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GENERAL ASPECTS OF DIGITAL TRANSMISSION SYSTEMS

CHARACTERIZATION OF LOW-RATE DIGITAL VOICE CODER PERFORMANCE WITH NON-VOICE SIGNALS

ITU-T Recommendation G.720

(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 G.720 was prepared by ITU-T Study Group 15 (1993-1996) and was approved under the WTSC Resolution No. 1 procedure on the 10th of July 1995.

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

In this Recommendation, an evaluation methodology is presented for the characterization of low-rate digital speech (or more generally source) coder performance with non-voice signals. The types of non-voice signals considered include voiceband data, network signalling, circuit continuity tones, and dual-tone multi-frequency signalling. Also addressed is the measurement of input/output delay and convergence time. Finally, appropriate test configurations, performance metrics, and test procedures are defined.

Recommendation G.720

CHARACTERIZATION OF LOW-RATE DIGITAL VOICE CODER PERFORMANCE WITH NON-VOICE SIGNALS

(Geneva, 1995)

1 Introduction

In selecting speech coding algorithms for network applications, characterization of their performance with a diversity of telephone network signals is normally required. Typical non-voice signals whose in-band transmission over the telephone network is desirable include the following.

- Voiceband Data – Some transparency to voiceband data may be desirable particularly for applications such as thin-route satellite systems, digital mobile services, and circuit multiplication systems, such as DCME and PCME. It is considered that such transparency should be afforded to Public Switched Telephone Network (PSTN) voiceband data modems operating at bit rates up to and including 2400 bit/s. These modems include those conforming to Recommendations V.22, V.22 *bis*, V.21, V.23, V.26 *bis* and V.26 *ter*. It is recognized that other leased line and proprietary modems have found extensive use in the telephone network. Therefore, it is also desirable to use voiceband data signals from other modems which are not standardized by the ITU-T.
- Supervisory and inter-register signals that are incorporated within various signalling systems in the PSTN – These signals include two frequencies (2400 Hz and 2600 Hz) present within Signalling System No. 5 for line signalling, 15 multi-frequencies used by Signalling System No. 5 for register signalling, and all valid combinations (pairs) of the six high-frequency and six low-frequency tones employed by Signalling System R-2.
- Dual-Tone Multi-Frequency (DTMF) signals – These signals may be used independently of a signalling system to provide end-user access to specialized services such as answering machine message retrieval, airline reservations and electronic banking.
- Tones employed by Signalling Systems No. 6 and No. 7 for the verification of end-to-end circuit continuity and the four high-group and four low-group frequencies, conforming to Recommendation Q.23.
- The 2100 Hz tone (including any associated phase reversals) specified in Recommendation V.25, which is employed by the V-Series modems for disabling network echo control devices.
- Finally, the tones utilized in national signalling systems to provide ringing, busy or congestion information (see Recommendation Q.35) could require support depending upon the location of the coder within the network (such as in land-mobile environments) and should therefore be included in these tests.

This methodology has evolved over several years from performance evaluations conducted during the development of Recommendations G.726, G.727 and G.728.

2 Scope

This Recommendation encompasses methods that can be used for quantifying and characterizing the performance of low-rate digital speech codecs with non-voice signals. The signals used are primarily those employed within the telephone network and, consequently, these methods are most appropriate for speech codecs intended for network (as opposed to end-user terminal) applications. The methods presented here can be used to quantify the performance of voice codecs that operate in the telephone band and that employ transmission rates that are less than or equal to 64 kbit/s.

3 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions to 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 ITU-T Recommendations is regularly published.

- ITU-T V-Series of Recommendations, *Data communication over the telephone network*.
- ITU-T Recommendation Clause 2 Q.141 (1993), *Line signalling – 2.1 signal code for line signalling*.
- CCITT Recommendation Q.151 (1988), *Signal code for register signalling*.
- CCITT Recommendation Q.441 (1988), *Signalling code*.
- CCITT Recommendation Q.271 (1988), *General*.
- CCITT Recommendation Q.724 (1988), *Signalling procedure Specifications of Signalling System No. 7*.
- CCITT Recommendation Q.23 (1988), *Technical features of push-button telephone sets*.
- CCITT Recommendation V.25 (1988), *Automatic answering equipment and/or parallel automatic calling equipment on the general switched telephone network including procedures for disabling of echo control devices for both manually and automatically established calls*.
- CCITT Recommendation Q.35 (1988), *Technical characteristics of tones for the telephone service*.
- CCITT Recommendation G.711 (1988), *Pulse Code Modulation (PCM) of voice frequencies*.
- CCITT Recommendation G.726 (1990), 40, 32, 24, 16 kbit/s *Adaptive differential pulse code modulation (ADPCM)*.
- CCITT Recommendation O.42 (1988), *Equipment to measure non-linear distortion using the 4-tone intermodulation method*.
- CCITT Supplement No. 3.1, *Measuring instrument requirements. Sinusoidal signal generators and level measuring instruments*, Green Book, Vol. IV.2, Supplement to Series-M, -N and -O Recommendations, pp. 530-533, Geneva, 1972.
- CCITT Supplement No. 3.2, *Noise measuring instruments for telecommunication circuits*, Green Book, Vol. IV.2, Supplement to Series-M, -N and -O Recommendations, pp. 534-548, Geneva, 1972.
- ITU-T O-Series of Recommendations, *Specifications for measuring equipment*.
- CCITT Recommendation Q.112 (1988), *Signal levels and signal receiver sensitivity*.
- CCITT Recommendation Q.114 (1988), *Typical transmission requirements for signal senders and receivers*.
- CCITT Recommendation Q.451 (1988), *Definitions*.
- CCITT Recommendation Q.454 (1988), *The sending part of the multifrequency signalling equipment*.
- CCITT Recommendation Q.455 (1988), *The receiving part of the multifrequency equipment. Range, speed, and reliability of interregister signalling*.
- CCITT Recommendation Q.143 (1988), *Line signal sender*.
- CCITT Recommendation G.144 (1988), *Line signal receiver*.
- ITU-T Recommendation G.165 (1993), *Echo cancellers*.
- ITU-T Recommendation O.133 (1993), *Equipment for measuring the performance of PCM encoders and decoders*.
- CCITT Recommendation O.91 (1988), *Phase jitter measuring equipment for telephone-type circuits*.