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Technical Specification

**Digital cellular telecommunications system (Phase 2+);
Test sequences for the GSM Enhanced Full Rate (EFR) speech codec
(3GPP TS 06.54 version 7.2.0 Release 1998)**

GLOBAL SYSTEM FOR
MOBILE COMMUNICATIONS

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Contents

Foreword

This Technical Specification has been produced by the 3rd Generation Partnership Project (3GPP).

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

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Test sequences for a bit exact implementation of the Enhanced Full Rate (EFR) speech transcoder are contained in the archive files which accompany the present document.

The archive contains ZIP compressed files, as follows:

Disk1_8	Clause 10: Test sequences for the GSM Enhanced Full Rate (EFR) speech codec; Speech test sequences TEST0.xxx to TEST8.xxx.
Disk2_8	Clause 10: Test sequences for the GSM Enhanced Full Rate (EFR) speech codec; Speech test sequences TEST09.xxx to TEST16.xxx.
Disk3_8	Clause 10: Test sequences for the GSM Enhanced Full Rate (EFR) speech codec; Speech test sequences TEST17.xxx to TEST20.xxx, Codec homing and synchronisation sequences.
Disk4_8	Clause 10: Test sequences for the GSM Enhanced Full Rate (EFR) speech codec; DTX test sequences.
Disk5_8 to Disk8_8	Clause 10: Test sequences for the GSM Enhance Full Rate (EFR) speech codec; 8 bit A- and µ-law compressed test sequences for alternative TRAU testing.
amr122_efr	Test sequences for the GSM-EFR speech codec using the Adaptive Multi-Rate (AMR) speech codec mode MR122 (GSM 06.74)

The present document specifies the digital test sequences for the GSM enhanced full rate speech codect for the digital cellular telecommunications system.

1 Scope

The present document specifies the digital test sequences for the GSM enhanced full rate speech codec. These sequences test for a bit exact implementation of the enhanced full rate speech transcoder (GSM 06.60 [2]), Voice Activity Detection (GSM 06.82 [6]), comfort noise (GSM 06.62 [4]) and the discontinuous transmission (GSM 06.81 [5]).

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, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.
- A non-specific reference to an ETS shall also be taken to refer to later versions published as an EN with the same number.
- For this Release 1998 document, references to GSM documents are for Release 1998 versions (version 7.x.y).

[1] GSM 01.04: "Digital cellular telecommunication system (Phase 2+); Abbreviations and acronyms".

[2] GSM 06.60: "Digital cellular telecommunications system (Phase 2+); Enhanced Full Rate (EFR) speech transcoding".

[3] GSM 06.61: "Digital cellular telecommunications system (Phase 2+); Substitution and muting of lost frames for Enhanced Full Rate (EFR) speech traffic channels".

[4] GSM 06.62: "Digital cellular telecommunications system (Phase 2+); Comfort noise aspects for Enhanced Full Rate (EFR) speech traffic channels".

[5] GSM 06.81: "Digital cellular telecommunications system (Phase 2+); Discontinuous Transmission (DTX) for Enhanced Full Rate (EFR) speech traffic channels".

[6] GSM 06.82: "Digital cellular telecommunications system (Phase 2+); Voice Activity Detection (VAD) for Enhanced Full Rate (EFR) speech traffic channels".

[7] GSM 06.53: "Digital cellular telecommunications system (Phase 2+); ANSI-C code for the GSM Enhanced Full Rate (EFR) speech codec".

[8] GSM 06.51: "Digital cellular telecommunications system (Phase 2+); Enhanced Full Rate (EFR) speech coding functions; General description".

3 Definitions and abbreviations

3.1 Definitions

Definition of terms used in the present document can be found in GSM 06.60 [2], GSM 06.61 [3], GSM 06.62 [4], GSM 06.81 [5] and GSM 06.82 [6].

3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:

ETS	European Telecommunication Standard
GSM	Global System for Mobile communications

For abbreviations not given in this subclause see GSM 01.04 [1].

4 General

Digital test sequences are necessary to test for a bit exact implementation of the enhanced full rate speech transcoder (GSM 06.60 [2]), Digital test Voice Activity Detection (GSM 06.82 [6]), comfort noise (GSM 06.62 [4]) and the discontinuous transmission (GSM 06.81 [5]).

The test sequences may also be used to verify installations of the ANSI C code in GSM 06.53 [7].

Clause 5 describes the format of the files which contain the digital test sequences. Clause 6 describes the test sequences for the speech transcoder. Clause 7 describes the test sequences for the VAD, comfort noise and discontinuous transmission.

