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Industry Overview

Spectral SDR-2000 Professional Processor and DVD Audio

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The Spectral team is actively developing precision high resolution digital technology. This endeavor also extends to Reference Recordings and Pacific Microsonics where much work with live musicians and advanced conversion systems has provided an exemplary knowledge and archival base. From this background and experience of high resolution development we can present a few important aspects of DVD Audio.

Upcoming DVD Audio Software Standards

Soon the format struggle for DVD Audio should resolve, possibly before the end of the year. As anticipated, this new software vehicle will provide multiple channels of high resolution playback. Compression coding is not used and the record label may choose the number of channels and intended playback format for their release. We think most recordings would provide three high information rate channels in front and two reduced sampling rate channels for surround. Other signals for bass augmentation and special use would be available when needed. Data for front channel analog conversion is expected to be 20 to 24 bits

with sampling rates at either 88.2 kHz or 96 kHz. To fit most programs to the DVD media, the surround information is more likely sampled at half these frequencies. Start up coding or preambles could preset the player for the correct sampling and bit depth. These codes also provide configuration commands to automatically optimize the sound system for playback levels and signal distribution. Based on experience, fully coded DVD releases should become available next year.

Accessing the New Software

The Spectral SDR-2000 professional processor is already ideally suited to support upcoming DVD Audio standards. The primary DAC core and DSP interface of today's SDR-2000 will operate from any of the above sampling rates and bit depths without truncating or dropping information. Hence the most difficult part of creating state-of-the-art performance is accessible to this new format using SDR-2000 technology.

Unfortunately, the industry has not worked out a simple practical way to access and connect multiple channels of high resolution digital audio data from DVD transports. For now, studio and post production facilities often use one AES/EBU cable for each 88.2 or 96 kHz channel. Sometimes a more jitter prone double speed system is used to get two channels on a wire. Clearly a multi-cable approach is impractical for consumer commodity transports needed to support DVD audio systems in the lower cost modular theatre market. Because of this situation, the first players might be self contained multi-function video audio players having six audio outputs. These could be upgraded, but the noisy environment inside similar systems precludes state-of-the-art conversion and performance. We prefer a dedicated and standardized interface to make more sophisticated systems.

We must be patient as standards and commodity politics are fierce in today's economy and only a mutual agreement will determine the interface situation. For example, Philips and Sony are still pushing their DSD/double disk encoding, a system which is totally incompatible with any high resolution high quality audio format in use now. Outcomes from these events become very big business and at the right time someone will develop the data and interface chip sets needed to communicate DVD audio software to DSP filters and DACs. For now we have orphan systems. Some operate from the video bandwidth interface of the DVD player to provide 2 channels. Others based on the Nagra recorder will also pass 2 channels of almost nonexistent software. These are not viable systems for the DVD audio format.

Spectral's State of the Art Modular Blocks

Spectral components are built from precision functional modules. As such, any module can be changed or its role in a system can be expanded when needed to fulfill a significant industry requirement. In this tradition, the SDR-2000 has self contained interface, DSP and conversion boards which operate independently of one another. Each performs a state-of-the-art stand alone function, giving the Spectral engineering team great flexibility to create product variations within the same model package. This classic design philosophy is more costly to implement; however, even the first equipment built by Spectral can have modular upgrades.

The Spectral SDR-2000 has its primary ultra precision core built on one assembly which combines DAC, clock and DSP interface. These parts operate in the oversampled mode to create a 22 bit conversion having a precision of almost one part in a million or 120 dB. When dithered from process DSP, the overall resolution becomes 145 dB, an amount needed to fully utilize a 24 bit data stream. Spectral's discrete circuit technology is essential for this performance. At this time, the best off the shelf DACs operating at 96 kHz 24 bit have about 3 to 5 times less accuracy!

To make or upgrade the SDR-2000 for 96 kHz 24 bit inputs, Spectral intends to replace the interface /

HDCD board. A new assembly would be installed having the appropriate high speed DVD audio interface and a much more powerful DSP system. Both the HDCD decode and DVD audio process functions become programmed operations, accessible from the DSP circuit. The DSP programming will be updatable to accommodate future software requirements. The Spectralink and Star Clock sections remain fully functional and operate as they were originally designed.

