

# Unit Testing of ETSI EVS Codec

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## ABSTRACT

As a part of software development process, the small testable parts are individually tested for correctness.

A superwideband audio coding standard called Enhanced Voice services provides 20kHz audio bandwidth. The standard intends to provide robustness to delay jitter and packet losses as the coding is channel aware.

Here the problem at hand is the EVS Codec code provided by ETSI. The encoder and decoder c code is made in linux into executable files and sample linux scripts are used determine the correctness of coding and decoding.

The successful running of test ensures quality of product.

## General Terms

UMTS: Universal Mobile Telecommunications System

EVS: Codec for Enhanced Voice Services

## Keywords

EVS, superwideband, bandwidth, Codec, unit testing.

## 1. INTRODUCTION

As a part of software development process, the small testable parts are individually tested for correctness.

A superwideband audio coding standard called Enhanced Voice services provides 20kHz audio bandwidth. The standard intends to provide robustness to delay jitter and packet losses as the coding is channel aware.

To considerably improve network capacity and voice quality [1], 3GPP has standardized voice services. The quality of speech rendered matches that of stored music.

The codec has a lot of new features which improve operation in harsh environments. The Codec makes use of ACELP and MDCT to switch between speech and audio compression modes. A collaborative effort amongst handset and infrastructure manufacturers resulted in the evolution of the standard [2].

The codec gives higher quality, better frame/packet error resilience and provides better compression efficiency. [4]

The codec is cost effective and provides better connectivity. In the previous years, only a small part of the dynamic range of human voice was transmitted. With the emergence of this codec it looks as if we are talking face to face with the other person.

Here the problem at hand is the EVS Codec code provided by ETSI. The encoder and decoder c code is made in linux into executable files and sample linux scripts are used determine the correctness of coding and decoding.

Although the technical rigor of understanding and coding the standard is immense, the level of testing [5] where individual components are validated is by no means trivial.

Each of the individual program modules are tested by creating representative meaningful test stimuli and the outcome is verified against an already available benchmark. [6]

The goal of unit testing is to isolate each part of the program and ensure that individual parts are working correctly. [7]

Sometimes developers try to cut costs by performing minimal testing which introduces defects which percolate through the final product. [8]

This increases the cost of system testing, alpha and beta testing. [9]

## 2. THE MAKE PROCESS

The code is loaded in a Linux machine and a standard makefile is used to compile the code. The targets EVS\_cod and EVS\_dec are made