Clause 8 describes the method by which synchronisation is obtained between the test sequences and the speech codec under test.

Clause 9 describes the alternative acceptance testing of the speech encoder and decoder in the TRAU by means of 8 bit A- or μ-law compressed test sequences on the A-Interface.

Test sequences for an alternative and fully interoperable implementation using as a basis the 12.2 kbit/s mode of the Adaptive Multi Rate speech coder are described in section 10.

Electronic copies of the digital test sequences are provided as clause 10, these digital test sequences are contained in the archive ts_100725v070100p0.zip which accompanies the present document.

5 Test sequence format

This clause provides information on the format of the digital test sequences for the GSM enhanced full rate speech transcoder (GSM 06.60 [2]), Voice Activity Detection (GSM 06.82 [6]), comfort noise (GSM 06.62 [4]) and the discontinuous transmission (GSM 06.81 [5]).

5.1 File format

The test sequence files are provided in archive ts_100725v070100p0.zip which accompanies the present document.

Following decompression, four types of file are provided:

- Files for input to the GSM enhanced full rate speech encoder: *.INP
- Files for comparison with the encoder output: *.COD
- Files for input to the GSM enhanced full rate speech decoder: *.DEC

- Files for comparison with the decoder output: *.OUT

The *.DEC files are generated from the corresponding *.COD files.

Tables 1, 2, 3 and 4 define the formats of the four types of file.

Each speech parameter within the speech frame of 244 bits/20 ms is contained in a serial string of 16 bit words, where each word contains the value of one bit of the parameter. In each string of *n* 16 bit words containing the *n* bits of a parameter, the most significant bit of the parameter is written first, and the least significant bit is written last. The bit value contained in a single 16 bit word is either 0x0000 or 0x0001 (right justified) for the binary values of “0” and “1”, respectively. See table 6 of GSM 06.60 [2] for the order of occurrence and bit allocation of speech parameters within the speech frame of 244 bits/20 ms.

The samples in the encoder input signal and in the decoder output signal are left justified.

5.2 Codec homing

Each *.INP file includes two homing frames at the start of the test sequence. The function of these frames is to reset the speech encoder state variables to their initial value. In the case of a correct installation of the ANSI-C simulation (GSM 06.53 [7]), all speech encoder output frames shall be identical to the corresponding frame in the *.COD file. In the case of a correct hardware implementation undergoing testing, the first speech encoder output frame is undefined and need not be identical to the first frame in the *.COD file, but all remaining speech encoder output frames shall be identical to the corresponding frames in the *.COD file.

Each *.DEC file includes two homing frames at the start of the test sequence. The function of these frames is to reset the speech decoder state variables to their initial value. In the case of a correct installation of the ANSI-C simulation (GSM 06.53 [7]), all speech decoder output frames shall be identical to the corresponding frame in the *.OUT file. In the case of a correct hardware implementation undergoing testing, the first speech decoder output frame is undefined and need not be identical to first frame in the *.OUT file, but all remaining speech decoder output frames shall be identical to the corresponding frames in the *.OUT file.

Table 1: Encoder input sequence (*.INP) format

Name	Description	No. of bits	Justification
s(n)	Encoder input signal	13	Left

Table 2: Encoder output sequence (*.COD) format

Name	Description	No. of bits	Justification
Speech parameters			
SPEECH	Serial stream of speech parameter bits to the channel encoder	244	Right
Additional information			
VAD	Voice activity detection flag	1	Right
SP	SP flag	1	Right

Table 3: Decoder input sequence (*.DEC) format

Name	Description	No. of bits	Justification
Additional information			
BFI	Bad Frame Indicator flag	1	Right
Speech parameters			
SPEECH	Serial stream of speech parameter bits to the channel encoder	244	Right
Additional information			
SID	Silence Descriptor flag	1	Right
TAF	Time Alignment Flag	1	Right

Table 4: Decoder output sequence (*.OUT) format

Name	Description	No. of bits	Justification
s'(n)	Decoder output signal	13	Left

6 Speech codec test sequences

This clause describes the test sequences designed to exercise the GSM enhanced full rate speech transcoder (GSM 06.60 [2]).

6.1 Codec configuration

The speech encoder shall be configured to operate in the non-DTX mode. The VAD and SP flags shall be set to 1 at the speech encoder output.

6.2 Speech codec test sequences

Table 5 lists the location and size of the speech codec test sequences.

