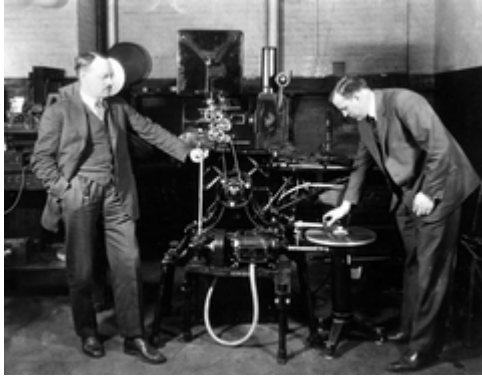


## Motion Picture Sound 1910-1929



sound-on-disc  
ERPI/Warner Vitaphone



sound-on-film  
ERPI/Fox variable density



sound-on-film  
RCA/RKO variable area

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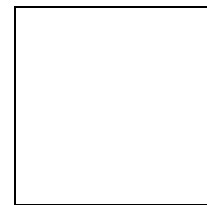
1930-1989 - see [Motion Picture Sound part 2](#)

1990-2000 - see [Motion Picture Sound part 3](#)

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1910 - Eugene A. Lauste was born in Paris in 1857, worked at Edison's Orange N.J. lab 1887-1892 under W.K.L. Dickson, joined Major Woodville Latham 1894 to develop the Eidoloscope, a wide film projector that used the Latham loop, first exhibited publicly in May 1894 in New York. While working for Edison, Lauste read a *Scientific American* 1881 article about Bell's Photophone and sought to use this method to record sound on 35mm motion picture film. He applied for a patent in England on Aug. 11, 1906, and granted in 1910, for a "new and improved method of and means for simultaneously recording and reproducing movements and sounds." (Fielding p. 173). His first device used a mechanical grate, then mirrors, and by 1910 developed a light gate of a vibrating silicon wire between two magnets. Lauste made many sound films 1910-1914, but was halted by the war.

1913 - Edison developed the Kinetophone that connected a special cylinder machine with oversize long-playing cylinders to a film projector by means of an overhead belt with 3-inch pulleys. The speed was governed by the phonograph behind the screen and the projector at the other end of the theater in the projection booth had a braking device to slow the film speed to keep synchronization.



Edison Kinetophone, 1913  
from Edison NHS

1915 - Harold Arnold began program at [Bell Labs](#) to improve sound recording using the vacuum tube amplifier, condenser microphone, balanced armature loudspeaker, and light

valve. This would lead to the [electrical recording](#) technology used by the two basic motion picture sound systems: sound-on-disc and sound-on-film. Edward B. Craft was asst. chief engineer at Western Electric 1918-1922, then VP of Bell Labs 1925. He led the motion picture sound project. He arranged demonstrations at Yale Oct. 27, 1922, and in Feb. 1924 for the sound-on-disc method that produced better sound than the sound-on-film method. A recording studio was set up in 1923 to make experimental films. The Western Electric sound-on-disc system made test films in room 1109 at 463 West St. by H. M. Stoller, under project chief J. P. Maxfield. T. L. Downey designed the recording turntable; H. C. Harrison designed the electrical recording head with cutting stylus; E. C. Wentz designed condenser microphone (Patent No. 1,333,744 filed December 20, 1916) and an improved light valve for sound-on-film (Patent No. 1,638,555 filed May 1, 1923).

1917 - Theodore W. Case developed the Thalofide photocell that used thallium oxysulfide. By 1922 he developed the Aeo-light as a source of modulated light. E. I. Sponable worked with Case after 1916 and from 1922 to 1925 he shared equipment with de Forest. Case and Sponable in 1924 developed a sound recording mechanism for a modified Bell and Howell camera using the Aeo-light tube. After breaking off from de Forest in 1925, Case began to develop a projector sound head, offset 20 frames at a speed of 90 ft. per min., using a narrow slit with a helical filament. General Electric and Western Electric were developing their own sound systems, so did not wish to buy into the Case-Sponable system. William Fox licensed the system July 23, 1926, and organized the Fox-Case Corp. with Courtland Smith as president to develop what became known as the Movietone News service. Sponable left the Case lab to join Fox in designing the recording studios in New York and Hollywood, and he designed in 1927 a screen that allowed sound to pass through the screen. The Fox-Case Corp. licensed amplifiers and speakers from Western Electric in 1926 and from ERPI organized in January 1927.

