HOW LONG DOES IT TAKE FOR COPYRIGHT LAW TO CATCH UP WITH TECHNOLOGY? SOME DATA POINTS FROM THE MUSIC INDUSTRY

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It is a truism that the law takes a long time to catch up with technology. Just how long does it take? This article measures the length of time it has taken for copyright law to catch up to a series of six technologies introduced since the beginning of the 20th century that enabled new ways of distributing music to the public, and in doing so, disrupted the music industry. For each such technology, we establish a timeline that starts when the pieces came together for that technology to become a mass medium for music distribution and ends with the last significant legal development that affected that technology. Such analysis may be useful in predicting the impact that the latest disruptive technology, generative AI, may have on creative industries. We show that the length of time for copyright law to resolve itself around these disruptive technologies has generally decreased over time, though only up to a point: the minimum has been 8 years, or longer if one looks outside of the United States.

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INTRODUCTION

Over the past century it has become a truism that the law takes too long to catch up with advances in technology. This has been recognized in copyright law, starting most notably in the 2000s after the emergence of the Internet and other personal digital

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technologies.[3] With the current rise of generative artificial intelligence (AI) and its disruptive effects on creative output and the creative industries, many are speculating about the time it will take for copyright law to realign with these new[4] technologies and perhaps planning activities with such a timeframe in mind.

In this light, it is worth exploring just how long it took for copyright law to adapt to previous technologies that profoundly disrupted creative industries. This article aims to do so with respect to music, a type of creative work to which new technologies expanded access towards the end of the nineteenth century and that is readily examined through the series of distinct formats for distributing music to the public that the industry has embraced since then.[5]

We examine six such formats: phonographs (sound recordings), radio (non-localized public performances), tape (home sound recording reproduction), file-sharing (digital file reproduction and distribution), interactive streaming (transmission of digital sound recordings to individual users on demand), and user-generated content services (public distribution of content uploaded by users to Internet servers).

For each of these, we describe the histories of the formats and how they manifested themselves in the music industry; we briefly summarize the copyright problems that the new formats posed; and we discuss the timeline of the steps the industry and government took to solve them. We consider the timeline for each format to have started when the pieces came into place for it to become a mass medium for music – which may have been years after the "raw" technology was invented. We consider the law to be "settled" around it with the last significant court decision or legislation addressed to the technology in question, i.e., the point in time after which the law no longer changed in a meaningful way to affect that technology.[6]

We show that the length of time for copyright law to resolve itself around the technology has generally decreased over time, though only up to a point: the minimum, for user-generated content services, has been 8 years in the United States and longer elsewhere.

I. PHONOGRAPH RECORDS

Thomas Edison invented a machine that recorded sound onto tin foil mounted on a cylinder in 1877. Eleven years later, Alexander Graham Bell and a couple of colleagues

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[3] *See*, e.g., JESSICA LITMAN, DIGITAL COPYRIGHT (Prometheus Books, 2001); DAVID NIMMER, COPYRIGHT: SACRED TEXT, TECHNOLOGY, AND THE DMCA, (Kluwer Law International, 2003); Ben Depoorter, *Technology and Uncertainty: The Shaping of Copyright Law*, 157 U. OF PA. L. REV. 1831(2009).

[4] Generative AI is only "new" in the sense that it burst into the public consciousness in November 2022 with OpenAI's launch of ChatGPT. The fundamental underlying technology of generative AI, artificial neural networks, dates back to the late 1950s. *See* F. Rosenblatt , *The Perceptron: A Probabilistic Model for Information Storage and Organization in the Brain*, 65 PSYCH. REV. 386-408 (1958) [no relation to the author].

[5] *See generally* HOWIE SINGER AND BILL ROSENBLATT, KEY CHANGES: THE TEN TIMES TECHNOLOGY TRANSFORMED THE MUSIC INDUSTRY (Oxford University Press, 2023).

[6] This does not take into account later legislative efforts that failed, such as various attempts at legislation to establish a performance right in sound recordings for AM/FM radio airplay and to address the so-called "value gap" with user-generated content services, as discussed herein.

introduced a phonograph system that improved on Edison's invention by using a wax-coated cylinder with a funnel or horn for playback and a foot treadle (similar to those on sewing machines) for mechanical rotation.[7] Commercial phonographic cylinder systems were available from Edison, Columbia, and other makers by the late 1880s, followed by Edison's Type M phonograph for the consumer market in 1893.[8] By 1901, Edison had created a molding process for manufacturing cylinders in volume.[9]

Meanwhile, German émigré Emile Berliner invented a competing device, the gramophone, that used discs instead of cylinders.[10] Unlike Edison, he originally intended his technology for music playback and for large-scale manufacture of copies of recordings. The discs would be made of rubber or metal, making them more durable than wax cylinders for multiple plays. Berliner first demonstrated his gramophone in Philadelphia in 1888; then he and Eldridge Johnson formed the Victor Talking Machine Company across the river in Camden, New Jersey in 1901 and introduced 10-inch records that year.[11] For the ensuing couple of decades, Edison's cylinders competed with Victor's discs.[12] Thus, 1901 was the time when sound recordings became a mass medium for music.

By the mid-1920s, discs had prevailed: the sound quality of cylinders was superior, but discs were easier to handle, took up much less shelf space,[13] and had information about the recording on a paper disc affixed to the center – the "label" – that cylinders lacked.[14] The first recordings using electrical microphones were made around that same time.[15] Recording and playback speeds varied widely until 1925, when 78.26 rpm[16] (or simply 78) became standard.[17] 78s came in varying diameters, up to 12 inches, which

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[7] Andre Millard, America on Record: A History of Recorded Sound 24-32 (Cambridge, UK: Cambridge University Press, 2nd ed. 2005).
[8] David L. Morton, Sound Recording: The Life Story of a Technology 24 (Baltimore: Johns Hopkins University Press, 2004).
[9] *History of the Cylinder Phonograph*, Library Of Congress (last visited Nov. 7, 2025), https://www.loc.gov/collections/edison-company-motion-pictures-and-sound-recordings/articles-and-essays/history-of-edison-sound-recordings/history-of-the-cylinder-phonograph/.
[10] Andre Millard, America on Record: A History of Recorded Sound 33-34 (Cambridge, UK: Cambridge University Press, 2nd ed. 2005).
[11] *Id.* at 48-49.
[12] *Id.* at 47-48.
[13] *Id.* at 124-135.
[14] Another purpose for the label was to prevent recording (and playback) too close to the center of the disc. Audio quality is proportional to the linear speed of the recording and playback, which decreases from the outer edge towards the middle. Marc Henshall, *Vinyl Record Inner-Groove Distortion (A Simple Explanation)*, Sound Matters (Oct. 10, 2016), https://www.yoursoundmatters.com/vinyl-record-inner-groove-distortion-simple-explanation/.
[15] Andre Millard, America on Record: A History of Recorded Sound 139-143 (Cambridge, UK: Cambridge University Press, 2nd ed. 2005).
[16] This speed resulted from a 3600rpm motor turning a 46-tooth gear; 3600 ÷ 46 = 78.26. Yale University Library, The history of 78 RPM recordings, *The history of 78 RPM recordings*, Yale University Library Irving S. Gilmore Music Library https://web.library.yale.edu/cataloging/music/historyof78rpms (last visited March 12, 2026).
[17] *Id.*

held 4-5 minutes of audio.[18] They were made of shellac, which was brittle and easily shattered.[19]

After World War II, the scientist Peter Goldmark, who had fled the Nazis from Hungary, led a team at Columbia Records that designed the "microgroove" long-playing (LP) record.[20] The LP used polyvinyl chloride (PVC), which could hold much narrower grooves than 78s could (meaning greater audio capacity per inch diameter) and was more durable than shellac.[21] 12-inch LPs could hold about 20 minutes per side, enough for a classical concerto or a Broadway musical soundtrack.[22] Sound quality was much higher as well; the LP could potentially reproduce the entire range of human hearing.

Columbia introduced the LP in 1948 and offered to license the technology to other record companies.[23] All but RCA did so; RCA instead launched its own competing format, the 45rpm microgroove disc in 1949. 45s had similar capacity to 78s but with even higher audio quality than LPs (faster speed means more information per second can be encoded). The 45's wider spindle hole was designed for use with a changer device so that RCA could release multi-45 sets containing anthologies or longer works.[24]

Of course, all labels eventually embraced both LP and 45 formats, and phonograph makers introduced models that could play all three speeds. By the mid-1950s, both formats had found their distinct markets: the 45 became the medium of choice for pop music singles, while the 33rpm LP prevailed for the new jazz of the time as well as for classical music and Broadway; and the 78 faded away.[25]

Vinyl technology has stayed largely the same ever since the standardization of stereo in 1957.[26] And a series of innovations starting around that time caused recorded music to grow steadily over the ensuing decades: mass-market retail stores; discount chains such as Sam Goody and Musicland; mail-order record clubs; proliferation of jukeboxes in bars and diners; and above all, the creation of huge pop stars through tightly-formatted radio programming to drive sales.[27]

Recorded music had become a multibillion-dollar business by the early 1970s. It reached a peak of $2.4 billion in wholesale revenue in 1978, two-thirds of which came

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[18] *Id.*
[19] *Id.*
[20] Sean Wilentz, 360 Sound: The Columbia Records Story 127-30 (San Francisco: Chronicle Books, 2012).
[21] *Id.*
[22] Accordingly, the first recordings on LP included the Mendelssohn Violin Concerto, performed by Nathan Milstein and the New York Philharmonic under the direction of Bruno Walter, and the Cole Porter-composed soundtrack to the musical Kiss Me, Kate.
[23] Sean Wilentz, 360 Sound: The Columbia Records Story 130 (San Francisco: Chronicle Books, 2012).
[24] Howie Singer and Bill Rosenblatt, Key Changes: The Ten Times Technology Transformed the Music Industry 99 (Oxford University Press, 2023).
[25] *Id.* at 99-100, 113-114.
[26] Technology from the Westrex division of AT&T was used; this was based on prior technology invented by Alan Blumlein at EMI in England in 1931. Andre Millard, America on Record: A History of Recorded Sound 192, 212 (Cambridge, UK: Cambridge University Press, 2nd ed. 2005).
[27] Howie Singer and Bill Rosenblatt, Key Changes: The Ten Times Technology Transformed the Music Industry 105-112 (Oxford University Press, 2023).

from vinyl sales. That's equivalent to almost $12 billion today, a height that was not exceeded until the peak compact disc (CD) era of the late 1990s (and has not been since then).[28]

The vinyl market began to collapse with the rise of the cassette in the early 1980s, as discussed below, followed in 1983 by the introduction of the CD in the U.S market.[29] Vinyl revenue sank to its nadir by the mid-2000s but then started to revive slowly and steadily. Vinyl became a billion-dollar market once again in 2021 as artists and labels began to recognize its value as "merch," and as fans sought music that they could truly own as alternatives to ephemeral streaming consumption.[30] Vinyl now accounts for 8% of all recorded music revenue,[31] second only to interactive streaming (see below) as a source of industry revenue.

