AAC-LC / HE-AAC / HE-AAC-v2 Encoder Test Report

Test Report

Document Number	IA-HE-AAC-Enc-TR
Version	1.3
Date	August 27, 2009

Ittiam Systems Confidential

Ittiam Systems (P) Ltd,
The Consulate, 1 Richmond Road,
Bangalore 560 025, India

Notice

Ittiam Systems reserves the right to make changes to its products or discontinue any of its products or offerings without notice.

Ittiam warrants the performance of its products to the specifications applicable at the time of sale in accordance with Ittiam's standard warranty.

Revision History

Version	Date	Changes
1.0	February 7, 2008	Original
1.3	August 27, 2009	Updated

Contents

1. Introduction 1
   - 1.1 Motivation 1
   - 1.2 Scope 1
   - 1.3 Glossary 1
2. Test Description 2
   - 2.1 Test Objective 2
   - 2.2 Test Criteria 2
   - 2.3 Test Resources 2
   - 2.4 Test Utilities 4
3. Test Results 5
   - 3.1 AAC-LC Encoder Results 5
   - 3.2 HE-AAC Encoder Results 7
   - 3.3 HE-AAC-v2 Encoder Results 9
4. References 11

Tables

Table 2-1 Description of the rating scheme for HE-AAC Encoder 2
Table 2-2 Description of SQAM test-files 4
Table 3-1 AAC-LC Enc Test Results 6
Table 3-2 HE-AAC Enc Test Results 8
Table 3-3 HE-AACv2 Enc Test Results 10

1. Introduction

1.1 Motivation

MPEG-2/4 AAC-LC (Advanced Audio Coding - Low Complexity version) is a popular audio coding technique recommended by MPEG committee. The codec handles audio signals sampled in the range of 8 kHz to 96 kHz. It operates on a frame of 1024 samples. The bit-rate can vary in the range from 8 to 576 kbps/channel (depending on the sampling rate). Low Complexity version of AAC provides good compromise between the codec complexity and the audio quality.

HE-AAC (High Efficiency Advanced Audio Coding) also known as AAC Plus is a popular audio coding technique recommended by MPEG (Moving Picture Experts Group) committee. SBR (Spectral Bandwidth Replication) tool is used in combination with the AAC general audio codec resulting in aacPlus. It provides significant increase in coding gain. In SBR, the high-band, i.e. the high frequency part of the spectrum is replicated using the low-band. The bit-rate is far below the bit-rate required when using conventional AAC coding. This translates into better quality at lower bit-rates.

This document describes the test process and result for the HE-AAC Encoder.

1.2 Scope

The scope of this document covers the test criteria, testing procedure and the test results for AAC-LC/HE-AAC/HE-AAC-v2 Encoder.

1.3 Glossary

Term	Explanation
MPEG	Moving Picture Experts Group
RMS	Root Mean Square.
ISO	International Standards Organization.
IEC	International Electro-technical Commission.
ODG	Objective Differential Grading
SQAM	Sound Quality Assessment Material
EBU	European Broadcasting Union

2. Test Description

2.1 Test Objective

Ittiam HE-AAC Encoder has been passed through objective tests to evaluate the quality of the same. Subjective tests (i.e. listening tests) have not been performed for lack of trained listeners.

2.2 Test Criteria

The testing procedure involves comparing, in an objective and subjective sense, the test file (i.e. encoded by Ittiam HE-AAC Encoder and then decoded by MPEG standard decoder) with the original wave file and giving a rating in accordance with the scale specified by ITU –R BS.1387. Depending on the change in audio quality between the reference and the test file, a rating on a scale between 0 and –4, with the following anchors :

Rating	Impairment
0.0	Imperceptible
-1.0	Perceptible, but not annoying
-2.0	Slightly Annoying
-3.0	Annoying
-4.0	Very Annoying

Table 2-1 Description of the rating scheme for HE-AAC Encoder

2.3 Test Resources

The reference files used to validate the algorithm are chosen from the SQAM CD made available by EBU. Following table describes them.

