INTERNATIONAL TELECOMMUNICATION UNION

CCITT

THE INTERNATIONAL
TELEGRAPH AND TELEPHONE
CONSULTATIVE COMMITTEE

BLUE BOOK

VOLUME IV – FASCICLE IV.1

GENERAL MAINTENANCE PRINCIPLES

MAINTENANCE OF INTERNATIONAL TRANSMISSION SYSTEMS AND TELEPHONE CIRCUITS

RECOMMENDATIONS M.10-M.782

IXTH PLENARY ASSEMBLY
MELBOURNE, 14-25 NOVEMBER 1988

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MODIFICATIONS TO THE SERIES M RECOMMENDATIONS

Reorganization within Volume IV of the CCITT Book

Due to certain re-arrangements within Volume IV of the CCITT *Red Book*, some existing Recommendations have been moved (or re-numbered) and appear now in other sections of the Volume.

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

CCITT Red Book (Malaga-Torremolinos, 1984)	*CCITT Blue Book* (Melbourne, 1988)
M.22	M.32
M.24	M.34
M.25	M.35
M.465	M.555
M.480	M.556
M.700	included in M.60
O.121	O.9
O.141	O.25

PRELIMINARY NOTES

1 The Questions entrusted to each Study Group for the Study Period 1989-1992 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.782

GENERAL MAINTENANCE PRINCIPLES

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 services, 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.

MAINTENANCE PHILOSOPHY FOR TELECOMMUNICATIONS NETWORKS

(The principles described in Recommendation M.21 should also be taken into account.)

1 General

1.1 Maintenance involves the whole of operations required for setting up and maintaining, within prescribed limits, any element entering into the setting-up of a connection (see Recommendation M.60)[1]. In order to properly plan and program the maintenance operations required to establish and maintain an analogue, digital or mixed network, the following general strategy is recommended.

1.1.1 A maintenance organization should be established using the guiding principles set forth in Recommendations M.70 and M.710 for automatic circuits switched over analogue, digital and mixed networks. In addition, the concept of control and subcontrol stations found in Recommendations M.80 and M.90 for international circuits and transmission systems should be implemented.

1.1.2 The strategy should include the following maintenance operations considerations:

a) It should consider the evolution of the network from the present highly analogue environment to the future almost wholly digital environment. In doing this, it must consider the new services and functions offered by the networks (e.g. CCITT Signalling System No. 7 and ISDN) and the maintenance tools and capabilities becoming available (e.g. performance monitoring).

b) It should employ an overall maintenance philosophy that uses the maintenance entity concept, failure classification and network supervision process specified in § 3.

c) It should provide for the maintenance of the network systems, equipment and circuits during the following activities:

   - installation and acceptance testing (§ 4);
   - bringing into service (§ 4);
   - keeping the network operational (§ 5).

   It should support other maintenance activities (§ 6) associated with the administration of maintenance operations (e.g., data bases, spare parts, failure statistics, etc.) along with a detailed plan for preventive maintenance, where required, on the various telecommunication equipments.

d) It should have as a major aim to minimize both the occurrence and the impact of failures and to ensure that in cause of failure:

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

1.2 To apply this general strategy 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.

[1] It is recognized that for some Administrations, bringing into service is not considered to be part of maintenance.

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 cost 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]).

2.4 *Centralized maintenance operations*

The introduction of digital telecommunications equipment with enhanced maintenance operations functions, including the facility for remote reporting and control, provides new opportunities for centralization. Supplement No. 6.2 [2] provides a description of a centralized maintenance organization. There are many benefits that can be gained from centralization. These include the ability to:

- be more flexible in the organization of maintenance operations and administration;
- utilize highly skilled mechanical resources more efficiently;
- utilize more effectively data and data bases;
- improve maintenance effectiveness;
- decrease maintenance costs;
- increase the availability of transmission and switching systems;
- improve quality of service.

Note – By the use of remote terminals, an Administration can choose how they allocate their technical staff between local and centralized locations.

Because of these benefits, it is recommended that centralized maintenance and other operations capabilities be considered when specifying new telecommunications systems and equipments. The general principles for setting-up, operating and maintaining a Telecommunication Management Network (TMN) to support centralized maintenance and other operations are given in Recommendation M.30.

3 Overall maintenance philosophy

3.1 *Maintenance entity concepts*

In order to facilitate efficient maintenance, the telecommunication network (analogue and digital) is divided into parts, called Maintenance Entities (MEs), Maintenance Entity Assemblies (MEAs) and Maintenance Sub-Entities (MSEs). Examples of MEs, MEAs and MSEs are given in Figures 1, 2 and 3/M.20.

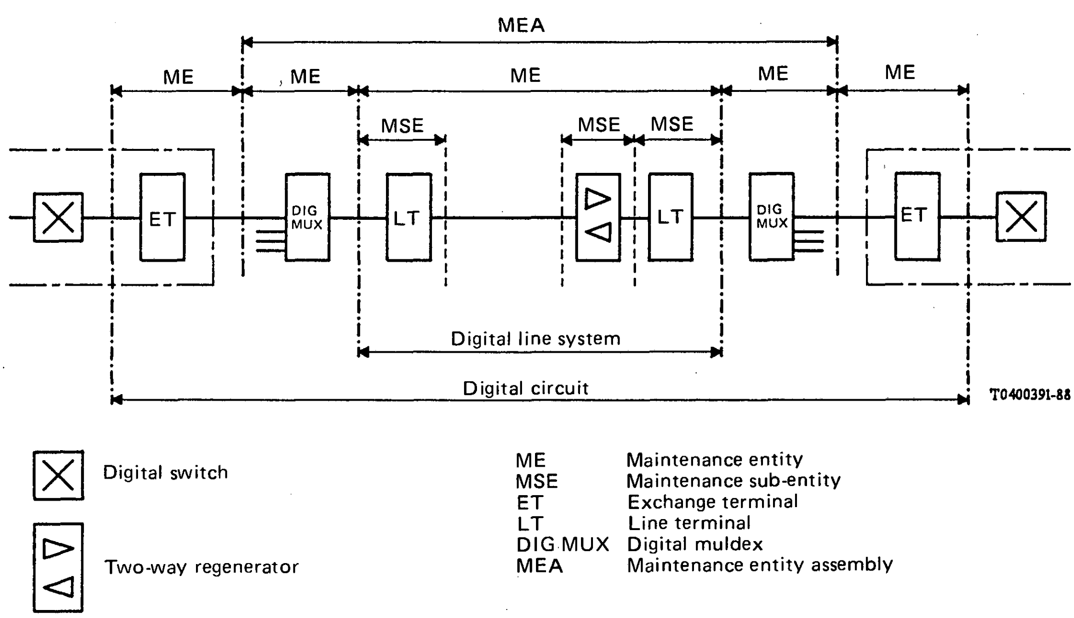
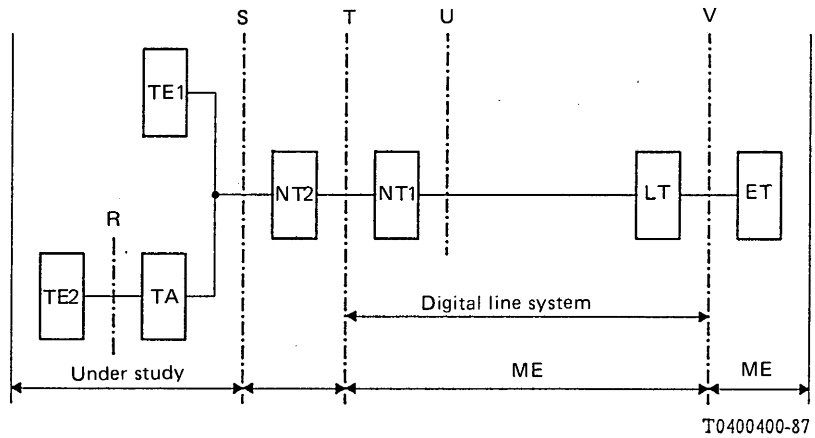


FIGURE 1/M.20

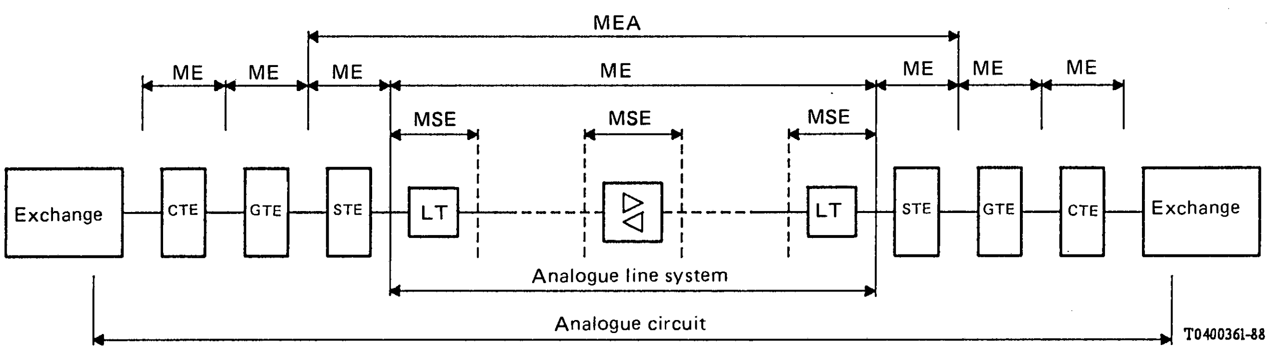
Maintenance entity concept for digital transmission networks



ET Exchange terminal
LT Line terminal
ME Maintenance entity
NT Network terminal
TA Terminal adaptor
TE Terminal equipment

FIGURE 2/M.20

Maintenance entity concept for the ISDN subscriber network



CTE Channel translation equipment
GTE Group translation equipment
STE Supergroup translation equipment
MEA Maintenance entity assembly
MSE Maintenance sub entity

FIGURE 3/M.20

Maintenance entity concept for analogue networks

3.1.1 *Definition of Maintenance Entity*

Maintenance entities are defined by the following principles:

- The different equipments of a telecommunications network constituting the MEs are interconnected at consecutive and easily identifiable interface points at which points the interface conditions defined for these equipments apply and which possess the means of detecting maintenance events and failures.[2)]

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2) If an easily identifiable interface point is not available, the interface point may be replaced by a point permitting sectionalization with functions such as, e.g., looping-back or performance monitoring.

– If the telecommunication equipment supports bidirectional transmission, it normally consists of telecommunications equipment transmitting in both directions and then both directions are considered part of the same ME.

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

– Maintenance alarm information indications in an entity should not cause related alarm information indications at other entities. In the event that such indications are permitted to occur, they should clearly indicate that the failure has occurred upstream, and not in the other entities displaying the information.

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

In an integrated digital network, for example, easily identifiable 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. The interface between the exchange terminals and the digital switch may be accessed on a virtual basis.

3.1.2 An ME has to perform a determined function between transmission interfaces (see Figure 4/M.20). The performance is checked by internal failure detection and conveyed to the maintenance interface either automatically after a failure occurrence, or after a request for maintenance information.

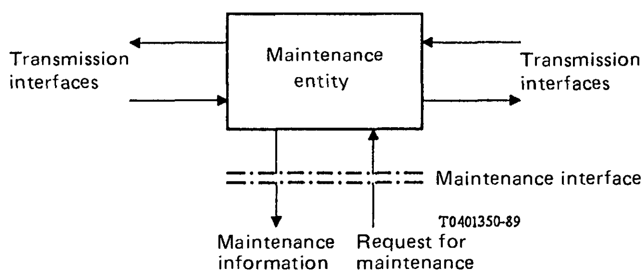


FIGURE 4/M.20

Maintenance entity interface

In addition, other operations and administrative functions may be carried out by the maintenance interface. Several types of maintenance interfaces are described in Recommendation M.30 which covers the TMN.

3.1.3 *Definition of Maintenance Entity Assembly*

A maintenance entity assembly (MEA) is defined by the following principles:

– An MEA contains a group of MEs assembled for additional maintenance purposes.

– Principles that apply for MEs apply also for MEAs.

– An MEA may detect failures and maintenance event information which can not be detected by MEs.

– An MEA may provide end-to-end maintenance alarm information which can not be provided by MEs.

End-to-end information may be collected by using additional supervision means.

3.1.4 *Defintion of Maintenance Sub-Entity (MSE)*

A maintenance sub-entity is defined by the following principles:

- The different parts of an MSE constituting the MEs are interconnected at consecutive and easily identifiable interface points.
- When a failure occurs within an MSE, it is desirable that the maintenance alarm information indication appears at the failed maintenance entity containing the MSE.
- An failed MSE should be identified as failed by the fault location process, but should lead only to the identification of the failed ME by the supervision process.
- An MSE generally corresponds to the item which is replaceable during routine operations in the event of a failure.

3.1.5 The choice of ME, MEA and MSE should be compatible with the maintenance organization of an Administration (Recommendations M.710, M.715 to M.725).

3.1.6 *Relationship between Maintenance Entities and Network Elements*

The relationship between maintenance entities and network elements is defined in Recommendation M.30.

3.2 *Failure concepts*

The following definitions and classifications are used in developing the concept of a failure.

3.2.1 *Anomalies*

An anomaly is a discrepancy between the actual and desired characteristics of an item.

The desired characteristic may be expressed in the form of a specification.

An anomaly may or may not affect the ability of an item to perform a required function.

As an example, for a multiplexer one type of elementary information that can be detected is an error in the frame alignment word. This elementary information is an anomaly. More examples of anomalies are given in Recommendation M.550.

3.2.2 *Defects*

A defect is a limited interruption in the ability of an item to perform a required function. It may or may not lead to maintenance action depending on the results of additional analysis.

Successive anomalies causing a decrease in the ability of an item to perform a required function are considered as a defect.

As an example, the G.700 [3] series recommends that three consecutive errored frame alignment words will give a loss of frame alignment. This loss of frame alignment is a defect. More examples of defects are given in Recommendation M.550.

The process of using anomalies and defects is explained in § 3.3.

3.2.3 *Failures*

A failure is the termination of the ability of an item to perform a required function.

Analysis of successive anomalies or defects affecting the same item can lead to the item being considered as "failed".

3.2.3.1 *Classification of failures*

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.

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 result in complete interruption of service(s) for one or several subscribers;
- failures which result in 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.
- A failure can be either a permanent or intermittent condition and this may alter its effect on the network.
- The severity of a failure can be determined by measuring the down time, up time and failure rate of the ME. These items are defined in Supplement No. 6 to Fascicle II.3 [4].

3.2.4 *Fault*

A fault is the inability of an item to perform a required function, excluding that inability due to preventive maintenance, lack of external resources or planned actions.

Note – A fault is often the result of a failure of the item itself, but may exist without prior failure.

3.3 *Network supervision*

Network supervision is a process in which the anomalies and defects detected by the maintenance entities ME or MEA are analyzed and checked. This analysis may be internal or external to the entity. In the external case it can be accomplished either locally or on a centralized basis.

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

a) Locating "failed" equipment, or the equipment in which a fault is suspected or a failure is believed to be imminent. It is generally carried out by analytical or statistical identification processes. The supervision process consists of three continuously running concurrent processes:

   - the supervisory process for anomalies (short period),
   - the defect supervisory process (medium period), and
   - the malfunction supervisory process (long period).

   Each process is interfaced by the characteristic data, e.g. accumulated anomaly data and accumulated defect data. The supervisory processes for anomalies and defects respectively, indicate that the anomaly or defect states have been reached. The malfunction supervisory process evaluates the performance level of the maintenance entity and judges it to be normal, degraded or unacceptable. These levels are determined from the anomalies and defects received and analyzed over a given time. The thresholds limiting degraded or unacceptable performance limits and the process period are defined for each defect and confirmed fault or group of anomalies and defects and also for each type of entity. Indications of degraded and unacceptable performance levels are generated each time the corresponding threshold is exceeded. This process is shown in Figure 5/M.20.

b) Reporting of failures to maintenance personnel.

c) Transmission of data to the maintenance 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.

e) Modify the supervision process due to:

   - the type of service being offered over a given portion of the network;
   - the time of day.

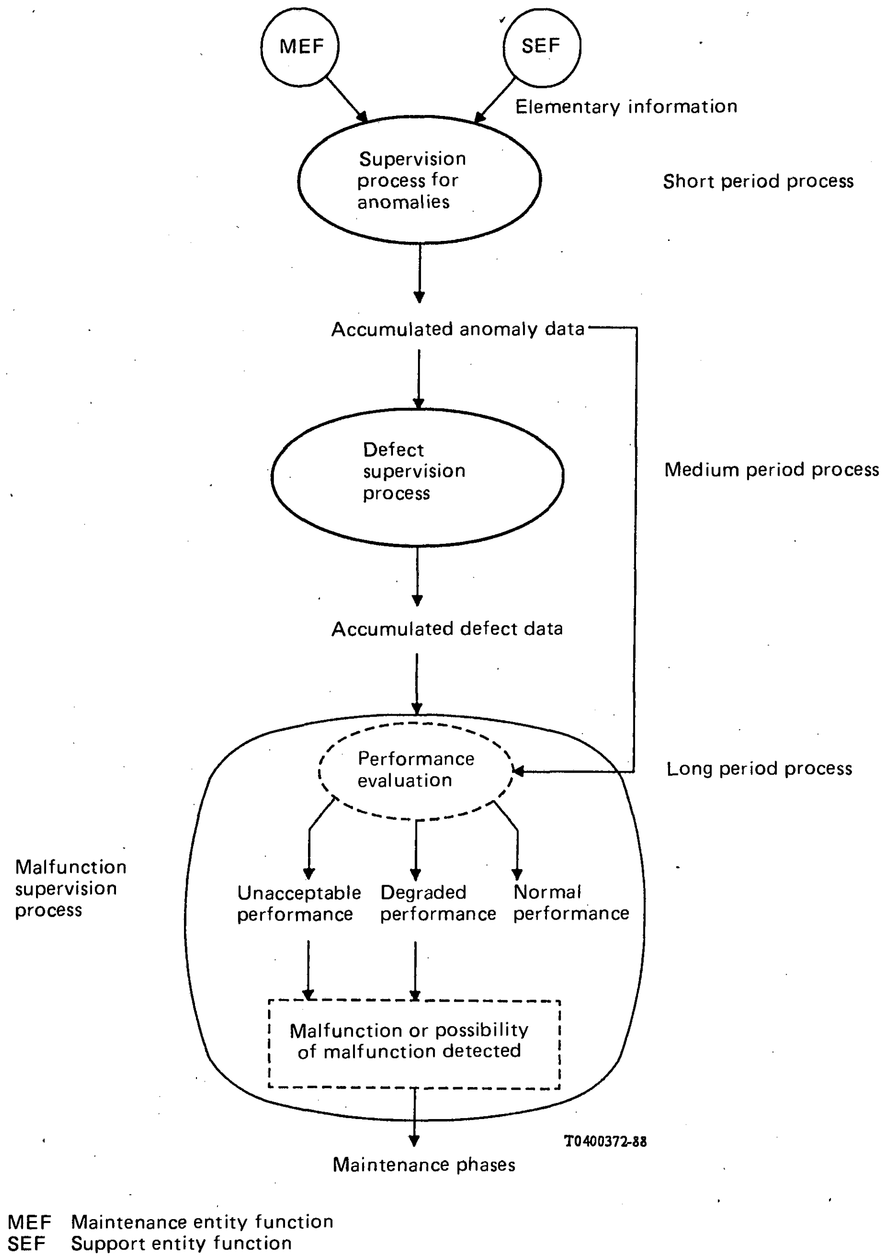


FIGURE 5/M.20

Supervision process for a maintenance entity

4 Bringing new international transmission systems and circuits into service

4.1 *Installation and acceptance testing*[3)]

For new systems, this work may include the necessary installation of new equipment. Once the new equipment is working, the Administration should make the necessary tests to ensure the new system meets required specifications. Acceptance testing of the new system or equipments should be based on policies established by the Administration. However, Administrations may wish to use the performances monitoring techniques found in Recommendation M.24 to aid in their acceptance testing of new transmission systems.

4.2 *Setting-up and lining-up*

As soon as Administrations have decided to bring a new international transmission system and/or circuit into service, the necessary contacts are made between their technical service for the exchange of information. Those services jointly select the control and sub-control stations for the new system or circuit (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 or circuit sections in its territory, and for arranging that the adjustments and tests required are made by the station staff concerned.

4.3 *Detailed considerations*

To set-up a line section or circuit which crosses a frontier, Administrations should arrive at bilateral agreements on the basis of CCITT Recommendations and, for radio-relay sections, the Recommendations of the CCIR. Administrations should refer to the following Recommendations for detailed considerations associated with bringing into service the following entities:

4.3.1 *New transmission systems*

CCITT Volume IV, § 2.3, Recommendations M.450 through M.480 and M.24.

4.3.2 *Telephone circuits*

CCITT Volume IV, § 3.1, Recommendations M.570 through M.590.

4.3.3 *Common channel signalling systems*

CCITT Volume IV, § 4, Recommendations M.761 and M.782.

4.4 *Bringing into service*

After the control station has determined from reports provided by the subcontrol station that appropriate tests and adjustments have been performed, the control station conducts overall tests of the system or circuit. The overall tests results are recorded, operations systems data bases are updated and synchronized between Administrations, and the system and/or circuits are placed in service. At this time the system and/or circuits are transferred to a performance measuring state (see § 5.1) to track and insure their continuing proper operation.

5 Maintenance phases under normal and fault conditions

Under normal conditions in the network, performance information should be gathered from MEs on a continuous or periodic basis. This data can be used to detect acute fault conditions which generate alarm reports. Further analysis may reveal subtle degradations which generate maintenance information reports.

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

As an example, Figure 6/M.20 lists the maintenance phases which are involved before and 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 mechanics used to implement the various maintenance processes should be defined in connection with each specific application in the relevant Recommendations. The maintenance phases are described below in more detail.

[3)] Installation and acceptance testing is not generally considered part of maintenance.

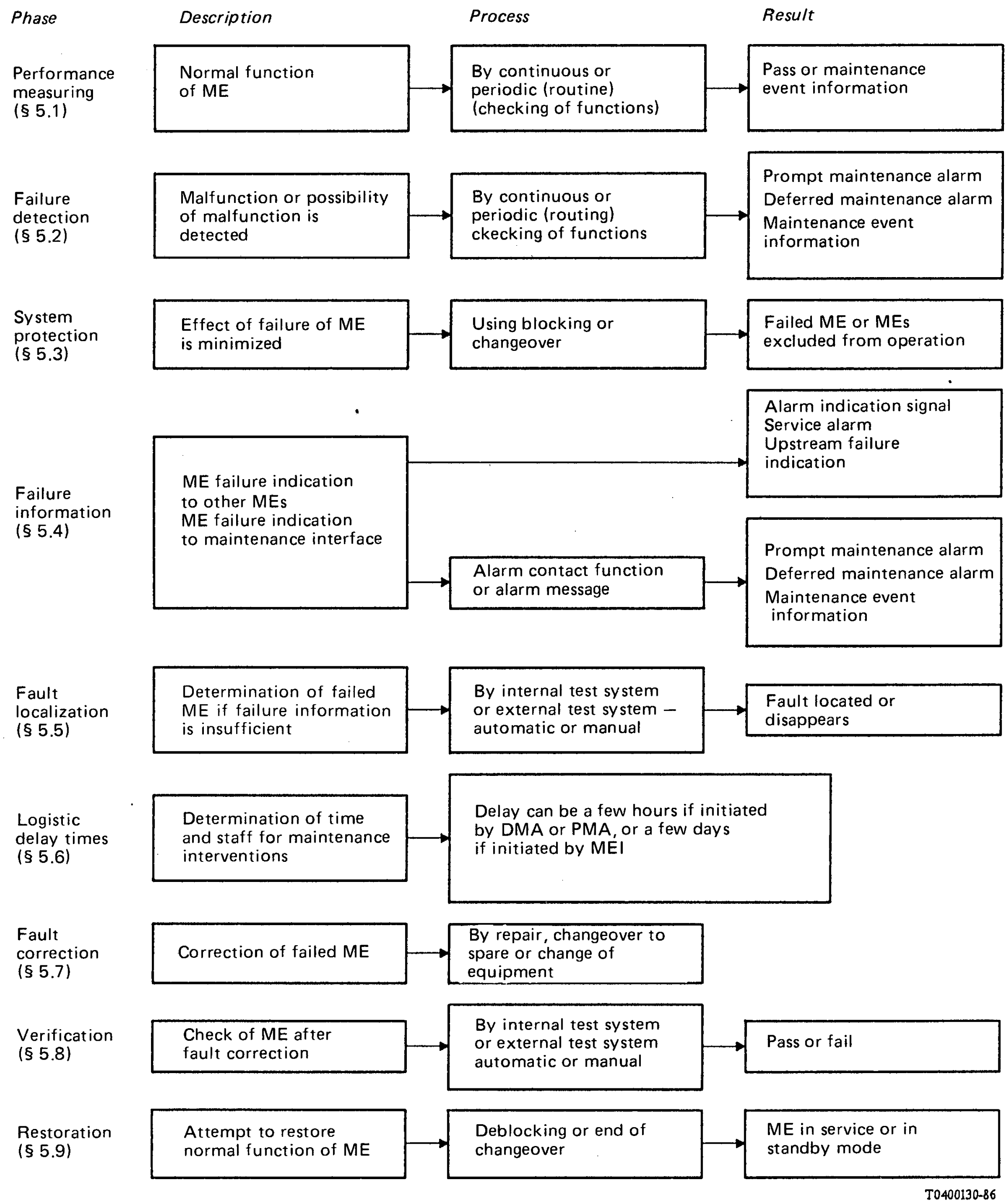


FIGURE 6/M.20

Maintenance phases under normal and failure conditions

5.1 *Performance measuring*

Different types of performance measuring mechanisms can be used:

a) continuous checking,

b) routine or periodic testing,

c) checking of behavior in live traffic,

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

The rules governing the measurement mechanisms are defined when conceiving the systems; no intervention of the maintenance 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 measurement 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 measurement mechanisms are listed below.

5.1.1 *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.

5.1.2 *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.

5.1.3 *Checking in live traffic*

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

This checking exists if the ME itself indicates a failed performance or the continuous detection of anomalies or defects.

All of the elementary information from the different detectors is either retransmitted by each entity to a processing unit or processed locally.

Performance parameters are derived from this information.

5.1.3.1 *Processing of performance parameters*

Some performance parameters in use are Errored Seconds (ES), Severely Errored Seconds (SES) and Degraded Minutes (DM). These particular parameters are defined in Recommendation G.821 [5].

Each of the performance parameters (e.g., ES, SES, DM) is to be processed separately in order to evaluate the performance level of the entity's operation.

5.1.3.2 *Evaluation of unacceptable performance*

Unacceptable performance is characterized by a significant and long-lasting degradation in quality. It can be associated with the failed state.

It is ascertained by statistical analysis of each of the performance parameters individually, throughout a given time T1.

As soon as the result of statistical analysis reaches a N1 threshold (defined for each entity individually), the entity is declared to be at an unacceptable level of performance.

Elsewhere, for each defect corresponding to an interruption, lasting x consecutive seconds, the entity is considered as having reached an unacceptable level.

5.1.3.3 *Evaluation of degraded performance*

Each of the performance parameters is analyzed statistically over a time T2 which can be a relatively long period.

As soon as the result of statistical analysis reaches a N2 threshold (to be defined), the entity can be considered to be at degraded performance. The time T2 will depend on the entity in question.

This checking leads to maintenance 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.

If the degraded performance level is characterized by a gradual degradation in quality, the maintenance personnel should be informed before this decrease in performance becomes unacceptable to the user.

5.1.4 *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.

5.2 *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. Corresponding maintenance alarm information is then passed on to the appropriate entities.

5.3 *System protection*

When a failure has occurred or performance has degraded, the following functions must be performed:

- as a result of the medium and longer period supervision process a signal must be transmitted to all the concerned network equipment of any necessary information for automatic (preferred) 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 failure 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 maintenance alarm information identifying 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 failure 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 maintenance alarm information indicating the maintenance entity containing the failed equipment.

5.4 *Failure or performance information*

Information on failure, unacceptable performance or degraded performance will normally be transmitted to the maintenance staff and other parts of the network notified when appropriate.

Information for the use of personnel is available either in the entity, when the processing of anomalies or defects is internal, or via a unit which provides processing, when external to the entity.

5.4.1 *Alarm information categories*

The following maintenance alarm information may be associated with the information of failure or unacceptable or degraded performance:

a) *Prompt maintenance alarm (PMA)*

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

b) *Deferred maintenance alarm (DMA)*

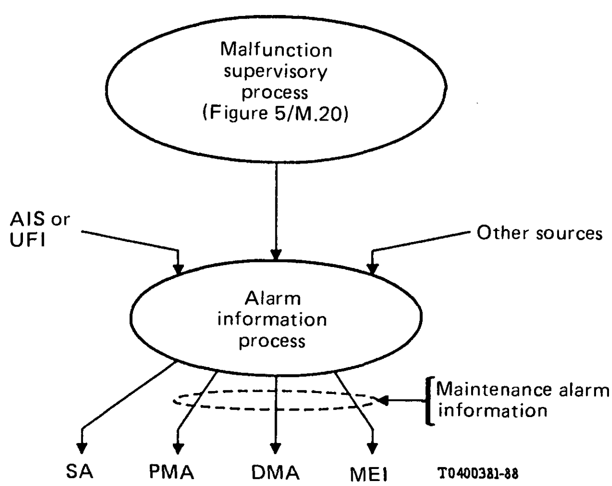
A deferred maintenance alarm is generated when immediate action is not required by maintenance personnel, e.g. when performance falls below standard but the effect does not warrant removal from service, or generally if automatic changeover to standby equipment has been used to restore service.

c) *Maintenance event information (MEI)*

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

Starting with the malfunction supervisory process from Figure 5/M.20, Figure 7/M.20 shows the alarm informtion process for an ME. The actual PMA, DMA or MEI may or may not be generated in the ME. When generated outside the ME, the alarm information process may combine information from other sources (e.g., other MEs, time of day, traffic load, etc.) with the output from the malfunction supervisory process to decide if a PMA, DMA or MEI should be generated. When an AIS or UFI is received, an ME may be required to generate an SA.

Both the malfunction supervisory process and the alarm information process, including the use of PMAs, DMAs and MEIs, can also be applied to other non-telecommunications equipment.



AIS Alarm indication signal
UFI Upstream failure indication
SA Service alarm
PMA Prompt maintenance alarm
DMA Deferred maintenance alarm
MEI Maintenance event information

FIGURE 7/M.20

Alarm information process

5.4.2 *Other fault and service indications*

In order to avoid unnecessary maintenance actions and to signal the unavailability of the service, the following fault indications are used:

– Alarm indication signal (AIS)

  An alarm indication signal (AIS) is a signal associated with 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 binary equivalent of the AIS corresponds to an all 1s signal.

  Note 1 – The AIS is different from the "alarm information to the remote end"; see § 5.4.4.

  Note 2 – The AIS capability does not impose any restrictions on the binary content of signals which may be transmitted over the digital hierarchy at the primary multiplex and higher levels. The implications at the 64-kbit/s level and at lower bit rates are under study, since ambiguity arises between AIS and an all 1s information signal.

  Note 3 – For a maintenance entity with multidestination ends (e.g. in networks with TDMA/DSI satellite systems) alarm indication signals on a circuit basis may useful. This subject is under study.

  Note 4 – In the particular case of the 44 736 kbit/s hierarchical level, the AIS is defined as a signal:

  i) with a valid frame alignment signal, parity and justification control bits as defined in Table 2/G.752 [6];

  ii) with the tributary bits being set to a 1010... sequence, starting with a binary one ("1") after each frame alignment, multiframe alignment and justification control bit;

  iii) and with all justification control bits being set to binary zero ("0").

  Demultiplexers of the 44 736 kbit/s hierarchical level must produce the all 1s AIS at their tributary outputs when they receive the 44 736 kbit/s AIS at their high speed inputs.

– 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 failure has occurred upstream of this point, and no unnecessary maintenance activities are initiated.

  The appearance of an alarm indicates either a fault 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.

5.4.3 *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.

5.4.4 *Alarm information to the remote end*

Equipment which is a source of digital multiple signals (i.e. multiple equipment or exchanges) may, in case of a fault condition, transmit alarm information within a specified bit or specified bits of the pulse frame. This information is intended for evaluation at the remote terminal (at the end of the digital link). Examples: see Recommendation G.704, § 2.3.2 [7], Recommendation G.732, § 4.2.3 [8] and Recommendation G.733, § 4.2.4 [9].

5.5 *Fault localication*

Where the initial failure information is insufficient for fault localization within a failing ME, it has to be augmented with information obtained by additional fault 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);
- if an ME can be subdivided into MSEs, the faulty MSE should be identified as failed in the fault localization process;
- for interchangeable items, the failed item must be identified uniquely.

5.6 *Logistic delay*

5.6.1 The logistic delay is the period of time between the fault 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 MEI.

5.6.2 Following a PMA or DMA alarm, fault 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.

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

5.7 *Fault correction*

Fault correction normally requires change or repair of an ME, MSE or a part thereof. One or more fault corrections can be performed in the course of a maintenance visit. It is desirable that strategies be developed to accomplish fault 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).

Normally, cooperation between maintenance elements in different Administrations will result in the satisfactory identification and correction of faults. There may be circumstances, however, where the fault escalation procedure defined in Recommendation M.711 may be required.

5.8 *Verification*

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

5.9 *Restoration*

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

6 Additional maintenance activities

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

6.1 *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.

6.2 *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.

6.3 *Preventive maintenance actions*

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

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

7 Other maintenance considerations

7.1 *Reference test frequency considerations*

(Under study.)

7.2 *Use of maintenance test lines and loop-backs*

(Under study.)

References

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

[2] CCITT Supplement *New operation and maintenance organization in the Milan Italcable Intercontinental telecommunication centre*, Vol. IV, Supplement No. 6.2.

[3] CCITT Recommendations of the G.700 Series *Digital networks*, Vol. III, Rec. G.700 to G.956.

[4] CCITT Supplement *Terms and definitions for quality of service, network performance, dependability and trafficability studies*, Vol. II, Fascicle II.3, Supplement No. 6.

[5] CCITT Recommendation *Error performance on an international digital connection forming part of an integrated services digital network*, Vol. III, Rec. G.821.

[6] CCITT Recommendation *Characteristics of digital multiplex equipments based on a second order bit rate of 6312 kbit/s and using positive justification*, Vol. III, Rec. G.752.

[7] CCITT Recommendation *Functional characteristics of interfaces associated with network nodes*, Vol. III, Rec. G.704.

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

[9] CCITT Recommendation *Characteristics of primary PCM multiplex equipment operating at 1544 kbit/s*, Vol. III, Rec. G.733.

Recommendation M.21

PRINCIPLES FOR MAINTENANCE PHILOSOPHY AND CONSIDERATIONS FOR MAINTENANCE STRATEGY FOR TELECOMMUNICATION SERVICES[1)]

1 Introduction

The purpose of this Recommendation is to provide principles for a maintenance philosophy which can be applied to all telecommunication services, and from which a common strategy can be derived.

2 Quality of Service

An important concept in the consideration of a maintenance philosophy is that of Quality of Service (QOS).

This is defined in Recommendation E.800 [1] as "the collective effect of service performances which determine the degree of satisfaction of a user service".

3 Quality of Service factors

QOS comprises a number of Quality of Service factors or performances which are enumerated and defined in Recommendation E.800 [1] and listed below. Some of these comprise further factors.

They are illustrated in Figure 1/M.21 which is taken from Recommendation E.800 [1].

i) service support performance;

ii) service operability performance;

iii) serveability performance;

iv) service accessibility performance;

v) service retainability performance;

vi) service integrity;

vii) transmission performance;

viii) trafficability performance;

ix) propagation performance;

x) availability (performance);

xi) reliability (performance);

xii) maintainability (performance);

xiii) maintenance support (performance).

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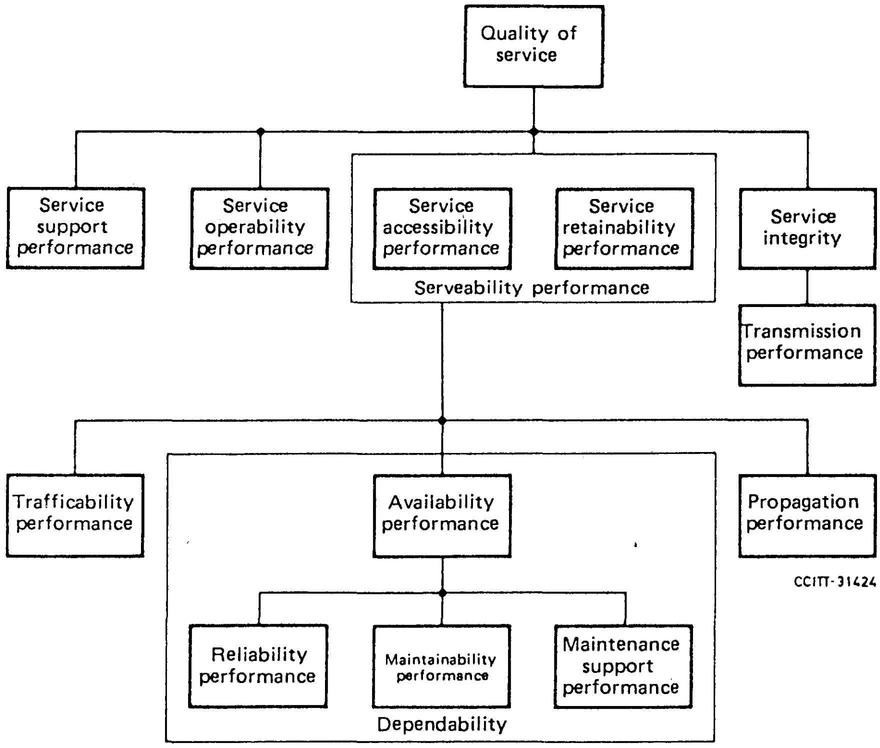
1) It is intended that the subject matters contained in this Recommendation will be studied and developed further as the results of the work done in other Study Groups on Quality of Service concepts become available.



Note — Not all connections between service concepts have been shown in this figure, e.g., connection between service integrity and maintainability performance.

FIGURE 1/M.21

Performance concepts

4 Relationship between Quality of Service factors which are relevant in maintenance

Figure 1/M.21 indicates the relationship between the availability performance of individual items (e.g., terminal equipment, networks, etc.) which are used in the operation of a service and the serveability performance of that service. This relationship is such that, given satisfactory trafficability and propagation performances, then the availabiity performance of each item is the means by which satisfactory serveability of a service is obtained.

5 Principles of maintenance philosophy for telecommunication service

5.1 Serveability performance of a service should be completely and precisely defined, in terms of parameters to be taken into consideration and performance objectives, tolerances and conditions for these parameters.

5.2 Performance objectives of items used for services should be considered with reference to the serveability performance of these services.

5.3 In the case where an item is shared by services, then its performance objectives should be such as to enable the service with the most stringent serveability requirement to meet this, given that trafficability and propagation performance are satisfactory.

5.4 Maintenance arrangements for a service should be such that all Quality of Service factors which are relevant to maintenance are satisfactory.

5.5 As factors other than those of Quality of Service (maintenance and operation costs, durability of equipments, etc.) and a large variety of networks and services need to be taken into consideration when organizing maintenance, arrangements for maintenance of a service should be defined as far as possible within a common and global approach.

6 Maintenance considerations for new telecommunication services

6.1 When a new service is to be introduced, early consideration should be given to its operational and maintenance requirements. In practice, these will depend on its Quality of Service objectives and therefore on the performance parameter objectives which are set for each item which is used for operating the service (e.g., terminal equipment, network, etc.). Thus each item should be considered individually.

6.2 If such an item is unique to a service, there will be new operational and maintenance requirements.

6.3 If such an item is not unique to a service and it is already used in providing an existing service, then consideration should be given to whether the existing operational and maintenance requirements need to be changed. This will depend on whether the performance parameter objectives are changed.

6.4 Operational and maintenance requirements should address the following areas:

- line-up and provisioning procedures;
- maintenance procedures, including those for fault prevention, detection, reporting and localization;
- restoration procedures;
- restoration requirements (e.g., maximum permitted number of restoration links in tandem, maximum permitted propagation delay, maximum tolerable interruption duration, degree of protection required);
- serveability performance;
- organization of operation and maintenance effort to deal with the above-mentioned areas;
- the interaction required between elements and centres of operation and maintenance effort;
- testing equipment and facilities for use within the operation and maintenance organization;
- the exchange of contact point information (as indicated in Recommendation M.93);
- maintenance limits for transmission performance parameters.

6.5 Consideration should also be given to whether, in the provision and maintenance of a service, these subject areas require inter-administration agreements or the development of specific CCITT Recommendations.

References

[1] CCITT Recommendation *Quality of Service and dependability vocabulary*, Vol. II, Rec. E.800.

Recommendation M.30

PRINCIPLES FOR A TELECOMMUNICATIONS MANAGEMENT NETWORK

1 General

This Recommendation presents the general principles for planning, operating and maintaining a Telecommunications Management Network (TMN). The purpose of a TMN is to support Administrations in management of its telecommunications network. A TMN provides a host of management functions to the telecommunication network and offers communications between itself and the telecommunication network. In this context a telecommunications network is assumed to consist of both digital and analogue telecommunications equipment and associated support equipment.

The basic concept behind a TMN, therefore, is to provide an organized network structure to achieve the interconnection of the various types of Operations Systems (OSs) and telecommunications equipment using an agreed upon architecture with standardized protocols and interfaces. This will provide the telecommunication network Administrations and telecommunication equipment manufacturers a set of standards to use when developing equipment for and designing a management network for modern telecommunication networks [including their Integrated Services Digital Networks (ISDNs)].

1.1 *Relationships of a TMN to a telecommunication network*

A TMN can vary in size from a very simple connection between an OS and a single piece of telecommunication equipment to a massive network interconnecting many different types of OSs and telecommunication equipment. It may provide a host of management functions and offers communications both between the OSs and between OSs and the various parts of the telecommunication network which consists of many types of digital and analogue telecommunication equipment and associated support equipment, such as transmission systems, switching systems, multiplexers, signalling terminals. Such equipment is referred to generically as network elements (NEs).

Figure 1/M.30 shows the general relationship between a TMN and a telecommunications network which it manages. Note that a TMN is conceptually a separate network that interfaces a telecommunications network at several different points to receive information from it and to control its operations. However, a TMN may often use parts of the telecommunication network to provide its communications.

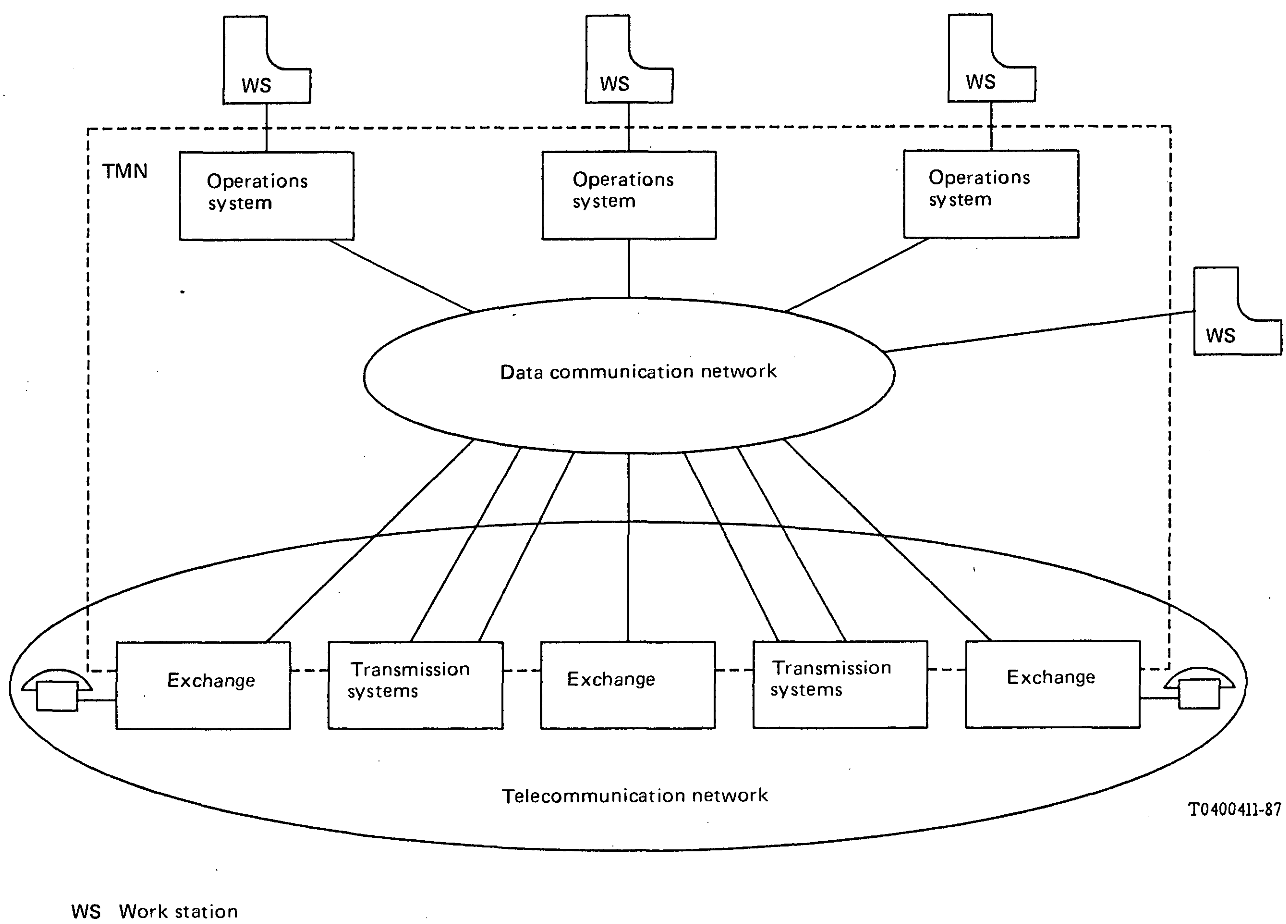


FIGURE 1/M.30

General relationship of a TMN to a telecommunication network

1.2 *Field of application*

The following are examples of the networks and major types of equipment that may be managed over the TMN:

- public and private networks, including ISDNs;
- transmission terminals (multiplexers, cross connects, channel translation equipment, etc.);
- digital and analogue transmission systems (cable, fibre, radio, satellite, etc.);
- restoration systems;
- digital and analogue exchanges;
- circuit and packet switched networks;
- signalling terminal and systems including signal transfer points (STP) and real time data bases;
- PBXs and customer terminals;
- ISDN user terminals;
- associated support systems (test modules, power systems, air conditioning units, building alarms systems, etc.).

In addition, by the monitoring, testing or control of these equipments, a TMN may be used to manage distributed entities such as circuits.

2 TMN architecture and definitions

The following definitions for the TMN architecture are conceptual in nature and are thus intended to be working definitions that cover the most common and general cases. It should be recognized that, because of the exceedingly complex nature of some telecommunications equipment and because of the ability, using microprocessors, to distribute functionality within various network parts, these definitions may not rigidly cover every possible physical configuration that may be encountered. However, even these exceptions are expected to fit within the general TMN concept and to be covered by its principles.

2.1 *TMN functional architecture*

A TMN functionally provides the means to transport and process information related to the management of telecommunication networks. As shown in Figure 2/M.30, it is made up of operations system functions (OSFs), mediation functions (MFs) and data communications functions (DCFs). The function blocks provide the TMN general functions which enable a TMN to perform the TMN application functions. A TMN is also connected to network element functions (NEFs) and workstation functions (WSFs).

Figure 2/M.30 shows the function blocks of a TMN. As shown, all like reference points (q to q, f to f, and x to x) are connected through the facility of the DCF. The WSF may also be directly connected to the NEF through a connection external to the TMN.

2.1.1 *Definition of function blocks*

2.1.1.1 **operations system function (OSF) block**

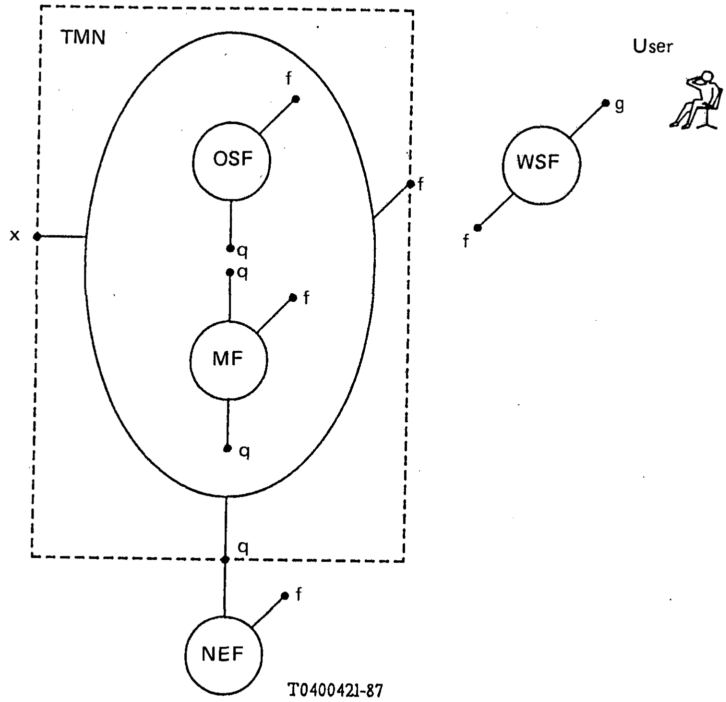
The OSF block processes information related to telecommunication management to support and/or control the realization of various telecommunication management functions. Details of the OSF are given in § 5.2.

2.1.1.2 **mediation function (MF) block**

The MF block acts on information passing between NEFs and OSFs to achieve smooth and efficient communication. Major MFs include communication control, protocol conversion and data handling, communication of primitive functions, processes involving decision making, and data storage. Details of the MF are given in § 5.4.

2.1.1.3 **data communications function (DCF) block**

The DCF block provides the means for data communication to transport information related to telecommunications management between function blocks. Details of the CDF are given in § 5.3.



Reference points:

q Class of reference points between OS, MF and NE functions

f Class of workstation reference points

g Class of workstation to user reference points

x Class of reference points to other networks, including other TMNs

Function blocks:

WSF Workstation function
OSF Operations system function
MF Mediation function
NEF Network element function
DCF Data communications function

FIGURE 2/M.30

A generalized functional architecture for a TMN

2.1.1.4 **network element function (NEF) block**

The NEF block communicates with a TMN for the purpose of being monitored and/or controlled. Details of the NEF are given in § 5.5.

2.1.1.5 **work station function (WSF) block**

The WSF block provides means for communications among function blocks (OSF, MF, DCF, NEF) and the user. Details of the WSF are given in § 5.6.

2.1.2 *Definitions of reference points*

The following reference points define conceptual points of information exchange between non-overlapping function blocks. A reference point becomes an interface when the connected function blocks are embodied in separate pieces of equipment.

2.1.2.1 **q reference points**

The q reference points connect the function blocks NEF to MF, MF to MF, MF to OSF and OSF to OSF either directly or via the DCF. Within the class of q reference points the following distinctions are made:

q_1: the q_1 reference points connect NEF to MF either directly or via the DCF;

q_2: the q_2 reference points connect MF to MF either directly or via the DCF;

q_3: the q_3 reference points connect MF to OSF and OSF to OSF either directly or via the DCF.

2.1.2.2 **f reference points**

The f reference points connect function blocks OSF, MF, NEF, DCF to the WSF.

2.1.2.3 **g reference points**

The g reference points are points between the WSF and the user.

2.1.2.4 **x reference points**

The x reference points connect a TMN to other management type networks including other TMNs.

2.2 *TMN physical architecture*

Figure 3/M.30 shows a generalized physical architecture for the TMN.

2.2.1 *Definitions of the physical architecture*

TMN functions can be implemented in a variety of physical configurations. The following are the definitions for consideration of implementation schemes.

2.2.1.1 **operations system (OS)**

The OS is the stand alone system which performs OSFs.

2.2.1.2 **mediation device (MD)**

The MD is the stand alone device which performs MFs. MDs can be implemented as hierarchies of cascaded devices.

2.2.1.3 **data communications network**

The DCN is a communication network within a TMN which supports the DCF at the reference point q_3.

2.2.1.4 **local communication network (LCN)**

The LCN is a communication network within a TMN which supports the DCF normally at the reference points q_1 and q_2.

2.2.1.5 **network element (NE)**

The NE is comprised of telecommunication equipment (or groups/parts of telecommunication equipment) and support equipment that performs NEFs and has one or more standard Q-type interfaces.

2.2.1.6 **workstation (WS)**

The WS is the stand alone system which performs WSFs.

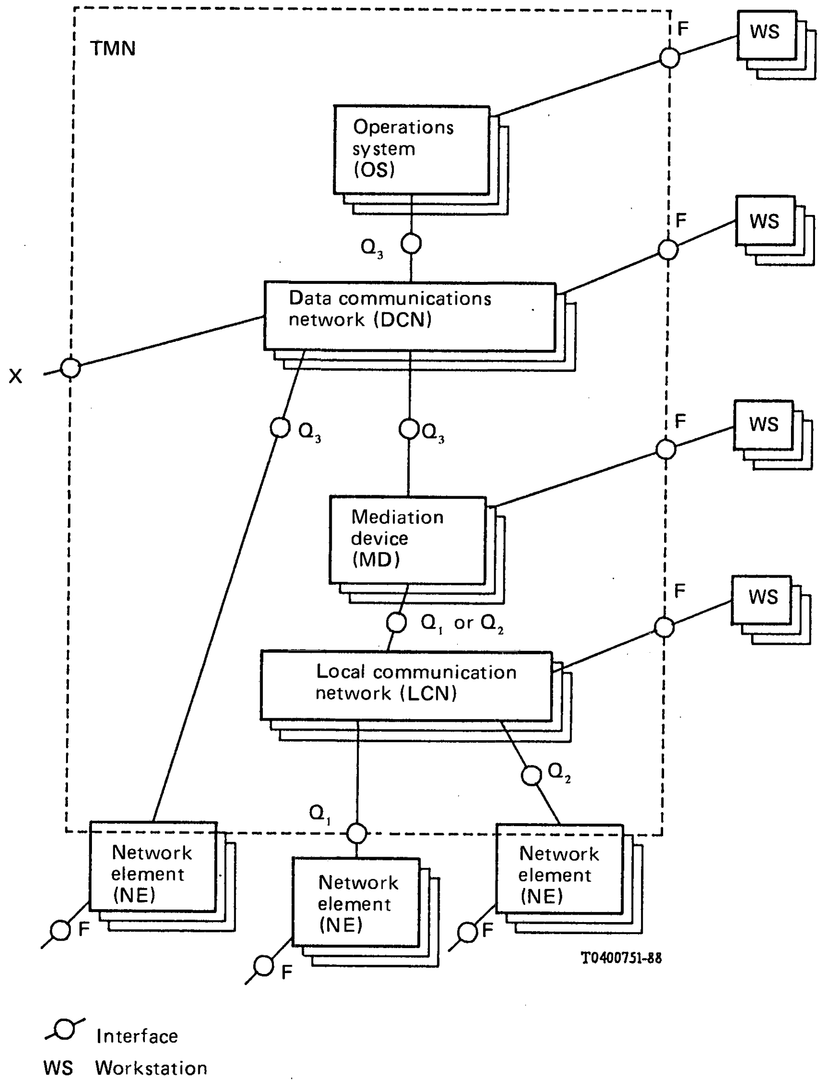


FIGURE 3/M.30

A generalized physical architecture for a telecommunications management network (TMN)

2.2.2 *Definitions of the standard interfaces*

Standard interfaces are defined corresponding to the reference points.

2.2.2.1 **Q interface**

The Q interface is applied at q reference points. To provide flexibility of implementation, the class of Q interfaces is made up of the following three subclasses:

- interface Q_1, intended to connect NEs containing no MF to MDs or to NEs containing MF via an LCN
- interface Q_2, intended to connect MDs to MDs, NEs containing MF to MDs or to other NEs containing MF via an LCN
- interface Q_3, intended to connect MDs, NEs containing MF and OSs to OSs via a DCN.

Note 1 – Applications different from primary applications are not excluded when different functions are combined for implementation.

Note 2 – A higher numbered interface will generally use a more sophisticated protocol than a lower numbered interface.

2.2.2.2 **F interface**

The F interface is applied at f reference points.

2.2.2.3 **G interface**

The G interface is applied at the g reference point.

2.2.2.4 **X interface**

The X interface is applied at the x reference point.

2.3 *TMN protocol families*

The Q interfaces as present on the DCN and the LCN determine protocol families PQ_{DCN} and PQ_{LCN}.

2.3.1 *Definitions of the TMN protocol families*

2.3.1.1 **PQ_{DCN}**

A family of protocol suites for use with the DCN applied to the Q_3 interface.

2.3.1.2 **PQ_{LCN}**

A family of protocol suites for use with the LCN, applied to the Q_1 and Q_2 interfaces.

2.4 *Consideration of reference and physical configurations*

2.4.1 *q-class considerations*

2.4.1.1 *q-class reference configuration*

Figure 4/M.30 shows the q-class reference configuration illustrating the q_1, q_2 and q_3 reference points and the types of functional blocks that can be connected to the reference points. Figure 4a/M.30 shows the case with explicit DCF (with data communication functions indicated). Since the DCF process preserves the information content, the same reference point appears on both sides of a DCF in the figure.

2.4.1.2 *Physical realization of the reference configuration*

Figure 5/M.30 shows examples of the relationship of the physical configurations to the reference configuration with DCFs not explicitly shown (implicit DCF case). It illustrates combinations of physical interfaces at the reference points q_1, q_2 and q_3. At reference points where a physical interface appears, this is denoted with a capital Q.

Figure 5/M.30, case a), shows an NE physically connected via a Q_1 interface to an MD, two MDs interconnected with a Q_2 interface and the top MD connected with OS via the Q_3 interface.

Figure 5/M.30, case b), shows an NE physically connected to an MD via a Q_1 interface. The MFs are merged into one MD which interfaces to the OS via a Q_3 interface, (see also Note 1).

Figure 5/M.30, case c), shows an NE with an internal MF which is interconnected to an MD via a Q_2 interface. The MD is connected to the OS via a Q_3 interface.

Figure 5/M.30, case d), shows an NE with MFs directly connected to the OS via a Q_3 interface.

Note 1 – Where a reference point is shown in Figure 5/M.30 this means that the point is inside a physical box. The designer is free to apply any implementation. It is not necessary that this point is physically present inside the equipment.

Note 2 – Any other equipment may be present between two adjacent boxes, which is necessary for the connection of these boxes. This equipment represents the DCF of Figure 2/M.30. Such equipments perform OSI network functions and are not shown in Figure 5/M.30, e.g., the Q_3 interface normally connects to the DCN which provides the data communication to the OS.

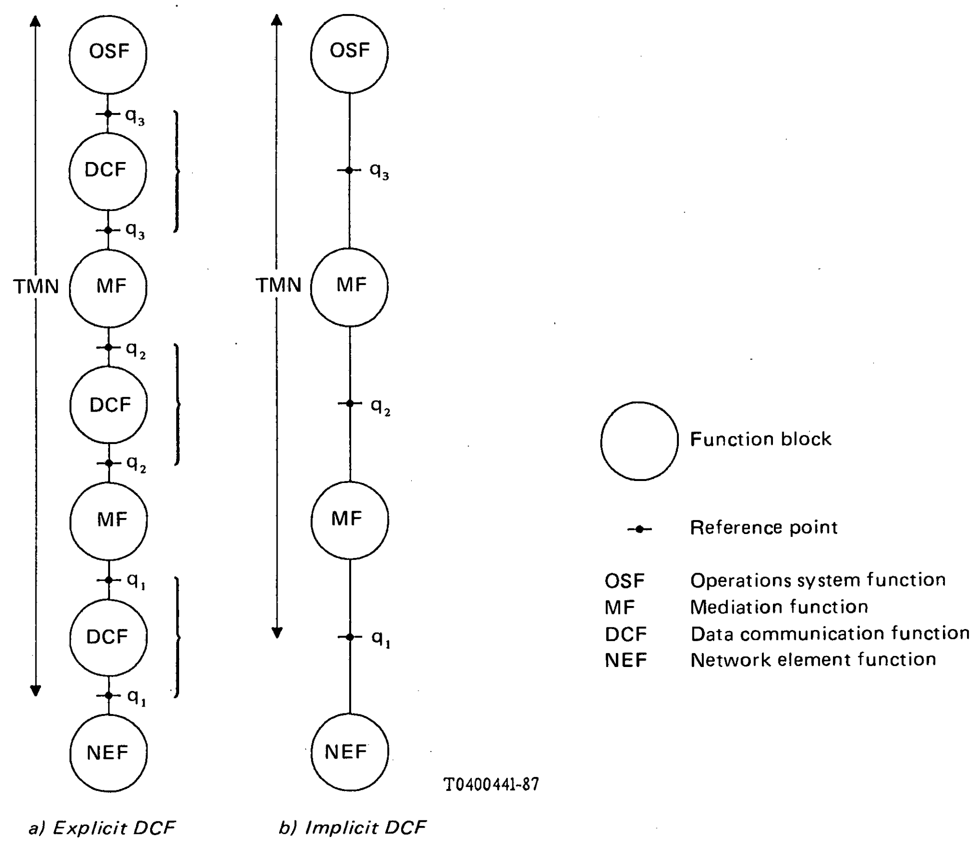
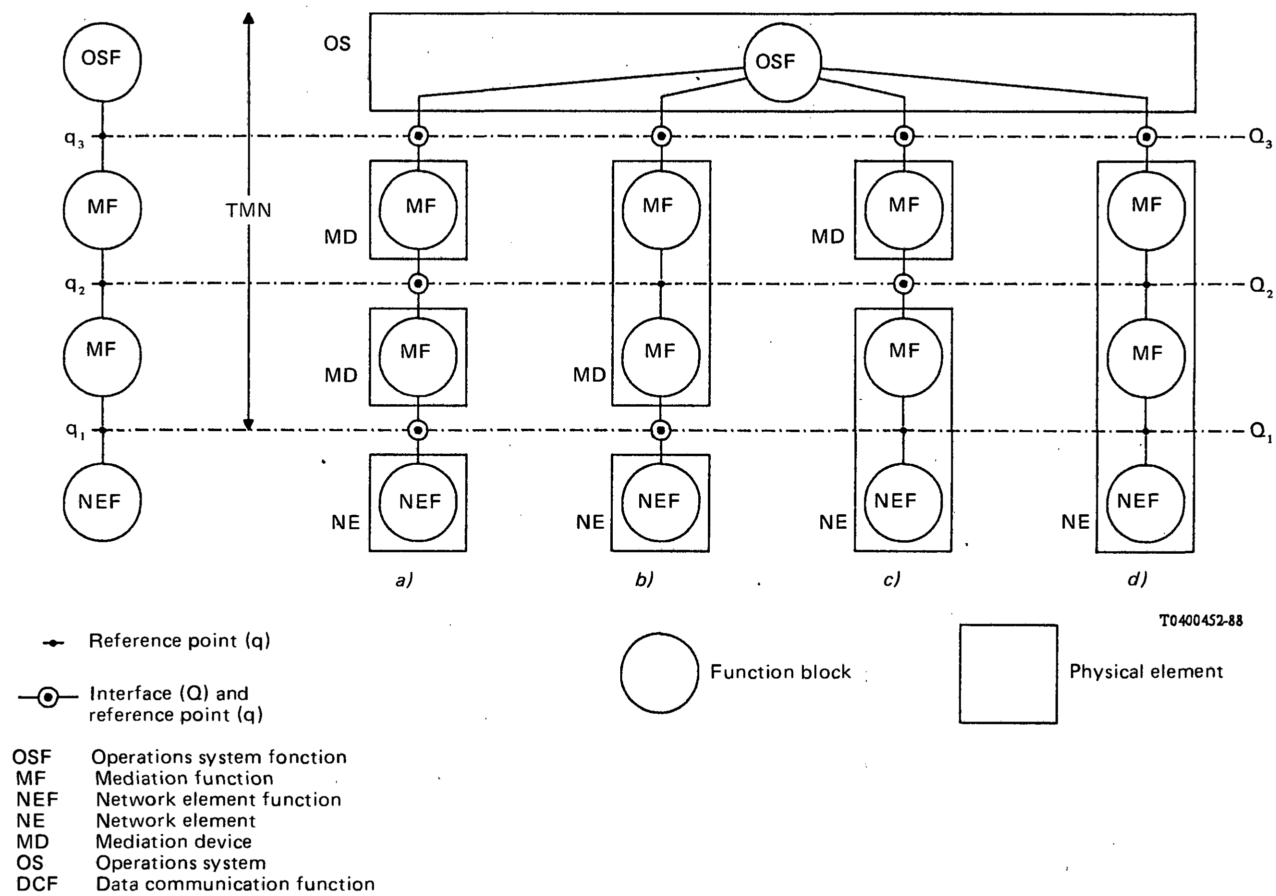


FIGURE 4/M.30

The q-class reference configuration

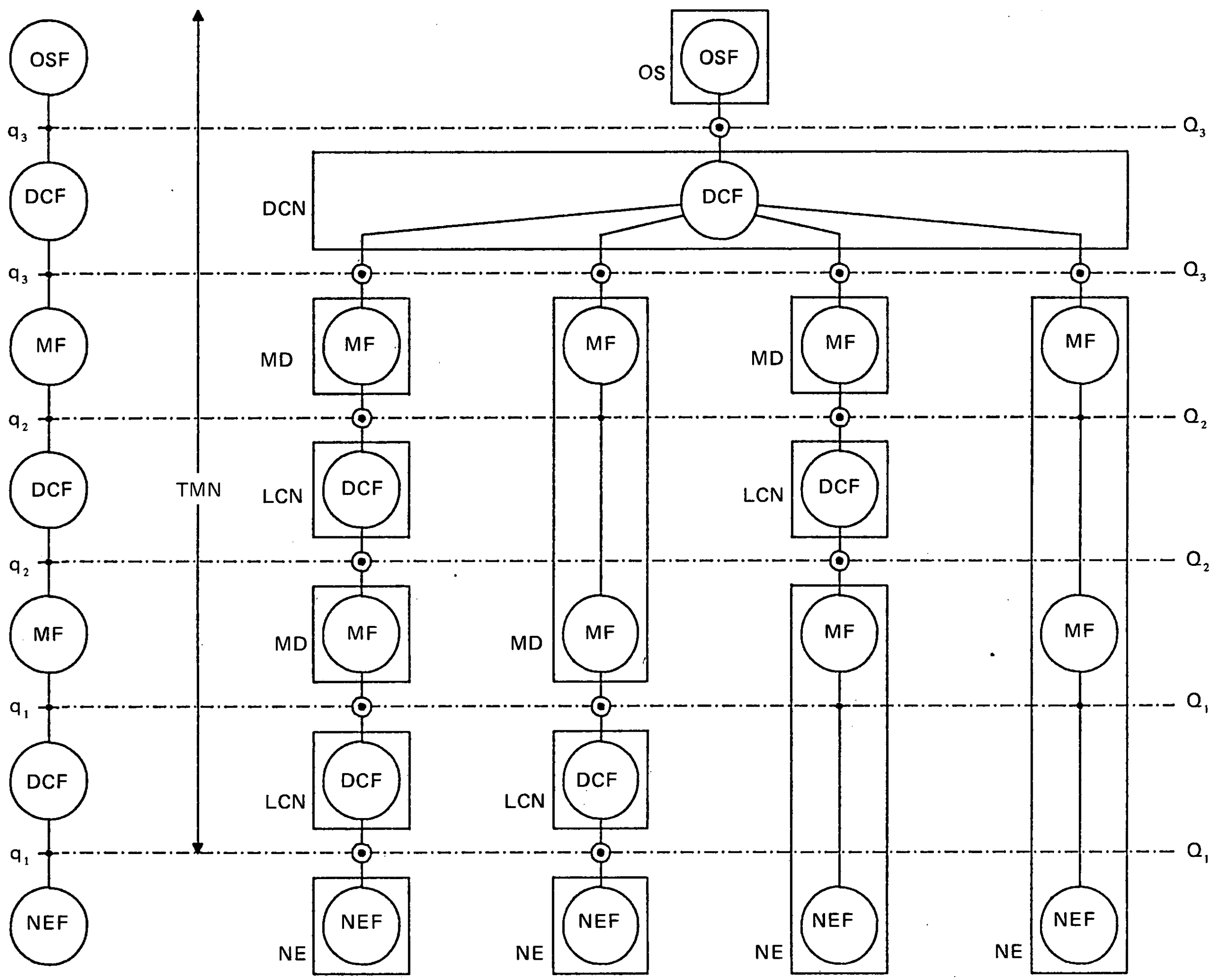
Figure 6/M.30 shows the same examples of the relationship of the physical configuration to the reference configuration as those given in Figure 5/M.30, but with the DCFs explicitly shown (explicit DCF case). It also shows different possible configurations that may be used for an LCN (e.g. star, bus or ring).



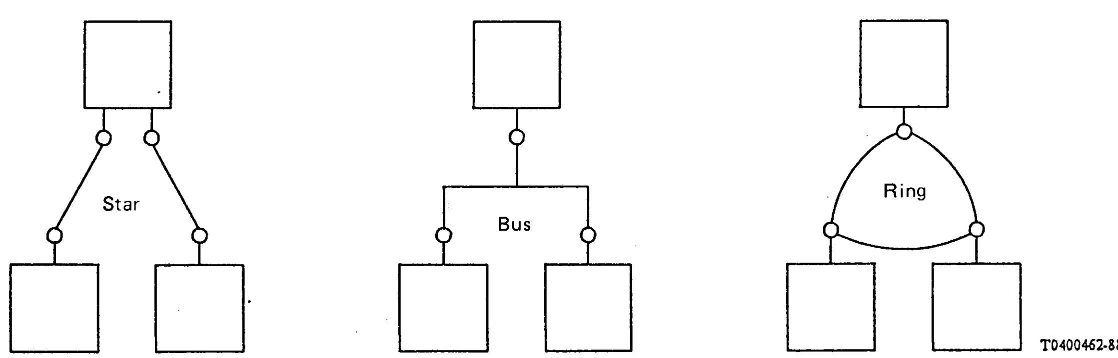
Note – The OSF shown on the top of this figure can consist of a family of OSFs.

FIGURE 5/M.30

Examples of the relationship of the physical configuration to the reference configuration (with implicit DCF)



a) Examples of TMN configurations



b) Examples of LCN configurations

—•— Reference point (q)

—○— Interface (Q)

—⊙— Interface (Q) and reference point (q)

LCN Local communication network
DCN Data communication network
OSF Operations system function
DCF Data communication function
MF Mediation function
NEF Network element function
NE Network element
OS Operation system
MD Mediation device

Note – The OSF shown on the top of this figure can consist of a family of OSFs.

FIGURE 6/M.30

Examples of the relationship of physical configuration to the reference configuration (with explicit DCF)

Figure 7/M.30 shows examples, with the DCFs not explicitly shown, of a special group of physical configurations in which NEs are cascaded to provide a single interface to the higher order TMN equipment. This is convenient for co-located NEs which generally contain different levels of MF, e.g., transmission equipment co-located with an exchange.

Figure 7/M.30 case a), shows how an NE without an internal MF is connected via a Q_1 interface to an NE with an internal MF which itself has a Q_2 interface to an MD.

Figure 7/M.30 case b), shows how an NE with an internal MF is connected via a Q_2 interface to an NE with higher level MF, which itself has a Q_3 interface to OS.

Figure 7/M.30 case c), shows another possibility where an NE without an internal MF has a Q_1 interface to an NE with an internal MF which itself has a Q_3 interface to OS.

Figure 8/M.30 shows simplified examples of how NEs and MDs might be physically cascaded to serve multiple NEs. The examples show the connections to the OSs, but do not explicitly show the connections to the DCFs.

3 Functions associated with a TMN

The functions associated with a TMN can be split into two parts:

- TMN general functions provided by the function blocks defined in § 2.1; and
- TMN application functions listed in § 3.2;

3.1 *TMN general functions*

The TMN general functions provide support for the TMN application functions. Examples of TMN general functions are:

- transport, which provides for the movement of information among TMN elements;
- storage, which provides for holding information over controlled amounts of time;
- security, which provides control over access for reading or changing information;
- retrieval, which provides access to information;
- processing, which provides for analysis and information manipulation;
- user terminal support which, provides for input/output of information.

3.2 *TMN applications functions*

A TMN is intended to support a wide variety of application functions which cover the operations, administration, maintenance and provisioning of a telecommunication network.

These four categories have a different meaning depending on the organization of an Administration. Moreover, some of the information which is exchanged over the TMN may be used in support of more than one management category. Therefore, the classification of the information exchange within the TMN is independent of the use that will be made of the information.

While it cannot claim to be complete, this section describes some of the most important application functions in terms of the OSI management categories, expanded to fit the need of a TMN.

The application functions have been classified in accordance with fields of use into major management categories:

a) performance management,

b) fault (or maintenance) management,

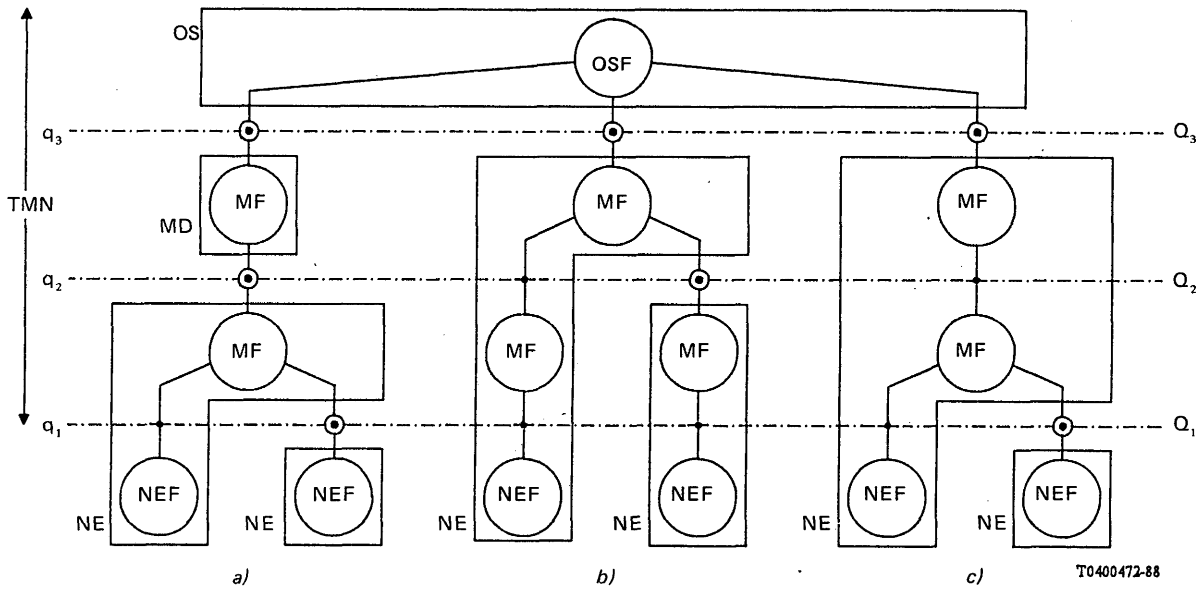
c) configuration management,

d) accounting management,

e) security management.

These allocations are provisional and subject to future review and rearrangement.

It should be noted that the functional configuration of the TMN will change depending on the phases in the life cycle and the momentary status of the related telecommunications equipment. Typical examples can be found in the development of installation functions and testing functions, notably when utilizing movable support equipment.



Reference point (q)

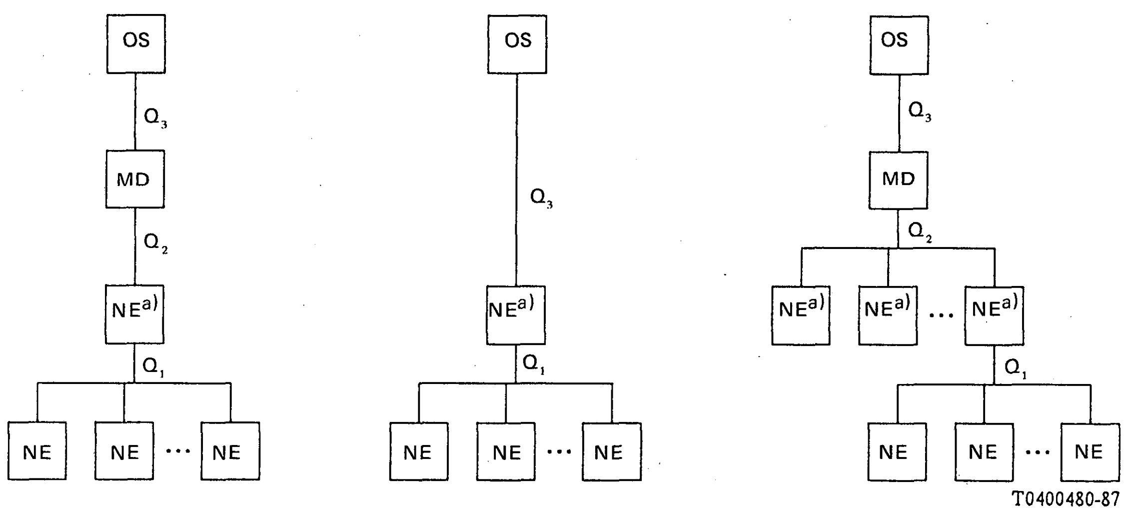
Interface (Q) and Reference point (q)

OS Operations system
OSF Operations system function
MD Mediation device
MF Mediation function
NE Network element
NEF Network element function
DGF Data communication function

Note – The OSF shown on the top of this figure can consist of a family of OSFs.

FIGURE 7/M.30

Examples of cascaded network elements (with implicit DCF)



OS Operations system
MD Mediation device
NE Network element

a) NE contains MF.

FIGURE 8/M.30

Examples of cascaded network elements (physical configurations)

3.2.1 *Performance management*

Performance management provides functions to evaluate and report upon the behaviour of telecom equipment and the effectiveness of the network or network element. Its role is to gather statistical data for the purpose of monitoring and correcting the behaviour and effectiveness of the network, network element or equipment and to aid in planning and analysis. As such, it is carrying out the performance measuring phase of Recommendation M.20.

The following functionalities have been defined:

3.2.1.1 *Performance monitoring functions*

Performance monitoring involves the continuous collection of data concerning the performance of the NE. While acute fault conditions will be detected by alarm surveillance methods, very low rate or intermittent error conditions in multiple equipment units may interact resulting in poor service quality. Performance monitoring is designed to measure the overall quality on the monitored parameters in order to detect such deterioration. It may also be designed to detect characteristic patterns before signal quality has dropped below an acceptable level.

3.2.1.2 *Traffic management and network management functions*

A TMN collects traffic data from NEs and sends commands to NEs to reconfigure the telecommunication network or modify its operation to adjust to extraordinary traffic.

A TMN may request traffic data reports to be sent from NEs, or such a report may be sent upon threshold triggering, or periodically, or on demand. At any time the TMN may modify the current set of thresholds and/or periods in the network.

Reports from the NE may consist of raw data which is processed in a TMN, or the NE may be capable of carrying out analysis of the data before the report is sent.

3.2.1.3 *Quality of Service (QOS) observation functions*

A TMN collects QOS data from NEs and supports the improvements in QOS. The TMN may request QOS data reports to be sent from the NE, or such a report may be sent automatically on a scheduled or threshold basis. At any time, the TMN may modify the current schedule and/or thresholds. Reports from the NE on QOS data may consist of raw data which is processed in a TMN, or the NE may be capable of carrying out analysis of the data before the report is sent.

Quality of Service includes monitoring and recording of parameters relating to;

- connection establishment (e.g. call set up delays, successful and failed call requests);
- connection retention;
- connection quality;
- billing integrity;
- keeping and examining of logs of system state histories;
- cooperation with fault (or maintenance) management to establish possible failure of a resource and with configuration management to change routing and load control parameters/limits for links etc.;
- initiation of test calls to monitor QOS parameters.

3.2.2 *Fault (or maintenance) management*

Fault (or maintenance) management is a set of functions which enables the detection, isolation and correction of abnormal operation of the telecommunication network and its environment. It provides facilities for the performance of the following maintenance phases from Recomendation M.20, § 5.

3.2.2.1 *Alarm surveillance functions*

A TMN provides the capability to monitor NE failures in near real time. When such a failure occurs, an indication is made available by the NE. Based on this, a TMN determines the nature and severity of the fault. For example, it may determine the effect of the fault on the services supported by the faulty equipment. This can be accomplished in either of two ways: a data base within a TMN may serve to interpret binary alarm indications from the NE, or if the NE has sufficient intelligence, it may transmit self-explanatory messages to a TMN. The first method requires little of the NE beyond a basic self-monitoring capability. The second method requires additionally that both the NE and a TMN support some type of message syntax which will allow adequate description of fault conditions.

3.2.2.2 *Fault localization functions*

Where the initial failure information is insufficient for fault localization it has to be augmented with information obtained by additional failure localization routines. The routines can employ internal or external test systems and can be controlled by a TMN (see Recommendation M.20).

3.2.2.3 *Testing functions (requested, on demand, or as a routine test)*

Testing can be carried out in one of two ways. In one case, a TMN directs a given NE to carry out analysis of circuit or equipment characteristics. Processing is executed entirely within the NE and the results are automatically reported to the TMN, either immediately or on a delayed basis.

Another method is where the analysis is carried out within the TMN. In this case, the TMN merely requests that the NE provide access to the circuit or equipment of interest and no other messages are exchanged with the NE.

3.2.3 *Configuration management*

Configuration management provides functions to exercise control over, identify, collect data from and provide data to NEs.

3.2.3.1 *Provisioning functions*

Provisioning consists of procedures which are necessary to bring an equipment into service, not including installation. Once the unit is ready for service, the supporting programmes are initialized via the TMN. The state of the unit, e.g., in service, out of service, stand-by, reserved, and selected parameters may also be controlled by provisioning functions.

Over the spectrum of network elements, the use of the provisioning functions can vary widely. For small transmission elements, these functions are used once and rarely again. Digital switching and cross-connect equipment may require frequent use of these functions as circuits are put up and dropped.

3.2.3.2 *Status and control functions*

The TMN provides the capability to monitor and control certain aspects of the NE on demand. Examples include checking or changing the service state of an NE or one of its sub-parts (in service, out of service, stand-by) and initiating diagnostics tests within the NE. Normally, a status check is provided in conjunction with each control function in order to verify that the resulting action has taken place. When associated with failure conditions, these functions are corrective in nature (e.g., service restoral).

Status and control functions can also be part of routine maintenance when executed automatically or on a scheduled periodic basis. An example is switching a channel out of service in order to perform routine diagnostic tests.

A TMN will enable the exclusion of faulty equipment from operation and as a result it may rearrange equipment or re-route traffic.

A TMN can enable the entry of a proposed configuration in order to automatically analyze the feasibility of that design before implementing it.

3.2.3.3 *Installation functions*

The TMN can support the installation of equipment which makes up the telecommunication network. It covers also the extension or reduction of a system. Some NEs call for the initial exchange of data between themselves and the TMN. An example of another function is the installation of programs into NEs from data base systems within the TMN. In addition, administrative data can be exchanged between NEs and the TMN.

Acceptance testing programmes can be done under control of, or supported by, the TMN.

A detailed list of installation functions for an SPC-exchange is provided in Recommendation Z.331, § 3.3 [1].

3.2.4 *Accounting management*

Accounting management provides a set of functions which enables the use of the network service to be measured and the costs for such use to be determined. It provides facilities to:

- collect accounting records,
- set billing parameters for the usage of services.

3.2.4.1 *Billing functions*

An OS within the TMN can collect data from NEs which is used to determine charges to customer accounts. This type of function may need extremely efficient and redundant data transport capabilities in order to maintain records of billing activity. Often the processing must be carried out in near real time for a large number of customers.

3.2.5 *Security management*

(For further study.)

4 Planning and design considerations

A TMN should be designed such that it has the capability to interface with several types of communications paths to ensure that a framework is provided which is flexible enough to allow for the most efficient communications between the NE and the TMN, work stations and the TMN, between elements within the TMN or between TMNs. The basis for choosing the appropriate interfaces however, should be the functions performed by the elements between which the appropriate communications are performed.

The interface requirements are measured in terms of function attributes that are required to provide the most efficient interface. The following is a listing of the function attributes. This list is incomplete and will be subject to further study.

4.1 *Functions attributes*

a) *Reliability*

The capability of the interface to ensure that data and control is transferred such that integrity and security are maintained.

b) *Frequency*

How often data is transferred across the interface boundary.

c) *Quantity*

The amount of data that is transferred across the interface during any transaction.

d) *Priority*

Indicates precedence to be given to data in case of competition for network resources with other functions.

e) *Availability*

Determines the use of redundancy in the design of the communications channels between interfacing elements.

f) *Delay*

Identifies the amount of buffering that may be tolerable between interfacing elements. This also impacts communications channel designs.

Annex C to this Recommendation provides a table of possible ranges for these function attributes and provides a definition for each range suggested.

4.2 *Functional characteristics*

Each major type of telecommunications equipment has functional characteristic needs that can be used to describe the complexity of the interface. There are, however, a basic group of TMN application functions that cross all major types of telecommunications equipment. However, there are also unique TMN application functions that are performed by specific categories of major telecommunications equipment. Alarm surveillance is an example of the former, whereas billing information collection is an example of the latter.

Functional characteristics of the elements within a TMN, e.g., OS, DCN, MD also describe the complexity of interfaces between these elements. Thus an identification of the functions performed by the elements within a TMN are also important considerations in determining the appropriate interfaces both within the TMN and to the NEs.

4.3 *Critical attributes*

Attribute values for a given function are generally consistent across the network elements. When considering a single Q interface it is important to identify the controlling attribute ranges for the design of the interface. If there are conflicting attribute values for different functions in a given network element, more than one interface may be needed.

Overall TMN attribute values for the interfacing of elements within the TMN depend on the type and number of functions performed within these elements. In this case the functions are not consistent across TMN elements, but are controlled by the individual TMN design of an Administration.

4.4 *Protocol selection*

In many cases more than one PQ protocol suites will meet the requirements for the network element or TMN element under consideration. Care should be taken by the Administration to select the protocol suite that optimizes the relationship between the total cost to implement that protocol suite and the data communications channels that carry the information across the interface.

The subject of protocol selection methodology will require further study in conjunction with other Study Groups.

4.5 *Communications considerations*

LCN and DCN architectures must be planned and designed to ensure that their implementation provides appropriate degrees of availability and network delay while minimizing cost. One must consider the selection of communications architectures, e.g., star, multipoint, loop, tree. The communications channels, e.g., dedicated lines, circuit switched networks and packet networks used in providing the communications paths, also play an important role.

5 Detailed TMN architectural considerations

5.1 *General*

The TMN architecture must provide a high degree of flexibility to meet the various topological conditions of the network itself and the organization of the Administrations. Examples of the topological conditions are the physical distribution of the NEs, the number of NEs and the communication volume of the NEs. Examples of the organization are the degree of centralization of personnel and the administrative practices. TMN architecture will be such that the NEs will operate in the same way, independently of the OS architecture.

The TMN must be carefully designed in order to prevent a single fault from making the transfer of critical management messages impossible. Congestion in the DCN or LCN should not cause blocking or excessive delay of network management messages that are intended to correct the congestion situation or restore a faulty system.

As an example of the single fault situation in a critical NE such as a local switch, a separate channel can be provided for *emergency action*. The emergency action function, when provided, requires an independent maintenance capability when the normal OS is inoperative or when the NE has degraded to the point where the normal surveillance functions cannot operate. For these reasons the emergency action OS may be separate from the normal maintenance OS, although they are usually at the same location. OSs and NEs which provide the emergency action function may require at least two physical access channels to the DCN for redundancy.

Another example is a TMN which is used to determine charges to the customers. The OSs and the NEs which are associated with this function require at least two physical DCN communication channels in order to provide sufficient reliability in the collection process by the OSs of charging messages from the NEs.

The nature of transmission line systems provides the possibility to transport a management message in two directions so that, assuming only one fault exists at a time, one of the two directions is available.

5.2 *Operations system*

5.2.1 *Functional OS configuration*

There are at least three functional types of OSFs, i.e. basic, network and service. Basic OSFs perform TMN application functions related to NEs located in specific regions. Network OSFs realize the network TMN application functions by performing the communication between basic OSFs. Service OSFs perform specific TMN application functions for managing an individual service. Basic OSFs and network OSFs share the same infrastructure of a telecommunication network. Service OSFs are concerned with service aspects of one or more telecommunication networks.

5.2.2 *Physical OS configuration*

The OS physical architecture must provide the alternatives of either centralizing or distributing the general functions, which include:

a) support application programs;

b) data base functions;

c) user terminal support;

d) analysis programs;

e) data formatting and reporting.

The OS functional architecture may be realized on various numbers of OSs, depending on the network size.

The categorization of TMN function attributes as given in Tables C-1/M.30 to C-3/M.30 are also important factors in the OS physical architecture. For example, the choice of hardware depends strongly on whether an OS provides real time, near real time or non-real time service.

Normally OS functions will be implemented in a set of OSs with a Q_3 interface connected to the DCN. However, this should not preclude a practical realization whereby some of these functions are implemented in an NE or an MD.

An OS which supports maintenance must provide for two types of data communication: spontaneous transmission of messages concerning problems from the NE to the OS, and two-way dialogue, when the OS obtains supporting information from the NE and sends commands to the NE. In addition, a maintenance OS is responsible for assuring the integrity of the maintenance data channels through a data communication network.

5.3 *TMN data communication considerations*

5.3.1 *Data communication networks considerations*

A DCN for a TMN should, wherever possible, follow the reference model for open systems interconnection for CCITT applications as specified in Recommendation X.200 [2].

Within a TMN the necessary physical connection (e.g. circuit switched or packet switched) may be offered by communication paths constructed with all kinds of network components, e.g., dedicated lines, public switched data network, ISDN, common channel signalling network, public switched telephone network, local area networks, terminal controllers, etc. In the extreme case the communication path provides for full connectivity, i.e. each attached system can be physically connected to all others.

All connections not using a type Q, F or X interface are outside of a TMN.

A data communications network (DCN) connects NEs with internal mediation functions or mediation devices to the OSs and always interfaces at the standard Q_3 level. The use of standard Q_3 interfaces enables maximum flexibility in planning the necessary communications. In general, a DCN does not provide all the data communication functions for a TMN. Therefore, the communication between Q_1, Q_2 and Q_3 interfaces may require communication links, as part of an LCN.

A DCN can be implemented using point-to-point circuits, a switched network or a packet network. The facilities can be dedicated to a DCN or be a shared facility (e.g. using CCITT Signalling System No. 7 or an existing packet switched network).

5.3.2 *Local communications network considerations*

Within a TMN, the necessary physical connection may be locally offered by all kinds of network configurations, e.g., point-to-point, star, bus or ring.

A local communication network (LCN) connects NEs to MDs or MDs to MDs and generally interfaces at two standard levels, Q_1 and Q_2, within a telecommunication center. However, for practical reasons, an LCN may connect remote NEs to local MDs. In some cases, NEs with internal mediation functions may be connected to a DCN through an LCN via a standard Q_3 interface.