6.2.1 Speech encoder test sequences

Twenty-one encoder input sequences are provided. Note that for the input sequences TEST0.INP to TEST3.INP, the amplitude figures are given in 13-bit precision. The active speech levels are given in dBov.

- TEST0.INP - Synthetic harmonic signal. The pitch delay varies slowly from 18 to 143.5 samples. The minimum and maximum amplitudes are -997 and +971.
- TEST1.INP - Synthetic harmonic signal. The pitch delay varies slowly from 144 down to 18.5 samples. Amplitudes at saturation point -4096 and +4095.
- TEST2.INP - Sinusoidal sweep varying from 150 Hz to 3400 Hz. Amplitudes ± 1250.
- TEST3.INP - Sinusoidal sweep varying from 150 Hz to 3400 Hz. Amplitudes ± 4000.
- TEST4.INP - Female speech, active speech level: -19.4 dBov, flat frequency response.
- TEST5.INP - Male speech, active speech level: -18.7 dBov, flat frequency response.
- TEST6.INP - Female speech, ambient noise, active speech level: -35.0 dBov, flat frequency response.
- TEST7.INP - Female speech, ambient noise, active speech level: -25.0 dBov, flat frequency response.
- TEST8.INP - Female speech, ambient noise, active speech level: -15.6 dBov, flat frequency response.
- TEST9.INP - Female speech, car noise, active speech level: -35.5 dBov, flat frequency response.
- TEST10.INP - Female speech, car noise, active speech level: -26.1 dBov, flat frequency response.
- TEST11.INP - Female speech, car noise, active speech level: -15.8 dBov, flat frequency response.
- TEST12.INP - Male speech, ambient noise, active speech level: -34.9 dBov, flat frequency response.
- TEST13.INP - Male speech, ambient noise, active speech level: -24.8 dBov, flat frequency response.
- TEST14.INP - Male speech, ambient noise, active speech level: -15.0 dBov, flat frequency response.
- TEST15.INP - Male speech, babble noise, active speech level: -34.1 dBov, flat frequency response.
- TEST16.INP - Male speech, babble noise, active speech level: -24.3 dBov, flat frequency response.
- TEST17.INP - Male speech, babble noise, active speech level: -14.4 dBov, flat frequency response.
- TEST18.INP - Female speech, ambient noise, active speech level: -26.0 dBov, modified IRS frequency response, with many zero frames.
- TEST19.INP - Male speech, ambient noise, active speech level: -36.0 dBov, modified IRS frequency response, with many zero frames.
- TEST20.INP - Sequence for exercising the LPC vector quantisation codebooks and ROM tables of the codec.

The TEST0.INP and TEST1.INP sequences were designed to test the pitch lag of the GSM enhanced full rate speech encoder. In a correct implementation, the resulting speech encoder output parameters shall be identical to those specified in the TEST0.COD and TEST1.COD sequences, respectively.

The TEST2.INP and TEST3.INP sequences are particularly suited for testing the LPC analysis, as well as for finding saturation problems. In a correct implementation, the resulting speech encoder output parameters shall be identical to those specified in the TEST2.COD and TEST3.COD sequences, respectively.

The TEST4.INP and TEST5.INP sequences contain a lot of low-frequency components. In a correct implementation, the resulting speech encoder output parameters shall be identical to those specified in the TEST4.COD and TEST5.COD sequences, respectively.

The TEST18.INP and TEST19.INP sequences contain some “all zeros” frames (silence) in between segments of speech. In a correct implementation, the resulting speech encoder output parameters shall be identical to those specified in the TEST18.COD and TEST19.COD sequences, respectively.

The TEST20.INP sequence was designed to force the encoder to select each of the LPC code indices and each but one of the the ROM table indices of the codec.

The remaining sequences (TEST6.INP to TEST17.INP) were selected on the basis of bringing various input characteristics (background noise) and levels to the test sequence set. In a correct implementation, the resulting speech encoder output parameters shall be identical to those specified in the TEST6.COD to TEST17.COD sequences, respectively.

6.2.2 Speech decoder test sequences

Twenty-one speech decoder input sequences TESTXX.DEC (XX = 0..20) are provided. These are derived from the corresponding TESTXX.INP sequences. In a correct implementation, the resulting speech decoder output shall be identical to the corresponding TESTXX.OUT sequences.

6.2.3 Codec homing sequence

In addition to the test sequences described above, two homing sequences are provided to assist in codec testing. TEST21.INP contains one encoder-homing-frame. TEST21.DEC contains one decoder-homing-frame. The use of these sequences is described in GSM 06.51 [8].

