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Foreword

This European Telecommunication Standard (ETS) has been produced by the Terrestrial Trunked Radio (TETRA) ETSI Project of the European Telecommunications Standards Institute (ETSI).

This ETS consists of four parts as follows:

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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Date of adoption of this ETS:	23 June 2000
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1 Scope

The objective of this ETS 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 this ETS) 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 subclause 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 subclause 6.3).

2 Normative references

This ETS incorporates, by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to, or revisions of, any of these publications apply to this ETS only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

[1] ETSI ETS 300 392-2: "Terrestrial Trunked Radio (TETRA); Voice plus Data (V+D); Part 2: Air Interface (AI)".

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

[3] ETSI ETS 300 395-2 (1996): "Terrestrial Trunked Radio (TETRA); Speech codec for full-rate traffic channel; Part 2: TETRA codec".

[4] ETSI ETS 300 395-3 (1997): "Terrestrial Trunked Radio (TETRA); Speech codec for full-rate traffic channel; Part 3: Specific operating features".

[5] ETSI ETS 300 607-1: "Digital cellular telecommunications system (Phase 2); Mobile Station (MS) conformance specification; Part 1: Conformance specification (GSM 11.10-1)".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of this ETS, the definitions given in the following ETSs apply:

- ETS 300 392-2 [1], clause 3;
- ETS 300 394-1 [2], clause 3.

3.2 Abbreviations

For the purposes of this ETS, the following abbreviations apply:

ACELP	Algebraic Code Excited Linear Predictive
BER	Bit Error Rate
BS	Base Station
DAI	Digital Audio Interface
dBm	Decibels relative to one milliWatt
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
TX	Transmit
VAD	Voice Activity Detector

See ETS 300 394-1 [2], clause 3, for conformance testing abbreviations.

4 General

The conformance testing of the TCH/S channel shall be conducted in identical or similar methodology as specified in ETS 300 394-1 [2]. However, as ETS 300 394-1 [2] is specified for both the TETRA V+D and TETRA Packet Data Optimized (PDO), only the TETRA V+D part of ETS 300 394-1 [2] shall be applicable to this ETS. Therefore, all references to ETS 300 394-1 [2] clauses shall refer to the TETRA V+D sections only. For the purpose of this ETS, the following where applicable shall apply:

- presentation of equipment for testing purposes shall be as specified in ETS 300 394-1 [2], subclause 4.1;

- facilities and information required for testing shall be as specified in ETS 300 394-1 [2], subclause 4.1.1;

- choice of radio frequency channels to be tested shall be as specified in ETS 300 394-1 [2], subclause 4.1.2;

- interpretation of the measurement results shall be as specified in ETS 300 394-1 [2], subclause 4.1.3;

- mechanical and electrical design shall be as specified in ETS 300 394-1 [2], subclause 4.2.

5 Radio test configuration, test signals and test modes

In order to perform the conformance testing specified in this ETS, the Terminal Equipment (TE) shall have been tested to, and passed, the relevant specifications as given in ETS 300 394-1 [2]. Thus, all appropriate logical channel types apart from the TCH/S shall have been tested.

In this ETS, the TETRA speech and channel codec as specified in ETS 300 395-2 [3], 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 ETS 300 395-3 [4] shall be excluded from the tests in this ETS. 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.

In this ETS, 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 this ETS. 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 ETS 300 394-1 [2], subclause 5.3.2.

In accordance to ETS 300 394-1 [2], the channel type tested under this ETS 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

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 ETS 300 395-2 [3], 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 ETS 300 395-2 [3], clause 6, while an informative example implementation is given in ETS 300 395-2 [3], annex A. The performance of the TCH/S channel decoder is specified in this clause.

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 ETS 300 394-1 [2]. Therefore, as described in ETS 300 394-1 [2], 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 this ETS shall be performed under normal test conditions as specified in ETS 300 394-1 [2], subclauses 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 ETS 300 394-1 [2], subclause 5.2.1.

