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TELEPHONE TRANSMISSION QUALITY METHODS FOR OBJECTIVE AND SUBJECTIVE ASSESSMENT OF QUALITY

MODULATED NOISE REFERENCE UNIT (MNRU)

ITU-T Recommendation P.810

(Previously "CCITT Recommendation")

FOREWORD

The ITU-T (Telecommunication Standardization Sector) is a permanent organ of the International Telecommunication Union (ITU). The ITU-T 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 World Telecommunication Standardization Conference (WTSC), which meets every four years, establishes the topics for study by the ITU-T Study Groups which, in their turn, produce Recommendations on these topics.

The approval of Recommendations by the Members of the ITU-T is covered by the procedure laid down in WTSC Resolution No. 1 (Helsinki, March 1-12, 1993).

ITU-T Recommendation P.810 was revised by ITU-T Study Group 12 (1993-1996) and was approved under the WTSC Resolution No. 1 procedure on the 6th of February 1996.

NOTE

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

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SUMMARY

This Recommendation describes the Modulated Noise Reference Unit (MNRU), a standalone unit for introducing controlled degradations to speech signals. As such, the MNRU has been used extensively in subjective performance evaluations of digital processes, both in conventional telephone bandwidth and in wideband (e.g. 70-7000 Hz) applications.

Historically, the MNRU has been implemented in analogue hardware. The revisions encompassed in this version of the Recommendation are the inclusion of descriptions of digital implementations of the MNRU. These descriptions are suitable for implementation in software or on digital hardware. One further revision is to note the need for a high-pass filter (removal of any DC component of the input speech material) for all implementations. Existing analogue hardware implementations of the MNRU will continue to meet the specifications in this Recommendation, provided such filtering is applied externally.

INTRODUCTION

The MNRU was originally devised to produce distortion subjectively similar to that produced by logarithmically companded PCM systems. This approach was based on the views:

- 1) that network planning would require extensive subjective tests to enable evaluation of PCM system performance over a range of compandor characteristics, at various signal levels and in combination with various other transmission impairments (e.g. loss, idle circuit noise, etc.) at various levels; and
- 2) that it would be as reliable and easier to define a reference distortion system, itself providing distortion perceptually similar to that of PCM systems, in terms of which the performance of PCM systems could be expressed. This requires extensive subjective evaluation of the reference system when inserted in one or more simulated telephone connections, but leads to the possibility of simplified subjective evaluation of new digital processing techniques.

KEYWORDS

Analogue MNRU, controlled degradation, digital MNRU, Modulated Noise Reference Unit (MNRU), subjective performance evaluation.

Recommendation P.810¹⁾**MODULATED NOISE REFERENCE UNIT (MNRU)**

*(Malaga-Torremolinos, 1984; amended Melbourne, 1988;
Helsinki, 1993; revised in 1996)*

1 Scope

The Modulated Noise Reference Unit (MNRU) is a standalone unit that is intended to introduce controlled degradations to speech signals. Various organizations (Administrations, scientific/industrial organizations), as well as the ITU-T itself, have made extensive use of the MNRU concept for evaluating the subjective performance of digital processes (in arriving at Recommendations G.722 and the 32 kbit/s ADPCM algorithm of Recommendation G.726, for example). A modified version for use in evaluating codecs of wider bandwidth (70-7000 Hz) is now common practice. However, the actual devices used, while based on common principles, may have differed in detail, and hence the subjective results obtained may also have differed. (Differences in subjective testing methodology are also relevant.) The purpose of this Recommendation is to define the narrow-band and wideband versions of the MNRU as completely and in as much detail as possible in order to minimize the effects of the device, and of its objective calibration procedures, on the results of subjective tests.

The need for a device, implemented in both hardware and software, that introduces controlled degradations to speech signals is exemplified by a number of factors:

- a) the use of digital processes (64 kbit/s PCM A-law or μ -law, A/D/A encoder pairs, A-/ μ -law or μ -A-law converters, digital pads based on 8-bit PCM words, 32 kbit/s ADPCM, etc.) in the international telephone network is now widespread;
- b) new digital processes are being standardized, e.g. 64 kbit/s 7 kHz wideband ADPCM;
- c) there is a need for standard tools to measure the quantization distortion performance of digital processes [for example, 32 kbit/s ADPCM (Recommendation G.726) and 64 kbit/s 7 kHz wideband codec (Recommendation G.722)], so that the tools can be used for estimating the subjective transmission performance of international connections containing digital processes;
- d) an objective speech quality assessment method has not yet been established;
- e) at the present time, subjective tests incorporating reference system conditions represent the only suitable method for measuring the speech transmission performance of digital processes;
- f) expressing results in terms of a common reference system may facilitate comparison of subjective test results obtained at different laboratories.

It is recommended:

- 1) that a narrow-band MNRU be used as the reference system in terms of which subjective performance of telephone bandwidth digital processes are expressed;
- 2) that a wideband MNRU be used as the reference system in terms of which subjective performance of wideband digital processes are expressed.

NOTES

1 The MNRU was originally constructed using analogue circuitry. Currently, however, it tends to be either constructed using digital circuitry or simulated on computers. Further information on the effects of the MNRU parameters is given in the bibliographic sources listed at the end of this Recommendation.

2 The listening-only method presently proposed when using the MNRU in subjective tests is described in Recommendation P.830. See 2.2/P.80 for precautions concerning the use of listening-only tests.

¹⁾ Previously P.81.