

multi media manufacturer

March/April 2006

Manager's Guide to AV Design and Development

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Conventioning

By David J. Weinberg (*Tobias Audio*)

Fall brought me to three conventions I found important for increasing my understanding of technology trends—CEDIA (Custom Electronic Design and Installation Association; www.CEDIA.org), AES (Audio Engineering Society; www.AES.org), and SMPTE (Society of Motion Picture and Television Engineers; www.SMPTE.org). I serve as AES—DC section vice chair, and one of the SMPTE—DC section managers, so attendance was for more than journalistic purposes.

(more than 500). The AES convention had many fewer exhibits, and SMPTE's count was quite small.

The conventions' real value was in the presentations by and discussions with other professionals who presented ideas and provided ideas worthy of serious thought and analysis.

CEDIA EXPO

CEDIA's keynote speaker was Ray Kurzweil (www.KurzweilTech.com and www.KurzweilAI.net), a notable inventor,



CEDIA



SMPTE



AES

Each event included exhibits of the latest-and-greatest hardware and software, and although it was not possible to properly judge quality where there were so many uncontrolled and unknown variables, it was informative to talk with company representatives about their products. CEDIA, aimed at home theater retailers and custom installers, had by far the most exhibits

author of four books (from *The Age of Intelligent Machines* to *The Age of Spiritual Machines*), and a futurist whose track record of accurate predictions cannot easily be ignored. His speech-recognition algorithms are still considered among the best. Themes of his talk were bio-nanotechnology leading to greatly extended lifespans (with benefits beginning within the next



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generation), and embedded computing being the basis for virtual reality as the future of home entertainment systems. He spoke of the accelerating rate-of-change in every aspect of our lives: "You can't take the last 50 years as the model of progression for the next 50 years." Although Kurzweil's speech didn't directly address the immediate needs of custom home theater installers, it complemented Nicholas Negroponte's keynote at the 2004 CEDIA Expo, and provided considerations for long-term business planning applicable to all entrepreneurs.

CEDIA has been working diligently to engender credibility to the custom home theater installer through testing and certification programs. At the convention, CEDIA handed out the *Electronic Systems Contractors State Licensing & Regulatory Reference Directory 2005*, which delineates, by state, the licenses required of custom home theater installers. CEDIA offered courses in a wide variety of business and technical areas, and gave exams for several levels of custom installation technician certification.

I have not attended CEDIA's business courses, being too busy covering the show floor and taking technical courses, which have been quite informative.

Rich Green (Rich@RichGreenInk.com) spoke of "Future Technologies: The Inside Scoop from Silicon Valley." Focusing on the personalization of technology, connectivity, interactivity, gaming, and social networking, Green highlighted the competing technologies while predicting the fairly obvious—an integrated networked world providing more individually customized experiences of increasing personal involvement.

Michael Heiss, in his "HDTV Improv" and his "New Technologies Up-

date," talked about SHVERA (Satellite Home Viewers Extension and Reauthorization Act of 2004; requires digital multi-cast must-carry), copy protection status, digital equipment connection standards and formats, HD, computer gaming, and so on.

Bill Whitlock (president of Jensen Transformers; www.Jensen-Transformers.com) gave his excellent "Understanding, Finding & Eliminating Ground Loops," which was even better than last year's course. This material is relevant to all who work with electronics and electricity, and I am pursuing having this course given in Boston and in Washington, DC.

Roy Hermanson (Extron; www.Extron.com), in "Video Cable Seminar" and "Video Distribution Technology," illuminated the electrical characteristics that are important in selecting cables and connectors for video use, including impedance, attenuation, return loss, shielding, and the need to maintain constant impedance through the cable-connector interface (using oscilloscope traces to show the problems). He also addressed analog versus digital video, video scalers, scan converters, digital connections, and HDCP. He included a table of data rates for various image formats, including uncompressed 1280 × 720p60 (1327Mbps) and 1920 × 1080i60 (1493Mbps), plus a table of digital video interface specs that included connector types, sample and data rates, transmission distances, and guiding documents (the technical standards).

Joel Silver's (Imaging Science Foundation; www.ImagingScience.com) three presentations—"Digital Video in the Analog World of Home Theater," "Digital Video: Perils & Pitfalls," and "Display Device Calibration"—were better structured with more substance than last year's. Silver reminded us

that our visual acuity is about 0.1° (the thumb at arm's length subtends about 2°, the pinky about 1°), with SDTV designed for a subtended angle of about 11°, while HDTV works for up to about 33°. He summarized the various display technologies' strengths and weaknesses (which are decreasing with technological developments), including pixel cropping, native display resolution, black levels, artifacts, red push, and so on. Naturally, Silver made a strong case for display calibration, while pointing out many factors beyond pixel count that substantially affect picture quality. He directed attendees to the Microsoft website (www.microsoft.com/windows/WindowsMedia/content_provider/film/ContentShowcase.aspx) for WMV9 HDV demos.

John Dahl (THX Ltd.) covered "Acoustics 101," a basic course in sound and acoustics. Much of his material was presented in greater depth by Floyd Toole and Anthony Grimani, but Dahl's course was a good starting point for novices.

