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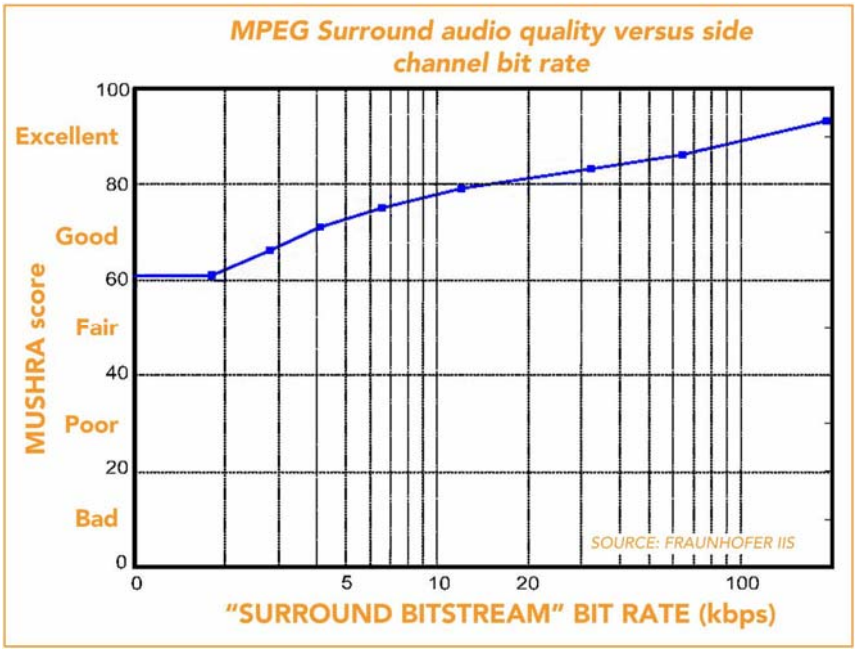
MPEG Surround Technology for Headphones

Surround sound audio is a very popular format since the advent of the home theater, and the variety of platforms which support surround is ever increasing. Video sources, such as ATSC digital TV, DVDs, and Blu-ray discs, are perhaps the most prevalent sources of surround material, but audio sources such as DVD-Audio and SACD support surround, as do digital radio technologies such as the in-band/on-channel (IBOC) HD Radio system developed by iBiquity Digital corporation. In addition, the popular MP3 music format can also be enhanced to support surround sound signals.

One of the most efficient methods of surround sound transmission and/or storage is known as MPEG Surround (www.mpegsurround.com). MPEG Surround captures the spatial image of a multi-channel audio signal into a compact set of parameters which are transported in a digital "side channel" along with a normal, one- or two-channel perceptually-coded digital audio signal. This side channel information is used (in the decoder) along with the digital audio signal to synthesize a high quality multi-channel representation. MPEG Surround is perceptual codec agnostic, that is, it is compatible with "virtually any" coding scheme including MPEG2, MPEG AAC, and HDC (the perceptual codec for the iBiquity HD Radio system). Typically the side channel information rate is very small compared to the bit rate required by the perceptual encoder (on the order of 10 %). See the October 15, 2007 issue of *Radio TechCheck* for additional information on MPEG Surround.

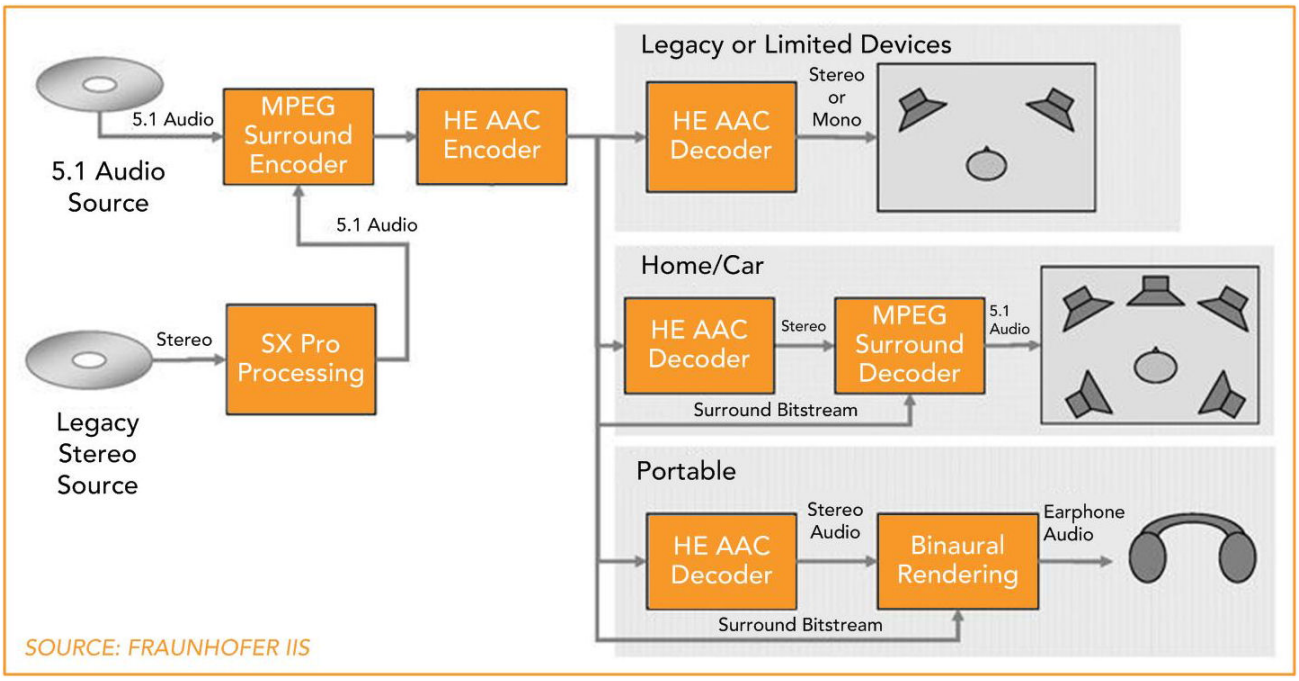
The graph at right illustrates how the audio quality of the surround sound signal varies with the bit rate of the surround side channel information (also called the "surround bitstream"). For the data shown here, a relatively high perceptual coding rate of 160 kbps (using MPEG AAC) was used for all cases, and consequently the differences in audio quality observed are reliably attributed to the different side channel bit rates. "MUSHRA" stands for "MUltiple Stimuli with Hidden Reference and Anchor," a widely used methodology for subjective evaluation of audio signals defined in ITU-R recommendation BS.1534. It is interesting to note how good the audio quality was judged to be with relatively low rate, 5 to 10 kbps side channels.