1918 - J.T. Tykociner developed a sound-on-film system at the University of Illinois that used mercury arc light and a Kunz photocell (a cathode of potassium on silver).

1921 - Charles A. Hoxie developed a sound film recorder called the "Pallphotophone" (meant "shaking light sound") at GE, a company that had a well-established photographic and motion picture laboratory under C. E. Bathcholtze for company use and publicity. He recorded speeches by President Coolidge and his Secretary of War and others that were broadcast on WGY in Schenectady in 1922. He developed that Pallotrope that was a photoelectric microphone to be used as the sound pickup. His film soundtracks were variable-area type. GE gave demos in 1926 and 1927 of the Hoxie system with loudspeakers and amplifiers from Bell Labs. The GE system was called the Kinegraphone and used to exhibit a "road show" version of the Paramount film *Wings* in 1927, using multiple-unit cone-and-baffle type loudspeakers in a bank on each side of the screen. The soundhead was placed on top of the projector because sound projectors had not yet been installed in theaters. Film speed was 90 ft. per min (24 fps) and the optical soundtrack was recorded on the edge of the film, image size having been reduced from 1 inch down to 7/8 inch to make room for the variable area soundtrack. In 1927 the film project was transferred from the Engineering Laboratory to the Radio Dept. for

commercial manufacturing. GE would work closely with Westinghouse and RCA in the manufacturing of sound film equipment.

1922 - Western Electric presented an experimental animated sound-on-disc film "The Audion" at Yale on Oct. 27, 1922. Cecil B. DeMille began using the Western Electric [public address system](#) to instruct extras on his movie sets at Paramount.

1923 - The Rivoli Theater in New York exhibited on April 15, 1923, one of the first programs of de Forest short Phonofilms. It featured vaudeville stars Weber & Fields, Sissle & Blake, Phil Baker, Eddie Cantor, Eva Puck & Sammy White, Conchita Piquir. The next year de Forest made a 2-reel sound comedy, *Love's Old Sweet Song*, with actress Una Merkel. But studios resisted spending millions to equip theaters with sound equipment.

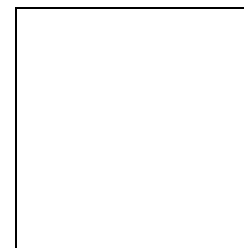
1924 - "The first experimental, electrically recorded talking picture was exhibited with success in Woolsey Hall at Yale University in New Haven in October, 1922. The New Haven success was followed by a

1924 film called *Hawthorne*. This was a film with sound-on-disc showing Western Electric's role as the manufacturing unit of the Bell System. It was the first industrial sound picture and was shown at the Hotel Astor in New York at a dinner given by C. G. DuBois, then president of Western Electric, to 250 Bell System officials. By 1924, many people thought sound motion pictures should be commercialized. Because of the numerous failures in the USA and Europe, the Bell System decided to produce a series of test films with professional talent. The superiority of the Western Electric's new sound picture equipment was repeatedly demonstrated. Even so, by the end of 1924, practically every major producer in Hollywood had rejected Western Electric's sound picture system.



E. B. Craft demonstrates Vitaphone, from AT&T Archives

The motion picture producers had large inventories of silent films, and performers were under long term contracts. Studios and theaters were not equipped for sound, and the costs for conversion were staggering." (from "BTL Historic Record Collection - Background Information" 1979)

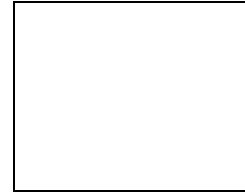


Vitaphone engineer George Groves at a 1925 electrical disc-cutting lathe for sound movies, from AT&T exhibit "The Dawn of Sound"

1925 - Warner Bros. was the only studio interested in the Western Electric system. Warner had bought the Vitagraph Co. 1925 and started the radio station KFWB in LA 1925. Nathan Levinson was the West Coast rep of Western Electric and took Sam Warner to a demonstration in New York City in April 1925, and Warner bought it and it became the Vitascope system. "Early in 1925, N. Levinson, Western's radio specialist from the Pacific district visited Bell Labs at 463 West Street to see the latest developments in public address equipment. During this visit,

he attended a sound picture demonstration of one of the musical shorts made in 1924. A few weeks later, he returned to California and told Sam Warner of the WE sound motion picture successes. Later in 1925, Sam Warner arrived in New York with Levinson and attended a demonstration. His reaction was that the system

