Rome 480NC1 (leading zeros omitted)

Figure 1/M.140 shows a typical analogue/digital arrangement and how it would be designated.

8.1.3 *End-to-end designations*

This matter is under study. At present no end-to-end designation is assigned. It is the responsibility of each Administration to associate, in its records, the designations of the analogue and digital parts of the route.

[5] This term is used provisionally in this context to designate various combinations of analogue and digital sections with appropriate intermediate equipment and usually also including terminal equipment, as illustrated in Figure 1/M.140 and Figure 2/M.140.

8.2 *Transmission routes with two analogue-to-digital conversions*

8.2.1 *End-to-end designations*

Where both ends of a route involving two analogue-to-digital conversions are analogue, an end-to-end designation, using the analogue notation described in § 8.1.1, should be agreed between the terminal Administrations.

Where both ends are digital, an end-to-end designation using the digital notation described in § 8.1.2, should be agreed between the terminal Administrations.

By the above means both terminal stations have available a common designation for the end-to-end transmission route, and are informed of its mixed analogue/digital nature.

8.2.2 *Intermediate section designation*

The intermediate part of the route is given a separate designation using the appropriate notation. The choice of this designation is the responsibility of the Administrations providing the intermediate part of the route, and it is their responsibility to associate, in their records, this intermediate designation with the overall designation.

Figure 2/M.140 shows two examples of routes involving two analogue-to-digital conversions and how they would be designated.

8.3 *Transmission routes with more than two analogue-to-digital conversions*

The transmission planning rules given in Recommendation G.113, § 3 [2] effectively restrict the number of unintegrated digital processes (e.g. analogue-to-digital conversions) permitted in the international part of a telephone connection.

Similarly, the routing plan given in Recommendation E.171 [3] restricts the number of international circuits in a connection to four. In view of these rules it is desirable to limit the number of analogue-to-digital conversions in each direction between international centres to a maximum of two. Therefore the detailed designation requirements of routes with more than two analogue-to-digital conversions are not considered.

9 **Data transmission systems**

The data transmission systems referred to in this section are described in Recommendation M.1300 [4]. They may be provided between private renters or between the premises of Administrations. For both cases the systems should be designated as follows.

9.1 Data transmission systems are designated by the names of the two terminal towns arranged in alphabetical order followed by a number part consisting of:

- a two- or three-digit number which indicates the bit rate;
- a letter which indicates the unit of measurement of the bit rate (i.e. hundreds, thousands bit/s);
- a 3-digit serial number.

Note – if bilaterally agreed between Administrations, the number may be given without the leading zeros.

All systems having the same terminal towns and the same bit rate are given serial numbers in the same sequence. The letters to be used to indicate the unit of measurement are:

Bit rate of system	*Letter*
Up to 999 bit/s	B
1000 to 9999 bit/s	H
10000 to 64000 bit/s	K

9.2 With bilateral agreement, Administrations may add a one or two-letter suffix to indicate the use of the data transmission system. The letters to be used are given in §§ 1 and 2. The suffix is placed immediately after the serial number. Designations with such a suffix are included in the normal numbering sequence and are not given a separate numbering sequence.

Examples: Birmingham – Toulouse 96H001DP

The first 9600 bit/s data transmission system between renters' premises in Birmingham and Toulouse. This system is used for data transmission.

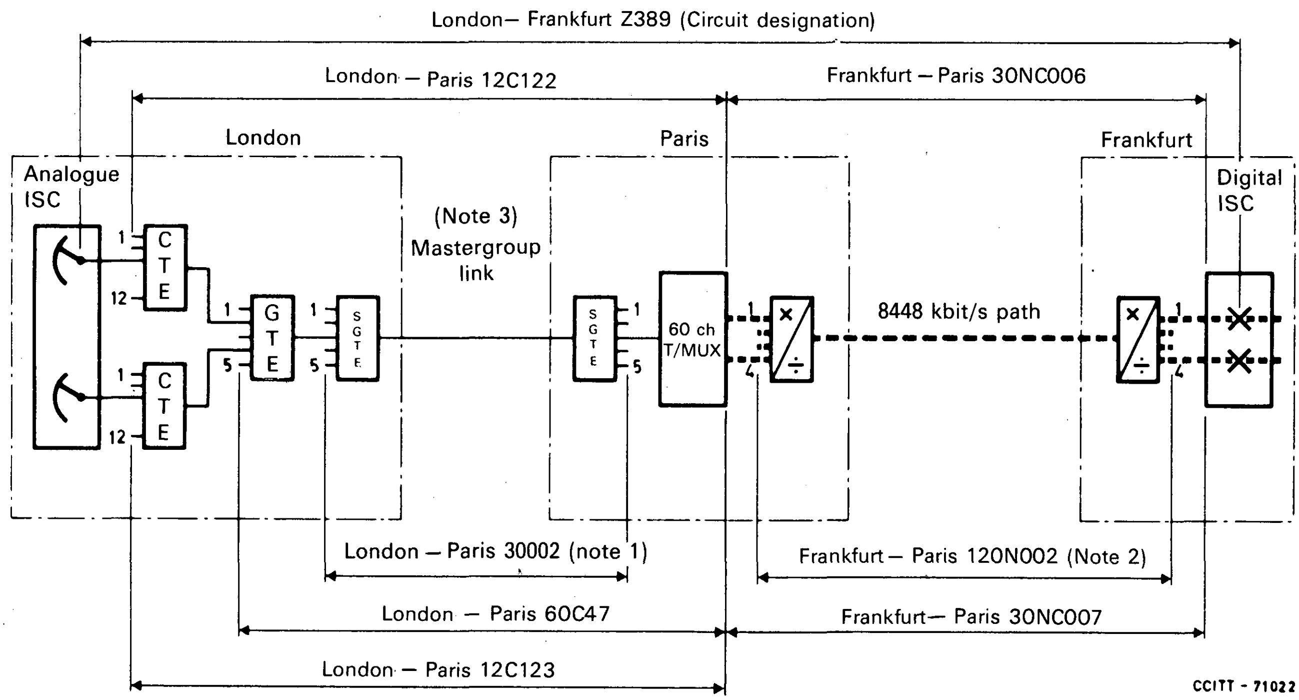
Genève – Roma 48K0Q7TD

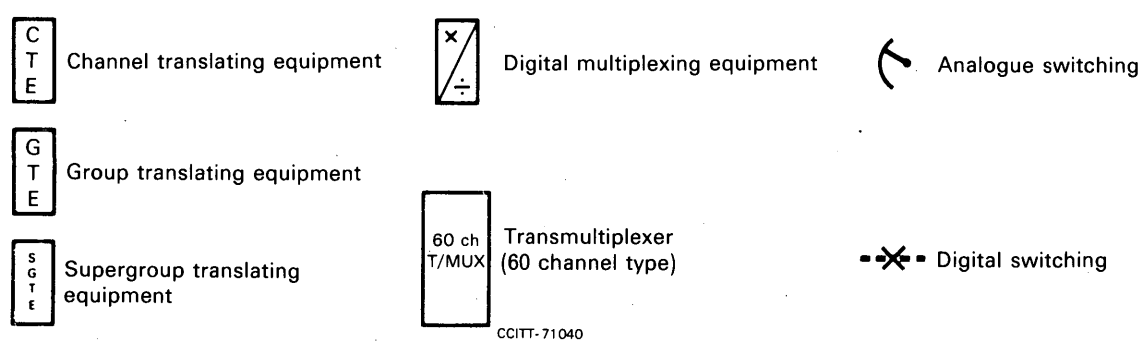
The seventh 48000 bit/s data transmission system between Genève and Roma. This system is used to provide TDM telegraph systems.

9.3 *Data transmission links*

9.3.1 Analogue data transmission links are designated as shown in §§ 1.3, 2.1.3, and 4.1.1.

9.3.2 Digital data transmission link designations require further study.





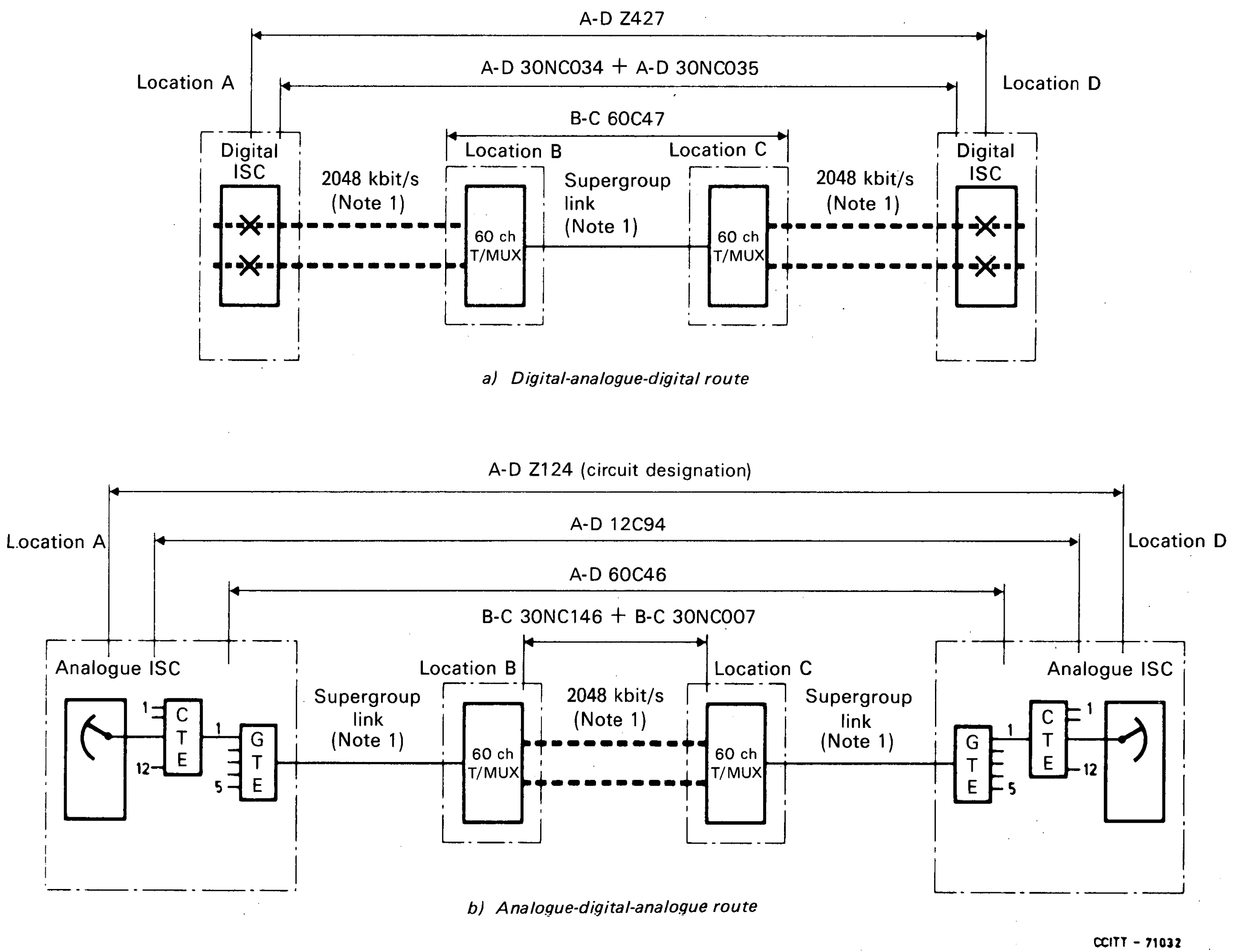
Note 1 – The conventional analogue designation is used.

Note 2 – The conventional digital designation is used.

Note 3 – Mastergroup link equipment is assumed and not shown here.

FIGURE 1/M.140

Example of a transmission route involving one analogue-to-digital conversion showing how the various parts should be designated



Note 1 – Higher order groups and digital blocks would be designated in the conventional manner.

Note 2 – Symbols are defined in Figure 1/M.140.

FIGURE 2/M.140

Examples of transmission routes involving two analogue-to-digital conversions showing how the various parts should be designated

References

[1] *Indicators for the telegram retransmission system (TRS) – Telex network identification codes (TNIC)*, 4th edition, ITU, Geneva, 1979.

[2] CCITT Recommendation *Transmission impairments*, Vol. III, Rec. G.113.

[3] CCITT Recommendation *International telephone routing plan*, Vol II, Rec. E.171.

[4] CCITT Recommendation *International data transmission systems operating in the range 2400 bit/s to 64 kbit/s*, Vol. IV, Rec. M.1300.

STABILITY OF TRANSMISSION[1]

1 Variation of circuit overall loss with time[2]

1.1 The objective is that the following values should not be exceeded:

1.1.1 difference between the mean value and the nominal value of the overall transmission loss:

0.5 dB for all circuits,

1.1.2 standard deviation about the mean value of the variation of the overall transmission loss:

1.0 dB for all circuits.

However, in the case of circuits which are set up, wholly or in part, on older type equipment, and which are composed of two or more circuit sections, a standard deviation not exceeding 1.5 dB may be admitted.

1.2 The method for achieving the above objective values is left to the discretion of Administrations (better maintenance, fitting of automatic regulators, etc.).

2 Variation of pilot levels with time on group, supergroup, etc. links

2.1 The objective is that the following values of M and S should be met, where M represents the mean deviation of the pilot level from its nominal value and S represents the standard deviation of the variations of the pilot level:

2.2 conditions concerning through-connection points of group, supergroup, etc. links:

$$|M| \leqslant 0.5 \text{ dB}, \qquad S \leqslant 1.3 \text{ dB}$$

2.3 conditions concerning the receiving end:

2.3.1 group links:

$$|M| \leqslant 0.3 \text{ dB}, \qquad S \leqslant 0.6 \text{ dB}$$

2.3.2 supergroup links:

$$|M| \leqslant 0.3 \text{ dB}, \qquad S \leqslant 0.5 \text{ dB}$$

2.3.3 mastergroup links:

$$|M| \leqslant 0.3 \text{ dB}, \qquad S \leqslant 0.4 \text{ dB}$$

2.3.4 supermastergroup links:

$$|M| \leqslant 0.3 \text{ dB}, \qquad S \leqslant 0.3 \text{ dB}.$$

3 Practical application of limits

The assumption is made that the limits set out in §§ 1 and 2 above for the variation with time of:

- the loss of each individual circuit, or
- the level of each individual group, supergroup, etc. pilot,

may be used as limits for the results of measurements made on a set of circuits, groups, supergroups, etc. at a given time. Experience indicates that such a use has a practical validity and hence Administrations are encouraged to use this Recommendation as giving currently practical limits for sets of circuits, groups, supergroups, etc. This does not preclude the application of these limits to single circuits, groups, supergroups, etc.

[1] Recommendation G.214 [4] also concerns the subject of the stability of transmission.

[2] See [1] concerning questions of statistical theory.

4 Reline-up of circuits, groups, supergroups, etc.

When a circuit, group, supergroup, etc., has its routing or composition permanently changed over part or all of its length, it is essential to ensure that a complete line-up of the circuit, group, etc., is made in accordance with the relevant line-up Recommendations since the rerouting constitutes a re-establishment of the circuit, group, etc.

This procedure is necessary in order to maintain the transmission performance and stability of the network. The pressing needs of the operating services should not be allowed to prevent these measurements from being properly carried out, since this could only result in a degradation of the stability and performance of the circuits in the network. Under all circumstances the circuit control station should be kept advised.

5 Basic factors for transmission stability

The CCITT recommends that the following basic factors should be taken into account for achieving a stable network:

5.1 *Staff training*

The importance of this factor cannot be overemphasized.

The staff should understand why level variations are to be kept to a low value and should be made fully aware of the results of incorrect adjustments. It is important that adjustments should be made only when absolutely necessary and an adjustment should never be made to cover up a fault.

The staff must realize the possible effects of a brief interruption on any type of circuit.

5.2 *Design of installations*

Installations should be such that sudden interruptions are avoided. For example, this may be achieved by:

a) the arrangement of transmission equipment to facilitate maintenance, patching out, the replacement of subassemblies;

b) the design of carrier generators with a view to great reliability;

c) the design of power supplies; attention is particularly drawn to the importance of the judicious choice and grading of protective devices (fuses, circuit-breakers) in the power feeds to repeater station racks.

Note – See in this connection Recommendation G.231 [2].

5.3 *Care in the organization of work in international exchanges, repeater stations, and on the transmission lines, cables and systems used in the international network*

Experience has shown that operations carried out on exchange and repeater station equipment and on the external plants (underground cables, etc.) are a major cause of attenuation and phase variations and of interruptions to service in the international network.

All work liable to cause interference should therefore be carried out, when possible, at times of light traffic. It must be recognized that for very long routes it will become increasingly difficult to find suitable periods of light traffic, bearing in mind the time differences which will exist between the terminal countries on such routes. This will require good coordination and cooperation between Administrations. In particular, the control stations should be consulted well in advance (see Recommendation M.221).

5.4 *Care in the organization of maintenance*

The same reasons for transferring working operations to times of light traffic apply to maintenance operations.

It is desirable to avoid all equipment changeovers which are not absolutely necessary.

It is also desirable to guard against maintenance operations which appear harmless but which may, however, result in short interruptions and which are all the more dangerous if they affect common units (e.g. changeover of master oscillators).

5.5 *Power supplies*

5.5.1 Too frequent changeover of power supplies for routine maintenance must be avoided. It should be possible to make partial tests to check that the standby motor-generator starts, without changing over the power supplies.

5.5.2 The instruction or training of staff during the day on working power supplies should be forbidden.

5.5.3 Changeover of power supplies should be carried out at times of light traffic and as far as possible at night.

5.5.4 To ensure that circuits in the international network are not interrupted owing to the failure of public power supplies, repeater stations in the international network should have power-continuity arrangements which ensure that the transmission equipment continues to operate, *without any interruption*, in the event of a failure of the public power supply.

5.6 *Care in the testing of new equipment*

Equipment should not be put into service until after the most thorough inspection. It is necessary to ensure that the pressing needs of the operating services do not result in these tests being omitted or hastily done.

Where the urgent requirements of the operating services resulted in equipment being put into service before it has been sufficiently tested, the equipment should be temporarily taken out of service and a thorough inspection made as soon as possible.

5.7 *Vibration testing*

Vibration tests, using the principles described in [3], help in improving transmission stability and in ensuring satisfactory operation of transmission equipment. They should be made, wherever applicable, when new equipment is put into service, under special circumstances for fault locating purposes or even as a routine measure for preventive maintenance, if the Administration concerned deems it necessary.

5.8 *Automatic regulation by pilots (group pilots, supergroup pilots, etc.)*

In carrier systems, the presence of pilots (line pilots, group pilots, supergroup pilots, etc.) makes it possible to supervise transmission, to keep track of short-duration phenomena where necessary and to give the alarm if there are large variations in level.

Regulation by pilots and the way such regulation (manual or automatic) is carried out has a decisive effect on transmission stability. In addition to regulation by line pilots, with which wideband transmission systems are normally equipped, it may be necessary to regulate the group links themselves (group links, supergroup links, etc.), both to achieve adequate stability for the circuits formed from the groups and to reduce system overloading risks due to the existence of unduly high line levels.

Automatic regulation of links is a convenient means to meet the requirements for the values of M and S of the pilot levels as stated under § 2 above. Therefore, automatic regulators should be fitted into a link when these limits cannot be achieved by other means.

However, when setting up a link the need for fitting automatic regulators cannot be determined solely by these requirements. It is also necessary to take practical considerations into account such as those given in the Annex to this Recommendation.

In the case of through-connection points of group, supergroup, etc. links, the insertion of automatic regulators prevents overloading of sections further down the line. If a link is through-connected several times and several regulators have to be inserted for the same direction of transmission to meet the conditions of § 2.2 above, the first insertion should be made at the first through-connection point requiring regulation in that direction of transmission. A regulator should be inserted at the through-connection point nearest the frontier (in the outgoing direction) when there are one or more other through-connection points before this point on the same link. This is to ensure that the level of the signals entering the next country is kept within the prescribed limits.

ANNEX A

(to Recommendation M.160)

Practical aspects to be considered when determining the need for regulators

When setting up a link the need for fitting regulators cannot be determined solely by the requirements of § 2 above of this Recommendation. It is necessary to take the following practical considerations into account.

A.1 In order to establish that a link meets the stability requirements of this Recommendation it is either necessary to conduct long-term tests at the time of setting up the link or to accept measurements made on similar links, that is, to predict the performance.

If the former method is adopted, then, in the case of a link passing in transit through the territory of a third Administration it is probable that transit charges will apply from the date the link is set up. In any event, the cooperation of the distant terminal Administration will be required and this may not be readily forthcoming.

If the latter method is adopted and the stability requirements are not met, then the problem will arise of taking the link out of service to fit a regulator and to reline the link. This could entail a substantial loss of revenue and will require distant end cooperation.

A.2 It is unusual for a supergroup to be provided with all five groups allocated from the outset and it cannot be assumed that these groups will end at the same point as the supergroup. In any case, if a group that ends at the same point is changed to a through-group, then, unless a supergroup regulator has already been fitted, it may be necessary to interrupt service to fit a regulator and reline the supergroup link.

A.3 Consideration also has to be given to the restoration requirements when deciding to fit regulators to supergroup links. Lack of such regulators may seriously hamper restoration arrangements.

A.4 Frequent rearrangements occur on international routes and are outside the control of the distant Administration.

References

[1] *Statistical theory requirements*, Green Book, Vol. IV.2, Supplement No. 1.6, ITU, Geneva, 1973.

[2] CCITT Recommendation *Arrangement of carrier equipment*, Vol. III, Rec. G.231.

[3] *Vibration testing*, Green Book, Vol. IV.2, Supplement No. 2.9, ITU, Geneva, 1973.

[4] CCITT Recommendation *Line stability of cable systems*, Vol. III, Rec. G.214.

Recommendation M.250

USE OF CCITT MAN-MACHINE LANGUAGE (MML) FOR MAINTENANCE

1 MML as an instrument of maintenance

1.1 *Introduction*

This Recommendation provides an introduction to the subject of MML as an instrument of maintenance.

MML is a stored program controlled (SPC) facility which can operate only within a computer controlled environment. When considering international telephone system maintenance this will generally mean an SPC controlled exchange or network.

MML is the medium used by the operations and maintenance staff to communicate with the exchange control processor and vice versa[1].

The purposes of this Recommendation are to:

- bring to the attention of the user the range of functions and facilities offered by MML in the field of maintenance;
- identify the full range of MML functions and facilities provided to deal with maintenance;
- define a standard terminology to describe the conditions that can exist within an SPC network.

The objectives, tests and measurements for the maintenance of circuits between exchanges, remain as described in all relevant Series M Recommendations. This Recommendation does not seek to supplant existing Recommendations nor to provide alternative methods or values for maintenance but to give guidance on how the use of MML might be applied to existing standards and procedures.

1.2 *Definition of MML functions*

MML functions are those system functions which provide the MML user with the means of control of system functions by MML. The word "control" is assumed to include all types of inputs and outputs.

Any MML function can be subdivided into a general part which relates to items such as the syntax check, information transmission control, etc., and an application part which relates to the job in hand.

The relationship between actual jobs to be performed, MML functions and system functions is shown in Figure 1/M.250.

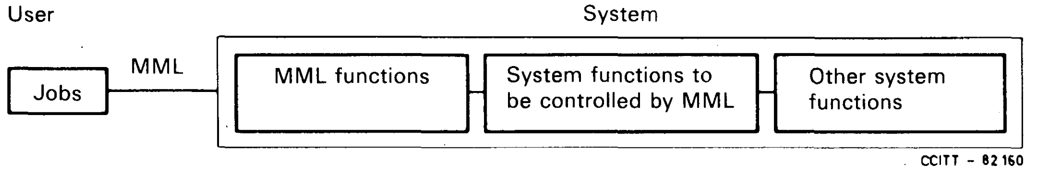


FIGURE 1/M.250

1.3 Although the purpose of this Recommendation is to cover the whole maintenance field, the following paragraphs deal only with maintenance of circuits between exchanges. The rest is for further study.

1) The structure, syntax and semantics of MML are fully described in the Series Z Recommendations published in Volume VI. Recommendation Z.311 describes the basis of the CCITT man-machine language and its fields of application. It also identifies the content of the other Series Z Recommendations all of which are addressed to the implementors of such languages rather than to the users.

2 List of system functions associated with the maintenance of circuits between exchanges

Table 1/M.250 presents a list of functions associated with the maintenance of circuits between exchanges which are considered to be controllable by means of MML.

TABLE 1/M.250

List of system functions

1	Tests/measurements of one circuit or a group of circuits and associated equipments
2	Observation and supervision of circuits and associated equipments between exchanges
3	Control of the status of a circuit or a group of circuits and associated equipments
4	Analysis of maintenance data
5	Administration and control of maintenance reports

The broad categories of system function shown in Table 1/M.250 relate to the activities engaged in by all Administrations with a responsibility for the maintenance of circuits interconnecting exchanges. The application of these activities will vary between Administrations as will the proportion of such activities that are performed by some degree of mechanization (partial or fully automatic).

System functions 4 and 5 may have such broad application that the extent of on-line and off-line treatment must be considered carefully by each Administration in relation to its requirements.

3 List of MML functions

Table 2/M.250 represents the list of MML functions necessary to control the system functions given in Table 1/M.250. The table presents the functions at their most basic level and does not necessarily represent the actual command structure of any real implementation of the man-machine language.

Each of the MML functions in the list could be implemented either by providing a separate and distinctive command, or several MML functions of the list could be implemented by means of a single command.

For example, in one implementation of MML, a single command CREATE, in which the object to be created will be defined as a parameter of the command (e.g. A MEASUREMENT), will perform internally precisely the same activities and functions as another implementation which provides a separate and distinctive command for the creation of each object (e.g. CREATE A MEASUREMENT). In this way the list of MML functions can be said to be system independent, as each function exists either implicitly or explicitly regardless of the methods of implementation chosen for particular systems.

The list of MML functions shown in Table 2/M.250 have a wider application than the maintenance of circuits between exchanges. Many of the functions identified are common to a wide range of maintenance and operational requirements, and the contents of the table should be considered whenever changes to the maintenance strategy and procedures are necessitated by the introduction or extension of MML in the maintenance field.

4 Terminology

The MML terminology to be used for maintenance is a subject for further study.

Note – Recommendation Z.341, Glossary of terms (for the man-machine language), suggests that a function may be considered as an "action upon an object", e.g. create a routine test. Actions e.g. "CREATE" are defined in the Appendix I to Recommendation Z.333 which describes the methodology for the specification of a man-machine interface. Objects and their modifiers, e.g. routine test, are the subject of further study.

TABLE 2/M.250

List of MML functions

1.1	Create a routine test
1.2	Create a routine measurement
1.3	Create a test set
1.4	Create a measurement set
1.5	Create a list of circuits
1.6	Create a time data list
1.7	Create an output media list
1.8	Delete a test set
1.9	Delete a measurement set
1.10	Delete a list of circuits
1.11	Delete a time data list
1.12	Delete an output media list
1.13	Interrogate a test
1.14	Interrogate a test set
1.15	Interrogate a measurement
1.16	Interrogate a measurement set
1.17	Interrogate a list of circuits
1.18	Interrogate a time data list
1.19	Interrogate an output media list
1.20	Activate a routine test
1.21	Activate a routine measurement
1.22	Activate an on-demand test
1.23	Activate an on-demand measurement
1.24	Deactivate a routine test
1.25	Deactivate a routine measurement
1.26	Output the results of a routine test
1.27	Output the results of a routine measurement
2.1	Interrogate the status of a circuit(s) and/or associated equipment(s)
2.2	Input trouble or restoral report
3.1	Remove a circuit (or group of circuits)
3.2	Restore a circuit (or group of circuits)
4.1	Activate maintenance analysis functions
4.2	Deactivate maintenance analysis functions
4.3	Change analysis thresholds
4.4	Change analysis groups
4.5	Interrogate analysis thresholds
4.6	Interrogate analysis groups
4.7	Allow, inhibit, initialize a threshold
5.1	Sort trouble or restoral reports
5.2	Move reports to other files
5.3	Browse report files
5.4	Create summary reports
5.5	Activate a report on demand
5.6	Activate a report on routine
5.7	Deactivate a report on routine
5.8	Change report classification
5.9	Output summary reports
5.10	Route output of reports

SECTION 2

INTERNATIONAL TRANSMISSION SYSTEMS

2.1 Definitions

Recommendation M.300

DEFINITIONS CONCERNING INTERNATIONAL TRANSMISSION SYSTEMS

1 Definitions concerning international analogue transmission systems

Note 1 – This Recommendation is partly duplicated in Recommendation G.211 [1].

Note 2 – Figure 1/M.300 refers to definitions 1.2 to 1.13. Figures 2/M.300, 3/M.300 and 4/M.300 refer to definitions 1.1 to 1.18.

Those of the following definitions that concern *links* or *sections* apply, unless otherwise stated, to the combination of both directions of transmission. A distinction between the two directions of transmission may, however, be necessary in the case of unidirectional, multiple-destination *links* or *sections* set up over multiple-destination communication satellite systems.

1.1 **line link (using symmetric pairs, coaxial pairs, radio-relay link, etc.)**

A transmission path, however provided, together with all the associated equipment, such that the bandwidth available, while not having any specific limits, is effectively the same throughout the length of the link.

Within the link there are no direct filtration points nor any through-connection points for groups, supergroups, etc., and the ends of the link are the points at which the band of line frequencies is changed in some way or other.

1.2 **group section**

The whole of the means of transmission using a frequency band of specified width (48 kHz) connecting two consecutive group distribution frames (or equivalent points).

1.3 **group link**

The whole of the means of transmission using a frequency band of specified width (48 kHz) connecting two terminal equipments, for example, channel translating equipments, wideband sending and receiving equipments (modems, etc.). The ends of the link are the points on group distribution frames (or their equivalent) to which the terminal equipments are connected.

It can include one or more group sections.

1.4 **group**

A group consists of a group link connected at each end to terminal equipments. These terminal equipments provide for the setting-up of a number of telephony channels (generally 12), one or more data transmission or facsimile channels, etc.

It occupies a 48 kHz frequency band. Figures 1/M.320, 2/M.320 and 3/M.320 show various possible arrangements of telephony channels in a basic group B (60 to 108 kHz).

1.5 supergroup section

The whole of the means of transmission using a frequency band of specified width (240 kHz) connecting two consecutive supergroup distribution frames (or equivalent points).

1.6 supergroup link

The whole of the means of transmission using a frequency band of specified width (240 kHz) connecting two terminal equipments, for example, group translating equipments, wideband sending and receiving equipments (modem, etc.). The ends of the link are the points on supergroup distribution frames (or their equivalent) to which the terminal equipments are connected.

It can include one or more supergroup sections.

1.7 supergroup

A supergroup consists of a supergroup link connected at each end to terminal equipments. These terminal equipments provide for the setting-up of five group links or sections occupying adjacent frequency bands in a 240 kHz band or for one or more data transmission or facsimile channels, etc.

The basic supergroup occupies the band 312 to 552 kHz. Figure 1/M.330 shows the position of groups and channels within the supergroup.

1.8 mastergroup section

The whole of the means of transmission using a frequency band of specified width (1232 kHz) connecting two consecutive mastergroup distribution frames (or equivalent points).

1.9 mastergroup link

The whole of the means of transmission using a frequency band of specified width (1232 kHz) connecting two terminal equipments, for example, supergroup translating equipments, wideband sending and receiving equipments (modems, etc.). The ends of the link are the points on mastergroup distribution frames (or their equivalent) to which the terminal equipments are connected.

It can include one or more mastergroup sections.

1.10 mastergroup

A mastergroup consists of a mastergroup link terminated at each end by terminal equipments. These terminal equipments provide for the setting-up of five supergroup links or sections occupying frequency bands separated by 8 kHz in a 1232 kHz band.

The basic mastergroup consists of supergroups 4, 5, 6, 7 and 8 within the band of frequencies 812 kHz to 2044 kHz. (See Figure 1/M.340.)

1.11 supermastergroup section

The whole of the means of transmission using a frequency band of specified width (3872 kHz) connecting two consecutive supermastergroup distribution frames (or equivalent points).

1.12 supermastergroup link

The whole of the means of transmission using a frequency band of specified width (3872 kHz) connecting two terminal equipments, for example, mastergroup translating equipments, wideband sending and receiving equipment (modems, etc.). The ends of the link are the points on supermastergroup distribution frames (or their equivalent) to which the terminal equipments are connected.

It can include one or more supermastergroup sections.

1.13 supermastergroup

A supermastergroup consists of a supermastergroup link connected at each end to terminal equipments. These terminal equipments provide for the setting-up of three mastergroup links or sections separated by two free spaces of 88 kHz and occupying a band whose total width is 3872 kHz. The basic supermastergroup is composed of mastergroups 7, 8 and 9 occupying the frequency band 8516-12 388 kHz. (See Figure 1/M.350.)

1.14 **15 supergroup assembly section** [1)]

The whole of the means of transmission using a frequency band of specified width (3716 kHz) connecting two consecutive 15 supergroup assembly distribution frames (or equivalent points) and connected, at least at one end, to through-15 supergroup assembly connection equipment. It always forms part of a 15 supergroup assembly link.

1.15 **supergroup assembly link** [1)]

The whole of the means of transmission using a frequency band of specified width (3716 kHz) connecting two 15 supergroup assembly distribution frames (or equivalent points). It can be made up of a number of 15 supergroup assembly sections. When terminal equipments are connected to both ends, it becomes a constituent part of a 15 supergroup assembly for carrying telephony or telegraphy channels or data or facsimile, etc.

1.16 **15 supergroup assembly**

A 15 supergroup assembly consists of a 15 supergroup assembly link terminated at each end by terminal equipments. These terminal equipments provide for the setting-up of 15 supergroup links or sections separated by free spaces of 8 kHz and occupying a band whose total width is 3716 kHz. The basic 15 supergroup assembly is made up of supergroups 2 to 16 occupying the frequency band 312-4028 kHz.

1.17 **through-group connection point**

When a group link is made up of several group sections, they are connected in tandem by means of through-group filters at points called through-group connection points.

1.18 **through-supergroup connection point**

When a supergroup link is made up of several supergroup sections, they are connected in tandem by means of through-supergroup filters at points called through-supergroup connection points.

1.19 **through-mastergroup connection point**

When a mastergroup link is made up of several mastergroup sections, they are connected in tandem by means of through-mastergroup filters at points called through-mastergroup connection points.

1.20 **through-supermastergroup connection point**

When a supermastergroup link is made up of several supermastergroup sections, they are connected in tandem by means of through-supermastergroup filters at points called through-supermastergroup connection points.

1.21 **through-15 supergroup assembly connection point**

When a 15 supergroup assembly link is made up of several 15 supergroup assembly sections, these sections are interconnected in tandem by means of through-15 supergroup assembly filters at points called through-15 supergroup assembly connection points.

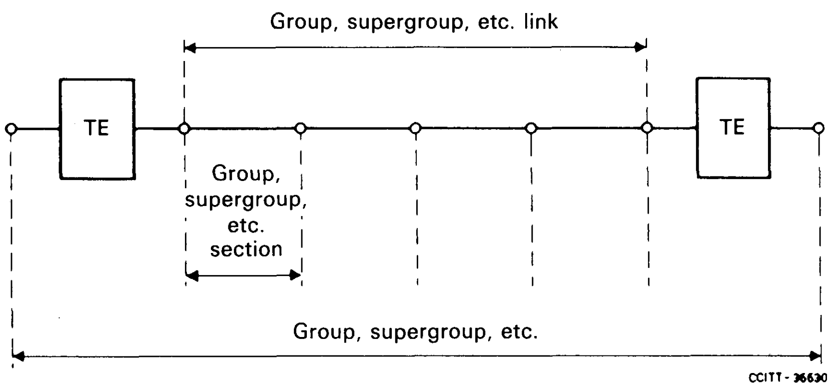
Note – In a country normally using mastergroup and supermastergroup arrangements, a 15 supergroup assembly can be through-connected without difficulty at the supermastergroup distribution frame by means of through-supermastergroup filters. In this case, the 15 supergroup assembly is through-connected to position 3 (8620-12 336 kHz) instead of position 1 (312-4028 kHz) as required by the definition of the through-connection point of such an assembly. The point where this through-connection is made is a through-supermastergroup connection point and not a through-15 supergroup assembly connection point.

---

1) This definition is still under study by Study Group IV and is not identical to the one given in Recommendation G.211 [1].

1.22 **regulated line section (symmetric pairs, coaxial pairs or radio relay links)**

In a carrier transmission system, a line section on which the line-regulating pilot or pilots are transmitted from end to end without being subjected to any intermediate amplitude regulation associated with the pilot or pilots.



TE = terminal equipment for telephony, data, facsimile transmission, etc.
—o— = distribution frame (or equivalent)

FIGURE 1/M.300

Group, supergroup, etc. link

2 Definitions concerning international digital transmission systems

Note 1 – This Recommendation is partly duplicated in Recommendation G.702 [2].

Note 2 – Figure 5/M.300 refers to definition 2.3 below. Figure 6/M.300 refers to definitions 2.10 to 2.19 below.

Those of the following definitions that concern digital paths or sections apply, unless otherwise stated, to the combination of both directions of transmission. A distinction between the two directions of transmission may, however, be necessary in the case of unidirectional, multiple-destination paths or sections set up over multiple-destination communication satellite systems.

2.1 **alarm indication signal (AIS)**

A signal that is used to replace the normal traffic signal when a maintenance alarm indication has been activated.

2.2 **upstream failure indication**

An indication provided by a digital multiplexer, line section or radio section, that a signal applied at its input port is outside its prescribed maintenance limit.

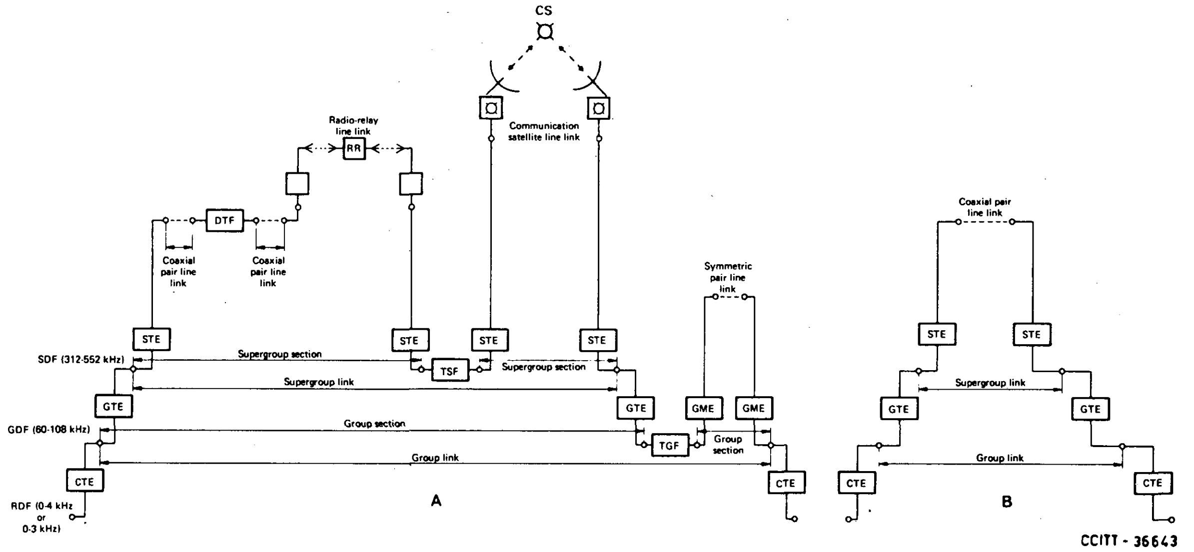
2.3 **primary block (American: digroup)**

A basic group of PCM channels assembled by time division multiplexing.

Note – The following conventions could be useful:

Primary block μ – a basic group of PCM channels derived from 1544 kbit/s PCM multiplex equipment.

Primary block A – A basic group of PCM channels derived from 2048 kbit/s PCM multiplex equipment.



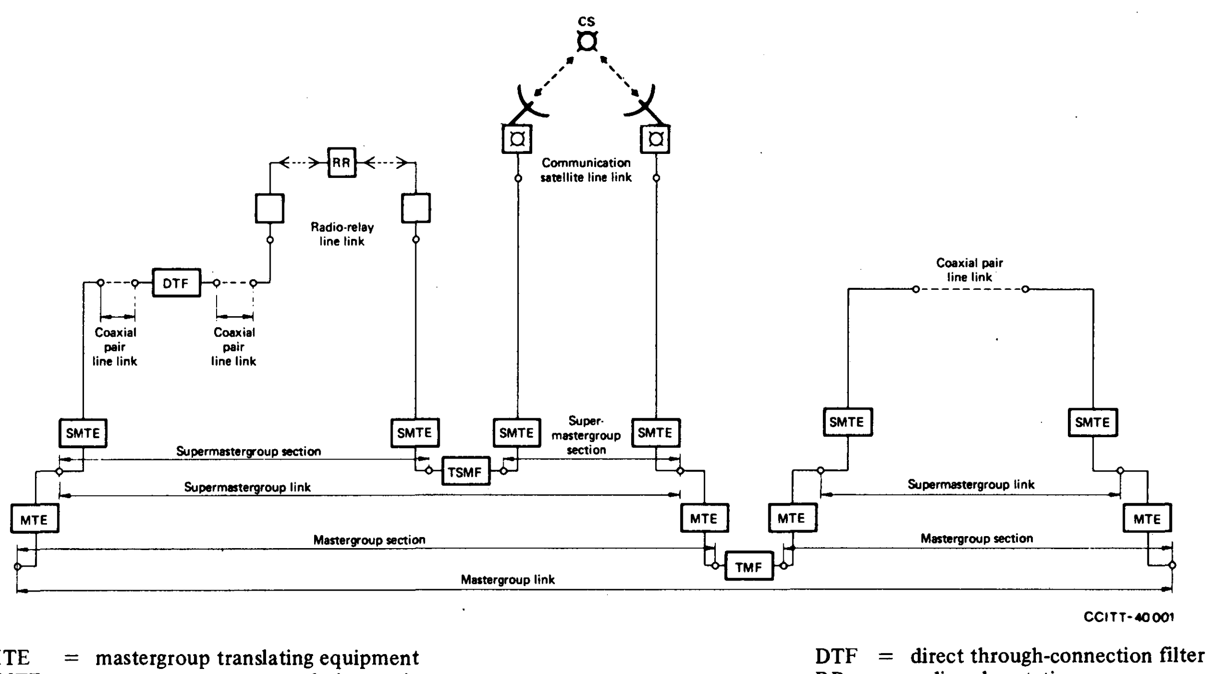
CTE = channel translating equipment
(translation of the audio band into the basic group or vice versa)
GTE = group translating equipment
(translation of the basic group into the basic supergroup)
STE = supergroup translating equipment
(translation of the basic supergroup into the line frequency on coaxial cable, or radio-relay system or vice versa)
GME = group modulating equipment

DTF = direct through-connection filter
TSF = through-supergroup filter
TGF = through-group filter
RDF = repeater distribution frame
GDF = group distribution frame
SDF = supergroup distribution frame
RR = radio-relay station
CS = communication satellite

(The terminology used in this figure is in conformity with the definitions of Recommendation M.300. However, there are small inconsistencies with respect to recommendations giving details of lining-up procedure.)

FIGURE 2/M.300

Channel of a group set-up on: several line links in tandem (A), a single line link (B)

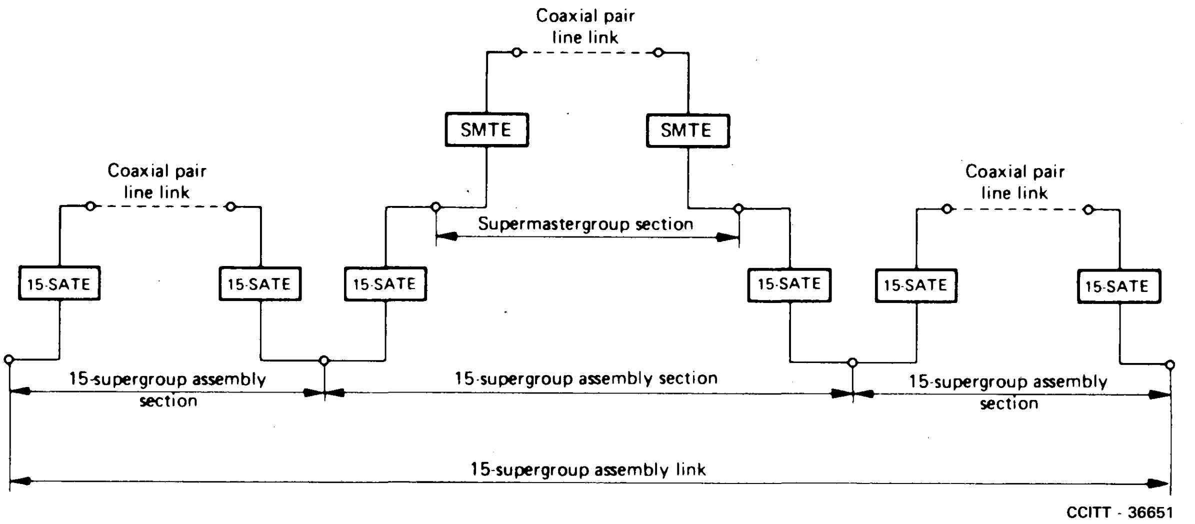


MTE = mastergroup translating equipment
SMTE = supermastergroup translating equipment
TMF = through-mastergroup filter
TSMF = through-supermastergroup filter

DTF = direct through-connection filter
RR = radio-relay station
CS = communication satellite

FIGURE 3/M.300

Mastergroup link



SMTE = supermastergroup translating equipment
15-SATE = 15-supergroup assembly translating equipment

FIGURE 4/M.300

15-supergroup assembly link

2.4 PCM multiplex equipment

Equipment for deriving a single digital signal at a defined digit rate from two or more analogue channels by a combination of pulse code modulation and time division multiplexing (multiplexer) and also for carrying out the inverse function (demultiplexer).

The term should be preceded by the relevant equivalent binary digit rate, e.g., 2048-kbit/s PCM multiplex equipment.

2.5 digital multiplexer

Equipment for combining by time division multiplexing two or more tributary digital signals into a single composite digital signal.

2.6 muldex

A contraction of multiplexer-demultiplexer. The term may be used when the multiplexer and demultiplexer are associated in the same equipment.

Note – When used to describe an equipment, the function of the equipment should qualify the title, e.g., PCM muldex, data muldex, digital muldex.

2.7 digital multiplex equipment

The combination of a digital multiplexer and a digital demultiplexer at the same location.

2.8 digital multiplex hierarchy

A series of digital multiplexers graded according to capability so that multiplexing at one level combines a defined number of digital signals, each having the digit rate prescribed for a lower order, into a digital signal having a prescribed digit rate which is then available for further combination with other digital signals of the same rate in a digital multiplexer of the next higher order.

2.9 transmultiplexer

An equipment that transforms frequency division multiplexed signals (such as group or supergroup) into corresponding time division multiplexed signals that have the same structure as those derived from PCM multiplex equipment. The equipment also carries out the inverse function.

2.10 **digital distribution frame**

A frame at which interconnections are made between the digital outputs of equipments and the digital inputs of other equipments.

2.11 **digital section**

The whole of the means of transmitting and receiving between two consecutive digital distribution frames (or equivalent) a digital signal of specified rate.

Note 1 – A digital section forms either a part or the whole of a digital path.

Note 2 – Where appropriate, the bit rate should qualify the title.

2.12 **digital path**

The whole of the means of transmitting and receiving a digital signal of specified rate between those two digital distribution frames (or equivalent) at which terminal equipments or switches will be connected. Terminal equipments are those at which signals at the specified bit rate originate or terminate.

Note 1 – A digital path comprises one or more digital sections.

Note 2 – Where appropriate, the bit rate should qualify the title.

Note 3 – Digital paths interconnected by digital switches form a digital connection.

2.13 **digital line section**

Two consecutive line terminal equipments, their interconnecting transmission medium and the in-station cabling between them and their adjacent digital distribution frames (or equivalents), which together provide the whole of the means of transmitting and receiving between two consecutive digital distribution frames (or equivalents) a digital signal of specified rate.

Note 1 – Line terminal equipments may include the following:

– regenerators,
– code converters,
– scramblers,
– remote power feeding,
– fault location,
– supervision.

Note 2 – A digital line section is a particular case of a digital section.

2.14 **digital line system**

A specific means of providing a digital line section.

2.15 **digital block**

The combination of a digital path and associated digital multiplex equipments.

Note – The bit rate of the digital path should form part of the title.

2.16 **digital line path**

Two or more digital line sections interconnected in tandem in such a way that the specified rate of the digital signal transmitted and received is the same over the whole length of the line path between the two terminal digital distribution frames (or equivalent).

2.17 **digital radio section**

Two consecutive radio terminal equipments and their interconnecting transmission medium which together provide the whole of the means of transmitting and receiving between two consecutive digital distribution frames (or equivalents) a digital signal of specified rate.

Note – A digital radio section is a particular case of a digital section.

2.18 **digital radio system**

A specific means of providing a digital radio section.

2.19 **digital radio path**

Two or more digital radio sections interconnected in tandem in such a way that the specified rate of the digital signal transmitted and received is the same over the whole length of the radio path between the two terminal digital distribution frames (or equivalent).

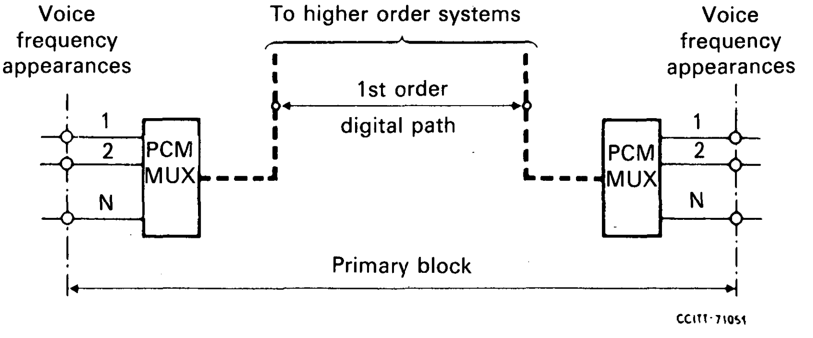


FIGURE 5/M.300

Example of a primary block

3 General definitions for international transmission systems

3.1 **national section**

The digital sections and group, supergroup, etc., sections between a station with control or subcontrol functions and a frontier station within the same country are termed comprehensively a national section. A national section will usually comprise several digital, group, supergroup, etc., sections. The digital, group, supergroup, etc., sections between the two stations with control functions within one country also constitute a national section.

3.2 **international section**

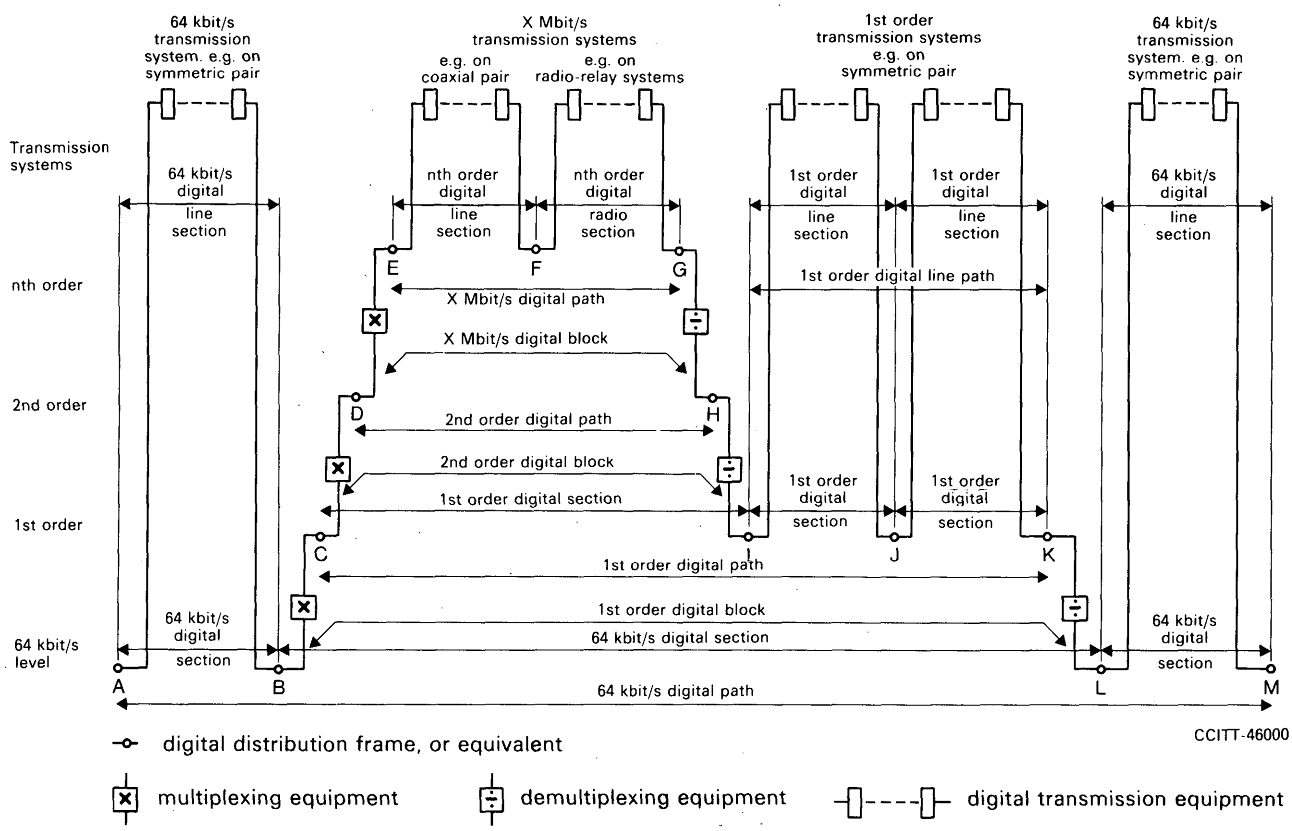
The digital, group, supergroup, etc., sections between two adjacent frontier stations in different countries constitute an international section. Some international sections may be a single digital, group, supergroup, etc., section routed over long submarine cable systems. If the international group, supergroup, etc., is routed via intermediate countries without the digital path being demultiplexed to its characteristic bit rate/basic frequency band, the frontier stations at the ends of the international digital, group, supergroup, etc., section are still considered to be adjacent.

3.3 **main section**

The sections into which a digital path or group, supergroup, etc., link is divided by the digital path, group, supergroup, etc., control and subcontrol stations are called main sections. A main section is the portion of the digital path or, group, supergroup, etc., link between two adjacent stations having control functions. In many cases, these two stations are in different countries. In the case of a country which has elected to have more than one station with control functions, a main section will lie wholly within that country. (See Figure 2/M.460.)

4 Definitions concerning international channels

Note 1 – Figure 7/M.300 refers to definition 4.2 below. Figures 8/M.300 and 9/M.300 refer to definition 4.3 below.



Note 1 — Digital line and radio sections may be at digit rates which are either hierarchical or non-hierarchical.
Note 2 — A-B is a 64 kbit/s digital line section, which is a particular case of a 64 kbit/s digital section.
Note 3 — A-M is a 64 kbit/s digital path which comprises three 64 kbit/s digital sections, A-B, B-L and L-M.
Note 4 — F-G is an X Mbit/s digital radio section which forms part of an X Mbit/s digital path E-G.
Note 5 — C-I is a 1st order digital section which contains a 2nd order digital path D-H.
Note 6 — I-K is an example of a digital line path.

FIGURE 6/M.300
Examples of digital path, digital section, digital line section, etc.

A channel, as used in the Series M Recommendations with international transmission systems and international telephone circuits, is a one-way transmission capability for a voice-frequency or equivalent voice-frequency signal. The specific types of channels are:

4.1 analogue channel

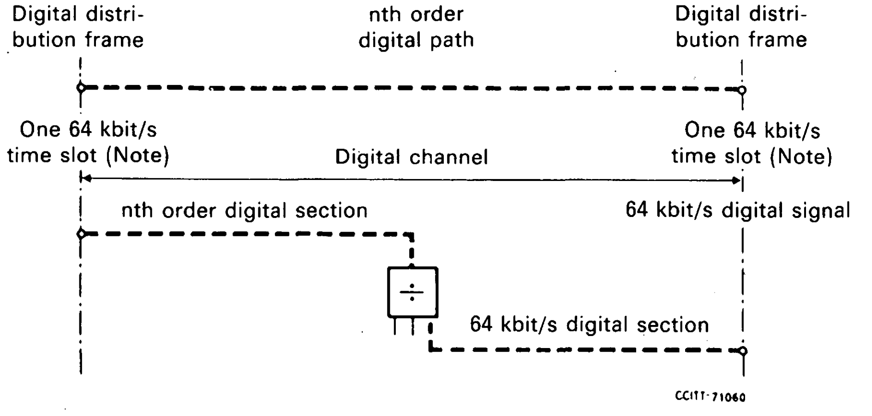
An analogue channel is a one-way transmission capability which is provided on audio pairs or analogue transmission systems, and which appears at voice frequency at both ends. Where an analogue channel is provided by an analogue transmission system, it will not have voice frequency appearances other than at its ends.

4.2 digital channel

A digital channel provides one-way 64 kbit/s transmission capability, on a digital path. A digital channel appears at both ends on a digital distribution frame or equivalent either at 64 kbit/s or as a 64 kbit/s time slot in a digital path at a specified level of the digital hierarchy.