Testvector Name	Description	Sampling frequency (in kHz)	No. of channels
01.wav	Sine wave 1kHz	44.1	2
02.wav	Band-limited pink noise	44.1	2
03.wav	Electronic gong 100Hz	44.1	2

04.wav	Electronic gong 400Hz	44.1	2
05.wav	Electronic gong 5KHz	44.1	2
06.wav	Electronic gong 500Hz, vibrato	44.1	2
07.wav	Electronic tune (Frere Jacques)	44.1	2
08.wav	Violin	44.1	2
09.wav	Violla	44.1	2
10.wav	VoilonCello	44.1	2
11.wav	Double-bass	44.1	2
12.wav	Picollo	44.1	2
13.wav	Flute	44.1	2
14.wav	Obeo	44.1	2
15.wav	Cor anglais	44.1	2
16.wav	Clarinet	44.1	2
17.wav	Bass-Clarinet	44.1	2
18.wav	Bassoon	44.1	2
19.wav	Contra-Bassoon	44.1	2
20.wav	Saxophone	44.1	2
21.wav	Trumpet	44.1	2
22.wav	Trombone	44.1	2
23.wav	Horn	44.1	2
24.wav	Tuba	44.1	2
25.wav	Harp	44.1	2
26.wav	Claves	44.1	2
27.wav	Castanets	44.1	2
28.wav	Side drum	44.1	2
29.wav	Bass drum	44.1	2
30.wav	Kettle-drums	44.1	2
31.wav	Cymbal	44.1	2
32.wav	Triangles	44.1	2
33.wav	Gong	44.1	2
34.wav	Tubular bells	44.1	2
35.wav	Glockenspeil	44.1	2
36.wav	Xylophone	44.1	2
37.wav	Vibraphone	44.1	2
38.wav	Marimba	44.1	2
39.wav	Grand piano	44.1	2
40.wav	Harpsichord	44.1	2
41.wav	Celesta	44.1	2
42.wav	Accordion	44.1	2
43.wav	Organ	44.1	2
44.wav	Soprano	44.1	2
45.wav	Alto	44.1	2
46.wav	Tenor	44.1	2
47.wav	Bass	44.1	2

48.wav	Quartet	44.1	2
49.wav	Female speech	44.1	2
50.wav	Male speech	44.1	2
51.wav	Female speech	44.1	2
52.wav	Male speech	44.1	2
53.wav	Female speech	44.1	2
54.wav	Male speech	44.1	2
55.wav	Trumpet	44.1	2
56.wav	Organ	44.1	2
57.wav	Organ	44.1	2
58.wav	Guitar	44.1	2
59.wav	Violin	44.1	2
60.wav	Piano	44.1	2
61.wav	Soprano	44.1	2
62.wav	Soprano	44.1	2
63.wav	Soloists	44.1	2
64.wav	Choir	44.1	2
65.wav	Orchestra	44.1	2
66.wav	Wind ensemble	44.1	2
67.wav	Wind ensemble	44.1	2
68.wav	Orchestra	44.1	2
69.wav	ABBA	44.1	2
70.wav	Eddie Rabbitt	44.1	2

Table 2-2 Description of SQAM test-files

2.4 Test Utilities

The utilities used for testing the quality of Ittiam HE-AAC Encoder are as follows.

- MPEG standard reference decoder.
- Eaqual.exe: This executable finds the ODG value by comparing the original wave file and the encoded-decoded wave file. Usage of the same is given below:

  Eaqual -fref <original wave file> -ftest <encoded decoded wave file>

3. Test Results

The following sections summarizes the test results for AAC-LC / HE-AAC / HE-AAC-v2 Encoder.

3.1 AAC-LC Encoder Results

Following table summarizes the test results for Ittiam AAC-LC Encoder with TNS enabled.