The copyright conundrum associated with sound recordings is simple to state: should sound recordings be eligible for copyright protection? For decades, musical compositions on printed sheet music were copyrighted but sound recordings were not.[32] It took until 1972 – the better part of a century – to resolve this question.

The first considerations of this question in the courts were not even about sound recordings; they were about mechanical reproductions of musical compositions – piano rolls. In 1888, a federal court in Massachusetts decided that the defendant's piano roll did not infringe the copyright in the plaintiff's musical work.[33] This laid the groundwork for the *Stern v. Rosey* case, in which the D.C. Circuit appeals court ruled that George "Rosey" Rosenberg's cylinder recordings of songs published by Stern & Company were

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[28] *US Music Revenue Database*, RIAA, https://www.riaa.com/u-s-sales-database/ (last visited May 2, 2026) ("RIAA Revenue Database").

[29] The CD was undoubtedly another transformational technology in the music industry; *see, e.g.*, Howie Singer and Bill Rosenblatt, Key Changes: The Ten Times Technology Transformed the Music Industry 189-214 (Oxford University Press, 2023). But for our purposes here it was really just an extension of older disc formats. Unlike every technology discussed here after the phonograph record, the music industry participated actively in the CD's design, launch, and promotion (e.g., Philips and Sony developed the technology; at the time, Philips owned a major record label group and Sony had a joint venture with CBS Records); and CDs were distributed through the same channels as disc and tape releases. More relevantly, CDs raised no significant novel issues of copyright law. (The Audio Home Recording Act of 1992 (*infra* n. 100) imposed restrictions and levies on certain home CD recording devices and media that emerged several years after the CD's launch, but this had virtually no impact on the industry. *Id.* at 210-212.) Therefore we do not consider the CD to be "disruptive" in the sense we mean here, and we do not discuss it separately.

[30] Howie Singer and Bill Rosenblatt, Key Changes: The Ten Times Technology Transformed the Music Industry 114-117 (Oxford University Press, 2023).

[31] *See* RIAA Revenue Database, *supra* note 28; or about double that amount if sales of used vinyl are counted. *See* Bill Rosenblatt, *Vinyl Is Bigger Than We Thought. Much Bigger*., Forbes (Sep.18, 2018), https://www.forbes.com/sites/billrosenblatt/2018/09/18/vinyl-is-bigger-than-we-thought-much-bigger/.

[32] Subcomm. on Cts., C.L., & the Admin. of Just. of the H. Comm. on the Judiciary, 95th Cong., Performance Rights in Sound Recordings 8 (Comm. Print 1978).

[33] Kennedy v. McTammanay, 33 F. 584 (C.C.D. Mass. 1888).

not copies of the musical compositions as defined by law and dismissed the case on summary judgment.[34]

The tide turned around the time of the landmark *White-Smith v. Apollo* case in 1908, in which the Supreme Court ruled that a copy of a musical composition must be a "tangible object that appeals to the sense of sight" and that a copy was defined as "a written or printed record in intelligible notation," and thus that makers of player pianos did not have to pay royalties to composers whose works they encoded into rolls – although Justice Oliver Wendell Holmes did suggest that Congress should act to make "anything that mechanically reproduces [a] collocation of sounds" a copy in law.[35]

Hearings on this issue in Congress had started during the pendency of *White-Smith*.[36] The result of these was a provision of the Copyright Act of 1909 that gave copyright protection to mechanical reproductions of musical compositions. It did so under a compulsory license, with a royalty rate set in the statute.[37]

But that law only applied to mechanical reproductions of compositions; it did not make sound recordings eligible for copyright.[38] Subsequent to the 1909 Act, several litigations were brought, and more than a dozen separate bills were put forward in the House and the Senate, all in hopes of establishing copyright protection for sound recordings. None of these efforts succeeded.[39]

Myriad reasons were given for why sound recordings shouldn't get copyrights. These included that sound recordings weren't sufficiently creative compared to musical compositions or other copyrightable works,[40] that they were already protected under a patchwork of state copyright laws and by unfair competition law,[41] and that copyright protection for sound recordings was unconstitutional.[42]

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[34] J.W. Stern vs. G. Rosey, 1901.

[35] White-Smith Music Publishing Company v. Apollo Company, 209 U.S. 1 (1908).

[36] SUBCOMM. ON CTS., C.L., & THE ADMIN. OF JUST. OF THE H. COMM. ON THE JUDICIARY, 95TH CONG., PERFORMANCE RIGHTS IN SOUND RECORDINGS (Comm. Print 1978). Washington, DC: U.S. Government Printing Office, 1978, quoting *Econ. Conditions in the Performing Arts Before the Select Subcomm. on Educ. of the H. Comm. on Educ. and Lab.*, 87th Cong. 1 and 2 (1961-62).

[37] The Copyright Act of 1909, Pub. L. 60–349, 35 Stat. 1075.

[38] SUBCOMM. ON CTS., C.L., & THE ADMIN. OF JUST. OF THE H. COMM. ON THE JUDICIARY, 95TH CONG., PERFORMANCE RIGHTS IN SOUND RECORDINGS 3 (Comm. Print 1978).

[39] *See generally* SUBCOMM. ON PATENTS, TRADEMARKS, AND COPYRIGHTS OF THE COMM. ON THE JUDICIARY, 86TH CONG., STUDY ON THE UNAUTHORIZED DUPLICATION OF SOUND RECORDINGS (Comm. Print 1961) (primarily the work of Barbara Ringer).
; SUBCOMM. ON CTS., C.L., & THE ADMIN. OF JUST. OF THE H. COMM. ON THE JUDICIARY, 95TH CONG., PERFORMANCE RIGHTS IN SOUND RECORDINGS 28-58 (Comm. Print 1978).; RALPH OMAN, REPORT ON COPYRIGHT IMPLICATIONS OF DIGITAL AUDIO TRANSMISSION SERVICES A REPORT OF THE REGISTER OF COPYRIGHTS (U.S. Copyright Office, Library of Congress, 1991).

[40] The eminent jazz critic Nat Hentoff testified at a 1961 Congressional hearing that "when [a jazz musician] performs on a record, his improvisation is what makes the tune quite a new one" and therefore that there should be no question of the performing artist's creativity. *See* SUBCOMM. ON CTS., C.L., & THE ADMIN. OF JUST. OF THE H. COMM. ON THE JUDICIARY, 95TH CONG., PERFORMANCE RIGHTS IN SOUND RECORDINGS 39 (Comm. Print 1978).

[41] SUBCOMM. ON PATENTS, TRADEMARKS, AND COPYRIGHTS OF THE COMM. ON THE JUDICIARY, 86TH CONG., STUDY ON THE UNAUTHORIZED DUPLICATION OF SOUND RECORDINGS 17-19 (Comm. Print 1961) (primarily the work of Barbara Ringer).

[42] *Id.*, 4-5, 22-30.

Even where there was general agreement that sound recordings ought to get copyright protection, the contours of that protection were unclear. Who should own the copyright—the record label or the performing artist? Record labels initially claimed that they should own the copyright, given that they engaged musicians to make records at their direction under work-for-hire agreements.[43] Later on, when the industry produced big stars and that position became more tenuous, the labels would suggest that they get rights on copying and distribution while artists get rights on public performances, such as radio broadcasts.[44]

Then there was the question of what rights the copyright should cover: Simple reproduction of recordings? Recorded performances that sounded similar to existing records? Radio broadcasts of recordings? Recordings made by radio stations for broadcasting later? Music recordings used in movies? It wasn't clear.

