INTERNATIONAL TELECOMMUNICATION UNION

ITU-T M.160

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

MAINTENANCE :
INTRODUCTION AND GENERAL PRINCIPLES

STABILITY OF TRANSMISSION

ITU-T Recommendation M.160

(Extract from the *Blue Book*)

NOTES

1 ITU-T Recommendation M.160 was published in Fascicle IV.1 of the *Blue Book*. This file is an extract from the *Blue Book*. While the presentation and layout of the text might be slightly different from the *Blue Book* version, the contents of the file are identical to the *Blue Book* version and copyright conditions remain unchanged (see below).

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

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:

$$|M| \leq 0.5 \text{ dB}, \quad S \leq 1.3 \text{ dB}$$

2.3 conditions concerning the receiving end:

2.3.1 group links:

$$|M| \leq 0.3 \text{ dB}, \quad S \leq 0.6 \text{ dB}$$

2.3.2 supergroup links:

$$|M| \leq 0.3 \text{ dB}, \quad S \leq 0.5 \text{ dB}$$

2.3.3 mastergroup links:

$$|M| \leq 0.3 \text{ dB}, \quad S \leq 0.4 \text{ dB}$$

2.3.4 supermastergroup links:

$$|M| \leq 0.3 \text{ dB}, \quad S \leq 0.3 \text{ dB}.$$

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.

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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.

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 over emphasized.

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.