Table 5: Location and size of speech codec test sequences

Disk No.	File Name	No. of frames	Size (bytes)
1/8	TEST0.INP	285	91 200
1/8	TEST0.COD		140 220
1/8	TEST0.DEC		140 790
1/8	TEST0.OUT		91 200
1/8	TEST1.INP	285	91 200
1/8	TEST1.COD		140 220
1/8	TEST1.DEC		140 790
1/8	TEST1.OUT		91 200
1/8	TEST2.INP	402	128 640
1/8	TEST2.COD		197 784
1/8	TEST2.DEC		198 588
1/8	TEST2.OUT		128 640
1/8	TEST3.INP	402	128 640
1/8	TEST3.COD		197 784
1/8	TEST3.DEC		198 588
1/8	TEST3.OUT		128 640
1/8	TEST4.INP	301	96 320
1/8	TEST4.COD		148 092
1/8	TEST4.DEC		148 694
1/8	TEST4.OUT		96 320
1/8	TEST5.INP	224	71 680
1/8	TEST5.COD		110 208
1/8	TEST5.DEC		110 656
1/8	TEST5.OUT		71 680
1/8	TEST6.INP	335	107 200
1/8	TEST6.COD		164 820
1/8	TEST6.DEC		165 490
1/8	TEST6.OUT		107 200
1/8	TEST7.INP	363	116 160
1/8	TEST7.COD		178 596
1/8	TEST7.DEC		179 322
1/8	TEST7.OUT		116 160
1/8	TEST8.INP	340	108 800
1/8	TEST8.COD		167 280
1/8	TEST8.DEC		167 960
1/8	TEST8.OUT		108 800
2/8	TEST9.INP	407	130 240
2/8	TEST9.COD		200 244
2/8	TEST9.DEC		201 058
2/8	TEST9.OUT		130 240
2/8	TEST10.INP	383	122 560
2/8	TEST10.COD		188 436
2/8	TEST10.DEC		189 202
2/8	TEST10.OUT		122 560
2/8	TEST11.INP	367	117 440
2/8	TEST11.COD		180 564
2/8	TEST11.DEC		181 298
2/8	TEST11.OUT		117 440
2/8	TEST12.INP	298	95 360
2/8	TEST12.COD		146 616
2/8	TEST12.DEC		147 212
2/8	TEST12.OUT		95 360
2/8	TEST13.INP	338	108 160
2/8	TEST13.COD		166 296
2/8	TEST13.DEC		166 972
2/8	TEST13.OUT		108 160
2/8	TEST14.INP	318	101 760
2/8	TEST14.COD		156 456
2/8	TEST14.DEC		157 092
2/8	TEST14.OUT		101 760

(continued)

Table 5 (concluded): Location and size of speech codec test sequences

Disk No.	File Name	No. of frames	Size (bytes)
2/8	TEST15.INP		104 960
2/8	TEST15.COD	328	161 376
2/8	TEST15.DEC		162 032
2/8	TEST15.OUT		104 960
2/8	TEST16.INP		113 280
2/8	TEST16.COD	354	174 168
2/8	TEST16.DEC		174 876
2/8	TEST16.OUT		113 280
3/8	TEST17.INP		101 120
3/8	TEST17.COD	316	155 472
3/8	TEST17.DEC		156 104
3/8	TEST17.OUT		101 120
3/8	TEST18.INP		128 640
3/8	TEST18.COD	402	197 784
3/8	TEST18.DEC		198 588
3/8	TEST18.OUT		128 640
3/8	TEST19.INP		128 640
3/8	TEST19.COD	402	197 784
3/8	TEST19.DEC		198 588
3/8	TEST19.OUT		128 640
3/8	TEST20.INP		201 920
3/8	TEST20.COD	631	310 452
3/8	TEST20.DEC		311 714
3/8	TEST20.OUT		201 920
3/8	TEST21.INP	1	320
3/8	TEST21.DEC		494

7 DTX test sequences

This subclause describes the test sequences designed to exercise the VAD algorithm (GSM 06.82 [6]), comfort noise (GSM 06.62 [4]) and discontinuous transmission (GSM 06.81 [5]).

7.1 Codec configuration

The VAD, comfort noise and discontinuous transmission shall be tested in conjunction with the speech encoder (GSM 06.60 [2]). The speech encoder shall be configured to operate in the DTX mode defined in GSM 06.62 [4].

