Proceedings of the Institute of Acoustics

THE EVOLUTION OF, AND CURRENT DEVELOPMENTS IN, NON-COMMERCIAL CINEMA/SURROUND AUDIO TECHNOLOGY

Frederick J. Ampel

Technology Visions, S.A., Overland Park, KS. 6621Z-4801

INTRODUCTION

As the audio industry begins the second decade of its second century, the blending and merging of what were previously decidedly disparate industries is in full sway. The once-isolated music, television, and cinema sound formats and their various end-products are now more than ever before being amalgamated to provide the consumer with a more consistent approach to sound reproduction.

As with many other core technologies in audio, the history of motion-picture sound begins with Edison. A number of attempts to provide "moving pictures" occurred during the years between the 1877 premiere of the phonograph and Edison's launch of his 1888-89 sprocketed loop "peep-shows". none enjoyed any wide commercial visibility or success.

By combining George Eastman's ultra-flammable (and occasionally explosive) nitro-cellulose strips with a phonographic system, Scotsman W.K.L. Dickson of Edison's laboratory produced the first commercially viable motion picture - of Dickson himself.

In fact the records show that Dickson's experiment always intended to combine sight and sound. So in reality not only did Edison's invention provide the world with what was clearly the first "motion picture". they also produced the first "talkie".

Edison's loop machines had no provision for sound, but one can assume that he intended to provide that a bit later at a higher cost. Not seeing the potential threat of larger scale exhibition, he didn't quite move quickly enough. So when in 1894 - 1895 the theatrical projection of motion pictures was clearly demonstrated, Edison's loops faded quickly into the dustbin of history (only to return 3/4 of a century later in service to a far less honourable industry).

The movement of sound onto film then wends its way through a complex maze of interlocking corporate technology wars and vicious competition as it marches onward past 1910.

The sound-reproduction work being pursued by both RCA and Western Electric (later E.R.P.I.) in the 1920's had no direct link to motion pictures until the 1924 demonstration staged by Edward Craft for all the largest film companies. That demonstration produced exactly nothing: not a single company expressed even the remotest hint of any interest.

With the foresight typical of those who revenues are soaring - the motion picture industry, triumphantly drowning in the profits from silent pictures, had no need of any new ideas. In fact, Edison himself commented in 1926, "no field exists for talking pictures."

That same year Samuel Warner, driven by his company's desperate financial situation, saw a

demonstration of Craft's system. Facing almost certain collapse anyway, he saw in sound a chance to rescue everything.

With the sole rights to the technology, now dubbed Vitaphone, in his possession, Warner released The Jazz Singer on 6 October 1927, almost exactly 66 years ago. Nothing was ever the same after that. Cecil B. DeMille said, "Well, boys, looks like we're working for the telephone company now."

The enormous success and thus the immense profits generated by The Jazz Singer, fueled a technological explosion like no other. By the end of the decade almost 8000 theaters in the U.S.A. were equipped for talkies. Worldwide the number was even higher.

No paradigm shift of similar size had ever occurred, except for the global impact of Edison's phonograph more than a half-century earlier. The details regarding the development of optical sound on film are well-covered by others, and not of direct importance here [1].

What is of interest is the expansion of sound on film from the basic monophonic source to 2, 3, 4, 5, 6 and ??? channels.

THE MULTI-CHANNEL ODYSSEY

The Cinema Trail

The fifty-years-plus that have elapsed since Disney/Buena Vista released Fantasia in FantaSound (1940) I have seen a multiplicity of multi-channel formats come and go.

None of the technology employed had any acoustic or aesthetic rationale that superseded the ultimate driving force in the motion-picture industry: profits.

There are some who claim that all the multi-channel formats owe their origins to the work done at Bell Labs in the early 1930's on auditory perspective [2]. That pioneering work with the Philadelphia Orchestra and Leopold Stokowski demonstrated that a multitude of channels provided a more accurate rendering of the "auditory stage" than either one or two channels.