6.3.1 General

The test set up, procedures and measurement methods detailed in ETS 300 394-1 [2] 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 %.

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 an 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

The TCH/S cases to be tested and the corresponding limit values for BER and MER are given in annex A, 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 annex A, table A.6.

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 ETS 300 394-1 [2], 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 ETS 300 395-2 [3], subclause 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

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

The test procedures detailed in ETS 300 394-1 [2], subclauses 9.3.1, 9.3.2 and 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

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 ETS 300 395-2 [3], 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.

7.2 Conformance test methodology

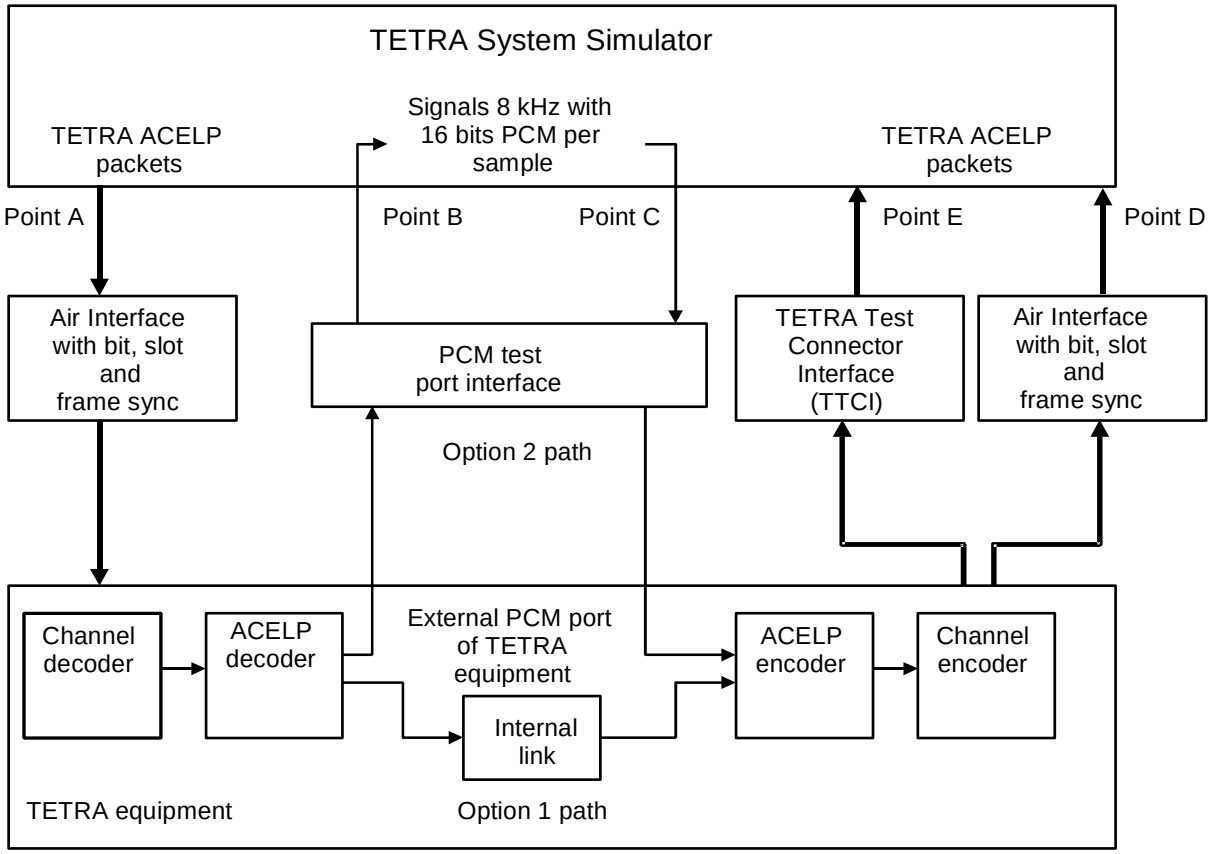


Figure 1: Diagram illustrating the test points for conformance testing the TE's speech codec