7.2 DTX test sequences

Each DTX test sequence consists of four files:

- Files for input to the GSM enhanced full rate speech encoder: *.INP
- Files for comparison with the encoder output: *.COD
- Files for input to the GSM enhanced full rate speech decoder: *.DEC
- Files for comparison with the decoder output: *.OUT

The *.DEC files are generated from the corresponding *.COD files.

In a correct implementation, the speech encoder parameters generated by the *.INP file shall be identical to those specified in the *.COD file; and the speech decoder output generated by the *.DEC file shall be identical to that specified in the *.OUT file.

Table 6 lists the DTX test sequences and their size in frames.

7.2.1 Predictor values computation

The computation of the predictor values described in GSM 06.82 [6] is not tested explicitly, since the results from the computation are tested many times via the spectral comparison and threshold adaptation tests.

7.2.2 Spectral comparison

The spectral comparison algorithm described in GSM 06.82 [6] is tested by the following test sequence:

- DTX01. *

7.2.3 Threshold adaptation

The threshold adaptation algorithm described in GSM 06.82 [6] is tested by the following test sequence:

- DTX02. *

7.2.4 Periodicity detection

The periodicity detection algorithm described in GSM 06.82 [6] is tested by the following test sequence:

- DTX03. *

7.2.5 Tone detection

The tone detection algorithm described in GSM 06.82 [6] is tested by the following test sequence:

- DTX04. *

7.2.6 Safety and initialisation

This sequence checks the safety paths used to prevent zero values being passed to the norm function. It checks the functions described in the adaptive filtering and energy computation, and the prediction values computation given in GSM 06.82 [6]. This sequence also checks the initialisation of thvad and the rvad array:

- DTX05. *

7.2.7 Comfort noise test sequence

The test sequences described in sub-subclauses 7.2.2 to 7.2.6 are designed to exercise the VAD described in GSM 06.82 [6] and the discontinuous transmission described in GSM 06.81 [5]. The following test sequence is defined to exercise the comfort noise algorithm described in GSM 06.62 [4]:

- DTX06.*

7.2.8 Real speech and tones

The test sequences cannot be guaranteed to find every possible error. There is therefore a small possibility that an incorrect implementation produces the correct output for the test sequences, but fails with real signals. Consequently, an extra sequence is included, which consists of very clean speech, barely detectable speech and a swept frequency tone:

- DTX07. *

NOTE: Some of the DTX test sequences contain homing frames. The DTX test sequences are therefore only suitable for testing a single transcoding.

Table 6: Location and size of DTX test sequences

Disk No.	File Name	No. of Frames	size *.INP	(bytes) *.COD	*.DEC	*.OUT
4/8	DTX01	710	227 200	349 320	350 740	227 200
4/8	DTX02	933	298 560	459 036	460 902	298 560
4/8	DTX03	156	49 920	76 752	77 064	49 920
4/8	DTX04	245	78 400	120 540	121 030	78 400
4/8	DTX05	56	17 920	27 552	27 664	17 920
4/8	DTX06	771	246 720	379 332	380 874	246 720
4/8	DTX07	1188	380 160	584 496	586 872	380 160

8 Sequences for finding the 20 ms framing of the GSM enhanced full rate speech encoder

When testing the decoder, alignment of the test sequences used to the decoder framing is achieved by the air interface (testing of MS) or can be reached easily on the A_{bis}-interface (testing on network side).

When testing the encoder, usually there is no information available about where the encoder starts its 20 ms segments of speech input to the encoder.

In the following, a procedure is described to find the 20 ms framing of the encoder using special synchronisation sequences. This procedure can be used for MS as well as for network side.

Synchronisation can be achieved in two steps. First, bit synchronisation has to be found. In a second step, frame synchronisation can be determined. This procedure takes advantage of the codec homing feature of the enhanced full rate codec, which puts the codec in a defined home state after the reception of the first homing frame. On the reception of further homing frames, the output of the codec is predefined and can be triggered to.

8.1 Bit synchronisation

The input to the speech encoder is a series of 13 bit long words (104 kbits/s, 13 bit linear PCM). When starting to test the speech encoder, no knowledge is available on bit synchronisation, i.e., where the encoder expects its least significant bits, and where it expects the most significant bits.

The encoder homing frame consists of 160 samples, all set to zero with the exception of the least significant bit, which is set to one (0 0000 0000 0001 binary, or 0x0008 hex if written into 16 bit words left justified). If two such encoder homing frames are input to the encoder consecutively, the decoder homing frame is expected at the output as a reaction of the second encoder homing frame.