Yet another point of debate was whether sound recording copyrights should carry a compulsory license scheme like the one for mechanical reproductions of compositions.[45] This brought up the issue of who would administer the royalties for such a license—the U.S. Copyright Office, or a private-sector entity such as one of the existing performing rights organizations (PROs; see below)?[46] Yet the musicians' union, the American Federation of Musicians, objected to sound recording copyrights. One reason was the potential for a compulsory license: they feared that a fixed statutory royalty would jeopardize musicians' bargaining power with labels.[47] Another was a disparity in the union between members who made recordings and those who didn't.[48] Others objected to the AFM administering the royalties out of fears that the union would engage in cronyism and not distribute the royalties equitably.[49]

So many industry factions disputed the terms of sound recording copyrights in so many ways that nothing happened for decades. Music publishers and songwriters didn't like having to split up the pie with performers or labels. As we discuss below, radio broadcasters fought against sound recording copyrights to avoid paying royalties for playing recorded music on the air. Jukebox makers objected to sound recording copyrights for similar reasons.[50]

Bills repeatedly failed to advance in Congress; as a 1940 committee report put it, "thought has not yet become crystallized on this subject ... and no way could be found ... for reconciling the serious conflicts of interest arising in the field." A 1961 Copyright Office report said the same thing, even using the word "crystallized" again.[51]

Yet by the mid-1960s, the various arguments—and those making them—had indeed "crystallized" around a set of ideas and compromises. It was decided that it wasn't unconstitutional to establish copyright in sound recordings. Once it was agreed that

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[43] SUBCOMM. ON CTS., C.L., & THE ADMIN. OF JUST. OF THE H. COMM. ON THE JUDICIARY, 95TH CONG., PERFORMANCE RIGHTS IN SOUND RECORDINGS 31-34 (Comm. Print 1978).
[44] *Id.* at 28-58.
[45] *Id*. at 1, 4-5, 34-52.
[46] *Id*. at 466-467.
[47] *Id.*at 37-38.
[48] *Id.* at 653-655.
[49] *Id.* at 36.
[50] *Id.* at 5, 33, 49-50.
[51] *Id.* at 37-38.

recorded performances were "writings," it made sense that the performing artist should get the copyright protection; labels could (and almost always did) assume ownership of those copyrights in contract terms anyway.[52]

The labels found themselves focusing on copyright infringement with the rise of bootlegging in the late 1960s. While some bootlegs were designed as blatant imitations of commercial releases, others contained music that bootleggers decided to release because the labels weren't doing so.[53] The labels argued that it was much more effective to fight bootlegging through a single federal law than by relying on a patchwork of laws in 50 states.[54]

Finally, international law had settled on copyrights in sound recordings with the Rome Convention for the Protection of Performers, Producers of Phonograms and Broadcasting Organisations (known simply as the Rome Convention), which was ratified in 1961 by the United International Bureaux for the Protection of Intellectual Property (now WIPO).[55] The United States didn't sign on to the Rome Convention, but the Rome Convention created incentives for the U.S. to establish some sort of protection for performers—among other things, so that American record labels could recover royalties from foreign countries through reciprocity agreements.[56] That is, the amount of money that the U.S. could get from other countries from exports of its rock & roll, soul, blues, and jazz was seen as economically significant.

Yet bootlegging of albums turned out to be the pivotal issue in getting radio broadcasters to soften their objections to copyrights in sound recordings. As discussed below, home taping of music from the radio wasn't considered a big issue in the late 1960s. So if bootlegging was the main concern, then copyrights on sound recordings could cover reproduction and distribution but not public performance, and this would mean, as we discuss below, that radio stations wouldn't have to pay royalties for the use of records.

With that obstacle out of the way, Congress passed the Sound Recording Act of 1971,[57] which went into effect in February 1972.[58] It established copyright protection for reproduction and distribution of sound recordings, but only on a prospective basis; older recordings would not get federal copyright protection.[59] The Sound Recording Act did

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[52] *Id.* at 8-9, 12.

[53] Well-known examples of these included 1967-68 sessions by Bob Dylan and The Band released as the bootleg *Great White Wonder*, and *Live'r Than You'll Ever Be*, a bootleg of a Rolling Stones concert in Oakland in 1969. Decca/London released an album of other Rolling Stones performances from the same tour as *Get Yer Ya-Ya's Out!* in 1970. Columbia eventually released the Dylan/The Band sessions as *The Basement Tapes* in 1975.

[54] SUBCOMM. ON CTS., C.L., & THE ADMIN. OF JUST. OF THE H. COMM. ON THE JUDICIARY, 95TH CONG., PERFORMANCE RIGHTS IN SOUND RECORDINGS 14-20 (Comm. Print 1978).

[55] International Convention for the Protection of Performers, Producers of Phonograms and Broadcasting Organisations, 18 May 1964, 496 U.N.T.S. 43.

[56] SUBCOMM. ON CTS., C.L., & THE ADMIN. OF JUST. OF THE H. COMM. ON THE JUDICIARY, 95TH CONG., PERFORMANCE RIGHTS IN SOUND RECORDINGS 747 (Comm. Print 1978).

[57] Sound Recording Act of 1971, No. 92-140, 1971 U.S.C.C.A.N. (Oct. 15, 1971).

[58] *Id.* ("This Act shall take effect four months after its enactment [on October 15, 1971].").

[59] *Id.* ("The provisions … shall apply only to sound recordings fixed, published, and copyrighted on and after the effective date of this Act … and nothing … shall be applied retroactively or be

not include a compulsory license with a fixed royalty for sound recordings, so anyone who wanted to reproduce or distribute sound recordings had to negotiate a license with the record label, and the label could refuse to license at all.

Nevertheless, copyrights in sound recordings most likely contributed to the economic rise of the recorded music industry in the 1970s discussed above. Sound recording reproduction and distribution became the predominant means of commercialization of music, likely eclipsing music publishing by revenue, during that same timeframe. Notwithstanding the limitations of rights in the 1971 Act – some of which were addressed later on, as we will see – it is fair to say that U.S. copyright law settled on sound recordings in 1971.[60] That's a period of **70 years** since Edison's and Berliner's introductions of phonographic cylinders and discs as mass-market entertainment products in 1901. For many countries outside of the United States, the period would be **60 years** from then until the Rome Convention of 1961.[61]

II. RADIO

The first scheduled radio broadcast to the public was at KDKA in Pittsburgh, PA, in November 1920.[62] Radio stations expanded rapidly: by 1923 there were over 500 in the United States.[63] And the first broadcast networks came quickly after that. AT&T built the National Broadcasting System (later NBC) by using its nationwide telephone network to transmit programming to affiliate stations, of which there were 16 by 1924.[64] United Independent Broadcasters (later CBS) launched in 1927.[65] Other networks were built in the ensuing decades.

Most music in radio's early days was performed live;[66] broadcasting of recorded music came more slowly. Sound quality of recordings played over the air in the earliest years was poor: they were played by placing a microphone in front of a phonograph

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construed as affecting in any way any rights with respect to sound recordings fixed before the effective date of this Act.").

[60] *Infra* note 101.

[61] At this time of writing, 99 countries have ratified the Rome Convention, most recently St. Kitts and Nevis in November 2025; the United States still has not. *See* International Convention for the Protection of Performers, Producers of Phonograms and Broadcasting Organisations, 18 May 1964, 496 U.N.T.S. 43.

[62] *History of Commercial Radio*, FED. COMMC'N COMM'N, https://www.fcc.gov/media/radio/history-of-commercial-radio (last visited March 26, 2026).

[63] Carole E. Scott, *The History of the Radio Industry in the United States to 1940*, https://eh.net/encyclopedia/the-history-of-the-radio-industry-in-the-united-states-to-1940/(last visited March 20, 2026).

[64] TIM WU, THE MASTER SWITCH: THE RISE AND FALL OF INFORMATION EMPIRES 75-81 (Alfred A. Knopf, 2010).

[65] ALFRED BALK, THE RISE OF RADIO: FROM MARCONI THROUGH THE GOLDEN AGE, 78-79 (McFarland & Company, 2006).

[66] MARC FISHER, SOMETHING IN THE AIR: RADIO, ROCK, AND THE REVOLUTION THAT SHAPED A GENERATION 11 (Random House, 2007).

horn.[67] Regulation was also a barrier: through the 1930s, regulators required frequent announcements that the music was pre-recorded,[68] prohibited large stations from playing records,[69] looked unfavorably on broadcast license applications from stations that played too much recorded music, and sped up license approval for stations that promised not to play any.[70] Still, the first regularly scheduled "disc jockey" style recorded music program on radio appeared in 1935: Martin Block's Make Believe Ballroom, on WNEW in New York.[71] The show spawned many imitators throughout the country.

Nevertheless, we give 1924 as the starting point for radio as a mass medium for music. The networks in the early years devoted the bulk of their airtime to music[72] and were important in getting national exposure for the likes of Duke Ellington, Benny Goodman, Bing Crosby, the New York Philharmonic, and the Metropolitan Opera: all of them did weekly live radio broadcasts before 1935. The latter two continue to this day.[73]

It took two other disruptive technologies to bring radio fully into the sphere of the recorded music industry a decade after World War II. One was television: the spread of broadcast television starting in the late 1940s led to a mass exodus of performing artists and associated talent from radio to the new medium, leaving radio with more airtime to fill.[74] The other was the transistor radio. This was introduced in 1954 with the Regency TR-1 from Regency Electronics and Texas Instruments,[75] followed in the ensuing few years by a series of more successful and cheaper models from Sony[76] and other companies from postwar Japan. These dramatically expanded the radio audience, notably

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[67] Christopher H. Sterling and John Michael Kittross, Stay Tuned: A History of American Broadcasting 71 (Lawrence Erlbaum Associates, 3rd ed. 1978).

[68] Peter Fornatale & Joshua E. Mills, Radio in the Television Age 12-13 (The Overlook Press, 1980).

[69] Christopher H. Sterling and John Michael Kittross, Stay Tuned: A History of American Broadcasting 82 (Mahwah, NJ: Lawrence Erlbaum Associates, 3rd ed. 1978).

[70] Marc Fisher, Marc Fisher, Something in the Air: Radio, Rock, and the Revolution that Shaped a Generation 11-12 (Random House, 2007).

[71] Marc Fisher, Marc Fisher, Something in the Air: Radio, Rock, and the Revolution that Shaped a Generation 12-13 (Random House, 2007). Make Believe Ballroom continued beyond Block's life (with some interruption) until 1992, when WNEW (AM) was sold and changed formats.

