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ATIS-0100521.2005(S2020)

Packet Loss Concealment for Use with ITU-T Recommendation G.711

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American National Standard for Telecommunications

Packet Loss Concealment for Use with ITU-T Recommendation G.711

Secretariat

Alliance for Telecommunications Industry Solutions

Approved March 11, 2005

American National Standards Institute, Inc.

Abstract

This standard describes Packet Loss Concealment algorithms for use in packetized speech transmission systems that use ITU-T Recommendation G.711 to code speech signals. These concealment algorithms enable high-quality speech transmission in operating environments where packet losses occur by providing high-quality packet loss recovery methods.

FOREWORD

The information contained in this Foreword is not part of this American National Standard (ANS) and has not been processed in accordance with ANSI's requirements for an ANS. As such, this Foreword may contain material that has not been subjected to public review or a consensus process. In addition, it does not contain requirements necessary for conformance to the Standard.

In recent years, the Network Performance, Reliability, and Quality of Service Committee (PRQC)—formerly T1A1—has studied signal processing and performance aspects of speech packetization systems, issuing an ANSI standard (T1.509-1999) and a T1 Technical Report (Technical Report No. 45) on the subject. A shortcoming of those documents was the lack of clear information on high-quality methods for mitigating the effects of packets that are lost or destroyed during transmission.

The intent of this standard is to describe techniques and associated benefits of packet loss concealment (PLC) methods for use with ITU-T Recommendation G.711. The algorithms described in Annexes A & B are both single-ended; the implementation involves only the receiver. No modifications are required at the transmitting end. The Annexes provide example code; however, other implementations of the individual algorithms are possible. The performance of the methods defined in this standard has been demonstrated in subjective listening tests; the Annex A and Annex B methods are subjectively equivalent for the range of conditions tested.

Annex A describes a low-complexity, high-quality Packet Loss Concealment algorithm. In informal listening tests it performs well under a variety of input signal conditions: clean speech, noisy speech, music, and background noises, and compares favorably with the Packet Loss Concealment algorithms in several of the CELP-based speech coders standardized by the ITU-T.

Annex B describes a technique that employs linear prediction to estimate missing speech and uses the resultant vocal tract model output and excitation information to reconstruct the signal contained in missing packets. Formal subjective tests have been performed to evaluate this technique and unprotected G.711, using packet losses up to 10%, packet sizes up to 40 ms, and with clean and noisy speech. The results show significant benefit from the application of this technique compared to unprotected G.711.

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ANSI guidelines specify two categories of requirements: mandatory and recommendation. The mandatory requirements are designated by the word *shall* and recommendations by the word *should*. Where both a mandatory requirement and a recommendation are specified for the same criterion, the recommendation represents a goal currently identified as having distinct compatibility or performance advantages.

Suggestions for improvement of this document are welcome. They should be sent to the Alliance for Telecommunications Industry Solutions, PRQC Secretariat, 1200 G Street NW, Suite 500, Washington, DC 20005.

At the time it approved this document, PRQC, which is responsible for the development of this Standard, had the following members:

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1.1 Purpose

In 1995, Working Group T1A1.7 (now, PRQC-QOS) published a Technical Report on speech packetization. That Report took note of the importance of packet loss recovery, but made no specific recommendations of how it should be achieved, choosing only to list a number of possible techniques. These included simple techniques such as repeating the previous packet, inserting white noise at the same power level as surrounding packets, or silence substitution.

To provide high-quality speech transmission in packetized systems that use G.711 and in which packet loss may occur, high quality methods for recovering from packet loss are required.

1.2 Scope

This standard describes Packet Loss Concealment algorithms for use in packetized speech transmission systems that use ITU-T Recommendation G.711 to code speech signals. Mechanisms for detecting packet loss are not defined in this standard and will depend on the application.

1.3 Application

The methods for Packet Loss Concealment (i.e., recovery from packet loss) described here are applicable to packetized speech transmission systems that use ITU-T Recommendation G.711 as the coding mechanism.

1.4 Conformance

Conformance with this standard will be achieved by use of either the algorithm defined in Annex A or that defined in Annex B.

2 NORMATIVE REFERENCE

The following standard contains provisions that, through reference in this text, constitute provisions of this American National Standard. At the time of publication, the editions indicated are valid. All ref-