Floyd Toole (Acoustical Engineering VP, Harman International) taught "Theater Loudspeakers" and "The Room and the Loudspeaker." The latter course used a subset of his hundreds of PowerPoint slides on the subject. He has incorporated results from research into multiple subwoofers over the past few years, concluding that four subwoofers in the center of each wall, each reproducing the same monophonic signal at the same level, will yield reasonably uniform bass coverage over the listening area, based on modal cancellation due to the subwoofers' locations and the fact that we don't listen to home theater sound from next to a wall.

David Griesinger (Lexicon) finds fault with this idea based on his belief that stereo bass is essential for

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effective spatial envelopment. Some of Toole's other tenets: speakers should have smooth on-axis response, and smooth/uniform dispersion versus frequency (Harman's test of several \$10k/pr speakers shows that just because they cost a lot doesn't mean they sound good); room treatments should affect essentially the whole audible frequency range (for example, thin absorbent panels are equivalent to turning down the tweeter and mess up the sound due to rolled-off reflections); speaker location is as important as speaker characteristics (objects blocking the sound, speakers in cabinetry, and so on); and much more. He also pointed out that speaker-wire impedance has a tempering effect on calculated damping factor, making very high numbers less important than some people claim. Nothing Toole says can be ignored, but should be seriously considered and analyzed in the context of the situation, even if your conclusion conflicts with his.

Anthony Grimani (PMI, Ltd; www.PMILtd.com and www.MSR-Inc.com) presented "Home Theater Architect: Design/Build a High-end Home Theater," "High Performance Home Theater Audio Calibrations," and "Room Acoustics: Acoustic Treatments," which provided a very good guideline for home theater design and setup. This year's changes included some of the recent work on multiple subwoofers by Floyd Toole's Harman research group. Grimani addressed designing the room, specifying and placing the gear, plus system control—naturally starting with the objective to bring a good movie theater experience home, and believing that a home theater system also can sound good for music playback. From his slides, his list of audio performance goals included dialog clarity and articulation, precise sound localization, smooth sound movement (panning), spacious surround, smooth tonal balance and tight bass, with every seat a good seat. His image goals were sharpness, image size, brightness, contrast, color accuracy and freedom from artifacts, plus, again, every seat a good seat.

Grimani walked the class through his analysis and planning process in de-

signing a home theater. When addressing standing waves, he pointed out that flexible walls absorb sound energy and reduce the severity of the peaks and valleys in the resultant frequency response. The material presented was quite comprehensive.

Attendee Stephen Owades found it interesting that Toole, whose companies make speakers, tends to solve certain problems with the use of additional speakers, while Grimani, whose company makes acoustic treatments, prefers to use that approach.

Steve Haas (SH! Acoustics) discussed "Room Acoustics: Isolation and Noise Control," including definitions of standard industry measurements (National Isolation Class, Sound Transmission Class, and so on) and construction methods to reduce noise intrusion from airborne, structure-borne, and duct-borne sounds.

Fred Ampel (Technology Visions; www.TechnologyVisions.com) was entertaining with his "Learning to Listen," during which he pointed out that we normally don't listen for all the information present in the sounds we hear. Ampel noted that measurements alone can lead to bad sound, and demonstrated how to use specific music and soundtrack samples, rather than test signals, to evaluate and make final adjustments to the sound of an audio or home theater system, once basic measurement-driven adjustments have been completed. He spoke passionately about the goal of a high reality creation quotient—the ability of a system with good source material to fool listeners into believing they are in a real space, not a simulation of one ("Remember: If the listening experience is not centripetal and doesn't pull you in, then there are probably things wrong with the acoustical envelope you are producing.").

A rarely heard claim in Ampel's commentary was that the time it takes sound at different frequencies to travel from a speaker to a listener is different from that calculated by dividing the measured distance by the accepted speed of sound (1130fps). This leads to the need for additional sonic evaluation techniques to time-correlate the sound from each of the speakers in a

surround-sound system.

There were other courses I would like to have attended, such as Don Stewart's (Stewart Filmscreens; www.StewartFilmscreen.com) "Projection Screen Technologies," Joel Rosenblatt (Russound; www.Russound.com) and Robert Ridenour's (Connected Technologies; www.TechnocomPartner.com) "7 Steps to Home Theater" (a rudimentary course), plus Eric Johnson (Universal Remote Control; www.UniversalRemote.com) and Ridenour's "User Interface Design" (a facet of all consumer equipment that needs substantial improvement).

Several companies produced the Acoustics Guild Engineered Home Theater Demo. Two adjacent, identical rooms were set up as small home theaters—one without any acoustic treatment or careful audio adjustment, the other with both (limited by the hotel's requirement not to affix anything to the walls). Using the same source material, listeners would experience first the untreated room, then the treated one. This was a pretty good A/B test that demonstrated the benefits of even relatively simple acoustic treatment and system calibration.

Speakerscraft sponsored a Cheap Trick concert in the Murat Centre's Egyptian Room that was so loud, distorted, and badly mixed (unintelligible lyrics) that even with EAR Grande earplugs, I had to leave shortly after it started.

