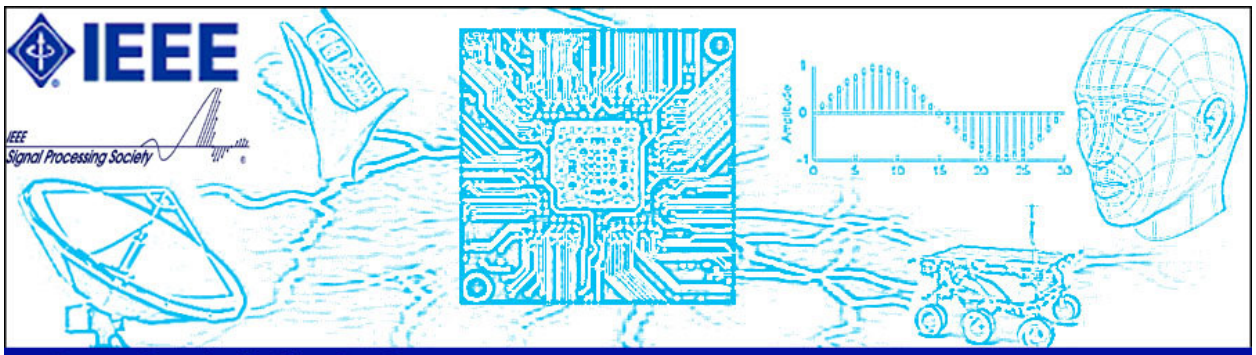

ISSUE #07, Apr 2007

FROM THE EDITORIAL TEAM

2007 may well be remembered as the year 4G wireless technologies came to the fore. This, despite the fact that we do not yet know how to define 4G, nor can we draw a clear line between 3G and 4G. With Qualcomm announcing its EVDO Rev B chipset (which delivers up to 9 Mbps downlink data rates) we have nearly achieved whatever 3G had promised. Long Term Evolution, the 4G standard in the 3GPP stream, is based on OFDMA technology. 3GPP2 have also identified OFDMA as their 4G technology. Although the standardization processes is still under way, companies are vying to beat the competition in building something in this space.

Some people are careful to distinguish between WiMax and OFDMA, but those who already have WiMax or similar technologies are quick to leverage their capabilities. For instance, TI is bundling its WiMax technology with some other hardware and software to offer the industry's first LTE development platform. A number of challenges remain, especially in the realm of MIMO antenna technology, power-optimized OFDMA solutions, mobility-

related issues etc. Remember the time when DSPs stepped in to do what hardware used to do, but better and cheaper? The tables seem to be turning (albeit slowly)! FPGAs are becoming smarter, less power-hungry and faster. They are giving DSPs a run for their money in some core territories. We have to wait and watch how this pans out.

Voice-enabled technologies are suddenly showing up on the radar screen this year. Not only do we see some new products based on voice recognition, but google seems to have put its best minds to work on a voice-based search engine. We may soon be able tell our computer what we want from the internet. And going by google's track record, it may actually work!

The Editorial team

ANNOUNCEMENTS

- The recently introduced Resource Corner provides links to interesting articles that have appeared elsewhere but are worth reading. It will also include some online resources that can be every DSP engineer's friend. Do send in your feedback, suggestions and contributions to ieeesp-blr-news@ieee.org.

- To keep our newsletter vibrant, we do need articles from readers like you. Please send in a brief abstract of your article to ieeesp-blr-news@ieee.org. If you have written an article in the past which you are willing to share with this community, that is most welcome too.

MAIN COURSE

High Definition Audio formats

Radha Meka (radha.meka@wipro.com)

1. Background

Audio plays a major role in multimedia presentations, videogames, cinema, graphic applications and many other multimedia applications. The quality of the sound makes huge difference with respect to the quality of the whole application. Having vast market potential, there has been huge progress in terms of audio formats. Even after DVD systems, there has been no end in the growth as the audience still seeks better and better formats and the technical experts are producing them too.

Although most of the home theater formats such as 5.1 and 7.1 formats reproduce very good sound quality, we look forward to High Definition Audio formats.
High Definition Audio makes sense only for home theater design settings, including proper room layout, seating arrangements, speaker placement etc. Essentially (home) theater is not just meant to watch the videos; its objective is getting immersed in the presentation with its incredible surround sound quality in sync with the visual clips.

2. Introduction

Let us discuss about High Definition Audio formats. Why did the thought of high definition audio formats emerge? Most important reason is DVD formats don't exactly reproduce studio quality sound. Many audiophiles say that even if audio formats like DTS, MLP have the capacity to encode with higher bit streams, because of the space constraints on the DVD-discs, they are incapable of reproducing the best effect, as the data has been encoded with lower bit stream compared to its full capacity. In short HD audio formats are simply extended form of the current bit streams to the higher rates with improved algorithmic changes. As a result High Definition multimedia applications need huge storage space. HD-DVD discs and Blu-ray discs have came up to compliment the storage requirement.