Compiling lib\_enc/ACcontextMapping\_enc.c

Compiling lib\_enc/acelp\_core\_enc.c

Compiling lib\_enc/acelp\_core\_switch\_enc.c

Compiling lib\_enc/acelp\_enc\_util.c

Compiling lib\_enc/amr\_wb\_enc.c

Compiling lib\_enc/analy\_lp.c

Compiling lib\_enc/analy\_sp.c

Compiling lib\_enc/ari\_enc.c

Compiling lib\_enc/ari\_hm\_enc.c

Compiling lib\_enc/arith\_coder\_enc.c

Compiling lib\_enc/avq\_cod.c

Compiling lib\_enc/bass\_psfiler\_enc.c

Compiling lib\_enc/bw\_detect.c

Compiling lib\_enc/cng\_enc.c

Compiling lib\_enc/cod2t32.c

Compiling lib\_enc/cod4t64.c

Compiling lib\_enc/cod\_ace.c

Compiling lib\_enc/cod\_tcx.c

Compiling lib\_enc/cod\_uv.c

Compiling lib\_enc/comvad\_decision.c

Compiling lib\_enc/core\_enc\_2div.c

Compiling lib\_enc/core\_enc\_init.c

Compiling lib\_enc/core\_enc\_ol.c

Compiling lib\_enc/core\_enc\_reconf.c

Compiling lib\_enc/core\_enc\_switch.c

Compiling lib\_enc/core\_enc\_updt.c

Compiling lib\_enc/core\_switching\_enc.c  
Compiling lib\_enc/corr\_xh.c  
Compiling lib\_enc/cor\_shif.c  
Compiling lib\_enc/decision\_matrix\_enc.c  
Compiling lib\_enc/detect\_transient.c  
Compiling lib\_enc/diffcod.c  
Compiling lib\_enc/dtx.c  
Compiling lib\_enc/enc\_acelp.c  
Compiling lib\_enc/enc\_acelp\_tcx\_main.c  
Compiling lib\_enc/enc\_acelpx.c  
Compiling lib\_enc/enc\_amr\_wb.c  
Compiling lib\_enc/enc\_gain.c  
Compiling lib\_enc/enc\_gen\_voic.c  
Compiling lib\_enc/enc\_gen\_voic\_rf.c  
Compiling lib\_enc/enc\_higher\_acelp.c  
Compiling lib\_enc/enc\_nelp.c  
Compiling lib\_enc/encoder.c  
Compiling lib\_enc/enc\_pit\_exc.c  
Compiling lib\_enc/enc\_ppp.c  
Compiling lib\_enc/enc\_prm.c  
Compiling lib\_enc/enc\_tran.c  
Compiling lib\_enc/enc\_uv.c  
Compiling lib\_enc/energy.c  
Compiling lib\_enc/eval\_pit\_contr.c  
Compiling lib\_enc/evs\_enc.c  
Compiling lib\_enc/ext\_sig\_ana.c  
Compiling lib\_enc/fd\_cng\_enc.c  
Compiling lib\_enc/FEC\_enc.c  
Compiling lib\_enc/find\_tar.c  
Compiling lib\_enc/find\_tilt.c  
Compiling lib\_enc/find\_uv.c  
Compiling lib\_enc/find\_wsp.c  
Compiling lib\_enc/frame\_spec\_dif\_cor\_rate.c  
Compiling lib\_enc/gain\_enc.c  
Compiling lib\_enc/gaus\_enc.c  
Compiling lib\_enc/gp\_clip.c  
Compiling lib\_enc/gs\_enc.c  
Compiling lib\_enc/guided\_plc\_enc.c  
Compiling lib\_enc/hf\_cod\_amrwb.c  
Compiling lib\_enc/hq\_classifier\_enc.c  
Compiling lib\_enc/hq\_core\_enc.c  
Compiling lib\_enc/hq\_env\_enc.c  
Compiling lib\_enc/hq\_hr\_enc.c  
Compiling lib\_enc/hq\_lr\_enc.c  
Compiling lib\_enc/hvq\_enc.c  
Compiling lib\_enc/igf\_enc.c  
Compiling lib\_enc/igf\_scf\_enc.c  
Compiling lib\_enc/init\_enc.c  
Compiling lib\_enc/inov\_enc.c  
Compiling lib\_enc/io\_enc.c  
Compiling lib\_enc/isf\_enc\_amr\_wb.c  
Compiling lib\_enc/lead\_indexing.c  
Compiling lib\_enc/long\_enr.c  
Compiling lib\_enc/lp\_exc\_e.c  
Compiling lib\_enc/lsf\_enc.c  
Compiling lib\_enc/lsf\_msvq\_ma\_enc.c  
Compiling lib\_enc/ltd\_stable.c  
Compiling lib\_enc/mdct\_classifier.c  
Compiling lib\_enc/mdct\_selector.c  
Compiling lib\_enc/mslvq\_enc.c  
Compiling lib\_enc/multi\_harm.c  
Compiling lib\_enc/nelp\_enc.c  
Compiling lib\_enc/noise\_adjust.c  
Compiling lib\_enc/nois\_est.c  
Compiling lib\_enc/normalizecoefs.c  
Compiling lib\_enc/peak\_vq\_enc.c  
Compiling lib\_enc/pitch\_ol2.c  
Compiling lib\_enc/pitch\_ol.c  
Compiling lib\_enc/pit\_enc.c  
Compiling lib\_enc/plc\_enc\_ext.c  
Compiling lib\_enc/ppp\_enc.c  
Compiling lib\_enc/pre\_proc.c  
Compiling lib\_enc/pvq\_core\_enc.c  
Compiling lib\_enc/pvq\_encode.c  
Compiling lib\_enc/q\_gain2p.c  
Compiling lib\_enc/qlpc\_avq.c  
Compiling lib\_enc/qlpc\_stoch.c  
Compiling lib\_enc/range\_enc.c  
Compiling lib\_enc/re8\_cod.c  
Compiling lib\_enc/reordernorm.c  
Compiling lib\_enc/rom\_enc.c  
Compiling lib\_enc/rst\_enc.c  
Compiling lib\_enc/set\_impulse.c  
Compiling lib\_enc/setmodeindex.c  
Compiling lib\_enc/sig\_clas.c  
Compiling lib\_enc/SNR\_calc.c