There is no doubt that CEDIA Expo has become the show for home-theater-centric technologists. There are so many exhibits and valuable courses that it is impossible for a custom installer to get all the information needed and available; sharing the load among several staff members is the only possible solution.

The expo has become too large for the current Indianapolis facilities, and is relocating to Denver for the next three years while the Indianapolis convention center is renovated and expanded.

AUDIO ENGINEERING SOCIETY CONVENTION

The 119th AES convention was in the Javits Convention Center, New York City.

While CEDIA's courses are designed to

teach custom installers, the papers at the AES and SMPTE conventions serve to share knowledge gleaned through research. There is some overlap.

“Acoustics and Psychoacoustics of Loudspeakers in Small Rooms: A Review.” For example, Floyd Toole gave this much more technical and extended version of his CEDIA talk. From the convention program tutorial synopsis: “The physical measures by which acousticians evaluate the performance of rooms have evolved in performance spaces. They rely on a set of assumptions that become progressively less valid as spaces get smaller and more acoustically absorptive. In live performances, sound sources radiate in all directions, and the room is a part of the performance. In sound reproductions, loudspeakers tend to exhibit significant directivity, and what we hear should ideally be independent of the listening room. What, then, should we measure in small rooms?—To what extent can we eliminate the room? Or do we need to? Is there a point beyond which the human hearing system is able to adapt to the listening space—hearing through the room and around the reflections to accurately perceive the source? A certain amount of the right kind of reflected sound appears to enhance the music listening experience and, interestingly enough, to improve speech intelligibility.”

Toole has concluded that normal reflections in a typical small living room seem not to interfere with perception of the recorded space. He has also determined that early lateral reflections (<50ms) have a beneficial effect on intelligibility similar to raising the dialog level, and that the reflection pattern is more important than reverberation.

This has led to Toole’s recommendation that too many or too few reflections can be a problem. In particular, acoustic absorption, diffusion, and reflection must be broadband, ideally

starting below 200Hz. He pointed out that the typical 1” or 2” sound panel most often affixed to walls works only at relatively high frequencies, and acts to effectively turn down the tweeter with no effect on the midrange or upper bass, thus unbalancing the sound.

Toole reminded us that many of the practices to deaden a room’s acoustics came from standards for broadcast and recording control rooms, where sound details must be heard more clearly, not for general listening rooms.

Harman testing has shown that sonic anomalies which are audible while the listener is moving around become much less obvious once the listening position is essentially fixed (the listener sat down!). Toole spoke of comb filtering, and has deduced that it is an artifact of measurement, not an audible problem in normal listening. We are less sensitive to room resonances in music than in broadband noise—our hearing is sensitive to the frequency response effects, not the time domain ringing, particularly in a reflective space, due to our “multiple looks” at the signal (except in the bass range, where both are factors). Audibility thresholds decrease with repetition and duration in reflective rooms.

Humans seem to be able to adapt to a room’s acoustics, up to a point. Thus, we should be able to predict real-room performance from a proper set of anechoic measurements, except for bass issues below about 300Hz. In Harman’s listening tests, low-frequency performance accounts for about 30% of a speaker’s rating.

Harman testing has shown that speakers with a fairly flat on-axis response and with a smooth and gentle off-axis level fade and rolloff are preferred by expert and amateur listeners. A speaker with an off-axis response that differs substantially from its on-axis response cannot be corrected with an equalizer. In-room measurements lower the accuracy of the data since they include a mix of direct and reflected sound. Since with most speakers the reflected sound has a different frequency response than the direct sound, an equalizer will cause more problems than it will cure.

He also noted that spatial-averag-

ing of speaker measurements is critical—single-point measurements are erroneous and meaningless. Also, many types of measurements are required to characterize the sound, and that 20th-octave data is necessary to unmask narrow-bandwidth frequency response problems that would be averaged out and masked in third-octave measurements.

Regarding bass, the Schroeder frequency is that threshold above which room resonances are considered so close together that they can be ignored with respect to frequency response anomalies. Toole has found that this works for large rooms, but the formula for its calculation yields too low a frequency for small rooms. In fact, Toole believes that calculation of room resonances is irrelevant in *real* home listening rooms, because not all modes have an equal effect or are heard equally, since there are multiple sources (speakers), and because all the formulas are based on a source in a corner with the measurement taken in the opposite corner (where there is never a listener). This has led to Harman’s recommendation to use four subwoofers in the center of each wall to provide the most uniform bass over the largest listening area in the widest range of small-room sizes; it reduces, and sometimes eliminates, the need for bass EQ.

An informal discussion with Fred Ampel revealed his finding that for a fused sound field and precise localization, matching the sound arrival time at the listening position from multiple speakers to within a few microseconds is critical, in spite of common wisdom. He also believes, from his experience and tests, that especially at low frequencies, the acoustic distance from a speaker to a listener can be up to 20% different than the measured distance, particularly in a small room. Naturally this reduces serious listening to a single location.

