

# High Definition Audio Developments at the AES

reporting from the 128<sup>th</sup> AES Convention London ( <http://www.aes.org/events/128/> )

The 128<sup>th</sup> AES Convention held in London, May 22-25, 2010 brought to light some promising developments in HD audio notwithstanding the official peer reviewed AES position based on the journal published and hence peer reviewed Meyer and Moran listening tests (Double-blind test of SACD and DVD-A vs. Redbook 16/44 in JAES, Brad Meyer and David R. Moran. JAES 55(9) September 2007) which show that under the conditions so defined a 16bit 44.1 kHz encode decode channel is transparent, i.e. entirely sufficient for audio reproduction.

Audiophiles and many recording engineers who routinely use higher definition audio systems find this ABX driven learned paper result baffling since awareness of the potential for better recording quality is based on regular and practical commercial use where the increased cost could not be justified if there was no benefit.

1. Obtainable from the Convention web site is the makeup of the AES Technical Committee for High Resolution Audio, a range of august and experience audio people including quality oriented characters such as Bob Stuart and Malcolm Hawksford not neglecting the following AES members, David Chesky, David Guade, David Walstra, Mike Story, Wieslaw Woszczyk James Johnston, Kevin Halverson Christoph Musialik, Siegfried Linkwitz, Steven Harris, Juergen Herre, Vicki R. Melchior, Stefan Geyersberger, Derk Reefman, and Josh Reiss.

Some information concerning this committee is reproduced below whose tasked topics generate sweet music in my ears, and I am sure that of many audiophiles, discerning designers and critical recording engineers.

## *AES Technical Committee*

## *High Resolution Audio*



*Vice Chair: Vicki R. Melchior*

*Vice Chair: Josh Reiss*

*Mission statement: AES high-resolution audio technical committee*

*The core mission of the committee is the quest for a comprehensive understanding of high-resolution, multi-channel audio technology in all its aspects.*

*The committee seeks to influence the advance of enabling technologies and audio engineering evolution by promoting the highest standards of technical performance and sound reproduction commensurate with application and channel capacity.*

*High-resolution audio embraces a wide parameter set that impinges on the primary elements of bandwidth, dynamic range and spatial acuity. New technologies are enabling system resolution to be extended to the extremes of engineering capabilities and ever-greater performance is expected. It is critical that the absolute performance boundaries be studied to enable a holistic understanding of both technology and supporting perceptual auditory theories.*

*The committee will embrace a wide range of activities that are seminal to its prime purpose. It aims to influence audio applications where a high standard of audio performance is expected and to promote best practice commensurate with the limitations of a given medium.*

### **Areas of Concentration**

- *Theoretical issues*
- *Bandwidth, sampling rate, dynamic resolution and spatial representation.*
- *High-resolution signal processing, 1 to n bit paradigms.*
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- *High-resolution system technology*
- *Spatial audio, virtual and acoustic spaces, virtual image manipulation.*
- *ADC and DAC system design and performance.*
- *Analogue and digital systems and circuitry.*
- *Network delivery of high-resolution audio.*
- *DVD: present and future audio coding formats.*
- *DVD: present and future physical structures.*
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- *Perception*
- *Perceptual modelling.*
- *Perceptual coding.*
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- *Objective evaluation and subjective performance of high-resolution audio*
- *Objective measurement techniques and resolution issues.*
- *Subjective procedures and evaluation psychology.*
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- *Education and networking*
- *To inform and educate the membership about the important issues of high-resolution audio technology and applications.*
- *To network with other Technical Committees in order to involve them in the study of high-resolution audio.*

2. The second high res aspect concerned a technical workshop at this convention entitled

#### ***W4 - Blu-ray as a High Resolution Audio Format for Stereo and Surround***

*Abstract: The decision for the Blu-ray disc as the only HD packaged media format also offering up to 8 channels of uncompressed high resolution audio has at least eliminated one of the obstacles of getting high-res surround sound music to the market. The concept of utilizing Blu-ray as a pure audio format will be explained, and Blu-ray will be positioned as successor to both SACD and DVD-A. The operational functionality and a double concept of making it usable both with and without screen will be demonstrated by showing a few products that are already on the market.*

In the chair was *Stefan Bock*, msm-studios GmbH - Munich, Germany with panelists *Simon Heyworth*, SAM – UK, *Morten Lindberg*, 2L - Norway *Johannes Müller*, msm-studios – Germany *Crispin Murray*, Metropolis - UK *Ronald Prent*, Galaxy Studios – Belgium. Several participants gave prepared presentations and were live demonstrations of the new Blu-ray audio format working, both here and at two other locations at the AES venue, from PMC and DTS. Many thanks to all concerned who worked so hard to get it all together.