3. HD – audio formats

This section describes existing HD audio formats, focusing on the capabilities and quality provided by each format.

3.1 High Definition Audio

Intel created High Definition audio format for their chipsets, its modified version of Audio Codec '97. It supports date rates up to 24Mbps. As it is specific to the Intel chip sets, not much flexibility in terms of consumer perspective is achieved. It concentrated on PC-based entertainment producing high quality sound.

Channels supported : Up to 7.1.
Sampling rates : Up to 192 KHz
Word Length : 32bits

3.2 DTS-HD formats

All DTS-HD formats are built on DTS digital surround, also known as DTS-core. DTS core encodes data at 1509Kbps whereas on DVD discs it's been restricted to half of its full capacity because of space constraint. All the DTS-HD formats use additional algorithms on the DTS core, which are capable of reproducing the high quality sound.

Data stream of all DTS-HD formats is resultant of DTS core and extension data. It is backward compatible which can play on the existing DTS decoders. As all the existing DTS decoders use DTS core, it discards the extension data and decodes the rest of the information.

3.2.1 DTS-HD Master Audio

DTS- HD master audio uses bit for bit "Variable Bit Rate" (VBR) algorithm for computing the data rate. This means it allocates higher data rates for complex data and lower data rates for less complex data. This has been embedded in the DTS core, which alone supports up to 1509Kpbs constant bit rate. It can reproduce studio quality sound with maximum supported bit rate of up to 24.5Mbps.

Channels supported : Up to 7.1 on Blu-ray discs and HD DVD discs.
Sampling rates : 48, 96, 192 KHz

It can also be down mixed to 5.1 from 7.1 formats.

3.2.2 DTS-HD High Resolution Audio

DTS-HD High Resolution Audio uses Constant bit rate (CBR) algorithm. With CBR the data rate is constant for every data block irrespective of its complexity. Hence there might be chances of more compression on highly complex data blocks. But this is well taken care of by extended, High Resolution algorithm on DTS core, producing huge bit rate of up to 5760Kbps from 2046Kbps, which minimizes the compression on highly complex data blocks. Hence results in high quality sound.

Channels supported : Up to 7.1 on Blu-ray discs and HD DVD discs.
Sampling rates : 48, 96 KHz

3.2.3 DTS Digital Surround

DTS Digital Surround is a version of original DTS which is compatible with HD-DVD and Blu-ray discs. It works on Constant Bit Rate method, produces data rate up to 1509Kbps.
It is used as DTS core in DTS-HD Master Audio and DTS-HD High Resolution Audio.

Channels supported : Up to 6.1
Sampling rates : 48, 96 KHz

It can be selected from Mono to 6.1

3.3 Dolby- formats

3.3.1 Dolby –TrueHD

Dolby-TrueHD uses the lossless packing principle. It is modified version of Meridian Lossless packing (MLP) algorithm. More information on MLP can be found in [4]. It supports Dynamic Range Control (DRC) and dialog normalization. This algorithm works on VBR with huge date rate of 18 Mbps. Hence it has the capacity to reproduce every bit that has been encoded resulting in studio quality sound.

Channels supported : Up to 7.1
Sampling rates : 48, 96 KHz

3.3.2 Dolby Digital Plus

Dolby Digital Plus is extended version of Dolby Digital (AC-3). The extended data provides huge data rate of up to 6Mbps also the algorithm has been modified for transient pre-noise processing, enhanced channel coupling and improved bit allocation and quantization algorithm.

Dolby Digital Plus is backward compatible with AC-3. AC-3 supports up to 640 Kbps. It is a mandatory audio codec on HD-DVD discs

Channels supported : Up to13.1
Sampling Rate : 32, 44.1, 48, 96 KHz
Data Rate : 3Mbps on HD-DVD discs and 1.7Mbps on Blu-ray discs

3.4 Synopsis

Table 1 compares the features of the HD Audio formats discussed.

Table 1Comparison of HD Audio formats

HD Audio Format	Channels	Sampling rates	Data rates
High Definition Audio	Up to 7.1	Up to 192 KHz	Up to 24 Mbps
DTS-HD Master Audio	Up to 7.1	48/96/192 KHz	Up to 24.5Mbps
DTS-HD High Resolution Audio	Up to 7.1	48/96 KHz	2.046 to 5.760 Mbps
DTS Digital Surround	Up to 6.1	48/96 KHz	Up to 1.509 Mbps
Dolby –TrueHD	Up to 7.1	48/96 KHz	18.0 Mbps
Dolby Digital Plus	Up to 13.1	32/44.1/48/96 KHz	3.0 Mbps (HD-DVD) 1.7 Mbps (Blu-ray)

4. Audio Quality - Brand perspective

Since many years there have been DTS and Dolby controversies over sound reproduction quality. As there are few methods to measure sound reproduction quality, it has become vastly subjective. DTS claim for its high data rate for better quality. Dolby claim for its smart algorithm, describing low data loss. The debate continues on HD audio formats also between the same brands, DTS-HD Master Audio and Dolby-TrueHD both being lossless formats.