“Measuring Room Acoustics—an Overview of Techniques and Relevance.” Sam Berkow (SIA Acoustics) and David Griesinger (Lexicon) gave this workshop addressing methods used to measure concert hall acoustics. The presentation included results from several real halls. Griesinger continues

to work diligently to determine what parameters describe a good-sounding hall, how and what to measure to characterize a hall, and how to increase the correlation between perception and measurement. There are some limited successes, like the need for RT60 to be relatively constant versus frequency, but a comprehensive set of parameters that can accurately predict that the constructed facility will be considered an acoustic success continues to evade all efforts.

David Moulton gave an introductory version of his course "Audio Ear Training" that included demonstrating how to use his techniques to become more sensitive to frequency response anomalies with music and to identify specific portions of the frequency range that are being boosted or cut.

"International Surround Mixes: a Listening Experience." Mick Sawaguchi hosted a session of rare surround recordings from around the world. Examples included recordings of Vivaldi, Oldfield ("Tubular Bells"), Bjork, Irish folk songs ("Music from the Hearth"), Brazilian jazz, and so on. His choices leaned toward strong use of the rear channels for more than merely ambience. Almost all his exemplars were from commercial releases. I would have preferred a better sound system, set up to provide more uniform coverage for the large audience.

"Doug Sax: What Happened to Dynamic Range, and Why" is a subject many of us deal with as we try to find recordings that excite us. It was good to have this talk, but nothing new was discussed.

"70th Anniversary of FM Broadcasting: A Look at Major Armstrong's Contribution to Broadcasting." This panel discussion, including several people who worked with Armstrong, reminded attendees how important his work was to widespread free access to music that sounded good over the radio. A group involved with the museum at his original transmitter site in Alpine, N.J., recreated his low-band FM broadcasts from that site (with FCC approval, of course).

The Richard C. Heyser Memorial Lecture—Jozef J. Zwislocki: "Sound Transmission and Analysis in the

Ear—Recent Insights." Zwislocki has spent 60 years since earning his engineering degree studying how we hear and analyze sounds. From the program guide: "All audio equipment must be adapted to the characteristics and properties of the auditory system. . . You know that the cochlea of the inner ear is crucial for sound analysis and sound transduction into neural activity. Over the last half century, much has changed in our concepts of how the cochlea does it, and the textbooks have a hard time keeping up with the progress. I will attempt to sketch the gradual development of these concepts, ending on those that are still subject of controversy. They include forward and backward propagation of cochlear waves, stimulation of the hair cells, the auditory receptors, the active process of sound analysis and pitch code, cochlear compression and its abolishment by cochlear pathology, transient and distortion product otoacoustic emissions, [plus] I will call your attention to a new principle for protecting the vulnerable cochlear hair cells against environmental noise." Having independently studied our hearing system years ago, I found his talk exciting and informative.

A related talk was Johns Hopkins School of Medicine's post-doctoral Fellow Poppy Crum's "Psychophysics and Physiology of Hearing," which even grabbed David Griesinger's attention as she addressed spatial hearing—(from the program guide) "how an acoustic signal in a free-field environment is encoded and represented in the nervous system, ultimately leading to the perceived location. In other words, where, and how, is a spatial signal interpreted and coded in the brain?"

Some of the sessions I would have liked to attend, but didn't have time, include:

- "Recording Studios Past, Present and Future," which addressed the dramatic changes in studio design and equipment due to the rapid improvement in PC-based sound recording and processing.
- Fred Ampel's "Live Surround Symposium: Surround Live III," an all-day panel that (from the program description) "brought together

working professionals from the performance audio, Broadway theater, sports television, environmental audio, fine arts, and other industry segments as well as the recording technology areas, to discuss the issues and technological challenges created by presenting sporting events, music, drama, theater, art, and cultural exhibitions in full multi-channel surround audio formats to an audience." The sessions included presentations, an interactive workshop, and live/prerecorded performances.

- "17th Annual Grammy Recording Soundtable." David Adelson (E! News Live) hosted this session with Robert Hurwitz (Nonesuch Records) and George Massenburg in a discussion on how music technology continues to change the music business model.
- Workshops on "Switching Amplifiers for High-Resolution Audio" and "Pre-fab Acoustics for the Audio Production Environment."

Sessions ran from 8am-6pm, so the days were full! Cassettes, CDs, and MP3-CDs of the sessions are available from www.ConferenceMediaGroup.com (800-575-0580; mention meeting #AU0501).

Almost all the papers presented at the AES convention are available for purchase at www.AES.org as convention preprints, and stand on their own much better than the handouts from CEDIA's courses. The convention also provided times for working groups' and standards committees' meetings that all can attend.

I took the technical tour of Jazz at Lincoln Center, a facility in the Time-Warner building that overlooks Central Park and houses several performance/recording venues. I would have liked a more in-depth explanation of the facility's unquities and the design rationale.

The exhibits filled a large exhibit hall (a bit smaller than the north hall of the Las Vegas Convention Center; about the same size as the exhibit space in the RCA Dome at CEDIA) with manufacturers of the latest array of professional products including Dolby (showing their Media Producer software suite that includes Dolby TrueHD) and DTS

(demoing their new encoder software), Tony Grimani's MSR (www.MSR-Inc.com; acoustical products), Excelsior Audio Design & Services (www.Excelsior-Audio.com; 704-675-5435; Charles Hughes offers use of his sophisticated system that can quickly collect and analyze speaker directivity data), and so on.