[72] For example, 71% of the programming in 1928-1929 on the two NBC networks (one of which became ABC later on) was music. Lawrence W. Lichty and Malachi C. Topping, American Broadcasting 227 (Hastings House, 1975).

[73] *The New York Philharmonic This Week*, New York Philharmonic, https://www.nyphil.org/explore-more/radio/ (last visited March 13, 2026) *Spirit of Radio*, The Metropolitan Opera, https://www.metopera.org/discover/articles/spirit-of-radio/ (last visited March 20, 2026).

[74] Marc Fisher, Marc Fisher, Something in the Air: Radio, Rock, and the Revolution that Shaped a Generation 4-7 (Random House, 2007).

[75] Allison Marsh, *The Incredible Story Behind the First Transistor Radio.*, IEEE Spectrum (Sep. 30, 2024), https://spectrum.ieee.org/transistor-radio-invented.

[76] *Product & Technology Milesones: Radio*, Sony, https://www.sony.com/en/SonyInfo/CorporateInfo/History/sonyhistory-b.html (last visited March 20, 2026).

to the children of baby-boomers who by the late 1950s were becoming teenagers – with disposable income to buy radios as well as the pop music 45s that they heard on the new Top 40 stations.[77]

The FCC created the FM band in the late 1930s, with better audio quality (approaching that of vinyl LPs) over shorter transmission ranges, but FM did not influence music until decades later. Many FM stations had been simulcasting programming that ran on AM stations owned by the same company; in 1967, the FCC began requiring that they start offering original programming instead.[78] The main result was the experimental "progressive" FM format of the late 1960s through early 1970s, which eventually morphed into highly lucrative commercial rock formats, as well as classical, jazz, and other formats that benefited from the enhanced sound quality.[79]

In the 1990s, streaming technology made radio-like experiences available over the Internet, with technology introduced by the Seattle-based startup Progressive Networks (later RealNetworks) and a few others.[80] The technology was capable of streaming stereo music with adequate sound quality over the 28.8 kbps dialup Internet connections that were common at the time. [81]

The first several uses of streaming audio for music transmission fell into two categories: simulcasts of AM or FM stations and "pure play" Internet radio with fixed music playlists.[82] Entrepreneurs figured out quickly that the Internet could also be used for listener input that would cause changes to the programming.[83] Some of these schemes enabled users to pick the specific music they wanted to hear, while others didn't. The former became known as interactive or on-demand streaming, which we discuss below. The latter took on features such as the ability to customize one's listening experience,

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[77] https://www.saturdayeveningpost.com/2018/02/brief-history-teenagers/.

[78] Peter Fornatale & Joshua E. Mills, Radio in the Television Age 125-126 (Overlook Press, 1980).

[79] Marc Fisher, Something in the Air: Radio, Rock, and the Revolution that Shaped a Generation 127-218 (Random House, 2007); Peter Fornatale & Joshua E. Mills, Radio in the Television Age 86 (Overlook Press, 1980).

[80] Julie Pitta, *Seattle Firm to Launch Internet Audio Venture*, L.A. Times (April 10, 1995), https://www.latimes.com/archives/la-xpm-1995-04-10-fi-53111-story.html.

[81] *See, e.g.*, *RealAudio Shatters the Sound Barrier*, RealAudio 3.0 showcase, https://web.archive.org/web/19961220175941/http://www.realaudio.com/hpproducts/ra3.0/index.html (last visited March 20, 2026) (RealNetworks web page from 1996).

[82] The first terrestrial broadcast stations to stream online were WXYC at the University of North Carolina-Chapel Hill and WREK at Georgia Tech in Atlanta, both in November 1994. *See WXYC's Simulcast*, WXYC, https://web.archive.org/web/20070213073017/http://www.wxyc.org/about/first/; Early "pure play" Internet radio stations included NetRadio, Imagine Radio, and Spinner.com; these launched in the 1995-1997 timeframe. *See* Matthew Broersma, *NetRadio wants you to whistle while you work*, ZDNET (Nov. 9, 1998), https://www.zdnet.com/article/netradio-wants-you-to-whistle-while-you-work/.

[83] For example, Imagine Radio, which launched in 1998, enabled users to start stations based on music genres and artists. It also enabled users to rate both artists and songs on a 0-to-10 scale, which would determine how often they heard the particular music. *See* Janelle Brown, *Net Radio: Waiting for Dream to Come True*, Wired (Jan. 19, 1998), https://www.wired.com/1998/01/net-radio-waiting-for-dream-to-come-true/.

such as by entering a "seed" artist, genre, decade, etc., or providing feedback through "thumbs up" and "thumbs down" icons. Today's services such as Pandora and iHeartRadio include such features.[84]

Radio was by far the most efficient way to promote recorded music for a long time; thus it achieved a position of unparalleled power and influence in the music industry.[85] It raised several questions of copyright law related to music, such as: did broadcasts of live music invoke any of the exclusive rights in copyright law? Was advance permission required to broadcast a musical work? And what rights on recorded music–if any–applied?

The first of these questions was resolved relatively quickly: for example, in 1925 the Sixth Circuit established that a broadcast of music was a public performance even though the audience was not gathered in one place.[86] The American Society of Composers, Authors, and Performers (ASCAP) was established in pre-radio 1914 as the first performance rights organization (PRO);[87] it organized blanket licenses for public performances of musical works for radio broadcasters. The broadcast industry started Broadcast Music Inc. (BMI) in 1939[88] as a competitive PRO, also offering a blanket license to works in its catalog. This made it straightforward for radio stations to license musical works for broadcast without having to obtain permission for individual works in advance.[89]

These PRO licenses covered musical works (compositions). Sound recordings were a completely different story. In 1940, the Second Circuit established that radio stations could purchase records and play them on the air as many times as they wanted without having to seek permission.[90] The Third Circuit confirmed in 1964 that radio broadcasts of recorded music counted as public performances of the compositions embodied in the recordings.[91] But as discussed above, Congress did not confer performance rights on the sound recordings themselves with the Sound Recording Act of 1971, so radio stations had no obligations under copyright law regarding sound recordings. This did not change with the major 1976 revision of the Copyright Act.

The advent of digital radio in the 1990s brought the subject of performance rights on sound recordings back again.[92] Although labels had long viewed radio airplay as

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[84] PANDORA, https://www.pandora.com/ (last visited March 10, 2026); iHEART RADIO, https://www.iheart.com/ (last visited March 19, 2026).

[85] *See generally, e.g.,* Fredric Dannen, *Hit Men: Power Brokers and Fast Money Inside the Music Business* (New York: Crown, 1990).

[86] Jerome H. Remick & Co. v. American Automobile Accessories Co., 5 F.2d 411 (6th Cir. 1925).

[87] *A Monumental Year in Music History*, ASCAP, https://www.ascap.com/100#1914 (last visited March 20, 2026).

[88] *BMI's Timeline Through History*, BMI, https://www.bmi.com/about/history (last visited March 20, 2026).

[89] The Supreme Court upheld the legality of these blanket licenses in *Broadcast Music, Inc. v. CBS, Inc*., 441 U.S. 1 (1979)..

[90] Whiteman and RCA vs. WBO Broadcasting, 114 F.2d 86 (2d Cir. 1940).

[91] Chappell & Co. v. Middletown Fanners Market and Auction Co., 334 F.2d 303 (3d Cir. 1964). *See generally* I. Fred Koenigsberg, *Performing Rights in Music and Performing Rights Organizations, Revisited*, 50 J. COPYRIGHT SOC'Y 355 (2003).

[92] RALPH OMAN, REPORT ON COPYRIGHT IMPLICATIONS OF DIGITAL AUDIO TRANSMISSION SERVICES A REPORT OF THE REGISTER OF COPYRIGHTS (U.S. Copyright Office, Library of Congress, 1991).

promotional to sales, they weren't inclined to view the new digital radio formats that way.[93] On the contrary: they were concerned that digital audio technology, which enabled users to make perfect copies of broadcast material, would lead to services that cannibalized record sales.[94]

The Copyright Office published a study on the effects of digital audio transmission on music piracy in 1991,[95] which led to Congress passing the Digital Performance Right in Sound Recordings Act (DPRA) in 1995.[96] The DPRA established the performance right for sound recordings, but only for digital radio; it left intact the lack of a performance right in sound recordings for traditional AM and FM.[97] It specified statutory royalties for digital radio services and a process for setting them.[98] The DPRA also established that interactive streaming services—which wouldn't exist until several years in the future—would need to negotiate licenses with record labels and would not get statutory royalty rates.[99]

The result of the DPRA was that all types of digital radio services—Internet pure-play, AM/FM simulcast, satellite (SiriusXM and its predecessors), the music channels on cable TV services, and so-called background/foreground services (e.g., Muzak)—got compulsory licenses to play any sound recordings they wanted as long as they pay the statutory royalties.[100]

A loophole regarding sound recording copyrights in digital radio remained for many years afterwards. The DPRA established copyright protection for digital broadcasts of sound recordings, but only as far back as 1972—because the Sound Recording Act of 1971 did not make it retroactive to older recordings.[101] This meant that digital radio services with stations that played genres such as oldies, jazz, and classical music technically could not rely on statutory licenses and needed to negotiate licenses with labels. A series of lawsuits were filed by the likes of Flo & Eddie (lead singers of the 1960s rock band the Turtles as well as solo artists) and ABS Entertainment (label of Sam Cooke, Jackie Wilson, and others).[102]

This loophole was finally closed in 2018 with the passage of the Music Modernization Act (MMA),[103] although only for digital radio. In addition to its provisions focused on mechanical licensing of musical compositions for interactive streaming,

