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**SERIES O: SPECIFICATIONS OF MEASURING
EQUIPMENT**

**Equipment for the measurement of digital and
analogue/digital parameters**

**Equipment to assess error performance
on STM-N interfaces**

ITU-T Recommendation O.181



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ITU-T Recommendation O.181

Equipment to assess error performance on STM-N interfaces

Summary

This Recommendation specifies the measuring equipment and the related test signal structures to perform in-service or out-of-service error performance measurements on STM-N interfaces.

Source

ITU-T Recommendation O.181 was revised by ITU-T Study Group 4 (2001-2004) and approved under the WTSA Resolution 1 procedure on 29 May 2002.

Keywords

Error performance, in-service, measuring equipment, measurement mode, out-of-service, test signal structure.

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Introduction

The requirements for the characteristics of the error performance measuring equipment which are described below must be adhered to in order to ensure compatibility between equipment produced by different manufacturers.

While requirements are given for the equipment, the realization of the equipment configuration is not covered and should be given careful consideration by the designer and user. In particular, it is not required that all features listed below shall be provided in one piece of equipment. Users may select those functions which correspond best to their applications.

ITU-T Recommendation O.181

Equipment to assess error performance on STM-N interfaces

1 Scope

This Recommendation specifies the functions of a measuring equipment capable of assessing SDH error performance at STM-N interfaces.

ITU-T Rec. G.707 [3] defines the STM-N signals applicable to these measurements. ITU-T Rec. G.703 [1], G.957 [10] and G.691 [17] define the STM-N physical interface characteristics.

Measurement modes and functions defined in this Recommendation enable:

- any measuring equipment to analyze information provided by another measuring equipment (e.g. measurement modes and test sequences are common to all measuring equipment);
- any two measuring equipments to provide the same means to analyze the error performance of a given digital transmission path or path segment.

With regard to the numerous possibilities to make measurements on STM-N signals, a set of measurements modes are defined (see clause 5). Each measurement mode depends on the type of network entity under test, i.e. on the type of measured STM-N signal and on the type of SDH network elements crossed by the measured signal.

In addition, the required functions of the Generator and Receiver part of the error performance measuring equipment are described below (see clauses 6 and 7).

2 References

The following Recommendations and other references contain provision which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; all users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published.

- [1] ITU-T Recommendation G.703 (2001), *Physical/electrical characteristics of hierarchical digital interfaces*.
- [2] ITU-T Recommendation G.706 (1991), *Frame alignment and Cyclic Redundancy Check (CRC) procedures relating to basic frame structures defined in Recommendation G.704*.
- [3] ITU-T Recommendation G.707/Y.1322 (2000), *Network node interface for the synchronous digital hierarchy*.
- [4] ITU-T Recommendation G.772 (1993), *Protected monitoring points provided on digital transmission systems*.
- [5] ITU-T Recommendation G.775 (1998), *Loss of Signal (LOS), Alarm Indication Signal (AIS) and Remote Defect Indication (RDI) defect detection and clearance criteria for PDH signals*.
- [6] ITU-T Recommendation G.783 (2000), *Characteristics of Synchronous Digital Hierarchy (SDH) equipment functional blocks*.
- [7] ITU-T Recommendation G.784 (1999), *Synchronous Digital Hierarchy (SDH) management*.

- [8] ITU-T Recommendation G.825 (2000), *The control of jitter and wander within digital networks which are based on the Synchronous Digital Hierarchy (SDH)*.
- [9] ITU-T Recommendation G.826 (1999), *Error performance parameters and objectives for international, constant bit rate digital paths at or above the primary rate*.
- [10] ITU-T Recommendation G.957 (1999), *Optical interfaces for equipments and systems relating to the synchronous digital hierarchy*.
- [11] ITU-T Recommendation M.2101 (2000), *Performance limits and objectives for bringing-into-service and maintenance of international SDH paths and multiplex sections*.
- [12] ITU-T Recommendation O.150 (1996), *General requirements for instrumentation for performance measurements on digital transmission equipment*.
- [13] ITU-T Recommendation O.3 (1992), *Climatic conditions and relevant tests for measuring equipment*.
- [14] ITU-T Recommendation V.24 (2000), *List of definitions for interchange circuits between Data Terminal Equipment (DTE) and Data Circuit-terminating Equipment (DCE)*.
- [15] ITU-T Recommendation V.28 (1993), *Electrical characteristics for unbalanced double-current interchange circuits*.
- [16] ITU-T Recommendation G.813 (1996), *Timing characteristics of SDH equipment slave clocks (SEC)*.
- [17] ITU-T Recommendation G.691 (2000), *Optical interfaces for single-channel STM-64, STM-256 systems and other SDH systems with optical amplifiers*.
- [18] ITU-T Recommendation G.806 (2000), *Characteristics of transport equipment – Description methodology and generic functionality*.
- [19] ITU-T Recommendation G.828 (2000), *Error performance parameters and objectives for international, constant bit rate synchronous digital paths*.
- [20] ITU-T Recommendation G.829 (2000), *Error performance events for SDH multiplex and regenerator sections*.

