

MPEG-4 HE-AAC v1 (HQ) Stereo Decoder for the Blackfin ADSP-BFxx processor family

Overview

MPEG-4 HE-AAC v1 (also known as aacPlus) is the combination of Advanced Audio Coding (AAC) and Sub Band Replication (SBR), standardized as the High-Efficiency profile in MPEG-4 (HE-AAC). SBR is a unique bandwidth extension technique which enables audio codecs to deliver the same quality at significant bit rate reduction. This version of the HE-AAC v1 decoder implements the High Quality (HQ) SBR tool.

Product Highlights

The HE-AAC v1 Decoder has been highly optimised to run on the Analog Devices' Blackfin processor family. It is a self-contained software module that is fully compliant with ISO/IEC 14496-3 MPEG-4 specification and rigorously tested and field-proven in commercial application.

It contains a standard C-callable 'push' API with the added flexibility using 'pull' (or 'poll') by adding a light wrapper. The code has been implemented using Instruction and Data cache, and has no dependencies on processor peripherals or registers, adding greater system flexibility and ease of use.

Specifications

Codec Functions	MPEG4 HE-AAC v1 Decoder
Conformance	ISO/IEC 14496-3 MPEG4-AACPlus V1 Decoder
Code base origin	ADI
Reference Code Revision #	ISO/IEC 14496-5:2001, March 2006
Target Processor	Optimised for the Blackfin Processor Architecture
Release Status	Production
Framework dependencies	None
Release format	Object code module with C source wrapper
Input format	Supports streams with • MPEG-2 AAC-LC profile (ISO/IEC 13818-7) • MPEG-4 AAC-LC audio object (ISO/IEC 14496-3) • MPEG-4 HE-AAC audio object (ISO/IEC 14496-3:2005)
Output format	Supports mono and two channels (Stereo) 16-bit PCM with configurable output buffer location and stride (interleaved LR samples or separate L/R buffers)
Output buffer samples per block	1920 or 2048 samples when the bitstream contains SBR information, otherwise 960 or 1024 samples.
Sample Rate	All sample frequency specified by the standard ISO/IEC 14496-3 (up to 96 kHz)
Bit Rate	All bit rates specified by standard
Multi-channel	Fully re-entrant and multi-instancing capable

Features:	
Transport Stream	Raw audio stream, ADIFF, ADTS
Output Status	Sample rate, average & maximum bit rates, etc
Fast Forward / Rewind	The decoder provides 'hooks' to seek forward or backward to desired position in a CBR or VBR streams. Users can also rewind into a previous track.
Extended Test Vector Testing	Compliant with ISO/IEC test vectors and additional test vectors with unusual content
Error Codes	Reports up to 9 unique error codes. Such as protected files, non-compliant streams etc

Performance is likely to improve with future code revisions.

Applications

- o Automotive - Infotainment
 - Head Units
 - Audio Playback Systems
- o Consumer
 - Portable Audio Players
 - PMP
 - Network boom box / Juke Box
 - DVD / HTiB
- o Digital Audio Streaming
- o Digital Media Broadcast (DMB)
- o Digital Radio Receiver

Memory & Performance

This section presents the MIPS & memory usage of the decoder and some performance figures based on several common memory configurations. Note that the following data is preliminary and is subject to change.

System Configuration

The MIPS performance are based on worst case test vectors & expressed as Average and Peak figures. Integrators will need to budget their MIPS requirements according to system conditions,

- 1) Audio Test Vector: Worst Case audio file from
- 2) Processor used: ADSP-BF533
- 3) Silicon Revision: 0.3
- 4) CCLK = 270 MHz
- 5) SCLK = 54 MHz
- 6) The minimum input buffer required is 1536 bytes per instance.
- 7) The size of the output PCM buffer required is 2048 16-bit words per audio channel per instance. (1 instance of the decoder is used, setup to output 2 channels)

- 8) Note that the input and output buffer sizes are not included in the memory tables listed below.
- 9) Utilize on-chip scratch pad memory for system stack.
- 10) Heap (or Malloc) is not used