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[93] *Id.*
[94] *Id.*
[95] *Id*.
[96] Digital Performance Right in Sound Recordings Act of 1995, Pub. L. 104–39, 109 Stat. 336.
[97] *Id.*
[98] 17 U.S.C. § 114(d).
[99] Digital Performance Right in Sound Recordings Act of 1995, Pub. L. 104–39, 109 Stat. 336.
[100] Music services that are played in commercial public spaces such as stores and restaurants, e.g., Mood Media.
[101] Sound Recording Act of 1971, No. 92-140, 1971 U.S.C.C.A.N. (Oct. 15, 1971).
[102] Flo & Eddie, Inc. v. Sirius XM Radio, Inc., 9 F.4th 1167 (9th Cir. 2021); Flo & Eddie, Inc. v. Pandora Media, Inc., 851 F.3d 950 (9th Cir. 2017);Abs Entm't v. CBS Corp., 908 F.3d 405 (9th Cir. 2018).
[103] *The Music Modernization Act*, COPYRIGHT OFF., https://www.copyright.gov/music-modernization/ (last visited March 20, 2026).

which we discuss below, the MMA also included a provision that was originally called the CLASSICS Act (Compensating Legacy Artists for their Songs, Service, and Important Contributions to Society), which established a performance right in pre-1972 sound recordings for digital radio.[104]

The final loophole wasn't closed: there is still no performance right in sound recordings (of any vintage) for terrestrial radio. The United States continues to be one of only a handful of countries in the world without this right; others include Iran, North Korea, and Rwanda.[105] AM and FM broadcasters in the U.S. still don't have to pay royalties to record labels or recording artists.

Arguments over whether radio should pay royalties to labels and artists have taken place numerous times since the 1930s.[106] Recent arguments have turned on whether radio still has the promotional value for recorded music that it did in the pre-digital era.[107] But the fundamental reason why there is still no general performance right in sound recordings takes us from copyright law to the FCC.

The FCC was established with the Communications Act of 1934[108] to regulate the public airwaves as a finite resource, akin to air or water. As radio stations proliferated around the country, the FCC moved to establish ownership limits: a single company could not own or operate more than seven stations nationwide, and no more than one in any given market.[109] Although ownership caps were eventually relaxed in the 1980s (as part of a general deregulation of broadcasting during that time), they helped shape a market for radio stations that had no nationally dominant players.

The Communications Act of 1996 eliminated national ownership caps;[110] but by that time no more desirable frequencies were available,[111] so anyone who wanted to own a radio station had to buy the license from someone else. The big broadcast chains went on buying sprees.[112] Yet when the dust settled, the total number of stations that the biggest four chains owned was less than one-fifth of the total number of about 15,000

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[104] CLASSICS Act, H.R. 3301, 115th Cong. (2017).

[105] China was on this list until 2021, when it passed legislation providing for royalties for radio play of sound recordings. *See Laws of the People's Republic of China*, ASIAN LII, http://www.asianlii.org/cn/legis/cen/laws/clotproc402/ (last visited March 20, 2026) (English translation of Article 43 of Copyright Law of the People's Republic of China, October 27, 2001).

[106] *See, e.g.*, Digital Performance Right in Sound Recordings Act of 1995, Pub. L. 104–39, 109 Stat. 336.

[107] *See, e.g.,* Eileen McDermott, *Senate IP Subcommittee Hears from Witnesses on Impact of Proposal to Compensate Artists for Radio Plays*, IP WATCHDOG (Dec. 10, 2025) *https://ipwatchdog.com/2025/12/10/senate-ip-subcommittee-hears-witnesses-impact-proposal-compensate-artists-radio-plays/* (summary of Senate Judiciary Committee, Subcommittee on Intellectual Property, hearing on the American Music Fairness Act of 2025, December 9, 2025).

[108] 47 U.S.C. §§ 151-614.

[109] 5 Fed. Reg. 2384 (1940).

[110] Telecomms. Act of 1996, Pub. L. 104–104, 110 Stat. 56.

[111] *See, e.g., Crowding the Airwaves*, N.Y. TIMES (Sep. 30, 1957), https://www.nytimes.com/1957/09/30/archives/crowding-the-airwaves.html (AM band); Modification of FM Broad. Station Rules to Increase the Availability of Commercially Assignable Spectrum, 47 C.F.R. §pt. 73 (1983) (FM band).

[112] *The Future and Past of Broadcast Radio*, PBS (May 4, 2005), https://www.pbs.org/newshour/nation/media-jan-june05-broadcast_05-04./15000.

FCC-licensed stations.[113] Even at its peak in 2004, Clear Channel, the largest chain, owned around 1200 stations, or 8% of the total.[114]

As a result, the majority of broadcast stations are owned by small to medium sized businesses that are based all over the country. In contrast, the recorded music industry is concentrated heavily in four states: New York (NYC), Tennessee (Nashville), California (Los Angeles/Santa Monica/Burbank), and Florida (Miami).[115] This means that whenever Congress considers legislation that pits the interests of radio against those of the music industry, there are members of Congress in just a few states being lobbied by the RIAA, while members of Congress in a larger number of states are being lobbied by the National Association of Broadcasters (NAB).[116]

That's why there is no performance right in sound recordings today, and radio pays no royalties to labels or artists. At this writing, yet another attempt to plug this legislative hole is making its way through Congress: The American Music Fairness Act (AMFA), first introduced in 2022 by senators and representatives from the states named above.[117] In response, the NAB has introduced the Local Radio Freedom Act, which would prohibit Congress from enacting royalties or other compensation for sound recording airplay on radio.[118]

Yet the impact that such legislation would have on recorded music industry revenues has diminished in the digital age. Radio listening has been diminishing: survey data shows that AM/FM radio as a percentage of Americans' audio listening time dropped from 51% in 2014 to 36% in 2024.[119] Homes with radios declined from 96% in 2008 to 61% by 2022.[120] Even the use of AM/FM radio in cars – the largest locus of radio listening – dropped from 86% in 2014 to 70% in 2024.[121] And fewer people listen to radio

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[113] *Id.*

[114] *Id*. Today, iHeartMedia, the renamed Clear Channel, owns about 860 stations out of the same 15,000. *See We are iHeartMedia*, IHEART RADIO, https://www.iheartmedia.com/ (last visited March 20, 2026).

[115] The major recorded music companies (Sony Music Entertainment, UMG, and WMG) each have offices in all of these cities.

[116] *See, e.g.,* Alex Siciliano, *Broadcasters From All 50 States Gather in Washington, D.C. for State Leadership Conference*, NAB (March 4, 2025), https://www.nab.org/documents/newsroom/pressRelease.asp?id=7168; *89 Artists Add Names To Effort Calling On Congress To Pass The CLASSICS Act*, RIAA (April 3, 2028), https://www.riaa.com/89-artists-add-names-effort-calling-congress-pass-classics-act/.

[117] American Music Fairness Act of 2022, H.R. 4130, 117th Cong. (2022);American Music Fairness Act, S.4932, 117th Cong. (2022).

[118] *A Performance Tax Threatens Local Jobs*, NAB, https://www.nab.org/advocacy/issue.asp?id=1889&issueid=1002 (last visited March 20, 2026).

[119] *Substantial Shifts in the Audio Day of Americans*, EDISON RESEARCH (July 30, 2024), https://www.edisonresearch.com/substantial-shifts-in-the-audio-day-of-americans/.

[120] Survey respondents reporting one or more radios in the household. Meanwhile, ownership of smart speakers – which includes listening to Internet streams of AM/FM signals – rose to 35% in 2022. *See The Infinite Dial 2022*, EDISON RESEARCH (March 23, 2022), https://www.edisonresearch.com/the-infinite-dial-2022/.

[121] THE INFINITE DIAL 2014, EDISON RESEARCH 29 (2014),

for music per se: of the reasons respondents to another annual survey give for listening to radio, music selection has ranked below "Particular DJs/Shows/Hosts" since 2019.[122]

This data means that many people still listen to the radio. Yet much radio listening is now not on AM or FM signals but from digital sources that pay performance royalties on sound recordings.[123] The latter survey shows that the percentage of listening to AM/FM stations that takes place over streaming and not terrestrial broadcast has been steadily increasing and is now 39%,[124] although another recent survey puts the figure at 13%.[125] Add to that the significant numbers of listeners to digital radio services like SiriusXM, Pandora, and iHeartRadio, and it is clear that a good portion of radio listening is done over digital services.

In other words, the DPRA anticipated—whether by design or happenstance[126]—a world in which a large share of radio plays generate performance royalties on sound recordings. This observation enables us to characterize the timeframe for copyright law to settle around the disruptive technology of radio broadcasting as **71 years**, from the emergence of radio as a mass medium for music in 1924 to the DPRA of 1995.

III. HOME TAPING

The technology of recording audio onto paper tape coated with magnetic particles was invented by Fritz Pfleumer in Germany in 1928.[127] AEG (the German equivalent of General Electric) created the first production tape recording device, the Magnetophon; the chemical company BASF created the first successful blank tape formulation.[128] The technology was first demonstrated to the public in 1935 and was adopted by the Nazi government to broadcast propaganda over the German state radio network.[129] The first known music recording on magnetic tape was made of a concert in 1936 by the London

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https://www.edisonresearch.com/wp-content/uploads/2014/03/The-Infinite-Dial-2014-from-Edison-Research-and-Triton-Digital.pdf; THE INFINITE DIAL 2024, EDISON RESEARCH 15 (2024), https://www.edisonresearch.com/wp-content/uploads/2024/06/Infinite-Dial-2024-Presentation.pdf.

[122] JACOBS MEDIA TECH SURVEY 2025, Jacob Media 21 (2025), https://jacobsmedia.com/wp-content/uploads/2025/04/TS-2025-industry-web-deck.pdf.