Compiling lib\_enc/spec\_center.c  
Compiling lib\_enc/spec\_flatness.c  
Compiling lib\_enc/speech\_music\_classif.c  
Compiling lib\_enc/stat\_noise\_uv\_enc.c  
Compiling lib\_enc/subband\_fft.c  
Compiling lib\_enc/swb\_bwe\_enc.c  
Compiling lib\_enc/swb\_bwe\_enc\_hr.c  
Compiling lib\_enc/swb\_bwe\_enc\_lr.c  
Compiling lib\_enc/swb\_pre\_proc.c  
Compiling lib\_enc/swb\_tbe\_enc.c  
Compiling lib\_enc/tcq\_core\_enc.c  
Compiling lib\_enc/tcx\_ltp\_enc.c  
Compiling lib\_enc/tcx\_utils\_enc.c  
Compiling lib\_enc/tfa\_enc.c  
Compiling lib\_enc/tns\_base\_enc.c  
Compiling lib\_enc/transient\_detection.c  
Compiling lib\_enc/transition\_enc.c  
Compiling lib\_enc/update\_decision.c  
Compiling lib\_enc/updt\_enc.c  
Compiling lib\_enc/updt\_tar.c  
Compiling lib\_enc/vad.c  
Compiling lib\_enc/vad\_param\_updt.c  
Compiling lib\_enc/vad\_proc.c  
Compiling lib\_enc/vbr\_average\_rate.c  
Compiling lib\_enc/vlpc\_1st\_cod.c  
Compiling lib\_enc/vlpc\_2st\_cod.c  
Compiling lib\_enc/voiced\_enc.c  
Compiling lib\_enc/waveadjust\_fec\_cod.c  
Compiling lib\_com/ACcontextMapping.c  
Compiling lib\_com/ari.c  
Compiling lib\_com/ari\_hm.c  
Compiling lib\_com/arith\_coder.c  
Compiling lib\_com/basop32.c  
Compiling lib\_com/basop\_com\_lpc.c  
Compiling lib\_com/basop\_lsf\_tools.c  
Compiling lib\_com/basop\_mpy.c  
Compiling lib\_com/basop\_tcx\_utils.c  
Compiling lib\_com/basop\_util.c  
Compiling lib\_com/bitalloc.c  
Compiling lib\_com/bitallocsum.c  
Compiling lib\_com/bits\_alloc.c  
Compiling lib\_com/bitstream.c  
Compiling lib\_com/calc\_st\_com.c  
Compiling lib\_com/cb\_shape.c  
Compiling lib\_com/cldfb.c  
Compiling lib\_com/cng\_exc.c  
Compiling lib\_com/codec\_tcx\_common.c  
Compiling lib\_com/core\_com\_config.c  
Compiling lib\_com/deemph.c  
Compiling lib\_com/delay\_comp.c  
Compiling lib\_com/disclaimer.c  
Compiling lib\_com/dlpc\_bfi.c  
Compiling lib\_com/edct.c  
Compiling lib\_com/enh1632.c  
Compiling lib\_com/enh40.c  
Compiling lib\_com/enhancer.c  
Compiling lib\_com/enr\_1\_az.c  
Compiling lib\_com/env\_adj.c  
Compiling lib\_com/env\_stab.c  
Compiling lib\_com/env\_stab\_trans.c  
Compiling lib\_com/est\_tilt.c  
Compiling lib\_com/fd\_cng\_com.c  
Compiling lib\_com/fft.c  
Compiling lib\_com/fft\_cldfb.c  
Compiling lib\_com/fft\_rel.c  
Compiling lib\_com/fill\_spectrum.c  
Compiling lib\_com/findpulse.c  
Compiling lib\_com/fine\_gain\_bits.c  
Compiling lib\_com/frame\_ener.c  
Compiling lib\_com/g192.c  
Compiling lib\_com/get\_gain.c  
Compiling lib\_com/g\_s\_bitallocation.c  
Compiling lib\_com/g\_s\_gains.c  
Compiling lib\_com/g\_s\_inact\_switching.c  
Compiling lib\_com/g\_s\_noisefill.c  
Compiling lib\_com/g\_s\_preech.c  
Compiling lib\_com/guided\_plc\_util.c  
Compiling lib\_com/hp50.c  
Compiling lib\_com/hq2\_bit\_alloc.c  
Compiling lib\_com/hq2\_core\_com.c  
Compiling lib\_com/hq2\_noise\_inject.c  
Compiling lib\_com/hq\_bit\_allocation.c  
Compiling lib\_com/hq\_conf.c  
Compiling lib\_com/hq\_tools.c  
Compiling lib\_com/hvq\_pvq\_bitalloc.c  
Compiling lib\_com/iff\_t\_rel.c