Some say that the "stereophonic" sound in Fantasia (using the same cast of players) was a derivative of that work. No proof exists to document this assumption however. In fact, the Bell Labs work occurred outside the motion picture sound cosmos, and probably had little effect directly.

The motion picture industry has seen three distinct waves of multi-channel sound. The first wave was the pioneering Fantasia effort using a left-sidewall, screen, right-sidewall format by Buena Vista [3]. The second was the return of this idea in a modified left-screen, center-screen, right-screen, and effects form, over a decade later, by both 20th Century-Fox for its CinemaScope releases, and by Warner Brothers for their 3D productions with WarnerPhonic sound. Those processes required that the

movie company maintain dual inventories: stereo release prints, with magnetic sound added, and mono-optical sound release prints.

The enormous expense this represented, plus the very high costs of stereo prints themselves, led to a very rapid demise of the dual-inventory concept.

During the second wave of multi-channel film releases a seven-channel format was employed by the Cinerama folks (left screen, left-center screen, center screen, right-center screen, right screen, left rear, and right rear). A number of 6-track magnetically striped 70mm wide-screen extravaganzas were produced, culminating in two of the largest "bombs" ever released: Hello Dolly (1969) and Ryan's Daughter (1970).

What those gigantic failures taught the money moguls in Hollywood was very simple: big film, and big sound won't sell tickets. This lead to the almost total disappearance of multi-channel sound until the arrival of the optically compatible, 35mm Dolby format in 1976.

What remained out of all the confusion and dead ends, was one distinct technical fact. By 1954, the three channels of motion picture stereo had become four, incorporating what was then called the "effects channel". This 3+1 approach became a de-facto standard for both the 35mm and early wide-screen 70mm formats (Todd-AO in 1956).

That fourth channel was used for what its name implies - effects mostly designed to make the audience react: startle them, scare them, or otherwise. It appeared out of small speakers placed on the sides and rear of the theater (remember FantaSound?).

As many film mixers point out, the effects approach is often far more useful and realistic than true stereo would be. Since the audience has already suspended disbelief by entering the theater to see and hear a story told, why not enhance the experience whenever possible. Reality is not what the punters are paying for ... excitement is.

Those who remember the ubiquitous voice of the HAL-9000 in 2001 A Space Odyssey (1968) may forget that it spoke only from the "effects" speakers to achieve this.

The third wave encompasses the current generation of Dolby formats, beginning with the early matrix version used for "Dolby Stereo" in 1976. It is with this wave that the consumer and professional industries began to re-acquaint themselves with each other.

The Consumer Trail

The "consumer" audio industry followed its own path, as is its wont. It moved carefully and gradually from mono to stereo on vinyl, and stayed there.

NON-COMMERCIAL CINEMA/SURROUND AUDIO TECHNOLOGY

Oh, yes. I forgot Q U A D R O P H O N I C sound - the 1970's technical marvel that was supposed to revolutionize the musical experience. The matrix-format wars, the incompatibility between them, and the consistently poor results nauseated an entire generation of audiophiles, the only consumers with real money.

Every other new technology to come down the pipe for about a decade suffered; remember the slow start for CD's and all the uproar surrounding digital audio about ten years ago?

The cynicism the quadrophonic disaster left behind, together with a number of other spectacular surround-audio flops including Q-Sound, is most probably responsible for the resistance toward the current generation of multi-channel formats felt by a wide base of music-only users.

Nevertheless a series of developments throughout the 1970's and early 1980's combined to produce what the consumer hi-fi industry has come to regard as the best thing to happen in 20 years: home theater. Key to this was the arrival of the stereo-capable VCR in 1978.

THE PRIVATIZATION OF THE MOVIE EXPERIENCE

There are those who claim to have invented this market segment, usually in the last five years, but history tells a far different tale. The private screening room has been a part of the entertainment technology lexicon for at least 80 years.

