The History of Dolby & it's core technologies.

The Company's Founding

Dolby Laboratories was founded by Ray Dolby, who started his career in high school, when he went to work part-time for Ampex Corporation in Redwood City, California. While still in college, he joined the small team of Ampex engineers dedicated to inventing the world's first practical video tape recorder, which was introduced in 1956; his focus was the electronics.

Upon graduation from Stanford University in 1957, Dolby was awarded a Marshall Fellowship to Cambridge University in England. After six years at Cambridge leading to a Ph.D. in physics, Dolby worked in India for two years as a United Nations Adviser to the Central Scientific Instruments Organization. He returned to England in 1965 to found his own company, Dolby Laboratories, Inc. in London. Always a US corporation, the company moved its headquarters to San Francisco in 1976.

The Decision to Manufacture Professional Equipment

Dolby's first development under the aegis of his new company was called Dolby A-type¤ noise reduction. It was a sophisticated new form of audio compression and expansion that dramatically reduced the background hiss inherent in professional tape recording without discernible side effects on the material being recorded. Among the new concepts incorporated into the system was the treatment of soft signals only, leaving the loud signals that naturally mask noise unprocessed, and dividing the spectrum into multiple bands to prevent the pumping (noise modulation) inherent with conventional wideband companders.

Dolby manufactured his new system himself, and marketed it primarily to record companies. That decision laid the foundation for what today accounts for a large percentage of Dolby Laboratories' worldwide turnover: manufacturing professional audio products in the company's own factories. Its freedom from side effects, more than any other feature, is what differentiated Dolby noise reduction from previous attempts at audio noise reduction, and ultimately earned it a place in virtually every recording and film sound facility in the world.

While at first glance noise reduction (NR) appears to be an esoteric invention with limited applications, its effects on the audio industry have been profound. The multitrack recording techniques that blossomed in the late 1960s and early 1970s, for example, came about only because of Dolby A-type NR. Without it, the high tape hiss resulting from the combination of narrow tracks and multiple mixdowns would have been intolerable. And when applied to consumer formats and motion picture sound, the results were to be even more far-reaching.

The Decision to License Consumer Technology

Dolby undertook the development of a consumer version of his noise reduction system at the urging of Henry Kloss, an American audio pioneer and entrepreneur who at the time was president of KLH Research and Development Corp., a manufacturer of home hi-fi equipment. The result in 1968 was the introduction of Dolby B-type¤ noise reduction, based on yet another new principle. Like A-type, B-type processed only low-level signals. But instead of dividing the signal into fixed multiple bands, B-type NR used a single, less-costly sliding band of compansion. This sliding band accomplished noise reduction in the higher-frequency hiss region, where most of the noise at consumer tape recording speeds resides, with much the same freedom from side effects as A-type.
Dolby B-type noise reduction, like A-type NR, is a complementary compression/expansion system, requiring encoding when a recording is made, and decoding when the recording is played back. To be successful, therefore, it had to be incorporated into products that would wind up in consumers' homes. As work on the B-type system neared completion, Dolby made a significant decision: Dolby Laboratories would manufacture professional audio products only, and it would license technology appropriate for consumer applications. This was truly a watershed decision, followed very closely by one of nearly equal importance.

Dolby and the Compact Cassette

The first consumer product to incorporate Dolby B-type noise reduction, under an exclusive license lasting until 1970, was an open-reel tape recorder brought to market by KLH in 1968. While this unit offered high performance, it nevertheless stuck with the cumbersome open-reel format, which never enjoyed wide consumer acceptance. Dolby had already realized that if tape was to do so, it would be with an easy-to-use cartridge format.

Dolby and his staff undertook an investigation of the then-available cartridge tape formats, and concluded that the Compact Cassette, which enclosed two reels within a cartridge small enough to fit into a shirt pocket, had the greatest potential. Introduced by Philips a few years earlier as a voice recording device, it made no pretense to high fidelity.
As a result of a narrow 1/8-inch tape width and a slow 1-7/8 inches per second recording speed, the cassette's fidelity was limited primarily in three areas: speed stability, frequency response, and background hiss. The first two were surmountable, and had already shown signs of improving through better tape drive mechanisms, heads, and tape formulations. But the hiss remained an insurmountable barrier until the advent of Dolby B-type noise reduction. By combining Dolby B with the best available cassette decks, Dolby Laboratories was able to demonstrate cassette recordings that rivaled LP records for high fidelity.
Believing in the potential of the Philips-type cassette combined with Dolby B-type noise reduction, Dolby Laboratories set out to license Dolby B to tape recorder manufacturers worldwide. This was a second key decision in the establishment of the Dolby licensing program: to license a seemingly esoteric development in terms of a specific, potentially popular application.