4.3 **mixed analogue/digital channel**

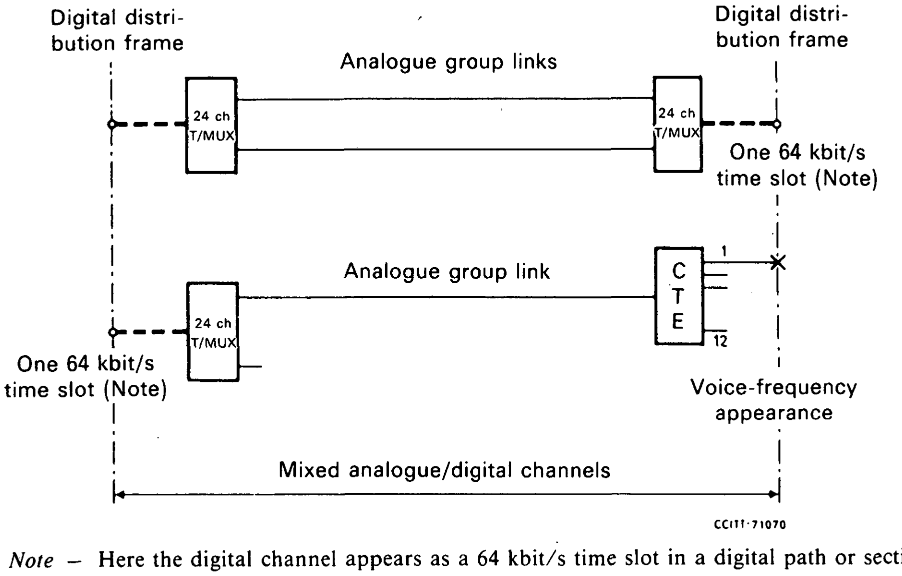
A mixed analogue/digital channel is a one-way transmission capability provided over an analogue transmission system with transmultiplexer equipment at one end and transmultiplexer or analogue translating equipment at the other end. Where the end of the channel is provided by transmultiplexer equipment, the channel appears as a 64 kbit/s time slot on a digital distribution frame at the output of the transmultiplexing equipment in a digital path at a specified level of the digital hierarchy. Where the end of the channel is provided by analogue translating equipment, it appears at voice frequency.



Note – Here the digital channel appears as a 64 kbit/s time slot in a digital path or section. It is not directly accessible.

FIGURE 7/M.300

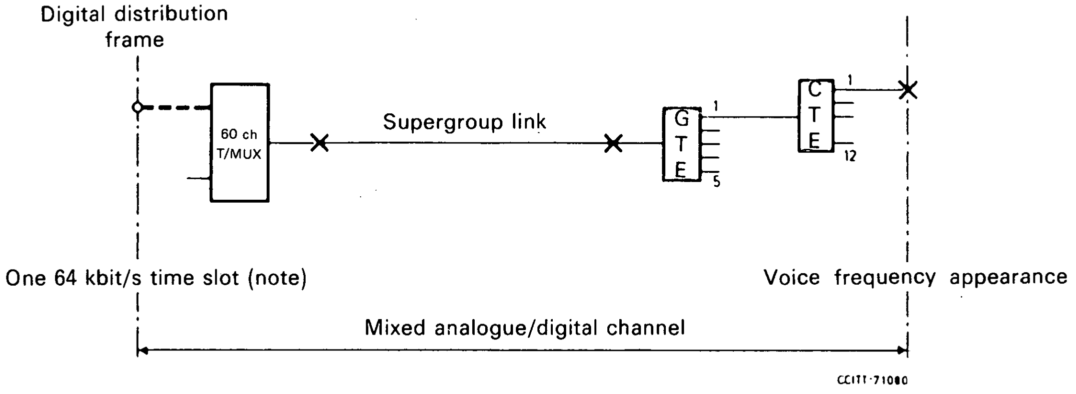
Diagrammatic representations of a digital channel



Note – Here the digital channel appears as a 64 kbit/s time slot in a digital path or section. It is not directly accessible.

FIGURE 8/M.300

Examples of mixed analogue/digital channels



60 ch T/MUX Transmultiplexer (60 channel type)

GTE Group translating equipment

CTE Channel translating equipment

Note – Here the digital channel appears as a 64 kbit/s time slot in a digital path. It is not directly accessible.

FIGURE 9/M.300

Example of a mixed analogue/digital channel

References

[1] CCITT Recommendation *Make-up of carrier links*, Vol. III, Rec. G.211.

[2] CCITT Recommendation *Vocabulary of pulse code modulation (PCM) and digital transmission terms*, Vol. III, Rec. G.701.

2.2 Numbering of channels, groups, supergroups, etc. and digital blocks in transmission systems

Recommendation M.320

NUMBERING OF THE CHANNELS IN A GROUP

1 General

The position of a channel within a group is identified by a number starting from 1, the numbers of the different channels being taken in order of frequency in the basic group frequency band.

A channel is said to be *erect* within a group when the frequencies in the group-frequency band corresponding to the audio-frequencies in the channels *ascend* in the same relative order as those in the channels forming the group.

Similarly, a channel is said to be *inverted* within a group when the frequencies in the group-frequency band descend in the same relative order as the ascending order of the frequencies in the channels.

A group, supergroup, etc., is said to be *erect* when all of its channels are *erect* and is said to be *inverted* when all of its channels are *inverted.*

1.1 *8 channel group*

Basic group B is *inverted.* The channels will be numbered from 1 to 8 in descending order of frequency within the group-frequency range. (See the recommended arrangement in Recommendation G.234 [1]).

The numbering is as shown in Figure 1/M.320.

1.2 *12 channel group*

Basic group B is *inverted.* The channels will be numbered from 1 to 12 in descending order of frequency within the group-frequency range.

The numbering is as shown in Figure 2/M.320.

1.3 *16 channel group*

Channels of a 16 channel group are normally assembled in the basic group B frequency range. The channels are numbered from 1 to 16 in descending order of frequency within the basic group B frequency band, the odd-numbered channels being *erect* and the even-numbered channels being *inverted.* It is therefore not possible in this case to speak of an *erect* or *inverted* group.

The numbering is as shown in Figure 3/M.320.

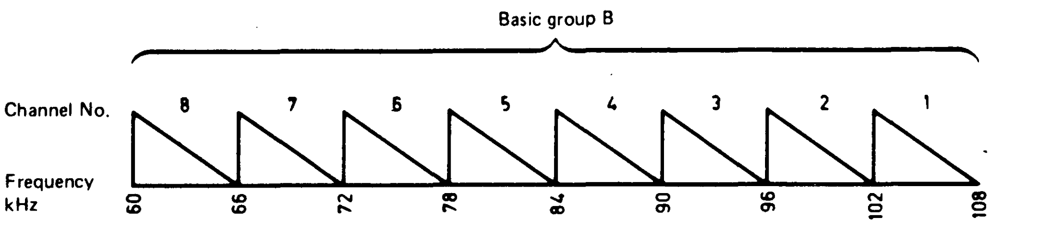
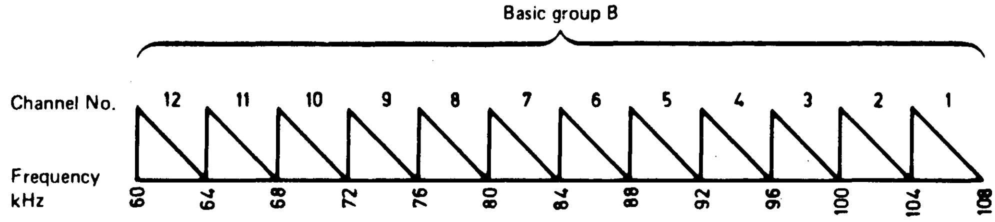


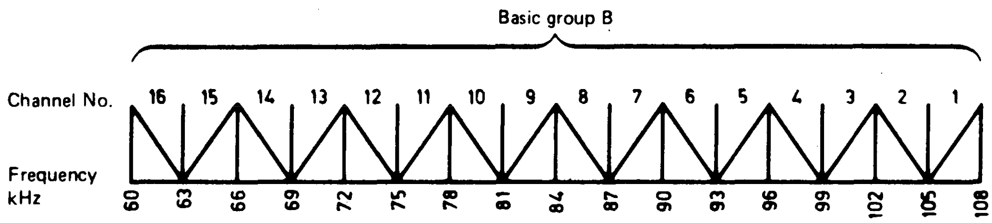
FIGURE 1/M.320
Numbering of channels in 8 channel group



CCITT - 36670

FIGURE 2/M.320

Numbering of channels in 12 channel group



CCITT - 36680

FIGURE 3/M.320

Numbering of channels in 16 channel group

Reference

[1] CCITT Recommendation *8-channel terminal equipments*, Orange Book, Vol. III-1, Rec. G.234, ITU, Geneva, 1977.

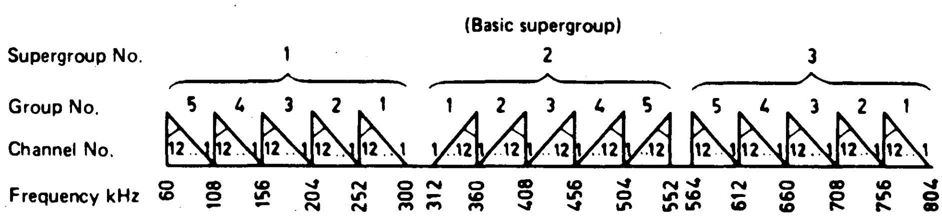
Recommendation M.330

NUMBERING OF GROUPS WITHIN A SUPERGROUP

The position occupied by a group within a supergroup is identified by a number in the series from 1 to 5, the numbers being allocated in ascending order of frequency in the basic supergroup 312 kHz to 552 kHz and in descending order of frequency in the other supergroups. (See Figure 1/M.330.)

If all the groups comprising the supergroup are erect:

- the basic supergroup is said to be *erect*;
- the other supergroups are said to be *inverted*.



CCITT - 36690

FIGURE 1/M.330

Numbering of 12 circuit groups and channels in supergroups

Recommendation M.340

NUMBERING OF SUPERGROUPS WITHIN A MASTERGROUP

The position of a supergroup within a mastergroup is identified by a number in the series from 4 to 8 which refers to one of the numbers of the supergroups constituting the basic mastergroup in the supergroup arrangement of the standard 4-MHz coaxial system.

The numbering is shown in Figure 1/M.340.

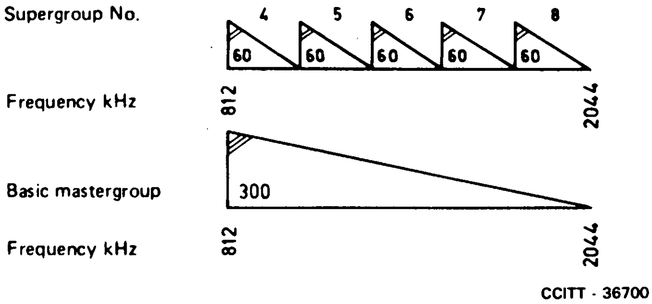


FIGURE 1/M.340

Numbering of supergroups within the basic mastergroup

Recommendation M.350

NUMBERING OF MASTERGROUPS WITHIN A SUPERMASTERGROUP

The position of a mastergroup within a supermastergroup is identified by a number in the series from 7 to 9 which refers to one of the numbers of the mastergroups constituting the basic supermastergroup.

The numbering is shown in Figure 1/M.350.

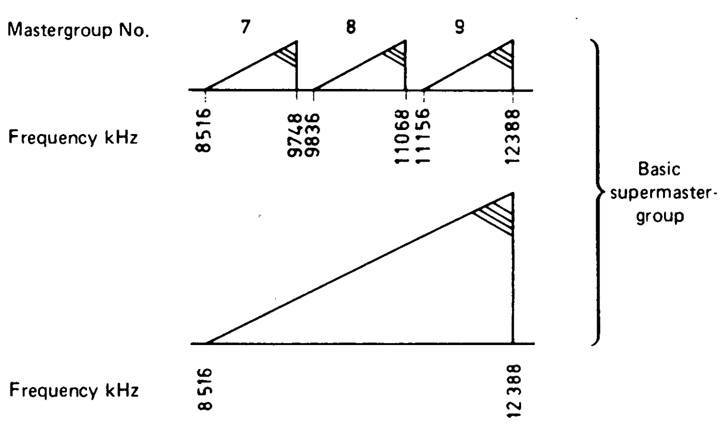


FIGURE 1/M.350

Numbering of mastergroup within a supermastergroup

NUMBERING IN COAXIAL SYSTEMS

1 Numbering of groups, supergroups, etc., and of channels in coaxial systems

1.1 *Numbering of a supermastergroup or of a 15 supergroup assembly*

The supermastergroups and 15 supergroup assemblies of a coaxial system are identified by numbers giving their respective position in the frequency spectrum transmitted on the line. The numbering is shown in Figures 1/M.380, 2/M.380 and 3/M.380.

1.2 *Numbering of a mastergroup*

The mastergroups of a coaxial system are identified by numbers giving their respective position in the frequency spectrum transmitted on the line. The numbering is shown in Figures 1/M.380, 2/M.380, 4/M.380, 8/M.380 and 10/M.380.

Alternatively, when a mastergroup is regarded as being part of a supermastergroup, the position of the mastergroup can be indicated by the number of that supermastergroup followed by the number of mastergroup within the basic supermastergroup (for example, in Figure 1/M.380, the 5652-6884 kHz mastergroup in a 12 MHz system with supermastergroup frequency allocation is designated by the two numbers 2 and 8).

1.3 *Numbering of a supergroup*

The supergroups of a coaxial system are identified by numbers giving their respective position in the frequency spectrum transmitted on the line. The numbering is shown in Figures 2/M.380, 5/M.380, 6/M.380, 7/M.380 and 9/M.380.

The position of a supergroup that is part of a mastergroup is designated by the number of that mastergroup followed by the number of the supergroup within the basic mastergroup (examples: in Figure 1/M.380, the 5652-5892 kHz supergroup in a 12-MHz system with supermastergroup frequency allocation is designated by the three numbers 2, 8 and 4; in Figure 8/M.380, the 4332-4572 kHz supergroup in a 6-MHz system with mastergroup frequency allocation is designated by the two numbers 4 and 4).

The position of a supergroup that is part of a 15 supergroup assembly is designated by the number of that 15 supergroup assembly followed by the number of the supergroup within the basic 15 supergroup assembly (for example, in Figure 3/M.380, the 10 356-10 596 kHz supergroup in a 12-MHz system with frequency allocation by 15 supergroup assemblies is designated by the two numbers 3 and 9).

1.4 *Numbering of a group*

The position of a group is designated by the number of the supergroup in which it is placed followed by the number of the group within that supergroup (examples: in Figure 1/M.380 the 5844 - 5892 kHz group in a 12-MHz system with supermastergroup frequency allocation is designated by the four numbers 2, 8, 4 and 1; in Figure 8/M.380, the 4924 - 4972 kHz group in a 6-MHz system with mastergroup frequency allocation is designated by the three numbers 4, 6 and 3).

1.5 *Numbering of a channel*

The position occupied by a channel is designated by the number of the group to which it belongs followed by the number of the channel within that group (examples: in Figure 1/M.380, the 5884-5888 kHz channel in a 12-MHz system with supermastergroup frequency allocation is designated by the five numbers 2, 8, 4, 1 and 2; in Figure 8/M.380, the 4936-4940 kHz channel in a 6-MHz system with mastergroup frequency allocation is designated by the four numbers 4, 6, 3 and 9).

Note – In this system of numbering, the order of the numbers corresponds to a decreasing bandwidth, that is to say, number of supermastergroup (if any) followed by the numbers of the mastergroup, supergroup, group and channel.

2 Standard frequency allocations on 2.6/9.5 mm coaxial pairs

The CCITT has recommended various methods for allocating supermastergroups, mastergroups, supergroups and 15 supergroup assemblies on 2.6/9.5-mm coaxial pairs. The method for each standard system is given below. The identification numbers are shown in each figure to facilitate application of the rules set forth above.

2.1 *12-MHz systems using valves or transistors*

The frequency allocation for 12-MHz systems is in conformity with scheme 1A, 1B or 2 shown in Figures 1/M.380, 2/M.380 and 3/M.380.

The CCITT has also recommended the frequency-allocation scheme in Figure 4/M.380 for the simultaneous transmission of telephony and television.

2.2 *4-MHz systems*

Scheme A of Figure 5/M.380 shows the frequency-allocation scheme used in this case. The 2604-kHz pilot is used only in the 2.6-MHz system described below in § 2.3.

The 4287-kHz pilot is recommended only for 4-MHz systems on 1.2/4.4-mm coaxial pairs.

2.3 *2.6-MHz systems*

The frequency-allocation scheme for a 2.6-MHz system uses the scheme in Figure 5/M.380 retaining only supergroups 1 to 10 inclusive.

The pilots are: 60 or 308 kHz and 2604 kHz.

3 Standard frequency allocations on 1.2/4.4-mm coaxial pairs

The CCITT has recommended various methods for allocating supermastergroups, mastergroups, supergroups and 15 supergroup assemblies on 1.2/4.4-mm coaxial pairs. The method for each standard system is given below. The identification numbers are shown in each figure to facilitate application of the rules set forth in § 1 above.

3.1 *12-MHz systems*

The frequency-allocation schemes are the same as for 2.6/9.5-mm pairs (see Figures 1/M.380, 2/M.380 and 3/M.380).

3.2 *6-MHz systems*

The frequency allocation for 6-MHz systems is in conformity with scheme 1, 2 or 3 shown in Figures 6/M.380, 7/.380 and 8/M.380.

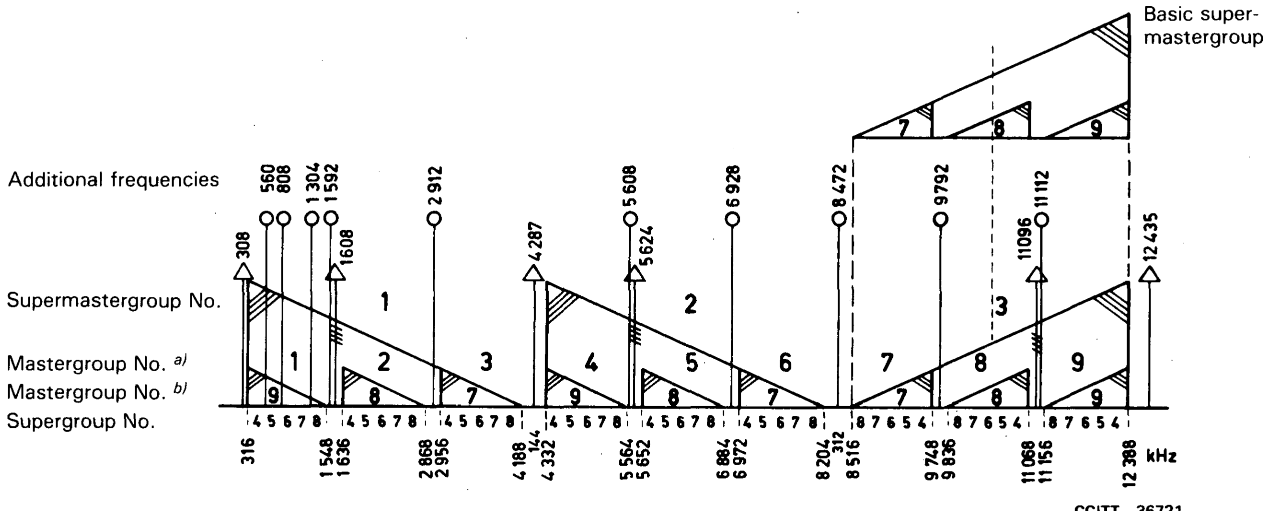
3.3 *4-MHz systems*

The line-frequency allocation scheme A shown in Figure 5/M.380 is the same as for 2.6/9.5-mm pairs. However, the 4287 kHz pilot must be transmitted continuously if one of the Administrations concerned so requests.

Scheme B of Figure 5/M.380 shows the line-frequency allocation scheme used for mastergroups.

3.4 *1.3-MHz systems*

The line-frequency allocation scheme is in conformity with one of the schemes shown in Figures 9/M.380 and 10/M.380.



a) Numbering of mastergroups transposed to line

b) Numbering of mastergroups transposed within the supermastergroups

FIGURE 1/M.380

Frequency allocation (Scheme 1A) for 12-MHz systems

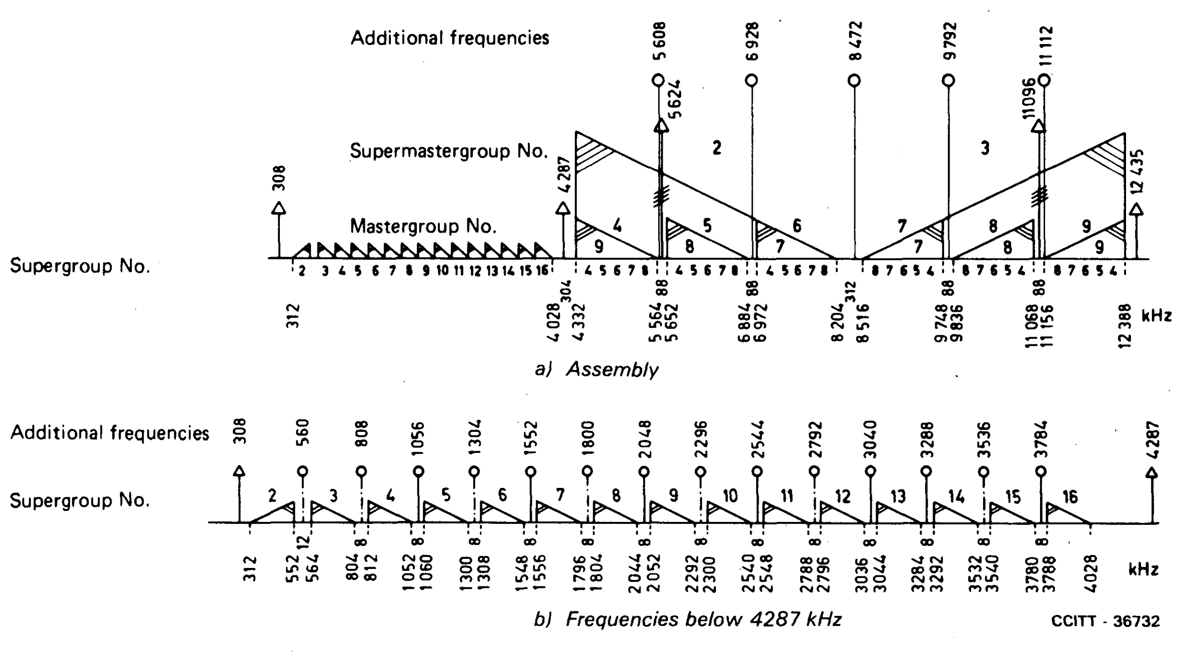


FIGURE 2/M.380

Frequency allocation (Scheme 1B) for 12-MHz systems

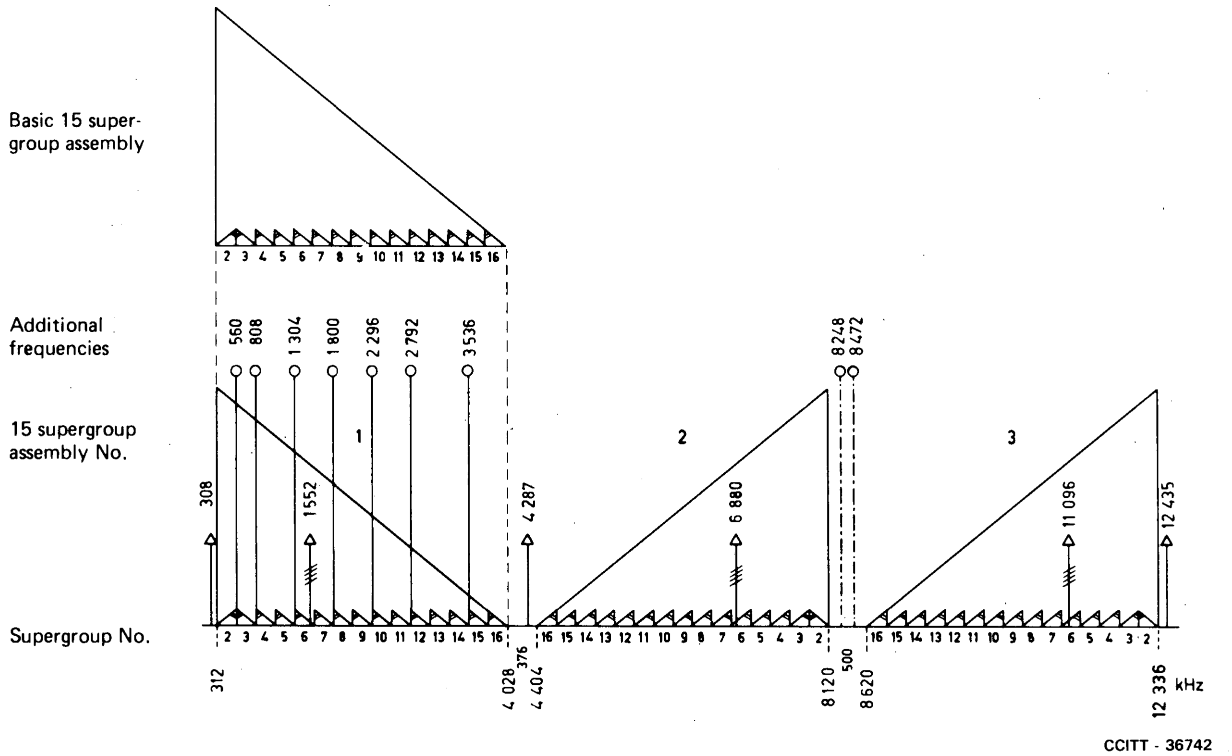


FIGURE 3/M.380

Frequency allocation (Scheme 2) for 12-MHz systems

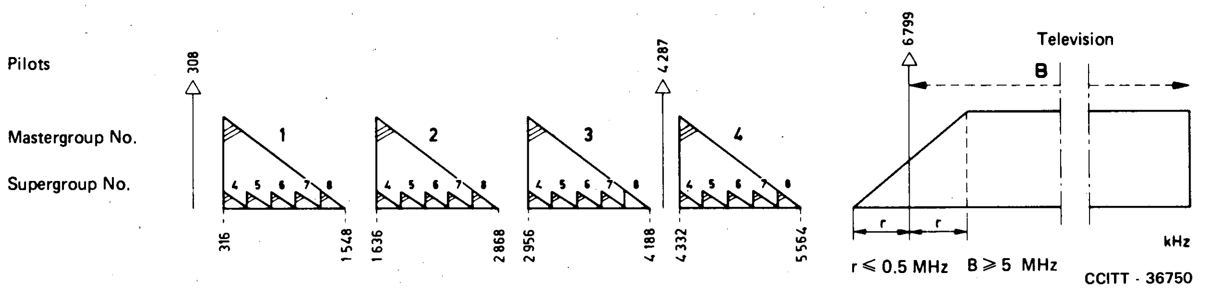


FIGURE 4/M.380

Line-frequency allocation for 12-MHz systems (simultaneous transmission of telephony and television)

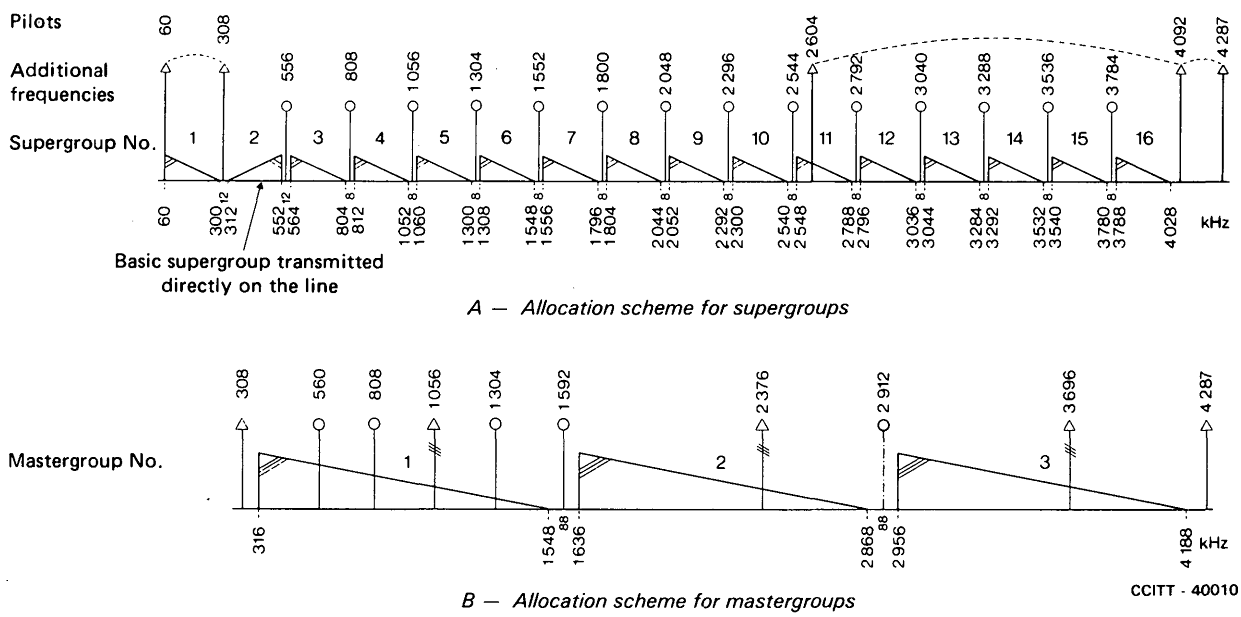


FIGURE 5/M.380

Line-frequency allocation for 4-MHz systems

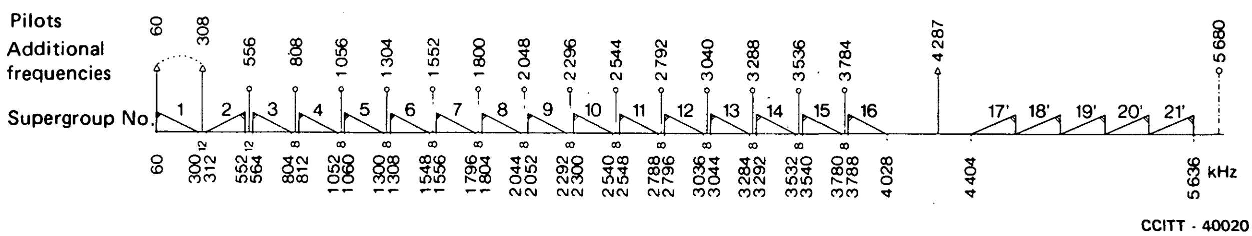


FIGURE 6/M.380

Line-frequency allocation for 6-MHz systems (Scheme 1)

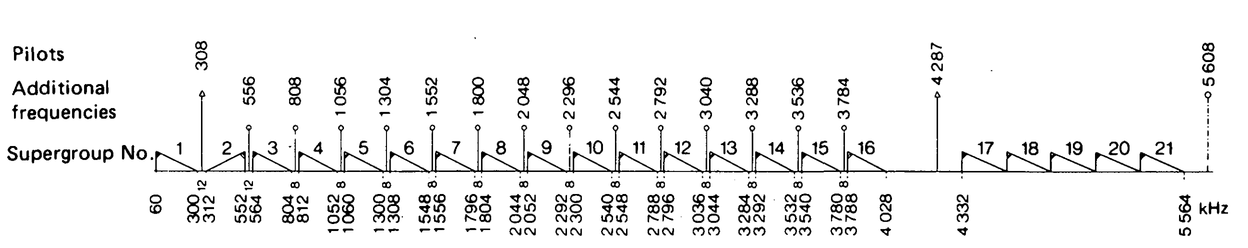


FIGURE 7/M.380

Line-frequency allocation for 6-MHz systems (Scheme 2)

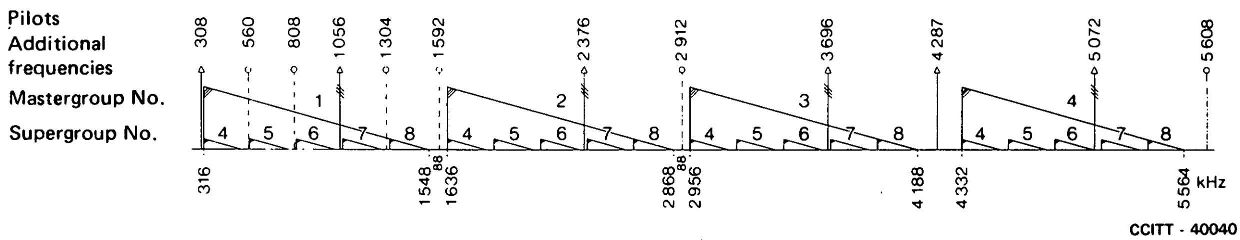


FIGURE 8/M.380
Line-frequency allocation for 6-MHz systems (Scheme 3)

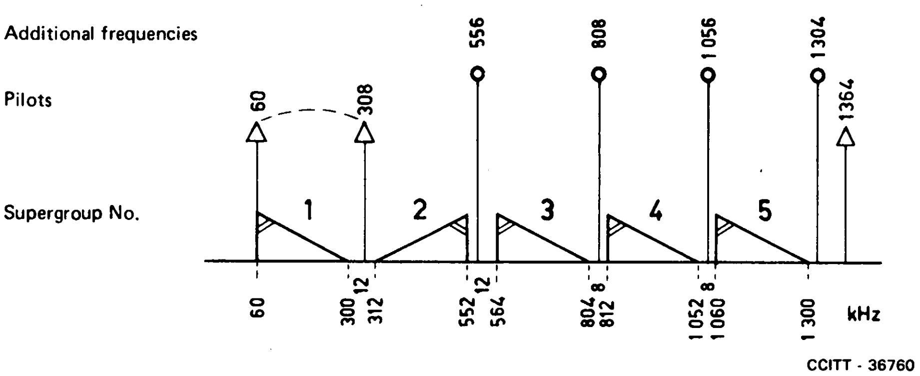


FIGURE 9/M.380
Line-frequency allocation for 1.3-MHz systems (Scheme 1)

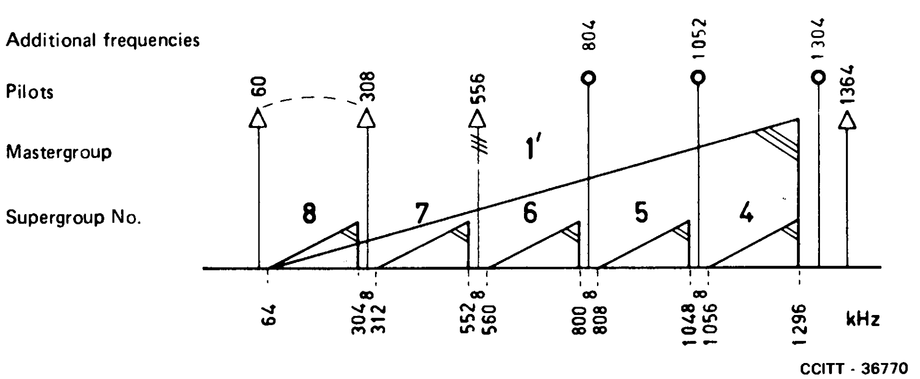


FIGURE 10/M.380
Line-frequency allocation for 1.3-MHz systems (Scheme 2)

Recommendation M.390

NUMBERING IN SYSTEMS ON SYMMETRIC PAIR CABLE

1 Systems providing 12 telephone carrier circuits on a symmetric pair in cable (12 + 12) systems

In systems of the 12 + 12 type, 12 go and 12 return channels constitute one 12 circuit group.

For the arrangement of the line frequencies transmitted for 12 + 12 cable systems using transistors, the Administrations concerned in setting up such an international system can make their choice from scheme 1 or scheme 2 of Figure 1/M.390. Systems using scheme 2 can use only pilot frequencies of 54 kHz or 60 kHz.

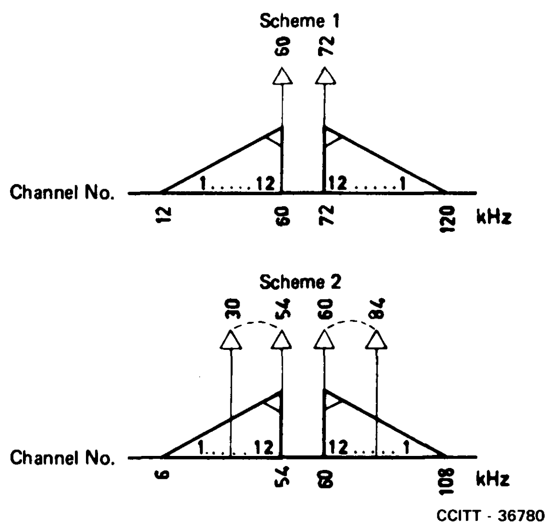


FIGURE 1/M.390

Figure 1/M.390 also applies to (12 + 12) systems using valves, provided that in the case of scheme 2 the indicated line-regulating pilots of 54 kHz and 60 kHz, or 30 kHz and 84 kHz, can be chosen as pilot frequencies.

2 Systems providing five groups or less

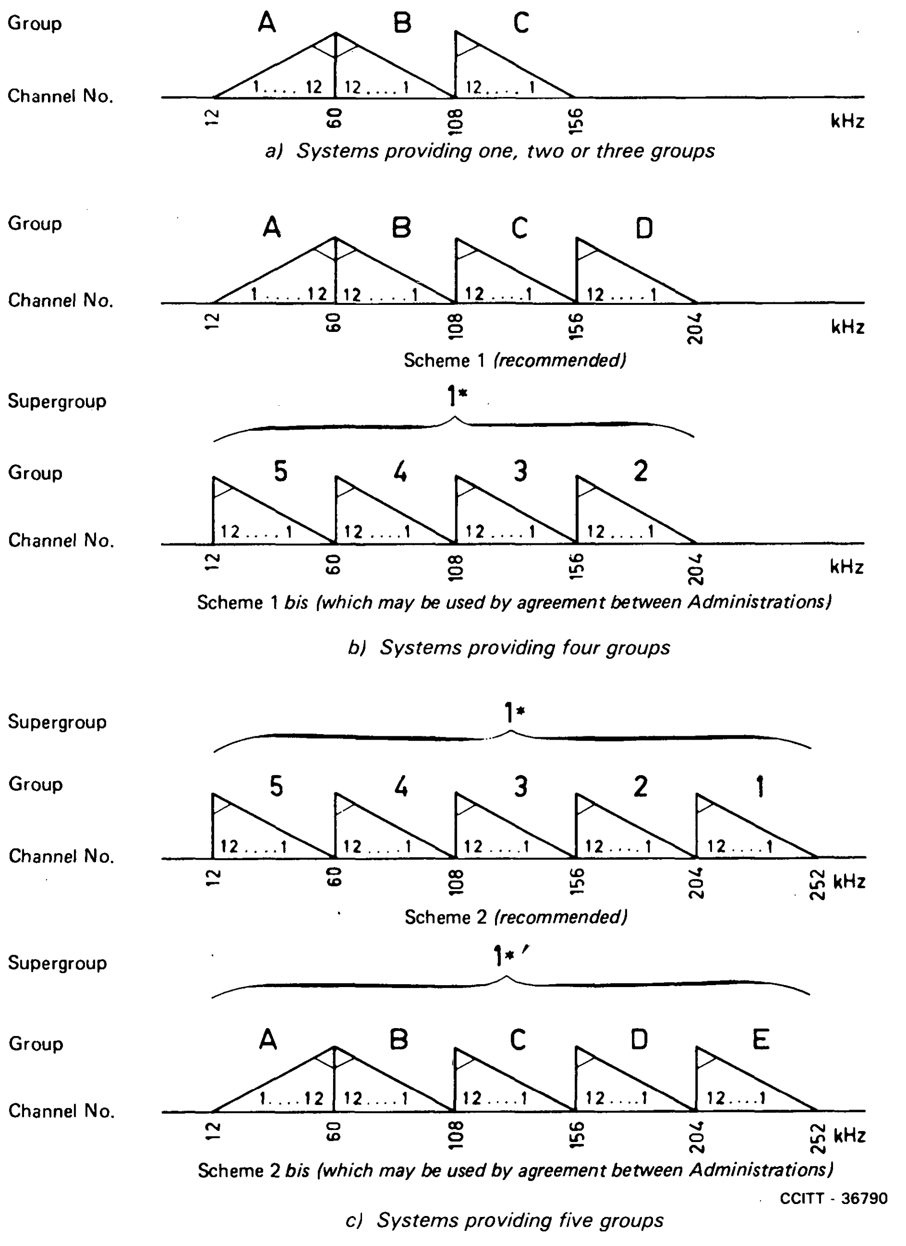
2.1 *Numbering in systems comprising both erect and inverted groups*

2.1.1 *Designation of groups*

The following indications are used to define the position of the group on the line, as shown in Figure 2/M.390:

A: 12-60 kHz group; B: 60-108 kHz group; C: 108-156 kHz group;

D: 156-204 kHz group; E: 204-252 kHz group.



Note — This figure also shows the channel numbering in the case of 12-channel groups. For the channel numbering of 8-channel and 16-channel groups respectively, see Figures 1/M.320 and 3/M.320.

FIGURE 2/M.390

Line-frequency allocation and arrangement of sidebands for carrier systems on symmetric pair cables

2.1.2 *Designation of channels*

The position occupied by a telephone channel of a carrier system is designated by means of a letter giving the position of the group (transmitted on the line) containing the channel and by means of the number of the channel within this group.

The designation of a channel on such a carrier system is therefore of the form A-7, C-9, D-4, etc. (i.e. group A, channel 7, etc.).

2.2 *Numbering in systems with inverted groups*

In this case, all the groups are in the same sense. For systems with five groups on symmetric pair cable, this is the normal arrangement which is as shown in Scheme 2 of Figure 2/M.390 *c)*.

2.2.1 *Numbering of the groups*

The five groups, all in the same sense, are numbered in the direction of ascending frequency, 5, 4, 3, 2, 1 and the assembly constitutes a supergroup having a displacement by 48 kHz towards the lower frequencies of supergroup 1 of 4-MHz coaxial system. For this reason the assembly of groups in the figure is designated by the number 1*, in order to integrate this supergroup with the general numbering for supergroups.

2.2.2 *Numbering of channels*

The place occupied by a telephone channel in such a carrier system is also designated by three numbers, e.g. 1*-4-11 (i.e. supergroup 1*, 12 channel group 4, channel 11).

2.3 *Systems with four groups*

By agreement between the Administrations concerned, one group of supergroup 1* may be omitted, but the above numbering of the groups and channels in the groups should be retained as if no group had been omitted [see scheme 1 *bis* of Figure 2/M.390 *b)*].

3 Systems providing two supergroups

3.1 *Alternative frequency arrangements*

The two recommended frequency arrangements are shown in scheme 3 and scheme 4 of Figure 3/M.390. In scheme 4, the line-frequency allocation is the same as that for coaxial cable systems, and permits satisfactory interconnection at basic supergroup frequencies (312-552 kHz) between supergroups in these coaxial systems and the two supergroups on symmetric pair cable systems.

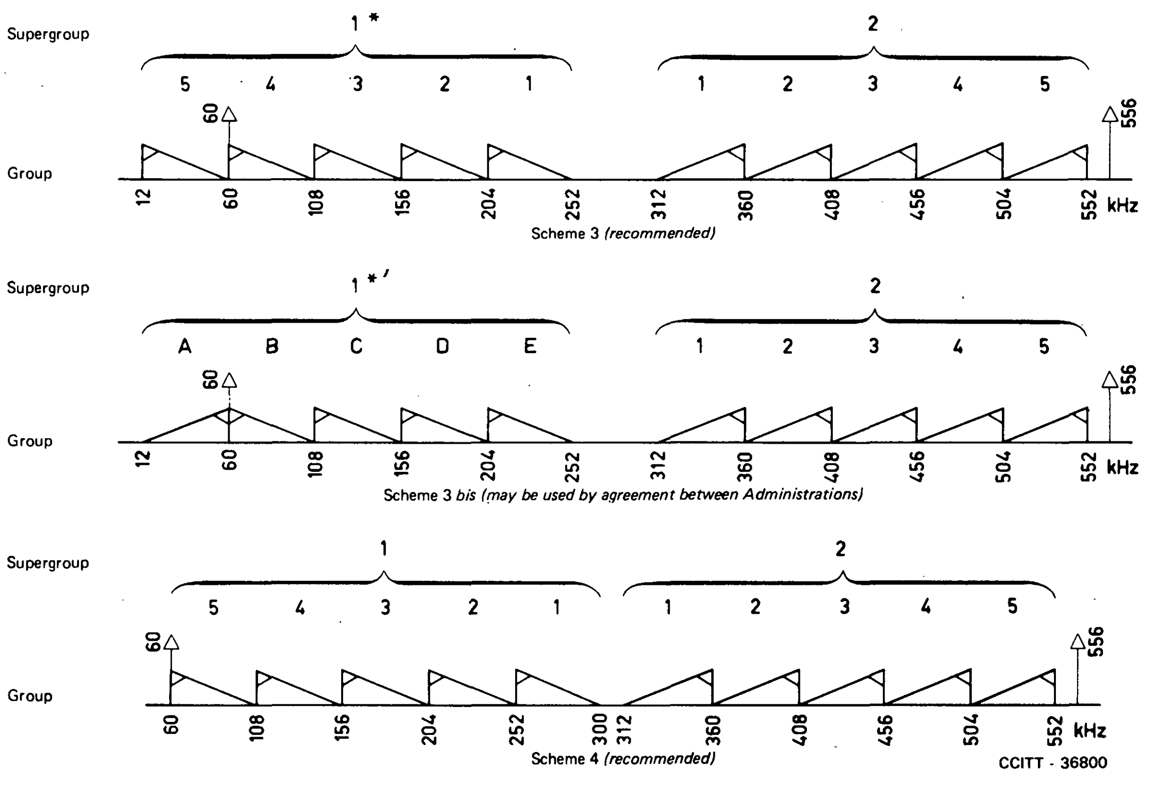


FIGURE 3/M.390

Line-frequency allocation for carrier systems providing two supergroups on symmetric pair cables

In scheme 3, the line-frequency allocation for supergroup 1* is the same as that recommended for a 5 group system on symmetric pair cables [scheme 2, Figure 2/M.390 *c)*].

The frequency allocation shown for supergroup 1* in scheme 3 *bis* may be used by agreement between Administrations where interconnection with existing systems having five groups or less is required.

3.2 *Numbering of supergroups, groups and channels*

3.2.1 The numbering of the groups and channels on a 2 supergroup system follows the principles given in Recommendations M.320 and M.330.

3.2.2 For supergroup 2 in each scheme and for supergroup 1 in scheme 4 the numbering used is that given in Recommendations M.320 and M.330 for coaxial systems.

3.2.3 For supergroup 1* and 1*′ the numbering used is the same as that shown for scheme 2 and scheme 2 *bis* in Figure 2/M.390 *c)*.

Recommendation M.400

NUMBERING IN RADIO-RELAY LINKS OR OPEN-WIRE LINE SYSTEMS

For numbering in a radio-relay link using freqency division multiplex, the channels, groups, supergroups, etc., are considered in the position they occupy in the baseband to be transmitted by that link.

In the interests of direct interconnection the CCIR and CCITT have collaborated in drawing up Recommendation G.423 [1] from which it follows that the numbering of the telephony channels, groups and supergroups, etc., of the radio-relay link is as described in Recommendations M.320 to M.390.

The same rules are applied to carrier systems on open-wire lines providing at least one group having 12 telephone channels.

Reference

[1] CCITT Recommendation *Interconnection at the baseband frequencies of frequency-division multiplex radio-relay systems*, Vol. III, Rec. G.423.

Recommendation M.410

NUMBERING OF DIGITAL BLOCKS IN TRANSMISSION SYSTEMS

1 General

This Recommendation gives the numbering of tributaries in digital blocks and the numbering of blocks within higher order blocks and digital line system. The Series G Recommendations referred to below can be found in Volume III (Digital networks, transmission systems and multiplexing equipments).

2 Primary multiplex equipment

2.1 *Primary PCM multiplex equipment operating at 2048 kbit/s (Recommendation G.732)*

Channel time slots 1 to 15 and 17 to 31 are assigned to 30 telephone channels numbered from 1 to 30 as indicated in Figure 1/M.410.

Channel time slots	0 1 2 .... 15 16 17 18 31
Numbering of telephone channels	– 1 2 .... 15 – 16 17 30

FIGURE 1/M.410

Example of primary multiplex equipment assignments

2.2 *Primary PCM multiplex equipment operating at 1544 kbit/s (Recommendation G.733)*

Channel time slots 1 to 24 are assigned to 24 telephone channels numbered from 1 to 24.

2.3 *Synchronous digital multiplex equipment operating at 2048 kbit/s (Recommendation G.736)*

Channel time slots 1 to 31 are assigned to 31 channels at 64 kbit/s numbered from 1 to 31.

2.4 *Synchronous digital multiplex equipment operating at 1544 kbit/s (Recommendation G.734)*

Channel time slots 1 to 23 are assigned to 23 channels at 64 kbit/s numbered from 1 to 23.

2.5 *Primary PCM multiplex equipment operating at 2048 kbit/s and offering synchronous 64 kbit/s digital access options (Recommendation G.737)*

It should be possible to assign channel time slots 1 to 15 and 17 to 31 to thirty telephone channels numbered from 1 to 30 as indicated in Figure 1/M.410.

Provision should also be made to provide 64 kbit/s digital access to at least two of these channel time slots, allocated in an order of priority given in Recommendation G.737.

If there are *n* telephone channels and (30 – *n*) 64 kbit/s digital accesses, the channels are numbered from 1 to 30, with the digital access channels having DA (digital access) appended to the channel number.

3 Second order PCM multiplex equipments

3.1 *Second order PCM multiplex equipment operating at 8448 kbit/s (Recommendation G.744)*

3.1.1 *Channel time slots assignment for the case of channel associated signalling*

Channel time slots 5 to 32, 34 to 65, 71 to 98 and 100 to 131 are assigned to 120 telephone channels numbered from 1 to 120 as indicated in Figure 2/M.410.

Channel time slots	0 1 2 3 4 5 6 .... 32 33 34 65
Numbering of channels	– – – – – 1 2 .... 28 – 29 60
Channel time slots	66 67 68 69 70 71 72 .... 98 99 100 131
Numbering of channels	– – – – – 61 62 .... 88 – 89 120

FIGURE 2/M.410

Example of second order PCM multiplex equipment assignments

3.1.2 *Channel time slot assignment for the case of common channel signalling*

The telephone channels corresponding to channel time slots 2 to 32, 34 to 65, 67 to 98 and 100 to 131 are numbered from 1 to 127.

When there is a bilateral agreement between the Administrations involved for using channel time slot 1 for another telephone or service channel, this channel will be numbered 0.

3.2 *Second order digital multiplex equipment operating at 8448 kbit/s (Recommendations G.742 and G.745)*

The four tributaries operating at 2048 kbit/s are numbered from 1 to 4 in the order of interleaving.

3.3 *Second order digital multiplex equipment operating at 6312 kbit/s (Recommendation G.743)*

The four tributaries operating at 1544 kbit/s are numbered from 1 to 4 in the order of interleaving.

4 Higher order multiplex equipment

4.1 *Digital multiplex equipments operating at the third order bit rate of 34 368 kbit/s (Recommendations G.751 and G.753)*

The four tributaries operating at 8448 kbit/s are numbered from 1 to 4 in the order of interleaving.

4.2 *Digital multiplex equipments operating at the fourth order bit rate of 139 264 kbit/s (Recommendations G.751 and G.754)*

4.2.1 *Method using a 3rd order bit rate in the digital hierarchy*

The four tributaries operating at 34 368 kbit/s are numbered from 1 to 4 in the order of interleaving.

4.2.2 *Method by directly multiplexing 16 digital signals at 8448 kbit/s*

The 16 tributaries at 8448 kbit/s are numbered from 1 to 16: 1 to 4 in the order of interleaving for the first intermediate tributary at 34 368 kbit/s, 5 to 8 for the second, 9 to 12 for the third and 13 to 16 for the fourth as indicated in Figure 3/M.410.

Four intermediate tributaries at 34 368 kbit/s in the order of interleaving	1				2				3				4			
Tributaries at 8448 kbit/s in the order of interleaving	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

FIGURE 3/M.410

Example of third order multiplex equipment assignments

4.3 *Digital multiplex equipment based on a second order bit rate of 6312 kbit/s (Recommendation G.752)*

4.3.1 *Third order digital multiplex equipment operating at 32 064 kbit/s*

The five tributaries operating at 6312 kbit/s are numbered from 1 to 5 in the order of interleaving.

4.3.2 *Third order digital multiplex equipment operating at 44 736 kbit/s*

The seven tributaries operating at 6312 kbit/s are numbered from 1 to 7 in the order of interleaving.

5 Digital line system at 564 992 kbit/s on coaxial pairs (Recommendation G.954)

The four tributaries operating at 139 264 kbit/s are numbered from 1 to 4 in the order of interleaving.

2.3 Bringing new international transmission systems into service. Setting up and lining up. Reference measurements

Recommendation M.450

BRINGING A NEW INTERNATIONAL TRANSMISSION SYSTEM INTO SERVICE

1 Preliminary exchange of information

As soon as Administrations have decided to bring a new international transmission system into service, the necessary contacts are made between their technical services[1] for the exchange of information. Those services jointly select the control and sub-control stations for the new system (see Recommendations M.80 and M.90).

The technical service of each Administration is responsible for the setting-up and lining-up of the line sections on its territory and for arranging that the adjustments and tests required are made by the repeater station staff concerned.

To set up a line section which crosses a frontier, Administrations should arrive at bilateral arrangements on the basis of CCITT Recommendations and, for radio-relay sections, the Recommendations of the CCIR.

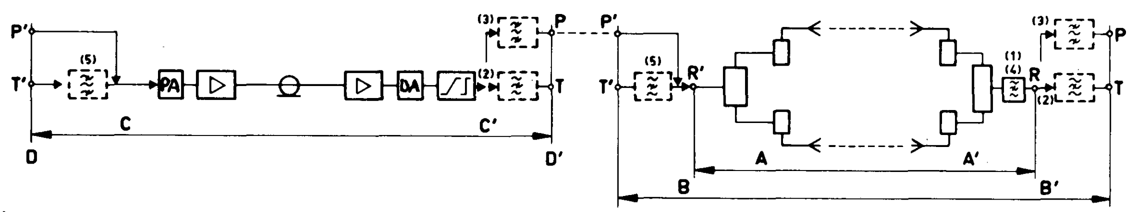
2 Setting up sections crossing a frontier

2.1 *Radio-relay section*

Details of the following points will have been settled by a bilateral agreement between the technical services of Administrations:

- geographical position of the radio-relay station nearest to the frontier;
- contour of the terrain of the radio section crossing the frontier, with details of the height of the antennae above normal level;
- directivity characteristic and gain of the antennae;
- radio-frequency channel arrangement (centre frequency, polarization, intermediate frequency);
- provision of supervisory system;
- radio equipment line-regulating pilots (if any);
- continuity pilots, used for supervising the radio-relay link, in accordance with the CCIR Recommendations on the frequency and frequency deviation of this signal, each country transmitting the pilot required by the system in the receiving country;
- noise measurement channels outside the transmitted baseband;
- total noise for the radio-relay section;
- frequency deviation of the telephony channel the level of which at the centre frequency is unaffected by pre-emphasis (either of the telephony channel itself or of the radio-frequency channel of the system);
- pre-emphasis characteristics of the radio-frequency channel;
- service, supervisory and remote channel circuits;
- level, frequency and coding of the signals transmitted over these lines;
- protective switching equipment;
- interconnection points T, R, T′, R′ (see Figure 1/M.450) defined in Recommendation G.213 [1] (see also [2] and especially the return loss at points R and R′ if required (see CCIR Recommendation 380-3 [3] for values).

[1] The *technical service* represents the appropriate authorities within the international maintenance organization of an Administration which have the responsibility for making international agreements on engineering provision and maintenance matters, specifying provision and maintenance facilities, determining engineering and maintenance policy and overseeing its implementation.



CCITT - 36811

A, A'	=	radio-relay system
B, B'	=	line link via radio-relay system
C, C'	=	line link via cable system
D, D'	=	boundary of the high-frequency line equipment
Point P'	=	provided for possible injection of regulating pilots
R	=	radio-relay system output
R'	=	radio-relay system input
Between T and T'	=	telephony translating equipment and/or direct through-connection equipment
DA	=	de-emphasis network
PA	=	pre-emphasis network
(1)	=	blocking of continuity pilots and, if necessary, of regulating pilots
(2)	=	blocking, if necessary, of line-regulating pilots, and of pilots that must not go beyond the line link.
(3)	=	through-connection filter for line-regulating pilots, if necessary. A through-connection filter for telephone groups can, if necessary, be inserted
(4)	=	blocking of unspecified pilots or supervisory signals
(5)	=	filter for blocking any unwanted frequency before injecting a pilot ensuring with (2) the requisite protection against a pilot (or other frequency) coming from another regulated line-section (system B or C, as the case may be)

FIGURE 1/M.450

Interconnection points T, R, T', R'

2.2 *Coaxial-pair line section*

Details of the following points will have been settled by bilateral agreement between the technical services of the Administrations:

- the choice of the frequency arrangement to be adopted;
- the pilot signals to be used for regulating the line, in accordance with CCITT Recommendations on the frequency and level of such signals, each country transmitting the pilot signals required by the equipment of the other country (see the table in Recommendation M.540 indicating the pilot frequencies for various systems);
- service, supervisory and remote control circuits;
- repeater identification method and frequencies for fault location and monitoring on transistorized systems;
- provisions for remote power feeding, where a section of the supply line crosses the frontier;
- the regulation systems used by each country;
- the nominal level at various frequencies, at the output of the frontier repeater.

Concerning this last item, at the incoming point, each Administration should as far as possible accept the conditions usual for the system of the other country.

During the lining-up tests, the relative power level measured at the output of the repeater in the unburied repeater station nearest to the frontier should not differ, for any frequency, by more than ± 2 dB from the nominal value (as defined by a graph drawn up beforehand and based on the characteristics of the system in question).

The frequencies used in lining up the line are determined by agreement between the Administrations concerned. Experience shows that, provided the number of test frequencies required is not too large, it is useful to make these tests at frequencies lying very close to each other at the edges of the frequency band, or at points where irregularities have to be corrected, and at frequencies less close to each other elsewhere in the band.

If the necessary test equipment is available sweep measurements can substantially facilitate the line-up procedure. But in this case also, some test frequencies have to be agreed upon to obtain reference values for later in-service maintenance measurements.

2.3 *Symmetric-pair line section*

The following points will have been settled by bilateral agreement between the Administrations:

- frequency allocation;
- pilots (see the table in Recommendation M.540 indicating the pilot frequencies for various systems);
- service, supervisory or remote control lines, etc.;
- repeater identification method and frequencies for fault location and monitoring on transistorized systems;
- provisions for remote power feeding, where a section of the supply line crosses the frontier.

