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Prizemni snopovni radio (TETRA) – Govorni kodek za kanal s polno hitrostjo – 4. del: Preskušanje skladnosti kodeka

Terrestrial Trunked Radio (TETRA); Speech codec for full-rate traffic channel; Part 4: Codec conformance testing

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Foreword

This European Standard (Telecommunications series) has been produced by ETSI Project Terrestrial Trunked Radio (TETRA).

The present document is part 4 of a multi-part deliverable covering speech codec for full-rate traffic channel, as identified below:

Part 1: "General description of speech functions";

Part 2: "TETRA codec";

Part 3: "Specific operating features";

Part 4: "Codec conformance testing".

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1 Scope

The objective of the present document is to define the conformance bounds for the TETRA speech and channel codec as deployed in the TETRA Speech Traffic Channel (TCH/S) channel type used in the TETRA Voice plus Data (V+D) equipment.

For the speech part of the TCH/S codec, the conformance testing (clause 7 of the present document) consists of a bit-exact test where the reference is pre-computed and fixed.

For the TCH/S channel encoding a bit exact conformance test is also defined (see clause 6.4).

For the TCH/S channel decoding, a non-bit exact test is employed with the specifications designed such that a sufficient quality of performance is met by the TETRA equipment (see clause 6.3).

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication and/or edition number or version number) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.

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[1] ETSI EN 300 394-1: "Terrestrial Trunked Radio (TETRA); Conformance testing specification; Part 1: Radio".

[2] ETSI EN 300 395-2: "Terrestrial Trunked Radio (TETRA); Speech codec for full-rate traffic channel; Part 2: TETRA codec".

[3] ETSI EN 300 395-3: "Terrestrial Trunked Radio (TETRA); Speech codec for full-rate traffic channel; Part 3: Specific operating features".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in EN 300 392-2 (see bibliography) and EN 300 394-1 [1] apply.

3.2 Abbreviations

For the purposes of the present document, the abbreviations given in EN 300 394-1 [1] and the following apply:

AACH	Access Assignment CHannel
ACELP	Algebraic Code Excited Linear Predictive
AMR	Adaptive Multi-Rate
BER	Bit Error Rate
BS	Base Station
DAI	Digital Audio Interface
dBm	deciBels relative to one milliWatt

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MER	Message Erasure Rate
MS	Mobile Station
PCM	Pulse Coded Modulation
PDO	Packet Data Optimized
PRBS	Pseudo Random Bit Sequence
PUEM	Probability of Undetected Erroneous Message
RF	Radio Frequency
RX	Receive
STCH	STealing CHannel
TCH/S	full rate Speech Traffic CHannel
TDM	Time Division Multiplexing
TE	Terminal Equipment
TSS	TETRA System Simulator
TTCI	TETRA Test Connector Interface
TX	Transmit
VAD	Voice Activity Detector

4 General

The conformance testing of the TCH/S channel shall be conducted in identical or similar methodology as specified in EN 300 394-1 [1]. However, as EN 300 394-1 [1] is specified for both the TETRA V+D and TETRA Packet Data Optimized (PDO), only the TETRA V+D part of EN 300 394-1 [1] shall be applicable to the present document. Therefore, all references to EN 300 394-1 [1] clauses shall refer to the TETRA V+D sections only. For the purpose of the present document, the following where applicable shall apply:

- presentation of equipment for testing purposes shall be as specified in EN 300 394-1 [1], clause 4.1;
- facilities and information required for testing shall be as specified in EN 300 394-1 [1], clause 4.1.1;
- choice of radio frequency channels to be tested shall be as specified in EN 300 394-1 [1], clause 4.1.2;
- interpretation of the measurement results shall be as specified in EN 300 394-1 [1], clause 4.1.3;
- mechanical and electrical design shall be as specified in EN 300 394-1 [1], clause 4.2.

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5 Radio test configuration, test signals and test modes

In order to perform the conformance testing specified in the present document, the Terminal Equipment (TE) shall have been tested to, and passed, the relevant specifications as given in EN 300 394-1 [1]. Thus, all appropriate logical channel types apart from the TCH/S shall have been tested.

In the present document, the TETRA speech and channel codec as specified in EN 300 395-2 [2], shall be conformance tested under standard TETRA specified configurations. All unspecified or informative parts of the TETRA speech and channel codec shall be disabled and not tested. For example, sub-systems such as the Voice Activity Detector (VAD) as given in EN 300 395-3 [3] shall be excluded from the tests in the present document. If these and other speech related sub-systems are standardized in future phases of TETRA then a separate conformance test may be generated to test these new additions. The present document also covers testing of the AMR 4,75 kb/s speech and channel codec.

