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High fidelity is a term used to mean the highly accurate reproduction of sounds within the spectrum of human hearing, usually considered to be between 20 hertz and 20,000 hertz. English engineer Harold Hartley first applied the term in 1926. Much of today's understanding of what constitutes high fidelity reproduction stems from pioneering research into the way humans hear and interpret sound done by Harry Olsen for the Radio Corporation of America (RCA) and Harvey Fletcher at the American Telephone and Telegraph Company's (AT &T) Bell Laboratories.

Origins

Early sound reproduction devices such as Edison's cylindrical phonograph (1877) and Emile Berliner's Gramophone disk developed a decade later demonstrated the feasibility of recording, but they produced tinny sound with significant distortion and limited reproduction of voice and music. The near - simultaneous developments of radio broadcasting and sound motion pictures led engineers to search for ways to improve sound quality.

E.C. Wente's invention of the condenser microphone (1916) and improvements in loudspeaker technology by Rice and Kellogg at General Electric, Peter Jensen and others (1925) greatly improved the ability to record and reproduce audio. In the 1920s Edwin Armstrong's development of the heterodyne circuit improved the sensitivity and selectivity of radio receivers, and Harold Black's discovery of negative feedback provided improved audio reproduction, but several obstacles still prevented accurate reproduction of sound. The surface noise associated with records, coupled with their limited audio range and short playing time, sharply curtailed improvements in mechanical sound reproduction. AM radio transmissions were subject to significant noise and static interference. Engineers thought that reducing the audio bandwidth would reduce annoying whistles and associated distortions.

Simultaneous research into improved audio occurred in Britain, Germany, and the United States, but it was AT &T that spearheaded high-quality audio development. AT &T's Bell Laboratories undertook long-term development of sound reproduction in conjunction with high-quality long-distance telephone service. With the 1922 construction of WEA, AT&T's flagship New York City radio station, the telephone company carried out research to improve broadcasting microphones, consoles, and transmitters. Bell Labs also developed the transcription turntable using a slower speed (33 1/3 revolutions per minute) to increase playing time to 30 minutes to meet the needs of broadcasters and motion picture engineers.

By 1929 the introduction of the matched -impedance recorder, coupled with development of gold master records, increased the attainable frequency response to 10,000 Hz and greatly reduced surface noise for records.

By 1930 both RCA and Bell Labs were experimenting with various means of improving audio quality for records. One year later Leopold Stokowski, the famed conductor of the Philadelphia Orchestra, enlisted Bell Labs' help in setting up an audio test room at the Academy of Music. The first disk recordings capable of accurate sonic reproduction were cut with Stokowski's help, and Bell Labs made more than 125 high-quality recordings of the 1931-32 Philadelphia musical season. During this time Stokowski recorded the first binaural recording using AT&T's new two-styli cutter, developed by Arthur C. Keller, and in 1933 the first U.S. stereophonic transmission over telephone lines occurred when Bell Labs demonstrated a three -channel audio system in Constitution Hall in Washington, D.C. In 1938 Keller received a patent for a single-groove stereophonic disk record system.

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Improving Radio

Although various advancements in the technology allowed AM radio to improve substantially, the narrow channel bandwidth adopted by the Federal Radio Commission and static interference problems created technical limitations to full high fidelity transmission. By 1935 radio stations that specialized in quality music were eager to adopt improved technology. The Federal Communications Commission (FCC) licensed four stations on three channels at the high end of the AM frequencies (in the 1500 -1600 kHz region) to experiment with high fidelity broadcasting using a wider channel bandwidth. WHAM, a clear channel station that originated Rochester Philharmonic Orchestra broadcasts on the National Broadcasting Company's Blue Network, and WQXR in New York were among the early pioneers of high fidelity AM broadcasting. These stations used new Western Electric transmitters boasting better frequency response with a wider dynamic range. Improved radio receivers capable of better fidelity were manufactured by WHAM's parent company, Stromberg-Carlson, E.H. Scott, and others.

Regularly scheduled high fidelity FM broadcasts began on 18 July 1939 as Edwin Armstrong's station retransmitted classical music programs from New York's WQXR via special telephone lines. That same year, the Yankee radio network began high fidelity FM broadcasting, soon followed by General Electric and others. In 1944 Britain's Decca records introduced full fidelity recordings capable of reproducing most of the audio spectrum.