A technique included as part of the MPEG Surround standard called "binaural rendering" (also called "MPEG Surround binaural") is currently generating significant interest in the broadcasting and consumer electronics industries. It offers simulation of a surround listening environment over standard stereo headphones or earbuds on mobile devices or for rear seat passengers in a vehicle. Binaural rendering relies on the fact that there are time, level, and spectral differences between sounds arriving at the left and right ears. Audio engineers can characterize these differences with what is called a "head-related transfer function" (HRTF). To

generate a binaurally rendered signal, each channel in the surround sound representation of an audio signal is processed by HRTFs and then summed to form left and right headphone channels.

The block diagram below illustrates the flexibility of MPEG Surround signals. First, a 5.1 channel audio source or a legacy stereo source which has been upconverted to 5.1 is sent through an MPEG Surround encoder. (In the block diagram, a technology developed by Fraunhofer IIS called “SX Pro” is shown for the upconversion of stereo – for additional information on SX Pro go to www.iis.fraunhofer.de/Images/SXProFlyer-web_tcm97-73219.pdf.) The one- or two-channel audio signal is then perceptually coded (in the diagram, an MPEG High-Efficiency Advanced Audio Coder is shown) and the perceptually coded signal and companion side-channel data (the “surround bitstream”) are then available for storage or transmission.



For playback, the capability of the playback device (or receiver) will determine the type of audio signal heard. A device capable of decoding the perceptual audio, but not the surround bitstream, will generate mono or stereo audio (depending upon what was encoded) as shown in the “Legacy or Limited Devices” block in the diagram. For an MPEG Surround-capable device with loudspeakers, as shown in the “Home/Car” block, 5.1 channel surround audio is produced. Finally, for a device capable of binaural rendering (the “Portable” block), audio with MPEG Surround binaural is generated for use with earphones.

A similar set of surround sound tools is available for systems unable to accommodate a surround side data channel. MP3 Surround enables high-quality surround sound at bit rates comparable to those currently used to encode stereo MP3 material. It is backwards compatible to stereo MP3; a legacy MP3 device plays back MP3 Surround as high quality stereo. MP3 SX is an upconverting technology which enhances stereo MP3 files from stereo to surround without changing the original stereo quality. MP3 3D is similar to MPEG Surround binaural and can simulate a surround sound experience using earphones; additional information on these MP3 technologies is available at www.all4mp3.com/info/mp3d.html.

Don’t miss this opportunity for broadcast engineers to learn the basics needed to utilize modeling software such as MININEC and nodal analysis for designing performance-optimized AM directional antenna phasing and coupling systems and proving the performance of directional antenna patterns.

You will learn about:

- Moment Method Modeling Basics
- DA Proofing Using Moment Method Modeling
- Overcoming Limitations of Using Field Strength Measurements for DA Proofs
- State of the Art in Phasing System Design Nodal Analysis of AM DA Phasing and Coupling Systems
- Pattern Design Considerations for Optimum Performance

AM antenna experts Ron Rackley and Ben Dawson, along with antenna modeling software specialist Jerry Westberg, will lead the seminar demonstrating how moment method modeling makes analysis of actual tower current distributions possible and how a model can be used to proof an array provided the proper criteria are considered. All instructors are well known in the radio industry as experts in the field of directional antenna design and maintenance. Their decades of experience offer station engineers an opportunity to learn techniques, tips and tricks that can be immediately useful.

Seminar fee: $395.00 (NAB members) and $495.00 (non-members). For more information on the curriculum, how to register or housing go to AM DA Seminar on the NAB Web site or call Sharon Devine at (202)-429-5338. Register now for the NAB AM Antenna Computer Modeling Seminar!