In the present document, only the standard un-encrypted TCH/S shall be tested. Thus the TE's encryption capability, if implemented by the TE, shall be disabled for the duration of the tests specified in the present document. Similarly, all parts related to the STealing CHannel (STCH) and the eventually associated half slot containing encoded speech shall not be tested and shall not be activated in the test.

The test signal T1 shall be as specified in EN 300 394-1 [1], clause 5.3.2.

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In accordance to EN 300 394-1 [1], the channel type tested under the present document shall be designated as channel type 15 and 16 for TCH/S channel codec testing and 19 and 20 for TCH/S speech codec testing. For Mobile Station (MS) testing, on frame 1 to 17, table 1 shall apply. For Base Station (BS) testing, on frame 1 to 17, table 2 shall apply.

Table 1: Channel type for MS testing

Channel type	Burst type	Block 1	Block 2	Broadcast block
15	normal	TCH/S PRBS		Access Assignment Channel (AACH)
19	normal	TCH/S speech codec test		Access Assignment Channel (AACH)

Table 2: Channel type for BS testing

Channel type	Burst type	Sub slot 1	Sub slot 2
16	normal	TCH/S PRBS	
20	normal	TCH/S speech codec test	

6 TCH/S channel codec

6.1 Objectives

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The objective of this clause is to specify and present performance limits for the TCH/S channel encoding and decoding sub-system. The TCH/S channel encoder is specified in bit exact terms and is given in EN 300 395-2 [2], clause 5, and all TE shall operate according to it. The TCH/S channel decoder is specified in non-bit exact terms and is given in EN 300 395-2 [2], clause 6, while an informative example implementation is given in EN 300 395-2 [2], annex A. The performance of the TCH/S channel decoder is specified in this clause.

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6.2 Conformance test methodology

The presentation of the conformance testing procedures for the TCH/S shall be the same as for the other logical channel types as specified in EN 300 394-1 [1]. Therefore, as described in EN 300 394-1 [1], all conformance test data between the TETRA System Simulator (TSS) and the TE shall be via two ports, namely the antenna port and the test connector.

The type tests described in the present document shall be performed under normal test conditions as specified in EN 300 394-1 [1], clauses 6.2 and 6.2.1.

6.3 Test decoding mode

For the TCH/S channel decoding test mode, the TE under test shall perform the test in a similar manner as other channel coded channels as specified in EN 300 394-1 [1], clause 5.2.1.

6.3.1 General

The test set up, procedures and measurement methods detailed in EN 300 394-1 [1] shall be used in testing TETRA V+D equipment TCH/S performance.

The required minimum number of samples and test limit error rates used in the following TCH/S receiver test are defined such that:

a) the probability of passing a bad unit is lower than 0,3 %;

b) the probability of passing a good unit, operating on the limit of performance, is at least 99,5 %.

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The Bit Error Ratio/Message Erasure Rate (BER/MER) test limits adopted have been selected in order not to pass a unit with a sensitivity performance 1 dB worse than that of a unit which just meets the specification.

NOTE: The above definition does not apply to Probability of Undetected Erroneous Message (PUEM) measurements.

6.3.2 TCH/S reference sensitivity performance

The minimum required reference sensitivity performance for V+D equipment is specified in annex A according to test condition, propagation condition and receiver class.

The maximum dynamic and static reference sensitivity levels for a BS receiver under normal test conditions shall not exceed the signal levels shown in table 3.

Table 3: BS receiver minimum reference sensitivity

Test condition	Dynamic reference sensitivity	Static reference sensitivity
Normal	-106 dBm	-115 dBm

The maximum dynamic and static reference sensitivity levels for a MS receiver under normal test conditions shall not exceed the signal levels shown in table 4.

Table 4: MS receiver minimum reference sensitivity

Test condition	Dynamic reference sensitivity	Static reference sensitivity
Normal	-103 dBm	-112 dBm

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The TCH/S cases to be tested and the corresponding limit values for BER and MER are given in tables A.1 to A.5.

All MS equipment shall achieve a PUEM on TCH/S class 2 bits of < 0,01 % measured in static channel conditions. The test cases, number of required samples and test limit values are given in table A.6.

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All TCH/S receiver tests shall be carried out under normal conditions only.