Compiling lib\_com/igf\_base.c  
Compiling lib\_com/index\_pvq\_opt.c  
Compiling lib\_com/interleave\_spectrum.c  
Compiling lib\_com/interpol.c  
Compiling lib\_com/int\_lsp.c  
Compiling lib\_com/isf\_dec\_amr\_wb.c  
Compiling lib\_com/lag\_wind.c  
Compiling lib\_com/lerp.c  
Compiling lib\_com/limit\_t0.c  
Compiling lib\_com/logqnorm.c  
Compiling lib\_com/longarith.c  
Compiling lib\_com/low\_rate\_band\_att.c  
Compiling lib\_com/lpc\_tools.c  
Compiling lib\_com/lsf\_dec\_bfi.c  
Compiling lib\_com/lsf\_msvq\_ma.c  
Compiling lib\_com/lsf\_tools.c  
Compiling lib\_com/lsp\_conv\_poly.c  
Compiling lib\_com/modif\_fs.c  
Compiling lib\_com/mslvq\_com.c  
Compiling lib\_com/nelp.c  
Compiling lib\_com/parameter\_bitmapping.c  
Compiling lib\_com/phase\_dispersion.c  
Compiling lib\_com/ppp.c  
Compiling lib\_com/pred\_lt4.c  
Compiling lib\_com/preemph.c  
Compiling lib\_com/pvq\_com.c  
Compiling lib\_com/range\_com.c  
Compiling lib\_com/re8\_ppv.c  
Compiling lib\_com/re8\_util.c  
Compiling lib\_com/realft.c  
Compiling lib\_com/recovernorm.c  
Compiling lib\_com/reordvct.c  
Compiling lib\_com/residu.c  
Compiling lib\_com/rom\_com.c  
Compiling lib\_com/stab\_est.c  
Compiling lib\_com/stat\_noise\_uv\_mod.c  
Compiling lib\_com/swb\_bwe\_com.c  
Compiling lib\_com/swb\_bwe\_com\_hr.c  
Compiling lib\_com/swb\_bwe\_com\_lr.c  
Compiling lib\_com/swb\_tbe\_com.c  
Compiling lib\_com/syn\_12k8.c  
Compiling lib\_com/syn\_filt.c  
Compiling lib\_com/tcq\_position\_arith.c  
Compiling lib\_com/tcx\_ltp.c  
Compiling lib\_com/tcx\_mdct.c  
Compiling lib\_com/tcx\_mdct\_window.c  
Compiling lib\_com/tcx\_utils.c  
Compiling lib\_com/tec\_com.c  
Compiling lib\_com/tns\_base.c  
Compiling lib\_com/tools.c  
Compiling lib\_com/trans\_direct.c  
Compiling lib\_com/trans\_inv.c  
Compiling lib\_com/vlpc\_2st\_com.c  
Compiling lib\_com/weight\_a.c  
Compiling lib\_com/weight.c  
Compiling lib\_com/wi.c  
Compiling lib\_com/window.c  
Compiling lib\_com/window\_ola.c  
Compiling lib\_com/wtda.c  
Linking EVS\_cod  
Compiling lib\_dec/ACcontextMapping\_dec.c  
Compiling lib\_dec/acelp\_core\_dec.c  
Compiling lib\_dec/acelp\_core\_switch\_dec.c  
Compiling lib\_dec/amr\_wb\_dec.c  
Compiling lib\_dec/ari\_dec.c  
Compiling lib\_dec/ari\_hm\_dec.c  
Compiling lib\_dec/arith\_coder\_dec.c  
Compiling lib\_dec/avq\_dec.c  
Compiling lib\_dec/bass\_psfiler.c  
Compiling lib\_dec/cng\_dec.c  
Compiling lib\_dec/core\_dec\_init.c  
Compiling lib\_dec/core\_dec\_reconf.c  
Compiling lib\_dec/core\_dec\_switch.c  
Compiling lib\_dec/core\_switching\_dec.c  
Compiling lib\_dec/dec2t32.c  
Compiling lib\_dec/dec4t64.c  
Compiling lib\_dec/dec\_ace.c  
Compiling lib\_dec/dec\_acelp.c  
Compiling lib\_dec/dec\_acelp\_tcx\_main.c  
Compiling lib\_dec/dec\_amr\_wb.c  
Compiling lib\_dec/dec\_gen\_voic.c  
Compiling lib\_dec/dec\_higher\_acelp.c  
Compiling lib\_dec/decision\_matrix\_dec.c  
Compiling lib\_dec/dec\_LPD.c  
Compiling lib\_dec/dec\_nelp.c  
Compiling lib\_dec/decoder.c