Since there are only 13 possibilities for bit synchronisation, after a maximum of 13 trials bit synchronisation can be reached. In each trial three consecutive encoder homing frames are input to the encoder. If the decoder homing frame is not detected at the output, the relative bit position of the three input frames is shifted by one and another trial is performed. As soon as the decoder homing frame is detected at the output, bit synchronisation is found, and the first step can be terminated.

The reason why three consecutive encoder homing frames are needed is that frame synchronisation is not known at this stage. To be sure that the encoder reads two complete homing frames, three frames have to be input. Wherever the encoder has its 20 ms segmentation, it will always read at least two complete encoder homing frames.

An example of the 13 different frame triplets is given in sequence BITSYNC.INP (see table 7).

8.2 Frame synchronisation

Once bit synchronisation is found, frame synchronisation can be found by inputting one special frame that delivers 160 different output frames, depending on the 160 different positions that this frame can possibly have with respect to the encoder framing.

This special synchronisation frame was found by taking one input frame and shifting it through the positions 0 to 159. The corresponding 160 encoded speech frames were calculated and it was verified that all 160 output frames were different. When shifting the input synchronisation frame, the samples at the beginning were set to 0x0008 hex, which corresponds to the samples of the encoder homing frame.

Before inputting this special synchronisation frame to the encoder, again the encoder has to be reset by one encoder homing frame. A second encoder homing frame is needed to provoke a decoder homing frame at the output that can be triggered to. And since the framing of the encoder is not known at that stage, three encoder homing frames have to precede the special synchronisation frame to ensure that the encoder reads at least two homing frames, and at least one decoder homing frame is produced at the output, serving as a trigger for recording.

The special synchronisation frame preceded by the three encoder homing frames are given in SEQSYNC.INP. The corresponding 160 different output frames are given in SYNC000.COD through SYNC159.COD. The three digit number in the filename indicates the number of samples by which the input was retarded with respect to the encoder framing. By a corresponding shift in the opposite direction, alignment with the encoder framing can be reached.

8.3 Formats and sizes of the synchronisation sequences

BIT SYNC.INP:

This sequence consists of 13 frame triplets. It has the format of the speech encoder input test sequences (13 bit left justified with the three least significant bits set to zero).

The size of it is therefore:

SIZE (BITSYNC.INP) = 13 * 3 * 160 * 2 bytes = 12480 bytes

SEQSYNC.INP:

This sequence consist of 3 encoder reset frames and the special synchronisation frame. It has the format of the speech encoder input test sequences (13 bit left justified with the three least significant bits set to zero).

The size of it is therefore:

SIZE (SEQSYNC.INP) = 4 * 160 * 2 bytes = 1280 bytes

SYNCXXX.COD:

These sequences consists of 1 encoder output frame each. They have the format of the speech encoder output test sequences (16 bit words right justified). The values of the VAD and SP flags are set to one in these files.

The size of them is therefore:

SIZE (SYNCXXX.COD) = (244 + 2) * 2 bytes = 492 bytes

Table 7 summarises this information.

Table 7: Location, size and justification of synchronisation sequences

Disk No.	Purpose of Sequence	Name of Sequence	No. of Frames	Size in Bytes	Justification
3/8	Bit Synchronisation	BITSYNC.INP	39	1 2480	Left
3/8	Frame Synchronisation (input)	SEQSYNC.INP	4	1 280	Left
3/8	Frame Synchronisation (output)	SYNC000.COD	1	492	Right
3/8		SYNC001.COD	1	492	Right
3/8		SYNC002.COD	1	492	Right
"		"	"	"	"
"		"	"	"	"
"		"	"	"	"
3/8		SYNC159.COD	1	492	Right

9 Trau Testing with 8 Bit A- and µ-law PCM Test Sequences

In the previous clauses, tests for the transcoder in the TRAU are described, using 13 bit linear test sequences. However, these 13 bit test sequences require a special interface in the TRAU and do not allow testing in the field. In most cases the TRAU has to be set in special mode before testing.

As an alternative, the speech codec tests in the TRAU can be performed using A- or µ-law compressed 8 bit PCM test sequences on the A interface. For this purpose modified input test sequences (*-X.INP) are generated from the original sequences by A or µ law compression. As an input to the encoder they result in modified encoder output sequences (*-X.COD). The same *.dec decoder input sequences as in subclause 6.2.2. are then used to produce the output sequences *-X.OUT, which are A- or µ compressed.