Overall, the AES convention serves its community well, providing a forum for dissemination and discussion of information that affects the audio community.

SOCIETY OF MOTION PICTURE AND TELEVISION ENGINEERS CONVENTION

This meeting was also held in New York City, at the Hilton New York hotel.



SMPTE started with an all-day digital cinema forum. Howard Lukk (Walt Disney) explained the Digital Cinema Initiative (DCI) consortium's finalized specifications (v1.0; free download at www.DCIMovies.com) for a single digital cinema system that has been accepted by the major studios. This document delineates user requirements, not equipment design characteristics. It is not comprehensive enough to enable successful equipment design and manufacture to meet needs or intent.

From the specification, DCI's objectives were to: define a system that would provide digital cinema imagery "better than what one could achieve now with a traditional 35mm Answer Print;" be based around global standards and formats; should be "easily upgradeable as advances in technology are made;" should "provide a reasonable path for upgrading to future technologies;" and "shall also not preclude the capability for alternate content presentations." DCI addressed issues of reliability, aiming higher than current film system reliability (which is certainly higher than most computer systems), and protection of intellectual property rights. SMPTE's DC28 Digi-

tal Cinema workgroup is central to the conversion of this specification into industry standards.

He also ran the ASC/DCI StEM (standardized evaluation material), a 12-minute mini-movie created jointly by members of the American Society of Cinematographers and the DCI consortium to challenge the digital cinema technology. It is available through SMPTE as uncompressed video in several digital file formats—4k, 2k, RGB, X'Y'Z' files on hard drives, and SMPTE274M HD 1920 × 1080i60 on D5 tape. It is being used for digital cinema testing and SMPTE image/video testing, industry standards evaluations and demonstrations, industry trade show demonstrations, and educational purposes. Described by Lukk, Michael Marcellin (University of Arizona), and Glenn Kennel (TI), the ASC/DCI StEM, created with the source material being the least limiting factor, is JPEG2000-encoded (wavelet compression; of the 13-part standard, only part 1 is relevant to the DCI spec; aka ISO 15444-1); the soundtrack is six channels (5.1 surround) of 24-bit/48ksps *.wav files. The trailing credits take several minutes because everyone involved donated their effort and time for a credit listing.

The ASC/DCI specs call for 12-bit color (36 bits per pixel; the resolution of chroma is the same as the luminance) in an on-screen image of 4096 × 2160 or 2048 × 1080 progressively scanned at either 24 or 48 frames per second (current technology limits the 4k frames to 24fps). While it doesn't prevent higher frame rates, it doesn't mention 30/60fps (current video frame rates, the higher one also the ShowScan film frame rate).

The pixel count is the container—the data space; there is no anamorphic imaging, not all of the data space is used depending on the image aspect ratio.

The color space is not display-centric with a coordinated color of white (like TV video), but is defined to encompass the entire CIE visible color gamut, with the reference coordinates of white based on current projector lamps.

While the light level of film projec-

tors is specified as a minimum of 16fL with an open gate (which translates roughly to 12fL with exposed film in the gate), the DCI spec calls for at least a 14fL brightness capability.

Encryption is optional, although everyone expects major studios to impose it on their digital movie files (fully half of the DCI spec addresses file security). Obviously the DCI spec is aimed at first-run movies—it is film-centric—as it doesn't address alternate sources for theater exhibition like pay-per-view concerts and boxing matches, and so on.

An uncompressed file, known as the Digital Cinema Distribution Master (DCDM) occupies about 300GB (for a 4k/48fps two-hour movie) and runs at about 7-8Gbps. A compressed file, such as the Digital Cinema Package (DCP), which is sent to theaters, runs at about 300Mbps. The JPEG2000 encoding results in less than 2:1 file compression, and can be lossless. The DCP is compressed at about 10-20:1, going for visually lossless, not mathematically lossless.

The soundtrack specs support up to 16 channels (eight are user definable) of 24-bit samples at 48 or 96ksps. While there are many metadata parameters in the DCI spec, those for audio are insufficient to adequately control sound characteristics such as channel levels, channel locations (vertical screen left, over-the-audience, and so on), and other factors that would be beneficial to consistent presentation quality.

In the theater, to create a show, the files can be linked via a playlist, which can include ads, previews, theater announcements, and, of course, the feature.

John Fithian, president of the National Association of Theater Owners (the *other* NATO; www.NATOonline.org), complimented the DCI/SMPTE-DC28 working group for setting a single international set of uniform technical parameters (that should become standards) that define high quality levels and ensure industry-wide and worldwide compatibility. He thinks that "it costs more not to operate in the world of bits," and sees digital cinema 3D as a capability not readily available in the home. Naturally, his primary

consideration is to get people to the theaters for an experience they can't get at home.