[123] *Id.*

[124] *Id.* at 30. The survey was distributed through "500 commercial radio stations in the U.S. & Canada," i.e., stations that originate as AM or FM; respondents were asked how they listened to the station that sent the survey. *Id.* at 2.

[125] *Most AM/FM Radio Listening Remains on Radio Receivers*, EDISON RESEARCH (Nov. 19, 2025), https://www.edisonresearch.com/most-am-fm-radio-listening-remains-on-radio-receivers/.

[126] For example, the 1991 Copyright Office study on digital audio transmission services (*supra* note 39) mentioned companies' interests in building new digital audio services that would attract listeners, but it did not mention the possibility of broadcast stations being transmitted over digital networks instead of AM or FM.

[127] Friedrich Engel, Peter Hammar, and Richard L. Hess, *A Selected History of Magnetic Recording*(Aug. 27, 2006), https://www.richardhess.com/tape/history/Engel_Hammar--Magnetic_Tape_History.pdf.

[128] *Id.*

[129] *Id.*

Philharmonic Orchestra under the direction of Sir Thomas Beecham while the orchestra was on tour in Germany.[130]

At the end of World War II, U.S. Army Major Jack Mullin found Magnetophon machines at a radio studio in Germany and had them shipped back to the United States. Mullin and his partner Bill Palmer created a version of the Magnetophon modified for American electronics; this led to a tiny startup called Ampex—in what is now Silicon Valley—producing the first American commercial tape recorders.[131]

The 7-inch reel of ¼-inch-wide tape running at 7.5 ips (inches per second) became the standard format for commercial music recordings,[132] which Ampex and other companies began releasing in the early 1950s.[133] Reel-to-reel tape machines had been available in the home market starting in 1947, but open-reel tapes were never a mass-market format.[134] Machines were bulky and not easy enough to use. Electronics retailers didn't include tape decks in bundled audio systems until the 1960s.[135]

Tape cartridge formats made tapes smaller and more convenient to use. They first appeared in the early 1950s, but they weren't used for commercial music releases until later. Earl Muntz, an automobile dealer in Southern California, saw their potential for music on demand in cars and in 1962 introduced the Stereo-Pak cartridge, which was based on the standard Fidelipac "cart" format used in radio stations.[136] Muntz arranged for commercial music releases on Stereo-Paks; electronics makers introduced aftermarket players for automobiles as well as home players. Stereo-Pak recorders did not appear until a few years later.[137]

The Stereo-Pak was soon eclipsed by the Stereo-8, a/k/a 8-track tape cartridge. Bill Lear designed the 8-track initially as a way to play music aboard his Lear Jet private

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[130] *Id*. The recording is available on CD as *Beecham – The Formative Years*. *See London Philharmonic Orchestra, Sir Thomas Beecham – The Formative Years. Pioneering Sound Recordings From The 1930s*, Discogs, https://www.discogs.com/release/18251656-London-Philharmonic-Orchestra-Sir-Thomas-Beecham-The-Formative-Years-Pioneering-Sound-Recordings-Fro?srsltid=AfmBOopfE5LmY0jS69nd3vmkIAhdsm0OblPSdByxyo7Zebt5mQ58RVDH (last visited March 10, 2026).

[131] Engel et al, *A Selected History of Magnetic Recording* at 8.

[132] Maxine Roth, *The Story of Music on Tape*,Tape Recording, January 1968, at 44-48.

[133] *Id.*

[134] Andre Millard, America on Record: A History of Recorded Sound 211-212 (Cambridge, UK: Cambridge University Press, 2nd ed. 2005); Howie Singer and Bill Rosenblatt, Key Changes: The Ten Times Technology Transformed the Music Industry 153 (Oxford University Press, 2023). The RIAA began tracking recorded music revenue by format in 1973 and did not bother to include open-reel tape as a separate category. *See* RIAA Revenue Database, *supra* note 28.

[135] *See, e.g.*, *Radio Shack Catalogs*, https://radioshackcatalogs.com/ (last visited March 10, 2026); *Lafayette Catalogs (Including Concord Radio and Wholesale Radio Service)*, World Radio History, https://www.worldradiohistory.com/Lafayette_Catalogs.htm (last visited March 10, 2026).

[136] David L. Morton, Sound Recording: The Life Story of a Technology 158 (Baltimore: Johns Hopkins University Press, 2004); *Stereo-Pak 4-Track Cartridge (1962 – 1970)*, Museum of Obsolete Media, https://obsoletemedia.org/stereo-pak-4-track-cartridge/ (last visited March 10, 2026).

[137] Eric D. Daniel, D. Dennis Mee, and Mark H. Clark, Magnetic Recording: The First 100 Years 99 (Piscataway, NJ: IEEE Press, 1999).

aircraft.[138] The 8-track included four pairs of stereo tracks; it doubled the audio capacity of the similarly-sized Stereo-Pak with a tradeoff in sound quality.[139] Ford introduced 8-track players in late 1965 in select models for the 1966 auto model year.[140] Sony released the first home component 8-track machine in 1968.[141] 8-tracks became more popular than Stereo-Paks owing to deals that Lear made with automakers to factory-install the devices, as well as the cartridges' increased audio capacity and greater ease of use.[142]

Philips Electronics of the Netherlands created the Compact Cassette format in 1963, two years before the 8-track. Philips's first cassette recorder, the EL 3300, was a portable about the size of a thick paperback book that weighed about two pounds.[143] The cassette itself was less than half the size of an 8-track or Stereo-Pak tape. But Philips originally intended the cassette as a low-cost convenient format for dictation and other personal uses, not as a commercial music format;[144] cassettes' slow speeds and narrow tape widths gave it audio quality that was inferior even to 8-tracks.[145]

Yet the cassette's portability and convenience made it attractive to consumers. The first commercial music recordings on cassette appeared in 1966, around the same time as the first commercial 8-track releases.[146] 1966 also saw the introduction of the Philips/Norelco 22RL962, the first cassette recorder with an AM/FM tuner and the ability

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[138] DAVID L. MORTON, SOUND RECORDING: THE LIFE STORY OF A TECHNOLOGY 160 (Baltimore: Johns Hopkins University Press, 2004).

[139] The 8-track had the same tape width and speed as the Stereo-Pak (0.25" wide tape running at 3.75ips) but with double the number of tracks (four stereo pairs instead of two), meaning half the tape width per track and thus inferior sound quality. Sound quality is proportional to the area of tape that passes the recording or playback head every second. *See 8-Track (Stereo 8) (1964 – 1988)*, MUSEUM OF OBSOLETE MEDIA, https://obsoletemedia.org/8-track/ (last visited March 10, 2026).

[140] Lear originally created Stereo-8 for use in his Lear Jet aircraft as a replacement for Stereo-Pak players.

[141] *HiFi/Stereo Review's Tape Recorder Annual 1968*, HIFI/STEREO REVIEW, https://www.worldradiohistory.com/Archive-All-Audio/Archive-HiFI-Stereo/SPECIALS/HiFi-Stereo-Review-1968-Tape-Recorder-Annual.pdf (last visited March 10, 2026).

[142] The user could advance an 8-track tape to the next "track," typically an album side, at the push of a button; the cartridge's tapered end made it easier to insert into a player in the car without looking.

[143] First Philips cassette recorder, 1963, PHILIPS (Jan. 1, 2019), https://www.philips.com/a-w/about/news/media-library/20190101-First-Philips-cassette-recorder-1963.html.

[144] The same was true for Edison's cylinders in their early days.

[145] 8-tracks contain 0.25" wide tape in four stereo pairs (0.03125" per track) running at 3.75ips. Cassettes contain 0.15" wide tape in two stereo pairs (0.0375" per track) running at 1.875ips – slightly wider per track but running at half the speed. This is 60% of the area per second of 8-tracks, which in turn have 25% of the area per second of standard commercial stereo open-reel tape. *See Compact Cassette (1963 –)*, MUSEUM OF OBSOLETE MEDIA, https://obsoletemedia.org/compact-cassette/ (last visited March 10, 2026); *8-Track (Stereo 8) (1964 – 1988)*, MUSEUM OF OBSOLETE MEDIA, https://obsoletemedia.org/8-track/ (last visited March 10, 2026).

[146] JOHN KOMURKI, CASSETTE CULTURES: PAST AND PRESENT OF A MUSICAL ICON 15 (Salenstein, Switzerland: Benteli, 2019).

to record audio off the air.[147] Thus 1966 was effectively the beginning of tape as a mass-market music technology.

By 1968, cassette recorders were outselling both open-reel and 8-track machines, and component stereo cassette decks began to appear.[148] And in the early 1970s, two technological innovations came together to improve cassettes' sound quality: DuPont's CrO_2 (chromium dioxide or "chrome") tape formulation, which increased high-frequency audio range,[149] and Ray Dolby's Dolby B system, which reduced noise.[150] The first home cassette decks with Dolby and chrome tape support appeared in 1971.[151] These features quickly became standard, and sound quality continued to improve. By the late 1970s, it was possible to make copies of LPs at home on moderate-priced cassette decks that sounded close to the originals,[152] using chrome tapes that sold for about $3 for a C-90 (which could hold two albums).[153]

The 8-track was never a popular format for home recording.[154] But it achieved moderate popularity as a commercial music format for use in automobiles. Through the 1970s, 8-tracks sold at about one-third the volume of vinyl LPs, with cassettes lagging behind.[155] But cassettes grew much further: they became the dominant format in recorded music by revenue for a period of a few years. The transition began after 1979 as sales of pre-recorded cassettes surpassed 8-tracks.[156] Then cassettes overtook vinyl by revenue in 1984 and stayed there until CDs leapt past them in 1990.[157]

The main catalysts for cassettes' rise in popularity, apart from their compact size, were two types of devices that appeared in quick succession in the late 1970s and made it possible to play music on demand while on the go: portable stereo radio/cassette machines with loudspeakers (boomboxes – metastasized descendants of Philips's 22RL962), and the personal portable player with high-quality headphones (the Sony

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[147] Hi-Fi Hall of Fame Technology Inductee Compact Cassette, Hi-Fi Hall of Fame, https://hifihalloffame.com/technology/compact-cassette/ (last visit March 26, 2026).