In figure 1, the various stages and blocks involved in testing a speech codec are illustrated. As can be seen, the injection of the test sequence can be made at various points in the chain. In order to minimize the cost overhead for testing TE and provide as much flexibility as possible for the different types of TE, two options are available to perform the conformance testing of the TETRA speech coding and decoding. It shall be the responsibility of the TE manufacturer together with the test laboratory to select the most appropriate option. The two options are:

Option 1) Internal link method: The injection of the test data shall be from Point A (see figure 1) and the reception of the resultant processed data shall be at Point E or D going via the internal link path. Therefore this option shall test both the decoder and the encoder together.

NOTE 1: This option is most suitable for TE capable of operating the codec in full-duplex mode or in fast half-duplex mode (i.e. able to switch between decode and encode within one TETRA frame).

An alternative arrangement for the Internal link method is that the internal link (figure 1) is replaced with an external link between two pieces of TETRA equipment. In this way, the output of the decoder of one piece of equipment is fed via an external Pulse Coded Modulation (PCM) port and link to the encoder of the second piece of equipment. The interface to the TSS is still the air interface at the input, and TCCI or air-interface at the output of the TE.

Option 2) Baseband method: The test data shall be injected from Point A (see figure 1) and the resultant processed data shall be received at Point B thus testing the decoder. The received data, having been effectively buffered, shall then be re-injected into the TE from Point C and the resultant processed data shall be received at Point E or D, thus testing the encoder. Therefore, an extra PCM data port shall be required for this option.

NOTE 2: This option is a baseband data injection method, and is most suitable for TE only capable of operating the codec in simplex mode

For both options the recovered data from the speech codec can be recovered either by the test connector interface at point E or by the air-interface method at point D, it shall be the responsibility of the TE manufacturer together with the test laboratory to select the most appropriate point.

The TETRA TEST Connector Interface and the RF-loopback as referred to in figure 1, is not specified in this ETS. However, an informative implementation of this port is given by ETS 300 394-1 [2], annex C, a normative implementation of the air-interface method is given by ETS 300 394-1 [2], annex D.

The test sequences for the TETRA speech codec as specified in ETS 300 395-2 [3], clause 4 are defined and pre-computed. The test sequences are available on floppy disks in IBM/AT MS-DOS format (attached to the back page of this ETS). The details for the format and size of the sequences are given in annex B.

The PCM test port as referred to in figure 1, is not specified in this ETS. However, an informative implementation of this port is given by ETS 300 607-1 [5], subclause 36.4 (Digital Audio Interface (DAI)). As the exact construction and capability of the TSS is unspecified for the TETRA system, this subclause cannot be too specific on the exact interactions between the TSS and the TE. However, whatever is the exact set-up the conformance specified shall be met.

In accordance to ETS 300 394-1 [2], for the purpose of speech codec testing the channel type 19 for MS and 20 for BS shall be used.

7.3 Option 1: Internal link method

7.3.1 Definition and applicability

Speech transcoding transforms the TCH/S 7,2 kbit/s bit stream by channel decoding the incoming bit stream from the air interface and performing speech decoding to produce the resultant 16-bit linear PCM. This is followed by speech encoding the 16-bit linear PCM bit stream and channel encoding it to produce the TCH/S 7,2 kbit/s. Therefore, this subclause provides the conformance test of the TETRA speech encoder and speech decoder as specified in ETS 300 395-2 [3].

The requirements and test shall apply to all TE supporting TCH/S and supporting the Option 1 configuration as given in subclause 7.2. The encoder and decoder may reside in different TEs, and be linked via external PCM ports and a link.