The A- and µ-law compression and decompression does not change the homing frames at the encoder input. The format of all A- and µ-law PCM files *-X.INP and *-X.OUT is one sample (8 bit) per byte. The format of all other files is as described in clause 5.

All files are contained in archive ts_100725v070100p0.zip which accompanies the present document. The 'X' in the tables below with the filenames stands for A (A-law) and U (µ-law), respectively. The decoder input files *.dec are the same as in table 5 and are not described in this clause.

Table 8: Location and size of compressed 8 bit PCM speech codec test sequences

Disk No.	File Name	No. of frames	Size (bytes)
5-8/8	TEST0-X.INP		45 600
5-8/8	TEST0-X.COD	285	140 220
5-8/8	TEST0-X.OUT		45 600
5-8/8	TEST1-X.INP		45 600
5-8/8	TEST1-X.COD	285	140 220
5-8/8	TEST1-X.OUT		45 600
5-8/8	TEST2-X.INP		64 320
5-8/8	TEST2-X.COD	402	197 784
5-8/8	TEST2-X.OUT		64 320
5-8/8	TEST3-X.INP		64 320
5-8/8	TEST3-X.COD	402	197 784
5-8/8	TEST3-X.OUT		64 320
5-8/8	TEST4-X.INP		48 160
5-8/8	TEST4-X.COD	301	148 092
5-8/8	TEST4-X.OUT		48 160
5-8/8	TEST5-X.INP		35 840
5-8/8	TEST5-X.COD	224	110 208
5-8/8	TEST5-X.OUT		35 840
5-8/8	TEST6-X.INP		53 600
5-8/8	TEST6-X.COD	335	164 820
5-8/8	TEST6-X.OUT		53 600
5-8/8	TEST7-X.INP		58 080
5-8/8	TEST7-X.COD	363	178 596
5-8/8	TEST7-X.OUT		58 080
5-8/8	TEST8-X.INP		54 400
5-8/8	TEST8-X.COD	340	167 280
5-8/8	TEST8-X.OUT		54 400
5-8/8	TEST9-X.INP		65 120
5-8/8	TEST9-X.COD	407	200 244
5-8/8	TEST9-X.OUT		65 120
5-8/8	TEST10-X.INP		61 280
5-8/8	TEST10-X.COD	383	188 436
5-8/8	TEST10-X.OUT		61 280
5-8/8	TEST11-X.INP		58 720
5-8/8	TEST11-X.COD	367	180 564
5-8/8	TEST11-X.OUT		58 720
5-8/8	TEST12-X.INP		47 680
5-8/8	TEST12-X.COD	298	146 616
5-8/8	TEST12-X.OUT		47 680
5-8/8	TEST13-X.INP		54 080
5-8/8	TEST13-X.COD	338	166 296
5-8/8	TEST13-X.OUT		54 080
5-8/8	TEST14-X.INP		50 880
5-8/8	TEST14-X.COD	318	156 456
5-8/8	TEST14-X.OUT		50 880
5-8/8	TEST15-X.INP		52 480
5-8/8	TEST15-X.COD	328	161 376
5-8/8	TEST15-X.OUT		52 480
5-8/8	TEST16-X.INP		56 640
5-8/8	TEST16-X.COD	354	174 168
5-8/8	TEST16-X.OUT		56 640
5-8/8	TEST17-X.INP		50 560
5-8/8	TEST17-X.COD	316	155 472
5-8/8	TEST17-X.OUT		50 560
5-8/8	TEST18-X.INP		64 320
5-8/8	TEST18-X.COD	402	197 784
5-8/8	TEST18-X.OUT		64 320
5-8/8	TEST19-X.INP		64 320
5-8/8	TEST19-X.COD	402	197 784
5-8/8	TEST19-X.OUT		64 320
5-8/8	TEST20-X.INP		100 960
5-8/8	TEST20-X.COD	631	310 452
5-8/8	TEST20-X.OUT		100 960
5-8/8	TEST21-X.INP	1	160

Table 9: Location and size of compressed 8 bit PCM DTX test sequences

				size	bytes
Disk No.	File Name	No. of Frames	*.INP	*.COD	*.OUT
5-8/8	DTX01-X	710	113 600	349 320	113 600
5-8/8	DTX02-X	933	149 280	459 036	149 280
5-8/8	DTX03-X	156	24 960	76 752	24 960
5-8/8	DTX04-X	245	39 200	120 540	39 200
5-8/8	DTX05-X	56	8 960	27 552	8 960
5-8/8	DTX06-X	771	123 360	379 332	123 360
5-8/8	DTX07-X	1188	190 080	584 496	190 080

In addition to the test sequences above, special input (seqsyncX.inp) and output (syncxxxX.cod) sequences for frame synchronization are provided. The X again stands for A and µ law compressed PCM. The synchronization procedure is described in clause 8.