5.4 *Mediation*

5.4.1 *Mediation considerations*

Mediation is a process within a TMN which acts on information passing between network elements (NE) and operations systems (OS) via a data communication network. Mediation devices use standard interfaces and can be shared by several NE(s) and/or OS(s).

Note – Mediation devices accommodate different designs of NEs when acting on information passing from these NEs to OSs by appropriate implementation of communication functions. The mediation function may be implemented in stand alone devices or combined with other unrelated functions (e.g. with a local processor or with a switching exchange). Mediation functions can be implemented as a hierarchy of cascaded devices using standard interfaces. Examples of the mediation function are concentration, protocol conversion, collection/control and processing. The mediation function may be absent in some implementations.

The cascading of mediation devices and various interconnection structures between MDs on one hand and MDs and NEs on the other hand provides for great flexibility in the TMN. Some options are shown in Figure 8/M.30. It enables cost effective implementations of the connection of NEs of different complexity (e.g. switching equipment and transmission multiplex equipment) to the same TMN. In addition, it gives the capability for future design of new equipment to support a greater level of processing within individual NEs, without the need to redesign an existing TMN.

It may be possible to recognize a mediation type process in some network elements similar to the one described above. For the purpose of this Recommendation, it is convenient to regard the function of mediation as being wholly contained within the TMN. However, this does not preclude practical realizations where some or all of the mediation functions are implemented within the network element, which must still interface to the TMN via a standardized Q interface. The choice of any interface which may be required for a network element is left to the discretion of the Administrations.

5.4.2 *Process of mediation*

Mediation is a process that routes and/or acts on information passing between NEs and OSs. The processes that can form mediation can be classified into the following five general process categories:

1) communication control;
2) protocol conversion and data handling;
3) transfer of primitive functions;
4) decision making processes;
5) data storage.

A number of more specific processes can be identified within each of these general process categories, some examples of which are given below. Mediation may consist of one or more of these specific processes:

a) communications control:
   - polling,
   - addressing,
   - communications networking,
   - ensuring integrity of data flows;
b) protocol conversion and data handling:
   - protocol conversion at either lower or upper OSI levels,
   - concentration of data,
   - compression or reduction of data,
   - collection of data,
   - data formatting,
   - data translation;

c) tranfer of primitive functions:
   - command/response statement,
   - alarm statements,
   - alarm forwarding,
   - test results/data,
   - operational measurement data,
   - upload of status report,
   - local alarming;

d) decision making processes:
   - work station access,
   - thresholding,
   - data communications back-up,
   - routing/re-routing of data,
   - security (e.g., log-in procedures),
   - fault sectionalization tests,
   - circuit selection and access for tests,
   - circuit test analysis;

e) data storage:
   - data-base storage,
   - network configuration,
   - equipment identification,
   - memory back-up.

Certain mediation processes may be carried out autonomously.

The mediation function of the TMN permits a flexible design of the architecture NE to OS. Different architectural designs for operations, administration and maintenance communications can be accommodated in the same TMN by appropriate implementation of the hierarchical configuration of mediation. By these means, NEs of different complexity (e.g. switching exchange or multiplex equipment) can connect into the same TMN.

5.4.3 *Implementation of mediation processes*

Mediation processes can be implemented as stand-alone equipment or as part of an NE. In either case the mediation function remains part of the TMN.

In the stand-alone case the interfaces towards both NEs and OSs are one or more of the standard operations interfaces (Q_1, Q_2 and Q_3). Where mediation is part of an NE only, the interfaces towards the OSs are specified as one or more of the standard operations interfaces (Q_2 and Q_3). Mediation that is part of an NE (e.g. as part of a switching exchange) may also act as mediation for other NEs. In this case standard operations interfaces (Q_1 and Q_2) to these other NEs are required.

Also, the mediation functions within an NE which carries out the mediation function for other NEs is regarded as being a part of the TMN.

5.5 *Network element considerations*

In the TMN reference model, a network element performs the network element function (NEF), and may in addition perform one or more MFs.

The study of various application examples leads to the desirability to distinguish between the following functions contained in an NEF:

- The Maintenance entity function (MEF) is involved in the telecommunication process. Typical MEFs are switching and transmission. A maintenance entity (ME) can contain one or more MEFs.
- The support entity function (SEF) is not directly involved in the telecommunication process. Typical SEFs are fault localization, billing, protection switching. A support entity (SE) can contain one or more SEFs.
- The Q-adapter function (QAF) is used to connect to TMN those MEs and SEs which do not provide standard TMN interfaces. Typical QAFs are interface conversions. A Q-adapter (QA) can contain one or more QAFs and may also contain MFs.

This approach to definitions of the parts of an NE which perform operations functions implies the following relationships:

- an NE contains MEs or SEs or both MEs and SEs;
- an NE may or may not contain a QA.

Note that the various parts of an NE are not geographically constrained to one physical location. For example, the parts may be distributed along a transmission system.

Figure 9/M.30 shows the NE reference model outside the TMN with related physical implementations. The m-reference point separates the maintenance entity function (MEF), the support entity function (SEF), and the Q-adapter function (QAF).

Figure 10/M.30 shows different types of Q-adapters connected to MEs and SEs. The Q-adapters are not required if MEs or SEs are supplied with Q-interfaces. The M-interface can be of parallel, star or bus-type.

Examples of network elements are shown in Annex A.

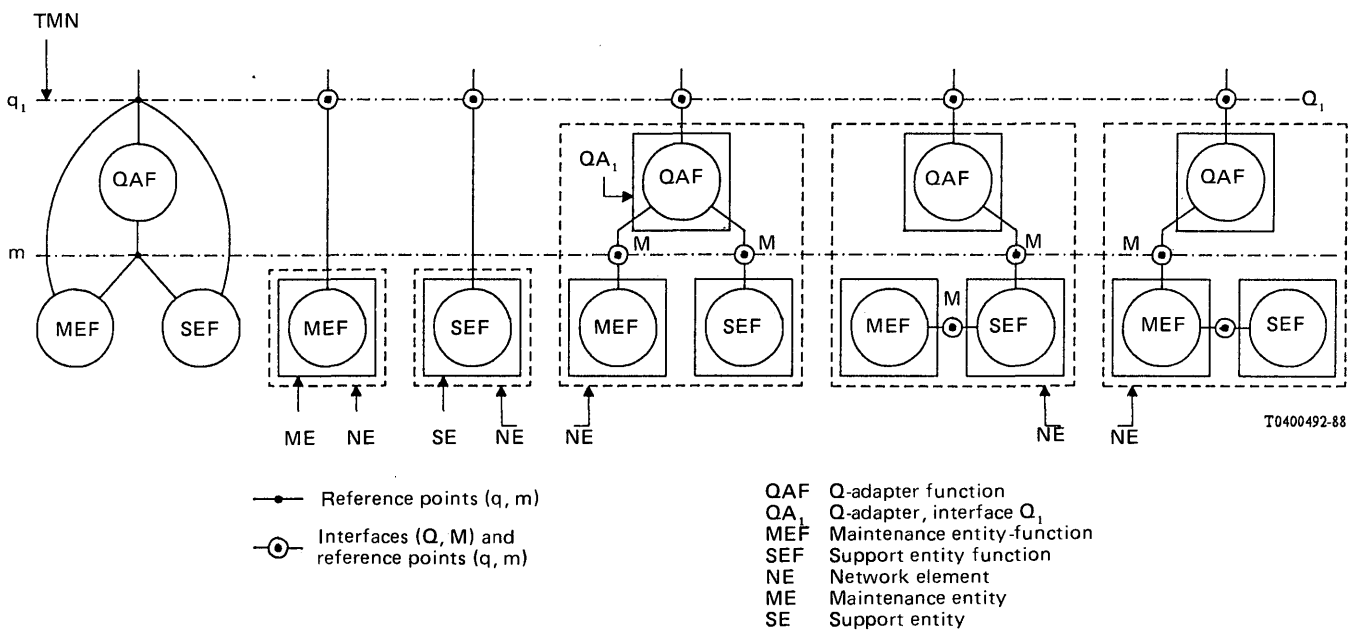


FIGURE 9/M.30

NE reference model and physical configuration outside the TMN

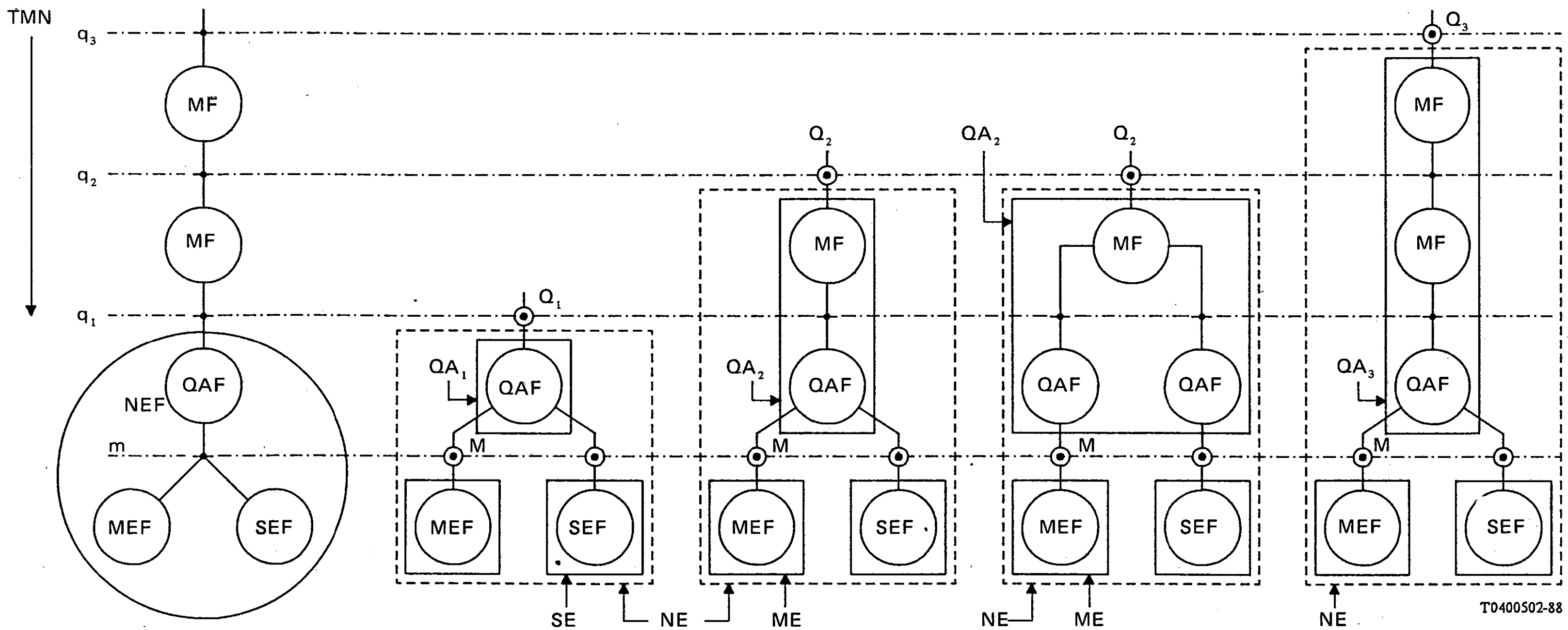
5.6 *Work stations*

In Figure 2/M.30 and 3/M.30, the work station reference points and interfaces are shown at a number of locations. An Administration may choose to implement a work station at only some of these locations.

The TMN work stations and their interfaces are subjects for further study.

5.7 *TMN standard interfaces*

TMN standard interfaces provide for the interconnection of NEs, OSs, MDs and WSs through the DCN or LCN. The purpose of an interface specification is to assure compatibility of devices interconnected to accomplish a given TMN application function, independent of the type of device or of the supplier. This requires compatible communication protocols and a compatible data representation method for the messages, including compatible generic message definitions for TMN application functions. A minimum set of protocol suites, to be applied to TMN standard interfaces, should be determined according to the protocol selection method described in § 4.4.



Reference points (q, m)

Interfaces (Q, M) and reference points (q, m)

QA_1	Q-adapter, interface Q_1
QA_2	Q-adapter, interface Q_2
QA_3	Q-adapter, interface Q_3
QAF	Q-adapter function
MF	Mediation function
ME	Maintenance entity
MEF	Maintenance entity function
SE	Support entity
SEF	Support entity function
NE	Network element
NEF	Network element function
DCF	Data communication function

FIGURE 10/M.30

NE + TMN reference model and physical configurations (with implicit DCF)

Consideration should be given to compatibility with the most efficient data transport facilities available to reach individual network elements (e.g. leased circuits, circuit switched connections, X.25 packet switched connections, CCITT Signalling System No. 7, embedded operations channels and ISDN access network D- and B-channels).

It is recognized that NEs, OSs, DCNs, LCNs, MDs and WSs may have other interfaces in addition to the Q, F, G and X interfaces defined in this Recommendation. It is also recognized that this equipment may have other functionality in addition to that associated with information sent or received via Q, F, G and X interfaces. These additional interfaces and related functionality are outside the TMN.

5.7.1 *Q_1 and Q_2 interfaces*

The PQ_{LCN} function attributes required at the Q_1/Q_2 interfaces are strongly dependent on the mediation functions needed, as well as the mediation function partitioning between cascaded MDs. Since the purpose of putting MDs between OSs and NEs is to make flexible implementation possible, mediation function partitioning should not be restricted to only one case. Therefore, one minimum set of protocol suites should be selected to be applied to both Q_1 and Q_2 interfaces instead of selecting a different set for each of them. The choice of individual protocol suites from the recommended PQ_{LCN} family should be left to the Administrations.

The protocol suites to be applied to the Q_1 and Q_2 interfaces need not implement all layers of the OSI model. Details of the Q_1 and Q_2 interface specification and the PQ_{LCN} family of protocol suites are given in Recommendation G.771 [3].

5.7.2 *Q_3 interface*

For the PQ_{DCN} protocols, it is recommended that each set of TMN application functions with similar protocol needs be supported with unique protocol selections for layers 4 to 7 as defined by the OSI Reference Model (Recommendation X.200 [2]). The anulling of service options of individual layers above layer 3, and even entire layers above layer 3, may be necessary for justifiable economic reasons. In addition, protocol options will likely be required for the PQ_{DCN} protocols for layers 1, 2 and 3 in order to permit the use of the most efficient data transport.

Details of the Q_3 interfaces and the PQ_{DCN} protocols are given in Recommendation Q.513 [4].

5.7.3 *F interface* (under study)

5.7.4 *X interface* (under study)

Interconnection to other TMNs.

6 **User interface** (under study)

This section will provide information and recommendations about the possible location and type of user work stations to be provided with a TMN. It will discuss work station back-up considerations when parts of the TMN have failed.

7 **TMN maintenance considerations** (under study)

This section will provide information and recommendations about the considerations associated with the maintenance of the TMN itself.

ANNEX A

(to Recommendation M.30)

Examples of network elements

A.1 A network element (NE) is the grouping of telecommunication and other equipment that can communicate operations and administrative messages via a telecommunication management network (TMN) over one or more standard interfaces for the purpose of being monitored and/or controlled.

Network elements are not part of a TMN if they contain only maintenance entities (ME) and/or support entities (SE), as defined in Recommendation M.20. Network elements with mediation functions are partly within a TMN, as described in § 5.5.

The various parts of NEs and their interfaces are shown in a) of Figure A-1/M.30 for ME, in b) of Figure A-1/M.30 for SE, and in c) of Figure A-1/M.30 for QA. Using these units, Figure A-2/M.30 shows an example of NE-configurations. As illustrated, one NE may contain a number of MEs and SEs connected to a Q-adapter.

The following interfaces are used:

a) T telecommunications interface, which carries the information flow to be managed by TMN;

b) Q Q_1, Q_2 and Q_3 TMN-interfaces as described in this Recommendation;

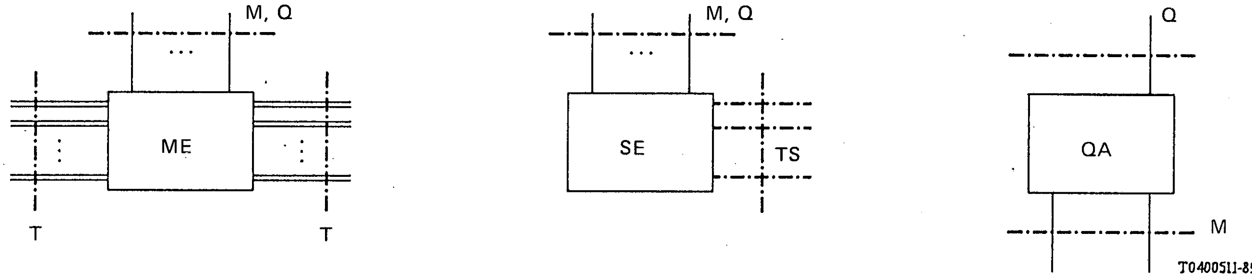
c) M non-standardized maintenance interface as described in this Recommendation;

d) TS telecommunication support interface, which is related to the function of the support element or used for connection of monitors/work stations.

A.2 Relations between NE, ME, SE and QA for maintenance are illustrated in Figures A-3/M.30 to A-10/M.30 using a number of examples.

The abbreviations used in the figures are:

CFS	Common frequency supply
CTE	Channel translation equipment
DCC	Digital cross connect
DIG MUX	Digital multiplexer
GTE	Group translation equipment
LT	Line terminal
M	(non-standardized) Maintenance interface
ME	Maintenance entity
MTE	Mastergroup translation equipment
NE	Network element
Q	Q_1, Q_2, Q_3 interfaces
QA	Q-adapter
SE	Support entity
SMTE	Supermastergroup translation equipment
STE	Supergroup translation equipment
SUR	Supervision unit, dependent repeater
SUT	Supervision unit, line terminal
T	Telecommunications interface
TS	Telecommunications support interface

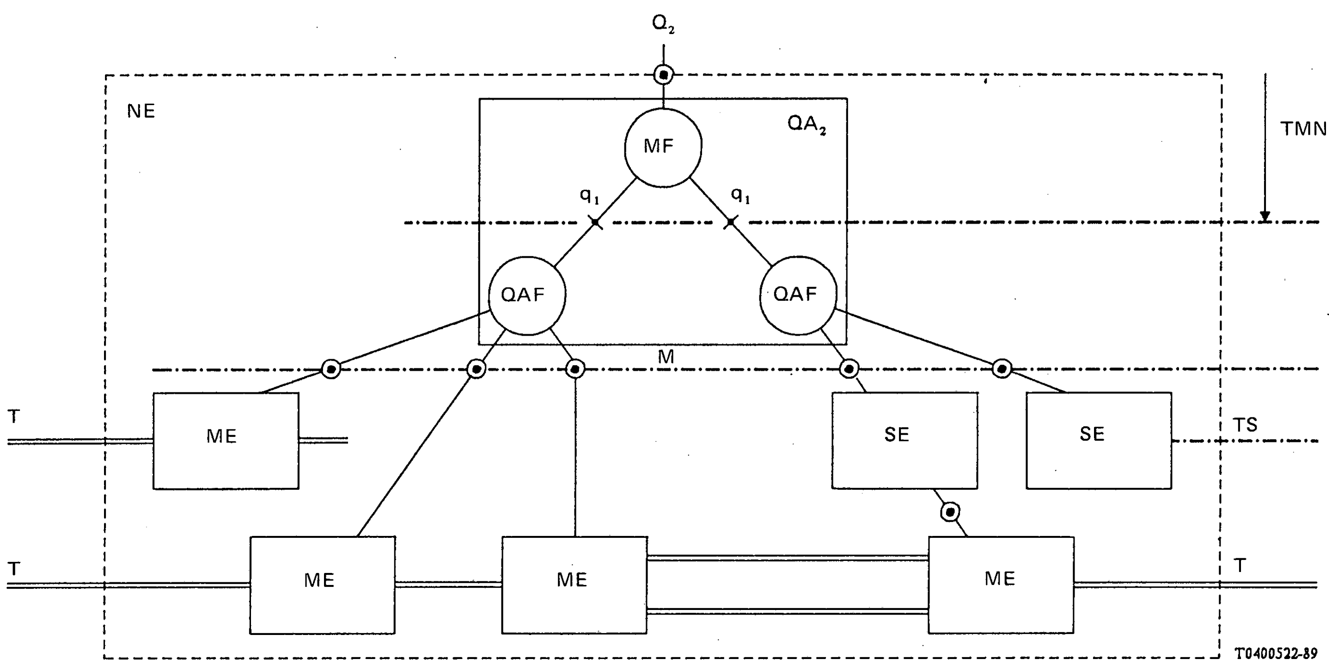


a) Maintenance entity *b) Support entity* *c) Q-adapter*

T = Telecommunications interface
Q = Q_1, Q_2, Q_3 interfaces
M = (Non-standardized) maintenance interface
TS = Telecommunications support interface

FIGURE A-1/M.30

Parts of network elements



Reference points (q, m)

Interface (Q, M) and reference points (q, m)

M (Non-standardized) maintenance interface
ME Maintenance entity
MF Mediation functional block
NE Network element
Q Q_1, Q_2, Q_3 interfaces

QA Q-adapter
QAF Q-adapter functional block
SE Support entity
T Telecommunications interface
TS Telecommunications support interface

FIGURE A-2/M.30

Example of network element configurations

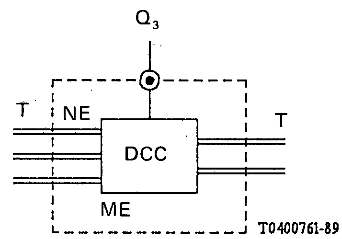


FIGURE A-3/M.30

Example: digital cross connect equipment with Q-interface; NE contains one ME

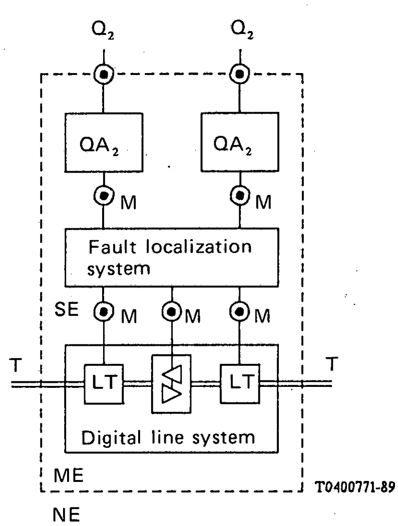


FIGURE A-4/M.30

Example: digital line system with NE-internal fault localization and two Q_2-interfaces; NE contains one ME (digital line system) and one SE (fault localization system) and two Q-adapters; the digital line system contains line terminals LT and dependent repeaters

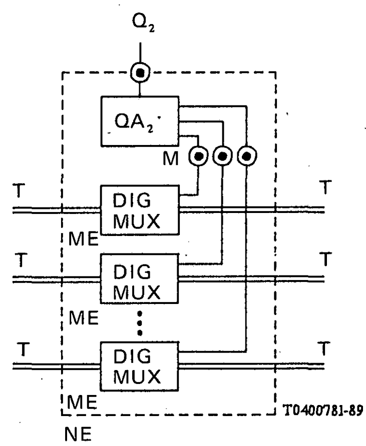


FIGURE A-5/M.30

Example: bay frame or shelf with digital multiplex equipment; SE is used for interface conversion between n maintenance interfaces and one Q_2-interface; NE contains one SE and n × MEs

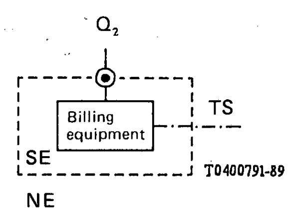


FIGURE A-6/M.30

Example: billing equipment (SE) with Q-interface; NE contains one SE

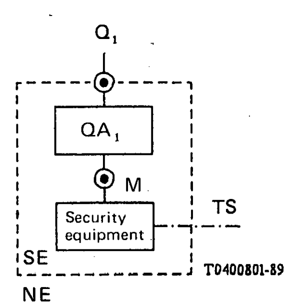
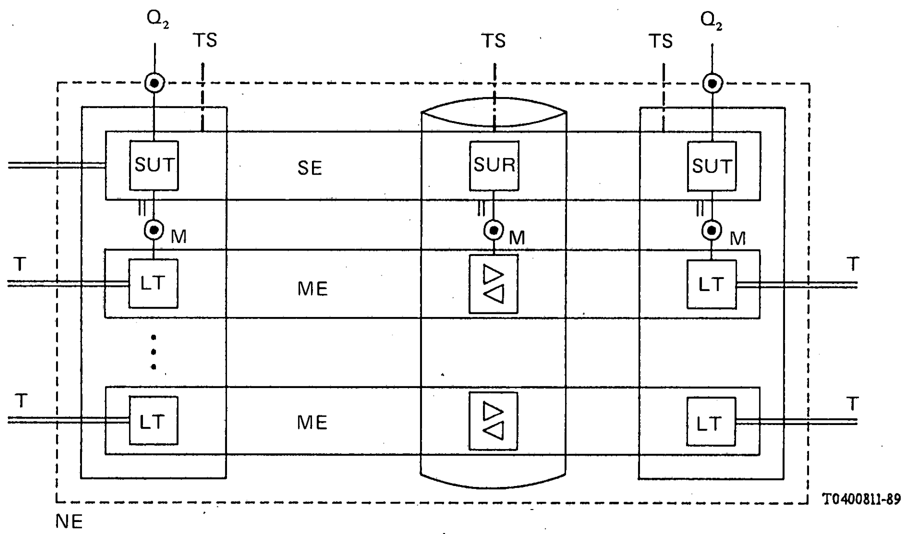


FIGURE A-7/M.30

Example: premises security equipment (SE); a Q-adapter is used for interface conversion; NE contains one SE and one QA_1



Note — Telecommunication support interfaces are shown which can be used for local maintenance, e.g. connection of portable monitors.

FIGURE A-8/M.30

Example: digital line systems with NE-internal fault localization and two Q_2-interfaces; NE contains one SE and n × ME; SE contains embedded transmission channels for communication between the various parts of ME, e.g. for fault localization

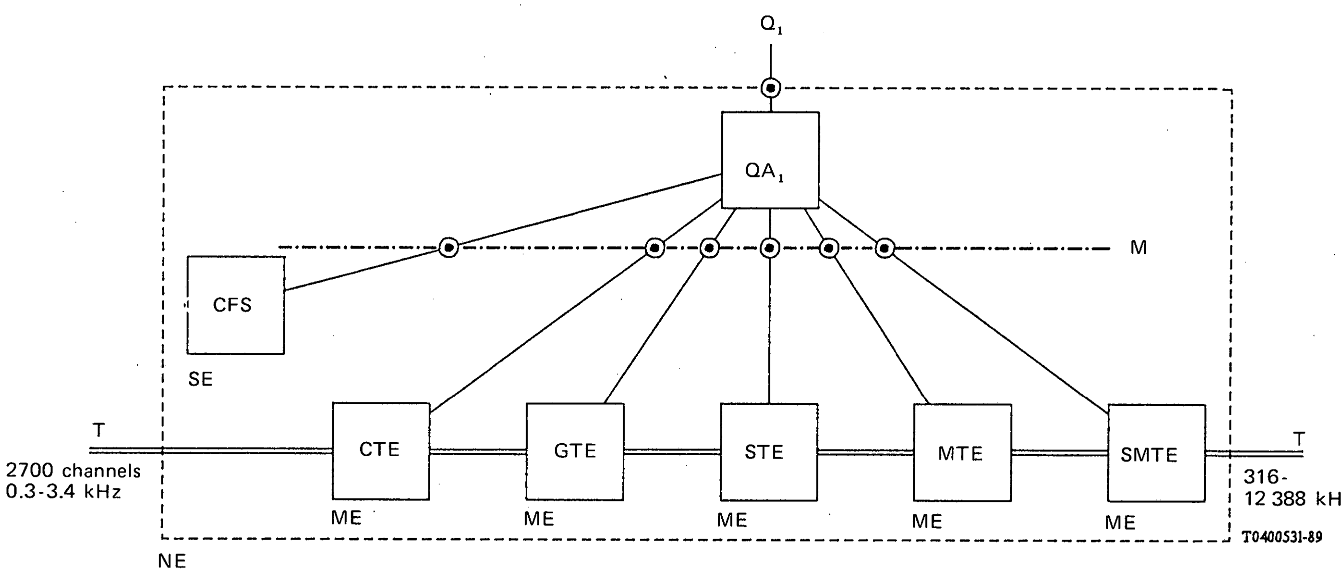


FIGURE A-9/M.30

Example: analogue terminal equipment converting 2,700 voice-frequency channels to the 12 MHz transmission band; NE contains 5 MEs and one SE

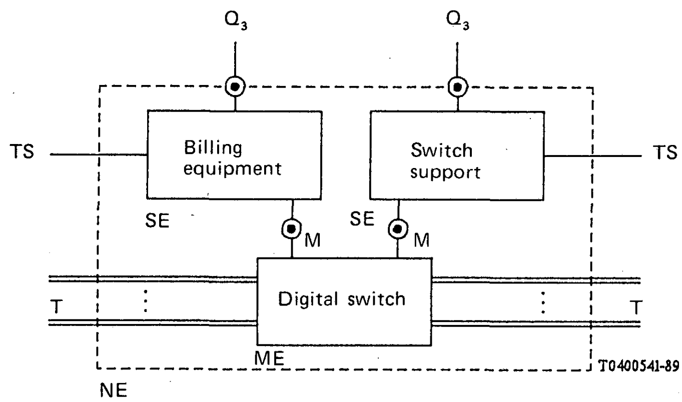


FIGURE A-10/M.30

Example: digital switch (ME) with billing equipment (SE) and switching support (SE)

ANNEX B

(to Recommendation M.30)

TMN application functions

B.1 *Introduction*

The TMN application functions are classified in the five categories specified in § 3.2.

The functional list has been classified according to the OSI management categories as an aid in selecting the protocol and the application language for the TMN interfaces.

The list of functions, its terminology and classification is preliminary and is expected to be refined as the study proceeds.

The application functions are not intended as requirements for any NE or TMN. Each function in the list is included because it may be necessary for some implementation of a related application. Some functions will be appropriate for a certain implementation of an interface application, but unnecessary or inconvenient for others.

B.2 *Index of list of application functions described in § B.3*

B.3 *List of application functions*

B.3.1 *Performance management*

B.3.1.1 *Performance monitoring (PM)*

1) *Request PM data* – TMN requests the NE to send current PM data;
2) *PM data report* – NE sends performance data to the TMN. It may be generated routinely by the NE, sent upon demand by the TMN or by exception when a parameter threshold has been exceeded;
3) *Schedule PM data report* – TMN directs NE to establish a schedule for the reporting of PM data;
4) *Request PM data report schedule* – TMN directs NE to send the current PM data reporting schedule. NE responds with the schedule;
5) *Start/stop PM data* – TMN directs the NE to start or stop the collection of PM data;
6) *Initialize PM data* – TMN directs NE to reset storage registers for PM data;
7) *Set PM attributes* – TMN directs NE to assign designated values to PM attributes;
8) *Request PM attributes* – TMN requests NE to send current PM attributes;
9) *PM attributes report* – NE sends the currently assigned PM attributes to TMN;
10) *Request protocol conversion data* – TMN requests NE to transmit the data concerning the protocol conversion performance, such as the types and their number of protocol conversions;
11) *Protocol conversion data report* – NE sends data concerning protocol conversion performance.

B.3.1.2 *Traffic management and network management (NM)*

1) *Set traffic data attributes* – TMN directs NE to set parameters to collect traffic data;
2) *Request traffic data attributes* – TMN requests NE to report the current traffic data attributes;
3) *Request traffic data* – TMN requests NE to transmit traffic data to TMN;
4) *Traffic data report* – NE sends specified traffic data to TMN;
5) *Request clock sync* – TMN requests NE to transmit its current clock time to TMN;
6) *Clock sync report* – NE sends the current clock time;

7) *Set error analysis* – TMN directs NE to assign designated values to error analyses parameters. These are used by NE to recognize that a given unit is faulty based on the detection of errors and intermittent troubles;

8) *Request error analysis data* – TMN requests NE to report the current error analysis parameters or resulting data;

9) *Error analyses report* – NE sends error analyses data to TMN;

10) *Set NM data attributes* – TMN directs NE to set parameters to generate required NM measurement data;

11) *Request NM data attributes* – TMN requests NE to report the current NM data attributes;

12) *Request NM data* – TMN requests NE to send the NM data to TMN. This includes periodic measurement data and status and alerting discrete information;

13) *NM data report* – NE sends required NM data to TMN;

14) *Sent NM control* – TMN directs the NE to perform specified real-time NM controls;

15) *Control report* – NE sends NM control status information to the TMN;

16) *Set NM thresholds* – TMN directs the NE to set or change the congestion thresholds used by the NE to perform automatic NM control;

17) *Request NM threshold* – TMN requests the NE to send the current congestion thresholds to the TMN;

18) *NM threshold report* – NE sends current congestion thresholds to TMN.

B.3.1.3 *Quality of service (QOS) observations*

1) *Schedule QOS data report* – TMN directs NE to establish a schedule for the report of QOS data;

2) *Request QOS data report schedule* – TMN directs NE to send the current QOS data reporting schedule;

3) *QOS report* – NE reports to TMN the value of an observed QOS parameter. It may be sent on demand by TMN or on a scheduled basis;

4) *Set QOS threshold* – TMN directs NE to set or change the QOS parameter threshold;

5) *Request QOS threshold* – TMN directs NE to send the current QOS threshold;

6) *Exceptional QOS report* – NE reports to TMN the value of an observed parameter when a parameter threshold has been exceeded;

7) *Initialize QOS data* – TMN directs NE to reset storage registers for QOS data;

8) *Start/stop QOS data* – TMN directs NE to start or stop the collection of QOS data;

9) *Schedule QOS test calls* – TMN directs NE to establish a schedule for the execution of QOS test calls;

10) *Request QOS test call schedule* – TMN directs NE to send the current QOS test call schedule;

11) *QOS test call report* – NE reports to TMN the result of QOS test calls. It may be sent on demand by TMN or on a scheduled basis;

12) *Set QOS test call attributes* – TMN directs NE to set or change the attributes of QOS test calls;

13) *Start/stop QOS test calls* – TMN directs NE to start or stop sending test calls;

14) *Initialize QOS test calls* – TMN directs NE to reset the storage registers for test calls;

15) *Request QOS test call attributes* – TMN directs NE to send the current QOS test call attributes;

16) *Schedule (semi) automatic observations* – TMN directs NE to establish a schedule for the execution of (semi) automatic observations;

17) *Request (semi) automatic observation schedule* – TMN directs NE to send the current (semi) automatic observation schedule;

18) *Automatic observation report* – NE reports to TMN the result of automatic observations. It may be sent on demand by TMN or on a scheduled basis;

19) *Set (semi) automatic observation attributes* – TMN directs NE to set or change the attributes of (semi) automatic observations;

20) *Start/stop (semi) automatic observations* – TMN directs NE to start or stop the (semi) automatic observations;

21) *Initialize automatic observations* – TMN directs NE to reset the storage registers for automatic observations;

22) *Request (semi) automatic observation attributes* – TMN directs the NE to send the current (semi) automatic observation attributes.

B.3.2 *Fault (or maintenance) management*

B.3.2.1 *Alarm surveillance*

1) *Request alarm information* – TMN requests NE to send current alarm information;

2) *Alarm information report* – NE notifies TMN of alarm information. It may be sent automatically on occurrence, or on demand by TMN;

3) *Schedule alarm report* – TMN directs NE to establish a schedule for the reporting of alarms;

4) *Request alarm report schedule* – TMN directs NE to send the current schedule for alarm reporting. NE responds with the schedule;

5) *Condition alarm* – TMN directs NE to assign alarm attributes, modes and thresholds;

6) *Request condition* – TMN requests NE to report the current assignment of alarm attributes, modes and thresholds; NE responds with the assignments;

7) *Route alarm* – TMN directs NE to send alarms to designated locations;

8) *Request alarm route* – TMN requests NE to send the current assignment of alarm routes for a specified set of alarms; NE responds with the routes;

9) *Allow/inhibit alarms* – TMN directs NE to allow/inhibit either local audible/visual alarms or remote alarms;

10) *Alarm cut-off* – TMN directs NE to reset designated audible alarms.

B.3.2.2 *Fault localization*

1) *Request diagnostic data* – TMN requests NE to send the results of a diagnostic sequence;

2) *Stop diagnostic in progress* – TMN directs the NE to stop a particular diagnostic procedure in progress;

3) *Diagnostic report* – NE reports the results of a diagnostic sequence to the TMN. It may be used in conjunction with the request and stop functions and has applications where it may be necessary or desirable to repeat diagnostic tests for a period of time to "catch" a failure;

4) *Schedule diagnostic* – TMN directs NE to establish a routine schedule for the initiation of a diagnostic;

5) *Request diagnostic schedule* – TMN requests NE to report the current schedule of diagnostics;

6) *Diagnostic schedule report* – NE sends the current schedule of diagnostics;

7) *Request exercise report* – TMN requests NE to send the results of a particular exercise;

8) *Exercise report* – NE sends the results of an exercise to TMN;

9) *Stop exercise* – TMN directs NE to stop a particular exercise in progress;

10) *Schedule exercise* – TMN directs NE to establish a routine schedule for the initiation of an exercise;

11) *Request exercise report schedule* – TMN directs NE to send the current schedule of an exercise. NE responds with the schedule;

12) *Operate/release loopback* – TMN directs NE to establish or release a specific loopback. It may be activated either remotely by TMN or locally by craft action;

13) *Test internal access path* – TMN directs NE to connect a termination on NE to another termination by a specified path within NE, then test the path;

14) *Hold network path* – TMN directs NE to hold a particular network path;

15) *Start/stop program traps* – TMN directs NE to start or stop a specific program trap;

16) *Program trap report* – NE automatically reports to TMN the occurrence of a program trap;

17) *Start/stop program trace* – TMN directs NE to start or stop a specific trace;

18) *Program trace report* – NE automatically reports to TMN the results of a trace;

19) *Start/stop audit* – TMN directs NE to start or stop an audit;

20) *Audit report* – NE automatically reports to TMN the results of an audit;

21) *Schedule audit* – TMN directs NE to establish a specified schedule for a given audit;

22) *Request audit schedule* – TMN requests NE to send the current audit schedule. NE responds with the test schedule;

23) *Start/stop loop insulation test* – TMN directs NE to start or stop a loop insulation test;

24) *Schedule loop insulation test* – TMN directs NE to schedule a loop insulation test;

25) *Request loop insulation test schedule* – TMN requests NE to send current loop insulation test schedule. NE responds with the schedule.

B.3.2.3 *Testing*

B.3.2.3.1 *Voiceband and voiceband data circuits test*

B.3.2.3.1.1 *Access and control*

1) *Connect test access* – TMN directs NE to provide a monitor connection to the transmission pairs of the accessed circuits;

2) *Disconnect test access* – TMN directs NE to drop access to the circuit under test and return the circuit to its normal state;

3) *Request test result* – TMN requests NE to report intermediate or final results from a measurement;

4) *Test result report* – NE sends the results of a test to TMN;

5) *Change terminate and leave (T&L)* – TMN directs NE to change T&L state of the circuit under test and report the resulting T&L state to TMN;

6) *Request to terminate and leave* – TMN directs NE to report the T&L status of the circuit under test;

7) *Terminate and leave report* – NE reports the T&L status of the circuit under test;

8) *Change pairs* – TMN directs NE to execute reversals of specified transmission pairs for 4- and 6-wire metallic circuits on either the equipment or facility side of the test port;

9) *Change leads* – TMN directs NE to execute reversal of tip and ring leads of metallic transmission pairs on the circuit under test;

10) *Change port restore* – TMN directs NE to clear all test conditions and restore the circuit to a monitor state;

11) *Request facility test status* – TMN directs NE to send the status of the facility carrying the circuit under test;

12) *Facility test status report* – NE sends the status of the facility carrying a specified circuit.

B.3.2.3.1.2 *Monitor and talk*

1) *Connect talk and split* – TMN directs NE to establish talk and listen paths between the circuit under test and the monitor/talk line;
2) *Connect monitor listen* – TMN listens selectively to the circuit under test and monitors any transmission pair in either direction;
3) *Change monitor level* – the TMN directs NE to change the level of the monitor connection;
4) *Change monitor filter* – TMN directs NE to remove or insert the single frequency notch filter placed in the monitor connection;
5) *Disconnect monitor* – TMN directs NE to remove any monitor or talk conditions established on the circuit under test.

B.3.2.3.1.3 *Measurement*

1) *Measure circuit characteristic* – TMN directs NE to measure a circuit characteristic including, but not restricted to, voltage, current, tip-ring-ground capacitance and resistance, noise, tone and outpulsing signals;
2) *Apply test signals* – TMN directs NE to send a test signal on the circuit. Examples are outpulsing and ringing signals;
3) *Remove test signal* – TMN directs NE to remove the test signal sent by the apply function;
4) *Stop measurement* – TMN directs NE to terminate continuous or repeating type measurements.

B.3.2.3.1.4 *Signalling and supervision*

1) *Change split and supervision* – TMN directs NE to set up metallic test access splitting of the circuit and supervise in both directions for both a.c. and d.c. supervision;
2) *Request supervision status* – TMN requests NE to send in an analysis of the current signalling state of the circuit under test;
3) *Supervision status report* – TMN reports the current signalling state of a circuit under test to TMN.

B.3.2.3.2 *Digital data circuit test*

B.3.2.3.2.1 *Test access*

1) *Connect test access digital* – TMN directs NE to provide test access to a digital data circuit;
2) *Monitor digital signals* – TMN establishes digital data monitor test access and determines the presence of network control codes or customer data;
3) *Change digital test access to split* – TMN directs NE to provide split test access to the digital circuit under test;
4) *Test digital loopback* – TMN directs NE to provide a loopback on the circuit under test and perform a loopback test;
5) *Change latching loopback* – TMN splits the circuit under test and changes the operate and release functions of digital network element latching loopback devices;
6) *Change multipoint junction unit functions* – TMN directs NE to perform various control functions such as block, select, unselect, and release, on the multipoint junction unit (MJU) in the circuit;
7) *Test multipoint junction unit* – TMN directs NE to split the circuit under test and performs primary and secondary channel tests on the multipoint junction unit (MJU);
8) *Test straightaway* – TMN directs NE to split the circuit under test and connect the required test modules to perform a straightaway test;
9) *Establish loop around access* – TMN directs NE to establish a test access to a metallic circuit by selecting a test access path (TAP) and providing a looparound on the selected TAP;
10) *Connect monitor state* – TMN directs NE to establish a monitor state without the need to re-access the circuit under test. This function will remove or reset any previous state or condition except the terminate and leave state;

11) *Change split metallic/digital* – TMN directs NE to split the specified pair or pairs at the metallic or digital access point of the circuit under test, and connect it to the TAP. Both the facility (F) and equipment (E) sides of the split circuit are connected to the TAP, in agreement with the lead-pair assignment and configuration code;

12) *Change terminate and leave metallic/digital* – TMN directs NE to change the terminate and leave state of the circuit under test;

13) *Silence repeater* – TMN directs NE to shut down a repeater;

14) *Request TAPs status* – TMN requests the status of all TAPs serving NE;

15) *TAPs status report* – NE reports the status of all TAPs to TMN;

16) *Reset TAPs* – TMN directs NE to release all existing test access connections in the NE. It also restores all TAPs involved to an idle state;

17) *Diagnose TAP* – TMN directs NE to carry out a looparound of the TAPs from the test system for purposes of diagnosis.

B.3.3 *Configuration management*

B.3.3.1 *Provisioning*

B.3.3.1.1 *NE configuration*

1) *Request configuration* – TMN requests that the NE report the current configuration of each entity;

2) *Configuration report* – For each entity, NE reports status, capacity of the entity, optional parameters, type of entity (in sufficient detail for TMN identification) and the version and revision of the version;

3) *Grow* – TMN notifies NE of the presence of a newly installed entity;

4) *Prune* – TMN notifies NE of the disconnection of an entity;

5) *Restore* – TMN notifies NE to begin monitoring the newly installed entity;

6) *Assign* – TMN notifies NE that a previously unequipped entity is now equipped;

7) *Delete* – TMN notifies NE that a previously unequipped entity is no longer equipped;

8) *Set service state* – TMN directs NE to place the specified entity in one of the following states: in service (available for use), out of service (unavailable for use), standby (not faulty but not performing normal function), reserved;

9) *Request assignments* – TMN requests that NE report the identity of each assigned entity. The request may be for a specified entity or for all equipped entities;

10) *Assignment reports* – NE reports the identity of each assigned channel for each equipped entity or for a specified entity;

11) *Set parameters* – TMN directs NE to set parameters associated with a specified entity;

12) *Set service thresholds* – TMN directs NE to set performance thresholds for the specified channel;

13) *Add/drop* – TMN directs NE to insert or remove a channel from the complement of through-channels;

14) *Cross-connect* – TMN directs NE to interconnect two specified channels operating at the same rate;

15) *Disconnect* – TMN directs NE to remove the interconnection between two specified channels;

16) *Start transmission test* – TMN directs NE to begin a transmission test on a given circuit;

17) *Balance* – TMN directs NE to perform a balance test/adjustment;

18) *Start transponder test* – TMN directs NE to look for a transponder signal on the given circuit;

19) *Set report periods* – The TMN directs NE to set or change report periods;

20) *Request report periods* – The TMN requests NE to send the current periods to the TMN.

B.3.3.1.2 *Administrative functions*

1) *Set clock* – TMN directs NE to set NE system clock to current calendar, date and time;
2) *Backup copy* – TMN directs NE to make a backup copy of the designated NE data base file for purposes of archiving for future restoral;
3) *Terminate procedure* – TMN directs the NE to terminate a process between a TMN and a NE;
4) *Route messages* – TMN directs NE to route automatic messages generated by NE to one or multiple communications channels;
5) *Set service controls* – TMN directs NE to assign user access and functional capability.

B.3.3.1.3 *Data base management*

1) *Initialize* – TMN configures a new data base which is related to an NE. This may or may not be downloaded to the NE. This may also include loading a new program related to the NE;
2) *Reinitialize* – TMN reconfigures the data base within an NE while it is in service;
3) *Update* – TMN adds, changes or deletes one or more records in the data base of an NE. This can be done in a delayed activation mode or upon command entry. It may also be able to enter data base updates on a test basis prior to permanent entry;
4) *Query* – TMN reads NE for all or part of its data base contents;
5) *Backup* – TMN keeps a copy of all or part of the data base of an NE. In case of memory failure in the NE, the TMN downloads the backup copy to the NE.

B.3.3.2 *Status and control*

1) *Request status* – TMN requests NE to send current status information;
2) *Status report* – NE reports to TMN the value of a monitored parameter. It may be sent on demand by TMN or on a scheduled basis;
3) *Schedule status report* – TMN directs NE to establish a schedule for the reporting of status information;
4) *Request status report schedule* – TMN directs NE to send the current schedule of status reporting. NE responds with the schedule;
5) *Allow/inhibit automatic restoration* – TMN directs NE to allow or inhibit automatic restoration in an M+N or duplex system;
6) *Operator/release automatic restoration* – TMN directs NE to switch a specified line or equipment to the redundant unit or release it from the redundant unit. For an M+N system, service is placed on the redundant unit and taken off of the working unit. For a duplex system the main unit becomes standby and the standby unit becomes the main unit.

B.3.3.2.1 *Message handling systems network*

1) *Request message storage status data* – TMN requests NE to transmit the message storage status data of store and forward communication to TMN;
2) *Message storage status data report* – NE sends the status data to TMN.

B.3.3.2.2 *Leased circuit network*

1) *Request status of dynamic provisioning of leased circuit network* – TMN requests NE to transmit the status of dynamic provisioning to TMN;
2) *Status report of dynamic provisioning of leased circuit networks* – NE sends the current status to TMN.

B.3.3.2.3 *Transmission network*

1) *Request status of automatic transmission restoration* – TMN requests NE to transmit the switching activities and current status of automatic transmission restoration;
2) *Status report of automatic transmission restoration* – NE sends the current status of the switching operations to TMN.

B.3.3.3 *Installation*

A detailed list of installation functions for an SPC-exchange is provided in Recommendation Z.331 [1], § 3.3.

B.3.4 *Accounting management*

This term and the subject is for further study.

B.3.5 *Security management*

1) *Change channel class* – TMN directs NE to change the security user class of an operations channel;
2) *Change terminal class* – TMN directs NE to change the security class of NE terminal;
3) *Dial capability* – TMN directs NE to initiate a secure dial-out/dial-back capability to TMN;
4) *Log in* – TMN sends the appropriate password and identification of an NE communications channel;
5) *Log off* – TMN directs NE to terminate communication on a channel;
6) *Change* – TMN directs NE to change the log-in code assigned to NE;
7) *Change dial number* – TMN directs NE to change the auto-dial-back number that NE uses to call back the calling party upon receipt of a dial-out call.

B.4 *Glossary*

B.4.1 **alarm**

An alerting indication to a condition that may have immediate or potential negative impact on the state of the monitored NE.

B.4.2 **alarm attribute**

A collective reference to delaying, stretching and severity of alarm indications.

B.4.3 **alarm route**

A path between an NE and a TMN for the transmission of alarm information.

B.4.4 **audit**

A test of the validity of data and/or generic programs in the NE.

B.4.5 **control**

A modifier of the state of an NE.

B.4.6 **delaying**

Withholding the report of alarm information until the condition has persisted for a predetermined amount of time.

B.4.7 **diagnostic**

A routine in the NE which performs detailed tests to isolate troubles.

B.4.8 **exercise**

Sequential operations which test the overall functioning of an NE or sub-system.

B.4.9 **initialization**

Setting a process to a specified state. This may be a restart state or intermediate levels.

B.4.10 **loopback**

A procedure used in fault location whereby a signal is returned to its source along the same path on which it was received.

B.4.11 **mode**

The alarm characteristic of being either continuous or self-retiring.

B.4.12 **performance monitoring (PM)**

The monitoring of various parameters of an NE on an in-service basis to measure the quality of performance.

B.4.13 **performance monitoring attributes**

Characteristics of PM parameters including thresholds and pattern recognition criteria.

B.4.14 **severity**

An alarm attribute indicating the magnitude of the related failure. Some measures of severity include major, minor, service affecting and non-service affecting.

B.4.15 **supervisory signal**

A signal indicating the state or change of state of a circuit.

B.4.16 **scheduling**

Can include the assignment of time intervals to the execution of one or more functions by the NE. It can also include inhibition or allowance of execution of the function without affecting prior scheduling.

B.4.17 **status**

Information on the current state of an NE.

B.4.18 **stretching**

Holding the indication of an alarm condition for a predetermined amount of time, even after the condition resolves to increase the chance that the TMN has scanned the indication.

B.4.19 **terminate and leave (T&L)**

Terminating one or both direction of transmission on an outgoing transmission path.

B.4.20 **test access point (TAP)**

A virtual or physical testing path between a test system and the circuit under test in the NE.

B.4.21 **thresholding**

Assignment of a specified value of a monitored parameter such that trouble indication is generated only when this value is exceeded.

B.4.22 **trace**

A report of the execution flow of a specified event.

B.4.23 **trap**

An automatic report of a specified event which would otherwise not be reported.

ANNEX C

(to Recommendation M.30)

Tables of function attribute ranges

The TMN should be designed such that it has the capability to interface with several types of communications paths, to ensure that a framework is provided which is flexible enough to allow for the most efficient communications between the NE and the TMN, workstations and the TMN, between elements within the TMN or between TMNs. In this case the term efficiency relates to the cost, reliability and quantity of the data transported.

Costs are impacted by two aspects. The first is the actual cost to transport data across the network between the TMN and the NE. To minimize this cost various network architectures are considered, e.g., star, multipoint, loop, tree. The communications required must also be considered, e.g. leased circuits, circuit switched or packet-switched networks. In making this choice, network availability and cross-network delays must be evaluated as attributes to be used in the decision-making process.

The second aspect is the design of the interface including the selection of the appropriate communications protocol. In this case there are several attributes associated with functions performed within the NE that would help to govern this choice. These attributes include: reliability, frequency, quantity and the requirement for priority.

This Annex provides tables of ranges for each of the function attributes that should be taken into consideration when planning the design of the data communications channels and selecting the appropriate protocol to be used to interface between a TMN and NE, TMN and workstation, or between elements within a TMN. Table C-1/M.30 shows the basic function attributes. Table C-2/M.30 shows examples of TMN attributes to support the OSs requiring real-time operations, and Table C-3/M.30 shows examples of the same attributes for a non real-time OS.

TABLE C-1/M.30

Basic table of function attributes

	Attributes	Requirements		Nature of attributes
Performance, or grade of service (P)	Delay (speed)	Short Medium Long		Objective of design and control (acceptable/unacceptable)
	Reliability (accuracy)	High Medium Low		
	Availability	High Medium Low		
Characteristics of TMN traffic (C)	Quantity	Large Medium Small		Condition or parameter of design and control
	Frequency	Non-periodic	Often Medium Seldom	
		Periodic	Often Medium Seldom	
	Priority	High Medium Low		

TABLE C-2/M.30

Example of function attributes for real-time operation [a), b)]

<table>
<tr><th></th><th>Attributes</th><th colspan="2">Requirements</th><th>Attribute ranges</th></tr>
<tr><td rowspan="3">(P)</td><td>Delay (speed)</td><td colspan="2">Short
Medium
Long</td><td>Network delay < 1 s
Network delay ⩽ 10 s
Network delay > 10 s</td></tr>
<tr><td>Reliability (accuracy)</td><td colspan="2">High
Medium
Low</td><td>No errors (goal)
Infrequent errors (not service affecting)
Can tolerate errors</td></tr>
<tr><td>Availability</td><td colspan="2">High
Medium
Low</td><td>Network availability > 99.95 %
Network availability > 99.5 %
Network availability < 99.5 %</td></tr>
<tr><td rowspan="3">(C)</td><td>Quantity</td><td colspan="2">Large

Medium
Small</td><td>> 256 octets per transaction
(10^6 to 10^7 octets per job) [c)]
< 256 octets per transaction
< 16 octets per transaction</td></tr>
<tr><td rowspan="2">Frequency</td><td>Non-periodic</td><td>Often
Medium
Seldom</td><td>> 1 transaction per 10 ms
> 1 transaction per 10 s
< 1 transaction per 10 s (week, month) [c)]</td></tr>
<tr><td>Periodic</td><td>Often
Medium
Seldom</td><td>> 1 transaction per 10 s
> 1 transaction per minute
< 1 transaction per minute (hour, day) [d)]</td></tr>
<tr><td></td><td>Priority</td><td colspan="2">High
Medium
Low</td><td></td></tr>
</table>

[a)] "Real-time" has a two-fold meaning:

i) on-line activities consistently carried out from time-to-time, such as sampling of system status (type A),

ii) activities that are not frequently done but require quick operation once they have been called for (type B).

[b)] Attributes can be considered for:

i) each command, each inquiry, the responses to them, and each spontaneous report,

ii) an operation which consists of the combination of the categories in i), e.g. a command and its response.

[c)] For example, file loading, system recovery, etc. (type B).

[d)] For example, system file saving, call data saving, etc.

TABLE C-3/M.30

Example of function attributes for non-real-time operation [a), b)]

	Attributes	Requirements		Attribute ranges
(P)	Delay (speed)	Short Medium Long		Network delay < 30 s Network delay < 15 min Network delay ≥ 15 min
	Reliability (accuracy)	High Medium Low		No errors (goal) Infrequent errors (not service affecting) Can tolerate errors
	Availability	High Medium Low		Network availability > 99.95 % Network availability > 95 % Network availability ≤ 95 %
(C)	Quantity	Large Medium Small		> 4096 octets per transaction (10^6 to 10^7 octets per job) [c)] < 256 octets per transaction < 256 octets per transaction
	Frequency	Non-periodic	Often Medium Seldom	> 1 transaction per minute ≥ 1 transaction per hour < 1 transaction per hour (week, month) [c)]
		Periodic	Often Medium Seldom	> 1 transaction per minute ≥ 1 transaction per hour < 1 transaction per hour
	Priority	High Medium Low		

a) Non-real time operation can include both off-line and on-line operations.

b) Attributes can be considered for:

i) each command, each inquiry, the responses to them, and each spontaneous report,

ii) an operation which consists of the combination of the categories in i), e.g. a command and its response.

c) For example, file transfer, large volume data transfer, etc.

References

[1] CCITT Recommendation *Introduction to the specifications of the man-machine interface*, Vol. X, Rec. Z.331.

[2] CCITT Recommendation *Reference model of open systems interconnection for CCITT applications*, Vol. VIII, Rec. X.200.

[3] CCITT Recommendation *Q-interfaces and associated protocols for transmission equipment in the telecommunication management network (TMN)*, Vol. III, Rec. G.771.

[4] CCITT Recommendation *Exchange interfaces for operations, administration and maintenance*, Vol. VI, Rec. Q.513.

Recommendation M.32

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 event information (MEI).

Definitions of PMA, DMA and MEI are found in Recommendation M.20, § 5.4.1.

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 of which the equipment is part. The general rule 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 aim 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, § 5.4.2.

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 objective when providing audible/visual alarm indications is that they should permit on-site maintenance staff to 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 considerations

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 MEI*

4.2.1 When reporting or displaying alarms either locally or remotely, it is important to distinguish between PMA/DMA indications and MEI indications. PMA/DMA indications are those which cause maintenance staff to be alerted (e.g., by ringing a bell), and MEI 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 MEI indications must be dealt with by maintenance staff.

4.2.3 MEI 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 MEI 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 of personnel, 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) 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.

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, MEI),

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

4.4 *Possible use of MEIs*

Administrations using MEI 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 MEI are left to their discretion.

4.5 *Considerations for protection switching and control*

To meet transmission system availability objectives or maintenance criteria, transmission systems may be provided with protection 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, for example, by radio path fading,

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

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

Recommendation M.34

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, § 5.4.

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 failing 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.

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

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 to other alarm information.

2.2 *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 to monitor distant transmission systems and equipment.

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 automatic performance monitoring, as opposed to monitoring or testing involving human intervention. This capability, however, implies that the performance monitor feature is built into the digital terminal system, or that dedicated external performance monitor equipment is provided for each termination.

An alternative to providing dedicated external performance monitor equipment is to provide remote access to protected monitor points and share external performance monitoring equipment with a number of terminal systems. This alternative of 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. While continuous performance monitoring capabilities built into transmission systems and terminals are clearly the preferred implementation for new systems, the concept of nearly continuous monitoring offers an efficient and cost-effective means of providing automatic monitoring capabilities for existing digital systems not having the built-in capabilities. In addition, continuous (or nearly continuous) monitoring is faster, more reliable, and less labor intensive than manual 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 is 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.32).

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.35

PRINCIPLES CONCERNING 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.36

PRINCIPLES FOR THE MAINTENANCE OF ISDNs

1 General

The purpose of this Recommendation is to apply general maintenance principles to determine the maintenance strategy to be adopted by Administrations and other maintenance service providers (MSP) in order to maintain ISDNs.

In providing this guidance, due consideration has been given to the principles identified in Recommendations M.20, M.30, M.32 and M.34 and to the activities identified in the I.600-Series Recommendations [1].

1.1 *Scope of application*

1) considering that Recommendation M.20 defines the maintenance philosophy for telecommunications networks;

2) considering that Recommendation M.30 defines the principles for the telecommunications management network (TMN);

3) considering that Recommendation I.601 [2] describes reference configurations, general architecture for maintenance of ISDN subscriber access and subscriber installation, which are applied in:
   - Recommendation I.602 [3] for the ISDN subscriber installations,
   - Recommendation I.603 [4] for the ISDN subscriber basic accesses,
   - Recommendation I.604 [5] for the ISDN subscriber primary rate accesses,
   - Recommendation I.605 [6] for the static multiplexed basic rate accesses,
   - Recommendation I.606 (under study) for the ISDN subscriber higher rate access;

4) considering that Recommendations Q.940 [7] and Q.942 (under study) describe the model, service elements and protocols to be provided at the ISDN user/network interfaces for management;

5) considering that Recommendation M.550 provides the maintenance limits for digital paths and sections to achieve the performance objectives given in Recommendation G.821 [8],

this Recommendation defines the ISDN maintenance concepts to be applied for the maintenance of subscriber installations, networks, including the transit network, and interworking between ISDNs and other networks, including both existing and future public and private networks.

This Recommendation takes into consideration basic ISDN features such as:

- open communication via the S/T reference points;
- portability of terminals between S/T reference points, from subscriber installation to subscriber installation, and from ISDN to ISDN.

2 Overview

2.1 *General maintenance principles for ISDN*

The fundamental maintenance strategy is to rely on performance monitoring wherever possible in order to apply the controlled maintenance principles of Recommendation M.20.

The maintenance capabilities provided must allow for the clear differentiation of troubles between subscriber and network equipment.

The maintenance capabilities provided must allow for clear differentiation between faults and legitimate subscriber activities.

A MSP should be able to localize the fault in his domain without disturbing the network or other domains. This should be possible locally and remotely, i.e., across networks and between any allowed management entities.

Testing will be needed both to supplement the performance monitoring for trouble detection and to provide additional trouble localization ability.

The subscriber installation should be able to receive failure or performance information if sent from the network side. The network should be able to receive failure or performance information from the subscriber side.

A capability should be provided to control the status of the subscriber access and of the subscriber equipment during maintenance operations.

The subscriber installation (or its MSP) should be able to receive information, if sent from the network, about the maintenance status of its access.

Only the Administration may initiate maintenance action within the subscriber access.

The subscriber or his MSP, either private or Administration, may initiate maintenance action within the subscriber installation.

2.2 *Supervision of the subscriber access and end-to-end performance measuring*

For maintenance purposes, each maintenance entity (ME) and maintenance entity assembly (MEA) provides its own performance measuring according to Recommendation M.20. The generated anomaly and defect informations allows decision and identification of ME or MEA in the degraded or unacceptable functioning state, and reporting that state to the associated management entity.

The network can only measure the performance of MEs and MEAs. The problem of how to combine the performance of the MEs and MEAs of the transit network with that of the subscriber accesses to determine the end-to-end performance as seen by the subscriber is for further study.

2.3 *Management reference models*

2.3.1 *Reference definitions*

2.3.2 **subscriber access maintenance center (SAMC)**

An SAMC represents a group of functions, network equipment elements and staff controlled by the Administration, which together have the responsibility and capability for maintenance functions and maintenance actions within the subscriber access.

2.3.2.1 **subscriber access maintenance entity (SAME)**

The SAME controls the subscriber access maintenance functions and provides communications for such activities. The SAME might be distributed.

Example of SAME functions:

- control loopbacks in an NT1 or LT;
- supervise the service state of the subscriber access;
- provide access to subscriber access performance information.

2.3.2.2 **subscriber installation maintenance entity (SIME)**

An SIME represents a group of dedicated functions contained within the functional groups (as specified in Recommendation I.411 [9]) of the subscriber installation (i.e. TE1 and NT2) which have, for example, the following purposes:

- interaction with the (human) user;
- handling of maintenance protocol from the SAME and/or a MSP;
- control of internal testing and maintenance mechanisms.

It is considered that the functions of the SIME may be distributed throughout the protocol layers implemented in the subscriber equipment and management/maintenance entities, including NT1 functions in some applications, but the precise architecture and protocol of the SIME is not a subject of this Recommendation.

Examples of SIME functions:

- control TE loopbacks;
- identify TE service capability;
- control generation of test signals for maintenance of subscriber installation wiring;
- provide access to performance data within subscriber installation, e.g. layer two and three protocol performance;
- security screen requests from MSPs.

2.3.2.3 **maintenance service provider (MSP)**

The MSP represents a group of functions, equipment and maintenance staff, that together have the responsibility for maintaining the subscriber installation or a part of the subscriber installation. A MSP cannot control the maintenance functions of the subscriber access. If authorized, it can request information from the SAMC about the subscriber access.

1) Agreement and responsibility for maintenance between the subscriber and the MSP for each part or parts of the subscriber installation should be made at the time of subscription to the maintenance service (this may take the form of a commercial contract). In any case, provision to allow a customer to change the maintenance service provider(s) is recommended. The subscriber may choose not to make such an agreement with a MSP.

2) Maintenance service providers can be

   – private providers,

   – the Administration,

   – the subscriber.

3) Private MSPs that are connected to ISDN by a S/T interface are referred to as external MSPs. Administration MSPs may also be connected via S/T interface or by other means as described below.

4) The interfaces between ISDNs and MSPs are for further study.

5) It is the sole responsibility of a subscriber installation and not of the network to ensure that an unauthorized MSP cannot obtain access to maintenance functions in the subscriber installation.

Examples of MSP functions:

– request SIME maintenance activity;

– request SAMC maintenance information that is allowed;

– provide test responders.

2.3.2.4 **operation, administration and maintenance centre (OAMC)**

The OAMC is an Administration's centre with the responsibility for the general operation, administration and maintenance of the network. It includes both staff and associated operations systems. The functions may be distributed among many centres and OSs.

Examples of OAMC functions:

– request SAME to control loopback activation;

– supervise the bringing into service of subscriber access;

– obtain performance information on the subscriber access from the SAME;

– manage teleservices provided to a subscriber;

– screen requests from MSPs for authorization.

The SAMC is composed of the SAME and part of the OAMC.

2.3.2.5 *Management entities*

Management entities are groups of capabilities that collectively provide management functions, such as operations, administration, maintenance and provisioning. For the network part, the functions may be implemented by a combination of capabilities in network elements and operations systems. For the subscriber part, management functions may be contained within the subscriber installations.

2.3.3 *Reference maintenance configuration*

Shown in Figure 1/M.36 is the reference maintenance configuration, which gives the relationship between the subscriber installation and subscriber access to be maintained and the various maintenance centers, entities and providers.

This reference model shows the possible physical interconnection between Terminal Equipment (TE), Local Exchanges (LE), OAMC and MSPs.

The lines between physical devices containing each functional entity represent physical communications paths over which the management information may flow. It is envisioned that the higher layer protocols for management and maintenance would be the same. See Figure 7/I.601 [2] for another representation of this communication. Service primitives are required to facilitate interworking with a variety of lower layer protocols. Further study is needed to define these service primitives. Thus, the connections between the various entities could be provided by D-channels, X.25 networks, Signalling System No. 7, or leased lines.

In this reference configuration, the subscriber access is maintained by a SAMC. Local or remote users or MSPs may communicate with the SAMC to request certain maintenance functions under its control. The SAME provides the communications interface for network local management functions and contains the control functions for such local activity. The SAME functions may either be entirely part of the local exchange or may be distributed between the LE and an OAMC.

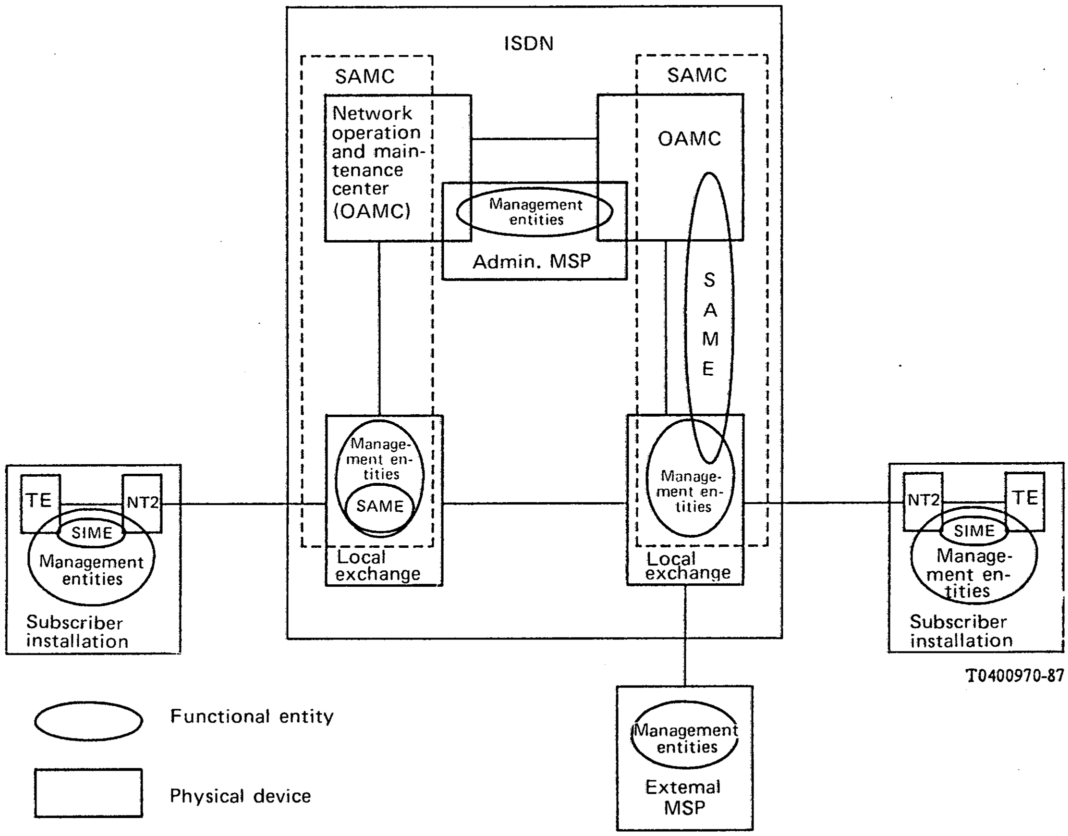


FIGURE 1/M.36

Network physical model for maintenance information transfer among O&M (operations and management) entities

2.3.4 *Relationship to telecommunications management network*

The telecommunications management network (TMN) is intended to provide an Administration with an independent communications network to carry its management (operations, administration and maintenance) messages to and from its operations system (OSs) to the telecommunications network it manages, including its ISDN and associated network elements. Figure 2/M.36 shows an example of one possible relationship of a TMN to the ISDN that is shown in Figure 1/M.36.

In Figure 2/M.36, the TMN would carry management messages between the OAMC (including an Administration MSP, if provided) and the ISDN over a Q-type TMN interface (see Recommendation M.30 for a description of the TMN interfaces). The TMN would also provide the communications for an Administration's externally provided MSP using the TMN PQ-DCN protocol suite (as defined in Recommendation M.30) over a T-type physical ISDN interface.

A private MSP may be connected directly to the ISDN via a T-type interface. It may also be connected to the TMN by interworking via other network interworking interfaces that are under study.

While supporting the ISDN, the TMN is also supporting other management functions for the Administration, including the maintenance of transmission system equipment.

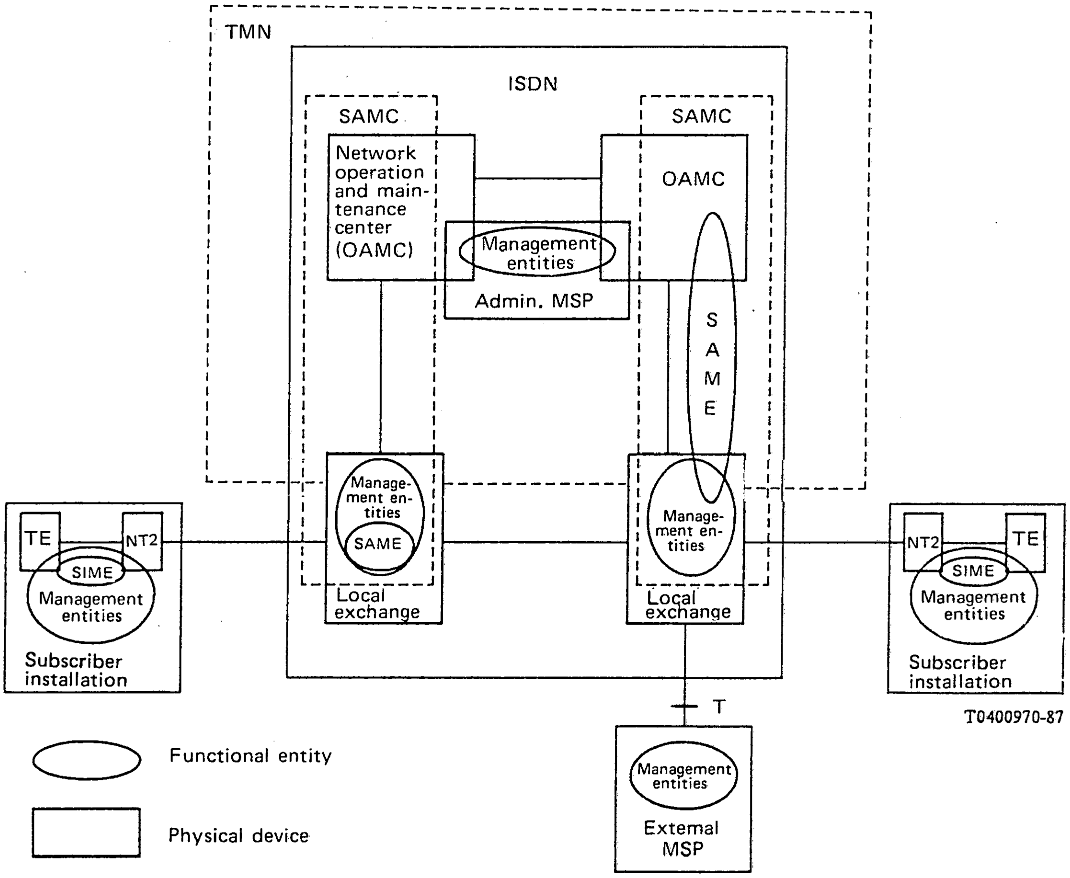


FIGURE 2/M.36

Relationship of a TMN to an ISDN

2.3.5 *Communications reference models*

Communications between functional groups is required for the maintenance of ISDNs. The communications configurations for maintenance of the subscriber access and the subscriber installation are shown in Recommendation I.601 [2]. Configurations for the transit part and for end-to-end ISDN maintenance are for further study.

2.4 *ISDN management protocol principles*

2.4.1 *General review*

The different management functions which may be contained, for example, in the SAMC, SIME, MSP, etc., are implemented in one or several real systems. A **real system** is a set of one or more computers, associated software, etc., that form an autonomous whole capable of performing information processing and/or information transfer. Each real system contains one or more management entities that supports management functions. A real open system is a real system which complies with the requirements of Recommendation X.200 [10] in its communication with other real systems.

Note – Two different modeling concepts are applicable to ISDN management protocol:

– ISDN protocol reference model (ISDN PRM), as defined in Recommendation I.320 [11];

– reference model of open systems interconnection for CCITT Applications (OSI PRM), defined in Recommendation X.200 [10].

These two reference models have the following commonalities:

- both the ISDN PRM and the OSI PRM organize communications functions into layers and describe the relation of these layers with respect to each other;
- the concepts and the associated terminology, which have been introduced in Recommendations X.200 [10] and X.210 [12] are fully applicable to the ISDN PRM. They include the concept of layer, layer service, and the notions of service primitives, peer entities and peer protocol.

2.4.2 *Requirements for ISDN maintenance activities*

Maintenance of ISDN equipments and interfaces is part of the general management process in an ISDN management entity. It is intended that maintenance of ISDN equipments by remote MPS through ISDN interfaces should follow the principles of Recommendation X.200 and of open systems management, which are under study.

Systems management is achieved through a set of application processes running in different management entities that communicate together and play complementary roles to provide management activities.

Within a management entity, system management functions are controlled and performed by the *system management element.* The system management element can be seen as a set of application processes communicating with remote application processes by the use of one or more application layer entities. An application process is an element within a management entity which performs the information processing for a particular application.

The definitions of the functions among management entities needed to maintain the ISDNs according to the principles stated in this Recommendation are for further study.

3 Basic rate access

3.1 *Basic rate access maintenance models*

Three access configurations are described below, along with a common subscriber equipment arrangement that applies to all three models. For each model, the maintenance entities are identified using reference points to delimit them. Some of these reference points are or may become standard interfaces. The ownership boundaries between network and customer are outside the scope of this Recommendation.

Because the D-channels shown in the models below all route through several MEs (maintenance entities), they are not MEs themselves but will be treated as maintenance entity assemblies. The D-channels carry several protocol layers that will be treated using the management and maintenance protocols that are under study. These include a definition of a layer management entity concept for each of the layers.

Other models are possible, but only a few, representative models are included here. Models including leased lines and digital crossconnect systems are left for further study.

3.1.1 *Simple model*

This model, shown in Figure 3/M.36, is similar to that shown in Figure 2/M.20. In the model, the V_1 interface may be replaced by a function, such as a loopback point in a combined LT/ET, while still providing a boundary between MEs.

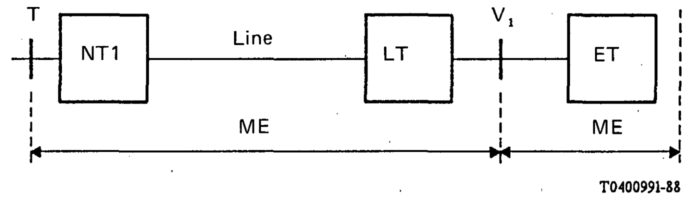
3.1.2 *Subscriber equipment arrangements*

This model is shown in Figure 4/M.36.

3.1.3 *Multiplexed interface*

This model is shown in Figure 5/M.36.

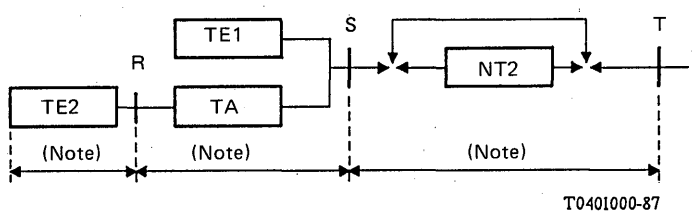
In this case, several basic rate accesses using V_1 reference points are multiplexed or concentrated to interface the exchange termination. For static multiplexing, a V_6 interface is applied. For dynamic multiplexing (multiplexing on the D-channel) or concentrating (dynamic assignment of the B-channels), a V_2 interface is applied. The V_2 and V_6 interfaces are defined in Recommendation Q.512 [13]. Performance monitoring is applied to the digital section of the basic rate access (between T interface and V_1 reference point) and between the multiplex/concentrator and the exchange termination.



Note – The network boundary of some Administrations excludes the NT1; this may require modifications to the MEs shown.

FIGURE 3/M.36

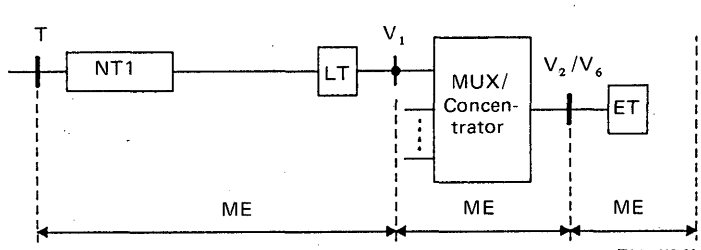
Simple basic rate access model



Note – The MEs for the subscriber installation are for further study.

FIGURE 4/M.36

Subscriber equipment arrangements



Note – The network boundary of some Administrations excludes the NT1; this may require modifications to the MEs shown.

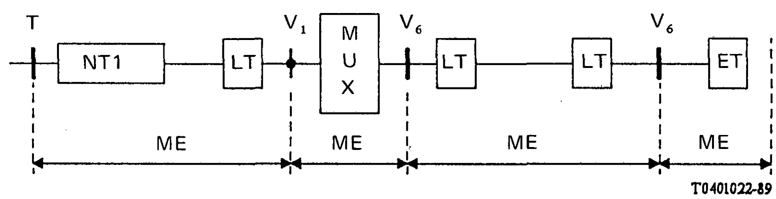
FIGURE 5/M.36

Multiplexed basic rate access model

3.1.4 *Remote multiplexed interface*

The model is shown in Figure 6/M.36.

This is similar to the previous model except that it is extended between the multiplex and the ET by one or more digital links which may route over higher order links.



Note – The network boundary of some Administrations excludes the NT1; this may require modifications to the MEs shown.

FIGURE 6/M.36

Remote multiplexed basic rate access model

3.1.5 *Basic rate leased lines*

This is for further study.

3.2 *Required capabilities*

3.2.1 *Transmission format maintenance features (layer 1)*

The format will be such as to support performance monitoring in both directions of transmission. Specifically, there will be error detection in each direction computed across the digital signal, for example, with CRC (cyclic redundancy check) or other error detection methods.

Transmission errors detected at the LT are converted to near-end error (NEE) indications. Transmission errors detected at the NT are converted to far-end error (FEE) indications and sent back to the LT. This enables performance for both directions to be assessed by the Administration.

A function of the C-channel may be to provide support of maintenance functions such as loopback activation and performance monitoring data gathering.

3.2.2 *Maintenance states and control*

This is an area for further study, including:

- restricting access to some capabilities to network or customer;
- security issues.

3.2.3 *Performance monitoring capabilities (layer 1)*

It shall be possible to report the performance information from the exchange to the OAMC (see § 3.2.3.2). It shall be possible to reset the parameter counts. Other issues under study include:

- combining all links in subscriber access;
- parameter consistency;
- identifying maintenance phases impacted by PM (performance monitoring).

3.2.3.1 *Maintenance entities monitored*

It shall be possible to monitor the NT to LT links.

3.2.3.2 *Required performance monitoring parameters and history*

The following principles apply to performance monitoring parameters and history:

a) parameters should be counted separately in each direction when feasible to help isolate troubles and to better estimate network service provided to users;

b) to support different maintenance uses, parameters should be counted for short durations (e.g., 15 minutes to one hour) and longer durations (e.g. 24 hours) as specified in Recommendation M.550;

c) error counts and when they occur should be retained to help deal with intermittent troubles;

d) thresholding, covered in Recommendations M.34 and M.550;

e) the threshold values should be settable by the OAMC;

f) performance information should be reported from the exchange to the OAMC:
   - when threshold crossings occur;
   - on demand from the OAMC.

3.2.4 *Testing capabilities*

Testing should introduce minimal disruption on other B- and D-channels, and should not disrupt the subscriber's terminal equipment. Other testing capabilities are for further study.

3.4.2.1 *Loopbacks*

The loopback capabilities for basic rate access, including types, locations, and control domains, are given in Recommendations I.602 [3] and I.604 [4].

3.2.4.2 *Test lines*

For further study.

3.2.4.3 *Test and monitor points*

For further study.

3.2.4.4 *Self tests and diagnostics*

For further study.

3.2.5 *Supervision and verification of protocol implementations*

The principles for the supervision and verification of ISDN access protocol implementations are:

a) Protocol errors due to implementation problems or other failures need to be detected. This may be based on the logging and counting of protocol violations;

b) Protocol problems need to be sectionalized, analyzed, and isolated. The following techniques may be used:
   - access to log of protocol violation information;
   - monitoring of the layer 2 frames and the layer 3 messages;
   - test access and protocol testing.

See Recommendation I.603 [4] for more information.

4 Primary rate access

4.1 *Primary rate access maintenance models*

Four primary rate access configurations are shown below, along with one figure showing four customer premises configurations, that can apply to any of the access models.

Maintenance entries are not indicated for these configurations, because there are several different implementations of primary rate access. The definitions of MEs is for further study.

4.1.1 *Simple access model*

The simple case of primary rate access from the NT2 directly to the exchange is shown in Figure 7/M.36. A variant of this model includes higher order links.

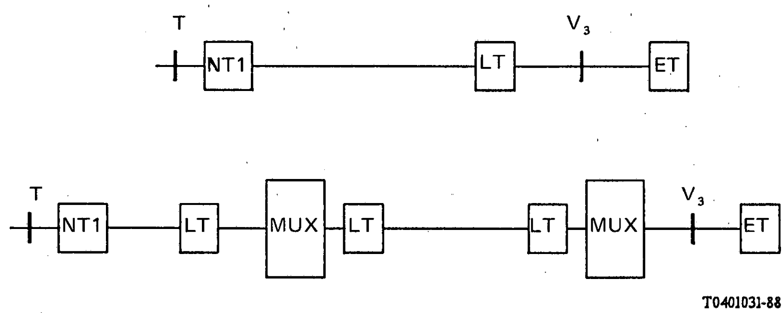


FIGURE 7/M.36

Simple primary rate access model

4.1.2 *Subscriber configurations*

There are several subscriber configurations that can appear behind any of the NT1s shown in the primary rate cases, as shown in Figure 8/M.36.

The first is the simplest case of separate NT1 and NT2, followed by a primary rate TE. Another case is with the NT1 and NT2 combined into one unit. A third case is a NT2 which is a PBX on which terminate several basic rate access lines connecting TEs to the PBX. A final case is one in which the NT2 is a multiplexer on which terminate several basic rate access lines connecting TEs to the multiplex.

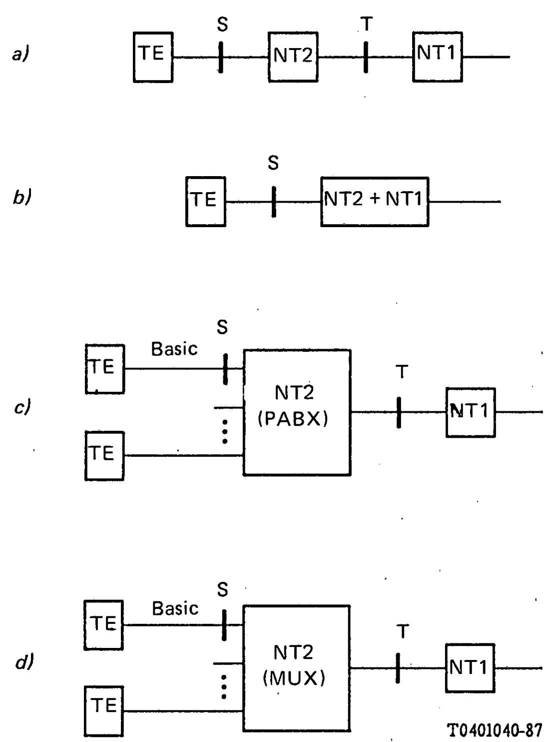


FIGURE 8/M.36

Primary rate subscriber configuration model

4.1.3 *Digital crossconnect system (DCS)*

A model introducing a new network element, the digital crossconnect system (DCS), in the simple access model is shown in Figure 9/M.36.

The DCS is a static crossconnect of B-channels, routing some to the exchange and some to the leased circuit network. Processing of the D-channel by the DCS is for further study, as discussed in Annex A.

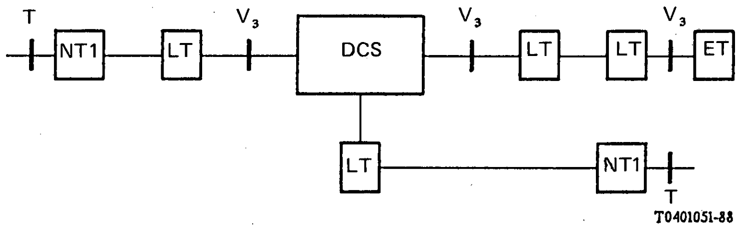


FIGURE 9/M.36

Primary rate access with DCS model

4.1.4 *Primary rate leased circuits*

In this case, all the B- and D-channels traverse the network from one NT2 to the other, without being terminated on a network switch. The network simply provides transport for a private ISDN, as shown in Figure 10/M.36.

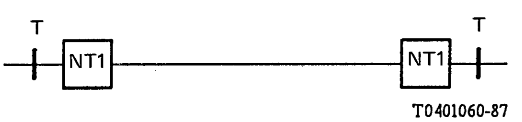


FIGURE 10/M.36

Leased circuit primary rate access model

4.2 *Required capabilities*

4.2.1 *Transmission format maintenance features*

For further study.

4.2.2 *Maintenance states and control*

For further study.

4.2.3 *Performance monitoring capabilities*

4.2.3.1 *Maintenance entities monitored*

For further study.

4.2.3.2 *Required performance monitoring parameters and history*

For further study. Includes layer 1 and layer 2 monitoring.

4.2.4 *Testing capabilities*

4.2.4.1 *Loopbacks*

The loopback capabilities for primary rate access, including types, locations, and control domains, are given in Recommendations I.602 [3] and I.604 [5].

4.2.4.2 *Test lines*

For further study.

4.2.4.3 *Test and monitor points*

For further study.

4.2.4.4 *Self tests and diagnostics*

For further study.

4.2.5 *Supervision and verification of protocol implementations*

The principles for the supervision and verification of ISDN access protocol implementations are:

a) protocol errors due to implementation problems or other failures need to be detected. This may be based on the logging and counting of protocol violations;

b) protocol problems need to be sectionalized, analyzed, and isolated. The following techniques may be used:

   – access to log of protocol violation information;

   – monitoring of the layer 2 frames and the layer 3 messages;

   – test access and protocol testing.

See Recommendation I.604 [5] for more information.

5 Broadband ISDN access

For further study.

6 End-to-end maintenance

6.1 *End-to-end models*

This section provides two examples of end-to-end ISDN connections. Figure 11/M.36 shows connection examples where a call from one subscriber access (primary or basic rate) is switched through the public network to another subscriber access.

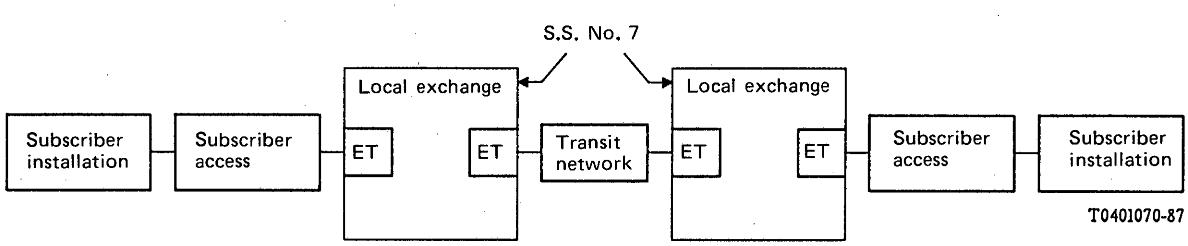


FIGURE 11/M.36

End-to-end public switched ISDN connection

Figure 12/M.36 shows an end-to-end leased circuit arrangement example where at each end a subscriber primary rate access is connected to a DCS. From the DCSs, B-channels are connected both to the switched and to provide an end-to-end connection between the subscriber locations.

A variation on this example would have a second primary rate access, without a D-channel, connected end-to-end via a DCS. In this case there is a possibility of a hidden fault between the DCSs that is not reported to either end and is not detected via the loss of the D-channel. Thus, this is a configuration where a continuity check is required to detect the fault.

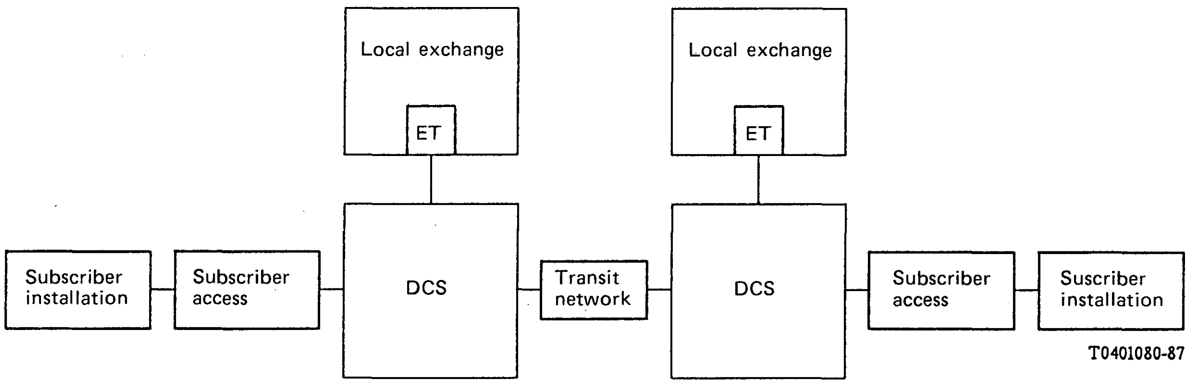


FIGURE 12/M.36

End-to-end leased circuit connection

6.2 *ISDN interworking model*

Primary or basic rate subscribers via their ISDN access may wish to interwork with other networks – with the public switched telephone network (PSTN), with a packet switched data network (PSDN) and with another public or private ISDN. A model for this interworking is shown in Figure 13/M.36.