Total Memory Usage

Code memory (KB)	Per Instance Data (KB)	Constant Data Tables (KB)
62.9	51	33.3

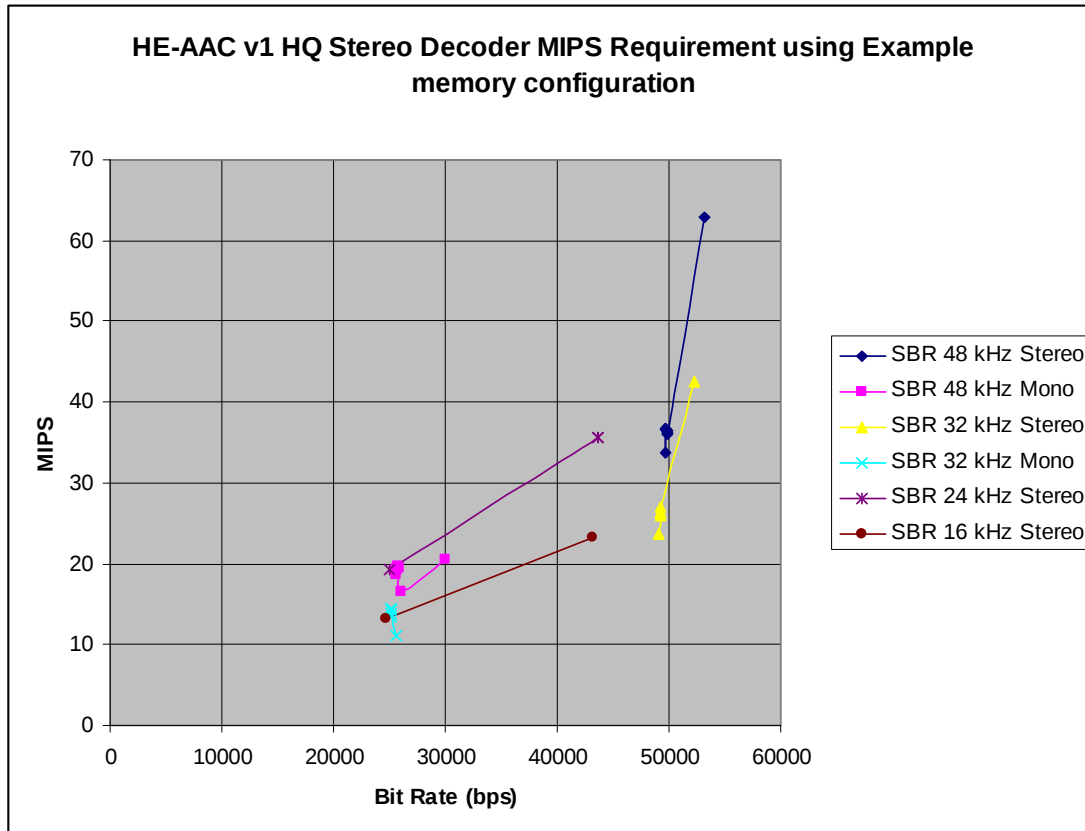
Memory Usage (Combination of On-chip , Off-chip, Cache enabled)

Code memory (KB)		Instance memory (KB)		Scratch memory (KB)		Lookup Tables (KB)	
On chip	Off chip	On chip	Off chip	On chip	Off chip	On chip	Off chip
46.1	16.8	11.7	20.1	19.2	-	0.1	33.2

Note:

- 1) Code has been ‘optimally’ laid out in memory to achieve best MIPS (used as a baseline for MIPS budgeting).
- 2) 16KB Code Memory of Blackfin is dedicated for the Instruction Cache.
- 3) 16KB Data Memory of Bank A and 16KB Data Memory of Bank B of the Blackfin is dedicated for the Data Cache.

<i>F_s</i> (kHz)	<i>BR</i> (kb/s)	<i>Channels</i>	<i>Test Vector</i>	<i>Average</i>	<i>Peak</i>
16kHz	25	2	al_sbr_sr_16_2_fsaac08.mp4	13.19	17.47
16kHz	43	2	al_sbr_sr_16_2_fsaac16.mp4	23.26	25.76
24kHz	25	2	al_sbr_sr_24_2_fsaac12.mp4	19.31	26.05
24kHz	44	2	al_sbr_sig_24_2_fsaac24_sig1.mp4	35.73	42.83
32kHz	25	1	al_sbr_i_32_1.mp4	14.45	18.17
32kHz	49	2	al_sbr_sr_32_2_fsaac16.mp4	27.01	35.99
32kHz	52	2	al_sbr_sr_32_2_fsaac32.mp4	42.57	43.87
48kHz	26	1	al_sbr_gh_48_1.mp4	18.72	25.67
48kHz	50	2	al_sbr_e_48_2.mp4	36.07	42.38
48kHz	53	2	al_sbr_sr_48_2_fsaac48.mp4	62.87	65.16



MIPS Requirement: MIPS required under example configurations

* Preliminary MIPS measurements. Optimisation still in progress.

Deliverables

- o ADSP-BF5xx (Blackfin) library module with a standard C-callable API (application programming interface) consistent with other Blackfin code modules
- o Reference C-source code interface routine which calls the code as a single library module
- o Demonstration software for execution on ADI evaluation boards
- o Documentation, including Application Notes and detailed Developers' Guides, with test reports made available on request

Availability

This module is available in object code format under the appropriate software license agreements. Evaluation and demonstration software is available for execution on the Analog Devices ADSP-BF5xx (Blackfin) processor or ADI evaluation boards.

Other Audio software available from ADI,
 MPEG-4 HE-AAC v1 (LP) Stereo decoder
 Stereo Codecs: MP3®, AAC-LC and WMA
 Multi-channel: AC3, Dolby Digital® Consumer Encoder (DDCE), DTS

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