was "the greatest thing in the world." Subsequently, the Vitaphone Corp. was organized in 1926 [*sic* - correct date for the formation of the Vitaphone Corporation is 1925, after Walter J. Rich signed a formal agreement with Western Electric May 27, 1925, to create a sound film company, and sold half interest of the rights to Warner Bros. June 25, 1925 - see Hochheiser p. 281] and on August 6th, 1926, Western Electric and Bell Labs in collaboration with Warner Brothers Pictures, Inc., and the Vitaphone Corp. showed the world's first successful commercial sound picture, *Don Juan*, featuring John Barrymore, at the Warners' Theater in New York. The success of *The Jazz Singer*, starring Al Jolson in 1927 completed the conquest of the "silents" by the Bell Labs/WE system." (from "BTL Historic Record Collection - Background Information" 1979)

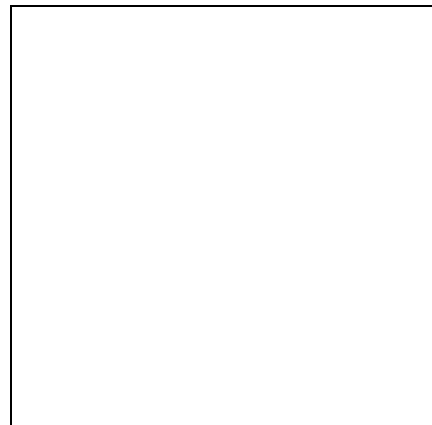


billboard 1926,  
from AT&T Archives

1926 - One of the first Vitaphone shorts was made with Bryan Foy in the Manhattan Opera House in New York, with subway noise frequently interrupting the recording, according to mixer George Groves.

Vitaphone used a 12-inch or a 16-inch disc on a turntable geared to a projector with a Western Electric 4-A pickup, at 33-1/3 rpm for 9-10 minutes, from inside to outside, on one side only, with a lateral-cut groove. Victor made the Vitaphone records with much less abrasive filler, causing the discs to wear out after only 24 plays. Vitaphone discs had a needle force of 3-6 ounces and frequency response of 4300 Hz. The Fox sound-on-film was 8000 Hz but had more wow and flutter and more noise caused by light cell reading film

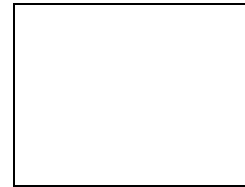
emulsion grain. The RCA-GE Photophone system used the variable area method that had less noise than the Fox variable density method. Wente's light valve in the Western Electric variable density sound-on-film method was capable of a frequency response of 8500 Hz. On Dec. 20, 1926, Western Electric and AT&T created the Electrical Research Products Inc. (ERPI) to license non-telephone technology, including Vitaphone and microphones and amplifiers and loudspeakers. On Dec. 31, Fox signed an agreement with ERPI to combine its Movietone sound-on-film method with Western Electric's amplification methods for theater use. This variable density system would compete for the next decade with the RCA variable area system that was adopted by RKO after 1928.



Vitaphone record,  
from AT&T exhibit  
"The Dawn of Sound"

1926 - Warner moved the Vitaphone studio to the old Manhattan Opera House in NYC (would move to Hollywood 1927/07). Production began on the first Vitaphone short May 24, *The Volga Boatman*. the music for *Don Juan* was recorded by the New York Philharmonic in June for the film's premier Aug. 6. E.C. Wentz brought the last equipment needed at the end of July: loudspeakers that were installed in the Warner Theatre orchestra pit only 2 weeks before the August premier. "On August 6, 1926, the glitter of Broadway was intensified by illuminated billboards announcing the

premiere of the world's first commercial movie with sound. Those lucky enough to get in paid a record \$10 to witness the passing of one era and the birth of another. Instead of watching a silent flick accompanied by a lone pianist in the pit, they saw moving images of the 107-member New York Philharmonic play and heard the symphonic sweep of the overture to Wagner's Tannhauser. Later, Elman, Bauer and Zimbalist played and Martinelli sang in a series of Vitaphone shorts. The main feature presented John Barrymore and Mary Astor in *Don Juan*, with a synchronized musical background." (Western Electric press release, August 6, 1976)



Warners' Theatre,  
from AT&T Archives

1927 - The first theater loudspeakers were put below or to the side of the screen, until Earl Sponable's development of the porous screen in 1927 allowed speakers behind the screen. This center placement of sound became the standard after 1927 until CinemaScope in the 1950s.