Dolby Licensing Takes Off

In the summer of 1970, the first cassette recorders with Dolby B-type NR all built by Nakamichi, at that time an exclusively OEM manufacturer in Japan were introduced by Advent, Fisher, and Harman Kardon. The concept met with instant acclaim, and four more manufacturers were licensed by the end of 1970. Dolby acquired the necessary expertise early on to deal effectively with manufacturers in Asia, which has been critical to the success of Dolby's licensing program. Today the company has its own licensing liaison offices in Tokyo, Shanghai, and Beijing to serve its many Asian licensees.

In 1971, with a growing number of licensees, Dolby introduced a simplified license agreement granting patent, trademark, and know-how rights, and a new royalty structure based on the number of Dolby circuits sold per quarter. This program remains the basis for Dolby licensing today, and the modest royalty rates have had much to do with the willingness of consumer electronics manufacturers to turn to Dolby Laboratories for technology and know-how. That the company has never competed with them by making its own consumer products further fosters the cordial relationship between Dolby and its licensees.
As licensees began to include companies catering to the middle and lower ends of the market, the need arose for more formally stated and enforced quality standards. The company then set up a formal quality control program for its licensees' products, which prevents products with substandard performance from reaching the market, thereby maintaining the quality image of products featuring Dolby technology and trademarks. Today, Dolby Laboratories tests samples of hundreds of licensed products every year.

Another key piece of the Dolby licensing program also fell into place in 1971: Dolby and Signetics Corporation began to cooperate in the development of a dedicated integrated circuit (IC) embodying key elements of the Dolby B-type circuit. That first IC and its many successors greatly simplified the implementation of Dolby technologies, widening the range of products in which they could be used and thus considerably increasing the size of the potential market. Today there are many IC iterations of both analog and digital Dolby technologies, all developed with Dolby's close cooperation, available to licensees for incorporation within their products. Costs for developing these ICs are borne by their manufacturers. Dolby, however, earns no royalties on the ICs themselves nor charges for the assistance it provides in their development; the company earns royalties only on the consumer products that incorporate the ICs.

Media Licensing

In 1970 Dolby began to promote the idea of releasing prerecorded cassettes encoded with the Dolby B-type¤ characteristic, so that they would have low noise when played on players equipped with Dolby B-type noise reduction. Listening tests performed by several record companies, notably Decca in the UK and Ampex Stereo Tapes in the US, showed that Dolby B encoded tapes were even preferred over non-encoded tapes when played on players without noise reduction, eliminating the need to release cassettes in both encoded and unencoded forms. Later that year, these companies issued their first B-type encoded tapes, using professional-quality B-type encoders manufactured by Dolby Laboratories. (Dolby has continued to supply the recording industry with encoders embodying its technology, thereby ensuring proper playback on the licensed consumer products that meet its quality standards).

Within a few years, virtually all prerecorded cassettes would be encoded with Dolby B-type NR, which remains true today. Indeed, the Dolby B encoded cassette was to become the most popular carrier of recorded music the world had ever seen, eventually surpassing LP record sales, and itself surpassed only by the CD in the early 1990s.

Dolby developed a trademark and quality-control license for record companies to use the Dolby trademarks on prerecorded tapes. To help establish Dolby B as the standard consumer tape noise reduction system and to promote sales of Dolby B equipped cassette recorders, the license was made royalty-free. This policy has remained in effect for all media recorded with Dolby technologies, which today encompasses not only virtually all audio cassette releases, but also thousands of videocassette, laser disc, video game, and DVD releases encoded with Dolby Surround and/or Dolby Digital.

Dolby Licensing Today

Dolby's licensing effort is administered by a large staff of engineers, technicians, and intellectual property specialists at the company's San Francisco headquarters. Dolby's comprehensive licensing program includes testing hundreds of product and software samples, regularly visiting consumer electronics factories and design centers worldwide, and assisting IC manufacturers in implementing Dolby technologies as integrated circuits for inclusion in consumer products.