Compiling lib\_dec/dec\_pit\_exc.c  
Compiling lib\_dec/dec\_post.c  
Compiling lib\_dec/dec\_ppp.c  
Compiling lib\_dec/dec\_prm.c  
Compiling lib\_dec/dec\_tcx.c  
Compiling lib\_dec/dec\_tran.c  
Compiling lib\_dec/dec\_uv.c  
Compiling lib\_dec/d\_gain2p.c  
Compiling lib\_dec/dlpc\_avq.c  
Compiling lib\_dec/dlpc\_stoch.c  
Compiling lib\_dec/er\_dec\_acelp.c  
Compiling lib\_dec/er\_dec\_tcx.c  
Compiling lib\_dec/er\_scale\_syn.c  
Compiling lib\_dec/er\_sync\_exc.c  
Compiling lib\_dec/er\_util.c  
Compiling lib\_dec/evs\_dec.c  
Compiling lib\_dec/EvsRXlib.c  
Compiling lib\_dec/fd\_cng\_dec.c  
Compiling lib\_dec/FEC\_adapt\_codebook.c  
Compiling lib\_dec/FEC.c  
Compiling lib\_dec/FEC\_clas\_estim.c  
Compiling lib\_dec/FEC\_HQ\_core.c  
Compiling lib\_dec/FEC\_HQ\_phase\_ecu.c  
Compiling lib\_dec/FEC\_lsf\_estim.c  
Compiling lib\_dec/FEC\_pitch\_estim.c  
Compiling lib\_dec/FEC\_scale\_syn.c  
Compiling lib\_dec/gain\_dec.c  
Compiling lib\_dec/gaus\_dec.c  
Compiling lib\_dec/gs\_dec\_amr\_wb.c  
Compiling lib\_dec/gs\_dec.c  
Compiling lib\_dec/hdecnrm.c  
Compiling lib\_dec/hf\_synth.c  
Compiling lib\_dec/hq\_classifier\_dec.c  
Compiling lib\_dec/hq\_conf\_fec.c  
Compiling lib\_dec/hq\_core\_dec.c  
Compiling lib\_dec/hq\_env\_dec.c  
Compiling lib\_dec/hq\_hr\_dec.c  
Compiling lib\_dec/hq\_lr\_dec.c  
Compiling lib\_dec/igf\_dec.c  
Compiling lib\_dec/igf\_scf\_dec.c  
Compiling lib\_dec/init\_dec.c  
Compiling lib\_dec/inov\_dec.c  
Compiling lib\_dec/io\_dec.c  
Compiling lib\_dec/jbm\_jb4\_circularbuffer.c  
Compiling lib\_dec/jbm\_jb4\_inputbuffer.c  
Compiling lib\_dec/jbm\_jb4\_jmf.c  
Compiling lib\_dec/jbm\_jb4sb.c  
Compiling lib\_dec/jbm\_pcmdsp\_apa.c  
Compiling lib\_dec/jbm\_pcmdsp\_fifo.c  
Compiling lib\_dec/jbm\_pcmdsp\_similarityestimation.c  
Compiling lib\_dec/jbm\_pcmdsp\_window.c  
Compiling lib\_dec/LD\_music\_post\_filter.c  
Compiling lib\_dec/lead\_deindexing.c  
Compiling lib\_dec/lp\_exc\_d.c  
Compiling lib\_dec/lsf\_dec.c  
Compiling lib\_dec/lsf\_msvq\_ma\_dec.c  
Compiling lib\_dec/nelp\_dec.c  
Compiling lib\_dec/peak\_vq\_dec.c  
Compiling lib\_dec/pitch\_extr.c  
Compiling lib\_dec/pit\_dec.c  
Compiling lib\_dec/post\_dec.c  
Compiling lib\_dec/ppp\_dec.c  
Compiling lib\_dec/pvq\_core\_dec.c  
Compiling lib\_dec/pvq\_decode.c  
Compiling lib\_dec/range\_dec.c  
Compiling lib\_dec/re8\_dec.c  
Compiling lib\_dec/rom\_dec.c  
Compiling lib\_dec/rst\_dec.c  
Compiling lib\_dec/stat\_noise\_uv\_dec.c  
Compiling lib\_dec/swb\_bwe\_dec.c  
Compiling lib\_dec/swb\_bwe\_dec\_hr.c  
Compiling lib\_dec/swb\_bwe\_dec\_lr.c  
Compiling lib\_dec/swb\_tbe\_dec.c  
Compiling lib\_dec/syn\_outp.c  
Compiling lib\_dec/tcq\_core\_dec.c  
Compiling lib\_dec/tcx\_utils\_dec.c  
Compiling lib\_dec/tns\_base\_dec.c  
Compiling lib\_dec/TonalComponentDetection.c  
Compiling lib\_dec/tonalMDCTconcealment.c  
Compiling lib\_dec/transition\_dec.c  
Compiling lib\_dec/updt\_dec.c  
Compiling lib\_dec/vlpc\_1st\_dec.c  
Compiling lib\_dec/vlpc\_2st\_dec.c  
Compiling lib\_dec/voiced\_dec.c  
Compiling lib\_dec/voip\_client.c  
Compiling lib\_dec/waveadjust\_fec\_dec.c