True, for the most part, until the early 1970's the private home theater was reserved for the stunningly wealthy or absurdly powerful. But beginning with arrival of Advent's Videobeam projector in the mid-1970's and the commensurate wider availability and small drop in price of the "pro-grade" 3/4 inch video recorders, plus the increasing accessibility of 1/2 stereo VCR units, the tab for admission to the private viewing environments club began to fall.

No longer was there a need for 35mm or 16mm projectors, projection booths, and the related expense and complexity. Now cassettes could be played by simply pushing a single button.

With this simplification, a number of media agencies, began to add "screening" facilities to their offices, and film and television producers, script writers and others being paid the average yearly wage on a weekly basis, also began to add such "media rooms" to their homes and offices.

This is clearly the foundation upon which the wide-scale industry that is emerging today was built.

Most of those early systems employed a hybrid mix of consumer and professional equipment, leading to the development of a small niche industry, usually affiliated with a professional pro-audio supplier, to serve the needs of this esoteric end-user group.

The application of surround speaker systems for these users was generally implemented with

professional decoders from Dolby, and small studio-monitor-type systems from such vendors as JBL, EV, and a few hi-fi companies such as ADS.

Just as the home-cassette taping explosion needed the widespread introduction of Dolby noise reduction to really take off, it once again required the "consumerization" of a professional format to open the floodgates of non-commercial multi-channel audio.

Although a few early visionaries such as Aphex/Proton offered decoder systems that did not use the Dolby format, it was the release of the first "Dolby Surround" decoders that provided the real kick-start for the home-cinema industry.

The instant consumer recognition of the name was a substantial part of this success.

The whole concept almost collapsed on itself right then however, since the first consumer decoders were a pale imitation of the theatrical units. They often provided "surround" information even when that was not what the filmmaker intended.

The cross-channel leakage in those very basic early matrix systems often led to quite bizarre positioning and movement in sound tracks especially when coupled with the less-than-stellar audio source provided by that generation of VCR.

By the mid-1980's two other crucial developments provided the final booster that fully launched the home theater concept.

The first was the arrival of commercial stereo television broadcasts and receivers, just at a point in the product life cycles when many consumers were on the verge of replacing their late 1970's sets. The second was the introduction, in 1987, of the extensively upgraded Dolby Pro-Logic decoder systems using signal steering.

Together these two events ultimately made it possible to recreate, far more accurately, the theatrical experience at home.

In parallel with these technological developments, the enormous growth in the movie-rental business, and the simple fact that for the most part rental revenues exceeded box office revenues gave the financially motivated motion-picture companies exactly what they wanted: a huge, hungry audience just waiting to rent, and even buy their products.

(As a note Blockbuster Entertainment, the U.S.A.'s largest national video rental chain will generate several hundred million dollars in operating profits this year)

NON-COMMERCIAL CINEMA/SURROUND AUDIO TECHNOLOGY

Coupled with the dramatic improvements offered by hi-fi VCR systems, and the bungee jump taken by VCR prices, the size of the potential consumer base essentially tripled in just 36 months.

Electronic Industries Association (EIA) estimates place the probable revenue from this product category for 1993 at just under 600 million dollars in North America. Projections put it at over 5 billion by decade end. Those are numbers quite big enough to draw a crowd, and quickly.

TODAY AND TOMORROW

As things stand today the market has separated into three distinct technology and price categories:

- theater-in-a-box,
- hi-fi expansion and
- custom systems.

Theater-in-a-box is the mass-market product group, with complete audio-system prices ranging from under $400 to around $1000. The second tier covers the price category from $1000 to about $3000 to $4000. The serious systems folks begin around the 4k mark and go as high as anyone wishes to count, with system costs of over $200,000 not all that uncommon. (One less-than-enthused buyer pointed out that he could build a real theater and charge admission for $200,000).

This price/technology segregation has also split the buying public into at least two groups, with two-thirds of those polled in a recent EIA Consumer Electronics Group survey having spent 3k or less. Other surveys place upwards of 75-80% of the buyers in the under 3k range.