In addition to analog noise reduction and home theater surround sound technology, licensed technologies today include many digital technologies, such as Dolby Digital, the multichannel digital surround sound format adopted for use with DVD, digital broadcast TV, digital cable, and direct satellite broadcast (DSB).

Dolby Investigates Film Sound

In the late 1960s, even as B-type noise reduction was coming to market, Dolby began to seek out additional applications for its noise reduction technology. One area that looked promising was film sound, in particular, the photographic or "optical" soundtrack, introduced in the late 1920s and, thanks in great part to Dolby's efforts, still by far the most popular kind of film soundtrack.
The optical soundtrack has many advantages, including economy, reliability, and relatively long print life. Equally as important, 35 mm film with optical sound is a truly universal medium: A film made in the US, for example, can play in theatres the world over. This universality, however, has its downside.

To forestall compatibility problems after a decade of theatres racing to install sound equipment and filmmakers rushing "talkies" into production, in the late 1930s the film industry adopted a standardized theatre playback response that today is called the "Academy" characteristic. While this resulted in a system of recording and playback that made it possible for just about any film to sound acceptable in any theatre in the world, it lacked the flexibility to incorporate improvements beyond the limitations of the 1930s. Indeed, well into the 1970s conventional optical sound reproduction in the theatre had a frequency response little wider than a telephone's.

Upon investigation, Dolby found that many of the limitations in optical sound stemmed directly from its significantly high background noise. To filter this noise, the high-frequency response of theatre playback systems was deliberately curtailed (the "Academy" characteristic). To make matters worse, to increase dialogue intelligibility over such systems, sound mixers were recording soundtracks with so much high-frequency pre-emphasis that high distortion resulted.

Off to a Slow Start

Dolby conjectured that applying Dolby A-type noise reduction to the optical soundtrack would enable wider frequency response in the theatre, and also permit mixers to record "flatter," less distorted soundtracks. The theoretical result significantly higher fidelity optical sound subsequently proved to be true.

Dolby went on to develop an A-type noise reduction unit specifically for use in movie theatres, which incorporated a special equalizer to widen the response of theatre speakers already in place. The compatibility of movie prints with A-type encoded soundtracks heard in theatres without a Dolby decoder was tested and judged acceptable, much as B-type encoded cassettes were being accepted as compatible. Thus, when lobbying the film industry to produce encoded films, Dolby could argue that only one type of release print would be needed for all theatres.

This first film sound attempt met with only modest success, however. While the improvement in fidelity was unquestionable, optical sound was still mono. By this time, superior hi-fi stereo systems had been installed in so many homes that a significant proportion of the movie-going public was used to better sound at home than could be heard in the theatre. And since the 1950s, the movie industry had had at its disposal a different soundtrack method that provided multichannel stereo sound.

This alternative method involves applying narrow stripes of iron oxide material (similar to the coating on magnetic recording tape) to the finished release print. The sound is then recorded on the magnetic stripes in real time. The film is played back on projectors equipped with magnetic heads similar to those on a tape recorder.

Many theatres had been equipped for magnetic sound in the 1950s. However, by the 1970s, the expense of magnetic release prints (more than ten times that of optical prints), their comparatively short life (compared to optical prints), and the high cost of maintaining magnetic playback heads led to a massive reduction in the number of magnetic releases and theatres capable of playing them. Magnetic stereo sound came to be reserved for a only handful of first-run engagements of blockbuster releases each year. By the time Dolby came on the scene, moviegoers were again usually hearing low fidelity, mono optical releases, with only an occasional multitrack stereo magnetic release.

The Formula for Film Sound Success

By the early 1980s, this logo appeared on hundreds of feature films yearly and on thousands of cinema marquees worldwide.

Recognizing that the film industry was not eager for an improved mono format, Dolby Laboratories introduced a true breakthrough in 1975: a highly practical 35 mm stereo optical release print format originally identified as Dolby Stereo¤. In the space allotted to the conventional mono optical soundtrack were two soundtracks carrying not only left and right information, but also information for a third center-screen channel and a fourth surround channel for ambient sound and special effects. Yet the new track was configured to allow mono playback too, requiring only one kind of release print.