Linking EVS\_dec

### 3. THE ENCODE PROCESS

#### 3.1 The organization of source and input test files.

A set of input audio files are properly prepared and stored in the test directory

```
[root@vlsibtechclient26 floatc]# ls
bin          encodscript1  lib_enc          switchPaths
build        EVS_cod       Makefile         test
copyscript   EVS_cod.exe   output           testv
decodscript   EVS_dec       Readme_EVS_dec_log.txt  Workspace_msvc
decodscript1 EVS_dec.exe   Readme_EVS_enc1_log.txt
enclog        lib_com       Readme_EVS_enc_log.txt
encodscript   lib_dec       readme.txt
[root@vlsibtechclient26 floatc]#
```

Fig 1: A snapshot of the directory structure of the codec files.

The directory lib\_enc contains c source files for the encoder which forms the acelp and mdct part.

The source files for the decoder are stored in the directory lib\_dec.

The common files are stored in lib\_com directory.

A Makefile is crafted to compile the encoder and decoder.

To test the codec a series of input speech files are created and stored as subdirectories under the directory testv.

```
[root@vlsibtechclient26 testv]# ls
bitstreams  decoded  input  preparedBitstreams
[root@vlsibtechclient26 testv]#
```

Fig 2: A subset of directories which contain the input speech files.

```
[root@vlsibtechclient26 testv]# ls
bitstreams  decoded  input  preparedBitstreams
[root@vlsibtechclient26 testv]# cd bitstreams/
[root@vlsibtechclient26 bitstreams]# ls
amrwb  nb          preparedBS_nb  preparedBS_wb  swb
fb     preparedBS_fb  preparedBS_swb  stv8c_8000_8kHz.COD  wb
[root@vlsibtechclient26 bitstreams]#
```