7.3.2 Conformance requirement and purpose

Using figure 1 as reference, the pre-defined input bit sequence designated SEQ1_72.IN injected from Point A shall produce the output bit stream at Point E or D after passing through the TE's processing blocks. The resultant output sequence shall be bit-by-bit exactly the same as the pre-defined output sequence SEQ4_72.OUT.

As an alternative test set-up, the internal link shown in figure 1 may be replaced by an external link between two TEs. In this way, the decoder from one TE feeds the encoder of the second.

7.3.3 Method of test

7.3.3.1 Initial conditions

Encryption and frame stealing mechanisms shall be de-activated.

The TCH/S speech codec shall be tested at –85 dBm at point A or at a signal level specified by the TE manufacturer, so the bit-by-bit matching of the output sequences are not influenced. If such a level does not exist, it shall be the responsibility of the TE manufacturer together with the test laboratory to find an alternative injection point for the test sequences to TETRA speech decoder.

7.3.3.2 Procedure

a) The TSS shall establish the air interface bit, slot and frame synchronization with the TE (or TEs if the internal link is replaced by an external link between two TEs) under test.

b) The TSS shall communicate with the TE, or TEs, to set the TE, or TEs, into speech codec conformance test mode on Option 1.

c) The homing sequence SEQ2_72.HOM shall be transmitted from the TSS to the TE, or TEs, from Point A to reset the speech decoder and encoder chain.

d) The test sequence SEQ1_72.IN shall be transmitted from the TSS to the TE from Point A.

e) The TE shall produce an output sequence TE4_72.OUT. This shall be achieved by:

- channel decoding SEQ1_72.IN according to ETS 300 395-2 [3], clause 6 to give TE1_46.CHD;
- speech decoding TE1_46.CHD according to ETS 300 395-2 [3], clause 4 to give TE2_128.PCM;
- speech encoding TE2_128.PCM according to ETS 300 395-2 [3], clause 4 to give TE3_46.SPE;
- channel encoding TE3_46.SPE according to ETS 300 395-2 [3], clause 5 to give TE4_72.OUT.

NOTE: The various stages internal to the TE is given here as a guide on how to transcode the input SEQ1_72.IN to TE4_72.OUT. Thus, the contents of the intermediate stages (TE1_46.CHE, TE2_128.PCM, TE3_46.SPE) are not specified in this ETS. However, reference files for these stages are given in annex C.

f) The TSS shall receive the output sequence TE4_72.OUT at Point E or D.

g) The TSS shall compare the received sequence TE4_72.OUT against the pre-defined reference sequence SEQ4_72.OUT.

h) If the internal link in figure 1 is replaced by an external link between two TEs, then the two TEs should be exchanged, and parts a) to g) repeated. Exchanging the TEs ensures that the encoder and decoder of both TEs are tested.

7.3.3.3 Internal link method requirements

As the sequences SEQ1_72.IN and TE4_72.OUT are transmitted and received via the air-interface, it is important to ensure that the reception and subsequent transmission times are aligned correctly to allow for the TETRA slot and frame 18 format buffering requirements.

If the TE is able to operate the codec in full duplex mode or fast half duplex mode then the proposed timing diagram is as shown below in figure 2:

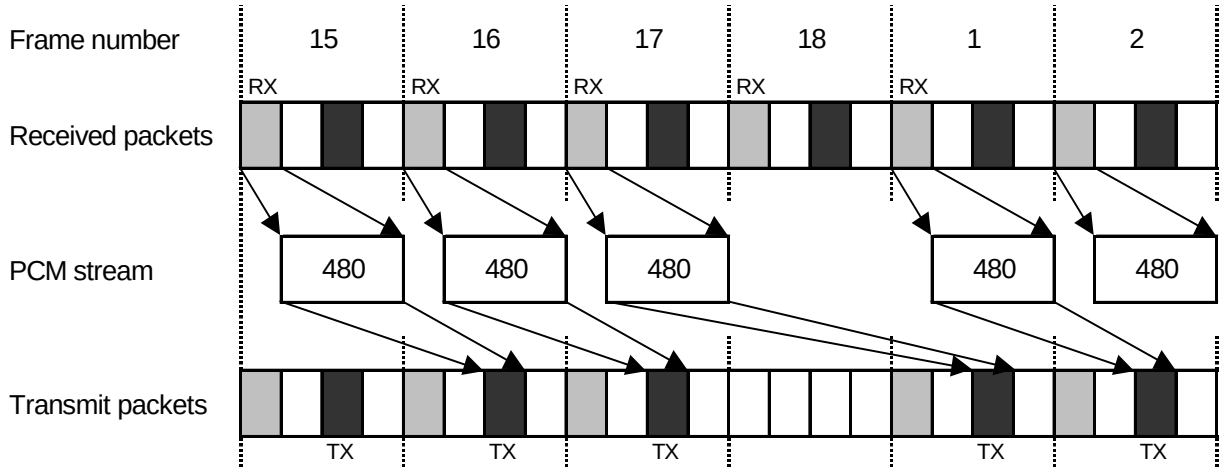
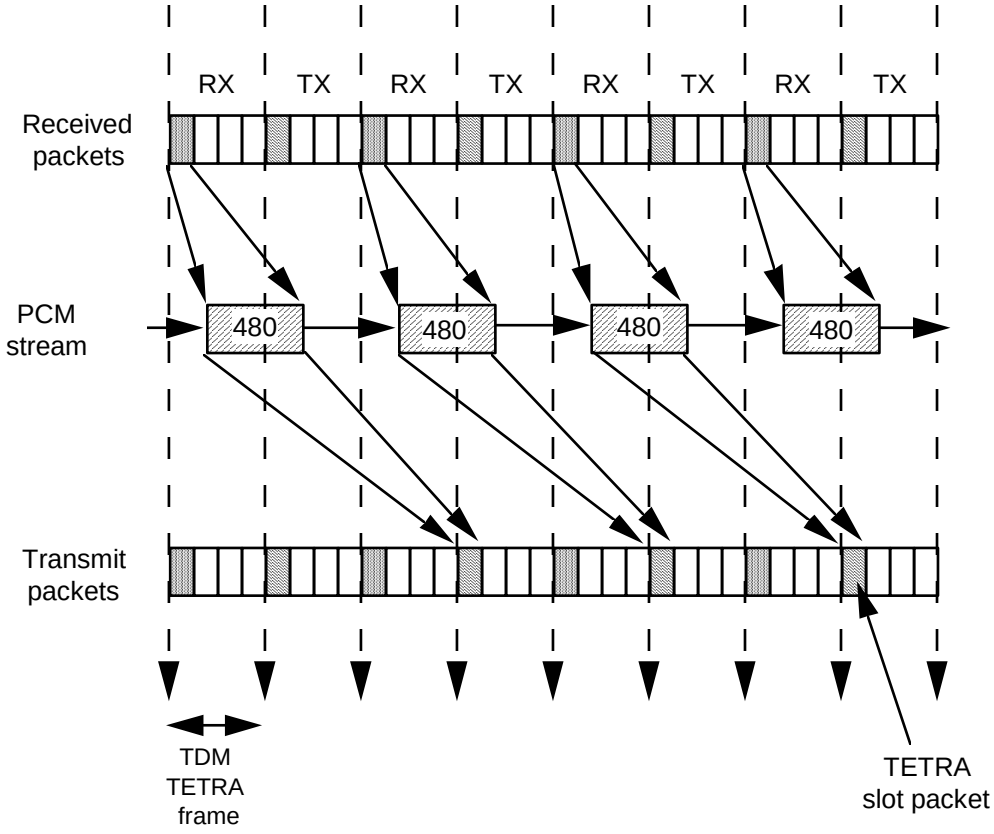


Figure 2: Diagram illustrating timing for TETRA codec conformance testing in the case of full-duplex or fast half duplex operation TEs using Option 1 Internal link method

In this mode of operation the TE will receive an encoded data burst, containing two compressed speech frames during slot number one. The ACELP encoded data will be decoded and encoded again by the TE. The decoded samples will be concatenated to form the continuous stream of TE2_128.PCM samples for the ACELP encoder. The encoded data will be transmitted in transmit slot number 1 of the next frame for every frame except frame number 18. The data received in frame number 17 will be transmitted in the transmit slot number 1 of frame number 1.