He announced that there are third-party financing models currently being employed, with studio commitments, which are making implementation of digital cinema projection in theaters possible. He recognizes that these funding models work best in the US, but that the situation is more complicated elsewhere where more of the product (movies) doesn't come from large Hollywood studios. He said that alternate events—concerts, sports, Broadway plays, and so on—are working now, especially in areas where these live events don't perform.

Fithian foresees a beta-market of about 200 screens to test operation, reliability, and interoperability of various technologies and systems integration. He also pointed out that "NOTHING is DCI-compliant," no matter what a manufacturer's rep might say. He has plans for a process that certifies component compliance, but "Hell, no!" to a THX-style of visiting certifiers.

Andy Maltz (Director, AMPAS Science and Technology Council) gave a history of the Academy of Motion Picture Arts and Sciences, which emphasized their members' involvement in the technical side of movie production and presentation, and added some perspective to the DCI's place in movie history.

Dave Schnuelle (Dolby) presented a case study in digital cinema—**Media Infrastructure—MXF, GXF, and AAF**. The wide use of computers and networks for movie and television program creation and processing has driven the need to have standardized image formats for cross-software compatibility. This session, chaired by Hugo Gaggioni (Sony) and Bruce Devlin (Snell & Wilcox), presented (from the program guide) "information related to the practical use of devices and systems that employ MXF and GXF interchange file formats, as well as the use of the Advance Authoring Format for complex content creation operations." One clarification made was that MXF is the "material" exchange format, not "media," since in SMPTE, media is a term used to describe the

carrier—tape, DVD, CD-R, and so on; material is the content.

Sound in the Digital Era was chaired by Tomlinson Holman (TMH Corp) and addressed (from the program guide) "where to do what with the program audio. Should production sound be compressed so that 'it sounds good on the Avid?' Should editors perform equalization? Where should it be protected from copying and how? What are the criteria for fully reproducing the recorded sound in theaters and homes?"

Ioan Allen (Dolby) presented "The X-Curve: Its Origins and History," which certainly put ANSI/SMPTE 202M in context, starting with background from 1937 on the Academy curve, through several key events in 1969—the first ISO proposal for a B-chain standard, publication of theater measurements in the US and in the UK, a December SMPTE *Journal* article on the use of pink noise for B-chain measurements.

He described experiments comparing near-field measurements with far-field data in theaters—one experiment using highly regarded hi-fi speakers 6' from the console on a sound mixing stage, carefully positioned to provide the best possible sound at the mixing position. Then he used "flat" BBC recordings, EQing the screen speakers (40' away) to match the timbre of the hi-fi speakers, keeping in mind the objective for the first arrival sound to be "flattish," as is most important for dialog naturalness and intelligibility.

It took until 1977 before ISO 2969 established the "X-curve" (the X was for experimental). The shape of the curve stems from the attempt to make a distant, mid-room measurement that takes into account the ear's longer integration time at low frequencies, and the high-frequency rolloff in a large room from high frequency absorption in the air as well as by patrons and surfaces.

This led to the technique ultimately codified in ANSI/SMPTE 202M (M is for metric). In 1982, scaling factors were added to adjust for various large room sizes.

Allen's goal has always been the ability to translate a soundtrack between theaters and the home with the

same sonic characteristics. He doesn't believe the current standard is too bad, but that an improved measurement technique is needed—one that combines first arrival and steady state parameters. This is an issue he is considering bringing to the SMPTE A12 Technical Committee on Audio Recording and Reproduction Technology, of which he is chairman.

Not discussed, but important, is Allen's continuing work on standardized levels and measurement of perceived loudness, which led to the Dolby LM100 Leq meter and recommendations for movie trailer levels as measured by the LM100. I believe this technology could be used to monitor program levels at TV production studios and stations, enabling the Dolby Digital DialNorm metadata parameter to be automatically set so home decoders could maintain more consistent levels.

I admit to having great respect for his work, and being such a fan that when I found his 1975 SMPTE *Journal* article (see below) on the use of noise reduction to improve film soundtrack bandwidth, I asked for and was granted his autograph! This article was first rejected by the AES *Journal*, yet won article-of-the-year in the SMPTE *Journal*.

"Cinema Sound Quality Redux" was about Tom Holman's continuing efforts to improve methods for quantifying sound reproduction quality. He and his USC students have been given access to a modern multiplex for their research. They have found problems, including: rear-wall slap-back (agreeing with Toole et al., who have pointed out that 2" of "fuzzy" absorbent material on the back wall isn't enough; Holman said that 4" minimum plus a curtain was needed to kill it). There is a seat-dip effect, even with stadium seating (in concert halls, reflections and reverberation fill it in, but in movie theaters, with deader acoustics, it's more audible; in Boston's Symphony Hall, Holman said it is about 12dB down at 80Hz and about an octave wide, yet with movie theater stadium seating it's narrower and centered around 110Hz) and rattles (needs a slow sine-wave sweep to find them). He even found sympathetic vi-

brations in walls (in one case it centered at around 160Hz, and he claimed that once deadened, the sound quality improved, albeit subtly). Holman's testing has led him to conclude that beryllium high-frequency horn drivers have better sonic characteristics than titanium drivers (but not for midrange frequencies).