When a symmetric-pair line section crossing a frontier section is first set up, tests should be made at clearly defined frequencies to determine the insertion loss/frequency characteristics. For example, frequencies spaced at the following intervals could be used, except at the edges of the band, where more closely spaced measuring frequencies are desirable.

4 kHz between 12 kHz and 60 kHz,

8 kHz between 60 kHz and 108 kHz,

12 kHz between 108 kHz and 252 kHz,

24 kHz between 288 kHz and 552 kHz,

The conditions for making measurements at line-pilot frequencies should be agreed by the technical service concerned.

Level measurements at the frequencies chosen will be made at each line amplifier at the unburied repeater station nearest to the frontier. The relative power level measured at any of the frequencies chosen should not differ by more than ± 2.0 dB from the nominal value.

3 **Overall reference measurements for the line**

The section across frontiers and national sections having been set up and connected, reference measurements are made between the high-frequency line terminals of the carrier system, excluding the terminal equipment.

3.1 *Level measurements*

These are made at several frequencies, even if the regulated line section or line link has been equalized by means of sweep frequency measurements.

3.1.1 *Radio-relay line section*

When a radio-relay section is put into service, measurements and adjustments in accordance with the CCIR Recommendations for the radio-relay system concerned are first made of:

- the frequency at which the level is unchanged by pre-emphasis and the deviation of that frequency;
- the level and frequency of the baseband reference frequency;
- the *central position of the intermediate frequency* (if necessary);
- check and adjustment of input and output levels baseband/baseband (see CCIR Recommendation 380-3 [3] for values);
- measure of overall loss/frequency characteristics using additional measurement frequencies [2)].

[2)] Reference measurements should be made at several frequencies in both directions of transmission between accessible measuring points corresponding as nearly as possible to points R and R′ as defined in Recomendation G.213 [1]. These measurements should be made at the frequencies specified in § 3.1.2 for each transmitted bandwidth.

3.1.2 *Coaxial line section*

The frequencies for reference measurements should be selected from the following values. (These values comprise the line pilot frequencies which, of course, cannot be sent into a system with the pilots already being transmitted.)

3.1.2.1 *For a 1.3-MHz system:* 60, 308, 556, 808, 1056, 1304, 1364 kHz.

3.1.2.2 *For a 2.6-MHz system:* 60, 308, 556, 808, 1056, 1304, 1552, 1800, 2048, 2296, 2604 kHz.

3.1.2.3 *For a 4-MHz system:*

- frequency allocation with supergroups:
  60, 308, 556, 808, 1056, 1304, 1552, 1800, 2048, 2296, 2544, 2792, 3040, 3288, 3536, 3784, 4092, 4287 kHz;
- frequency allocation with mastergroups (Figure 5/M.380, scheme 2):
  308, 560, 808, 1304, 1592, 2912, 4287 kHz.

3.1.2.4 *For a 6-MHz system:*

- frequency allocation with supergroups:
  308, 556, 808, 1056, 1304, 1552, 1800, 2048, 2296, 2544, 2792, 3040, 3288, 3536, 3784, 4287 (5680[3]) kHz;
- frequency allocation with mastergroups (Figure 8/M.380, scheme 3):
  308, 560, 808, 1304, 1592, 2912, 4287, 5608[3]) kHz.

3.1.2.5 *For a 12-MHz system:*

- at frequencies below 4 MHz:
  if frequency allocation without mastergroups is used:
  308, *560*, *808*, 1056, *1304*, 1552, *1800*, 2048, *2296*, 2544, *2792*, 3040, 3288, *3536* and *3784* kHz
  (the frequencies in italics are those at which the measurements must always be made);
  if frequency allocation with mastergroups is used:
  308, 560, 808, 1304, 1592 and 2912 kHz;
- at frequencies above 4 MHz:
  if frequency allocation with 15 supergroup assemblies is used:
  5392, 7128, 8248, 8472, 8864, 9608 and 11 344 kHz;
  if frequency allocation with mastergroups is used:
  5608, 6928, 8248[4]), 8472, 9792 and 11 112 kHz.

3.1.2.6 *For an 18-MHz system:*

- if frequency allocation is according to Plan 1 of Recommendation G,334 [4]:
  560, 808, 1304, 1592, 2912, 5608, 6928, 8248[4]), 8472, 9792, 11 112, 12 678 or 12 760, 14 408, 15 728 and 17 242 kHz;
- if frequency allocation is according to Plan 2 of Recommendation G.334:
  560, *808*, 1056, *1304*, 1552, *1800*, 2048, *2296*, 2544, *2792*, 3040, 3288, *3536*, 3784, *5392*, *7128*, *8248*, *8472*, *8864*, *9608*, *11 344*, *12 678* or *12 760*, *14 408*, *15 728* and *17 242* kHz (the frequencies in italics are those at which measurements must always be made);
- if frequency allocation is according to Plan 3 of Recommendation G.334:
  552, 1872, 3192, 4758, 6272, 7592, 9158, 10 672, 11 992, 13 558, 15 072 and 16 392 kHz[5]).

3) This frequency may be 5640 kHz.

4) A frequency of 8248 can be used as a radio-relay link line regulating pilot. In such a case, the precautions shown in Recommendation G.423 [5] should be applied.

5) These measuring frequencies are provisional and subject to further study by Study Group XV.

3.1.2.7 *For a 60-MHz system:*

- frequencies which do not cause interference to a regulated line section and, therefore, can be sent at any time:
  8472, 12 678 or 12 760[6], 17 488, 26 922, 31 322, 35 722, 40 122[6], 42 322, 46 722, 51 122, 55 522 kHz;
- frequencies which should not be sent without the agreement of the Administration at the receiving end:
  4200[7] or 4287[8], 8316[7], 12 435[8], 22 302, 22 372[8], 40 920[8], 59 992 kHz.

3.1.3 *Symmetric-pair line section*

Frequency of the line pilot or pilots, and frequencies showing the insertion loss/frequency characteristic of the line, for example, frequencies spaced at:

4 kHz between 12 kHz and 60 kHz,
8 kHz between 60 kHz and 108 kHz,
12 kHz between 108 kHz and 252 kHz,
24 kHz between 288 kHz and 552 kHz.

3.2 *Loss/frequency distortion*

The loss/frequency distortion of the regulated line section (symmetric pair, coaxial or radio-relay link) shall be such that the relative level at any frequency does not differ by more than ± 2 dB from the nominal level for older type-systems and ± 1 dB in case of modern transistorized systems.

Reference measurements at the frequencies chosen will be made at all attended stations at the output of each amplifier and also at the unburied station nearest the frontier.

Reference tests at unattended stations other than frontier stations are left to the discretion of each Administration.

The setting of equalizers should be noted and recorded during the reference measurements as well as the temperature of the cable, or the resistance of one of the conductors, from which the temperature could be deduced.

3.3 *Measurement of noise power*

Measurements of noise power shall be made by sending a uniform continuous spectrum signal in the transmitted frequency band in accordance with Recommendations G.228 [6] and G.371 [7] and CCIR Recommendation 399-3 [8][9].

3.4 *Complementary measurements*

If the Administrations find it necessary, the following measurements could also be made:

- check of near-end crosstalk with artificial loading of radio channels;
- check of the suppression of line pilots from other regulated sections;
- check of power supply modulation, etc. (including checking of the baseband for the presence of interfering signals from radio-frequency sources outside the system);
- check of stability using a level recorder.

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6) It may be necessary to use this frequency if an adjacent auxiliary line pilot is used for regulation.

7) These frequencies may also be in use as frequency comparison pilots.

8) In accordance with Recommendation M.500, Administrations choosing to use these frequencies must ensure that interference is not caused to a following regulated line section which may be using these frequencies as line pilots.

9) In the case of a radio-relay line section, measurements should also be taken outside the baseband on the noise measurement channels indicated in CCIR Recommendation 398-3 [9]. These noise values will serve as reference values for subsequent maintenance measurements.

3.5 *Line-up record*

The results of the reference measurements made at the line terminals and at the output of frontier repeaters will be entered in a line-up record, specimens of which are included as examples in Appendices I (coaxial or radio-relay regulated line section line-up record) and II (symmetric-pair regulated line section line-up record) below.

APPENDIX I

(to Recommendation M.450)

Line-up record for a coaxial-pair regulated line section*

Control station: . . . . Annemasse
Designation of link: . . . . Annemasse-Courmayeur
Date of measurements: . . . . 16 November 1972
Direction of transmission[4]: . . . . . Courmayeur-Annemasse

Stations	Courmayeur	Chamonix			Cluses			Annemasse	
Distance (km)	18.6			42.3			34.96		
Resistance of conductor used for temperature compensation (ohms)	982			2222			1846		
Frequencies (kHz)	Send[1]	Var. eq.[2]	Rec.[3]	Send[1]	Var. eq.[2]	Rec.[3]	Send[1]	Var. eq.[2]	Rec.[3]
308	−65	−8	−53.8	−65		−53.7	−64.7	−4	−53.8
560	−65	−6	−53.9	−65.2		−53.7	−64.8	−2	−53.7
808	−65.2	−6	−53.8	−65.2		−53.7	−65.1	−4	−53.8
1056	−65.3	−6	−53.8	−65.3		−53.7	−65.1	−4	−53.8
1304	−65.3	−6	−53.9	−65.4		−53.9	−65	−4	−53.9
1800	−65.4	−4	−53.8	−65.5		−53.8	−65.4	−2	−53.9
2296	−65.4	−4	−53.8	−65.5		−53.8	−65.4	−2	−53.9
2792	−65.4	−6	−53.8	−65.4		−53.8	−65.4	−2	−53.9
3536	−65.4	−8	−53.8	−65.4		−53.9	−65.4	−2	−53.9
4032	−65.3		−53.6	−65.2		−53.7			
4287	−65.3	−4	−53.8	−65.3		−53.7	−64.8	−2	−53.8
4648	−65.3		−53.8	−65.2		−54	−65.1		−53.9
5144	−65.2		−54.9	−65.3		−54	−65.2		−54.1
5640	−65.1	−6	−53.8	−65	Not used	−53.8	−65	−4	−53.8
6136	−65		−53.9	−65		−53.8	−64.9		−54
6632	−64.7	−8	−53.9	−64.7		−53.9	−64.9	−6	−53.8
7128	−64.5		−53.9	−64.5		−54.1	−64.8		−53.8
7624	−64.3		−53.9	−64.3		−54	−65.1		−53.8
8124	−64	−6	−53.8	−64		−53.8	−63.9	−6	−53.7
8864	−63.4		−53.9	−63.5		−54.1	−63.6		−53.7
9360	−63	−8	−53.9	−63		−53.8	−62.8	−4	−53.7
9856	−62.4		−53.9	−62.5		−53.8	−62.3		−53.6
10352	−61.7		−53.8	−61.8		−53.8	−61.6		−53.6
10848	−61		−53.8	−61		−53.9	−60.9		−53.6
11344	−60.2	−6	−53.8	−60.2		−54.1	−60.4	−6	−53.8
12340	−58.6		−53.9	−58.6		−54	−58.6		−53.7
12435	−58.1	−6	−53.9	−58.5		−54.1	−58.4	+4	−53.8

* Can also be used for a radio-relay regulated line section.
[1] 600 ohm through-level (dB) at repeater output points.
[2] Variable equalizer setting.
[3] 600 ohm through-level (dB) at special measuring points.
[4] There will be a corresponding form for the other direction of transmission.

APPENDIX II

(to Recommendation M.450)

Line-up record for a symmetric-pair line

Control station: . . . . Antwerpen
Designation of link: . . . . Antwerpen-Rotterdam
Date of measurements: . . . . 10 October 1959
Issue: . . . . 22 March 1960

	Direction: Antwerpen-*Rotterdam*				Direction: Rotterdam-*Antwerpen*			
Distance (km)	15.8		17.7	72.4	72.4	17.7		15.8
Test frequencies kHz	Antwerpen dB	Brasschaat dB	Zundert dB	Rotterdam dB	Rotterdam dB	Zundert dB	Brasschaat dB	Antwerpen dB
12	+1.75	+1.75	+1.80	+1.85	+1.75	+1.65	+1.65	+1.65
16		1.75	1.80	1.90		1.65	1.70	1.65
20		1.75	1.80	1.90		1.70	1.70	1.70
24		1.80	1.85	1.95		1.70	1.70	1.70
28		1.85	1.85	1.90		1.70	1.65	1.75
32		1.85	1.90	1.90		1.75	1.65	1.80
36		1.85	1.90	1.85		1.75	1.70	1.80
40		1.80	1.90	1.85		1.75	1.70	1.85
44		1.80	1.85	1.85		1.80	1.75	1.90
48		1.75	1.85	1.80		1.80	1.75	1.90
52		1.75	1.85	1.75		1.75	1.70	1.90
56		1.75	1.80	1.75		1.75	1.75	1.85
60		1.80	1.80	1.75		1.70	1.65	1.85
68		1.75	1.75	1.75		1.70	1.65	1.85
76		1.70	1.75	1.80		1.70	1.60	1.80
84		1.70	1.80	1.80		1.70	1.65	1.75
92	Sending station	1.75	1.80	1.85	Sending station	1.65	1.65	1.75
100		1.80	1.80	1.85		1.65	1.70	1.75
108		1.80	1.85	1.85		1.65	1.70	1.70
120		1.85	1.85	1.90		1.70	1.75	1.70
132		1.85	1.85	1.95		1.70	1.80	1.70
144		1.85	1.90	1.95		1.75	1.85	1.75
156		1.80	1.90	1.95		1.80	1.85	1.80
168		1.80	1.90	1.90		1.85	1.90	1.80
180		1.85	1.85	1.90		1.85	1.95	1.85
192		1.90	1.85	1.85		1.90	1.90	1.80
204		1.85	1.80	1.80		1.90	1.85	1.80
216		1.80	1.75	1.75		1.95	1.80	1.80
228		1.75	1.75	1.70		2.00	1.80	1.75
240		1.75	1.70	1.65		2.00	1.80	1.75
252		1.70	1.70	1.65		1.85	1.80	1.70
256		1.70	1.65	1.60		1.70	1.75	1.70
60 kHz line pilot	−13.2	−13.1	−13.1	−13.2	−13.2	−13.2	−13.3	−13.1
Additional measuring frequencies[1]	–	–	–	–	–	–	–	–
Equalizers	–	0	+1	0	–	+1	+1	+1
Temperature or resistance . .	–	391 Ω	221 Ω	+4.7°C	–	+4.5°C	226 Ω	392 Ω

[1] Indicate frequencies of these pilots.

References

[1] CCITT Recommendation *Interconnection of systems in a main repeater station*, Vol. III, Rec. G.213.

[2] CCIR Recommendation *Interconnection at baseband frequencies of radio-relay systems for telephony using frequency-division multiplex* , Vol. IX, Rec. 380-3, Annex I, ITU, Geneva, 1982.

[3] CCIR Recommendation *Interconnection at baseband frequencies of radio-relay systems for telephony using frequency-division multiplex*, Vol. IX, Rec. 380-3, ITU, Geneva, 1982.

[4] CCITT Recommendation *18-MHz systems on standardized 2.6/9.5-mm coaxial cable pairs*, Vol. III, Rec. G.334.

[5] CCITT Recommendation *Interconnection at the baseband frequencies of frequency-division multiplex radio-relay systems*, Vol. III, Rec. G.423.

[6] CCITT Recommendation *Measurement of circuit noise in cable systems using a uniform-spectrum random noise loading*, Vol. III, Rec. G.228.

[7] CCITT Recommendation *FDM carrier systems for submarine cable*, Vol. III, Rec. G.371.

[8] CCIR Recommendation *Measurement of noise using a continuous uniform spectrum signal on frequency-division multiplex telephony radio-relay systems*, Vol. IX, Rec. 399-3, ITU, Geneva, 1982.

[9] CCIR Recommendation *Measurements of noise in actual traffic over radio-relay systems for telephony using frequency-division multiplex*, Vol. IX, Rec. 398-3, ITU, Geneva, 1982.

Recommendation M.460

BRINGING INTERNATIONAL GROUP, SUPERGROUP, ETC., LINKS INTO SERVICE

1 Preliminary exchange of information

The technical services concerned nominate the control and sub-control stations for the link to be brought into operation in accordance with Recommendations M.80 and M.90.

The technical services should indicate the routing to be followed and the method given in Recommendation M.570 may be applied. In the case of group or supergroup links, they will mutually agree on the pilot or pilots to be used.

In determining the routing of group links, in order to avoid interference between the pilots on two supergroup links, the technical services will try to arrange that position No. 3 is not occupied by the same group link on two supergroup links. (Where this is impossible, the supergroup pilot should be blocked at the through-group connection point.)

Information necessary for the control station, which will be entered on a *routing form* [see specimens in Appendix I (supergroup routing form) and Appendix III (A or B) (group routing form) of this Recommendation] is indicated below:

- routing of the link,
- names of control and sub-control stations,
- through-connection points,
- points where regulators are fitted.

The overall routing form for the entire link is drawn up by the control station on the basis of information furnished by its technical service and by each sub-control station for the sections for which the latter is responsible.

2 Frequencies and levels of group, supergroup, etc., pilots

2.1 Details of the recommended frequency and level of pilots are given in Table 1/M.460.

The specifications of terminal equipments provide that for every group or supergroup two pilots can be simultaneously transmitted. However, the normal case is that only one is being transmitted.

Note – Special considerations apply to the use of group and supergroup pilots if circuits are to be provided using Signalling System R2. Group and supergroup pilots placed at 140 Hz from a virtual carrier frequency are incompatible with signalling at 3825 Hz. Hence, the pilot at 84.140 kHz should not be applied to groups in which channel 6 is to be operated with this out-of-band signalling. Similarly, the pilot on 411.860 kHz should not be applied to supergroups in which channel 1 of the group in the group 3 position is to be operated with signalling at 3825 Hz.

TABLE 1/M.460

Group, supergroup and mastergroup pilots for	Frequency (kHz)		Power level[a)]
	8 ch. and 12 ch.	16 ch.	dBm0
Basic group (60-108 kHz)	84.080 84.140 104.080	84[b)]	−20 −25 −20
Basic supergroup	411.860 411.920 547.920	444[c)]	−25 −20 −20
Basic mastergroup	1552		−20
Basic supermastergroup	11096		−20
Basic 15 supergroup assembly	1552		−20

a) To avoid errors in interpreting measurement results, the results of measurements on pilots will be stated in terms of the departure from the nominal pilot level in dBm at that particular point.

b) A pilot of 84 kHz is normally used. A different frequency can be used by agreement between Administrations.

c) A pilot of 444 kHz with a power level of —20 dBm0 is used.

2.2 *Level tolerances for transmitted pilots*

2.2.1 At the point where a pilot is injected, its level should be so adjusted that its measured value is within ± 0.1 dB of its nominal value. The measuring equipment used for making this measurement must give an accuracy of at least ± 0.1 dB.

2.2.2 The change in output level of the pilot generator with time (which is a factor included in equipment specifications) must not exceed ± 0.3 dB.

2.2.3 The total maximum variation resulting from §§ 2.2.1 and 2.2.2 above will be ± 0.5 dB. It is advisable to have a device to give an alarm when the variation at the generator output exceeds these limits, the zero of the warning device being aligned as accurately as possible with the lining-up level of the transmitted pilot.

2.3 *Frequency tolerances for transmitted pilots*

The permissible frequency tolerances for transmitted pilots are as follows:

- 84 kHz and 444 kHz (if used as reference pilots for 16-channel systems) . . . . ± 1 Hz
- 84.080 kHz and 411.920 kHz pilots . . . . ± 1 Hz
- 84.140 kHz and 411.860 kHz pilots . . . . ± 3 Hz
- 104.080 kHz and 547.920 kHz pilots . . . . ± 1 Hz
- 1552-kHz pilot . . . . ± 2 Hz
- 11 096-kHz pilot . . . . ± 10 Hz

3 Frequencies and levels of test signals

Reference measurements for a link and its component sections are made at some or all of the following frequencies:

- supermastergroup link:

  8516, 9008, 11 096, 11 648, 12 388 kHz;
- 15 supergroup assembly link:

  312, 556, 808, 1056, 1304, 1552, 2048, 2544, 3040, 3536, 4028 kHz;
- mastergroup link:

  814, 1056, 1304, 1550, 1800, 2042 kHz;
- supergroup link (4-kHz channels):

  313, 317, 333, 381, 412, 429, 477, 525, 545, 549 kHz;
- supergroup link (3-kHz channels or 3 + 4-kHz channels):

  312.1, 313, 317, 333, 381, 412, 429, 477, 525, 545, 549, 551.9 kHz;
- group link (4-kHz channels):

  61, 63, 71, 79, 84, 87, 95, 103, 107 kHz[1];
- group link (3-kHz channels):

  60.1, 60.6, 61, 63, 71, 79, 84, 87, 95, 103, 107, 107.3, 107.9 kHz[1].

Administrations may also make measurements at other frequencies as considered necessary. In the case of group and supergroup links of simple constitution, three measuring frequencies (midband and at the two edges) may suffice.

The overall loss will be measured by means of a test frequency being equal or very close to the reference pilot frequency.

The level of the test signal to be used for the measurements will be −10 dBm0[2].

4 Reference measurements for a link

The measurements described in § 7.2 below for lining-up also constitute reference measurements. These data should be recorded at every group, supergroup, etc. sub-control station and in the through-connection stations adjacent to frontiers and, on request, forwarded to the control station which then can draw up a *line-up record.*

5 Some features of a multiple destination unidirectional transmission link as might be provided by a communication-satellite system

This section refers to Figure 1/M.460, which is drawn in terms of a supergroup. An analogous arrangement can occur for groups or, in principle, for higher-order assemblies. There is no loss of generality in describing the arrangement of a supergroup.

5.1 In the example the supergroup is assembled in London and portions of it appear in three other places. Hence the designatory letter M standing for **MULTIPLE DESTINATION**.

5.2 In the return directions of transmission for any or all of the groups in this supergroup, the transmission path may be quite different and will not necessarily bear any relationship to the direction illustrated. Hence the designatory letter U standing for **UNIDIRECTIONAL**.

5.3 The supergroup may be set up initially with only some of the destinations, for example, Montreal may be connected some time, say a year or so, after Bogota and Lusaka.

Furthermore, a destination may alter the amount of bandwidth it exploits, e.g. Bogota may initially derive Groups 1 and 2, Group 5 being derived some time later.

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[1] If the group-measuring frequencies are generated by applying 800 Hz to the input of channel modulating equipment, special precautions will have to be taken at the receiving end to prevent carrier leak from affecting the readings of the measuring equipment. In these circumstances, the measuring device must be of the selective kind.

[2] A level of 0 dBm0 may be used by agreement between the Administrations concerned.

5.4 The portions of the supergroup defined by the stations 1-2-3, 4-5-6, and 8-9 are supergroup sections which are to be treated in the way described in the following paragraphs of this Recommendation.

5.5 The routings connecting stations 3, 4, 7 and 8 to their corresponding earth stations A, B, C and D can be markedly dissimilar. For example, the routing to control station 4 from earth station B need not resemble in any way the analogous routing from earth station D to control station 8. Control station 4 may be at the earth station, that is, the *distance* between B and 4 is zero whereas the *distance* between D and 8 may be several hundreds of miles perhaps and may be routed over a variety of coaxial line or radio-relay systems.

5.6 The portion 1-2-3 is referred to as a common path. Operations on the common path can affect all destinations whereas operations on the other paths (4-5-6 and 8-9) can affect only one destination.

5.7 Station 3 is likely to have a community of interest with each of stations 4, 7 and 8. This is not necessarily so likely among 4, 7 and 8 themselves.

5.8 The stations 4, 7 and 8 each receive the whole of the basic supergroup band from station 3 though none of them exploits the whole of it.

The above-mentioned distinctive features of a multiple destination unidirectional group, supergroup, etc. (such as might be provided by a communication-satellite system) make special procedures for lining-up and maintenance a necessity. This fact is taken into account below.

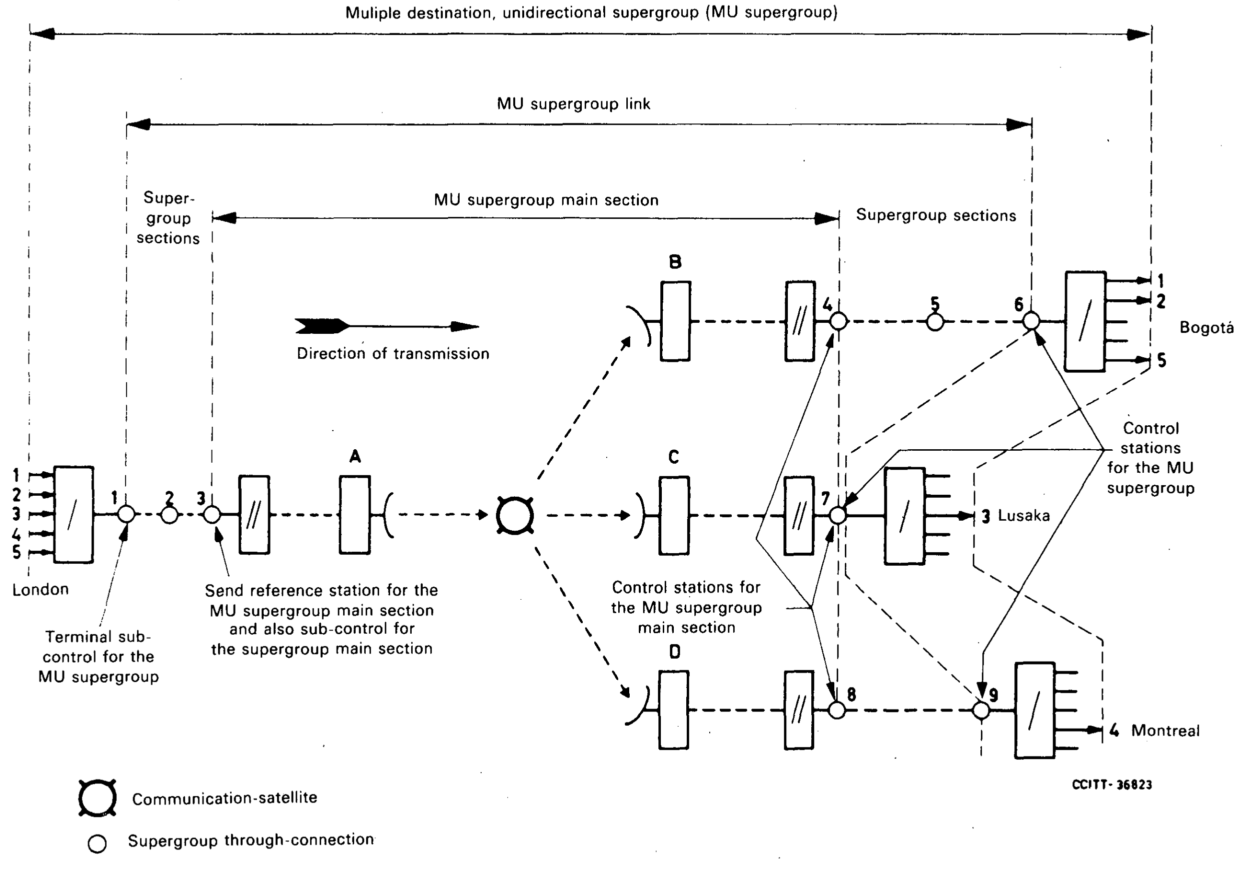

FIGURE 1/M.460

Arrangements for a multiple-destination, unidirectional supergroup (MU supergroup)

6 Organization of the control of an international group, supergroup, etc.

6.1 *Classes of station*

6.1.1 As far as international cooperation is concerned, only two classes of through-connection stations need be designated by any country:

a) stations which exercise control functions, i.e. group, supergroup, etc., control stations and group, supergroup, etc., sub-control stations;

b) attended stations nearest the frontier, which in this Recommendation are referred to as *frontier stations.*

6.1.2 In accordance with Recommendations M.80 and M.90 the station at each end of the group, supergroup, etc., is the *control station* for the receiving direction of transmission and the terminal *sub-control station* for the sending direction. Stations having control functions in intermediate countries are *group, supergroup, etc., intermediate sub-control stations.* Other stations involved in international maintenance are frontier stations.

6.1.3 In general, a transit country will have one station with control functions or one with sub-control functions and two frontier stations. A country in which the group, supergroup, etc., terminates has only one frontier station. In some countries, a station with control functions or sub-control functions and a frontier station will be the same.

6.2 *Classes of group, supergroup, etc. section*

For the purposes of setting-up, lining-up and subsequent maintenance, an international group, supergroup, etc., link is subdivided into national sections, international sections and main sections as defined in Recommendation M.300.

These terms are illustrated in Figure 2/M.460.

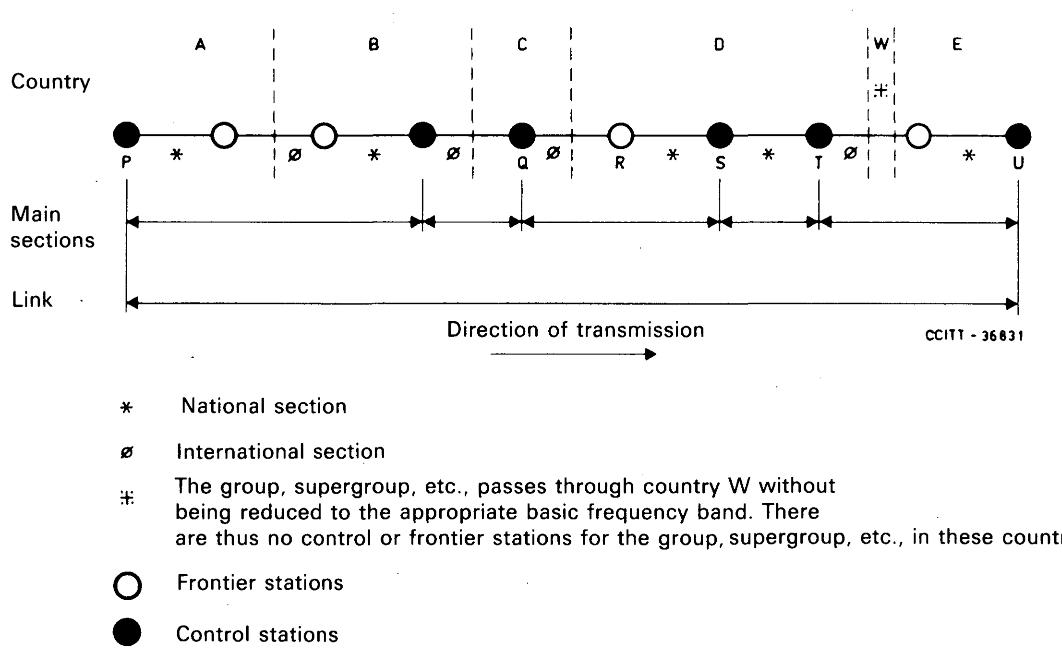

FIGURE 2/M.460

Example of an international link showing how it may be divided into sections of control for lining-up and maintenance

6.3 *Organization of control functions*

The terminal stations of each national, international and main section will be appointed as a control or sub-control station for that class of section with which they are concerned. However, as a consequence of the definitions of national, international and main sections of a link some stations will be nominated for more than one control or sub-control function. For example, station S in Figure 2/M.460 is:

- control station for main section Q-S,
- sub-control station for main section S-T,
- control station for national section R-S.

6.4 *Control functions in case of multiple destination (MU) transmission links*

The multiple destination unidirectional section defined by the through-connection stations nearest to the earth stations is to be a main section. The full designation is: *multiple destination unidirectional main group, supergroup, etc., section.*

In the example (Figure 1/M.460), stations 3, 4, 7 and 8 serve to define this main section.

The through-connection stations defining the extent of the MU main section will be assigned the control functions normally called for in the case of group, supergroup, etc. sections.

It follows that if the group, supergroup, etc., appears in the earth station at the basic group, supergroup, etc., frequencies, the earth station must function as a main section control or sub-control station for the multiple destination unidirectional section.

A very clear distinction must be made between:

- satellite control stations that might be concerned with baseband-to-baseband response (for example),
- group, supergroup, etc., control stations concerned with the performance of the group, supergroup, etc. (These are places where the bands 60-108, 312-552 kHz, etc., are normally accessible.) Such control stations are not called *satellite* stations because group, supergroup, etc., control functions are independent of the means of transmission.

In addition:

- the sub-control station for the MU main group, supergroup, etc., section is designated the *send reference station* for the MU main group, supergroup, etc., section (in the example, station 3 is so designated).

Again the distinction must be maintained between any coordination stations nominated for the satellite system (concerned with baseband, etc., matters) and MU main group, supergroup, etc., section reference stations. If stations 3, 4, 7 and 8 are physically in earth stations A, B, C and D respectively, then those earth stations will also have to function as the MU main section reference stations in addition to other responsibilities associated with coordination functions of the satellite system.

In addition to the responsibilities conferred on the send reference station by Recommendations M.80, M.90 and this Recommendation, the following responsibilities also apply:

a) coordinating the lining-up of the MU main section;

b) cooperating with MU main section control stations during the lining-up of the section;

c) keeping a record of the measurements made at MU section control stations during the lining-up of the section;

d) coordinating maintenance action for the MU main section when called upon to do so by one of the MU main section control stations.

7 Setting up and lining up an international group, supergroup, etc., link

7.1 *Setting up the link*

7.1.1 Once the route has been agreed, the supermastergroup, mastergroup, supergroup or group link control station will direct the operations needed to set up the link.

All the repeater stations concerned – i.e. the stations at the ends of each supermastergroup, mastergroup, supergroup, or group section that will make up the link – should make setting-up tests and check the equipment to be used, such as the through supermastergroup, mastergroup, supergroup, and group filters, etc. The check should include a general visual inspection and vibration tests, particularly if the equipment has remained unused for some time since acceptance tests were carried out after installation.

7.1.2 Each country sets up the national part within its territory, each international supermastergroup, mastergroup, supergroup or group section is set up by the stations at the ends of this section in the two countries concerned (which are the supermastergoup, mastergroup, supergroup or group through-connection stations closest to the frontier) and these national and international supermastergroup, mastergroup, supergroup or group sections are interconnected by through-supermastergroup, through-mastergroup, through-supergroup or through-group filters, as may be appropriate. The sub-control stations inform the control station when each interconnection is completed.

7.2 *Lining up the link*

7.2.1 The lining-up procedure for an international group, supergroup, etc., link is based on the progressive line-up of its component sections as follows. The limits to apply are given in Table 2/M.460.

i) National and international sections, which are then interconnected to form main sections.

ii) Main sections. When there are three or more main sections, the line-up is made in two or more stages. The first two main sections are connected together and lined up to main section standards, the third main section is added and this part of the link lined up, and so on.

iii) Overall link

a) Comprising two main sections. The two main sections are connected together and the link lined up to the standards given in Table 2/M.460.

b) Comprising three and more main sections. Lining-up is in two or more stages. The first two main sections are connected together and lined up to main section standards. The third main section is added and the complete link lined up. With more than three main sections the overall link is lined up accordingly in more than two stages.

The frequencies and levels of the pilots and testing signals are given in §§ 2.1 and 3 above.

Note – Where circuits using Signalling System R2 are to be provided, additional measurements on group and supergroup links may be necessary. The group-translating and through-connection equipments are specified with a passband extending from 60.600 kHz to 107.700 kHz. If it is wished to use channel 12 with signalling at 3825 Hz, it is necessary to ensure when the group is set up, that the corresponding frequency (60.175 kHz) is transmitted satisfactorily from end to end of the group link.

Provisionally, in view of the operating margin of the receiving part of the signalling equipment, it is desirable to check that the attenuation at this frequency does not exceed the attenuation at the group-pilot frequency by more than 3 dB.

A similar precaution should be taken on setting up group links when signalling is to be used at 3825 Hz on channel 12 of the group transmitted in position 5 of the supergroup.

7.2.2 In addition to the measurements specified in § 7.2.1 above, the levels of unwanted signals and random noise at the receive end of group and supergroup links may also be checked. Such additional measurements are optional, and need only be carried out at the discretion of Administrations. The following (provisional) limits should apply for group and supergroup links:

7.2.2.1 *Unwanted signals*

The levels of unwanted signals should not exceed the following values:

a) –40 dBm0 (provisional), where such signals originate from carrier or pilot generating equipment;

b) –60 dBm0 (provisional), where such signals originate from other sources.

The measured levels of any unwanted signals, and their location in the group or supergroup frequency band, should be recorded for subsequent maintenance purposes.

7.2.2.2 *Random noise*

Random noise should be measured using an instrument with an effective noise bandwidth of 3.1 kHz taking into account the correction factor for weighting which is 2.5 dB or using an instrument with an effective bandwidth of 1.73 kHz. (See Recommendation G.223 [1].)

The limits in Table 3/M.460 apply.

TABLE 2/M.460

Line-up limits

	Loss at reference or pilot frequency as appropriate		Loss/frequency response relative to loss at reference or pilot frequency		Remarks
	Groups (dB)	Supergroups etc. (dB)	Groups (dB)	Supergroups (db)	
1. National and international sections					
a) Sections which are not main sections	± 0.5	± 0.5	± 1	± 1.5	
b) Main sections	± 0.1	± 0.1	± 1	± 1.5	
2. Main sections	± 0.1	± 0.1	± 1	± 1.5	A main section equalizer, whether terminal or intermediate, is not considered to be part of a national or international section.
3. Link	± 0.1	± 0.1	± 1.5	± 2.0	A link equalizer is not considered to be part of a main section.

TABLE 3/M.460

Limits for random noise on group and supergroup links

Distance in kilometres	$\leqslant$ 320	321 to 640	641 to 1600	1601 to 2500	2501 to 5000	5 001 to 10 000	10 001 to 20 000
Noise (dBm0p)	—56	—54	—52	—50	—47	—44	—41

Note — For satellite routed group and supergroup links, the satellite section (between earth stations) will contribute approximately 10 000 pWp (−50 dBm0p) to the overall random noise. Therefore, for the purpose of determining the noise limits for satellite routed group and supergroup links, the section provided by the satellite may be considered to be equivalent to a length of 2500 km. The effective noise length of such a link will be 2500 km plus the length of the terminal routings.

It should be noted that the measured level of random noise will be influenced by unwanted signals in the group or supergroup frequency band. This must be taken into account when considering the results of random noise measurements.

7.2.3 *Frequency error*

The frequency error over the group link should not exceed 5 Hz. When this measurement is necessary, it should be made according to bilateral agreement between Administrations.

7.3 *Lining up an MU main section for the first time*

The MU main section will first be lined up between the send reference station and the initial MU main section control station using the procedure and limits given above. The whole of the band should be brought to within the appropriate limits even if the destination concerned is not exploiting the whole band. This is to ensure that the various pilots and other measuring signals that can be inserted (for example, intersupergroup measuring signals) are received at the correct levels, and can be measured at the receive station to provide valid reference measurement results for use in maintenance. There are other obvious advantages if this could be done. Unforeseen increases in exploitation or rearrangement of the allocated bandwidth (permanent or emergency) would be eased if the whole band were equalized. Such matters the Administration concerned must decide.

The sections to the other MU main section control stations (associated with the paths to the other destinations) should now be lined up in accordance with the procedures given above.

7.4 *Lining up (or other maintenance operations) on the common path of an MU group, supergroup, etc., when portions of its bandwidth are already in service*

Operations on the exclusive path to a particular destination, made by an intermediate station, need the consent of only one control station. However, operations on the common path would, in principle, require the consent of several remote control stations.

In consequence, the following recommendations are made:

7.4.1 Control and sub-control stations on the common path should be equipped with decoupled testing points (see [2]). It is recommended that these decoupled testing points be test hybrids because, as explained in [2], there is no need to break the transmission path and make terminated-level measurements if test hybrids are used and, furthermore, test signals may be inserted via a test hybrid.

7.4.2 The only signals that may be inserted and measured are:

- pilot signals;
- additional measuring signals (e.g. intersupergroup measuring signals);
- test signals at frequencies lying within the portion of the band concerned (for example, referring to Figure 1/M.460 if Group 4 to Montreal is to be lined up (all others being in service) then stations 1 or 3 may be required to inject signals only at frequencies lying in the band 456-504 kHz).

7.4.3 On the MU main section the record of the response of the portion of bandwidth concerned held by the send reference station can be used to see if any significant difference exists between what was originally achieved on the portion between the send and receive stations.

7.5 *Records*

For each class of section, terminal receiving stations will make terminated-level measurements and sending and intermediate stations will make through-level measurements.

The measurements made at each station should be recorded for reference purposes and be made available to the appropriate control stations as required.

7.6 *Connecting the group, supergroup, etc., reference pilot*

Control stations, sub-control stations and frontier stations may be equipped with reference pilot monitors fitted with limit alarms. In addition, there may be automatic devices at these stations in accordance with Recommendation M.160. Pilot monitors should be provided at the input to the automatic regulator.

The settings of such pilot monitors and automatic regulators at different stations are interdependent and the devices must be set up successively.

7.6.1 The sending terminal station should connect the reference pilot at a level that is within ± 0.1 dB of the nominal value. (This sometimes requires an appropriate translating equipment to be connected at this stage.)

7.6.2 The frontier stations and the control station of the first main section should be successively asked to check the level of the reference pilot and, where appropriate, to adjust any pilot monitors, automatic regulators or other devices associated with the link.

a) The level at the frontier stations and at the main section control station should be checked to verify that there is nothing obviously wrong. (In general, small variations in level are to be expected and no limits can be given. Automatic regulation devices are installed to compensate for these small changes, which must therefore be accepted.)

b) The pilot monitors should be adjusted so that they subsequently indicate departures from the line-up value, that is to say, they should be adjusted to indicate 0 dB under line-up conditions. Stations not equipped with pilot monitors should measure and record the level of the group reference pilot.

c) At stations where automatic regulation devices are fitted they should be arranged to operate symmetrically about the line-up level. At main section control stations they should be adjusted, where appropriate, so that the output level of the reference pilot is within ± 0.1 dB of the nominal value of the reference pilot level.

7.6.3 When the first main section has been dealt with, the first main section control station should inform the control station of the second main section, which should then follow the procedure of § 7.6.2, a)-c) above, the sending terminal station leaving the reference pilot connected.

7.6.4 When the second main section has been dealt with, the second main section control station should inform the control station of the third main section, which again follows the procedure of § 7.6.2 a)-c) above, and so on until the whole of the link has been lined up.

In the case of MU links the appropriate reference pilot should be connected by the MU terminal sub-control station after the sections in the common path have been successively adjusted in accordance with 7.2 and 7.3 above. Then, the MU main section control stations should make any necessary adjustments to pilot receivers or automatic regulators. The reference pilot signals now appearing on the remaining section on each of the paths to the various destinations are adjusted as stated above.

8 Reliability tests on the link

When the initial overall lining-up measurements have been made on a link, and the automatic regulators (if any) have been installed, it is desirable to check the working of the link before putting it into service by testing it over a period of a few hours, if practicable. If the observed results are not satisfactory, taking into account the routing of the link and the services involved, the check should be continued to allow the trouble to be investigated and cleared. The checking is done using the pilot (or, if there is none, using a test frequency at about the same frequency), whose level is continuously recorded during the test, at the far end of the link. The recording devices should be able to record short interruptions in addition to recording the level.

9 Setting up lower order sections after line-up of the higher order links

The different orders of sections have to be set up in sequence.

9.1 Thus, when a supermastergroup link, mastergroup link or supergroup link has been lined up, each end of it is connected to the appropriate translating equipment (supermastergroup link to mastergroup translating equipment, mastergroup link to supergroup translating equipment, and supergroup link to group translating equipment) and the corresponding lower-order sections are then set up.

9.2 The translating equipment, before it is connected to the ends of the link, must be checked and adjusted to ensure that it meets CCITT Recommendations and other relevant specifications.

9.3 When the lower-order sections have been set up in the above manner, they are interconnected as necessary to form links, as described in § 7.1 above, and the appropriate link line-up procedure as detailed in §§ 7.2 to 7.4 above, is then applied.

10 Setting up and lining up links for wide-spectrum transmission (data, facsimile, etc.)

When the whole bandwidth of a group, supergroup, etc., link is used for wide-spectrum transmission (data, facsimile, etc.) the transmission characteristics are those of the relevant Recommendations of Volume III and IV of the *CCITT Book*. In particular, Recommendations H.14 [3], M.900 [4] and M.910 [5] concern such group links.

APPENDIX I

(to Recommendation M.460)

Routing form[1] for a supergroup

1.	Date of issue	1 December 1978
2.	Technical service of	United Kingdom
3.	Supergroup designation	Bruxelles (1) - London (Stag Lane) 6011
4.	Length	446 km
5.a)	Control stations for supergroup	London (Stag Lane), Bruxelles (1)
5.b) i)	Sub-control stations in the direction London to Bruxelles	London (Stag Lane), Broadstairs, Oostende
5.b) ii)	Sub-control stations in the direction Bruxelles to London	Bruxelles (1), Oostende, Broadstairs
6.	Stations where automatic regulators are fitted	London (Stag Lane)
7.	Supergroup pilot frequency(ies)	411.92 kHz

Stations and designation of cable[2]	Length of section (km)	Section in cable				Section on radio link		Nominal levels at supergroup measuring points dBr		Remarks[3]
		Symmetrical pair sections		Coaxial pair sections						
		Pair number	Position of supergroup	Number of coaxial system	Position of supergroup	Designation of radio link	Position of supergroup	↓	↑	
A	B	C	D	E	F	G	H	J	K	L
London (Stag Lane)								−35	−30	
	193			1002	6					Coaxial pair
Broadstairs								−35	−30	
	119									Submarine cable
Oostende								−35	−30	
	134			30002	4					Coaxial pair
Bruxelles (1)								−30	−35	

[1] A diagram can be associated in complicated cases.

[2] Underline through-supergroup points.

[3] Mention any special types of carrier system, e.g. submarine cable system. In such cases state the frequency band for the two directions of transmission. Show type of through-supergroup equipment and supplementary information if necessary.

APPENDIX II

(to Recommendation M.460)

Line-up record for a supergroup link

Date of issue .... 1 December 1978
Technical service of.......... United Kingdom
Supergroup designation .... Bruxelles (1) - London (Stag Lane) 6011
Length .... 446 km
Control station .... Bruxelles (1)
Sub-control stations .... Broadstairs, Oostende, London (Stag Lane)
Date of measurements .... November 1978
Direction .... London-Bruxelles

Distance (km)	Stations	Relative levels[1], dB — Test frequencies kHz 313	317	333	381	429	477	525	545	549	Pilot A[1]	Pilot B[1]	Measuring point	Measuring equipment[2]	Nominal relative level at measuring point dBr	Impedance at measuring point (ohms)	Remarks[3]
	London (Stag Lane)	0	0	0	0	0	0	0	0	0	0		HF Test and fatch frame	NS	−35	75	
193																	
	Broadstairs	−0.1	−0.1	−0.1	0	0	0	0	−0.1	−0.1	0		HF Test and fatch frame	NS	−35	75	
119																	
	Oostende	−0.3	−0.1	−0.1	0	0	0	0	−0.2	−0.2	0		SDF	S	−35	75	
134																	
	Bruxelles (1)	−0.4	−0.2	−0.1	0	0	0	0	−0.2	−0.4	0		SDF	S	−30	75	

Frequency (kHz) of supergroup reference pilot: 411.920 kHz.
Absolute power level dBm (referred to 1 mW) of supergroup reference pilot at a zero relative level point: −20 dBm0.

[1] Show in these columns the differences relative to the nominal values.
[2] State if the equipment is selective (S) or not (NS).
[3] Indicate the presence of supergroup automatic gain control (AGC).
SDF: Supergroup distribution frame.

APPENDIX III (A)

(to Recommendation M.460)

EXAMPLE FOR A SIMPLE GROUP

Routing form[1] for a group

1.	Date of issue	1 June 1979
2.	Technical service of	United Kingdom
3.	Group designation	London (Faraday) - Amsterdam (1) 1203
4.	Length	516.5 km
5.a)	Control stations for group	London (Faraday), Amsterdam (1)
5.b) i)	Sub-control stations in the direction London to Amsterdam	London (Faraday), Aldeburgh, Goes
5.b) ii)	Sub-control stations in the direction Amsterdam to London	Amsterdam (1), Goes, Aldeburgh
6.	Stations where automatic regulators are fitted	London (Faraday), Amsterdam (1)
7.	Group pilot freqnency(ies)	84.080 kHz

Stations and designation of cable[2]	Length of section (km)	Group sections[3]		Supergroup sections[4]		Nominal levels at through-group points dBr		Remarks[5]
		Pair numbers	Position (A B C D E) of group	Super-group number	Position of the supergroup followed by the position of the group in the supergroup	↓	↑	
A	B	C	D	E	F	G	H	J
London (Faraday)						—37	— 8	
	152			6001	14/3			Coaxial pair
Aldeburgh						—37	— 8	
	153							Submarine cable
Domburg								
	39			6001	3/5			
Goes						—30	—30	
	164.5			6004	4/3			Microwave
Amsterdam (2)						—37	—30	
	8			6024	2/2			Coaxial pair
Amsterdam (1)						—30	—37	

[1] A diagram can be associated in complicated cases.
[2] Underline the through-group points.
[3] Sections in cable, open-wire or radio link not providing a supergroup.
[4] Sections in cable or radio links with at least one supergroup.
[5] Mention the type of carrier system: 12, 24..., 12 + 12... channels and if not underground cable, state: open-wire, radio link, submarine cable. In such cases give the frequency bands for the two directions of transmission. Show the type of through-group equipment.

APPENDIX III (B)

(to Recommendation M.460)

EXAMPLE OF A COMPLICATED GROUP

Routing form* for a group

1.	Date of issue	July 1979
2.	Technical service of	United Kingdom
3.	Group designation	London (Stag Lane) - Sydney (Broadway) 1214
4.	Length	12606 km + satellite section
5.a)	Control stations for group	London (Stag Lane), Sydney (Broadway)
5.b) i)	Sub-control stations in the direction London to Sydney	London (Stag Lane), Beaver Harbour, Montreal, Vancouver, Lake Cowichan, Moree
5.b) ii)	Sub-control stations in the direction Sydney to London	Sydney (Broadway), Moree, Lake Cowichan, Vancouver, Montreal, Beaver Harbour
6.	Stations where automatic regulators are fitted	London (Stag Lane), Sydney (Broadway)
7.	Group pilot frequency(ies)	104.08 kHz

Stations and constitutions[1,4]	Length of section (km)	Group sections[2]		Supergroup sections[3]		Nominal levels at through-group points dBr		Remarks[4]
		Pair numbers	Position of group	Super-group number	Position of the supergroup followed by the position of the group in the supergroup	↓	↑	
A	B	C	D	E	F	G	H	J
London (Stag Lane)						—37	— 8	
	317				8/2			Coaxial pair
Widemouth Bay						—37	— 8	
	5180			6008	20/2			Submarine cable (CANTAT 2)
Beaver Harbour						—37	—37	
	1931			6006	12/5			Microwave
Montreal						—37	—37	
	4431			6004	3/5			Microwave
Vancouver						—37	—37	
	97			6004	4/5			Microwave
Lake Cowichan						—37	—37	
	(satellite)			6001	4/4			Satellite (Pacific Ocean)
Moree						—30.5	—36.5	
	650			6010	10/4			Coaxial pair
Sydney (Broadway)						—30.5	—36.5	

* A diagram can be associated in complicated cases.

1 Underline the through-group points.

2 Sections in cable, open-wire or radio link not providing a supergroup.

3 Sections in cable or radio links with at least one supergroup.

4 Mention the type of carrier system: 12, 24..., 12 + 12... channels and if not underground cable, state: open-wire, radio link, submarine cable. In such cases give the frequency bands for the two directions of transmission. Show the type of through-group equipment.

APPENDIX IV (A)

(to Recommendation M.460)

EXAMPLE FOR A SIMPLE GROUP LINK

Line-up record for a group link

Date of issue	1 June 1979
Technical service of	United Kingdom
Group designation	Amsterdam (1) - London (Faraday) 1203
Length	516.5 km
Control station	Amsterdam (1)
Sub-control stations	Goes, Aldeburgh, London (Faraday)
Date of measurement	14 January 1979
Direction	London - Amsterdam

Distance (km)	Stations	Relative levels[1] dB											
		Test frequencies in kHz (4 kHz spacing)											
		61	63	71	79	84	87	95	103	107			
	London (Faraday)	0	0	0	0	0	0	0	0	0			
152													
	Aldeburgh	+0.3	+0.7	+0.7	+0.3	+0.3	+0.5	+0.4	+0.7	+0.9			
192													
	Goes	—0.8	—0.2	0	0	0	0	0	—0.1	+0.2			
172.5													
	Amsterdam (1)	—1.5	—0.3	—0.2	—0.2	0	—0.15	—0.05	—0.45	0			

Distance (km)	Stations	Pilot A[1] dB	Measuring point	Measuring equipment[2]	Nominal relative level at measuring point dBr	Impedance at measuring point (ohms)	Remarks[3]
	London (Faraday)	0	GDF	NS	—37	75	
152							
	Aldeburgh	+0.1	GDF	NS	—37	75	
192							
	Goes	0	GDF	S	—30	150	
172.5							
	Amsterdam (1)	0	GDF	S	—30	150	AGC

Frequency of group reference pilot in kHz: 84.080 kHz.
Absolute power level dBm (referred to 1 mW) of group reference pilot at a point of zero relative level: —20 dBm0.

[1] Show in these columns the differences relative to the nominal values.
[2] State if the equipment is selective (S) or not (NS).
[3] Indicate the presence of group automatic gain control (AGC).
GDF: Group distribution frame.

APPENDIX IV (B)

(to Recommendation M.460)

EXAMPLE FOR A COMPLICATED GROUP LINK

Line-up record for a group link

Date of issue	July 1979
Technical service of	United Kindom
Group designation	London (Stag Lane) - Sydney (Broadway) 1214
Group length	12606 km + satellite section
Control station	Sydney (Broadway)
Subcontrol stations	London (Stag Lane), Beaver Harbour, Montreal, Vancouver, Lake Cowichan, Moree
Date of measurement	18 July 1978
Direction	London - Sydney

Distance (km)	Stations	Relative levels[1] dB								
		Test frequencies in kHz								
		61	63	71	79	84	87	95	103	107
	London (Stag Lane)	0	0	0	0	0	0	0	0	0
7428	Montreal	—0.4	—0.7	—0.3	—0.15	—0.1	0	0	0	+0.2
4431	Vancouver	—0.7	—0.5	—0.3	—0.1	—0.1	—0.1	—0.1	0	0
747 + satellite	Sydney (Broadway)	—1.0	—1.0	—0.8	—0.7	—0.2	—0.5	—0.25	—0.1	—0.05

Distance (km)	Stations	104.08 kHz pilot[1]	Measuring point	Measuring equipment[2]	Nominal relative level at measuring point dBr	Impedance at measuring point (ohms)	Remarks[3]
	London (Stag Lane)	0	HF Test and Patch frame	NS	—37	75	
7428	Montreal	0	GDF	S	—37	75	
4431	Vancouver	0	GDF	S	—37	75	
747 + satellite	Sydney (Broadway)	0	Group control rack	S	—30.5	150	AGC

Absolute power level dBm (referred to 1 mW) of group reference pilot at a point of zero relative level: —20 dBm0.

[1] Show in these columns the difference relative to the nominal values.
[2] State if the equipment is selective (S) or not (NS).
[3] Indicate the presence of group automatic gain control (AGC).
GDF: Group distribution frame.

References

[1] CCITT Recommendation *Assumptions for the calculation of noise on hypothetical reference circuits for telephony*, Vol. III, Rec. G.223.

[2] *Measuring errors and differences due to impedance inaccuracies of instruments and apparatus. Use of decoupled measuring points*, Green Book, Vol. IV.2, Supplement No. 2.5, ITU, Geneva, 1973.

[3] CCITT Recommendation *Characteristics of group links for the transmission of wide-spectrum signals*, Vol. III, Rec. H.14.

[4] CCITT Recommendation *Use of leased group and supergroup links for wide-spectrum signal transmission (data, facsimile, etc.)*, Vol. IV, Rec. M.900.

[5] CCITT Recommendatioin *Setting up and lining up an international leased group link for wide-spectrum signal transmission*, Vol. IV, Rec. M.910.

Recommendation M.465

BRINGING INTERNATIONAL DIGITAL BLOCKS, PATHS AND SECTIONS INTO SERVICE[1)]

1 Preliminary exchange of information

The technical services concerned nominate the control and sub-control stations for the digital block, path or section to be brought into operation in accordance with Recommendations M.80 and M.90.

The technical services should indicate the routing to be followed and the method given in Recommendation M.570 may be applied.

Information necessary for the control station, which will be entered on a *routing form* is indicated below:

- routing of the block, path or section,
- names of control and sub-control stations,
- names of stations where the block or path appears at its characteristic bit rate.

The overall routing form for an entire block or path is drawn up by the control station on the basis of information furnished by its technical service and by each sub-control station for the sections for which the latter is responsible.

2 Digital system arrangements

2.1 *Digital hierarchy*

The layout of the presently identified hierarchical digital bit rates is given in Table 1/M.465, both for hierarchies based on 1544 kbit/s systems and for hierarchies based on 2048 kbit/s systems.

TABLE 1/M.465

Hierarchical bit rates

Level	1544 kbit/s structure		2048 kbit/s structure
1	1544		2 048
2	6312		8 448
3	32 064	44 736	34 368
4	97 728	Note	139 264

Note – Level 4 bit rates presently under study.

1) The procedures for introducing services using digital satellite systems are not covered in this Recommendation. This matter is for further study for Study Group IV.

2.2 *Digital interworking arrangements*

(The standard digital interworking arrangements presently under study by Study Group XVIII will be shown when they are available).

3 Reference measurements for a path

The measurements described in § 5.2 below for ensuring that the digital path is within limits also constitute reference measurements. These data should be recorded at every sub-control station and at stations adjacent to frontiers where the block or path appears at its characteristic bit rate. On request, this data should be forwarded to the control station which then can draw up a record of reference measurements.