Nevertheless with 95 million households in the U.S.A., and a world market estimated at an initial total of 150 to 175 million households it doesn't take a degree in Fourier-transform math to calculate the potential revenue stream even at a 1% growth factor per year.

The gargantuan size of this money pile has allowed the consumer electronics industry to enjoy its first real upward jump in sales in some time. Even the quicksand into which both the DCC and the Mini-Disc appear to be sinking has not dampened this surge.

The imminent availability of cable-delivered enhanced-definition, at least the promise of some form of high-definition television both with 5+ encoded and matrixed digital channels, and the introduction of full-scale DSP processing capabilities into the mid and upper market segments will only expand the possibilities.

The up-coming consumer electronics shows are expected to be the watershed for surround/home cinema, with every major product producer on-board in some way.

The emergence of an ultra-high-end product category supported by the esoteric audio community is proof positive that this tidal wave of demand can not be ignored. People want this experience.

NON-COMMERCIAL CINEMA/SURROUND AUDIO TECHNOLOGY

The next 24 months should see the forging of critical alliances between software providers, such as video dealers, and the motion picture studios, and the hardware providers such as manufacturers, retail dealers and custom installation companies, both for consumer and business applications.

The emergence of the *Home Theater Industry Association* whose membership includes all of the above plus the trade media is a significant step in this direction. That organization will be organizing consumer shows, using the support of the various constituencies, all of whom can profit from increased awareness and sales of home theater/surround audio products and systems.

It has already set up and run a home theater pavilion at the recent Video Software Dealers Association trade show in Las Vegas, attended by more than 25,000 video rental dealers. The sales and profit potential of joint promotions between dealers and movie rental stores is largely untapped - so far.

The recent spate of Telephone company/cable company and hardware commune/software providers mergers (Sony/MCA -- Bell Atlantic/ TCI) only enhances the possibilities for creative marketing.

The two buyer categories with the most money - the 35-to-50 baby boomers, and the 28-to-35 near-boomers - who want to enjoy their homes, and have grown up with hi-fi, surround-motion pictures, and TV, are queuing up to get in.

The on-the-horizon multi-media digital cable/satellite systems, and all they might provide, can only expand the demand even further.

Remaining almost as an afterthought so far has been the use of these systems to expand and enhance the musical listening experience itself. In the more than 50 custom systems I have designed and created, the user has universally been "stunned" by the sound of his musical collection when played back through a multi-channel system. In many cases the listeners spend considerable time re-exploring music they have not listened to in years, because it sounds much closer to the way they remember the "live" concert they last attended for that artist.

This year's arrival of video games with Dolby-licensed surround audio is designed to bring yet another generation into the fold.

The possibilities are enormous, and the rewards tangible. Very soon re-creating the live experience will not be just a pure fantasy, but simply a question of available processing power and control.

REFERENCES

[1]. T. Uzzlel, 'When the Movies Learned to Talk', Kinotic Press, 1991.

[2]. H. Fletcher, 'Basic requirements for auditory perspective', J. C. Steinberg and W. B. Snow, 'Physical factors in auditory perspective', and E. C. Wente and A. L. Thuras, 'Loudspeakers and microphones for auditory perspective', reprinted in JourSoc Motion Picture and Tele. Eng., v. 61 n. 3 pt. 2 pp. 415-446, September 1953.

[3]. Howard Tremaine, Audio Cyclopedia, 2nd edition, Howard W. Sams, 1973, pp. 1060-1061.

Author's acknowledgements: The author would like to thank Mr. Ted Uzzle for his substantial assistance with the historical aspects of this paper and for his courtesy in reviewing the manuscript for technical accuracy regarding film sound formats. For those seeking more information on the history of sound on\for motion pictures, Mr. Uzzle's monograph When the Movies Learned to Talk (Kinotic Press 1991, available from Mr. Uzzle fax 913 -967 1905) is highly recommended. Additional technical information for this paper was obtained from Dolby Laboratories publications and The Society of Motion Picture and Television Engineers (SMPTE).