

EUROPEAN TELECOMMUNICATION STANDARD

ETS 300 961

May 1997

Source: ETSI TC-SMG

Reference: DE/SMG-110610Q

ICS: 33.020

Key words: Digital cellular telecommunications system, Global System for Mobile communications (GSM)



**Digital cellular telecommunications system;
Full rate speech;
Transcoding
(GSM 06.10 version 5.0.1)**

ETSI

European Telecommunications Standards Institute

ETSI Secretariat

Postal address: F-06921 Sophia Antipolis CEDEX - FRANCE

Office address: 650 Route des Lucioles - Sophia Antipolis - Valbonne - FRANCE

X.400: c=fr, a=atlas, p=etsi, s=secretariat - **Internet:** secretariat@etsi.fr

Tel.: +33 4 92 94 42 00 - Fax: +33 4 93 65 47 16

Copyright Notification: No part may be reproduced except as authorized by written permission. The copyright and the foregoing restriction extend to reproduction in all media.

Whilst every care has been taken in the preparation and publication of this document, errors in content, typographical or otherwise, may occur. If you have comments concerning its accuracy, please write to "ETSI Editing and Committee Support Dept." at the address shown on the title page.

Contents

Foreword	5
1 Scope	7
1.1 Normative references	7
1.1.1 Abbreviations.....	8
1.2 Outline description	8
1.3 Functional description of audio parts	8
1.4 PCM Format conversion	9
1.5 Principles of the RPE-LTP encoder	9
1.6 Principles of the RPE-LTP decoder	9
1.7 Sequence and subjective importance of encoded parameters.....	10
2 Transmission characteristics.....	12
2.1 Performance characteristics of the analogue/digital interfaces	12
2.2 Transcoder delay	12
3 Functional description of the RPE-LTP codec	13
3.1 Functional description of the RPE-LTP encoder.....	13
3.1.1 Offset compensation	13
3.1.2 Pre-emphasis	13
3.1.3 Segmentation	14
3.1.4 Autocorrelation	14
3.1.5 Schur Recursion.....	14
3.1.6 Transformation of reflection coefficients to Log.-Area Ratios.....	14
3.1.7 Quantization and coding of Log.-Area Ratios.....	15
3.1.8 Decoding of the quantized Log.-Area Ratios.....	15
3.1.9 Interpolation of Log.-Area Ratios.....	15
3.1.10 Transformation of Log.-Area Ratios into reflection coefficients	15
3.1.11 Short term analysis filtering	16
3.1.12 Sub-segmentation	16
3.1.13 Calculation of the LTP parameters.....	16
3.1.14 Coding/Decoding of the LTP lags.....	17
3.1.15 Coding/Decoding of the LTP gains.....	17
3.1.16 Long term analysis filtering.....	17
3.1.17 Long term synthesis filtering.....	18
3.1.18 Weighting Filter	18
3.1.19 Adaptive sample rate decimation by RPE grid selection	18
3.1.20 APCM quantization of the selected RPE sequence	18
3.1.21 APCM inverse quantization	20
3.1.22 RPE grid positioning	20
3.2 Decoder	20
3.2.1 RPE decoding section	20
3.2.2 Long Term Prediction section	20
3.2.3 Short term synthesis filtering section.....	20
3.2.4 Post-processing.....	20
4 Computational details of the RPE-LTP codec	25
4.1 Data representation and arithmetic operations	25
4.2 Fixed point implementation of the RPE-LTP coder.....	27
4.2.0 Scaling of the input variable	27
4.2.1 Downscaling of the input signal.....	27
4.2.2 Offset compensation	27
4.2.3 Pre-emphasis	28
4.2.4 Autocorrelation	28
4.2.5 Computation of the reflection coefficients	29
4.2.6 Transformation of reflection coefficients to Log.-Area Ratios	30
4.2.7 Quantization and coding of the Log.-Area Ratios.....	30
4.2.8 Decoding of the coded Log.-Area Ratios	31