This new optical format provided both multichannel stereo and higher quality sound. As with the original mono format, Dolby noise reduction lowered the hissing and popping, and loudspeaker equalization was provided to adjust the theatre sound system to a new, wide-range standard response curve.

Unlike expensive magnetic prints, the Dolby optical four-channel stereo format prints cost no more than mono prints. What's more, conversion to Dolby optical was relatively simple and once the equipment was installed, very little maintenance was required, particularly compared to magnetic stereo playback systems.

Four-channel surround sound from stereo optical soundtracks remains the standard analog format today, although much improved with the application of Dolby SR beginning in 1987.

The Dolby Film Program

Although the potential for the new stereo optical format was far greater than the original mono Dolby format, success did not come overnight. Whereas Dolby noise reduction for professional tape recording was a relatively straightforward add-on and could be marketed as such, Dolby's new film format required significant changes throughout the film sound recording/producing chain, and thus throughout the film industry.

Dolby's ultimate goal seemed simple enough: to produce and profit from a new range of theatre sound-processing equipment. However, for that to happen, film producers had to be educated about the benefits of the new format. Sound mixers had to be brought up-to-date with new techniques. Distributors had to be reassured that stereo release prints were compatible with mono theatres. Theatre equipment suppliers had to be educated in system requirements and installation procedures. And theatre owners had to be convinced that investing in the new equipment would pay off at the box office. As a result, it was necessary to implement and staff a film sound program that would reach out to all these disparate segments of the film industry.

The resulting international program is multifaceted. Dolby film sound consultants assist at the mix of films slated for release with soundtracks utilizing Dolby technology (available today in every film production center in the world). Dolby has also established offices in New York and Los Angeles to further assist the US film industry, and it regularly conducts training courses for equipment installers and technicians on Dolby theatre sound

equipment.

As with other media, Dolby builds the encoding equipment necessary to produce soundtracks incorporating Dolby advances. This equipment is not sold outright, but is leased to film companies and studios. This policy, along with the quality control applied to film soundtracks by Dolby consultants, the fact that Dolby manufactures theatre sound processors with the same standards as the encoding equipment, and the various Dolby training programs, helps ensure the high quality presentation audiences have come to expect from seeing the name Dolby on the cinema marquee.

One further element was needed to ensure Dolby's lasting presence in the field of film sound: audience awareness. This came in 1977, with the release of two immensely popular films that were recorded with the new Dolby technology: *Star Wars and Close Encounters of the Third Kind*. These blockbusters were exhibited in enough theatres that had the new Dolby equipment for audiences and industry alike to sit up and take notice. Marketing research soon showed that moviegoers would seek out theatres exhibiting in the Dolby stereo format, and avoid mono presentations of the same films.

While "big" films were early adopters of the new Dolby technology, it wasn't long before films of all types were released with stereo optical soundtracks. This created a profound change in the moviegoing experience. In 1976, when you went to the movies, chances were that it would have low-fidelity, mono sound; multichannel hi-fi stereo was a rarity. Today, chances are your film will be presented with multichannel stereo sound attributable directly to Dolby Laboratories and its film sound program.

Dolby Surround and Home Theater

Recognizing the potential for decoding multichannel sound at home, in 1982 Dolby introduced Dolby Surround, a consumer extension of the Dolby film sound project. The first technology to be licensed to consumer electronics manufacturers was a means of decoding the surround channel in home systems. This was followed by Dolby Surround Pro Logic, a technology that made it possible to decode the center channel as well, and to take advantage of advanced circuitry developed originally for theatrical playback.

Unlike the quadraphonic sound of the 1970s, Dolby Surround quickly gained marketplace acceptance. For one thing, the multiple channel configuration and its ideal utilization it were firmly established within one industry (film) in advance of its introduction to another. Also, it was developed with a clear objective, specifically to enhance the viewing experience. And third, software and hardware standards for both the film and consumer electronics industries are defined by one organization.

As home viewers began to set up more surround systems, the consumer electronics industry realized that a new category of home playback system was being forged. "Home theater," as it is now called, soon became the fastest-growing consumer electronics segment, bringing new life to a stagnating industry. Like Dolby noise reduction, Dolby Surround is administered by the Dolby Laboratories licensing program with quality standards both for hardware and for recorded and broadcast media.