Fig 2: Different directories of input speech files amrwb, narrowband, wideband superwideband are generated and stored in different directories.

```
[root@vlsibtechclient26 input]# cd amrwb
[root@vlsibtechclient26 amrwb]# ls
>tx1.INP  Dtx5.INP  T03.INP  T07.INP  T11.INP  T15.INP  T19.INP  T22.MOD
>tx2.INP  T00.INP  T04.INP  T08.INP  T12.INP  T16.INP  T20.INP  T23.INP
>tx3.INP  T01.INP  T05.INP  T09.INP  T13.INP  T17.INP  T21.INP
>tx4.INP  T02.INP  T06.INP  T10.INP  T14.INP  T18.INP  T22.INP
[root@vlsibtechclient26 amrwb]# cd ..
[root@vlsibtechclient26 input]# ls
amrwb  fb  nb  swb  wb
[root@vlsibtechclient26 input]# cd fb
[root@vlsibtechclient26 fb]# ls
stv48c.INP  stv48n1.INP  stv48n2.INP
[root@vlsibtechclient26 fb]# cd ..
[root@vlsibtechclient26 input]# cd nb
[root@vlsibtechclient26 nb]# ls
stv8c.INP  stv8n1.INP  stv8n2.INP
[root@vlsibtechclient26 nb]# cd ..
[root@vlsibtechclient26 input]# ls
amrwb  fb  nb  swb  wb
[root@vlsibtechclient26 input]# cd swb
[root@vlsibtechclient26 swb]# ls
stv32c.INP  stv32n1.INP  stv32n2.INP
[root@vlsibtechclient26 swb]#
```

Fig 3: A listing different INP files which are speech files.

```
[root@vlsibtechclient26 input]# ls
amrwb  fb  nb  swb  wb
[root@vlsibtechclient26 input]# cd fb
[root@vlsibtechclient26 fb]# ls
stv48c.INP  stv48n1.INP  stv48n2.INP
[root@vlsibtechclient26 fb]# cd ..
[root@vlsibtechclient26 input]# cd nb
[root@vlsibtechclient26 nb]# ls
stv8c.INP  stv8n1.INP  stv8n2.INP
[root@vlsibtechclient26 nb]# cd ..
[root@vlsibtechclient26 input]# ls
amrwb  fb  nb  swb  wb
[root@vlsibtechclient26 input]# cd swb
[root@vlsibtechclient26 swb]# ls
stv32c.INP  stv32n1.INP  stv32n2.INP
[root@vlsibtechclient26 swb]# cd ..
[root@vlsibtechclient26 input]# ls
amrwb  fb  nb  swb  wb
[root@vlsibtechclient26 input]# cd wb
[root@vlsibtechclient26 wb]# ls
stv16c.INP  stv16n1.INP  stv16n2.INP
[root@vlsibtechclient26 wb]#
```

Fig 4: A listing different INP files for different speech formats.

#### 3.2 The encoding script

Now the encoding process is initiated by passing the input files one after the other on the command line to the input codec and the result is obtained as \*.COD file. The entire process is encoded as a script. A part of the script is shown here for reference.

```
ENC_BIN=./EVS_cod # EVS encoder binary under test
DIFF_BIN=/usr/bin/diff # default test tool
LOG_FILE=Readme_EVS_enc_log.txt # test result log file
if [ -f $LOG_FILE ]; then
rm $LOG_FILEfi
$ENC_BIN ./switchPaths/sw_72_244.bin 8
./testv/input/nb/stv8c.INP
./output/bitstreams/stv8c_sw_72_244_8kHz.COD
$DIFF_BIN
./testv/bitstreams/nb/stv8c_sw_72_244_8kHz.COD
./output/bitstreams/stv8c_sw_72_244_8kHz.COD >>
$LOG_FILE 2>&1
$ENC_BIN 7200 8 ./testv/input/nb/stv8c.INP
./output/bitstreams/stv8c_7200_8kHz.COD
$DIFF_BIN ./testv/bitstreams/nb/stv8c_7200_8kHz.COD
./output/bitstreams/stv8c_7200_8kHz.COD >> $LOG_FILE
2>&1
```

```
$ENC_BIN 8000 8 ./testv/input/nb/stv8c.INP
./output/bitstreams/stv8c_8000_8kHz.COD

$DIFF_BIN ./testv/bitstreams/nb/stv8c_8000_8kHz.COD
./output/bitstreams/stv8c_8000_8kHz.COD >> $LOG_FILE
2>&1

$ENC_BIN 9600 8 ./testv/input/nb/stv8c.INP
./output/bitstreams/stv8c_9600_8kHz.COD

$DIFF_BIN ./testv/bitstreams/nb/stv8c_9600_8kHz.COD
./output/bitstreams/stv8c_9600_8kHz.COD >> $LOG_FILE
2>&1

$ENC_BIN -dtx 5900 8 ./testv/input/nb/stv8c.INP
./output/bitstreams/stv8c_dtx_5900_8kHz.COD

$DIFF_BIN ./testv/bitstreams/nb/stv8c_dtx_5900_8kHz.COD
./output/bitstreams/stv8c_dtx_5900_8kHz.COD >>
$LOG_FILE 2>&1

$ENC_BIN 13200 8 ./testv/input/nb/stv8c.INP
./output/bitstreams/stv8c_13200_8kHz.COD

$DIFF_BIN ./testv/bitstreams/nb/stv8c_13200_8kHz.COD
./output/bitstreams/stv8c_13200_8kHz.COD >> $LOG_FILE
2>&1
```