6.3.3 Methods of measurement for TCH/S testing

The test system, test conditions and test configuration used in TCH/S testing are detailed in EN 300 394-1 [1], clauses 4 and 5 with the following exceptions:

- unlike other protected logical channels, the TCH/S channel splits the data bits from the TETRA speech codec into three classes of bits, the lowest priority designated class 0, medium priority designated class 1, and highest priority designated class 2. The assignment of the bits of the TETRA speech parameters to its sensitivity classification shall be as given in EN 300 395-2 [2], clause 5.4.1, table 4;

- in the case of BS V+D receiver testing the test system shall transmit in T1 time-slot 1 on frames 1 to 17 an uplink channel type 16 burst (see table 5).

Table 5: TCH/S uplink channel type

Channel type	Burst type	Subslot 1 + Subslot 2
16	Normal	TCH/S

- in the case of MS V+D receiver testing the test system shall transmit in T1 timeslot 1 on frames 1 to 17 a downlink channel type 15 burst (see table 6).

Table 6: TCH/S downlink channel type

Channel type	Burst type	Block 1 + Block 2
15	Normal	TCH/S

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The equipment shall be connected to the test system via its antenna connector.

The test procedures detailed in EN 300 394-1 [1], clauses 9.3.1 to 9.3.3 for sensitivity performance and PUEM performance shall be adopted for TCH/S testing.

The TSS shall incorporate some mechanism for preserving frame synchronization between the transmitted and decoded data so that the error rates for each class of bits can be correctly determined.

In summary, the following procedure is adopted for channel decoding testing:

- establish test receive mode for the TE under test;
- transmit test sequence (7,2 kbit/s) from TSS to TE via the antenna port using the TCH/S type;
- the TE receives the test sequence and performs channel decoding;
- the TE transmits the decoded information bits in the correct type classification to the TSS via the test port;
- the TSS receives and processes the TE data bits.

The above procedure shall be repeated for all the different conditions as set out in annex A.

7 TCH/S speech codec

7.1 Objectives

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The objective of this clause is to specify the test methodology and the conformance requirements for the TETRA speech coding and decoding sub-systems as given by EN 300 395-2 [2], clause 4 of the TETRA TCH/S channel type. The objective of the test is to present to both the TETRA speech encoder and decoder a pre-defined sequence which when processed shall match exactly with a stored conformance output sequence. The matching shall be performed on a bit-by-bit basis, thus the testing is a bit exact conformance test. Similar conformance sequences are provided for testing the AMR 4,75 kb/s speech coding and decoding sub-systems.

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7.2 Conformance test methodology

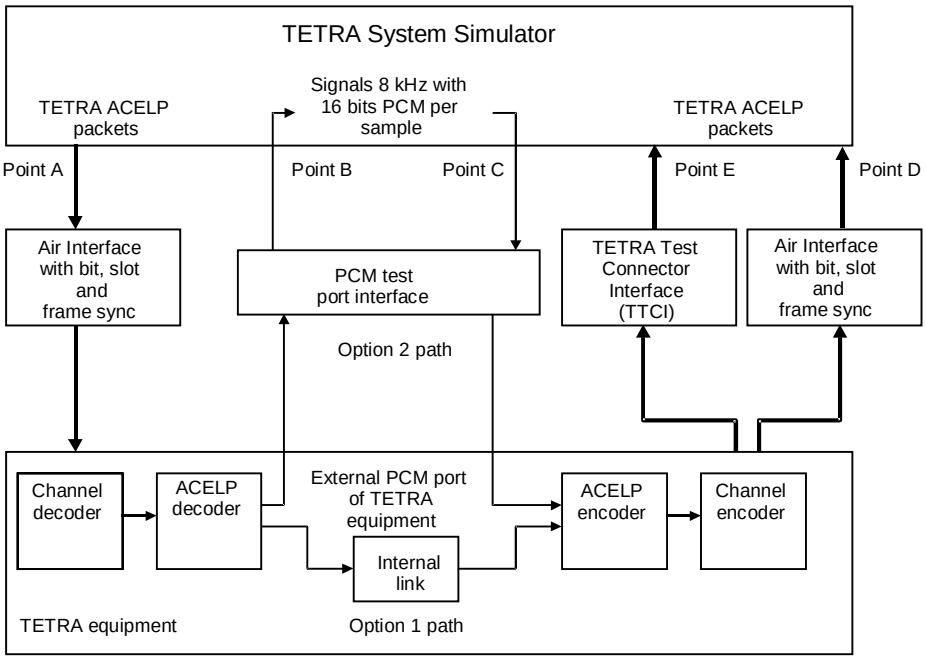

Figure 1: Diagram illustrating the test points for conformance testing the TE's speech codec