[148] Robert Angus and Norman Eisenberg, *Are Cassettes Here to Stay?*, High Fidelity, July 1, 1969, at 46-53.

[149] Robert Donadio, *Cassette Tape Progress*. Stereo Review's Tape Recording and Buying Guide 1979, at 21-24, https://www.worldradiohistory.com/Archive-All-Audio/Archive-HiFI-Stereo/SPECIALS/Stereo-Review-Tape-Recording-Guide-1979.pdf.

[150] Eric D. Daniel, D. Dennis Mee, and Mark H. Clark, Magnetic Recording: The First 100 Years 105-106 (Piscataway, NJ: IEEE Press, 1999); David L. Morton, Sound Recording: The Life Story of a Technology 163 (Baltimore: Johns Hopkins University Press, 2004)

[151] Julian Hirsch, *Advent 201 Cassette Tape Deck*, Stereo Review, October 1971, 40-42.

[152] In rough terms, this meant flat frequency response extending past 15 KHz, signal-to-noise ratio of at least 60 dB, and wow/flutter at less than 0.1%. By the late 1970s, those specs were widely available in mid-line cassette decks costing less than $300. *See, e.g., Stereo Review's Stereo Directory & Buying Guide 1979*, Stereo Review, 115-129.

[153] *Id*.

[154] For example, electronics makers sold far fewer 8-track recording models than cassette recording models, and none of the former were high-priced audiophile models. *Compare id*. at 115-129 *with id.* at 134.

[155] *See* RIAA Revenue Database, *supra* note 28.

[156] *Id.*

[157] *Id.*

Walkman and its imitators).[158] Another factor was record labels' decisions around 1978 to set retail prices for cassettes equal to vinyl LPs instead of pricing them a dollar or two higher.[159]

The copyright-related concerns related to home taping were obvious: what to do about unauthorized copies of commercial music releases that people were making at home? These copies were nominally infringements; for decades, no court cases tested, for example, whether making such copies was fair use.

Record labels had been concerned about tape's potential for home recording of commercial music releases since making them available on cassettes and 8-tracks.[160] They pushed back against home stereo component cassette and 8-track recorders starting in 1967, to no avail.[161] Their concerns were heightened at the end of the 1970s, after the release of a Copyright Royalty Tribunal study showing that 20% of the U.S. population taped music at home[162] and amid a dramatic industry revenue downturn in 1979.[163]

There were a few distinct home taping use cases to consider.[164] The original one – enabled by devices such as Philips's radio/cassette recorder – was taping music from radio broadcasts. Another was taping your own vinyl albums so that you could play them on a portable or in the car. A third was taping your friends' albums (or albums borrowed from the library) so that you didn't have to buy them yourself.

The third of these was obviously not legal, but there was no practical way to enforce it. The U.K. music industry attempted to do so with a public relations campaign called Home Taping Is Killing Music, which it launched—to little success—in 1981,[165] just after the first appearance of dubbing cassette decks in the country.[166]

The U.S. recording industry attempted to respond through levies on blank tape and recording equipment. Bills introduced in 1982 would have made home taping legal while imposing royalty fees on tape recorders of up to 25% of wholesale prices and a levy on blank tapes that would have resulted in a price hike of about 30% on 90-minute chrome

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[158] *Product & Technology Milestone: Personal Audio*, SONY, https://www.sony.com/en/SonyInfo/CorporateInfo/History/sonyhistory-e.html (last visited March 10, 2026).

[159] Sam Goody ads in the *New York Daily News*, 1973-1981.

[160] Maxine Roth, *The Story of Music on Tape*, TAPE RECORDING, January 1968.

[161] *Id.*

[162] Richard Harrington, *The Record Industry Goes To War On Home Taping*, WASHINGTON POST, June 15, 1980.

[163] Inflation-adjusted revenue plummeted 20% from 1978. *See* RIAA Revenue Database. This was the worst industry downturn since the early 1950s when the industry suffered from the LP vs. 45 format war.

[164] Of course, commercial bootlegs were also concerning to rightsholders, but those concerns were the same as for vinyl, which we discussed above.

[165] Annie Zaleski, *35 Years Ago: the U.K. Launches the 'Home Taping is Killing Music' Campaign*, DIFFUSER (Oct. 25, 2016), https://diffuser.fm/home-taping-is-killing-music-uk/.

[166] The first dubbing cassette deck to appear in the West was in the Amstrad TS-55, a low-cost all-in-one stereo system released in the U.K. in 1981. Amstrad CEO Alan Sugar adapted the dubbing deck design from studio equipment he had seen in Japan. The device survived a lawsuit in the U.K. that went all the way up to the House of Lords. *See* CBS Songs Ltd. v. Amstrad Consumer Elecs. Plc. [1988] AC 1013 (HL).

cassettes.[167] These efforts failed due to stiff opposition from the electronics industry,[168] as did a similar effort in the U.K.[169]

The first of the aforementioned use cases, home taping of broadcasts (known as "time shifting"), wound up in court in the context of videocassettes. Sony had released the first successful home videocassette recording technology, the Betamax system, in 1975. A group of Hollywood movie studios led by Universal sued Sony[170] in 1978 over taping from broadcast television. The result was the landmark 1984 *Sony v. Universal* Supreme Court decision, which held—among many other things—that home taping of broadcast material for personal "time-shifting" use was fair use.[171]

The music industry made no other significant attempts to regulate home taping of music.[172] Instead the labels engaged in subtler tactics, such as threatening to pull ads from radio stations that played albums in their entirety and from publications that put blank tape ads on the same pages as ads for music.[173] The RIAA eventually adopted a stance that "[i]t's okay to copy music onto an analog cassette, but not for commercial purposes"[174] but stopped short of saying that doing so is legal. It maintains a similar stance regarding duplication of digital media such as licensed downloads and CDs to this day.[175]

The rapid rise of CDs in the 1980s and 1990s rendered cassettes irrelevant to the music industry; tape revenues had dropped to negligible levels by the mid-2000s.[176] Thus, the last word in copyright law on home taping was *Sony v. Universal* in 1984. This puts

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[167] Bill Holland, *Audio-Only Home Taping Bill Readied on Senate Side*, BILLBOARD, Sep. 7, 1985.

[168] John Pareles, *Royalties on Recorders and Blank Audio Tapes*, N.Y. TIMES, Nov. 21, 1985.

[169] CLINTON HEYLIN, BOOTLEG: THE SECRET HISTORY OF THE OTHER RECORDING INDUSTRY 238 (New York: St. Martin's Griffin, 1994).

[170] Sony would not own a motion picture studio itself until 1989.

[171] Sony Corp. of Am. v. Universal City Studios, Inc., 464 U.S. 417 (1984). Ironically, Sony ended up losing a format war to VHS, which JVC had introduced a year after Sony introduced Betamax. VHS became a hugely successful home video format until supplanted by the DVD in the 1990s.

[172] Sony introduced the Digital Audio Tape (DAT) format as a potential successor to cassettes in 1987. The music industry got Congress to enact levies and copy restriction mandates on DATs, as well as certain types of recordable CDs and CD recording equipment, with the Audio Home Recording Act of 1992, but DATs were never used as a consumer music format, and recordable CDs were never popular. Both were rendered obsolete by Internet technologies for consumer use, though DATs were used in recording studios and as computer backup media.

[173] HOWIE SINGER AND BILL ROSENBLATT, KEY CHANGES: THE TEN TIMES TECHNOLOGY TRANSFORMED THE MUSIC INDUSTRY 134-144 (Oxford University Press, 2023).

[174] William Patry, *What RIAA Has Said About Home Taping*, THE PATRY COPYRIGHT BLOG (Jan. 07, 2008), https://williampatry.blogspot.com/2008/01/what-riaa-has-said-about-home-taping.html.

[175] *Resources and Learning*, RIAA, https://www.riaa.com/resources-learning/about-piracy/ (last visited March 10, 2026).

[176] *See* RIAA Revenue Database, *supra* note 28. Some commentators have proclaimed a "cassette revival" in recent years, akin to the vinyl revival. But while this may be relevant as a cultural phenomenon, it is not in terms of industry revenue: the biggest-selling cassette titles sell in the tens of thousands of copies per year, compared to in the millions for vinyl. *See, e.g.,* LUMINATE 2025 YEAR-END MUSIC REPORT, 65-66 (2025), https://luminatedata.com/reports/yearend-music-industry-report-2025/.

the length of time between the emergence of cassettes as a mass-market music format in 1966 and that decision at **18 years**.

IV. DIGITAL FILES

Technology for encoding audio in digital files dates back to the late 1940s, when Bernard Oliver, John Pierce, and Claude Shannon at AT&T Bell Labs invented pulse code modulation (PCM) as a means of creating digital samples of audio.[177] The first digital audio recorders appeared in the late 1960s and early 1970s in Japan, and were used in recording studios by the end of the 1970s.[178] But the resulting files were far too large to send over the digital networks of the early-mid 1990s.