However if the TE is not able to operate the codec in full duplex or fast half duplex mode it shall be the responsibility of the TE manufacturer together with the test laboratory to find a suitable timing sequence for the test of the TETRA speech decoder.



7.3.3.4 Test requirements

In order to pass the TETRA codec conformance test, the bit stream output from the TE under test, TE4_72.OUT shall be bit by bit exactly the same as the sequence given by the file SEQ4_72.OUT.

7.4 Option 2: Baseband method

7.4.1 Definition and applicability

Speech decoding transforms the TCH/S 7,2 kbit/s bit stream by channel decoding the incoming bit stream from the air interface and performing speech decoding to produce the resultant 16-bit linear PCM. This PCM is transmitted to, and stored by, the TSS. Speech encoding transforms the stored 16-bit linear PCM bit stream by speech and channel encoding it to produce the TCH/S 7,2 kbit/s. Therefore, this subclause defines conformance tests for the TETRA speech encoder and speech decoder as specified in ETS 300 395-2 [3] in separation.

The requirements and tests shall apply to all TE supporting TCH/S and supporting the Option 2 configuration as given in subclause 7.2.

7.4.2 Conformance requirement and purpose

Using figure 1 as reference, the pre-defined input bit sequence designated SEQ1_72.IN injected from Point A shall produce the output PCM bit stream at Point B after passing through the TE's speech decoding processing blocks. The resultant output sequence shall be stored and re-injected into the TE via Point C. The TE shall process the stream through its speech and channel encoding processing blocks to produce the resultant output stream which shall be received by the TSS at Point E or D. The resultant output sequence shall be bit-by-bit exactly the same as the pre-defined output sequence SEQ4_72.OUT.

7.4.3 Method of test

7.4.3.1 Initial conditions

Encryption and frame stealing mechanisms shall be de-activated.

7.4.3.2 Procedure

a) The TSS shall establish the air-interface bit, slot and frame synchronization with the TE under test. The TSS shall also establish the PCM port bit and frame synchronization with the TE under test.

b) The TSS shall communicate with the TE to set the TE into speech codec conformance test mode on Option 2.

c) The homing sequence SEQ2_72.HOM shall be transmitted from the TSS to the TE from Point A to reset the speech decoder.

d) The test sequence SEQ1_72.IN shall be transmitted from the TSS to the TE from Point A.

e) The TE shall produce an output sequence TE2_128.PCM and received by the TSS at Point B. This shall be achieved by:

   - channel decoding SEQ1_72.IN according to ETS 300 395-2 [3], clause 6 to give TE1_46.CHD;

   - speech decoding TE1_46.CHD according to ETS 300 395-2 [3], clause 4 to give TE2_128.PCM.

f) The TSS shall receive and store the TE sequence TE2_128.PCM.

   NOTE 1: The above up to stage f) effectively tests the TETRA speech decoder.

g) The homing sequence SEQ3_128.HOM shall be transmitted from the TSS to the TE from Point C to reset the speech encoder.

h) The stored sequence TE2_128.PCM shall be transmitted from the TSS to the TE from Point C.

i) The TE shall produce an output sequence TE4_72.OUT. This shall be achieved by:

- speech encoding TE2_128.PCM according to ETS 300 395-2 [3], clause 4 to give TE3_46.SPE.

- channel encoding TE3_46.SPE according to ETS 300 395-2 [3], clause 5 to give TE4_72.OUT.