Vitaphone theater,  
from AT&T Archives

1927 - [\*The Jazz Singer\*](#) premier Oct. 6 by Warner Bros., using the Vitaphone sound-on-disc method.

1928 - *Steamboat Willie* was Disney's first sound film, featuring Mickey Mouse whose animation was drawn by the beat of a metronome, with a fully-synchronized soundtrack of music and sound effects and dialogue, recorded optically as sound-on-film.

1929 - *The Broadway Melody* premiered Feb. 1, the first of MGM's "all talking -- all singing -- all dancing films," after the studio licensed the sound-on-film process from ERPI. The film was produced at a cost of \$280,000 but grossing \$4, 000,000 and winning the Oscar for Best Film. When Irving Thalberg ordered one of the musical numbers re-shot, the actors saved time and money by mouthing the songs from the first version's soundtrack, and thus introduced the technique of dubbing separately-recorded sound into a new scene.

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## Motion Picture Sound 1930-1989

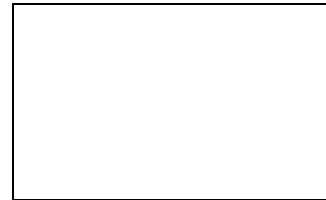
1910-1929 - see [Motion Picture Sound part 1](#)

1990-2000 - see [Motion Picture Sound part 3](#)

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1930 - After the invention of [electrical recording](#) that made sound pictures possible after 1926, the motion picture soundtrack was standardized as a single-track (monaural) sound-on-film (optical) track on the edge of a 35mm film strip.

An example of such a soundtrack can be seen at right, in the image of a 35mm film with the wavy line of the optical sound on the left side between the image and the sprocket holes. Some variable width tracks had a solid black left edge, as in the example at right, or some had a solid right edge, or some were variable on both edges. In most theaters, a Western Electric 35mm film projector had an optical pickup head that read the variable width or variable density image with a selenium photoelectric cell, producing an electrical signal that went to a monaural tube amplifier that drove a large horn speaker behind the screen at the front of the theater (see [Sound Research at Bell Labs](#) for the development of electrical recording).



frame with soundtrack from the 1935 WPA film *We Work Again*, National Archives.

1934 - RCA introduced a 16mm sound motion picture camera for the amateur market that recorded an optical soundtrack on the edge of the film

1935 - Douglas Shearer at MGM developed a two-way speaker system that became standard in theaters for the next 20 years. This system used a multicellular high-frequency horn and a low-frequency section of 15-inch woofers. MGM first installed the speakers in the New York Loew's 5000-seat Capitol Theater on Broadway for the premier of *Romeo and Juliet*. To make components, MGM turned to the Lansing Manufacturing Co. in Los Angeles that grew into the Altec Lansing Co. by 1941 and JBL in 1955, the industry leader in motion picture loud speakers. The Shearer-Lansing system won an Academy award in 1936 for technical excellence. (see [A Brief History of James B. Lansing](#) by John Eargle)

1937 - The film *One Hundred Men and a Girl* starring Deanna Durbin was released by Universal in standard monophonic sound, but it was the first film soundtrack originally recorded by RCA in the "Multiple Channel Recording" process that had been developed by Bell Labs and RCA since 1932 at the Philadelphia Academy of Music. The songs of Durbin and the orchestra of Leopold Stokowski were recorded on 9 channels, each channel printed optically on separate 35mm motion picture film. The 9



poster from [IMDb](#)

channels were then edited into one channel for the optical soundtrack on edge of the release prints. The same recording process would be used in 1940 for Disney's *Fantasia*.

1940 - Nov. 13 premier of Walt Disney's *Fantasia* in New York's Broadway Theater with a multichannel soundtrack produced by [Leopold Stokowski](#) who recorded an optical track for each section of the orchestra, resulting in 9 separate soundtracks.