4 Organization of the control of international digital blocks, digital paths, etc.

4.1 *Classes of station*

4.1.1 As far as international cooperation is concerned, only two classes of through-connection station need to be designated by any country:

a) stations which exercise control functions, i.e., digital block/digital path control stations and digital block/digital path sub-control stations;

b) attended stations nearest the frontier, which in this Recommendation are referred to as *frontier stations.*

4.1.2 In accordance with Recommendations M.80 and M.90, the station at each end of the digital block or digital path is the *control station* for the receiving direction of transmission and the terminal *sub-control station* for the sending direction. Stations having control functions in intermediate countries are digital block, digital path intermediate sub-control stations. Other stations involved in international maintenance are frontier stations.

4.1.3 In general, a transit country will have one station with control functions or one with sub-control functions and two frontier stations. A country in which the digital block or path terminates has only one frontier station. In some countries, a station with control functions or sub-control functions and a frontier station will be the same.

4.2 *Classes of digital sections*

For the purposes of setting-up, making initial tests and subsequent maintenance, an international digital path is subdivided into national sections, international sections and main sections as defined in Recommendation M.300. These terms are illustrated in Figure 1/M.465.

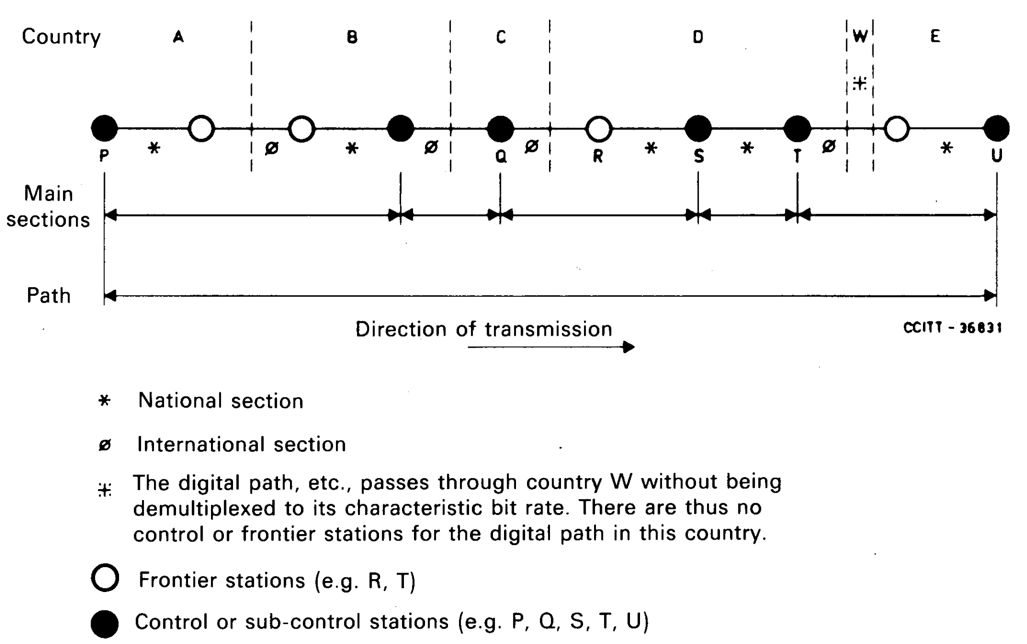

FIGURE 1/M.465

Example of an international digital path showing how it may be divided into sections of control for initial testing and maintenance

4.3 *Organization of control functions*

The terminal stations of each national, international and main section will be appointed as a control or sub-control station for that class of section with which they are concerned. However, as a consequence of the definitions of national, international and main sections of a digital path, some stations will be nominated for more than one control or sub-control function. For example, station S in Figure 1/M.465 is:

- control station for main section Q-S,
- sub-control station for main section S-T,
- control station for national section R-S.

5 Setting up and initial testing of an international digital path

5.1 *Setting up the path*

5.1.1 Once the route has been agreed, the (n-th order) digital path control station will direct the operations needed to set up the digital path.

All the repeater stations concerned – i.e., the stations at the ends of each digital section that will make up the digital path – should make setting-up tests and check the equipment to be used. The check should include a general visual inspection and vibration tests, particularly if the equipment has remained unused for some time since acceptance tests were carried out after installation.

5.1.2 Each country sets up the national part within its territory, each international digital section is set up by the stations at the ends of this section in the two countries concerned (generally the frontier stations) and these national and international sections are interconnected as may be appropriate. The sub-control stations inform the control station when each interconnection is completed.

5.2 *Initial testing of the digital path*

5.2.1 The procedure for an international n-th order digital path is based on the progressive testing of its component sections as follows:

i) national and international sections which are then interconnected to form main sections,

ii) main sections which are then interconnected to form the overall path,

iii) overall path.

The setting-up tests should include a quick test of the digital error performance. The function of such a check is not to guarantee compliance with performance objectives nor is it the testing of the system as part of a commissioning process (which might require measurement of margins), but rather to detect any immediate problems instead of having the user do so. Thus, it is analogous to a continuity check of a circuit, not to a measurement of the loss and noise of the circuit. The limits to apply are given in Table 2/M.465.

For these tests, satellite paths should be considered to have an equivalent length of 12 500 km.

5.2.2 The following procedures should be used when making the tests recommended in Table 2/M.465:

1) All tests should be performed at a first order digital connection point. Thus, tests of second order and other higher bit rate digital systems must have the appropriate multiplexers and demultiplexers in the test path. This ensures a complete test of the path regardless of its bit rate.

2) A test of digital path between two stations is set up by connecting a QRSS (quasi-random signal source) to the input for the digital path at the transmitting station distribution frame and connecting the output at the receiving station distribution frame to a receive input of a test set such as that described in Recommendation O.151 [1].

3) Tests may be one way in each direction or "looped" (combined 2-way). If looped, then test equipment is required at only one location, and the other end is arranged to be looped back (output connected to the input at the distribution frame).

4) Test equipment should have the features described in Recommendation O.151 [1]. Back-to-back tests of test equipment should occasionally be performed (connect output to input on the same test instrument) to test for locally generated errors due to unfiltered a.c. power or station equipment interference. In general, whenever possible, use protected d.c. power for all test equipment.

5) The results of error tests may be contaminated by events which cause the test instrument to lose synchronization. In general, all such "lost sync" tests should be repeated.

6) If the tests fail:

   a) Determine if some special circumstance was responsible for a circuit interruption or high error rate. If it was, repeat the test to verify that the circuit is working correctly.

   b) If no special circumstance is found, an attempt should be made to isolate the problem section for repair or replacement. If the digital path starts to function correctly during trouble isolation, repeat the original test.

   c) For marginal failures (i.e. just a few counts over the limit), the test should be repeated, but with the time limit and the maximum allowable count doubled.

TABLE 2/M.465

Quick check test of digital error performance for digital section and paths at the primary rate (Provisional)

Effective distance (kilometres)	Minimum test duration (in minutes)	Maximum allowed counts [a] in errored seconds [b]
500	15	5
1 000	15	10
2 000	15	20
4 000	15	40
8 000	15	80
12 500	15	125
18 000	15	180
25 000	15	250

[a] Values relate to 1.5 or 2.0 Mbit/s and may be linearly interpolated for other distances.

[b] For the meaning of the term "errored seconds", see Recommendation G.821.

6 Setting up lower-order sections after the initial testing of the higher-order paths

The different hierarchical orders of sections have to be set up in sequence.

6.1 Thus, when the digital path has been initially tested, each end of it is connected to the appropriate digital multiplexing equipment and the corresponding lower-order sections are then set up.

6.2 In each case, the digital multiplexing equipment, before it is connected to the ends of its associated path, must be checked and adjusted to ensure that it meets CCITT Recommendations and other relevant specifications.

6.3 When the lower-order sections have been set up in the above manner, they are interconnected as necessary to form paths, as described in § 5.1 above, and the appropriate path testing procedure as detailed in § 5.2 above, is then applied.

Reference

[1] CCITT Recommendation *Specification for instrumentation to measure error-performance on digital systems*, Vol. IV, Rec. O.151.

SETTING UP AND LINING UP ANALOGUE CHANNELS FOR INTERNATIONAL SERVICES

1 Check of channel-translating equipment

The translating equipment, before it is connected to the ends of the link, must be checked and adjusted to ensure that it meets CCITT Recommendations and the other relevant specifications. The check should include a general visual inspection and vibration tests, if applicable. This is of particular importance if the equipment has remained unused since acceptance tests were carried out after installation.

2 Setting up and lining up the analogue channels

2.1 *Measurement and adjustment of levels*

After the group link has been set up, and the channel-translating equipment at each end of the group link has been connected and checked, the channels are adjusted as follows.

An 800 Hz[1)] test signal is sent over each channel in turn at a level of -10 dBm0[2)]. At the transmitting end, the channel-translating equipment is adjusted so that the sideband level on each channel at its output is as near to nominal as possible. At the receiving end, the channel-translating equipment should then be adjusted to bring the received level on each channel as near as possible to its nominal value.

2.2 *Checking the analogue channel performance*

Channel performance measurements are only required when the need is indicated during circuit line-up. On such occasions the parameters to be checked will depend on the particular difficulty experienced during circuit line-up.

3 Check level of line signalling

In the case of groups which are intended to be used for telephone circuits employing Signalling System R2, the checks of signalling level stipulated in the Specifications of Signalling System R2 should be made [2].

For other signalling systems, the check of signalling level should be carried out at the circuit line-up stage (see Recommendation M.580, § 8).

References

[1] *Test frequencies on circuits routed over PCM systems*, Supplement No. 3.5, Vol. IV, Fascicle IV.4.

[2] CCITT Recommendations *Specifications of Signalling System R2*, Vol. VI, Recs. Q.400 to Q.480.

1) For international circuits, 800 Hz is the recommended frequency for single-frequency maintenance measurements. However, by agreement between the Administrations concerned, 1000 Hz may be used for such measurements, since it is a fact that 1000 Hz is widely used for single-frequency measurements on international and intercontinental circuits.

Multi-frequency measurements made to determine the loss/frequency characteristic will include a measurement at 800 Hz, and therefore the reference frequency for such characteristics can still be 800 Hz.

Reference should be made to supplement No. 3.5 [1] concerning measuring frequencies to be used on circuits routed over PCM systems.

2) A level of 0 dBm0 may be used by agreement between the Administrations concerned.

SETTING UP AND LINING UP MIXED ANALOGUE/DIGITAL CHANNELS FOR INTERNATIONAL SERVICES

1 Check of FDM multiplex or transmultiplexer equipment

The FDM multiplex or transmultiplexer equipment, before it is connected to a group or supergroup link, must be checked to ensure that it meets CCITT Recommendations and the other relevant specifications. The check should include a general visual inspection and vibration tests, if applicable. This is of particular importance if the equipment has remained unused since acceptance tests were carried out after installation.

2 Setting up and lining up mixed analogue/digital channels

The definition of a mixed analogue/digital channel is given in Recommendation M.300. When these channels are used for international telephone circuits, the required circuit transmission loss will in many cases be established through the use of variable loss pads in the transmultiplexer. For these mixed analogue/digital channel applications, Administrations may, through bilateral agreement, defer the separate channel line-up procedures contained in this Recommendation, and perform, instead, the appropriate circuit section and circuit line-up procedures of Recommendation M.580.

As a prerequisite to setting up and lining up channels using the procedures in this Recommendation, the involved group and supergroup links shall have been set up and lined up in accordance with Recommendation M.460.

2.1 *Measurement and adjustment of levels*

Depending upon the type of test equipment used, and the access features of the transmultiplexer, the following procedures may require taking an entire transmultiplexer out of service while each channel is being lined up. Careful consideration should be given to procedures for removing transmultiplexers from service, and for restoring them to service, especially where the group links which terminate on the transmultiplexer are not co-terminous, or where international leased circuits are provided on transmultiplexers.

2.1.1 *Transmultiplexers at each end of the group or supergroup link*

Note – These configurations are shown in a) and b) of Figure 1/M.475.

After the group or supergroup links have been set up, and the transmultiplexing equipments at the ends of the group or supergroup links have been checked and connected, the channels are adjusted as follows.

. At the transmitting end, a bit sequence corresponding to 800 Hz[1] test tone at a level of -10 dBm0[2] is applied to the 64 kbit/s time slot appearance of each channel in turn, at the digital path access point associated with the input to the transmultiplexer, using appropriate digital test equipment. At the receiving end, the 64 kbit/s time slot appearance of each channel is monitored in turn at the digital path access point associated with the output of the transmultiplexer, using appropriate digital test equipment, and each channel is adjusted as near as possible to its nominal level.

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1) For international circuits, 800 Hz is the recommended frequency for single-frequency maintenance measurements. However, by agreement between the Administrations concerned, 1000 Hz may be used for such measurements, since it is a fact that 1000 Hz is widely used for single-frequency measurements on international and intercontinental circuits.

Multi-frequency measurements made to determine the loss frequency characteristic will include a measurement at 800 Hz, and therefore the reference frequency for such characteristics can still be 800 Hz.

Reference should be made to supplement No. 3.5 [1] concerning measuring frequencies to be used on circuits routed over PCM systems.

2) A level of 0 dBm0 may be used by agreement between the Administrations concerned.

2.1.2 *24-channel transmultiplexer at one end of the group links, with channel translating equipment at the other end*

Note – This configuration is shown in c) of Figure 1/M.475.

After the group links have been set up, and the transmultiplexing and channel translating equipments at the ends of the group links have been checked and connected, the channels are adjusted as follows.

Transmitting from the channel translating equipment towards the transmultiplexer, an 800 Hz[3)] test signal is sent over each channel in turn at a level of −10 dBm0[4)]. The channel translating equipment is adjusted so that the sideband level on each channel is as near to the nominal level as possible. At the receiving end, the 64 kbit/s time slot corresponding to each channel is monitored in turn at the digital path access point associated with the output of the transmultiplexer, and each channel is adjusted to obtain the bit sequence corresponding to the nominal level of the received test signal.

Transmitting from the transmultiplexer towards the channel translating equipments, a bit sequence corresponding to 800 Hz[3)] test tone at a level of −10 dBm0[4)] is applied to the 64 kbit/s time slot of each channel in turn, at the digital path access point associated with the digital input to the transmultiplexer, using appropriate digital test equipment. At the receiving end, the channel translating equipment should then be adjusted to bring the received level on each channel as near as possible to its nominal value.

2.1.3 *60-channel transmultiplexer at one end of a supergroup link, with group and channel translating equipments at the other end*

Note – This configuration is shown in d) of Figure 1/M.475.

After the supergroup link and group links have been set up, and the transmultiplexing, group translating, and channel translating equipments at the ends of the supergroup link and group links have been checked and connected, the channels are adjusted by the following procedures in § 2.1.2 above.

3 Check level of line signalling

In the case of groups which are intended to be used for telephone circuits employing Signalling System R2, the checks of signalling level stipulated in the Specifications of Signalling System R2 should be made [2].

For other signalling systems, the check of signalling level should be carried out at the circuit line-up stage (see the Recommendation M.580).

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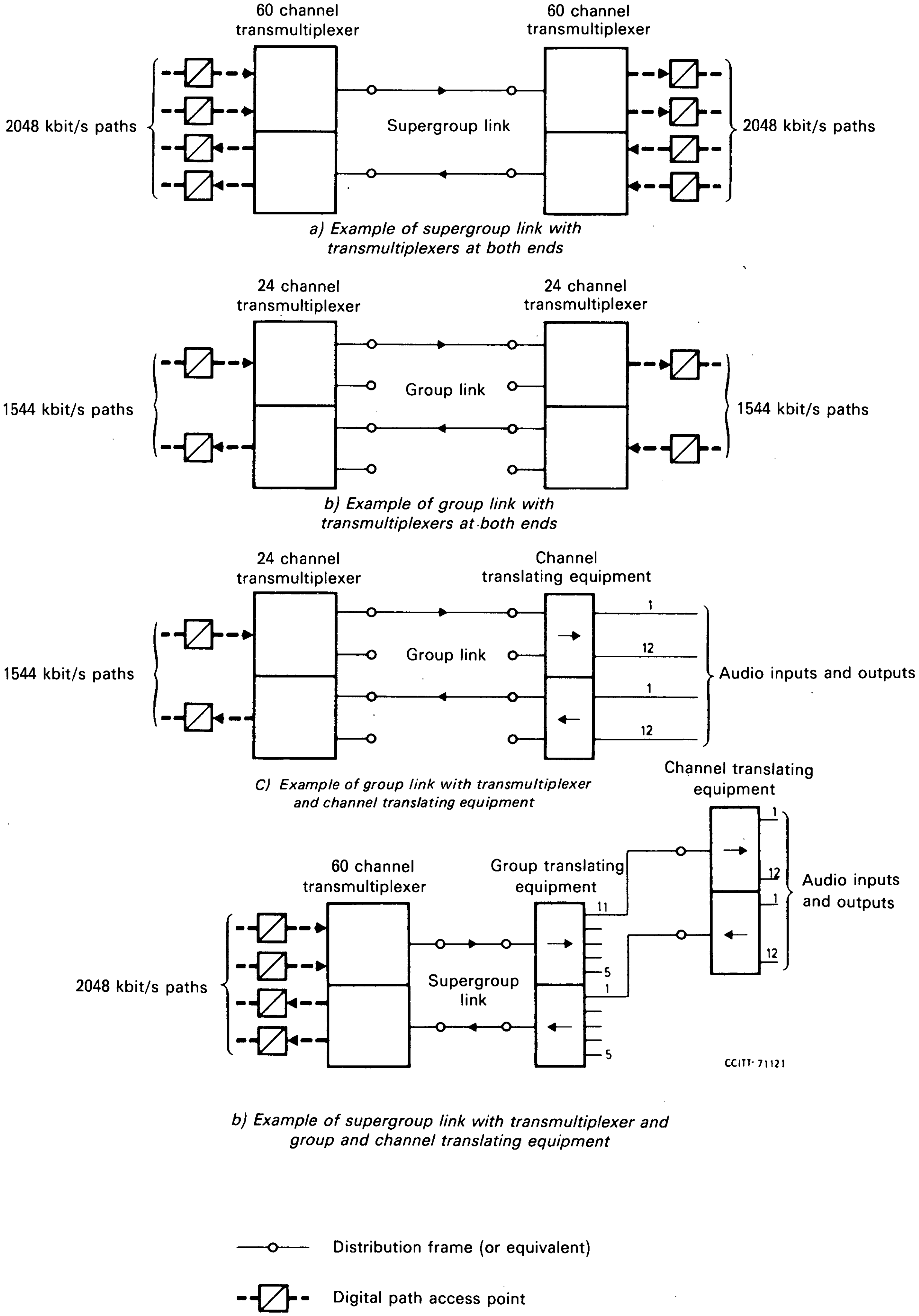
3) For international circuits, 800 Hz is the recommended frequency for single-frequency maintenance measurements. However, by agreement between the Administrations concerned, 1000 Hz may be used for such measurements, since it is a fact that 1000 Hz is widely used for single-frequency measurements on international and intercontinental circuits.

Multi-frequency measurements made to determine the loss frequency characteristic will include a measurement at 800 Hz, and therefore the reference frequency for such characteristics can still be 800 Hz.

Reference should be made to supplement No. 3.5 [1] concerning measuring frequencies to be used on circuits routed over PCM systems.

4) A level of 0 dBm0 may be used by agreement between the Administrations concerned.



a) *Example of supergroup link with transmultiplexers at both ends*

b) *Example of group link with transmultiplexers at both ends*

C) *Example of group link with transmultiplexer and channel translating equipment*

b) *Example of supergroup link with transmultiplexer and group and channel translating equipment*

FIGURE 1/M.475

References

[1] *Test frequencies on circuits routed over PCM systems*, Supplement No. 3.5, Vol. IV, Fascicle IV.4.

[2] CCITT Recommendation *Specifications of Signalling System R2*, Vol. VI.

Recommendation M.480

SETTING UP AND INITIALLY TESTING DIGITAL CHANNELS ON AN INTERNATIONAL DIGITAL PATH OR BLOCK

The definition of a digital channel is given in Recommendation M.300. Procedures in CCITT Recommendation M.465 for bringing into service digital blocks and digital paths are adequate to ensure satisfactory operation of digital channels which are provided on the respective digital blocks or paths. No specific tests are required for individual digital channels.

Where digital channels are terminated at each end by mixed analogue/digital terminals, Administrations may, with bilateral agreement, choose to apply a procedure similar to that in CCITT Recommendation M.470, to test from each audio input to each audio output of the combined mixed analogue/digital terminal plus digital channel configuration. This procedure would be applied as an alternative to the mixed analogue/digital terminal circuit section line-up procedure in CCITT Recommendation M.580.

2.4 Planned outages and restoration of transmission systems

Recommendation M.490

EXCHANGE OF INFORMATION FOR PLANNED OUTAGES OF TRANSMISSION SYSTEMS

1 General

Planned outages of transmission systems are required to allow planned work to be done with the minimum impairment to the service concerned. All tests, measurements, rearrangements, etc., which are not attributed directly to a failure – and are known in advance – are considered to be *planned work*. Such work will include installation of new equipment, routine maintenance, work on power supply equipment and in some cases, work for the clearance of faults which at first could only be remedied provisionally (mainly cable faults).

In the event of planned work which results in the complete or partial interruption in a transmission system, efforts are at first made to reroute the telecommunication traffic as required. If special restoration plans exist for cases of faults, these plans can also be used in the event of planned outages. Should rerouting be impossible, planned work is generally carried out during periods of light traffic, e.g. at night. To allow appropriate measures to be taken, all stations affected by the planned outage must be informed in good time.

2 Planned outages of international groups, supergroups, etc.

When an Administration plans the outage of a transmission system carrying international group/supergroup, etc. links, it should inform all other Administrations in whose territories the links concerned terminate. This information should be given by telex at least three working days in advance.[1] An example is given in Figure 1/M.490. There are cases in which more than three days are necessary, such as those involving extensive rearrangements. If, in exceptional cases, a three-day notice cannot be given, advice should be given by telephone so as to ensure that the Administrations concerned still have sufficient time to take the appropriate steps. Planned outages should not be carried out if notice cannot be given and received at least 24 hours in advance.

In practice, Administrations have entrusted different entities, i.e. either their international centres or their technical services with the exchange of information for planned outages. Therefore, it is essential that each Administration states clearly to whom reports on outages are to be sent[2]. In any case, the technical service of an Administration should be aware of the outages planned in its own country, and try to reduce their impact on international services to a minimum. Passing on of the information within the area of an Administration, e.g. to the control stations for leased and special circuits, or to the users of leased circuits, is done according to the national practice.

3 Planned outages of national transmission systems, which affect international leased and special circuits

In the international centres, international leased and special circuits are frequently through-connected in the voice-frequency band and routed to the destination via national group links. An outage of these group links leads to a break in the international circuit. In these cases, informing the circuit control station and the users is of particular importance in order to avoid unnecessary fault location in the other country.

If an outage is planned for a national system within the area of the Administration being entrusted with the terminal sub-control function for a circuit, the circuit control station should be informed direct or via the two transmission maintenance points (international line) (see Recommendation M.1014 [1] or via the technical service so as to enable the control station to inform the user in good time. In addition, it may be advisable that the terminal sub-control station informs the user at its end of the circuit of the planned outage, since an exchange of information between the users at both ends of the circuit is not always possible. Figure 2/M.490 illustrates the possible flow of information for this case.

A similar procedure should be applied if a planned outage of a national system in a transit country affects an international leased or special circuit.

If an outage is planned for a national system within the area of an Administration having control functions for a circuit, it is recommended that the sub-control station be advised in order to avoid unnecessary queries in the event of a fault report being submitted by the user in the distant country concerned. The transmission maintenance point (international line) in its own country should be informed in any case.

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1) The time limit of three working days is not intended to affect other agreements in special cases, e.g. a notification time of two weeks in planned outages of submarine cable systems.

2) Normally such information is exchanged between the System Availability Information Points (see Recommendation M.721).

from: . . . .

to: . . . .

because of urgent work in our country the following groups and supergroups will be out of service from 20th march 23.00 to 21st march 06.00 (gmt):

ffm – luxemburg 6003
ffm – paris 6002
ffm – oslo 1202
ffm – rotterdam 6002, 6005
ffm – amsterdam 6002
amsterdam – budapest 1201
ffm – london 1214, 1246
duesseldorf – milano 6001

regards.

FIGURE 1/M.490

Example of a telex message concerning a planned outage of international groups and supergroups

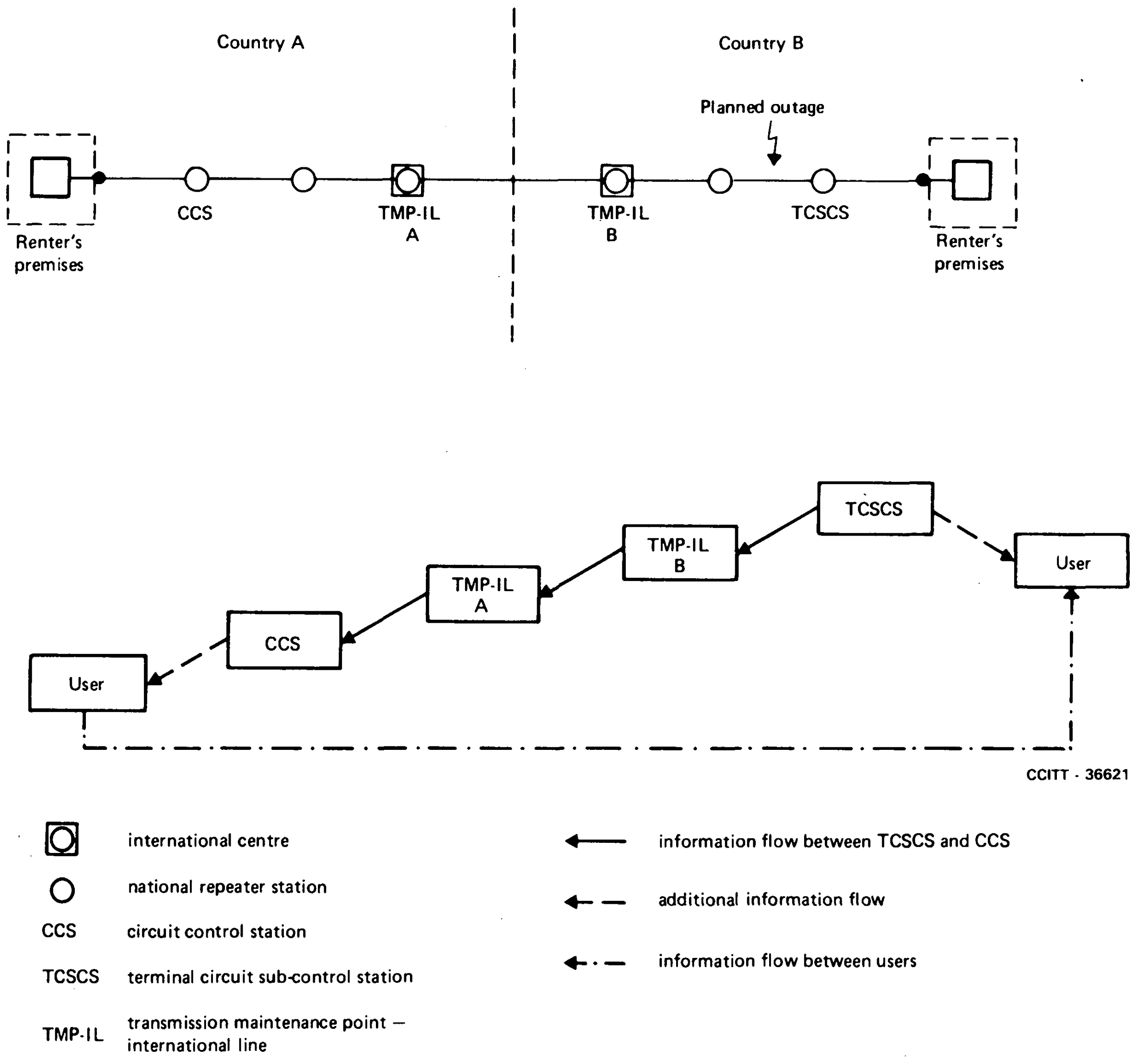

FIGURE 2/M.490

Example of a possible information flow in case of a planned outage of a national transmission system affecting an international leased circuit

Reference

[1] CCITT Recommendation *Transmission maintenance point international line (TMP-IL),* Vol. IV, Rec. M.1014.

TRANSMISSION PATH RESTORATION FOR SERVICE PROTECTION

1 Definitions concerning transmission path restoration methods

1.1 *Preventive method*

Protection switching is that category of restoration in which one transmission path is substituted for another to permit maintenance operations either for the protection against component failure or to remedy temporary conditions such as fading. This is intended to reflect a configuration in which *m* paths protect *n* paths on the same route.

1.2 *Corrective methods*

These are either *physical repair* or *rerouting.* **Rerouting** may be defined as the restoration of a transmission path on another path when a total or partial physical route failure has occurred or when the normal route protection channel is not available due to a previous or simultaneous failure, or when there is no such protection channel provided. Such rerouting is normally effected by manual switching using plugs and cords but it could be accomplished by automatic switching, if appropriate.

2 Principles of transmission path restoration

2.1 In case of a failure on an international transmission system complete service restoration is a maintenance objective. Line and terminal equipment allocated for restoration should be left available to the extent that the objective can be achieved. This equipment may sometimes be used for other purposes as required, e.g. planned outages.

2.2 When planning new routes or changes to existing routes, account should be taken of the requirements of restoration.

2.3 The responsibility for restoration should be based on the following principles in the case of an interruption due to a fault or to a planned outage of a route:

a) when the interruption of an international route takes place on a national section, restoration is solely the affair of the country involved;

b) when an interruption takes place on an international section of an international route, restoration is the affair of the two countries directly involved even if other countries are concerned;

c) in the case of satellite failure the responsibility to restore the satellite capability rests with the designated satellite system manager;

d) restoration should be effected in the transmission network at the highest order of group or line permitted by the network (group, supergroup, etc.) taking into account the service restoration required;

e) it would be desirable to arrive, if possible, at complete restoration based upon bilateral and/or multilateral agreements. Special consideration is necessary when, in practical cases, complete restoration cannot be achieved. When complete restoration is not possible the group, supergroup, etc. line links to be restored should contain those circuits that satisfy the special needs of the Administrations involved to the extent possible. Sufficient restoration capacity should therefore be provided to reflect the special interests of each Administration involved;

f) in the case where it is not possible to restore all circuits through the procedures envisaged under a), b), and c), each terminal country should make the necessary agreements to use all available routes lending themselves to restoration.

3 Methods of transmission path restoration

3.1 *Restoration methods*

The links provided for service restoration are used in the event of both failures and planned outages. Methods for restoration will necessarily vary according to the particular system and circumstances involved. They will include protection switching, physical repair and rerouting using manual, semiautomatic or fully automatic methods. In order to choose the restoration method, it is appropriate for the Administrations involved to take into account the following elements in a bilateral or multilateral agreement:

a) the level of availability desired;

b) the facilities that may be used for restoration;

c) the economics related to the particular system being considered;

d) the compatibility of equipment at appropriate locations.

3.2 *Manual restoration (patching)*

The complexity of the evolving international transmissions network demands flexibility in any service restoration arrangement. In general, service restoration is presently achieved by manual patching. The links used for service restoration are arranged in a network configuration with particular restoration requirements being met by using such links either singly or connected in tandem. This arrangement is flexible and maximizes the use of international restoration links which are expensive to provide and therefore limited in number.

3.3 *Semiautomatic restoration*

Where manual patching is used for restoration, especially in the case of planned outages, an interruption of service will occur for a significant time while the operation takes place. Any such interruption is undesirable and may be avoided by the use of high speed switchers. Such switchers would be activated manually when it is required to change from the normal route to a previously set-up and tested restoration route.

3.4 *Considerations involved in planning automatic switching systems for corrective restoration*

Restoration arrangements for transmission systems may be applied at any level in the multiplex hierarchy that is bilaterally or multilaterally agreed upon. The switching configuration itself may be a one-to-one or more complex relationship, involving more than one system to be protected by more than one alternative path. When planning a physical restoration system on an international basis the following considerations, among others, should be taken into account in the context of the desired availability and the economics involved:

a) availability of restoration capacity, taking into account the number of standby and normal working paths;

b) transmission characteristics of the standby path(s);

c) services to be restored and the acceptability of additional delay to minimize switching and confirm failure;

d) threshold at which failure is to be established (this may be adjustable in a range);

e) switching level in the multiplex hierarchy and whether any restorative switching is to be applied at more than one level;

f) switch-back techniques to be manual or automatic, if desired at all;

g) telemetry and control system to be used if required;

h) the need for a unidirectional or bidirectional system;

i) maximum degradation to be permitted by the switches.

It would also be useful to consider the restoration system in terms of the component time intervals involved. Some of these have been identified as follows:

T1 – time interval between the actual failure and the initial recognition of that failure;

T2 – time interval to ensure that the apparent failure requires a restoration action;

T3 – time interval required for the processing and the transmission of appropriate controls to establish the necessary restoration switching;

T4 – time interval for switch operations;

T5 – time interval to permit the restored system to stabilize (this may include the verification of switch operations).

The above time intervals would vary depending on whether the transmission system was analogue or digital. If it were digital the bit rate involved would also be a factor. None of these intervals have been considered appropriate to standardize to date.

2.5 Routine maintenance of an international carrier system

Recommendation M.500

ROUTINE MAINTENANCE MEASUREMENTS TO BE MADE ON REGULATED LINE SECTIONS

1 Radio-relay regulated line section

Measurements should be made as indicated below:

1.1 *Regulated line section terminal stations:*

a) daily reading of the line pilot level if necessitated by the type of system. It is preferable that such measurements should always be made at the same time of day;

b) as necessary, readjustment to the nominal value as described in Recommendation M.510.

1.2 *Radio-systems terminals*

1.2.1 At intervals to be determined by agreement between the Administrations concerned, and based on experience of the reliability of the system:

- measurement of the loss/frequency distortion at frequencies in the baseband (additional measuring frequencies) (permissible limits ± 2 dB);
- when there is no continuous recording of noise, measurement of the total noise level on the noise-measurement channels outside the baseband in accordance with CCIR Recommendation No. 398-3[1)] [1]. This measurement can be made without causing any interference in the transmission channel.

1.2.2 When the measurement mentioned in § 1.2.1 above gives unacceptably high noise values, or more often, when the reliability of the system makes it desirable, check of the following measurements in accordance with the appropriate CCIR Recommendations for the radio-relay system concerned should be made, the radio-frequency channel being switched to the standby equipment, and the measurement results compared with the results of the reference measurements required by Recommendation M.450, § 3:

- the deviation of the frequency at which the level is unchanged by pre-emphasis;
- the pilot frequency deviation;
- the central position of the intermediate frequency in the non-modulated condition of the system;
- the level of the baseband reference frequency (single frequency check);
- the relative level at the radio reference measurement frequencies (multifrequency check);
- the level of individual interfering signals in the baseband in the non-modulated condition of the system.

1.2.3 So as to enable the limits for circuit loss variation to be met (see Recommendation M.160), the difference in response between two systems in diversity reception or between a working and standby system should be minimized.

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1) Where a protection channel is provided, and if Administrations so desire, noise measurements may be made on that channel with artificial loading, in accordance with CCIR Recommendation 399-3 [2].

2 Coaxial regulated line section

The following measurements should be made at regulated line section terminal stations:

a) daily reading of the line pilot level if necessitated by the type of system. It is preferable that such measurements should always be made at the same time of day;

b) as necessary, readjustment to the nominal value as described in Recommendation M.510.

The Administrations concerned are left to decide for themselves about measurements at additional measuring frequencies and about checking the operation of the regulators.

Note – Precautions to be taken with additional measuring frequencies:

i) When the end of a regulated line section:

- is not the same as the end of a line link (i.e. when all the groups, supergroups, etc., are through-connected from one regulated line section to another without passing via the through-connection equipment to the basic groups);
- is the same as the end of a line link without complete demodulation to the groups, supergroups or mastergroups (i.e. when only part of the groups, supergroups, etc., are through-connected direct from one line link to another, without passing via the through-connection equipment to the basic groups);

the maintenance personnel should:

a) avoid sending a measuring frequency that is the same as a pilot frequency of a following regulated line section (unless the pilot frequency on such a following section is protected by a blocking filter at the beginning of the section);

b) take into account the possibility of attenuation to additional measuring frequencies lying at the edges of the frequency band of a through-connected basic group, supergroup, etc., due to the presence of through-connection filters.

ii) Interference between additional measuring frequencies on adjacent coaxial links is possible if precautions are not taken to avoid carrying out simultaneous measurements on adjacent links. For this reason:

a) there should be different dates for routine maintenance measurements on two adjacent links;

b) before making any measurement using an additional measuring frequency, and especially those made when clearing faults, repeater station staff should see to it that measurements are not in progress on an adjacent coaxial link.

3 Symmetric pair regulated line section

The following measurements should be made at regulated line section terminal stations:

a) daily reading of the line pilot level if necessitated by the type of system. It is preferable that such measurements should always be made at the same time of day;

b) as necessary, readjustment to the nominal value as described in Recommendation M.510.

The Administrations concerned are left to decide on measurements at additional measuring frequencies and on checking the operation of the regulators, if applicable. The same applies to any kind of measurement or pilot level reading at intermediate attended or unattended stations.

References

[1] CCIR Recommendation *Measurements of noise in actual traffic over radio-relay systems for telephony using frequency-division multiplex*, Vol. IX, Rec. 398-3, ITU, Geneva, 1982.

[2] CCIR Recommendation *Measurement of noise using a continuous uniform spectrum signal on frequency-division multiplex telephony radio-relay systems*, Vol. IX, Rec. 399-3, ITU, Geneva, 1982.

Recommendation M.510

READJUSTMENT TO THE NOMINAL VALUE OF A REGULATED LINE SECTION (ON A SYMMETRIC PAIR LINE, A COAXIAL LINE OR A RADIO-RELAY LINK)

After the routine measurement or clearance of the fault and when it has been ensured that no faults remain on the system, adjustments should be made as necessary to bring the levels of the line pilots and additional measuring frequencies as close as possible to their nominal value.

Making the whole adjustment in the receiving terminal station should be avoided; adjustments should be made where they are necessary, under the direction of the control or sub-control station concerned.

Methodical readjustment should be carried out when the level measured at the terminal station exceeds the maintenance limits for the carrier system. Due allowance should be made for measuring errors and for random effects which may cause slight short-term variation. The tolerance to be allowed depends on the type of system, its length and the periodicity of the measurements.

For example, the following tolerances may be allowed:

a) in the case of a system with continuous gain control an adjustment should be made only if an improvement of at least 0.3 dB can be obtained;

b) in the case of a system with step-by-step gain control allow a permissible tolerance of ± (one-half the gain control step ± 0.3 dB).

Recommendation M.520

ROUTINE MAINTENANCE ON INTERNATIONAL GROUP, SUPERGROUP, ETC., LINKS

1 Type of routine tests

Only measurements of the pilot level are made on international group, supergroup, etc. links. These do not involve other stations. Therefore, Administrations are free to decide on the methods and periodicities. In order to ensure that the performance limits of the links laid down in Recommendation M.160 are met, the following tests are recommended for consideration.

2 Links without an automatic regulator

At control stations routine measurements should be made of the pilot level. The periodicity of these routines may be weekly or monthly depending on the complexity of the routing and constitution of the link.

3 Links with an automatic regulator

At control stations where a regulator is installed, the level at the input and output of the regulator, if these measurement points are provided by the equipment, may be measured every six months.

4 Continuous recording of pilot level

In addition to the above it is useful to be able to take continuous pilot-recordings as required to detect fault conditions which do not trigger the normal alarm systems.

READJUSTMENT TO THE NOMINAL VALUE OF AN INTERNATIONAL GROUP, SUPERGROUP, ETC., LINK

1 General

Before any adjustment is made to a link it must first be ensured that each regulated line section or higher-order link over which the link concerned is routed is correctly adjusted and that the level of the reference pilot at the transmitting end is correct. No readjustments will be made on the link except under the direction of the control station, after consideration of measurement results.

2 Links without a regulator

2.1 For links which use only one regulated line section, or one higher-order link, readjustment of levels to values as close as possible to their nominal value must be made systematically after any measurement or clearance of a fault. Any departure in excess of ± 2 dB from the original line-up at the time the link was first established must be investigated to ensure that there is no fault.

2.2 For links of more complex constitution, no readjustment need be made until the departure from the nominal value exceeds 0.5 dB (see the Note in § 3 of this Recommendation). When the departure from the nominal value exceeds these limits, adjustment to a value as near as possible to the nominal value should be carried out. Adjustment at the terminal station only is permissible within the limits of departure from the settings at the time of the previous reference measurements as a function of the distance to the origin of the link or to the nearest upstream automatic regulator, as given in Table 1/M.530.

TABLE 1/M.530

Distance to origin or regulator	Limit for departure from the settings noted for previous reference measurements beyond which the possibility of a fault should be investigated (see the note in § 3 of this Recommendation)
Up to 1000 km	± 2 dB
1000-2000 km	± 3 dB
Above 2000 km	± 4 dB

If, for the distance concerned, adjustment at the terminal station would cause departures greater than those permitted by the table, measurements should be made at all through-connection points to find if a fault exists. If a fault exists, it should be located and cleared. If no fault exists, but the change is due to normal causes, e.g. temperature changes, aging, etc., adjustments should be made at each through-connection point to bring the level of the reference pilot as near as possible to its nominal value before making a final adjustment at the terminal station.

3 Links with a regulator

No readjustment need be made until the departure from the nominal value measured at the input to the regulator exceeds ± 4 dB. Any departure in excess of ± 4 dB from the nominal value measured at this point must be investigated.

Note – In determining the margins within which equipment should be readjusted, it has been found useful to distinguish three ranges about the nominal value into which the received level might fall:

- a relatively small range in which no action need be taken. This enables the staff to avoid waste of time in continually readjusting in order to compensate minor changes;

– a somewhat larger range in which the received level may be readjusted to as near the nominal value as possible by the terminal station, without having to ask intermediate stations to measure and/or readjust. (This is subject to the overriding proviso that the cumulative adjustment made at the terminal station must not exceed a certain amount relative to the settings noted when the last set of reference measurements was made);
– a range in which it must be assumed that a fault may exist which must be sought and cleared before any readjustment is permitted. After the fault (if any) has been found and all stations, intermediate and terminal, have, if necessary, readjusted their levels to as near the nominal value as possible, the new settings are noted for future reference purposes when making subsequent adjustments.

The three ranges are shown in Figure 1/M.530 in relation to a typical distribution of level values.

A suitable value for y in Figure 1/M.530 is considered to be 2 S, where S is the observed standard deviation. This concept is the basis of Table 1/M.530.

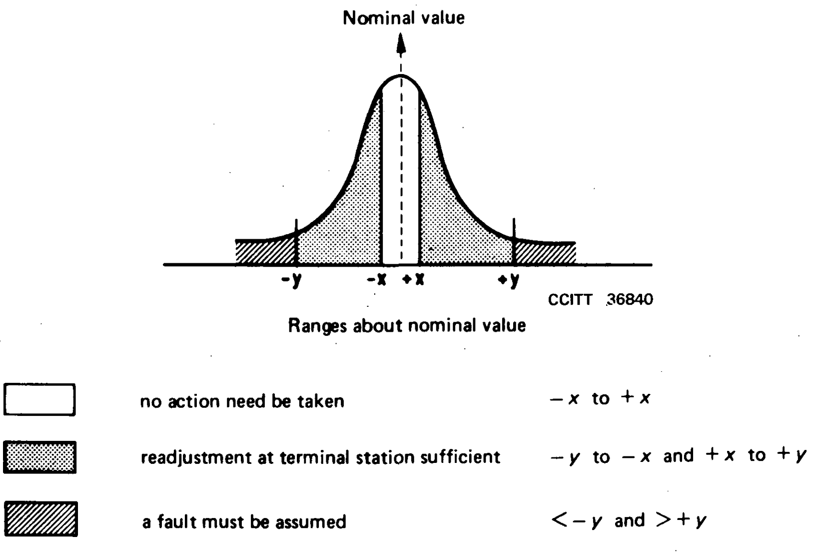

FIGURE 1/M.530

Typical distribution of observed values of level, showing ranges in which different action is necessary

Recommendation M.535

SPECIAL MAINTENANCE PROCEDURES FOR MULTIPLE DESTINATION, UNIDIRECTIONAL (MU) GROUP AND SUPERGROUP LINKS

The Recommendations covering the maintenance of groups and supergroups will apply as far as possible but there will be a number of new maintenance problems which are peculiar to multiple destination links. In particular, arrangements will be needed to check the performance of the MU main section of such links. In order to simplify the procedures and minimize interference to other users of the common path, it is recommended that the send reference station (see Figure 1/M.460) for the MU main section should act as a focal point for reports and inquiries concerning the MU main section. The group, supergroup, etc., control stations will still be responsible for localizing a fault to a particular section of a link in accordance with Recommendation M.130.

When a fault is found to be in the communication satellite link, the send reference station will report the fault to the satellite control responsible for this link from baseband-in to baseband-out. When the fault is cleared, the send reference station will advise the MU main section controls which will in turn advise the group, supergroup, etc., controls concerned.

ROUTINE MAINTENANCE OF CARRIER AND PILOT GENERATING EQUIPMENT

1 If a country has a national frequency standard, it is desirable to use it for checking the frequency of the master oscillators of carrier systems. (See Table 1/M.540 showing the recommended frequency accuracy for various carrier systems.) This frequency standard can be guaranteed to about 1 part in 10^8 by means of the three-way frequency comparisons organized by the CCIR. However, we must note that a larger accuracy can be obtained in the countries that will use an atomic frequency standard (for example cesium or rubidium).

2 If a country has no national frequency standard, there are two possibilities:

a) to receive by radio the standard signals transmitted in accordance with CCIR Recommendations;

b) to receive from a neighbouring country, over a metallic circuit, a frequency derived from the national standard of that country.

It may be necessary in some cases to make a direct comparison of the frequency of the master oscillators of the carrier systems of different countries; this comparison will be effected by means of the frequency comparison pilots.

3 The changeover of master oscillators may cause a short interruption of a few milliseconds and a sudden phase-change. Because the effect of these interruptions and phase-changes is felt throughout the carrier system, changeover of master oscillators should be made only when absolutely necessary.

TABLE 1/M.540

Table showing the recommended frequency accuracy for reference pilots, carriers, etc., in various carrier systems

System		Frequency and accuracy		
		Reference pilot		Carrier generator
(1)		(2)		(3)
(1 + 3) open-wire		16.110 kHz 31.110 kHz	2.5×10^{-5}	2.5×10^{-5}
8 circuit open-wire				10^{-5}
12 circuit open-wire		5×10^{-6}		5×10^{-6}
Symmetric pair 1, 2, 3, 4 or 5 groups		Line regulating 60 kHz Auxiliary	 ± 1 Hz ± 3 Hz	Channel virtual carriers of a group $\pm 10^{-6}$ Groups and supergroups $\pm 10^{-7}$ Mastergroups and supergroups $\pm 5 \times 10^{-8}$
2 supergroups		Line regulating 60 kHz 556 kHz	 ± 1 Hz ± 3 Hz	
Coaxial pair 2.6/9.5 mm	2.6 MHz	Line regulating 2604 kHz	 ± 30 Hz	
	4 MHz	Line regulating 60 kHz 308 kHz 4092 kHz Auxiliary 2792 kHz Additional measuring frequencies (all)	 ± 1 Hz ± 3 Hz ± 40 Hz ± 5 Hz ± 40 Hz	
	12 MHz	Line regulating 308 kHz 4287 kHz 12435 kHz Additional measuring frequencies: < 4 MHz > 4 MHz	 $\pm 1 \times 10^{-5}$ ± 40 Hz $\pm 1 \times 10^{-5}$	
	60 MHz	Line regulating 4287 kHz 12435 kHz 22372 kHz 40920 kHz 61160 kHz Additional measuring frequencies (all)	 $\pm 1 \times 10^{-5}$ $\pm 1 \times 10^{-5}$	
Coaxial pair 1.2/4.4 mm	1.3 MHz	Line regulating 1364 kHz Auxiliary 60 or 308 kHz	 $\pm 1 \times 10^{-5}$ $\pm 1 \times 10^{-5}$	
	4 MHz	Line regulating 60, 308, 4287 kHz	 $\pm 1 \times 10^{-5}$	
	6 MHz	Line regulating 308, 4287 kHz	 $\pm 1 \times 10^{-5}$	
12 + 12		60 kHz Others by agreement between Administrations	± 1 Hz	Error in reconstituted frequency over a 140 km section not to exceed 0.3 Hz (provisional value)

TABLE 1/M.540 (cont.)

System	Frequency and accuracy	
	Reference pilot	Carrier generator
(1)	(2)	(3)
6 MHz		Video carrier 1056 kHz ± 5 Hz
12 MHz		Video carrier 6799 kHz ± 100 Hz
4 kHz spacing Basic group B and Basic supergroup	84.080 kHz, 104.080 kHz 411.920 kHz and 547.920 kHz ± 1 Hz 84.140 kHz and 411.860 kHz ± 3 Hz	
Basic mastergroup and 15-supergroup assembly	1552 kHz ± 2 Hz	
Basic supermastergroup	11096 kHz ± 10 Hz	
3 kHz spacing	84 kHz or other frequency by agreement ± 1 Hz	
Basic group and Basic supergroup	*	

* A supergroup reference pilot frequency of 444 kHz with a tolerance of ± 1 Hz is used.

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SECTION 3

INTERNATIONAL TELEPHONE CIRCUITS

3.1 Bringing an international telephone circuit into service

Recommendation M.560

INTERNATIONAL TELEPHONE CIRCUITS – PRINCIPLES, DEFINITIONS AND RELATIVE TRANSMISSION LEVELS

1 General

The purpose of this Recommendation is to provide the necessary background information for other Recommendations in the M Series.

The CCITT transmission plan and international telephone connections are explained. The Recommendation also introduces the concepts of "virtual analogue switching points", and their conventional relative transmission levels. Appropriate definitions are given where necessary.

Extracts from the relevant Recommendations in Volume III and from Recommendation Q.45 [1] are included in this Recommendation.

2 The CCITT Transmission Plan

2.1 *Principles*

The CCITT transmission plan has been drawn up with the object of making use, in the international service, of the advantages offered by 4-wire switching. However, the recommendations in the plan are considered to be met if the use of technical media other than those described give an equivalent performance at the international centre.

Note – Short transfrontier circuits are not covered by the transmission plan; they should be the subject of agreement between the Administrations concerned.

2.2 *International telephone connections*

A complete **international telephone connection** has three parts, as shown in Figure 1/M.560, namely:

– An **international chain**

  An international chain is made up of one or more 4-wire international circuits. These are connected on a 4-wire basis to other international circuits (in transit international centres) or to national systems (in terminal international centres).

– Two **national systems**, one at each end.

  These may comprise one or more 4-wire amplified national circuits with 4-wire interconnection, and circuits with 2-wire connection to terminal exchanges and subscribers.

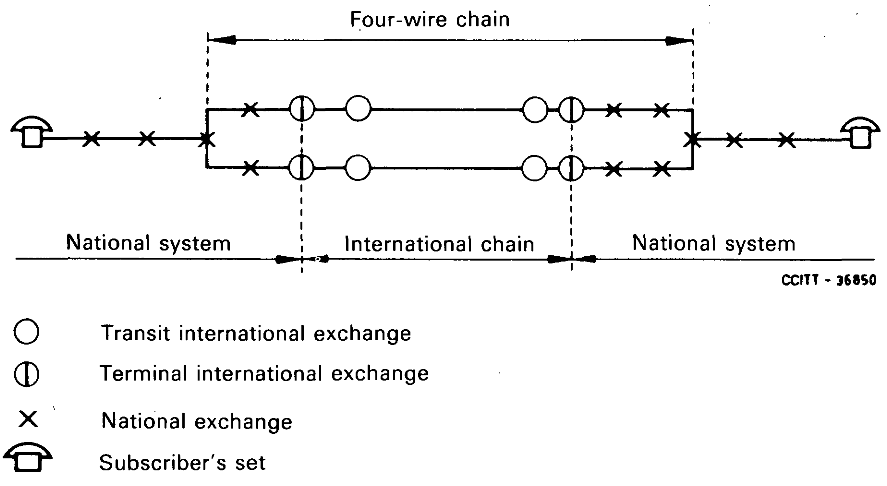


FIGURE 1/M.560

Constituent parts of an international telephone connection

2.3 *International telephone circuits, virtual analogue switching points and relative transmission levels*

2.3.1 From a transmission planning point of view, an international telephone circuit is defined by its "virtual analogue switching points" in the international centre.

2.3.2 *Virtual analogue switching points*

Virtual analogue switching points are theoretical points with specified relative levels.

For circuits terminating at a digital international centre, the concept of virtual analogue switching points postulates the existence of ideal analogue-to-digital coders and digital-to-analogue decoders, via which the desired analogue points could be derived.

The virtual analogue switching points may not be the same as the points at which the circuit terminates physically in a switching equipment. These latter points are known as the circuit terminals; the exact position of the terminals is decided in each case by the Administration concerned (see Figure 2/M.560).

For illustrative purposes, Figure 2/M.560 depicts the virtual analogue switching points for wholly digital and wholly analogue international telephone circuits. Recommendation M.562 deals in detail with circuits provided by a mixture of analogue and digital systems.

2.3.3 *Relative transmission levels at virtual analogue switching points*

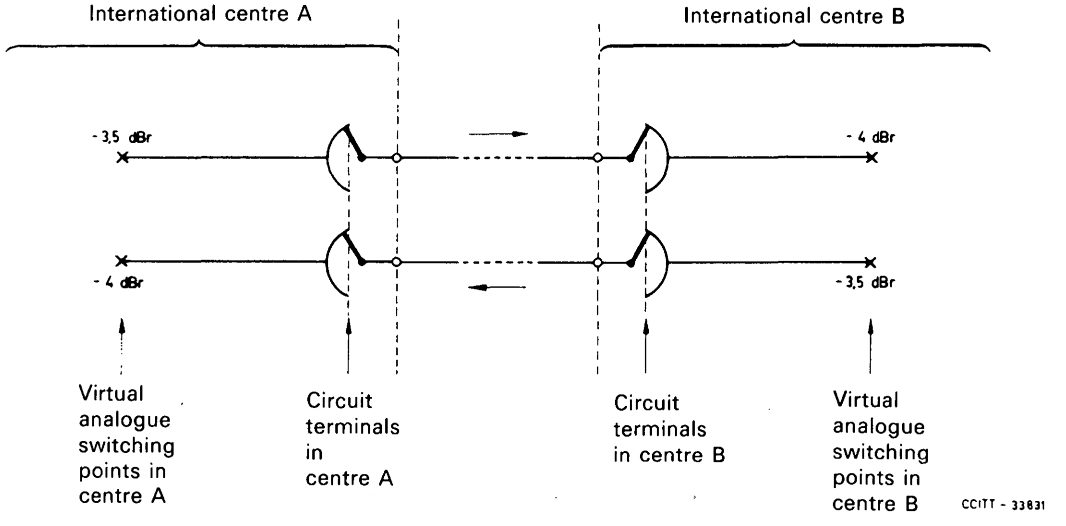
The virtual analogue switching points of an international 4-wire telephone circuit are fixed by convention at points of the circuit where the nominal relative levels at the reference frequency are:

– sending: −3.5 dBr;
– receiving: −4.0 dBr, for analogue circuits and the analogue end of mixed analogue/digital circuits;
  −3.5 dBr for digital circuits.

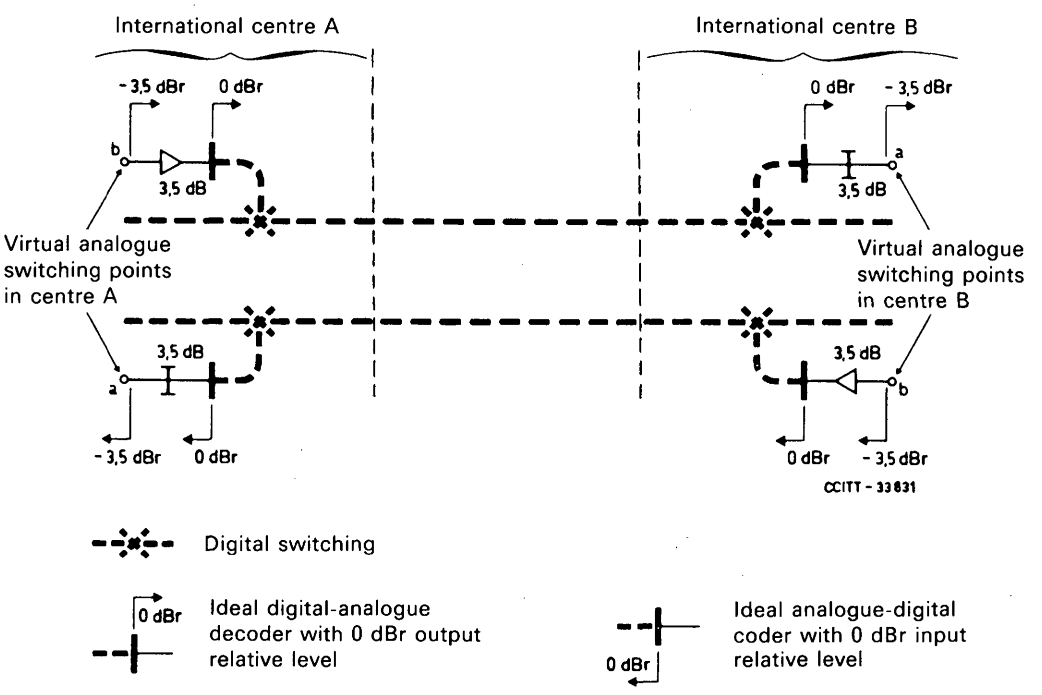
The nominal transmission loss of circuits at the reference frequency between virtual analogue switching points is therefore 0.5 dB for both analogue and mixed analogue/digital circuits and 0 dB for digital circuits.

Two international circuits interconnected in an international centre are considered to be connected together directly at their virtual analogue switching points without any pad or amplifier between those virtual analogue switching points (see Figure 3/M.560).