NOTE 2: The stages from g) to i) effectively tests the TETRA speech encoder.

j) The TSS shall receive the output sequence TE4_72.OUT at Point E or D.

k) The TSS shall compare the received sequence TE4_72.OUT against the pre-defined reference sequence SEQ4_72.OUT.

7.4.3.3 Test requirements

In order to pass the TETRA codec conformance test, the bit stream output from the TE under test, TE4_72.OUT shall be bit-by-bit exactly the same as the sequence given by the file SEQ4_72.OUT.

Annex A (normative): TCH/S test cases and conditions for BS and MS receivers

This annex contains receiver test tables for Tetra BS and MS for V+D equipment supporting speech traffic channels TCH/S. The tables list test type, channel type, test limits, minimum sample size and signal levels.

NOTE: In the following tables, a sample is defined as:

- a bit in case of BER measurements;
- a message (i.e. a slot) in case of MER measurements.

Test specifications and limits identified with symbol "B" indicate a BER measurement while those identified with symbol "M" are MER measurements. Test tables for PUEM measurements are given at the end of the annex.

Table A.1: Test conditions for MS receiver V+D, class A

Test type	Channel type	Prop. Condition	Signal level (dBm)	Codec bit class	Spec. BER "B" or MER "M" (%)	Test limit BER "B" or MER "M" (%)	Min. samples
Sensitivity	15	Static	-112	class 0	3,5 B	4,27 B	30 000
Sensitivity	15	Static	-112	class 1	0,15 B	0,23 B	30 000
Sensitivity	15	Static	-112	class 2	0,018 M	0,045 M	30 000
Sensitivity	15	HT200	-103	class 2	2,6 M	2,9 M	11 000

Table A.2: Test conditions for MS receiver V+D, class B

Test type	Channel type	Prop. Condition	Signal level (dBm)	Codec bit class	Spec. BER "B" or MER "M" (%)	Test limit BER "B" or MER "M" (%)	Min. samples
Sensitivity	15	Static	-112	class 0	4 B	4,88 B	30 000
Sensitivity	15	Static	-112	class 1	0,15 B	0,23 B	30 000
Sensitivity	15	Static	-112	class 2	0,018 M	0,045 M	30 000
Sensitivity	15	TU50	-103	class 2	2,2 M	2,5 M	11 000

Table A.3: Test conditions for MS receiver V+D, class E

Test type	Channel type	Prop. Condition	Signal level (dBm)	Codec bit class	Spec. BER "B" or MER "M" (%)	Test limit BER "B" or MER "M" (%)	Min. samples
Sensitivity	15	Static	-112	class 0	3,5 B	4,27 B	30 000
Sensitivity	15	Static	-112	class 1	0,15 B	0,23 B	30 000
Sensitivity	15	Static	-112	class 2	0,018 M	0,045 M	30 000
Sensitivity	15	EQ200	-103	class 2	6,8 M	7,6 M	5 600

Table A.4: Test conditions for BS receiver V+D, class A

Test type	Channel type	Prop. Condition	Signal level (dBm)	Codec bit class	Spec. BER "B" or MER "M" (%)	Test limit BER "B" or MER "M" (%)	Min. samples
Sensitivity	16	Static	-115	class 0	3 B	3,66 B	30 000
Sensitivity	16	Static	-115	class 1	0,15 B	0,23 B	30 000
Sensitivity	16	Static	-115	class 2	0,012 M	0,045 M	30 000
Sensitivity	16	HT200	-106	class 2	2,7 M	3,0 M	9 500

Table A.5: Test conditions for BS receiver V+D, class B

Test type	Channel type	Prop. Condition	Signal level (dBm)	Codec bit class	Spec. BER "B" or MER "M" (%)	Test limit BER "B" or MER "M" (%)	Min. samples
Sensitivity	16	Static	-115	class 0	4 B	4,88 B	30 000
Sensitivity	16	Static	-115	class 1	0,15 B	0,23 B	30 000
Sensitivity	16	Static	-115	class 2	0,02 M	0,045 M	30 000
Sensitivity	16	TU50	-106	class 2	2,2 M	2,5 M	11 600

