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MAINTENANCE : INTRODUCTION AND GENERAL PRINCIPLES

PERFORMANCE MONITORING ON INTERNATIONAL TRANSMISSION SYSTEMS AND EQUIPMENT

ITU-T Recommendation M.34

(Extract from the *Blue Book*)

NOTES

1 ITU-T Recommendation M.34 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.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.

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.