4.2.9	Computation of the quantized reflection coefficients	31
4.2.9.1	Interpolation of the LARpp[1..8] to get the LARp[1..8]	31
4.2.9.2	Computation of the rp[1..8] from the interpolated LARp[1..8]	32
4.2.10	Short term analysis filtering	32
4.2.11	Calculation of the LTP parameters	32
4.2.12	Long term analysis filtering	34
4.2.13	Weighting filter	34
4.2.14	RPE grid selection	35
4.2.15	APCM quantization of the selected RPE sequence	35
4.2.16	APCM inverse quantization	36
4.2.17	RPE grid positioning	36
4.2.18	Update of the reconstructed short term residual signal dp[-120..-1]	37
4.3	Fixed point implementation of the RPE-LTP decoder	37
4.3.1	RPE decoding section	37
4.3.2	Long term synthesis filtering	37
4.3.3	Computation of the decoded reflection coefficients	38
4.3.4	Short term synthesis filtering section	38
4.3.5	De-emphasis filtering	39
4.3.6	Upscaling of the output signal	39
4.3.7	Truncation of the output variable	39
4.4	Tables used in the fixed point implementation of the RPE-LTP coder and decoder	39
5	Digital test sequences	41
5.1	Input and output signals	41
5.2	Configuration for the application of the test sequences	42
5.2.1	Configuration 1 (encoder only)	42
5.2.2	Configuration 2 (Decoder only)	42
5.3	Test sequences	42
5.3.1	Test sequences for configuration 1	42
5.3.2	Test sequences for configuration 2	43
	Annex A1 (informative): Codec performance	47
A.1	Performance of the RPE-LTP	47
A.1.1	Introduction	47
A.1.2	Speech performance	47
A.1.2.1	Single encoding	47
A.1.2.2	Speech performance when interconnected with coding systems on an analogue basis	48
A.1.2.2.1	Performance with 32 kbit/s ADPCM (G.721, superseded by G.726)	48
A.1.2.2.2	Performance with another RPE-LTP codec	48
A.1.2.2.3	Performance with encoding other than RPE-LTP and 32 kbit/s ADPCM (G.721, superseded by G.726)	48
A.1.3	Non-speech performance	48
A.1.3.1	Performance with single sine waves	48
A.1.3.2	Performance with DTMF tones	48
A.1.3.3	Performance with information tones	49
A.1.3.4	Performance with voice-band data	49
A.1.4	Delay	49
A.1.5	Bibliography	51
	Annex A2 (informative): Subjective relevance of the speech coder output bits	52
	Annex A3 (informative): Format for test sequence distribution	54
A.3.1	Type of files provided	54
A.3.2	File format description	54
	Annex B (informative): Test sequence diskette	55
	History	56

Foreword

This European Telecommunication Standard (ETS) has been produced by the Special Mobile Group (SMG) Technical Committee (TC) of the European Telecommunications Standards Institute (ETSI).

This ETS specifies the full rate speech transcoding within the digital cellular telecommunications system.

This ETS is a GSM technical specification version 5. The ETS from which this ETS has evolved is GSM Phase 2 ETS 300 580-2 (GSM 06.10 version 4.0.2).

NOTE: This ETS is a reproduction of recommendation T/L/03/11 "13 kbit/s Regular Pulse Excitation - Long Term Prediction - Linear Predictive Coder for use in the digital cellular telecommunications system".

A 3,5 inch diskette (annex B) is attached to the back cover of this ETS, the diskette contain test sequences, as described in clause 5.

The diskette contain LHA compressed files and is labelled as follows:

Diskette 1 ETS 300 961, annex B: Test sequences for the GSM Full Rate speech codec;
 Test sequences SEQ01.xxx to SEQ05.xxx.

The specification from which this ETS has been derived was originally based on CEPT documentation, hence the presentation of this ETS may not be entirely in accordance with the ETSI/PNE rules.

Transposition dates	
Date of adoption:	18 April 1997
Date of latest announcement of this ETS (doa):	31 August 1997
Date of latest publication of new National Standard or endorsement of this ETS (dop/e):	28 February 1998
Date of withdrawal of any conflicting National Standard (dow):	28 February 1998

Explore Litigation Insights



Docket Alarm provides insights to develop a more informed litigation strategy and the peace of mind of knowing you're on top of things.

Real-Time Litigation Alerts



Keep your litigation team up-to-date with **real-time alerts** and advanced team management tools built for the enterprise, all while greatly reducing PACER spend.

Our comprehensive service means we can handle Federal, State, and Administrative courts across the country.

Advanced Docket Research



With over 230 million records, Docket Alarm's cloud-native docket research platform finds what other services can't. Coverage includes Federal, State, plus PTAB, TTAB, ITC and NLRB decisions, all in one place.

Identify arguments that have been successful in the past with full text, pinpoint searching. Link to case law cited within any court document via Fastcase.

Analytics At Your Fingertips



Learn what happened the last time a particular judge, opposing counsel or company faced cases similar to yours.

Advanced out-of-the-box PTAB and TTAB analytics are always at your fingertips.

API

Docket Alarm offers a powerful API (application programming interface) to developers that want to integrate case filings into their apps.

LAW FIRMS

Build custom dashboards for your attorneys and clients with live data direct from the court.

Automate many repetitive legal tasks like conflict checks, document management, and marketing.

FINANCIAL INSTITUTIONS

Litigation and bankruptcy checks for companies and debtors.

E-DISCOVERY AND LEGAL VENDORS

Sync your system to PACER to automate legal marketing.