## 4. THE DECODE PROCESS

Now the decoding process is initiated by passing the encoded \*.COD through the EVS decoder to produce \*.OUT files. These OUT files are compared to an existing benchmark file using the diff command. A portion of the decoder script is attached for reference.

### 4.1 The decoding script

```
DEC_BIN=./EVS_dec # EVS decoder binary under test

DIFF_BIN=diff # default test tool

LOG_FILE=Readme_EVS_dec_log.txt # test result log file

if [ -f $LOG_FILE ]; then

rm $LOG_FILEfi

$DEC_BIN 8
./testv/bitstreams/nb/stv8c_13200_8kHz.f06.COD
./output/decoded/stv8c_13200_8kHz.f06.OUT

$DIFF_BIN ./testv/decoded/nb/stv8c_13200_8kHz.f06.OUT
./output/decoded/stv8c_13200_8kHz.f06.OUT >>
$LOG_FILE 2>&1

$DEC_BIN 8
./testv/bitstreams/nb/stv8c_13200_8kHz.COD
./output/decoded/stv8c_13200_8kHz.OUT

$DIFF_BIN ./testv/decoded/nb/stv8c_13200_8kHz.OUT
./output/decoded/stv8c_13200_8kHz.OUT >> $LOG_FILE
2>&1

$DEC_BIN 8
./testv/bitstreams/nb/stv8c_13200_8kHz.b10.COD
./output/decoded/stv8c_13200_8kHz.b10.OUT

$DIFF_BIN ./testv/decoded/nb/stv8c_13200_8kHz.b10.OUT
./output/decoded/stv8c_13200_8kHz.b10.OUT >>
$LOG_FILE 2>&1

$DEC_BIN 8
./testv/bitstreams/nb/stv8c_8000_8kHz.b10.COD
./output/decoded/stv8c_8000_8kHz.b10.OUT
```

```
$DIFF_BIN ./testv/decoded/nb/stv8c_8000_8kHz.b10.OUT
./output/decoded/stv8c_8000_8kHz.b10.OUT >>
$LOG_FILE 2>&1
```

## 5. THE UNIT TESTING PROCESS

A portion of the encoding log as a part of encoding is as shown below:

EVS Codec (Floating Point) 3GPP TS26.443 Apr 03, 2018.  
Version 12.10.0 / 13.6.0 / 14.2.0

Bandwidth switching file:

./switchPaths/bw\_switch\_NB\_WB\_SWB\_FB.txt

Bitrate switching file: ./switchPaths/bw\_59\_1280.bin

Input audio file: ./testv/input/fb/stv48n2.INP

Output bitstream file:

./output/bitstreams/stv48n2\_bw\_59\_1280\_48kHz.COD

Input sampling rate: 48000 Hz

Bitrate: 7.20 kbps

Bandwidth limited to WB. To enable FB coding, please use -max\_band FB.

Running the encoder -----

Frames processed: 700

Encoding finished

At the end of the total encoding and decoding process we get the log

TEST PASSED SUCESSFULLY

## 6. DISCUSSION

Even when performing unit testing the task should not be considered as trivial. The quality of the output is dependent on how meticulously the unit test benchmarks are created. This process even though simple illustrates that unit testing is by no means a simple task. Lack of proper planning can result in a faulty product being handed over to the end customer

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