INTERNATIONAL TELECOMMUNICATION UNION

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

G.729
Appendix I
(06/2001)

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ITU-T Recommendation G.729 – Appendix I

(Formerly CCITT Recommendation)

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ITU-T Recommendation G.729

Coding of speech at 8 kbit/s using conjugate-structure algebraic-code-excited linear-prediction (CS-ACELP)

APPENDIX I

External synchronous reset performance for G.729 codecs in systems using external VAD/DTX/CNG

Summary

This appendix deals with external synchronous reset capability in systems using external VAD/DTX/CNG, e.g. CMEs (Circuit Multiplication Equipments) in conjunction with ITU-T G.729 main body and ITU-T G.729 Annexes A and C.

The use of the external synchronous reset is intended for systems using external VAD/DTX/CNG in conjunction with ITU-T G.729 main body and ITU-T G.729 Annexes A or C. In this situation, the use of external synchronous reset is generally preferable to obtain the best possible speech quality in noisy scenarios where VAD is used. This is especially true when an aggressive VAD is used. When the external VAD has long-enough hangover period (i.e. a less-aggressive VAD), the quality increase of external synchronous reset case compared with "no reset" case is less perceivable.

Source

Appendix I to ITU-T Recommendation G.729 was prepared by ITU-T Study Group 16 (2001-2004) and approved under the WTSA Resolution 1 procedure on 8 June 2001.

FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications. The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. 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 Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

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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As of the date of approval of this Recommendation, ITU had received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementors are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database.

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Scope

Although ITU-T G.729 Annex B defines a "native" (or internal) VAD/DTX/CNG mechanism, some applications require that a different algorithm be used, because of system or complexity constraints. In these cases, when an external VAD/DTX/CNG algorithm (i.e. one that operates independently and does not exploit the internal information of the encoder) is used, there is the possibility that the state of the encoder and decoder will differ significantly, which will degrade quality. Hence, synchronous reset of the encoder and decoder can be beneficial to the overall quality when such external VAD/DTX/CNG algorithms are used. This appendix deals with external synchronous reset capability in systems using external VAD/DTX/CNG, such as CME (Circuit Multiplication Equipment) in conjunction with ITU-T G.729 main body, ITU-T G.729 Annex A and ITU-T G.729 Annex C.

I.1 Introduction

The definition of the synchronous reset is that both the encoder state variables and the decoder state variables are set to their respective initial values at the same frame time.

The use of the external synchronous reset is intended for systems using an external VAD/DTX/CNG in conjunction with ITU-T G.729 main body, ITU-T G.729 Annex A or ITU-T G.729 Annex C. In this situation, the use of external synchronous reset is generally preferable to obtain the best possible speech quality in noisy scenarios where VAD is used. This is especially true when an aggressive VAD using a relatively short hangover period is used. When the external VAD has long-enough hangover period (i.e. a less-aggressive VAD), the quality increase of external synchronous reset case compared to the "no-reset" case is less perceivable. In any case, no harm is expected on quality by applying synchronous reset to the G.729 encoder and decoder in systems using an external VAD/DTX/CNG. On the opposite, in spite of the quick convergence of the G.729 algorithm after loss of synchronization, there is evidence that the use of synchronous reset will generally allow attaining the best possible speech quality.

I.2 Experimental design

Some limited experiments have been performed to test the impact on quality of the introduction of synchronous reset in G.729 codecs into systems using external VAD/DTX/CNG, such as CME (Circuit Multiplication Equipment) in conjunction with ITU-T G.729 main body, ITU-T G.729 Annex A and ITU-T G.729 Annex C. The experience has been limited to simulation of CME operation in a pooled codec configuration using ITU-T G.729 Annex C (and ITU-T G.729 main body). In this CME operation, the "one-to-one relationship" between encoders and decoders cannot be expected throughout the call, which will lead to loss of synchronization between encoder and decoder.

To test the effect of the introduction of synchronous reset in G.729 codecs, some experiments have been run to evaluate the quality of both schemes (*with* synchronous reset and *without* synchronous reset). Various test conditions were used: clean speech at nominal-, high- and low-input levels, and speech with different types of background noise (babble noise, hall noise, vehicular noise) at different signal-to-noise ratio (SNR) values. For each condition, one male and one female talker were used. Two expert listening experiments were performed, one in North American English and the other in French, each experiment using its own external VAD indicator.

To simulate CME operation with pooled codecs configuration, the input bitstream for the G.729 decoder has been composed by interleaving two bitstream files coming from two different G.729 encoders. The interleaving was done according to the respective VAD of the two input files (first active segment of file 1, first active segment of file 2, second active segment of file 1, second active segment of file 2, etc). Finally, the decoder output file was decomposed into two decoded files according the interleaving scheme. When synchronous reset was used, both encoder and decoder were reset at the beginning of each active spurt, otherwise no reset was used.

I.3 Performance observations

To evaluate the impact on quality of both schemes, an informal expert listening test has been performed using pair-comparison of the active speech segments in the decoded files. The results depended on the external VAD and on the background noise similarities of the two interleaved files. When the external VAD has long-enough hangover period (i.e. a less-aggressive VAD), the two schemes have similar performances when the two interleaved files have similar or high SNR background noise; no artefacts were perceived. When low SNR background noise segments were interleaved with high SNR background noise segments, some artefacts were heard at the beginning of active periods, although their duration was short thanks to the quick convergence of G.729 after loss of synchronization. When a more aggressive VAD was used, the synchronous reset provides a clear improvement.

I.4 Conclusion

Some limited experiments have been performed to test the impact on quality of the introduction of synchronous reset in G.729 codecs. The existing evidence confirms the expectation that that no degradation in quality occurs by applying synchronous reset of the G.729 encoder and decoder in CME scenarios. Furthermore, it has been found that the introduction of synchronous reset was generally preferable to obtain the best possible speech quality in noisy scenarios where VAD is used. It is expected that this result can be extended to other systems using external VAD/DTX/CNG in conjunction with ITU-T G.729.

I.5 Bibliography

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[3] ITU-T G.729 Annex B (1996), *A silence compression scheme for G.729 optimized for terminals conforming to Recommendation V.70*.

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