An example of the interworking unit (IWU) would be a modem pool used in the PSTN case. Maintenance of interworking is for further study.

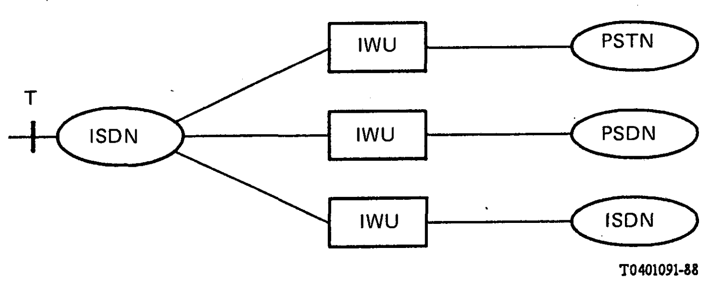


FIGURE 13/M.36

ISDN interworking model

6.3 *Terminal equipment functions for remote operations*

For further study.

6.4 *Network to network interworking functions for maintenance*

For further study.

ANNEX A

(to Recommendation M.36)

Digital crossconnect system considerations for ISDN

DCSs may also process the D-channel. They may break the D-channel layer 2, so that there are two tandem layer 2 links between the NT2 and the ET. The DCS routes layer 3 packets from the NT2 either to the exchange or to the leased network based on the routing of the associated B-channel. Thus, the DCS may also act as a packet crossconnect for the D-channel.

However, the DCS does not perform switch functions. Its crossconnect function is controlled over a separate administrative link, not over the D-channel with Q.931 [14] call control. This model also includes leased circuits.

The B-channels traverse the network without terminating on a switch. The associated D-channel information can be carried in the leased network in the same digital paths as the B-channels, or separately from the B-channels, on the Signalling System No. 7 signalling network.

References

[1] CCITT Recommendations of the I.600-Series *Maintenance principles for ISDN*, Vol. III.

[2] CCITT Recommendation *General maintenance principles of ISDN subscriber access and subscriber installation*, Vol. III, Rec. I.601.

[3] CCITT Recommendation *Application of maintenance principles to ISDN subscriber installation*, Vol. III, Rec. I.602.

[4] CCITT Recommendation *Application of maintenance principles to ISDN basic accesses*, Vol. III, Rec. I.603.

[5] CCITT Recommendation *Application of maintenance principles to ISDN primary rate access*, Vol. III, Rec. I.604.

[6] CCITT Recommendation *Application of maintenance principles to static multiplexed ISDN basic accesses*, Vol. III, Rec. I.605.

[7] CCITT Recommendation *ISDN user network interface protocol for management*, Vol. VI, Rec. Q.940.

[8] CCITT Recommendation *Error performance of an international digital connection forming part of an integrated services digital network*, Vol. III, Rec. G.821.

[9] CCITT Recommendation *ISDN user-network interfaces – reference configurations*, Vol. III, Rec. I.411.

[10] CCITT Recommendation *Reference model of open system interconnection for CCITT applications*, Vol. VIII, Rec. X.200.

[11] CCITT Recommendation *ISDN protocol reference model*, Vol. III, Rec. I.320.

[12] CCITT Recommendation *Open system interconnection (OSI) layer service definition conventions*, Vol. VIII, Rec. X.210.

[13] CCITT Recommendation *Exchange interfaces for subscriber access*, Vol. VI, Rec. Q.512.

[14] CCITT Recommendation *ISDN user-network interface layer 3 specification*, Vol. VI, Rec. Q.931.

Recommendation M.50

USE OF TELECOMMUNICATION TERMS FOR MAINTENANCE

For their dealings with their colleagues in other countries, personnel at operation centres and other maintenance units should refer to Fascicle I.3, *Terms and Definition*, of Volume I of this Book.

For maintenance technology, the definitions given in Recommendation M.60 are preferred.

Recommendation M.60

MAINTENANCE TERMINOLOGY AND DEFINITIONS

Introduction

This Recommendation consists primarily of those terms and definitions that are considered essential to the understanding of the maintenance of services and networks. Reference is provided to relevant Recommendations from which these terms are derived.

The terms and definitions are given with a section number. Annex A presents the list of terms in alphabetical order with the section number.

For additional definitions concerning transmission systems, see Recommendation M.300; for additional definitions concerning maritime systems, see Recommendation M.1100; and for additional definitions concerning international sound-programme transmission, see Recommendation N.1, N.51 and N.81. Also, complementary definitions concerning transmission restoration can be found in Recommendation M.495.

1 alarm indication signal (AIS)

F: signal d'indication d'alarme (SIA)

S: señal de indicación de alarma (SIA)

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 non-effective entities that a failure has been identified and that other maintenace alarms consequent to this failure should be inhibited. (Rec. M.20)

2 anomaly

F: anomalie

S: anomalía

An anomaly is a discrepancy between the actual and desired characteristic of an item.

The desired characteristic may be expressed in the form of a specification.

An anomaly may or may not affect the ability of an item to perform a required function. (Rec. M.20)

3 automatic switching equipment

F: équipement de commutation automatique

S: equipo de conmutación automática

That part of an international exchange concerned with switching operations for routing the call in the desired direction. (Rec. M.700, *Red Book*)

4 availability (performance)

F: disponibilité

S: disponibilidad

The availability of an item to be in the state to perform a required function at a given instant of time or at any instant of time within a given time interval, assuming that the external resources, if required, are provided.

Note 1 – This ability depends on the combined aspects of the reliability performance, the maintainability performance and the maintenance support performance of an item.

Note 2 – In the definition of the item the external resources required must be delineated.

Note 3 – The term availability is used as an availability performance measure.

(Supplement No 6, Fascicle II.3)

5 **bit error ratio (BER)**

F: taux d'erreur sur les bits (TEB)

S: tasa de errores en los bits; tasa de error en los bits (TEB)

The ratio of the number of bit errors to the total number of bits transmitted in a given time interval. (Rec. E.800)

6 **bridging loss**

F: affaiblissement dû à la dérivation

S: pérdida por derivación

A term frequently used when a measuring instrument is connected (bridged) across a transmission path or telephone channel. The bridging loss is the resulting reduction in the signal level, and is usually expressed in dBs.

7 **channel; access channel**

F: canal d'accès [canal]

S: canal de acceso [canal]

A designated part, having specified characteristics, of the information transfer capability at the user-network interface.

Note 1 – The information transfer may be, and usually is, bi-directional.

Note 2 – See also the definition for transmission channel. (Rec. I.112)

8 **channel; transmission channel**

F: voie de transmission

S: canal; canal de transmisión

See Recommendation M.300 for the definition of analogue channel, digital channel and mixed analogue digital channel.

9 **circuit; telecommunication circuit**

F: circuit; circuit de télécommunications

S: circuito; circuito de telecomunicación

A combination of two transmission channels permitting bidirectional communication between two points, to support a single call.

Note 1 – If the telecommunication is by nature unilateral, for example: long distance television transmission, the term "circuit" is sometimes used to designate the single channel providing the facility.

Note 2 – In telephony, use of the term "circuit" is generally limited to a telecommunication circuit with associated terminating equipment directly connecting two switching devices or exchanges.

Note 3 – A telecommunication circuit does not necessarily permit simultaneous transmission in both directions.

Note 4 – The "go" and "return" channels may be permanently associated together or may be selected from separate sets of associations together throughout the call.

Note 5 – The term circuit may be preceded by other qualifiers than telecommunication e.g. telephone, digital, etc. (Rec. Q.9)

10 **circuit; digital circuit**

F: circuit numérique

S: circuito; circuito digital

A circuit which transmits information signals in digital form between two exchanges. It includes termination equipment but not switching stages. (Rec. Q.9)

11 **circuit access points**

F: points d'accès au circuit

S: 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. (Rec. M.565)

12 **circuit control station**

F: station directrice de circuit

S: estación directora de circuito

The circuit control station is the point within the general maintenance organization for the international automatic and semi-automatic telephone service that fulfils the control responsibilities for the automatic circuits assigned to it. (Rec. M.723)

13 **circuit sub-control station**

F: station sous-directrice de circuit

S: estación subdirectora de circuito

The circuit sub-control station is a point within the general maintenance organization for the international automatic and semi-automatic telephone service that assists the circuit control station and fulfils the control responsibilities for a circuit section assigned to it. (Rec. M.724)

14 **code violation**

F: violation du code

S: violación de código

Definition for code violation:

a) AMI – Two consecutive marks of the same polarity. This may not be the absolute number of errors.

b) HDB3 – Two consecutive bipolar violations of the same polarity. This may not be the absolute number of errors.

c) B6ZS – Two consecutive marks of the same polarity excluding violations caused by the zero substitution code. This may not be the absolute number of errors.

d) B8ZS – Two consecutive marks of the same polarity excluding violations caused by the zero substitution code. This may not be the absolute number of errors. (Rec. O.161)

15 **connection**

F: chaîne de connexion

S: conexión

An association of transmission channels or circuits, switching and other functional units set up to provide a means of transfer of information between two or more points in a telecommunication network. (Rec. Q.9)

16 **connection; digital connection**

F: connexion numérique

S: conexión digital

A concatenation of digital transmission channels or digital telecommunication circuits, switching and other functional units set up to provide for the transfer of digital signals between two or more points in a telecommunication network, to support a single communication. (Rec. G.701)

17 **connection; international connection**

F: communication internationale

S: conexión internacional

Whole of the means joining temporarily two subscribers and enabling them to exchange information. (Rec. M.700, *Red Book*)

18 **connection; international telephone connection**

F: communication téléphonique internationale

S: conexión telefónica internacional

A complete international telephone connection has three parts, as shown in Figure 1/M.560:

– an international chain

– two national systems, one on each end. (Rec. M.560)

19 **continuity check**

F: contrôle de continuité

S: prueba de continuidad

A check made to a circuit or circuits in a connection to verify that an acceptable path (for transmission of data, speech, etc.) exists. (Rec. Q.9)

20 **continuous checking**

F: contrôle continu

S: comprobación continua

At 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. (Rec. M.20)

21 **control station**

F: station directrice

S: estación directora

A control station is that point within a general maintenance organization which fulfills the control responsibilities for the circuit, group, supergroup, digital section, etc., assigned to it. (Rec. M.80)

22 **data communication network**

F: réseau de communication de données

S: red de comunicación de datos

A data network which is established and operated either by Administrations or by private organizations. (Rec. X.15 *Red Book*)

23 **data communications network (DCN)**

F: réseau de communication de données (RCD)

S: red de comunicación de datos (RCD)

A DCN is a communications network within the TMN which supports the DCF at reference point q_3. (Rec. M.30)

24 data communications function (DCF) block

F: bloc de fonction de communication de données (FCD)

S: bloque de funciones de comunicaciones de datos (FCD)

The DCF block provides the means for data communication to transport information related to telecommunications management between function blocks. Details of the DCF are given in § 5.3 of Recommendation M.30. (Rec. M.30)

25 dead time

F: temps mort

S: tiempo muerto

The dead time is defined for the purpose of Recommendations O.61 and O.62 as the time after which the counter is ready to record another interruption following the end of the preceding interruption. (Rec. O.61)

26 defect

F: faute (ou défaut)

S: defecto

A defect is a limited interruption of the ability of an item to perform a required function. It may or may not lead to maintenance action depending on the results of additional analysis. (Rec. M.20)

27 deferred maintenance alarm (DMA)

F: alarme de maintenance différée (AMD)

S: alarma de mantenimiento diferido (AMD)

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 generally if automatic changeover to standby equipment has been used to restore service. (Rec. M.20)

28 degraded minute (DM)

F: minutes dégradées (MD)

S: minuto degradado (MD)

A degraded minute is a group of 60 consecutive seconds, after excluding SES (severely errored seconds), with a BER (bit error ratio) of 10^{-6} or worse.

A pseudo-degraded minute is a group of 60 consecutive seconds, after excluding SES, with at least N2 anomalies or at least one slip (when the anomaly is not a binary error). N2 is calculated similarly to N1, to detect a BER of 10^{-6} in one minute. (Rec. M.550)

29 echo

F: écho

S: eco

An electric, acoustic or electromagnetic wave which arrives at a given point, after reflection or indirect propagation, with sufficient magnitude and delay for it to be perceptible at the given point, as a wave distinct from that directly transmitted. (Rec. G.601)

30 echo canceller

F: annuleur d'écho

S: compensador de eco; cancelador de eco

A voice operated device placed in the 4-wire portion of a circuit and used for reducing near-end echo present on the send path, by subtracting an estimation of that echo from the near-end echo. (Rec. G.165)

31 echo suppressor

F: suppresseur d'écho

S: supresor de eco

A voice-operated device placed in the 4-wire portion of a circuit and used for inserting loss in the transmission path to suppress echo. The path in which the device operates may be an individual circuit path or a path carrying a multiplexed signal. (Rec. G.164)

32 error

F: erreur

S: error

An inconsistency between a digit in a transmitted digital signal and the corresponding digit in the received digital signal. (Rec. G.701)

33 error; random error

F: erreur aléatoire

S: error aleatorio

Errors distributed over the digital signal so that they can be considered statistically independent from each other. (Rec. Q.9)

34 error burst

F: paquet d'erreurs

S: ráfaga de errores

A group of bits in which two successive erroneous bits are always separated by less than a given number (x) of correct bits. The number (x) should be specified when describing an error burst. (Rec. Q.9)

35 error free seconds (EFS)

F: secondes sans erreur (SSE)

S: segundos sin error (SSE)

The ratio of the number of one-second intervals during which no bits are received in error to the total number of one-second intervals in the time interval.

Note 1 – The length of the time interval needs to be specified.

Note 2 – This ratio is usually expressed as a percentage. (Rec. E.800)

36 errored seconds

F: secondes erronées (SE)

S: segundos con error (SE)

An errored second is a second with at least one anomaly or defect. (Rec. M.550)

37 exchange

F: commutateur [central]

S: central

An aggregate of traffic carrying devices, switching stages, controlling and signalling means, and other functional units at a network node that enables subscriber lines, telecommunication circuits and/or other functional units to be interconnected as required by individual users. (Rec. I.112)

38 **failure**

F: défaillance

S: fallo

The termination of the ability of an item to perform a required function.

Note – After failure the item has a fault. (Supplement No 6, Fascicle II.3; Rec. M.20)

39 **fault**

F: panne; dérangement

S: avería

The inability of an item to perform a required function, excluding that inability due to preventive maintenance, lack of external resources or planned actions.

Note – A fault is often the result of a failure of the item itself, but may exist without prior failure. (Supplement No 6, Fascicle II.3; Rec. M.20)

40 **fault; intermittent fault**

F: panne intermittente

S: avería intermitente

A fault of an item which persists for a limited time duration following which the item recovers the ability to perform a required function without being subjected to any action of corrective maintenance.

Note – Such a fault is often recurrent. (Supplement No 6, Fascicle II.3)

41 **fault correction**

F: correction (de panne)

S: corrección (de una avería)

Actions taken after a fault localization intended to restore the ability of the faulty item to perform a required function. (Supplement No 6, Fascicle II.3)

42 **fault localization; localization of faults**

F: localisation des dérangements

S: localización (de una avería)

The broad localization of fault consists in finding the general part of the equipment in which it exists. Fault finding consists of determining the faulty item of the equipment. (Rec. M.700, *Red Book*)

43 **fault report point (circuit)**

F: service de signalisation des dérangements sur les circuits

S: punto de avisos de averías en los circuitos

The fault report point (circuit) is an element within the general maintenance organization for the international automatic and semi-automatic telephone 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. (Rec. M.715)

44 **fault report point (network)**

F: service de signalisation des dérangements dans le réseau

S: punto de avisos de averías en la red

The fault report point (network) is an element within the general maintenance organization for the international automatic and semi-automatic telephone 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 principle 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 organization 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). (See Recommendation E.413.)

The fault report point (network) is equipped with all the necessary facilities and arranged in such a way as to enable it:

a) to receive from different sources, fault reports of difficulties on the international telephone network or of problems with the international telephone 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) to make such fault reports to other points and initiate the fault location and clearing operations.

(Rec. M.716)

45 **interface**

F: interface

S: interfaz

The common boundary between two associated systems. (Rec. I.112)

46 **international automatic circuit**

F: circuit automatique international

S: circuito automático internacional

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 (see definition for *circuit access points*). (Rec. M.700, *Red Book*)

47 **international chain**

F: chaîne internationale

S: cadena internacional

An international chain is made up of one or more 4-wire international circuits. These are connected on a 4-wire basis to international circuits (in transit international centres) or to national systems (in terminal international centres). See Figure 1/M.560. (Rec. M.560)

48 international leased circuit

F: circuit international loué

S: circuit internacional arrendado

The whole of the assembly of lines and apparatus connecting the renter's terminal equipment (e.g. data modem) in one country to the renter's terminal equipment in another. The interfaces between the circuit and the renter's terminal equipment will be defined by the respective Administrations. See Figure 2/M.1010. (Rec. M.1010)

49 international main section

F: section internationale principale

S: sección principal internacional

The whole of the assembly of national and international group or supergroup sections, between the defined test access points at the two terminal international centres (see Recommendation M.460). These access points should be the same points as those for the ends of the national main sections involved in the leased link. See Figure 1/M.900. (Rec. M.900)

50 interruption; break of service

F: interruption; coupure (d'un service)

S: interrupción (de un servicio); corte (de un servicio)

Temporary inability of a service to be provided persisting for more than a given time duration, characterized by a change beyond given limits in at least one parameter essential for service.

Note 1 – An interruption of a service may be caused by disabled states of the items used for the service or by external reasons such as high service demands.

Note 2 – An interruption of a service is generally an interruption of the transmission, which may be characterized by an abnormal value of power level, signal distortion, error rate, etc. (Rec. E.800)

51 interruption

F: interruption

S: interrupción

For the purpose of Recommendation O.61, an interruption shall be regarded as a break in transmission or drop in the level of a test tone below a designated threshold. (Rec. O.61)

52 interruption

F: interruption

S: interrupción

For the purpose of Recommendation O.62, an interruption shall be regarded as a break in transmission or drop in the level of a 2 kHz test tone below a designated threshold. (Rec. O.62)

53 line; international line

F: ligne internationale

S: línea internacional

The 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 nearest the international centre. (Rec. M.700, *Red Book*)

54 **line; international line**

F: ligne internationale

S: línea internacional

The whole of the assembly of international and national circuit sections between terminal international centres. See Figure 2/M.1010. (Rec. M.1010)

55 **line; national line**

F: ligne nationale

S: línea nacional

The whole of the assembly of national circuit sections connecting the terminal national centre to the terminal international centre. When a distinction is needed to indicate the transmission direction in one country, the expressions national sending line, that is, outgoing from the render, and national receiving line, that is, incoming to the renter, may be used. See Figure 2/M.1010. (Rec. M.1010)

56 **line access point**

F: points d'accès à la ligne

S: puntos de acceso a la línea

A point 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. (Rec. M.565)

57 **link; international link**

F: liaison internationale

S: enlace internacional

The whole of the assembly of international and national circuit sections between terminal national centres. See Figure 2/M.1010. (Rec. M.1010)

58 **link; transmission link**

F: liaison de transmission

S: enlace de transmisión

A means of transmission with specified characteristics between two points.

Note – The type of the transmission path or the capacity is normally indicated, e.g. radio link, coaxial link, or 2048 kbit/s link. (Rec. I.112)

59 **logistic delay**

F: délai logistique

S: retardo logístico; demora logística

The logistic delay is the period of time between the fault localization and arrival of the maintenance staff on site. In case of an ISDN, the logistic delay will depend on the type of failures and how they are reported, i.e. by prompt maintenance alarm (PMA), deferred maintenance alarm (DMA) or maintenance event information (MEI). (Rec. M.20)

60 **loopback**

F: mise en boucle

S: bucle

A mechanism incorporated into a terminal or into the network whereby the transmit path of a communication may be connected back upon the receive path.

61 loopback; complete loopback

F: mise en boucle, complète

S: bucle completo

A complete loopback is a layer 1 [of the open system interconnection (OSI) model] mechanism which operates on the full bit stream. At the loopback point, the received bit stream shall be transmitted back towards the transmittting station without modification. (Rec. M.125)

62 loopback; digital loopback

F: mise en boucle numérique

S: bucle digital

A digital loopback is a mechanism incorporated into a piece of equipment whereby a bidirectional communication path may be connected back upon itself so that some or all of the information contained in the bit stream sent on the transmit path is returned on the receive path. (Rec. M.125)

63 loopback; logical loopback

F: mise en boucle logique

S: bucle lógico

A logical loopback acts selectively on certain information within a specified channel or channels and may result in some specified modification of the looped information. Logical loopbacks may be defined at any layer of the OSI model depending on the detailed maintenance procedure specified. (Rec. M.125)

64 loopback; non-transparent loopback

F: boucle non transparente

S: bucle no transparente

A non-transparent loopback is one in which the signal transmitted beyond the loopback point (the forward signal) when the loopback is activated is not the same as the received signal at the loopback point. The forward signal may be a defined signal or unspecified. (Rec. M.125)

65 loopback; partial loopback

F: mise en boucle partielle

S: bucle parcial

A partial loopback is a layer 1 mechanism which operates on one or more specified channels multiplexed within the full bit stream. At the loopback point, the received bit stream associated with the specified channel(s) shall be transmitted back towards the transmitting station without modification. (Rec. M.125)

66 loopback; transparent loopback

F: boucle transparente

S: bucle transparente

A transparent loopback is one in which the signal transmitted beyond the loopback point (the forward signal) when the loopback is activated, is the same as the received signal at the loopback point. (Rec. M.125)

67 loopback application

F: application de la mise en boucle

S: aplicación de bucle

The maintenance phase for which the loopback operation is used. (Rec. M.125)

68 **loopback control mechanism**

F: mécanisme de commande de mise en boucle

S: mecanismo de control de bucle

The means by which the loopback is operated and released from the loopback control point. (Rec. M.125)

69 **loopback control point**

F: point de commande de mise en boucle

S: punto de control de bucle

The loopback control point is the point which has the ability to directly control loopbacks.

The loopback control point may receive requests for loopback operation from several loopback requesting points. (Rec. M.125)

70 **loopback point**

F: point de mise en boucle

S: punto de bucle

A loopback point is the location of the loopback. (Rec. M.125)

71 **loopback requesting point**

F: point de demande de mise en boucle

S: punto de petición de bucles

The loopback requesting point is the point which requests the loopback control point to operate loopbacks.

Note 1 – Loopback requests should be subject to identification and authorization.

Note 1 – Possible locations of loopback requesting points are: in the network, in the TMN, in maintenance service providers (MSP). (Rec. M.125)

72 **loopback test pattern**

F: signal destiné à l'essai de mise en boucle

S: secuencia de prueba de bucle

The information transmitted during the operation of the loopback in the channel or channels which are to be re-directed by the loopback. (Rec. M.125)

73 **maintainability (performance)**

F: maintenabilité

S: mantenibilidad

The ability of an item under stated conditions of use, to be retained in, or restored to, a state in which it can perform a required function, when maintenance is performed under given conditions and using stated procedures and resources.

Note – The term maintainability is used as a measure of maintainability performance.
(Supplement No 6, Fascicle II.3)

74 **maintenance**

F: maintenance

S: mantenimiento

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 the international automatic telephone 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;

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. (Rec. M.700, *Red Book*)

75 **maintenance**

F: maintenance

S: mantenimiento

The combination of all technical and corresponding administrative actions, including supervision actions, intended to retain an item in, or restore it to, a state in which it can perform a required function. (Supplement No 6, Fascicle II.3)

76 **maintenance; automatic maintenance**

F: maintenance automatique

S: mantenimiento automático

Maintenance accomplished without human intervention. (Supplement No 6, Fascicle II.3)

77 **maintenance; controlled maintenance**

F: maintenance dirigée

S: mantenimiento dirigido

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. (Rec. M.20)

78 **maintenance; corrective maintenance**

F: maintenance corrective

S: mantenimiento correctivo

The maintenance carried out after fault recognition and intended to restore an item to a state in which it can perform a required function. (Rec. M.20)

79 **maintenance; deferred maintenance**

F: maintenance différée

S: mantenimiento diferido

Such corrective maintenance which is not immediately initiated after a fault recognition, but is delayed in accordance with given maintenance rules. (Supplement No 6, Fascicle II.3)

80 **maintenance; preventive maintenance**

F: maintenance préventive

S: mantenimiento preventivo

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. (Rec. M.20)

81 **maintenance entity (ME)**

F: entité de maintenance (EM)

S: entidad de mantenimiento (EM)

Maintenance entities are defined by the following principles:

– The different equipments of the telecommunications network constituting the MEs are interconnected to consecutive and easily identifiable interface points, at which points the interface conditions defined for these equipments apply and which possesses the means of detecting maintenance events and failures;
– If the telecommunication equipment supports bidirectional transmission, normally consisting of telecommunications equipment trasmitting in both directions, then both directions are considered part of the same ME;

- When a failure occurs within a network it is desirable that the maintenance alarm information indication appears at the failed maintenance entity. When this is not practical, the indication should appear at the closest possible entity;
- Maintenance alarm information indications in an entity should not cause related alarm information indications at other entities. In the event that such indications are permitted to occur, they should clearly indicate that the failure has occurred upstream, and not in the other entities displaying the information. (Rec. M.20)

82 maintenance entity assembly (MEA)

F: assemblage d'entités de maintenance (AEM)

S: conjunto de entidades de mantenimiento (CEM)

The maintenance entity assembly is defined by the following principles:

- An MEA contains a group of MEs assembled for additional maintenance purposes;
- Principles that apply to MEs apply also to MEAs;
- An MEA may detect failures and maintenance event information which can not be detected by MEs;
- An MEA may provide end-to-end maintenance alarm information which can not be provided by MEs.

End-to-end information may be collected by using additional supervision means. (Rec. M.20)

83 maintenance sub-entity (MSE)

F: sous-entité de maintenance (SEM)

S: subentidad de mantenimiento (SEM)

The maintenance sub-entity is defined by the following principles:

- The different parts of an MSE constituting the MEs are interconnected at consecutive and easily identifiable interface points;
- When a failure occurs within an MSE it is desirable that the maintenance alarm information indication appears at the failed maintenance entity containing the MSE;
- A failed MSE should be identified as failed by the fault location process, but should lead only to the identification of the failed ME by the supervision process;
- An MSE generally corresponds to the item which is replaceable during routine operations in the event of failure. (Rec. M.20)

84 maintenance event information (MEI)

F: information sur les événements de maintenance (IEM)

S: información de evento de mantenimiento (IEM)

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

(Rec. M.20)

85 maintenance philosophy

F: philosophie de maintenance

S: filosofía de mantenimiento

A system of underlying principles for the organization and execution of the maintenance.

(Supplement No 6, Fascicle II.3)

86 maintenance policy

F: politique de maintenance

S: política de mantenimiento

A description of the interrelationship between the maintenance echelons, the indenture levels and the levels of maintenance to be applied for the maintenance of an item. (Supplement No 6, Fascicle II.3)

87 **maintenance service provider (MSP)**

F: fournisseur de service de maintenance (FSM)

S: proveedor de servicios de mantenimiento (PSM)

The MSP represents a group of functions, equipment and maintenance staff, that together have the responsibility for maintaining the subscriber installation or a part of the subscriber installation. A MSP cannot control the maintenance functions of the subscriber access. If authorized, it can request information from the SAMC about the subscriber access. (Rec. M.36)

88 **maintenance strategy**

F: stratégie de maintenance

S: estrategia de mantenimiento

A plan for the organization and execution of maintenance.

89 **maintenance support (performance)**

F: logistique de maintenance

S: logística de mantenimiento

The ability of a maintenance organization, under given conditions, to provide upon demand the resources required to maintain an item, under a given maintenance policy.

Note – The given conditions are related to the item itself and to the conditions under which the item is used and m aintained. (Supplement No 6, Fascicle II.3)

90 **management entities**

F: entités de gestion

S: entidades de gestión

Management entities are groups of capabilities that collectively provide management functions, such as operations, administration, maintenance and provisioning. For the network part, the functions may be implemented by a combination of capabilities in the network elements and operations systems. For the subscriber part, management functions may be contained within the subscriber installations. (Rec. M.36)

91 **measurement**

F: mesure

S: medida; medición

The numerical assessment, in suitable units, of the value of a simple or complex quantity or magnitude. (Rec. M.700, *Red Book*)

92 **mediation device (MD)**

F: dispositif de médiation (DM)

S: dispositivo de mediación (DM)

The MD is the stand alone device which performs mediation functions (MFs). MDs can be implemented as hierarchies of cascaded devices. (Rec. M.30)

93 **mediation function (MF) block**

F: bloc de fonction de médiation (FM)

S: bloque de funciones de mediación (FM)

The MF block acts on information passing between network element function blocks (NEFs) and operations system function blocks (OSFs) to achieve smooth and efficient communication. Major MFs include communication control, protocol conversion and data handling, communication of primitive functions, processes involving decision making, and data storage. Details of the MF are given in § 5.4 of Recommendation M.30. (Rec. M.30)

94 **multiterminal service circuit**

F: circuit de service multiterminal

S: circuito de servicio multiterminal

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. See Figure 2/M.100. (Rec. M.100)

95 **national main section**

F: section nationale principale

S: sección principal nacional

The whole of the assembly of national group or supergroup sections containing the defined test access points at the terminal national centre and defined test access points at the terminal international centre (see Figure 1/M.900). (Rec. M.900)

96 **national system**

F: système national

S: sistema nacional

This system may comprise one or more 4-wire amplified national circuits with a 4-wire interconnection, and circuits with 2-wire connection to terminal exchanges and subscribers. See Figure 1/M.560. (Rec. M.560)

97 **network analysis point**

F: centre d'analyse du réseau

S: punto de análisis de la red

The network analysis point is an element within the general maintenance organization for the international automatic and semi-automatic telephone 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. (Rec. M.720)

98 **network element (NE)**

F: elément de réseau (ER)

S: elemento de red (ER)

The NE is comprised of telecommunication equipment (or groups/parts of telecomunication equipment) and support equipment that performs network element functions (NEFs) and has one or more standard Q-type interfaces. (Rec. M.30)

99 **network element function (NEF) block**

F: bloc de fonction d'élément de réseau (FER)

S: bloque de funciones de elemento de red (FER)

The NEF block communicates with a telecommunication management network (TMN) for the purpose of being monitored and/or controlled. Details of the NEF are given in § 5.5 of Recommendation M.30. (Rec. M.30)

100 **omnibus service circuit**

F: circuit de service omnibus

S: circuito de servicio ómnibus

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. See Figure 1/M.100. (Rec. M.100)

101 **operation, administration and maintenance centre (OAMC)**

F: centre de gestion, d'exploitation et de maintenance (CGEM)

S: centro de operaciones, administración y mantenimiento (COAM)

The OAMC is an administration's centre with the responsibility for the general operation, administration and maintenance of the network. It includes both the staff and associated operations systems. The functions may be distributed among many centres and operation systems. (Rec. M.36)

102 **operations systems (OS)**

F: système d'exploitation (SE)

S: sistema de operaciones (SO)

The OS is the stand alone system which performs operation system functions (OSFs). (Rec. M.30)

103 **operations system function (OSF) block**

F: bloc de fonction de système d'exploitation (FSE)

S: bloque de funciones de sistema de operaciones (FSO)

The OSF block processes information related to telecommunication management to support and/or control the realization of various telecommunication management functions. Details of the OSF are given in § 5.2 of Recommendation M.30. (Rec. M.30)

104 **path; telecommunication path**

F: itinéraire de télécommunications

S: trayecto de telecomunicación

The continuous course taken by a transmission signal beween two points.

Note 1 – This may be a physical transmission medium, a frequency band in a frequency multiplex, a time slot in a time division multiplex, etc.

Note 2 – The path includes the transmission media and the means used for connecting them together. (Rec. Q.9)

105 **path; digital path**

F: conduit; conduit numérique

S: trayecto digital

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 sections.

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

Note 3 – Digital paths interconnected by digital switches form a digital connection. (Rec. M.300)

106 **point**

F: point

S: punto

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. (Rec. M.700, *Red Book*)

107 **prompt maintenance alarm (PMA)**

F: alarme de maintenance immédiate (AMI)

S: alarma de mantenimiento inmediato (AMI)

A prompt maintenance alarm is generated in order to initiate maintenance activities (normally immediately) by maintenance personnel to remove from service a defective equipment for the purpose of restoring good service and effecting repair of the failed equipment. (Rec. M.20)

108 **propagation performance**

F: caractéristiques de propagation

S: característica de propagación

The ability of a propagation medium, in which a wave propagates without artificial guide, to transmit a signal within the given tolerances.

Note – The given tolerances may apply to variations in signal level, noise, interference levels, etc. (Rec. E.800)

109 **protection switching**

F: commutation sur liaison de réserve

S: conmutación de protección

Note – This term was used in the CCITT *Red Book* and has been deleted in the *Blue Book*. For more information, see the definitions for terms relating to direct transmission restoration (protection link switching) and automatic and semi-automatic transmission restoration (protection network switching) in Recommendation M.495.

110 **protected monitoring point**

F: point de surveillance protégé

S: punto de monotorización protegido

A protected monitoring point provides a digital interface at which it is possible to monitor the transmitted signal and to make measurements with suitable test equipments (described in Fascicle IV.4, *Red Book*).

The degree of protection is considered to be sufficient when a variation of the pulse mask as given in Recommendation G.703 is less than x% with a short circuit at the protected monitoring point. (The value of x is for further study in connection with the electrical characteristics.)

Note – The above definition is a working definition and is under study in Study Groups IV and XV.

111 **quality of service (QOS)**

F: qualité de service (QDS)

S: calidad de servicio (CDS)

The collective effect of service performances which determine the degree of satisfaction of a user of the service.

Note – The quality of service is characterized by the combined aspects of service support performance, service operability performance, service integrity and other factors specific to each service. See Figure 1/E.800. (Rec. E.800)

112 **redundancy, standby**

F: redondance en attente; redondance passive; redondance en secours

S: redundancia pasiva; redundancia de reserva

That redundancy wherein one means for performing a required function is intended to operate while the alternative means are inoperative until needed. (Supplement No. 6, Fascicle II.3)

113 **reliability (performance)**

F: fiabilité

S: fiabilidad

The ability of an item to perform a required function under given conditions for a given time period.

Note 1 – It is generally assumed that the item is in a state to perform this required function at the beginning of the time interval.

Note 2 – The term reliability is used as a measure of reliability performance.

(Supplement No. 6, Fascicle II.3)

114 **restoration; recovery**

F: rétablissement

S: restablecimiento

That event when the item regains the ability to perform a required function after a fault.

(Supplement No. 6, Fascicle II.3)

113 **restoration control point (RCP)**

F: centre de commande de rétablissement du service (CCR)

S: punto de control del restablecimiento (PCR)

The restoration control point (RCP) is an element within the general maintenance organization for the international telecommunication 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 of the Administration concerned. (Rec. M.725)

116 **routine or periodic testing**

F: essai de routine ou périodique

S: pruebas periódicas; pruebas de rutina

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. (Rec. M.20)

117 **serveability performance**

F: servibilité (d'un service)

S: servibilidad (de un servicio)

The ability of a service to be obtained, within specified tolerances and other given conditions, when requested by the user and continue to be provided for a requested duration.

Note – Serveability performance may be subdivided into the service accessibility performance and the service retainability performance. (Rec. E.800)

118 **service**

F: service

S: servicio

A set of functions offered to a user by an organization. (Rec. E.800)

119 **service; bearer service**

F: service support

S: servicio portador

A type of telecommunication service that provides the capability for the transmission of signals between user-network interfaces. (Rec. I.112)

120 service; telecommunication service

F: service de télécommunications

S: servicio de telecomunicación

That which is offered by an Administration to its customers in order to satisfy a specific telecommunication requirement.

Note – Bearer service and teleservice are types of telecommunication service. Other types of telecommunication service may be identified in the future. (Rec. I.112)

121 service; teleservice

F: téléservice

S: teleservicio; servicio final

A type of telecommunication service that provides the complete compatibility including terminal equipment functions, for communications between users according to protocols established by agreement between Administrations. (Rec. I.112)

122 service alarm (SA)

F: alarme de service (AS)

S: alarma de servicio (AS)

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. (Rec. M.20)

123 service accessibility performance

F: accessibilité (d'un service)

S: accesibilidad (de un servicio)

The ability of a service to be obtained, within specified tolerances and other given conditions, when requested by the user.

Note – This takes into account the transmission tolerance and the combined aspects of propagation performance, trafficability performance and availability performance of the related systems. (Rec. E.800)

124 service integrity

F: intégrité de service

S: integridad del servicio

The degree to which a service is provided without excessive impairments, once obtained.

Note – This service is characterized by the transmission performance of the system. (Rec. E.800)

125 service operability performance

F: facilité d'utilisation (d'un service)

S: facilidad de utilización (de un servicio)

The ability of a service to be successfully and easily operated by a user. (Rec. E.800)

126 service retainability performance

F: continuabilité (d'un service)

S: retenibilidad (de un servicio)

The ability of service, once obtained, to continue to be provided under given condition for a requested duration.

Note – Generally this depends on the transmission tolerances, the propagation performance and reliability performance of the related systems. For some services, for example packet switching, this also depends on the trafficability performance and the availability performance of the related systems. (Rec. E.800)

127 service support performance

F: logistique de service

S: logística del servicio

The ability of an organization to provide a service and assist in its utilization.

Note – An example of service support performance is the ability to provide assistance in commissioning a basic service, or a supplementary service such as the call waiting service or directory enquiries service. (Rec. E.800)

128 severely errored seconds (SES)

F: secondes gravement erronées (SGE)

S: segundos con muchos errores (SME)

A severly errored second is a second with a binary error ratio [as can be measured using a QRSS (quasi-randon signal source)] greater than or equal to 10^{-3}, or at least one defect (except slips).

A pseudo-severely errored second is a second with at least N1 anomalies (when the anomaly is not a binary error, i.e. when it is an error indicator such as a code violation, CRC error, etc.), or one defect (except slips). The value of N1 is an estimator defined to correspond to a BER of 10^{-3} in one second. N1 is a function of the accuracy of the anomaly detectors. (Rec. M.550)

129 sub-control station

F: station sous-directrice

S: estación subdirectora

A sub-control station is a point within the general maintenance organization which fulfills the sub-control responsibilities of the circuit, group, supergroup, etc., digital section assigned to it. (Rec. M.90)

130 subscriber access maintenance centre (SAMC)

F: centre de maintenance d'accès d'abonné (CMAA)

S: centro de mantenimiento de accesos de abonado (CMAA)

The SAMC represents a group of functions, network equipment elements and staff controlled by the Administration, which together have the responsibility and capability for maintenance functions and maintenance actions within the subscriber access. (Rec. M.36)

131 subscriber access maintenance entity (SAME)

F: entité de maintenance d'accès d'abonné (EMAA)

S: entidad de mantenimiento de accesos de abonado (EMAA)

The SAME controls the subscriber access maintenance functions and provides communications for such activities. The SAME might be distributed. (Rec. M.36)

132 subscriber installation maintenance entity (SIME)

F: entité de maintenance d'installation d'abonné (EMIA)

S: entidad de mantenimiento de instalaciones de abonado (EMIA)

A SIME represents a group of dedicated functions contained within the functional groups (as specified in Recommendation I.411) of the subscriber insallation (i.e. TE1 and NT2) which have the following purposes; e.g.

– interaction with the (human) user;
– handling of maintenance protocol from the SAME and/or MSP;
– control of internal testing and maintenance mechanisms. (Rec. M.36)

133 **system availability information point**

F: service collectant les informations relatives a la disponibilité des systèmes

S: punto de información sobre disponibilidad del sistema

The system availability information point is an element within the general maintenance organization for the international automatic and semi-automatic telephone 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. (Rec. M.721)

134 **telecommunication**

F: télécommunication

S: telecomunicación

Any transmission and/or emission and reception of signals representing signs, writing, images and sounds or intelligence of any nature by wire, radio, optical or other electromagnetic systems. (Recs. G.701, I.112)

135 **telecommunication Administration**

F: Administration des télécommunications

S: Administración de telecomunicaciones

An Administration, or the part of a combined postal and telecommunication Administration, concerned with the provision of telecommunication service. (Rec. D.70)

136 **telecommunications management network (TMN)**

F: réseau de gestion des télécommunications (RGT)

S: red de gestión de las telecomunicaciones (RGT)

A telecommunications management network provides the means used to transport and process information related to management functions for the telecommunications network. (Rec. M.30)

137 **terminal international centre**

F: centre terminal international

S: centro terminal internacional

The international centre (for example, an international repeater station) serving the renter in the country in which the renter's installation is situated. There will be two terminal international centres in an international leased group or supergroup link, or more in the case of a multiterminal link (see Figure 1/M.900) (Rec. M.900)

138 **terminal international centre**

F: centre terminal international

S: centro terminal internacional

The terminal international centre (TIC) for leased and special circuits is the international centre serving the renter in the country in which the renter's installation is situated. It marks the interface of the international and national lines and is normally located in association with a terminal international centre for the international public telephony circuits.

Some Administrations may wish to locate the TIC for international leased and special circuits independently of that for public telephony circuits.

In all cases there will be a transmission maintenance point (international line) (MTP-IL) (see Recommendation M.1014) located at each TIC for leased and special circuits.

There will be two TICs in a point-to-point international circuit. There may be more in a multiterminal circuit. See Figure 2/M.1010. (Rec. M.1010)

139 **terminal national centre**

F: centre terminal national

S: centro terminal nacional

The nearest national installation (for example, a repeater station) to which the renter's equipment is connected by the terminal national section. This centre will normally be staffed and equipped to make transmission measurements (see Figure 1/M.900). (Rec. M.900)

140 **terminal national centre**

F: centre terminal national

S: centro terminal nacional

The national centre (e.g., repeater station, telephone exchange) that is:

- nearest to the renter's installation;
- provided with a circuit test point, so that transmission measurements can be made by appropriate staff. See Figure 2/M.1010. (Rec. M.1010)

141 **terminal national section**

F: section nationale terminale

S: sección terminal nacional

The lines and apparatus between the defined test access points at the interface in the renter's premises and corresponding defined access points at the terminal national centre (see Figure 1/M.900). (Rec. M.900)

142 **terminal national section**

F: section nationale terminale

S: sección terminal nacional

The lines and apparatus connecting the renter's installation with the terminal national centre concerned. There may be intermediate installations (e.g., telephone exchanges) in the terminal national section but they are assumed to have no testing facilities normally available. See Figure 2/M.1010. (Rec. M.1010)

143 **test**

F: essai

S: prueba

A direct practical trial in whatever manner it may be made. (Rec. M.700, *Red Book*)

144 **test; functional test**

F: essai de fonctionnement

S: prueba de funcionamiento

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. (Rec. M.700, *Red Book*)

145 **test; limit test**

F: essai aux limites

S: prueba en los límites

A test made to indicate whether a quantity would fall within or outside a pair of limits or boundaries. (Rec. M.700, *Red Book*)

146 test; yes or no test

F: essai par "tout ou rien"

S: prueba de viabilidad

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. (Rec. M.700, *Red Book)*

147 testing point (line signalling)

F: centre pour les essais de la signalisation de ligne

S: punto de pruebas de la señalización de línea

The testing point (line-signalling) is an element within the general maintenance organization for the international automatic and semi-automatic telephone 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.

Note – In practice, at digital international exchanges, a line access point at the circuit level may not exist when the exchanges 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). (Rec. M.718)

148 testing point (switching and interregister signalling)

F: centre pour les essais de commutation et de la signalisation entre enregistreurs

S: punto de pruebas de conmutación y señalización entre registradores

The testing point (switching and interregister signalling) is an element within the general maintenance organization for the international automatic and semi-automatic telephone 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.

Note – 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). This would include line signalling aspects, if any. (Rec. M.719)

149 testing point (transmission)

F: centre pour les essais de la transmission

S: punto de pruebas de la transmisión

The testing point (transmission) is an element within the general maintenance organization for the international automatic and semi-automatic telephone 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. (Rec. M.717)

150 trafficability performance

F: traficabilité; capacité d'écoulement du trafic

S: aptitud para cursar tráfico

The ability of an item to meet a traffic demand of a given size and other characteristics, under given internal conditions.

Note – Given internal conditions refer, for example, to any combination of faulty and non-faulty sub-items. (Rec. E.800)

151 **transmission**

F: transmission

S: transmisión

The action of conveying signals from one point to one or more other points.

Note 1 – Transmission can be effected directly or indirectly, with or without intermediate storage.

Note 2 – The use of the English word "transmission" in the sense of emission is deprecated. (Recs. G.701, I.112)

152 **transmission performance**

F: qualité de transmission

S: calidad de transmisión

The level of reproduction of a signal offered to a telecommunications system, under given conditions, when this system is in an up state. (Rec. E.800)

153 **transmission restoration**

F: rétablissement de la transmission

S: restablecimiento de la transmisión

The different actions taken in order to restore the transmission of a signal affected by a transmission fault. (Rec. M.495)

154 **transmission route**

F: trajet de transmission

S: ruta de transmisión

A transmission facility on a specific medium used by a certain number of transmission systems between two stations.

Note 1 – For example, one cable between two stations could be regarded as one transmission route (whatever the number of systems using this cable is) and a radio system between these two points could be regarded as another route.

Note 2 – This represents a physical route; this is different from the term "route" which is defined in the E.600, Q.9 and Z.341 Recommendations, which represents a logical route. (Rec. M.495)

155 **transmission route diversity**

F: diversité de routage de transmission

S: diversidad de rutas de transmisión

The provision of at least two links between two nodes in a transmission network which are routed over different transmission routes.

Note – In case of a failure of one link, transmission route diversity allows some traffic between the two nodes still to be carried over the remaining link(s). (Rec. M.495)

156 **upstream failure indication (UFI)**

F: indication de défaillance en amont (IDA)

S: indicación de fallo atrás (IFA)

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 failure has occurred upstream of this point and no unnecessary maintenance activities are initiated. (Rec. M.20)

ANNEX A

(to Recommendation M.60)

List of maintenance terms

This Annex presents the maintenance terms in alphabetical order together with their section number.

Section No.	*Term*
1	Alarm indication signal (AIS)
2	Anomaly
3	Automatic switching equipment
4	Availability (performance)
5	Bit error ratio (BER)
6	Bridging loss
7	Channel; access channel
8	Channel; transmission channel
10	Circuit; digital circuit
9	Circuit; telecommunication circuit
11	Circuit access points
12	Circuit control station
13	Circuit sub-control station
14	Code violation
15	Connection
16	Connection; digital connection
17	Connection; international connection
18	Connection; international telephone connection
19	Continuity check
20	Continuous checking
21	Control station
22	Data communication network
23	Data communications network (DCN)
24	Data communications function (DCF)
25	Dead time
26	Defect
27	Deferred maintenance alarm (DMA)
28	Degraded minute (DM)
29	Echo
30	Echo canceller
31	Echo suppressor
32	Error
33	Error; random error
34	Error burst
35	Error free seconds (EFS)
36	Errored seconds
37	Exchange
38	Failure
39	Fault
40	Fault; intermittent fault
41	Fault correction
42	Fault localization; localization of faults
43	Fault report point (circuit)
44	Fault report point (network)
45	Interface
46	International automatic circuit
47	International chain
48	International leased circuit
49	International main section
51	Interruption
52	Interruption
50	Interruption; break of service
53	Line; international line
54	Line; international line
55	Line; national line
56	Line access point
57	Link; international link
58	Link; transmission link
59	Logistic delay
60	Loopback
61	Loopback; complete loopback
62	Loopbback; digital loopback
63	Loopback; logical loopback
64	Loopback; non-transparent loopback
65	Loopback; partial loopback
66	Loopback; transparent loopback
67	Loopback application
68	Loopback control mechanism
69	Loopback control point
70	Loopback point
71	Loopback requesting point
72	Loopback test pattern
73	Maintainability (performance)
74	Maintenance
75	Maintenance
76	Maintenance; automatic maintenance
77	Maintenance; controlled maintenance
78	Maintenance; corrective maintenance
79	Maintenance; deferred maintenance
80	Maintenance; preventive maintenance

Section No.	*Term*
81	Maintenance entity (ME)
82	Maintenance entity assembly (MEA)
84	Maintenance event information (MEI)
85	Maintenance philosophy
86	Maintenance policy
87	Maintenance service provider (MSP)
88	Maintenance strategy
83	Maintenance sub-entity (MSE)
89	Maintenance support (performance)
90	Management entities
91	Measurement
92	Mediation device (MD)
93	Mediation function (MF) (block)
94	Multiterminal service circuit
95	National main section
96	National system
97	Network analysis point
98	Network element (NE)
99	Network element function (NEF) block
100	Omnibus service circuit
101	Operation, administration and maintenance centre (OAMC)
102	Operations system (OS)
103	Operations system function (OSF) block
105	Path; digital path
104	Path; telecommunication path
106	Point
107	Prompt maintenance alarm
108	Propagation performance
110	Protected monitoring point
109	Protection switching
111	Quality of service (QOS)
112	Redundancy; standby
113	Reliability (performance)
115	Restoration control point
114	Restoration recovery
116	Routine or periodic testing
117	Serveability performance
118	Service
119	Service; bearer service
120	Service; telecommunication service
121	Service; teleservice
123	Service accessibility performance
122	Service alarm (SA)
124	Service integrity
125	Service operability performance
126	Service retainability performance
127	Service support performance
128	Severely errored seconds (SES)
129	Sub-control station
130	Subscriber access maintenance centre (SAMC)
131	Subscriber access maintenance entity (SAME)
132	Subscriber installation maintenance entity (SIME)
133	System availability information point
134	Telecommunication
135	Telecommunication Administration
136	Telecommunications management network (TMN)
137	Terminal international centre
138	Terminal international centre
139	Terminal national centre
140	Terminal national centre
142	Terminal national section
142	Terminal national section
143	Test
144	Test; functional test
145	Test; limit test
146	Test; yes or no test
148	Testing point (switching and interregister signalling)
149	Testing point (transmission)
147	Testing point (line signalling)
150	Trafficability performance
151	Transmission
152	Transmission performance
153	Transmission restoration
154	Transmission route
155	Transmission route diversity
156	Upstream failure indication (UFI)

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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.710 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;
- the escalation procedure in Recommendation M.711 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.1012.

[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.

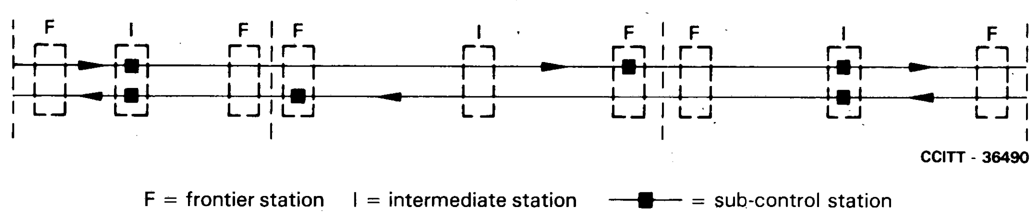


FIGURE 1/M.90

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

This Recommendation lists services for which information should be exchanged. The list is not exhaustive and Administrations are asked to consider, when intending to introduce a new service, what contact point information will be required.

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, exchange of information for changes in national numbering plans and circuit order of selection) 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 *Other international services*

Contact point information, which should at least include information for fault reporting purposes, should be exchanged for the following international services:

- circuit-switched public data communication service;
- packet-switched public data communication service;
- public telegram service;
- teletex service;
- telex service;
- public facsimile service (bureau and telefax);
- store and forward facsimile switching service;
- phototelegraph service.

2.5 *Common channel signalling systems*

For each international centre where common channel signalling is employed, contact point information should be exchanged for the maintenance units which have responsibility for the following:

- signalling system No. 6 transfer link (Recommendation M.760);
- signalling system administrative control (Recommendations M.762 and M.782).

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.

2.6 *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.

2.7 *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]).

2.8 *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.

2.9 *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.

[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 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

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						
Common channel signalling system (CCSS)	SS No. 6 transfer link						
	CCSS 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: INTERNATIONAL CENTRE:

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					
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

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 telephone service [1];

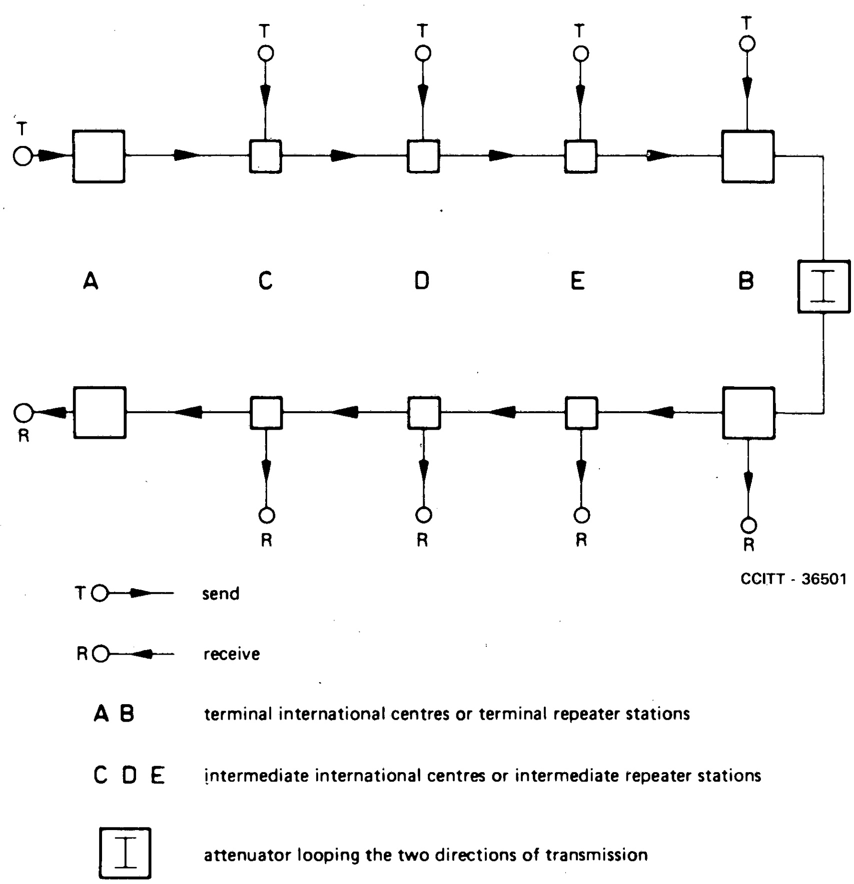
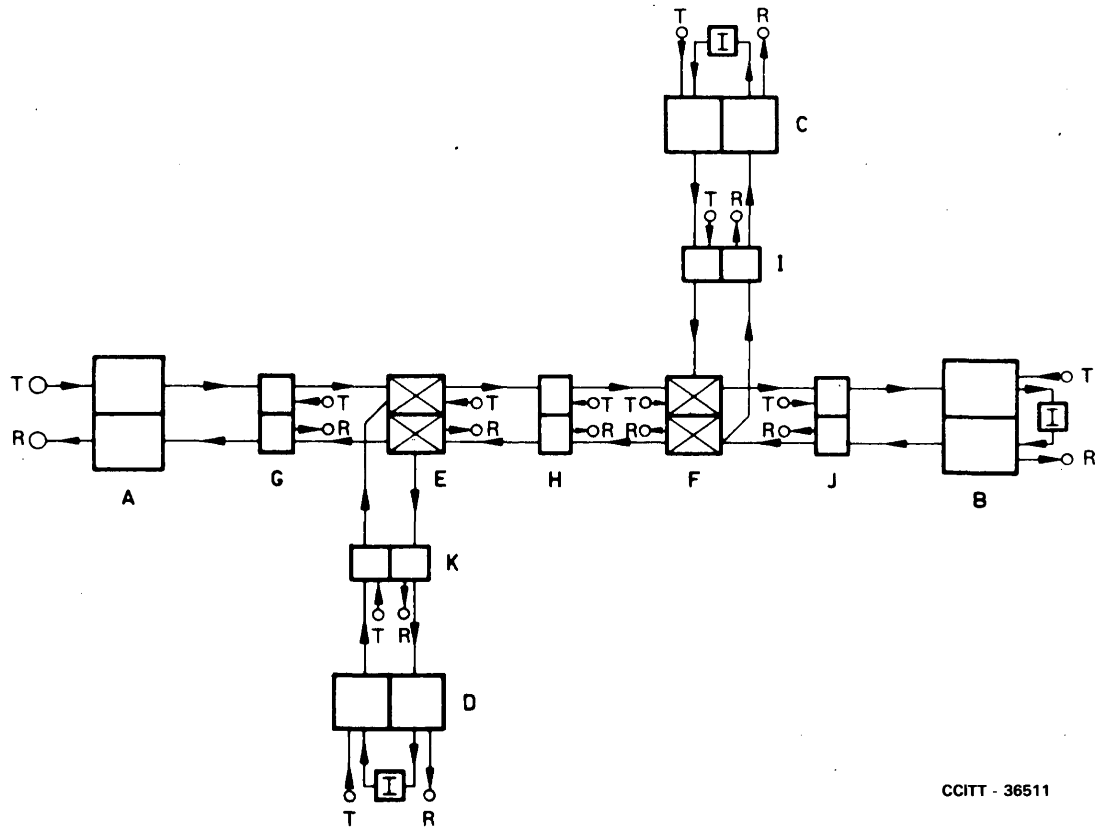


FIGURE 1/M.100

Example of an omnibus service circuit



T ○→ send

R ○← 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 concerning service circuits for radio-relay links. (For the convenience of readers, this Recommendation is reproduced below. CCIR Report 444 [2] also applies.)

CCIR RECOMMENDATION 400-2*

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

(Question 4/9, Geneva, 1982)

(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.

* 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.

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, ITU, Geneva, 1986.

Recommendation M.110

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 which are used for the provision of international telecommunication services.

Where a circuit uses channel associated signalling, it should be possible to identify and measure at the circuit access points, the signal-transmission parameters, e.g., type of signal, sequence, timing, duration, level and frequency.

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 in-service circuit monitoring to be carried out when, for example, digital paths are directly interfaced with digital exchanges or transmultiplexers.

When the digital path is out of service, this same point can be used to transmit and receive signals for both digital path and circuit testing.

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.

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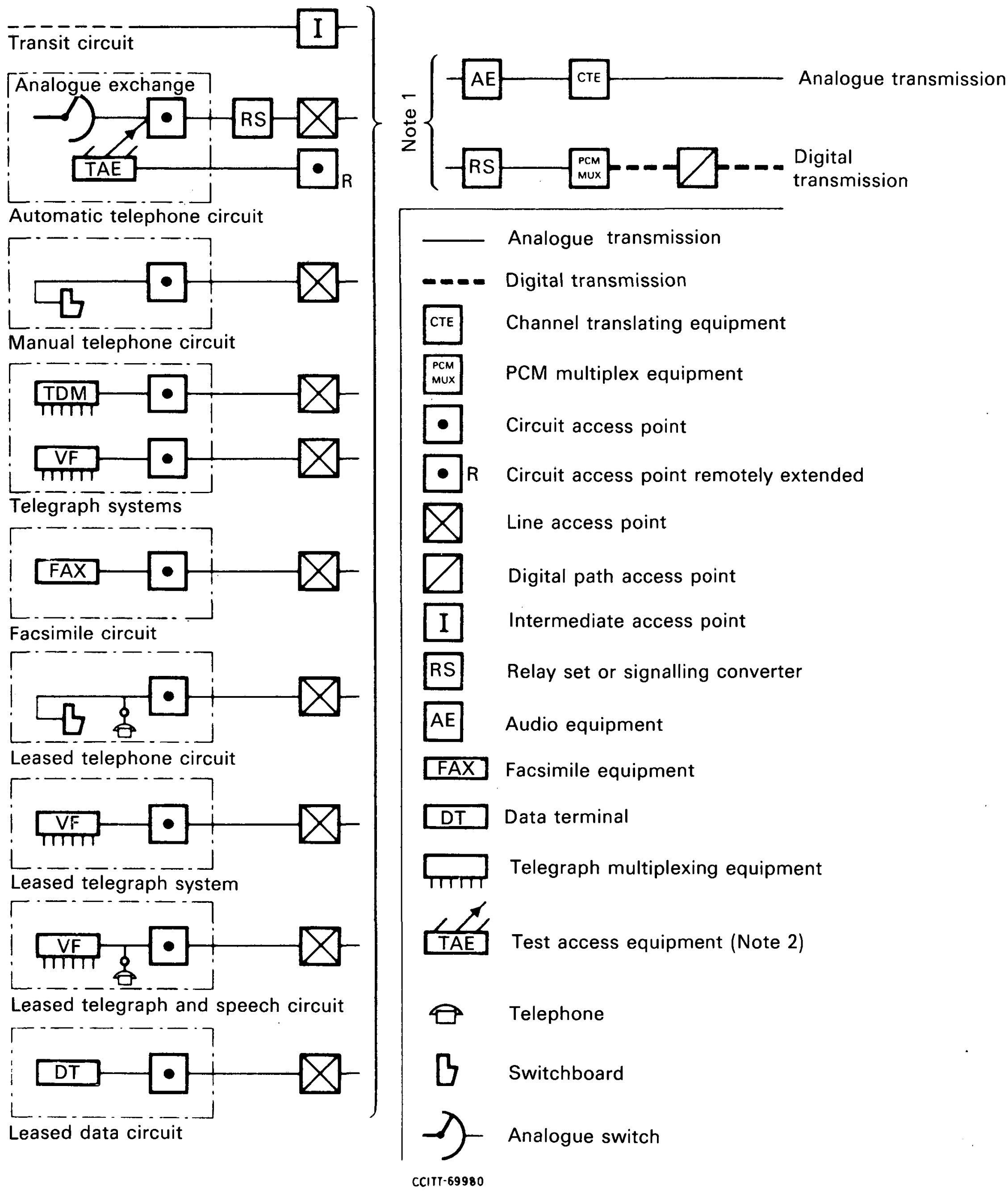
1) The access points required for digital leased circuits have yet to be specified. This matter is for further study by Study Group IV, in association with Study Group XV.



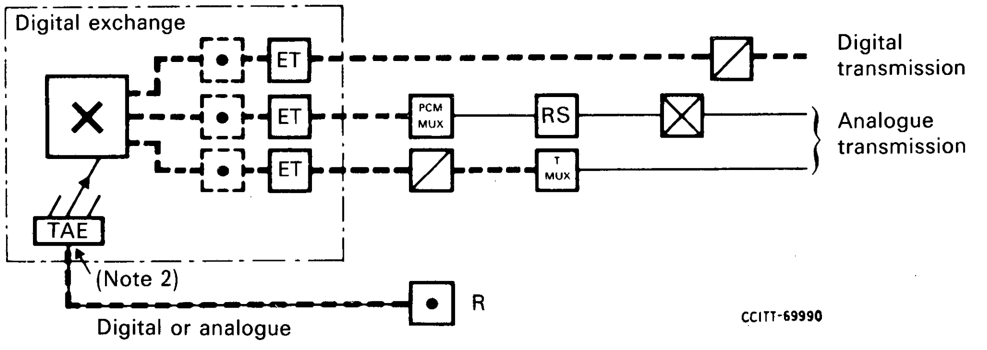
TDM = Time division multiplex
VF = Voice frequency multiplex

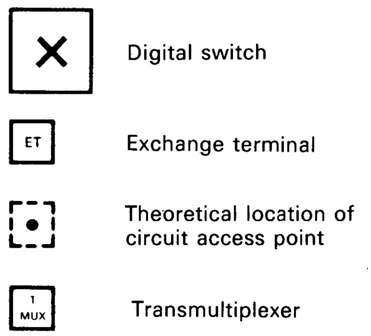
Note 1 – Circuits may be routed by analogue or digital transmission media.

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

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.

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 responsibilities 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].

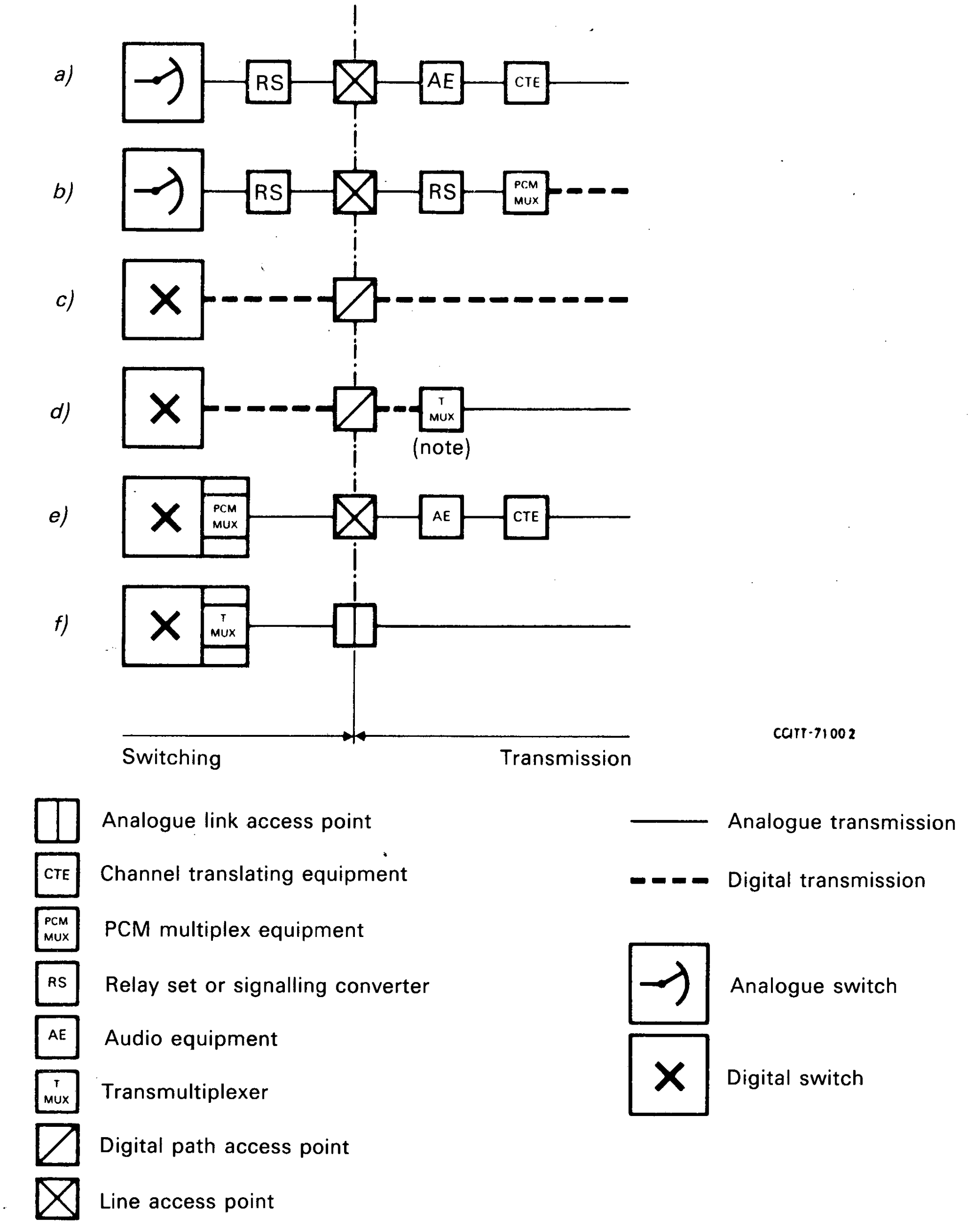
   Digital path access points are located at the input and output ports of digital paths. Interfaces are defined in Recommendation G.703 [3].

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*, Red Book, Vol.VI, Rec. Q.502, ITU, Geneva, 1985.

[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.

Recommendation M.125

DIGITAL LOOPBACK MECHANISMS

1 General

Loopback can be one of the mechanisms which may be applied to fault localization and failure detection. This Recommendation provides digital loopback definitions and describes loopback applications related to the maintenance phases of Recommendation M.20.

2 Digital loopback definitions

A **digital loopback** is a mechanism incorporated into a piece of equipment whereby a bidirectional communication path may be connected back upon itself so that some or all of the information contained in the bit stream sent on the transmit path is returned on the receive path.

The **loopback point** is the location of the loopback.

The **loopback control mechanism** is the means by which the loopback is operated and released from the loopback control point.

The **loopback control point** is the point which has the ability to directly control loopbacks.

The loopback control point may receive requests for loopback operation from several loopback requesting points.

The **loopback requesting point** is the point which requests the loopback control point to operate loopbacks.

Note 1 – Loopback requests should be subject to identification and authorization.

Note 2 – Possible locations of loopback requesting points are: the network, or a telecommunications management network (TMN), or a maintenance service provider (MSP).

The **loopback test pattern** is the test information transmitted during the operation of the loopback in the channel or channels which are to be redirected by the loopback.

Note 1 – The generation of the test pattern used over the loopback may or may not take place at the control point.

The **loopback application** is the maintenance phase for which the loopback operation is used, as defined in Recommendation M.20.

2.1 *Loopback types*

The following three types of loopback mechanisms are defined:

a) **complete loopback** – A complete loopback is a physical layer [1] mechanism which operates on the full bit stream. At the loopback point, the received bit stream shall be transmitted back towards the transmitting station without modification.

   Note – The use of the term "complete loopback" is not related to implementation since such a loopback may be provided by means of active logic elements or controlled unbalance of hybrid transformer, etc. At the control point only the information channels may be available.

b) **partial loopback** – A partial loopback is a physical layer [1] mechanism which operates on one or more specified channels multiplexed within the full bit stream. At the loopback point, the received bit stream associated with the specified channel(s) shall be transmitted back towards the transmitting station without modification.

c) **logical loopback** – A logical loopback acts selectively on certain information within a specified channel or channels and may result in some specified modification of the looped information. Logical loopbacks may be defined to apply at any layer [1], depending on the detailed maintenance procedures specified.

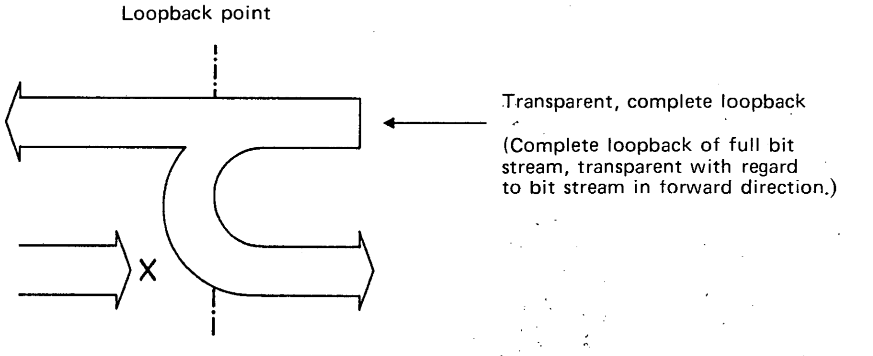
For each of the above three types of loopback mechanisms, the loopback may be further categorized as either transparent or non-transparent:

i) A **transparent loopback** is one in which the signal transmitted beyond the loopback point (the forward signal) when the loopback is activated, is the same as the received signal at the loopback point. See Figure 1 a)/M.125.

ii) A **non-transparent loopback** is one in which the signal transmitted beyond the loopback point (the forward signal) when the loopback is activated is not the same as the received signal at the loopback point. The forward signal may be defined signal or unspecified. See Figure 1 b)/M.125.

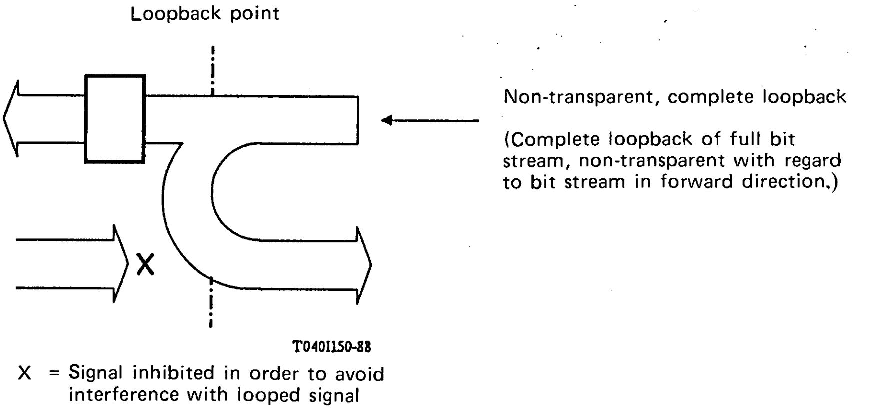
Note – Whether or not a transparent loopback is used, the loopback should not be affected by facilities connected beyond the point at which the loop is provided, e.g., by the presence of short circuits, open circuits or foreign voltages.

Annex A to this Recommendation shows some examples of loopbacks.



X = Signal inhibited in order to avoid interference with looped signal

a) Transparent loopback



X = Signal inhibited in order to avoid interference with looped signal

L1 = Device which changes or inhibits the transferred signal

b) Non-transparent loopback

FIGURE 1/M.125

3 Loopback applications

3.1 *Failure detection*

In order to detect failures related to networks maintained by different maintenance organizations, loopbacks should be applied at the borderline separating the maintenance responsibilities. Loopbacks should be located in the maintenance entities (ME) adjacent to the borderline and as close as possible to the borderline. Part of the bit stream can be involved in failure detection. Figure 2/M.125 shows an example with failure detection originated in locations A and B.

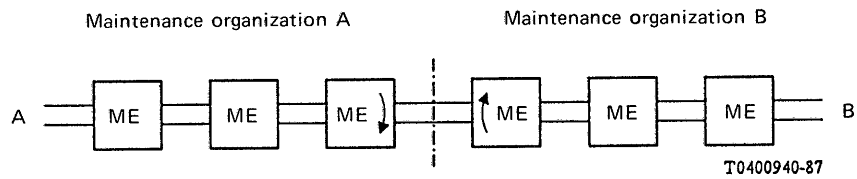


FIGURE 2/M.125

Failure detection with loopbacks

3.2 *Fault localization*

The localization of faults in networks consisting of *n* maintenance entities requires at least $n + 1$ loopback mechanisms. The loopback point should be as close as possible to the in- and output ports of the ME in order to include as much as possible of the ME in the loopback mechanism. (See example in Figure 3/M.125.) Part of the bit stream or the complete bit stream can be involved in fault localization, originated in locations A or B.

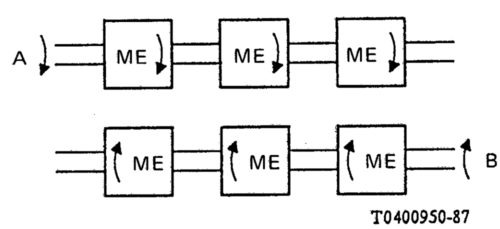


FIGURE 3/M.125

Fault localization with loopback mechanisms

3.3 *Verification*

Verification can require performance tests and measurements of the complete bit stream.

The same loopback location can be used as for fault localization.

4 Loopback operation and release

Loopbacks can be operated/released locally or remotely. Remote operation/release can be based on in-service addressing (e.g., layer 1 protocols) or it can require separate loopbacks addressing systems.

5 Loopback examples (under study – see Annex A)

ANNEX A

(to Recommendation M.125)

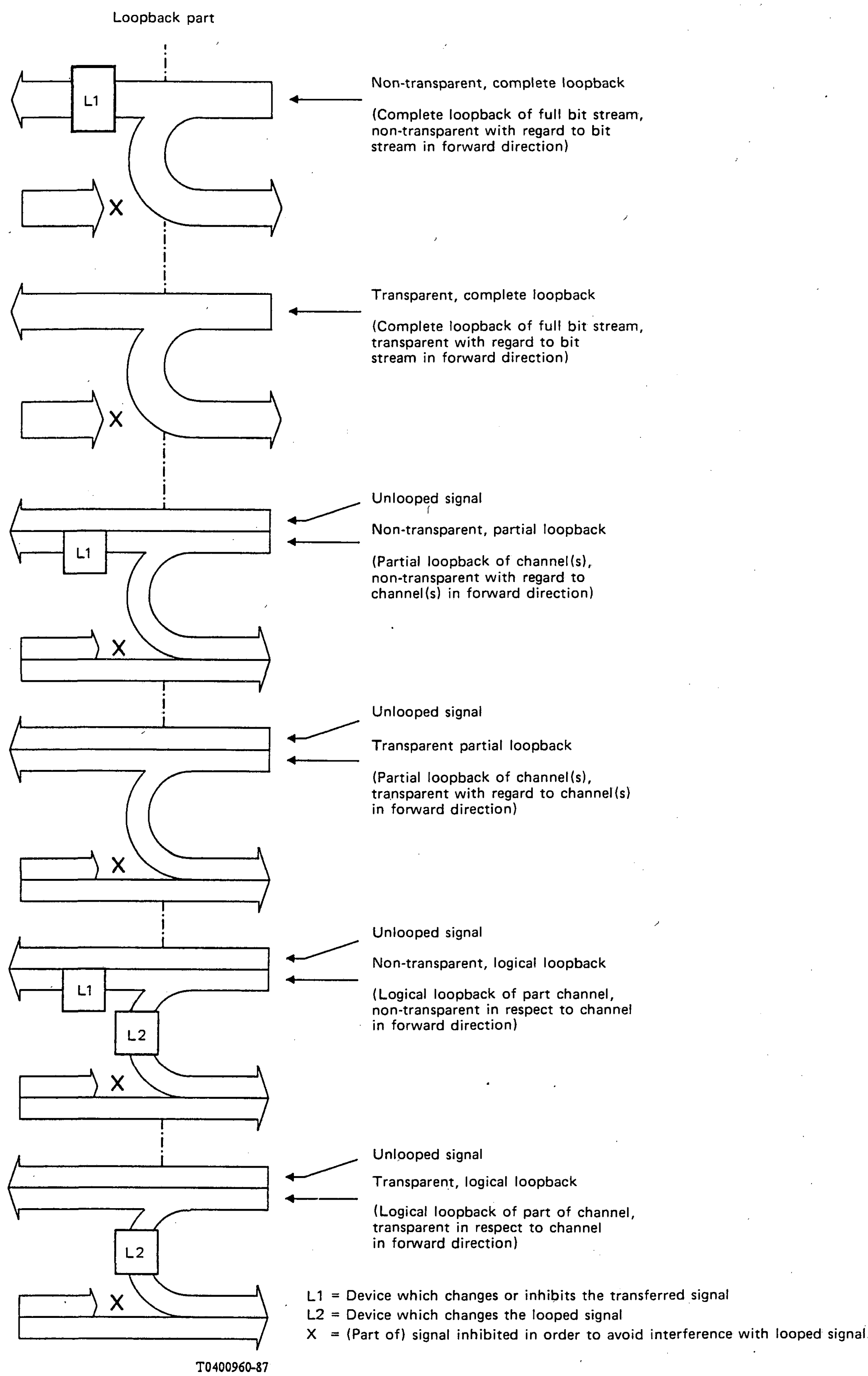


FIGURE A-1/M.125

Examples of loopbacks

Reference

[1] CCITT Recommendation *Reference model of open system interconnection for CCITT applications*, Vol. VIII, Recommendation X.200.

Recommendation M.130

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. (See also Supplement No. 3.6 [4])

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

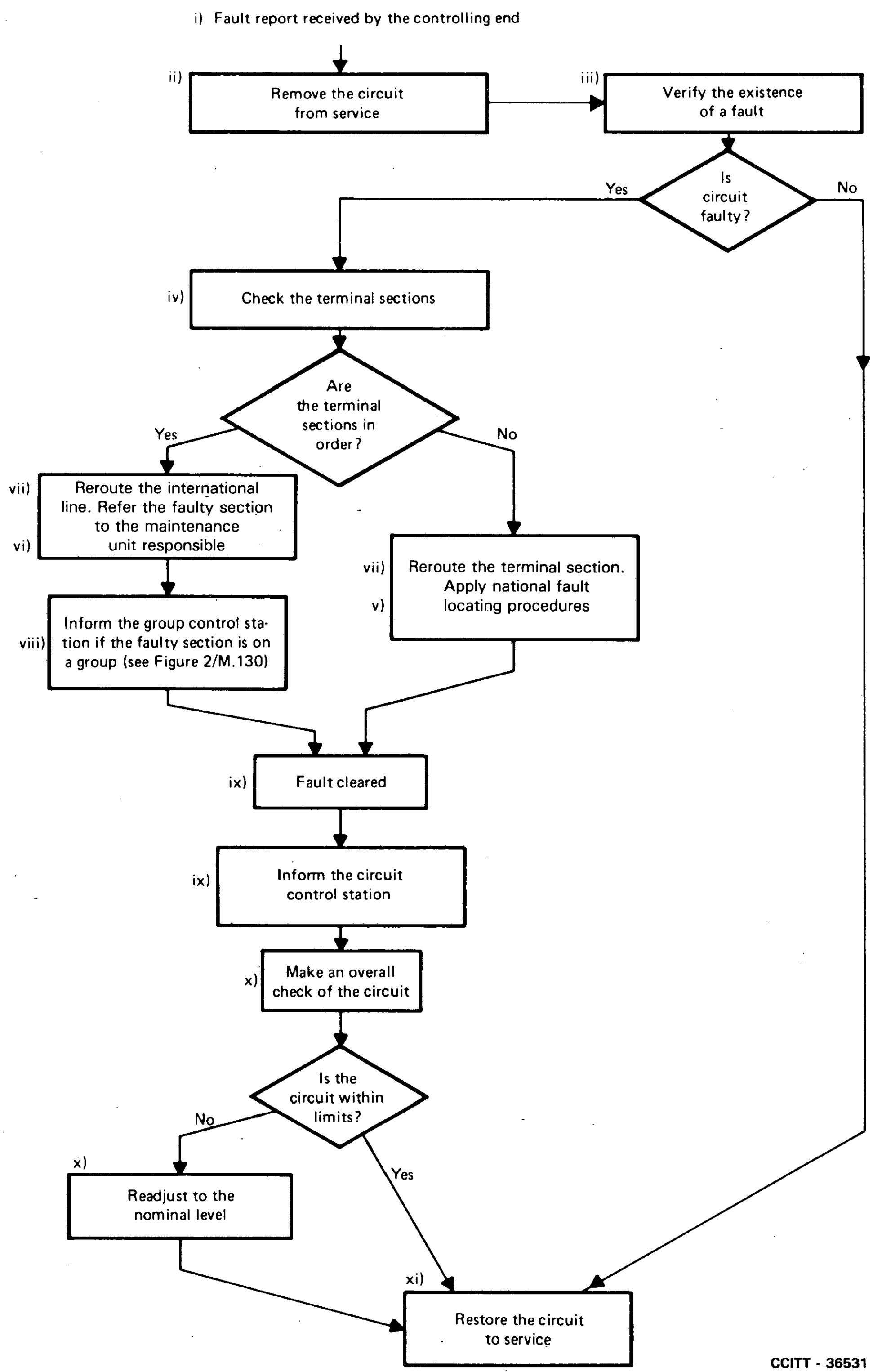
All fault conditions affecting transmission that are observed at repeater stations as a result of local or extended alarms should be reported to the relevant fault report points of the country concerned, so that arrangements can be made to apply the fault clearing procedure.

4 Special faults

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

5 Escalation procedure

Normally cooperation between maintenance elements in different Administrations will result in the satisfactory identification and correction of faults. There may be circumstances, however, where the fault escalation procedure defined in Recommendation M.711 may be required.



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

FIGURE 1/M.130

Example of possible action following a circuit fault report

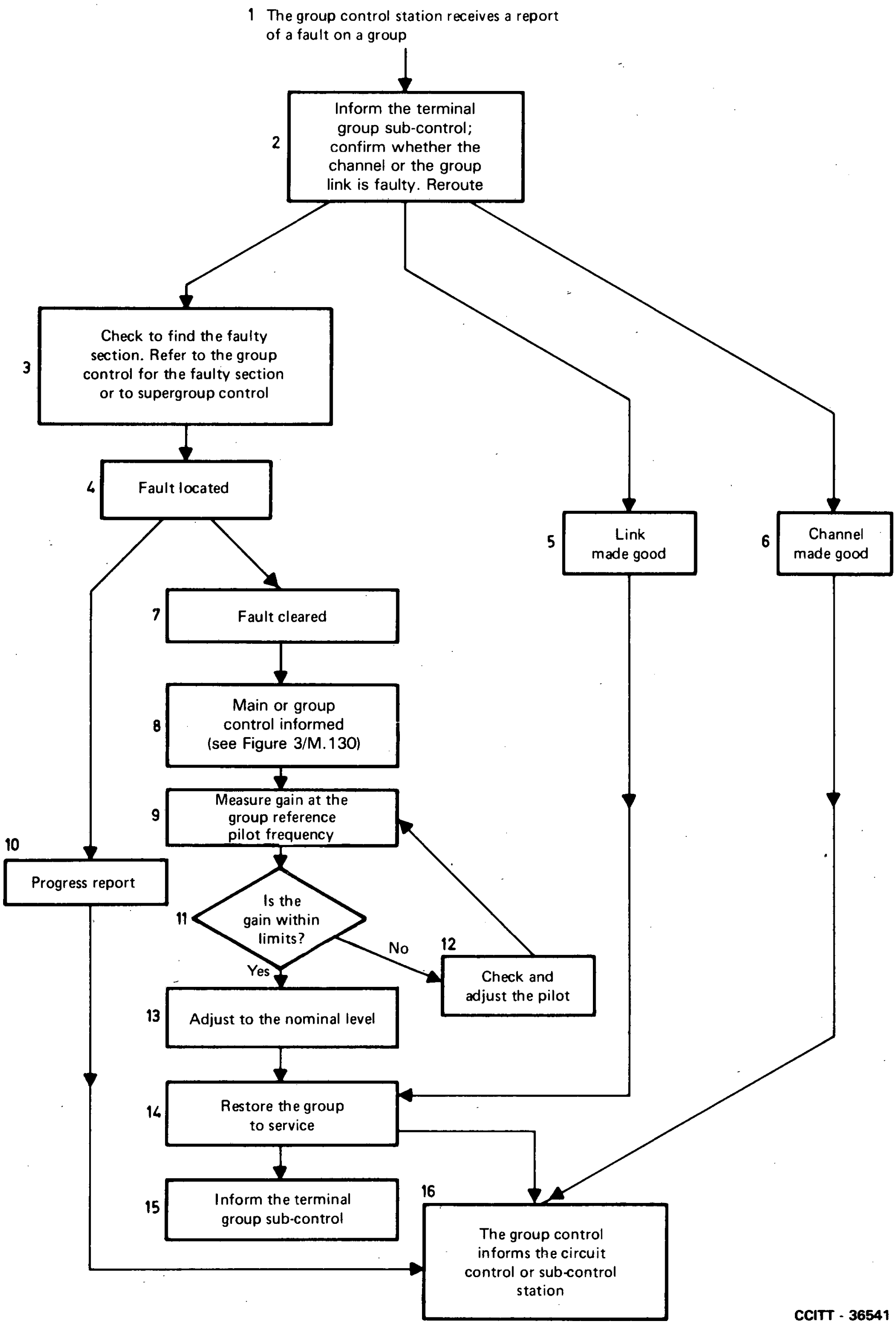


FIGURE 2/M.130

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

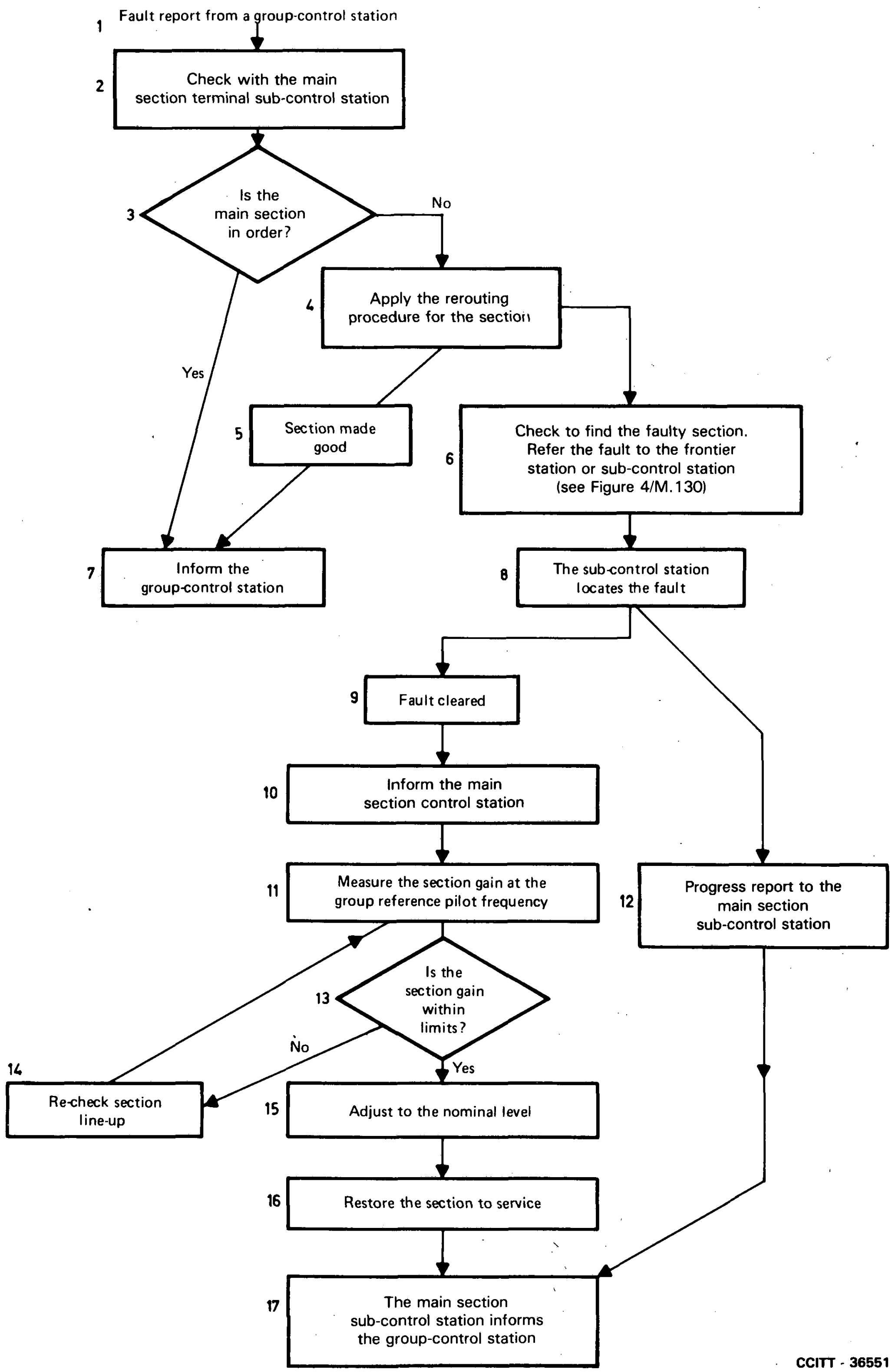


FIGURE 3/M.130

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

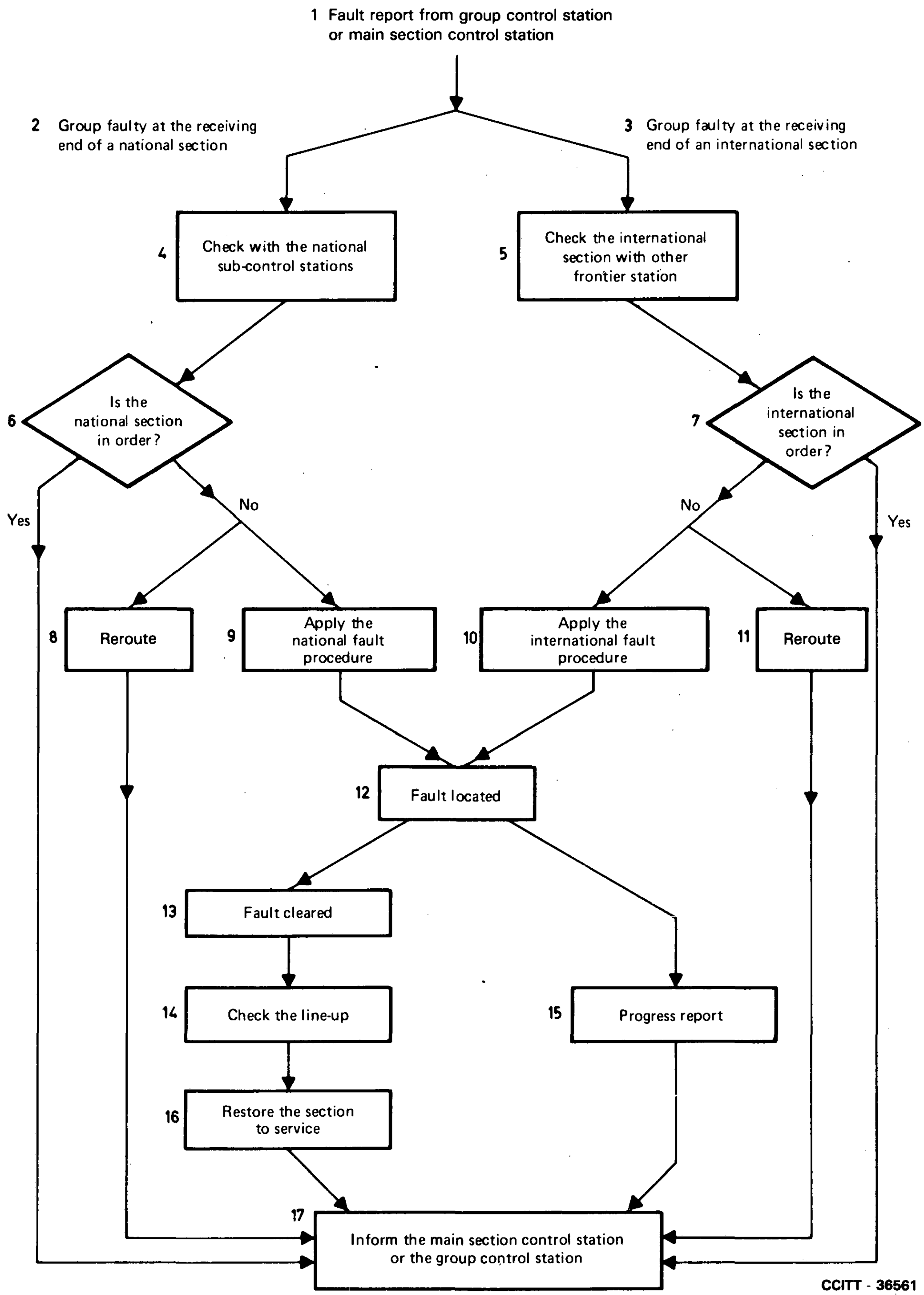


FIGURE 4/M.130

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

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*

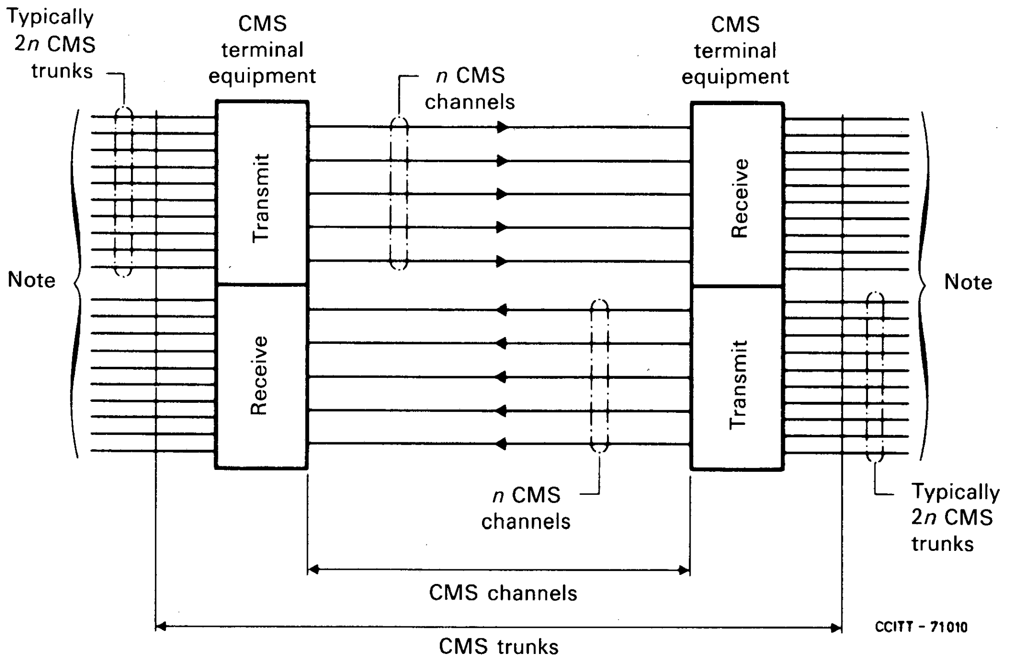
A.2.1 *Impact of CMS operation*

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.