Dolby Surround programming now includes television broadcasts not only films with soundtracks encoded with Dolby technology, but also regular TV series, specials, and sports events transmitted in Dolby Surround. Dolby Surround has even spread to video games and other multimedia applications. As with Dolby films, material encoded with Dolby Surround is compatible with two-channel stereo, and even mono playback.

Dolby and the Digital Age

Dolby's reputation as a leader in audio technology was greatly enhanced in 1986 with the introduction of a powerful new system, Dolby SR (spectral recording), intended to bring analog recording into the digital age. By combining both the fixed and sliding band technologies invented for the earlier noise reduction systems, Dolby SR improved the performance of existing professional analog recorders to the point where they equaled, and in some respects surpassed, very costly digital recorders. This proved a boon to many professional recording facilities unable to afford digital equipment.

Just as important, Dolby SR improved film sound significantly, both in the mixing of soundtracks and in the soundtracks themselves. Today the Dolby SR encoded analog optical soundtrack, with its ultra-low noise and distortion, is the state-of-the-art in analog film sound, and is used for the vast majority of releases, including

those that also have digital soundtracks. Dolby SR also fostered a new, more powerful NR system for consumer cassette recording, Dolby S-type.

Concurrent with developing these advanced analog systems, Dolby Laboratories began researching digital audio in 1982. The primary goal was, and remains, to reduce the amount of data required to transmit and store high-quality digital audio. Without such perceptual coding, as reduced bit-rate digital audio systems are sometimes called, digital audio's appetite for bandwidth would severely limit its potential.

The first Dolby digital coding system, Dolby AC-1, was introduced in 1984. It was adopted beginning in 1985 in a number of direct satellite broadcast and cable distribution systems. Encoding units are manufactured by Dolby Laboratories, while the decoder is licensed. Dolby AC-2, a more sophisticated system providing full professional quality audio, was introduced in 1989. It has since become particularly popular with music recording and film studios for interconnecting widely separated facilities via economical ISDN lines for remote monitoring, dubbing, and other applications. Dolby AC-3, now known simply as Dolby Digital, was introduced in 1992; it was developed specifically for multichannel applications, including film sound and digital surround sound in the home. Dolby Digital (AC-3) is a multichannel digital audio coding technology first used for cinema sound (1992). Today it is also used to bring multichannel sound into the home via a wide variety of digital formats, including DVD, DTV, digital cable, and DBS.
Dolby's move into the world of digital audio has been facilitated by its many years of research into psychoacoustics and noise reduction, which is in essence a form of analog audio coding. For example, as the amount of available digital data for audio goes down, background noise goes up. Dolby's digital technologies use that apparent weakness to its advantage, by deliberately allowing the noise level to go up to a point at which it is just hidden, or masked, by audio signal itself.

Once noise is below a certain threshold, it is inaudible so there is no point in further reducing it. However, that threshold varies in different parts of the audio spectrum, called critical bands, and also varies with how loud the signal is in each band at any given moment. Both Dolby AC-2 and Dolby Digital constantly monitor how loud the signal is in each of these critical bands, and code it with just enough data to keep the noise just below that band's threshold of audibility. Dolby Digital also compares what's happening in these bands in different channels, so that sounds in one channel can provide masking for noise in another. The net result of this complex process is a dramatic gain in efficiency: Dolby Digital makes it possible to transmit or store six audio channels with less data than is needed for just one channel on a CD.

Dolby Digital and the Future

The first application for Dolby Digital was film sound. Its bit-rate reduction made it possible to put a completely separate optical soundtrack on 35 mm release prints (between the sprocket holes). With this space savings, Dolby Digital movie prints can have an analog Dolby SR optical track in the usual location to ensure compatibility with all theatres. Dolby Digital is now also used for laser discs, DVDs, ATSC digital broadcast TV, digital cable systems, and satellite systems.

When it comes to digital sound with film, on disc, and other consumer formats, Dolby Laboratories faces considerable competition; however, the company remains unique in its ability not only to develop superior technology, but also to foster its adoption worldwide by means of its professional equipment manufacturing facilities, its licensing program, and its film sound program. Add to these advantages a skilled, dedicated staff and an unmatched reputation for quality, and Dolby Laboratories faces the future with confidence.