On a related note, the raging debate on the relative merits and demerits of HD-DVD- discs and Blu-ray continues.

5. High Definition Multimedia Interface (HDMI)

SPDIF (Sony-Philips Digital Interface Formats) is not capable of streaming High Definition multimedia formats. To drive the uncompressed high definition audio and video we need HDMI.HDMI is compatible with High-bandwidth Digital Content Protection. It carries HD audio and video on a single cable. It supports all video and audio formats.

Channels Supported : Up to 7.1
Sampling Rate : Up to 192 KHz
Word length : 24 bits
Versions available : HDMI 1.0, 1.1, 1.2. 1.3 and 1.3a

HDMI 1.3 and after versions supports Dolby TrueHD and DTS-HD Master audio formats

References:

1. www.dolby.com
2. www.dtsonline.com
3. www.hdmi.org
4. http://www.meridian-audio.com/w_paper/mlp_jap_new.PDF

About the Author

Radha graduated from JNT Univertisty, Hyderabad with Electronic and Communications majors. She has been working for the past six years for DSP & Multimedia division of Wipro Technologies, Bangalore. She has been working on a variety of multimedia applications including GSM and CDMA Speech codecs, Audio decoding and post processing, Video codec and post processing algorithms.

UPCOMING EVENTS

UPCOMING EVENTS IN BANGALORE

A hands-on summer school and workshop in Automatic Speech Recognition is being planned. It will be a 10-day school with computer lab taught by well-known experts of ASR, Dr. Biksha Raj of MERL/CMU and a team from CMU [Carnegie-Mellon Univ] during July 16-28th.

A one-day mini- symposium on ASR is planned for July 29th. This event will include industry-academia-vendor participation to discuss "the relevance, need, status of ASR applications, products and deployment in Indian market, research and development issues, user expectation and state of the art, etc". Venue most likely will be at the IISc campus. Limited registration, so please contact amitavd@microsoft.com. Kindly include details on how many people from your organization will attend the summer school and/or the mini-symposium.

For other IEEE SP Worldwide events including ICASSP, please see the IEEE SP Conferences web page.

RESOURCE CORNER

- This article on H.264 video compression for consumer electronics takes a comprehensive look at the technological aspects of the algorithm. Of special interest are comparisons with MPEG-2.

  http://www.embedded.com/showArticle.jhtml?articleID=196802837

- Matlab is an essential tool for signal processing. But the code is not usable in products as-is. It needs to be rewritten for C or another language. This process is tedious and error-prone. The article cited below describes a new tool that allows you to automatically convert matalb into C. This could be an invaluable resource for DSP engineers!

  http://www.dspdesignline.com/showArticle.jhtml?articleID=196900003

- Continuing on the matlab thread, how many times have you written ugly-looking code to simulate the operations performed by a fixed-point machine? Now, you can design and implement fixed-point algorithms and analyze fixed-point data using the Fixed Point Toolbox 2 from mathworks.

  http://www.mathworks.com/academia/student_version/r2007a_products/fixed.pdf

- Here is a very informative article on how to implement optimal FIR filters on DSPs

  http://www.dspdesignline.com/showArticle.jhtml?articleID=199200436

- While designing or implementing a piece of DSP code, we often need to know how the algorithm is expected to perform on the selected target platform. This information is not always readily available. BDTI's benchmark scores can help estimate the resource requirements of your software. View them at

  http://www.bdti.com/bdtimark/benchmarks.htm

- Finally, here is a one-stop shop for FFT. Anything you need starting from theory to downloadable implementations is available on this very useful website.

  http://www.fftw.org/links.html

  Note that if you want to directly use code from this or any other site, you need to exercise the usual copyright cautions!

GETTING CONNECTED

Mailing list for IEEE SP Bangalore chapter

To facilitate better information spread across the wide spectrum of members and volunteers of the SP Bangalore chapter, a LISTSERV list is available.

- To email all of the list's subscribers (please use this responsibly), send your mail to IEEESP-BLR@LISTSERV.IEEE.ORG

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Links

This link contains information related to IEEE SP conferences
http://www.ieee.org/organizations/society/sp/SPSConf.html

IEEE SP Bangalore Chapter Homepage
http://ewh.ieee.org/r10/bangalore/sps/

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