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CONSULTATIVE COMMITTEE

M.20

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MAINTENANCE: INTRODUCTION AND GENERAL PRINCIPLES

MAINTENANCE PHILOSOPHY FOR TELECOMMUNICATION NETWORKS



Recommendation M.20

FOREWORD

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

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

Recommendation M.20 was revised by Study Group IV and was approved under the Resolution No. 2 procedure on the 5th of October 1992.

CCITT NOTES

- 1) In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized private operating agency.
- 2) A list of abbreviations used in this Recommendation can be found in Annex A.

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Recommendation M.20

MAINTENANCE PHILOSOPHY FOR TELECOMMUNICATIONS NETWORKS¹⁾

(revised 1992)

Abstract

This Recommendation describes maintenance philosophy for telecommunications networks. It also defines network maintenance phases, network supervision capabilities, and bringing into service requirements.

Keywords

- maintenance,
- maintenance entity,
- network.

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)²⁾. 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 [11] and M.710 [12] for automatic circuits switched over analogue, digital and mixed networks. In addition, the concept of control and subcontrol stations found in Recommendations M.80 [13] and M.90 [14] 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).
- d) 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 (hardware and software).

¹⁾ The principles described in Recommendation M.21 [15] should also be taken into account.

²⁾ It is recognized that for some Administrations, bringing into service is not considered to be part of maintenance.

- e) It should have as a major aim to minimize both the occurrence and the impact of failures and to ensure that in case 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; and
 - the right notification.

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.

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 of sustaining a desired technical performance by the systematic application of supervision, testing and performance sampling in order 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.

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 including ISDNs

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 digital equipment. Analogue equipment often requires additional external maintenance systems in order to permit controlled maintenance, e.g. ATME No. 2 (see 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 human 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 equipment. 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.3010 [16].

In addition, the introduction of open or standardized interfaces between Network Elements (NEs) and Operations Systems (OS) via TMN, including interfaces between TMNs will allow for enhancing maintenance, operations and testing procedures. These new enhanced procedures will be based upon remote capabilities to perform the following:

- loopbacks;
- access to performance and test data;
- status change and control;
- switchovers;
- others.

3 Overall maintenance philosophy

3.1 Network components for maintenance

3.1.1 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/M.20, 2/M.20 and 3/M.20.