1940 poster from  
[Disneymania](#)

These were mixed by Stokowski into 4 master optical tracks that were played in synchronization on special equipment made by RCA for a multiple-loudspeaker theater installation called "Fantasound"; behind the screen were three horns and placed around the other walls of the theater were 65 smaller speakers. The separation and directionality of sounds was impressive. However, the system was not practical because of the \$85,000 cost to equip each theater, opposition by unions, and a demand by the government that RCA stop manufacturing the necessary sound components because of defense priorities. After the 2nd full installation of equipment at the Carthay Circle Theater in Los Angeles, it was not installed in any other theaters. Instead, eight "Fantasia Road Show" versions were assembled, each with 15,000 pounds of equipment but without the full surround sound loudspeaker system. Fantasound ended in 1941 and would not be heard again until a remastered version in Dolby Stereo was recorded in 1982 with Irwin Kostal conducting the Stokowski arrangements. In 1990 Disney re-released the film in magnetic 6-channel "Fantasound '90" at the Cinerama Dome Theater in Los Angeles with a similar arrangement of surround sound equipment as was used in the 1940 Carthay Circle Theater showing, but all other theaters in America would show it in standard Dolby 70mm magnetic 4-track matrix stereo sound. See the [articles](#) on Fantasound at the [American WideScreen Museum](#).

1952 - [This is Cinerama](#) premiered Sept. 30 at the Broadway Theater in New York and would play for 122 weeks. This 3-projector system designed by Fred Waller

used a wide curved screen and a separate 7-track magnetic soundtrack designed by Hazard E. Reeves and Walter Hicks for specially-equipped Cinerama theaters [[pictures](#) of the Neon Movies' Cinerama in Dayton, Ohio show historian/technician John Harvey threading the Cinerama 7-track magnetic sound reproducer]. Because of the high cost of equipment and technical complexity, Cinerama, Inc. would make only a few more feature films in the 3-strip process, such as [Seven Wonders Of The World](#) in 1956 and [How the West Was Won](#) in 1962. The State Dept. exhibited the film in 1955 at a trade fair in Damascus, Syria, finding propaganda value in the film, especially the *America the Beautiful* segment. The USSR produced its version of cinerama called KinoPanorama; its *Great Is My Country* won a prize at the Brussels World's Fair in 1957 (see Cinerama at [American WideScreen Museum](#))



1953 ad from

1953 - *The Robe* premiered Sept. 16 at the Roxy in New York in Cinemascope by Twentieth Century Fox with 4-track magnetic soundtrack on the edge of each 35mm cellulose tri-acetate film strip (allowing smaller sprocket holes than weaker nitrate film, and more room for the soundtrack). The Cinemascope technique used an anamorphic lens to film and project a wide image on a curved screen 64 1/2 ft. wide and 26 1/2 ft. high, with three speakers behind the screen (see Cinemascope at [American WideScreen Museum](#))

1954 - *White Christmas* released April 27 in Paramount's VistaVision horizontal 35mm widescreen format with Perspecta sound. "Perspecta employed a

poster from [IMDb](#) single, conventional monophonic soundtrack onto which were encoded sub-audible control signals. Tones of 30, 35 and 40Hz were detected by an integrator unit connected to the projector's sound head and used to turn up the gain on left, centre and right hand speaker channels. Although this did not provide true stereo, it did create directional effects with the additional advantage that mixing for Perspecta was considerably quicker than mixing for a CinemaScope magnetic soundtrack, as it merely required the sound to be panned between the three channels to follow the action on screen." (quote from Mark R. Baldock's [VistaVison](#) page). Paramount's *Strategic Air Command* opened in April 1955 with an improved form of VistaVision projecting an image on a curved screen 64 ft. wide and 35 ft. high.

1955 - *Oklahoma!* premiered Oct. 10 at the Rivoli Theater in New York in 65mm [Todd-AO](#) with a separate 6-track magnetic soundtrack system designed by Westrex and Ampex, running at 90 ft. per minute (24 fps) in synch with the film projector running at 112.5 ft. per minute (30 fps).

Michael Todd joined with Joe Schenck of Fox and George Skouras of United Artists Theatre Circuit to form the Magna Theatre Corporation for production and distribution of Todd-AO films. The special camera was developed by Dr. Brian O'Brien at the American Opeical Company. The image was projected on a curved screen 50 ft. wide and 25 ft. high, and 13 ft. deep in the center. The format was also used for *Around The World in 80 Days* in 1955 and *South Pacific* in 1958, but was discontinued and replaced by the 70mm format. Image at right is from a [newspaper ad](#) for *Oklahoma!* 1955/10/11.



Image at left from 1955 [newspaper ad](#) for the Cinemascope version of *Oklahoma!* that was filmed at the same time as the experimental Todd-AO version and was exhibited in theaters not equipped with Todd-AO equipment. The 1994 laserdisc restoration of *Oklahoma!* used the Todd-AO version with some scenes filmed differently than the Cinemascope version. From 1950s to 1970s,



expensive 70mm films used 6-track magnetic soundtrack 5mm wide placed on the filmstrip between the image and the sprocketholes.