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.

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



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

FIGURE A-1/M.130

Generalized representation of a circuit multiplication system (CMS)

A.2.2 *CMS-and-through circuits*

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

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

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

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

A.2.3 *CMS-only circuits*

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

The procedures for dealing with verified and unverified faults specified in § A.2.2 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.

[4] CCITT Supplement No. 3.6 to Volume IV *Crosstalk test device for carrier-transmission systems on coaxial systems.*

Recommandation M.140

DESIGNATIONS OF INTERNATIONAL CIRCUITS, GROUPS, GROUP AND LINE LINKS, DIGITAL BLOCKS, DIGITAL PATHS, DATA TRANSMISSION SYSTEMS AND RELATED INFORMATION

CONTENTS

8 Designations of international digital blocks (bidirectional and unidirectional)

9 Designations of international digital paths

10 Designations of routes in the mixed analogue/digital transmission network

11 Designation of data transmission systems

12 Related information for international digital blocks, digital paths and data transmission systems

Annex A – Full examples for designation information

Annex B – Reference section numbers for the various types of routes

Note – For the definition of the terms unidirectional, bidirectional, one way and two way (both way), refer to Recommendation E.600 [1] (definitions 3.3 and 3.4).

0 General

Designation of international routes [1] are of great importance for identification and information.

Technical developments, especially those due to digital technology have brought a much greater variety of techniques and allow for a more efficient use of equipment.

Information on the equipment and techniques used is of great interest to staff working in the field of maintenance and operation. Present operational conditions can be more complicated than those previously, e.g. as a consequence of greater competition in the field of telecommunication. Another consideration is automated file handling which is often a necessity for Administrations and the standardization of designation is an important factor to facilitate this.

To cover the need for standardized designations which are easy to handle but which give precise information, the designation information is built up from two layers:

- layer 1 provides the unique identification: the *designation*;
- layer 2 provides the necessary additional information which must be known at both terminations of the routes: the *related information.*

If Administrations need more route data to be stored, they are free to create independently or bilaterally a third layer for which no standardization is intended for the time being.

0.1 *Layer 1*

The general format of layer 1 for the designation of all types of international routes is shown in Table 1/M.140.

TABLE 1/M.140

Format of designation	Town A	/	Suffix	–	Town B	/	Suffix		Function code	Serial number
Signs	Characters	Slash	Letters/ digits	Hyphen	Characters	Slash	Letters/ digits	Space	Letters/ digits	Digits
Number of characters	⩽ 12	1	⩽ 3	1	⩽ 12	1	⩽ 3	1	⩽ 6	⩽ 4

No space

[1] The term "routes" is used in this text to cover all types of telecommunication connections: circuits, groups, blocks. etc.

The use of suffixes applies particularly to international public switched circuits. Their use is optional for international non-switched circuits, groups, group links, digital blocks and paths and data transmission systems. It provides more detailed information on the termination of the routes.

The first part of the designation, the traffic relation, presents the origin and destination of a route. The function code shows the type of route whilst the serial number counts the routes (i.e. circuits, groups, digital blocks, etc.) within the same traffic relation and same function code.

If a town name exceeds 12 characters, Administrations should apply a suitable abbreviation which should be unique.

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 designation by adding after the place name a three letter country code as defined in ISO 3166 [2]. This country code must be included within the 12 characters of the town name, if necessary by providing an abbreviation of the town name.

The serial number should be written without leading zeros.

0.2 *Layer 2*

The general format for layer 2 (related information) is as follows:

1 . . . , . . . ;

2 . . . , . . . ;

3 . . . , . . . ; etc.

The numbers identifying the fields in layer 2 indicate the various items. Each item provides information on the route, e.g. *operational*: operating companies and control station, etc. or *technical*: analogue/digital, use of special equipment etc. The items provide flexibility in designation information because they can be extended in the future if there is a need.

0.3 *Layer 3*

Not subject to standardization at the present time.

0.4 *Implementation*

It is recommended that the new designation types be applied to newly installed routes starting on 1 January 1990 (or earlier with the agreement of the Administrations involved).

Existing route designations (circuits, groups, digital blocks, etc.) should be converted gradually. The conversion to the new type designation should be completed by 1 January 1994.

To facilitate the change, Administrations with control station responsibility should prepare proposals containing designations conforming to layer 1 and propose the items of related information to be included in layer 2.

Agreement should then follow on the designation as well as an exchange of the agreed layer 2 information.

Administrations will need to ensure that the layer 2 related information is kept up to date and that other concerned Administrations are informed of any changes.

1 Designations of international public switched circuits

1.1 *General*

The format of the designation of public switched circuits is shown in Table 2/M.140.

The elements of the format are as follows:

a) *Traffic relation*

Towns A and B (maximum 12 characters or space, see Note 1): refers to the names of the two towns in which the international exchanges of the circuit are located. The place names in all types of designations should always be written in Roman characters taking the official name of a town as used in the country to which it belongs (see § 0.1).

International exchange suffix (maximum 3 alpha-numeric characters): the international exchange is indicated by letters, digits or a combination. The suffix will refer to the whole exchange (to the building or to a part of it, see Note 2). It will be chosen by the Administration, see Note 3 and 4.

TABLE 2/M.140

Format of designation	Town A	/	International exchange suffix	–	Town B	/	International exchange suffix		Function code	Serial number
Signs	Characters	Slash	Letters/digits	Hyphen	Characters	Slash	Letters/digits	Space	Letters	Digits
Number of characters	⩽ 12	1	⩽ 3	1	⩽ 12	1	⩽ 3	1	1 or 2	⩽ 4

No space

b) *Function code* (1 or 2 alphabetical characters)

The function code indicates the type of circuit.

c) *Serial number* (maximum 4 numeric characters)

The serial numbering starts anew if there is a difference in:

- town A or town B;
- international exchange suffix;
- function code.

Note 1 – If the name of the town exceeds 12 characters the responsible Administration will supply an appropriate abbreviation, which should be unique.

Note 2 – In the example given in Figure 1/M.140 there may be only one suffix or three to be decided by the Administration.

Note 3 – The 3 alphanumeric characters make it possible to include carrier's name information in the suffix, e.g. Tokyo/SJK: the international exchange in Tokyo–Shinjuku where the K in the suffix reflects the responsible carrier KDD.

Note 4 – The different companies operating in the same town have to agree on the suffixes used, in order that they be different.

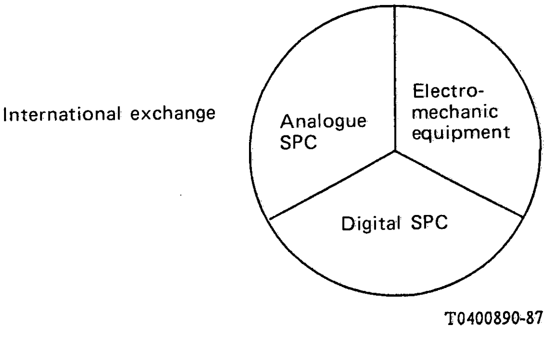


FIGURE 1/M.140

1.2 *Telephone-type circuits*

1.2.1 *General*

Possible function codes are:

M manual telephone circuits

Z automatic and semi-automatic telephone circuits in one-way operation

B both-way telephone circuits

The serial number has a maximum of 4 numeric characters. Serial numbering starts anew if there is a difference in:

- town A or town B
- international exchange suffix [2)]
- function code.

1.2.2 *Telephone circuits used in manual operation*

The terminal points of the circuit are arranged in alphabetical order.

The function code is: M.

Example:

The first telephone circuit for manual operation between London Keybridge and Paris Bagnolet is designated:

London/KB – Paris/BAG M1.

1.2.3 *One-way telephone circuits used for semi-automatic or automatic operation*

The terminal points of the circuits are arranged in the order according to the direction of operation of the circuit.

The function code is: Z.

Serial numbering: Circuits operated in the direction corresponding to the alphabetical order of the terminations should have odd numbers. Circuits operated in the direction corresponding to an inverse alphabetical order of the terminations should have even numbers. [3)]

Examples:

The 11th circuit operated in the London Mollison to Montreal 1TE direction (alphabetical order of towns) is designated:

London/SM – Montreal/1TE Z21.

The 9th circuit operated in the Montreal 1TE to London Mollison direction (inverse alphabetical order of towns) is designated:

Montreal/1TE – London/SM Z18.

1.2.4 *Both-way telephone circuits used for semi-automatic or automatic operation*

The terminal points of the circuit are arranged in alphabetical order.

The function code is: B.

Example:

The first both-way circuit between London Kelvin and New York 24 is designated:

London/J – New York/24 B1.

1.3 *Circuit used for switched telex and telegraph services*

See CCITT Recommendation R.70 [3].

1.4 *Circuits in the international public switched data network*

The terminations of the circuit are arranged in alphabetical order.

The function code is: XD.

Example:

The first international public switched data circuit between Oslo A and Stockolm H is designated:

Oslo/A – Stockholm/HYX XD1.

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2) By bilateral agreement Administrations may wish to apply a serial number to telephone-type circuits on a town-to-town basis rather than on an exchange-to-exchange basis.

3) By bilateral agreement, Administrations may wish to apply continuous serial numbering on Z + B circuits.

1.5 *Related information*

The additional information on public switched circuits is covered by the following items:

1. urgency for restoration;
2. terminal countries;
3. administrations' or carriers' names;
4. control and subcontrol station(s);
5. fault report points;
6. routing;
7. association;
8. equipment information;
9. use;
10. transmission medium information;
11. composition of transmission;
12. bandwith or bit rate;
13. signalling type.

The various items will be dealt with in § 2.

2 Related information for international public switched circuit

The following sections explain the items of related information concerned with international public switched circuits. A full example for the designation information of an international public switched telephone circuit is given in Annex A, § A.1.

2.1 *Urgency for restoration (item 1)*

This item supplies information on the urgency of restoration of the circuit based upon bilateral agreement between the terminal Administrations.

Format:

1. xxx .... xx; (maximum 10 characters)

Illustration:

a) if the priority is top: 1;
if the priority is second: 2;
if the priority is third: 3; or

b) if repair is required within e.g. 24 hours: $\leqslant$ 24 h; or

c) if no urgency has to be indicated: –;

2.2 *Terminal countries (item 2)*

This item presents the countries in which the circuit is terminating.

Format:

2. XXX, YYY; (3 characters for each)

Specification:

XXX: code for country of town A

YYY: code for country of town B

Note – The codes are according to ISO Standard 3166 [2].

Example:

For the circuit London/KB – Tokyo/SJK Z101:

2. GBR, JNP:

2.3 *Names of Administrations or carriers (item 3)*

This item records the names of the Administrations or carriers which operate the circuit.

Format:

3. YYYYYY, ZZZZZZ; (maximum 6 characters for each)

Specification:

YYYYYY code for company operating in town A

ZZZZZZ code for company operating in town B

Example:

For the circuit London/KB – Tokyo/SJK Z101 operated by BTI and KDD:

3. BTI, KDD;

2.4 *Control station [sub-control station(s)] (item 4)*

This item lists the appointed control station and sub-control stations (according to Recommendations M.80 and M.90). Further details about the stations can be found in the list of contact points (Recommendation M.93).

Format:

4.	CS:	designation of control station,
	SCS1:	designation of sub-control station,
	SCS2:	designation of sub-control station,
	.	. . .
	.	. . .
	.	. . .
	SCSn:	designation of sub-control station.

Specification:

CS:	designation of the control station,
SCS1:	designation of the terminal sub-control station,
SCS2 to SCSn:	if applicable, other sub-control stations; have to be placed in the geographical order according to the traffic relation.

Example:

For the circuit New York/10 – Stockholm/1 B1 where New York is the control station and sub-control stations are in London and Stockholm:

4.	CS:	New York,
	SCS1:	Stockholm,
	SCS2:	London;

2.5 *Fault report points (item 5)*

This item presents the names of both fault report points on the circuit. Further information about the fault report points can be found in the list of contact points (Recommendation M.93).

Format:

5. Designation of fault report point, designation of fault report point;

Specification:

The first report point is that of the country of town A.

The second fault report point is that of the country of town B.

Example:

For the circuit London/M – Reims/IP1 Z999 with fault report points in London M and Reims XRE:

5. London/M, Reims/XRE;

2.6 *Routing (item 6)*

This item shows the international primary group(s) or primary block(s) and channel number(s) which carry the circuit. If there are more than one, the groups or blocks appear in the geographical order from town A to town B.

Format:

6. Designation of an international primary group or primary block/channel number, designation of a primary group/channel number, ..., designation of a primary group/channel number;

Note – Primary groups or blocks can be unidirectional as well. Two consecutive unidirectional groups or blocks are separated by a + sign instead of a comma.

Example:

For a circuit London/KB – Santiago/1 Z27:

6. London – Paris 1204/4, Paris – (MU) 1202/2 + Santiago – (MU) 1203/3;

2.7 *Association (item 7)*

This item informs whether there are associated circuits and if so, of which nature.

Format:

7. Association code: designation of associated circuit;

Specification:

If the circuit *has* a reserve circuit the association code is: S followed by the function code and the serial number of the principal circuit.

If the circuit *is* a reserve circuit the association code is: Function code followed by S and the serial number of the reserve circuit.

Example:

7. ZS13: Roma/AS1 – Zuerich/SEL T1;

Which indicates that the actual circuit Z13 is a reserve circuit for the circuit Roma/AS1 – Zuerich/SEL T1.

2.8 *Equipement information (item 8)*

This item records any equipment in the circuit which requires special maintenance attention.

Format:

8. XX, XX, XX, XX, XX;

Specification:

If the circuit has been routed via analogue circuit multiplication equipment: AM

If the circuit has been routed via digital circuit multiplication equipment:
- using reduced bit rate encoding: RB
- using speech interpolation: SI

If the circuit has a compandor: CO

If the circuit has an echo suppressor: ES

If the circuit has an echo cancellor: EC

If the circuit has an echo suppressor in terminal country of town A and an echo cancellor in terminal country of town B: ES, EC (any combination of EC and ES is possible).

If the circuit is a bearer circuit: BC

If the circuit is a derived circuit: DC

Note 1 – If there is a need to record an additional special equipment, the places free for a code are available for this purpose. They can be used after bilateral agreement between the Administrations. The codes must be unique and shall have two characters.

Note 2 – A bearer circuit refers to the circuit type that continues to be provided in the case of a breakdown of the circuit multiplication equipment. For a derived circuit this is not the case.

2.9 *Use (item 9)*

This item supplies information on the usage of the circuit. It concerns the role of the circuit in the traffic (e.g. belonging to a final route) and the usage of the circuit made by the user.

Format:

9. XX, YYYY; (maximum 7 characters)

Specification:

XX refers to the type of traffic carried by the circuit:
- if it belongs to a final group of circuits: FN
- if it belongs to an overflow group of circuits: OF
- if it belongs to a transit group of circuits: TR
- if the information is not known: –

YYYY refers to the use of the circuit:

in the case where a public telephone circuit is used for phototelegraphy or facsimile: F

2.10 *Transmission medium information (item 10)*

This item identifies whether a satellite is involved in the routing of the circuit.

Format:

10. ST; or –;

Specification:

If the circuit has been routed via satellite: ST

If the circuit is not being routed via satellite: –

Example:

For the circuit Amsterdam/2H – New York/24 Z33 routed partly via satellite:

10. ST;

2.11 *Composition of the transmission (item 11)*

This item shows the type of transmission on the circuit.

Format:

11. A; or N; or C;

Specification:

If the transmission is analogue: A

If the transmission is digital: N

If the transmission is mixed analogue/digital: C

2.12 *Bandwidth or bit rate (item 12)*

This item shows the bandwidth (in the case of an analogue or mixed circuit) or the bit rate (in the case of a digital circuit).

Format:

12. xxxx.x Hz; or kHz; or MHz; bit/s; or kbit/s; or Mbit/s;

Rule for the notation of the figures:

Leading zeros may be omitted, and if the decimal is a zero, this decimal and the decimal point may also be omitted.

If the figure is up to 999, use Hz, bit/s.

If the figure is between 1000 and 9 999 999, use kHz, kbit/s.

If the figure is 10 000 000 or more, use MHz, Mbit/s.

Specification:

If the circuit is analogue or mixed analogue/digital: the bandwidth in Hz, kHz, MHz

If the circuit is digital: the bit rate in bit/s, kbit/s, Mbit/s.

2.13 *Signalling type (item 13)*

This item presents the signalling information that applies to the circuit.

Format:

13. xx .... xx; (maximum 20 characters).

Specification:

If the signalling is of the type xxxx Hz/xx Hz: xxxx/xx

If the CCITT Signalling System R2 is applied: R2

If the CCITT Signalling System R2-digital is applied: R2D

If the CCITT Signalling System No. 4 is applied: C4

If the CCITT Signalling System No. 5 is applied: C5

If the CCITT Signalling System No. 6 is applied: C6, xxx/yy

where xxx/yy refers to band and circuit number respectively

If the CCITT Signalling System No. 7 is applied: C7, xxxx, Y – YYY – Y, Z – ZZZ – Z where xxxx refers to the circuit identification code (CIC)

Y–YYY–Y refers to the international signalling point code (ISPC) for town A/international exchange

Z–ZZZ–Z refers to the ISPC for town B/international exchange.

Example:

For a circuit with C6-signalling type and being the 7th circuit in band number 32:

13. C6, 032/06; (circuit counting starts at 0).

3 Designations of international fixed (non-switched) circuits

3.1 *General*

The designations of leased circuits and public fixed circuits are treated in §§ 3.2 and 3.3 respectively. The format of the designation of fixed circuits are shown in Table 3/M.140.

TABLE 3/M.140

Format of designation	Town A	/	Trans-mission station [a] suffix (optional)	–	Town B	/	Trans-mission station [a] suffix (optional)		Function code	Serial number
Signs	Characters	Slash	Letters/ digits	Hyphen	Characters	Slash	Letters/ digits	Space	Letters/ digits	Digits
Number of characters	⩽ 12	1	⩽ 3	1	⩽ 12	1	⩽ 3	1	1 to 14	⩽ 4

No space

[a] For some circuits the international exchange may be more suitable (see §§ 3.3.9 and 3.2.15, Note 2).

The elements of the format are as follows:

a) *Traffic relation*

Towns A and B, possibly with a transmission station suffix, identify the terminal points of the circuit. The identification of the terminal point is up to the Administration concerned. In the case where a town name exceeds the maximum length of 12 characters, the Administration should supply a suitable abbreviation which must be unique (see § 0.1).

The transmission station suffix (maximum 3 characters) is an optional field which may be used to further identify the terminal point, e.g., when there is more than one carrier operating in the town. The necessity for a suffix and its form should be decided by the Administration operating the circuit in the town concerned.

b) *Function code* (maximum 4 characters)

This code identifies the type of the circuit; see §§ 3.2 and 3.3.

c) *Serial number* (maximum 4 digits)

There should be a separate serial numbering series for each traffic relation and function code. In case of more than one carrier in the town, the serial numbering will be on a transmission station to transmission station basis.

The designations of the different categories of leased circuits are given below. In special cases in which CCITT Recommendations do not apply, agreement should be reached between the terminal Administrations.

3.2 *International leased circuits*

3.2.1 *General*

Leased circuits are fixed circuits for private services or particular purposes. They are distinguished by the letter P.

The designation format for leased circuits is as stated in § 3.1. Possible function codes are:

P	for analogue leased circuits used wholly for telephony
TP	for analogue leased circuits used for voice-frequency telegraphy
TDP	for analogue leased circuits used for TDM-telegraphy
DP	for analogue leased circuits used wholly for data transmission
FP	for analogue leased circuits used wholly for phototelegraphy or facsimile
RP	for analogue leased unidirectional sound-programme circuits
RRP	for analogue leased reversible sound-programme circuits
VP	for analogue leased unidirectional television-programme circuits
VVP	for analogue leased reversible television-programme circuits
XP	for analogue leased circuits used for multiple type transmissions
NP	for digital leased circuits.

Note – In case of leased circuits connecting three or more locations the letter M should follow these function codes.

3.2.2 *Analogue leased circuits used for telephony*

The terminal points of the circuits are arranged in alphabetical order.

The function code is: P.

Example:

The lst analogue leased circuit used for telephony between Paris and Wellington (New Zealand) is designated:

Paris – WellingtoNZL P1.

3.2.3 *Analogue leased circuits used for telegraphy*

3.2.3.1 *Voice-frequency telegraphy*

The terminal points of the circuits are arranged in alphabetical order.

The function code is: TP.

Example:

The lst analogue leased circuit used for voice-frequency telegraphy between Bern 1RS and New York 1RC is designated:

Bern/1RS – New York/1RC TP1.

3.2.3.2 *TDM-telegraphy*

The terminal points of the circuits are arranged in alphabetical order.

The function code is: TDP.

Example:

The 3rd analogue leased circuit used for TDM-telegraphy between London and Montreal is designated:

London – Montreal TDP3.

3.2.4 *Leased telegraph circuits*

See Recommendation R.70 [3].

3.2.5 *Analogue leased circuits used for data transmission*

The terminal points of the circuits are arranged in alphabetical order.

The function code is: DP.

Example:

The 3rd analogue leased circuits used for data transmission between London and Paris is designated:

London – Paris DP3.

3.2.6 *Analogue leased circuits used for phototelegraphy or facsimile*

The terminal point of the circuits are arranged in alphabetical order.

If these circuits are different from P-circuits the function code is: FP.

Example:

The 2nd analogue leased circuits used for phototelegraphy between London and Paris is designated:

London – Paris FP2.

If normal P-circuits are used, then these circuits are designated accordingly.

3.2.7 *Analogue leased circuits used for sound-programme transmission*

3.2.7.1 *Analogue leased unidirectional sound-programme circuit*

The terminal points of the circuits are arranged in the order corresponding to the direction of transmission (instead of alphabetically, if this is different).

The function code for these circuits is: RP.

Serial numbering: Circuits which transmit in the direction corresponding to the alphabetical order of the terminals should have odd serial numbers, circuits in the other direction even numbers.

Examples:

The first leased sound-programme circuit transmitting in the direction Montreal to Wellington (New Zealand) will be designated:

Montreal – WellingtoNZL RP1.

The first leased sound-programme circuit transmitting in the direction Wellington (New Zealand) to Montreal will be designated:

WellingtoNZL – Montreal RP2.

3.2.7.2 *Analogue leased reversible sound-programme circuits*

The terminal points of the circuits are arranged in alphabetical order.

The function code is: RRP.

Example:

The first leased circuit with reversible sound-programme transmission between Montreal and Wellington (New Zealand) is designated:

Montreal – WellingtoNZL RRP1.

3.2.8 *Analogue leased circuits used for television transmission*

3.2.8.1 *Analogue leased unidirectional television-programme circuits*

The terminal points of the circuit are arranged in the order corresponding to the direction of transmission (instead of alphabetically if this is different).

The function code is: VP.

Serial numbering, circuits which transmit in the direction corresponding to the alphabetical order of the terminals should have odd serial numbers, circuits in the other direction even numbers.

Example:

The first leased television programme circuit transmitting in the direction Wellington (New Zealand) to Montreal will be designated:

WellingtoNZL – Montreal VP2.

3.2.8.2 *Analogue leased reversible television-programme circuits*

The terminal points of the circuits are arranged in alphabetical order.

The function code is: VVP.

Example:

The first circuit with reversible television transmission between Montreal and Wellington (New Zealand) is designated:

Montreal – WellingtoNZL VVP1.

3.2.9 *Leased circuits used for digital video transmission*

These circuits are designated as digital leased circuits (irrespective of the use), see §§ 3.2.15 and 3.2.16.

3.2.10 *Analogue leased circuits connecting circuit multiplication terminal equipments as renters' premises*

These circuits are designated as normal leased circuits. The information indicating that these circuits connect circuit multiplication terminal equipment can be recorded under item 9 (use) of related information (see § 4.9).

Circuits routed via circuit multiplication equipment are also designated as normal circuits. The multiplication equipment appears under item 8 (equipment information) of related information (see § 4.8).

3.2.11 *Analogue leased circuits used for transmission other than those designated in the paragraphs above, or used for combinations of transmissions*

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 transmissions.

The terminal points of the circuits are arranged in alphabetical order.

The function code is: XP.

Example:

Bruxelles – Paris XP8.

3.2.12 *Analogue leased circuits connecting three or more locations*

Various types and configurations of multiterminal circuits fall into this category. Each section of the circuit should have a unique designation. A section is any part of the circuit which connects a branching point to either a customer terminal or another branching point.

International sections should use the designation described below.

The terminal town points of each section are arranged in alphabetical order.

The function code is formed by adding the letter M to the function codes recommended in §§ 3.2.2 to 3.2.11. This leads, in principle, to the function codes PM, TPM, TDPM, DPM, FPM, RPM, RRPM, VPM, VVPM and XPM.

The association between sections should be recorded in the related information of each section under item 7 (association) (see § 4.7).

Wholly national sections with national designations may be included if bilaterally agreed.

Example:

Let there be an international multiterminal leased circuit connecting Bruxelles and Paris (7th PM circuit between Bruxelles and Paris) with branches from Bruxelles to Edinburgh (1st PM circuit on this relation) and from Bruxelles to Aachen (4th PM-circuit) and with an extension from Paris to Marseille.

The international sections are designated:

Bruxelles – Edinburgh PM1

Aachen – Bruxelles PM4

Bruxelles – Paris PM7.

3.2.13 *Leased analogue groups, supergroups, etc.*

These groups, supergroups, etc. will receive a circuit type designation. The additional information on the constitution of these leased groups, supergroups, etc. is to be recorded in related information under item 12 (bandwidth or bit rate, see § 4.12) and under item 6 (routing, see § 4.6).

The function codes are according to the relevant codes for circuits.

Example:

A supergroup between renters' premises in London and Paris for data transmission which is the 15th lease circuit for data transmission on this relation, is designated:

London – Paris DP15.

3.2.14 *Leased analogue group, supergroup links*

These group and supergroup links will receive a circuit type designation. The additional information on the constitution of these leased group, supergroup links, etc. is to be recorded in related information under item 12 (bandwidth or bit rate, see § 4.12) and under item 6 (routing, see § 4.6).

Example:

A group link provided between renters' premises in London and Montreal devoted to data transmission which is the 10th leased circuit for data transmission on this relation, is designated:

London – Montreal DP10.

3.2.15 *Digital leased circuits connecting two locations*

Destinations given below also apply for leased digital blocks and paths.

Note 1 – For digital leased circuits, the use of the circuit will no longer be taken into account for the designation: the use may change without notification to the Administration or may be unknown.

The additional information concerning the bit rate is to be found in related information under item 12 (bandwidth or bit rate, see § 4.12).

The terminations of the circuit are placed in alphabetical order.

The function code is: NP.

Example:

The 5th digital leased circuit between Birmingham and Toulouse is designated:

Birmingham – Toulouse NP5.

Note 2 – It may happen that a digital leased circuit has been routed via one or more international exchanges; in this case, they are designated as normal digital leased circuits. However, in such cases, an international exchange suffix may replace the transmission station suffix. The information concerning the permanent switched mode is recorded in related information under item 8 (equipment information, see § 4.8).

Example:

The 12th digital leased circuit between users' premises in Athens and Reims which is connected to transmission station TS2 in Athens and permanently switched in the international exchange IP2 in Reims is designated:

Athinai/TS2 – Reims/IP2 NP12.

(Recording of suffixes is not mandatory.)

3.2.16 *Digital leased circuits connecting three or more locations*

Various types and configurations of multiterminals circuits fall into this category. Each section of the circuit should have a unique designation. A section is any part of the circuit which connects a branching point to either a customer terminal or another branching point. (See also Recommendation M.1055 [4]).

International sections should use the designation described below.

The terminal points of each section are arranged in alphabetical order.

The function code is formed by adding the letter M to the function code recommended in § 3.2.15, i.e., the function code is: NPM.

The association between sections should be recorded in the related information of each section under item 7 (association, see § 4.7).

Wholly national sections with national designations may be included if bilaterally agreed.

Example:

In an international digital multiterminal leased circuit connecting Oslo, London, Paris, Rome and Amsterdam, the international section between Oslo and London (being the lst NPM circuit on this relation) is designated:

London – Oslo NPM1.

3.3 *Fixed (non-switched) public circuits*

3.3.1 *General*

The designation format is according to § 3.1. Possible function codes are:

R	for a unidirectional sound-programme circuit
RR	for a reversible sound-programme circuit
RK	for telephone type circuits for narrow band sound-programme transmission
V	for a unidirectional television circuit
VV	for a reversible television circuit
F	for a phototelegraphy or facsimile circuit
T	for circuits providing voice-frequency telegraph links
TD	for circuits providing TDM-telegraph systems
D	for data transmission circuits
DL	for circuits providing transfer link for common channel signalling systems.

Note – Information on whether a sound-programme circuit together with a second sound-programme circuit form a stereophonic pair will be recorded in the related information under the item No. 7 (association, see § 4.7).

3.3.2 *Circuits used for sound-programme transmission*

3.3.2.1 *Circuits used for unidirectional sound-programme transmission*

The terminations of the circuit are arranged in the order corresponding to the direction of transmission (instead of alphabetically, if this is different).

The function code is: R.

Serial numbering: Circuits which transmit in the direction corresponding to the alphabetical order of the terminals should have odd serial numbers. Circuits which transmit in the direction corresponding to the inverse alphabetical order of the terminals should have even serial numbers.

Example:

The 1st circuit transmitting in the direction Wellington (New Zealand) to Montreal is designated:

WellingtoNZL – Montreal R2.

3.3.2.2 *Circuits used for reversible sound-programme transmission*

The terminations of the circuit are arranged in alphabetical order.

The function code is: RR.

Example:

The 1st circuit with reversible sound-programme transmission between Montreal and Wellington (New Zealand) is designated:

Montreal – WellingtoNZL RR1.

3.3.2.3 *Telephone-type circuits used for narrow-band sound-programme transmission*

In the traffic relation, the terminals of the circuit are arranged in the order corresponding to the direction of operation (instead of alphabetically, if this is different).

The function code is: RK.

Serial numbering: Circuits which transmit in the direction corresponding to the alphabetical order of the terminals should have odd serial numbers. Circuits which transmit in the direction corresponding to the inverse alphabetical order of the terminals should have even serial numbers.

Example:

The 1st telephone-type circuit set up for the narrow-band sound-programme transmission in the direction from Milano to Madrid is designated.

Milano – Madrid RK2.

3.3.3 *Circuits used for television transmission*

3.3.3.1 *Circuits used for unidirectional television transmission*

In the traffic relation, the terminations of the circuit are arranged in the order corresponding to the direction of transmission (instead of alphabetically, if this is different).

The function code is: V.

Serial numbering: Circuits which transmit in the direction corresponding to the alphabetical order of the terminals should have odd serial numbers. Circuits which transmit in the direction corresponding to the inverse alphabetical order of the terminals should have even serial numbers.

Example:

The 1st unidirectional television circuit transmitting in the direction Paris to Helsinki is designated:

Paris – Helsinki V2.

3.3.3.2 *Circuits used for reversible television transmission*

The terminations of the circuit are arranged in alphabetical order.

The function code is: VV.

Example:

The 1st reversible television transmission circuit between Tokyo TS1 and New Delhi is designated:

New Delhi – Tokyo/TS1 VV1.

3.3.4 *Circuits for digital audio and video transmission*

These circuits are designated according to the data transmission system, see § 11.

3.3.5 *Telephone-type circuits used for phototelegraphy or facsimile*

Circuits used for phototelegraphy or facsimile which are different from normal telephone circuits will have the function code: F.

The terminal points of the circuit are arranged in alphabetical order.

If normal telephone circuits are used, they are designated accordingly. Information about the usage may be recorded in the related information under item 9 (use, see § 4.9).

Example:

The first circuit for phototelegraphy between Koebenhavn and Tokyo:

Koebenhavn – Tokyo F1.

3.3.6 *Telephone-type circuits used to provide voice-frequency telegraph links*

The terminal points of the circuit are arranged in alphabetical order.

The function code is: T.

Example:

The 1st circuit to provide a voice-frequency telegraph link between Koebenhavn 1 and Montreal 1TE is designated:

Koebenhavn/1 – Montreal/1TE T1.

(Suffixes are optional)

A reserve T-circuit is designated according to its present function. Information concerning the nature of the reserve T-circuit is found in the related information under item 7 (association, see § 4.7).

3.3.7 *Telephone-type circuits used to provide TDM (time division multiplex) telegraph systems*

The terminal points of the circuit are arranged in alphabetical order.

The function code is: TD.

Example:

The first circuit to provide a TDM-telegraph system between London Keybridge and Montreal 1TE:

London/KB – Montreal/1TE TD1.

(Suffixes are optional)

A reserve TD-circuit is designated according to its present function. Information concerning the nature of the reserve TD-circuit is found in the related information under item 7 (association, see § 4.7).

3.3.8 *Telephone-type circuits used for data transmission*

The terminal points of the circuit are arranged in alphabetical order.

The function code is: D.

Example:

The 1st circuit used for data transmission between Frankfurt 1 and Toronto 1TE is designaged:

Frankfurt/1 – Toronto/1TE D1.

(Suffixes are optional)

3.3.9 *Telephone-type circuits used as transfer links for common channel Signalling Systems No. 6 and No. 7*

The terminal points of the circuit are arranged in alphabetical order.

The function code is: DL.

Example:

The first data link used for common channel signalling between Sacramento 4ESS and Tokyo Shinjuku is designated:

Sacramento/4ES – Tokyo/SJK DL1

(Suffixes are optional.)

3.4 *Related information*

The additional information on fixed circuits is covered by the following items:

1. urgency for restoration;
2. terminal countries;

3. administrations'carriers, or broadcasting companies's names;
4. control and sub-control station(s);
5. fault report points;
6. routing;
7. association;
8. equipment information;
9. use;
10. transmission medium information;
11. composition of transmission;
12. bandwidth or bit rate;
13. signalling type;
14. applicable CCITT Recommendations;

The various items will be dealt with in § 4.

4 Related information for international fixed circuits

The following sections explain the items of related information concerned with international fixed circuits. A full example for the designation information of an international leased analogue circuit is given in Annex A, § A.2.

4.1 *Urgency for restoration (item 1)*

This item supplies information on the urgency of restoration of the circuit based upon bilateral agreement between the terminal Administrations.

Format:

1. xxx . . . xx; (maximum 10 characters)

Illustration:

a) if the priority is top: 1;
   if the priority is second: 2;
   if the priority is third: 3; or
b) if repair is required within e.g., 24 hours: $\leq$ 24 h; or
c) if no urgency has to be indicated: – ;

Note – In the case of a digital leased circuit, the priority or urgency may be decided upon by taking into account the bit rate of the circuit.

4.2 *Terminal countries (item 2)*

This item presents the countries in which the circuit is terminating.

Format:

2. XXX, YYY; (3 characters for each)

Specification:

XXX: code for country of town A
YYY: code for country of town B

Note – The codes are according to the ISO Standard 3166 [2].

Example:

For the circuit Paris – WellingtoNZL P1:
2. FRA, NZL;

4.3 *Names of Administrations, carriers or broadcasting companies (item 3)*

This item records the names of the Administrations or carriers which operate the circuit or, in the case of sound-programme and television circuits, the name of the broadcasting company.

Format:

3. YYYYYY, ZZZZZZ; (maximum 6 characters for each)

Specification:

YYYYYY: code for company operating in town A
XXXXXX: code for company operating in town B

Example:

For the circuit Bern/1RS – NewYork/1RC TP1 operated by Radio Suisse and RCA:

3. RS, RCA;

4.4 *Control station [sub-control station(s)] (item 4)*

This item lists the appointed control station and sub-control stations (according to Recommendations M.80 and M.90 or M.1012 [5] and M.1013 [6] for leased circuits). Further details about the stations can be found in the list of contact points (Recommendation M.93).

Example:

4.	CS:	designation of control station,
	SCS1:	designation of sub-control station,
	SCS2:	designation of sub-control station,
	.	. . .
	.	. . .
	.	. . .
	SCSn:	designation of sub-control station.

Specification:

CS:	designation of the control station,
SCS1:	designation of the terminal sub-control station,
SCS2 to SCSn:	if applicable: other sub-control station; have to be placed in the geographical order according to the traffic relation.

Example:

For the circuit London/KB – Paris/ARC RP1 where Paris Archives is the control station and London Keybridge is the sub-control station:

4.	CS:	Paris/ARC,
	SCS1:	London/KB.

4.5 *Fault report points (item 5)*

This item presents the names of both fault report points on the circuit. Further information about the fault report points can be found in the list of contact points (Recommendation M.93).

Format:

5. Designation of fault report point, designation of fault report point.

Specification:

The first fault report point is that of the country of town A.

The second fault report point is that of the country of town B.

Example:

The fault report points for the circuit Athinai – Roma DP3:

5. Athinai, Roma/TS1.

4.6 *Routing (item 6)*

This item shows the international primary group(s) or primary block(s) and the channel number(s) which carry the circuit (see Notes 1 and 2). If there are more than one, the groups or blocks appear in the geographical order from town A to town B.

Format:

6. Designation of an international primary group (Note 1) or primary block/channel number, designation of a primary group of block/channel number, . . ., designation of a primary group or block/channel number;

Example 1:

For the circuit from London Mollison to Paris Archives DP7:

6. London – Paris 1204/4;

Example 2:

For the wide-band circuit Frankfurt – London DP5:

6. Amsterdam – Frankfurt 6005/2, Amsterdam – London 6002/3;

Note 1 – In the case where a leased circuit consists of a group or block, the primary groups or blocks are to be replaced by the next higher groups or blocks. In this case the channel numbers are to be replaced by the group numbers.

Note 2 – Primary groups or blocks can be unidirectional as well. Two consecutive unidirectional groups or blocks are separated by a + sign instead of a comma.

4.7 *Association (item 7)*

This item informs whether there are associated circuits and if so, of what nature.

Format:

7. Association code: Designation(s) of associated circuit(s);

Specification:

If the circuit *has* a reserve circuit, the association code is: S followed by the function code and the serial number of the principal circuit.

If the circuit *is* a reserve circuit, the association code is: function code followed by S and the serial number of the reserve circuit.

If the circuit is one of a stereophonic pair, the other circuit will appear in this item. Association code is: H followed by a 2 digit serial number indicating the number of the stereophonic pair. This is followed by the function code and the serial number of actual circuit.

If the circuit belongs to a multiterminal leased circuit, the association code is: PM, DPM, etc. (see §§ 3.2.12 and 3.2.16) followed by the serial number of the circuit.

Example 1:

7. ST1: Roma/AS1 – Zuerich/SEL Z13;

which indicates that the reserve circuit for the principal circuit T1 is Roma/AS1 – Zuerich/SEL Z13.

Example 2:

If the circuit London/KB – Paris/ARC R1 is bearing one channel of the second stereophonic pair from London to Paris, and London/KB – Paris/ARC R5 bearing the other channel of this pair:

7. H02R1: London/KB – Paris/ARC R5;

which indicates that circuit R1, being one of the stereophonic pair number 2, has as the other circuit of this pair: London/KB – Paris/ARC R5.

Example 3:

If the circuit Bruxelles-Edinburgh PM1 is a part of an international multiterminal telephone circuit connecting Bruxelles and Paris (being the 7th PM-circuit on that relation) with branches from Bruxelles to Edinburgh and to Aachen (being the 2nd PM-circuit on that relation) and with an extension from Paris to Marseille, then for the circuit Bruxelles – Edinburgh PM1:

7. PM1: Aachen – Bruxelles PM2, Bruxelles – Paris PM7;

Note – The international branches may appear in any order. National branches may be added after bilateral agreement.

4.8 *Equipment information (item 8)*

This item records any equipment in the circuit which requires special maintenance attention.

Format:

8. XX, XX, XX, XX, XX;

Specification:

If the circuit has been routed via digital circuit multiplication equipment: AM

If the circuit has been routed via digital circuit multiplication equipment
- using reduced bit rate encoding: RB
- using speech interpolation: SI

If the circuit has a compandor: CO

If the circuit consists of a semi-permanent switched connection: SP

Note – If there is a need to record an additional special equipment, the free code places are available for that purpose. The codes to be used must consist of two characters, be unique and can be chosen by bilateral agreement between Administrations.

4.9 *Use (item 9)*

This item identifies for what purpose the circuit is used (if this is known by the Administration and of use for maintenance).

Format:

9. XXX . . XX; (maximum 7 characters)

Specification:

XX . . XX allows the record of the usage of the circuit.

If the circuit has been provided with circuit multiplication equipment at renters' premises with connection channels: CC.

4.10 *Transmission medium information (item 10)*

This item identifies whether a particular transmission medium is required in the routing of the circuit.

Format:

10. ST: XX . . . XX; or 10. NS: XX . . . XX; or 10. –; (XX . . . XX maximum 10 characters)

Specification:

If the circuit has to be routed via satellite: ST followed by the designation of the satellite.

If the circuit must not be routed via satellite: NS followed by the designation of the terrestrial transmission medium.

If there is no transmission medium requirement: –.

Example:

For the circuit London – Paris DP3 that has to be routed via satellite Telecom 1:

10. ST: Tel 1.

4.11 *Composition of the transmission (item 11)*

This item shows type of transmission on the circuit.

Format:

11. A; N; or C;

Specification:

If the transmission is analogue: A

If the transmission is digital: N

If the transmission is mixed analogue/digital: C

4.12 *Bandwidth or bit rate (item 12)*

This item shows the bandwidth (in the case of an analogue circuit or mixed circuit) or the bit rate (in the case of a digital circuit).

Format:

12. xxxx.x Hz; or kHz; or MHz; bit/s; or kbit/s; or Mbit/s;

Rules for the notation of the figures:

Leading zeros may be omitted, and if the decimal is a zero, this decimal and the decimal point may also be omitted.

If the figure is up to 999, use Hz, bit/s.

If the figure is between 1000 and 9 999 999, use kHz, kbit/s.

If the figure is 10 000 000 or more, use MHz, Mbit/s.

Specification:

If the circuit is analogue or mixed analogue/digital: the bandwidth Hz, kHz, MHz.

If the circuit is digital: the bit rate in bit/s, kbit/s, Mbit/s.

Example:

For the circuit Bordeaux – Darmstadt NP7 with a bit rate of 64 kbit/s:

12. 64 kbit/s.

4.13 *Signalling type (item 13)*

This item presents the signalling type that applies to the circuit (reference is made to Recommendations M.1045 [7] and Q.8 [8]).

Format:

13. xxxxxxx; (maximum 7 characters)

Specification:

If the signalling is of the type xxxx Hz/xx Hz: xxxx/xx. Otherwise the characters can be used on the basis of bilateral agreement between the two terminal Administrations.

Example:

For a circuit with in-band signalling 1000 Hz/20 Hz:

13. 1000/20.

4.14 *Application CCITT Recommendations (item 14)*

This item records the CCITT Recommendation(s) applied as regards the parameters of the circuit.

Format:

14. Rec. X.xxxx, Rec. Y.yyyy; or 14. Rec. X.xxxx; or 14. – ;

Specification:

The number of Recommendations to be recorded (2, 1 or 0) is dependent on the need.

Example:

14. Recommendation M.1020;

5 Designations of international groups, supergroups etc. (bidirectional and unidirectional)

5.1 *General*

The format of the designation of groups etc. is shown in Table 4/M.140.

TABLE 4/M.140

Format of designation	Town A	/	Trans-mission station suffix (optional)	–	Town B	/	Trans-mission station suffix (optional)		Function code	Serial number
Signs	Characters	Slash	Letters/ digits	Hyphen	Characters	Slash	Letters/ digits	Space	Letters/ digits	Digits
Number of characters	⩽ 12	1	⩽ 3	1	⩽ 12	1	⩽ 3	1	1 to 6	2 to 3

No space

The elements of the format are as follows:

a) *Traffic relation*

Groups etc. are indicated by the names of the towns where the groups, etc. terminate. For the spelling, see § 1.1. The town names are arranged in alphabetical order. For multiple destination unidirectional groups the name of town B is replaced by (MU) (see § 5.3.1). In the case that a town name exceeds the maximum length of 12 characters, the responsible Administration should supply a suitable abbreviation that must be unique (see § 0.1).

The transmission station suffix (maximum 3 characters) is an optional field which may be used to further identify the terminal point when there is more than one carrier operating in the town. The necessity for a suffix and its form should be decided by the Administration operating the circuit in the town concerned.

b) *Function code*

This code consists of the nominal number of channels in the group (see Note). In the case of a unidirectional single destination group, the number is preceded by (U) (see § 5.3.2).

Note – Where group, supergroup, etc., links are directly interfaced by analogue to digital conversion equipment, the number of channels is followed by the letter "C" (see § 10).

c) *Serial numbering*

The numbering is on a town-to-town basis with an exception for the case where the suffix is used. The numbering for that case is made on a transmission station to transmission station basis.

The numbering of a group, supergroup, etc., is applied between the point where the group, etc. is assembled to the point where it is broken down, independently of the position it occupies in the band of line frequencies.

If the number is less than 10, it is preceded by a zero.

5.2 *Bidirectional groups, etc.*

5.2.1 *Group*[4]

The function code is a number that indicates the nominal number of channels in the group, as follows:

8 for 8 channel groups,

12 for 12 channel groups,

16 for 16 channel groups.

Example:

The third 12-channel group between Moskva and New York is designated:

Moskva – New York 1203.

5.2.2 *Supergroup*[4]

The function code is a number that indicates the nominal number of channels in the supergroup, as follows:

60 for 60 channel supergroups.

80 for 80 channel supergroups.

Example:

The first 60 channel supergroup between London and Amsterdam is designated:

Amsterdam – London 6001.

5.2.3 *Mastergroup*[4]

The function code is: 300.

Example:

The first mastergroup between Bruxelles and London is designated:

Bruxelles – London 30001.

[4] For the definition, see Recommendation M.300.

5.2.4 *Supermastergroup*[5)]

The function code is: 900.

Example:

The tenth supergroup between Amsterdam and Paris is designated:

Amsterdam – Paris 90010.

5.2.5 *Use of the groups, etc.*

This information will be contained in related information under item 9 (use, see § 7.9). If groups are used for private purposes, see § 3.2.13.

5.2.6 *Restoration groups and supergroups*

Groups and supergroups set up on restoration groups and supergroups, or on spare groups and supergroups for restoration purposes, will receive a serial number from the 800 series, in descending order and starting from 899.

Restoration groups:	8899, 8898, 8897, etc., 12899, 12898, 12897, etc., or 16899, 16898, 16897, etc., as appropriate.
Restoration supergroups:	60899, 60898, 60897, etc.

Example 1:

The second 12-channel restoration group between London and Sydney is designated:

London – Sydney 12898.

Example 2:

The first restoration supergroup between Amsterdam and Bruxelles is designated:

Amsterdam – Bruxelles 60899.

5.3 *Unidirectional groups and supergroups*

5.3.1 *Multiple destination unidirectional groups and supergroups*

The unidirectional route will be designated by the name of the sending terminal station (in the general format: town A) followed by a hyphen, whilst the letters MU (multiple destination unidirectional) in parentheses replace town B. This will be followed by the function code and serial number of the group or supergroup.

Example 1:

The first multiple destination unidirectional supergroup from London (to, for example Bogota, Lusaka and Montreal) is designated:

London – (MU) 6001.

The next such supergroup from the same point of origin to any destination would take the next number in the series, e.g., the second supergroup from London is designated:

London – (MU) 6002.

This supergroup might go, for example, to Tokyo, Hawaii and Melbourne.

Example 2:

The first supergroup from Montreal (to, for example, London, Lusaka and Paris) is designed:

Montreal – (MU) 6001.

Note – Groups and supergroups routed via a multiple-access 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.

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5) For the definition, see Recommendation M.300.

5.3.2 *Single destination unidirectional groups and supergroups*

The unidirectional route will be designated by the name of the sending terminal station (in the general format: town A) followed by a hyphen and the name of the receiving terminal station (town B). The function code consists of the letter U (unidirectional) in parentheses and the nominal number of channels 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 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.

5.4 *Related information*

The additional information on groups etc., is covered by the following items:

1. urgency for restoration;
2. terminal countries;
3. administrations', carriers' or broadcasting companies' names;
4. control and sub-control station(s);
5. fault report points;
6. routing;
7. association;
8. equipment information;
9. use;
10. transmission medium information;
11. (empty item, use: "– ;");
12. bandwidth;
13. occupancy.

The various items will be dealt with in § 7.

6 Designations of international group links, supergroup links and line links

6.1 *Group and supergroup links*

Group links and supergroup links are designated according to the general format for groups (see § 5.1). In practice, it may be that terminal equipment is not connected to a group link or supergroup link. Nevertheless, for designation purposes, the link will be numbered as though terminal equipment were connected.

6.1.1 *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.

When a group link or supergroup link is used only part time with terminal translating equipment (to provide a conventional group or supergroup) it will be designated in the normal way. The part time condition of the group link has to be indicated in related information under item 9 (use, see § 7.9).

Example:

The group link between Amsterdam and London set up following 5 groups already in service, is designated:

Amsterdam – London 1206.

6.1.2 *Restoration links*

Group links and supergroup links nominated for restoration purposes will receive a serial number from the 800-series in ascending order and starting from 801.

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

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

Example:

The second restoration group link between Hong Kong and Sydney is designated:

Hong Kong – Sydney 12802.

Note – The first two digits (e.g., 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.

6.2 *Line links*[6)]

The format of the designation of line links is shown in Table 5/M.140.

TABLE 5/M.140

Format of designation	Town A	/	Trans-mission station suffix (optional)	–	Town B	/	Trans-mission station suffix (optional)		Function code	Serial number
Signs	Characters	Slash	Letters/ digits	Hyphen	Characters	Slash	Letters/ digits	Space	Letters/ digits	Digits
Number of characters	⩽ 12	1	⩽ 3	1	⩽ 12	1	⩽ 3	1	3 to 5	2

No space

The elements of the format are as follows:

a) *Traffic relation*

The two terminals are arranged in alphabetical order. For the use of the suffix, see § 5.1.

b) *Function code*

This code consists of a number indicating the nominal telephone channel transmission capacity followed by the letter A.

c) *Serial number*

This is a two-digit number.

Example 1:

The first 1840 telephone channel capacity line link between Beaver Harbour and Widemouth is designated:

Beaver Harbo – Widemouth 1840A01.

Example 2:

The first 432 telephone channels capacity line link between Etam and Pleumeur-Bodou is designated:

Etam – Pleumeur-Bod 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.

6) For the definition, see Recommendation M.300.

6.3 *Related information*

The additional information on group links, supergroup links and line links is covered by the following items:

1. urgency for restoration;
2. terminal countries;
3. administrations', carriers', or broadcasting companies' names;
4. control and sub-control station(s);
5. fault report points;
6. routing;
7. association;
8. equipment information;
9. use;
10. transmission medium information;
11. (empty item, use: "– ;");
12. bandwidth;
13. occupancy (this item is not in use for group, etc.); links,

The various items will be dealt with in § 7.

7 Related information for international groups, goup links and line links

The following sections explain the items of related information concerned with international groups, group links, line links, etc. Full examples for the designation information of an international group and an international group link is given in Annex A, § A.3.

7.1 *Urgency for restoration (item 1)*

This item supplies information on the urgency of restoration of the group/group link based upon bilateral agreement between the terminal Administrations.

Format:

1. xxx .... xx; (maximum 10 characters)

Illustration:

a) if the priority is top: 1;
   if the priority is second: 2;
   if the priority is third: 3; or

b) if repair is required within e.g., 24 hours: $\leq$ 24 h; or

c) if no urgency has to be indicated: – ;

Example:

If the group Bonn – Paris 1201 needs top priority restoration:

1. 1;

7.2 *Terminal countries (item 2)*

This item presents the countries in which the group/group link is terminating.

Format:

2. XXX, YYY; or XXX; (3 characters for each)

Specification:

XXX code for country of town A

YYY code for country of town B

In the case of a multiple destination unidirectional group (MU), only XXX applies.

Example 1:

For the group Beograd – Roma 1201:

2. YUG, ITA;

Example 2:

For the multiple destination group Toronto – (MU) 1202

2. CAN;

Note – The codes are according to ISO Standard 3166 [2].

7.3 *Names of Administrations, carriers or broadcasting companies (item 3)*

This item records the names of the carriers, etc., which operate the group/group link.

Format:

3. XXXXXX, YYYYYY; or XXXXXX; (maximum 6 characters for each)

Specification:

XXXXXX: name of company in town A

YYYYYY: name of company in town B

In the case of an unidirectional multiple destination, only XXXXX applies.

Example 1:

For the supergroup Amsterdam – London 6002:

3. NLDPTT, BTI;

Example 2:

For the multiple destination group Hong Kong – (MU) 1201:

3. HKGTEL;

7.4 *Control station [sub-control station(s)] (item 4)*

This item lists the appointed control station and sub-control stations (according to Recommendations M.80 and M.90). Further details about the stations can be found in the list of contact point (Recommendation M.93).

Format:

4. CS: designation of control station,
   SCS1: designation of sub-control station,
   SCS2: designation of sub-control station,
   .
   .
   .
   SCSn: designation of sub-control station,

or in the case of a multiple destination unidirectional group:

4. CS: designation of control station;

Specification:

CS: designation of the control station;

SCS1: designation of the terminal sub-control station;

SCS2 to SCSn: if applicable: other sub-control stations, are to be placed in the geographical order according to the traffic relation.

In the case of a multiple destination unidirectional group, only CS applies.

Example 1:

For a group Helsinki – Paris 1201 where the control station is Helsinki TM1 and the sub-control station is Paris Archives:

4. CS: Helsinki/TM1,
   SCS1: Paris/ARC;

Example 2:

For the multiple destination unidirectional group Wien – (MU) 1201:

4. CS: Wien/ARS;

7.5 *Fault report points (item 5)*

This item presents the names of both fault report points on the group/group link (according to Recommendation M.130). Further details about the fault report points can be found in the list of contact points (Recommendation M.93).

Format:

5. Designation of fault report point, designation of fault report point;

or

5. Designation of fault report point;

Specification:

The first fault report point is that of the country of town A. The second fault report point is that of the country of town B. In the case of a multiple destination unidirectional group, there is only one fault report point under item 5.

Example 1:

For the group Moskva – Paris 1201;

5. Moskva/MNA, Paris/ARC;

Example 2:

For the multiple destination unidirectional group Caracas – (MU) 1201:

5. Caracas/TS1;

7.6 *Routing (item 6)*

This item records the next higher group within the multiplex hierarchy on which the group/group link has been routed and the position number, or in the case of the highest multiplex level, the transmission media on which the group/group link has been routed.

Format:

6. Designation of an international group/position number or designation of transmission medium, designation of an international group/position number or designation of transmission medium, . . ., designation of an international group/position number or designation of transmission medium;

Note – Two consecutive unidirectional groups are separated by a + sign instead of a comma.

Specification:

The designation of an international group refers to the next higher level in the multiplex hierarchy. If there are more than one, the groups are noted in geographical order from town A to town B

The designation of the transmission medium refers to the transmission medium leaving the country of town A and to the transmission medium entering the country of town B respectively.

As no CCITT designations of transmission media are provided for the time being, the terminal countries should provide designations or agree on designations.

If there is only one transmission medium, the designation of this medium applies.

Example 1:

A group Alger – London 1201 has been routed internationally as follows:

6. Alger – Paris 6002/2, London – Paris 6040/5;

Example 2:

A supermaster group Barcelona – Perpignan 90001 has been routed as follows:

6. Gerona – Perpignan 1800A08;

Example 3:

A group Caracas – Paris 1201 has been routed as follows:

6. Caracas – Paris 6001/2 + Caracas – (MU) 6002/3;

7.7 *Association (item 7)*

This item informs whether there are associated group/group links and if so, of which nature.

Format:

7. Association code: designation(s) of the associated group(s) or group link(s);

Specification:

If the group *has* a reserve group the association code is:

S followed by the function code and the serial number of the group.

If the group *is* a reserve group the association code is:

function code followed by S and the serial number of the reserve group.

The same applies for group links.

Example:

If the normal group is Bruxelles – Luxembourg 1215 and if the group Bruxelles – Luxembourg 12899 serves as a restoration group for the group Bruxelles – Luxembourg 1215:

7. S1215: Bruxelles – Luxembourg 12899;

For the group Bruxelles – Luxembourg 12899 there has to be recorded under item 7:

7. 12S899: Bruxelles – Luxembourg 1215;

7.8 *Equipment information (item 8)*

This item records information on equipment in the group/group link which requires special maintenance attention.

Format:

8. XX, XX, XX, XX;

Specification:

If the group is carrying companded circuits: CO

If a group has been routed via TDMA: TD

If there is no special equipment: –

Note – If there is a need to record any additional equipment information, the free codeplaces are available for that purpose. The codes to be used must consist of two characters, be unique and can be chosen by bilateral agreement between Administrations.

Example:

If a group Geneva – Mexico 1210 is carrying companded circuits:

8. CO;

7.9 *Use (item 9)*

This item identifies for what purpose the group/group link is used (if this is known by the Administration and of use for maintenance).

Format:

9. XXXXXX; (maximum of 6 characters)

Specification:

XXXXXX refers to (among others) the designatory letters Z, B, D, X, DP, RP, VP, etc., as explained in §§ 1 and 3. If no other information available, the sign – is used.

Example:

If the group London – Melbourne 1212 is dedicated to DP – circuits:

9. DP;

7.10 *Transmission medium information (item 10)*

This item identifies whether a satellite is involved in the routing.

Format:

10. ST; or –;

Specification:

If the group/group link has been routed via satellite: ST

If the group/group link has not been routed via satellite: –

Example:

If the group Caracas – Madrid 1203 has been routed via satellite:

10. ST;

7.11 *End-to-end information (for mixed analogue/digital routes only) (item 11)*

This item provides information on the destinations of the traffic carried by the group.

Format:

11. X . . . X, Y . . . Y; (maximum 12 characters each) or –;

Specification:

X . . . X and Y . . . Y are the names of a town and refer to the destinations of the traffic on the group. The destinations are placed according to the order of towns in the traffic relation.

If the group has a multiple destination, one town name is replaced by the code: M.

If the group is within an analogue environment, X . . . X, Y . . . Y is replaced by the sign –.

Example:

If the group Athinai – Paris 60C11 carriers traffic from Bruxelles to Sofia:

11. Sofia, Bruxelles;

7.12 *Bandwidth (item 12)*

This item shows the bandwidth of the group/group link.

Format:

12. xxxx kHz or MHz or GHz

Rules for the notation of the bandwidth figures:

No leading zeros required

If the figure is between 10 000 and 9 999 999, use kHz

If the figure is between 10 000 000 and 9 999 999 999, use MHz

If the figure is 10 000 000 000 or more, use GHz.

Example:

A group Bangkok – New Delhi 1201:

12. 48 kHz;

7.13 *Occupancy (for groups/supergroups, etc., and for line links) (item 13)*

This item lists the occupancy of the group expressed by the next lower group and/or circuits which have been routed in the group.

Format in the case of a group (lowest level):

13. Position number: designation of the circuit, or the sign –,

. . . . . .

. . . . . .

. . . . . .

Position number: designation of the circuit, or the sign –;

Format in the case of a supergroup or higher level group:

13. Position number: designation of a group, of a leased circuit, or the sign –,

. . . .

. . . .

. . . .

Position number: designation of a group of a leased circuit, or the sign –;

Specification:

If the position number is occupied by a next lower group: designation of this group.

If the position number is occupied by a leased circuit (with a bandwidth corresponding to the bandwidth of the next lower multiplex level, e.g., see § 3.2.13): designation of this leased circuit.

If the position number is not in use: –

Example:

For a supergroup Athinai – Paris 6002:

13. 01: Beyrouth – Paris 1209,
02: London – Sofia 1202,
03: Athinai – Paris 1205,
04: Athinai – Rotterdam 1202,
05: Athinai – Paris DP4;

8 Designations of international digital blocks (bidirectional and unidirectional)

8.1 *General*

This section refers to blocks which are part of the digital multiplex hierarchy and which are formatted according to Recommendations G.734, G.736, G.742, G.743, G.745, G.751, G.752, G.753 and G.754 [10]. All other blocks are designated according to § 11.

The format of the designation of digital blocks is shown in Table 6/M.140.

TABLE 6/M.140

Format of designation	Town A	/	Suffix for transmission station or international exchange (optional)	–	Town B	/	Suffix for transmission station or international exchange (optional)		Function code	Serial number
Signs	Characters	Slash	Letters/ digits	Hyphen	Characters	Slash	Letters/ digits	Space	Letters/ digits	Digits
Number of characters	⩽ 12	1	⩽ 3	1	⩽ 12	1	⩽ 3	1	3-6	⩽ 4

No space

The elements of the format are as follows:

a) *Traffic relation*

Town A and town B, possibly with a suffix for the transmission station or international exchange, indicate the terminal points of the block. For the spelling, see § 1.1. If a town name exceeds the maximum length of 12 characters, the Administration should apply a suitable abbreviation which must be unique (see § 0.1). The town names are arranged in alphabetical order.

The suffix for the transmission station or international exchange (maximum 3 characters) is an optional field which may be used to further identify the terminal point when there is more than one carrier operating in the town. The necessity for a suffix and its form should be decided by the Administration operating the circuit in the town concerned.

In the case of a multiple destination undirectional block, town B is replaced by (MU) (see § 8.4).

b) *Function code:*

This code consists of a number indicating the nominal number of channels in the block followed by the letter N.

For blocks in a mixed analogue/digital environment, see § 10.1.2. (In this case 6 characters or less are required.)

c) *Serial number*

This is a 1 to 4 digit number which counts the number of blocks with the same traffic relation and the same function code.

8.2 *Bidirectional digital blocks*

These blocks are designated according to the principles stated in § 8.1.

Example 1:

The fourth secondary order block between London and Paris is designated:

London – Paris 120N4.

Example 2:

The tenth primary order block between New York and Tokyo is designated:

New York – Tokyo 24N10.

8.3 *Restoration digital blocks*

Digital blocks set up on restoration digital paths or spare digital paths for restoration purposes will receive a serial number from the 800 series, in descending order and starting from 899.

Example:

The first fourth order restoration block between Koebenhavn and Stockholm is designated:

Koebenhavn – Stockholm 1920N899.

8.4 *Multiple destination unidirectional digital blocks*

For these blocks the traffic relation is composed of the name of the sending terminal station followed by a hyphen and the letters MU (Multiple destination Unidirectional) in parentheses.

Examples:

The first multiple destination unidirectional primary digital block from Bercenay (to, for example, London and Bruxelles) is designated:

Bercenay – (MU) 30N1.

The next multiple destination unidirectional primary digital block from Bercenay (to, for example, Frankfurt and Roma) is designated:

Bercenay – (MU) 30N2.

Note – Digital blocks routed via a multi-access 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.

8.5 *Single destination unidirectional digital blocks*

These blocks are designated as normal digital blocks and numbered in the same sequence. The unidirectional property as well as the direction of transmission has to be registered in Related Information under item 16 (Direction of transmission, see § 12.16).

Example:

A unidirectional primary digital block transmitting in the direction Roma to London, which is the 21st primary digital block on that relation is designated:

London – Roma 30N21.

8.6 *Related information*

The additional information on digital blocks is covered by the following items:

1. Urgency for restoration;
2. Terminal countries;
3. Administrations', carriers' or broadcasting companies' names;

4. Control and sub-control station(s);
5. Fault report points;
6. Routing:
7. Association;
8. Equipment information;
9. Use;
10. Transmission medium information;
11. (Empty item, use: "– ;");
12. Bit rate;
13. Occupancy;
14. Actual number of channels (for primary blocks only);
15. Clocking information;
16. Direction of transmission (for unidirectional blocks only);

The various items will be dealt with in § 12.

9 Designation of 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 (see § 8.1).

9.1 *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.

9.2 *Restoration digital paths*

Digital paths nominated for restoration purposes are designated by serial numbers taken from the 800 series in ascending order and starting from 801.

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

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

Example 1:

The 4th second order restoration digital path between London and Paris is designated:
London – Paris 120N804.

Example 2:

The first third order restoration digital path between Amsterdam and Paris is designated:
Amsterdam – Paris 480N801.

9.3 *Digital line sections and digital radio sections*

Designations of digital line sections and digital radio sections are under consideration.

9.4 *Related Information*

The additional information on digital paths is covered by the following items:

1. Urgency for restoration;
2. Terminal countries;
3. Administrations', carriers' or broadcasting companies' names;
4. Control and sub-control station(s);
5. Fault report points;
6. Routing;
7. Association;
8. Equipment information;

9. Use;
10. Transmission medium information;
11. (Empty item, use: "– ;");
12. Bit rate;

The various items will be dealt with in § 12.

10 Designations of routes[7] in the mixed analogue/digital transmission network

Conforming to 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. The funcion code may, therefore, consist of a maximum of 6 characters.

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

10.1 *Transmission routes with one analogue-to-digital conversion*

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

Groups, supergroups, etc., which are converted into digital paths at some point are designated in the same way as conventional groups or supergroups (see § 5.1), but have a letter C included in the function code and placed after the nominal number of channels.

Examples:

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

Figure 2/M.140 shows a typical analogue/digital arrangement and how it will be designated.

10.1.2 *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.

Figure 2/M.140 shows a typical analogue/digital arrangement and how it will be designated.

10.1.3 *End-to-end designations*

This subject is covered by item 11 in Related Information for digital blocks (see § 12.11).

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

10.2.1 *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 § 10.1.1 should be agreed between the terminal Administrations.

---

[7] 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 2/M.140 and Figure 3/M.140.

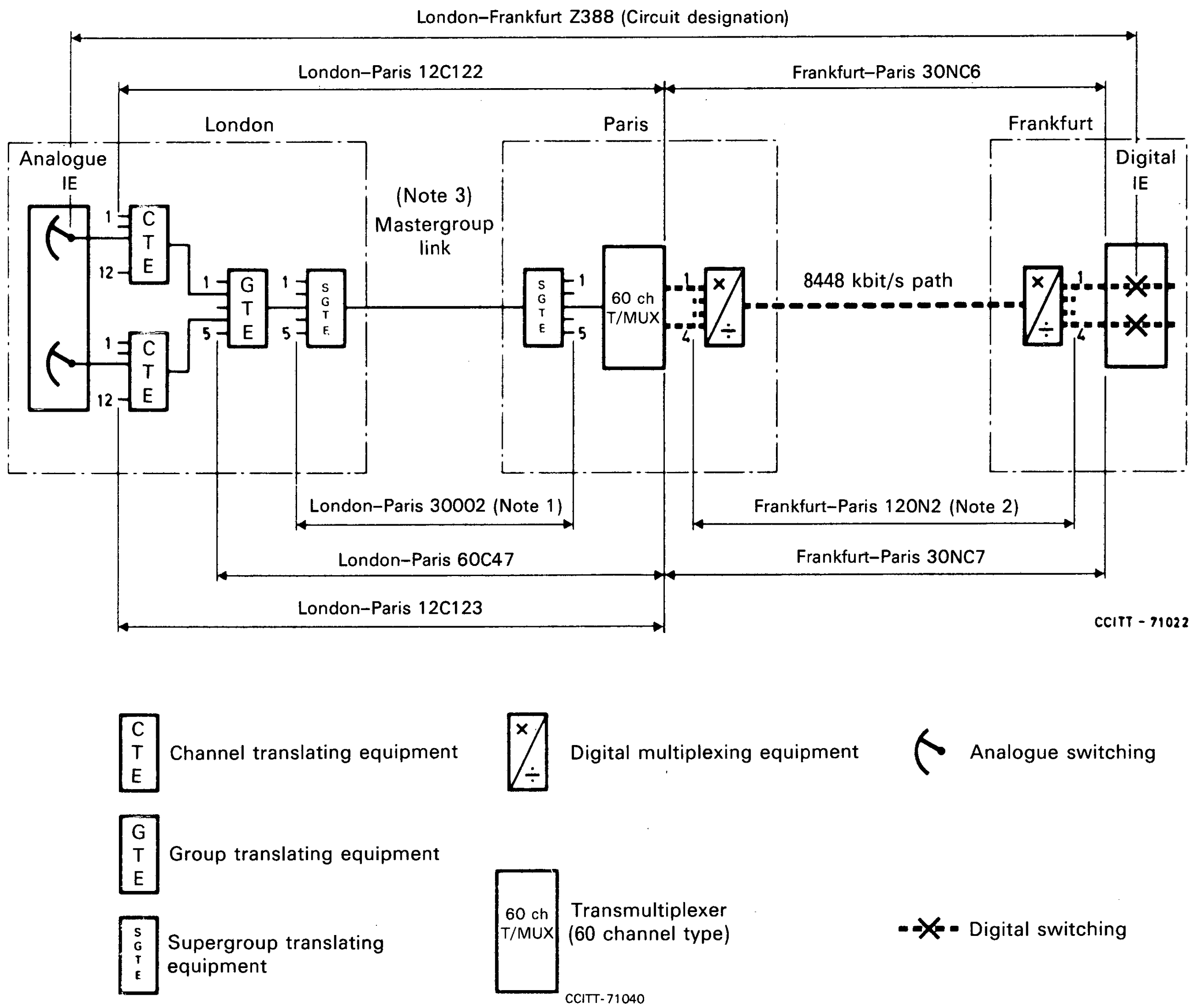
Where both ends are digital, an end-to-end designation using the digital notation described in § 10.1.2 should be agreed between the terminal Administrations.

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.

10.2.2 *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 3/M.140 shows two examples of routes involving two analogue-to-digital conversions and how they will be designated.



IE International exchange

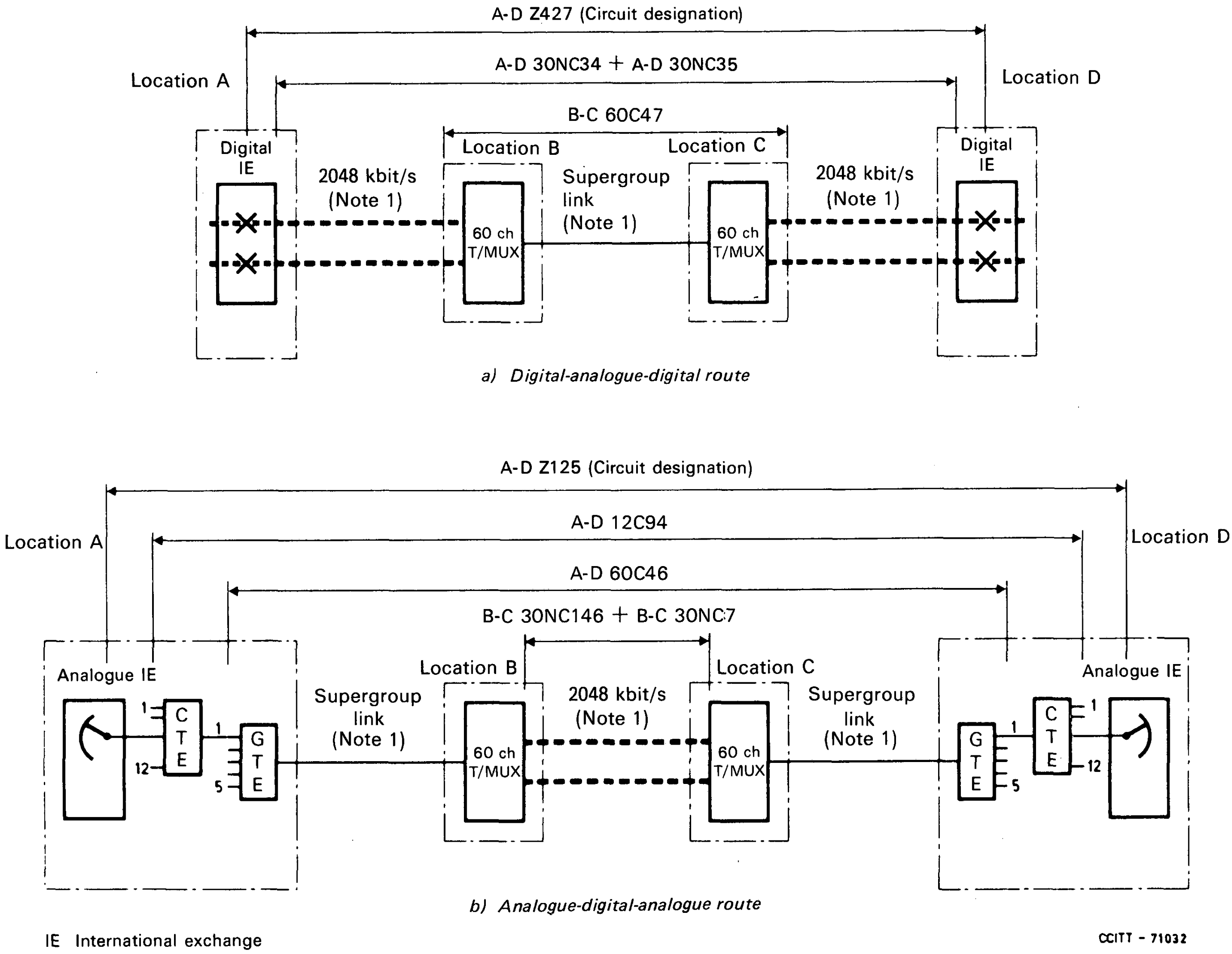
Note 1 – The conventional analogue designation is used.

Note 2 – The conventional digital designation is used.

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

FIGURE 2/M.140

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



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

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

FIGURE 3/M.140

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

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

The transmission planning rules given in Recommendation G.113, § 3 [11] 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 [12] 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.

10.4 *Related Information*

The additional information on groups and blocks in the mixed analogue/digital network is covered by the same items as analogue groups and digital blocks respectively. However the item 11, "End-to-end information" is used in addition (see §§ 7.11 and 12.11).

11 Designation of data transmission systems

11.1 *General*

This section deals with data transmission systems provided between the premises of Administrations. (Those between renters' premises are designated according to § 3.2.15 concerning digital leased circuits connecting two locations.)

The designation scheme of these data transmission systems can only be used if they are non-hierarchical or not formatted according to the Recommendations G.734, G.736, G.742, G.743, G.745, G.751, G.752, G.753 and G.754 [10]. This means that digital blocks from a digital multiplex hierarchy, with a format defined in Rec. G.702 [13] cannot have a designation taken from this section. They should be designated according to § 8.

Note – This section deals with digital transmission only. Analogue data transmission systems and links are covered by the sections treating circuits, groups and group links.

The format of designations of data transmission systems are shown in Table 7/M.140.

TABLE 7/M.140

Format of designation	Town A	/	Suffix for transmission station or international exchange (optional)	–	Town B	/	Suffix for transmission station or international exchange (optional)		Function code	Serial number
Signs	Characters	Slash	Letters/ digits	Hyphen	Characters	Slash	Letters/ digits	Space	Letters/ digits	Digits
Number of characters	⩽ 12	1	⩽ 3	1	⩽ 12	1	⩽ 3	1	⩽ 5	1-3

↑ No space

The elements of the format are as follows:

a) *Traffic relation*

Town A and town B, possibly with a transmission station or international exchange suffix, represent the two terminal stations of the data transmission system. The names are arranged in alphabetical order. For the spelling see § 1.1. If the town name exceeds the maximum length of 12 characters, the responsible Administration should supply a suitable abbreviation which must be unique (see § 0.1).

The transmission station or international exchange suffix (maximum 3 characters) is an optional field which may be used to further identify the terminal point when there is more than one carrier operating in the town. The necessity for a suffix and its form should be decided by the Administration operating the circuit in the town concerned.

b) *Function code*

This code consists of a 2 to 4 digits number which together with a letter showing the multiplication factor, indicates the bit rate.

The letters to be used to indicate the multiplication factor are:

Bit rate of system	*Letter*
Up to 999 bit/s	B
1 000 to 9 999 bit/s	H
10 000 to 9 999 999 bit/s	K
10 000 000 to 9 999 999 999 bit/s	M

c) *Serial number:*

This is a 1 to 3 digit number counting the number of data transmission systems with the same traffic relation and the same function code.

Note – The use of the data transmission system (e.g. multiplex of digital leased circuits, broadcasting, video) will be recorded in Related Information under item 9 (Use, see § 12.9.).

Example 1:

The first 9600 bit/s data transmission system between Lisboa and New York (for example in use for a multiplex of 2400 bit/s and 7200 bit/s circuits):

Lisboa – New York 96H1.

Example 2:

The eleventh 2048 kbit/s data transmission system between London and Paris (used, for example, for public video conference):

London – Paris 2048K11.

11.2 *Data transmission links*

Data transmission links are designated as data transmission systems.

11.3 *Related Information*

The additional information on data transmission systems is covered by the following items:

1. Urgency for restoration;
2. Terminal countries;
3. Administrations', carriers' or broadcasting companies' names;
4. Control and sub-control station(s);
5. Fault report points;
6. Routing;
7. Association;
8. Equipment information;
9. Use;
10. Transmission medium information;
11. Composition of transmission;
12. (Empty item, use: "– ;");
13. Occupancy;

The various items will be dealt with in § 12.

12 **Related information for international digital blocks, paths and data transmission systems**

The following sections explain the items of Related Information concerned with international digital blocks, paths and data transmission systems. Full examples for the designation information of an international digital block, an international digital path and an international data transmission system are given in Annex A, § A.4.

12.1 *Urgency for restoration (item 1)*

This item supplies information on the urgency of restoration of the block, path, etc. based upon bilateral agreement between the terminal Administrations.

Format:

1. xx .... xx; (maximum 10 characters)

Illustration:

a) If the priority is top: 1;
If the priority is second: 2;
If the priority is third: 3; or

b) If repair is required within e.g. 24 hours: $\leq$ 24 h; or

c) If no urgency has to be indicated: – ;

Example:

If a block needs top priority in the case of restoration:

1. 1;

12.2 *Terminal countries (item 2)*

This item presents the countries in which the block, path or data transmission system is terminating.

Format:

2. XXX, YYY; (3 characters for each) or 2. XXX;

Specification:

XXX: code for country of town A

YYY: code for country of town B

In the case of multiple destination unidirectional block, only XXX applies.

Note – The codes are according to ISO Standard 3166 [2].

Example:

For a digital block Bruxelles – Frankfurt 120N1:

2. BEL, DEU;

12.3 *Names of Administration, carriers or broadcasting companies (item 3)*

This item records the names of the carriers, etc. which operate the block, path, etc.

Format:

3. XXXXXX, YYYYYY; (maximum 6 characters for each) ou 3. XXXXXX;

Specification:

XXXXXX: name of company in town A

YYYYYY: name of company in town B

In the case of a multiple destination unidirectional block, only XXXXXX applies.

Example:

For a digital block Frankfurt – London 30N1 operated by British Telecom International and Deutsche Bundespost:

3. DBP, BTI;

12.4 *Control station (sub-control station(s)) (item 4)*

This item lists the appointed control station and sub-control stations (according to Recs. M.80 and M.90). Further details about the stations can be found in the list of contact points (Rec. M.93).

Format:

4. CS: designation of control station,
SCS1: designation of sub-control station,
SCS2: designation of sub-control station,
. . . . .
. . . . .
. . . . .
SCSn: designation of sub-control station,

or, in the case of a multiple destination unidirectional block:

4. CS: designation of control station.

Specification:

CS: designation of the control station,

SCS1: designation of the terminal sub-control station,

SCS2 to SCSn: if applicable: other sub-control stations, are to be placed in the geographical order according to the traffic relation.

In the case of a multiple destination unidirectional block, only CS applies.

Example 1:

For the digital block Stockholm – Venezia 30N1 with control station Stockholm and sub-control stations Venezia and Paris:

4. CS: Stockholm/HAM;
   SCS1: Venezia/CEN;
   SCS2: Paris/ARC;

Example 2:

For the digital block Rio de Janeiro – (MU) 30N1:

4. CS: Rio de Janei/1;

12.5 *Fault report points (item 5)*

This item presents the names of both fault report points on the block, path, etc. (according to Rec. M.130). Further details about the fault report points can be found in the list of contact points (Rec. M.93).

Format:

5. Designation of fault report point, Designation of fault report point;

or

5. Designation of fault report point;

Specification:

The first fault report point is the one of country of town A.

The second fault report point is the one of country of town B.

In the case of a multiple destination unidirectional block, the second station and the comma are omitted.

Example 1:

For the digital block Lisboa – Zuerich 30N1:

5. Lisboa/MAR, Zuerich/SEL;

Example 2:

For the digital block Jakarta – (MU) 30N1:

5. Jakarta/1;

12.6 *Routing (item 6)*

This item records the next higher block within the multiplex hierarchy on which the block path, data transmission system, has been routed and the position number, or in the case of the highest multiplex level, the transmission media on which the block has been routed.

Format:

6. Designation of an international block/position number or designation of transmission medium, Designation of an international block/position number or designation of transmission medium, . . ., Designation of an international block/position number or designation of transmission medium;

Note – Two consecutive unidirectional blocks are separated by a + sign instead of a comma.

Specification:

The designation of an international block refers to the next higher level in the digital multiplex hierarchy. If there are more than one, the blocks are noted in geographical order from town A to town B.

The designation of the transmission medium refers to the transmission medium leaving the country of town A and to the transmission medium entering the country of town B respectively.

As no CCITT designations of transmission media, nor digital line or radio sections are provided for the time being, the terminal countries should provide designations or agree on designations.

If there is only one transmission medium, the designation of this medium applies.

Example 1:

For the primary digital block Frankfurt – Zuerich 30N7:

6. Frankfurt – Zuerich 120N1/3;

Example 2:

For the block Bruxelles – London 1920N1, with transmission medium corresponding to submarine cable:

6. UK – B 5;

12.7 *Association (item 7)*

This item identifies whether there are associated blocks, paths, data transmission systems and if so, of which nature.

Format:

7. Association code: designation(s) of the associated block(s), path(s);

Specification:

If the block *has* a reserve block the association code is: S followed by the function code and the serial number of the principal block.

If the block *is* a reserve block: the association code is: function code followed by S and the serial number of the reserve block.

The same applies for digital paths and data transmission systems.

Example:

If the path Hongkong – Singapore 30N801 is the restoration path for the normal block Hongkong – Singapore 30N3, the Related Information for the normal block under Association must show:

7. S30N3: Hongkong – Singapore 30N801;

12.8 *Equipment informations (item 8)*

12.8.1 This item records information on equipment in the block, path, etc. which requires special maintenance attention.

Format:

8. XX, XX, XX, XX;

Specification:

If the block has been routed via TDMA: TD.

Note – If there is a need to record any additional equipment information, the next free codeplaces are available for that purpose. The codes to be used must consist of two characters, be unique and can be chosen by bilateral agreement between Administrations.

12.8.2 For data transmission systems this item supplies information about the multiplex configuration.

Format for data transmission systems only:

8. XXXXXXYYYYZZZZZ

Specification:

XXXXXX	refers to the Recommendation series,
YYYY	refers to the Recommendation number,
ZZZZZ	refers to the section, paragraph, table etc., number.

Example:

For a 9600 bit/s data transmission system with a multiplex configuration as defined in Table A-1/M.1320, item 8 will present:

8. Rec. M.1320TA-1;

12.9 *Use (item 9)*

This item identifies for what purpose the block, path, data transmission system is used (if this known by the Administration and of use for maintenance).

Format:

9. XXXXXX; (maximum 6 characters)

Specification:

XXXXXX refers to (among others) the designatory letters Z, B, D, V, etc., to indicate the use of the block. If no information is available, the sign – is used.

Example:

If the digital block Frankfurt – Luxembourg 30N1 is used for sound-programme transmission:

9. R;

12.10 *Transmision medium information (item 10)*

This item identifies whether a satellite is involved in the routing.

Format:

10. ST; or –;

Specification:

If the block has been routed via satellite: ST

If the block has not been routed via satellite: –

Example:

For the block Paris – (MU) 30N1:

10. ST;

12.11 *End-to-end information or composition of transmission (item 11)*

12.11.1 *End-to-end information (for blocks and paths on mixed analogue/digital routes only)*

This item provides information on the destinations of the traffic carried by the block or path.

Format:

11. X ... X, Y ... Y; (maximum 12 characters each) or –;

Specification:

X ... X and Y ... Y are the names of a town and refer to the destinations of the traffic on the block/path. The destinations are placed according to the order of towns in the traffic relation.

If the block has multiple destination the town name is replaced by the code: M.

If the block is within a digital environment X ... X, Y ... Y is replaced by the sign –.

Example 1:

For primary digital block Frankfurt – Paris 30NC6 carrying from Frankfurt – London:

11. Frankfurt, London;

Example 2:

For primary block Amsterdam – Bruxelles 30NC146 carrying traffic from London to Luxembourg:

11. London, Luxembourg;

12.11.2 *Composition of transmission (for data transmission systems)*

This item shows the type of transmission on the data transmission system.

Format:

11. A; N; or C;

Specification:

If the transmission is analogue: A

If the transmission is digital: N

If the transmission is mixed analogue/digital: C

12.12 *Bit rate (for blocks and paths) (item 12)*

This item shows the bit rate of the block or path.

Format:

12. xxxx.x kbit/s or Mbit/s;

Rules for the notation of the bit rate figures:

Leading zeros may be omitted and if the decimal is a zero, this decimal and the decimal sign may also be omitted.

If the figure is up to 9 999 999, use kbit/s.

If the figure is 10 000 000 or more, use Mbit/s.

Note – For data transmission systems, use the sign –.

Example 1:

For the digital block New York – Tokyo 24N2:

12. 1544 kbit/s;

Example 2:

For the digital block Bruxelles – Luxembourg 480N1:

12. 34 Mbit/s;

12.13 *Occupancy (for blocks and for data transmission systems) (item 13)*

This item lists the occupancy of the block expressed by the next lower blocks and/or circuits and/or data transmission systems which have been routed in the block.