The relationship between the actual switching points and the virtual analogue switching points in a practical international exchange is illustrated in Figure 3/M.560.



a) Wholly analogue circuit showing virtual analogue switching points and circuit terminals



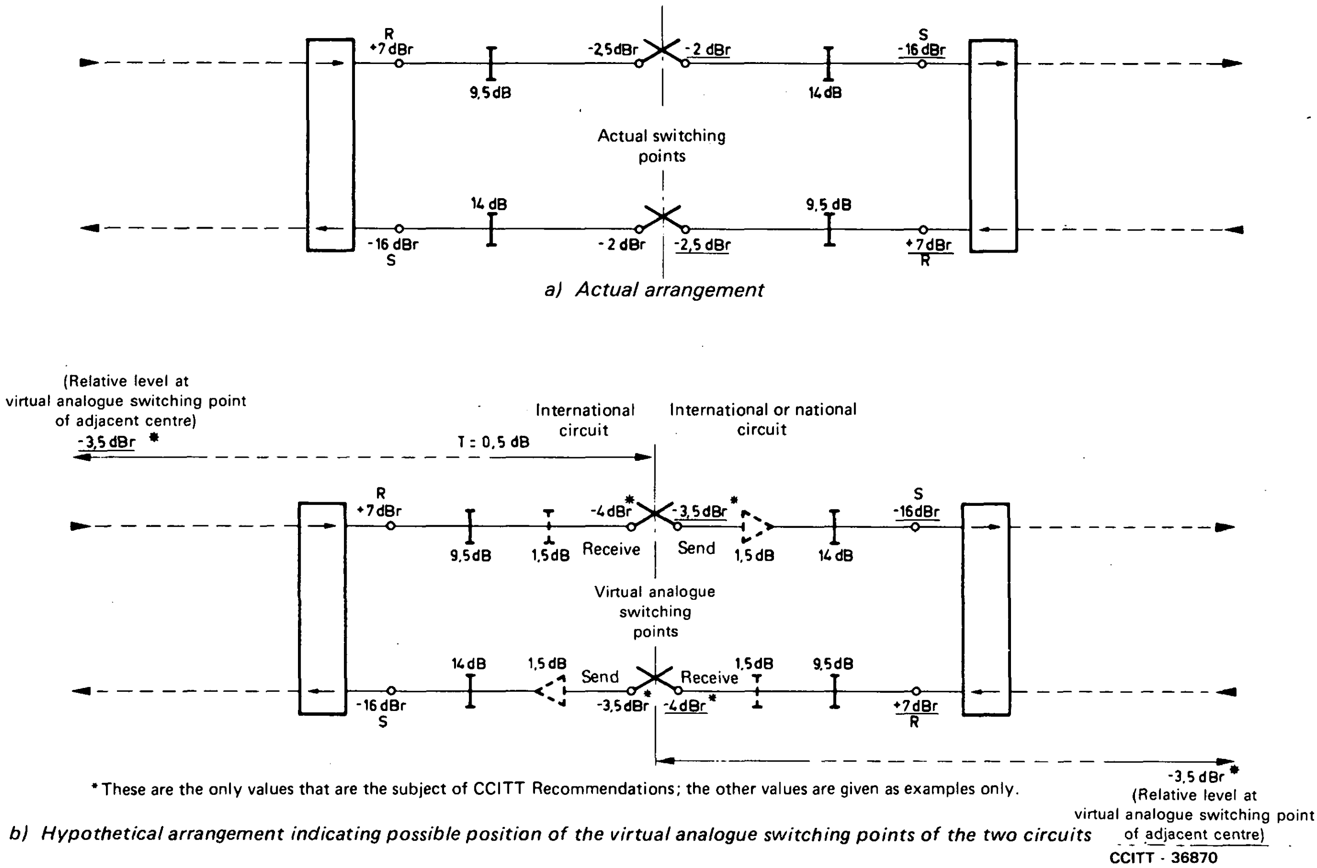
b) Wholly digital circuit showing virtual analogue switching points

FIGURE 2/M.560

International telephone circuits

3 Access points for line-up and maintenance purposes

Recommendation M.565 describes the types of access points which should be provided on international telephone circuits for line-up and maintenance purposes.



Note – Underlined values of relative level refer to the circuit on the right of the point concerned. Values of relative level not underlined refer to the circuit on the left of the point concerned. In an actual switching centre the virtual analogue switching points would not physically exist.

FIGURE 3/M.560

Example showing a simplified representation of a transit connection in an international exchange with actual arrangement and possible location of virtual analogue switching points

Reference

[1] CCITT Recommendation *Transmission Characteristics of an International Exchange*, Vol. VI, Rec. Q.45.

TYPES OF CIRCUIT AND CIRCUIT SECTION

1 General

1.1 The purpose of this Recommendation is to describe the terms "circuit section" and "circuit", as they are used in the Series M Recommendations, taking into consideration analogue, digital, and mixed analogue/digital constitutions.

1.2 The circuit types described in this Recommendation differ somewhat from those in Recommendation G.101 [1], in order to emphasize distinctions that are useful in setting forth maintenance procedures.

2 Circuit sections

Each of the first three section types listed below corresponds to one of the three channel types defined in Recommendation M.300. Each of the last two circuit section types corresponds to one of the two terminal types also defined in Recommendation M.300.

2.1 *Analogue circuit section*

An analogue circuit section comprises two analogue channels, one for each direction of transmission.

2.2 *Mixed circuit section*

A mixed circuit section comprises two mixed channels, one for each direction of transmission.

2.3 *Digital circuit section*

A digital circuit section comprises two digital channels, one for each direction of transmission.

2.4 *Mixed analogue/digital terminal circuit section*

A mixed analogue/digital terminal circuit section comprises the two directions of transmission, for one equivalent voice-frequency signal, through a PCM multiplex equipment. In the analogue to digital direction, the mixed analogue/digital terminal circuit section extends from the audio input of the PCM multiplex equipment, to the associated 64 kbit/s time slot appearance at the digital output. In the digital to analogue direction, the mixed analogue/digital terminal circuit section extends from the 64 kbit/s time slot appearance of a particular channel at the digital input to the PCM multiplex equipment, to the associated audio output.

2.5 *Digital terminal circuit section*

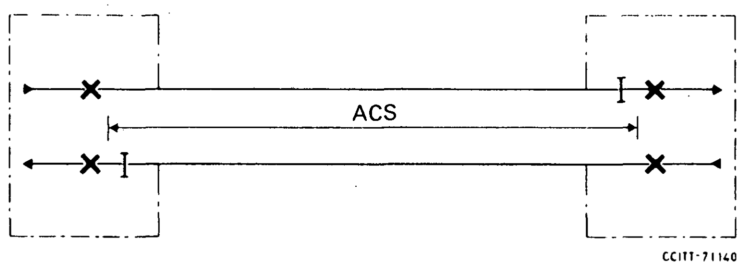
A digital terminal circuit section comprises the two directions of transmission, for one equivalent voice-frequency signal, through a digital terminal. For each direction of transmission, the digital terminal circuit section extends from a particular 64 kbit/s time slot appearance, in the input bit stream to the digital terminal, to the corresponding 64 kbit/s time slot appearance in the output bit stream of the digital terminal.

3 Circuits

International circuits comprise various combinations of national and international circuit sections, together with ancillary equipment as required. The following circuit types are defined in terms of their constituent circuit sections, as a basis for recommending appropriate maintenance procedures.

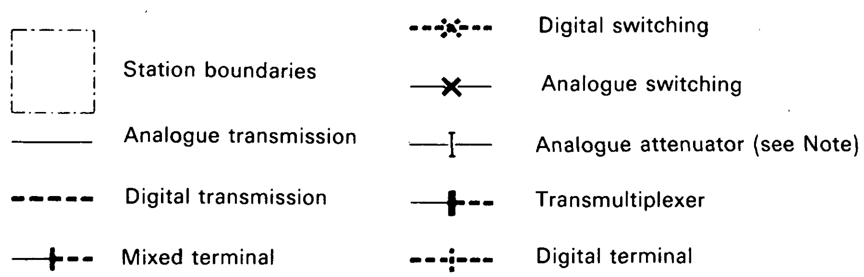
3.1 *Analogue circuit*

An analogue circuit comprises one or more analogue circuit sections. These circuits terminate at both ends in analogue switching machines. A schematic drawing is shown in Figure 1/M.562.



Symbols and nomenclature used in Figures 1/M.562 to 3/M.562

ACS – Analogue circuit section
MCS – Mixed analogue/digital circuit section
DCS – Digital circuit section
MTCS – Mixed analogue/digital terminal circuit section
DTCS – Digital terminal circuit section



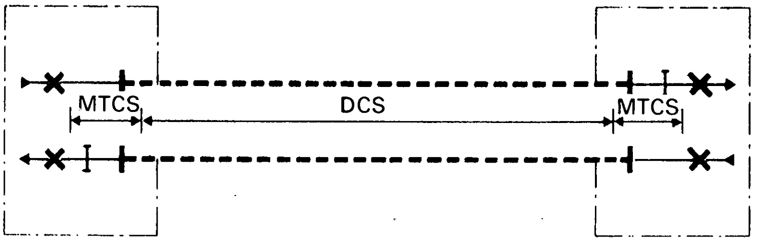
Note – The use of this symbol in the figures indicates the location of any analogue attenuation required to meet the CCITT transmission plan.

FIGURE 1/M.562

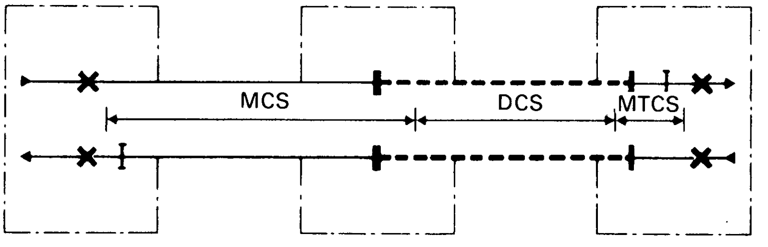
Analogue circuit

3.2 *Mixed analogue/digital circuit*

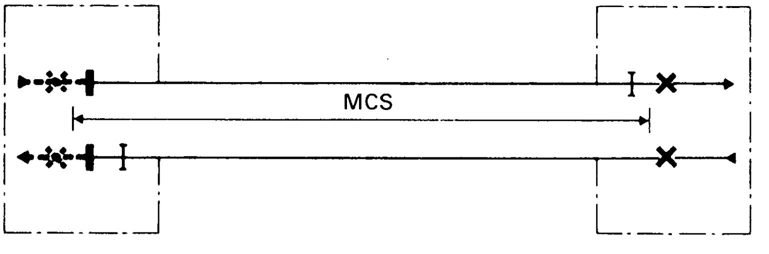
A mixed analogue/digital circuit comprises any combination of circuit sections that includes one or more analogue to digital, or digital to analogue, conversion processes. Mixed analogue/digital circuits may terminate at either end in analogue or digital switching machines. Combinations of various types of circuit sections that are acceptable in making up mixed analogue/digital circuits are constrained by the need to avoid excessive transmission impairments. These constraints are discussed in § 5 below. Examples of permitted mixed analogue/digital circuit configurations are shown schematically in Figure 2/M.562.



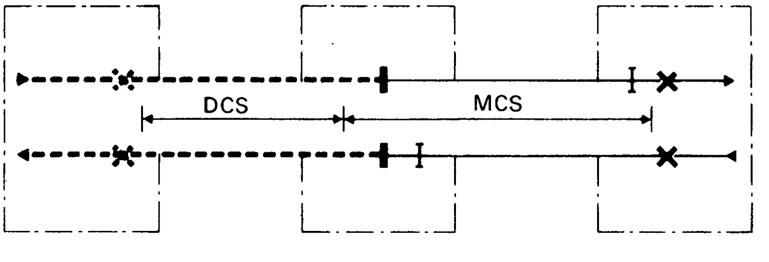
a) Analogue switching at each end; digital transmission; mixed terminals



b) Analogue switching at each end; both analogue and digital transmission, with transmultiplexer at transmission interface; mixed terminal



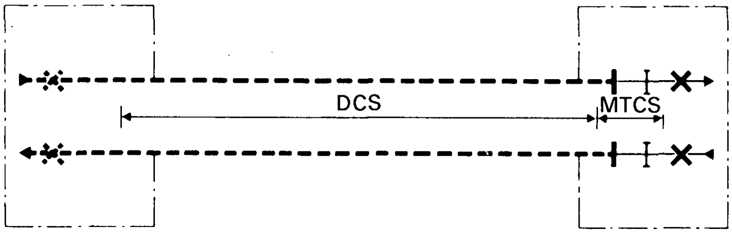
c) Digital switching at one end, with analogue switching at the other end; analogue transmission; transmultiplexer



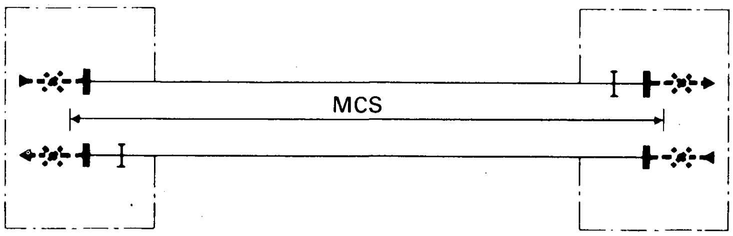
d) Digital switching at one end, with analogue switching at the other end; both digital and analogue transmission, with transmultiplexer at transmission interface

FIGURE 2/M.562

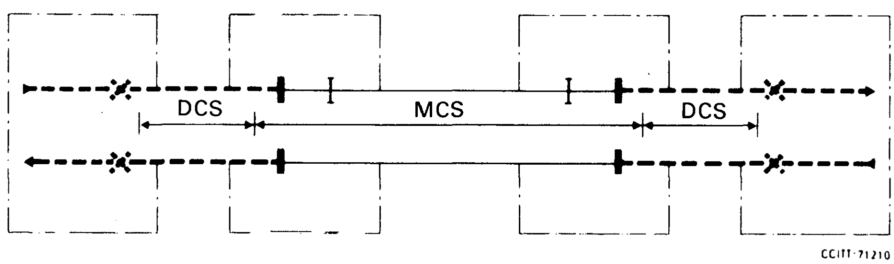
Mixed analogue/digital circuits



e) Digital switching at one end, with analogue switching at the other end; digital transmission; mixed terminal



f) Digital switching; analogue transmission: transmultiplexer



g) Digital switching; both digital and analogue transmission; transmultiplexers at the transmission interfaces

Note – Explanation of symbols and nomenclature is given in Figure 1/M.562.

FIGURE 2/M.562 *(cont.)*

Mixed analogue/digital circuits

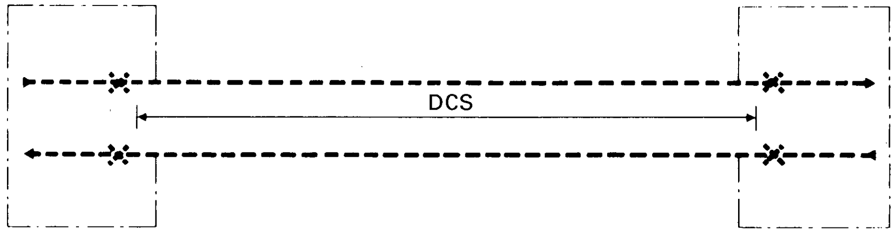
3.3 *Digital circuit*

A digital circuit comprises one or more digital circuit sections. In addition to the digital circuit section(s), a digital circuit may include one or more digital terminal circuit sections. These circuits terminate at both ends in digital switching machines. A schematic drawing is shown in Figure 3/M.562.

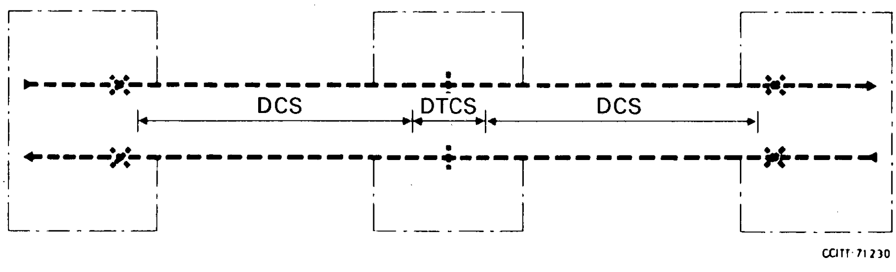
4 Allocation of losses in mixed analogue/digital circuits

In Figure 2/M.562, the attenuators needed to control any variability in the analogue portions of the circuits, arising from loss variations with time, or attenuation distortion, are shown symmetrically for both directions of transmission. However, in practice, such arrangements may require nonstandard levels at the boundaries between circuit sections.

Administrations are advised that should they prefer to adopt an asymmetric arrangement, e.g., by putting all the loss into the receive direction at only one end of a circuit or circuit section, then, provided that the loss is small, e.g., a total of not more than 1 dB, the small amount of asymmetry that results in the international portion of the connection will be acceptable, bearing in mind the small number of international circuits encountered in most actual connections.



a) Digital circuit



b) Digital circuit with digital terminal circuit section

Note – Explanation of symbols and nomenclature is given in Figure 1/M.562.

FIGURE 3/M.562

Digital circuits

5 Number of unintegrated PCM digital processes

5.1 *General principle*

It is recognized that in the mixed analogue/digital period, there could be a considerable presence of unintegrated digital processes in the worldwide telephone network. Consequently, it is important that the incorporation of these processes should take place in such a way that when integration of functions can occur, unnecessary items of equipment will not remain in the all-digital network.

5.2 *Restrictions due to transmission impairments*

In the mixed analogue/digital period, it may be necessary to include a substantial number of unintegrated digital processes in international telephone connections. To ensure that the resulting transmission impairments (quantization, attenuation and group-delay distortion) introduced by such processes do not accumulate to the point where overall transmission quality can be appreciably impaired, it is recommended that the planning rule given in Recommendation G.113, § 3 [2], be complied with. The effect of this rule is to limit the number of unintegrated digital processes in both the national and international parts of telephone connections.

In the case of all-digital connections, transmission impairments can also accumulate due to the incorporation of digital processes (e.g., digital pads). The matter of accumulating such impairments under all-digital conditions is also dealt with in Recommendation G.113, § 3 [2].

References

[1] CCITT Recommendation *The transmission plan*, Vol. III, Rec. G.101.

[2] CCITT Recommendation *Transmission Impairments*, Vol. III, Rec. G.113.

ACCESS POINTS FOR INTERNATIONAL TELEPHONE CIRCUITS

1 General

This Recommendation specifies the access points required for testing and measuring purposes on international telephone circuits. (Access points for other types of circuit are dealt with in Recommendation M.110.)

2 Types of access point and their uses

2.1 Three basic types of access points are required for international telephone circuits. These should be provided and used in accordance with the following principles:

2.1.1 The international circuit for public telephony includes the international line (as defined in Recommendation M.700). Points serving to distinguish the ends of the international line should be provided, where possible, in the form of 4-wire access points called line access points as defined below.

line access points (points d'accès à la ligne – puntos de acceso a la línea)

Points used by the CCITT to define the limits of an international line, and from which measurements are made. Only one "line access point" exists at each end of an international line. The precise location of each such point depends on the Administration concerned [1].

Where a digital international exchange is interfaced with the transmission network by primary (or higher order) digital paths, a line access point at "circuit" level cannot generally be provided. In this case, any necessary tests and measurements normally carried out at the line access point may be performed at the digital path access point [2] nearest to the international exchange. Alternatively, if practical and convenient, such tests may be carried out from the circuit access point, as defined in § 2.1.2.

2.1.2 At the international switching centres, at the terminals of a circuit, "circuit access points" as defined below should be provided.

circuit access points (points d'accès au circuit – puntos de acceso al circuito)

Four-wire access points so located that as much as possible of the international circuit is included between corresponding pairs of these access points at the two centres concerned. These points, and their relative level (with reference to the transmission reference point) are determined in each case by the Administration concerned. They are taken as the basic practical reference points of known relative level to which other transmission measurements will be related. In other words, for measurement and lining-up purposes, the level at the appropriate circuit access point is the relative level with respect to which other levels are adjusted.

The requirement to provide a circuit access point within a digital international exchange will be met by any suitable method of obtaining access to the digital bit stream (time slot) corresponding to an individual telephone circuit.

2.1.3 Where an international telephone circuit appears at its basic frequencies or basic bit rate within a transit country, an intermediate access point for testing and measuring purposes should be provided at that location in the transit country.

---

[1] A compandor, if fitted, should be connected on the line side of the line access points and not between the line access point and the circuit access point. In this way the relationship between the nominal transmission levels at these two points on a circuit with a compandor is the same as for other circuits.

[2] The access points required for digital leased circuits have yet to be specified. This matter is for further study by Study Group IV.

2.2 The line access points and circuit access points (and any intermediate access points in transit countries) will be used by the appropriate testing points[3)] in all tests and measurements for the line-up and maintenance of international telephone circuits.

2.3 At the discretion of Administrations, means of giving access to the circuit access points and/or the line access points from remote locations may be provided – such remote locations being within or outside the international centre. Such arrangements avoid the need for staff to enter equipment areas for circuit testing purposes, and increase the flexibility and efficiency of the maintenance organization where large numbers of circuits must be maintained.

2.4 In order to line-up and maintain circuits routed on a mixture of analogue and digital systems it is necessary to carry out measurements of analogue circuit parameters at digital international exchanges. If this requirement cannot be met by suitable digital test equipment, it may be necessary to provide a "test coder/decoder" to convert digital access points (operated at 64 kbit/s for example) to analogue access points (at voice frequency), thus enabling analogue measuring equipment to be used.

2.5 Figure 1/M.565 shows typical access and test equipment arrangements for analogue and digital international exchanges. Subject to meeting the requirements in §§ 2.1 to 2.4 above, the actual arrangements at a particular international centre are left to the discretion of the Administration concerned.

Note – Remote access arrangements, as described in § 2.3, are only a physical extension of the access points to a more convenient location(s). Thus, in the Series M Recommendations, the terms "line access points" and "circuit access points" are used (without qualification) irrespective of the manner in which the required access is obtained.

3 Transmission characteristics and choice of levels at analogue access points

3.1 The impedance at analogue access points should have a return loss against the nominal impedance of the measuring apparatus of the station (for example 600 ohms, nonreactive) of not less than 20 dB over the range 600-3400 Hz and not less than 15 dB over the range 300-600 Hz.

3.2 It should be recognized that the analogue link access point shown in Figure 1b/M.565 is suitable only as a maintenance access point. It is not intended for the setting-up or lining-up of individual circuits, because the circuits levels at these points are not specifically defined. This occurs because the shape of the group and supergroup filters have not been compensated for at this point by the channel translating equipment adjustments.

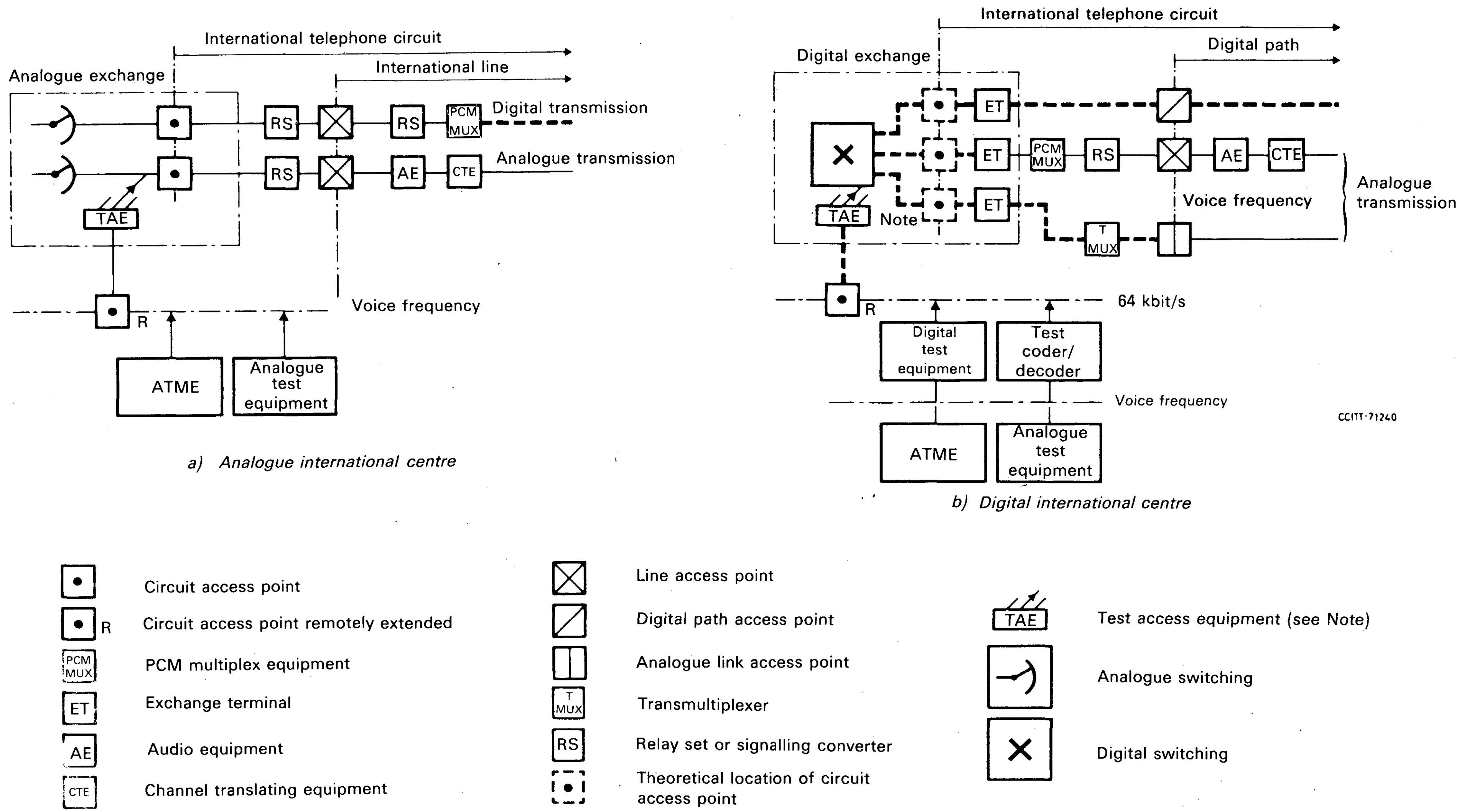
3.3 It is not possible to recommend a value for the nominal transmission loss between the circuit access points of a switched public telephony circuit, because of the freedom accorded to Administrations in choosing the transmission levels at these points. However, bearing in mind that the attenuation between the circuit access points and the virtual analogue switching points will have a fixed and known value and that it is possible to build out the wiring to circuit access points to a known loss, the send and receive level at the circuit access point should be chosen such that the circuit level diagram is respected.

3.4 It is advantageous to adopt the same value of relative level at the send line access points for every circuit connected to the exchange. Similarly, all the receive line access points could also be at a particular common nominal value of relative level. When relative levels are made uniform in this way, line-up and maintenance activity is greatly simplified. Also, lines can be readily cross-connected at the line access points, which is useful in the immediate replacement of faulty lines in an emergency.

3.5 If the nominal relative level at the receive line access point is chosen to be higher than that at the send line access point of the same exchange, this level difference can be used to offset the inherent transmission loss in the signalling and switching equipment, and the requirements of the CCITT transmission plan can be met without the obligation to install supplementary audio-frequency amplifiers.

Note – It is preferred to make transmission measurements between 4-wire access points but, as a permissible alternative, a terminating unit may be provided together with an associated 2-wire access point for measurement purposes. The transmission levels and losses must be chosen so that the nominal loss between virtual analogue switching points is 0.5 dB (or 0.0 dB for wholly digital circuits), and the circuit level diagram is respected.

[3)] For example, those defined in Recommendations M.717 and M.718.



a) Analogue international centre

b) Digital international centre

Note – Access is normally provided by the exchange switching equipment.

FIGURE 1/M.565

Typical access and test equipment arrangements at international centres

4 Interface requirements at digital access points

4.1 Digital access points at 64 kbit/s should be operated in the contradirectional mode and should meet the interface requirements of § 1.2.3 of Recommendation G.703. [1].

4.2 Digital path access points, operated at 1544 kbit/s or 2048 kbit/s (or higher hierarchical bit rates) should meet the interface requirements of Recommendation G.703. [1].

4.3 Interface requirements for digital access points on circuits using an encoding technique other than PCM are under study by Study Group IV.

Reference

[1] CCITT Recommendation, *Physical electrical characteristics of hierarchical digital interfaces*, Vol. III, Rec. G.703.

Recommendation M.570

CONSTITUTION OF THE CIRCUIT; PRELIMINARY EXCHANGE OF INFORMATION

As soon as it is decided to bring a new circuit into operation, the technical services of the terminal countries should agree upon the circuit control station, and the technical service of each transit country should advise the other technical services concerned of the name of the sub-control station chosen for its territory. If the circuit is routed in a direct group or block crossing a transit country without demodulation or demultiplexing, no sub-control station need be provided for the transit country. When a circuit is subjected to analogue to digital conversion using, for example, a transmultiplexer, the location of the transmultiplexer should be designated as circuit sub-control station.

Also the technical services of all the countries concerned should send to the technical service responsible for the circuit control station information which will be required for the preparation of the circuit routing form (see the Appendix to this Recommendation) using the letter and number code on the form. The information for a circuit without audio sections will consist of the numbers of the groups or blocks used and the number of the channel in each group or block.

The information should preferably be sent by telex and the examples below show typical telex messages concerning the provision of Bucuresti-London 1 when the circuit is analogue, digital or mixed analogue/digital.

This method using the telex services enables agreement on routing details to be obtained quickly and also enables circuit routing forms to be completed by the technical services responsible for the circuit control stations as soon as a circuit is put into service or rearranged.

Example 1 – Telex message from the technical services of the United Kingdom to the technical services of the Federal Republic of Germany, Austria, Hungary and Roumania for an analogue circuit:

```
NETWORK CONTROL DIVISION BTI LONDON TO FTZ DARMSTADT
                                       GENTEL WIEN
                                       GENTEL BUDAPEST
                                       GENTEL BUCUREŞTI
OUR REF.
PROPOSE PROVISION OF BUCUREŞTI LONDON 1
USING FRANKFURT LONDON 1201/9 SIGNALLING 500/20
GRATEFUL FOR YOUR AGREEMENT OR COUNTER PROPOSALS. REGARDS.
```

Example II – Telex message from the technical services of the Federal Republic of Germany in reply to telex in example I:

```
FTZ SCHALT DMST TO NETWORK CONTROL DIVISION BTI LONDON
10 APR
YOUR REF.                    OUR REF.
2 = FEDERAL REPUBLIC OF GERMANY 3—BUCUREŞTI—LONDON 1
5 = FRANKFURT/MAIN
A = FFT — L 1201/9 B = 840
A = FFT — WIEN 1201/11 B = 740
        REGARDS.
                COPIES TO WIEN, BUDAPEST, BUCUREŞTI
```

Similar messages could be used for a digital circuit. The channel to be used then could be, for example, Frankfurt-London 30N003/22.

Example III – Telex message from the technical services of the United Kingdom to the technical services of the Federal Republic of Germany, Austria, Hungary, and Roumania for a mixed analogue/digital circuit using a transmultiplexer at Frankfurt:

```
NETWORK CONTROL DIVISION BTI LONDON TO FTZ DARMSTADT
                                       GENTEL WIEN
                                       GENTEL BUDAPEST
                                       GENTEL BUCUREŞTI

OUR REF.

PROPOSE PROVISION OF BUCUREŞTI–LONDON 1
USING FRANKFURT–LONDON 30NC004/7 SIGNALLING SYSTEM NO. 5.
GRATEFUL FOR YOUR AGREEMENT OR COUNTER PROPOSALS. REGARDS.
```