1967 - *The Graduate* became one of the first films to use old songs from records as a major part of its musical soundtrack. The songs were taken from earlier LPs by Simon and Garfunkel. The song "Mrs. Robinson" was the only original tune but sung in the film only in fragments. Later, the full version was composed and recorded for the soundtrack album, and became the first popular song that mentioned "Jesus" by name, and some radio stations would not play it. See [Paul Simon - Now and Then](#) by Spencer Leigh, 1973, from [The Graduate Soundtrack](#). The technique of using popular records in film soundtracks would become standard practice in the 1970s after the success of nostalgic films such as *American Graffiti* in 1973.

1970 - November - Dolby A-type noise reduction, developed in 1965 by Ray M. Dolby, was tested on the film *Jane Eyre*

1971 - *A Clockwork Orange*, the first film to be mastered with Dolby noise reduction, released in December with conventional optical soundtrack; 3 months later the Dolby Model 364 cinema unit was introduced to decode optical soundtracks that contained A-type noise reduction. Image at right of Alex from the [Kubrick page](#) by Patrick Larkin - also [poster](#)

1974 - *Earthquake* premiered Nov. 15 in the Chinese Theater in Hollywood with Universal Picture's Sensurround process developed by W. O. Watson and Richard Stumpf at Universal. Four large low-frequency horns were located behind the screen, two in each corner. The Model W horn in each corner was 8 ft. long, 4 ft. wide, 4 ft. high. The Model C horn in each corner was a modular unit 1 ft. wide and 5 ft. high. Two additional horns were located on a platform in the rear of the theater. Each horn was driven by a 1000-watt amplifier controlled by inaudible tones on a special optical control track along with the normal 4-track magnetic soundtrack of the 35mm Panavision filmstrip. These films could only be played with Sensurround-equipped projectors. Normal 4-track magnetic projectors could play the soundtrack but not the Sensurround effects. A 35mm optical print was released with monophonic sound and included the control signals to activate the special speakers if they were installed in the theater. Some prints released in Europe and Japan were 70mm with 6-track magnetic soundtracks using tracks 2 and 4 for the control signals. The tones turned the horns on and off at preset volumes, creating low-frequency vibrations 5-40 cycles at sound pressures of 110-120 db, causing the audience, chairs, floor to "feel" the vibrations of the earthquake and dam destruction scenes. Image at left from the Nov. 1974 *American Cinematographer* [diagram](#) for Sensurround

1974 - November - Dolby Labs demonstrated the first 35 mm Dolby Stereo optical soundtrack on a section of the film, *Stardust*, at the Society of Motion Picture and Television Engineers (SMPTE) convention in Toronto; the Dolby Stereo 4-channel optical stereo variable area (SVA) was encoded with left, middle, right, and surround

channels that became the ISO 2969 standard for motion picture soundtracks, and was the origin of home consumer versions later known as Dolby Surround and Dolby Pro Logic.

1975 - [Nuoptix](#) developed an Anticipatory Noise Reduction system for its FR-1 Optical Sound Recording System that was adopted by Hollywood studios to produce optical soundtracks. The system was also sold by Westrex, the former sound and motion picture equipment distributor of Western Electric. The system evolved to use digital audio delay technology for the anticipatory noise reduction and became the worldwide standard system for recording Dolby stereo optical sound tracks.

1975 - March premier in London of the film *Tommy*, with a Dolby Stereo soundtrack played on the Dolby CP100 Cinema Processor designed to decode magnetic and optical soundtracks.

1975 - September - *Lisztomania* released as the first feature film with a Dolby Stereo optical soundtrack.

1976 - Spring - *A Star Is Born* released with surround sound effects encoded in the Dolby Stereo optical track.

1977 - May - *Star Wars* released in 46 U.S. theatres equipped for Dolby Stereo; *Star Wars* next spring won the Academy Award for Best Achievement in Sound.

1979 - November - *Apocalypse Now* released in 15 theaters equipped to play the first Dolby Stereo 70 mm film with surround sound.

1981 - August - Inauguration of Music Television (MTV) in stereo with B-type noise reduction; Dolby B was developed 1968 and used in FM broadcasting after 1971 and in consumer electronics, but did not replace the professional A-type used in motion pictures.