Format in the case of a primary block:

(The same format applies to data transmission systems, replacing "time slot number" by "channel number" according to Recommendation M.1320 [14]).

. . . . . .
. . . . . .
. . . . . .

Time slot number: designation of the circuit, or the sign –;

Format in the case of a secondary or higher level block:

13. Position number: designation of a block, of a leased circuit, of a data transmission system or the sign –,

. . .
. . .
. . .

Position number: designation of a block, of a leased circuit, of a data transmission system or the sign –,

Specification:

If the position number is occupied by a next lower digital block: designation of this block.

If the position number is occupied by a digital leased circuit (with a bit rate corresponding to the bit rate of the next lower multiplex level): designation of this leased circuit.

If the position number is occupied by a data transmission system (with a bit rate corresponding to the bit rate of the next lower multiplex level): designation of this data transmission system.

If the position number is not in use: the sign –.

Example 1:

For the digital block Geneve – Paris 120N2:

13. 01: Geneve – Lisboa 30N1,
 02: –,
 03: Geneve – Paris 2048K1,
 04: Bruxelles – Wien 30N1;

Example 2:

For the digital block New York – Paris 24N5:

13. 01: New York/24 – Paris/PT2 Z1,
    02: New York/24 – Paris/PT2 Z3,
    03: New York/24 – Paris/PT2 Z5,
    04: Paris/PT2 – New York/24 Z2,
    05: Paris/PT2 – New York/24 Z4,
    06: Paris/PT2 – New York/24 Z6,
    07: –,
    08: –,
    09: –,
    10: Orlando/TS1 – Toulouse/FER 64K1,
    11: –,
    12: –,
    13: –,
    14: –,
    15: New York/TS1 – Paris/ARC R1,
    16: New York/TS1 – Paris/ARC R3,
    17: –,
    18: –,
    19: –,
    20: Paris/BEA – Washington/TS1 NP1,
    21: –,
    22: –,
    23: –,
    24: –,

12.14 *Actual number of channels (primary blocks only) (item 14)*

This item contains the actual number of channels on a primary digital block.

Format:

14. xxx;

Specification:

xxx indicates the actual number of channels.

For higher blocks xxx is replaced by the sign –.

Example 1:

For the digital block New York – Paris 30N5 dedicated to leased circuits:

14. 31;

Example 2:

For the digital block London – New York 30N3 used for switched public telephone circuits with ADPCM, the information may be:

14. 60;

Example 3:

For the digital block Honolulu – Osaka 24N2 used for switched public telephone circuits:

14. 24;

12.15 *Clocking information (for blocks only) (item 15)*

This item specifies whether Administrations apply a clocking system according to Rec. G.811 [15] or use a master/slave system.

Format:

15 XX ... XX; (maximum 30 characters)

Specification:

If clocking according to Rec. G.811 is applied: Rec. G.811;

If a master/slave clocking is applied:

M = XX ... XX, S = XX ... XX;

(Town name for the master) (Town name for the slave)

Example 1:

Clocking according to Rec. G.811:

15. Rec. G.811;

Example 2:

Clocking according to Master/Slave system:

15. M = London, S = Frankfurt;

12.16 *Direction of transmission (for unidirectional blocks) (item 16)*

This item gives information on the direction of transmission of a unidirectional digital block.

Format:

16. I; or A;

Specification:

If the block is unidirectional and if it has a single destination:

– if the direction of transmission is in alphabetical order A;
– if the direction of transmission is in inverse alphabetical order I;

Example:

For the unidirectional digital block London-Roma 30N1 transmitting in the direction Roma to London:

16. I;

ANNEX A

(to Recommendation M.140)

Full examples for designation information

A.1 *Full example for the designation information of a public switched telephone circuit*

The circuit is the 604th both-way telephone circuit between Sherman Oaks 4ES and Tokyo Shinjuku, operated by AT&T and KDD. The signalling type is CCITT No. 6 with band/circuit number assigned as 000/03. The control station and sub-control station of the circuit are Sherman Oaks-transmission station 1 and Tokyo-transmission station 1 respectively. Both stations are also the fault report points of the circuit. The circuit has been routed on the 4th channel of the first group between Sherman Oaks and Ibaraki which is routed via satellite and has been connected to digital blocks in domestic networks.

Designation:

Sherman Oaks/4ES – Tokyo/SJK B604

Related Information:

1. 2;
2. USA, JPN;
3. ATT, KDD;
4. CS: Sherman Oaks/TS1,
   SCS1: Tokyo/TS1;
5. Sherman Oaks/TS1, Tokyo/TS1;
6. Ibaraki – Sherman Oaks 12CO1/4;
7. –;

8. – ;
9. – ;
10. ST;
11. C;
12. 3.4 kHz;
13. C6, 000/03.

A.2 *Full example for the designation information of a leased analogue circuit*

The circuit is the first analogue leased circuit used for data transmission between London and Frankfurt, operated by British Telecom International and the Deutsche Bundespost. The signalling type is 500 Hz/20 Hz. The control station and sub-control station of the circuit are London Mollison and Frankfurt 0 respectively. Both stations are also the fault report points of the circuit. The circuit is routed on the 3rd channel of the first group between Frankfurt and London. As regards the parameters of the circuit, Recommendation M.1020 [9] is applied. The maintenance contract between Administrations and customer is repair within 24 hours.

Designation:

Frankfurt – London DP1.

Related Information:

1. ≤ 24 h;
2. DEU, GBR;
3. DBP, BTI;
4. CS: London/SM,
   SCS1: Frankfurt/0;
5. Frankfurt/0, London/SM;
6. Frankfurt – London 1201/3;
7. – ;
8. – ;
9. D;
10. – ;
11. A;
12. 3.4 kHz;
13. 500/20;
14. Rec. M.1020.

A.3 *Full examples for the designation information of an international group and an international group links*

A.3.1 *Full example for the designation information of an international group*

Note – The numbers between parentheses refer to the numbers of the items in the Related Information.

The international group is the fifth group between Amsterdam and Paris. The urgency for restoration (1) is 3rd priority, the terminal countries (2) are Netherlands and France, the Administrations involved (3) are Netherlands PTT and France Telecom, the control station and sub-control station (4) are Paris Archives and Amsterdam 1 respectively, the fault report points (5) are Amsterdam 2 and Paris Archives, the routing (6) of the group is in the supergroup Amsterdam – Bruxelles 6011 on position 1 and in the supergroup Bruxelles – Paris 6002 on position 3, there is an associated group (7) carrying traffic but indicated for restoration namely Amsterdam – Paris 1209, there is special equipment involved (8) because the group is carrying companded circuits, the use (9) is: Z-circuits and a DP circuit, no satellite (10) is involved, no end-to-end information (11) is to be recorded, the bandwith (12) is 48 kHz and the occupancy (13) is to be seen from the example.

Designation:

Amsterdam – Paris 1205

Related Information:

1. 3;
2. NLD, FRA;
3. NLDPTT, FRATEL;
4. CS: Paris/ARC,
   SCS1: Amsterdam/1;
5. Amsterdam/2, Paris/ARC;
6. Amsterdam – Bruxelles 6011/1,
   Bruxelles – Paris 6002/3;
7. S1205: Amsterdam – Paris 1209;
8. CO;
9. Z, DP;
10. –;
11. –;
12. 48 kHz;
13. 01: Amsterdam – Paris Z111,
    02: Amsterdam – Paris Z113,
    03: Amsterdam – Paris Z115,
    04: Amsterdam – Paris Z117,
    05: Amsterdam – Paris Z119,
    06: Amsterdam – Paris Z121,
    07: Paris – Amsterdam Z120,
    08: Paris – Amsterdam Z122,
    09: Paris – Amsterdam Z124,
    10: Paris – Amsterdam Z126,
    11: Paris – Amsterdam Z128,
    12: Amsterdam – Paris DP5,

A.3.2 *Full example for the designation information of an international group link*

Note – The numbers between parentheses refer to the numbers of the items in the Related Information.

The link is the first restoration group link between Paris and Geneve. The urgency for restoration (1) is 3rd priority, the terminal countries (2) are Switzerland and France, the Administrations (3) are Swiss PTT and France Telecom, the control and sub-control stations (4) are Geneve Monthoux and Paris Archives respectively, the fault report points (5) are the same stations, the routing (6) is in the second supergroup between Geneve and Annemasse on position 1, there is no information to be recorded about association (7), special equipment (8), use (9), there is no satellite involved (10), no end-to-end information (11) is required, the bandwith (12) is 48 kHz.

Designation:

Geneve – Paris 12801

Related Information:

1. 3;
2. CHE, FRA;
3. CHEPTT, FRATEL;
4. CS: Geneve/MON,
   SCS1: Paris/ARC;
5. Geneve/MON, Paris/ARC;
6. Annemasse – Geneve 6002/1;
7. –;
8. –;
9. –;
10. –;
11. –;
12. 48 kHz;

A.4 *Full examples for the designation information of an international digital block, digital path and data transmission system*

A.4.1 *Full examle for the designation information of an international digital block*

Note – The numbers between parentheses refer to the numbers of the items in the Related Information.

The international digital block is the 12th primary digital block between Roma and Paris. The urgency for restoration (1) is 2, the terminal countries (2) are France and Italy, the Administrations involved (3) are France Telecom and ASST, control station (4) is Roma 1 and sub-control station is Paris Archives, the fault report points (5) are the same stations, the block has been routed (6) in the secondary digital block Paris – Roma 120N2 on position number 3, it has an associated block (7) indicated for restoration: Paris – Roma 30N5, no special equipment (8) is involved, the use of the block (9) is DP- and NP-circuits, no satellite is involved (10), no end-to-end information (11) is required, the bit rate (12) is 2.048 Mbit/s, the occupancy (13) is seen in the example, the actual number of channels (14) is 31, the clocking system (15) is a master/slave system with the master in Paris and the slave in Roma.

Designation:

Paris – Roma 30N12

Related Information:

1. 2;
2. FRA, ITA;
3. FRATEL, ASST;
4. CS: Roma/1,
   SCS1: Paris/ARC;
5. Paris/ARC, Roma/1;
6. Paris – Roma 120N2/3;
7. S30N12: Paris – Roma 30N5;
8. –;
9. DP, NP;
10. –;
11. –;
12. 2048 kbit/s;
13. 01: London – Roma DP12,
    02: Paris – Roma DP2,
    03: Napoli – Rouen NP1,
    04: Paris – Roma NP3,
    05: Paris – Roma NP4,
    06: Paris – Roma NP5,
    07: –,
    08: –,
    09: –,
    10: Lille – Roma DP1,
    11: Paris – Roma DP5,
    12: –,
    13: –,
    14: –,
    15: –,
    16: Bruxelles – Roma DPM4,
    17: Paris – Roma NPM1,
    18: –,
    19: –,
    20: –,
    21: –,
    22: –,
    23: –,

24: –,
25: –,
26: –,
27: –,
28: –,
29: –,
30: –,
31: –;

14. 31;
15. M = Paris, S = Roma;

A.4.2 *Full example for the designation information of an international digital path*

Note – The numbers between parentheses refer to the numbers of the items in the Related Information.

The international digital path is the first restoration digital second order path between Paris and Bruxelles. The urgency for restoration (1) is 3, the terminal countries (2) are Belgium and France, the Administrations involved (3) are the Belgium RTT and France Telecom, control station (4) is Bruxelles BLA and sub-control station is Paris Archives, the fault report points (5) are the same stations, the path has been routed (6) in the first third order block Bruxelles – Paris on position number 1, there are no associated blocks (7), no special equipment (8), use (9) has not been indicated, no satellite is involved (10), no end-to-end information (11) is required, the bit rate (12) is 8.448 Mbit/s.

Designations:

Bruxelles – Paris 120N801

Related Information:

1. 3;
2. BEL, FRA;
3. BELRTT, FRATEL;
4. CS: Bruxelles/BLA,
   SCS1: Paris/ARC;
5. Bruxelles/BLA, Paris/ARC;
6. Bruxelles – Paris 480N1/1;
7. –;
8. –;
9. –;
10. –;
11. –;
12. 8448 kbit/s;

A.4.3 *Full example for the designation information of an international data transmission system*

Note – The numbers between parentheses refer to the numbers of the items in the Related Information.

The international data transmission system is the first 64 kbit/s data transmission system between London and Paris. The urgency for restoration (1) is 1, the terminal countries (2) are United Kingdom and France, the Administrations involved (3) are British Telecom International and France Telecom, the control and sub-control stations (4) are London Mollison and Paris Archives respectively, the fault report points (5) are the same stations, the system has been routed (6) in the 12th primary block between Paris and London on timeslot number 3, there is no information to be recorded about association (7), equipment information (8) and use (9), there is no satellite involved (10), composition of transmission (11), is digital, item (12) does not apply, the occupancy (13) is seen in the example.

Designation:

London – Paris 64K1

Related Information:

1. 1;
2. GBR, FRA;
3. BTI, FRATEL;

4. CS: London/SM,
   SCS1: Paris/ARC;
5. London/SM, Paris/ARC;
6. London – Paris 30N12/3;
7. – ;
8. – ;
9. – ;
10. – ;
11. N;
12. – ;
13. A4: London – Paris NP12,
    B4: London – Toulouse NP3,
    C4: – ;
    D4: Dublin – Paris NP6,
    E4: London – Paris NP11,
    F4: London – Paris NP14;

ANNEX B

(to Recommendation M.140)

Reference section numbers for the various types of routes

Section	*Type of international route*
1.2.2	Telephone circuits used in manual operation
1.2.3	One-way telephone circuits used for semi-automatic or automatic operation
1.2.4	Both-way telephone circuits used for semi-automatic or automatic operation
1.3	Circuits used for switched telex and telegraph service
1.4	Circuits in the international public switched data network
3.2.2	Analogue leased circuit used for telephony
3.2.3.1	Analogue circuits used for voice-frequency telegraphy
3.2.3.2	Analogue leased circuits used for TDM-telegraphy
3.2.4	Leased telegraph circuits
3.2.5	Analogue leased circuits used for data transmission
3.2.6	Analogue leased circuits used for phototelegraphy or facsimile
3.2.7.1	Analogue leased unidirectional sound-programme transmission circuits
3.2.7.2	Analogue leased reversible sound-programme transmission circuits
3.2.8.1	Analogue leased unidirectional television-programme circuits
3.2.8.2	Analogue leased reversible television-programme circuits
3.2.9	Leased circuits used for digital video transmission
3.2.10	Analogue leased circuits connecting circuit multiplication terminal equipment at renters' premises
3.2.11	Analogue leased circuits used for combinations of transmissions, etc.
3.2.12	Analogue leased circuits connecting three or more locations
3.2.13	Leased analogue groups, supergroups, etc.
3.2.14	Leased analogue group, supergroup links
3.2.15	Digital leased circuits connecting two locations
3.2.16	Digital leased circuits connecting three or more locations

3.3.2.1 Public circuits used for unidirectional sound-programme transmission

3.3.2.2 Public circuits used for reversible sound-programme transmission

3.3.2.3 Public circuits used for narrow-band sound-programme transmission

3.3.3.1 Public circuits used for unidirectional television transmission

3.3.3.2 Public circuits used for reversible television transmission

3.3.4 Public circuits for digital audio and video transmission

3.3.5 Public telephone-type circuits used for phototelegraphy or facsimile

3.3.6 Telephone-type circuits used to provide voice-frequency telegraph links

3.3.7 Telephone-type circuits used to provide time division multiplex telegraph systems

3.3.8 Telephone-type circuits used for data transmission

3.3.9 Telephone-type circuits used as transfer links for common channel Signalling Systems Nos. 6 and 7

5.2.1 Groups (bidirectional)

5.2.2 Supergroups (bidirectional)

5.2.3 Mastergroups (bidirectional)

5.2.4 Supermastergroup (bidirectional)

5.2.6 Restoration groups and supergroups (bidirectional)

5.3.1 Multiple destination unidirectional groups and supergroups

5.3.2 Single destination unidirectional groups and supergroups

6.1.1 Conventional group and supergroup links

6.1.2 Restoration links

6.2 Line links

8.2 Bidirectional digital blocks

8.3 Restoration digital blocks

8.4 Multiple destination unidirectional digital blocks

8.5 Single destination unidirectional digital blocks

9.1 Conventional digital paths

9.2 Restoration digital paths

10.1.1 Groups and supergroups, etc. on a mixed analogue/digital route

10.1.2 Digital blocks and paths on a mixed analogue/digital route

10.2 Routes with two analogue-to-digital conversions

11.1 Data transmisssion systems

11.2 Data transmission links

References

[1] CCITT Recommendation *Terms and definitions of traffic engineering*, Vol. II, Rec. E.600.

[2] ISO International standard 3166 *Codes for the representation of names of countries*, Second edition, 1981.

[3] CCITT Recommendation *Designation of international telegraph circuits*, Vol. VI, Rec. R.70.

[4] CCITT Recommendation *Lining up an international miltiterminal leased circuit*, Vol. IV, Rec. M.1055.

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

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

[7] CCITT Recommendation *Preliminary exchange of information for the provision of international leased circuits*, Vol. IV, Rec. M.1045.

[8] CCITT Recommendation *Signalling systems to be used for international normal and automatic working on analog leased circuits*, Vol. VI, Rec. Q.8.

[9] CCITT Recommendation *Characteristics of special quality international leased circuits with special bandwidth conditioning*, Vol. IV, Rec. M.1020.

[10] CCITT Recommendations concerning the *Specification of primary, secondary and higher order digital multiplex equipment*, Vol. III, Rec. G.731 to G.755.

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

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

[13] CCITT Recommendation *Digital hierarchy bit rates*, Vol. III, Rec. G.702.

[14] CCITT Recommendation *Numbering of channels in data transmission systems*, Vol. IV, Rec. M.1320.

[15] CCITT Recommendation *Timing requirements at the outputs of reference clocks and network nodes suitable for plesiochronous operation of international digital links*, Vol. III, Rec. G.811.

Recommendation M.160

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:

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

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

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

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.

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.490).

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 had 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] CCITT Supplement *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] CCITT Supplement *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.

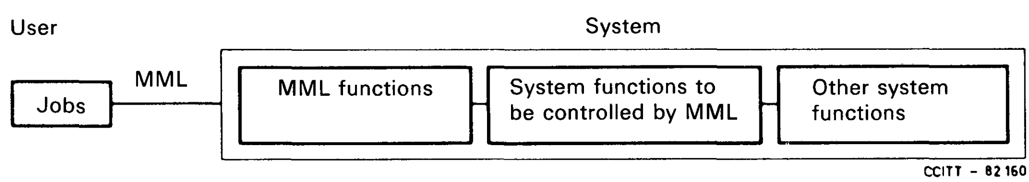


FIGURE 1/M.250

1) 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.

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.

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

Recommendation M.251

MAINTENANCE FUNCTIONS TO BE IMPLEMENTED IN CCITT-MML[1)]

1 Introduction

This Recommendation identifies the maintenance functions to be controlled by means of the CCITT-MML.

The CCITT-MML (man-machine language) is intended to handle the functions required to manage telecommunication systems, e.g. via a telecommunication management network (TMN) (see Recommendation M.30). The man-machine interface (MMI) enables the exchange of information between users and systems encoded in MML.

Interaction between the users and the controlled systems is based on a repertoire of inputs, outputs, special actions and man-machine interaction mechanisms, including dialogue procedures.

This Recommendation deals with the specification and control of maintenance functions. The tests appropriate to particular maintenance functions remain as described in the relevant M-series Recommendations.

When defining MML-functions the tasks which need to be performed (jobs) are first identified, in order to derive system functions to be controlled.

The relationship between jobs, system functions and MML-functions is described in § 1.2 of Recommendation M.250.

For each system function, one or more MML-functions are derived. Each MML-function is then described using the "meta-language" defined in Recommendation Z.333 [1], which permits the information structure to be defined in detail[2)]. MML-functions do not necessarily represent the actual command structure of any real implementation of the man-machine language.

Each of the MML-functions could be implemented by providing a separate and distinctive command, or several MML-functions could be implemented using a single command.

2 System functions

System functions can often be categorized and divided to break down a task and simplify the implementation and control of such functions by the use of MML.

An example showing the generalized functional architecture for a TMN is given in Figure 1/M.251. The MML will be implemented at the g reference point.

Maintenance functions are related to the network element functions, as well as to the TMN general functions and TMN application functions as defined in Recommendation M.30.

This complex of maintenance functions are to be described in two ways:

i) on the basis of the "maintenance phases" of Recommendation M.20;

ii) the rest (under study).

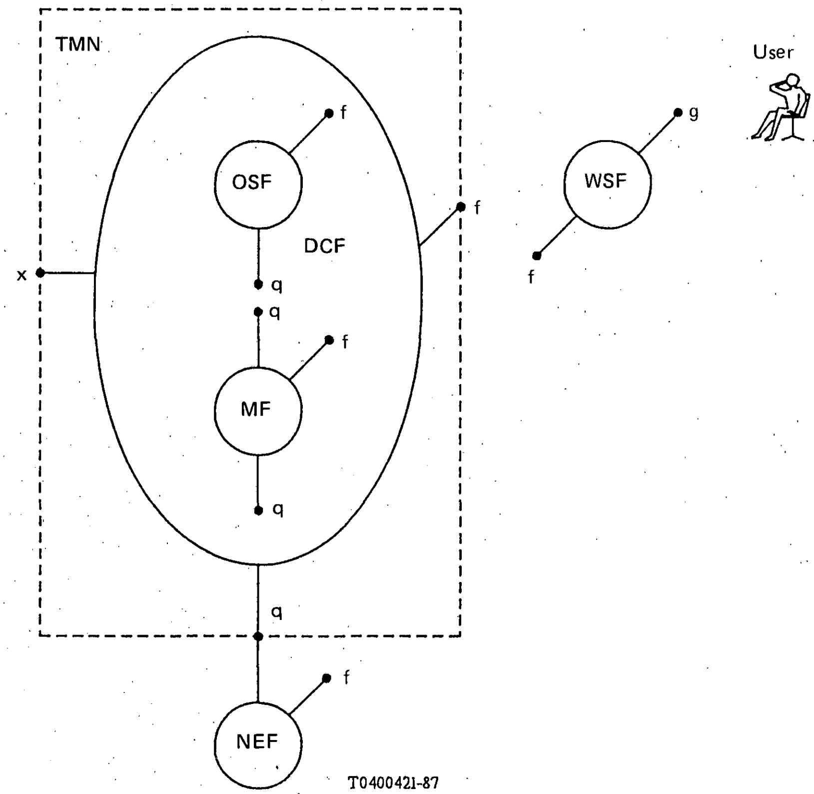
3 Scope

The term "maintenance" covers all aspects which have to do with failures, such as supervision, detection, localization, information, repair, etc.

The general concepts and philosophy are fully described in Recommendation M.20. The description of the maintenance functions on the basis of Recommendation M.20 has the advantage that general descriptions of the various maintenance activities are obtained, valid for all network elements. In this case no separate descriptions for maintenance of "terminals", "subscriber lines", "exchanges", "lines between exchanges", etc. are necessary.

1) This Recommendation is not yet complete, a number of items are for continuing studies.

2) For further studies, other methodologies than those described in Z.333 [1] may be considered.



Reference points:

q Class of reference points between OS, M and NE functions
f Class of workstation reference points
g Class of workstation to user reference points
x Class of reference points to other networks, including other TMNs

Function blocks:

WSF Workstation function
OSF Operations system function
MF Mediation function
NEF Network element function
DCF Data communication function

FIGURE 1/M.251

Generalized functional architecture
(Diagram derived from Figure 2/M.30)

4 Maintenance functions in the various maintenance phases

The maintenance functions and their relationship to the maintenance phases, defined in § 4 of Recommendation M.20, are listed in Table 1/M.251.

These maintenance functions have to be described; the status of these descriptions are given below:

4.1 *Failure detection*

4.1.1 *Continuous checking* (see Note)

4.1.2 *Routine or periodic testing* (see Note)

4.1.3 *Checking in live traffic* (see Note)

4.1.4 *Checking in absence of live traffic* (see Note)

TABLE 1/M.251

Maintenance phases	Maintenance functions
1 Failure detection	1.1 Continuous checking 1.2 Routine or periodic testing 1.3 Checking in live traffic 1.4 Checking in absence of live traffic
2 System protection	
3 Failure information	
4 Failure localization	4.1 Assembling alarm messages 4.2 Request for failure information 4.3 Test/Measurement 4.4 Setting of loops
5 Failure correction	
6 Verification	6.1 Test/Measurement
7 Restoration	7.1 Deblocking

4.2 *System protection* (under study)

4.3 *Failure information* (under study; e.g. change of alarm levels)

4.4 *Failure location*

4.4.1 *Assembling alarm messages* (under study)

4.4.2 *Request for failure information* (under study)

4.4.3 *Test/measurement* (see Note)

4.4.4 *Setting of loops* (under study)

4.5 *Failure correction* (under study)

4.6 *Verification*

4.6.1 *Test/measurement* (see Note)

4.7 *Restoration*

4.7.1 *Deblocking* (under study)

Note – As far as these functions are controlled by MML, they are covered by Annex A (whether the totality has been covered is still under study).

5 Other maintenance functions

The maintenance functions in the areas of support of maintenance, of failure statistics and of preventive maintenance are under study.

6 Relation to Recommendation Z.331 "Maintenance functions"

In Recommendation Z.331 [2], a list is given of maintenance functions. Items of that list which are covered, in a general way, by this Recommendation are listed in Table 2/M.251.

TABLE 2/M.251

Maintenance functions	Covered in this Recommendation
Maintenance of subscribers' lines	
Testing one subscriber line and associated equipment	Yes
Testing a group of subscriber lines and associated equipment	Yes
Measuring one subscriber line and associated equipment	Yes
Measuring a group of subscriber lines and associated equipment	Yes
Blocking or unblocking a subscriber line for maintenance	Under study
Observing or supervising subscriber lines and equipment	Under study
Maintenance of circuits between exchanges and associated equipment	
Testing/Measuring one or group circuit(s) and associated equipment	Yes
Observing and supervising circuit(s) and associated equipment	Under study
Control the status of one or group circuit(s)	Under study
Analyzing maintenance data	Under study
Administering and controlling maintenance reports	Under study
Switching network maintenance	
Making test calls	Yes
Initiating a call trace	Yes
Holding faulty connections	Under study
Testing and measuring peripheral equipment	Yes
Testing and measuring switching units	Yes
Reducing service for low priority subscribers	Under study
Setting up a connection via a specific path	Under study
Supervising and measuring the Quality of Service	Yes
Localizing faults in the speech path	Yes
Providing access for traffic observations for maintenance	Under study
Reporting alarms	Under study
Recording switching unit status	Under study
Control system maintenance	
Reporting system status	Under study
Reporting alarms	Under study
Localizing faults	Yes
Testing on a functional basis after repair	Yes
Initiating periodic testing operations	Yes
Changing system configuration for maintenance	Under study
Checking consistency of data	Under study
Initiating restart	Under study
Setting traps for programme faults tracing	Under study
Changing memory contents	Under study
Memory dumping for maintenance purposes	Under study
Controlling overload parameters	Under study
Changing the criteria for degradation of service	Under study
Reducing service for low-priority subscribers	Under study

7 Description of maintenance functions in annexes to this Recommendation

Annex A – General description of maintenance tests/measurements

Annex B – General description of failure information (under study)

Annex C – Protection, restoration (under study)

Annex D – Support of maintenance (under study).

ANNEX A

(to Recommendation M.251)

General description of maintenance tests/measurements

A.1 *Introduction*

One of the purposes of maintenance is to detect, localize and repair failures.

Failures can be detected by means of different methods, one of them being tests/measurements.

The following description of tests/measurements is valid for all objects in a network. An object being defined for this purpose is anything in the network upon which a test/measurement can be performed.

This description has been made according to Recommendation Z.332 [3].

A.2 *Tests and measurements*

A.2.1 *Document A*

A.2.1.1 *Introduction*

Maintenance tests and/or measurements may be performed on a demand and routine basis, according to the maintenance strategies.

A.2.1.2 *List of class B functions*

A.2.1.2.1 *Tests/measurements*

A.2.1.3 *List of jobs*

A.2.1.3.1 *Plan a routine test/measurement*

- The purpose of the job is to create (or change) a list of tests and test programmes containing all of the data necessary for the test/measurements to be run successfully and to identify the objects on which the tests/measurements are to be run.
- The system is supposed to record all of the necessary data and create (or change) required test/measurement sets.
- The user is supposed to introduce all the data needed.
- The complexity of the job may be high depending on the amount of data to be introduced.
- The frequency of the job is very low.
- The job is supposed to be performed at network and/or OMC level.

A.2.1.3.2 *Define/change/delete the schedule of routine tests/measurements*

- The purpose of the job is to schedule new (or change/delete existing) routine tests/measurements depending on the number and types of objects to be tested/measured and the availibility of test equipment and test functions.
- The system is supposed to schedule (or change/delete) the requested tests/measurements according to the schedule input by the user.

- The user is supposed to input the test/measurement types and related data (test/measurement sets information) and time parameters, such as start time, stop time, etc., in order to obtain the required schedule.
- The complexity of the job is medium.
- The frequency of the job is low.
- The job is supposed to be performed at network and/or OMC level.

Note – Change of the schedule may be done by a combination of deleting the schedule in use and defining a new one.

A.2.1.3.3 *Activate the execution of routine tests/measurements*

- The purpose of the job is to perform a routine test/measurement according to a specified schedule. This allows the verification on a routine basis of the correct functioning of one or more objects.
- The system is supposed to perform the tests/measurements according to the specified schedule. The results may be stored within the system for later analysis and/or output or routed to a designated hardcopy device. The system may also be required to provide an output error message if it is unable to perform some of the requested tests/measurements.
- The user may be required to input variables such as schedule identity, start time, stop time and a start point for a series of tests/measurements.
- The complexity of the job is low.
- The frequency of the job is medium.
- The job is supposed to be performed at network and/or OMC level.

A.2.1.3.4 *Stop/suspend the execution of a certain routine test/measurement*

- The purpose of the job is to stop/suspend the execution of the test/measurement before the scheduled stop time.
- The system is supposed to stop/suspend the execution of the test/measurement according to the time data introduced by the user.
- The user is supposed to introduce the identity of the test measurement to be stopped/suspended and the time data of the actual stop/suspension.
- The complexity of the job is low.
- The frequency of the job is low.
- The job is supposed to be performed at network and/or OMC level.

A.2.1.3.5 *Activate the execution of on-demand tests/measurements*

- The purpose of the job is to perform on-demand tests/measurements on one or more objects in order to verify the correct functioning of the object(s).
- The system is supposed to perform the actions requested on the specified objects as soon as possible. As many of the system parameters as possible should be system resident. The results may de displayed to the user, stored within the system and/or routed to hardcopy devices depending on the routing control information. The system should output an error message (or code) if it is unable to perform the requested test/measurement.
- The user is supposed to input the type of the test/measurement and the identities of the objects to be tested/measured. The user may also have to input relevant parameters. These would normally be modifications of the system resident default values for a particular test/measurement execution (e.g., the number of times the test/measurement is retried).
- The complexity of the job is low, unless the user has to input a large number of parameters values.
- The frequency of the job is high.
- The job is supposed to be performed at network and/or OMC level.

A.2.1.3.6 *Delete one or more obsolete test/measurement data*

- The purpose of the job is to delete the data related to a certain test/measurement component which are of no more interest.
- The system is supposed to delete the specified data, providing the necessary safety strategies.
- The user is supposed to specify the identity of the data to be deleted.

- The complexity of the job is low.
- The frequency of the job is low.
- The job is supposed to be performed at network and/or OMC level.

A.2.1.3.7 *Retrieve relevant data of tests/measurements*

- The purpose of the job is to retrieve information on the tests and/or measurements that are currently defined in the system.
- The system is supposed to provide to the user the requested information.
- The user is supposed to identify the requested information.
- The complexity of the job is low.
- The frequency of the job is high.
- The job is supposed to be performed at network and/or OMC level.

A.2.1.3.8 *Retrieve the results of tests and/or of measurements already performed*

- The purpose of the job is to retrieve the recorded results in order to examine them.
- The system is supposed to provide to the user the requested information.
- The user is supposed to introduce the identity of the items to be displayed.
- The complexity of the job is low.
- The frequency of the job is high.
- The job is supposed to be performed at network and/or OMC level.

A.2.2 *Document B*

A.2.2.1 *Introduction*

The model in Figure A-1/M.251 describes in a general (function independent) way those system functions called tests/measurements which can be controlled by the user by means of MML functions.

This model can be applied to measurements as well as to tests for maintenance purposes.

A.2.2.2 *Maintenance test/measurement model*

A.2.2.2.1 *Test/measurment elements*

A test/measurement is identified by three basic elements: time, entities, objects (when, what, where).

Time includes all necessary information to define the start, the duration and periodicity of a certain test/measurement.

Entities describe the quantities for which data collection must be performed with a certain test/measurement, e.g. loss, noise, gain/slope, signalling performance, etc.

Objects are intended as individual items within each object type on which the tests/measurements are performed. Examples of objects types are circuits, group of circuits, transmission equipment, facilities, etc.

A.2.2.2.2 *Test/measurement matrix*

The definition of tests/measurements is based on an abstract model which contains the definition of a test/measurement matrix (see Figure A-1/M.251), in which each row represents one uniquely definable entity, e.g. transmission loss/noise test, and each column represents a uniquely definable object type, e.g. a group of circuits, a destination.

A certain combination of entities and object types corresponds to certain entities in the test/measurement matrix and forms a test/measurement type.

It is recognized that part of these test/measurement types may be standardized while the rest of them could be system and/or administration dependent. It should be noted that not all the entries in the test/measurement matrix can be used because some of them will be meaningless (e.g. signalling tests on incoming circuits).

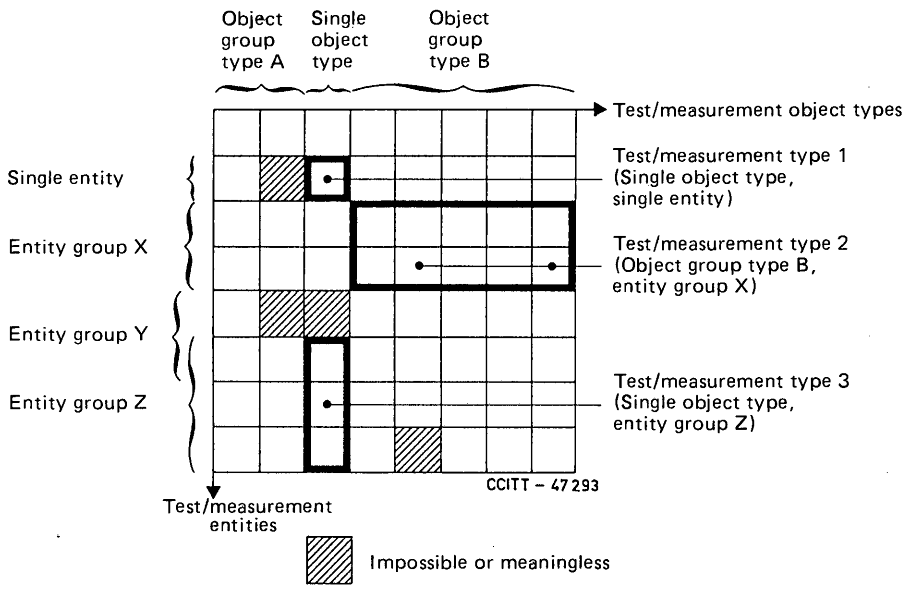


FIGURE A-1/M.251

Test/measurement matrix

A single object is defined by its type and/or its individual object identity. In some test/measurement types the number of the objects is fixed, in other types one can choose, for the actual test/measurement, some or all the allowed objects by means of administration MML commands. Chosen (selected) objects form an object list.

The object identity contains all necessary information to identify the address of the object in any part of the network (e.g. node-address, exchange-address, etc.).

The structure of division of object types and entities is open-ended in such a way that any new object type or entity may be added.

If the start of a test/measurement is instantaneous, it can also be called "on-demand" or "one-shot" test/measurement.

A.2.2.2.3 *Basic categories of tests/measurements*

Two basic categories of tests/measurements are envisaged (see Figure A-2/M.251). The category A is a test/measurement of undetermined duration while the category B is intended to be performed only for a predetermined duration.

The start of a test/measurement may be intended as instantaneous or delayed for a defined time duration Δt_1 from the activation of the measurement. Since the stop time of a measurement of category. A is not given when the test/measurement is activated or created, it has to be given during the test/measurement unless the test/measurement is intended to go on forever.

When deactivation is requested, there may be a defined delay of Δt_2 before the test/measurement is stopped. In the creation of a test/measurement, a start time optionally be provided, in which case for that particular test/measurement, the activation function is not necessary.

Time parameters needed to control a test/measurement can be divided into three groups:

1) test/measurement type dependent time parameters (interval parameters of a test/measurement type, e.g repeat test interval)[3];
2) test/measurement dependent time parameters (e.g. time parameters which define the periodicity of test measurement). These parameters refer always to relative time or specific dates;
3) test/measurement independent time parameters (e.g. time parameters which are related to the actual start or stop of a certain test/measurement in activation and deactivation functions).

[3] A repeat test interval is the minimum time interval before the repetition of a test can be attempted.

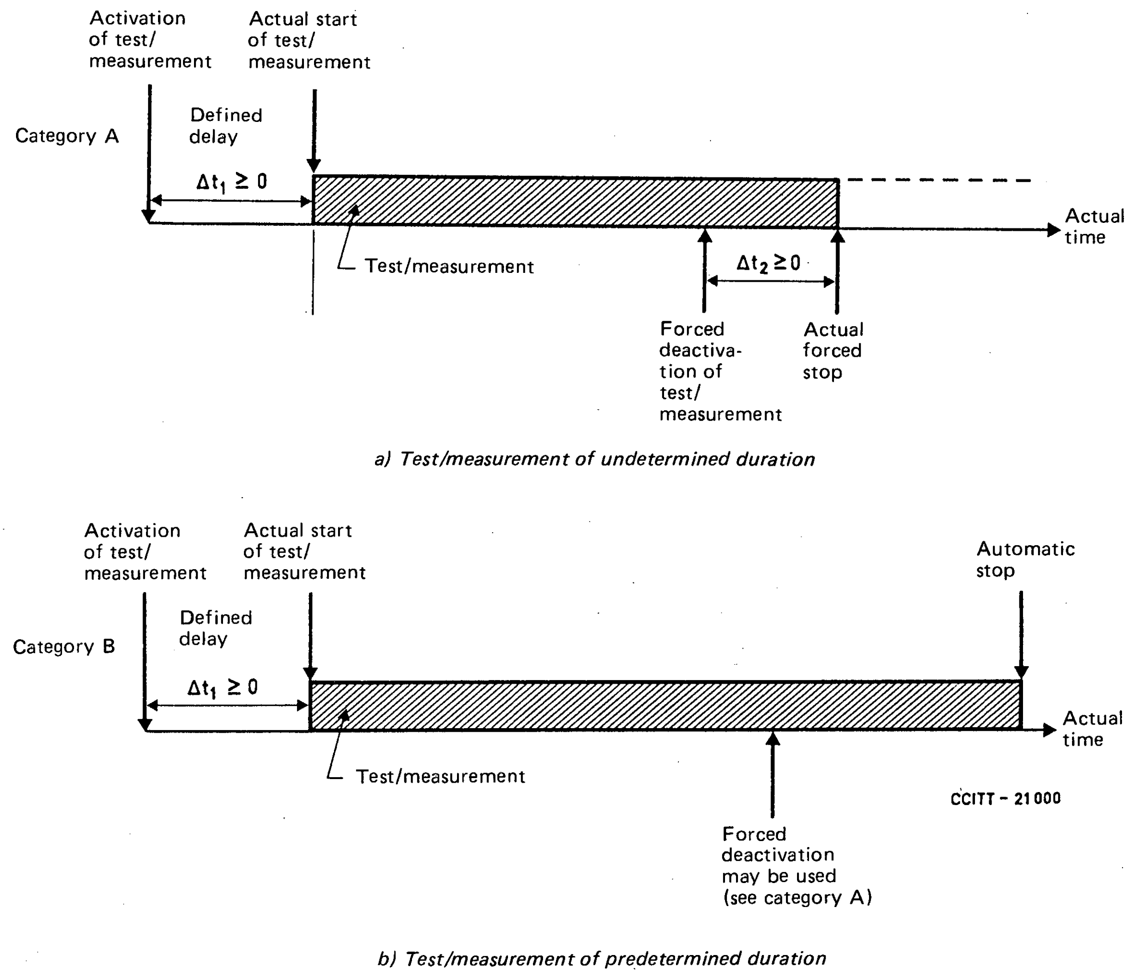


FIGURE A-2/M.251

Basic categories of tests/measurements

A.2.2.2.4 *Structure of a test/measurement*

A test/measurement consists of:

– test/measurement set information;

– time information;

– output routing information.

Figure A-3/M.251 shows a model relating these parameters to maintenance tests/measurements. This model is useful in illustrating the relationships between test/measurement sequences (test/measurement sets), time parameters, some of which relate to routing tests only (i.e., they have no relevance to on-demand tests/measurements) and the specification of output media [which can be assumed to be according to the specification of the output destination(s)].

Test/measurement set information, time information, output media information as well as object lists may be predefined. It should be noted that predefinition characteristics are system dependent.

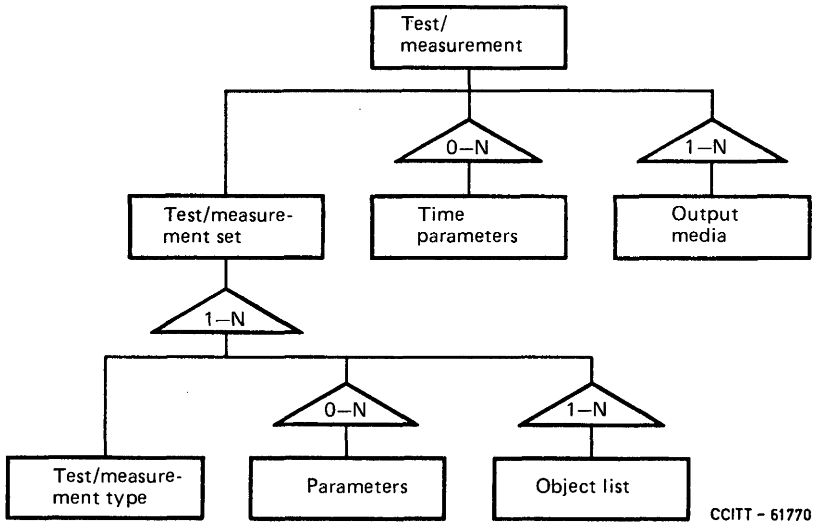


FIGURE A-3/M.251

Maintenance test/measurement model

A.2.2.2.4.1 *Test/measurement set information*

Test/measurement set information consists of one or more selected test/measurement types with defined objects (object lists) and test/measurement type dependent parameters.

Note that normally, for maintenance purposes, test/measurement types are fixed at a given moment in time and that they cannot be created, deleted or changed by MML commands; only later supplier releases may change these test/measurement types according to new requirements.

It is recognized that the Administrations may require MML functions to administer test/measurement types, grouping predefined entities with object types. Such functions should be considered as a system extension and upgrade function and, therefore, should belong to the system control function area. However, due to the fact that system control functions are not yet recommended, they are included in the subsequent descriptions.

A.2.2.2.4.2 *Time information*

Tests/measurements of categories A and B (see Figure A-2/M.251) may perform continuous recording or recording on predetermined days (recording days).

For tests/measurements performing continuous recording, only the start date is needed.

A.2.2.2.4.3 *Output routing information*

Output routing information defines the output destinations (there may be more than one), the output formats and the number of copies required. An output destination may be an internal (system resident) log or file. This file may be analyzed at a later time and its data used to provide reports both to the users and for administrative purposes.

A.2.2.2.4.4 *Summary*

Test/measurement set information, time information, output routing information as well as object lists may be predefined. It should be noted that predefinition characteristics are normally system dependent.

A.2.3 *Document C*

A.2.3.1 *List of MML functions*

1) *Creation*
   - create a test/measurement set
   - create a list of objects
   - create a time data list
   - create an output media list
   - create a routine test/measurement
2) *Changing*
   - change a test/measurement set
   - change a list of objects
   - change a time data list
   - change an output media list
   - change a routine test/measurement
3) *Deletion*
   - delete a test/measurement set
   - delete a list of objects
   - delete a time data list
   - delete an output media list
   - delete a routine test/measurement
4) *Interrogation*
   - interrogate a test/measurement set
   - interrogate a list of objects
   - interrogate a time data list
   - interrogate an output media list
   - interrogate a routine test/measurement
5) *Activation*
   - activate a routine test/measurement
   - activate an on-demand test/measurement
6) *Deactivation*
   - deactivate a routine test/measurement
   - deactivate an on-demand test/measurement
7) *Output*
   - output the results of a routine test/measurement
   - output the results of an on-demand test/measurement
8) *Administration of test/measurement types*
   - create a test/measurement type
   - change a test/measurement type
   - delete a test/measurement type

Note – These functions are not yet recommended, but are included, so that Administrations are able to consider the management of different test/measurement types.

A.2.4 *Document D*

A.2.4.1 *Introduction*

All the information entities needed for the MML functions related to the maintenance tests administration have been identified and are reported in this Document D by means of diagrams representing each MML function information structure. See Figures A-5/M.251 to A-35/M.251. The same information structure diagrams apply to maintenance measurements administration functions.

A schematic overview of these functions is given in Figure A-4/M.251.

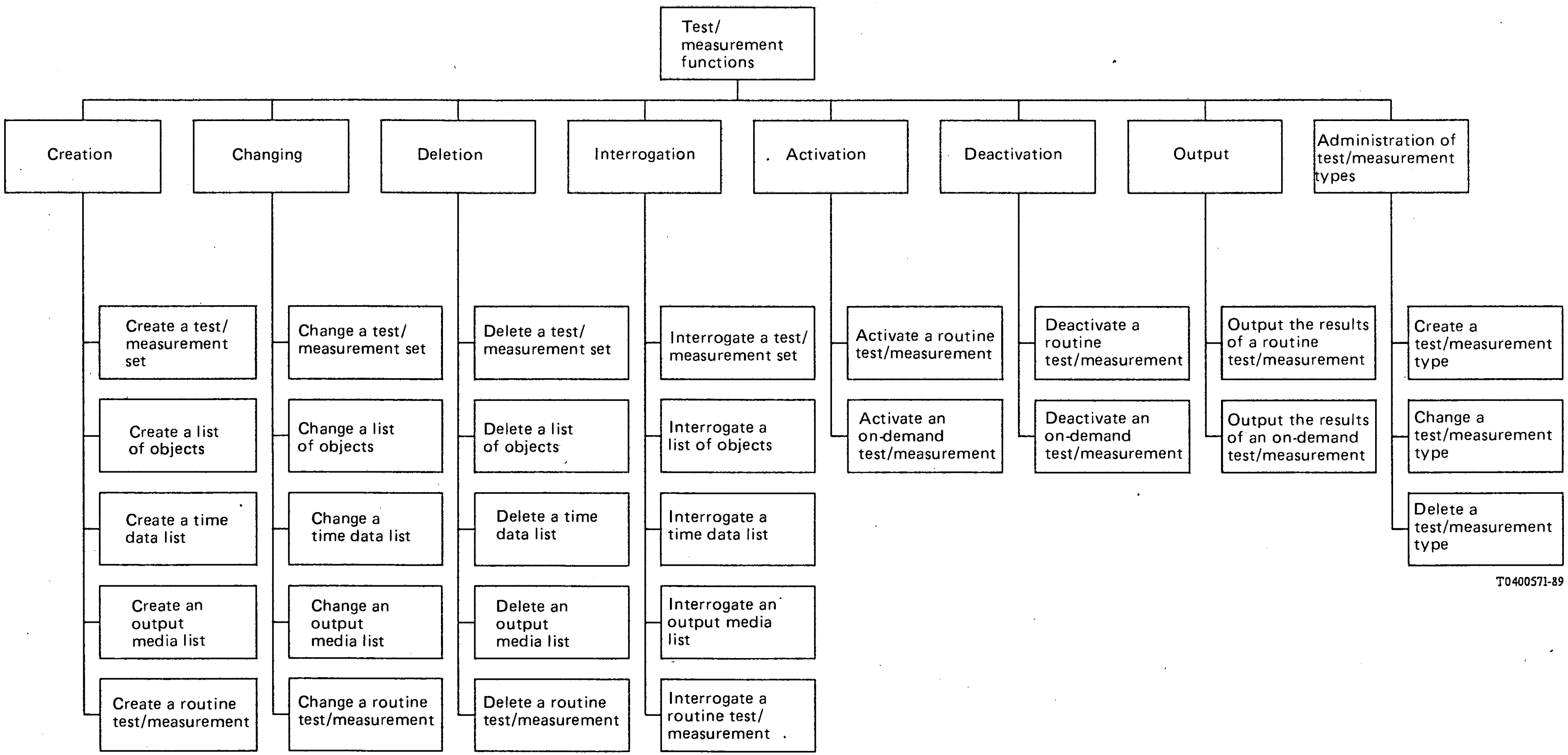


FIGURE A-4/M.251

MML functions for tests/measurements

A.2.4.2 *Information structure diagrams for each MML function*

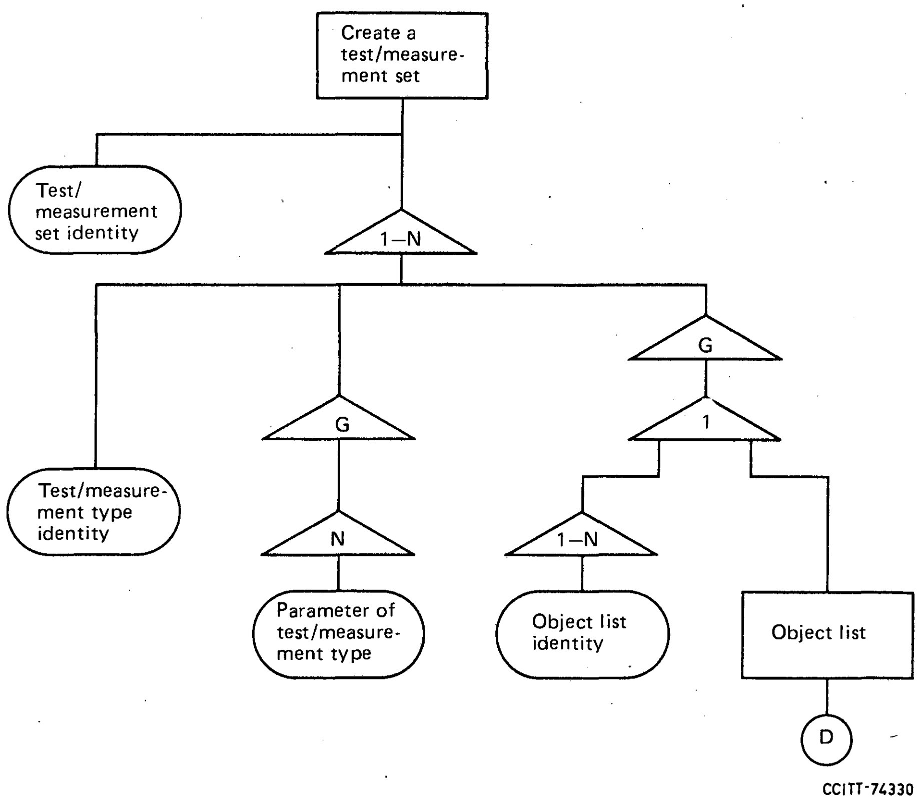


FIGURE A-5/M.251

Create a test/measurement set

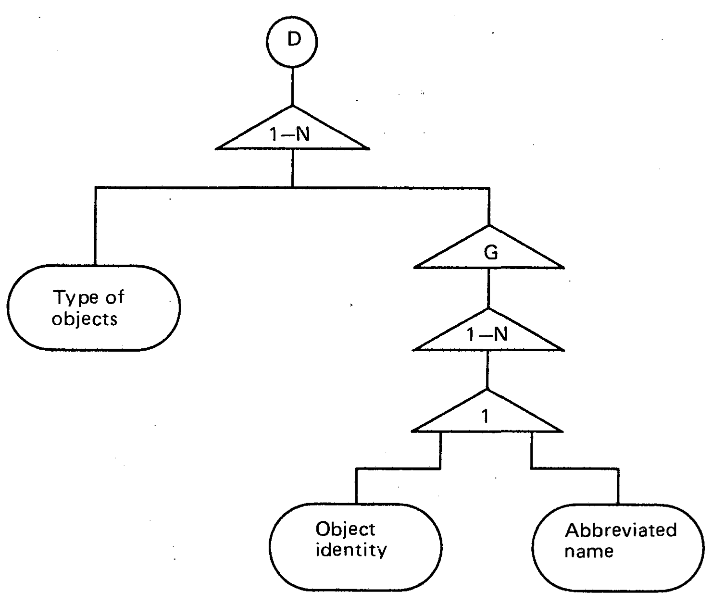


FIGURE A-6/M.251

Create a test/measurement set *(cont.)*

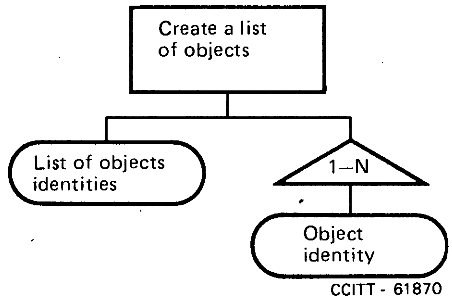


FIGURE A-7/M.251

Create a list of objects

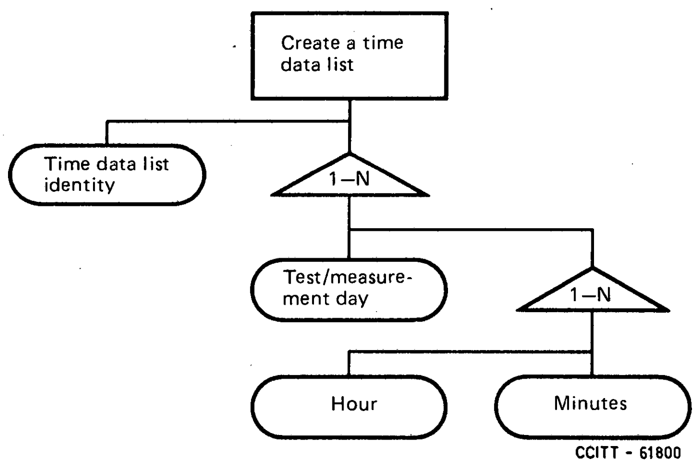


FIGURE A-8/M.251

Create a time data list

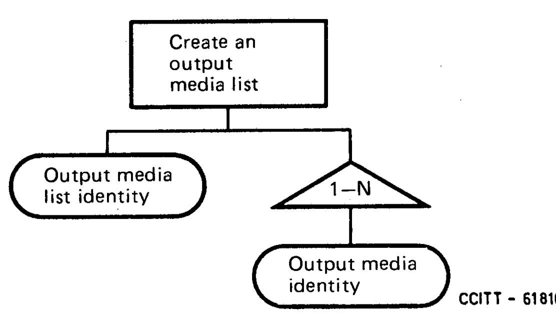


FIGURE A-9/M.251

Create an output media list

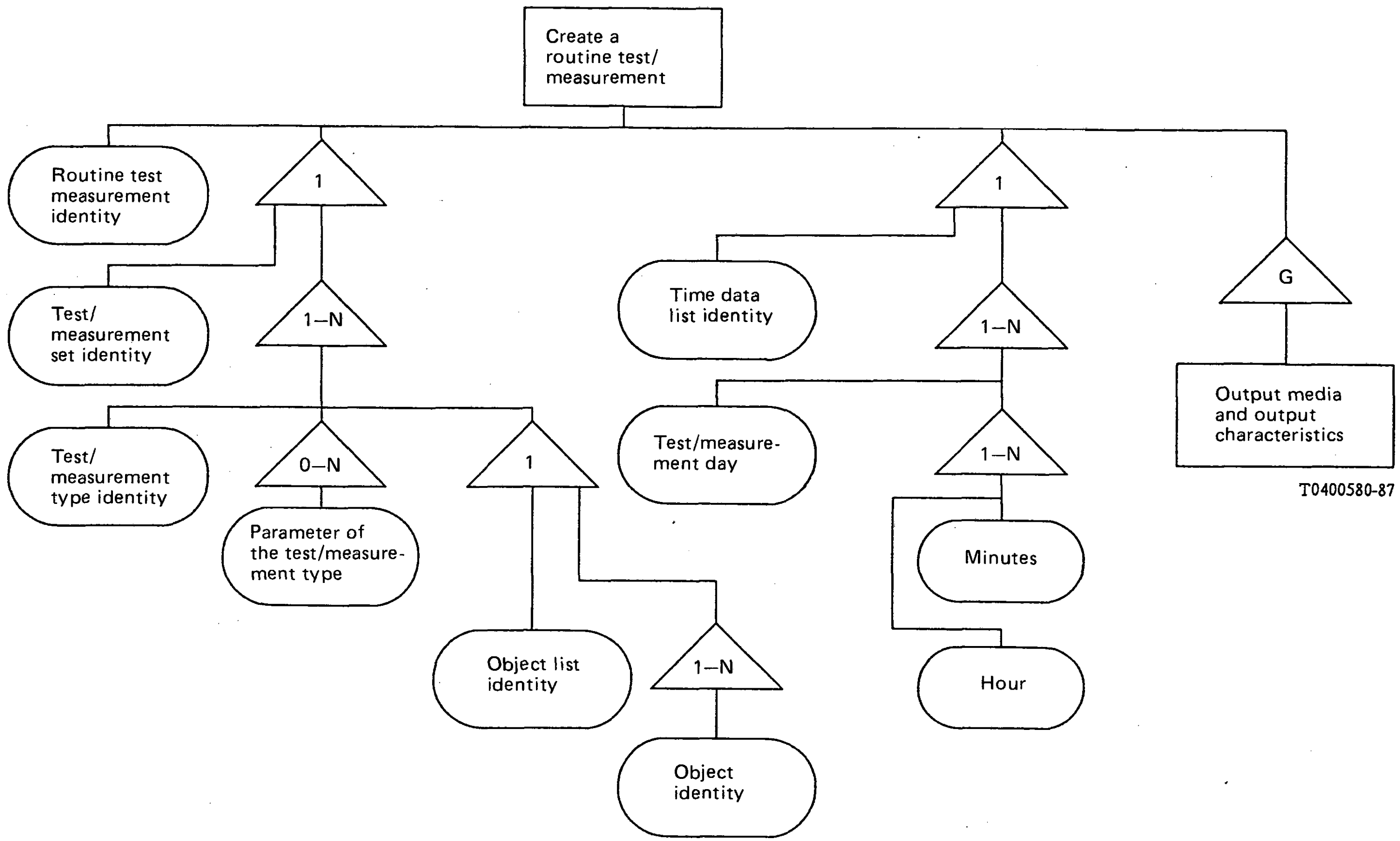


FIGURE A-10/M.251

Create a routine test/measurement

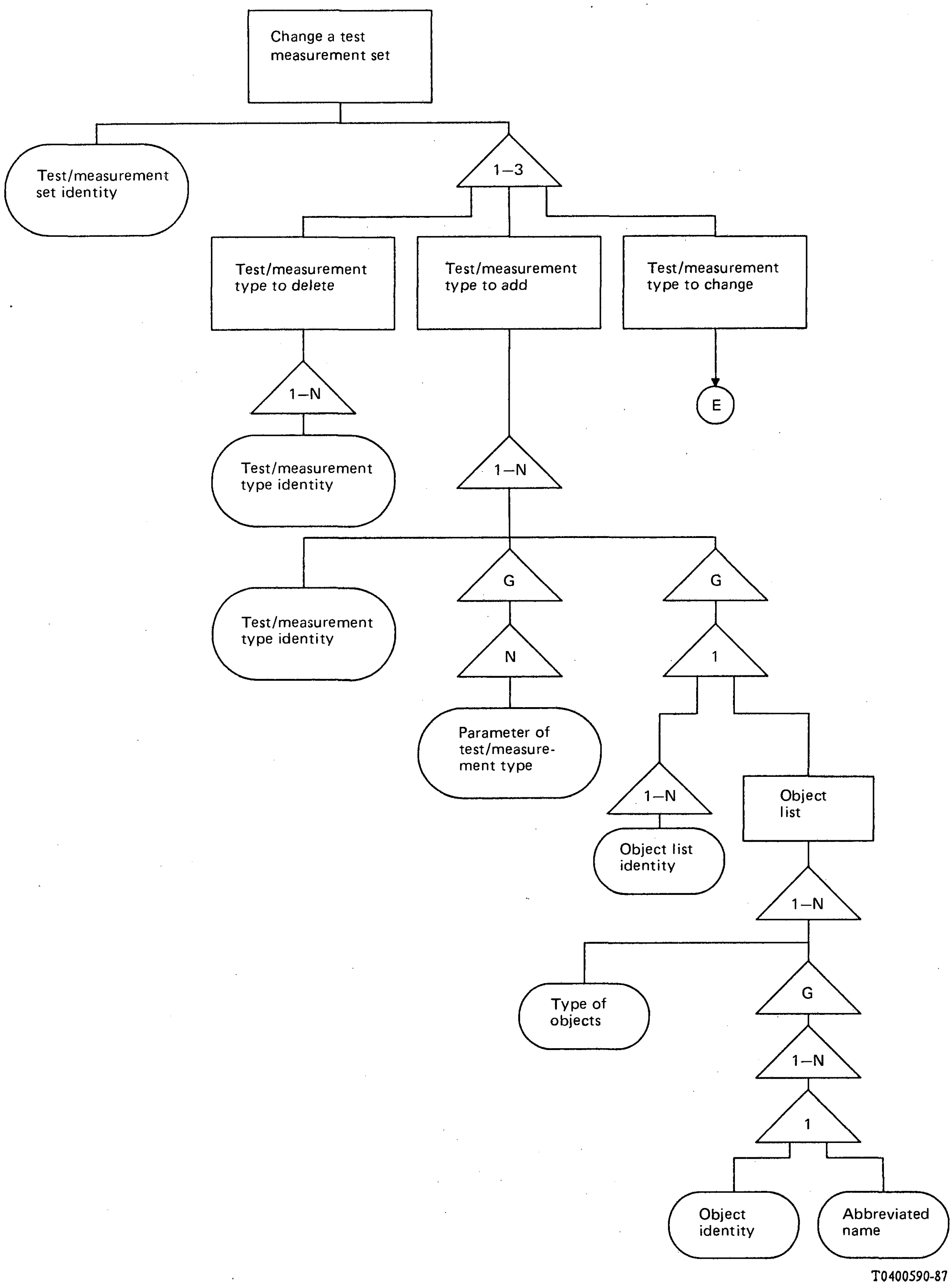


FIGURE A-11/M.251

Change a test/measurement set

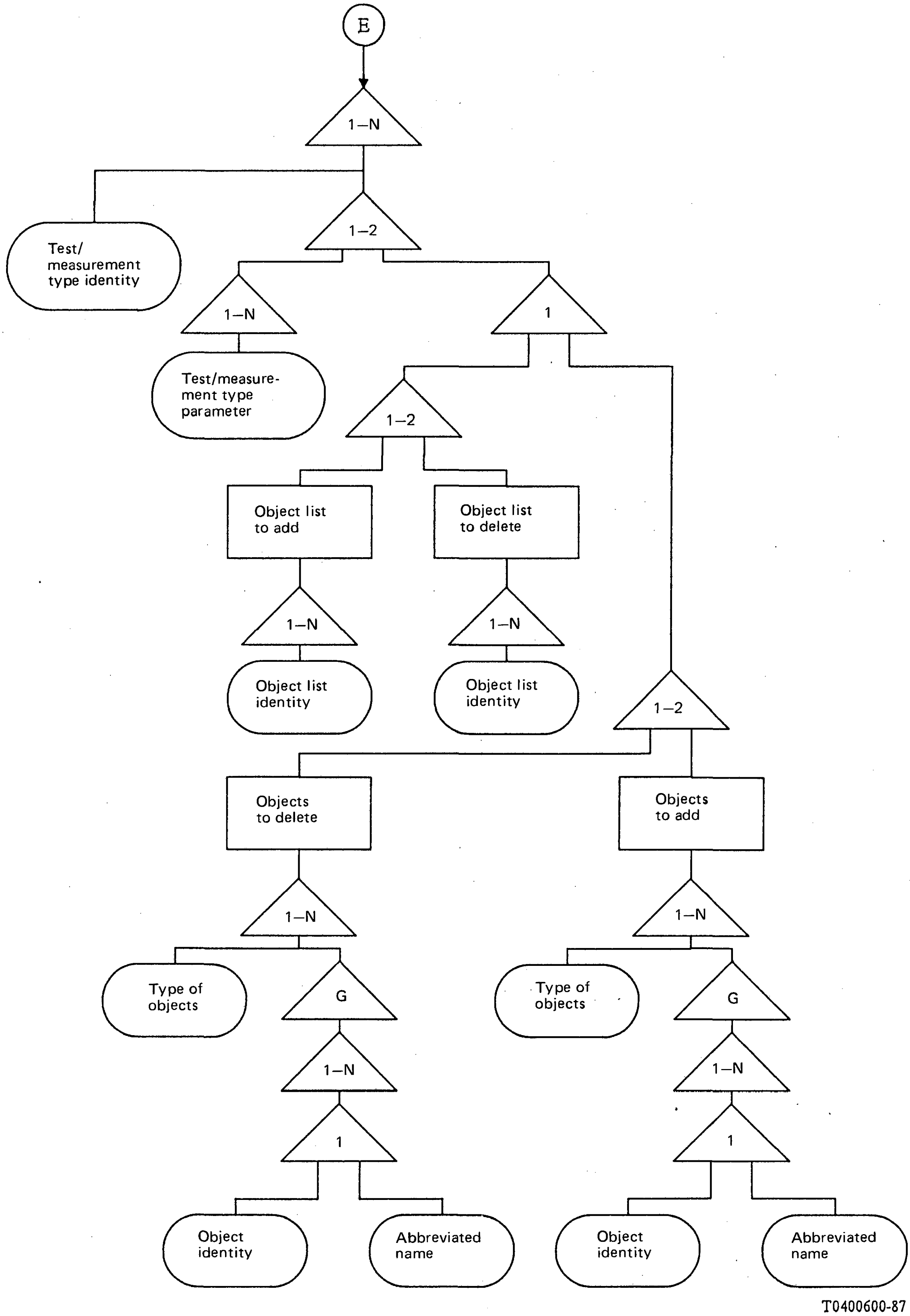


FIGURE A-12/M.251

Change a test/measurement set *(cont.)*

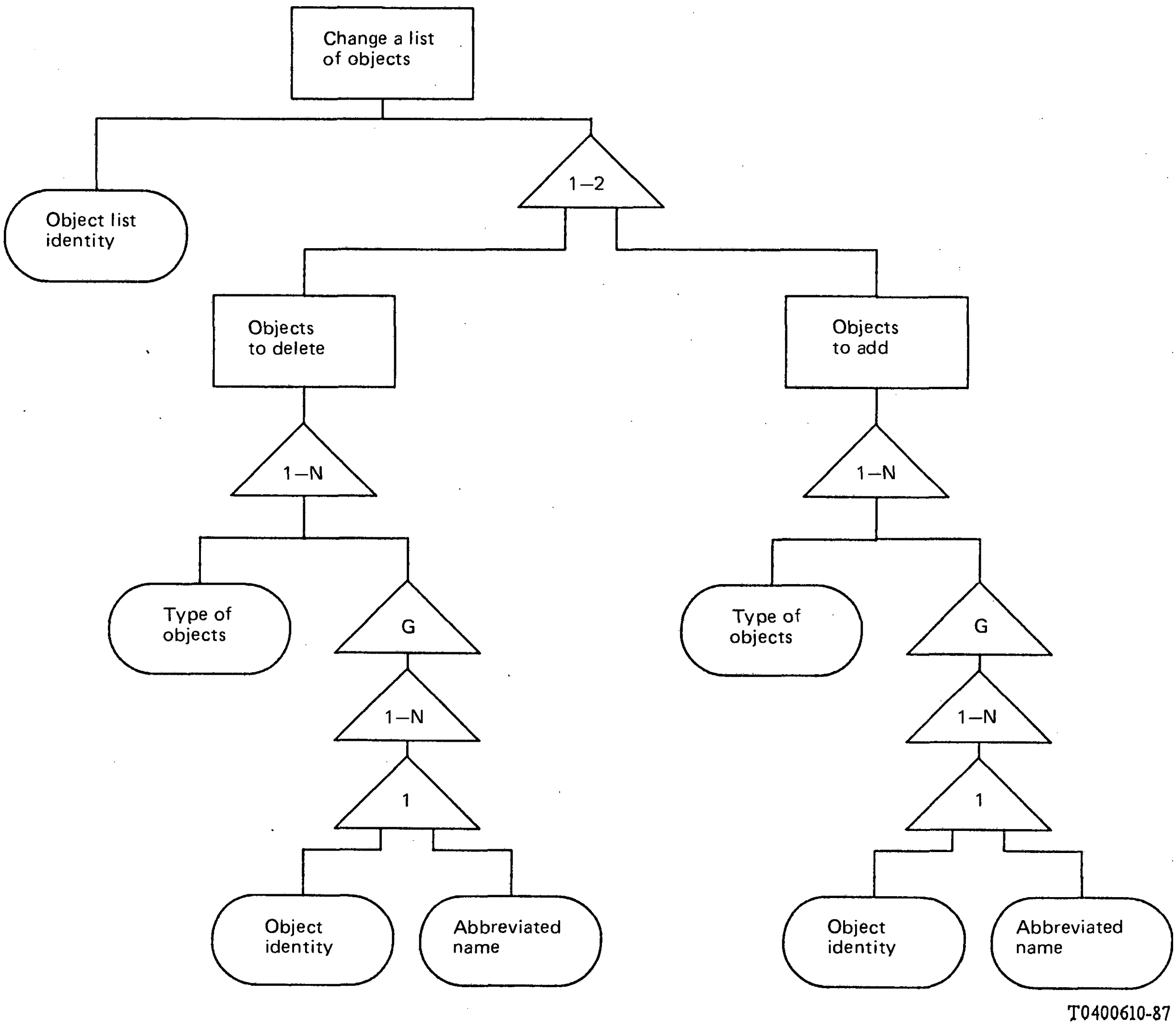


FIGURE A-13/M.251

Change a list of objects

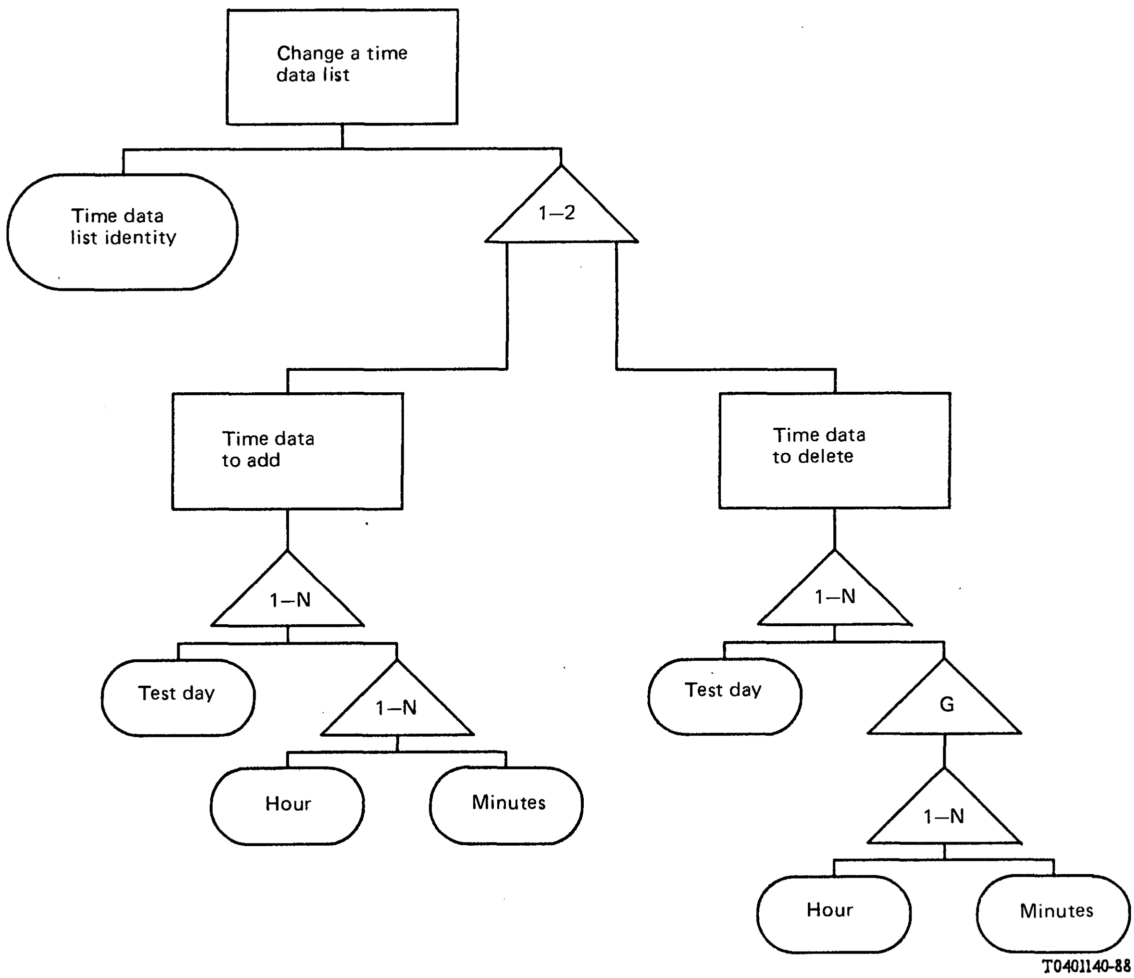


FIGURE A-14/M.251

Change a time data list

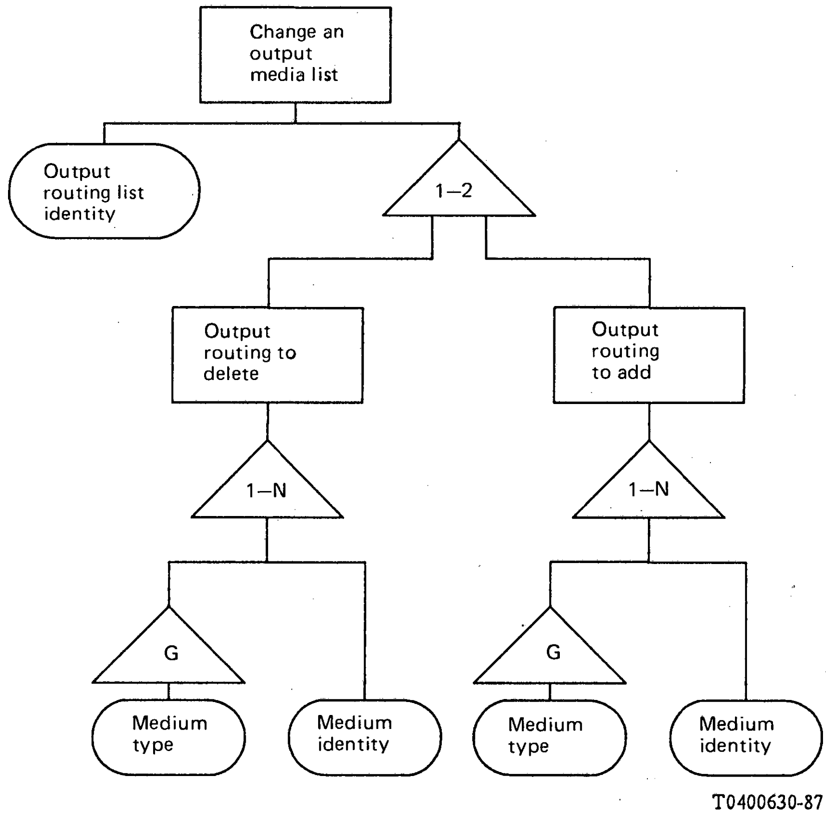


FIGURE A-15/M.251

Change an output media list

(Under study)

FIGURE A-16/M.251

Change a routine test/measurement

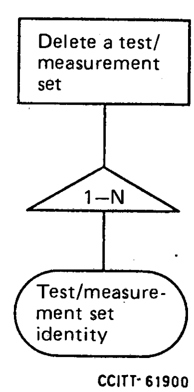


FIGURE A-17/M.251

Delete a test/measurement set

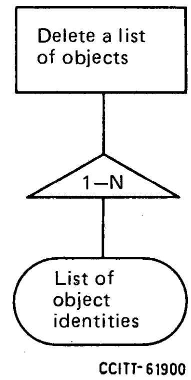


FIGURE A-18/M.251

Delete a list of objects

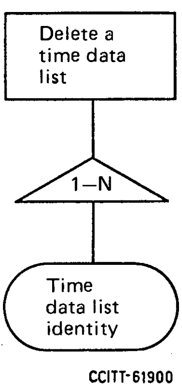


FIGURE A-19/M.251

Delete a time data list

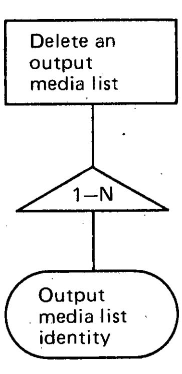


FIGURE A-20/M.251

Delete an output media list

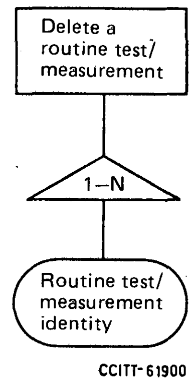


FIGURE A-21/M.251

Delete a routine test/measurement

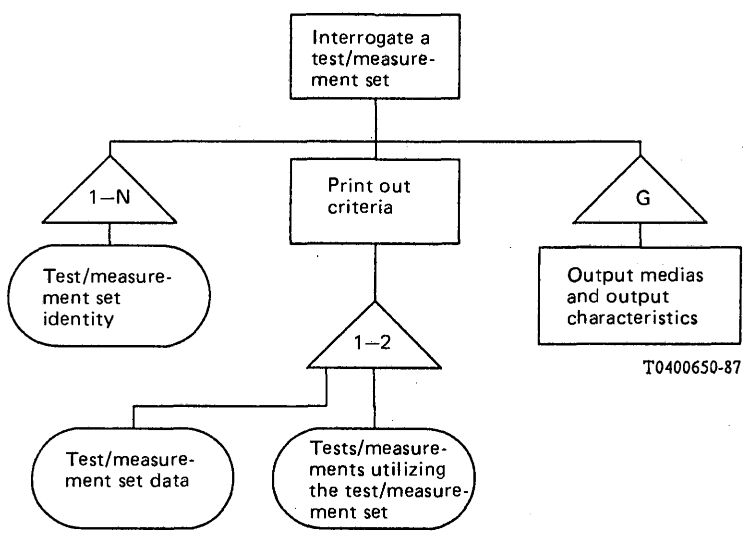


FIGURE A-22/M.251

Interrogate a test/measurement set

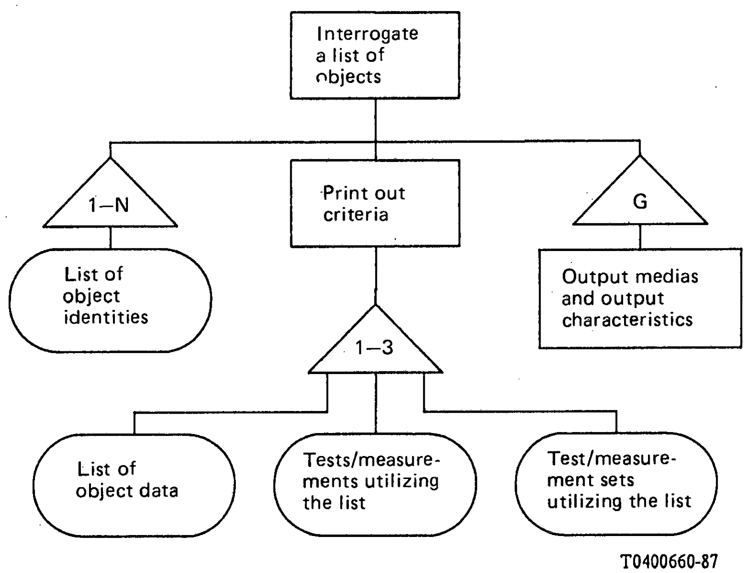


FIGURE A-23/M.251

Interrogate a list of objects

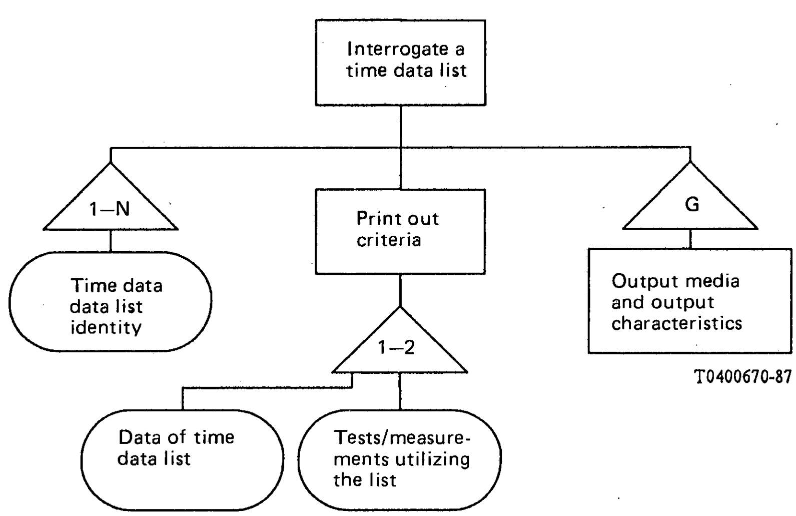


FIGURE A-24/M.251

Interrogate a time data list

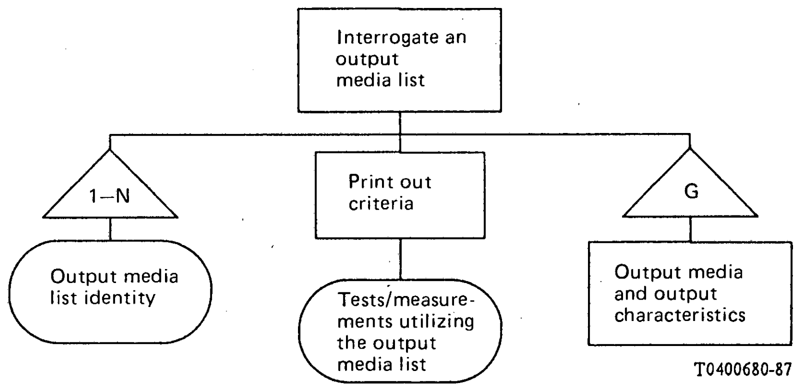
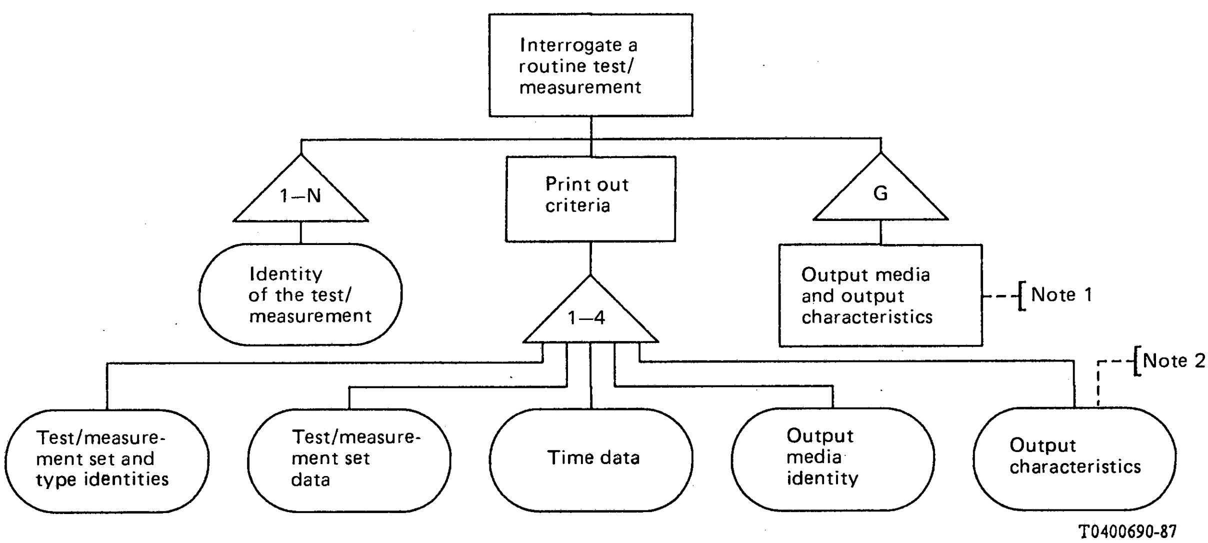


FIGURE A-25/M.251

Interrogate an output media list

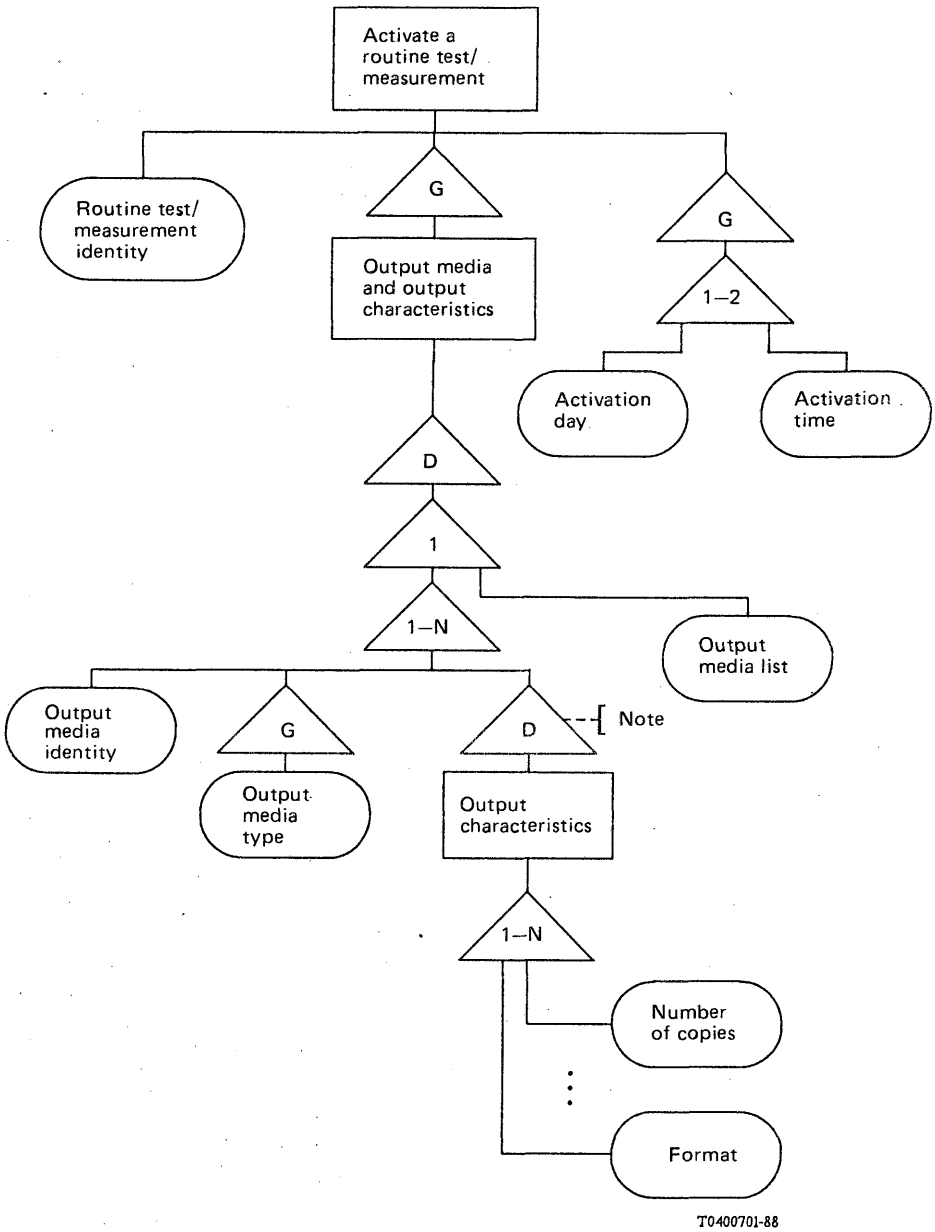


Note 1 — For response to the interrogation.

Note 2 — Format types; number of pages.

FIGURE A-26/M.251

Interrogate a routine test/measurement



Note – Additional defaults with respect to particular output medium.

FIGURE A-27/M.251

Activate a routine test/measurement

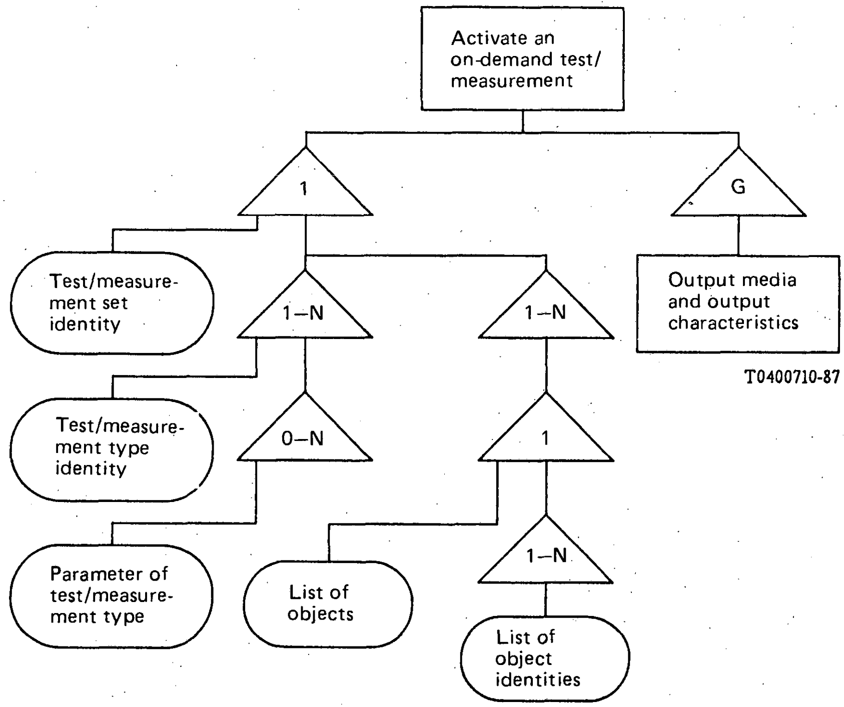
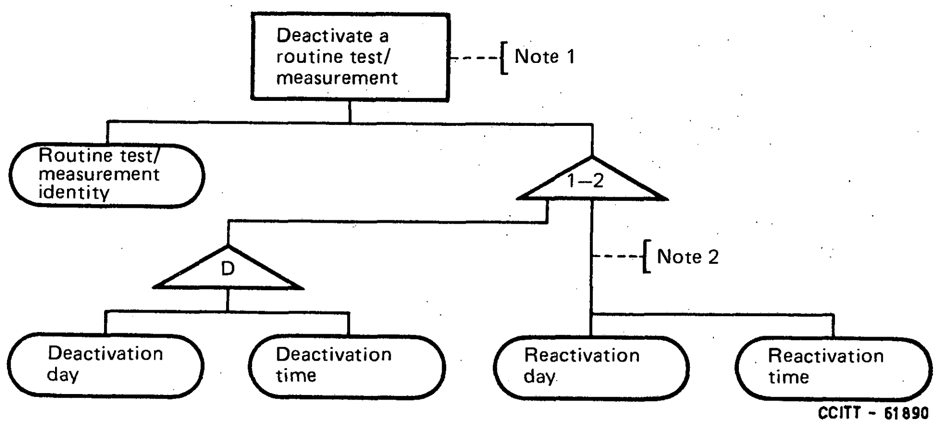


FIGURE A-28/M.251

Activate an on-demand test/measurement



Note 1 – This function is intended to support also the stopping/suspending of a test/measurement execution.