Ease of Listening and Involvement

The experience we have had with many recordings made at 88.2 kHz has shown one can expect a remarkably smooth and effortless presentation. Resolution and perception of subtle nuance is more acute, particularly in complex material. Probably the most important attribute is a very subtle enhancement of the trance state or subliminal involvement we experience with live music. Analog tapes and LPs only hint at this effect. The consciousness state, as in being there, is an effect that builds up over time. Yet it seems quickly damaged or destroyed by artifacts from truncated digital processing and inaccurate conversion. These observations have been made by many people in the industry. The effects producing persuasive audio performance are subtle, and emphasize the great care needed to fully realize the most rewarding sonic improvement potential of DVD audio.

Higher sampling rates are primarily accountable. They allow much less energy storage and settling residue from the decimation filtering needed to prevent unpleasant alias distortion. The resulting sonic smoothness and subliminal involvement experiences become the primary advantages over carefully crafted HDCD reproduction. DVD improvements will be subtle because Red Book limitations posed on CDs have already been addressed by the filter swapping and bit extension techniques of the HDCD processes. These techniques work, as even commodity players can reproduce timbre accuracy, staging and inner resolution. Clearly, conventionally encoded recordings from good analog sources will probably benefit more with faster sampling and more bits. But there are limits! Unless DVD audio conversion is done well,

carefully crafted HDCD reproduction will **still** have better sonics. Our engineering intent at Spectral is to combine new DSP power with SDR-2000 precision to transcend the best of current analog or digital performance.

Harnessing DSP Power

Powerful new interpolation filters are planned for the SDR-2000 DSP. These will follow proven conjugate rules pioneered with the introduction of the Spectral SDR-1000 and greatly augmented in the later HDCD process. Essentially, the decimation or antialias filter used to make the recording and the interpolation or smoothing filter used for playback are designed and optimized as a single system. In this manner, residual energy can be opposed or shifted in time or frequency to create superior inter-event silence or subtle resolution.

Spectral expects to license from Pacific Microsonics the DSP algorithms to provide this proven feature for 88.2 and 96 kHz sampling rates. At that time the "Red Book" HDCD process filters may be expanded to fully utilize the more powerful DSP on the new SDR-2000 interface board.

Future After Thoughts

A few historical notes may give future perspective. The entertainment industry thrives on technology, talent, and promotion. These interplay. Caruso's voice was ideal for the tin horn and Nipper did a good job of getting the message across. Transistors made possible the loud sound and cheap stereo entertainment vehicle of the psychedelic era. Eventually, the aftermath was a glut of airbrushed LP albums and an industry grasping for the CD holy grail. This put Sony and Philips in the political standards arena to proclaim the "perfect" red book standard.

Now, commodity profits are almost non-existent for low cost entertainment hardware and a technological development frenzy is under way. The computer, movie and sound experiences are targeted and merging. This time the cast of characters is much larger and the end product more tenuous. Will people put speakers all over their houses or purchase multi-chan-

nel modules? Will they invest in clearer pictures? Buy more expensive software? Will they hear better sound from more bits and faster sampling? Will DSD confuse or change the marketplace? These uncertainties temper our desire to immediately enter the fray.

96 kHz 24 Bit

Spectral is actively investigating and assembling functional parts to create a world class converter for DVD Audio software. Potential interface, DSP, algorithm libraries and modules to support this format are now being identified. These parts will combine to make a very powerful interpolation filter and HDCD decoder module for the SDR-2000. Plenty of power reserve and space is provided in our existing modular package for this conversion. Oversampled Spectral DACs will yield 24 bit analog resolution for 96 kHz DVD recordings. HDCD decoding will be performed by DSP and could be augmented in the future. We are developing this new process module concurrent with events affecting DVD standards and transport availability.

The Final Analysis

In the evolution of consumer audio formats, history usually repeats itself. One only need recall the rush to proclaim the early first-effort CD recordings and players as "perfect" to understand how a new technology is used to drive mass-market sales. The extreme eagerness on the part of the press to review new format recordings and components as "superior" also plays into this scenario.

Predictably, the rush to be first with a new 24/96 format consumer product will also affect high-end companies resulting in early DVD and theatre oriented machines which, while improved over mass-market products, will not reflect state-of-the-art refinements. Uncompromising performance will not be achieved in early 24/96 digital components, but will remain to be explored in the most ambitious later designs. Invariably, this level of care and thoroughness takes time and is pursued only by the most dedicated audio manufacturers. We believe the Spectral design team is equal to the challenge of realizing the ultimate promise of the 24/96 format.