1982 - *Return of the Jedi* was the first movie exhibited on the THX sound system designed by George Lucas and Tomlinson Holman; THX "is comprised of customized acoustical design work for each auditorium, a special screen speaker installation method, a proprietary electronic crossover network, and rigorous audio equipment specifications and performance standards." (quote from [Overview](#), Lucasfilm THX Theater Sounds Systems page)



[Lucasfilm's THX Home Page](#)

1985 - January - VH-1, the 2nd music tv channel, distributed by satellite using the digital process known as Dolby AC-1

1986 - Dolby SR (spectral recording) optical format demonstrated to the Academy of Motion Picture Arts



Image from [Voyager](#)

and Sciences, with double the noise reduction of A-type; was the origin of Dolby S-type noise reduction for consumer electronics by 1989; in November 1990 Dolby S incorporated into 24-track recorders using one-inch magnetic tape, the Tascam MSR-24S and Fostex G24S

1987 - July - *Innerspace* and *Robocop* released in Dolby Stereo SR

1988 - The [IMAX](#) digital sound system was developed by Sonics Associates of Birmingham, Alabama. Sonics was founded in 1971 by Lynn McCroskey and Jim Cawhon who began in the early 1980s to develop a sound system for the IMAX theater at the U.S. Space & Rocket Center in Huntsville. By 1988, they developed a Digital Disc Playback system (DDP) that recorded 2 channels of uncompressed digital sound on an audio compact disc. This system with 3 discs and 6 channels began to replace the multitrack magnetic tape sound systems used in IMAX theaters since 1971. In 1993, Sonic introduced the IMAX 3D sound system with 10 channels for the Sony IMAX theater in New York. Theater speakers produce 8 channels from 4 CD disks synchronized with the 15-perforation 70 mm filmstrip running through the projector horizontally past a 15,000-watt lamp at 48 frames per second. The 3D headset has 2 additional channels for the binaural Personal Sound Environment (PSE).

Next - [Digital Motion Picture Sound](#)

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## Digital Film Sound Formats



IMAX DDP  
introduced 1988  
by [Sonic Associates](#)



Dolby SR-D  
introduced 1991  
by [Dolby Laboratories](#)

DTS

introduced 1993  
by [Digital Theater Systems](#)

Sony SDDS

introduced 1993  
by [Sony Electronics](#)

1990 - *Dick Tracy* released June 15 as the first 35mm feature film distributed with a digital soundtrack by Cinema Digital Sound (CDS), developed by Eastman Kodak and Optical Radiation Corp. "The system was set up in the typical Left, Center, Right, Right Surround, Left Surround, LFE channel format. CDS encoded 16-bit PCM audio in a compression process called Delta Modulation. The process is very similar to normal PCM coding, but with one major difference. PCM coding records the intensity of every sample to a zero db level. That requires 16-bits for each sample. Delta Modulation records the intensity differences of successive samples, and that doesn't require nearly as much data. The compression level of CDS ran approximately 4:1." (quote from Bobby Henderson, [CDS](#)) However, the system replaced the optical analog soundtrack without allowing any backup track for theaters not equipped with the \$20,000 digital playback system. Also, theaters preferred to wait for the Dolby digital system that was compatible with an analog track.

1991 - Dolby Stereo Digital (SR-D), with compatible Dolby SR 35mm prints providing both digital and analog optical soundtracks, announced at ShoWest in Las Vegas in February as the first application of Dolby AC-3 multi-channel digital audio coding; the SR-D digital sound film format added 6 digital optical tracks, recorded between sprocket holes, to the 4 existing Dolby SR analog optical tracks on the edges of the film strip - SR-D has a compression ratio of 10:1, a dynamic range 120db, a frequency response of 20-20,000Hz, and a 16-bit data rate of 384 kb.