Testvector Name	ODG Value (128 kbps AAC)
01.wav	-0.63
02.wav	-1.3
03.wav	-0.07
04.wav	-0.58
05.wav	-0.06
06.wav	-0.14
07.wav	-0.2
08.wav	-1.41
09.wav	-1.4
10.wav	-0.98
11.wav	-1.02
12.wav	-0.6
13.wav	-0.59
14.wav	-0.58
15.wav	-0.65
16.wav	-0.51
17.wav	-1
18.wav	-0.8
19.wav	-1.15
20.wav	-0.77
21.wav	-0.22
22.wav	-0.08
23.wav	-0.06
24.wav	-0.06
25.wav	-0.24
26.wav	-0.24
27.wav	-0.76
28.wav	-0.97

29.wav	-0.02
30.wav	0.02
31.wav	-0.89
32.wav	-0.79
33.wav	-0.18
34.wav	-0.15
35.wav	-0.44
36.wav	-0.66
37.wav	-0.35
38.wav	-0.6
39.wav	-0.13
40.wav	-1.26
41.wav	-0.21
42.wav	-0.99
43.wav	-0.94
44.wav	-0.76
45.wav	-0.28
46.wav	-0.75
47.wav	-0.48
48.wav	-1.18
49.wav	0
50.wav	0.09
51.wav	-0.21
52.wav	-0.28
53.wav	-0.02
54.wav	0.02
55.wav	-0.74
56.wav	-0.94
57.wav	-0.32
58.wav	-0.43
59.wav	-1.06
60.wav	-0.18
61.wav	-0.9
62.wav	-0.42
63.wav	-0.81
64.wav	-1.16
65.wav	-0.95
66.wav	-0.78
67.wav	-0.32
68.wav	-0.4
69.wav	-0.75
70.wav	-0.4

Table 3-1 AAC-LC Enc Test Results

3.2 HE-AAC Encoder Results

Following table summarizes the test results for Ittiam HE-AAC Encoder at Quality Level 2 with TNS enabled.

Testvector Name	ODG Value (64 kbps AAC+SBR)	ODG Value (128 kbps AAC)
01.wav	-0.52	-0.27
02.wav	-1.7	-1.13
03.wav	-0.07	-0.07
04.wav	-1.3	-0.56
05.wav	-1.89	-0.01
06.wav	-0.82	0.03
07.wav	-0.69	-0.11
08.wav	-2.62	-1.15
09.wav	-2.71	-1.24
10.wav	-2.62	-0.87
11.wav	-1.35	-0.92
12.wav	-1.91	-0.41
13.wav	-1.64	-0.45
14.wav	-2.52	-0.52
15.wav	-2.63	-0.66
16.wav	-1.92	-0.42
17.wav	-2.88	-0.78
18.wav	-1.41	-0.80
19.wav	-1.91	-1.06
20.wav	-1.46	-0.72
21.wav	-1.86	-0.13
22.wav	-1.06	-0.06
23.wav	-0.95	-0.09
24.wav	-1.2	-0.03
25.wav	-0.98	-0.27
26.wav	-1.53	-0.18
27.wav	-1.59	-0.66
28.wav	-1.36	-0.81
29.wav	-0.9	-0.12
30.wav	-0.99	0.05
31.wav	-2.18	-0.61
32.wav	-1.62	-0.43
33.wav	-1.12	-0.14
34.wav	-0.9	-0.09
35.wav	-2.44	-0.25
36.wav	-1.48	-0.44

37.wav	-1.17	-0.35
38.wav	-0.7	-0.57
39.wav	-0.95	-0.10
40.wav	-2.36	-0.77
41.wav	-1.05	-0.20
42.wav	-2.86	-0.69
43.wav	-2.05	-0.73
44.wav	-1.74	-0.78
45.wav	-1.6	-0.26
46.wav	-1.75	-0.70
47.wav	-1.6	-0.46
48.wav	-1.98	-1.09
49.wav	-0.86	0.02
50.wav	-0.7	0.10
51.wav	-0.74	-0.14
52.wav	-0.99	-0.22
53.wav	-0.79	-0.00
54.wav	-0.75	0.00
55.wav	-2.08	-0.74
56.wav	-1.88	-0.74
57.wav	-2.2	-0.15
58.wav	-1.48	-0.34
59.wav	-2.65	-0.93
60.wav	-1.21	-0.11
61.wav	-2.28	-0.83
62.wav	-1.45	-0.41
63.wav	-1.61	-0.77
64.wav	-1.98	-1.05
65.wav	-2.6	-0.78
66.wav	-1.44	-0.71
67.wav	-1.24	-0.36
68.wav	-0.98	-0.37
69.wav	-1.66	-0.67
70.wav	-0.77	-0.32

Table 3-2 HE-AAC Enc Test Results

3.3 HE-AAC-v2 Encoder Results

Following table summarizes the test results for Ittiam HE-AAC v2 Encoder at Quality Level 2 with TNS enabled.