Holman prefers subwoofers in the four corners of the theater for smoother bass response around the room. I wouldn't think this would be of much benefit in large rooms.

Holman agrees with Allen that a better measurement process is needed, and has been working on a technique that involves averaging multiple 10ms first-arrival windows, finding that problems show up which are obscured by traditional procedures.

"DC-PCM, an Audio Packaging Proposal for D-Cinema" is a suggestion from Stan Cossette and Pierre Lemieux (both from Dolby) to further codify the digital cinema soundtrack characteristics, including channel IDs, metadata for mixdown decisions, and so on.

Advancing the call for better use of digital cinema metadata for audio, David Strachan presented Orest Holyk's (Evertz Microsystems) "Dolby Metadata Woes? Standardization to the Rescue!" Strachan pointed out that metadata must be maintained throughout the signal chain all the way to the theater or home, an idea that should be applied more comprehensively and accurately in the DTV world. The SMPTE A29 technical committee (Television Audio Technology) is addressing the issue.

Further addressing problems in TV sound, Birney Dayton (NVision), in talking about "Managing Multichannel Audio in Master Control," recommended setting the Dolby 569 encoder at the broadcast station to defaults of two-channel with a DialNorm of -20, so that Lt/Rt will be properly decoded (Dolby Pro-Logic) in the home; if the receiver doesn't see Dolby Digital in two-channel mode, it will not try to decode the Lt/Rt signal. He said that Dolby E multichannel film sources set DialNorm at -27 (also the Dolby equipment default), while TV stations use -20dBFS nominal level, which is why

his suggested defaults will work together better than current practice. The broadcast station still needs a Dolby DP570 or DP563 with metadata input to feed the NTSC transmitter consistent proper levels and Lt/Rt. Holman reminded the audience that the ATSC standard requires all DTV receivers to recognize and properly process the DialNorm metadata parameter.

Tim Carroll (Linear Acoustic; www.LinearAcoustic.com) continued the theme that metadata is critical, and pointed interested parties to the standards: SMPTE 337-340.

Consuming Content—An Unquenchable Thirst. Mike Tsinberg (Key Digital Systems; www.KeyDigital.com/index.asp) chaired this session looking at the ballooning quantity and variety of content and consumer material available.

Kilroy Hughes (Microsoft) discussed the "Advanced Video Capabilities of HD-DVD-Video," describing it as an application format for use on various media, naturally emphasizing networking.

Stevan Eidson (Silicon Image) presented "Enabling Digital Home Media Distribution with HDMI" (on the Key Digital home page, click on the SMPTE logo to get to Eidson's slides), during which he announced that HDMI (High-Definition Multimedia Interface; www.HDMI.org) v1.2 had been released on Aug. 23, 2005, and that it supports 5Gbps over four twisted pairs plus two more UTP. The DTV video formats it supports are defined in EIA/CEA 861C (a digital video interface standard). Eidson believes implementation of HDMI v1.2 will facilitate use of a single remote for all devices in a system, and thus simpler system control without the complexity of an AMX or Crestron product that requires a lot of programming. He said that most early interoperability failures could be blamed on bad HDCP implementation, and that HDMI certification testing procedures have been improved to include interoperability and HDCP (HDCP test v1.1).

The session included a presentation on multi-room DVR and home networking (Multimedia Over Coax Alliance; www.MoCAAlliance.org). Points included

mention that 60-100Mbps is needed for home entertainment networking; the biggest consumer complaints are about cable confusion, input choices, and the need for multiple remotes.

Don Eklund (Blu-Ray Disc Association; www.Blu-RayDisc.com) in "Blu-Ray: New Opportunities and Challenges," said that MPEG2 at >15Mbps is equal to Microsoft's VC1 performance at a variable bitrate of 18Mbps, but that MPEG4 and VC1 are better than MPEG2 at much lower bitrates, which makes them more appealing for future applications. DTS and Dolby Digital hardware high definition lossless decoders aren't yet available, but their lossless encoding is being used for Blu-Ray mastering.

Content Protection—Preserving and Sharing Rights in a Digital World. Naturally, no conference on digital video technology would be complete without at least one session on content ownership rights protection. Co-chaired by attorneys James M. Burger (Dow, Lohnes & Albertson) and C. Bradley Hunt (MPAA), the presentations provided a relatively fair and balanced accounting of the issues.

Kathleen Fuller (Dow, Lohnes & Albertson) gave a clear, comprehensive history of the Betamax case through the Grokster Supreme Court decision. She emphasized the "active inducement" test (Was the defendant's action intended to promote use for infringing purposes?) used by the Supreme Court in the Grokster ruling, which left the Betamax "safe harbor" concept intact.

Troy Dow (Walt Disney) addressed what the Supreme Court did not say (too complex for this brief synopsis).

David Beddow (Movieline) presented "DRMs and High-Value Video Content Business Models" to show that there are ways for theaters to make money.

Pierre-Anthony Lemieux (Dolby), Florian Pestoni (Microsoft), and Alan Bell (Warner Bros.) each talked about protecting digital cinema content from pirates.