Hi -Fi Era

After World War II, rapid improvements in recording and playback technology accelerated the development of true high fidelity sound reproduction. Crosby Research and Ampex (1948) introduced high fidelity tape recorders. The broadcasting and

recording industries quickly adopted these new machines. Columbia Records (1948) and RCA Victor (1949) revolutionized the record industry with their respective introduction of the 33 1/3 rpm long play album (LP) and the 45 rpm record. The new records used small microgrooves and a vinyl medium to reduce surface noise and improve fidelity. With the introduction of the LP, entire symphonic movements could be played at home without having to change records. Quality three-speed record changers developed by Webster - Chicago (Webcor), Voice of Music, and Garrard could play stacks of records without interruption. These innovations substantially improved the sound quality of recorded music, making affordable record players available to the general listening public. In 1950 Seeburg introduced its soon legendary 100 series jukebox, boasting high fidelity amplifiers and large speakers and capable of playing 80 different 45 rpm selections. These jukeboxes were immediate hits with teens and helped usher in the era of the 45 hit single.

By the early 1950s all of the components necessary for accurate sound reproduction were available to consumers and the "high fidelity era" industry began. Fairchild and General Electric introduced magnetic phonograph cartridges, while Rek-O-Kut, Thorens, and Grado introduced specialized turntables and tone arms for audiophiles. Webcor's famous model 210 high fidelity tape recorder was introduced and specialized radio manufacturers such as Fisher, H.H. Scott, Macintosh, and Sherwood Labs began selling limited production high fidelity amplifiers and FM tuners. Speaker manufacturers improved the quality of home loudspeaker systems. Jensen's development of the SG -300 triaxial speaker (1949) and bass reflex enclosure made it possible for enthusiasts to build their own high-quality systems, whereas AR (Acoustic Research) introduced the acoustic suspension system (1954), capable of reproducing powerful bass with small

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bookshelf enclosures. Altec Lansing and JBL speakers became popular with audiophiles. Specialized magazines such as *High Fidelity* and *Audio* catered to the "hi-fi" enthusiast by reviewing the latest in audio equipment. Commercial development of stereophonic sound continued throughout the 1950s, culminating with RCA Victor's introduction of the stereophonic LP in 1958 and the FCC's approval of FM stereophonic broadcasting in early 1961. Combination AM/FM phonograph consoles gained popularity throughout the early 1960s, but with the introduction of transistorized equipment and new smaller sound formats such as the audio cassette (1963) and the 8-track (1966), compact stereophonic equipment eventually replaced larger console systems. Although four-channel record systems were introduced in the 1970s, they never received wide acceptance. By 1988 audio cassettes and compact discs were outselling LP records more than three to one.

The introduction of the compact disc player by Sony and Phillips ushered in the beginning of the digital audio era in 1982. Various digital recording formats, including digital audio tape systems (1986), recordable compact discs (1990), and minidisks (1992.) currently provide the capability to make high fidelity recordings that are virtually indistinguishable from the original sound sources. Today, new broadcasting technologies such as satellite-based and in band digital audio broadcasting and computer data compression advances suggest that even higher quality broadcast distribution of music is on the horizon.

See also Dolby Noise Reduction; Receivers; Recordings and the Radio Industry; Stereo

Further Reading

Aldred, John, 100 Years of Cinema

Loudspeakers,

<www.filmsound.org/articles/amps/loudspeakers.htm>

Grado, Joseph, "Audio Milestones: 50 Years and More of Record Playing," *Audio* 81, no. 5 (May 1997)

Jordan, Robert Oakes, and James Cunningham, *The Sound of High Fidelity*, Chicago: Windsor Press, 1958

Long, John J., Jr., "High Fidelity Broadcasting: Details of the Newly Installed System at WHAM, Rochester,"

Communication and Broadcast Engineering (February 1935)

McGinn, Robert E., "Stokowski and the Bell Telephone Laboratories: Collaboration in the Development of High-Fidelity Sound Reproduction," *Technology and Culture* 2.4, no. 1 (1983)

Schoenherr, Steven E., "Sound Recording Research at Bell Labs," <history.acusd.edu/gen/recording/bell-labs.html>