Testvector Name	ODG Value (48 kbps AAC+SBR+PS)	ODG Value (64 kbps AAC+SBR)	ODG Value (128 kbps AAC)
01.wav	-1.33	-0.52	-0.27
02.wav	-2.73	-1.7	-1.13
03.wav	-0.07	-0.07	-0.07
04.wav	-3.42	-1.3	-0.56
05.wav	-3	-1.89	-0.01
06.wav	-2.4	-0.82	0.03
07.wav	-2.5	-0.69	-0.11
08.wav	-3.22	-2.62	-1.15
09.wav	-2.74	-2.71	-1.24
10.wav	-3.04	-2.62	-0.87
11.wav	-1.94	-1.35	-0.92
12.wav	-3.07	-1.91	-0.41
13.wav	-2.64	-1.64	-0.45
14.wav	-2.98	-2.52	-0.52
15.wav	-2.87	-2.63	-0.66
16.wav	-2.62	-1.92	-0.42
17.wav	-1.97	-2.88	-0.78
18.wav	-2.11	-1.41	-0.80
19.wav	-2.02	-1.91	-1.06
20.wav	-2.06	-1.46	-0.72
21.wav	-3.13	-1.86	-0.13
22.wav	-2.28	-1.06	-0.06
23.wav	-2.34	-0.95	-0.09
24.wav	-2.86	-1.2	-0.03
25.wav	-1.64	-0.98	-0.27
26.wav	-2.9	-1.53	-0.18
27.wav	-1.79	-1.59	-0.66
28.wav	-2.25	-1.36	-0.81
29.wav	-1.79	-0.9	-0.12
30.wav	-2.08	-0.99	0.05
31.wav	-3.18	-2.18	-0.61
32.wav	-2.7	-1.62	-0.43
33.wav	-2.08	-1.12	-0.14
34.wav	-2.2	-0.9	-0.09
35.wav	-2.71	-2.44	-0.25
36.wav	-2.79	-1.48	-0.44

37.wav	-2.3	-1.17	-0.35
38.wav	-1.45	-0.7	-0.57
39.wav	-2.04	-0.95	-0.10
40.wav	-2.54	-2.36	-0.77
41.wav	-1.61	-1.05	-0.20
42.wav	-3.23	-2.86	-0.69
43.wav	-3.19	-2.05	-0.73
44.wav	-3.1	-1.74	-0.78
45.wav	-2.84	-1.6	-0.26
46.wav	-3.11	-1.75	-0.70
47.wav	-2.63	-1.6	-0.46
48.wav	-2.95	-1.98	-1.09
49.wav	-1.31	-0.86	0.02
50.wav	-1.1	-0.7	0.10
51.wav	-1.04	-0.74	-0.14
52.wav	-1.13	-0.99	-0.22
53.wav	-1.27	-0.79	-0.00
54.wav	-1.13	-0.75	0.00
55.wav	-3.26	-2.08	-0.74
56.wav	-3	-1.88	-0.74
57.wav	-2.73	-2.2	-0.15
58.wav	-2.1	-1.48	-0.34
59.wav	-2.55	-2.65	-0.93
60.wav	-2.86	-1.21	-0.11
61.wav	-3.08	-2.28	-0.83
62.wav	-2.49	-1.45	-0.41
63.wav	-2.39	-1.61	-0.77
64.wav	-2.68	-1.98	-1.05
65.wav	-3.29	-2.6	-0.78
66.wav	-2.41	-1.44	-0.71
67.wav	-2.72	-1.24	-0.36
68.wav	-1.82	-0.98	-0.37
69.wav	-2.94	-1.66	-0.67
70.wav	-1.18	-0.77	-0.32

Table 3-3 HE-AACv2 Enc Test Results

4. References

[1] *MPEG-4 Part 3 (Formerly ISO/IEC 14496-3)*