Example IV – Telex message from the technical services of the Federal Republic of Germany in reply to the telex in Example III:

```
FTZ SCHALT DMST TO NETWORK CONTROL DIVISION BTI LONDON

10 APR
YOUR REF.                    OUR REF.

2  = FEDERAL REPUBLIC OF GERMANY
3  = BUCUREŞTI–LONDON 1
5  = FRANKFURT/MAIN
19 = FRANKFURT/MAIN
A  = FFT – L 30N0004/7 B = 840
A  = FFT – WIEN 12008/7 B = 740

        REGARDS.

                COPIES TO WIEN BUDAPEST BUCUREŞTI.
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Using the above-mentioned information and the data supplied by sub-control stations, the circuit control station makes out a *circuit routing form* (see Appendix to this Recommendation, which can serve as a routing form or level diagram) which is used as a level diagram for voice-frequency sections. This routing form shows the nominal relative levels at:

- circuit control and sub-control stations;
- frontier stations, if the circuit is reduced to a voice-frequency section across a frontier;
- stations where the circuit is reduced to voice frequency, in those cases where the circuit passes via a series of groups or blocks.

The technical service of the circuit control station sends the routing form to the technical services of the sub-control stations of the international circuit concerned in the following cases:

a) only at the specific request of one of the Administrations concerned when the circuits are routed on one channel of a single international group link or digital path;

b) in all cases for circuits otherwise constituted.

The despatches are sent in duplicate, one copy for the technical service and one for the sub-control station.

APPENDIX

(to Recommendation M.570)

Routing form for an international circuit

1.	Date of issue	
2.	Technical service of	American Telephone and Telegraph Co.
3.	Circuit designation	New York (10) – Stockholm 1
4.	Length	7870 km
5a.	Control station	New York
5b.	Sub-control stations	London, Stockholm
6.	Date of putting into service	October 1972
7.	Type of ISC at control station end	Analogue
8.	Type of ISC at sub-control station end	Analogue
9a.	Echo suppressors at	New York (½), Stockholm (½)
9b.	Echo cancellers at	None
10.	Compandors at	None
11.	Signalling	System No. 5
12.	Switching equipment	
13.	Special equipment at	None
14.	Special concentrator [1]	None
15.	Estimated weighted noise power	−48 dBm0 (36 dBa)
16.	Special performance requirements at	None
17.	Hangover time of suppressors at	New York: 50 ms Stockholm: 50 ms
18.	Estimated total distortion power	Not applicable
19.	Transmultiplexer at	None

Stations and constitution	Length of section (in km)	Nominal relative level at reference measurement point[2] (dBr)		Estimated group delay time at 800 Hz (milliseconds)	Remarks[3]
		Direction ↓	Direction ↑		
(A)	(B)	(C)	(D)	(E)	(F)
New York		0.0	−4.5		
34-A-/C/-8	522			3.2	
Green Hill		+7.0	+7.0		Through-group connection points Conil (Spain), Sesimbra (Portugal)
1602-05-/A/-5	5813			36.5	
London		+4.0	−4.0		
1211/1	1535			9.5	
Stockholm		+3.5	−11.0		

[1] Insert *CMS only, through and CMS,* or *none* as appropriate (or equivalent).
[2] An asterisk after the relative level indicates that the nominal value of the impedance at the measuring point differs from 600 ohms.
[3] When this column is completed for loaded cables the effective bandwidth of the section will be inserted.

SETTING UP AND LINING UP AN INTERNATIONAL CIRCUIT FOR PUBLIC TELEPHONY

1 Introduction

This Recommendation applies to all circuits operated on a manual, semiautomatic or fully automatic basis, whether provided solely by analogue transmission and switching systems or by a mixture of analogue and digital systems.

2 Organization

The guiding principles for the general maintenance organization of international circuits are given in Recommendation M.70.

2.1 An international circuit may consist of various national and international circuit sections; these circuit sections consist of two telephony channels, one for each direction of transmission, or a mixed analogue/digital terminal section or a digital terminal section. The types of circuits and circuit sections for public telephony are described in Recommendation M.562.

2.2 At the terminal stations of the circuit, access points are provided in accordance with Recommendation M.110 (see also Recommendation M.640). At intermediate stations an access point is provided (see also Recommendation M.110 for transit circuits), its position in the circuit being so chosen that as much as possible of the audio-frequency apparatus in the station is included in any measurement made at that station in the direction of transmission concerned.

2.3 In establishing an international circuit, the circuit, line and circuit section access points define the limits of the circuit, line and circuit section, and these are used as the basic elements involved in setting-up, lining-up, and fault location.

Note – The line access point at the terminal station will also be used as the circuit section access point at that station.

3 Limits for the overall loss of a circuit and circuit sections

3.1 *Limits for overall loss at 800 Hz*

The objective is to make the value of overall loss at 800 Hz as near as possible to its nominal value. When adjustment is provided in steps, these should enable the loss to be adjusted to within ± 0.3 dB of the nominal value.

3.2 *Limits for the overall loss/frequency characteristic*

National telephone networks are planned and provided by Administrations to give satisfactory telephone transmission on national calls in the most economical way and will, in consequence, have but little margin against additional transmission impairment in calls on the longest connections.

International telephone calls require the two corresponding parts of the national networks in the terminal countries to be interconnected by a switched chain of international circuits. The present CCITT plan for worldwide telephone connections specifies a maximum of six international circuits in a connection. In some circumstances the nominal reference equivalent of the connection could be 3 dB greater than in the past. This additional loss, in combination with increased line noise, makes it very desirable to minimize the transmission impairments introduced by the international circuits.

In order to have an objective for a circuit for maintenance purposes, the following principles should be applied.

3.3 The overall loss/frequency distortion of a circuit depends on whether it is set up entirely on 4-kHz spaced channels, or entirely on 3-kHz spaced channels or on combinations of such channels, even including small sections of audio cable. Three sets of limits are given in Tables 1/M.580, 2/M.580 and 3/M.580.

The principles on which the tables are based are as follows:

a) the maximum loss in the relevant frequency range should not be greater than 9.0 dB relative to the loss at 800 Hz in order to avoid disturbing the noise power distribution in the circuit to any extent;

b) the use of equalizers at intermediate stations should be avoided as far as possible;

c) where a mixed type of composition is used the arrangement of 3-kHz plus 4-kHz spaced channels in a circuit would cater for most of the cases of composition likely to be encountered in practice (for example, one 3-kHz channel in series with two 4-kHz channels);

d) to permit some flexibility to Administrations to use a measure of pre-equalization if necessary in order to avoid low-level signals entering a long section.

TABLE 1/M.580

Limits for the overall loss/frequency characteristic between circuit access points and the access points of circuit sections for circuits and circuit sections using 4-kHz spacing

Frequency Hz	Overall loss relative to that at 800 Hz	
	Between circuit access points	At the access point at intermediate stations
	dB	dB
Below 300	not less than 0.0 otherwise unspecified	not less than −3.0 otherwise unspecified
300 to 400	+3.5 to −1.0	+9.0 to −3.0
400 to 600	+ 2.0 to −1.0	+6.0 to −3.0
600 to 2400	+1.0 to −1.0	+6.0 to −3.0
2400 to 3000	+2.0 to −1.0	+6.0 to −3.0
3000 to 3400	+3.5 to −1.0	+9.0 to −3.0
Above 3400	not less than 0.0 otherwise unspecified	not less than −3.0 otherwise unspecified

TABLE 2/M.580

Limits for the overall loss/frequency characteristic between circuit access points and the access points of circuit sections for circuits and circuit sections using 3-kHz spacing

Frequency Hz	Overall loss relative to that at 800 Hz	
	Between circuit access points	At the access point at intermediate stations
	dB	dB
Below 200	not less than 0.0 otherwise unspecified	not less than – 1.5 otherwise unspecified
200 to 250	+10.5 to –0.5	not less than –1.5 otherwise unspecified
250 to 300	+ 6.5 to –0.5	+9.0 to – 1.5
300 to 2700	+1.0 to –0.5	+7.0 to – 1.5
2700 to 2900	+2.5 to –0.5	+7.0 to – 1.5
2900 to 3050	+6.5 to –0.5	+9.0 to – 1.5
Above 3050	not less than 0.0 otherwise unspecified	not less than – 1.5 otherwise unspecified

TABLE 3/M.580

Limits for the overall loss/frequency characteristic between circuit access points and the access points of circuit sections for circuits and circuit sections using 3-kHz and 4-kHz spacing

Frequency Hz	Overall loss relative to that at 800 Hz	
	Between circuit access points	At the access point at intermediate stations
	dB	dB
Below 300	not less than 0.0 otherwise unspecified	not less than – 3.0 otherwise unspecified
300 to 400	+3.5 to – 1.0	+9.0 to – 3.0
400 to 600	+ 2.0 to – 1.0	+6.0 to – 3.0
600 to 2400	+1.0 to – 1.0	+6.0 to – 3.0
2400 to 2700	+2.0 to – 1.0	+6.0 to – 3.0
2700 to 2900	+2.5 to – 1.0	+9.0 to – 3.0
2900 to 3050	+6.5 to – 1.0	+9.0 to – 3.0
Above 3050	not less than 0.0 otherwise unspecified	not less than –3.0 otherwise unspecified

3.4 Table 1/M.580 is based on the limits recommended for a pair of 4-kHz channel equipments (Recommendation G.232 [1]), a small addition having been made to the recommended limits to allow for the additional distortions likely to be introduced by the group link and by the circuit and exchange apparatus. The equalization limits are three times the circuit limits.

Table 2/M.580 is similarly based on the limits recommended for a pair of 3-kHz channel equipments (Recommendation G.235 [2]) with an allowance for the group link and for circuit and exchange apparatus.

For international circuits composed of 4-kHz and 3-kHz sections, the limits given in Table 3/M.580 are a combination of the limits given in Tables 1/M.580 and 2/M.580, taking into account the factors given in 3.3 a) to 3.3 c) above.

The limits to be imposed on the loss/frequency characteristic at intermediate stations are also shown in Tables 1/M.580, 2/M.580 and 3/M.580.

Where a circuit or circuit section contains mixed analogue/digital channels, the table to be used should be based on the channel spacing of the analogue carrier associated with the mixed circuit or circuit section.

A circuit section or that portion of a circuit made up of wholly digital channels should be treated as an analogue circuit section or circuit having 4 kHz spaced channels.

Circuit sections made up of digital or mixed analogue/digital terminals should follow the limits given for measurements between circuit access points in Table 1/M.580.

4 Setting up and lining up analogue and mixed circuit sections

4.1 The circuit sub-control stations responsible for the various national and international circuit sections should arrange to set up these sections.

The circuit sections are lined up and the overall loss/frequency characteristic of each is recorded from terminated-level measurements.

This is done by sending at a level of −10 dBm0 [1)] at the reference test frequency at the access point at the intermediate sub-control station or at the line access point at the control station or terminal sub-control station and adjusting the received level at the access point at the adjacent intermediate sub-control station to as close to its nominal level as possible in the direction of transmission concerned.

4.2 The loss/frequency characteristic should then be measured at frequencies chosen from the following list, according to the characteristics of the circuit section to be set up:

200, 250, 300, 400, 600, 800, 1000, 1400, 2000, 2400, 2700, 2900, 3000, 3050 and 3400 Hz.

Technical services may agree to make measurements at other frequencies if it is considered useful to do so. The test signals should be applied at a level of −10 dBm0 [1)].

For circuit sections effectively transmitting up to only 3000 Hz (for example, circuits using 3 kHz spaced channels) the measurement at 3400 Hz is, of course, not applicable.

The overall loss at 800 Hz [2)] should be as near as possible to the nominal value.

The overall loss at other frequencies should lie within the limits given in Tables 1/M.580, 2/M.580 and 3/M.580 (see 3.3 above).

For each circuit section the results for each direction of transmission are forwarded to the control and terminal sub-control stations.

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1) This is the preferred level. However, by agreement between Administrations, a level of 0 dBm0 may be used.

2) For international circuits, 800 Hz is the recommended frequency for single-frequency maintenance measurements. However, by agreement between the Administrations concerned, 1000 Hz may be used for such measurements, since it is a fact that 1000 Hz is widely used for single-frequency measurements on international and intercontinental circuits.

Multi-frequency measurements made to determine the loss/frequency characteristic will include a measurement at 800 Hz and therefore the reference frequency for such characteristic can still be 800 Hz.

Reference should be made to Supplement No. 3.5 [3] concerning measuring frequencies to be used on circuits routed over PCM systems or through digital exchanges.

At terminal stations, during these measurements, the signalling connections to the automatic equipment should be disconnected if the signalling units are incorporated in the carrier terminal equipment. When the line-signalling relay sets are included in the lines and apparatus being measured, any voice-frequency signalling receiver must be rendered inoperative or its action made ineffective.

5 Setting up and lining up mixed analogue/digital and digital terminal circuit sections

5.1 As shown in Figure 2/M.562, mixed analogue/digital and digital terminal circuit sections can occur at both terminal and intermediate locations in a circuit. However, in both cases these terminal circuit sections fall wholly within an individual Administration's boundaries. Thus, they would normally be set up and lined up independently using national practices. However, Administrations may bilaterally choose to apply a single procedure for setting up and lining up a combination of a digital circuit section terminated at each end by a mixed analogue/digital terminal section. In this case, the procedures and limits given in § 4 above for analogue circuit sections should be applied to this combination of circuit sections.

5.2 In order to provide some guidelines for the setting up and lining up of mixed analogue/digital terminal sections, two suggested procedures are described in Annex A.

6 Setting up and testing digital circuit sections

6.1 As with digital channels, because the test procedures required for setting up and initially testing the digital path also set-up and test the digital circuit section, no additional tests on a circuit section are recommended.

7 Setting up and lining up an international circuit

7.1 *Setting up the circuit*

7.1.1 The sub-control station responsible for the various circuit sections having completed the setting-up and lining-up of those sections should arrange to connect them together and advise the control station. In addition, the control and terminal sub-control stations, in conjunction with their testing points, should ensure that all associated signalling, switching and other terminal equipment has been connected, is free from faults, and is operating satisfactorily.

7.1.2 When the control station has been advised by all the sub-control stations that the sections constituting the circuit have been connected together, the control station should agree with the sub-control stations upon a time when the whole circuit may be lined up.

7.2 *Lining up the circuit*

7.2.1 *Preliminary work*

7.2.1.1 The receiving terminal sub-control station studies the test results of the individual circuit sections, particularly observing the way in which the variations within the permissible tolerances will accumulate when the sections are interconnected. The receiving terminal sub-control station for each direction of transmission determines from these studies and observations the amount of gain and equalization adjustment which will be required at intermediate and terminal stations to obtain a satisfactory overall characteristic.

7.2.1.2 From the test results the cumulative overall loss over the frequency band at intermediate sub-control stations is calculated with respect to the overall loss at 800 Hz. An equalizer should be fitted at the request of the receive terminal sub-control station at those stations at which the sum of the measured overall loss/frequency characteristics of the individual sections exceeds the provisional limits (see 3.4 above). In determining the limits, due account must be taken of the presence of 3-kHz spaced channel translating equipment.

The number of intermediate equalizers should be kept to a minimum. When the receiving terminal sub-control station has been advised by all the other sub-control stations that the circuit sections and any prescribed equalizers have been connected together, a time when the circuit can be lined up should be agreed upon.

7.2.2 *Adjustment of the overall loss at the reference test frequency*

7.2.2.1 At the appropriate time of line-up, the control station, in cooperation with the various sub-control stations, proceeds with the overall line-up of the circuit, first at a frequency of 800 Hz[3)].

For this, the control station arranges to send an 800-Hz test signal at a level of -10 dBm0[4)], for example at the circuit access point of the circuit. In addition, the level at the line access point at the terminal stations should be adjusted to as close to the nominal value as possible.

7.2.2.2 The intermediate sub-control stations will then arrange to measure the level of the 800-Hz test signal and to adjust it to the nominal value at the access points of the circuit (as defined in 2.2 above) in that direction of transmission. Measurements and adjustments should also be made at frontier stations where the circuit includes an audio-frequency section crossing a frontier.

7.2.2.3 At the distant terminal sub-control station the received level of the test signal should be adjusted until the required overall loss is obtained at the circuit access point.

The procedure is then repeated for the other direction of transmission of the circuit.

In order to minimize cumulative gain or loss at 800 Hz the receive terminal sub-control station may request intermediate sub-control stations to alter the gain setting for the receive direction of their sections by not more than one gain control step. In this way it should be possible to compensate, at successive stations, the departures from the nominal value while staying within the permissible limits. Theoretically, this adjustment will be needed in not more than half the stations.

7.2.2.4 It is not possible to recommend a value for the nominal transmission loss between the circuit access points of a switched public telephony circuit because of the freedom accorded to Administrations in arranging the relative levels at these points. However, bearing in mind that at each end of the circuit the attenuation between the circuit access point and the virtual switching points will have a fixed and known value and that it is possible to *build out* the wiring to circuit access points to a known loss, the send level at the circuit access point should be so chosen that, on the circuit, the circuit level diagram is respected. [See also Recommendation M.640, § 2.1 d).]

7.2.3 *Measurement of the overall loss/frequency response*

7.2.3.1 When the circuit has been lined up at 800 Hz, measurements should be made between circuit access points at the terminal stations and also at intermediate sub-control stations and frontier stations when an audio-section crosses a frontier. The loss/frequency characteristic should then be measured at frequencies chosen from the following list, according to the characteristics of the circuit to be set up:

200, 250, 300, 400, 600, 800, 1000, 1400, 2000, 2400, 2700, 2900, 3000, 3050 and 3400 Hz.

Technical services may agree to make measurements at other frequencies if it is considered useful to do so. The test signals should be applied at a level of -10 dBm0[4)].

7.2.3.2 If necessary, the receiving terminal sub-control station may equalize the circuit at this stage by means of an equalizer in that station, so that the overall loss/frequency characteristic lies within the required limits. Minor adjustments to compensate for accumulated manufacturing tolerances in pad and equalizer values can now also be made at intermediate stations. Those stations at which receive equalizers were necessary should remeasure the section including the equalizer, making terminated-level measurements. The results of those measurements should be passed to the receive terminal station.

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3) For international circuits, 800 Hz is the recommended frequency for single-frequency maintenance measurements. However, by agreement between the Administrations concerned, 1000 Hz may be used for such measurements, since it is a fact that 1000 Hz is widely used for single-frequency measurements on international and intercontinental circuits.

Multi-frequency measurements made to determine the loss/frequency characteristic will include a measurement at 800 Hz and therefore the reference frequency for such characteristic can still be 800 Hz.

Reference should be made to Supplement No. 3.5 [3] concerning measuring frequencies to be used on circuits routed over PCM systems or through digital exchanges.

4) This is the preferred level. However, by agreement between Administrations, a level of 0 dBm0 may be used.

These results now replace those previously submitted under operation § 7.2.1.2 above for these sections, and are the results with which comparison is to be made in subsequent maintenance. (The overall loss/frequency characteristic of a *section + equalizer* may not now lie within the limits appropriate to a circuit section. It should be noted that one consequence of this is that such a combination cannot be used as a replacement for a faulty circuit section; for such replacement purposes the circuit section should be transferred without the equalizer.)

7.2.4 When the above measurements and necessary adjustments have been carried out, the control and terminal sub-control stations ensure that the limits are achieved. The circuit can be regarded as being lined up.

8 Measurement of circuit noise

8.1 The measurement of circuit noise should be made for both directions of transmission.

For the measurements of noise in one direction of transmission, the far end of the circuit should be terminated at the circuit access point, with an appropriate value of pure resistance.

At the circuit access point at the other end of the circuit (near end) a measurement of the psophometric voltage should be made, using a psophometer having the characteristics recommended by the CCITT (see the weighting curve for this psophometer in Recommendation O.41 [4]).

8.2 Circuit line-up noise measurements should be compared with the noise maintenance objectives shown in Table 4/M.580 according to the length of the circuit concerned. The values in Table 4/M.580 apply to single measurements (see Note). It is assumed that the noise measurement will follow the measurements and adjustments outlined in 7.2.2 and 7.2.3 above.

8.3 Where the measured noise is higher by 5 decibels or more than the appropriate value from Table 4/M.580, or is higher than −37 dBm0p, whichever is the more stringent requirement, action should immediately be taken to locate and remedy any fault where possible. It may be useful to compare noise measurements on circuits of identical or similar constitution to help locate a possible fault.

TABLE 4/M.580

Noise objectives for public telephone circuit maintenance

Distance in kilometres	<320	321 to 640	641 to 1600	1601 to 2500	2501 to 5000	5001 to 10000	10001 to 20000
Noise (dBm0p)	−55	−53	−51	−49	−46	−43	−40

Note — For circuits routed via satellite, the section of the circuit provided by satellite (between earth stations) will contribute approximately 10 000 pWp (—50 dBm0p) to the overall circuit noise. Therefore, for the purpose of determining the maintenance noise limits for international public telephony circuits, the section of the circuit provided by the satellite may be considered, from Table 4/M.580, to be equivalent to a length of 2500 km. The effective *noise length* of such a circuit will be 2500 km plus the total length of the terminal routings.

8.4 Where the measured noise is greater than −44 dBm0p, and once it is ensured that no fault exists, the fitting of a compandor should be considered. Such consideration is particularly necessary if the circuit is likely to be used in a 6-circuit chain. Reference should be made to Recommendation G.143 [5] for technical guidance on the fitting of compandors. In particular, note should be taken of the need to restrict their use to circuit sections provided on inherently stable transmission systems.

8.5 The noise measured at the circuit access point during the initial line-up should be recorded for comparison against subsequent maintenance measurements.

9 Measurements of other parameters

Circuits used for reserve purposes in certain applications, for example, data and facsimile transmission, have particular requirements in respect of group-delay distortion, noise, etc. Reference should be made to the CCITT Recommendations relating to the type of circuit concerned in order to find what these requirements are.

Note – The measurement of total distortion is under study. Provisional objectives are contained in Annex 4 to Question 18/IV in Contribution COM IV-No.1 of the present study period. These objectives are intended as a preliminary guide to the maximum total distortion which could be present on a circuit.

10 Check of signalling level

Measurements should also be made to check that the absolute power level of the signalling current at the transmitting end of the circuit in each direction of transmission has a nominal value in accordance with Table 5/M.580, or as agreed between Administrations for signalling systems not covered by CCITT Recommendations.

Reference should be made to Recommendation M.470 for the check of Signalling System R2 line signals. The interregister signals will be found in Table 5/M.580.

Note – Such a check is not appropriate for speech circuits of Signalling System No. 6.

11 Functional tests

11.1 When the line-up procedure as described above has been completed, a check should be made of the functioning of the compandors where appropriate in accordance with Recommendation M.590. This should be followed by a speaking test including a check of the satisfactory operation of echo suppressors and echo cancellers and a check that signalling transmission over the circuit is satisfactory. For an automatically operated circuit using channel-associated signalling, the signal-transmission testing facilities available at the control station should at least enable a check to be made of the line-signals transmitted between circuit access points, for example, to verify that the forward signals are followed by the return of the appropriate backward signals.

11.2 For manually operated circuits a check should be made to confirm that line-signalling to the distant end is satisfactory.

Where possible, both for manually and automatically operated circuits, test calls should be made to the distant-end operators or technical staff, as the case may be, to check the circuit both for signalling and transmission performance.

11.3 Some Administrations find a rapid check of the echo suppressors useful when setting up a circuit. A suitable method is described in [6] which can be carried out by agreement between Administrations.

12 Records of results

Each station should keep a careful record of the measurement results for the receiving direction of transmission of the sections terminating in the station. A record should be kept of the overall loss at the reference frequency and also of the overall loss/frequency characteristic relative to the overall loss at 800 Hz.

The measurements made must include the characteristics of any equalizers which have been fitted and the final choice of gain setting must be stated.

The receiving terminal stations will also maintain a careful record of all the section measurements in the receiving direction of transmission. In addition the terminal sub-control station should send a copy of the overall records to the control station which thus will hold records for both directions of transmission. (Stations should prepare local records of in-station tests of equalizers and records of equalizer and gain settings.)

Careful records of the results of tests given in §§ 4 to 11 above should be made by both terminal stations. The control station should hold a copy of the records for both directions of transmission.

TABLE 5/M.580

Absolute power of signalling current

Type of signalling	Signalling frequency		Absolute power
	Nominal value	Tolerance	Nominal value in dBm0 (tolerance ± 1 dB)
Manual signalling (System No. 1)	500 Hz interrupted at 20 Hz	± 2%	uninterrupted (500 Hz) 0
		± 2%	interrupted (500/20 Hz) —3
One-frequency signalling (System No. 3)	2280 Hz	± 6 Hz	—6
Two-frequency signalling (System No. 4)	2040 Hz 2400 Hz	± 6 Hz ± 6 Hz	—9 —9
Multi-frequency systems (Systems No. 5 and 5*bis*) Line signals[a] (two-frequency)	2400 Hz 2600 Hz	± 6 Hz ± 6 Hz	—9 —9
Register signals[b] (multi-frequency)	700 Hz 900 Hz 1100 Hz 1300 Hz 1500 Hz 1700 Hz	± 6 Hz ± 6 Hz ± 6 Hz ± 6 Hz ± 6 Hz ± 6 Hz	—7 —7 —7 —7 —7 —7
Signalling System R1. Line signals	2600 Hz	± 5 Hz	—8/—20 [c]
Register signals[d]	700 Hz 900 Hz 1100 Hz 1300 Hz 1500 Hz 1700 Hz	± 1.5% ± 1.5% ± 1.5% ± 1.5% ± 1.5% ± 1.5%	—7 —7 —7 —7 —7 —7
Signalling System R2. Register signals[b]			
Forward	1380 Hz 1500 Hz 1620 Hz 1740 Hz 1860 Hz 1980 Hz	± 4 Hz ± 4 Hz ± 4 Hz ± 4 Hz ± 4 Hz ± 4 Hz	—8 —8 —8 —8 —8 —8
Backward	540 Hz 660 Hz 780 Hz 900 Hz 1020 Hz 1140 Hz	± 4 Hz ± 4 Hz ± 4 Hz ± 4 Hz ± 4 Hz ± 4 Hz	—8 —8 —8 —8 —8 —8

a) For compound signals, the difference between the sent levels of f_1 and f_2 should not exceed 1 dB.

b) The difference between the sent levels of two frequencies of which a signal is composed should not exceed 1 dB.

c) —8 dBm0 for the duration of the signal or for a minimum of 300 ms (whichever is the shorter) and for a maximum of 550 ms after which the level of the signal shall be reduced to —20 dBm0.

d) The difference between the sent levels of the two frequencies of which a signal is composed should not exceed 0.5 dB.

ANNEX A

(to Recommendation M.580)

Methods proposed for setting up and lining up of mixed analogue/digital terminal sections

A.1 *Check of the mixed analogue/digital terminal equipment*

The mixed analogue/digital terminal equipment must be checked to ensure that it meets CCITT Recommendations and the other relevant specifications (e.g. the check should include a general visual inspection and vibration tests, if applicable). The check should, if possible, also include a test of both the equipment and transmission system related alarms and alarm indicators associated with the mixed terminal. This is of particular importance if the equipment has remained unused since acceptance tests were carried out after installation.

A.2 *Measurement and adjustment of levels*

Either of the methods A or B below may be used in lining up the circuit sections on a mixed terminal, depending on the features of the equipment and on the availability of digital test equipment. Note, both methods require all of the circuit sections associated with the particular primary block on the mixed terminal to be out-of-service.

A.2.1 *Method A – use of internal milliwatt test tone*

This method is only applicable for mixed analogue/digital terminals equipped with an internally generated digital test signal with a power of 1 milliwatt at 800 Hz[5], which can be applied internally either in turn or simultaneously in the analogue receive output direction to all the circuits.

As shown in a) of Figure A-1/M.580, in the first step the internal digital test signal is actuated. Then for each internal circuit the analogue receive direction pad is adjusted, using an analogue meter to bring the receive level as near as possible to its nominal value.

To complete the measurement in step 2 as shown in b) of Figure A-1/M.580, first the internal digital test signal is removed and the digital side of the terminal is looped (either internally or externally). Next, using external analogue test equipment a nominal 800 Hz 0dBm0[6] tone is applied to the analogue transmit input port of each channel in turn. The transmit pad is then adjusted using the analogue meter connected to the analogue receive output port of the terminal to again bring the receive level as near as possible to its nominal value.

A.2.2 *Method B – use of digital test equipment*

This method, as shown in c) of Figure A-1/M.580, assumes that the appropriate digital test equipment is available to make measurements on individual 64 kbit/s time slots within the 2048 (1544) kbit/s digital path on the digital side of the mixed terminal section.

To make the measurements on the circuit sections, in the analogue to digital direction, a nominal 800 Hz test signal is sent over each circuit section in turn at a level of –10 dBm0. The 64 kbit/s time slot corresponding to each circuit is monitored in turn at the primary PCM hierarchical level, using appropriate digital test equipment, and each circuit is adjusted, where applicable, to obtain the correct bit sequence.

Next, in the digital to analogue direction, a bit sequence corresponding to a nominal 800 Hz test tone at –10 dBm0 is applied to the 64 kbit/s time slot corresponding to each circuit section in turn, at the primary PCM hierarchical level, using a digital word generator, and each circuit is adjusted to bring the received level as near as possible to its nominal value.

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[5] For international circuits 800 Hz is the recommended frequency for single-frequency maintenance measurements. However, by agreement between the Administrations concerned, 1000 Hz may be used for such measurements, since it is a fact that 1000 Hz is widely used for single-frequency measurements on international and intercontinental circuits.

[6] Reference should be made to Supplement No. 3.5 [3] concerning measuring frequencies to be used on circuits routed over PCM systems or through digital exchanges.

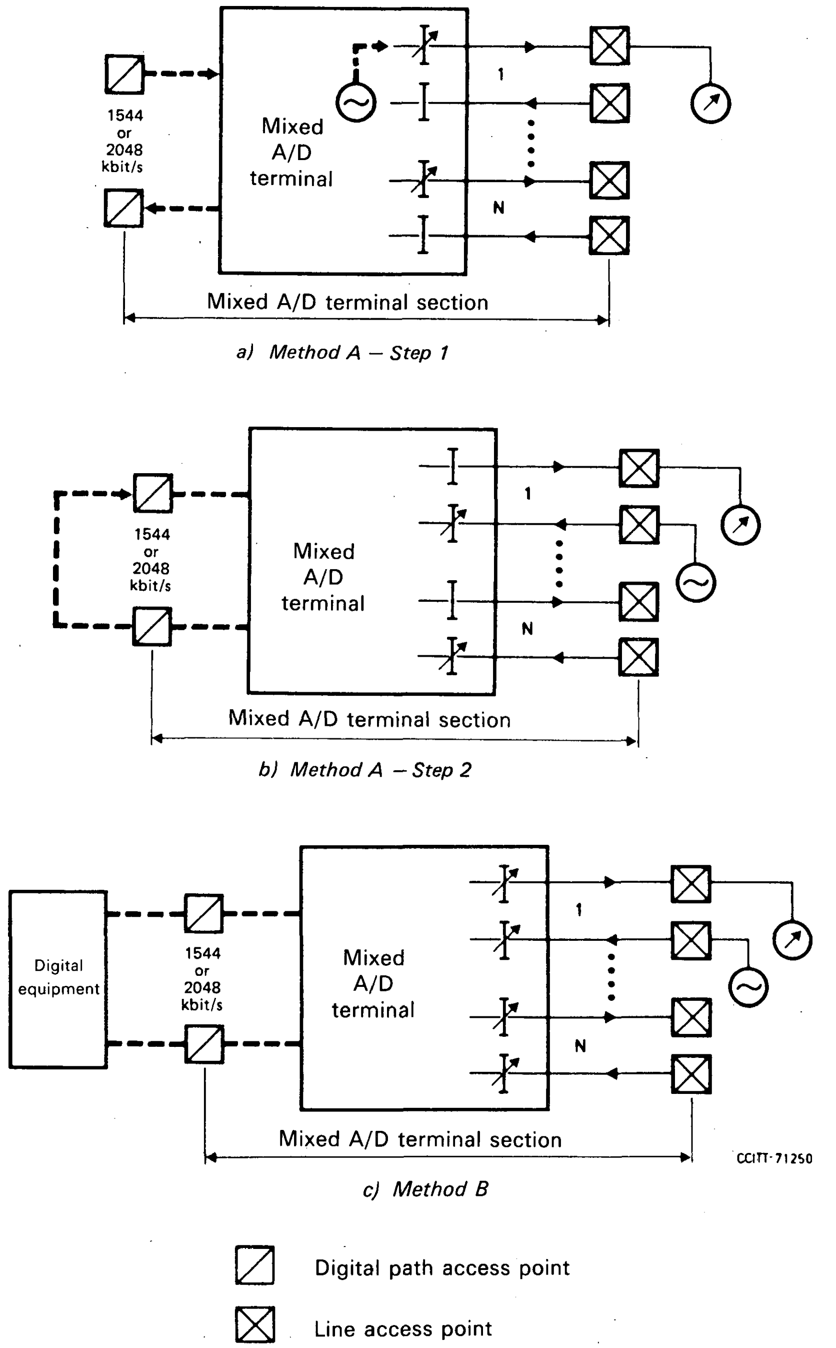

FIGURE A-1/M.580

A.3 *Other measurements*

No other measurements are recommended at the time when the mixed analogue/digital terminal circuit sections are being set up and lined up. However, other measurements may be required when the need is indicated during circuit line-up.

A.4 *Mixed analogue/digital sections at terminal exchanges*

A.4.1 *At analogue switching exchanges*

Where a mixed analogue/digital terminal circuit section is connected to an analogue switching exchange, method B described above could be extended to include all the audio equipment associated with the switching exchange. In this case the measurements would be made between the digital path access point and the circuit access points (see Figure 1/M.110). The types of measurements to be performed for this case should be dictated by national practices.

A.4.2 *At digital switching exchanges*

Where a mixed analogue/digital terminal circuit section is connected to a digital switching exchange, method B can also be applied. In this case the digital test equipment shown in Figure A-1c/M.580 would be connected at the circuit access point through the digital exchange. The analogue test equipment would be connected at an intermediate access point. The types of measurements to be performed for this case should be dictated by national practices.

References

[1] CCITT Recommendation *12-channel terminal equipments*, Vol. III, Rec. G.232.

[2] CCITT Recommendation *16-channel terminal equipments*, Vol. III, Rec. G.235.

[3] *Test Frequencies on circuits routed over PCM systems*, Vol. IV, Supplement No. 3.5.

[4] CCITT Recommendation *Specification for psophometer for use on telephone-type circuits*, Vol. IV, Rec. O.41.

[5] CCITT Recommendation *Circuit noise and the use of compandors*, Vol. III, Rec. G.143.

[6] *Rapid verification test for echo control*, Green Book, Vol. IV.2, Supplement No. 2.11, ITU, Geneva, 1973.

Recommendation M.590

SETTING UP A CIRCUIT FITTED WITH A COMPANDOR

1 The compandor should first be tested in accordance with the appropriate design information which should be made available in a suitable form to the repeater station staff.

2 The compandor should be fitted to the circuit only after the circuit without its compandor is satisfactory in respect of loss and loss/frequency response (see Recommendation M.580). The loss/frequency characteristic of a circuit fitted with a compandor is likely to be misleading and need not be measured.

3 The loss (or gain) at the reference frequency between circuit access points[1] should be measured in both directions of transmission with an input level of U dBm0 both with and without the compandor in circuit, where U dBm0 is the unaffected level of the circuit (see Recommendation G.162 [1]). The difference caused by inserting the compandor should not exceed 0.3 dB.

4 The noise power level, psophometrically weighted and unweighted, should be measured with and without the compandor in circuit and the values noted. The inputs to the channels should be terminated with 600-ohm resistors during this test. No limit is specified as the apparent noise advantage gained depends on the level of uncompandored noise, the unaffected level, the compression ratio and the dynamic range of the compandor.

5 A speaking test should be made on the circuit to verify that there are no gross tracking errors.

Note – Repeater station staff should be well instructed as to the subjective effect of errors and the location of faults affecting compandors.

Reference

[1] CCITT Recommendation *Characteristics of compandors for telephony*, Vol. III, Rec. G.162.

[1] A compandor, if fitted, should be connected on the line side of the line test-access points and not between the line test-access point and the circuit test-access point. In this way the relationship between the nominal transmission levels at these two points on a circuit with a compandor is the same as for other circuits.

3.2 Routine maintenance of international telephone circuits

Recommendation M.600

ORGANIZATION OF ROUTINE MAINTENANCE MEASUREMENTS ON CIRCUITS

The organization of routine maintenance measurements on all telephone-type circuits should follow the general requirements given in Recommendation M.733.

Recommendation M.605

ROUTINE MAINTENANCE SCHEDULE FOR INTERNATIONAL PUBLIC TELEPHONY CIRCUITS

1 General

A schedule for the routine maintenance of the international public telephony circuits linking any two countries (including speech circuits of Signalling System No. 6), is drawn up by bilateral agreement between the technical services[1] of the countries concerned. The programming of the tests to be performed within the agreed scheduled time is the responsibility of each Administration. It is for the circuit control stations to ensure that the routines are carried out within the agreed schedule except as allowed for in § 2.5 below.

2 Routine measurements carried out manually: establishment of the schedule

2.1 *Schedule form*

Figure 1/M.605 shows the form to be used for establishing the routine schedule; an example of its use is given in Figure 2/M.605.

As far as possible the schedule is drawn up on the principle of batch measurements of circuits on a given route and shows the days and times during which the routine maintenance measurements should be carried out.

Each international test centre will require a set of eight forms to cover the four weeks of the *odd* and the four weeks of the *even* months, four weeks constituting a month for the purpose of the schedule.

Week 1 is the first whole week of a month beginning with a Monday. Week 4 may include days belonging to the following calendar month.

Odd months denotes January, March, May, etc., and *even* months February, April, etc.

The schedule form allows for simultaneous testing on two different routes where two test positions are provided for routine measurements. If more than two routine test positions are available, additional or suitably modified forms will be required.

2.2 *Arranging the schedule*

The periodicity for circuit routines should be determined from Recommendation M.610.

The total time required to routine test all the circuits on a route should be assessed. It will depend on:

a) the total number of circuits,

b) the type of measurements and tests to be made, and

c) the expected rate of completion of routines for each circuit.

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[1] In some Administrations this function may be delegated by the technical service, but in all cases the technical services are responsible for ensuring the satisfactory preparation and application of the schedule.

The determination of item c) will require particular care. The duration of circuit routines may be expected to differ from one test centre to another due to the different facilities provided: for example, circuit test access arrangements, and the organization of the work. Thus, no guidance can be given to the expected rate of completion of routines.

To reduce the need to make frequent changes to the schedule, due allowance should be made for any planned increase of the number of circuits on a route.

The individual testing periods may be of 1, 2, 3 or 4 hours duration. Where the total routine time required for a route would make a single testing period impracticable, two or more testing periods should be allocated to the route, but these periods should be separated in time by at least 4 hours.

The days and times of the testing periods will be decided by a bilateral agreement between the two technical services concerned. To initiate the scheduling of routines for a route, the technical service to which the circuit control station is responsible should request copies of the current schedule form from the distant end technical service. The controlling end technical service should indicate on the forms the day(s) and time(s) it proposes, choosing any unallocated periods on the forms for this purpose. The forms should then be returned to the distant technical service and agreement sought on the proposals[2)].

It is intended that individual testing periods be allocated to the circuits of one control station only. However, subject to the bilateral agreement between the two technical services involved, individual testing periods may be used on a common basis for the circuits of both control stations.

2.3 *Changes to the schedule*

As far as possible testing periods should be chosen so that new circuits can be incorporated without change to the schedule.

Modifications to the days and/or times of testing for existing circuits, or expansion of the schedule to accommodate additional circuits or new routes should be determined by the technical service to which the circuit control station is responsible, in agreement with the other interested technical service(s). If the technical service responsible for a circuit sub-control station considers it necessary to alter the routine maintenance schedule, it should propose changes and obtain the agreement of the technical service responsible for the control station. Any intended modifications or additions to the schedule should be entered in red on a current copy which should be forwarded to the distant technical service(s) concerned. Agreement or counterproposals can then be made by any suitable means[2)].

2.4 *Programming of routine measurements and tests*

It is the responsibility of each Administration to decide how the agreed scheduled test periods should be utilized for the effective completion of routines on the circuits it controls.

This will involve determining the type of measurements and tests to be made on each circuit taking into account the recommended periodicities.

2.5 *Unscheduled periods*

Available periods in the schedule which are unallocated may be used for any purpose relating to circuit routines. Such use is on an *ad hoc* basis and each occasion must be agreed by the terminal control and sub-control stations concerned.

3 Circuit routines by automatic transmission measuring equipment ATME No. 2

Note – As long as ATME No. 1 equipment is still in use a corresponding procedure should be applied (see Recommendation cited in [1]).

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2) In some Administrations this function may be delegated by the technical service, but in all cases the technical services are responsible for ensuring the satisfactory preparation and application of the schedule.

3.1 *Schedule form*

For the orderly and effective use of ATME for circuit routines it is necessary to schedule its use.

For each distant end international centre an Administration will require the following information to enable it to make proposals for ATME routines on the circuits for which it has control responsibility:

a) type and quantity of responding facilities at distant end;

b) periods when distant end responding facilities are not scheduled for use;

c) periods to be avoided due to exchange peak traffic at distant end.

This information should be applied by the distant end Administration on request and use of a standard form for this purpose is considered necessary. The form to be used is shown in Figure 3/M.605; an example of its use is given in Figure 4/M.605. Weeks 1, 2, 3 and 4 and *odd* and *even* months are as defined in § 2.1 above.

For ATME No. 2, three types of responding facilities are possible (see Recommendation O.22 [2]):

type a – for signalling tests and transmission measurements;

type b – for signalling tests only;

type c – for busy flash tests.

Two forms will be required for *each type a* and *b* responding equipment to cater for *odd* and *even* months. If the controlling end wishes to conduct routines at monthly or more frequent intervals then appropriate entries will need to be made on both *odd* and *even* month forms.

The type of ATME No. 2 responding equipment (*type a* or *b*) needs to be entered on the form. Each form should be given a unique reference number for administrative purposes.

Although two forms are required for each *type a* and *b* responding equipment, this does not imply that a particular responding equipment of the required type will be accessed. This will depend on local incoming arrangements.

Separate forms are *not* required for *type c* responding facilities. Where busy flash tests are to be made at the same time as transmission and/or signalling routines they should be considered as an extension of these routines and due allowance should be made for them when estimating the scheduled testing time required. An indication to show if *type c* responding facilities are or are not provided should be given on the schedule forms for *type a* and *b* responders.

The incoming access address for each type of responding facility is standard for each signalling system (see the Recommendation cited in [3]) and need not be entered on the schedule form.

3.2 *Arranging the schedule*

The technical service of an Administration wishing to commence routine testing using its ATME directing equipment, or to modify its routine programme, should request a copy of the current schedule of responding equipment availability for the distant international centre(s) of interest from the technical service concerned. This schedule will be entered on the form given in Figure 3/M.605.

The technical service at the controlling (i.e., directing equipment) end should indicate the test period(s) it proposes on the schedule and return it to the distant end for agreement.

The technical service at the controlling end will need to take the following factors into consideration when determining the test periods required on a route:

a) circuit routine periodicity (from Recommendation M.610.

b) total routine time for all circuits on the route. This will depend on:

   i) total number of circuits;

   ii) type of tests and measurements;

   iii) routine time for circuits;

c) quantity of available responding equipments of required type at distant end (This is required when it is intended to test with more than one directing equipment simultaneously to the same distant testing centre.);

d) quantity of directing equipments to be used;

e) that test periods should be multiples of 1 hour;

f) that busy traffic periods should be avoided.

To reduce the need to make frequent changes to the schedule, due allowance should be made for any planned increase of the number of circuits on a route.

3.3 *Utilization of scheduled test periods*

It is the responsibility of each Administration to decide how the agreed scheduled test periods should be utilized for the effective completion of routines on the circuit it controls.

3.4 *Unscheduled periods*

Demand testing with ATME No. 2.

During the busy traffic period, when ATME No. 2 is not being used for routine testing, it can serve the need to permit single and rapid circuit testing on a demand basis for fault location and for testing of individual circuits following fault clearance, as well as for testing of new circuits to be added. For this reason responding equipments should be available at all times. Demand testing of large numbers of circuits for whatever purpose should be agreed between testing centres concerned.

3.5 *Utilization of directing equipment*

In addition to a current schedule of the availability of responding equipments at each of its international centres for the information of other Administrations, each Administration will have to maintain a schedule of the utilization of its own directing equipments. This is a matter for each Administration to arrange and does not require formulating by CCITT but the same type of form may also be used as indicated in Figure 5/M.605.

3.6 *Down time of ATME No. 2 equipment*

If ATME No. 2 equipment is to be out of service for a long period of time (several days), e.g. due to a fault condition or rearrangements in the international centre, so that automatic testing cannot be carried out or is heavily affected, the Administrations concerned should be advised accordingly.

International centre: ________________________________ Month: odd/even[1]

Telephone number: ________________________________ Week: 1/2/3/4[1]
(for circuit routine
cooperation)

For one routine test position use row A.

For two routine test positions use rows A and B.

Time (UTC)		0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400
MON	A																									
MON	B																									
TUES	A																									
TUES	B																									
WED	A																									
WED	B																									
THUR	A																									
THUR	B																									
FRI	A																									
FRI	B																									
SAT	A																									
SAT	B																									
SUN	A																									
SUN	B																									

[1] Delete as applicable.

CCITT-36570

FIGURE 1/M.605

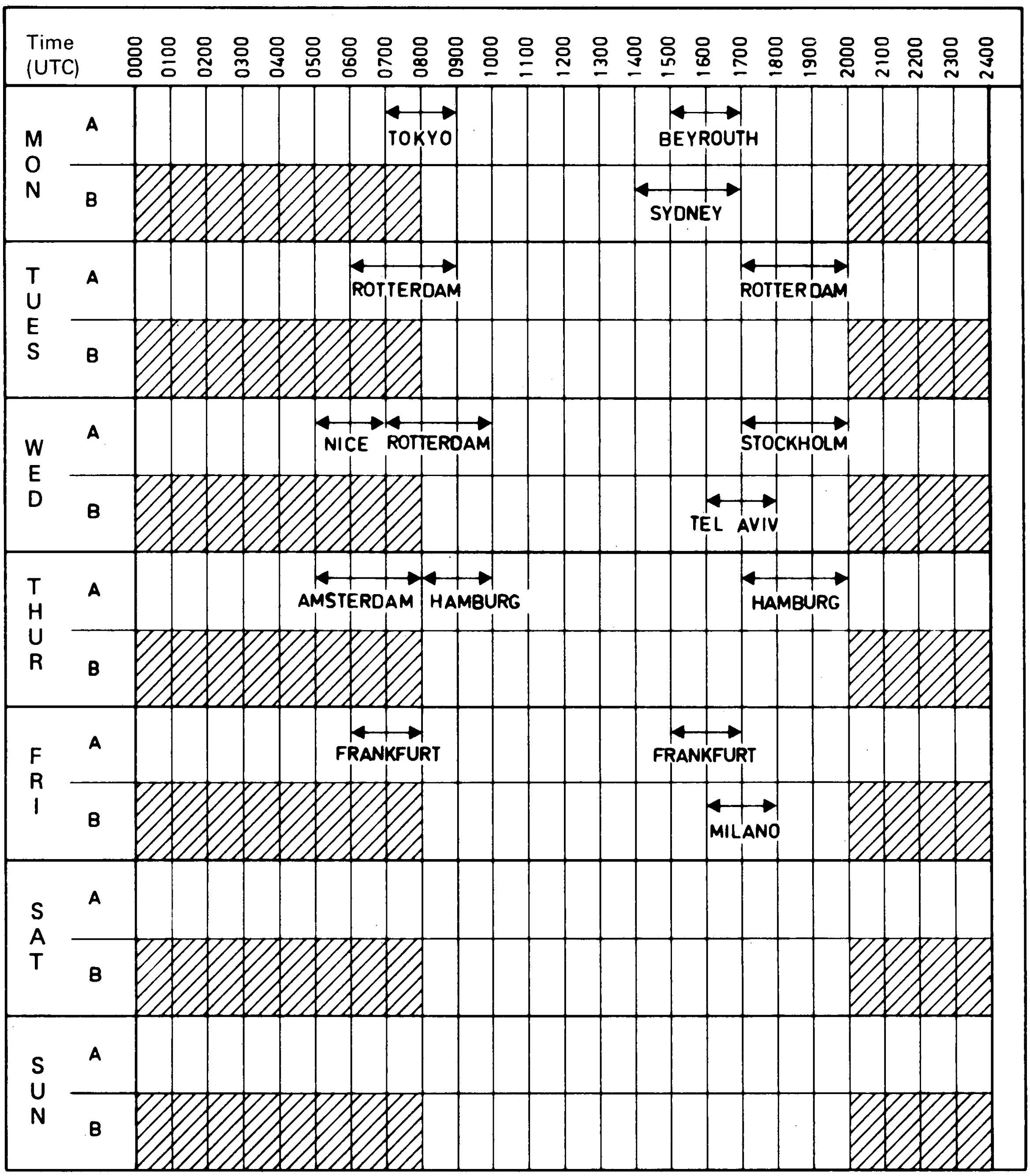
Manual routine testing schedule

International centre: London – Wood Street — Month: odd/~~even~~[1]

Telephone number: (for circuit routine cooperation) London 606 2064 — Week: 1/~~2/3/4~~[1]

For one routine test position use row A.

For two routine test positions use rows A and B.



[1] Delete as applicable.

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FIGURE 2/M.605

Manual routine testing schedule (hypothetical example)

International centre:

Month: odd/even[1]

Reference number:

Responding equipment *type a*/*type b*[1]

Type c responding facility is/is not[1] available at this centre.

Week/day	Time (UTC)	0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400
1	Mo																									
	Tu																									
	We																									
	Th																									
	Fr																									
	Sa																									
	Su																									
2	Mo																									
	Tu																									
	We																									
	Th																									
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3	Mo																									
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4	Mo																									
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	Th																									
	Fr																									
	Sa																									
	Su																									

[1] Delete as applicable.

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FIGURE 3/M.605

ATME No. 2 availability schedule

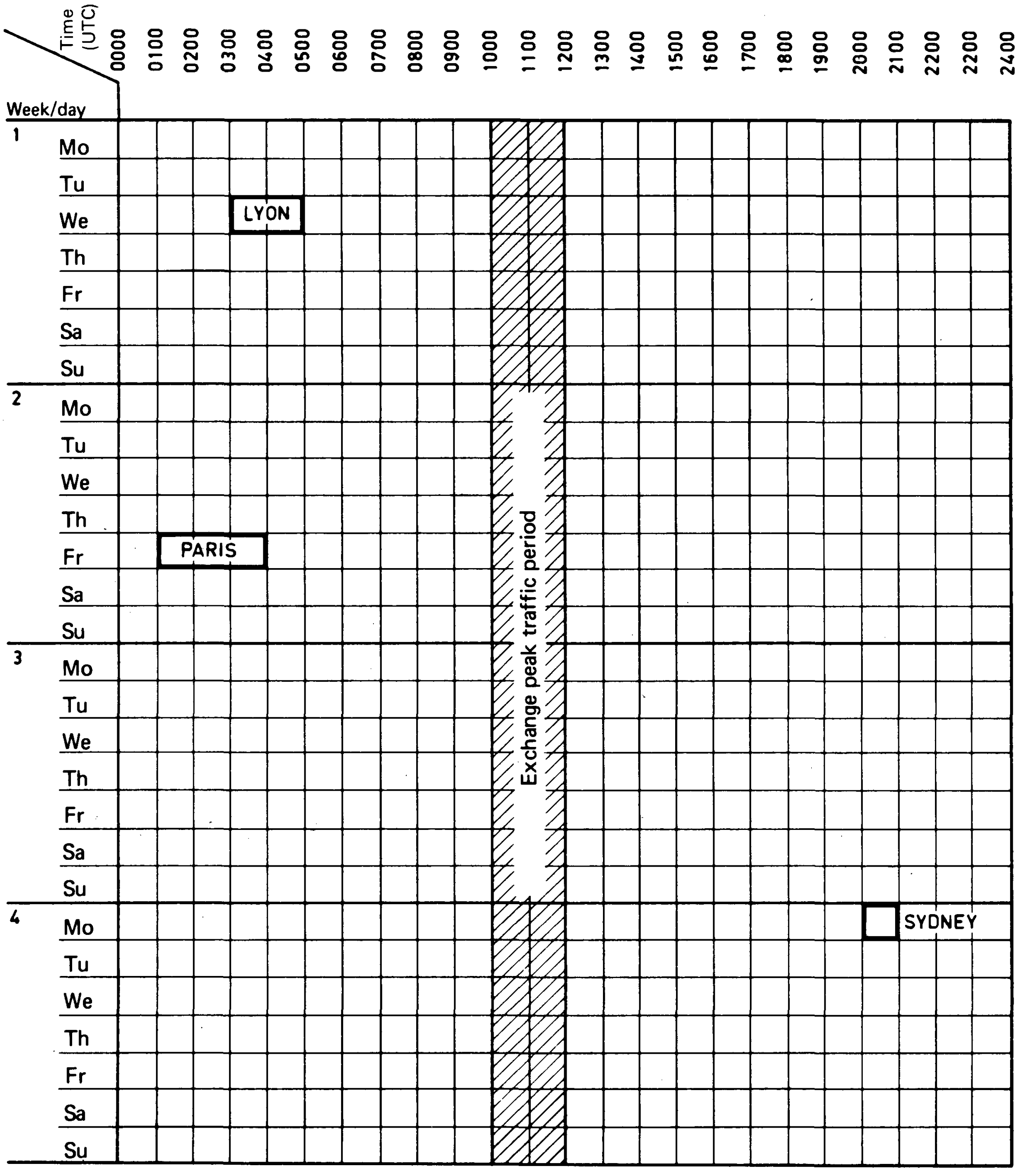
International centre: Frankfurt/Main

Month: odd/~~even~~[1]

Reference number:

Responding equipment *type a*/~~*type b*~~[1]

Type c responding facility ~~is~~/is not[1] available at the centre.



[1] Delete as applicable.

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FIGURE 4/M.605

ATME No. 2 availability schedule (hypothetical example for a responding equipment)

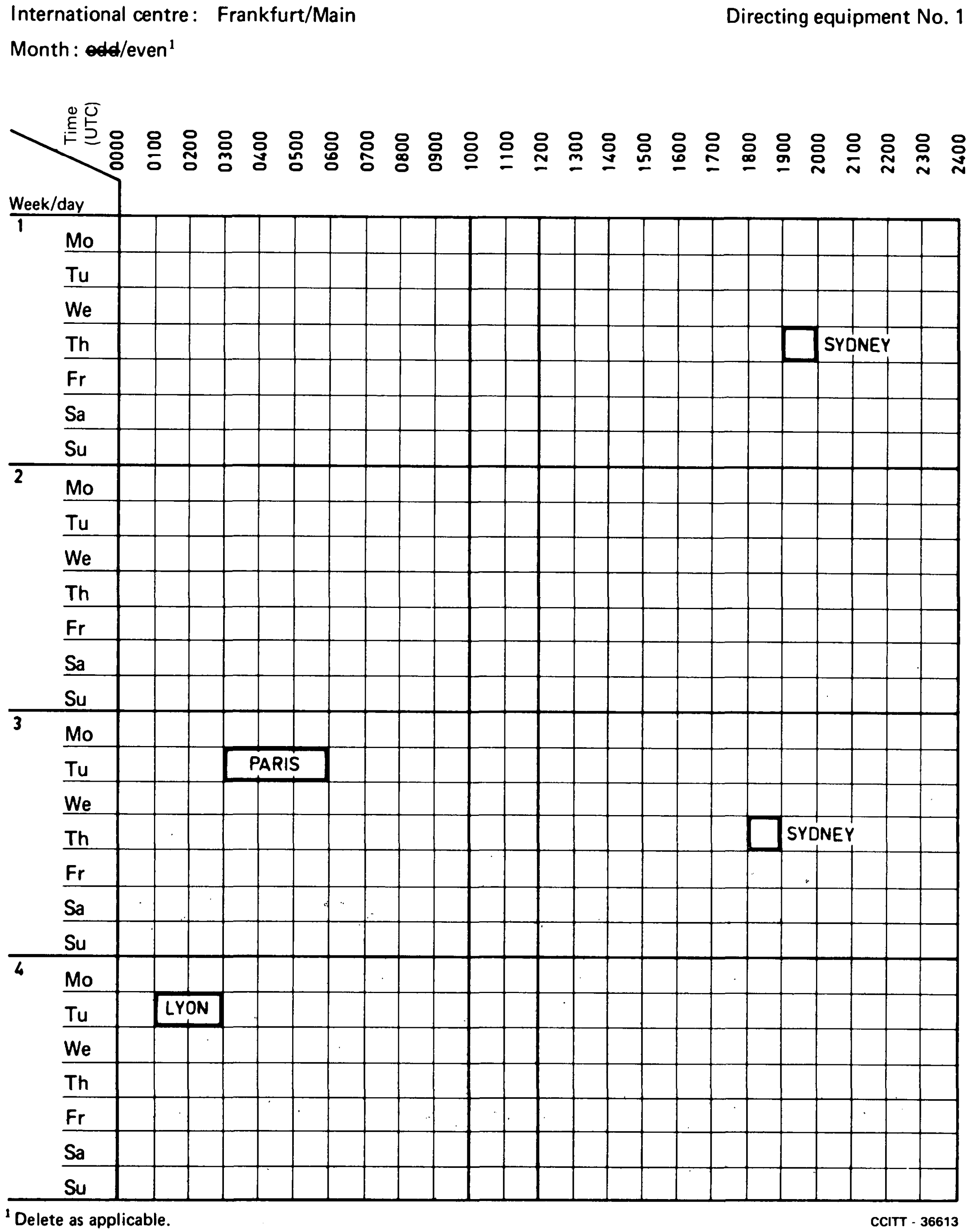

FIGURE 5/M.605

ATME No. 2 availability schedule (hypothetical example for a directing equipment)

References

[1] CCITT Recommendation *Routine maintenance programme*, Green Book, Vol. IV.1, Rec. M.15, ITU, Geneva, 1973.

[2] CCITT Recommendation *Specification for the CCITT automatic transmission measuring and signalling testing equipment ATME No 2*:, Vol. IV, Rec. O.22.

[3] *Ibid.*, § 4.4.1.

PERIODICITY OF MAINTENANCE MEASUREMENTS ON CIRCUITS

Routine maintenance measurements should be made on a complete circuit and should comprise measurements of:

a) overall loss and levels at one frequency;

b) overall loss and levels at several frequencies;

c) stability (for two-wire audio circuits or sections of circuit only);

d) signalling;

e) noise.

The periodicity for measurements of loss, noise, stability and signalling is given in Tables 1/M.610 and 2/M.610; in addition, other types of measurements are given in Table 1/M.610 for which the periodicity may be determined by the Administrations concerned.

Table 1/M.610 shows the periodicity for measurements on the types of circuit normally used in the international telephone network (except for frontier circuits). When automatic transmission measuring and testing equipments are available, transmission measurements and signalling tests may be carried out more frequently than indicated in this table.

These circuits are:

– 4-wire audio-frequency circuits. Included also in this category are circuits on carrier systems providing a small number of telephone channels. No distinction is made between circuits in underground cables and circuits on open-wire lines unless the open-wire section is equipped with repeaters;

– 4-wire carrier circuits on telephone channels of systems providing at least one group;

– 4-wire circuits of mixed constitution, i.e. consisting of a mixture of audio and carrier sections.

Table 2/M.610 shows the periodicity of measurements to be made on short-distance international circuits that are generally used for terminal traffic, but which can, when necessary, be used to extend more important international circuits. It is desirable that the same recommendations be applied to national circuits that are frequently used for international communications.

TABLE 1/M.610

Periodicity of measurements and tests to be made on international telephone circuits
(circuits normally used in the international network)

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	
Type of Circuit	Description	Measurement of overall loss at one frequency and measurement of noise[a)]	Measurements of overall loss at several frequencies	Systematic subjective testing Signal-to-crosstalk ratio between *go* and *return* paths Frequency translation error	Signalling tests Manual circuits	 Automatic circuits
Audio frequency 4-wire	1 to 14 repeaters	Monthly	Half-yearly	None	To be tested at the same time as the measurement of overall loss at several frequencies	Testing to follow the Series Q Recommendations
	15 or more repeaters	Weekly	Half-yearly			
	Same, with open-wire section with at least one repeater	At least monthly or as agreed	Half-yearly			
Wholly carrier	Circuits set up on channels on a simple group link and terminating at the same points as the group	Two-monthly or as agreed	Yearly	As agreed in accordance with need and experience		
	Circuits routed over several groups	Monthly	Yearly	As agreed in accordance with need and experience		
4-wire circuits of mixed constitution		At least monthly or as agreed	Yearly	As agreed in accordance with need and experience		

a) Measurements of overall loss at one frequency and of noise shown in column 3 are included in the measurements made at several frequencies shown in column 4.

TABLE 2/M.610

Periodicity of measurements to be made on international telephone circuits
(Types of circuit not normally used in the international network)

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	
Category of circuit	Type of circuit	Measurements of overall loss at one frequency and measurement of noise[a)]	Measurements of overall loss at several frequencies	Measurements of stability	Signalling tests	
					Manual circuits	Automatic circuits
Audio-frequency	2-wire circuits with one repeater	Yearly	Yearly	Yearly	At the same time as measurements of overall loss and levels at several frequencies (see column 4)	As agreed between Administrations
	2-wire circuits with two or three repeaters	Half-yearly	Yearly	Half-yearly		
	2-wire circuits with at least four repeaters	Quarterly	Half-yearly	Quarterly		
	2-wire circuits including an open-wire section with at least one repeater	Monthly	Half-yearly	Monthly		
	4-wire circuits with a 2-wire section having at least one repeater	As agreed between Administrations				

a) Measurements of overall loss at one frequency and of noise shown in column 3 are included in the measurements made at several frequencies shown in column 4.

Recommendation M.620

METHODS FOR CARRYING OUT ROUTINE MEASUREMENTS ON CIRCUITS

1 Measurements and tests carried out manually

1.1 *Measurements of overall loss*

The measurements should be made by applying to the circuit access points (see Recommendation M.565, § 2) test signals at a level of -10 dBm0 [1]:

- at the frequency of 800 Hz [2] when measurements are confined to one frequency;
- at frequencies of 400, 800, (or 1000) and 2800 Hz, when measurements are made at more than one frequency. Measurements may be made at additional frequencies if required.

Whenever automatic level recorders or display sets are available at the ends of the circuit, the measurements should be made with this equipment at all frequencies over the range of interest.

1) This is the preferred level. However, by agreement between Administrations, a level of 0 dBm0 may be used.

2) For international circuits, 800 Hz is the recommended frequency for single-frequency maintenance measurements. However, by agreement between the Administrations concerned, 1000 Hz may be used for such measurements, since it is a fact that 1000 Hz is widely used for single-frequency measurements on international and intercontinental circuits.

Multi-frequency measurements made to determine the loss/frequency characteristic will include a measurement at 800 Hz and therefore the reference frequency for such characteristic can still be 800 Hz.

Reference should be made to Supplement No. 3.5 [1] concerning measuring frequencies to be used on circuits routed over PCM systems.

1.2 *Noise measurements*

The psophometric noise power as indicated by a CCITT psophometer should be measured in both directions of transmission. It would be useful to make this measurement at the same time as the measurement of overall loss.

1.3 *Signalling tests*

1.3.1 *Manually operated circuits*

The power of the voice-frequency signalling current, in its normal operating condition, should be measured at the same time as the overall loss at several frequencies is measured.

If n is the relative power level at the point of measurement, the measured absolute power level of the signalling current transmitted at 500/20-Hz interrupted signalling current should fall within the following limits:

$$(n - 3) \pm 1/2 \text{ dB}$$

assuming that the signalling units used conform to the specifications of the Series Q Recommendations.

The operation of the voice-frequency signalling receivers is tested as an in-station test.

For information, the operating limits of the signalling receiver are as follows:

If n is the relative power level at the point of connection in the circuit where the receiver is connected, it will operate reliably when the absolute power level N of the signalling current at the input of the receiver falls within the following limits:

$$-8.5 + n \leqslant N \leqslant +2.5 + n \text{ dB}.$$

1.3.2 *Semiautomatic or automatic circuits*

See Recommendation M.732.

1.4 *Records*

All the results of measurements and tests should be recorded by the control and sub-control stations concerned.

2 Use of automatic transmission measuring and signalling testing equipment – ATME No. 2

See Recommendation O.22 [2].

2.1 *Transmission measurements*

When ATME No. 2 is available for the routine maintenance of automatic and semiautomatic international circuits, it should be used to make the following measurements:

- overall loss at 800 (or 1000) Hz or at 400, 800 (or 1000) and 2800 Hz, as required;
- psophometric noise power level.

The test frequencies for overall loss measurements should be at a level of −10 dBm0[3].

2.2 *Signalling tests* (Note)

The signalling functions involved in the setting-up and clearing down of a connection between the directing and responding equipments will be checked during each test call. In addition, ATME No. 2 should be used to make the following line signalling tests:

- forward transfer (where provided),
- clear back,
- re-answer,
- busy flash.

Note – It is inappropriate to perform a signalling test using a Type B ATME No. 2 responder on Signalling System No. 6 speech circuits.

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[3] This is the preferred level. However, by agreement between Administrations, a level of 0 dBm0 may be used.

3 Corrective action

3.1 *Readjustment of overall loss*

When, during a routine measurement, the overall loss at 800 Hz or 1000 Hz is not equal to its nominal value, the procedure below should be followed.

Deviations of less than ± 1 dB from nominal shall be deemed not to require adjustment. If measurements at a terminal station reveal a deviation from the nominal value of ± 1.0 dB up to and including ± 2.5 dB, adjustment to as near the nominal value as possible should be made at the terminal station and if practical at any intermediate station involved. Where it is appropriate and practical to do so, adjustment shall be made on the group or supergroup links in accordance with Recommendation M.530. If the deviation from nominal exceeds ± 2.5 dB a fault should be suspected which should be sought and cleared. If no fault is found, readjustment should be carried out at the intermediate and terminal stations as necessary, with particular attention to alignment of the group and supergroup link or links that may be involved.

3.2 *Measurements at more than one frequency*

When measurements are made at more than one frequency, a check should be made to ensure that the values obtained are within the limits permitted (see Tables 1/M.580, 2/M.580 and 3/M.580). If they are not, appropriate steps should be taken.

3.3 *Noise measurements*

It should be noted that any substantial deterioration in performance from the original line-up value may serve to indicate a fault. Comparison should also be made to noise measurements on circuits of identical or similar constitution to help locate a possible fault.

4 Other measurements without recommended periodicity

a) Systematic subjective testing, see Recommendation M.731;

b) Measurement of signal-to-crosstalk ratio between *go* and *return* channels. The measured signal-to-crosstalk ratio should not be worse than 43 dB;

c) Frequency errors arising from frequency translation. The difference between the sent and received audio frequencies should not exceed 2 Hz. See Recommendation O.111 [3] for a method of measuring this error.

References

[1] *Test frequencies on circuits routed over PCM systems*, Vol. IV, Supplement No. 3.5.

[2] CCITT Recommendation *Specification for the CCITT automatic transmission measuring and signalling testing equipment ATME No. 2*, Vol. IV, Rec. O.22.

[3] CCITT Recommendation *Specification of essential clauses for an instrument to measure frequency shift on a carrier channel*, Vol. IV, Rec. O.111.

Recommendation M.630

MAINTENANCE OF CIRCUITS USING CONTROL CHART METHODS

Administrations which so wish may replace the periodical measurements specified in Recommendations M.610 and M.620 by measurements using sampling methods. They will need to arrange their own programme for these on a bilateral basis. Administrations which wish to use such methods are requested to report their conclusions to the CCITT giving their comments on:

- the method used (for information, some methods are described in [1];
- the saving in manpower;
- the transference of work from field staff to administrative offices;
- any observed change in the quality of groups of circuits maintained by sampling methods.

Reference

[1] *Methods of quality control*, Green Book, Vol. IV.2, Supplement No. 1.4, ITU, Geneva, 1973.

ROUTINE LINE MEASUREMENTS TO BE MADE ON THE LINE REPEATERS OF AUDIO-FREQUENCY SECTIONS OR CIRCUITS

Besides the routine tests made from end-to-end on the complete circuit, routine maintenance measurements of the equipment of audio-frequency circuits should be made throughout the line for purposes of repeater maintenance.

These routine measurements comprise:

- measurements of repeater gain (where there is little or no feedback);
- measurements of *relative level* at the output of the repeaters (when measuring overall loss on the complete circuit, in the frontier stations and wherever else such measurements are considered necessary);
- measurements of circuit *stability* and test for determining singing points (with 2-wire repeaters).

The measurement of stability is obtained from the definition of stability σ of the circuit considered:

$$\sigma = q - (q_1 + q_2)/2$$

q being the mean of the nominal overall loss of the circuit in each of the two directions of transmission under normal working conditions and q_1 and q_2 being the singing points measured for the two directions of transmission respectively.

In order to measure these singing points in the case of a 2-wire circuit, singing is started by increasing, step-by-step and simultaneously for the two directions of transmission, the gains of one or of several repeaters (preferably those in the middle of the circuits because they are usually in the most critical position from the point of view of singing). Having done this, without touching the adjustment which has been obtained, the transmission in the reverse direction is suppressed and the overall loss of the circuit at 800 Hz is measured for the forward direction of transmission; this is the singing point q_1 above. Next the transmission in the first direction is suppressed and the overall loss of the circuit at 800 Hz is measured for the reverse direction of transmission: this is the singing point q_2 above.

When the circuit is composed of 2-wire and 4-wire sections, or carrier sections, the method of measurement given for 2-wire circuits is valid.

This stability should be determined with the ends of the circuit open-circuited; when there are high-impedance relays permanently connected across the line during a call, these relays may remain during stability tests.

PERIODICAL IN-STATION TESTS OF ECHO SUPPRESSORS COMPLYING WITH RECOMMENDATIONS G.161 AND G.164

Note 1 – Certain of the tests in this Recommendation may conveniently be carried out on an in-station (or in-circuit) basis using measuring equipment to the specification in Recommendation O.141 [1]. This equipment will not provide reliable test results for a circuit which is routed through circuit multiplication systems (CMS) employing interpolation techniques [this includes the case where a circuit is routed over time division multiple access/digital speech interpolation (TDMA/DSI) satellite channels] and therefore should not be used in this instance unless a permanent trunk-channel association in both directions of transmission can be made for the duration of the test sequence. The reason for this is that without such a trunk-channel association, circuit continuity may not be maintained within the CMS in the absence of a signal and during very low signal level conditions.

Note 2 – The tests and periodicities specified in this Recommendation have been prepared to meet the needs of echo suppressors conforming to Recommendations G.161 [2] and G.164 [3].

1 Tests and periodicities applied to valve, rectifier and relay type echo suppressors

1.1 The following tests should be made monthly:

1.1.1 *Check of suppression operate level*

If not within ± 2 dB of the initial value, readjust to be as close to the initial value as possible.

1.1.2 *Check of suppression loss (blocking attenuation)*

The suppression loss should not be less than 30 dB in the frequency range 200 - 3500 Hz and not less than 40 dB in the range 1000 - 1500 Hz.

1.1.3 *Check of differential sensitivity*

a) Check that the suppression loss is removed in the presence of signal on the send path of sufficient magnitude as compared with a signal on the receive path. This check should be made with magnitudes of the signal on the receive path, ranging from the operate level to the expected maximum speech level.

b) Check also that the suppression loss is not removed by the echo produced under the conditions corresponding to the worst expected return loss. Use of an interrupted signal at the operate-frequency or a test speech signal is likely to be effective for this check.

Note – These tests will be necessary when the break-in function is provided.

1.1.4 *Check of disabling facilities*

a) Some echo suppressors can be disabled by the associated signalling and switching equipment. The correct performance of this function, when provided, should be checked.