Note 2 – This branch allows the possibility of stopping/suspending the test/measurement execution.

FIGURE A-29/M.251

Deactivate a routine test/measurement

(Under study)

FIGURE A-30/M.251

Deactivate an on-demand test/measurement

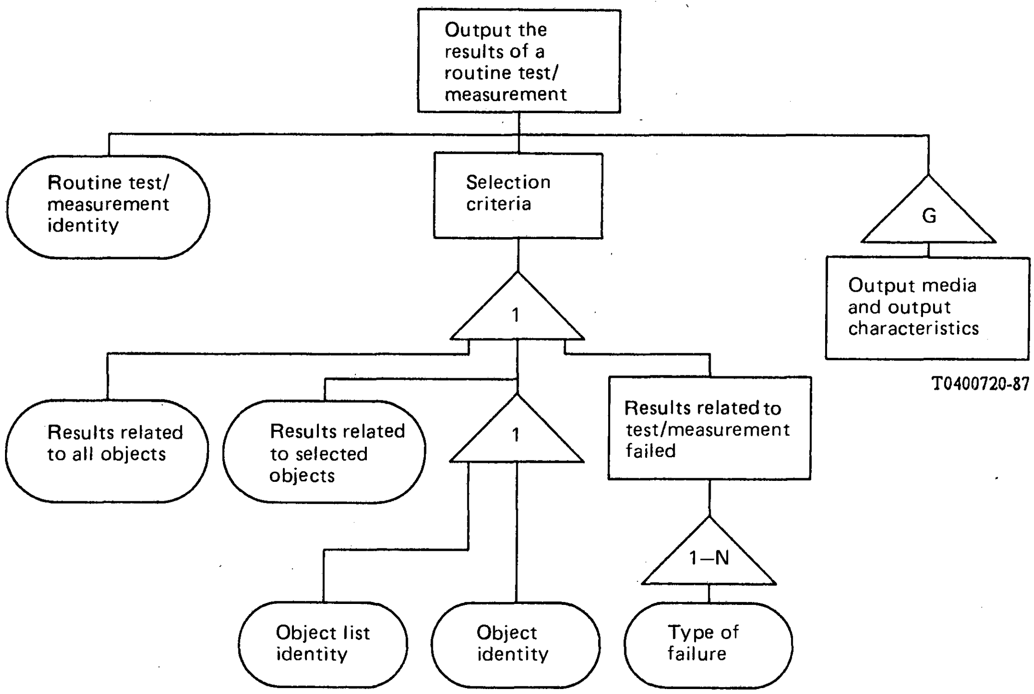


FIGURE A-31/M.251

Output the results of a routine test/measurement

(Under study)

FIGURE A-32/M.251

Output the results of an on-demand test/measurement

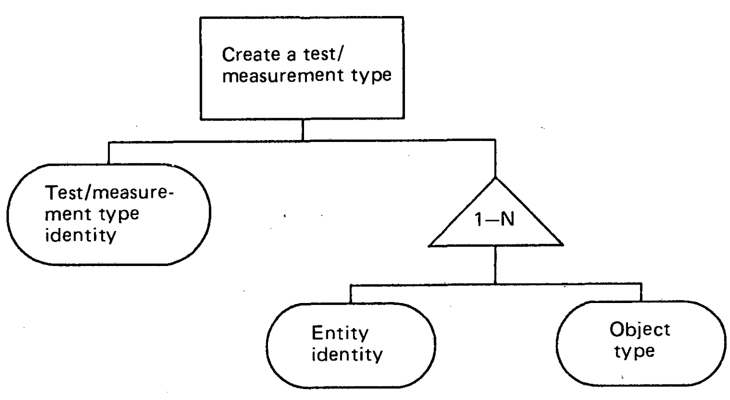


FIGURE A-33/M.251

Create a test/measurement type

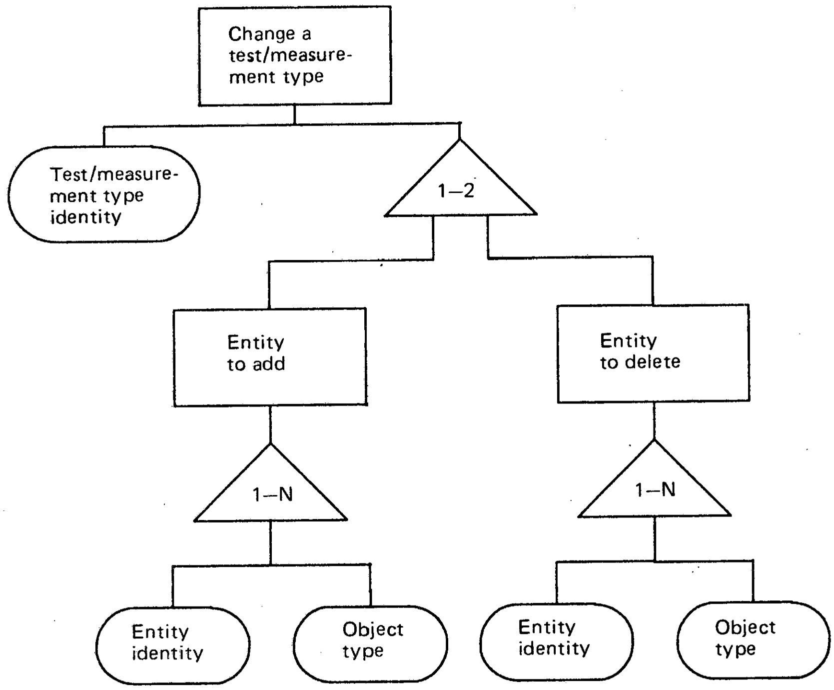


FIGURE A-34/M.251

Change a test/measurement type

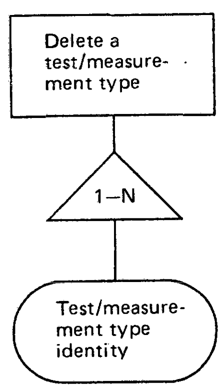


FIGURE A-35/M.251

Delete a test/measurement type

A.2.5 *Document G*

Glossary of used terms[4]:

a) **start/stop date** – The start/stop day of a test/measurement on a routine basis.

b) **start/stop time** – The start/stop time of a test/measurement on a routine basis.

c) **test/measurement day** – Day in which the test/measurement is performed according to the associated schedule.

d) **objects** – Individual items on which test/measurements are performed (e.g. circuits, group of circuits, transmission equipments, etc.)

e) **OMC** – Operation and maintenance centre.

[4] This list is the subject of further study.

ANNEX B

(to Recommendation M.251)

General description of failure information
(under study)

ANNEX C

(to Recommendation M.251)

Protection, restoration
(under study)

ANNEX D

(to Recommendation M.251)

Support of maintenance
(under study)

References

[1] CCITT Recommendation *Methodology for the specification of the man-machine interface – Tools and methods*, Vol. X, Rec. Z.333.

[2] CCITT Recommendation *Introduction to the specification of the man-machine interface*, Vol. X, Rec. Z.331.

[3] CCITT Recommendation, *Methodology for the specification of the man-machine interface – General working procedure*, Vol. X, Rec. Z.332.

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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 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.

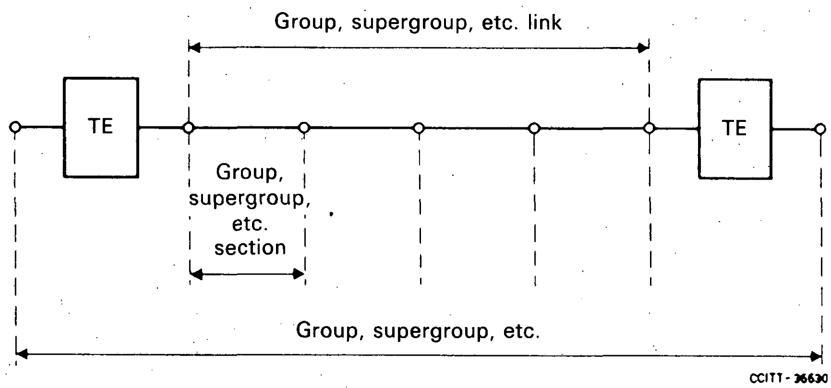
Note – In a country normally using mastergroup and supermastergroup arrangements, a 15 supergroup assembly can be through-connected without difficulty at the supermastergroup distribution frame by means of through-supermastergroup filters. In this case, the 15 supergroup assembly is through-connected 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.701 [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.

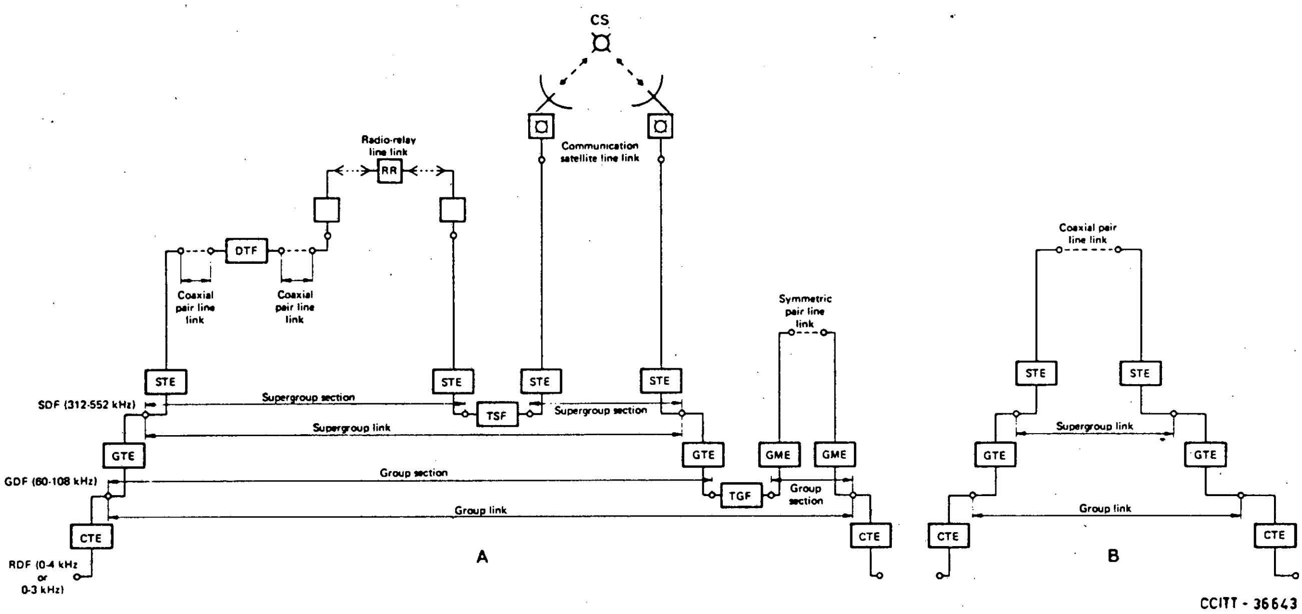
2.3 **primary block (American: digroup)**

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.

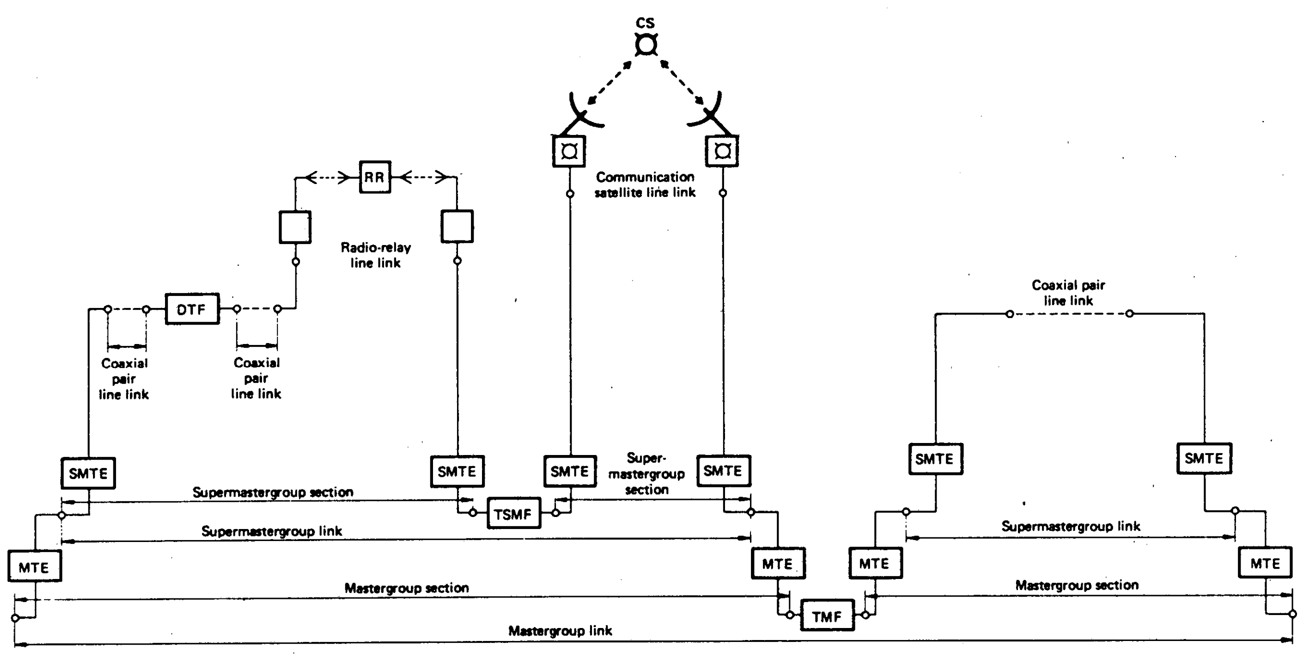


CTE	=	channel translating equipment (translation of the audio band into the basic group or vice versa)	DTF	=	direct through-connection filter
GTE	=	group translating equipment (translation of the basic group into the basic supergroup)	TSF	=	through-supergroup filter
STE	=	supergroup translating equipment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

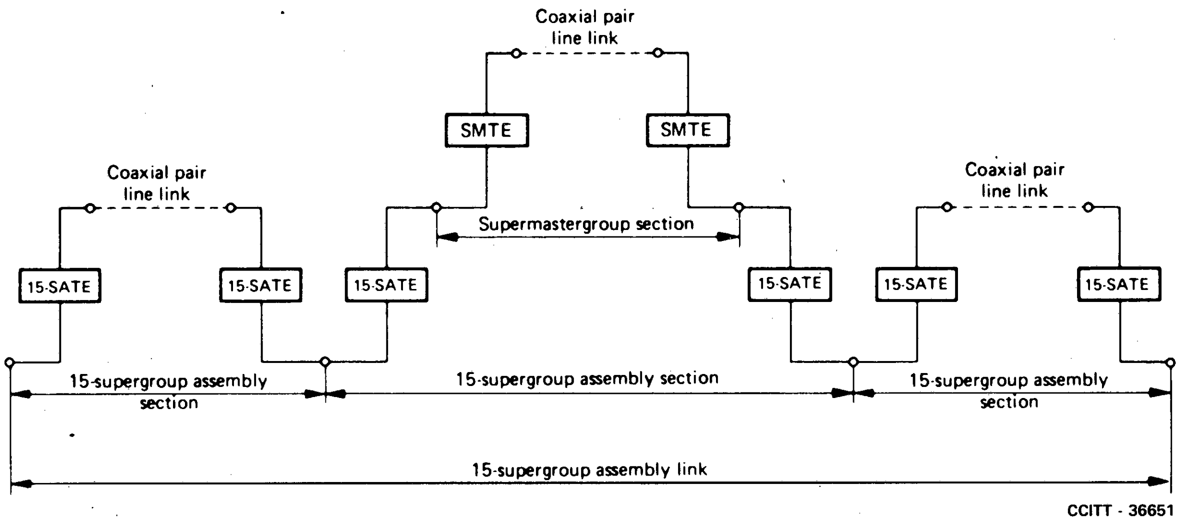
Channel of a group set-up on: several line links in tandem (A), a single line link (B)



MTE	=	mastergroup translating equipment	DTF	=	direct through-connection filter
SMTE	=	supermastergroup translating equipment	RR	=	radio-relay station
TMF	=	through-mastergroup filter	CS	=	communication satellite
TSMF	=	through-supermastergroup filter			

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).

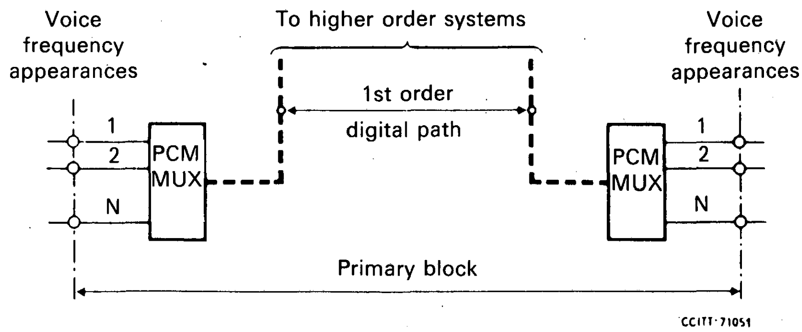


FIGURE 5/M.300

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**

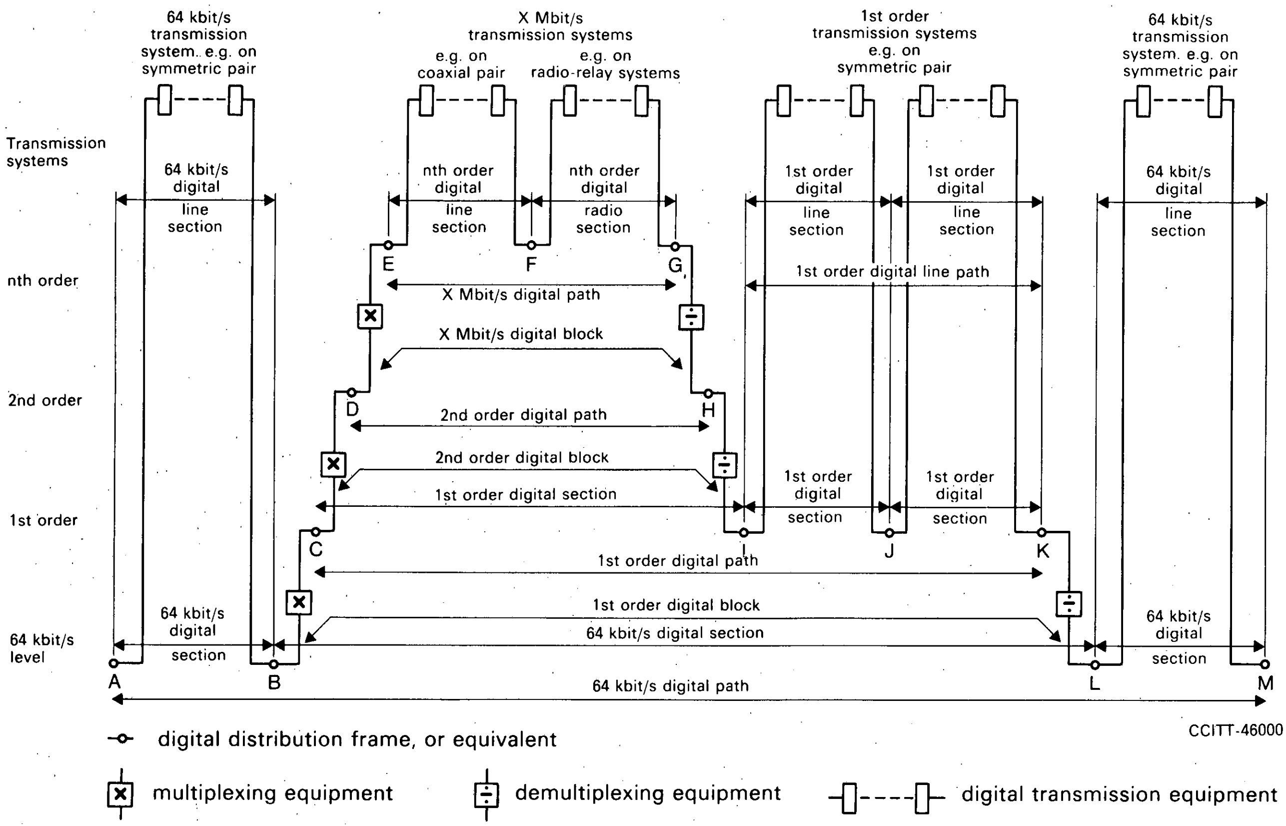
The digital, group, supergroup, etc., sections between two adjacent frontier stations in different countries constitute an international section. Some international sections may be a single digital, group, supergroup, etc., section routed over long submarine cable systems. If the international group, 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

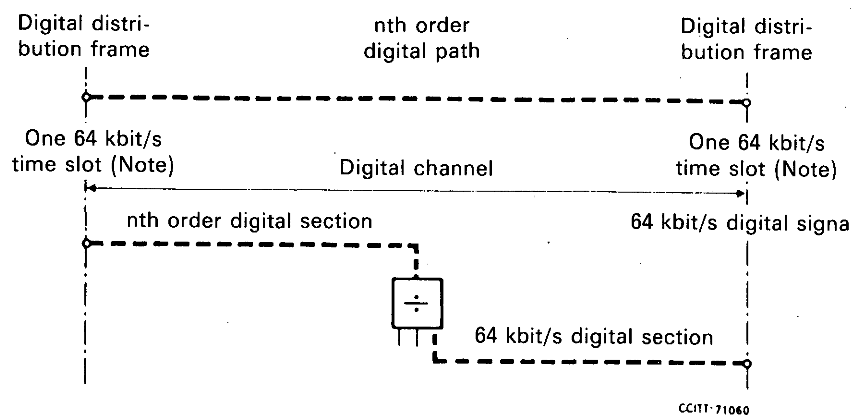
An analogue channel is a one-way transmission capability which is provided on audio pairs or analogue transmission systems, and which appears at voice frequency at both ends. Where an analogue channel is provided by an analogue transmission system, it will not have voice frequency appearances other than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

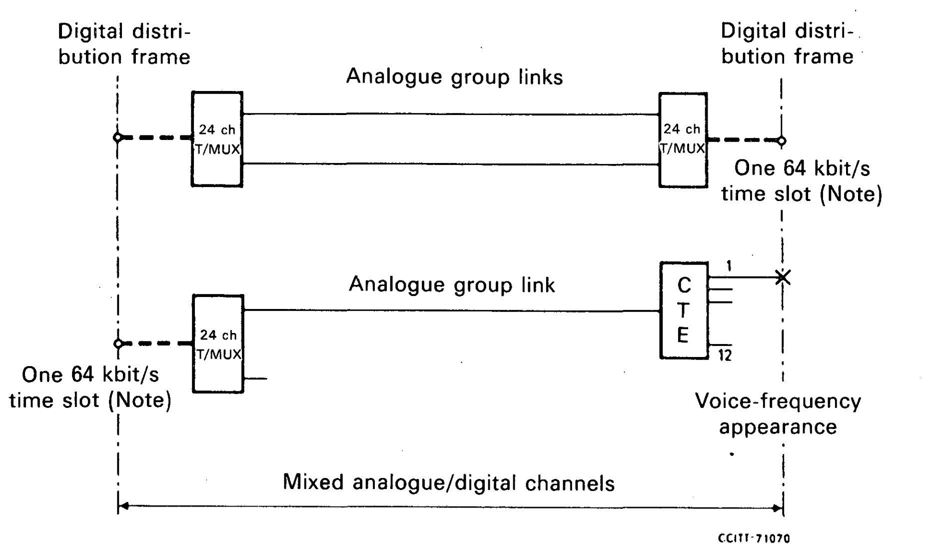
A mixed analogue/digital channel is a one-way transmission capability provided over an analogue transmission system with transmultiplexer equipment at one end and transmultiplexer or analogue translating equipment at the other end. Where the end of the channel is provided by transmultiplexer equipment, 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

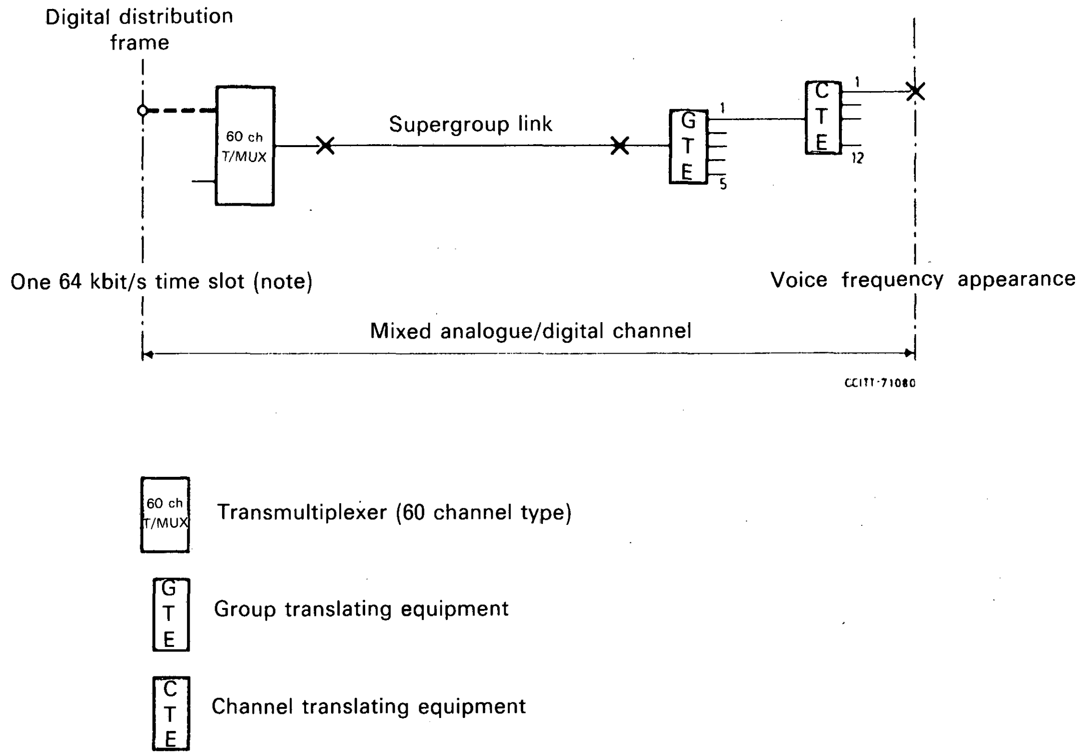
Diagrammatic representations of a digital channel



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



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.

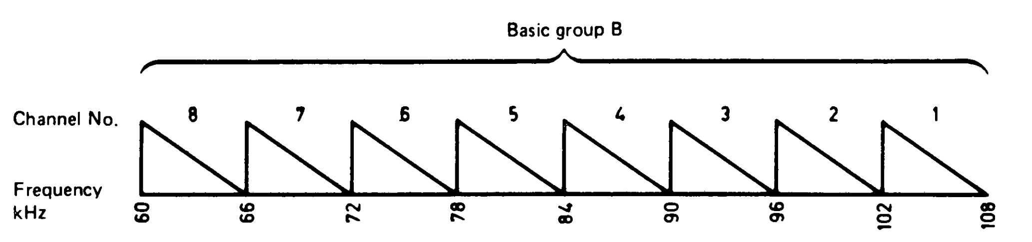
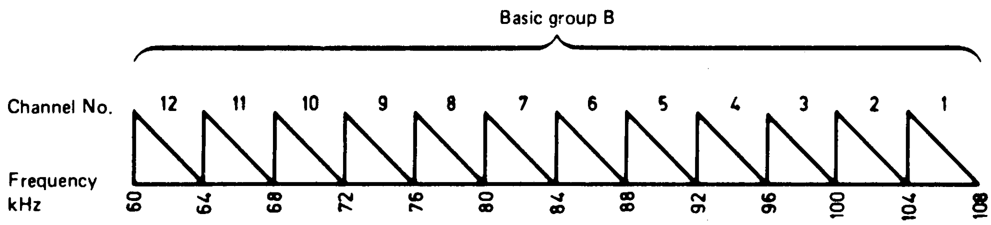


FIGURE 1/M.320

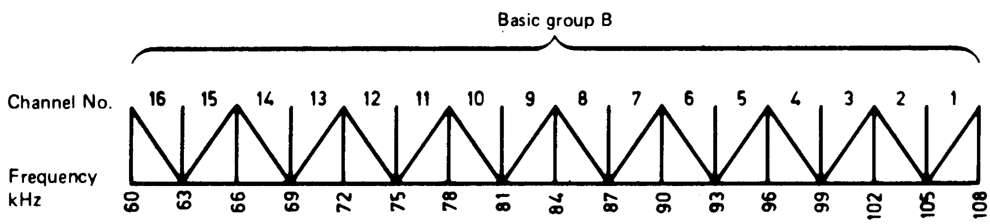
Numbering of channels in 8 channel group



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

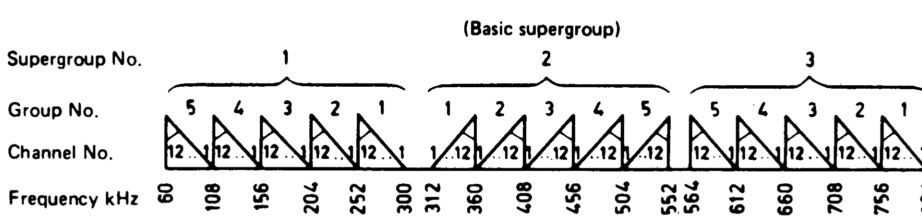
NUMBERING OF GROUPS WITHIN A SUPERGROUP

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.

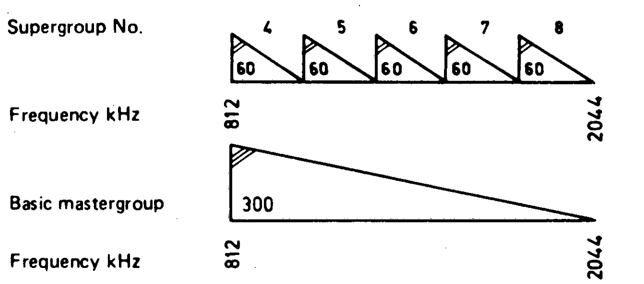


FIGURE 1/M.340

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.

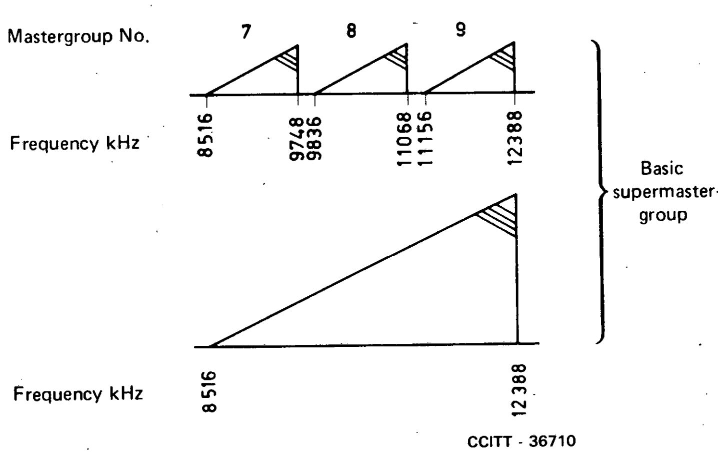


FIGURE 1/M.350

Numbering of mastergroup within a supermastergroup

Recommendation M.380

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/M.380 and 8/M.380.

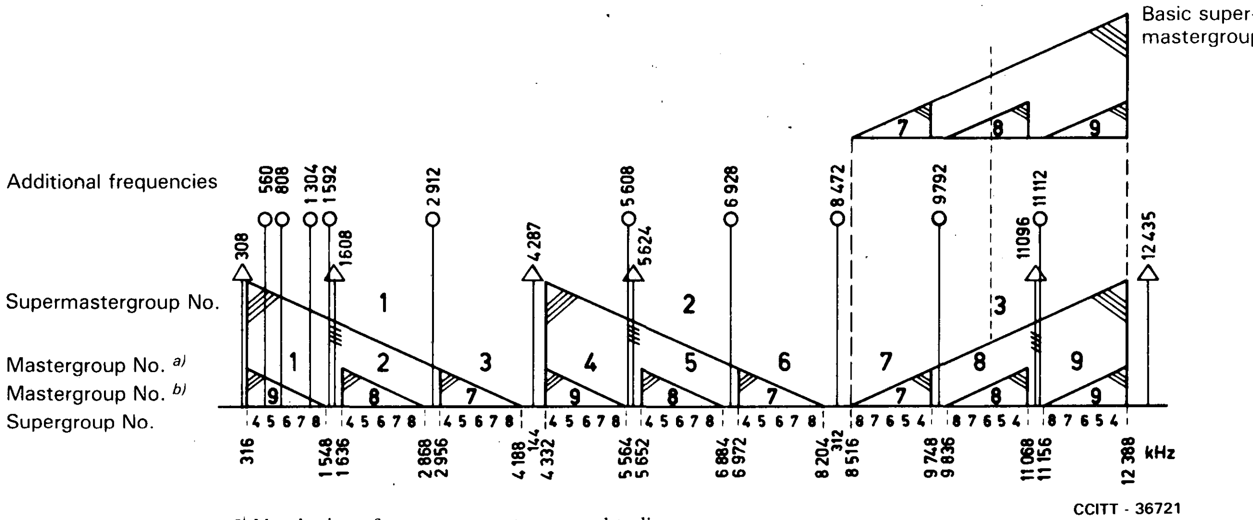
3.3 *4-MHz systems*

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

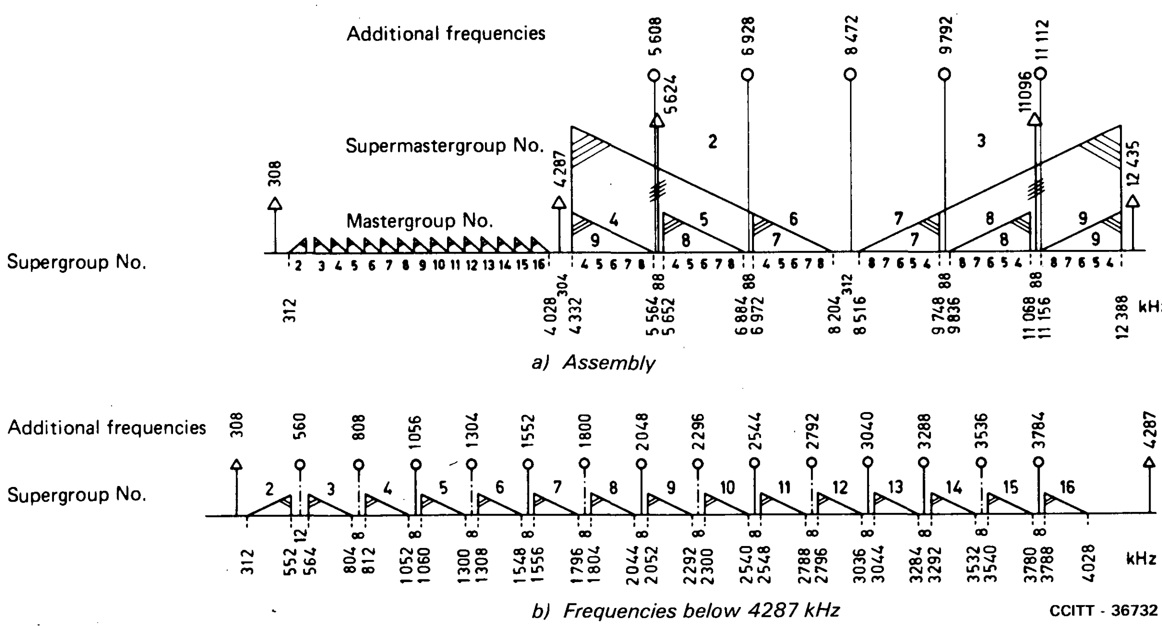


FIGURE 2/M.380

Frequency allocation (Scheme 1B) for 12-MHz systems

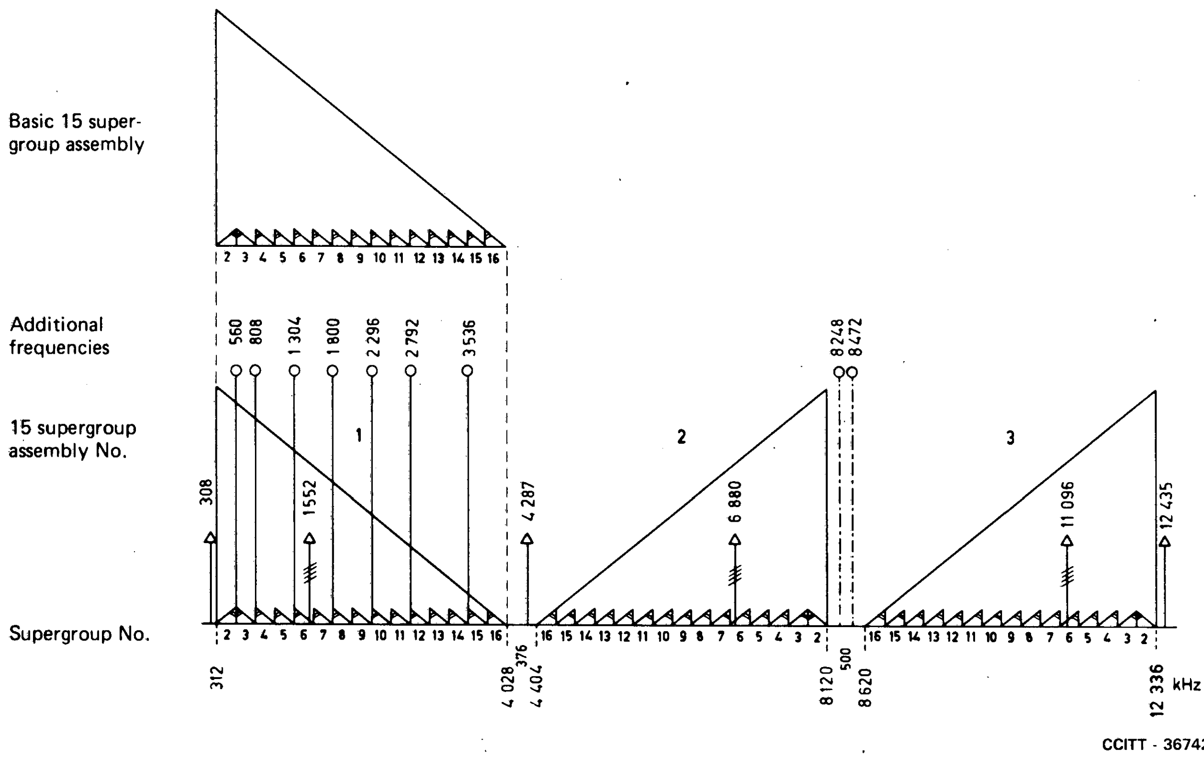


FIGURE 3/M.380

Frequency allocation (Scheme 2) for 12-MHz systems

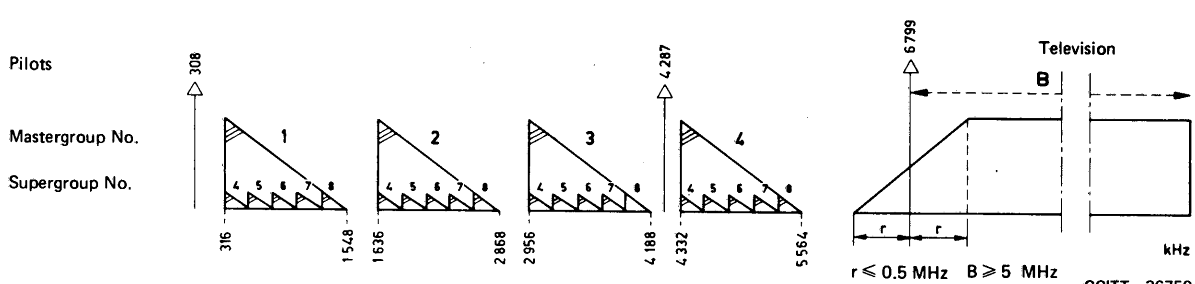


FIGURE 4/M.380

Line-frequency allocation for 12-MHz systems (simultaneous transmission of telephony and television)

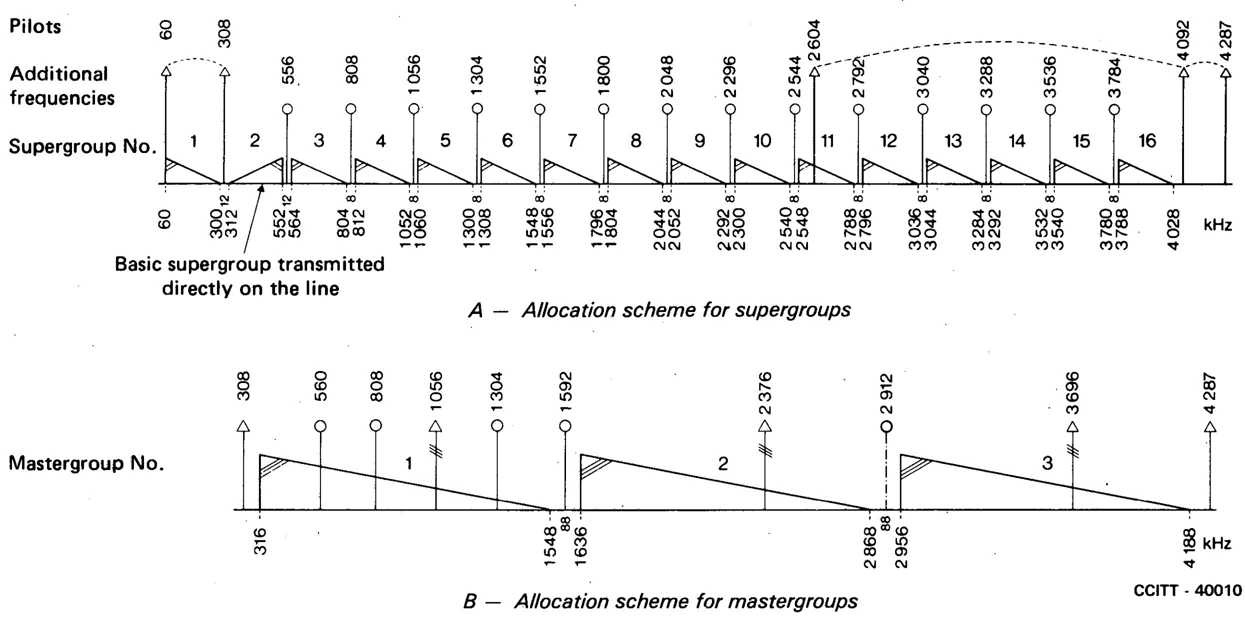


FIGURE 5/M.380

Line-frequency allocation for 4-MHz systems

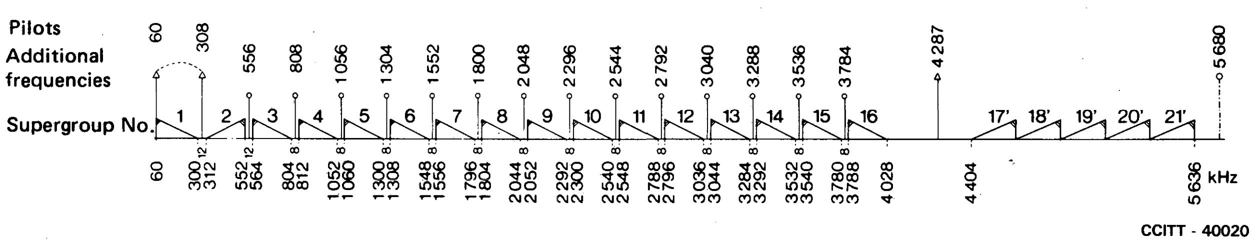


FIGURE 6/M.380

Line-frequency allocation for 6-MHz systems (Scheme 1)

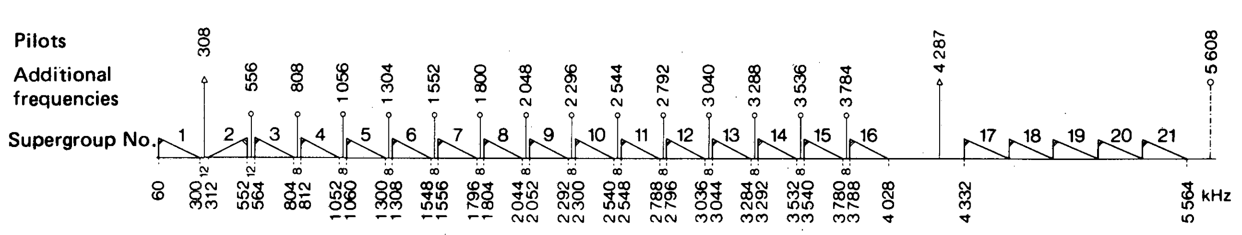


FIGURE 7/M.380

Line-frequency allocation for 6-MHz systems (Scheme 2)

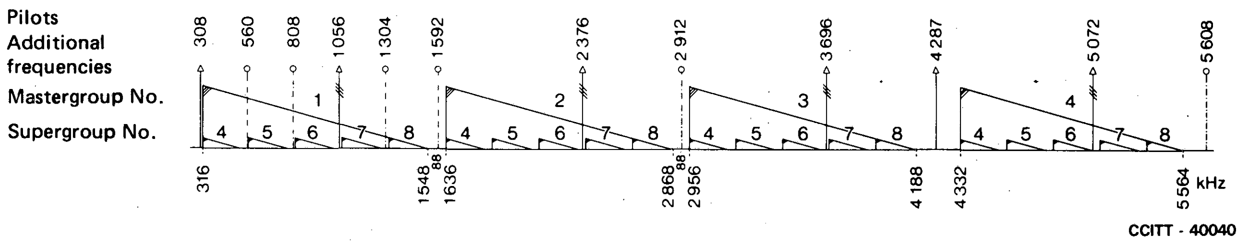


FIGURE 8/M.380

Line-frequency allocation for 6-MHz systems (Scheme 3)

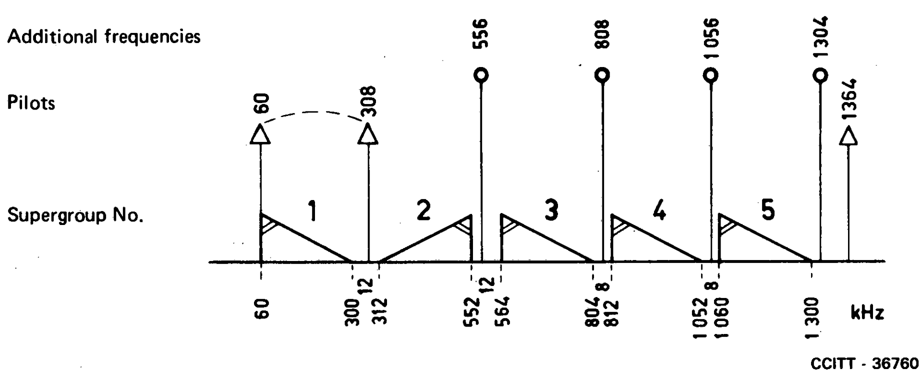


FIGURE 9/M.380

Line-frequency allocation for 1.3-MHz systems (Scheme 1)

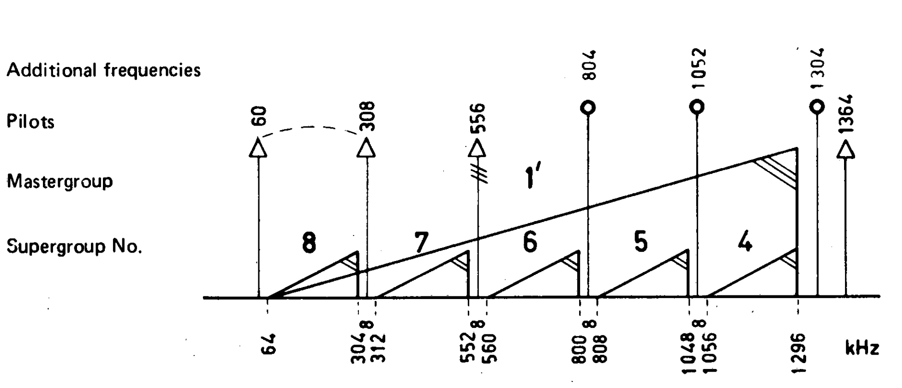


FIGURE 10/M.380

Line-frequency allocation for 1.3-MHz systems (Scheme 2)

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.

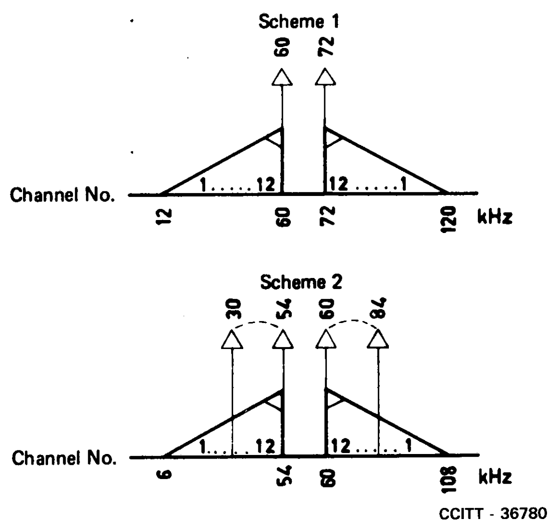


FIGURE 1/M.390

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

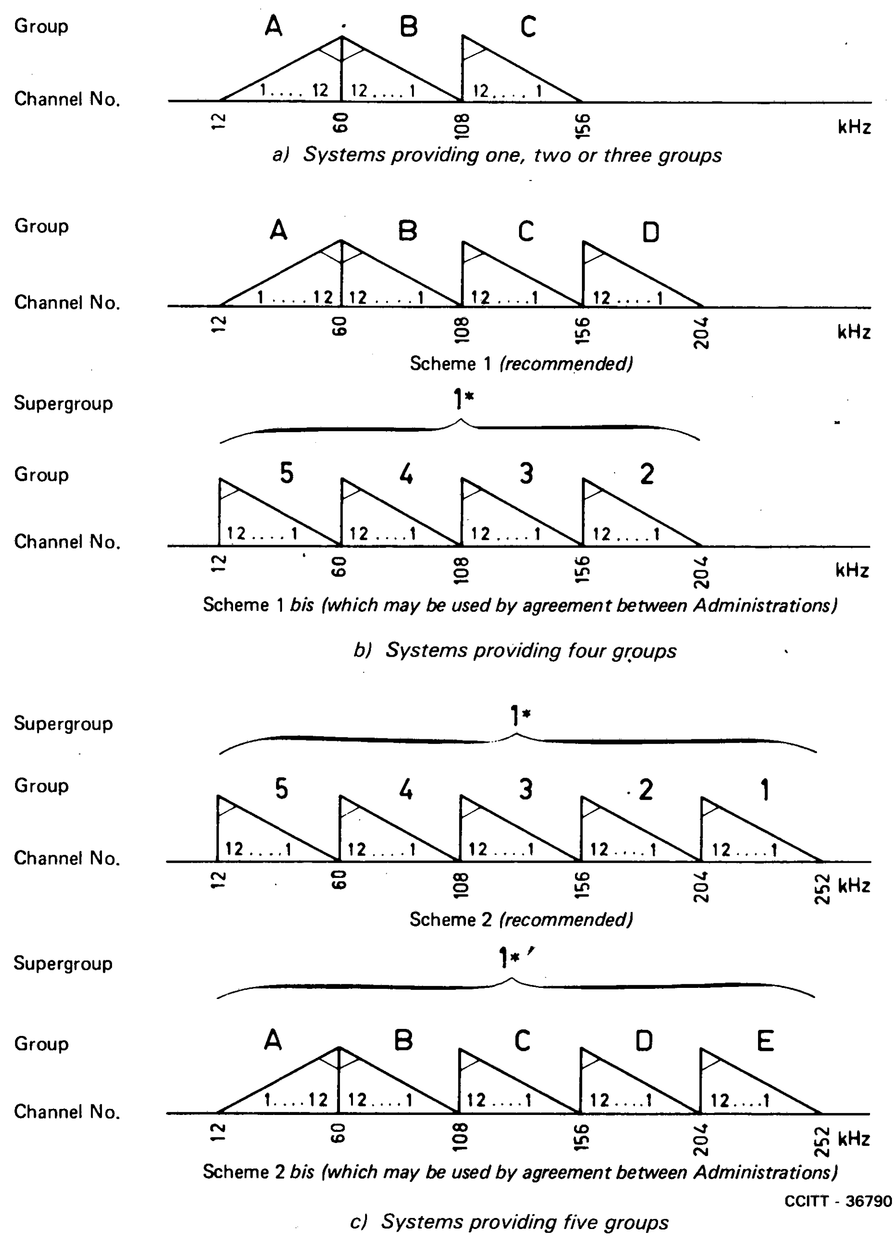
2.1 *Numbering in systems comprising both erect and inverted groups*

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.

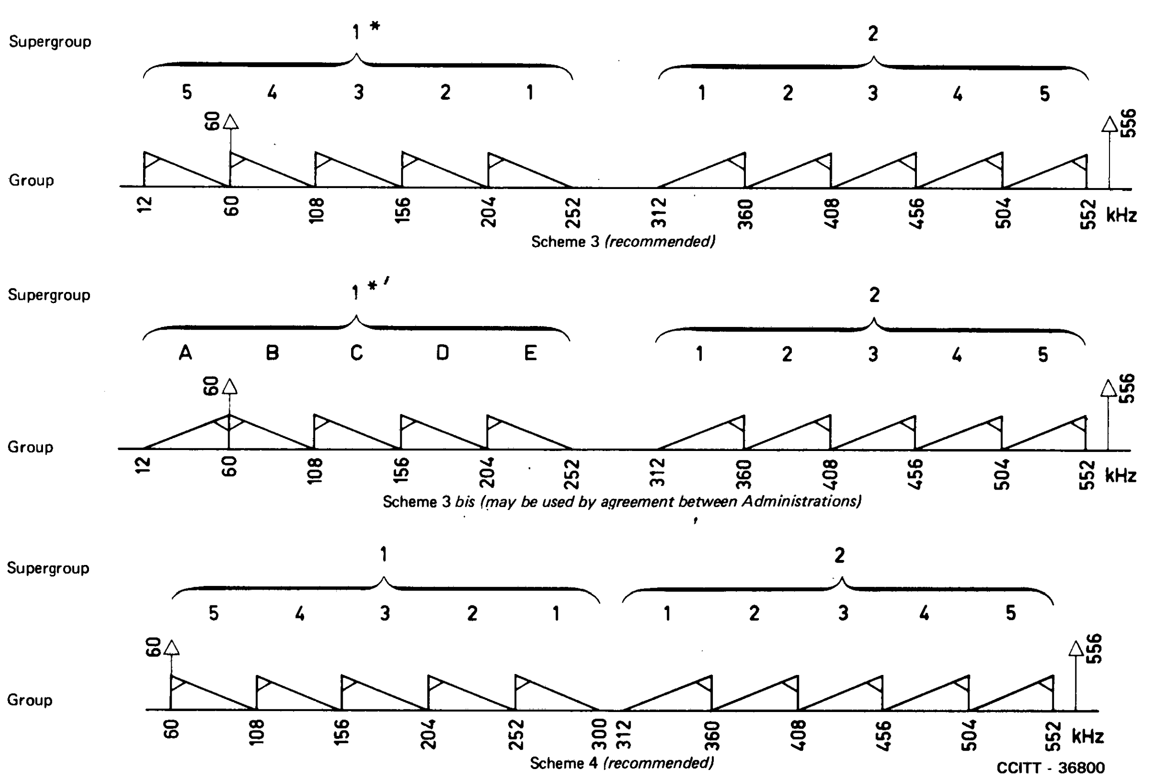


FIGURE 3/M.390

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] for values).

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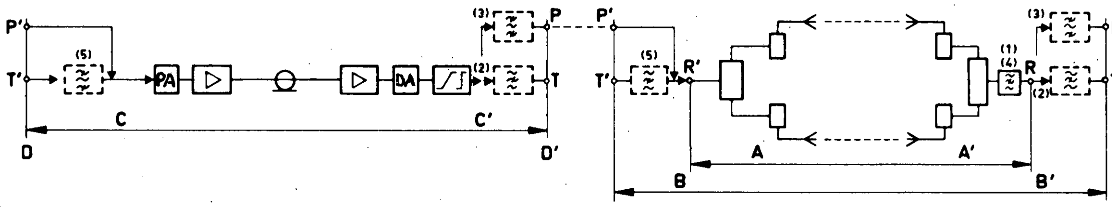
[1] The *technical service* represents the appropriate authorities within the international maintenance organization of an Administration which have the responsibility for making international agreements on engineering provision and maintenance matters, specifying provision and maintenance facilities, determining engineering and maintenance policy and overseeing its implementation.



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] 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 [4]:
  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 [4]:
  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 kHz 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 [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 [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 Novembre 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)
$\boxed{308}$	−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
1 056	−65.3	−6	−53.8	−65.3		−53.7	−65.1	−4	−53.8
1 304	−65.3	−6	−53.9	−65.4		−53.9	−65	−4	−53.9
1 800	−65.4	−4	−53.8	−65.5		−53.8	−65.4	−2	−53.9
2 296	−65.4	−4	−53.8	−65.5		−53.8	−65.4	−2	−53.9
2 792	−65.4	−6	−53.8	−65.4		−53.8	−65.4	−2	−53.9
3 536	−65.4	−8	−53.8	−65.4		−53.9	−65.4	−2	−53.9
4 032	−65.3		−53.6	−65.2		−53.7			
$\boxed{4\,287}$	−65.3	−4	−53.8	−65.3		−53.7	−64.8	−2	−53.8
4 648	−65.3		−53.8	−65.2		−54	−65.1		−53.9
5 144	−65.2		−54.9	−65.3		−54	−65.2		−54.1
5 640	−65.1	−6	−53.8	−65	Not used	−53.8	−65	−4	−53.8
6 136	−65		−53.9	−65		−53.8	−64.9		−54
6 632	−64.7	−8	−53.9	−64.7		−53.9	−64.9	−6	−53.8
7 128	−64.5		−53.9	−64.5		−54.1	−64.8		−53.8
7 624	−64.3		−53.9	−64.3		−54	−65.1		−53.8
8 124	−64	−6	−53.8	−64		−53.8	−63.9	−6	−53.7
8 864	−63.4		−53.9	−63.5		−54.1	−63.6		−53.7
9 360	−63	−8	−53.9	−63		−53.8	−62.8	−4	−53.7
9 856	−62.4		−53.9	−62.5		−53.8	−62.3		−53.6
10 352	−61.7		−53.8	−61.8		−53.8	−61.6		−53.6
10 848	−61		−53.8	−61		−53.9	−60.9		−53.6
11 344	−60.2	−6	−53.8	−60.2		−54.1	−60.4	−6	−53.8
12 340	−58.6		−53.9	−58.6		−54	−58.6		−53.7
$\boxed{12\,435}$	−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 Octobre 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	Sending	1.70	1.80	1.80	Sending	1.70	1.65	1.75
92	station	1.75	1.80	1.85	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, Annex I, ITU, Geneva, 1986.

[3] CCIR Recommendation *Interconnection at baseband frequencies of radio-relay systems for telephony using frequency-division multiplex*, Vol. IX, Rec. 380, ITU, Geneva, 1986.

[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, ITU, Geneva, 1986.

[9] CCIR Recommendation *Measurements of noise in actual traffic over radio-relay systems for telephony using frequency-division multiplex*, Vol. IX, Rec. 398, ITU, Geneva, 1986.

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.

Note – When group, supergroup, etc. links are used to provide the terrestrial links to a time division multiple access (TDMA) satellite system, the pilots are not transmitted over the satellite section. An alternative method of supervision for the individual circuits is described in Recommendation Q.33 [1].

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.

When the group link is assigned its designation (according to Recommendation M.140, §§ 5 and 6), the Administration with control station responsibility will assemble the necessary technical and operational information. This is entered into the list of *Related information* (as defined in Recommendation M.140, § 7) which consists of the items shown in Annex A.

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	1 552		−20
Basic supermastergroup	11 096		−20
Basic 15 supergroup assembly	1 552		−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.

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.

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[1] If the group-measuring frequencies are generated by applying 1020 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. For further information about the choice of the test signal frequency, refer to Recommendation O.6 [2].

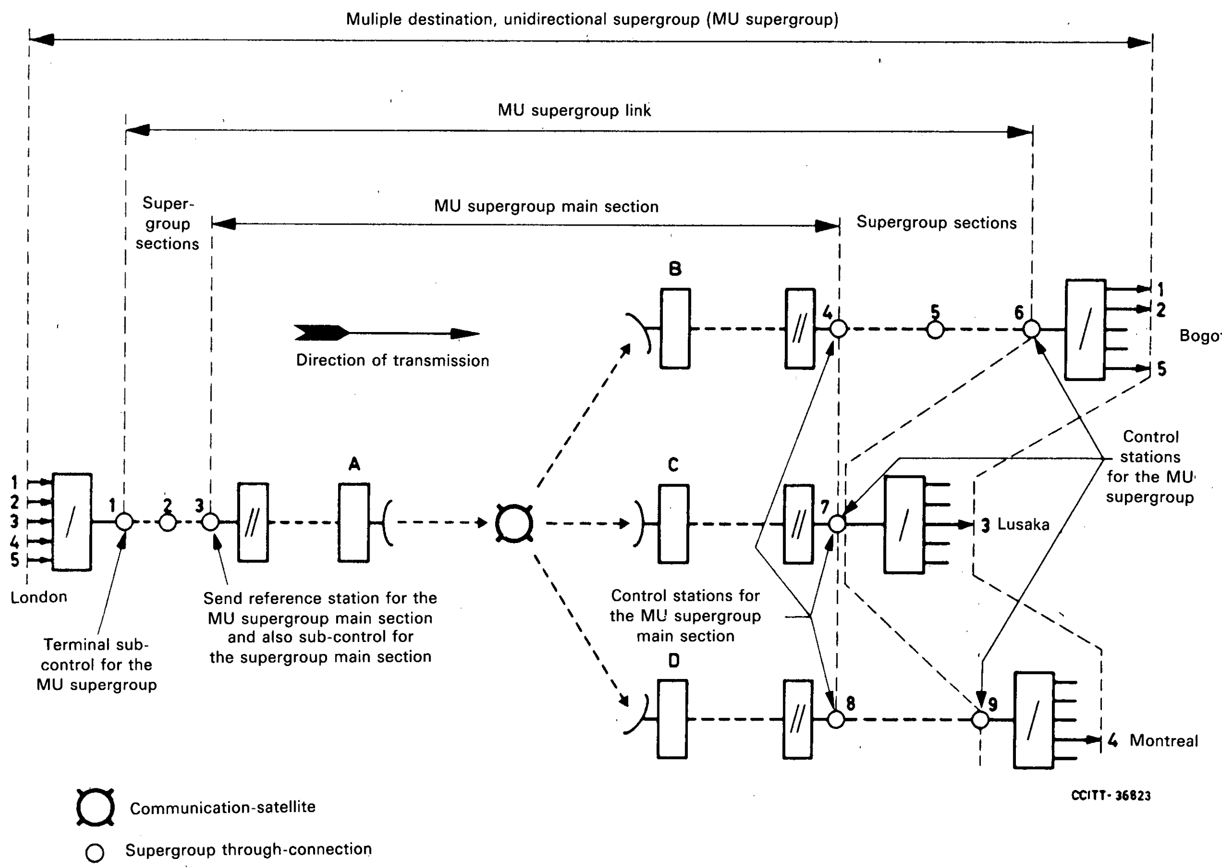


FIGURE 1/M.460

Arrangements for a multiple-destination, unidirectional supergroup (MU 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.

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.

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.

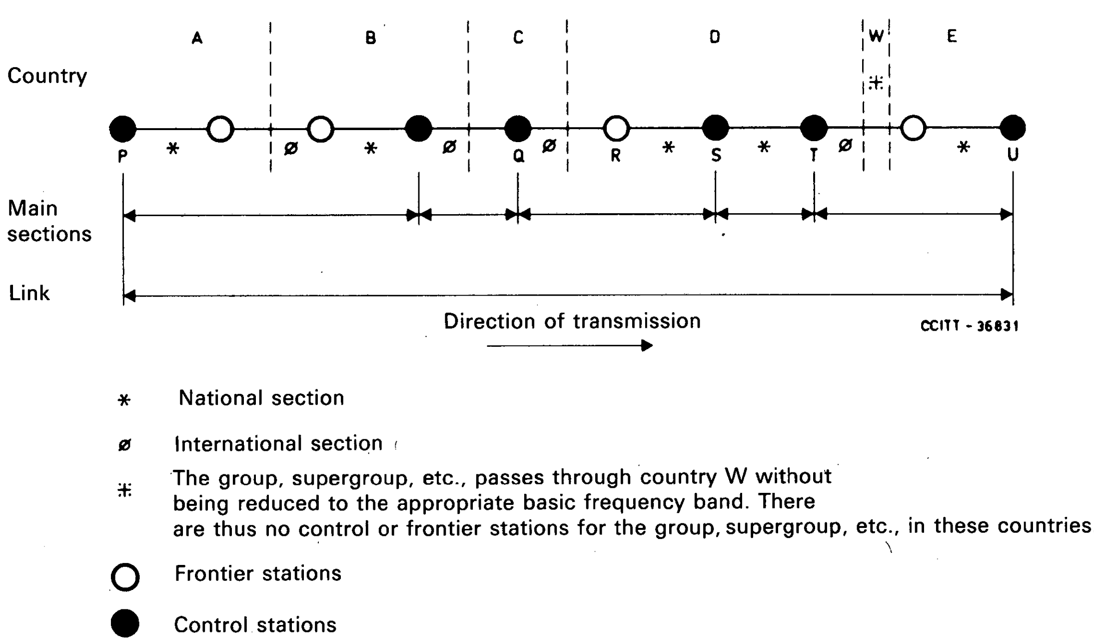


FIGURE 2/M.460

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. (See Supplement 3.6 [3].)

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 [4].)

The limits in Table 3/M.460 apply.

TABLE 2/M.460

Line-up limits

	Loss of reference or pilot frequency as appropriate		Loss/frequency response relative to loss at reference or pilot frequency		Remarks
	Groups (dB)	Supergroups (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	⩽ 320	321 to 640	641 to 1600	1601 to 2500	2501 to 5000	5001 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. It is recommended that these decoupled testing points be test hybrids because 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 [5], M.900 [6] and M.910 [7] concern such group links.

ANNEX A

(to Recommendation M.460)

Designation information on international group links, etc.

A.1 *Designation*

The designation is according to Recommendation M.140, §§ 5 and 6.

A.2 *Related information (RI)*

The additional information on groups etc. is covered by the following items:

RI 1. Urgency for restoration;

RI 2. Terminal countries;

RI 3. Carriers' names;

RI 4. Control and sub-control station(s);

RI 5. Fault report points;

RI 6. Routing;

RI 7. Association;

RI 8. Equipment information;

RI 9. Use;

RI 10. Transmission medium;

RI 11. (Empty item, use "– ;") only for the mixed analogue-digital network: End-to-end information;

RI 12. Bandwidth;

RI 13. Occupancy (for groups/supergroups, etc. and for line links).

The various items will be dealt with in § 7 of Recommendation M.140.

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.	Station 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 super-group	Number of coaxial system	Position of super-group	Desig-nation of radio link	Position of super-group	↓	↑	
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 station	Broadstairs, Oostende, London (Stag Lane)
Date of measurements	November 1978
Direction	London-Bruxelles

Distance (km)	Stations	Relative levels [1] dB									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]
		Test frequencies kHz															
		313	317	333	381	429	477	525	545	549							
	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 frequency(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 super-group followed by the position of the group in the super-group	↓	↑	
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 FOR 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	12,606 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 section 2)		Supergroup sections 3)		Nominal levels at through-group points dBr		Remarks 4)
		Pair numbers	Position of group	Super-group number	Position of the super-group followed by the position of the group in the super-group	↓	↑	
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 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 Kingdom
Group designation	London (Stag Lane) – Sydney (Broadway) 1214
Group length	12 606 km + satellite section
Control station	Sydney (Broadway)
Sub-control 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 *Protection against the effects of faulty transmission on groups and circuits*, Vol. VI, Rec. Q.33.

[2] CCITT Recommendation *1020 Hz test reference frequency*, Vol. IV, Rec. O.6.

[3] CCITT Supplement *Crosstalk test device for carrier-transmission systems on coaxial systems*, Vol. IV, Supplement No. 3.6.

[4] CCITT Recommendation *Assumptions for the calculation of noise on hypothetical reference circuits for telephony*, Vol. III, Rec. G.223.

[5] CCITT Recommendation *Characteristics of group links for the transmission of wide-spectrum signals*, Vol. III, Rec. H.14.

[6] CCITT Recommendation *Use of leased group and supergroup links for wide-spectrum signal transmission (data, facsimile, etc.)*, Vol. IV, Rec. M.900.

[7] CCITT Recommendation *Setting up and lining up an international leased group link for wide-spectrum signal transmission*, Vol. IV, Rec. M.910.

Recommendation M.470

SETTING UP AND LINING UP ANALOGUE CHANNELS FOR INTERNATIONAL TELECOMMUNICATION 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 1020 Hz test[1] signal is sent over each channel in turn at a level of −10 dBm0. 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] CCITT Recommendation *1020 Hz reference test frequency*, Vol. IV, Rec. O.6.

[2] CCITT Recommendations *Specifications of Signalling System R2*, Vol. VI, Recs. Q.400 to Q.490.

[1] For further information about the choice of the test signal frequency, refer to Recommendation O.6 [1].

Recommendation M.475

SETTING UP AND LINING UP MIXED ANALOGUE/DIGITAL CHANNELS FOR INTERNATIONAL TELECOMMUNICATION 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 1020 Hz[1)] test tone at a level of -10 dBm0 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.

2.1.2 *24-channel transmultiplexer at one end of the group links, with channel translating equipment at the other end*

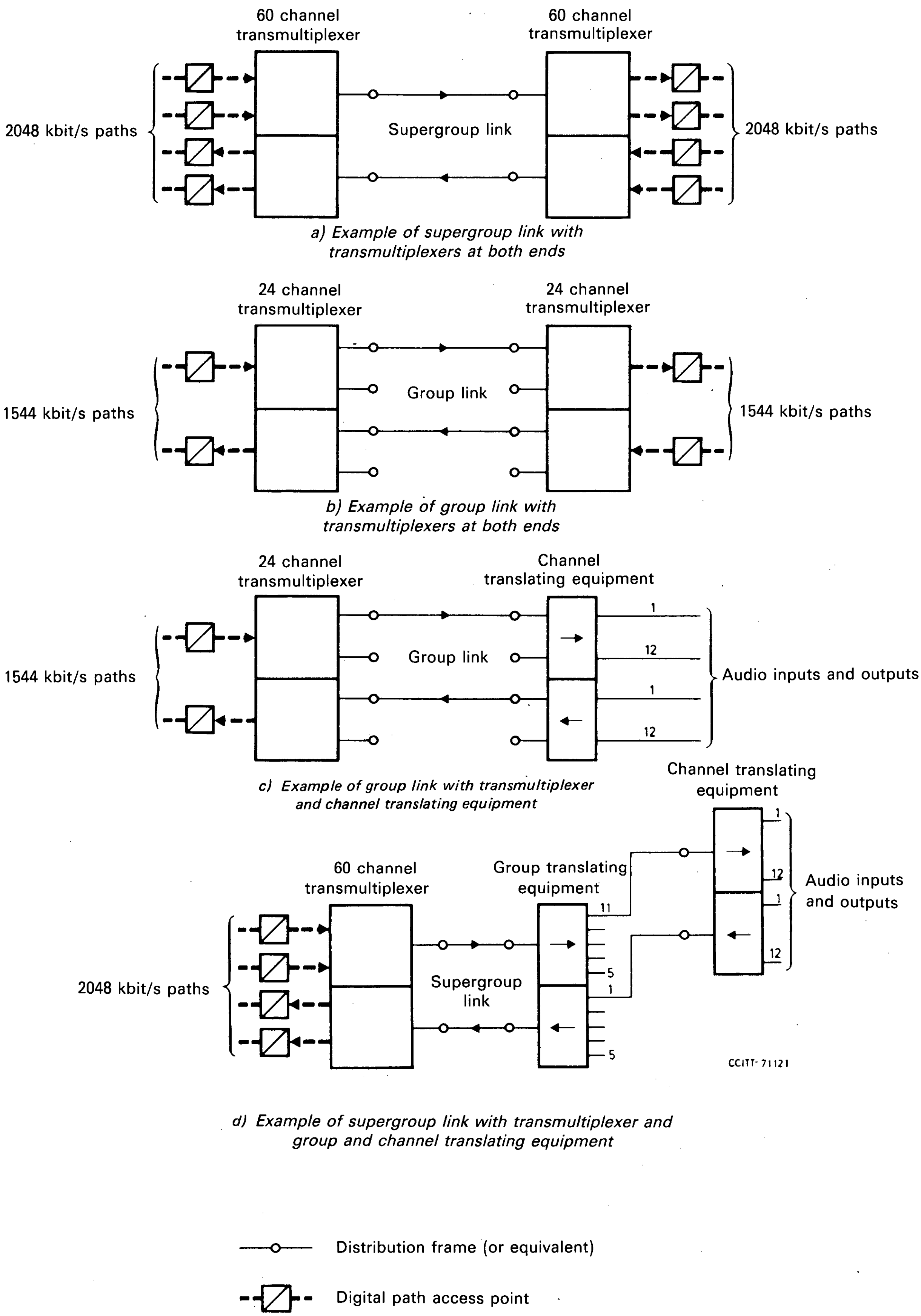
Note – This configuration is shown in c) of Figure 1/M.475.

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 1020 Hz[1)] test signal is sent over each channel in turn at a level of -10 dBm0. 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.

---

1) For further information about the choice of the test signal frequency, refer to Recommendation O.6 [1].



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

d) Example of supergroup link with transmultiplexer and group and channel translating equipment

FIGURE 1/M.475

Transmitting from the transmultiplexer towards the channel translating equipments, a bit sequence corresponding to 1020 Hz[2)] test tone at a level of -10 dBm0 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).

References

[1] CCITT Recommendation *1020 Hz reference test frequency*, Vol. IV, Rec. O.6

[2] CCITT Recommendations *Specifications of Signalling System R2*, Vol. VI, Recs. Q.400 to Q.490.

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)] For further information about the choice of the test signal frequency, refer to Recommendation O.6 [1].

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 0.6.00 (gmt):

ffm – luxemburg 6003
ffm – paris 6002
ffm – oslo 1202
ffm – rotterdam 6002, 6005
ffm – amsterdam 6002
amsterdam – budapest 1201
ffm – london 1214, 1246
dusseldorf – milano 6001

regards.

FIGURE 1/M.490

Example of a telex message concerning a planned outage of international groups and supergroups

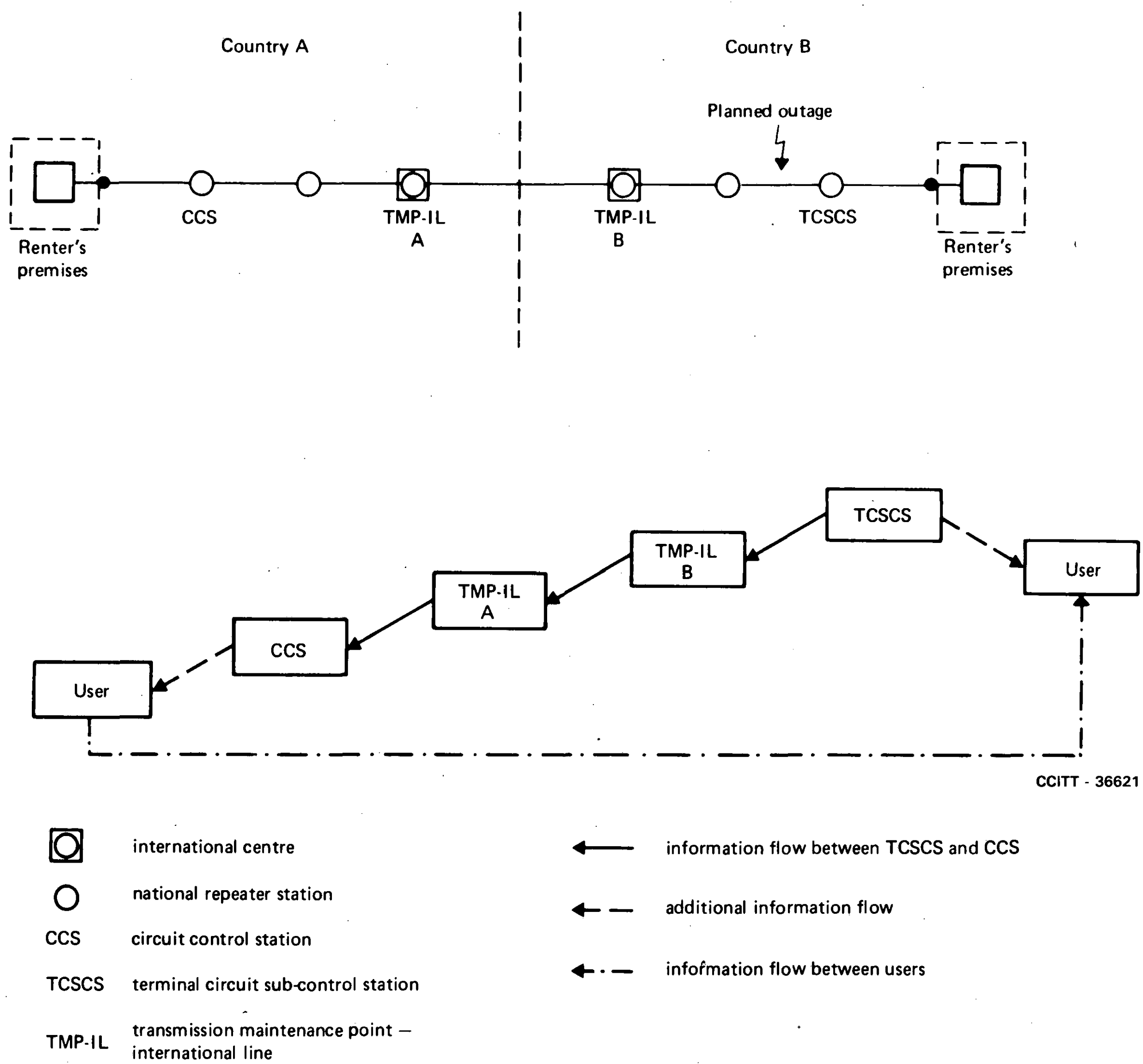


FIGURE 2/M.490

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.

Recommendation M.495

TRANSMISSION RESTORATION AND TRANSMISSION ROUTE DIVERSITY: TERMINOLOGY AND GENERAL PRINCIPLES

1 Purpose of transmission restoration and transmission route diversity

The purpose of transmission restoration and transmission route diversity is to protect the continuity and quality of international telecommunication services by minimizing the effects of potential effects of a transmission failure.

This Recommendation applies to both analogue and digital transmission.

Note – This Recommendation may also apply in the case of hazardous conditions.

2 Causes of transmission failures

The causes of transmission failures can be divided into three major categories:

- equipment failure: this can be reduced by improving equipment reliability;
- outages due to the operating organization. For example, maintenance work or human errors;
- external causes which are very difficult to prevent and for which specific protection might be needed. For example weather conditions or excavation work.

In this Recommendation, failures or faults that are referred to may be either total or partial failures or faults. The relevant terminology concerning failures and faults can be found in Supplement No. 6 [1].

3 Definitions concerning transmission restoration and transmission route diversity

The purpose of this terminology is to define a vocabulary which can be used in connection with transmission restoration and transmission route diversity.

Note – In this terminology, the term "link" is used as a generic term for digital section, digital path, group link or section, supergroup link or section, mastergroup link or section, supermastergroup link or section, line section, section and line link.

3.1 *Basic concepts*

3.1.1 **transmission restoration**

The different actions taken in order to restore the transmission of a signal affected by a transmission fault.

3.1.2 **transmission restoration function**

The ability to perform under stated conditions and within given time constraints the transmission restoration.

Note 1 – This function is aimed at increasing the transmission availability; it can provide transmission link supervision and control, the sending and receiving of control and check signals, and the changeover from normal to an alternative link, if necessary by assembling links.

Note 2 – This function can allow the restoration of failed transmission systems, links, groups, digital blocks, equipment, etc., as well as the restoration for maintenance purposes such as planned outages, or to remedy conditions that affect transmission such as fading.

Note 3 – The transmission restoration function can be implemented by equipment that is dedicated to it, or by equipment that has other functions, such as, for example, automatic digital distribution frames.

3.1.3 **transmission restoration function: direct transmission restoration (protection link switching)**

Direct transmission restoration is that category of transmission restoration function in which one transmission link between two stations is substituted for another between those two stations.

Note – This reflects a configuration in which M links proctect N links, or in which N+M links give redundancy to a relation requiring N links, with the extremities of all links in the same locations. It is recommended to use the expression N+M direct transmission restoration to designate such a configuration. See Figure 1/M.495.

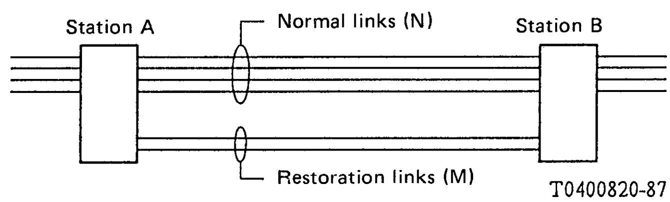


FIGURE 1/M.495

N+M direct transmission restoration system (protection link switching)

3.1.4 **transmission restoration function: automatic or semi-automatic transmission rerouting (protection network switching)**

Automatic or semi-automatic transmission rerouting is that category of transmission restoration function in which transmission links are assembled together and substituted for another link.

Note – This reflects a configuration in which a certain number of links form a restoration network and protect normal links. Within a given transmission station, or for a given switching equipment, M links protect N links. It is recommended to use the expression N+M automatic transmission rerouting to designate such a configuration.

Figure 2/M.495 shows un example. In Station A, M restoration links can be used for restoration of N normal. A link between A and B can be restored, for example, directly or via C.

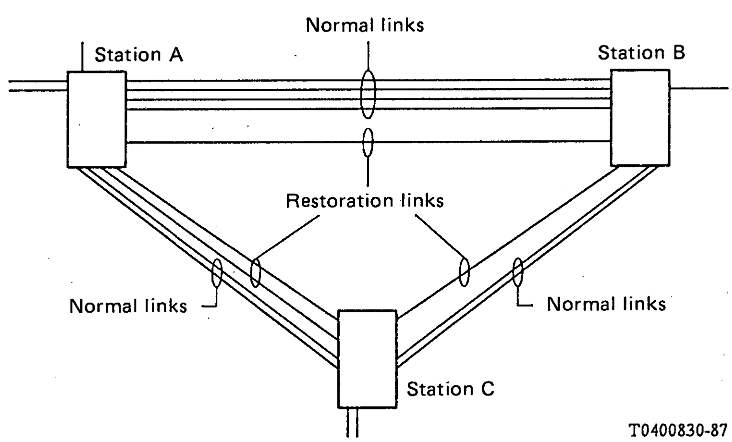


FIGURE 2/M.495

N+M automatic transmission rerouting system (protection network switching)

3.1.5 **transmission restoration function: 1 + 1 restoration**

1 + 1 restoration is that category of transmission restoration function in which one transmission link is substituted for another associated link, generally on another transmission route. See Figure 3/M.495.

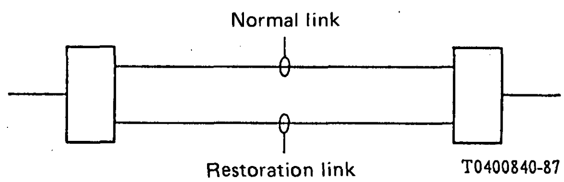


FIGURE 3/M.495

1 + 1 restoration system

3.1.6 **transmission restoration function: manual transmission rerouting**

Manual transmission rerouting is that category of transmission restoration function in which one transmission link is replaced manually by another when a complete or partial transmission route failure has occurred or when the normal route restoration link is not available due to a previous or simultaneous interruption, or when there is no such restoration link provided.

Note – Such rerouting is normally effected using plugs and cords.

3.1.7 **transmission restoration control function**

This is the function which decides whether restoration is necessary on the basis of information from the link supervision system or link alarms.

Note – The control function might be included in a specific equipment, or in the transmission restoration equipment itself, or within a restoration control centre. Control decisions can also be taken by people in, for example, a control centre.

3.2 *Systems and equipment*

3.2.1 **transmission restoration system**

A system that can be used to implement the transmission restoration function. An example is shown in Figure 4/M.495.

3.2.2 **transmission restoration equipment**

The part of the transmission restoration system that switches the transmission from the normal link to a restoration link.

3.2.3 **normal transmission link/equipment; normal digital block, group, supergroup, etc.**

A transmission link/equipment or a digital block, group, supergroup, etc., which is used for transmission under normal operating conditions.

3.2.4 **restoration link/equipment**

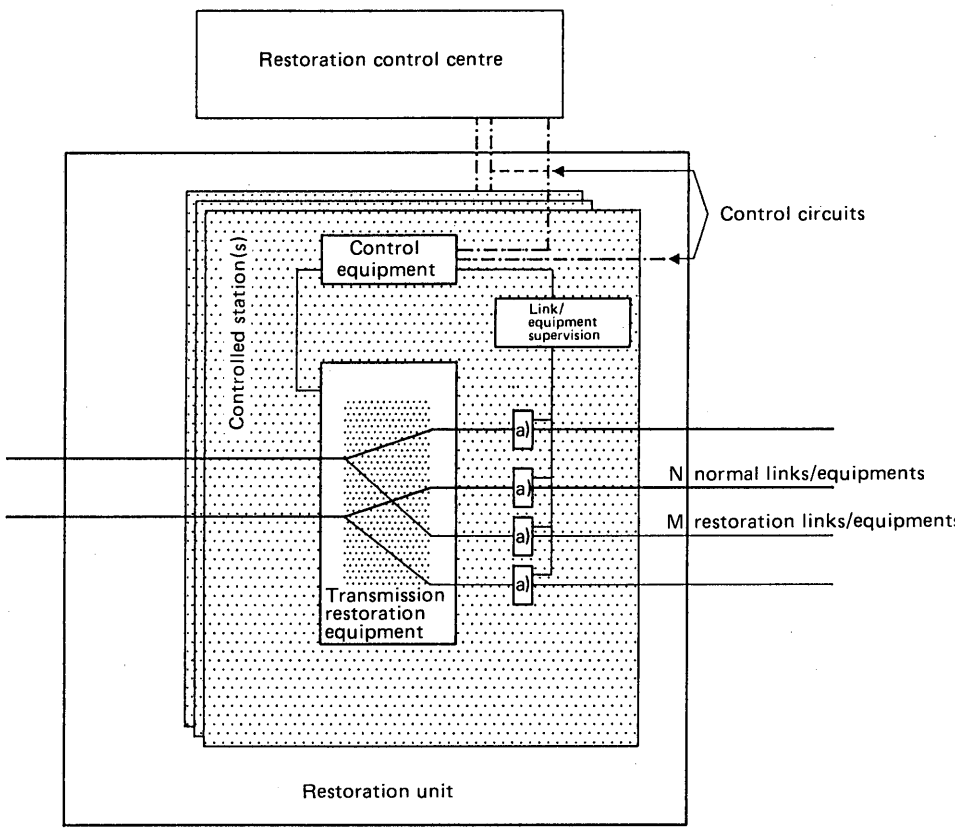
A transmission link/equipment which is used for transmission when the normal link/equipment is not available.

Note 1 – A restoration link or equipment is generally idle under normal operating conditions, but might be used under these conditions by low-priority traffic for which a lower degree of service availability is accepted.

Note 2 – Note 1 may not apply to 1 + 1 type restoration system where both links are carrying the traffic.

3.2.5 **restoration network**

The network formed by all restoration links.



a) Line terminal equipments and/or multiplex equipments

Note – This illustration is only an example. The structure of a transmission restoration system can be different (for example, the control function might be implemented within a restoration control centre, with no specific equipment).

FIGURE 4/M.495

Example of transmission restoration system

3.3 *Control* (see also Figure 5/M.495)

3.3.1 **control equipment**

An equipment that is used to implement the transmission restoration control function.

3.3.2 **restoration control centre**

A centre supervising all or part of normal and restoration transmission systems.

Note – A restoration control centre can be included within a control centre which is not dedicated to restoration.

3.3.3 **controlled station**

The station that has its systems, links and other maintenance elements supervised, where the information and commands for switching are sent to and received from, the control centre, and where the switching is effected.

3.3.4 **restoration unit**

All normal and restoration links and associated switching equipment capable of being controlled from a particular control centre.

Note – Some networks areas may be controlled from more than one control centre.

3.3.5 **control circuit**

A circuit used for the transmission of restoration control information.

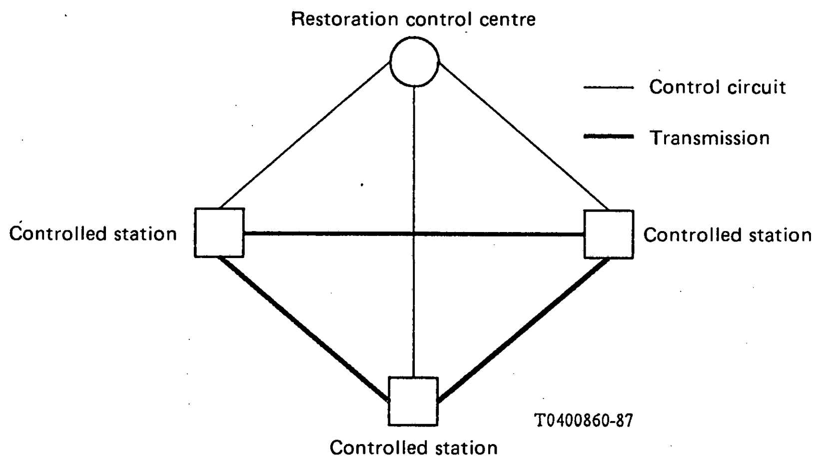


FIGURE 5/M.495

Restoration control

3.4 *Time intervals associated with transmission restoration processes*

The following time intervals are intended to describe the different time components between the failure of a signal and its restoration. These time intervals can be used to characterize those transmission restoration systems, equipment etc. See also figure 6/M.495.