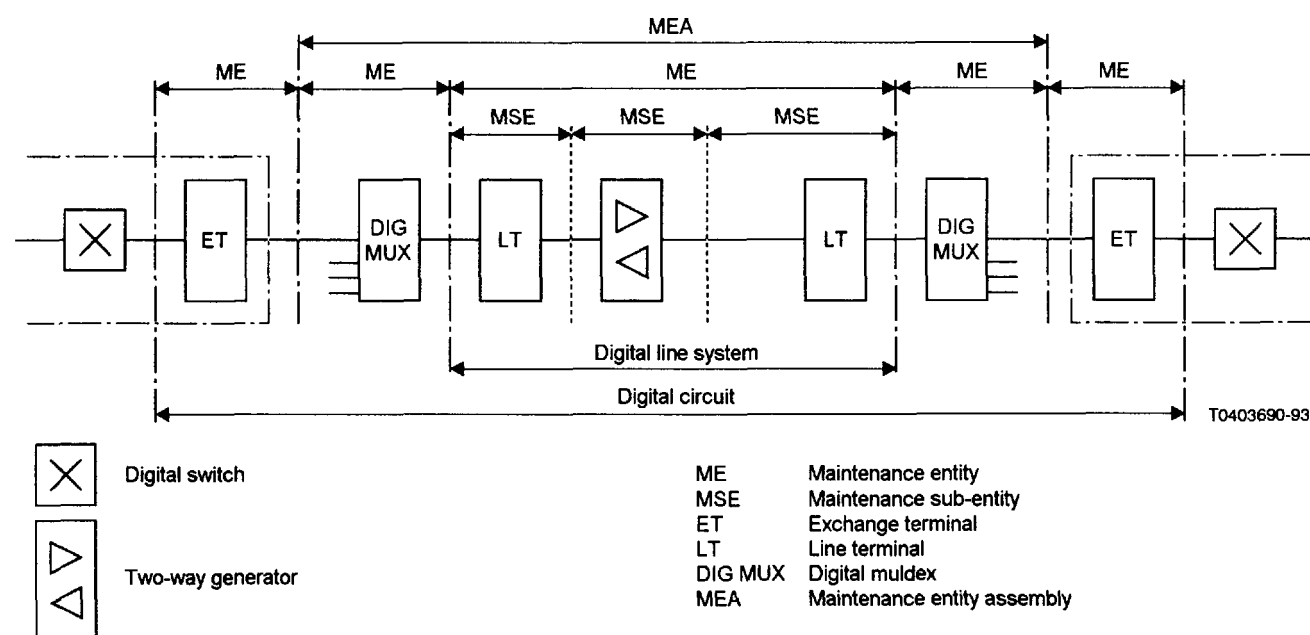


FIGURE 1/M.20

Maintenance entity concept for digital transmission networks

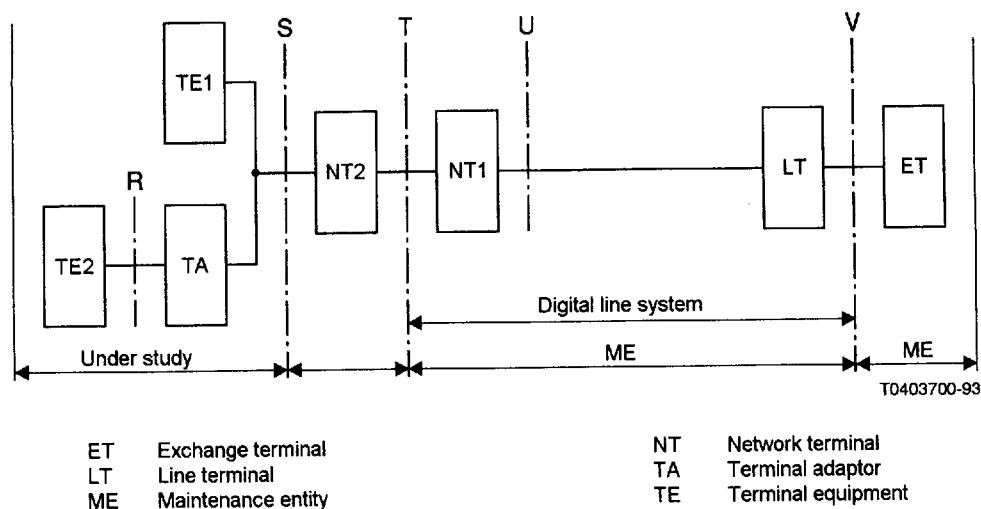


FIGURE 2/M.20
Maintenance entity concept for the ISDN subscriber network

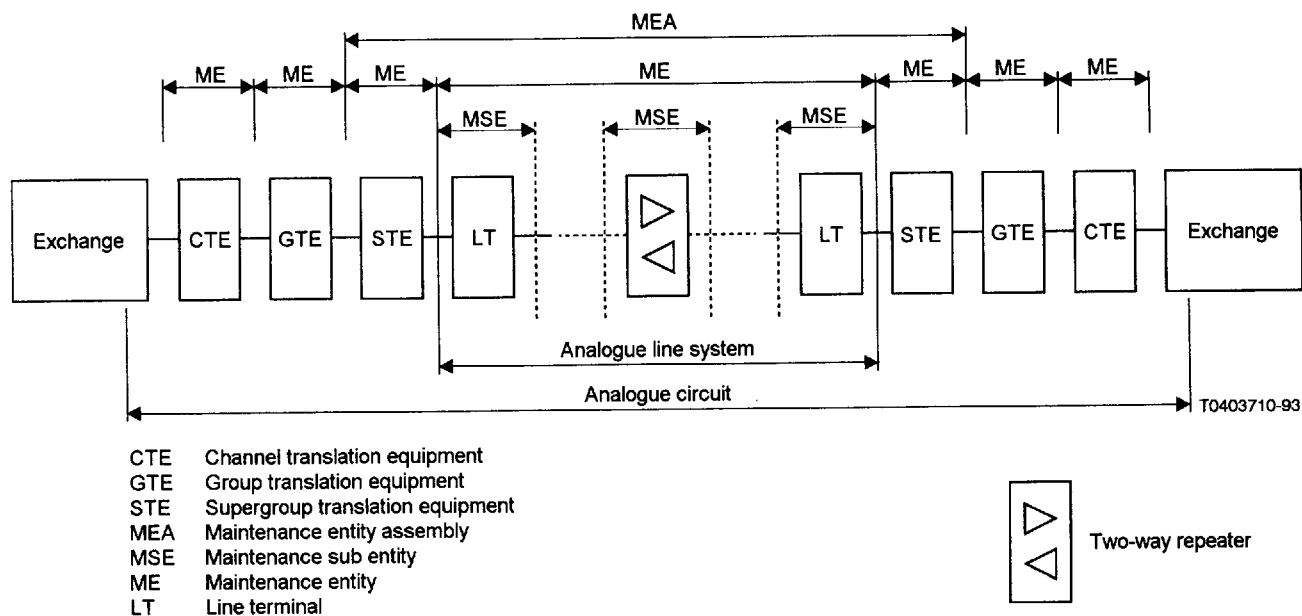


FIGURE 3/M.20
Maintenance entity concept for analogue networks

3.1.1.1 *Definition of Maintenance Entity*

Maintenance entities are defined by the following requirements:

- The different equipment of a telecommunications network constituting the MEs are interconnected at consecutive and easily identifiable interface points.³⁾ At these points the interface conditions defined for these equipment apply and they possess the means of detecting maintenance events and the means of restoration.
- 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 requirements ensures that the responsible maintenance personnel are called into action, and that usually no unnecessary maintenance activity is initiated elsewhere.

In a 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.

3.1.1.2 *Maintenance Entity interface*

An ME has to perform a determined function between telecommunication 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.

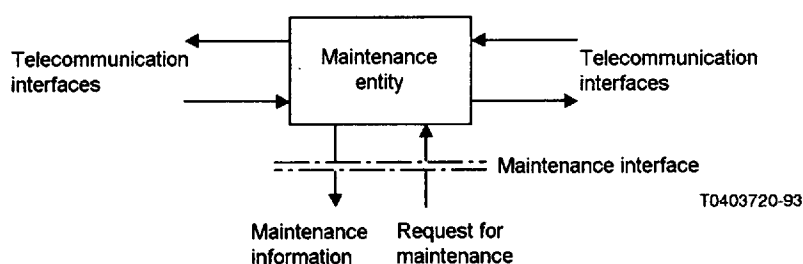


FIGURE 4/M.20
Maintenance entity interface

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.3010 [16] which covers the TMN.

³⁾ 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.