Table A.6: PUEM test table

Equip. type	Channel type	Prop. Condition	Signal level (dBm)	Codec bit class	Spec PUEM (%)	Bad unit PUEM (%)	Test limit (Max. No. Errors)	Sample size
MS	15	static	-112	class 2	0,01	0,028	8	30 000
BS	16	static	-115	class 2	0,01	0,028	8	30 000

Annex B (normative): Codec conformance test vector sequences

The input and output conformance test files for testing the TETRA speech encoder and decoder are supplied on disks attached to the last page of this ETS.

Table B.1 gives the size and format of the input and output conformance test files for testing the TETRA speech encoder and decoder with the following important notes.

NOTE 1: For the case of the TCH/S and the un-coded ACELP files each information bit is encoded using a 16-bit word, with only the least significant bit in the word being used and the rest of the word zero filled.

NOTE 2: The standard channel coder output as specified in ETS 300 395-2 [3], clause 8 was designed for testing with an error insertion device which is unsuitable for real practical implementations. Hence, for the conformance testing the true TCH/S output shall be used, i.e. 432 type-4 bits per TETRA slot which corresponds to 60 ms worth of speech.

NOTE 3: For simulation purposes as well as for error insertion purposes, the output format used in ETS 300 395-2 [3], clause 8 may be of interest. Therefore both formats are provided. The files seq1_an.in, seq4_an.out and seq2_an.hom are versions of seq1_72.in, seq4_72.out and seq2_72.hom compatible with the C code specified in ETS 300 395-2 [3], clause 8. The conversion program fromansi.c converts files seq1_an.in, seq4_an.out and seq2_an.hom to files seq1_72.in, seq4_72.out and seq2_72.hom. The program fromansi.c shall be compiled with the files tetra_op.c and sub_cd.c supplied as part of the bit exact C description (ETS 300 395-2 [3], clause 8). The conversion program toansi.c converts files seq1_72.in, seq4_72.out and seq2_72.hom to files seq1_an.in, seq4_an.out and seq2_an.hom. The program toansi.c should be compiled with the files tetra_op.c and sub_cc.c supplied as part of the bit exact C description (ETS 300 395-2 [3], clause 8).

Table B.1: File size and format for conformance test files

File name	Format	Size / bytes
seq1_72.in	TCH/S	2 306 880
seq2_72.hom	TCH/S	1 728
seq3_128.hom	8 kHz with 16-bits per sample according to ETS 300 395-2 [3], clause 8	2 400
seq4_72.out	TCH/S	2 306 880

Annex C (informative): Codec reference test vector sequences

Table C.1 provides, as a reference, files to facilitate the implementation of the TE and TSS by TETRA manufacturers.

The files are supplied on diskette attached to the last page of this ETS.

Table C.1: File size and format for reference test files

File name	Format	Size / bytes
te1_46.chd	ACELP (137+1) bits per 30 ms according to ETS 300 395-2 [3], clause 8	1 473 840
te2_128.pcm	8 kHz with 16-bits per sample according to ETS 300 395-2 [3], clause 8	2 563 200
te3_46.spe	ACELP (137+1) bits per 30 ms according to ETS 300 395-2 [3], clause 8	1 473 840

NOTE: For the case of the uncoded ACELP files each information bit is encoded using a 16-bit word, with only the least significant bit in the word being used and the rest of the word zero filled.

Annex D (informative): Bibliography

The following material, though not specifically referenced in the body of the present document (or not publicly available), gives supporting information.

- ITU-T Recommendation O.153: "Basic parameters for the measurement of error performance at bit rates below the primary rate".

History

Document history	
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