Table 10: Location, size and justification of compressed 8 bit PCM test sequences

Disk No.	Purpose of Sequence	Name of Sequence	No. of Frames	Size in Bytes	Justification
5-8/8	Frame Synchronisation (input)	SEQSYNCX.INP	4	640	-
5-8/8	Frame Synchronisation (output)	SYNC000X.COD	1	492	Right
5-8/8		SYNC001X.COD	1	492	Right
5-8/8		SYNC002X.COD	1	492	Right
"		"	"	"	"
"		"	"	"	"
"		"	"	"	"
5-8/8		SYNC159X.COD	1	492	Right

10 Alternative Enhanced Full Rate implementation using the Adaptive Multi Rate 12.2 kbit/s mode

The 12.2 kbit/s mode of the Adaptive Multi Rate speech coder described in TS 26.071 is functionally equivalent to the GSM Enhanced Full Rate speech coder. An alternative implementation of the Enhanced Full Rate speech service based on the 12.2 kbit/s mode of the Adaptive Multi Rate coder is allowed. Alternative implementations shall implement the functionality specified in TS 26.071 for the 12.2 kbit/s mode, with the difference that the DTX transmission format from GSM 06.81, the comfort noise generation from GSM 06.62 and the decoder homing frame from GSM 06.60 shall be used.

The test sequences are derived from the corresponding AMR test sequences. The modifications that were made and the use of the respective sequences are described below. The input sequences are identical to the AMR test input sequences *.inp.

<u>Speech codec test sequences</u>

- with DTX disabled

  t00.inp ... t22.inp (encoder input, from TS 26.074)

  t00_efr.cod ... t22_efr.cod (encoder output)

  t00_efr.dec ... t22_efr.dec (decoder input)

  t00_efr.out ... t22_efr.out (decoder output)

- with DTX enabled, VAD option 1

  Dtx1.inp ... Dtx4.inp (encoder input, from TS 26.074)

  Dtx1_efr.cod ... Dtx4_efr.cod (encoder output)

  Dtx1_efr.dec ... Dtx4_efr.dec (decoder input)

  Dtx1_efr.out ... Dtx4_efr.out (decoder output)

- with DTX enabled, VAD option 2

  Dt21.inp .... Dt24.inp (encoder input, from TS 26.074)

  Dt21_efr.cod ... Dt24_efr.cod (encoder output)

  Dt21_efr.dec ... Dt24_efr.dec (decoder input)

  Dt21_efr.out ... Dt24_efr.out (decoder output)

The format of the *.cod files is identical to the GSM_EFR *.cod file format (244 Data Bits, VadFlag, SpFlag equaling 246 Words per 20ms frame). The format of the *.dec files is identical to the GSM_EFR *.dec file format, that is (Bfi, 244 Data Bits, Sid, Taf equaling 247 Words per frame (20ms).

In summary, the differences to the AMR Mode MR122 test sequences are:

- DTX handling (VadFlag and SpFlag instead of TxType; different SID frames)
- Decoder homing frame (Decoder homing frame for GSM_EFR is different than for AMR MR122).

Annex A (informative): Change Request History

Change history					
SMG No.	**TDoc. No.**	**CR. No.**	**Section affected**	**New version**	**Subject/Comments**
SMG#23				4.0.1	ETSI Publication
SMG#23				5.1.0	Release 1996 version
SMG#27				6.0.0	Release 1997 version
SMG#29				7.0.0	Release 1998 version
				7.0.1	Version update to 7.0.1 for Publication
SMG#32	P-00-274	A005	4 and new 10	7.1.0	Alternative EFR implementation using the AMR 12.2 mode

Change history							
Date	**TSG SA#**	**TSG Doc.**	**CR**	**Rev**	**Subject/Comment**	**Old**	**New**
12-2000	10	SP-000573	A010		Corrections to the test vectors of the alternative EFR version	7.1.0	7.2.0

History

Document history		
V7.0.0	August 1999	One-step Approval Procedure OAP 9956: 1999-08-25 to 1999-12-24
V7.0.1	January 2000	Publication as EN 300 725
V7.1.0	August 2000	Publication
V7.2.0	December 2000	Publication