b) Some echo suppressors can be disabled by special audio frequency signals on the circuit. The correct performance of this function, when provided, should be checked.

1.2 The following characteristic times should be measured every six months and if they are not within 20% of the initial values they should be readjusted to be as close to the initial values as possible.

1.2.1 *Suppression operate times*

a) Relay-type echo suppressor. The operate time should not exceed 4 ms. Alternatively, the operate time should not be greater than 12 ms with a test signal at the operating frequency and 3 dB above the operate level.

b) Valve or rectifier type echo suppressor. The operate time should not exceed 4 ms. The period subsequent to the operate time, during which the specified suppression loss is achieved, should not exceed 0.5 ms. Thereafter, as long as the test signal is applied, the loss should not fall below that specified.

1.2.2 *Suppression hangover time*

The hangover time of the echo suppressor should be 50 ms. Exceptionally, where there is a long chain of national or international circuits beyond the point where the half-echo suppressor is fitted, the hangover time should be 70 ms.

2 Tests and periodicities applicable to semi-conductor type echo suppressors

2.1 The following tests should be made every six months:

2.1.1 *Check of suppression operate level*

If not within ± 2 dB of −31 dBm0 readjust to be as close to this level as possible.

2.1.2 *Check of suppression loss*

The suppression loss should be at least 50 dB.

2.1.3 *Check of break-in differential sensitivity and receive loss*

Check that the suppression loss is removed when the signal applied to the send-in port is within ± 2 dB of the level of a signal of the same frequency applied to the receive-in port. The level of the signal applied at the receive-in port should be between −15 and −20 dBm0. Check that the loss in the receive path (receive loss), when break-in occurs is between 5 and 15 dB when the level applied at the receive-in port is in the range −15 to −20 dBm0.

2.1.4 *Check of signalling disabling*

The operation and release of the signalling disabler circuit should be checked.

2.1.5 *Check of tone disabling*

The characteristics of the tone disabler circuit should be checked and should be within the following limits:

a) *Disabler sensitivity*

The disabler should operate for any single frequency within the disabling design range at a level of −30 dBm0.

The disabler should be released when the disabling tone is reduced to a level of −36 dBm0.

b) *Guard sensitivity*

With either an 800 or 1000 Hz signal applied to the receive-in port and a 2100 Hz signal at a level of −28 dBm0 applied simultaneously to the send-in port, the suppressor should disable when the level of the 800 or 1000 Hz signal is below −33 dBm0 and should not disable when this signal is above −28 dBm0.

c) *Broadband holding and release*

Once disabled a −31 dBm0 signal of either 800 or 1000 Hz should hold disabling and a −36 dBm0 signal should not.

2.2 The following characteristic times should be measured every six months and should be within the limits shown:

2.2.1 *Suppression*

a) Suppression operate time: 5 ms (maximum).

b) Suppression hangover time: 40-75 ms.

2.2.2 *Break-in*

a) Break-in operate time: 30 ms (maximum).

b) Break-in hangover time: 150-350 ms.

2.2.3 *Tone disability*

a) Tone disabler operate time: 300 ± 100 ms.

b) Tone disabler hangover time: 250 ± 150 ms.

Note – The disabler should not release for breaks of less than 100 ms in the disabling tone.

(For definitions of terms see Recommendation G.161 [2].)

3 Tests and periodicities applicable to echo suppressors conforming to Recommendation G.164

3.1 The following tests should be made, e.g. every six months.

Note 1 – If the echo suppressor interface is digital (for example, 2048 kbit/s) the levels prescribed for the various tests are coded in corresponding bit sequences.

Note 2 – Modern digital techniques may allow the tests listed below to be carried out continuously without causing any disturbance of the traffic on the circuit (in-built test system).

3.1.1 *Check of suppression operate level*

The operate level in the receive paths should be within ± 2 dB of –31 dBm0.

3.1.2 *Check of suppression loss*

The suppression loss should be at least 50 dB.

3.1.3 *Check of break-in differential sensitivity and receive loss*

Check that the suppression loss is removed when the signal applied to the send-in port is within the range 0 to –3 dB of the level of a signal of the same frequency applied to the receive-in port. The level of the signal applied at the receive-in port should be any single value within the range –15 and –20 dBm0.

Check that the loss in the receive path (receive loss), when break-in occurs, corresponds to the design value of the echo suppressor when the level applied at the receive-in port is in the range –15 dBm0 to –20 dBm0.

3.1.4 *Check of signalling disabling*

The operation and release of the signalling disable circuit should be checked.

3.1.5 *Check of tone disabling*

The characteristics of the tone disabler circuit should be checked and should be within the following limits:

a) Disabler sensitivity

The disabler should operate for any single frequency within the disabling design range at a level of –30 dBm0. The disabler should be released when the disabling tone is reduced to a level of –36 dBm0.

b) Broadband holding and release

Once disabled, a –31 dBm0 signal of either 800 or 1000 Hz or a corresponding bit sequence should hold disabling and a –36 dBm0 signal should not.

3.2 The following characteristic times should be measured and should be within the limits shown:

3.2.1 *Suppression*

a) Suppression operate time: $\leqslant$ 1 ms (see Note under § 3.2.2).

b) Suppression hangover time: 24-36 ms.

3.2.2 *Break-in* (L_R = constant)

See Table 1/M.660.

TABLE 1/M.660

Time conditions for break-in

Function	Operate times	Hangover times
Partial break-in	$\leqslant$ 2 ms (see Note)	$\leqslant$ 26 ms
Full break-in	6-10 ms	48-66 ms

L_R: Level of signal at receive-in ports.

Note – Some types of built-in processor-controlled digital test systems use scanning periods in excess of these values (for example, 4 ms) and would therefore affect the measured values. It is for Administrations using such test systems to assess the impact of this ambiguity and to determine the need for any supplementary tests.

3.2.3 *Tone disability*

a) Tone disabler operate time: 300 ± 100 ms.

b) Tone disabler hangover time: 250 ± 150 ms (release time).

Note – The disabler should not release for breaks of less than 100 ms in the disabling tone (for definitions of terms, see Recommendation G.164 [3]).

3.3 *Adaptive function*

If the echo suppressor incorporates the adaptive function, the following test should be made:

Check that the break-in sensitivity of the echo suppressor increases at a speed of at least 4 dB/s during the phase of convergence if a level greater than −20 dBm0 is applied to the input of the receive equipment.

3.4 *Consequence*

If an echo suppressor is found not to comply with one of these tests, it should be taken out of service.

References

[1] CCITT Recommendation *Description and basic specification for a semi-automatic in-circuit echo suppressor testing system (ESTS)*, Vol. IV, Rec. O.141.

[2] CCITT Recommendation *Echo suppressors suitable for circuits having either short or long propagation times*, Orange Book, Vol. III, Rec. G.161, ITU, Geneva, 1977.

[3] CCITT Recommendation *Echo suppressors*, Vol. III, Rec. G.164.

Recommendation M.670

MAINTENANCE OF A CIRCUIT FITTED WITH A COMPANDOR

1 In-station tests

The compandor should be tested at intervals determined by the Administration. The tests should be in accordance with the appropriate design information which should be made available in a suitable form to the repeater station staff.

2 Circuit tests

No special objective test of the circuit to check the operation of the compandor is recommended, but when the circuit is routine tested a speaking test should also be made.

The unaffected level of the circuit and the noise advantage should be checked in accordance with §§ 3 and 4 of Recommendation M.590, at intervals determined by the Administration.

3.3 Maintenance of demand assignment circuits

Recommendation M.675

LINING UP AND MAINTAINING INTERNATIONAL DEMAND ASSIGNMENT CIRCUITS (SPADE)

General

Section 3.3 refers to Figure 1/M.675 and describes the features of *demand assignment (DA) circuits*[1] established by means of single channel per carrier, PCM, multiple access demand assignment, equipment (SPADE) located in satellite earth stations.

Circuits thus provided are established between two international exchanges (CTs) on demand, with the constituent transmission paths making up the circuit being connected only for the duration of each demand. A transmission link is established between earth stations as required by the outgoing CT. The international DA circuit is formed via the distant earth station and its connection to the incoming CT by the terrestrial demand assignment section.

Upon release of this demand the transmission link establishing the demand assignment section is returned to a common pool allowing its reuse when required by other international exchanges operating in the demand assignment satellite network. Recommendation Q.48 [1] outlines the signalling system incorporated between demand assignment equipments located in satellite earth stations.

In general the Series M Recommendations concerned with preassigned international circuits apply equally to the sections of DA circuits. However, because of the variable nature concerning the establishment of circuits on demand, special consideration in provisioning, maintenance and fault finding is required. The following sections will provide details concerning these requirements.

[1] This type circuit may be considered to be equivalent to an international telephone circuit (preassigned) from a transmission point of view and is under study by Study Group XVI.

1 Initial line-up and maintenance of demand assignment circuits and their constituent parts

1.1 The demand assignment circuit may be seen as being divided into three parts for setting-up, lining-up and maintenance: the outgoing terrestrial demand assignment section, the satellite demand assignment section and the incoming terrestrial demand assignment section. It is considered that the overall limits in Recommendation M.580 will be met by the application of the line-up limits given in Table 1/M.675 for the individual DA sections. However, sectional requirements prevail if the limits of Recommendation M.580 are not met on overall measurements.

1.2 The maintenance schedule, Table 2/M.675, should be utilized in the development of an initial demand assignment capability with a given CT (for example, commissioning of a new SPADE terminal) and establishing the appropriate periodic tests.

1.3 When terrestrial DA sections are added or a new corresponding terminal comes into service, tests should be conducted in accordance with Table 2/M.675.

2 Demand assignment circuit control responsibilities and fault location procedures

2.1 In the assignment of maintenance responsibilities, recognition is given to the constitution of a DA circuit as outlined in § 1.1 above. Section control and sub-control stations will be nominated for each terrestrial DA section. The initiation of fault localization procedures for a faulty DA circuit will be the responsibility of the fault report point (circuit) receiving the report. Upon being notified, the control station initiates tests to determine the location of the fault. If the fault condition is located beyond the satellite DA section, the fault report point (circuit) associated with the distant terrestrial DA section will be notified of the condition and will assume control responsibility for further localization and clearance of the fault.

2.2 Faults should be investigated in a systematic manner, section by section. After verifying the report, e.g., by performance records or test calls, a recommended procedure for fault location is as follows:

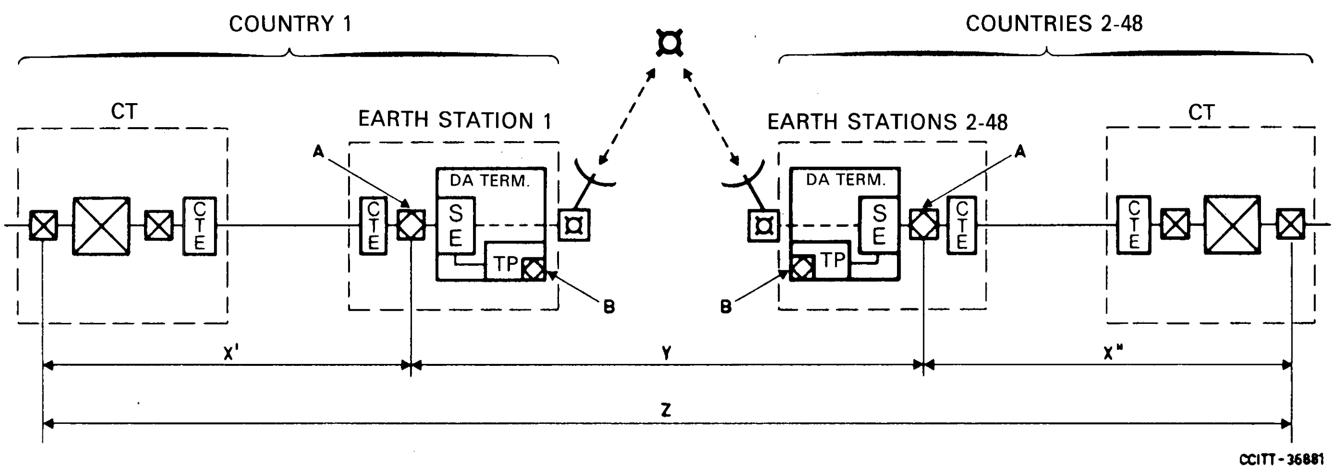
2.2.1 Establish a CT to one's own CT satellite loop circuit, utilizing the suspected outgoing terrestrial DA section.

2.2.2 Determine if this configuration is faulty. If this is not the case then the associated earth station should, as sub-control, be instructed to check the satellite DA section to the particular distant earth station involved. If this section is found to be performing satisfactorily then the fault report is passed to the fault report point (circuit) at the distant CT. The distant CT then assumes responsibility for fault localization and the originating fault report point (circuit) advises its associated network analysis point of the action taken.

2.2.3 If the satellite loop of § 2.2.1 above was found faulty, action should be taken by the control station and its associated DA terminal to localize the fault to the outgoing terrestrial DA section.

2.3 Full use should be made of the operational status indications available to the DA satellite section sub-control station to determine fault situations on the outgoing terrestrial DA section and on the incoming and outgoing satellite DA sections. The DA section sub-control station should advise the fault report point (circuit) or fault report point (network), as appropriate, at its associated CT, of any observations indicating fault situations and ensure that the control station is aware of the situation.

2.4 Administrations establishing international circuits utilizing satellite demand assignment links should be able to obtain statistical information concerning the outgoing call processing of their respective countries from the demand assignment system operating authority. The information is required by the network analysis points, in their continuing analysis of the quality of the international network.



Test access point

Earth station test access point

Channel translating equipment

Terminating equipment

Signalling equipment

CT	=	international exchange
DA TERM.	=	demand assignment terminal
TP	=	test trunk panel
A	=	access point 'A'
B	=	access point 'B'
X', X"	=	terrestrial demand assignment section
Y	=	satellite demand assignment section
Z	=	demand assignment circuit

FIGURE 1/M.675

Constitution of an international demand assignment circuit

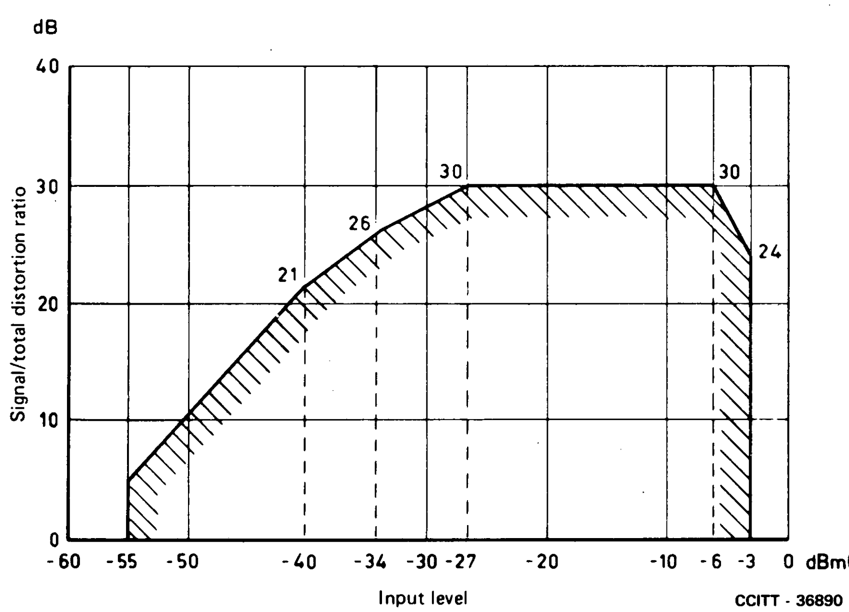


FIGURE 2/M.675

Signal/total distortion ratio as a function of input level utilizing a (provisional) **pseudo-random noise stimulus**

TABLE 1/M.675

Target objectives for setting up and lining up a demand assignment (SPADE) international public telephone circuit and its sections

Transmission parameters	Demand assignment circuit	Demand assignment section	
	Z CT to CT between circuit access points	Y Between SPADE terminals, demand assignment	X CT to SPADE terminal, terrestrial
1. Loss/frequency* relative to the loss at reference frequency (in dB)	(Series M Recommendations)		
300- 400 Hz	+3.5 to −1.0	+0.5 to −0.5	+1.7 to −0.5
400- 600 Hz	+2.0 to −1.0	+0.5 to −0.5	+0.9 to −0.5
600-2400 Hz	+1.0 to −1.0	+0.5 to −0.5	+0.5 to - 0.5
2400-3000 Hz	+2.0 to −1.0	+0.9 to −0.5	+0.9 to −0.5
3000-3400 Hz	+3.5 to −1.0	+1.8 to −0.5	+1.7 to −0.5
2. Overall loss at reference frequency Line-up level limits relative to nominal (in dB)	± 0.3	± 0.2	± 0.2
3. Idle Noise (−dBm0p)	Table 4/M.580 (See Note 3)	--60	Table 4/M.580
4. Quantizing distortion (signal/total distortion ratio in dB)	Not applicable	Figure 2/M.675 (See Note 1)	Not applicable
5. Signal crosstalk ratio (Go-return) (in dB)	43	60	48

* Reference frequency = 1020 Hz (see Note 2).

Notes to Table 1/M.675

1. Quantizing distortion should be measured in accordance with the test procedure agreed upon by the satellite system operators.
2. Test frequencies that are sub-harmonics of the PMC sampling rate should be avoided. (See Supplement No. 3.5 [2].)
3. Noise measurements should be made with the demand assignment codec voice detector enabled. This can be accomplished by utilizing a holding tone and notch filter or by conducting tests with the demand assignment equipment, in the pre-assigned mode.

TABLE 2/M.675

Testing and maintenance schedule

Tests	Demand assignment terminal access point	CT-Earth station X′, X″	From CT to own CT looped via satellite* Z	Earth station-earth station Y	Demand assignment terminal access point	CT-CT Z
		When tested				When tested
Comprehensive signalling and compatibility tests Q.163 [3] or equivalent	A and B (Note 1)	Initial system commissioning	—	—	—	—
Functional signalling test Q.163 [4] or equivalent	B (Note 1)	Initial line-up and periodic maintenance of section	Initial line-up and periodic maintenance of section	Initial system commissioning and new channel line-up (Notes 5 and 8)	B (Note 1)	(Note 7)
Measurement of loss and noise Rec. M.610	(Note 4)	Initial line-up and periodic maintenance of section	Initial line-up and periodic maintenance of section (Notes 2 and 3)	Initial system commissioning and new channel line-up (Notes 5 and 8)	A (Note 1)	(Notes 6 and 3)
Loss/frequency characteristics and crosstalk ratio Rec. M.610	(Note 4)	Initial line-up and periodic maintenance of section	Initial line-up and periodic maintenance of section (Notes 2 and 3)	Initial system commissioning and new channel line-up (Note 8)	A (Note 1)	(Notes 6 and 3)
Measurement of quantizing distortion	—	—	—	Initial system commissioning and new channel line-up (Note 8)	A (Note 1)	—
Spurious signal and channel intermodulation	—	—	—	Initial system commissioning and new channel line-up (Note 8)	A (Note 1)	—
Subjective tests Rec. M.610	B (Note 1)	Initial line-up and periodic maintenance of section	Initial line-up and periodic maintenance of section (Notes 2 and 3)	Initial system commissioning and new channel line-up (Notes 5 and 8)	B (Note 1)	(Notes 9 and 3)

* Simulated demand assignment circuit.

Notes to Table 2/M.675

1. *A* and *B* refer to the DA terminal testing interface. See Figure 1/M.675 for the location of these interfaces.
2. The outgoing CT must be capable of outpulsing its own country code and exchange digits.
3. Sectional requirements supersede if the overall requirements of Recommendation M.580 are not met.
4. *A* and/or *B* for line-up and *A* or *B* for periodic tests. (Reference measurements at initial line-up should include measurements made at the access point decided upon for periodic tests.)
5. Demand assignment system is assumed to operate internal diagnostics to check functional capability and continuity.
6. Loss, noise, loss/frequency and signal/crosstalk ratio tests may be applied on a sample basis when the system is initially commissioned, and as required for the extension of service.
7. Test calls may be carried out to verify operational capability initially, and as required.
8. These are as agreed upon by the satellite system operators.
9. Subjective testing CT-CT may be used on a sample basis, as required.

References

[1] CCITT Recommendation *Demand assignment signalling systems*, Vol. VI, Rec. Q.48.

[2] *Test frequencies on circuits routed over PCM systems*, Vol. IV, Supplement No. 3.5.

[3] CCITT Recommendation *Manual testing*, Green Book, Vol. VI-2, Rec. Q.163, § 4.3.4, parts 1 and 2, ITU, Geneva, 1973.

[4] Ibid., § 4.3.3.

3.4 Guiding principles for the maintenance of the international automatic service [1)]

The guiding principles for the maintenance of automatic telephone circuits deal with the division of responsibility for the maintenance of international automatic or semi-automatic telephone circuits between those concerned (operating services, transmission services, etc.). These principles which are intended to cover circuits and networks provided by wholly analogue systems, wholly digital systems, or a mixture of analogue and digital systems, are found in Recommendations M.700 to M.734. The maintenance organization for transmission systems and leased and special circuits is outlined in Recommendation M.70.

Recommendation M.700

DEFINITIONS FOR THE MAINTENANCE ORGANIZATION

1 point

a) To identify an element within a maintenance organization where specified functions are carried out. Examples of its use in this context are: fault report point-circuit, restoration control point, testing point-transmission.

b) To identify an electrical location in a circuit, group, digital path, etc., where access is required for testing purposes. Examples of its use in this context are: circuit access point, analogue link access point, digital path access point.

2 international line

Transmission system contained between the line access points (see § 2 of Recommendation M.565), of the two terminal international centres. Where a digital international centre is interfaced by primary (or higher order) digital paths, a *line access point* on a per circuit basis may not exist. In such cases, the international line is deemed to end at the *digital path access point* [2)] nearest to the international centre.

3 international automatic circuit

The whole of the international line and the outgoing and incoming equipment (or both-way equipments) proper to the automatic circuit considered. The ends of this circuit are defined by the *circuit access points* [3)] (see § 2 of Recommendation M.565).

4 automatic switching equipment

That part of an international exchange concerned with switching operations for routing the call in the desired direction.

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1) As is mentioned in Volumes IV and VI, the expression *automatic circuit*, except where otherwise indicated, means circuits which may be used either for semi-automatic or automatic operation.

2) For definition, refer to Recommendation M.110, § 1.6.

3) See also Figure 1/M.110 for an example of basic test access on various classes of circuits.

5 maintenance

The whole of the operations required for setting up and maintaining, within prescribed limits, any element entering into the setting-up of a connection. In international automatic service, maintenance is particularly concerned with circuits and automatic switching equipment. Circuit and automatic equipment maintenance includes:

a) carrying out setting-up measurements and adjustments[4];

b) planning and programming a maintenance scheme;

c) carrying out the prescribed routine preventive maintenance measurements and all other tests and measurements deemed necessary;

d) locating and clearing faults.

6 preventive maintenance

The maintenance carried out at predetermined intervals or according to prescribed criteria and intended to reduce the probability of failure or the degradation of the functioning of an item.

7 corrective maintenance

The maintenance carried out after fault recognition and intended to restore an item to a state in which it can perform a required function.

8 controlled maintenance[5]

A method to sustain a desired quality of service by the systematic application of analysis techniques using centralized supervisory facilities and/or sampling to minimize preventive maintenance and to reduce corrective maintenance.

9 international connection

Whole of the means joining temporarily two subscribers and enabling them to exchange information (see Recommendation G.101 [2]).

10 measurement

The numerical assessment in suitable units of the value of a simple or complex quantity or magnitude.

11 test

A direct practical trial in whatever manner it may be made.

12 yes or no test

A test made to indicate whether a quantity or magnitude would fall above or below a specified limit or boundary defined to distinguish pass and fail conditions.

13 functional test

A *yes or no* test made to indicate whether a circuit, equipment or part of an equipment will function or not function under actual working conditions.

14 limit test[6]

A test made to indicate whether a quantity would fall within or outside a pair of limits or boundaries.

The required degree of precision of expression is to be achieved by extending the term to state:

– on what the limit test is made, for example, *circuit limit test,*

– the function or characteristic that is tested, for example, *limit test of signalling,*

– for what purpose the limit test is intended, for example, *limit test for readjustment purposes.*

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4) The results of these measurements provide reference values for subsequent maintenance.

5) See [1] for a method of controlled maintenance procedure.

6) Such a test might be made to ascertain the margin of security in actual operating conditions.

15 localization of faults

The *broad localization* of a fault consists of finding the general part of the equipment in which it exists. *Fault finding* consists of determining the faulty item of the equipment.

References

[1] *Methods of quality control*, Green Book, Vol. IV, Supplement No. 1.4, ITU, Geneva, 1973.

[2] CCITT Recommendation *The transmission plan*, Vol. III, Rec. G.101.

Recommendation M.710

GENERAL MAINTENANCE ORGANIZATION[1)]FOR THE INTERNATIONAL AUTOMATIC AND SEMI-AUTOMATIC SERVICE

1 General

To ensure satisfactory service quality in the international automatic and semi-automatic telephone service, it is necessary to have an organization which can use the techniques recommended for achieving this. The organizational elements defined in § 2 below relate to the maintenance of the different component parts of the international automatic network and are intended to cover wholly analogue networks and networks provided by a mixture of analogue and digital systems (switching and transmission). Administrations are requested to apply these recommendations in order to obtain satisfactory service quality.

The organization for international network management is specified in Recommendation E.413 [1], but it has been recognized that many common points exist between maintenance and network management activities. Therefore, it must be noted that, although the general maintenance organization and the network management organization are separately specified, it is not intended that separate organizations be established unless so desired by Administrations.

2 Maintenance organization

2.1 *Basic elements and their functions*

Cooperation in the maintenance of the international automatic and semi-automatic service should be based on an organization which comprises all of the following basic elements in each country – each element representing a set of functions:

2.1.1 *Fault report point (circuit)*, which accepts and assigns for clearance all faults relating to one, or more, specifically identified circuits.

2.1.2 *Fault report point (network)*[2)], which accepts and assigns for clearance all faults that, when reported, are not identified with specific circuits or a specific international centre. This should include all switching difficulties.

2.1.3 *Testing point (transmission)*, which performs transmission testing on international circuits for lining-up purposes, on a routine basis, and in case of reported faults.

2.1.4 *Testing point (line signalling)*, which performs testing of line signalling on international circuits, employing channel associated signalling, for setting-up purposes, on a routine basis, and in case of reported faults.

Note – Testing line signalling is not relevant to Signalling System No. 6. Maintenance organization aspects of Signalling System No. 6 are dealt with in Recommendation M.762 while signalling tests are dealt with in Recommendation M.732.

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1) The phrase *general maintenance organization* does not necessarily relate to a specific organizational structure in any particular Administration.

2) The use of the word *network* in this and subsequent Recommendations, refers to the public telephone network. This does not restrict the combination of any element with other maintenance units which have functions dedicated to services not noted herein.

2.1.5 *Testing point (switching and interregister signalling)*, which performs testing of switching and interregister signalling on international equipment for setting-up purposes, on a routine basis, or in case of reported faults.

2.1.6 *Network analysis point*[3], which receives information on service quality, and faults not identified with specific circuits. It carries out the analysis of this information to investigate the problems involved. It acts as a single point of contact for general enquiries concerning the maintenance of the international telephone network.

2.1.7 *System availability information point*, which collects and disseminates information concerning the non-availability of telecommunications systems affecting the international automatic and semi-automatic service.

2.1.8 *Circuit control station*, which is responsible for the satisfactory operation of the international circuits that it controls.

2.1.9 *Circuit sub-control station*, which is responsible for the satisfactory operation of the international circuit sections that it controls. It will assist the circuit control station in its work to ensure the satisfactory operation of the entire circuit.

2.1.10 *Restoration control point*, which initiates and coordinates the restoration activities in case of failures or planned outages of transmission systems.

The detailed responsibilities and functions as well as the facilities needed for the elements in §§ 2.1.1-2.1.10 above are described in Recommendations M.715 to M.725.

2.2 *Grouping of basic elements*

It is left to the Administration concerned to decide whether to keep these elements separate or to combine them into one or more maintenance units to suit the particular situation in the country. However, the functions of an individual element should not be divided up between two or more maintenance units.

The elements in § 2.1 above should be grouped in the manner most suitable for a given Administration. The simplest form would combine all the elements into one maintenance unit capable of carrying out all the specified functions. Such an arrangement may be appropriate for those countries where international automatic circuits are few in number. For countries that support larger numbers of international automatic circuits, the functional grouping should be based on the following considerations:

a) the location of testing and measuring facilities;

b) the physical environment of the existing circuit, switching and other equipment;

c) the location of records of circuits, fault reports and service quality;

d) the location and availability of communication facilities;

e) the existence of comparable national functions which might be expanded to include international aspects;

f) the location of national system availability and traffic flow information which should be related to the international automatic network;

g) the level of coordination that is anticipated between elements within the Administration;

h) the staff workload that is anticipated for each element and the potential efficiencies involved in combining elements;

i) the anticipated ability to provide the necessary staff expertise and language facility where needed;

j) the arguments for and against centralization of a given element for an Administration;

k) the availability of supervisory and surveillance facilities at potential maintenance locations;

l) the existence of maintenance units for other services, e.g. leased circuits, having similar maintenance functions;

m) the expected growth in international automatic and semi-automatic services in the country concerned;

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3) The use of the word *network* in this and subsequent Recommendations, refers to the public telephone network. This does not restrict the combination of any element with other maintenance units which have functions dedicated to services not noted herein.

n) the expected evolution of the international network;

o) the maintenance requirements and maintenance organization for Signalling System No. 6.

Illustrative examples of possible groupings of maintenance elements are given in Annex A.

Note – The maintenance organization described in this Recommendation does not preclude the use of the terms: international transmission maintenance centre (ITMC), international switching maintenance centre (ISMC) and international service coordination centre (ISCC). Administrations have the freedom to give names to their maintenance units which suit their situation and requirements.

2.3 *Cooperation between maintenance elements*

2.3.1 *Cooperation between maintenance elements within an Administration*

Elements should normally be free to contact each other as required except for any restrictions placed on such contacts by the Administration itself for reasons of efficiency or organization. The information paths and interactions between elements will be influenced by any grouping of elements which an Administration may decide upon – see § 2.2 above.

2.3.2 *Cooperation between maintenance elements in different Administrations*

2.3.2.1 Maintenance elements should primarily communicate with their corresponding elements in other countries. Other channels of communication may also appear necessary or useful under certain circumstances. Figure 1/M.710 illustrates in a matrix, probable communication paths from an originating country to a distant country. It demonstrates the possibility of fault reports, for example, from a number of elements to the distant fault report point (circuit).

Originating country		*Distant country:* FRP (N)	NAP	SAIP	FRP (C)	TP (T)	TP (LS)	TP (SIS)	CSCS	CCS	RCP
Fault report point (network)	FRP (N)	X									
Network analysis point	NAP	0	X		0						
System availability information point	SAIP			X							0
Fault report point (circuit)	FRP (C)	0			X					0	
Testing point (transmission)	TP (T)				0	X				0	
Testing point (line signalling)	TP (LS)				0		X	0		0	
Testing point (switching and interregister signalling)	TP (SIS)				0		0	X		0	
Circuit control station	CCS				0	0	0	0	X		
Circuit sub-control station	CSCS				0					X	
Restoration control point	RCP			0							X

X – Primary intercommunication symbol is indicated for communication paths between corresponding elements. Note that the corresponding element for CCS is CSCS.

0 – This symbol represents other intercommunications that may be necessary or useful under certain circumstances.

FIGURE 1/M.710

An illustration of the matrix of probable communication paths between elements of the maintenance organizations of two countries

2.3.2.2 Each fault report received by a fault report point should be identified (to include the date and the hour if possible) for reference by all concerned during fault clearance and for informing the reporting element of the disposition of the faults. Fault reports should be accepted by any element performing tests with a distant maintenance element. The element which accepts the report should always forward it to its appropriate fault report point. The fault report point should give priority to receiving fault reports and initiating fault clearances over all other duties.

2.3.2.3 In addition to the requirements of technical and operational knowledge, the staff responsible for the functions listed in § 2.1 above should be selected and trained with a view to avoiding language difficulties.

The attention of Administrations is also drawn to the benefit that may be derived from enabling staff in the international service who work in corresponding units in different countries to meet and discuss their work.

3 Examples of cooperation between elements

The examples of cooperation indicated in Figures 2/M.710 and 3/M.710 show only simple cases of cooperation between elements.

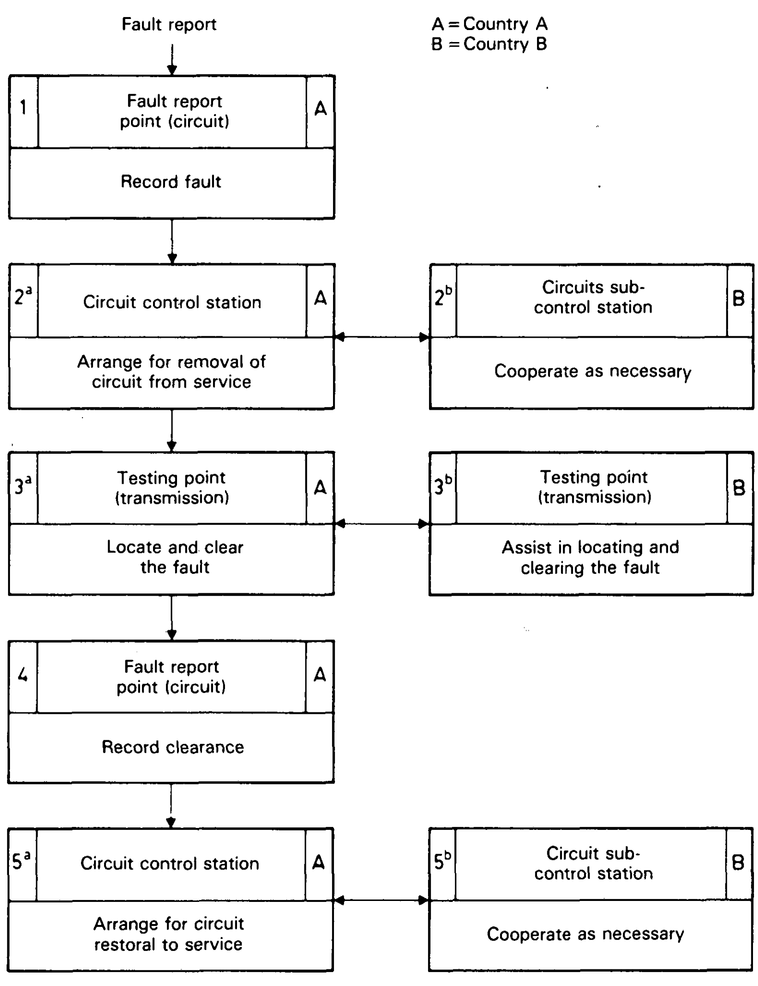

FIGURE 2/M.710

General procedure in acting upon the report of a circuit transmission fault

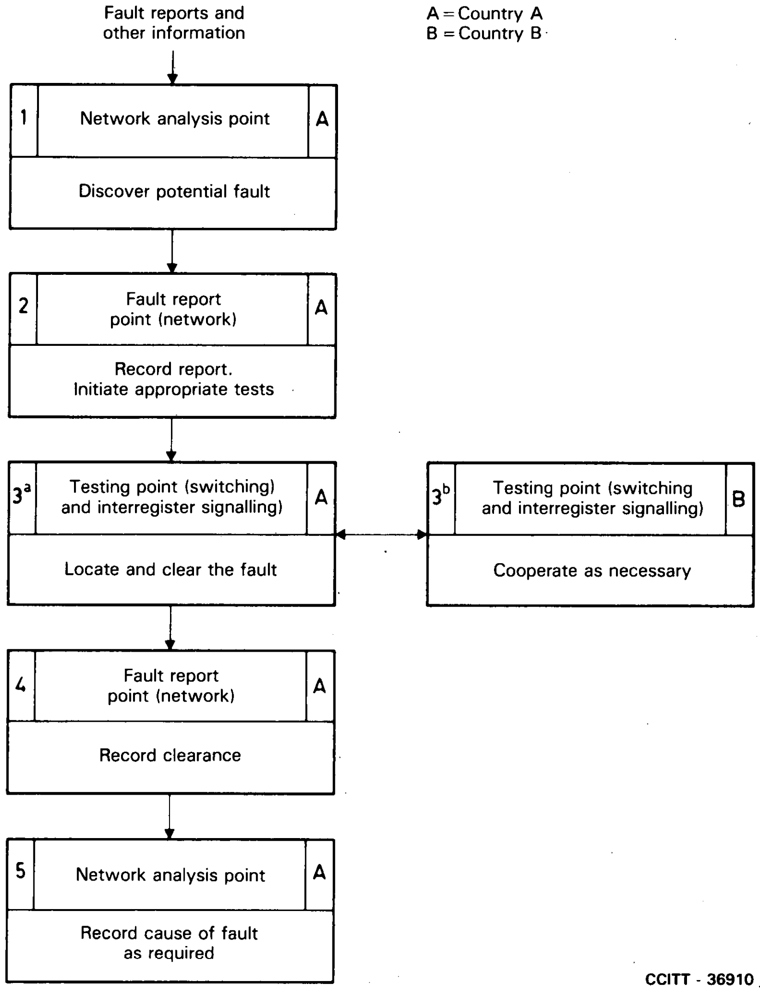

FIGURE 3/M.710

General procedure in acting upon indications of potential faults revealed by the network analysis point

4 Cooperation between maintenance elements and network management elements

Within an Administration, considerable benefits can be obtained from close cooperation and coordination between maintenance elements and network management elements[4]. In particular, close liaison between the fault report point (network) and the network management implementation and control point[4] should be ensured.

5 Exchange of contact point information

The most important benefit to be derived from defining the maintenance organization as consisting of a number of basic elements is to establish the means whereby those responsible for such elements may be contacted.

For efficient cooperation between maintenance elements in different countries, it is essential that Administrations frequently exchange appropriate contact point information (for example: telephone numbers, telex numbers, service hours, etc.). Reference should be made to Recommendation M.93.

[4] For definitions of these terms, refer to Recommendation E.413 [1].

ANNEX A

(to Recommendation M.710)

Illustrative groupings of elements into maintenance units

Note – Network management elements, as defined in Recommendation E.413 [1] may be combined with any of the illustrative maintenance units mentioned in §§ A.1 to A.3 below.

A.1 All maintenance functions performed by a single maintenance unit (see Figure A-1/M.710).

Testing point (transmission) Testing point (switching and interregister signalling) Testing point (line signalling) Fault report point (circuit) Circuit control and circuit sub-control	Network analysis point Fault report point (network) System availability information point Restoration control point

FIGURE A-1/M.710

A.2 All circuit and equipment testing facilities are at one location (maintenance unit A), while all network and system maintenance aspects are the responsibility of a separate unit (maintenance unit B) (see Figure A-2/M.710).

Maintenance unit A	Maintenance unit B
Testing point (transmission) Testing point (switching and interregister signalling) Testing point (line signalling) Fault report point (circuit) Circuit control and circuit sub-control	Network analysis point Fault report point (network) System availability information point Restoration control point

FIGURE A-2/M.710

A.3 All circuit matters are the responsibility of a single unit (maintenance unit A), while testing of switching and interregister signalling is performed by staff in the international exchange (maintenance unit B). A separate group of staff have responsibility for network analysis, network fault reports and service restoration (maintenance unit C). System availability functions for the international network are carried out at a location which has similar responsibilities for the national network (maintenance unit D) (see Figure A-3/M.710).

Maintenance unit A	Maintenance unit B
Fault report point (circuit) Circuit control and circuit sub-control Testing point (line signalling) Testing point (transmission)	Testing point (switching and interregister signalling)

Maintenance unit C	Maintenance unit D
Fault report point (network) Network analysis point Restoration control point	System availability information point [a)]

a) Where similar national functions are fulfilled.

FIGURE A-3/M.710

Reference

[1] CCITT Recommendation *International network maintenance/organization*, Vol. II, Rec. E.413.

Recommendation M.715

FAULT REPORT POINT (CIRCUIT)

1 Definition of fault report point (circuit)

The fault report point (circuit) is an element within the general maintenance organization for the international automatic and semi-automatic service at each international centre or common for more than one international centre.

The fault report point (circuit) is equipped with all the necessary facilities and arranged in such a way that it may receive fault reports relating to one or more specifically identified circuits from different sources or make such fault reports to other points and initiate the fault localization and clearing operations.

The fault report point (circuit) will undertake its given responsibilities and functions for circuits provided by wholly analogue transmission and switching systems, and those provided by a mixture of analogue and digital systems.

2 Responsibilities and functions

The fault report point (circuit) is responsible for the following set of functions:

2.1 Receiving fault reports from:

- similar fault report points of other Administrations;
- fault report point (network);
- fault indication functions in repeater stations and the various testing points (e.g. transmission, line signalling, switching and interregister signalling). This can be done manually by the staff, or automatically by automatic supervision functions built into the switching and/or transmission system.

2.2 Recording the fault reports and keeping fault records up to date.

2.3 Performing preliminary diagnosis to determine to which maintenance unit the fault has to be assigned for clearance.

2.4 Initiating detailed fault location and subsequent clearing.

2.5 Sending fault reports as appropriate to:

- circuit control station in its own country in case of controlling end;
- the distant end fault report point (circuit) in case of noncontrolling end;
- the fault report point (network).

2.6 Providing the information and cooperation needed to deal with inquiries by traffic and maintenance staff or by the fault report point (circuit) at the distant end.

2.7 Advising the fault report point (network), the network analysis point, the system availability information point and the network management (implementation and control point)[1] of faults affecting the automatic service as required.

2.8 Requesting the circuit control station within its own country, if controlling end, to arrange for the withdrawal from service of circuits reported faulty.

2.9 Keeping informed of the progress of fault clearance.

2.10 Receiving the information about the cause of the faults.

2.11 Notifying details of fault clearance to the point of origin of a fault report when the fault has been cleared.

2.12 Requesting the circuit control station to arrange for the return of the circuit of service, if controlling end.

2.13 Making or arranging for an analysis of faults as may be necessary.

2.14 Identifying repeated faults and advising the circuit control station.

2.15 Forwarding details of faults found or faults the causes of which could not be found to the network analysis point for analysis to detect long-term trends.

3 Facilities

The fault report point (circuit) should be provided with the following facilities:

3.1 *Service circuits*

Access to various kinds of service circuits, e.g.:

- direct telephone service circuits to relevant contact points within its Administration or to other Administrations in the home country, or in other countries;
- teleprinter circuits;
- telex, teletex, telefax, etc.

3.2 Access to information concerning circuits in service, for instance, by means of data terminals.

3.3 Access to information from the internal and, where provided, external supervisory functions of stored-program control (SPC) exchanges and/or transmission systems, for instance, by means of data terminals.

3.4 Access to manual maintenance access lines as described in Recommendation O.11 [2].

References

[1] CCITT Recommendation *International network maintenance/organization*, Vol. II, Rec. E.413.

[2] CCITT Recommendation *Specifications for manual maintenance lines*, Vol. IV, Rec. O.11.

[1] See Recommendation E.413 [1].

FAULT REPORT POINT (NETWORK)

1 Definition of fault report point (network)

The fault report point (network) is an element within the general maintenance organization for the international automatic and semi-automatic service at each international centre or for more than one international centre. If more than one international centre is associated with a given relation, it is desirable to designate one fault report point (network) as the principal one for that relation. If such is not practical, one of the fault report points (network) or a central organization may be nominated to coordinate the activities of the various fault report points (network) that are involved.

Such arrangements provide the maintenance organizations of other Administrations with a single point of contact for directing fault reports and service problems which involve more than one international centre.

While the fault report point (network) is essentially a maintenance element, it will in fact receive reports of network difficulties which may result in network management actions. In other cases, network fault reports may be explained by information already available to the network management (implementation and control point) and collected as a result of its network surveillance responsibility. Therefore, to avoid duplication of report points, considerable benefit is derived from close liaison between the fault report point (network), and the network management (implementation and control point) [1].

The fault report point (network) is equipped with all the necessary facilities and arranged in such a way as to enable it to:

a) receive, from different sources, fault reports of difficulties on the international telephone network or of problems with the international service that, at the time of reporting, cannot be related to specific circuits or, in some cases, even to a specific international centre; and

b) make such fault reports to other points and initiate the fault location and clearing operations.

2 Responsibilities and functions

The fault report point (network) is responsible for the following set of functions:

2.1 Receiving fault reports from:

- similar fault report points of other Administrations;
- traffic operating personnel;
- customers via the appropriate customer service points;
- service observation staff;
- accounting (charging) analysis service;
- staff at the network analysis point;
- various maintenance centres including information regarding the quantities of equipment or circuits available following a major breakdown;
- services concerned with the national network of the country;
- any other source.

2.2 Recording the fault reports and keeping fault records up to date.

1) See Recommendation E.413 [1].

2.3 Performing preliminary diagnosis to determine to which maintenance unit the fault has to be assigned for clearance.

2.4 Initiating detailed fault location and subsequent clearing.

2.5 Sending fault reports as appropriate to similar fault report points of other Administrations.

2.6 Providing the information and cooperation needed to deal with inquiries by traffic and maintenance staff or by fault report points of another Administration.

2.7 Advising the network analysis point, the system availability information point and the network management (implementation and control) point[2)] of faults affecting the automatic service.

2.8 Arranging where appropriate for the withdrawal from service of faulty equipment and restoral after clearance.

2.9 Keeping informed of the progress of fault clearance.

2.10 Receiving the information about the cause of the faults.

2.11 Notifying details of fault clearance to the point of origin of a fault report when the fault has been cleared.

2.12 Keeping general routing information, diagrams or plans of the arteries relevant to the international network and the national network of the country concerned up to date.

2.13 Making an analysis of faults as may be necessary.

2.14 Identifying repeated faults, and advising the circuit control station.

2.15 Forwarding details of faults found or faults the cause of which could not be detected to the network analysis point for analysis to detect long-term trends.

2.16 Advising all fault report points (network) that may be concerned with changes in the numbering plan of its country together with actions taken to deal with calls to old numbers.

3 Facilities

The fault report point (network) should be provided with the following facilities:

3.1 *Service circuits*

Access to various kinds of service circuits, e.g.:

- direct telephone service circuits to relevant contact points within its Administration or to other Administrations in the home country or in other countries;
- teleprinter circuits;
- telex, teletex, telefacsimile, etc.

3.2 Access to appropriate network information, e.g. number of circuits in service, routing plans, network configuration.

3.3 Access to information from relevant supervisory functions of stored-program controlled (SPC) exchanges and/or transmission systems, for instance, by means of data terminals.

Reference

[1] CCITT Recommendation *International network maintenance/organization* Vol. II, Rec. E.413.

2) See Recommendation E.413 [1].

TESTING POINT (TRANSMISSION)

1 Definition of testing point (transmission)

The testing point (transmission) is an element within the general maintenance organization for the international automatic and semi-automatic service at each international centre. It carries out transmission testing on international circuits whether provided by wholly analogue transmission and switching systems or by a mixture of analogue and digital systems.

2 Responsibilities and functions

The testing point (transmission) is responsible for the following set of functions:

2.1 Carrying out transmission measurements in connection with the setting-up and lining-up of international circuits.

2.2 Carrying out routine transmission tests.

2.3 Diagnostic testing on receipt of fault indications.

2.4 Passing details of the location of faults to the appropriate maintenance unit and cooperating as necessary in detailed fault localization.

2.5 Advising the circuit control or the sub-control station and the fault report point (circuit) of any difficulties detected by routine tests and the action taken in progressing the clearance of faults.

2.6 Cooperating with staff in other international centres as required.

3 Facilities

The testing point (transmission) should be provided with the following facilities:

3.1 Access to the circuit access point (for definition of these access points, refer to § 2 of Recommendation M.565).

3.2 Access to the line access point (for definition of these access points, refer to § 2 of Recommendation M.565) [1].

3.3 Test equipment for lining-up, fault localization and routine testing of the following type of circuits:

- analogue;
- mixed analogue/digital;
- digital.

Note 1 – For definition of the circuits, see Recommendation M.560.

Note 2 – Routine tests can be omitted if the supervision functions built into the transmission and switching equipment provide sufficient indication of the overall performance.

3.4 Association of test equipment to the access points so that all transmission parameters specified for the circuits concerned may be measured.

3.5 Communication to the circuit control station and other points concerned with circuit maintenance within the same international centre.

3.6 Communication to similar points in other international centres to which circuits are routed to enable cooperation to be obtained and given.

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[1] In practice, at digital exchanges, a line access point at circuit level may not exist when the exchange is interfaced by primary (or higher order) digital paths.
For digital circuits, reference should be made to Recommendation M.565.

TESTING POINT (LINE SIGNALLING)

1 Definition of testing point (line signalling)

The testing point (line signalling) is an element within the general maintenance organization for the international automatic and semi-automatic service at each international centre. It carries out line signalling tests on international circuits using channel-associated signalling systems, e.g. R2, No. 5, whether provided by wholly analogue transmission and switching systems or by a mixture of analogue and digital systems [1].

2 Responsibilities and functions

The testing point (line signalling) is responsible for the following set of functions:

2.1 Carrying out line signalling tests in connection with the setting-up and lining-up of international circuits.

2.2 Carrying out routine line signalling tests.

2.3 Carrying out diagnostic tests to localize a reported difficulty in line signalling.

2.4 Passing details of line signalling problems to the appropriate maintenance unit as necessary and cooperating in detailed fault localization.

2.5 Reporting details to the circuit control station, the fault report point (circuit) or the originating fault report point as appropriate of action taken.

2.6 Cooperating with staff in other international centres as required.

3 Facilities

The testing point (line signalling) should be provided with the following facilities:

3.1 Access to the circuit access point (for definition of these access points, refer to § 2 of Recommendation M.565).

3.2 Access to the line access point (for definition of these access points, refer to § 2 of Recommendation M.565).

The line access point can be deleted for circuits with simple terminals. Digital circuits are not provided with line access points.

3.3 Association of test equipment to the access points to assess the performance of the line signalling entities.

3.4 Access to information from the internal and, where provided, external supervisory and testing functions of SPC exchanges, for instance, by means of data terminals.

3.5 Communication with other points concerned with circuit maintenance and signalling equipment maintenance within the same international centre.

3.6 Communication with similar points in other international centres to which circuits are routed to enable cooperation to be obtained and given.

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[1] In practice, at digital international exchanges, a line access point at the circuit level may not exist when the exchange is interfaced by primary (or higher order) digital paths. Thus, all signalling testing may need to be carried out from one location – generally the testing point (switching and interregister signalling). Signalling tests on Signalling System No. 6 are controlled and coordinated by the administrative control (see Recommendation M.762).

3.7 Access to manual maintenance access lines as described in Recommendation O.11 [1].

3.8 Access to information from automatic transmission measuring and signalling testing equipment (ATME No. 2) as described in Recommendation O.22 [2].

References

[1] CCITT Recommendation *Specification for manual maintenance lines*, Vol. IV, Rec. O.11.

[2] CCITT Recommendation *Specification for the CCITT automatic transmission measuring and signalling testing equipment ATME No. 2*, Vol. IV, Rec. O.22.

Recommendation M.719

TESTING POINT (SWITCHING AND INTERREGISTER SIGNALLING)

1 Definition of testing point (switching and interregister signalling)

The testing point (switching and interregister signalling) is an element within the general maintenance organization for the international automatic and semi-automatic service at each international centre. It carries out tests concerned with switching and interregister signalling functions associated with international circuits, whether provided by wholly analogue transmission and switching systems or by a mixture of analogue and digital systems [1)].

Administrations may organize testing of equipment and functions for common channel signalling systems either at the testing point or at a separate point. Attention is drawn to Recommendation M.762 regarding common channel signalling system maintenance.

2 Responsibilities and functions

The testing point (switching and interregister signalling) is responsible for the following set of functions:

2.1 Carrying out switching and interregister signalling tests in connection with the setting-up and lining-up of international circuits.

2.2 Taking any necessary action as a result of outputs from supervisory and testing functions of SPC exchanges.

2.3 Ensuring that new circuits can be accessed via the switching equipment, and that auxiliary equipment (e.g. accounting equipment, ATME) is correctly associated.

2.4 Carrying out routine tests of the switching and interregister signalling entities.

2.5 Diagnostic testing to confirm existence and location of switching and interregister signalling problems indicated by monitorial equipment or fault reports.

2.6 Passing details of the locations of faults to the appropriate maintenance units for clearance and cooperating with them as necessary.

2.7 Advising the fault report point (network) and the network management (implementation and control point) [2)] of any problems which may affect service on a route or routes and the action taken.

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1) In practice, at digital international exchanges, a line access point at circuit level may not exist when the exchange is interfaced by primary (or higher order) digital paths. Thus, all signalling testing may need to be carried out from one location, generally the testing point (switching and interregister signalling). This would include line signalling aspects, if any.

2) See Recommendation E.413 [1].

2.8 Advising the circuit control station of any difficulties detected by routine tests or monitorial means which affect individual circuits.

2.9 Cooperating with staff in other international centres as required.

3 Facilities

The testing point (switching and interregister signalling) should be provided with the following facilities:

3.1 Ability to test common equipment elements for performance and/or availability.

3.2 Access to information from internal or external supervisory testing functions of SPC exchanges.

3.3 Means for assessing switching capability and interregister signalling in accordance with Annex A.

3.4 Communication with other maintnenance entities as appropriate.

3.5 Access to manual maintenance access lines as described in Recommendation O.11 [2].

3.6 For common channel signalling systems, access to information on signalling link status and signalling routing, and from signalling performance monitoring equipment.

ANNEX A

(to Recommendation M.719)

Measuring and testing equipment (signalling and switching)

The basic types of equipment needed by a testing point (switching and interregister signalling) are as follows:

1) equipment for signalling tests;
2) equipment for switching tests;
3) signalling encoders consisting of a signal generator with facilities to vary frequency, amplitude and timing within defined limits, in conjunction with a test call generator, so that test calls using nominal or marginal signals can be generated;
4) signal decoders, i.e. a device capable of responding to incoming signals such as to indicate whether or not the received signals are within limits;
5) signal displays, i.e. a device capable of displaying the signals, line or register, transmitted or received by a circuit. The display should preferably be in digital form;
6) signal timers, i.e. a device capable of measuring the length of signals and the interval between signals (line and register) transmitted or received over a circuit;
7) signal level measuring device;
8) signal distortion measuring device;
9) signal recording device, for permanent records of line and register signals.

Further details of equipment for testing switching and interregister signalling are given in the relevant Recommendations on the different signalling systems.

References

[1] CCITT Recommendation *International network maintenance/organization*, Vol. II, Rec. E.413.

[2] CCITT Recommendation *Specification for manual maintenance lines*, Vol. IV, Rec. O.11.

NETWORK ANALYSIS POINT

1 Definition of network analysis point

The network analysis point is an element within the general maintenance organization for the international automatic and semi-automatic service associated with one or more international centres.

It receives information concerning service quality and faults not associated with specific circuits. It analyses all relevant information to investigate the problems involved. It may request the fault report point (network) to initiate investigatory and/or remedial actions in one or more maintenance centres in the home country or via a fault report point (network) in another country.

The network analysis point acts as a single point of contact for general enquiries concerning the day-to-day maintenance of the international telephone network, as may be made by the maintenance organizations of other Administrations.

2 Responsibilities and functions

The network analysis point is responsible for the following set of functions:

2.1 Analysing all fault reports received from the fault report point (network).

2.2 Collecting and analysing all information necessary for the evaluation and supervision of the quality of the international service and the diagnosis and localization of faults reported to it. The following items are recommended for consideration:

a) Call failure information derived from operator and subscriber reports.
b) Traffic service observations for preparation of Tables 1/E.422 [1] and 1/E.423 [2].
c) Traffic service observations undertaken for specific purposes.
d) Results of manual and automatic test calls.
e) Reports from fault report points (network) of other Administrations and also from maintenance units of its own Administration.
f) Summarized information from group reference pilots.
g) Information from automatic supervision of switching equipment.
h) Information that all circuits on a route are busy.
i) Summarized information from traffic monitoring and accounting equipment.
j) Information derived from circuit and circuit group surveillance equipment.
k) Periodic data from traffic measuring equipment, e.g. loading in erlangs, percentage occupancy and overflow intensities.

2.3 Analysing summaries of transmission measurements that may be received from maintenance units of its own Administration.

2.4 Receiving information concerning major breakdowns affecting international service and evaluating their effect with respect to network condition.

2.5 Receiving reports of all events likely to affect the international service.

2.6 Analysing out-of-service times and cooperating with the maintenance units in their efforts to reduce such times to a minimum.

2.7 Making optimum use of statistical methods (e.g. trouble pattern techniques) for determining the probable location of failure points.

2.8 Cooperation with the network analysis points of other countries in order to coodinate action in case of service defects existing in the part of the network depending on those points.

2.9 Employing information concerning routing, signalling, switching, and transmission systems in its country and other countries to help locate and clear impediments to good service.

2.10 Advising the fault report point (network) of the results of its analyses as necessary.

2.11 Receiving general enquiries concerning the maintenance of the international telephone network from other Administrations, and answering such enquiries or undertaking any necessary analyses or investigations.

3 Facilities

The network analysis point should be provided with the following facilities:

3.1 Appropriate communication facilities in order to assume its responsibilities.

3.2 Access to information from the internal and, where provided, external supervisory and statistical functions of SPC-exchanges, for instance, by means of data terminals.

3.3 Means to receive and process information associated with the functions listed above.

3.4 Means of storing received and processed information.

3.5 Means of accessing stored information.

References

[1] CCITT Recommendation *Observations on international outgoing telephone calls for quality of service*, Vol. II, Table 1/E.422 of Rec. E.422.

[2] CCITT Recommendatiion *Observations on traffic set up by operators*, Vol. II, Table 1/E.423 of Rec. E.423.

Recommendation M.721

SYSTEM AVAILABILITY INFORMATION POINT

1 Definition of system availability information point

The system availability information point is an element within the general maintenance organization for the international automatic and semi-automatic service associated with one or more international centres. It collects and disseminates information concerning the non-availability of telecommunications systems which affects the international service. The term availability is used here in the broadest sense of the word.

2 Responsibilities and functions

The system availability information point is responsible for the following set of functions:

2.1 Collecting information concerning major breakdowns, planned outages, or other special circumstances in the *national* and *international* networks which would materially affect international traffic whether incoming, outgoing or transit.

2.2 Keeping aware of the probable duration of major breakdowns and noting whether the relevant traffic load is such that service is likely to be affected.

2.3 Keeping close contact with the restoration control point(s) and assisting in restoration matters.

2.4 Collecting information concerning the status of restoration activities related to major failures, and the return to normal conditions.

2.5 Making available information concerning failures and restoration progress to interested parties and other centres not directly involved in the activities, as appropriate.

2.6 Furnishing reports to the operating authorities of abnormal conditions, as required, including progress reports in connection with prolonged disruptions.

2.7 Furnishing major breakdown information to network management or traffic operating personnel when a major breakdown occurs, so that suitable changes may be made in operating procedures.

2.8 Notifying other international centres as required, through the approriate authorities, of actions taken in connection with major breakdowns.

2.9 Continuously observing system conditions and if a situation arises where service disturbances can be minimized with a change in normal procedures, advising the appropriate maintenance unit (e.g. concerning postponement of a planned outage).

3 Facilities

The system availability information point should be provided with the following facilities:

3.1 Appropriate communication facilities in order to assume its responsibilities.

3.2 Means to receive, store, have access to, and up-date system availability information.

3.3 Access to information concerning the availability of equipment and routes in SPC exchanges, for instance, by means of data terminals.

Recommendation M.722

NETWORK MANAGEMENT POINT

Note – Recommendation M.722 of the CCITT Yellow Book, Fascicle IV.1 contains the definition, functions and responsibilities of a so-called, "network management point".

The organization for international network management has now been further developed and is specified in Recommendation E.413 [1].

Reference

[1] CCITT Recommendation *International network maintenance/organization*, Vol. II, Rec. E.413.

Recommendation M.723

CIRCUIT CONTROL STATION

1 Definition of circuit control station

The circuit control station is the point within the general maintenance organization for the international automatic and semi-automatic service that fulfils the control responsibilities for the automatic circuits assigned to it.

The responsibilities, functions and criteria for appointing circuit control stations given in §§ 2 to 4 below apply to circuits provided solely by analogue transmission and switching systems and those involving a mixture of analogue and digital systems.

2 Responsibilities

The circuit control station is responsible for ensuring that an automatic circuit assigned to it is set up and maintained to the required standards in both directions of transmission and that, if the circuit fails, the outage time is kept to a minimum.

3 Functions

3.1 Arranging for the setting-up of the circuit, and of the signalling and switching equipment associated directly with the circuit, and the related adjustment.

3.2 Controlling lining-up measurements to within the recommended limits.

3.3 Ensuring that routine maintenance measurements and tests are carried out in accordance with the agreed schedule using the specified methods and in such a way that interruptions to service are limited to the shortest possible duration.

3.4 Requesting that the circuit sub-control station takes action as required.

3.5 Arranging for the blocking of circuits as required.

3.6 Ensuring that fault location and clearing is carried out by the responsible testing point and/or maintenance unit in a proper manner.

3.7 Initiating investigation of repeated circuit faults.

3.8 Controlling the withdrawal of circuits from service.

3.9 Controlling the return of circuits to service, after the fault clearance.

3.10 Being continuously informed of the condition of the automatic circuits under its control.

3.11 Keeping up to date records of the routing of the automatic circuits under its control.

3.12 Knowing what are the possibilities of rerouting any faulty circuits and making arrangements for such reroutings where necessary.

4 Appointment of circuit control stations

A circuit control station is appointed for each international circuit used for the automatic and semi-automatic telephone service. When the circuit is operated unidirectionally the circuit control station is generally at the outgoing end. When the circuit is operated both-way, the circuit control station can be at either end by common agreement between the technical services of the Administrations concerned. In making the choice, special consideration will be given to:

- whether the location to be nominated as the circuit control station is permanently attended,
- the amount of work at each terminal point,
- the length of the circuit within the territory of each terminal country.

Recommendation M.724

CIRCUIT SUB-CONTROL STATION

1 Definition of circuit sub-control station

The circuit sub-control station is a point within the general maintenance organization for the international automatic and semi-automatic service that assists the circuit control station and fulfils the control responsibilities for a circuit section assigned to it.

The responsibilities, functions and criteria for appointing circuit sub-control stations given in §§ 2 to 4 below apply to circuits provided solely by analogue transmission and switching systems and those involving a mixture of analogue and digital systems.

2 Responsibilities

It is the responsibility of the circuit sub-control station to inform the circuit control station about all noted events likely to affect the circuit under their control. If the circuit sections are assigned to the circuit sub-control for the purpose of controlling them, the circuit sub-control is responsible for these circuit sections in the same way as the circuit control station is for the complete circuit.

3 Functions

3.1 Performing the control functions for circuit sections, especially national sections, as given for the circuit control station.

3.2 Cooperating with the circuit control station and other circuit sub-control stations in ensuring that routine maintenance fault location and clearance are carried out by the responsible testing points and/or maintenance units in a proper manner.