This well prepared workshop delivered two key points. Firstly I saw and heard a standard Blu-ray player behave like any old cd player with a remote control; pop in the ‘HD’ audio disc wait a second two, press play, and away you go, no TV or monitor required. There was direct access to music tracks, back and forward, attained in sub second timings. Since stereo HD and the surround HD 5.1 or 7.1 can be run in parallel the format designers have allowed for secondary buttons on the remote to do things such as switch replay on the fly, from stereo to surround, with no resetting or access to a start-up menu required. Demos in the lecture hall were on a flagship active high power pro monitoring system by PMC for stereo and 5.1 and were of high quality.

3. The workshop chairman Stefan Bock was able to announce that the High Resolution Committee had just approved this Blu-ray Audio Disc Standard, to be published in full shortly, entitled ‘X-188’, at last paving the way for adoption and dissemination by recording engineers and hardware producers. The original proposal on which this standard is based dates from 2002 is reproduced below:

#### ***High-resolution audio content for Blue-ray DVD (BD) 05.06.02***

*It is evident that the current proposal for content on Blue-ray Disk (BD) technology has made little no provision for high-resolution audio. Studying the specification shows that only low resolution audio is to be used as a companion to video supported in both standard and high-resolution formats. On current DVD format (4.7 Gb) two audio formats are available, namely SACD and DVD-A. It is therefore unfortunate that BD has been configured to be substantially inferior in terms of its audio capabilities even though it offers much higher capacity and data transfer rates that are ideally suitable for multi-channel, high-resolution audio.*

*Following a meeting of the High-Resolution Audio Technical Committee of the AES at the Munich Convention in May 2002, it was proposed that consideration be given to providing flexible options for high-resolution multi-channel audio content in one or more of the private*

sectors of BD. The committee suggests that urgent consideration be given to accommodating the two existing high-resolution audio formats:

- SACD using multi-channel DSD/DST coding.
- DVD-A with multi-channel and MLP compression.

BD should be configurable so that there are options for both video and high-resolution audio content including options for either null video or null audio content. It is also mandatory that synchronisation between the private sector for high-resolution audio content and either standard or high-definition video streams be attainable to allow high-quality video content to be accompanied by high-resolution audio content. The committee recognises the important application area for concerts and music performance that require the highest possible quality of reproduction, they were also extremely concerned that no consideration had been given to high-resolution, multi-channel audio content.

Although the minimum audio requirement is for SACD and DVD-A to be located in a private sector, it should be observed that there is growing interest and research in more sophisticated multi-channel audio options where, for example, height information has received attention. Therefore, recognising the greater data capacity of BD, it is recommended that provision be made to extend the high-resolution audio content to include supplementary auxiliary information channels that can be assigned dynamically with the assistance of metadata embedded on the disc. In such a scheme and in order to achieve system compatibility, 5 channels would be assigned to loudspeaker feeds following current practice, allowing the supplementary channels to be used creatively to augment performance. Such a scheme could accommodate effectively new coding schemes derived from future research as well as facilitating creative opportunities in the domain of audio-video production.

BD can offer profound benefits to the evolution of high-resolution multi-channel audio, therefore it is crucial that the format recognises the exciting opportunities for enhanced audio both for audio-only applications and as a companion to video.

*This proposal has the full endorsement of the AES*

*.(Professor Malcolm Hawksford, Chairman of the AES Technical Committee for High-Resolution Audio)*

The enabling means for mastering HD audio discs for replay on any Blu-ray player is simply the addition of some Java code written to the disc which tells the player what is going on, and presets it to operate with the usual, simple track select and play-pause commands, without a visible menu loading process and the consequent need for a display. ( mShuttle software)

Audio material may be chosen by the record company to be available on the SPDIF output at up to 24/96k, while the top quality stuff and multichannel may be output in analogue format, or as digital feed via HDMI to a suitable decoder, or as found in many surround sound installations, to a complete HDMI equipped receiver.

Lexicon make an HDMI input quality DAC and surround processor but we should now see the evolution of many more stand alone Hi Fi DACs , and in addition modified audiophile Blu-ray players and the like with HDMI audio input and higher quality audio

outputs. DTS provided an HD sampler Blu-ray disc at the convention with music and movie material on it, of course requiring DTS playback capability.

This really is the beginning of the stand alone Hi Res audio disc, up to 24/192 stereo and surround, up to 7.1 channels, with or without video content. The producer can add other lower res content, even MP3 which may be readily ported out of the Blu-ray player via its network socket and uploaded to music and video servers in the home, and on to portable players if required.