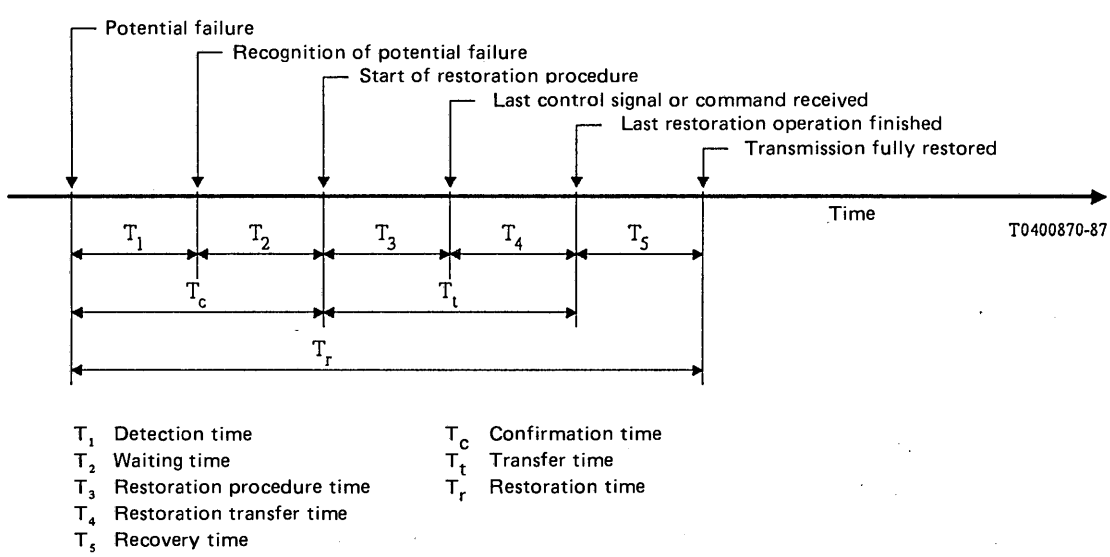


FIGURE 6/M.495

Defined restoration times

3.4.1 **detection time, T_1**

Time interval between a potential failure of transmission and the recognition of that potential failure.

3.4.2 **waiting time, T_2**

Time interval after the recognition of a potential failure and its confirmation as a fault requiring restoration.

3.4.3 **restoration procedure time, T_3**

Time interval between the confirmation of a fault and completion of the processing and transmission of the control signals required to effect restoration.

3.4.4 **restoration transfer time, T_4**

Time interval between completion of the processing and transmission of the control signals required to effect restoration and the completion of transmission restoration operations.

3.4.5 **recovery time, T_5**

Time interval between the completion of transmission restoration operations and the full restoration of failed transmission.

Note – This may include the verification of switching operations, re-synchronization of digital transmission, etc.

3.4.6 **confirmation time, T_c**

The time from the occurrence of the potencial failure to the instant when the fault is confirmed as requiring a restoration: $T_c = T_1 + T_2$.

3.4.7 **transfer time, T_t**

The time interval after the confirmation that a fault requires a restoration to the completion of the transmission restoration operation; $T_t = T_3 + T_4$.

3.4.8 **restoration time, T_r**

The time from the occurrence of the failure to the restoration of the faulty transmission: $T_r = T_1 + T_2 + T_3 + T_4 + T_5 =$ confirmation time + transfer time + T_5.

Note – An apparent fault might be detected by an equipment and not confirmed after the confirmation operations. In this case, only times T_1 and T_2 are relevant.

3.5 *Software related terms*

3.5.1 **network image**

Software description of the transmission network to be protected.

3.5.2 **fault definition program**

Program which collects fault information and defines faulty transmission links.

3.5.3 **restoration algorithm**

Method for forming restoration links for faulty normal transmission links.

3.5.4 **restoration control program**

A decision making program which controls restoration processes.

3.6 *Route diversity*

3.6.1 **transmission route**

A transmission facility on a specific medium used by a certain number of transmission systems between two stations.

Note 1 – For example, one cable between two stations could be regarded as one transmission route (whatever the number of systems using this cable might be) and a radio system between these two points could be regarded as an other route.

Note 2 – This definition represents a physical route; this is different from the term "route" which is defined in the Recommendations E.600 [2], Q.9 [3] and Z.341 [4], which represents a logical route.

3.6.2 **transmission route diversity**

The provision of at least two links between two nodes in a transmission network which are routed over different transmission routes.

Note – In case of a failure of one link, transmission route diversity allows some traffic between the two nodes still to be carried over the remaining link(s).

4 Principles of transmission restoration and transmission route diversity

4.1 *General principles*

4.1.1 In case of a fault of an international transmission system, complete and fast transmission restoration is a maintenance objective. Line and terminal equipment allocated for transmission 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.

4.1.2 When planning new routes or changes to existing routes, account should be taken of the requirements of restoration.

4.1.3 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 transmission link:

a) when the fault of an international transmission link takes place on a national section, restoration is solely the affair of the Administration involved;

b) when a fault takes place on an international section of an international route, restoration is the affair of the Administrations of the two countries directly involved, even if Administrations of other countries are concerned;

c) in the case of a satellite fault, 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 link permitted by the network (group link, supergroup link, etc.) taking into account the service which is carried;

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 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. Certain services might be considered as priority services by bilateral agreements; in this case, they should be grouped on groups or digital blocks that are restored in priority;

f) in the case where it is not possible to restore all circuits through the procedures envisaged under a), b), and c), each terminal Administration should make the necessary agreements to use all available routes lending themselves to restoration.

4.2 *Transmission restoration systems*

The following points regarding transmission restoration systems should be noted:

a) in the case when a transmission restoration network exists, it might be used under normal operating conditions for preemptible traffic. However, the restoration time might be a little longer when low priority traffic has to be interrupted before the restoration;

b) transmission restoration systems might be used for specific maintenance purposes such as planned outages. In this case, a planned restoration should be effected in such a way that the resulting impact on tranmission quality and availability is minimized;

c) certain normal transmission links may have a priority restoration, with preemption on restoration links. On these links should be routed groups and digital blocks bearing services that are considered having priority;

d) in general, when the normal transmission link can be used again, transmission is switched back from the restoration link. This switch-back can be made manually, semi-automatically or automatically; it should be made in such a way that the resulting impact on transmission quality and availability is minimized;

e) in certain cases, restoration of transmission might be effected separately for the receive and transmit directions;

f) in case of automatic or semi-automatic restoration systems, there should be a possibility of manual action for a forced restoration or an inhibition. This action has to be possible semi-automatically for automatic restoration systems;

g) transmission restoration systems should be built in such a way that a fault of one of its components or a maintenance action on it will result, in most cases, in minimal impact on normal transmission quality and availability.

4.3 *Transmission route diversity*

Transmission route diversity is a way of protecting circuits groups (a number of circuits with the same terminal points) against the effects of transmission failures. Circuit groups are divided into smaller groups which are carried on different transmission routes. In this way, a transmission faults of one transmission route does not completely interrupt the service.

For example, 60 public circuits between two exchanges can be divided into 2 groups of 30 circuits routed on cable and radio link. See Figure 7/M.495.

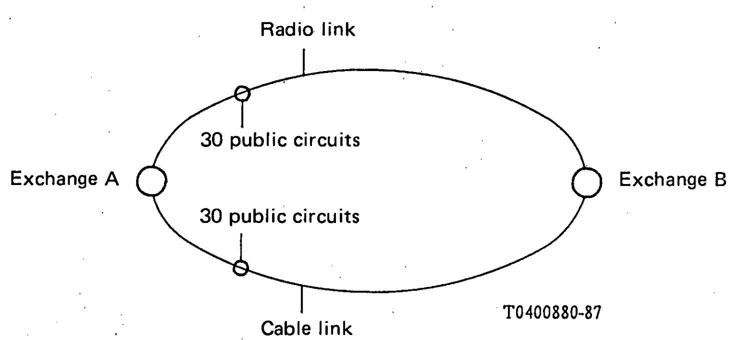


FIGURE 7/M.495

Diverse routing

4.4 *Restoration times*

4.4.1 It is useful to consider the restoration system in terms of the component time intervals involved. Some of these have been identified in the above terminology. These time intervals vary depending on whether the transmission system is analogue or digital. In the case of digital, the bit rate is also a factor.

4.4.2 It might be necessary, when specifying restoration times, and especially the confirmation time, to examine the different transmission restoration systems that might be used at the same time on a given link: for example, a 1+1 restoration system with its normal link beared by a transmission system protected by an N+1 direct transmission restoration system.

4.4.3 The aim for restoration time performance objective will come from service interruption objectives which were currently under study by CCITT.

There might be different aims for various types of failure and of restoration type: single transmission system or complete transmission route failure; automatic, semi-automatic or manual restoration, etc.

4.5 *Restoration criteria*

The criteria used to decide if a restoration action is necessary can be based upon transmission fault and also occurrence of bad quality (signal-to-noise ratio for analogue transmission, bit error ratio, thresholds of Recommendation G.821 [5] for digital transmission, etc.).

5 Methods of transmission restoration

5.1 *General*

The links provided for transmission restoration can be used in the event of both faults and planned outages. Methods for restoration will necessarily vary according to the particular system and circumstances involved. They will include transmission restoration and physical repair using manual, semi-automatic 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 transmission equipment at appropriate locations (for example analogue/digital, satellite/coaxial etc.).

5.2 *Automatic restoration*

Automatic restoration is possible with the use of automatic restoration systems, which can be of three main types:

- 1+1 transmission restoration;
- direct transmission restoration (protection link switching);
- automatic transmission rerouting (protection network switching).

The functional organization of these restoration systems is described within Recommendation M.496.

5.3 *Semi-automatic restoration*

Specific equipment and transmission restoration systems are introduced in order to allow automatic restoration. As any interruption of service is undesirable, especially in the case of planned outages, this equipment should generally allow the remote manual activation and control of automatic transmission rerouting systems in order to change from the normal route to a previously set-up and tested restoration route.

5.4 *Manual restoration*

The complexity of the evolving international transmission network demands flexibility in any transmission restoration arrangement. In general, transmission restoration can be achieved by manual switching, for example on analogue or digital distribution frames. In this case a distribution frame is necessary. The links used for transmission 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.

6 Considerations involved in planning transmission restoration systems

6.1 *Parameters to be taken into account:*

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 1 + 1 or more complex N + M relationship, involving N normal links being protected by M restoration links. 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 restoration and normal links;

b) transmission characteristics of the restoration link(s);

c) services to be restored and the acceptability of additional delay to confirm a fault and minimize switching (see § 4.4 of this Recommendation);

d) threshold at which fault is to be established (this may be adjustable in a range) (see § 4.5);

e) switching level in the multiplex hierarchy and whether any restorative switching is to be applied at more than one level;

f) manual or automatic switch-back techniques;

g) use of telemetry and control system, if required;

h) the need of a unidirectional or bidirectional system;

i) apportionment to the switches of the maximum degradation of the transmission characteristics (for example, maximum crosstalk, maximum unavailability. . .);

j) desirable restoration time (see § 4.4 of this Recommendation);

k) changed propagation time resulting from restoration over another route (this may be particularly important in the case of data transmission);

l) other functions that might be included in restoration equipment for maintenance purposes.

6.2 *Restoration network planning*

The restoration network should be dimensioned according to the objectives of the restoration capability for faulty transmission systems or equipment, as well as for planned outages.

One example of a method for dimensioning a restoration network without the help of simulation software is to add systematically a certain proportion of restoration links to the normal links.

Another method is to dimension the restoration network for the restoration of certain priority services in case of a single transmission route or transmission link fault. A priority protection for specific services would allow these services to have a better availability. This would allow the planning of a smaller and therefore cheaper restoration network that would be required for a systematic restoration of all transmission routes failures. The restoration network obtained in such a way would not only cost less in investment, but it would also serve to restore non-priority traffic when restoration links are available.

References

[1] CCITT Supplement *Terms and definitions for quality of service, network performance, dependability and trafficability studies*, Fascicle II.3, Supplement No. 6.

[2] CCITT Recommendation *Terms and definitions of teletraffic engineering*, Vol. II, Rec. E.600.

[3] CCITT Recommendation *Vocabulary of switching and signalling terms*, Vol. VI, Rec. Q.9.

[4] CCITT Recommendation *Glossary of terms*, Vol. VI, Rec. Z.341.

[5] CCITT Recommendation *Error performance of an international digital connection forming part of an Integrated Services Digital Network*, Vol. III, Rec. G.821.

Recommendation M.496

FUNCTIONAL ORGANIZATION FOR AUTOMATIC TRANSMISSION RESTORATION

This Recommendation is a description of the functional organization for three general types of automatic transmission restoration systems:

- 1+1 transmission restoration;
- N+M direct transmission restoration (protection link switching);
- N+M automatic rerouting (protection network switching).

The terminology and general principles of transmission restoration are described in Recommendation M.495. Specifications for equipment of the 1+1 restoration system type can be found in Recommendation G.181 [1]. Specifications for equipment of the N+M direct transmission restoration or automatic rerouting system type can be found in Recommendation G.180 [2].

1 1+1 transmission restoration

1.1 *Purpose of 1+1 transmission restoration*

1.1.1 1 + 1 restoration is used for the restoration of one group or digital block or link on one restoration link that is dedicated to its transmission restoration.

1.1.2 This type of restoration is generally reserved for specific services with a need for a very high availability.

1.1.3 As this method of restoration is rather expensive (duplication of transmission links), it is often effected, at the present time, at low hierarchichal levels (for example, group or primary digital block). This is a preventive protection, adapted to specific services, whereas restoration at the highest order group or digital block is a corrective protection for part of the network.

Figure 3/M.495 illustrates such a configuration.

1.2 *Method of transmission restoration*

1.2.1 The transmission signal is sent on the normal link and generally also on the restoration link at the same time.

1.2.2 In order to ensure the best availability of transmission, it is recommended to have the restoration link routed on a transmission route different from the route of the normal link.

1.2.3 Control equipment or a control function implemented in equipment with other functions, at both ends of the link, ensures link supervision and control and detects the occurrence of such conditions that may need a restoration action. Generally, there is no control circuit in such a transmission restoration system: control and switching can be done at both receive ends of the signal.

When a fault has been detected and confirmed, the switching equipment receives a command for a switching action.

1.2.4 If a switchback function is provided, when the normal link becomes available again for transmission, it is advisable to perform the switchback at a time when there is the least impact on the traffic concerned. At that time, a switching command is sent by the control equipment. The switching equipment switches back the transmission to the normal link.

This switching is normally effected in such a way that it has minimal impact on transmission quality and availability.

1.3 *Restoration time*

Restoration time should be kept as short as possible, in order to have minimal impact on service availability.

2 N + M direct transmission restoration (protection link switching)

2.1 *Purpose of N + M direct transmission restoration*

N + M direct transmission restoration systems provide M restoration links for N normal links. All the links have their terminal equipments located at the same locations.

Figure 1/M.495 illustrates such a configuration.

2.2 *Method of transmission restoration*

2.2.1 The M restoration links may be routed on the same transmission route as all, or part, of the N normal link; but preferably, some restoration links may be routed over a different route, so that a fault of a whole transmission route allows the restoration of some links.

2.2.2 This type of transmission restoration can be effected at all hierarchical levels. It is often used at the transmission system level.

2.2.3 At both ends of the links, control equipment (or a control function implemented in equipment) ensures link supervision and control, and detects the occurrence of a failure. The control circuits for this function might be on a restoration link, or on another link which is not one of the N normal links, or duplicated on at least 2 of the N normal links.

2.2.4 Some of the N normal links might have a higher priority. In this case, when one of them is in fault, it is restored in priority and can use a restoration link on a preemptive basis. This means that:

- in case of a simultaneous fault of several links, and if a complete restoration is not possible, only the highest priority links are restored;
- if all restoration links are in use and if a normal link having a priority higher than the priority of one of the restored links has a failure, the lower priority restored link is interrupted so that the link in fault can be restored.

2.2.5 When a restoration action has been detected, confirmed and accepted (restoration link available or priority link in fault), the switching equipment receives a command for a switching action. Switching might be effected at both ends systematically, but it is also possible to switch only the faulty direction, if necessary.

2.2.6 In the case of automatic switchback, after the normal link is available again for a normal transmission, the control equipment sends a switchback command. In this case, the switching equipment switches back the signal transmitted from the restoration link to the normal link. This switching is normally effected in such a way that it has a minimal impact on transmission quality and availability.

2.3 *Restoration time*

N + M direct transmission restoration is characterized by a requirement to detect a degraded or faulty normal link and switch to a restoration link in a time interval that is short enough not to cause established telephone calls to be released.

2.4 *Other considerations*

2.4.1 A restoration link might be used, when a restoration is not needed, for other purposes such as planned outages or non-priority traffic. In this case, it can be preferable that the N normal links have a preemption of the restoration link when they are in fault.

2.4.2 The maximum number N of normal links for one restoration has to be dimensioned correctly to avoid a too large number of non-restored faults. When a large number of links have to be restored, N + M direct transmission restoration (with $M > 1$) is necessary; in this case M restoration links can be used for the restoration of N normal ones.

2.4.3 The N + M direct transmission restoration is an automatic system, but it should also allow manual or semi-automatic (remote manual) actions, in order to force switching or inhibit restoration.

3 N + M automatic rerouting (protection network switching)

3.1 *Purpose of N + M automatic rerouting*

N + M automatic rerouting systems provide, on a single switching equipment, M restoration links to N normal ones. The restoration of 1 normal link is effected by a certain number of restoration links that are assembled together.

The restoration systems belong to a restoration network.

Figure 2/M.495 illustrates such a configuration.

3.2 *Method of transmission restoration*

3.2.1 At the present time, this type of restoration is generally effected at high hierarchical levels.

3.2.2 The organization of N + M automatic rerouting systems is generally complex: a network of normal links is protected by a network of restoration links.

There is a supervision and control of every link that can be done by or under the control of one or several restoration control centres. Restoration can be a specific function of a more general control centre.

3.2.3 After a failure is detected on a normal link, the restoration is normally effected according to certain preestablished restoration plans, if the restoration links are available. It is also possible to have a restoration plan computed after failure detection.

A certain number of restoration links are assembled together through switches located at the nodes of the network and connected to the faulty link through switches located at its ends.

3.2.4 It should also be possible to have manual or semi-automatic (remote-manual) action or inhibition of N + M automatic rerouting systems.

3.2.5 If a restoration plan fails or a restoration link used for a restoration has a failure, all restoration links involved in the restoration plan should be released.

3.2.6 After the fault of the normal link is removed, there can be a switchback to the normal link which should have a minimal impact on transmission quality and availability.

3.2.7 Certain equipment, such as automatic digital distribution frames, might have a function of N + M automatic rerouting but might not be dedicated to it.

3.3 *Restoration time*

As the operations of N + M automatic rerouting take network conditions into account, they can involve considerable data processing; they may entail all calls being cleared or lost before the operations are completed. Restoration times can be in the order of seconds, minutes, or even hours, depending on the complexity of the network and its state at that moment.

3.4 *Other considerations*

3.4.1 Restoration links might be used under normal conditions by low-priority traffic. In this case, there is generally a preemption by normal traffic in case of normal link failure.

3.4.2 As the restoration network might not be dimensioned for the total restoration of all transmission route interruptions and multiple failures, it might be necessary to define certain priorities among normal links. In this case, certain links might be restored in priority with preemption of restoration links used by non-priority links.

References

[1] CCITT Recommendation, *Characteristics of 1 + 1 type restoration systems for use on digital transmission links*, Rec. G.181.

[2] CCITT Recommendation, *Characteristics of N + M type direct transmission restoration systems for use on digital sections, links or equipments*, Rec. G.180.

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 [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.

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);

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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 [2].

– 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, ITU, Geneva, 1986.

[2] CCIR Recommendation *Measurement of noise using a continuous uniform spectrum signal on frequency-division multiplex telephony radio-relay systems*, Vol. IX, Rec. 399, ITU, Geneva, 1986.

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.

Recommendation M.525

AUTOMATIC MAINTENANCE PROCEDURES FOR INTERNATIONAL GROUP, SUPERGROUP, ETC., LINKS

1 General

In order to reduce corrective maintenance and minimize preventive maintenance in accordance with Recommendation M.20 the routine measurements of group, supergroup, etc. links may be carried out by automatic measurements without interruption.

Such routine measurements, where provided, should be for the same characteristics given in Recommendation M.460, e.g. overall loss, random noise, etc.

The decision to use automatic measurement procedures and the determination of intervals between routine measurements are matters for agreement by the concerned Administrations.

The need for readjustment based on the results of these measurements should be determined according to Recommendation M.530.

2 Frequencies and levels of test signals

The recommended frequencies for overall loss measurement are given in Table 1/M.525. The maintenance measurements can be made at some or all of those frequencies.

The test frequencies for group, supergroup, etc. links are chosen to fall between channels, groups, supergroups, etc. These frequencies are shifted at ± 80 Hz with respect to 4 kHz multiplied frequencies to avoid carrier leaks and other spurious tones interference. The automatic measurement equipment usually makes use of pre-defined software and/or hardware.

Test frequencies for supermastergroups are not shifted at ± 80 Hz, as they are located in wide guard intervals and do not coincide with carrier leaks and pilot frequencies.

Test frequencies 9008 kHz, 11 096 kHz and 11 648 kHz given in Recommendation M.460 should be shifted to avoid interferences between supermastergroup and mastergroup No. 7 and No. 9 pilot frequencies (see Recommendation M.350).

Test signal levels should generally not exceed −20 dBm0. A level of −10 dBm0 may be used for master and supermastergroup measurements. When the measurement of Group No. 3 (see Recommendation M.330) is being made, the test signal at 103.92 kHz has to be blocked, otherwide it is necessary to make the correction for the loss at the frequency 103.92 kHz, caused by the 411.86 kHz reject filter.

TABLE 1/M.525

Frequencies of test signals

Type of link	Frequencies (kHz)
Supermaster group	8516.3*, 8760, 9004, 9256, 9504, 9792, 10 080, 10 324, 10 576, 10 824, 11 150, 11 400, 11 644, 11 896, 12 144, 12 387.4*
Master group	812.6*, 871.92, 931.92, 1055.92, 1179.92, 1303.92, 1427.92, 1555.92, 1675.92, 1799.92, 1923.92, 1983.92, 2043.7*
Supergroup (4 kHz channels)	312.3*, 320.08, 328.08, 344.08, 360.08, 376.08, 392.08, 408.08, 432.08, 456.08, 472.08, 488.08, 504.08, 520.08, 536.08, 544.08, 551.4*
Group (4 kHz channels)	60.6*, 63.92, 67.92, 71.92, 75.92, 79.92, 83.92, 87.92, 91.92, 95.92, 99.92, 103.92, 107.7*

Note – As a rule the frequencies marked by an asterisk (*) cannot be used for measurements without traffic interruption. These frequencies may be used in the absence of traffic in the edge channels or a low level of test signal (below −45 dBm0).

Recommendation M.530

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.

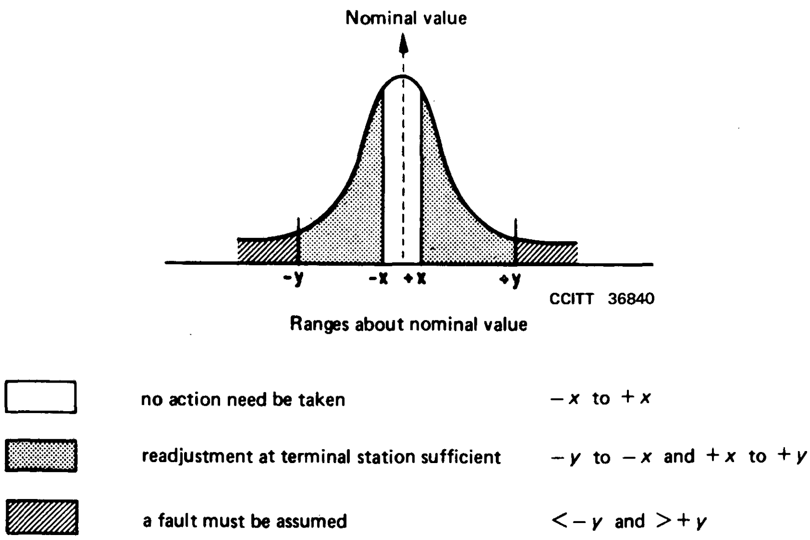


FIGURE 1/M.530

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.

Recommendation M.540

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	
2 supergroups		Line regulating 60 kHz 556 kHz	± 1 Hz ± 3 Hz	
	2.6 MHz	Line regulating 2 604 kHz	 ± 30 Hz	
Coaxial pair 2.6/9.5 mm	4 MHz	Line regulating 60 kHz 308 kHz 4 092 kHz Auxiliary 2 792 kHz	 ± 1 Hz ± 3 Hz ± 40 Hz ± 5 Hz	
		Additional measuring frequencies (all)	± 40 Hz	
	12 MHz	Line regulating 308 kHz 4 287 kHz 12 435 kHz	± 1 × 10^{-5}	Channel virtual carriers of a group ± 10^{-6} Groups and supergroups ± 10^{-7} Mastergroups and supergroups ± 5 × 10^{-8}
		Additional measuring frequencies: < 4 MHz > 4 MHz	 ± 40 Hz ± 1 × 10^{-5}	
	60 MHz	Line regulating 4 287 kHz 12 435 kHz 22 372 kHz 40 920 kHz 61 160 kHz	± 1 × 10^{-5}	
		Additional measuring frequencies (all)	± 1 × 10^{-5}	
Coaxial pairs 1.2/4.4 mm	1.3 MHz	Line regulating 1 364 kHz Auxiliary 60 or 308 kHz	 ± 1 × 10^{-5} ± 1 × 10^{-5}	
	4 MHz	Line regulating 60, 308, 4287 kHz	± 1 × 10^{-5}	
	6 MHz	Line regulating 308, 4287 kHz	± 1 × 10^{-5}	

TABLE 1/M.540 *(cont.)*

System	Frequency and accuracy	
	Reference pilot	Carrier generator
(1)	(2)	(3)
12 + 12	60 kHz ± 1 Hz Others by agreement between Administrations	Error in reconstituted frequency over a 140 km section and not to exceed 0.3 Hz (provisional value)
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	1 552 kHz ± 2 Hz	
Basic supermastergroup	11 096 kHz ± 10 Hz	
3 kHz spacing	84 kHz (or other frequency by agreement) ± 1 Hz	
Basic group and Basic supergroup	[a]	

[a] A supergroup reference pilot frequency of 444 kHz with a tolerance of ± 1 Hz is used.

2.6 Bringing into service and maintenance of international digital transmission systems

Recommendation M.550

PERFORMANCE LIMITS FOR BRINGING INTO SERVICE AND MAINTENANCE OF DIGITAL PATHS, SECTIONS, AND LINE SECTIONS

1 General

The purpose of this Recommendation is to provide limits for bringing into service, and limits for maintenance of digital paths, sections, and line sections in order to achieve the performance objectives given for ISDN in the Series G Recommendations. These objectives include error performance (Rec. G.821 [1]), slips (Rec. G.822 [2]), jitter and wander (Rec. G.823 [3] and Rec. G.824 [4]), and availability. This Recommendation presently only contains limits for error performance. The other limits are under study. This Recommendation describes the parameters to be mesured and the measurement techniques to be employed to meet the principles given in Recommendations M.20, M.32 and M.34.

The methods and procedures for applying these limits are described in Recommendation M.555 for the bringing into service procedures.

Since the performance limits are intended to satisfy the needs of the future digital network, it must be recognized that such limits cannot be readily achieved by all of today's digital equipment and systems. Nonetheless, it is intended that there will be a single set of limits that applies to all technologies.

It is desirable to do in-service, continuous measurements. In some cases e.g. for bringing into service, out-of-service measurements may be necessary.

This Recommendation covers all digital paths, sections, and line sections which operate at 64 kbit/s and higher, including the ISDN subscriber access described in Recommendation I.412 [5], and the network digital hierarchy described in Recommendation G.702 [6].

There is a need to reduce measured data to that which is essential and relevant to maintenance staff.

2 Allocation of objectives

Digital error performance objectives on which this Recommendation is based are given in Recommendation G.821 [1] for an end-to-end 64 kbit/s hypothetical reference connection (HRX) defined in Recommendation G.801 [7]. These objectives are further allocated in Recommendation G.821 [1] to local, medium, and high grade parts of the connection. However, maintenance limits are needed for smaller entities. Hence, a further allocation is necessary, so that limits can be developed for digital paths, digital sections, and digital line sections, as these are defined in Recommendation M.300. Following are described the reference models to be used when allocating the digital performance objectives on which bringing into service and maintenance limits will be based.

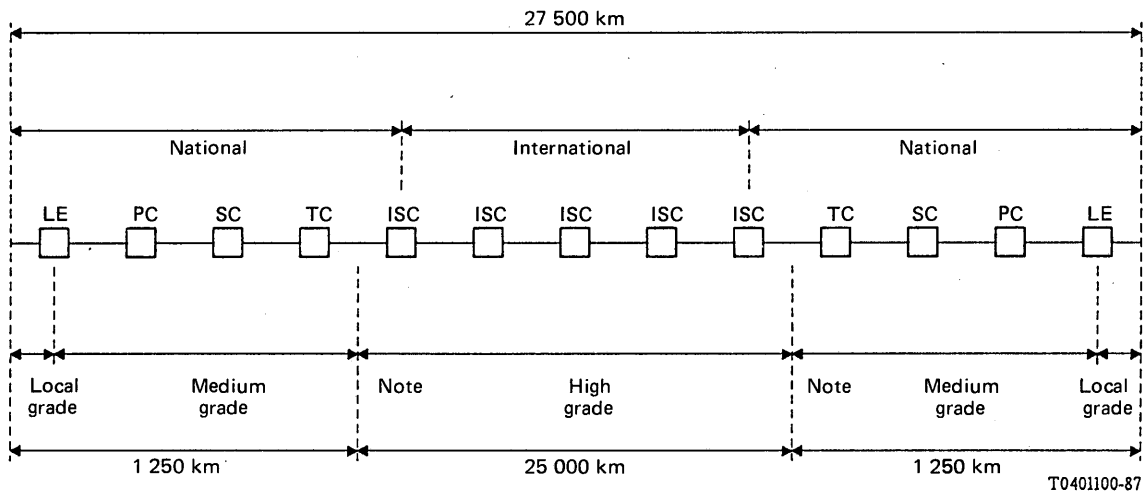
2.1 *Reference models*

The HRX of Recommendation G.801 [7] and the circuit quality demarcation of Recommendation G.821 [1] are shown combined in Figure 1/M.550.

The error performance objectives for this 64 kbit/s connection are given in Table 1/M.550.

Half of the overall severely errored seconds, (SES) objective of 0.2% is reserved as a block allocation to accommodate adverse network conditions (e.g. for digital radio systems) so the values in Table 2/M.550 apply to the remaining 0.1% SES. These overall objectives are further allocated to the circuit quality classifications of the HRX as shown in Table 2/M.550.

For Recommendation G.921 [8], a further allocation of objectives to hypothetical reference digital sections (HRDS) based on the 2.048 Mbit/s hierarchy is shown in Table 3/M.550. An HRDS is a digital line section in the terminology of Recommendation M.300.



Note – The exact boundary between medium and high grade circuit quality classification, which always occurs at an exchange, cannot be specified, since the 1250 km allowed for medium grade may not cover the entire distance from the local exchange to the international switching centre in large countries.

FIGURE 1/M.550

HRX and circuit quality demarcation

TABLE 1/M.550

Error performance objectives

Performance classification	Objective (maximum % of time)
Degraded minutes (DM)	10
Severely errored seconds (SES)	0.2
Errored seconds (ES)	8

TABLE 2/M.550

Allocation of objectives

HRX circuit quality classification	Percentage of objective
Local (each end)	15
Medium (each end)	15
High	40

TABLE 3/M.550

Digital line section quality classificaton for error performance

Section quality class	HRDS length (km)	Allocation (%)	For circuit class
1	280	0.45	High or medium
2	280	2	Medium
3	50	2	Medium
4	50	5	Medium

The allocation is a percentage of the overall objective for the HRX for Errored Seconds (ES), SES, and Degrated Minutes (DM). For shorter sections, there is no reduction in the allocation. For a longer section, its overall allocation should correspond to that of an integer number of HRDSs, the combined length of which is at least as long as the real section.

These figures and tables are simplified versions of those in Recommendations G.801 [7], G.821 [1], and G.921 [8]. For a full explanation, the original figures and tables, along with their footnotes, should be consulted.

The comparable allocations for the 1.5 Mbit/s hierarchy is under study in Recommendation G.911 [9].

2.2 *Allocation principles to be employed*

For this Recommendation, the allocation of the error performance objectives for each digital path, digital section and digital line section, as defined in Recommendation M.300, must be determined. This will be based on the allocation for the different parts of the HRX as defined in Recommendation G.821 [1], and on the allocations for digital line sections as defined in Recommendations G.911 [9] and G.921 [8].

The allocation principles for satellites are for further study, taking into account Recommendation G.821 [1].

The significant performance degradation of radio-relay systems tend to be concentrated into a few days or even hours (those times with severe fading). For this reason, a direct linear derivation of performance limits for shorter time periods from Recommendation G.821 [1] monthly performance objectives may not be suitable for digital sections containing radio-relay systems.

The effect of fluctuations that occur in radio-relay system performance, as well as to a lesser degree in other transmission media, requires further study to set appropriate bringing into service limits, maintenance limits and test durations.

2.2.1 *Allocation principles for sections*

The objectives to be used for digital line sections can be taken directly from Recommendations G.911 [9] and G.921 [8].

However, digital sections and digital paths are achieved by interconnections of digital line sections and multiplexing equipment at various hierarchical levels (8, 34, 45, 140 Mbit/s).

The performance allocation for digital sections is the sum of the allocations of the digital line sections from which the digital section is derived.

2.2.2 *Allocation principles for digital paths*

The allocation principles for the paths differ for bringing into service and for maintenance.

For bringing into service, the allocation is the same as that for digital sections, namely the sum of the allocations of the digital line sections from which the path is derived. This results in an allocation based on the real physical configuration of the path. If the performance objective for a path is denoted A, then:

$$A = \sum_j N_j \cdot Q_j$$

where

N_j Number of digital line sections of quality class j,

Q_j Allocation for a digital line section of quality class j.

For maintenance allocation, to minimize the number of thresholds that must be monitored in the exchange, a different objective is used, namely the maximum allowed allocation for the type of path. This allocation is determined by the class of exchange at each end of the path. The allocation principle is illustrated by the following example.

If the nominal section of Figure 1/M.550 is made up of the 1250 km medium grade allocation, the medium grade path allocations can be defined as:

A = Allocation for path LE-PC (local exchange-primary centre)

B = Allocation for path PC-SC (primary centre-secondary centre)

C = Allocation for path SC-TC (primary centre-tertiary centre)

D = Allocation for path TC-ISC (tertiary centre-international switching centre)

Further, let

W_i = Number of digital sections of class 1 (allocation 0.45%)

X_i = Number of digital sections of class 2 (allocation 2%)

Y_i = Number of digital sections of class 3 (allocation 2%)

Z_i = Number of digital sections of class 4 (allocation 5%)

where subscript i denotes the paths LE-PC (denoted as a), PC-SC (denoted as b), etc. with allocations A, B, etc., as defined above.

To meet the Recommendation G.821 [1] objectives, each Administration must jointly determine A to D and W_i to Z_i based on its transmission plan and on its network design in order to meet the equations below:

$$A + B + C + D \leqslant 15\%$$

$$A \geqslant 0.45\ W_a + 2.0\ X_a + 2.0\ Y_a + 5.0\ Z_a$$

$$B \geqslant 0.45\ W_b + 2.0\ X_b + 2.0\ Y_b + 5.0\ Z_b$$

$$C \geqslant 0.45\ W_c + 2.0\ X_c + 2.0\ Y_c + 5.0\ Z_c$$

$$D \geqslant 0.45\ W_d + 2.0\ X_d + 2.0\ Y_d + 5.0\ Z_d$$

For example, if the paths between the LE and PC in this Administration's network in the worst case are made up of two line sections of class 2 and one of class 3, then A must be $2 \times 2\% + 1 \times 2\% = 6\%$. Thus, $B + C + D$ must be $\leqslant 9\%$. Similarly, values of B to D can be selected.

3 Relationship between performance limits and objectives

3.1 *Relationship between short-term limits and long-term objectives*

The limits in this Recommendation are to be used to indicate the need for actions during the phases of maintenance and bringing into service. These procedures are intended to result in network performance which meets the performance objectives of the relevant Series G Recommendations. The particular parameters measured, the measurement duration, and the limits used for the procedure need not be identical to those used for specifying the performance objectives as long as they result in network performance which meets these objectives. For example, the error performance objectives refer to long periods, such as one month. However, practical considerations demand that maintenance and bringing-into-service limits be based on shorter measurement intervals.

Statistical fluctuations in the occurrence of anomalous events in time means that one cannot be certain that the long-term objectives are met. The limits on the numbers of events and the duration of measurements must be set to ensure that passing the tests will predict, with an acceptable level of confidence, that the long-term objectives will be met. The limits and durations given as examples below were arrived at after comparing limits derived from statistical theory to empirically observed network performance.

3.2 *Types of limits*

Limits are needed for several maintenance functions as defined in Recommendation M.20. This Recommendation provides limits for three of these functions: bringing into service, keeping the network operational (called maintenance here) and system restoration. Limits for commissioning (installation and acceptance testing) are not provided in CCITT Recommendations.

Bringing-into-service tests are rigorously done by measuring using a quasi-random signal source (QRSS) between digital junction interfaces. Due to the statistical character of the degradation in digital networks, these measurements should be long-term measurements. This applies to new equipment or routes. However, for practical reasons (a new path on a route with many paths already in-service, rearrangements of the network, etc.) the measurements between junctions may be reduced to a quick measurement and the supervision completed with performance monitoring equipment.

Two limits are provided for use in bringing-into-service testing. If performance is better than the first limit, the entity can be brought into service without doubt. If performance is between the two limits, further testing is necessary. Corrective action is required if performance is worse than the second limit. The definition of the limits are a function of a given allocation and of the measurement duration and will be based on a predictive model under study. These limits depend on Recommendation G.821 [1] parameters for a given bit rate.

Once entities have been placed into service, supervision of the network requires additional limits, as described in Recommendation M.20. This supervision is done on an in-service basis using performance monitoring equipment. The supervision process involves analyzing anomalies and defects detected by maintenance entities to determine if the performance level is normal, degraded, or unacceptable. Thus, degraded and unacceptable performance limits are required. In addition, a limit on performance after intervention (repair) is also required. It may be different than the bringing-into-service limit.

3.2.1 *Reference performance objectives*

The reference performance objectives are defined as the performance objectives for ES, SES, and DM directly derived from Recommendations G.821 [1], G.911 [9] and G.921 [8] using recommended allocations and from the additional allocations described above in § 2 for digital paths, sections and line sections.

Reference performance objectives are calculated on a long-term basis (one month is suggested). These form the basis from which limits for bringing into service and maintenance are set.

3.2.2 *Bringing-into-service limits*

The aging margin is the difference between the reference performance objective and the bringing-into-service limit. This margin should be as large as possible to minimize maintenance interventions.

This margin for digital line sections will depend on the procedures of individual Administrations. A stringent limit which is 10 times better than the reference performance objective and a measuring period of a few days should be used when previous commissioning tests have not been conducted.

When previous commissioning tests have been carried out, the out-of-service test for bringing into service can be conducted for a shorter period and does not require the same stringent limits.

Continuous in-service monitoring is required to provide sufficient confidence in the long-term performance. (Typically, commissioning tests have durations of several days and have more stringent limits than bringing-into-service tests).

The ageing margin for digital sections and paths is on the order of two times better than the reference performance objective. The testing duration will obviously be limited to no more than a few days.

All of these bringing-into-service limits and durations are for further study.

Two limits can be calculated:

- S1, a limit corresponding to a number of events (ES, SES, DM) under which the entity can be brought into service without any doubt;
- S2, a limit corresponding to a number of events above which it is necessary to improve the performance of the entity under test.

For an observed number of events between the values of S1 and S2 the entity may be conditionally be brought into service. It then becomes necessary to monitor the evolution of its performance during a longer period of time. This monitoring can be performed using the TMN surveillance capability. The value of S1 is equal to the bringing-into-service limit described above. The value of S2 can be derived from S1 using a statistical coefficient under study.

3.2.3 *Maintenance limits*

3.2.3.1 *Unacceptable performance limits*

This performance level is defined in Recommendation M.20 (§ 5.1.3).

The unacceptable performance limit for a given entity is at least 10 times worse than the reference performance objective. The monitoring duration is between 15 minutes and one hour.

3.2.3.2 *Degraded performance limits*

This performance level is defined in Recommendation M.20 (§ 5.1.3).

The degraded performance limit for a given entity is on the order of two times better for line sections and 1.3 times better for paths and sections than the reference performance objective. The monitoring duration may be a fixed duration that depends on the rate in the digital hierarchy.

3.2.3.3 *Performance limit after intervention (repair)*

This performance limit is on the order of eight times better than the reference preformance objective for digital line sections and the same as the bringing-into-service limit for digital paths and sections (see Recommendations M.35 and M.555).

3.2.4 *System restoration limits*

The "restoration indication signal" is used to control sytem restoration (under study).

3.3 *Performance limits*

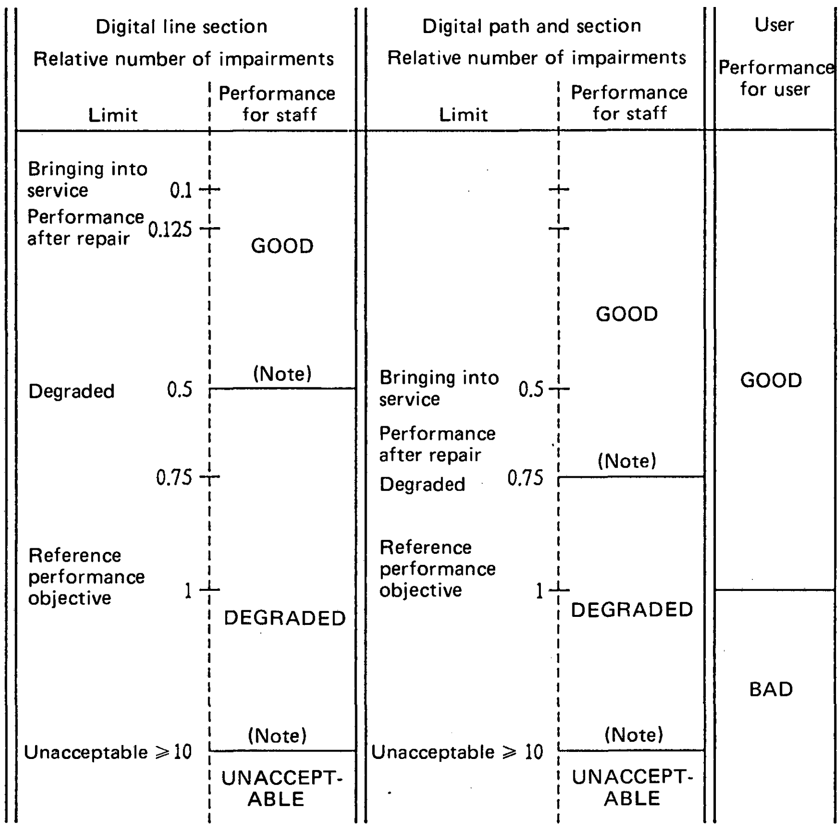
Performance limits are defined for Recommendation G.821 [1] parameters (ES, SES, DM). It is obvious that each performance limit will have its own threshold and will require its own measurement duration. Examples of the above principles and limits are shown in Figure 2/M.550.

3.4 *Translation of performance measurements*

Translation of performance measurements at primary rate and above, to error performance parameters at 64 kbit/s will follow the rules in Annex D of Recommendation G.821 [1].

3.5 *Use of thresholds*

The general strategy for the use of performance monitoring information and thresholds is described in Recommendation M.34. It is expected that these thresholds and information will be reported to operations systems via the TMN for both real time and longer term analysis. When thresholds of unacceptable or degraded performance level are reached [e.g. prompt maintenance alarm (PMA) or deferred maintenance alarm (DMA)], maintenance action should be initiated independently of the performance measurement. Other thresholds may be used for maintenance and longer term quality analysis. The operations systems will use real time processing to assign maintenance priorities to these thresholds and information, using the performance supervision process described in Recommendation M.20.



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Note – When exceeding these limits, the monitoring process should generate input information for the alarm information process (as defined in Rec. M.20).

FIGURE 2/M.550

Example of relative limits

4 Parameters for performance limits

The basic performance parameters to be estimated are ES, SES, and DM as defined in Recommendation G.821 [1]. This allows measurement of the unavailability of digital paths, sections, and line sections and of their performance. These parameters are measured using the concepts of anomalies and defects defined in Recommendation M.20 as shown in Figure 3/M.550.

4.1 *Basic performance parameters*

The basic performance parameters are the following:

– *Errored seconds (ES)*

  An errored second is a second with at least one anomaly or defect.

– *Severely errored seconds (SES)*

  A severely errored second is a second with a binary error ratio (BER) [as can be measured using a quasi-random signal source (QRSS)] greater than or equal to 10^{-3} or at least one defect (except slips).

  A pseudo-severely errored second is a second with at least N1 anomalies (when the anomaly is not a binary error, i.e. when it is an error indicator such as a code violation, CRC error, etc.) or one defect (except slips). The value of N1 is an estimator defined to correspond to a BER of 10^{-3} in one second. N1 is a function of the accuracy and efficiency of the anomaly detectors.

– *Degraded minutes (DM)*

A degraded minute is a group of 60 consecutive seconds, after excluding SES, with a BER of 10^{-6} or worse.

A pseudo-degraded minute is a group of 60 consecutive seconds, after excluding SES, with at least N2 anomalies or at least one slip (when the anomaly is not a binary error). N2 is calculated similarly to N1, to detect a BER of 10^{-6} in one minute.

Two techniques used to make these measurements are QRSS and performance monitoring.

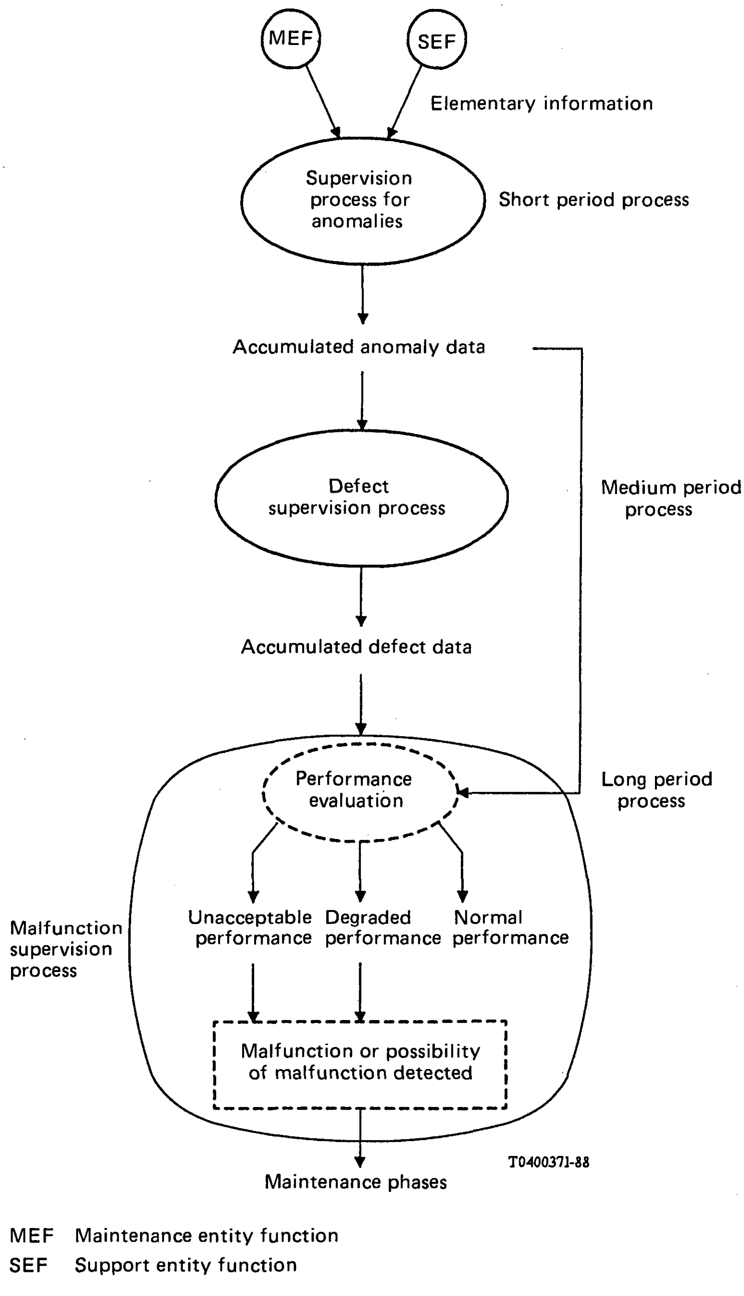

FIGURE 3/M.550

Supervision process for a maintenance entity

4.2 *Measurements using a QRSS*

When a QRSS is used to measure the basic performance for bringing into service or maintenance, the anomalies and defects detected by the measuring equipment are defined below.

4.2.1 *Anomalies*

Bit errors are the only types of anomalies detected by a QRSS measurement.

4.2.2 *Defects*

Loss of signal and loss of synchronization are the types of defects detected by a QRSS measurement.

4.3 *Measurements using performance monitoring*

When performance monitoring is used to estimate the basic performance parameters for maintenance, the anomalies and defects detected by network elements (NEs) are defined below. DM may be calculated in NEs or in an operations system.

4.3.1 *Anomalies*

Anomalies detected by NEs include the following:

a) Bit error indicators:
   - code violations,
   - CRC errors,
   - frame alignment signal errors,
   - block parity errors.

b) Loss of signal energy (possibly brief).

The probability of error detection must be specified for both Poisson and bursty error models. The efficiency (detected errors/actual errors) of the information generated will be taken into account in the establishment of the basic performance parameters. [1)]

4.3.2 *Defects*

Defects include the following parameters generated by the equipment:

- loss of frame alignment (or loss of synchronisation);
- loss of signal;
- alarm indication signal (AIS);
- alarm information to the remote end;
- slips;
- restoration indication signal (under study).

Loss of frame alignment is defined in G.704 [10] and AIS and alarm information to the remote end are defined in Recommendation M.20, § 5.4. A string of N_i zeros at bit rate i will be considered a loss of signal. The value of N_i is for further study.

5 Performance limits

Performance limits are expressed by the number of events in the specified time interval, not by the percent of time.

The tables are entered using the percent allocation of the overall objective that applies to the entity in question. These reference performance objectives are defined in § 2. They are calculated as follows:

$$\text{Reference performance objective} = \text{duration} \times \text{allocation} \times \text{objective}$$

6 Bringing-into-service and maintenance limits for digital line sections

The particular allocations given in Tables 4/M.550 and 5/M.550 are for the 2 Mbit/s hierarchy. No similar allocations exist for the 1.5 Mbit/s hierarchy.

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1) Further study is needed to relate these anomalies to the performance parameters specified in Recommendation G.821 [1], taking into account error distributions, e.g. Poisson and bursty, and algorithms for estimating performance parameter values from observed anomalies. This study needs to be coordinated with Working Party IV/2 and with Study Groups XV and XVIII.

The duration of the test indicated in the tables is for example only and requires further study. It should be noted that some Administrations use one duration (e.g. on the order of days) for the test of the first digital section in a block and a shorter duration (e.g. on the order of hours) for the remaining sections in that block that are brought into service within a few weeks. The possibility of using shorter test durations in those cases when in-service performance monitoring will be used following the bringing-into-service test is an area for further study.

TABLE 4/M.550

Bringing-into-service limits for 64 kbit/s digital line sections [a)]

Allocation (%)	Reference performance objective Events/4 days			S1 limit Events/4 days			S2 limit Events/4 days		
	ES	SES	DM	ES	SES	DM	ES	SES	DM
0.45	124	2	3	12	0	0	For further study		
2.0	553	7	12	55	1	1			
5.0	1382	17	29	138	2	3			

[a)] The bit rate translation rules of Annex D of Recommendation G.821 [1] must be applied to the measurements made at the entity rate in order to establish a comparison with the limits outlined in this table.

Note – The values in this table are for example only.

TABLE 5/M.550

Maintenance limits for 64 kbit/s digital line sections [a)]

Allocation (%)	Reference performance objective Events/24 hours			Unacceptable limit Events/15 minutes			Degraded limit Events/24 hours		
	ES	SES	DM	ES	SES	DM	ES	SES	DM
0.45	31	0	1	For further study			For further study		
2.0	138	2	3						
5.0	346	4	7						

[a)] The bit rate translation rules of Annex D of Recommendation G.821 [1] must be applied to the measurements made at the entity rate in order to establish a comparison with the limits outlined in this table.

Note – The values in this table are for example only.

6.1 *Performance limits for digital line sections at other rates*

Performance limits for digital line sections at other rates, e.g. 1.5, 2, 6, 8, 32, 45, 97 and 140 Mbit/s are for further study.

7 Bringing-into-service and maintenance limits for digital sections

The limits are shown in Tables 6/M.550 and 7/M.550.

The duration of the test indicated in the tables is for example only and requires further study. It should be noted that some Administrations use one duration (e.g. on the order of days) for the test of the first digital section in a block and a shorter duration (e.g. on the order of hours) for the remaining sections in that block that are brought into service within a few weeks. The possibility of using shorter test durations in those cases when in-service performance monitoring will be used following the bringing-into-service test is an area for further study.

TABLE 6/M.550

Bringing-into-service limits for 64 kbit/s digital paths and sections [a)]

Allocation (%)	Reference performance objective Events/3 days			S1 limit Events/3 days			S2 limit Events/3 days		
	ES	SES	DM	ES	SES	DM	ES	SES	DM
≤ 1	207	3	4	104	1	2	For further study		
≤ 2	415	5	9	207	3	4			
≤ 3	622	8	13	311	4	6			
≤ 4	829	10	17	415	5	9			
≤ 5	1037	13	22	518	6	11			
≤ 6	1244	16	26	622	8	13			

a) The bit rate translation rules of Annex D of Recommendation G.821 [1] must be applied to the measurements made at the entity rate in order to establish a comparison with the limits outlined in this table.

Note – The values in this table are for example only.

TABLE 7/M.550

Maintenance limits for 64 kbit/s digital sections [a)]

Allocation (%)	Reference performance objective Events/24 hours			Unacceptable limit Events/15 minutes			Degraded limit Events/24 hours		
	ES	SES	DM	ES	SES	DM	ES	SES	DM
≤ 1	69	1	1	For further study			For further study		
≤ 2	138	2	3						
≤ 3	207	3	4						
≤ 4	276	4	6						
≤ 5	346	4	7						
≤ 6	415	5	8						

a) The bit rate translation rules of Annex D of Recommendation G.821 [1] must be applied to the measurements made at the entity rate in order to establish a comparison with the limits outlined in this table.

Note – The values in this table are for example only.

7.1 *Performance limits for digital sections at other rates*

Performance limits for digital sections at other rates, e.g. 1.5, 2, 6, 8, 32, 34, 45, 97 and 140 Mbit/s are for further study.

8 Bringing-into-service and maintenance limits for digital paths

Bringing-into-service limits for digital paths are the same as those for digital sections, as shown in Table 6/M.550. The maintenance limits are given in Table 8/M.550.

TABLE 8/M.550

Maintenance limits for 64 kbit/s digital paths [a)]

Allocation (%)	Reference performance objective Events/24 hours			Unacceptable limit Events/15 minutes			Degraded limit Events/24 hours		
	ES	SES	DM	ES	SES	DM	ES	SES	DM
≤ 2.5	173	2	4	For further study			For further study		
≤ 3.5	242	3	5						
≤ 4	276	4	6						
≤ 5.5	380	5	8						
≤ 6	415	5	9						

a) The bit rate translation rules of Annex D of Recommendation G.821 [1] must be applied to the measurements made at the entity rate in order to establish a comparison with the limits outlined in this table.

Note – The values in this table are for example only.

8.1 *Performance limits for digital paths at other rates*

Performance limits for digital paths at other rates, e.g. 1.5, 2, 6, 8, 32, 34, 45, 97 and 140 Mbit/s are for further study.

ANNEX A

(to Recommendation M.550)

Example performance limits

A.1 *Calculation of performance limits*

The values in the following tables are for example only.

The reference performance objectives are calculated as specified in § 5. For example, the first three numbers in Table 4/M.550 are calculated as follows:

Number of ES $= 4$ days $\times 24 \times 60 \times 60 \times 0.0045 \times 0.08 = 124$

Number of SES $= 4$ days $\times 24 \times 60 \times 60 \times 0.0045 \times 0.001 = 2$

Number of DM $= 4$ days $\times 24 \times 60 \times 0.0045 \times 0.10 = 3$

The value of S1 is calculated as specified in § 3.2.2. For example, the first three values in Table 4/M.550 are calculated as follows:

Number of ES $= 0.1 \times$ Reference performance objective $= 12$

Number of SES $= 0.1 \times$ Reference performance objective $= 0.16 \approx 0$

Number of DM $= 0.1 \times$ Reference performance objective $= 0.26 \approx 0$

The value of S2 is calculated from S1 by applying a statistical parameter.

The values for unacceptable and degraded performance limits are calculated from the values specified in §§ 3.2.3.1 and 3.2.3.2 and include confidence limit in addition.

It is expected that the maintenance limits will be used as thresholds for continuous in-service performance monitoring. One crossing of these thresholds (e.g. after exceeding the limits specified in Table A-2/M.550 for 24 hours) would not necessarily generate information requiring human response. Rather, as noted in the footnote to Figure 2/M.550, it would be an input to the alarm information process, which would collect inputs until a representative value has been reached (which may occur over several days) and then process such values and generate alarm information requiring human response at the apropriate time.

A.2 *Example of bringing-into-service and maintenance limits for digital line sections*

The values of Tables A-1/M.550 and A-2/M.550 are measured at the rate of the digital sections and referred to the 64 kbit/s rate using Annex D of Recommendation G.821 [1].

TABLE A-1/M.550

Example of bringing-into-service limits for 64 kbit/s digital line sections

Allocation (%)	Reference performance objective Events/4 days			S1 limit Events/4 days			S2 limit Events/4 days		
	ES	SES	DM	ES	SES	DM	ES	SES	DM
0.45	124	2	3	12	0	0	25	1	1
2.0	553	7	12	55	1	1	75	2	2
5.0	1382	17	29	138	2	3	175	4	6

TABLE A-2/M.550

Example of maintenance limits for 64 kbit/s digital line sections

Allocation (%)	Reference performance objective Events/24 hours			Unacceptable limit Events/15 minutes			Degraded limit Events/24 hours		
	ES	SES	DM	ES	SES	DM	ES	SES	DM
0.45	31	1	1	50	10	10	30	1	1
2.0	138	2	3	50	10	10	90	2	3
5.0	346	4	7	50	10	10	200	5	8

A.3 *Example of bringing-into-service and maintenance limits for digital sections*

The values of Tables A-3/M.550 and A-4/M.550 are measured at the rate of the digital sections and referred to the 64 kbit/s using Annex D of Recommendation G.821 [1].

TABLE A-3/M.550

Example of bringing-into-service limits for 64 kbit/s digital paths and sections

Allocation (%)	Reference performance objective Events/3 days			S1 limit Events/3 days			S2 limit Events/3 days		
	ES	SES	DM	ES	SES	DM	ES	SES	DM
⩽ 1	207	3	4	104	1	2	130	2	3
⩽ 2	415	5	9	207	3	4	250	4	6
⩽ 3	622	8	13	311	4	6	360	6	9
⩽ 4	829	10	17	415	5	9	470	7	12
⩽ 5	1037	13	22	518	6	11	580	9	15
⩽ 6	1244	16	26	622	8	13	690	11	18

TABLE A-4/M.550

Example of maintenance limits for 64 kbit/s digital sections

Allocation (%)	Reference performance objective Events/24 hours			Unacceptable limit Events/15 minutes			Degraded limit Events/24 hours		
	ES	SES	DM	ES	SES	DM	ES	SES	DM
⩽ 1	69	1	1	100	12	12	51	2	2
⩽ 2	138	2	3	100	12	12	103	3	4
⩽ 3	207	3	4	100	12	12	155	4	6
⩽ 4	276	4	6	100	12	12	207	5	8
⩽ 5	346	4	7	100	12	12	259	6	10
⩽ 6	415	5	9	100	12	12	311	7	12

A.4 *Example of bringing-into-service and maintenance limits for digital paths*

The bringing-into-service limits for digital paths are the same as those for digital sections, as shown in Table A-3/M.550.

The values of Table A-5/M.550 are usually measured at the primary rate and referred to the 64 kbit/s rate using Annex D to Recommendation G.821 [1].

TABLE A-5/M.550

Example of maintenance limits for 64 kbit/s digital paths

Allocation (%)	Reference performance objective Events/24 hours			Unacceptable limit Events/15 minutes			Degraded limit Events/24 hours		
	ES	SES	DM	ES	SES	DM	ES	SES	DM
≤ 2.5	173	2	4	120	15	15	130	2	3
≤ 3.5	242	3	5	120	15	15	181	3	4
≤ 4	276	4	6	120	15	15	207	4	5
≤ 5.5	380	5	8	120	15	15	285	5	6
≤ 6	415	5	9	120	15	15	311	6	7

References

[1] CCITT Recommendation *Error performance of an international digital connection forming part of an integrated services digital network*, Vol. III, Rec. G.821.

[2] CCITT Recommendation *Controlled slip rate objectives on an international digital connection*, Vol. III, Rec. G.822.

[3] CCITT Recommendation *The control of jitter and wander within digital networks which are based on the 2048 kbit/s hierarchy* Vol. III, Rec. G.823.

[4] CCITT Recommendation *The control of jitter and wander within digital networks which are based on the 1544 kbit/s hierarchy*, Vol. III, Rec. G.824.

[5] CCITT Recommendation *ISDN user-network interfaces – Interface structures and access capabilities*, Vol. III, Rec. I.412.

[6] CCITT Recommendation *Digital hierarchy bit rates*, Vol. III, Rec. G.702.

[7] CCITT Recommendation *Digital transmission models*, Vol. III, Rec. G.801.

[8] CCITT Recommendation *Digital sections based on the 2048 kbit/s hierarchy*, Vol. III, Rec. G.921.

[9] CCITT Recommendation *Digital line sections at 1544 kbit/s*, Red Book, Vol. III, Rec. G.911, ITU, Geneva, 1984.

[10] CCITT Recommendation *Functional characteristics of interfaces associated with network nodes*, Vol. III, Rec. G.704.

Recommendation M.555

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.

Note – When digital paths are used to provide the terrestrial links to a time division multiple access (TDMA) satellite system, the usual digital system supervisory signals (AIS, remote alarm, etc.) are not transmitted over the satellite section. An alternative method of supervision for the individual circuits is described in Recommendation Q.33. [1].

When the block or path is assigned its designation (according to Recommendation M.140 §§ 9 and 10), the Administration with control station responsibility will assemble the necessary technical and operational information. This should be entered into the list of related information (as defined in Recommendation M.140, § 12) which consists of the items shown in the Annex A.

2 Digital system arrangements

2.1 *Digital hierarchy*

The layout of the presently identified hierarchical digital bit rates is given in Table 1/M.555, both for hierarchies based on 1544 kbit/s systems and for hierarchies based on 2048 kbit/s systems.

TABLE 1/M.555

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.

2.2 *Digital interworking arrangements*

(The standard digital interworking arrangements presently under study by Study Group XVIII will be shown when they are available).

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.

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.555.

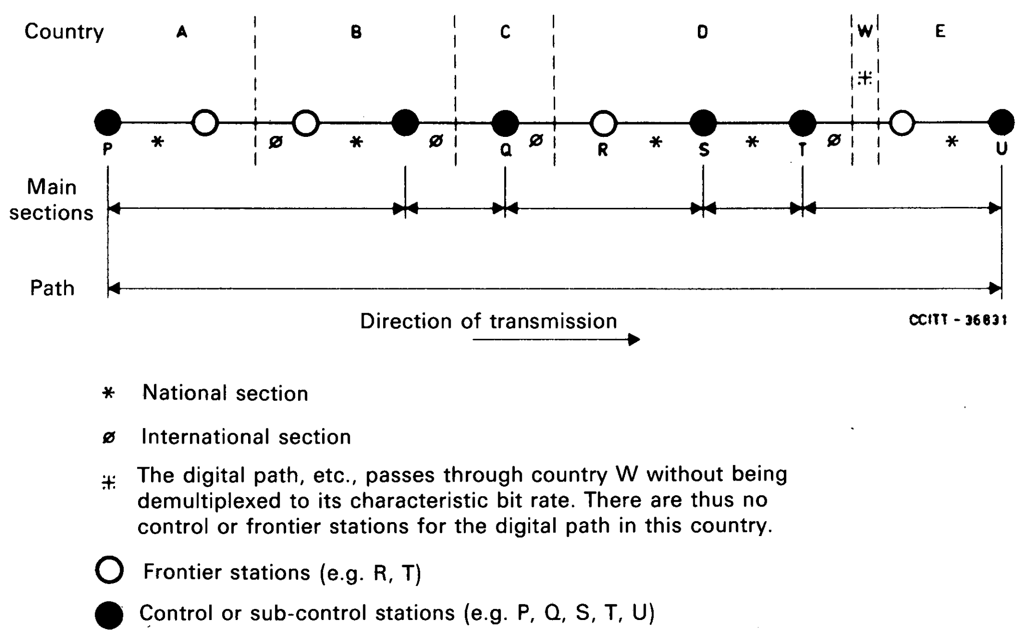

FIGURE 1/M.555

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.555 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.555.

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.555:

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 [2].

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 [2]. 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.555

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 [3].

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.

ANNEX A

(to Recommendation M.555)

Designation information of international digital blocks and paths

A.1 *Designation*

The designation is according to Recommendation M.140, §§ 9 and 10.

A.2 *Related information*

The additional information on digital blocks, etc. is covered by the following items:

RI 1. urgency for restoration;
RI 2. terminal countries;
RI 3. carriers' names;
RI 4. control and subcontrol station(s);
RI 5. fault report points;
RI 6. routing;
RI 7. association;
RI 8. equipment information;
RI 9. use;
RI 10. transmission medium;
RI 11. (empty item, use "–"); only for the mixed analogue/digital network: end-to-end information;
RI 12. bit rate;
RI 13. occupancy (for blocks);
RI 14. actual number of channels (for primary blocks);
RI 15. clocking information (for blocks);
RI 16. direction of transmission (for unidirectional blocks).

The various items will be dealt with in § 12 of Recommendation M.140.

References

[1] CCITT Recommendation *Protection against the effects of faulty transmission on groups and circuits*, Vol. VI, Rec. Q.33.

[2] CCITT Recommendation *Error performance measuring equipment for digital systems*, Vol. IV, Rec. O.151.

[3] CCITT Recommendation *Error performance of an international digital connection forming part of an integrated services digital network*, Vol. III, Rec. G.821.

Recommendation M.556

SETTING UP AND INITIAL TESTING OF 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.555 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. This procedure is an alternative to the mixed analogue/digital terminal circuit section line-up procedure in CCITT Recommendation M.580.

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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.

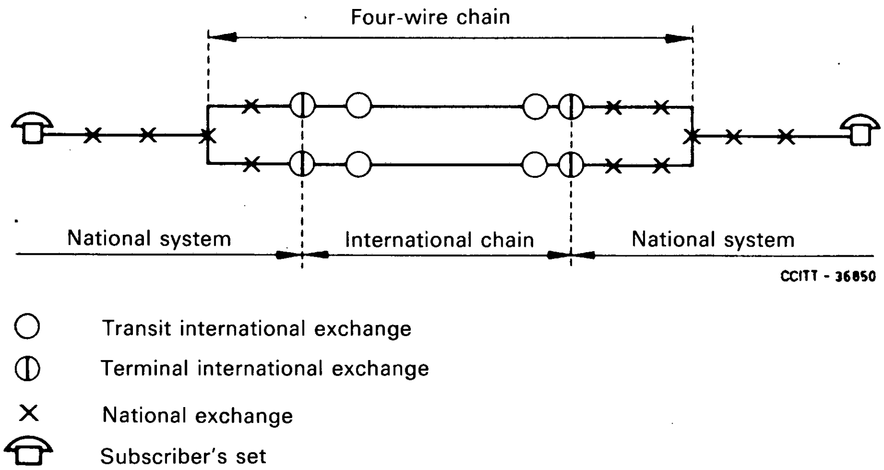


FIGURE 1/M.560

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*

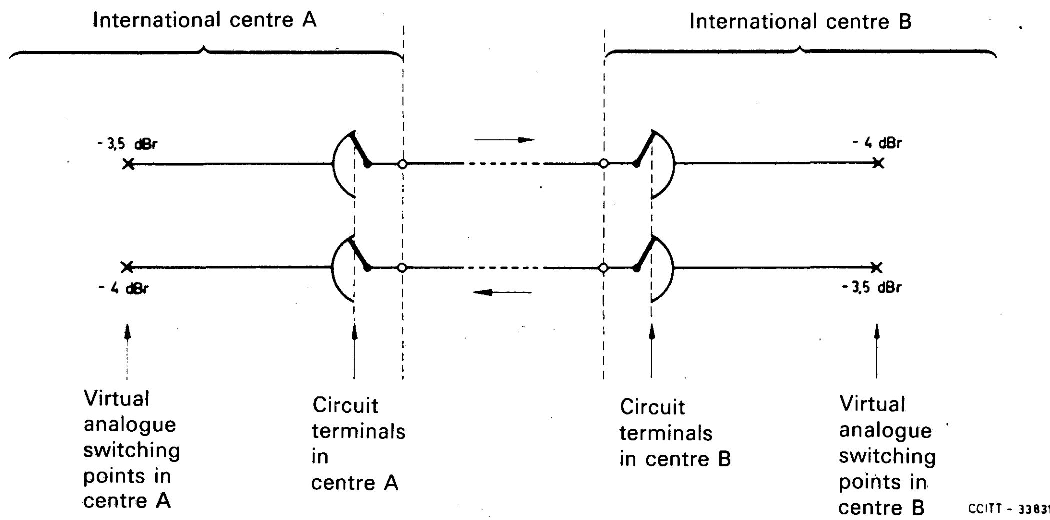
The virtual analogue switching points of an international 4-wire telephone circuit are fixed by convention at points of the circuit where the nominal relative levels at the reference frequency are:

- 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.

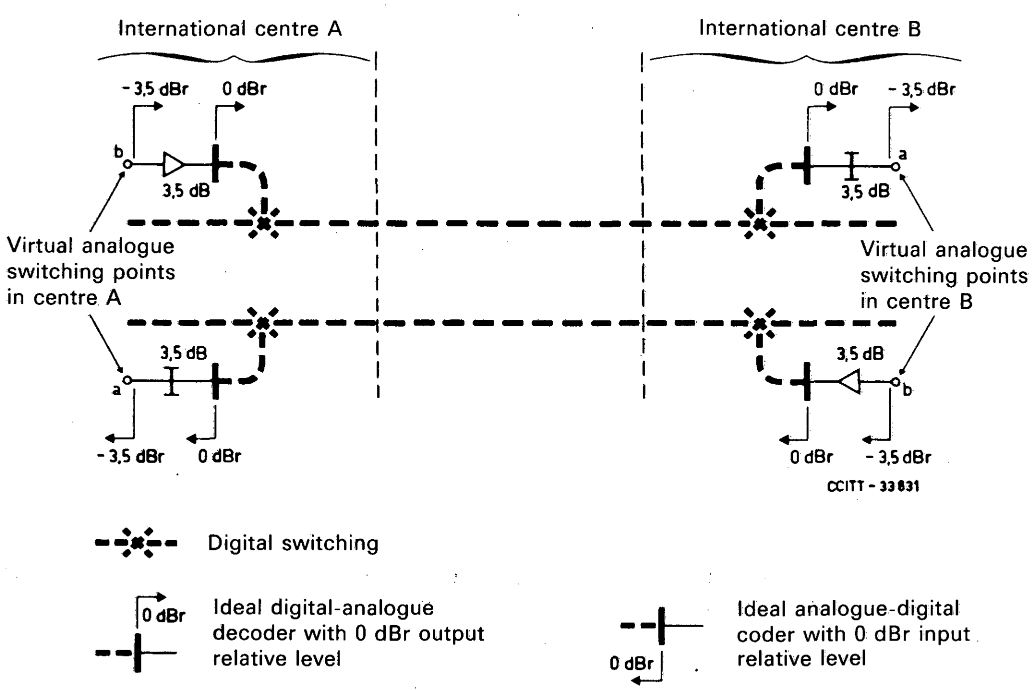
The nominal transmission loss of circuits at the reference frequency between virtual analogue switching points is therefore 0.5 dB for both analogue and mixed analogue/digital circuits and 0 dB for digital circuits.

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



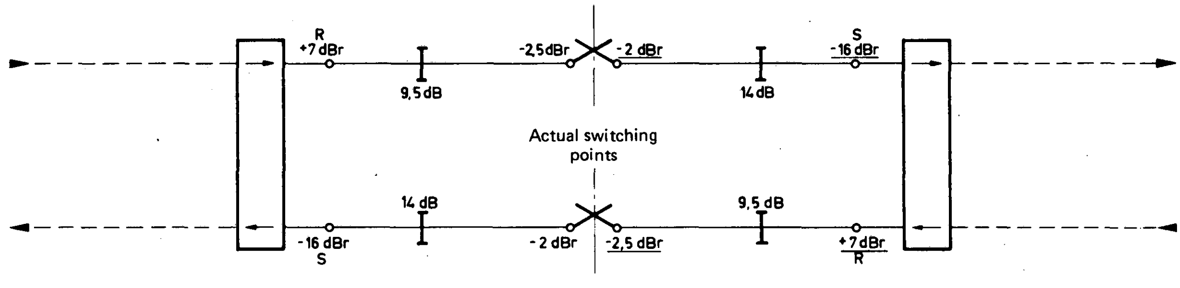
b) Wholly digital circuit showing virtual analogue switching points

FIGURE 2/M.560

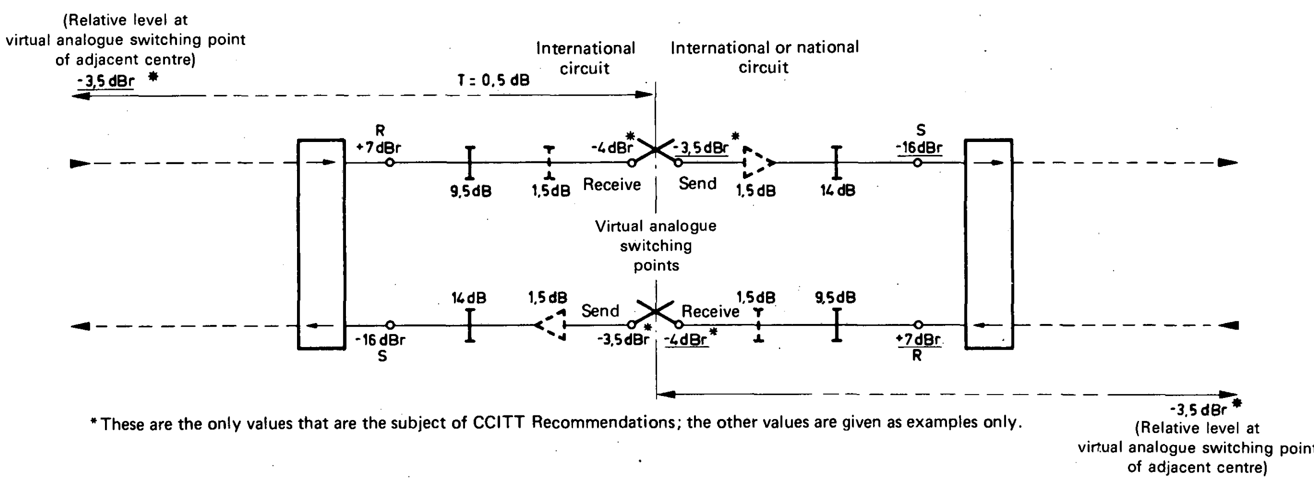
International telephone circuits

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.



a) Actual arrangement



* These are the only values that are the subject of CCITT Recommendations; the other values are given as examples only.

b) Hypothetical arrangement indicating possible position of the virtual analogue switching points of the two circuits

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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.

Recommendation M.562

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*

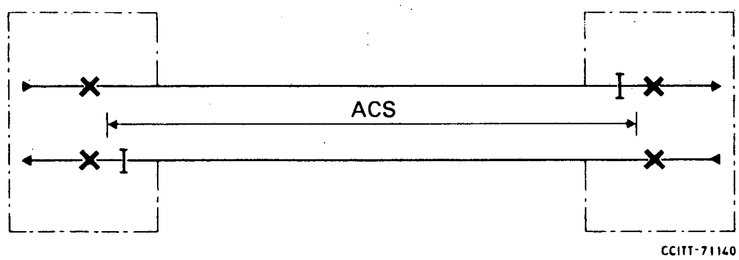
A digital terminal circuit section comprises the two directions of transmission, for one equivalent voice-frequency signal, through a digital terminal. For each direction of transmission, the digital terminal circuit section extends from a particular 64 kbit/s time slot appearance, in the input bit sequence to the digital terminal, to the corresponding 64 kbit/s time slot appearance in the output bit sequence 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.

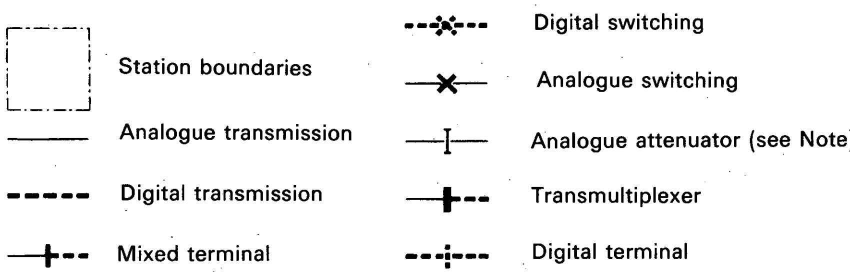
3.1 *Analogue circuit*

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



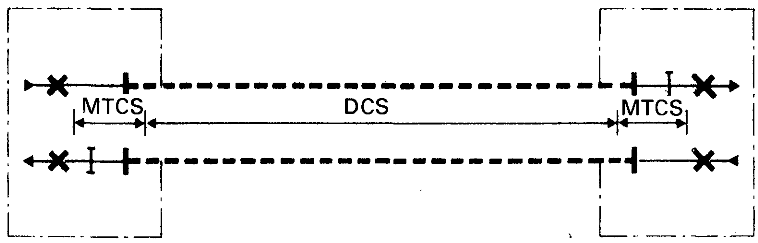
Note – The use of this symbol in the figures indicates the location of any analogue attenuation required to meet the CCITT transmission plan.

FIGURE 1/M.562

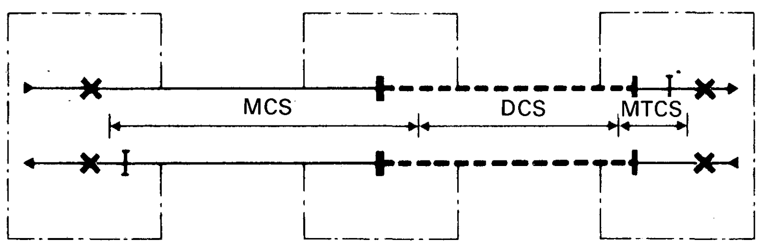
Analogue circuit

3.2 *Mixed analogue/digital circuit*

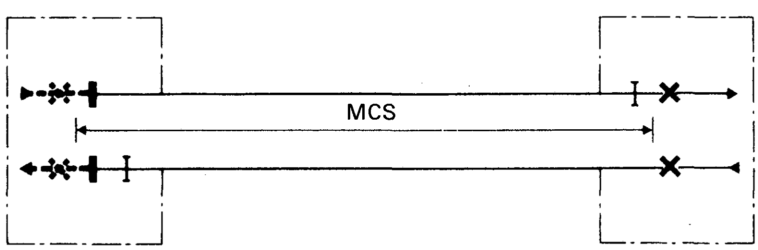
A mixed analogue/digital circuit comprises any combination of circuit sections that includes one or more analogue to digital, or digital to analogue, conversion processes. Mixed analogue/digital circuits may terminate at either end in analogue or digital switching machines. Combinations of various types 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.



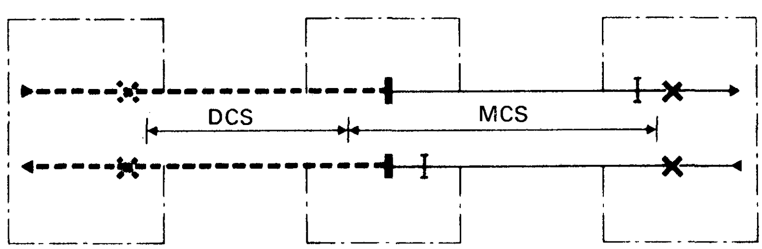
a) Analogue switching at each end; digital transmission; mixed terminals



b) Analogue switching at each end; both analogue and digital transmission, with transmultiplexer at transmission interface; mixed terminal



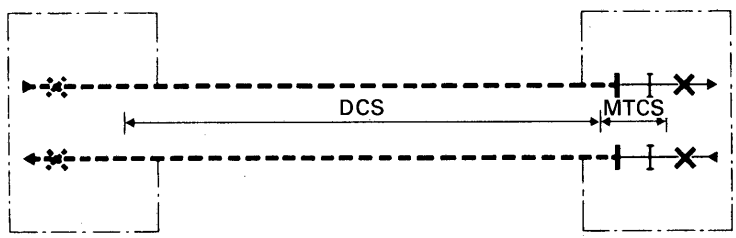
c) Digital switching at one end, with analogue switching at the other end; analogue transmission; transmultiplexer



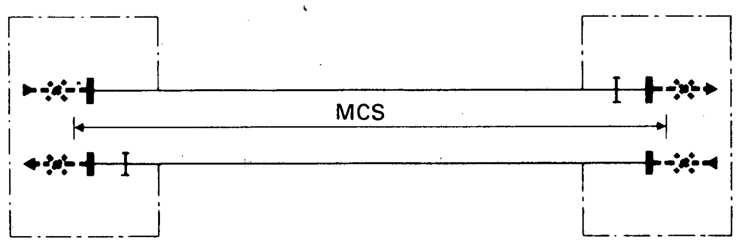
d) Digital switching at one end, with analogue switching at the other end; both digital and analogue transmission, with transmultiplexer at transmission interface

FIGURE 2/M.562

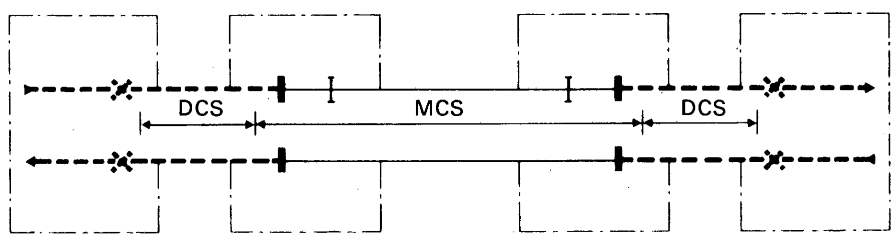
Mixed analogue/digital circuits



e) Digital switching at one end, with analogue switching at the other end; digital transmission; mixed terminal



f) Digital switching; analogue transmission: transmultiplexer



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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

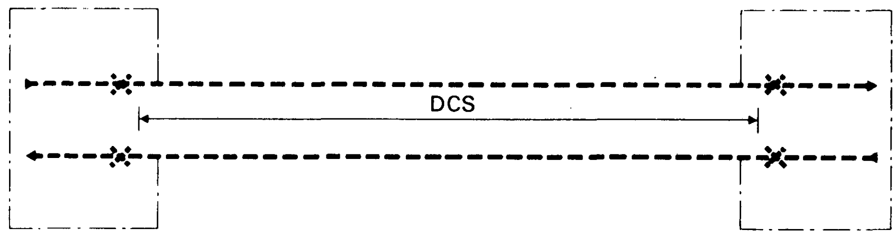
3.3 *Digital circuit*

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.

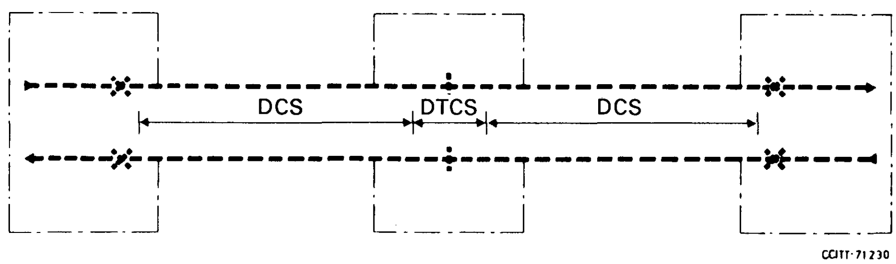
4 Allocation of losses in mixed analogue/digital circuits

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.

Recommendation M.565

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 testing of circuits normally carried out at the line access point may be performed at the digital path access point [2] nearest to the international exchange. Circuit tests which involve the sending of test signals should be carried out from the circuit access point as defined in § 2.1.2 below.

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 sequence (time slot) corresponding to an individual telephone circuit.

Where a circuit uses channel associated signalling it should be possible to identify and measure at the circuit access points, the signal-transmission parameters, e.g., type of signal, sequence, timing, duration, level and frequency.

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, in association with Study Group XV.

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.

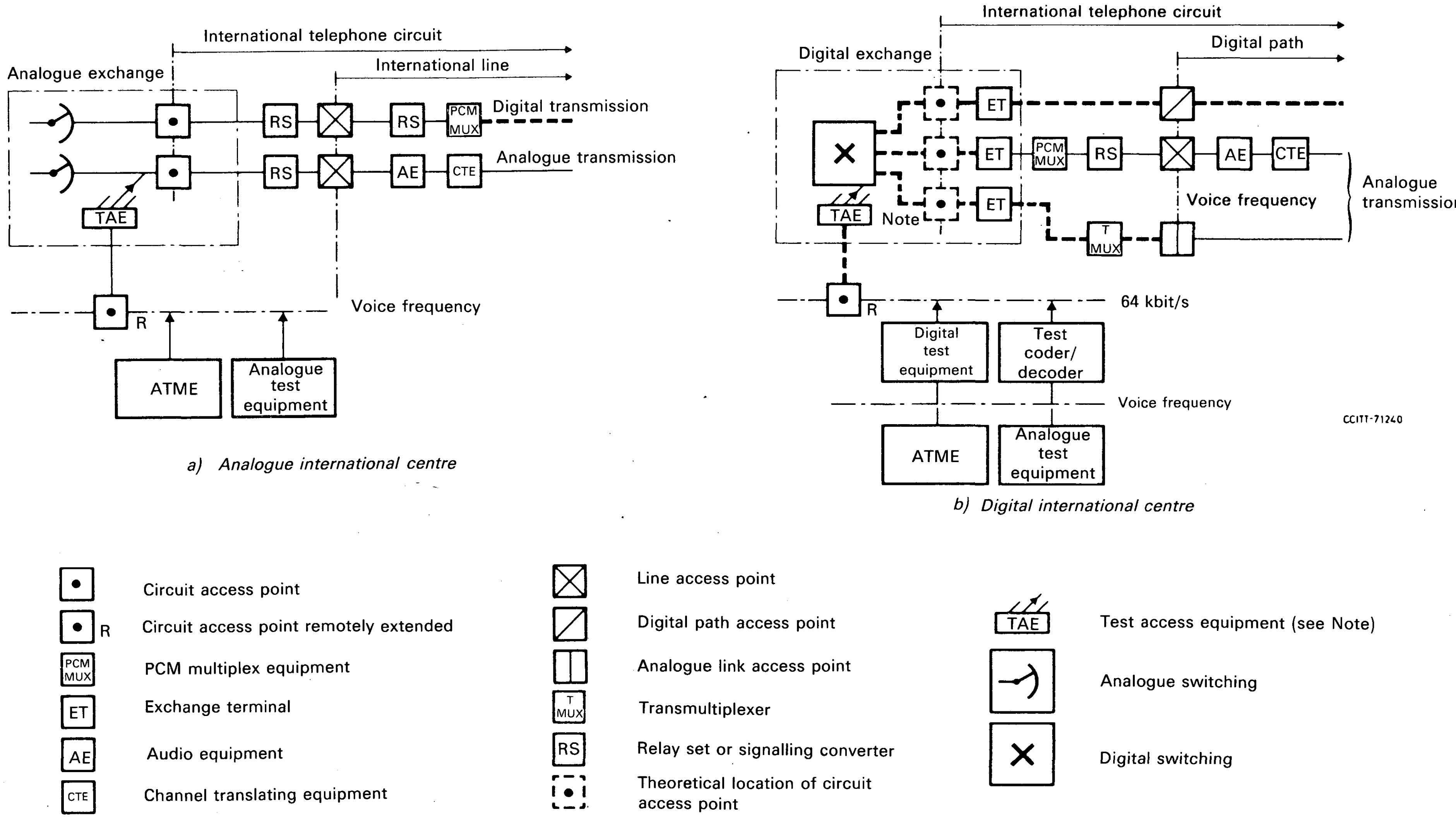
3.3 It is not possible to recommend a value for the nominal transmission loss between the circuit access points of a switched public telephony circuit, because of the freedom accorded to Administrations in choosing the transmission levels at these points. However, bearing in mind that the attenuation 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.



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

1 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 I 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.

In the case of a both-way circuit, the circuit order of selection should be stated, including the method by which the International Switching Centre selects circuits (i.e., sequentially by circuit, fully randomly or sequentially by block of circuits but randomly within the block, etc.).

When the circuit is assigned its designation (according to Recommendation M.140, § 1), the Administration with control station responsibility will assemble the necessary technical and operational information. This should be entered into the list of Related Information (as defined in Recommendation M.140, § 2) which consists of the items shown in Annex A.

2 Exchange of information

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 I – 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/A1 – LONDON/M B1
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 A 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.

Using the above-mentioned information and the data supplied by sub-control stations, the circuit control station makes out a *circuit routing form* which is used as a level diagram for voice-frequency sections (see Appendix I to this Recommendation, which can serve as a routing form or level diagram). 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:

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.

ANNEX A

(to Recommendation M.570)

Designation information on international public switched circuits

A.1 *Designation*

The designation is according to Recommendation M.140, § 1.

A.2 *Related information*

The additional information on public switched circuits is covered by the following items:

RI 1. Urgency for restoration;
RI 2. Terminal countries;
RI 3. Carriers' names;
RI 4. Control and sub-control station(s);
RI 5. Fault report points;
RI 6. Routing;
RI 7. Association;
RI 8. Equipment information;
RI 9. Use;
RI 10. Transmission medium information;
RI 11. Composition of transmission;
RI 12. Bandwidth or bit rate;
RI 13. Signalling information;

The various items will be dealt with in § 2 of Recommendation M.140.

APPENDIX I

(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 distorsion power	Not applicable
19.	Transmultiplexer at	None
20.	Echo cancellation stages at	
21.	Echo path delay characteristics, per stage, at	

Stations and constitution	Length of section (in km)	Nominal relative level at reference measurement point [2] (dBr)		Estimated group delay time at 1020 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.