3.3 Arranging that all relevant details concerning the location and subsequent clearance of faults are reported to the fault report point (circuit) at the controlling end.

4 Appointment of circuit sub-control stations

For each circuit used for the automatic and semi-automatic telephone service a terminal circuit sub-control station is appointed. This is generally the end of the circuit remote from the circuit control station. In transit countries in which a circuit is brought to audio frequencies, an intermediate circuit sub-control station is appointed at a suitable point for each direction of transmission. It is left to the Administration concerned to choose:

- where this point shall be,
- whether the sub-control functions for the two directions of transmission are vested in one station or two stations,
- whether, as may be desirable in the case of a large country, each direction of transmission has more than one circuit sub-control station per transit country.

The technical service of the Administration concerned indicates its choice to the technical service of the Administration responsible for the control station.

Recommendation M.725

RESTORATION CONTROL POINT

1 Definition of restoration control point (RCP)

The restoration control point (RCP) is an element within the general maintenance organization for the international services. It initiates and coordinates service restoration activities in case of failures or planned outages of transmission systems in accordance with plans and *ad hoc* arrangements agreed by the technical services[1] of the Administrations concerned.

Since two or more RCPs are involved in agreed restoration plans, it is practical to nominate one RCP as the Overall RCP which then initiates and controls implementation of the plan. The additional responsibilities and functions of an Overall RCP are given in § 3 below.

2 Responsibilities and functions

The restoration control point (RCP) is responsible for the following set of functions:

2.1 Initiating the implementation of a restoration plan and *ad hoc* arrangements with the other stations involved within its Administration's boundaries.

2.2 Monitoring the implementation of the restoration plan.

2.3 Coordinating the restoration activities of the repeater stations and other stations involved within its Administration's boundaries.

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[1] Generally, Administrations involved in agreeing such restoration plans or *ad hoc* arrangements have appointed restoration liaison officers (RLO) who are responsible for liaising or restoration matters. However, some Administrations may wish to delegate the responsibility for the agreement of *ad hoc* arrangements to their RCPs.

2.4 Liaising with restoration control points of other Administrations as necessary and agreeing the times of events with them.

2.5 Exchanging information with the network management (implementation and control point)[2] for coordination purposes as appropriate.

2.6 Monitoring and coordinating the return to normal service conditions after the fault has been cleared or the planned work has been finished.

2.7 Keeping, throughout the period during which the restoration and the return to normal conditions is executed, an accurate log of events, including any circuit, channel, group, supergroup, etc., or baseband patching which takes place.

2.8 Requesting and receiving reports from other RCPs and disseminating this information within its own Administration as required.

2.9 Reporting the events to the responsible authorities[3] of its Administration as desired and advising the system availability information point about the progress of restoration.

2.10 Sending a final restoration report, after the return to normal, containing all relevant data (including agreed times) for accounting purposes to the responsible authorities[3] within its Administration.

2.11 If no restoration plan exists or, for some reason, an existing plan cannot be implemented, advising the responsible authorities[3] in its own Administration and suggesting suitable *ad hoc* arrangements in the light of the information available.

3 Additional responsibilities of an overall RCP

The responsibilities of an overall RCP are much the same as an ordinary RCP but with additional responsibilities as follows:

3.1 Initiating the implementation of a restoration plan with other RCPs concerned.

3.2 Requesting and receiving reports from other RCPs and disseminating this information as necessary.

3.3 Coordinating and controlling all restoration activities including the return to normal conditions.

4 Facilities

The restoration control point should be provided with the following facilities:

4.1 Appropriate communication facilities in order to assume its responsibilities.

4.2 Access to information appropriate to its functions and this includes:

a) status of relevant international transmission systems;

b) current restoration plans;

c) list of the sections of border-crossing transmission traffic routes;

d) routing information for international group, supergroup, etc., links;

e) inventory of spare transmission facilities, in its own and neighbouring countries, lending themselves to restoration.

Reference

[1] CCITT Recommendation *International network maintenance organization*, Vol. II, Rec. E.413.

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2) See Recommendation E.413 [1].

3) Generally, Administrations involved in agreeing such restoration plans or *ad hoc* arrangements have appointed restoration liaison officers (RLO) who are responsible for liaising or restoration matters. However, some Administrations may wish to delegate the responsibility for the agreement of *ad hoc* arrangements to their RCPs.

Recommendation M.726

MAINTENANCE ORGANIZATION FOR THE WHOLLY DIGITAL INTERNATIONAL AUTOMATIC AND SEMI-AUTOMATIC TELEPHONE SERVICE

The recommended maintenance organization for a wholly digital international telephone service is under study by Study Group IV. The detailed development of such an organization cannot be undertaken until such time as Administrations have gained sufficient experience of the operation and maintenance of digital transmission and switching systems – these systems being relatively few in number in the international network at present. However, based on present knowledge and experience, Study Group IV intends that the maintenance organization for the fully digital international telephone service be based on the following principles and concepts:

- That there be a gradual evolution of the current maintenance organization (which is intended to cover the wholly analogue and mixed analogue/digital situations) towards the organization suitable for the wholly digital network. The rate of this evolution will reflect the rate of introduction of digital systems in the international and national networks.

  According to this principle, it is recognized that, in the transition from a wholly analogue to a wholly digital network, the maintenance organization of a particular international centre may be responsible for wholly analogue, wholly digital and mixed analogue/digital circuits since the three types may be terminated at a single international centre.

- That the "element" approach to defining a maintenance organization, as currently used in Recommendations M.710 to M.725, be used to define future maintenance organizations.

  By the intended adoption of this concept it is recognized that the maintenance element approach offers the means of specifying a maintenance organization which can meet the needs of all Administrations, irrespective of the number of international circuits and international switching centres they operate.

In accordance with the current Study Group IV practice, significant national trends in the area of maintenance organization (for example, the trend towards increased centralization of maintenance) should be reflected in the Series M Recommendations where appropriate.

Recommendation M.729

ORGANIZATION OF THE MAINTENANCE OF INTERNATIONAL PUBLIC SWITCHED TELEPHONE CIRCUITS USED FOR DATA TRANSMISSION

1 General

1.1 Data transmissions may be made over the public switched telephone network in a manner similar to voice transmissions. Such data calls, while expected in most cases to be satisfactory, cannot always be assured success in view of the variety of routing and transmission characteristics that may be found in national extensions between international switching centers and user stations.

1.2 As the exact configuration of an international call is essentially impossible to determine without an extensive and complicated tracing process, some means must be specified to enable each Administration to investigate, as it considers necessary, reports of data transmission difficulties.

2 Fault investigations and maintenance

2.1 Each country agreeing to the transmission of data over the public switched telephone network shall set up a Data Coordinating Point (DCP)[1]. This point:

- shall be the contact point between Administrations for referring data transmission difficulties for investigation in respective national networks;
- shall be the point to undertake discussions and agree on a course of action to be taken on public telephone network circuits regarding data transmission difficulties. It should be noted that agreement may be reached to take no actions regarding the international circuits;
- shall initiate any actions related to national network extensions in accordance with its national practices and procedures.

2.2 Fault investigations undertaken should be on the basis of the transmission requirements of public telephone calls. Such investigations, while possibly initiated by a DCP, will be carried out by the maintenance organization (Recommendation M.710) according to standards defined by Recommendation M.580, etc.

2.3 Transmission tests *(fault location or scheduled routine measurements)* between subscriber locations, that is, on an end-to-end basis, are not expected to be made. Considering routing complexities and the low probability of duplicating an exact connection, such end-to-end tests would not necessarily be meaningful and would be very difficult to coordinate. However, if end-to-end tests are deemed to be essential by an Administration, then such tests shall be implemented in accordance with agreements reached by the respective DCPs.

2.4 Routine maintenance measurements will be accomplished according to agreements reached in conformity with Recommendation M.605.

Recommendation M.730

MAINTENANCE METHODS

1 General

In order to meet the service demands of a progressive and rapidly expanding international fully automatic telephone network with the best possible quality of service, it is essential that all factors adversely affecting the quality of service should be detected and service restored as quickly as possible. In setting this objective it is recognized that perfect performance is unattainable and that beyond a certain point, costs can rise sharply out of proportion to service quality gain.

When choosing a suitable maintenance method or a combination of methods one should consider:

- the reliability of the plant to be maintained;
- the availability of testing and supervisory facilities as well as the availability and quality of manpower in the maintenance organization;
- the availability of facilities in the plant that indicate the existence and frequency of disturbances;
- the availability of arrangements for automatic remedial action;
- the availability of automatic means to process and analyse operational data received from the plant;
- the final objective i.e to ensure a satisfactory overall service quality (subscriber-to-subscriber) in the international connection, giving equal importance to the national and international parts of the chain that constitute the connection.

It is recognized that a combination of maintenance methods may be applied.

See [1].

[1] The term "point" is used in the same sense as in the M.700 series of Recommendations – see particularly Recommendations M.700 and M.710.

2 Preventive maintenance methods

2.1 *General*

The introduction of stored program control (SPC) exchanges and digital transmission systems reduce the need for preventive maintenance. SPC exchanges should in general be provided with functions which supervise the signalling, switching and transmission processes. If a fault occurs or if pre-set disturbance limits are reached, data which indicate the concerned device(s) or circuit(s) should be printed out.

External supervision, testing and fault localization functions should be avoided if internal functions in SPC exchanges or digital transmission systems can provide the same facilities.

2.2 *Functional tests*

2.2.1 In carrying out functional tests, ordinary working conditions apply and the equipment and circuits are taken as found.

They are carried out on a systematic basis to discover faults that would influence the quality of service. The response to each signal may be tested by equipment provided for this purpose. Such tests may be applied to any part of the signalling path.

2.2.2 Functional tests are carried out locally, or from either end of an international circuit to the other.

2.2.3 The organization of the programme for carrying out functional tests locally is left to the discretion of the Administration responsible for the international exchange.

2.2.4 Overall functional tests on an international circuit are such that they can be made from one end of the circuit without cooperation of technical personnel at the other end of the circuit. These tests may utilize the switching equipment at each end of the circuit, but such equipment is not being tested directly, only the circuit.

The verification of satisfactory signalling operation may be done by using various types of tests:

- Certain types of tests not requiring any special equipment, for example checking that a seizing signal is followed by the return of a proceed-to-send signal and that a clear-forward signal is followed by the return of a release-guard signal.
- Other types combining several tests, using special equipment at both ends. Any type which is in general use by Administrations may be used if suitable and agreed between the Administrations concerned [1)].

2.3 *Circuit limit tests*

2.3.1 A circuit limit test is made to verify that the international circuit meets specified operating margins. These tests enable the performance of the whole international circuit to be checked. They will be made as required but normally at the following times:

- before putting the circuit into service;
- according to a systematic test programme which may be based on measurement results or fault (trouble) statistics or quality of service observations (see Recommendation M.605).

They may also be made if functional tests indicate a fault, in order to locate such a fault.

Circuit limit tests may be made with respect either to transmission or to signalling conditions.

2.3.2 The frequency of such tests will be determined by the Administrations concerned and the test conditions to be applied will be in conformity with CCITT Recommendations.

2.3.3 The test equipment, the specifications and methods of gaining access to this equipment are described in the specifications of international signalling, switching and transmission equipment.

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1) See the specification for the CCITT Automatic Transmission Measuring and Signalling Testing Equipment ATME No. 2 (Recommendation O.22 [2]).

2.4 *Limit tests on the constituent parts of a circuit*

2.4.1 These limit tests are made to verify that the constituent parts of a circuit meet specified operating margins. They will be made as required but normally at the following times:

- at installation;
- if functional or limit tests on the circuit indicate a fault, if such tests will help in fault location;
- systematic test programmes which may be based on measurement results or trouble statistics or quality of service observations.

2.4.2 The frequency of such tests will be determined by the Administrations concerned and the test conditions to be applied will be in conformity with CCITT Recommendations.

2.4.3 Limit tests on constituent parts may indicate that the latter need to be readjusted; in such a case, measurements are made on those constituent parts and they are then readjusted in accordance with the relevant CCITT Recommendations.

2.4.4 The test equipment, its specification and the provision of access points will be determined by the Administration concerned taking into account the relevant CCITT Recommendations.

2.5 *Maintenance measurements*

2.5.1 *General*

Maintenance measurements are made periodically on complete circuits as well as on their constituent parts. Their object is to indicate whether the circuits and equipments are maintained to their specified values when first put into service and, if not, to allow the necessary readjustment to be carried out.

Some maintenance measurements are made to check signalling; others are made to check transmission. They are carried out by the respective technical services responsible for signalling and transmission.

2.5.2 *Measurements concerning signalling*

The conditions for carrying out such measurements, the apparatus used and the periodicity of operations are determined by the relevant Series Q Recommendations. Interventions following such measurements are determined by:

a) CCITT Recommendations;

b) equipment specifications when these are not given in detail by the CCITT.

Information on the equipment and functions required are given in the Recommendations listed in Table 1/M.730.

TABLE 1/M.730

Signalling System	Recommendation
No. 4	Q.138 [3]
No. 5	Q.164 [4]
No. 6	Q.295 [5]
R2	Q.490 [6]
No. 7	Q.707 [7]

2.5.3 *Measurements concerning transmission*

These measurements include:

- local measurements, for which the Administrations concerned decide the conditions and periodicity;
- circuit and line measurements for which the conditions are generally defined in the Series M Recommendations.

These Series M Recommendations give, in particular, the periodicity of the measurements and the conditions for readjustment of transmission equipment. (See also Recommendation M.733.)

The CCITT has already specified certain transmission measuring apparatus, and other apparatus specifications are being studied.

3 Corrective maintenance methods

These methods may apply to certain parts of the plant where it is possible to locate and clear faults solely after they have affected the service. Corrective maintenance, if exclusively practised in the entire plant, can create unsatisfactory service conditions due to extreme variations in functional quality and can cause very irregular application of maintenance effort.

The application of exclusively corrective maintenance methods would presuppose such system design that even if breakdowns of single units or parts of the plant occur, they should have a minor effect on the service quality offered to the subscribers.

4 Controlled maintenance methods

Whereas it has been the practice to undertake programmes of preventive maintenance procedures together with day-to-day corrective maintenance procedures, recent equipment development has made it possible to introduce new maintenance methods. Modern systems can provide immediate information concerning irregularities and of abnormal conditions. Although preventive maintenance gives a comparatively good service, the number of defects caused by interference of preventive operations may be considerable.

A maintenance method utilizing the supervising facilities now available may enable the maintenance organization to considerably reduce preventive routines in the maintenance work. Preventive routine tests may then be replaced by methods of continuous supervision of the function of the plant and by means which check continuously the performance of the equipment and give signals to the maintenance staff when the quality of service is below a preset acceptance limit. Alternatively, when facilities for continuous supervision are not available, a sampling technique could be introduced to determine the number of routine tests necessary to gain a reasonable assurance that all equipments are in proper order.

Introduction of a system of maintenance control of this kind will necessitate a certain degree of centralization of administrative and technical means in the maintenance organization. Rapid and informative indication of the state and performance of the international and concerned parts of the national network is required from the maintenance point of view at strategic points in the network.

Various types of information on operational conditions in the plant can be utilized for maintenance supervision purposes, such as:

- traffic data;
- accounting data;
- maintenance data;
- service performance data.

Such data may be analysed manually but could also be processed in computers, allowing for a more extensive analysis, for instance, to compare performance statistics with preset standards which are set for particular routes, circuits, etc. Information held in the computer store may be extracted on-line and could be made directly available to those maintenance and management centres where it is required.

Application of computer processing as described necessitates a high degree of centralization, but also other factors support a centralized maintenance organization such as the increasing use of network management signals. The introduction of processor-controlled switching and digital transmission systems is also expected to increase the possibilities to apply remote controlled and centralized maintenance supervision methods in the future.

References

[1] *Methods of quality control*, Green Book, Vol. IV-2, Supplement No. 1.4, ITU, Geneva, 1973.

[2] CCITT Recommendation *Specification for the CCITT automatic transmission measuring and signalling testing equipment ATME No.2*, Vol. IV, Rec. O.22.

[3] CCITT Recommendation *Instruments for checking equipment and measuring signals*, Vol. VI, Rec. Q.138.

[4] CCITT Recommendation *Test equipment for checking equipment and signals*, Vol. VI, Rec. Q.164.

[5] CCITT Recommendatiion *Testing and maintenance*, Vol. VI, Rec. Q.295.

[6] CCITT Recommendation *Testing and maintenance*, Vol. VI, Rec. Q.490.

[7] CCITT Recommendation *Testing and maintenance*, Vol. VI, Rec. Q.707.

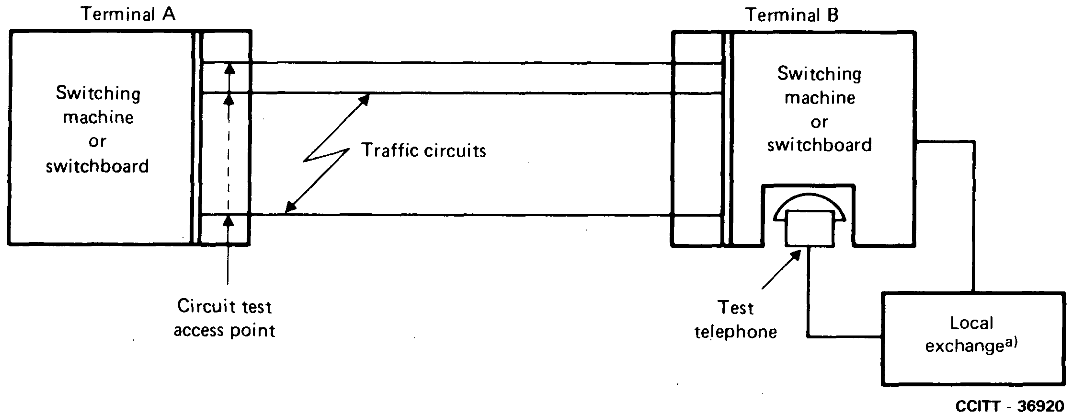
Recommendation M.731

SUBJECTIVE TESTING

1 The need for subjective testing of circuits depends to a great extent on whether or not automatic or semi-automatic supervisory, testing and fault localization equipment is already provided. For example, subjective testing of circuits is not necessary on routes where ATME No. 2 (as described in Recommendation O.22 [1]) is available. Also, the supervisory and fault localization functions built into SPC exchanges and digital transmission systems reduce or even remove the need for subjective testing. For those Administrations wishing to use subjective testing, the methods described in §§ 2-4 below are recommended.

2 Circuits used for the automatic and semi-automatic telephone service may be tested subjectively to reveal gross faults, by systematic test calls from circuit Terminal A to a telephone located at circuit Terminal B. (See Figure 1/M.731.) Such test calling may be done independently of all other tests or combined with functional signalling test calls as described in the *Second method* in Recommendations Q.139 [2] and Q.163 [3] for Signalling Systems No. 4 and No. 5, respectively. Such test calls may be classed as type 3 test calls as defined in Recommendation E.424 [4]. They may be applied on a periodic basis for systematically checking each trunk in a group for excessive echo, clipping, loss, noise, distortion and crosstalk. Any fault suspected as a result of this subjective check should be investigated in the normal manner. When type 3 test calls are used in this manner a test telephone is assumed to exist at the distant international centre. The test telephone is connected to a local exchange, if possible, not located at the same point as the international centre so as to permit a realistic appraisal of the service quality. The test should be initiated at the outgoing terminal for one-way circuits and at both terminals sequentially on both-way circuits. Such test calls for checking service quality should be scheduled with the distant international centre during light load periods.

3 Another method of subjective testing, that may be alternatively considered involves *type 1 test calls* as defined in Recommendation E.424 [4]. It permits systematic evaluation from Terminal A to a location at Terminal B which would not consist of a test telephone, as shown in Figure 1/M.731, but rather to a test location at Terminal B that is not associated with a local exchange. Such an agreement might not be as effective in detecting echo control problems (since the simulation of a normal connection would be less realistic) but might be useful when the first technique suggested above is impractical due to local conditions.



a) If possible, not located at the same point as Terminal B so as to develop a realistic return loss.

FIGURE 1/M.731

Use of a type 3 test call for systematic circuit evaluation

4 In order to obtain the greatest value from subjective tests it might be advantageous to apply them in association with the tests prescribed in Recommendation M.610 and with *in-station* tests such as those for the maintenance of echo suppressors.

References

[1] CCITT Recommendation *Specification for the CCITT automatic transmission and signalling testing equipment ATME No. 2*, Vol. IV, Rec. O.22.

[2] CCITT Recommendation *Manual testing*, Vol. VI, Rec. Q.139.

[3] CCITT Recommendation *Manual testing*, Vol. VI, Rec. Q.163.

[4] CCITT Recommendation *Test calls*, Vol. II, Rec. E.424.

Recommendation M.732

SIGNALLING AND SWITCHING ROUTINE MAINTENANCE TESTS AND MEASUREMENTS

The object of routine maintenance tests and measurements of signalling and switching is to detect changes in the functioning of signalling and switching which are likely to cause a reduction in the quality of service provided. These changes are those which occur in relation to the values indicated in the specifications for the signalling systems concerned (see the pertinent Series Q Recommendations). In the various sections of the Series Q Recommendations, limits are laid down within which:

– no action is necessary,

– action is required by the maintenance service at either of the terminal exchanges.

For Signalling Systems Nos. 4, 5, 6 and R2, reference should be made to Recommendations Q.139 [1], Q.163 [2], Q.295 [3] and Q.490 [4] respectively which contain guidance on the methods to be used for signalling and switching routine tests, together with the minimum frequencies at which such tests should be carried out. On routes where ATME No. 2 (Recommendation O.22 [5]) is in use, many of the required tests and measurements can be performed by that equipment. Supervision and fault localization functions included in the exchange and/or in the transmission system also reduce or remove the need for routine maintenance tests and measurements.

Where staffing arrangements permit, manual and semi-automatic routine maintenance of signalling and switching equipment should be done at times when traffic is light. Any routines performed during normal working hours must be carried out with great care to ensure that the effect on live traffic is minimized.

In stored program control (SPC) and digital exchanges many of the required checks for correct functioning of signalling and switching equipment are carried out automatically by supervisory functions within the exchange, thus removing the need for the majority of manual and semi-automatic routine tests. One of the characteristics of such supervisory functions is that performance "thresholds" have to be set which, if exceeded, cause appropriate outputs to alert maintenance staff (for example, alarms, printouts, etc.). Maintenance staff should not only ensure that all relevant supervisory functions are invoked, but must regularly review the thresholds set to ensure that faults and problems will be detected before service is unacceptably affected.

Where the outputs to maintenance staff from SPC and digital exchanges indicate that a fault exists or is suspected, suitable action must be taken to localize the problem. Before seeking cooperation from the distant maintenance centre, maintenance staff shall ensure that the problem is not within their own exchange. As examples, ATME No. 2 (Recommendation O.22 [5]) the facilities given in Recommendation O.11 [6] and the internal self-diagnostic routines within the exchange should be used to this end.

In view of the variety of different types of international exchange now in use and the differing facilities offered by these exchanges, it is not possible to specify any particular periodicity for routine maintenance tests on signalling and switching equipment. The most appropriate periodicity must be established by the Administration concerned based on such factors as:

- the availability of staff;
- the technology of the exchange (for example, crossbar, Strowger, digital);
- the incidence of faults and problems within the exchange;
- the possible need for cooperation from distant maintenance centres;
- the periodicities recommended by the manufacturer of the exchange or equipment involved;
- the periodicities given in the Series Q Recommendations cited above.

References

[1] CCITT Recommendation *Manual testing*, Vol. VI, Rec. Q.139.

[2] CCITT Recommendation *Manual testing*, Vol. VI, Rec. Q.163.

[3] CCITT Recommendation *Testing and maintenance*, Vol. VI, Rec. Q.295.

[4] CCITT Recommendation *Testing and maintenance*, Vol. VI, Rec. Q.490.

[5] CCITT Recommendation *Specification for the CCITT automatic transmission measuring and signalling testing equipment ATME No. 2*, Vol. IV, Rec. O.22.

[6] CCITT Recommendation *Specifications for manual maintenance lines*, Vol. IV, Rec. O.11.

Recommendation M.733

TRANSMISSION ROUTINE MAINTENANCE MEASUREMENTS ON AUTOMATIC AND SEMI-AUTOMATIC CIRCUITS

The object of routine maintenance measurements is to detect changes in transmission conditions before such changes cause a reduction in the quality of service provided. These changes are those which occur relative to the values recorded for maintenance purposes for the circuits or link concerned. In the various sections of the Series M Recommendations limits are laid down within which:

- no readjustment is necessary,
- readjustment may be made at the terminal stations,
- readjustment must be made along the whole circuit or link.

Routine maintenance measurements should be made according to an agreed maintenance schedule (see Recommendation M.605). The periodicities for the measurements are given in Tables 1/M.610 and 2/M.610. These are to be considered as recommended values and may be increased or reduced if special circumstances require.

Routine maintenance measurements must normally be made at times of light traffic, where staffing arrangements permit. If such measurements have to be made on a large group of circuits, it may nevertheless be necessary to do the measurements on some of the circuits during the busy period, if the operating services are not adversely affected thereby.

Circuits on a given route are generally measured in batches based on the way in which the maintenance schedule has been arranged (see Recommendation M.605). The advantages are:

- once cooperation has been arranged for routine testing with a distant station, time is saved if test cooperation can be maintained for as long as necessary;
- testing a large number of circuits on one route within a fairly short period enables a more accurate overall notion of the route to be obtained than could be gained from measurements on only a few circuits.

Routine maintenance measurements should be made on a complete circuit and should include measurements of overall loss and levels at one and several frequencies, stability (for 2-wire audio circuits only), and noise.

Recommendation M.734

EXCHANGE OF INFORMATION ON INCOMING TEST FACILITIES AT INTERNATIONAL SWITCHING CENTRES

The attention of Administrations is drawn to the need to exchange information on the incoming test facilities which they have provided at their international switching centres. The exchange of such information has an important bearing on maintenance efficiency since it helps to avoid unnecessary requests for maintenance cooperation and the under utilization of the facilities which have been provided.

The form to be used for this purpose is shown in Figure 1/M.734. It provides, for the international switching centre and signalling system concerned, a description of the available test facilities, their CCITT reference (where applicable), the access code to be used, and any necessary remarks (for example, an outline of the response to be expected where the facility is not specified by CCITT). Figure 2/M.734 shows a hypothetical example of this form completed for a particular international switching centre.

Each Administration should distribute the completed forms to other Administrations as appropriate. Upon receipt, Administrations should arrange that the information be distributed to the appropriate points within their maintenance organization, for example, circuit control station, testing point (transmission).

Reference

[1] CCITT Recommendation *Specification for the CCITT automatic transmission measuring and signalling testing equipment ATME No. 2*, Vol. IV, Rec. O.22.

PROVISION OF INCOMING TEST FACILITIES

ADMINISTRATION: INTERNATIONAL SWITCHING CENTRE:

DATE: SIGNALLING SYSTEM:

Test facilities	CCITT reference	Access code	Remarks

FIGURE 1/M.734

Form for incoming test facilities

PROVISION OF INCOMING TEST FACILITIES

ADMINISTRATION: United Kingdom

INTERNATIONAL SWITCHING CENTRE: London/Mollison

DATE: November, 1979

SIGNALLING SYSTEM: CCITT No. 5

Test facilities	CCITT reference	Access code	Remarks
Balanced test termination	—	KP1 C7 C12 022 ST	Answer signal, then 600 Ω termination
Reference test tone	—	KP1 C7 C12 031 ST	Answer signal, then 1000 Hz at —10 dBm0
ATME No. 2: responder Type a	Rec. O.22 [1]	KP1 C7 C12 061 ST	
ATME No. 2: responder Type b	Rec. O.22 [1]	KP1 C7 C12 062 ST	
ATME No. 2: responder Type c	Rec. O.22 [1]	KP1 C7 C12 063 ST	

FIGURE 2/M.734

Form for incoming test facilities (hypothetical example only)

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SECTION 4

COMMON CHANNEL SIGNALLING SYSTEMS

Recommendation M.750

INTER-ADMINISTRATION AGREEMENTS ON COMMON CHANNEL SIGNALLING SYSTEM No. 6

1 Introduction

The bringing into service of new telephone circuits and signalling systems requires that a number of agreements be made in advance by the Administrations involved. Examples of such agreements are:

- routing of circuits (cable, satellite, etc.);
- mode of operation (incoming, outgoing, both-way);
- circuit designations;
- order of selection of both-way circuits.

For common channel signalling systems, a number of agreements, in addition to those required for channel-associated signalling systems (e.g. R2), are also required.

This Recommendation explains the principal inter-administration agreements which must be made in advance of opening a Signalling System No. 6 service and is provided as guidance to those Administrations intending to operate such a service.

Many of the aspects covered by this Recommendation relate to matters contained in the specification of Signalling System No. 6, as appearing in the Series Q Recommendations [1]. Where appropriate, cross references to such Recommendations are given.

2 Common channel Signalling System No. 6 (SS No. 6)

The introduction to the specification of SS No. 6 and Recommendation Q.251 [2] provide general and functional descriptions of the signalling system.

Recommendation M.760 contains a basic diagram of SS No. 6 and a general description of the (signalling) transfer link.

3 Aspects of SS No. 6 requiring inter-administration agreement

3.1 *Signalling links and signalling security arrangements*

Signals for a given group of speech circuits between two exchanges may be "associated" (routed on a signalling link between the two exchanges), "non-associated" (routed on two or more signalling links in tandem, involving one or more signal-transfer-points) or a mixture of both (Recommendation Q.253, § 1.3.1) [3]. The possible modes of operation range from simple arrangements of one signalling link and associated mode of signalling, to more complex arrangements, for example, the fully dissociated mode where signals are transferred via any available path in a signalling "network".

Before entering detailed discussions on the type of signalling security arrangements required, it is desirable that the terminal Administrations exchange information on the type and manufacturer of their international exchanges and the options available within their existing software systems. This information will enable each Administration to have an overall view of available signalling security arrangements, will avoid misunderstanding and thus enable rapid progress in establishing detailed arrangements. Subsequently, agreement on the following matters will be required:

i) The number of signalling links and reserves to be provided (Recommendations Q.292 and Q.293) [4] [5]. In general, a choice will be made between:

- regular link plus synchronized reserve(s);
- regular link plus non-synchronized reserve(s). Such non-synchronized reserves may be reserve transfer links or nominated speech circuit reserves. Where the latter is chosen, the measures to be taken to ensure that there is a high probability of one of the chosen speech circuits being free (at both ends) when required should be discussed between Administrations (Recommendation Q.292, § 8.4.3a)) [4];
- load-sharing.

ii) The order of selection (ranking order) of regular/reserve signalling links, reserve transfer links and nominated speech circuit reserves, as provided. Where non-synchronized reserves are concerned, the time each terminal exchange will attempt to regain synchronization (5 or 7.5 seconds) must be agreed between Administrations (Recommendation Q.293, § 8.6.3.2) [5].

iii) The order of selection between alternative signalling routes (where more than one has been provided).

iv) The need to specify an "automatic load transfer" procedure (Recommendation Q.293, § 8.6.3.2) [5].

v) Which exchange will act as "emergency restart control exchange" (Recommendation Q.293, § 8.7c)) [5].

3.2 *Signalling link routing and line-up aspects*

Administrations must reach agreement on the physical routing and line-up requirements of the signalling links and reserves. Among the aspects which are important are:

i) diversity of routing for alternative signalling links and reserves, as required for security purposes;

ii) the propagation delay of signalling links and reserves. This should be as low as possible and should not be significantly greater than that of any speech circuit with which it is normally associated. By this means the possibility of the called party being distorted or "clipped" is reduced (Recommendation Q.272) [6];

iii) the existence or absence of restoration plans to restore transmission facilities over which signalling links and reserves are routed;

iv) the transmission characteristics and limits to be used for the transfer links (Recommendation M.761).

3.3 *Method of signalling*

Signalling System No. 6 provides for two basic methods of sending signalling information namely, "en-bloc" or "overlap" (Recommendations Q.262 and Q.265) [7] [8]. The method to be used for each direction of traffic should be discussed between Administrations.

3.4 *Use of optional facilities*

3.4.1 *Network maintenance signals*

Network maintenance signals are specified as an optional facility in the specification of SS No. 6 (Recommendation Q.295, § 9.5) [9]. Where both terminal exchanges are equipped with these facilities, the involved Administrations may wish to reach agreement on their use, for example to facilitate recovery from major exchange or signalling system disturbances. In making such agreements, it must be ensured that any "signal-transfer-point" involved between the two terminal exchanges is able to transfer the necessary network maintenance signals.

3.4.2 *Automatic repeat attempt*

The specification for SS No. 6 requires that an automatic repeat attempt be made in a number of specified call failure situations. However, the potential exists to use an automatic repeat attempt in circumstances other than those specified. Administrations may wish to discuss the advantages (if any) of additional application of the automatic repeat attempt facility (Recommendation Q.264) [10] and the implications, for example, on the load on the signalling data link, of such additional use.

3.5 *Label assignment*

By agreement between Administrations, each SS No. 6 speech circuit must be assigned a "label", comprising a "band number" and a "circuit number" (Recommendation Q.257) [11]. Any relationship required between the band numbering scheme and the physical routing of the speech circuits (via cable, via satellite, etc.) must also be agreed between Administrations. It may be noted that there need be no relationship between the circuit number part of the label and the circuit designation (which would be in accordance with Recommendation M.140). For convenience, however, it is desirable where possible to retain an orderly and consistent equivalence between circuit number and circuit designation.

3.6 *Double seizure of both-way circuits*

Signalling System No. 6 incorporates a procedure for dealing with a situation where a both-way circuit has been simultaneously seized at both ends (Recommendation Q.263) [12]. This procedure requires that control and non-control exchanges be appointed for each (both-way) circuit. It may be noted that there need be no relationship between control and non-control exchanges for double seizure and the circuit control and sub-control stations as defined in Recommendations M.723 and M.724 (unless so desired by the involved Administrations). For convenience, however, it is desirable where possible that Administrations exercise both dual seizure control and maintenance control over the same circuits.

3.7 *Signal-transfer-point working*

Among the aspects upon which Administrations may need to reach agreement are:

i) label translation and the need for control of label assignment (Recommendation Q.253, § 1.3.3.2) [3];

ii) financial accounting. Where the non-associated mode of signalling has been adopted, either normally or as a signalling security arrangement, signalling information will be relayed via one or more signal-transfer-points and would typically involve one or more transit Administrations. Arrangements for any necessary financial accounting may need to be discussed between involved Administrations.

The inter-Administration aspects of signal-transfer-point working require further study based on the experience of Administrations.

3.8 *Engineering test programme*

Details of an engineering test programme, to be carried out prior to the start of the SS No. 6 service, should be agreed between Administrations. This agreement and the resulting test schedule should take account of the relative experience of the participating Administrations. The following aspects should be covered in such a programme:

i) functional and synchronization aspects of the signalling links and reserves;

ii) signalling security arrangements;

iii) call processing. Tests should cover normal, abnormal, transit and signal-transfer-point signalling sequences;

iv) system failure response. Both signalling system and exchange failures should be covered;

v) tests on individual speech circuits, e.g. using ATME No. 2;

vi) limited period, live traffic tests.

Engineering test programmes require further study. Thus the programme suggested above should be considered "provisional" and may not be complete. But in considering the test programme to be implemented, attention is drawn to the detailed and comprehensive publication cited in [13].

3.9 *Maintenance and maintenance organization*

Inter-administration agreements necessary for the maintenance of SS No. 6 are the subject of other Recommendations in the M-Series. Reference should be made to Recommendations M.760, M.761, M.762 and M.93.

4 Timing of inter-administration agreements

Due to the differing practices and procedures of Administrations, no specific timetable for the inter-administration agreements necessary on SS No. 6 can be offered. However, experience indicates that initial discussions between involved Administrations concerning a new SS No. 6 service should preferably commence about two years prior to the required "ready for service" date.

References

[1] CCITT Recommendation *Specification of Signalling System No. 6*, Vol. VI, Recs. Q.251-Q.300.

[2] CCITT Recommendation *General*, Vol. VI, Rec. Q.251.

[3] CCITT Recommendation *Association between signalling and speech networks*, Vol. VI, Rec. Q.253.

[4] CCITT Recommendation *Reserve facilities provided*, Vol. VI, Rec. Q.292.

[5] CCITT Recommendation *Intervals at which security measures are to be invoked*, Vol. VI, Rec. Q.293.

[6] CCITT Recommendation *Requirements for the signalling data link*, Vol. VI, Rec. Q.272.

[7] CCITT Recommendation *Analysis of digital information for routing*, Vol. VI, Rec. Q.262.

[8] CCITT Recommendation *Speed of switching and signal transfer in international exchanges*, Vol. VI, Rec. Q.265.

[9] CCITT Recommendation *Testing and maintenance*, Vol. VI, Rec. Q.295.

[10] CCITT Recommendation *Potential for automatic repeat attempt*, Vol. VI, Rec. Q.264.

[11] CCITT Recommendation *General*, Vol. VI, Rec. Q.257.

[12] CCITT Recommendation *Double seizing with both-way operation*, Vol. VI, Rec. Q.263.

[13] CCITT publication *CCITT Signalling System No. 6 Test Schedule*, ITU, Geneva, 1982.

Recommendation M.760

TRANSFER LINK FOR COMMON CHANNEL SIGNALLING SYSTEM No. 6

1 General description of the transfer link

1.1 The transfer link for the common channel Signalling System No. 6 and its relationship with the signalling link and signalling data link are depicted in Figure 1/M.760.

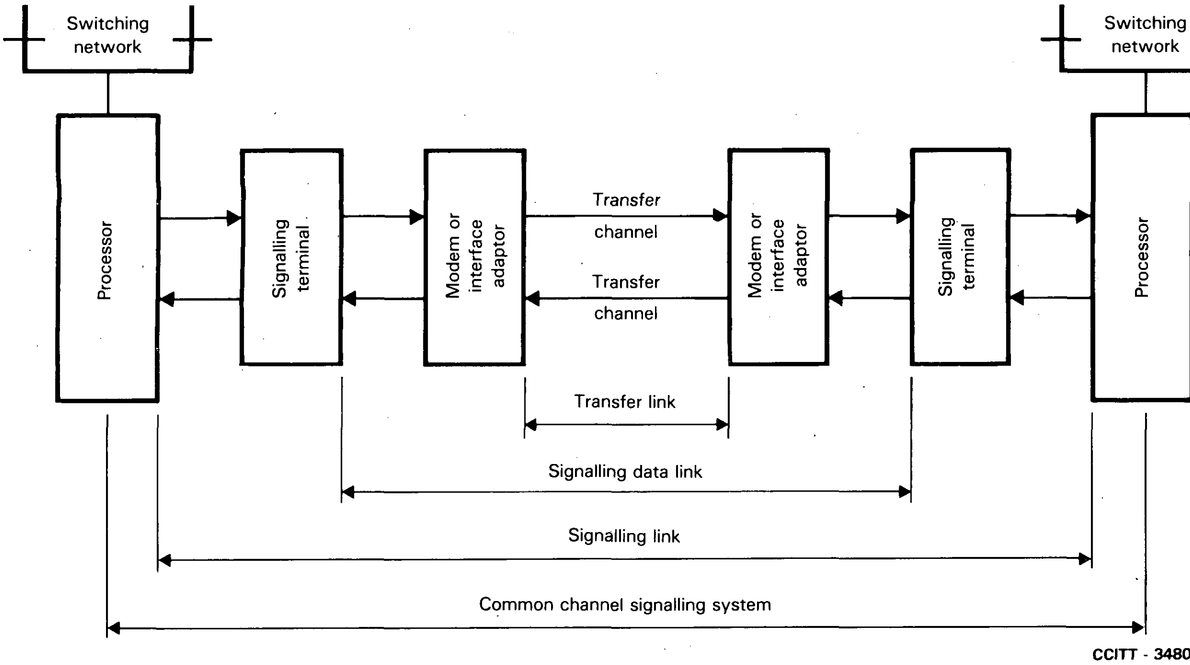


FIGURE 1/M.760

Basic diagram of the common channel Signalling System No. 6

1.2 The signalling link may be operated over either an analogue or a digital transfer link. Analogue transfer links are used to interconnect data modems located within, or adjacent to, international switching centres, thus forming signalling data links. Analogue transfer links are 4-wire transmission channel pairs having no audio terminating units, signalling equipment or echo suppressors. These channels can be derived from purely analogue, a combination analogue and digital, or purely digital transmission systems. Guidance on the setting-up and lining-up of analogue transfer links is given in Recommendation M.761.

Digital transfer links are used to interconnect interface adaptors to form signalling data links.

For guidance on the testing and maintenance of Signalling System No. 6, reference should be made to Recommendation Q.295 [1].

2 Continuity of service

2.1 Since the signalling link carries the signals for many speech circuits, a failure of the link will affect all speech circuits served. Therefore, arrangements should be made to ensure continuity of service of the signalling link.

2.2 Continuity of service will normally involve the provision of reserve facilities, which may be one or more of the following:

- quasi-associated reserve signalling links,
- full-time reserve transfer links,
- nominated direct circuits.

In the last two cases the transfer links must be equipped with signalling terminals and modems or interface adaptors to form signalling links. Reference should also be made to Recommendation Q.292 [2], which provides a detailed description of the above reserve arrangements.

2.3 Whenever possible, the reserve facility to be used should follow a different route from the route of the regular signalling link.

2.4 In order to reduce the number of interruptions on the signalling link to a minimum, it is recommended that all equipment associated with such links (for example, channel translating equipment, modems, distribution frames, etc.) be positively marked to make them readily identifiable to maintenance staff. Such markings assist maintenance efficiency and help staff to avoid causing inadvertent interruptions to the link when carrying out maintenance work in repeater stations and switching centres.

2.5 The proper functioning of Signalling System No. 6 is essential to the operation of the international network and various means are suggested in order to ensure this operation. If a fault occurs in the normal transfer link, service will continue (see § 2.2). However, a second (or simultaneous) failure would cause a significant impairment in traffic between centres so affected. Therefore, immediate maintenance attention should be given to transfer link faults and they should be returned to their normal configurations as rapidly as possible following a failure.

3 Transfer link designation

The form of designation to be used for the transfer link and its nominated reserve is given in Recommendation M.140.

4 Maintenance organization

4.1 The maintenance organization for common channel Signalling System No. 6 is in two parts:

a) the maintenance of the overall signalling system with respect to delivering necessary signalling information between international centres, and to the functioning of data modems, signalling terminals and related equipment. The overall maintenance requirements is a subject for further study;

b) the maintenance of the transfer link between two centres, from the output of one data modem to the input of another data modem. This link does not include data modems.

4.2 By agreement between Administrations, one terminal international centre, or an equivalent point specified by the Administration concerned, will be designated as the overall maintenance control station. This station will maintain an overview of the performance of Signalling System No. 6 and in general be responsible to ensure that actions are coordinated when responsibility for a particular fault is not clearly identified. Additionally, one terminal international centre should function as the control station for transfer link maintenance activities.

Note – For a signalling system this role may be combined with that of overall maintenance control.

4.3 Organizational points or stations need to be assigned to provide for the following functions:

a) Overall signalling system maintenance

  i) control station

  ii) sub-control station

  iii) fault report point

  iv) testing point

b) Transfer link maintenance

  i) control station

  ii sub-control station

  iii) fault report point

  iv) transmission maintenance point (international line) (TMP-IL)

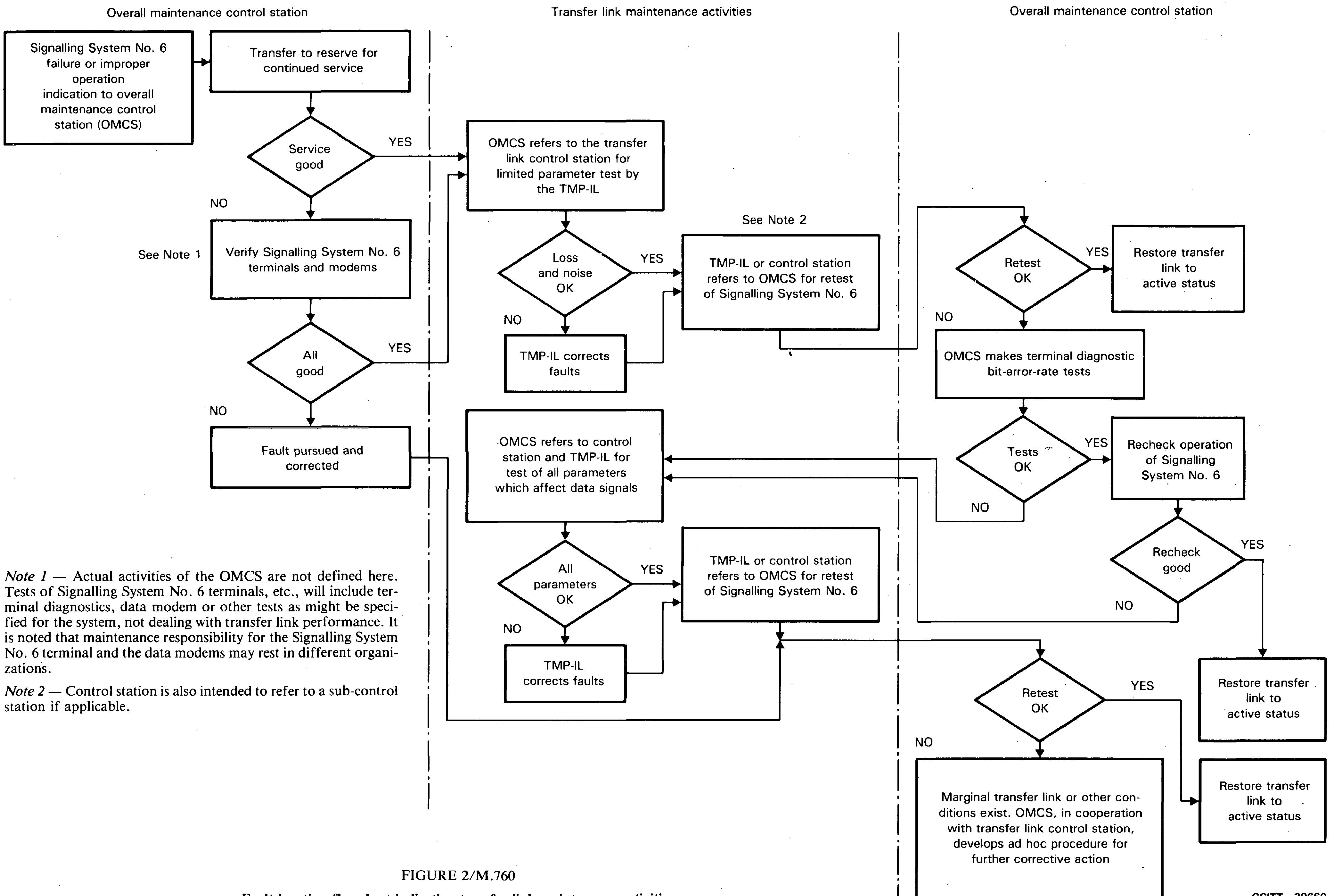
These may be assigned by an Administration as best suited to its individual needs.

It is essential that the appropriate contact point information be exchanged in order to minimize maintenance difficulties. Figure B-1/M.93 offers a plan for the exchange of contact point information for the international telephone service and allows for the exchange of contact point information Signalling System No. 6 maintenance.

4.4 This Recommendation relates to the maintenance of the transfer link. However, maintenance activities on the transfer link should be controlled in order to preclude interruption of signalling functions, either during normal service or while tests initiated by the overall maintenance control station are being carried out. Furthermore, the TMP-IL for the transfer link is not likely to be aware of any faults in the signalling system unless advised by the overall signalling maintenance control station or transfer link control station. Therefore, testing of the transfer link will not be undertaken until advice (or concurrence) is received from the overall maintenance control station or the transfer link control station.

4.5 Once a fault is indicated in Signalling System No. 6, a possible series of events is illustrated in Figure 2/M.760. In the presentation of the flowchart it has been necessary to assume a possible organizational arrangement and assignment of responsibilities [see § 4.1, a) above].

This chart does not go into all possibilities. It is intended to depict a process toward fault correction, looking first at the most likely causes of faults in the transfer link with speedy correction in mind, and then toward more detailed and time-consuming tests to discover more elusive faults. It should be noted that some long-term testing may be required in this latter process.



Note 1 — Actual activities of the OMCS are not defined here. Tests of Signalling System No. 6 terminals, etc., will include terminal diagnostics, data modem or other tests as might be specified for the system, not dealing with transfer link performance. It is noted that maintenance responsibility for the Signalling System No. 6 terminal and the data modems may rest in different organizations.

Note 2 — Control station is also intended to refer to a sub-control station if applicable.

FIGURE 2/M.760

Fault location flowchart indicating transfer link maintenance activities

References

[1] CCITT Recommendation *Overall tests of Signalling System No. 6*, Vol. VI, Rec. Q.295.

[2] CCITT Recommendation *Reserve facilities provided*, Vol. VI, Rec. Q.292.

Recommendation M.761

SETTING UP AND LINING UP A TRANSFER LINK FOR COMMON CHANNEL SIGNALLING SYSTEM No. 6 (ANALOGUE VERSION)[1)]

1 Setting up and lining up a transfer link

1.1 The method to be used and procedure to be followed in setting up and lining up a transfer link are similar to those given in Recommendation M.1050 [1] in so far as it applies. However, in this context, any reference to national sections in Recommendation M.1050 should be ignored since a transfer link exists between terminal international centres and does not include national sections.

1.2 Routing restrictions may be necessary to achieve the loss/frequency and group-delay distortion limits specified below if the need to insert equalizers is to be avoided. Factors that may contribute to difficulties in meeting these limits are the number of through-group filters in group links, the use of edge band channels in group links, etc.

In addition, the number of channel translating equipments should be minimized in order that equalization, if required, may be more easily achieved, and that the effect of other parameters, such as noise, may be minimized.

2 Transmission characteristics of a transfer link

2.1 *General*

The transmission characteristics of the circuit to be used as the signalling data link are based on those for international leased circuits conforming to Recommendation M.1020 [2]. Optionally, the relaxed overall loss/frequency characteristic and group-delay distortion limits specified in the Recommendation cited in [3] may be applied where agreed between the Administrations involved and if tests confirm suitability.

2.2 *Overall loss at reference frequency*

The overall loss at reference frequency of the channels of a transfer link is not specified.

The channels of a transfer link should be set up so that when a test signal at a level of −10 dBm0 is connected to the input of the transfer channel, the level received at the output of the transfer channel at the distant end is as close as possible to −10 dBm0.

2.3 *Variation with time of the overall loss at reference frequency*

The variation with time of the overall loss at reference frequency should be as small as possible but should not exceed the following limits:

– short-term variation (over a period of a few seconds): ± 3 dB;
– long-term variation (over long periods including daily and seasonal variations): ± 4 dB.

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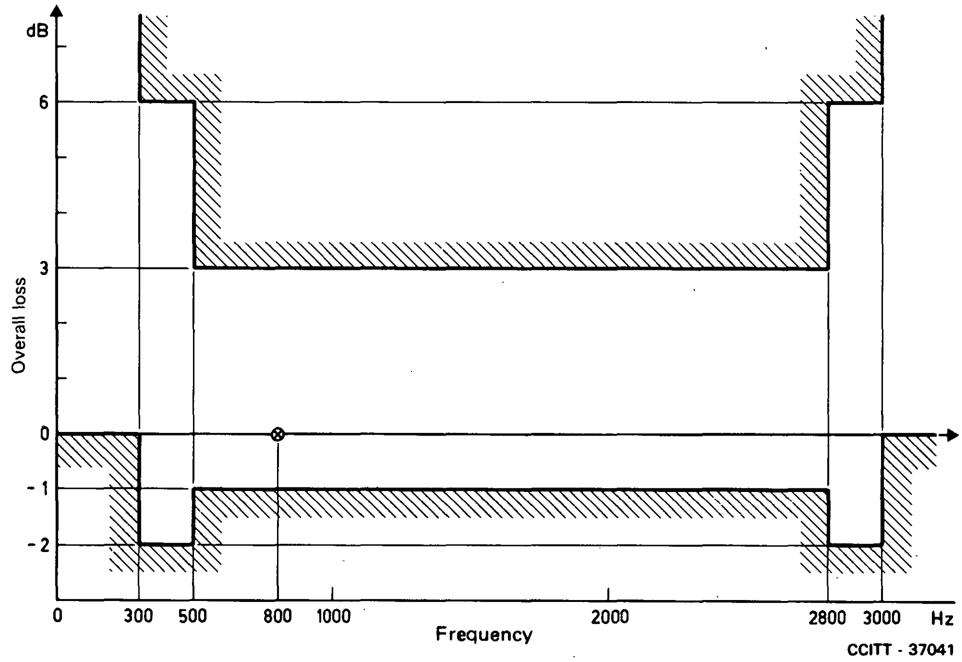
1) A general description of the transfer link for the common channel Signalling System No. 6 may be found in Recommendation M.760.

2.4 *Loss/frequency distortion*[2)]

The variation of overall loss with frequency relative to the loss at reference frequency should not exceed the limits shown in Figure 1/M.761.



Note — Below 300 Hz and above 3000 Hz the loss shall not be less than 0.0 dB but is otherwise unspecified.

FIGURE 1/M.761

Limits for overall loss of the transfer link relative to that at reference frequency

2.5 *Group-delay distortion*

The group-delay distortion relative to the minimum delay, should not exceed the limits shown in Figure 2/M.761.

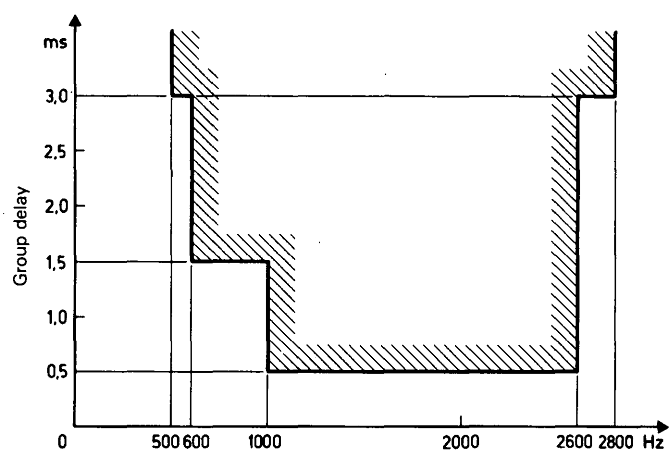


FIGURE 2/M.761

Limits for group delay relative to the minimum measured group delay in the 500-2800 Hz band

2) Provisionally the limits of Recommendation M.1020 [2] have been chosen for the loss/frequency characteristics although these limits are appropriate for a leased circuit extending over national plant including local lines to customers' premises. However, transfer links will only extend between international centres and their routing will not involve any audio line plant with its inherent increasing attenuation with frequency. Therefore, further study is needed concerning the possible need to change the frequency (3000 Hz), from which the zero gain restriction extends, to some higher frequency.

Note 1 – It is believed that in many cases the limits specified in §§ 2.4 and 2.5 may be achieved without the addition of equalizing equipment.

Note 2 – The overall loss/frequency characteristic and group-delay distortion limits are currently under study for the feasibility of more relaxed limits. However, initial experience indicates that the limits specified in §§ 2.4 and 2.5 are necessary for reliable operation of the signalling system data link.

2.6 *Random noise*

The level of the psophometric noise power at the receiving terminal international centre depends upon the actual length and constitution of the transfer link. The provisional limit for transfer links of distances greater than 10 000 km is –38 dBm0p. However, transfer links of shorter length will have substantially less random noise, as shown in Figure 3/M.761.

Figure 3/M.761 displays random noise versus length and is presented as a guide to the random noise performance which may be found on a transfer link.

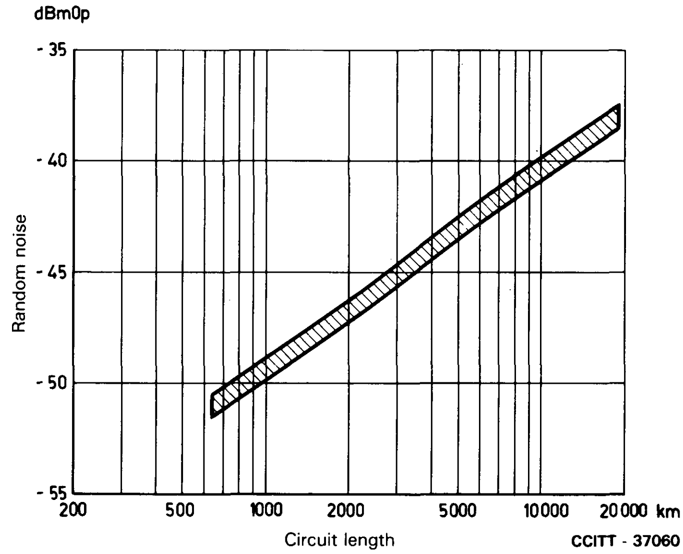


FIGURE 3/M.761
Random noise performance

Note – For transfer links routed via satellite, the satellite section (between earth stations) will contribute approximately 10 000 pW0p (–50 dBm0p) to the overall circuit noise. Therefore, for the purpose of determining the noise limits for the Signalling System No. 6 transfer link, the section of the transfer link provided by the satellite may be considered to be equivalent to a length of 1000 km. The effective noise length of such a transfer link will be 1000 km plus the total length of the terminal routings.

2.7 *Impulsive noise*

Impulsive noise should be measured with an instrument complying with Recommendation O.71 [4]. As a provisional limit, the number of impulsive noise peaks exceeding –21 dBm0 should not be more than 18 in 15 minutes.

2.8 *Phase jitter*

The value of phase jitter depends upon the actual constitution of the transfer link (for example, upon the number of modulation equipments involved). It is expected that any measurement of phase jitter using an instrument complying with Recommendation O.91 [5] will not normally exceed 10° peak-to-peak. However, for transfer links of necessarily complex constitution, and where 10° peak-to-peak cannot be met, a limit of up to 15° peak-to-peak is permitted. These limits are provisional and subject to further study.

2.9 *Quantizing noise*

If any section of the transfer link is routed over a pulse code modulation system or through a digital exchange, the signal will be accompanied by quantizing noise. The minimum ratio of signal-to-quantizing noise normally expected is 22 dB.

2.10 *Single tone interference*

The level of single tone interference in the band 300-3400 Hz shall not exceed a value which is 3 dB below the circuit noise objective indicated in Figure 3/M.761. This limit is provisional pending further study.

2.11 *Frequency error*

The frequency error introduced by the transfer link must not exceed ± 5 Hz. It is expected that in actual practice the frequency errors encountered will be less than 5 Hz.

2.12 *Harmonic distortion*

When a 700-Hz test frequency at − 13 dBm0 is injected at the transmit end of the transfer link, the level of any individual harmonic frequency at the receiving end shall provisionally be at least 25 dB below the received level of the fundamental frequency.

3 Recording of results

All measurements made in completing the line-up of the transfer link are valuable as references. These final measurements should be recorded using an appropriate form.

If subsequent realignment or adjustment is necessary these records should be updated.

References

[1] CCITT Recommendation *Lining up an international point-to-point leased circuit*, Vol. IV, Rec. M.1050.

[2] CCITT Recommendation *Characteristics of special quality international leased circuits with special bandwidth conditioning*, Vol. IV, Rec. M.1020.

[3] CCITT Recommendation *Requirements for the signalling data link*, Vol. VI, Rec. Q.272, Annex.

[4] CCITT Recommendation *Specification for an impulsive noise measuring instrument for telephone-type circuits*, Vol. IV, Rec. O.71.

[5] CCITT Recommendation *Essential clauses for an instrument to measure phase jitter on telephone circuits*, Vol. IV, Rec. O.91.

Recommendation M.762

MAINTENANCE OF COMMON CHANNEL SIGNALLING SYSTEM No. 6

1 General

1.1 It is essential that a common channel signalling system perform with very high reliability over the long term. It is also desirable that maintenance staff perform at the highest practical efficiency. In order to achieve both of these objectives with regard to common channel signalling systems, maintenance responsibilities and actions must be clearly defined and controlled. Such objectives make it necessary, in some cases, to place limitations on the freedom of involved maintenance units in performing independent maintenance actions.

1.2 This Recommendation considers the signalling system as an integrated system. It is not intended to replace or impose upon any Recommendation or procedure (national network or otherwise) which might apply to specific components or sub-systems, for example a data modem or the transfer link; rather, it proposes criteria regarding when and how such actions are to be initiated. Moreover, the general administration of the systems is considered and not the detailed interworking of its various equipments.

1.3 Various maintenance organizational units may have functional responsibility for individual sub-systems which comprise a common channel signalling system (for example modems, processors, etc.). As the activities of any of these units will have an effect on the overall operation of the signalling system, and because in some cases it may not be possible to independently determine a need for maintenance attention, one point should be designated as an overall signalling system control. This point is titled signalling system administrative control. The corresponding point at the distant terminal is known as the signalling system administrative sub-control.

2 Appointment of administrative control and sub-control

2.1 The appointment of administrative control and sub-control will be made by agreement between the Administrations involved. These two points must be assigned for each signalling system which is placed in operation. It is suggested that the most appropriate point to act as administrative control or sub-control is the maintenance unit having responsibility for the signalling terminal and processor. However, this matter is left to the discretion of the Administrations concerned.

2.2 In the case of multiple signalling systems between the same two points, it may be appropriate to divide control and sub-control assignments, therefore sharing the burden of control responsibility. This is a subject for agreement between the Administrations concerned; however, this assignment and that of the control station for the transfer link should be to the same Administration.

3 Functions and responsibilities of the administrative control

These responsibilities fall into four main areas:

i) day-to-day maintenance of working systems;

ii) history and long-term analysis;

iii) operation under signal transfer point (STP) configurations;

iv) implementing a new signalling system.

3.1 *Day-to-day maintenance of signalling systems*

3.1.1 Except as noted in § 3.1.2, maintenance activity on any part of a common channel signalling system must only be undertaken with the agreement and knowledge of the administrative control. Such activities might relate to routine maintenance measurements of the transfer link, service affecting reconfigurations of transmission systems over which the transfer link is routed (i.e. planned outages), maintenance of the data modem used in the system, the temporary removal from service of a signalling terminal, etc.

3.1.2 In the event of total failure of a signalling system due to a malfunction of one of its parts, immediate steps should be taken to remedy the fault condition. As soon as possible, the administrative control should be informed so that the event can be correlated with other reported events or known signalling failures. An example of such a fault event might be the failure of a transmission system over which the transfer link is routed [1].

[1] See Recommendation M.760, § 4 and Figure 2/M.760 which illustrate a possible series of events following the failure of a transfer link.

3.1.3 Faults which are observable only at a signalling system terminal, for example intermittent failures resulting from an apparent high data bit error rate, must be analysed by the administrative control (and sub-control, depending on the direction of the indicated fault) in order to determine where maintenance attention is required. Such dynamic analysis might involve terminal diagnostic tests, error performance tests with the distant terminal, etc. The result of this dynamic analysis and tests will be corrective action, taken either by the administrative control or the sub-control if under either's jurisdiction, or the referral by the administrative control to the indicated part of the maintenance organization, for example the control station for the transfer link.

3.2 *History and long-term analysis*

3.2.1 The administrative control should maintain a record of all recognized or reported faults pertaining to each signalling system for which it is responsible.

This information includes (but is not limited to) the following:

i) date and time a fault was reported or actually occurred;

ii) the nature of the reported fault;

iii) the reporting location;

iv) the location of the fault, when found;

v) the actual fault condition found and the corrective action taken.

This information should become a part of the history record maintained by the administrative control.

3.2.2 History records will enable long-term analysis to identify repeated faults of a signalling system. Such efforts should improve the long-term operation of a signalling system and therefore afford more economical maintenance.

It is suggested that historical records should be retained for at least 12 months. From the provision of a new signalling system, the history record should be initiated and continued until 12 months have passed. After analysis, each succeeding month will permit the discarding of records accrued during that same month of the previous year. Therefore, an administrative control can examine 13 months of (possible) events, which should be adequate to identify persistent faulty conditions.

3.3 *Operations under signal transfer point (STP) configurations*

3.3.1 With two or more signalling systems in tandem used to convey signalling information between two international centres, signal transfer point operation presents possible maintenance complications. Events which occur in one system can affect the functioning between centres which have no control or sub-control responsibility for the faulty signalling system. If an administrative control determines that a fault has occurred in its signalling system which is part of an STP configuration, it must apprise the administrative control of the signalling system not directly involved, that a fault exists that affects (or will affect) signalling processes. The advice should also include an estimate of the time necessary to correct the condition and, when appropriate, the time the condition was actually corrected.

3.3.2 When a condition affecting signalling via an STP warrants coordinated testing in order to determine the faulty part of either signalling system, the administrative control first involved in the fault report should coordinate testing efforts. Once the fault is localized, referrals can be made via normal procedures to achieve maintenance action.

When the fault is corrected, the administrative control for each of the signalling systems should be advised and the administrative control which was first involved should confirm proper signalling via the STP.

3.4 *Implementing a new signalling system*

3.4.1 The Administrations involved must reach all of the agreements necessary for the orderly provision of a common channel signalling system, such as label assignments, constitution of the transfer link routing, security arrangements, initial testing, etc. (see also Recommendation M.750).

3.4.2 The administrative control should receive and record for future reference the results of final engineering tests carried out prior to putting a new system into service. In the event of subsequent failures, a reference to these test results may be valuable to the fault location process and also a significant factor in assessing signalling system performance and fault occurrences over the long term.

4 Functions and responsibilities of the administrative sub-control

In general, the responsibilities of the administrative sub-control with respect to its own terminal are similar to those of the administrative control. Additionally, the administrative sub-control should:

i) cooperate with the administrative control in fault localization and clearing activities as necessary;

ii) respond with all relevant details of investigations and fault clearance activities to the administrative control;

iii) advise the administrative control of any known present or future event likely to impact on the operation of the signalling system(s) for which it has responsibility.

5 Contact point information

It is essential that contact point information be exchanged between Administrations in order to minimize maintenance difficulties and speed fault localization and clearance activities, (see Recommendation M.93).

Printed in Switzerland — ISBN 92-61-02091-7