It's clear from the presentations, and from the fact that ever more home entertainment equipment connects to the Internet, that to enjoy future consumer material, digital rights manage-

ment will force high-bandwidth Internet connections, possibly even while watching/listening on portable devices. This is a concern all of us need to think about and be wary of.

Advances in Motion Picture Film Technologies, chaired by Chris Dumont (Eastman Kodak), included a presentation by Simon Lund and Dan DeVincent (Cineric) with Schawn Belston (20th Century Fox) on restoration of "Carousel" and "The King and I" from deteriorated Cinemascope 55 prints and color separation prints, remastered onto 35mm film in their full 2.55 aspect ratio. A lot of intense effort and high tech went into the restoration. From the brief excerpt shown, the results are impressive.

Display Technologies: Anarchy or Opportunities?—Session chair Peter Putman (Roam Consulting) started with an overview of LCD technology, noting that there are only three major manufacturers of the larger LCD panels (Samsung, Sharp, and LG Philips). He talked about the cold cathode and hot cathode lamps used in various models, plus an LED array (used in the Samsung LNF460D, which he said was the same panel as in the Sony Qualia). Putman said that the primary problems with LCD panels are inadequate contrast and off-axis color shift, suggesting prospective purchasers check the image at about 60° off-axis for color saturation, color accuracy, and image contrast. The LCD's motion blur and smearing is due to the slow transition time of an LCD pixel, a problem that has been corrected in the latest generation of panels.



Bill Schindler (Panasonic) talked about plasma panel characteristics, suggesting viewers look at diagonal lines for reduced stair-stepping, an

improvement resulting from sub-pixel image processing.

Jed Deame (Silicon Optix, Teranex Division; www.SiliconOptix.com) provided guidance on how to evaluate display performance, emphasizing static versus dynamic characteristics—dynamic performance is more critical to real-world use. He spoke about horizontal and vertical resolution, motion-adaptive de-interlacing, directional interpolation, digital noise processing, the problems handling film mode and other cadences (there are several not normally recognized, particularly in animation), and mixed film/video content. Deame pointed us to www.Belle-Nuit.com for HD and SD post-production test charts that cover most of the static parameters. He also recommended the HQV Benchmark DVD (www.HQV.com; \$30) that includes a wide variety of video tests (some conceived and created by David Ranada), which show up many of the flaws in pixelated displays and MPEG2 processing; the website, like the booklet that comes with the DVD, shows the original image and examples of the kinds of image flaws you should look for. I have tried it, and recommend its use as a learning tool and for display evaluation.

Presentations about the Sony 4k digital cinema projector, the JVC D-ILA 1920 × 1080 projector, and the latest in DLP projector technology rounded out the session.



SMPTE papers are available from SMPTE on the convention proceedings CD-ROM.

Beyond the sessions, SMPTE working group meetings were held so those involved, who are from all over the world, have a better chance to confer in person without special travel expense. These meetings are open to all attendees, and the committees are always looking for interested parties to become actively involved, which gives

them access to review draft standards, provide comments, and vote on draft standards. I will soon be joining the SMPTE A12 Technical Committee on Audio Recording and Reproduction Technology, and am considering others that are of interest.

This SMPTE convention came with a great bonus. Someone cleaned out their basement of old SMPTE journals as far back as the 1940s, and put them out for us to peruse and take. During those mid-20th century decades, SMPTE members were performing a lot of fundamental research, as opposed to now, when most of the work is more applications engineering than research. We understand much more of the scientific fundamentals now, but it is fascinating to read those papers that laid the groundwork for today's motion picture and video technology.

The only convention downside was the sound system for the speakers in one of the two presentation rooms:

- Sitting front and center during the digital cinema forum, the presenters were all but unintelligible, and close to inaudible (the portable speakers were on stands at the front corners of the stage, and according to the person on the soundboard were turned down to reduce feedback since some of the lecturers preferred talking from the floor in front of the stage using wireless lavalier mikes);
- During the Media Infrastructure session, there was a whistle through about a third of Jim Wilkinson's presentation, only present while he talked, that seemed to be traceable to his wireless mike. I finally pointed this out to the sound man, who had heard it but hadn't been concerned, and never did find a solution.

Isn't it time the organizations hiring these support companies demand better quality, particularly when quality of sound and image presentation is part of the function of the society?

Overall, however, the SMPTE convention is an important and unique source of information about the state and future of motion picture (including television) program creation, collection, processing, and presentation.

AFTERWORD

Conventioning is a pain for exhibitors, presenters, and attendees—it interferes with work and requires substantial expenditure for travel, plus the cost to manufacturers for exhibits and exhibit space, all of which ultimately is recovered from the consumer in the cost of products.

However, conventions clearly provide benefits to manufacturers, presenters, and attendees. A convention consolidates multiple sources of information and brings together people who otherwise could not easily interact in their pursuit of progress (and profit).

There are many more conventions each year (I do attend the Consumer Electronics Show, as much as anyone can cover such a huge event), and always consider the possibilities. I have found CEDIA, AES, SMPTE, and CES to be the four that most efficiently provide me the information and industry guidance I need. I would find it much more difficult to keep up with my areas of interest without them.