Recommendation M.580

SETTING UP AND LINING UP AN INTERNATIONAL CIRCUIT FOR PUBLIC TELEPHONY

1 Introduction

This Recommendation applies to all circuits operated on a manual, semi-automatic or fully automatic basis, whether provided solely by analogue transmission and switching systems or by a mixture of analogue and digital systems.

As an alternative to the procedures given in §§ 7 to 14 which require testing personnel to be present at both ends of the circuit, § 15 gives a procedure involving the use of the CCITT Automatic Transmission Measuring and Signalling Testing Equipment (ATME) No. 2 (Recommendation O.22 [1]) (with Type a responding equipment) which may be used subject to the agreement of the Administrations involved.

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.565). 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 1020 Hz*

The objective is to make the value of overall loss at 1020 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.

3.2.1 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 1020 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) Administrations should be allowed some flexibility 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 1020 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 1020 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 1020 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

3.2.2 Table 1/M.580 is based on the limits recommended for a pair of 4-kHz channel equipments (Recommendation G.232 [2]), 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 [3]) 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 3.2.1 a) to 3.2.1 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 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 as close as possible to its nominal level 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.

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 1020 Hz[1)] 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 § 3.2.1).

For each circuit section the results for each direction of transmission are forwarded to the control and terminal sub-control stations.

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 made inoperative.

1) For further information about the choice of test signal frequency, refer to Recommendation O.6 [4].

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 according to 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 [2)]

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 at which 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 1020 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 3.2.2). 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 at which the circuit can be lined up should be agreed upon.

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2) The procedure given in § 15 may be followed as an alternative to those given in §§ 7 to 14 if agreement has been reached with the distant Administration to use ATME No. 2 for lining up, measurement of circuit noise and functional tests. It should be noted that this procedure does not include the tests in § 12. The Administrations involved should consider scheduling such tests, if applicable, when cooperative effort can be arranged.

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 1020 Hz[3].

For this, the control station arranges to send an 1020 Hz test signal at a level of -10 dBm0, 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 as close as possible to the nominal value.

7.2.2.2 The intermediate sub-control stations will then arrange to measure the level of the 1020 Hz test signal and to adjust it to the nominal value at the access points of the circuit (as defined in § 2.2) 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 1020 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.

7.2.3 *Measurement of the overall loss/frequency response*

7.2.3.1 When the circuit has been lined up at 1020 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.

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.

These results now replace those previously submitted under operation § 7.2.1.2 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.

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3) For further information about the choice of test signal frequency, refer to Recommendation O.6 [4].

8 Measurement of circuit noise

8.1 Where a circuit is routed via a circuit multiplication system employing digital speech interpolation techniques, it may not be possible to make a reliable noise test using the method described in this section. In this case, a total distortion measurement should be made instead, as described in § 9.3.

8.2 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 [5]).

8.3 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.

8.4 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 10 000	10 001 to 20 000
Noise (dBm0p)	−55	−53	−51	−49	−46	−43	−40

Note – At the present time the section of a circuit provided by a satellite employing FDM techniques with a earth station at its receiving end conforming to the INTELSAT Standard A (Figure of merit 40.7 dB/K) or Standard C (Figure of merit 39.0 dB/K) contributes approximately 10 000 pW0p (−50 dBm0p) of noise. The noise contributed by earth stations with revised figures of merit are for further study. Therefore, for the purpose of determining maintenance limits for noise measurements on international public telephony circuits, the length of this section may be considered to be equivalent to a terrestrial length of 2500 km.

The section of a circuit provided by a satellite employing FDM techniques with an earth station at its receiving end conforming to the INTELSAT Standard B contributes approximately 80 000 pW0p (−41 dBm0p) of noise for FM companded circuits. The methods of determining total distortion and/or noise objectives for such a circuit are given in Recommendation M.590.

The contribution to noise of a circuit section provided by a satellite employing TDM techniques remains a subject for further study.

8.5 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 [6] 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.

8.6 The noise measured at the circuit access point during the initial line-up should be recorded for comparison against subsequent maintenance measurements.

9 Measurement of total distortion

9.1 *General*

This measurement is required for composite (i.e. mixed analogue/digital) circuits only. The measurement of total distortion should be made for both directions of transmission. The measuring equipment should be as specified in Recommendation O.132 [7]. The measurement equipment should be applied at the circuit access points. A test frequency of 1020 Hz should be used.

It is assumed that the measurements and adjustments outlined in §§ 7.2.2 and 7.2.3 above have already been carried out.

9.2 *Measurement of total distortion using a test signal level of −10 dBm0*

9.2.1 The results of the total distortion measurement should be compared with the total distortion objectives shown in Table 5/M.580 according to the number of Quantizing Distortion Units (QDUs) in the circuit and the total length of the analogue circuit sections.

9.2.2 If these objectives are exceeded by a circuit which has satisfied the noise objectives described in § 8, then a fault on a digital equipment causing excessive quantizing distortion should be suspected.

TABLE 5/M.580

Signal-to-total distortion ratio for public telephone circuit maintenance using a test frequency level of −10 dBm0

Type of circuit	Number of QDU (Note 1)	Unit	Distance in analogue transmission (km) (Note 3)						
			< 320	321 to 640	641 to 1600	1601 to 2500	2501 to 5000	5001 to 10 000	10 001 to 20 000
Analogue	0 (Note 2)	dB	45	43	41	39	36	33	30
Composite circuit	0.5	dB	35	35	34	34	33	31	29
	1	dB	33	33	32	32	31	30	28
	2	dB	30	30	30	29	29	28	27
	3	dB	28	28	28	28	28	27	26
	3.5	dB	27	27	27	27	27	26	26
	4	dB	27	27	27	27	26	26	25

Note 1 – The number of QDUs contributed by various digital processes are given in Table 1/G.113 [8].

Note 2 – The values are idle noise terminated with a nominal impedance of 600 Ω.

Note 3 – The section of the circuit provided by satellite (between earth stations) employing FDM techniques contributes approximately 10 000 pWp (−50 dBm0p) of noise. Therefore, for the purpose of determining the total distortion limits for international public telephony circuits, the length of this section may be considered, from Table 4/M.580, to be equivalent to 2500 km.

9.3 *Measurement of total distortion using a test signal level of −25 dBm0*

9.3.1 On circuits routed via a circuit multiplication system employing digital speech interpolation, this measurement may be regarded as a substitute for a measurement of circuit noise. The results of the measurement should be compared with the objectives shown in Table 6/M.580.

9.3.2 If the measured total distortion is higher by 5 dB or more than the appropriate value from Table 6/M.580 or is higher than −37 dBm0p, whichever is the more stringent requirement, on a circuit which has satisfied the test in § 9.2 above, then a fault on an analogue circuit section causing excessive noise should be suspected.

9.3.3 For maintenance purposes, a measurement of total distortion using a −25 dBm0 signal level can be useful on all composite circuits. In conjunction with a measurement using a −10 dBm0 signal level, it may be possible to identify whether a fault lies in an analogue or digital circuit section, from end-to-end measurements using the same instrument. If the circuit satisfies the objectives of Table 5/M.580 but exceeds the objectives of Table 6/M.580, a faulty analogue circuit section should be suspected. Conversely, if the objectives of Table 6/M.580 are satisfied but those of Table 5/M.580 are not, faulty digital equipment is likely.

Note – If the number of QDUs is 4 and the analogue noise level is −55 dBm0p, this procedure will produce less accurate results. In this case, a −30 dBm0 test tone will be appropriate to check the analogue section, when a circuit is not fitted with an echo-canceller or the echo canceller can be disabled.

TABLE 6/M.580

Signal-to-total distortion ratio for public telephone circuit maintenance using a test frequency level of −25 dBm0

Type of circuit	Number of QDU (Note 1)	Unit	Distance in analogue transmission (km) (Note 3)						
			< 320	321 to 640	641 to 1600	1601 to 2500	2501 to 5000	5001 to 10 000	10 001 to 20 000
Analogue	0 (Note 2)	dB	30	28	26	24	21	18	15
Composite circuit	0.5	dB	29	27	26	24	21	18	15
	1	dB	28	27	25	23	21	18	15
	2	dB	27	26	25	23	20	18	15
	3	dB	26	25	24	23	20	18	15
	3.5	dB	26	25	24	22	20	18	15
	4	dB	25	24	23	22	20	17	15

Note 1 – The number of QDUs contributed by various digital processes are given in Table 1/G.113 [8].

Note 2 – The values are idle noise terminated with a nominal impedance of 600 Ω.

Note 3 – The section of the circuit provided by satellite (between earth stations) employing FDM techniques contributes approximately 10 000 pWp (−50 dBm0p) of noise. Therefore, for the purpose of determining the total distortion limits for international public telephony circuits, the length of this section may be considered, from Table 4/M.580, to be equivalent to 2500 km.

10 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.

11 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 7/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 7/M.580.

Note – Such a check is not appropriate for speech circuits of Signalling Systems No. 6 and No. 7.

12 Functional tests

12.1 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.

12.2 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.

12.3 Some Administrations find a rapid check of the echo control devices useful when setting up a circuit. A suitable method is described in [9] which can be carried out by agreement between Administrations.

In addition, a check of the echo control device with the corresponding tester as specified in Recommendations O.22 [1] and O.25 [10] should be made if available.

13 Exchange of information on echo canceller test capability

When echo cancellers are fitted to a circuit, tests by other Administrations using test facilities specified in Recommendation O.22 [1] can successfully be carried out only if the canceller stages and echo path delay characteristic are programmed into the test sequence. Therefore, the Administration placing echo cancellers in their international switching centre should so apprise the other Administration(s). This may be done by a specific communication, for example a telex message, or by including such information with the exchange of routine maintenance schedules (Recommendation M.605).

14 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 1020 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 13 above should be made by both terminal stations. The control station should hold a copy of the records for both directions of transmission.

15 Setting up and lining up an international circuit using ATME

15.1 The following procedure should be followed when it has been agreed between the Administrations concerned that ATME No. 2 can be used. Generally, it is suitable only when there are no intermediate circuit sub-control stations and for circuits which do not have particular measurement requirements (see § 10).

TABLE 7/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
Muli-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.

15.2 *Setting up the circuit*

The circuit control and 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. This should include the check of signalling level specified in § 11. The sub-control station should advise the control station that these checks have been made.

15.3 *Lining up the circuit*

On receiving the advice from the sub-control station, the control station should test the circuit using ATME No. 2. The time at which the tests are performed should take into account the availability schedules of the ATME No. 2 responding equipments and the period of peak traffic at the distant terminal exchange (see Recommendation M.605, § 3). The ATME No. 2 should be programmed to perform the full range of transmission measurements and signalling tests.

If the transmission level in the receive direction at the control station is not within ± 1 dB of its nominal level, the level should be adjusted to within ± 0.3 dB of its nominal level, and the circuit should then be retested.

If the transmission level in the receive direction at the sub-control station distant end is not within ± 1 dB of its nominal level or if any of the other limits specified in this Recommendation are not met in either direction of transmission, then the procedures given in §§ 7 to 14 should be followed.

When the ATME No. 2 tests have been successfully completed, the control station informs the sub-control station of the results.

15.4 *Other tests*

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.

15.5 *Recording of results*

The control station should record all results given by ATME No. 2 for both directions of transmission.

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 test tone*

This method is only applicable for mixed analogue/digital terminals equipped with an internally generated digital test signal with a power of -10 dBm0 at 1020 Hz[4)], 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 1020 Hz, -10 dBm0 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 1020 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 1020 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.

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 c) of Figure A-1/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.

[4)] For further information about the choice of test signal frequency, refer to Recommendation O.6 [4].

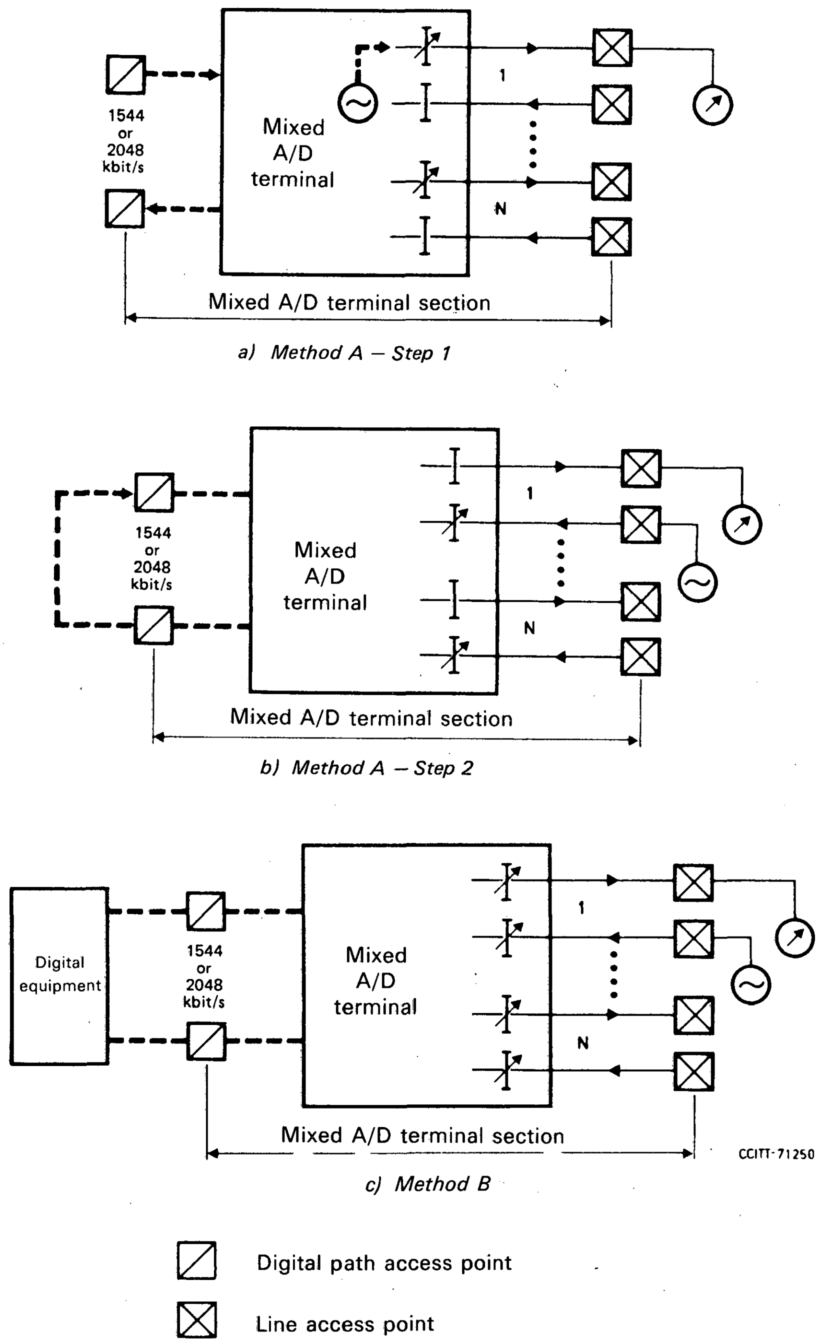

FIGURE A-1/M.580

References

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

[2] CCITT Recommendation *12-channel terminal equipments*, Vol. III, Rec. G.232.

[3] CCITT Recommendation *16-channel terminal equipments*, Vol. III, Rec. G.235.

[4] CCITT Recommendation *1020 Hz reference test frequency*, Vol. IV, Rec. O.6.

[5] CCITT Recommendation *Psophometer for use on telephone-type circuits*, Vol. IV, Rec. O.41.

[6] CCITT Recommendation *Circuit noise and the use of compandors*, Vol. III, Rec. G.143.

[7] CCITT Recommendation *Quantizing distortion measuring equipment using a sinusoidal test signal*, Vol. IV. Rec. O.132.

[8] CCITT Recommendation *Transmission impairements*, Vol. III, Rec. G.113.

[9] CCITT Supplement *Rapid verification test for echo control devices*, Vol. IV, Supplement No. 2.11.

[10] CCITT Recommendation *Semi-automatic in-circuit echo suppressor testing system*, Vol. IV, Rec. O.25.

Recommendation M.585

BRINGING AN INTERNATIONAL DIGITAL CIRCUIT INTO SERVICE

1 Organization

The guiding principles for a general maintenance organization for international circuits are given in Recommendation M.70.

An international digital circuit may consist of one or more digital circuit sections and digital terminal circuit sections. The types of digital circuit and digital circuit sections for public telephony are described in Recommendation M.562.

In establishing an international digital circuit, circuit access points define the limits of a circuit. These circuit access points are used as the means for performing functional tests including those for channel associated line signalling.

2 Transmission tests

2.1 *Error performance*

When a circuit is brought into service immediately after the digital path(s) over which it is routed are commissioned, the procedures in Recommendation M.555 (see also Recommendation M.550) are adequate to ensure a satisfactory initial error performance for the circuit.

When a circuit is brought into service some time after the digital path over which it is routed is commissioned, the circuit control station should ascertain, either directly or from the circuit sub-control station, that the digital path is satisfying the required performance objectives.

2.2 *Other tests*

When the circuit is to be fitted with a 64 kbit/s device e.g. echo canceller or μ/A law converter, these should first be tested before bringing the circuit into service (for echo suppressors and echo cancellers, see Recommendations M.660 and M.665 respectively).

3 Functional tests

A speaking test should be made including a subjective check of the satisfactory operation of echo control devices.

For a circuit using channel-associated signalling, the signal-transmission test 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.

SETTING UP AND LINING 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 repeater station staff. In particular, because the unaffected level of a compandor is defined with reference to an 800 Hz signal, it should be verified for each type of compandor that use of a reference test frequency of 1020 Hz produces the same results as using a reference test frequency of 800 Hz.

2 Circuits fitted with compandors should be lined up to achieve the same limits as circuits without compandors. The compandor should be fitted to the circuit only after the circuit without its compandor is considered satisfactory in respect of loss and loss/frequency response. It should be noted that to achieve the limits for loss/frequency response on the companded circuit without equalization, it will be necessary for the loss/frequency response of the uncompanded circuit to be within one half of the circuit limits.

3 Measurements of total distortion and idle channel noise

After compandors have been fitted, total distortion and idle channel noise measurements should be made. The test signal used for the total distortion measurement should be applied at the unaffected level of the compandor.

In the case of a circuit which is fitted with a compandor to subjectively reduce the noise generated within a terrestrial circuit section, the measurements should be noted.

In the case of a circuit which is fitted with a compandor to subjectively reduce the noise generated by a satellite circuit section, the procedure is as follows:

- For analogue routed circuits[1)], the noise objectives given in Table 4/M.580 for the appropriate terrestrial length of circuit should be combined with the total distortion objective for the satellite channel[2)] to produce a total distortion objective for the whole circuit. See Annex A for an example of this calculation.
- For mixed analogue/digital routed circuits, the total distortion objectives given in Table 5/M.580 for the appropriate terrestrial length of circuit should be combined with the total distortion objective for the satellite channel[2)] to produce a total distortion objective for the whole circuit. See Annex A for an example of this calculation.
- If the measured total distortion is higher than the calculated total distortion objective, then a fault should be suspected and action should be taken to locate and remedy any fault where possible.
- When the total distortion measurement has been made and is found to meet the calculated total distortion objectives, an idle channel noise measurement should be made.
- The idle channel noise measurement should be compared with the maintenance objective given in Table 4/M.580 for the appropriate length of circuit, taking into account the note associated with that table which states that the satellite section of the circuit may be considered to have an equivalent length of 2500 km. This is a valid consideration provided that the total distortion objective of the satellite channel is not greater than −30 dBm0p.
- If the measured value is higher by 5 dB or more than the noise objective given in Table 4/M.580 or is higher than −37 dBm0p, whichever is the more stringent requirement, then a fault should be suspected and action should be taken to locate and remedy any fault where possible.

4 A speaking test should be made on the circuit to verify the correct operation of the compandors.

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1) It should be noted that in the case of mixed analogue/digital circuits, if the unaffected level is other than −10 dBm0 then this procedure will produce less accurate results and in this case it should be used as a general guide only.

2) The total distortion objective for INTELSAT single sideband Standard B satellite channels is −41 dBm0p (FM companded circuit).

5 Designations

Companded circuits and groups of circuits which are all companded should be designated in accordance with Recommendation M.140.

Note – Repeater station staff should be well instructed as to the subjective effect of errors and the location of faults affecting compandors.

ANNEX A

(to Recommendation M.590)

Total distortion and idle channel noise objectives for circuits which are fitted with compandors in order to subjectively reduce the effect of noise generated on satellite channels

A.1 A distinction is made between:

a) circuits which are fitted with compandors to subjectively improve the noise generated by a terrestrial section, and

b) circuits which are fitted with compandors to subjectively improve the noise generated by a satellite section.

This distinction is made because in case a) it is not possible to specify noise or total distortion objectives. However, in case b), the satellite system operator can specify noise objectives for the satellite section. Thus these limits can be combined with those contained in Recommendation M.580 to calculate an overall limit.

A.2 *Examples of calculations of total distortion for case b)*

Example 1

Consider an analogue circuit which has a terrestrial length of 1600 km and which is routed via a satellite which has a specified idle channel noise objective of −41 dBm0p for analogue channels.

From Table 4/M.580, the noise objective for a length of 1600 km is −51 dBm0p.

Combining −41 dBm0p and −51 dBm0p gives a total distortion of −40.59 dBm0p.

Thus the total distortion objectives should be −41 dBm0p.

Example 2

Consider a mixed analogue/digital circuit which has a terrestrial length of 1600 km, two analogue/digital conversions using 8 bit coding (i.e., 2 QDUs) and which is routed via a satellite which has a specified idle channel noise objective of −41 dBm0p for analogue channels.

From Table 5/M.580, the total distortion objective for a length of 1600 km is −30 dB or −40 dBm0p.

Combining −41 dBm0p and −40 dBm0p gives a total distortion of −37.46 dBm0p.

Thus the total distortion objective should be −37 dBm0p.

A.3 *Idle channel noise objectives for case b)*

It is stated in § 3 that provided the total distortion objective of the satellite channel is not greater than −30 dBm0p, it is valid to consider that this section of the circuit has an equivalent length of 2500 km.

This statement is justified because the compandor characteristic which is illustrated in Figure A-1/M.590 indicates that an idle channel noise of −30 dBm0p generated in a satellite section would be reduced to −50 dBm0p. This value of noise is that which from Table 4/M.580 is attributed to an equivalent circuit length of 2500 km.

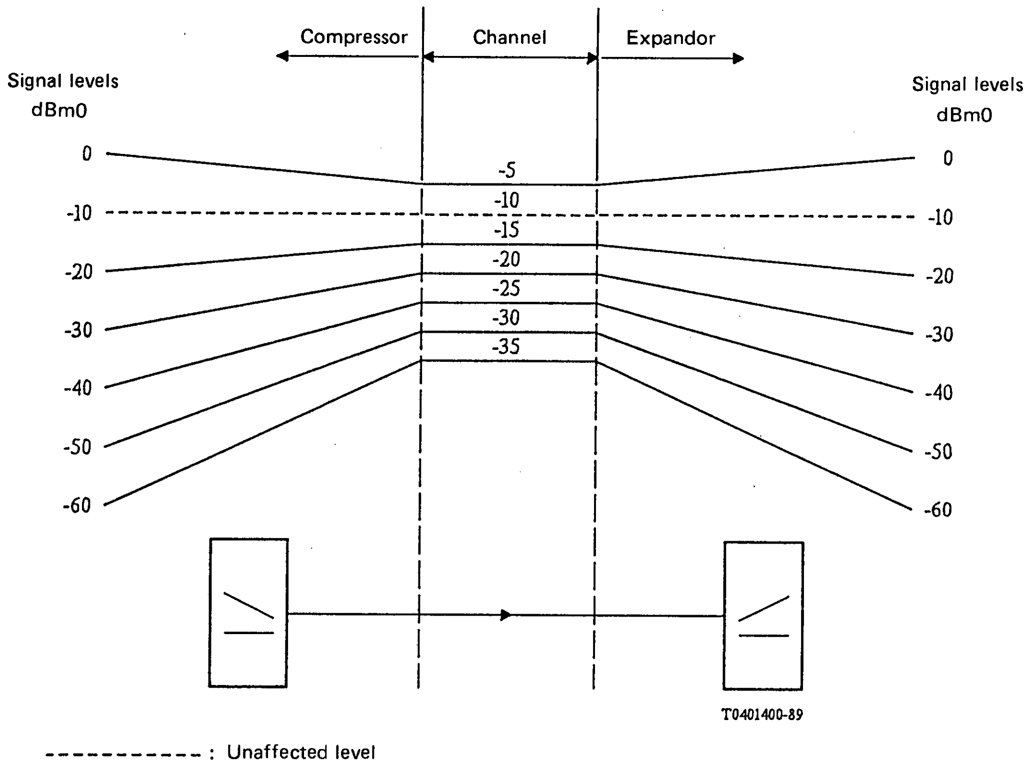

FIGURE A-1/M.590

Compandor characteristic

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.

[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.

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.

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 *Use of echo canceller devices*

The number of echo cancellation stages and the echo path delay characteristics must be stated in order to program tests properly using the echo canceller test facility as specified in Recommendation O.22 [1]. These characteristics should be included in ATME No. 2 schedule forms when exchanged between Administrations. If ATME No. 2 is not used between Administrations, echo canceller delay information should be conveyed by other means, for example a telex message, or the manual routine testing schedule (Figure 1/M.605).

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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.

2.4 *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 [3)].

2.5 *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.

2.6 *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**

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 [1]):

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.

3) 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.

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 [2]) 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.

Number of echo cancellation stages ....

Echo path delay characteristic .... ms

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																									
	B																									
TUES	A																									
	B																									
WED	A																									
	B																									
THUR	A																									
	B																									
FRI	A																									
	B																									
SAT	A																									
	B																									
SUN	A																									
	B																									

[1] Delete as applicable.

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FIGURE 1/M.605

Manual routine testing schedule

International centre: London – Wood Street — Month: odd/even[1]

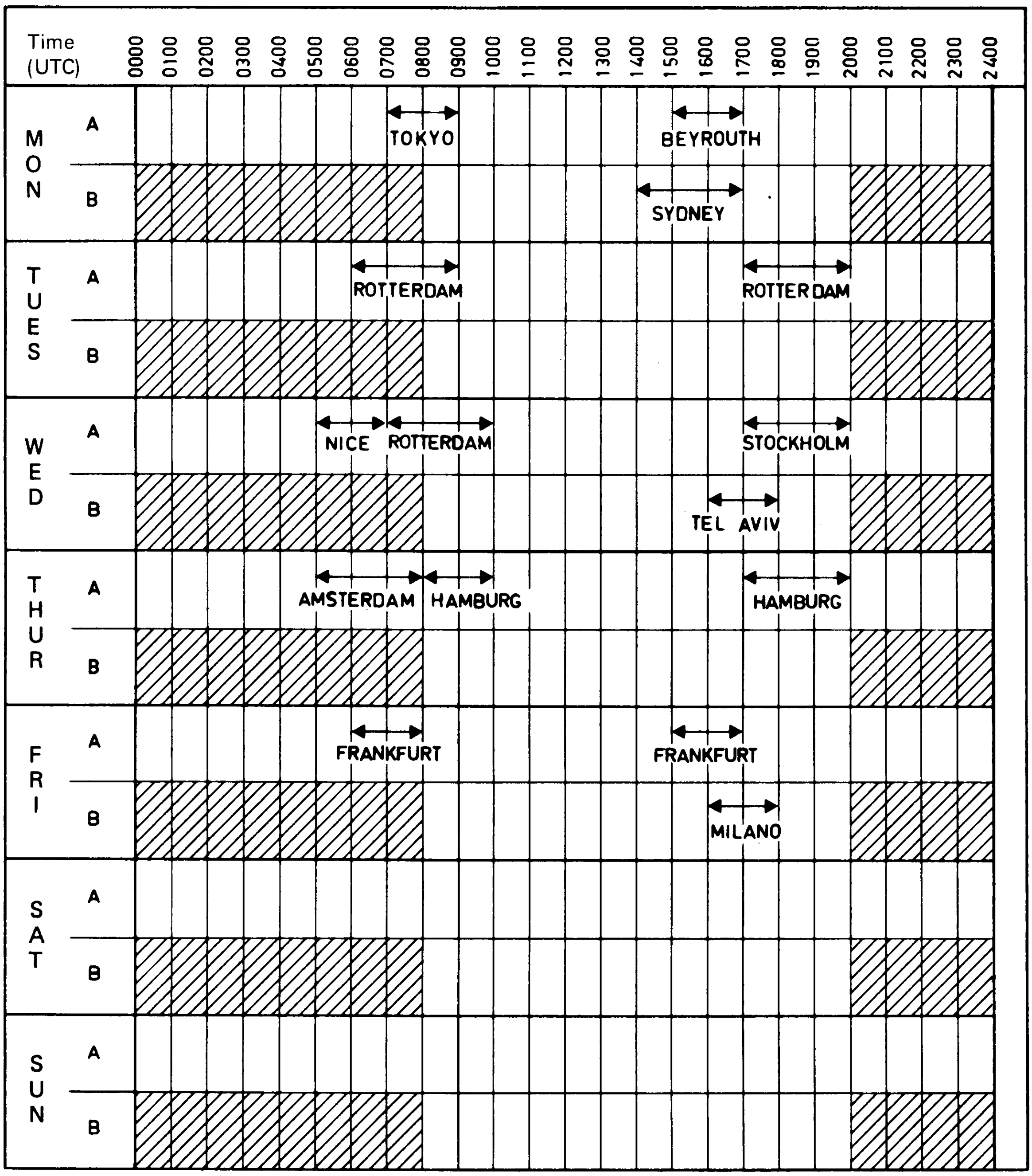
Telephone number: (for circuit routine cooperation) London 606 2064 — Week: 1/2/3/4[1]

For one routine test position use row A.

For two routine test positions use rows A and B.

Number of echo cancellation stages ....

Echo path delay characteristic .... ms



[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.

Number of echo cancellation stages ....

Echo path delay characteristic .... ms

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																									
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3	Mo																									
	Tu																									
	We																									
	Th																									
	Fr																									
	Sa																									
	Su																									
4	Mo																									
	Tu																									
	We																									
	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]

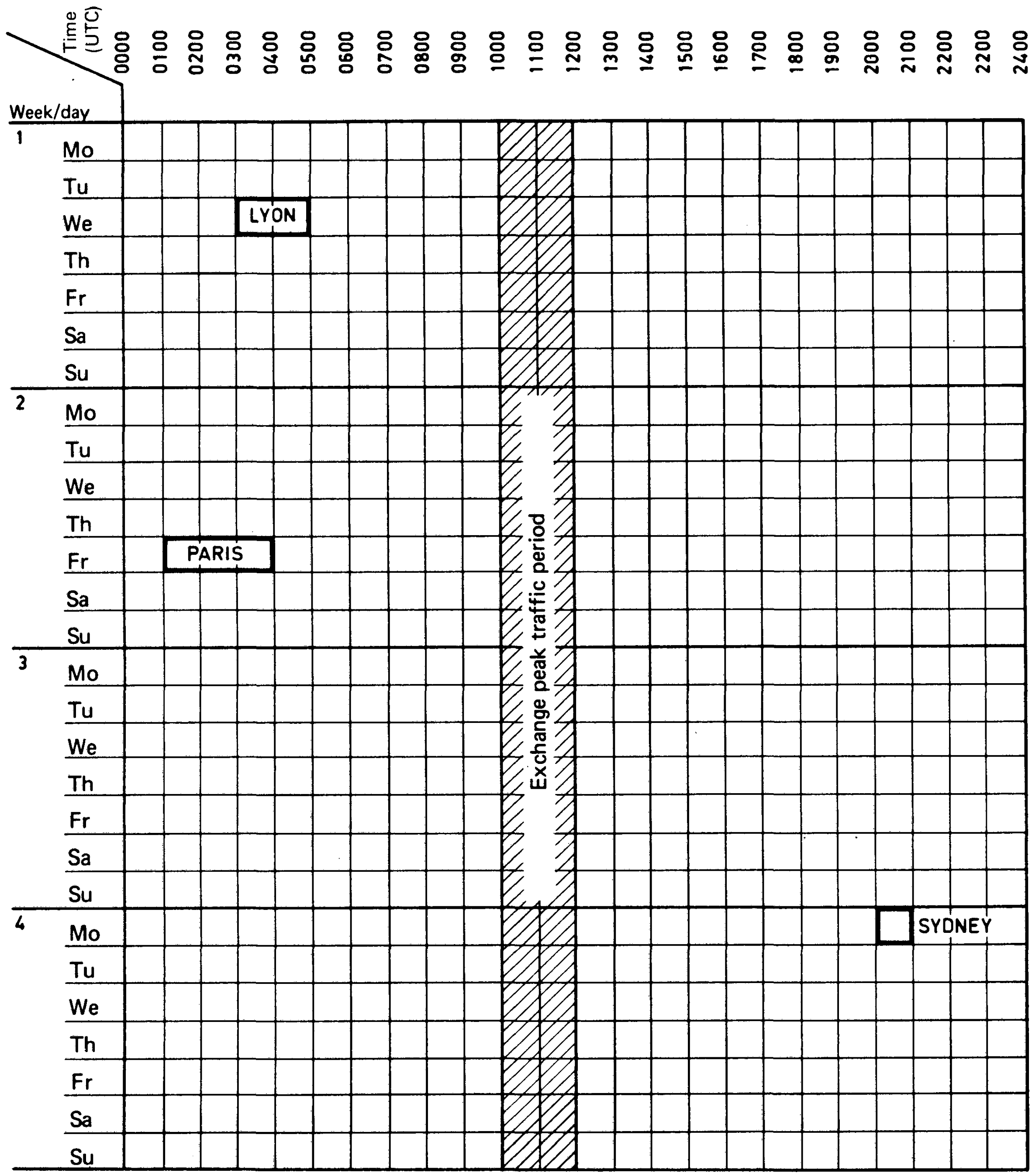
Reference number:

Responding equipment *type a/type b*[1]

Type c responding facility is/is not[1] available at the centre.

Number of echo cancellation stages ....

Echo path delay characteristic .... ms



[1] Delete as applicable.

CCITT - 36602

FIGURE 4/M.605

ATME No. 2 availability schedule (hypothetical example for a responding equipment)

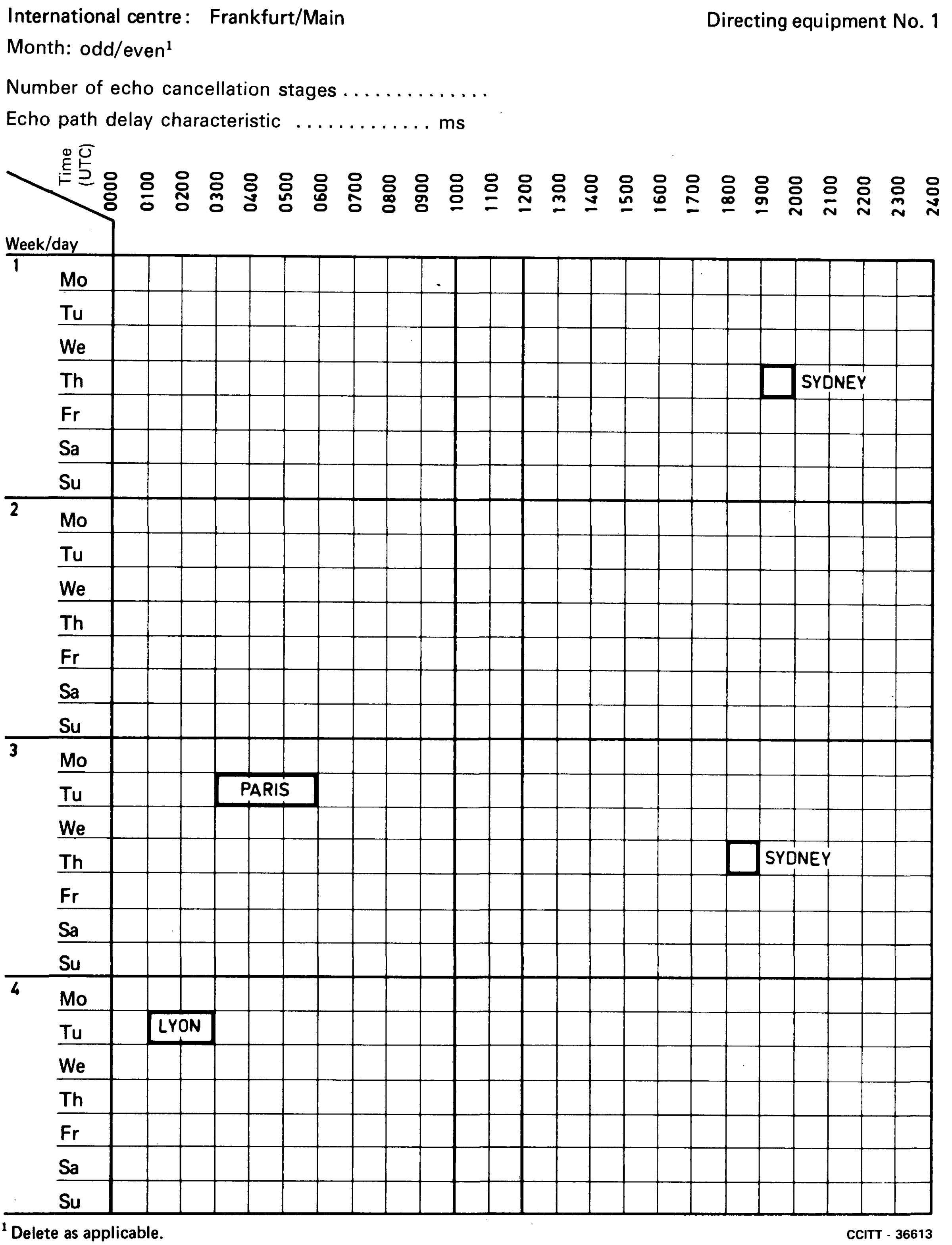


FIGURE 5/M.605

ATME No. 2 availability schedule (hypothetical example for a directing equipment)

References

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

[2] CCITT Recommendation *Maintenance access lines,* Vol. IV Rec. O.11.

PERIODICITY OF MAINTENANCE MEASUREMENTS ON CIRCUITS

Routine maintenance measurements should be made on a complete circuit[1] 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;

f) echo control devices.

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.

Echo control devices (echo suppressors or cancellers) may be tested using semi-automatic/automatic test instruments or facilities when such are deployed by Administrations. If semi-automatic/automatic instruments, etc., are not available, Administrations should agree bilaterally regarding these tests.

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.

[1] This is the general rule. In a few exceptional cases, however, routine measurements may be found desirable on constituent elements of circuits if they can give indications not otherwise readily obtained. For example, in accordance with Recommendation G.131 § 2.4 [1], echo suppressors are not necessarily permanently associated with circuits and must then be checked by separate in-station tests as provided in Recommendation M.660. Also, in some special cases mentioned in the introductory notes to that Recommendation, the complete-circuit measurements afforded by the ESTS instrument, specified in Recommendation O.25 [2], might be found inadequate.

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		Column 7	
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		Echo control devices	
					Manual circuits	Automatic circuits	Suppressors [b]	Cancellers [c]
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 Serie Q Recommendations	6 months	6 months
	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.
[b] Assumes the use of an echo suppressor test facility as part of an ATME as specified in Recommendation O.22 [3].
[c] Assumes the use of an echo canceller test facility as part of an ATME as specified in Recommendation O.22 [3].

TABLE 2/M.610

Periodicity of measurements to be made on international telephone circuits
(Types of circuit not normally used in the international network)

<table>
<tr><th>Column 1</th><th>Column 2</th><th>Column 3</th><th>Column 4</th><th>Column 5</th><th colspan="2">Column 6</th></tr>
<tr><th rowspan="2">Category of circuit</th><th rowspan="2">Type of circuit</th><th rowspan="2">Measurements of overall loss at one frequency and measurement of noise [a)]</th><th rowspan="2">Measurements of overall loss at several frequencies</th><th rowspan="2">Measurements of stability</th><th colspan="2">Signalling tests</th></tr>
<tr><th>Manual circuits</th><th>Automatic circuits</th></tr>
<tr><td rowspan="6">Audio-frequency</td><td>2-wire circuits with one repeater</td><td>Yearly</td><td>Yearly</td><td>Yearly</td><td rowspan="6">At the same time as measurements of overall loss and levels at several frequencies (see column 4)</td><td rowspan="6">As agreed between Adminis-trations</td></tr>
<tr><td>2-wire circuits with two or three repeaters</td><td>Half-yearly</td><td>Yearly</td><td>Half-yearly</td></tr>
<tr><td>2-wire circuits with at least four repeaters</td><td>Quarterly</td><td>Half-yearly</td><td>Quarterly</td></tr>
<tr><td>2-wire circuits including an open-wire section with at least one repeater</td><td>Monthly</td><td>Half-yearly</td><td>Monthly</td></tr>
<tr><td>4-wire circuits with a 2-wire section having at least one repeater</td><td colspan="3">As agreed between Administrations</td></tr>
</table>

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.

References

[1] CCITT Recommendation *Stability and echo,* Vol. III, Rec. G.131.

[2] CCITT Recommendation *Semi-automatic in-circuit echo suppressor testing system (ESTS),* Vol. IV Rec. O.25.

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

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:

- at the frequency of 1020 Hz[1)] when measurements are confined to one frequency;
- at frequencies of 400, 1020 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.

1.2 *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 *Semi-automatic 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].

1) For further information about the choice of the signal frequency, refer to Recommendation O.6 [1].

2.1 *Transmission measurements*

When ATME No. 2 is available for the routine maintenance of automatic and semi-automatic international circuits, it should be used to make the following measurements:

- overall loss at 1020 Hz or at 400, 1020 and 2800 Hz, as required;
- psophometric noise power level.

The test frequencies for overall loss measurements should be at a level of -10 dBm0.

2.2 *Signalling tests*

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.

2.3 *Test of echo control devices*

Echo control devices may be tested using an appropriate test system such as that specifies as an option in Recommendation O.22 [2]. If a test system is not available, then subjective test calls may be used. However it should be noted that these test calls will not quantitatively assess echo control device performance [3].

3 Corrective action

3.1 *Readjustment of overall loss*

When, during a routine measurement, the overall loss at 1020 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 less 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 [4] for a method of measuring this error.

References

[1] CCITT Recommendation *1020 Hz reference test frequency*, Vol. IV, Rec. O.6.

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

[3] *Rapid verification test for echo control devices*, Vol. IV, Supplement No. 2.11.

[4] CCITT Recommendation *Frequency shift measuring equipment for use on carrier channels*, Vol. IV, Rec. O.111.

Recommendation M.630

MAINTENANCE OF CIRCUITS USING CONTROL CHART METHODS

Administrations 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 applying 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] CCITT Handbook on *Quality of service, network management and network maintenance*, ITU, Geneva, 1984.

Recommendation M.650

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 1020 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 1020 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.

Recommendation M.660

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.25 [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 a 1020 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 1020 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 1020 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 1020 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: $\leq$ 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	$\leq$ 2 ms (see Note)	$\leq$ 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 *Semi-automatic in-circuit echo suppressor testing system (ESTS),* Vol. IV, Rec. O.25.

[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.665

TESTING OF ECHO CANCELLERS

This Recommendation applies to all echo cancellers specified in accordance with Recommendation G.165 [1], which are located either in international or national networks and which are used for international calls.

1 Periodicity of routine tests

Echo cancellers should be tested every six months.

2 Cancellers which are permanently associated with international circuits

Administrations should choose one of the following methods of canceller testing.

2.1 *Tests using the Echo Canceller Test System (ECTS) or Automatic Transmission Measuring Equipment (ATME) with ECTS facilities*

If the Administrations at each end of a circuit have an ECTS or ECTS facilities specified in accordance with Recommendation O.22 [2], these should be used for in-circuit canceller testing. The following Recommendations should be referred to: Recommendations M.605, M.610 and M.620.

2.2 *Tests using an In-Station-Echo canceller Tester (ISET)*

The following pass/fail tests should be made and where a faulty canceller is identified, it should undergo the tests, including those of tone disabling, which are specified in Recommendation G.165 [1].

Note 1 – If the echo canceller interface is digital (for example 8448, 2048 or 1544 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 using any disturbance to the traffic on the circuit (in-built test system).

Note 3 – The specification of an in-station echo canceller tester is given in Recommendation O.27 [3].

These tests can be made on an echo canceller while in-circuit, such that the adaptation and the non-linear processing are activated. Access to the echo canceller to be tested will be on a 4-wire basis and the tests will be made by applying test signals to the "receive-in" and the "send-in" ports of the echo canceller. The signals level at the "send-out" port will be measured.

The pass/fail tests consist of the following items:

- steady state residual and returned echo level test;
- convergence test;
- performance under conditions of double-talk-A;
- performance under conditions of double-talk-B;
- infinite return loss convergence test;
- tone disabler control signal detection sensitivity, DIS S;
- tone disabler control signal detection sensitivity, DIS R.

(This list is provisional and is the subject of further study.)

3 Cancellers permanently associated with national circuits

Administrations should choose one of the following methods of canceller testing:

- the use of ECTS or ECTS facilities as part of an ATME-type equipment (where this equipment is provided at both ends of a circuit); or
- the use of an in-station tester. Tests to be performed are listed in § 2.2.

4 Testing of pooled cancellers

When echo cancellers are not permanently associated with circuits, Administrations should use an in-station tester. Tests to be performed are listed in § 2.2.

5 Use of group-diagnostics

This method of testing is under study. It comprises self-diagnostics which are shared between cancellers on a per rack or per shelf basis and which perform tests similar to those of an in-station tester. The advantages of using this method are that tests can be made very frequently, thus obviating the need for routine testing, and that a failure can be very quickly brought to the attention of maintenance staff.

References

[1] CCITT Recommendation *Echo cancellers,* Vol. III, Rec. G.165.

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

[3] CCITT Recommendation *In-station echo canceller tester,* Vol. IV, Rec. O.27.

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 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 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.

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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 XII.

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.

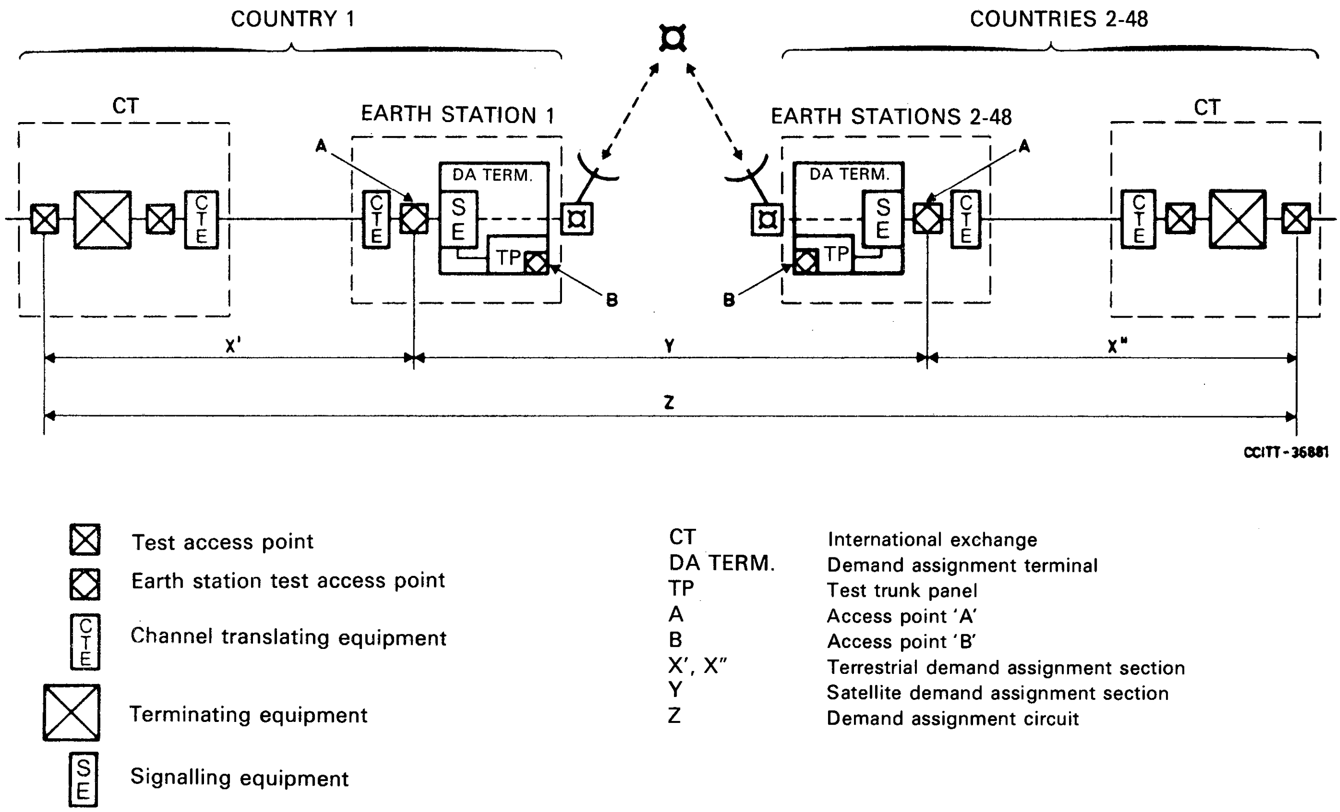

FIGURE 1/M.675

Constitution of an international demand assignment circuit

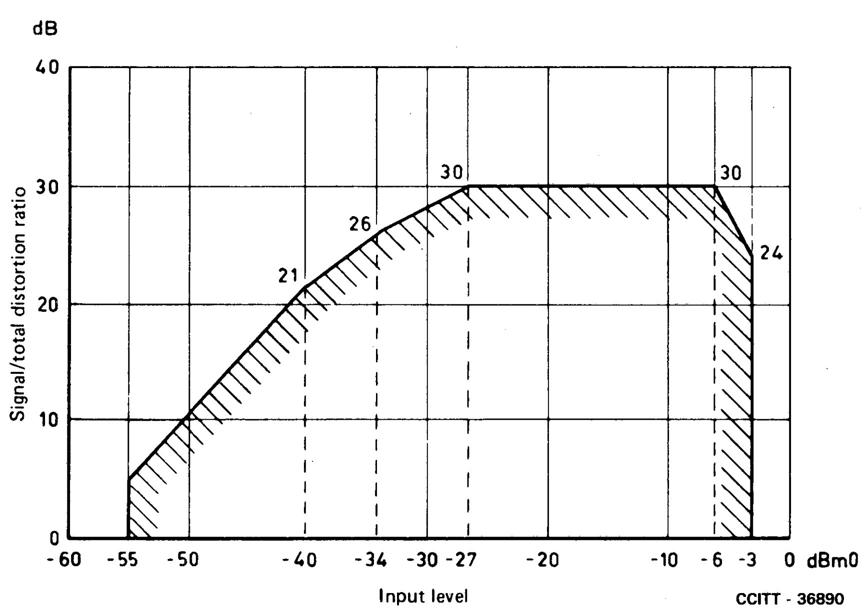

FIGURE 2/M.675

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 [a] 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

[a] Reference frequency = 1020 Hz (See Note 2).

Note 1 – Quantizing distortion should be measured in accordance with the test procedure agreed upon by the satellite system operators.

Note 2 – Test frequencies that are sub-harmonics of the PCM sampling rate should be avoided. (See Rec. O.6 [2].)

Note 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 [a] Z	Earth station-earth station Y	Demand assignment terminal access point	CT-CT Z
		When tested				When tested
Comprehensive signalling and compatibility test 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)

[a] Simulated demand assignment circuit.

Notes relative to Table 2/M.675:

Note 1 – *A* and *B* refer to the DA terminal testing interface. See Figure 1/M.675 for the location of these interfaces.

Note 2 – The outgoing CT must be capable of outpulsing its own country code and exchange digits.

Note 3 – Sectional requirements supersede if the overall requirements of Recommendation M.580 are not met.

Note 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).

Note 5 – Demand assignment system is assumed to operate internal diagnostics to check functional capability and continuity.

Note 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.

Note 7 – Test calls may be carried out to verify operational capability initially, and as required.

Note 8 – These are as agreed upon by the satellite system operators.

Note 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] CCITT Recommendation *1020 Hz reference test frquency*, Vol. IV, Rec. O.6.

[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 telephone service

The guiding principles for the maintenance of the automatic telephone service deal with the division of responsibility for the maintenance of international automatic or semi-automatic telephone circuits between the concerned maintenance elements. 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.710 to M.734. The maintenance organization for transmission systems and leased and special circuits is outlined in Recommendation M.70.

Recommendation M.710

GENERAL MAINTENANCE ORGANIZATION[1)]FOR THE INTERNATIONAL AUTOMATIC AND SEMI-AUTOMATIC TELEPHONE 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.

[1)] The phrase *general maintenance organization* does not necessarily relate to a specific organizational structure in any particular Administration.

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 telephone 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.

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*[2], 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 telephone 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.

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[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.

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;

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 telephone 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.

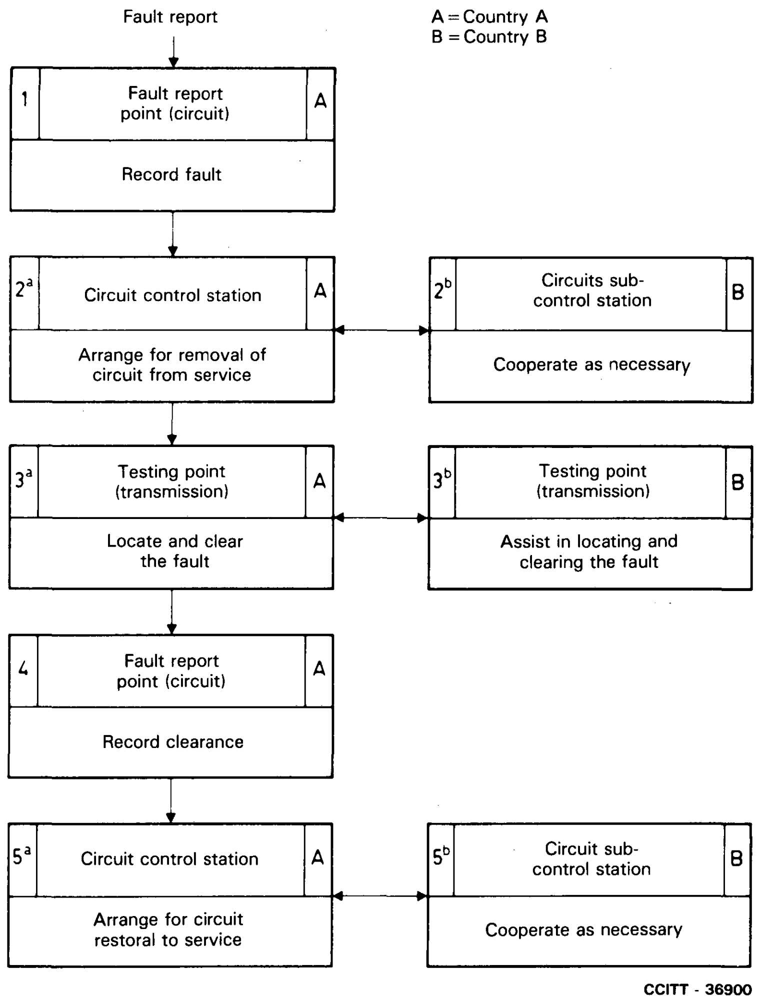

FIGURE 2/M.710

General procedure in acting upon the report of a circuit transmission fault

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[3]. In particular, close liaison between the fault report point (network) and the network management implementation and control point[3] should be ensured.

[3] For definitions of these terms, refer to Recommendation E.413 [1].

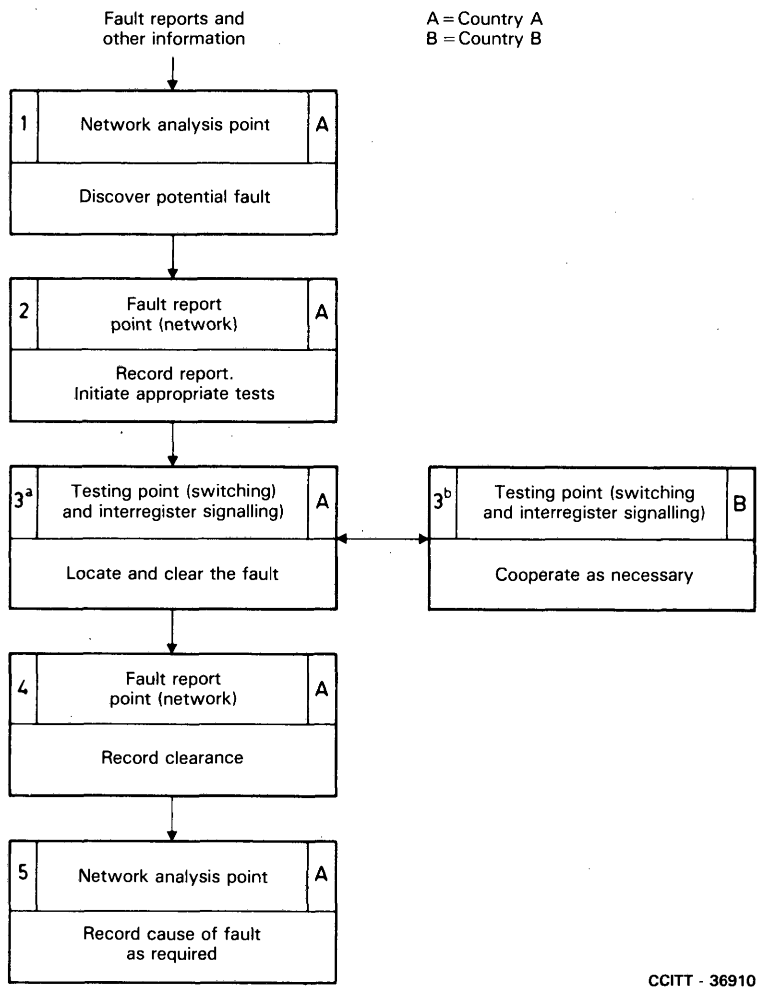

FIGURE 3/M.710

General procedure in acting upon indications of potential faults revealed by the network analysis point

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.

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 management-Planning*, Vol. II, Rec. E.413.

Recommendation M.711

ESCALATION PROCEDURE

An escalation procedure is the process of referring a matter to an organizational entity with a greater degree of expertise or authority. For persistant maintenance problems the organizational entity will, in the first instance, be the technical service described in Recommendation M.75.

Normally cooperation between maintenance elements in different Administrations, described in § 2.3.2 of Recommendation M.710 will result in the satisfactory identification and correction of faults. There may be circumstances, however, where the fault escalation procedure needs to be used. Generally this will occur when:

– indications of a network malfunction persist despite repeated fault investigations;
– the same fault recurs within short intervals;
– a fault is not cleared or is not likely to be cleared within a reasonable period of time.

In all these cases, the stage at which an Administration will invoke the escalation procedure is a matter for its discretion and will depend on such factors as the severity of the effect of a fault on the service. A network malfunction or fault should not persist for longer than 14 days without the escalation procedure being invoked, unless there are exceptional circumstances.

Subsequent action in the event that the situation is not resolved by the technical service, is for further study.

Note – The period of 14 days is a preliminary value and may be changed after further study.

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 telephone 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) (see Recomendation E.413 [1]) of faults affecting the automatic telephone 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 and automatic maintenance access lines as described in Recommendation O.11 [2].

References

[1] CCITT Recommendation *International network management-Planning*, Vol. II, Rec. E.413.

[2] CCITT Recommendation *Maintenance acces lines*, Vol. IV, Rec. O.11.

Recommendation M.716

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 telephone 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). (See Recommendation E.413 [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 telephone 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;
- telecommunication 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.

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 (see Recommendation E.413 [1]) of faults affecting the automatic telephone 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 management-Planning*, Vol. II, Rec. E.413.

Recommendation M.717

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 telephone 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].

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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.

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.

Recommendation M.718

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 telephone 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.

[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 Systems No. 6 and No. 7 are controlled and coordinated by the administrative control (see Recommendations M.762 and M.782).

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.

3.7 Access to 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 *Maintenance acces lines*, Vol. IV, Rec. O.11.

[2] CCITT Recommendation *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 telephone 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.

[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 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) (see Recommendation E.413 [1]) of any problems which may affect service on a route or routes and the action taken.

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 maintenance entities as appropriate.

3.5 Access to 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 management-Planning*, Vol. II, Rec. E.413.

[2] CCITT Recommendation *Maintenance acces lines*, Vol. IV, Rec. O.11.

Recommendation M.720

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 telephone 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. The general considerations for checking the quality of the international telephone service are given in Recommendation E.420 [1].

The network analysis point 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. It 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 [2] and 1/E.423 [3].

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 the international telephone service and evaluating their effect with respect to network condition.

2.5 Receiving reports of all events likely to affect the international telephone 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 *Checking the quality of the international service*, Vol. II, Rec. E.420.

[2] CCITT Recommendation *Observations on international outgoing telephone calls for quality of service*, Vol. II, Table 1/E.422 of Rec. E.422.

[3] CCITT Recommendation *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 telephone 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 management-Planning*, 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 telephone 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 take 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 telephone 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 telecommunication 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 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.

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) (see Recommendation E.413 [1]) 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 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 within its Administration.

2.11 If no restoration plan exists or, for some reason, an existing plan cannot be implemented, advising the responsible authorities 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 management - Planning*, Vol. II, Rec. E.413.

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.

[1] The term "point" is used in the same sense as in the M.700 series of Recommendation – see particularly Recommendations M.710.

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 compared with 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.

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.

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.

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1) See the specification for the CCITT Automatic Transmission Measuring and Signalling Testing Equipment ATME No. 2 (Recommendation O.22 [1]).

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 (and exceptionally, are indicated in Recommendation M.610 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 [2]
No. 5	Q.164 [3]
No. 6	Q.295 [4]
R2	Q.490 [5]
No. 7	Q.707 [6]

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 the existence of 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] CCITT Recommendation *CCITT automatic transmission measuring and signalling testing equipment ATME No. 2*, Vol. IV, Rec. O.22.

[2] CCITT Recommendation *Instruments for checking equipment and measuring signals*, Vol. VI, Rec. Q.138.

[3] CCITT Recommendation *Test equipment for checking equipment and signals*, Vol. VI, Rec. Q.164.

[4] CCITT Recommendatiion *Testing and maintenance – Overall tests of Signalling System No. 6*, Vol. VI, Rec. Q.295.

[5] CCITT Recommendation *Testing and maintenance*, Vol. VI, Rec. Q.490.

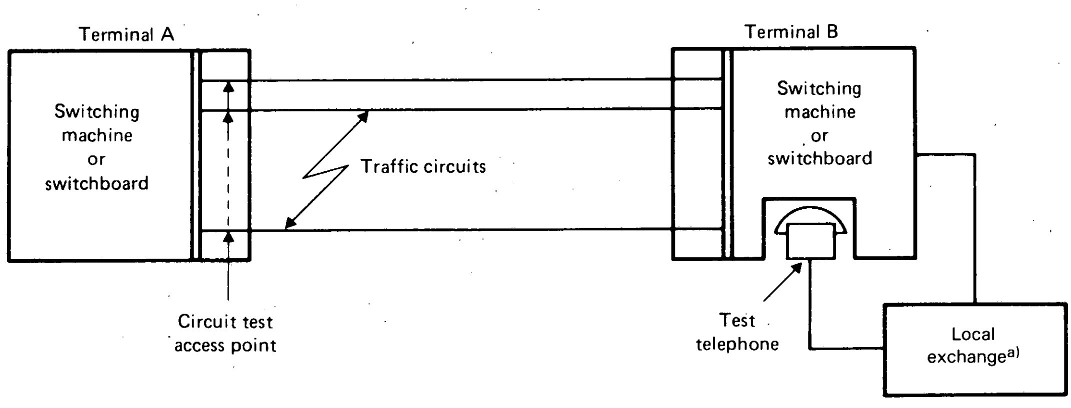
[6] CCITT Recommendation *Testing and maintenance*, Vol. VI, Rec. Q.707.

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 *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, 7 and R2, reference should be made to Recommendations Q.139 [1], Q.163 [2], Q.295 [3], Q.707 [4] and Q.490 [5] 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 [6]) 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 [6]) the facilities given in Recommendation O.11 [7] 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 – Overall tests of Signalling System No. 6*, Vol. VI, Rec. Q.295.

[4] CCITT Recommendation *Testing and maintenance*, Vol. VI, Rec. Q.707.

[5] CCITT Recommendation *Testing and maintenance*, Vol. VI, Rec. Q.490.

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

[7] CCITT Recommendation *Maintenance access lines*, Vol. IV, Rec. O.11.

Recommendation M.733

TRANSMISSION ROUTINE MAINTENANCE MEASUREMENTS ON AUTOMATIC AND SEMI-AUTOMATIC TELEPHONE 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 *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

DATE: November, 1979

INTERNATIONAL SWITCHING CENTRE: London/Mollison

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

4.1 Maintenance of common channel Signalling System No. 6

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 are needed, in addition to those required for channel-associated signalling systems (e.g. R2).

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; it will avoid misunderstandings 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 – Overall tests of Signalling System No. 6*, 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.

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.

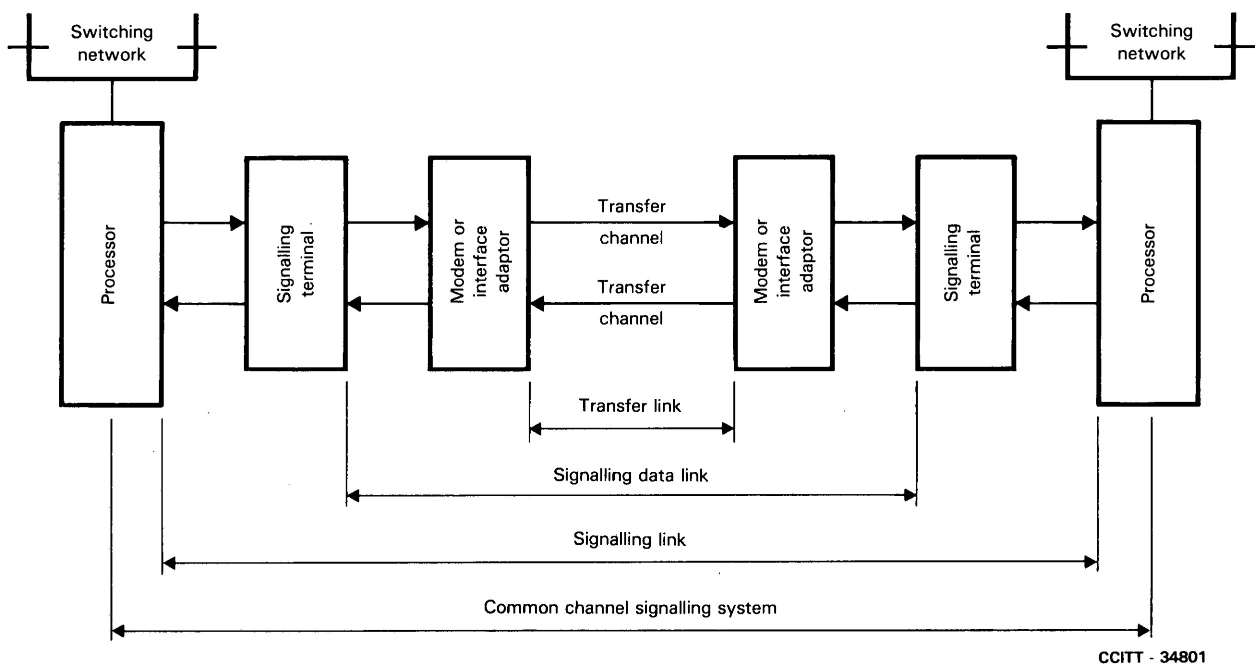


FIGURE 1/M.760
Basic diagram of the common channel Signalling System No. 6

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 operation centres 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)

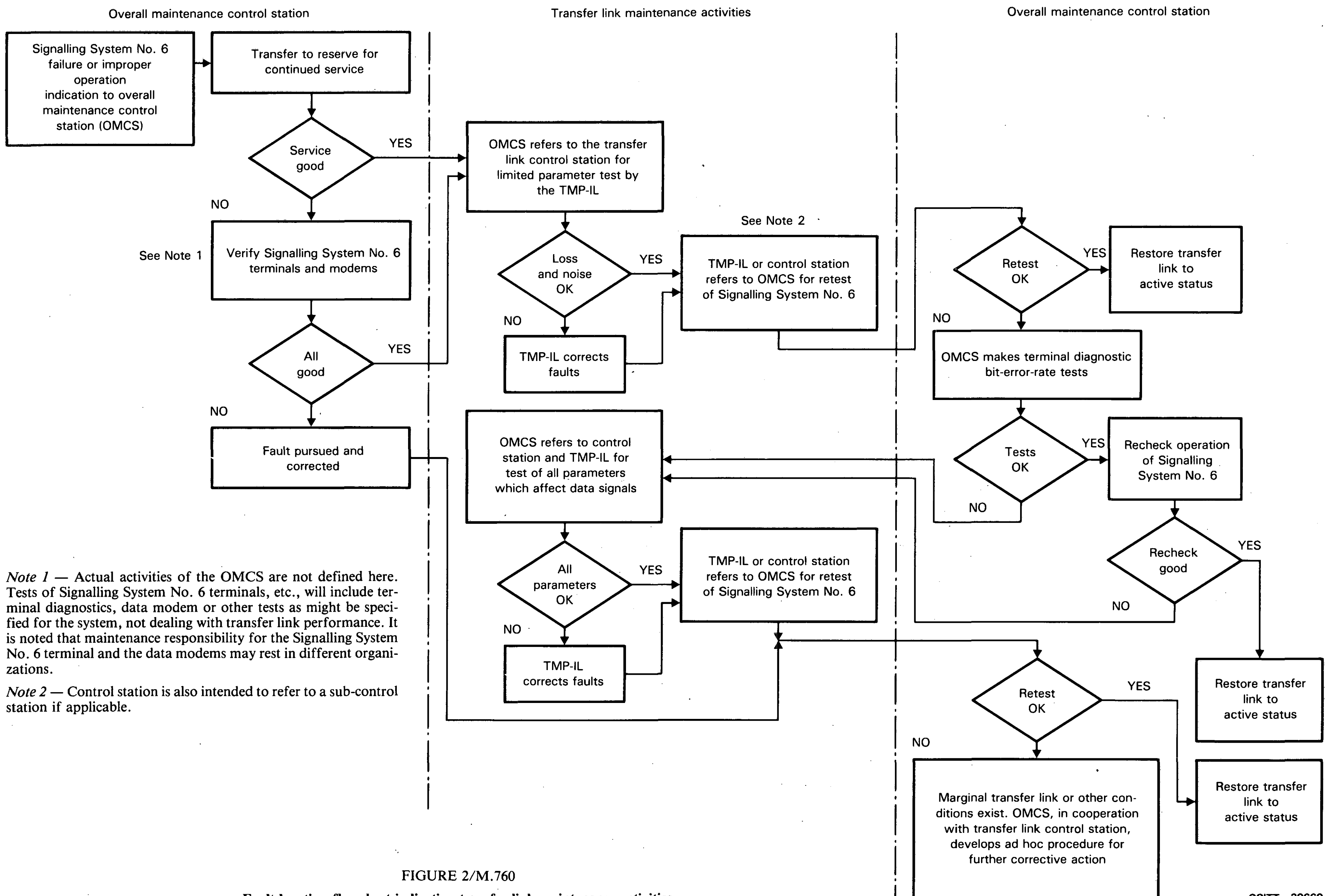
These may be assigned by an Administration as best suited to its individual needs.

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 *Testing and maintenance – 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.

[1] A general description of the transfer link for the common channel Signalling System No. 6 may be found in Recommendation M.760.

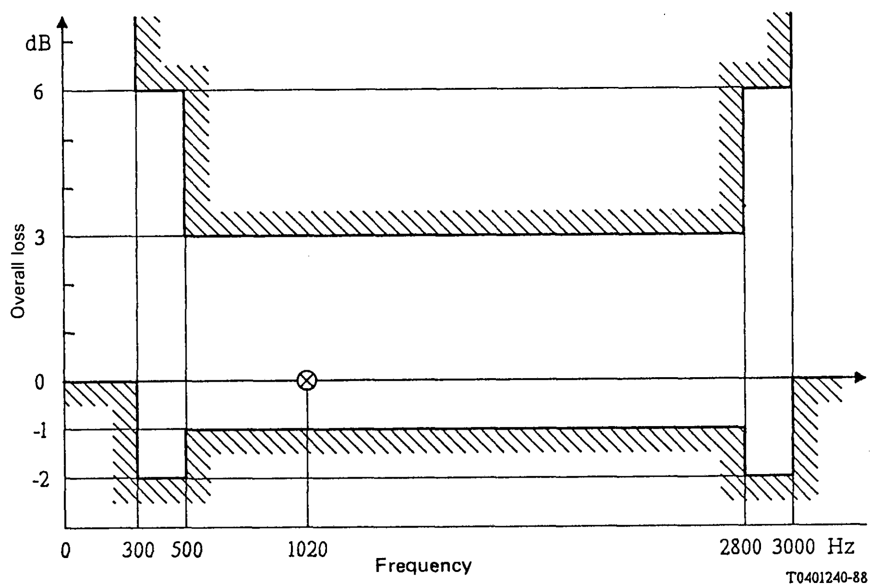
2.3 *Variation with time of the overall loss at reference frequency*

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.

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.

[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.

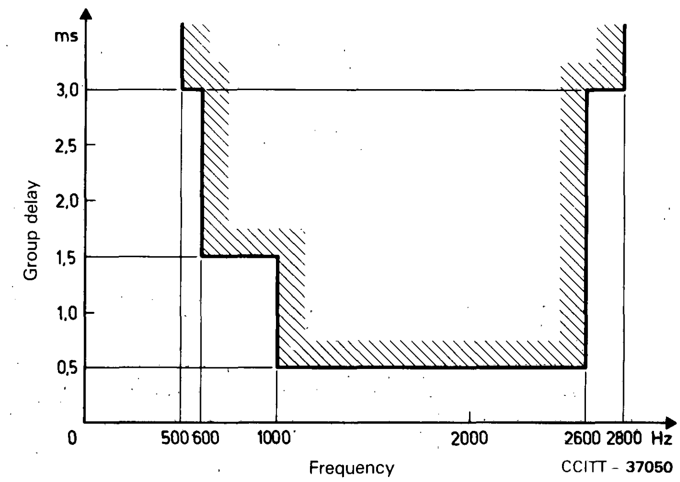


FIGURE 2/M.761

Limits for group delay relative to the minimum measured group delay in the 500-2800 Hz band

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.

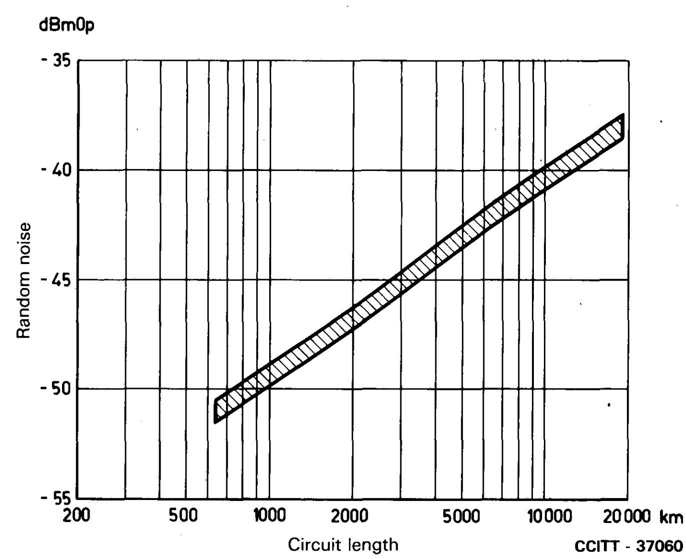


FIGURE 3/M.761

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 *Impulsive noise measuring equipment for telephone-type circuits*, Vol. IV, Rec. O.71.

[5] CCITT Recommendation *Phase jitter measuring equipment for 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 signalling terminal 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 signalling terminals, 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, or an existing signalling system modification.

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), 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].

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.

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[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 of the common channel Signalling System No. 6.

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 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).

4.1 Maintenance of common channel Signalling System No. 7

Recommendation M.770

INTER-ADMINISTRATION AGREEMENTS ON COMMON CHANNEL SIGNALLING SYSTEM No. 7

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. Such agreements may concern, for exemple:

- routing of circuits (cable, satellite, etc.);
- mode of operation (incoming, outgoing, both-way);
- circuit designation;
- order of selection of both-way circuits.

For common channel signalling systems, a number of agreements are needed in addition to those required for channel-associated signalling systems (e.g., Signalling System R2).

This Recommendation explains the principal inter-Administration agreements which must be made in advance of opening a Signalling System No. 7 service and is provided as guidance to those Administrations intending to operate such a service.

2 Common channel Signalling System No. 7 (SS No. 7)

Many of the aspects covered by this Recommendation relate to matters contained in the specifications of Signalling System No. 7, as appearing in the Series Q Recommendations [1]. Where appropriate, cross references to such Recommendations are given.

Recommendations Q.701 [2] and Q.721 [3] provide functional descriptions of the Message Transfer Part (MTP) and Telephone User Part (TUP) respectively.

The Q.780 [4] Series of Recommendations provide guidance on how to test SS No. 7. (Level 1, 2 and 3).

3 Aspects of SS No. 7 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), or "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.701, § 3.1.2 [2].

Before entering into 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 exchange 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. It will avoid misunderstandings and thus enable rapid progress in establishing detailed arrangements. Subsequently, agreement on the following matters will be required:

i) The use of "associated" and/or "non-associated" modes of signalling.

ii) The choice of signalling transfer points (STPs) in the case where the "non-associated" mode of signalling is used.

iii) Security measures against signalling network link failure, e.g., the use of load sharing between link sets. If load sharing between link sets is to be used, agreement must be reached as to the number of link sets involved.

iv) Alternative routing within the signalling network in the event of failure of a link set, i.e., if load sharing is not used, which STPs are available for a given signalling network relation, and the order of selection of these. Due regard must be paid to the limitation of the number of STPs in tandem in a given signalling network relation (see Recommendation Q.705 § 5) [5].

v) The routing of the signalling network links must ensure that the propagation delay of the links is as low as possible, and not significantly higher than that of the speech circuits which are served by Signalling System No. 7. This is to minimize the initial speech clipping of the verbal answer from the called party. The above factors must also be considered in any restoration plans, although the non-availability of links may force administrations to accept the possibility of clipping under failure conditions.

vi) The nature of the signalling network link to be used, e.g., 4.8 kbit/s analogue or 64 kbit/s digital, transmission routing, etc.

vii) The method of error correction to be employed in a given signalling relation, i.e., basic or preventive cyclic retransmission (see Recommendation Q.703 § 5) [6].

viii) Emergency restart conditions. (If there is automatic allocation of signalling terminals or signalling data links at the end of a signalling link, it must be ensured that the value (T2) of the timeout is different at each end (see Recommendation Q.703, § 7.3 and Q.704, § 3.4.3) [6] and [7]).

3.2 *Mode of signalling*

Signalling System No. 7 provides for two basic modes of sending signalling information namely, "en-bloc" or "overlap" (Recommendation Q.724) [8].

3.3 *Signalling network consideration for cross-border traffic*

For cross-border traffic between signalling points, a bilateral agreement needs to be made for the routing label assignment of signalling point codes.

Two alternative arrangements are described in Recommendation Q.705, § 6 [5]. One arrangement provides for signalling points which are handling cross-border traffic to be given signal point codes taken from the international numbering plan contained in Recommendation Q.708 [9]. The other provides for these signalling points to be identified by common national point codes.

3.4 *Routing label assignment*

The routing label is that part of the message label which contains the information necessary to deliver the message to its destination point. It comprises the following (see Recommendation Q.704, § 2.2) [7]:

- destination point code (DPC);
- originating point code (DPC);
- signalling link selection (SLS) field or signalling link code (SLC).

DPC and OPC labelling will be in accordance with Recommendation Q.708 [9]. However it may be necessary to have a bilateral agreement for the SLS, so that it can be assigned individually to signalling links.

3.5 *Circuit identification code*

The circuit identification code (CIC) indicates one speech circuit among those directly interconnecting the destination and the originating points. The allocation of CICs to individual circuits is determined by bilateral agreement and/or in accordance with predetermined rules. See Recommendation Q.723, § 2.2.3 [10].

3.6 *Reset of circuit and circuit group messages*

In systems which maintain status in memory there may be occasions when the memory becomes mutilated. In such cases the circuits must be reset to the idle condition in both exchanges to make them available for new traffic. Since the exchange with mutilated memory does not know whether the circuits are idle, busy outgoing, busy incoming, blocked, etc., reset-circuit signals or a circuit group reset should be sent as appropriate for the affected circuits (see Recommendation Q.724, § 1.15) [8].

Under certain failure conditions however, where a large number of circuits is involved, it is possible that some realisations of SS No. 7 terminal equipment will be unable to process the volume of reset messages generated. It is necessary, therefore, that Administrations agree bilaterally whether circuit and circuit group messages should both be used.

3.7 *Use of the circuit continuity check procedure*

Because the SS No. 7 signalling does not pass over the speech path, facilities should be provided for making a continuity check of the speech paths (see Recommendation Q.724, § 1.4) [8].

Use of this procedure on a particular circuit will depend on the type of transmission system (e.g., analogue, digital, mixed analogue/digital) which is used for the circuit and whether end-to-end supervision is provided on the transmission system. It should therefore be bilaterally agreed.

3.8 *Choice of the time slot to be used within the primary order digital path for the signalling link*

In the case where time slot 16 is utilized for circuit supervision purposes (see Recommendation Q.33, § A.1) [11], it is necessary to agree bilaterally on which time slot within the primary order digital path should be used for the signalling link.

3.9 *Changing from one specification of the signalling system to another*

If an Administration changes from one version of the specification of the signalling system to another, distant Administrations should be informed as a precautionary measure before the change takes place since potential interworking problems can then be anticipated. It is desirable therefore, that Administrations should be aware of the need for, and agree to, this exchange of information.

4 Timing on inter-Administration agreements

Due to the differing practices and procedures of Administrations no specific timetable for the inter-Administration agreements necessary on SS No. 7 can be offered. However, experience indicates that initial discussions between Administrations concerning the implementation of a new common channel signalling system should preferably commence about two years prior to the required "ready for service" date.

References

[1] CCITT Recommendation *Specification of Signalling System No. 7*, Vol. VI, Recommendations Q.701-Q.795.

[2] CCITT Recommendation *Functional description of the signalling system* (*Message Transfer Part*), Vol. VI, Recommendation Q.701.

[3] CCITT Recommendation *Functional description of the signalling system* (*Telephone User part (TUP)*), Vol. VI, Recommendation Q.721.

[4] CCITT Recommendation *Signalling System No. 7 test specification, general description*, Vol. VI, Recommendation Q.780.

[5] CCITT Recommendation *Signalling network structure*, Vol. VI, Recommendation Q.705.

[6] CCITT Recommendation *Signalling link*, Vol. VI, Recommendation Q.703.

[7] CCITT Recommendation *Signalling network functions and messages*, Vol. VI, Recommendation Q.704.

[8] CCITT Recommendation *Signalling procedures*, Vol. VI, Recommendation Q.724.

[9] CCITT Recommendation *Numbering of international signalling point codes*, Vol. VI, Recommendation Q.708.

[10] CCITT Recommendation *Formats and codes*, Vol. VI, Recommendation Q.723.

[11] CCITT Recommendation *Protection against the effects of faulty transmission on groups of circuits* Vol. VI, Recommendation Q.33.

Recommendation M.782

MAINTENANCE OF COMMON SIGNALLING SYSTEM No. 7

1 General

1.1 It is essential that a 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 supersede any Recommendation or procedure (national network or otherwise) which might apply to specific components or sub-systems, for example a signalling terminal or the signalling data 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 signalling terminals, 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 entitled *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 or a change to an existing 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 measurement of the signalling link, services affecting reconfigurations of transmission systems over which signalling links are routed (i.e., planned outages), 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 failure.

3.1.3 Faults which are observable only at a signalling system terminal, for example intermittent failures resulting from an apparently high data bit error rate, must be analyzed 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, if under its jurisdiction, or by the sub-control, if under its 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 reported 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 continue 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 of correction and the condition 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 or a change to an existing system*

3.4.1 The Administrations involved must reach all the agreements necessary such as circuit identification code (CIC) assignments, label assignment, constitution of the signalling link routing, security arrangements, testing, etc. (see also Recommendation M.750).

3.4.2 It is necessary to conduct tests on those signalling routes which could be affected by such implementations. The purpose of the tests is to provide confidence that the software, hardware and data for a signalling system is correct in that:

- a traffic circuit using that route can enter, or be removed from service;
- changes made to signalling and traffic routes for which circuits are already in service function correctly.

This objective must be achieved without disruption to live traffic.

3.4.3 Prior to tests being made, it should be ensured that:

- exchange data has been loaded;
- diagnostic checks of the signalling terminals in each exchange have been made;
- test equipment and facilities are available. (The precise requirements are a subject for further study.)

3.4.4 The following situations require tests. The list is not exhaustive since combinations of situations may occur.

For each situation it is necessary to consider whether or not traffic circuits are in service and whether they are being added to or ceased or whether there is no change.

i) no signalling route existing between two switching centres:
   - signalling transfer point (STP) route to be provided
   - direct linkset to be provided

ii) STP signalling route existing between two switching centres:
   - STP route to be added
   - STP route to be ceased
   - direct linkset to be provided

iii) direct signalling route existing between two switching centres:

- STP route to be added
- STP route to be ceased
- direct linkset to be provided

iv) direct linkset to be ceased:

- link to be provided
- link to be ceased.

3.4.5 For the present, tests should be chosen from those specified as compatibility tests in Recommendations Q.781 [1], Q.782 [2] and Q.783 [3] by agreement between the Administrations concerned. The question of whether particular tests can be specified for particular situations remains as a subject of further study. The actual tests chosen will depend on the nature of the changes which have been made to the signalling network and the relative experience of the participating Administrations. However, when implementing a new signalling system, the following aspects should be covered:

- Level 1 and 2 tests which cover normal and failure conditions for synchronization and Message Transfer Part (MTP) functions;
- Level 3 tests which cover the application of failure conditions in order to test single recovery arrangements;
- Level 4 tests which cover Telephone User Part (TUP) call processing functions and normal STP signalling functions. Test should cover normal, abnormal, transit and call failure sequences;
- tests on individual speech circuits, e.g. using ATME No. 2;
- limited period, live traffic tests.

3.4.6 The test equipment and facilities required remain as a subject for further study.

3.4.7 After completion of testing, there should be an increased level of supervision on the route for a period, the duration of which should be agreed by the Administration concerned. Generally it should not be less than one week. During this period traffic signalling performance statistics should be obtained relating to both the Message Transfer Part (MTP) and Telephone User Part (TUP) in order to confirm that the route performance is functioning correctly. These should be chosen by agreement between the Administrations concerned. Those for the MTP should be taken from Recommendation Q.791 [4] (Monitoring and measurements for the MTP).

3.4.8 The administrative control should receive and record for future reference the results of tests carried out. 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:

- cooperate with the administrative control in fault localization and clearing activities as necessary;
- respond with all relevant details of investigations and fault clearance activities to the administrative control;
- advise the administrative control of any known present or future event likely to affect 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).

6 Monitoring requirements for maintenance purposes

This section specifies the monitoring requirements for maintenance of the common channel Signalling System No. 7.

It considers three aspects of monitoring which are as follows:

- a monitoring facility for the signalling system which is realized in the digital exchange software. It would be called into operation by command when required in order to manually observe signalling sequences. It is referred to hereafter as a software monitor;
- a facility (provided by means of hardware) which allows for the connection of monitoring equipment to the signalling link, i.e. a monitoring point;
- the requirements for testing equipment which is connected at the monitoring point.

6.1 *The software monitor*

6.1.1 A software monitor should be provided which will allow signals handled in the implementation of the signalling system in the SPC exchange, to be selectively output to an input/output terminal for the purpose of manually observing signalling sequences.

It is considered that this facility should be the primary means of manually observing signalling sequences.

6.1.2 The software monitor should meet the following requirements:

- it must be capable of operations without interfering with the operation of the signalling system;
- it must be capable of monitoring Message Transfer Part (MTP) and Telephone User Part (TUP) messages. Other User Parts are the subject of further study;
- it must be capable of displaying all MTP messages which relate to specified linksets or destinations or both. It should record registration time, direction, linkset identity, link identity, signal acronym and any change of signalling link state for all messages. It must be possible to monitor several destinations and linksets simultaneously. The precise number of destinations and linksets will depend upon such factors as the size of the exchange and its position in the network (i.e. local, transit, etc.);
- it must be capable of displaying the contents of all TUP message signal units sent and received for specified speech circuits or groups of circuits. It would also be useful to register the link on which the TUP signals have been sent and record any changes to the link used. It must be possible to monitor several circuits simultaneously. The precise number of circuits will depend on such factors as the size of the exchange and its position in the network (i.e. local, transit, etc.).

6.2 *Monitoring point requirements*

6.2.1 A means of connecting independent monitoring equipment to a 64 kbit/s signalling link should be provided. This facility would be used either when more information is required than the software monitor is able to provide or when verification by an independent means is required of the information supplied by the software monitor.

The means of connection to a 64 kbit/s signalling link should be either at the 64 kbit/s level, in which case interface requirements of Recommendation G.703, § 1 [5] apply, or at the primary order level, in which case the interface requirements of G.703, § 2 (1544 kbit/s) or § 6 (2048 kbit/s) apply.

6.2.2 The means of connection should be such that:

- signals can be monitored in both directions simultaneously;
- the connection of monitoring equipment does not affect the signals present on the link or on other time slots in the primary order path which carried the link;
- signals may be monitored irrespective of the current link status;
- any or all of the protocol levels of any signal units on the link may be observed.

6.3 *Requirements of test equipment used for monitoring purposes*

Requirements for test equipment used for monitoring purposes are:

- that the equipment should be self-contained and independent of the terminal equipment of the system;
- that the equipment should be able to display all signals which are necessary to be examined in order to detect faults at all levels of the signalling system;
- that the form in which signals are displayed should enable them to be easily recognizable to the maintenance staff. In particular it should be possible to display specified fields of a message or all the fields;
- that the equipment should be capable of storing information from the link for later off-line examination (amount and extent of this information has yet to be determined);
- that information should be displayed (and recorded, where applicable) to allow the operator to determine the time when a signal or message was received;
- that the equipment should be able to display and store information on the link at all times;
- that the equipment should have the facility to allow the maintenance staff to determine which categories of signals or messages are to be displayed;
- that the equipment should allow the maintenance staff to specify conditions such as the receipt of messages or signals which would trigger the commencement of display or storage;
- that when triggered, the equipment should display, in chronological order the signals which occurred prior to the triggering and after it. The number of these messages has yet to be determined.

Note – It is intended that a Recommendation in the O series will be developed which will specify this test equipment in detail.

References

[1] CCITT Recommendation *MTP Level 2 test specification,* Vol. VI, Recommendation Q.781.

[2] CCITT Recommendation *MTP Level 3 test specification,* Vol. VI, Recommendation Q.782.

[3] CCITT Recommendation *TUP Test specification,* Vol. VI, Recommendation Q.783.

[4] CCITT Recommendation *Monitoring and measurements for the MTP,* Vol. VI, Recommendation Q.791.

[5] CCITT Recommendation *Physical/electrical characteristics of hierarchical digital interface,* Vol. III, Recommendation G.703.

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