3 Definitions

This Recommendation defines the following terms:

- **Test Sequence Error (TSE):** See Annex A.
- **Test Signal Structure (TSS):** See Annex C.
- **End-to-End Transparency:** See 5.3.

4 Abbreviations

This Recommendation uses the following abbreviations.

EUT	Entity Under Test
PDH	Plesiochronous Digital Hierarchy
SDH	Synchronous Digital Hierarchy
TSS	Test Signal Structure

See also 5.2.1 and Annex A for anomalies and defect abbreviations.

5 Measurement modes and events to be monitored

This clause gives a list of the measurement modes which can be provided by one or more measuring equipments.

5.1 Definition of the measurement modes

Two sets of measurement modes are identified:

1) *Out-of-service measurement modes*

After setting up a path through the Entity Under Test (EUT) by appropriate means, a suitable test sequence is applied to the input at one side of the EUT. The received information is analyzed at an access point at the same or the other side of the EUT.

2) *In-service measurement modes*

The digital signal transported by the SDH elements under test is analyzed at a given access point of the EUT.

Both measurement modes can be used simultaneously: It is possible to apply the in-service measurement mode to a test path which has been set up in order to perform out-of-service measurements.

The measurement modes are defined according to the different types of SDH network entities under test (e.g. multiplex section, regenerator section, path, etc.), i.e. according to the structure of the measured STM-N signal at the connection point and according to the characteristics of the SDH network elements passed by the measuring signal.

In order to specify the error performance measurement procedure for each measurement mode, it is necessary to define the network events to be monitored. Moreover, the test signal structures with associated test sequences to be used in case of out-of-service measurements need to be defined.

The Test Signal Structures named TSSX (X being a number) which shall be used for such measurement modes are defined in Annex C.

5.2 Events to be monitored

This subclause lists the defects, anomalies and the other events related to error performance which can be detected by the measuring equipment on STM-N signals. Criteria for detecting anomalies and defects are given in Annex A.

Annex B classifies the indications available in SDH, according to those defined in ITU-T Recs. G.783 [6] and G.784 [7]. It separates events related or not related to error performance.

A subset of these events is selected for each measurement mode according to the SDH network entity under test.

5.2.1 Network events

Network anomalies

- Out of Frame alignment (OOF).
- B1 error.
- B2 error.
- B3 error.
- Higher-order Path Remote Error Indication (HP-REI).
- Lower-order Path Remote Error Indication (LP-REI).
- Multiplex Section Remote Error Indication (MS-REI).
- BIP-2 error.

Network defects

- Loss of Signal (LOS).
- Loss of Frame alignment (LOF).
- Multiplex Section Alarm Indication Signal (MS-AIS).
- Multiplex Section Remote Defect Indication (MS-RDI).
- Administrative Unit Loss of Pointer (AU-LOP).
- Administrative Unit Alarm Indication Signal (AU-AIS).
- Higher-order Path Remote Defect Indication (HP-RDI).
- Higher-order Path Tandem Connection Remote Defect Indication (HPTC RDI).
- Higher-order Path Loss of Multiframe alignment (HP-LOM).
- Tributary Unit Loss of Pointer (TU-LOP).
- Tributary Unit Alarm Indication Signal (TU-AIS).
- Lower-order Path Tandem Connection Remote Defect Indication (LPTC RDI).
- Lower-order Path Remote Defect Indication (LP-RDI).
- Regenerator Section Trace Identifier Mismatch (RS-TIM).
- Higher-order Path Tandem Connection Loss of Tandem Connection Monitoring (HPTC-LTC).
- Higher-order Path Trace Identifier Mismatch (HP-TIM).
- Higher-order Path Tandem Connection Trace Identifier Mismatch (HPTC-TIM).
- Lower-order Path Tandem Connection Loss of Tandem Connection Monitoring (LPTC-LTC).
- Lower-order Path Trace Identifier Mismatch (LP-TIM).
- Lower-order Path Tandem Connection Trace Identifier Mismatch (LPTC-TIM).
- Higher-order Path Unequipped (HP-UNEQ).
- Higher-order Path Tandem Connection Unequipped (HPTC-UNEQ).
- Lower-order Path Unequipped (LP-UNEQ).
- Lower-order Path Tandem Connection Unequipped (LPTC-UNEQ).
- Higher-order Path PayLoad Mismatch (HP-PLM).

NOTE 1 – The list of network defects and anomalies given above shall conform to the last agreed versions of the relevant SDH Recommendations such as G.707/Y.1322 [3] and G.783 [6].

NOTE 2 – The list of other events being neither defects nor anomalies is for further study.

5.2.2 Test signal structure events

Monitoring of network events shall be complemented by the following events directly related to the test signal structure when performing out-of-service measurements.

- Loss of Sequence Synchronization (LSS).
- Test Sequence Error (TSE).

5.3 Out-of-service measurement modes

For each measurement mode, a subset of network events to be monitored is taken from the list given in 5.2. In addition, several test signal structures which shall be used for error performance measurement are defined.