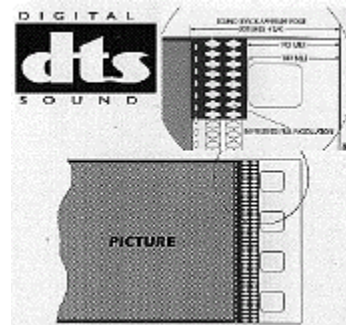


from [Dolby Labs](#)

1992 - *Batman Returns* premiered June 19 in 10 theatres equipped with new Dolby DA10 Digital Film Sound Processor

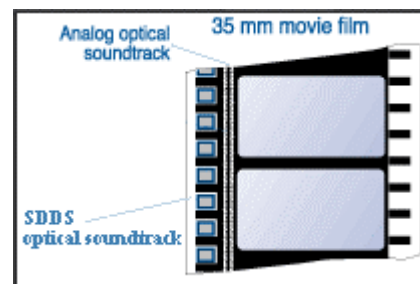
1993 - *Jurassic Park* released May 30 as the first film with DTS sound, developed by Terry Beard, founder of Digital Theater Systems in Westlake Village, CA, partly owned by Steven Spielberg and Universal Pictures. This digital sound film format records 6 tracks on separate CD-ROM disks, synchronized by an optical timecode track recorded on the film, co-existing with a backup optical soundtrack similar to Dolby Stereo.

DTS has a compression ratio of 4:1, a dynamic range of 96db and a frequency response of 20-20,000Hz; DTS Coherent Acoustic Coding is flexible and can combine lossy compression (data beyond normal hearing range is removed) with lossless compression (data is sampled and restored), capable of a 24-bit linear PCM data rate, although most common is a 20-bit data rate that is higher quality than the 16-bit rate used in compact discs, and at 240 kb/s per discrete channel or 1040 kb for all six channels, it is faster than the 384 kb used by Dolby AC-3. Theaters are allowed different installations, some known as DTS-6 or as a lesser quality 4-channel DTS-S (see comments of Dan Sharnhorst at "[Digital Sound](#)." Bill Neighbors, current president of DTS, claims DTS is installed in 10,000 theaters world-wide with annual sales of \$20 million. DTS films include *Braveheart* (1995, Oscar winner for Best Picture), *Apollo 13* (1995, Oscar winner for Best Sound), *Twister* (1996), *Independence Day* (1996), the *Star Wars* Trilogy 1997 re-release, *Batman and Robin* (1997), *Con Air* (1997)



from the unofficial [DTS Page](#)

1993 - *Last Action Hero* released July 18 using the Sony Dynamic Digital Sound (SDDS) digital sound film format that put 6 or 8 tracks of digital sound on 2 optical stripes on each edge of the film strip, recorded on the cyan layer beneath the other emulsion layers, using the lossy ATRAC algorithm of the Sony [Minidisc](#) technology with a compression ratio of 5:1, dynamic range of 105db and a frequency response from 5-20,000Hz. It is compatible with a backup standard optical soundtrack such as Dolby SR.



from the unofficial [SDDS Page](#)

1996 - DTS trailer film for *Jurassic Park: The Lost World* released: "The teaser trailer, which debuted on December 13 at forty locations in the United States and two in Toronto, Canada, is driven by a modified DTS that activated six strategically placed strobe lights employed to complement the images that appear on the screen. Using DTS technology, the timing for the strobe lights is encoded into the trailer's print, which is synched to the highly reliable DTS CD-ROM system. Audiences viewing the teaser trailer feel as if they are caught in a rainstorm complete with life-like sound and lightning provided by the strobe lights." (press release from [DTS](#)).

1996 - [The English Patient](#) was the first Oscar-winning American film with a digitally edited soundtrack, winning [Walter Murch](#) two Academy Awards for film and sound editing.

1998 - [Dolby](#) became the leading producer of motion picture sound processors used in theaters worldwide with over 50,000 sold; projector attachments such as the CP500

digital cinema processor introduced in 1995 were capable of decoding 2 of the 4 soundtracks recorded on most film prints (see [chart](#) at right from *Audio*).



1998 - [Lost in Space](#) premiered April 3 as the first major American film with an all-digitally produced soundtrack. [chart](#) from "The Magic of Film Sound" in *Audio* 1999/05

1998 - [The Last Broadcast](#) premiered Oct. 19 as "the first desktop feature film" produced and exhibited digitally, co-sponsored by [Texas Instruments](#) using its DLP digital cinema projector.

1999 - *Star Wars: Episode I - The Phantom Menace* was released May 19 in the U.S. with Dolby Digital Surround EX providing an added rear center audio channel. On June 18, it was the first major studio motion picture to be exhibited in digital cinema in 4 theaters with digital projectors by [Texas Instruments](#) and by [CineComm](#).

2000 - Jan. 1 Disney released [Fantasia/2000](#) in the [IMAX](#) film format with 6-channel digital sound.

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1910-1929 - see [Motion Picture Sound part 1](#)

1930-1989 - see [Motion Picture Sound part 2](#)

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