#### 4. The next Hi Res event was a second workshop:

AES London 2010 Sunday, May 23, 14:00 — 15:45 (Room C2) 6 –

#### **How Do We Evaluate High Resolution Formats for Digital Audio?**

Chair: *Hans van Maanen*, Temporal Coherence - The Netherlands

Panelists: *Peter Craven*, *Milind Kunchur*, University of South Carolina - SC, USA

*Thomas Sporer*, Fraunhofer Institute for Digital Media Technology IDMT - Ilmenau, Germany,

*Menno van der Veen*, Ir. Bureau Vanderveen, *Wieslaw Woszczyk*, McGill University - Montreal, Quebec, Canada

*Abstract: Since the introduction of the High Resolution Formats for Digital Audio (e.g. SACD, 192 kHz / 24 bit), there has been discussion about the audibility of these formats, compared to the CD format (44.1 kHz / 16 bit). What difference does high sample rate and bit depth make in our perception? Can we hear tones above 20 kHz? Can we perceive quantization errors in 16-bit audio? Does high sample rate make a difference in our phase resolution? Are we even asking the right questions? Controlled, scientific listening tests have mostly given ambiguous or inconclusive results, yet a large number of consumers, using "high-end" audio equipment, prefer the sound from the "high resolution" formats over the CD. The workshop will start with introductory notes from the panel members, discussing the differences between "analog" and first-generation digital formats, address some of the paradoxes of the CD format, present results on "circumstantial" evidence and subjective testing, show results on the audibility of the human hearing, which cannot be explained by the commonly accepted 20 kHz upper limit and discuss the problems and pitfalls of "scientific" listening tests, where possible illustrated with demonstrations.*

*These introductory notes should provoke a discussion with the audience about the audibility of the improvements of the "high resolution" formats. We attempt to reach consensus, where possible, regarding what is known and what is not with respect to our ability to perceive the differences between standard and high resolution audio. We further discuss the paradigms of testing for evaluating the quality and perception of high resolution audio, how to structure the tests, how to configure the testing environment, and how to analyze the results.*

*The outcome of the workshop should also be to find the way forward by identifying the bottlenecks which—at this moment—hamper the further implementation of the "high resolution" formats for "high-end" audio as these formats create an opportunity for the audio industry as a whole: better sources stimulate the development of better reproduction systems.*

These thought provoking presentations gave some teaching for psychoacoustic test methods and some fascinating recent results on perception thresholds. Peter Craven gave an insight into subjective testing and how the forced decision ABX test may in fact fail to find out what the ear /brain perception is doing, where the test blocks the natural perceived response to audio quality variation unless the differences are relatively gross. Milind Kunchur outlined the extreme care necessary to establish sensitive tests to establish a 5uS or so temporal detection threshold, backed by a theoretical analysis of this aspect of hearing.

5.Finally in the paper sessions, ‘AES London 2010 P18 - Audio Coding and Compression’ there was a presentation on the audibility of differences between 88.2 and 44.1kHz recordings with statistical verification of the preference for the higher resolution, whether a recorded original or when compared with a carefully down sampled version of the Hi Res material. The abstract and reference is given below:

***P18-6 Sampling Rate Discrimination: 44.1 kHz vs. 88.2 kHz***—Amandine Pras, Catherine Guastavino, *McGill University - Montreal, Quebec, Canada*

*It is currently common practice for sound engineers to record digital music using high-resolution formats, and then down sample the files to 44.1 kHz for commercial release. This study aims at investigating whether listeners can perceive differences between musical files recorded at 44.1 kHz and 88.2 kHz with the same analog chain and type of AD-converter. Sixteen expert listeners were asked to compare 3 versions (44.1 kHz, 88.2 kHz, and the 88.2 kHz version down-sampled to 44.1 kHz) of 5 musical excerpts in a blind ABX task. Overall, participants were able to discriminate between files recorded at 88.2 kHz and their 44.1 kHz down-sampled version. Furthermore, for the orchestral excerpt, they were able to discriminate between files recorded at 88.2 kHz and files recorded at 44.1 kHz.*

Convention Paper 8101

### **Comment:**

Taken as a whole these reported developments suggest that Hi Res audio is beginning to take off, its credibility is clearly improving, and we have the means to deliver it to audiophiles via a low cost and now widely available carrier. About 20 titles have been announced so far with intent for 20 more from Naxos and Sony. Web delivery of Hi-Res surround sound is clearly impractical, the audio Blu-ray disc has the potential to deliver value to all concerned with genuinely higher quality sound, stereo and surround.

Notes:

[www.msm-studios.com](http://www.msm-studios.com)

mShuttle (the software to make audio Blu-ray discs )

C Martin Colloms 28/05/2010 HIFICRITIC