At that time, Karlheinz Brandenburg, a psychoacoustics researcher at the Fraunhofer IIS research lab in Germany, invented an algorithm that could compress the size of a digital audio file by a factor of several and still sound acceptable.[179] He created this to make it possible to upload and download music files to/from online services in reasonable timeframes over the slow-speed digital networks of that time.[180] After extensive testing, in 1993 the MPEG standards body approved his algorithm as MPEG-1 Layer 3, known commonly as MP3 (for the .mp3 filename extension).[181] MP3 effectively reduces the size of audio data on a CD by as much as 90%.[182]

The Internet started to flourish through the 1990s, with most consumers having access over dialup lines.[183] It became possible for ordinary users to obtain MP3 compression software, such as WinAmp or MusicMatch Jukebox, which they could run on their PCs to "rip" CDs into MP3 files that they could then upload to any of these networks and send to their friends.[184] On a typical late 1990s dial-up connection of 56 kbps (kilobits per second), it took about 7-8 minutes to upload or download a 3-minute song that was encoded in MP3 with common settings;[185] transmitting the uncompressed CD audio would take an hour and a quarter.[186]

Yet encoding music in MP3 files and transmitting copies of them to people over digital networks required too much technical savvy for most people. That changed when

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[177] Oliver, B. M., Pierce, J. R., & Shannon, C. E., *The Philosophy of PCM*, 36 Proceedings of the IRE 1324 (1948).
[178] Eric D. Daniel, D. Dennis Mee, and Mark H. Clark, Magnetic Recording: The First 100 Years 120 (Piscataway, NJ: IEEE Press, 1999).
[179] 30 Years of .mp3: Three Letters That Changed the World, Fraunhofer IIS (July 4, 2025), https://www.iis.fraunhofer.de/en/magazin/panorama/2025/30-years-of-mp3.html.
[180] *Id.*
[181] *Id.*
[182] *Id.*
[183] Falling Through the Net: Toward Digital Inclusion, 23 (2000), https://www.ntia.gov/files/ntia/publications/fttn00.pdf.
[184] Matt Richtel and Sara Robinson, *Technology; Ear Training: A Digital Music Primer*, N.Y. Times (July 19, 1999), https://www.nytimes.com/1999/07/19/business/technology-ear-training-a-digital-music-primer.htm.
[185] 128 kbps MP3 encoding, 4.3 MB file size. At 192 kbps (better sound quality) it would take about 10 minutes.
[186] CD audio is encoded at 44,100 16-bit samples per second per stereo channel, resulting in a 32 MB file.

Shawn Fanning and Sean Parker created Napster.[187] Napster was a software application for PCs that communicated over the Internet with a central server.[188] When a user installed the Napster application, it created a list of all the music files on that user's machine and created entries for them in an index on the server.[189] When another user wanted a song, the software searched the index and enabled the user to select the track they wanted. That user was then connected directly with the PC of a user who had the desired song, and a file transfer occurred from one "peer" (user) directly to another. Each user viewed lists of files available for sharing on a simple spreadsheet-like user interface.[190] This became known as peer-to-peer or p2p file-sharing.[191]

Napster made all of this easy, so that users didn't have to know any details about codecs, file formats, communication protocols, or file transfer utilities.[192] It replaced older methods of sharing files online, such as via Usenet bulletin-board software or the IRC chat service, that required much more technical know-how and patience to use.[193]

Napster launched in June 1999.[194] It spread like wildfire at colleges and universities (starting with Fanning's Northeastern University in Boston),[195] with their potent combinations of fast campus networks and students who were passionate about music but short on cash. In December, a group of record labels filed suit against it.

Meanwhile, other entrepreneurs built servers that hosted MP3 files themselves and enabled artists to sell them.[196] One of these was Michael Robertson and his MP3.com site. MP3.com started out in 1997 as a site with news and information about how to create and use MP3 files, and a function for searching FTP (File Transfer Protocol) servers for music and other types of files.[197] It also encouraged independent artists to post their songs for sale on the site in MP3 format and split the profits with them.[198] By 1999, MP3.com had over 56,000 songs from 11,000 artists.[199] When the company raised over $370

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[187] TIME Staff, *Meet the Napster*, TIME (Oct. 2, 2000), https://time.com/archive/6954963/meet-the-napster/.
[188] *Id.*
[189] Jennifer Sullivan, *Napster: Music Is for Sharing*, WIRED (Nov. 1, 1999) https://www.wired.com/1999/11/napster-music-is-for-sharing/.
[190] *Id.*
[191] *Id.*
[192] *Id.*
[193] *Id.*
[194] Stephen Dowling, *Napster turns 20: How it Changed the Music Industry*, BBC (May 31, 2019), https://www.bbc.com/culture/article/20190531-napster-turns-20-how-it-changed-the-music-industry.
[195] Spencer E. Ante, *Inside Napster*, BLOOMBERG (Aug. 14, 2000), https://www.bloomberg.com/news/articles/2000-08-13/inside-napster.
[196] Lesley Anderson, *MP3 is Web's Newest Craze* (Feb. 10, 1999), https://www.cnn.com/TECH/computing/9902/10/mp3craze.idg/index.html.
[197] Neal Bloom, *San Diego Tech Companies Series: The MP3.com Mafia Part 1*, CRUNCHBASE (Nov. 12, 2025), https://about.crunchbase.com/blog/san-diego-tech-company-mp3-com-p1/.
[198] CNET Staff, *Some MP3 Artists Scarping by Without Labels*, CNET (Feb. 10, 2000), https://www.cnet.com/tech/services-and-software/some-mp3-artists-scraping-by-without-labels/.
[199] Bloomberg News, *Music Concern Files With S.E.C.*, BLOOMBERG (MAY 19, 1999), https://www.nytimes.com/1999/05/19/business/music-concern-files-with-sec.html.

million in an initial public offering, it was the largest tech IPO ever until that point in time.[200]

In 2000, MP3.com began offering a service called My.MP3.com where users could register CDs they owned, create MP3 files from them, upload them to the site, and play the files from there.[201] This entailed "certifying" that a user owned a CD by placing it in their PC's CD drive so that the service could record a code from it.[202] This feature drew a lawsuit from Universal Music Group (UMG) in January 2000, one month after the Napster lawsuit was filed.[203] MP3.com was found liable in September 2000.[204] The following year, Napster was shut down after the Second Circuit Appeals Court affirmed Judge Marilyn Hall Patel's district court decision which found Napster liable for copyright infringement.[205]

Rightsholders gradually began to license content to file download services. Apple had launched iTunes music management software in 2001[206] to go with its iPod hard-disk-based portable music players,[207] which were major improvements over early portable digital music players (such as the Diamond RIO) that used flash memory and could only hold a few songs at a time;[208] in contrast, the original iPod could hold, as Apple's advertising put it, "1000 songs in your pocket."[209]

But users had few *licensed* sources of MP3 files to put on them. Some early licensed music services used digital rights management (DRM) technology that encrypted files and rendered them playable only on devices attached to a given user's account;[210] these

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[200] Jennifer Sullivan, *The Sound of Busic (sic)*, WIRED (Feb. 26, 1999), https://www.wired.com/1999/02/the-sound-of-busic/.
[201] Wired Stadd, *MP3.com Stores Your CDs*, WIRED (Jan. 12, 2000), https://www.wired.com/2000/01/mp3-com-stores-your-cds/.
[202] *Id.*
[203] UMG Recordings, Inc. v. MP3.com, Inc., 92 F. Supp. 2d 349 (S.D.N.Y. 2000).
[204] *MP3.com Loses Copyright Case*, N.Y. TIMES (Sep. 6, 2000), https://www.nytimes.com/2000/09/06/technology/mp3com-loses-copyright-case.html.
[205] Matt Richtel, *The Napster Decision: The Overview; Appellate Judges Back Limitations on Copying Music*, N.Y. TIMES (Feb. 13, 2001), https://www.nytimes.com/2001/02/13/business/napster-decision-overview-appellate-judges-back-limitations-copying-music.html.
[206] *Apple Introduces iTunes — World's Best and Easiest To Use Jukebox Software*, APPLE (Jan. 9, 2001), https://www.apple.com/newsroom/2001/01/09Apple-Introduces-iTunes-Worlds-Best-and-Easiest-To-Use-Jukebox-Software/.
[207] *iPod*, APPLE, https://web.archive.org/web/20011214094253/http://www.apple.com/ipod/ (last visited March 10, 2026).
[208] Douglas F. Gray, *Diamond Shines with New Rio MP3 Player*, CNN (Sep. 24, 1999), https://www.cnn.com/TECH/computing/9909/24/rio500.idg/index.html. The model in this review contained 64MB of memory, enough to hold less than two albums' worth of music.
[209] Apple Presents iPod, Apple (Oct. 23, 2001), https://www.apple.com/newsroom/2001/10/23Apple-Presents-iPod/. The original iPod came equipped with a 5GB drive, 78 times as much memory as the RIO.
[210] Jason Chervokas, Music Industry Fears Digital Music Pirates, N.Y. TIMES (April 6, 1998), https://archive.nytimes.com/www.nytimes.com/library/tech/98/04/biztech/articles/06mpeg.html.

didn't work with iPods or iTunes. Others, such as eMusic, didn't use DRM and worked with iPods but only included content from independent labels.[211]

In 2003 Apple launched the iTunes Music Store, which sold licensed digital song files for 99 cents each.[212] Apple used a DRM technology that enabled the purchased files to be transferred from users' computers to their iPods over cables in a seamless, fuss-free process.[213]

Steve Jobs convinced the major labels to license their catalogs to Apple for the iTunes Music Store.[214] At first, the Store only ran on Apple Mac computers, which amounted to a limited experiment; in October 2003, the major labels permitted Apple to launch a version for the much more widely used Windows PC.[215] This was the real start of a robust market for licensed music downloads. While all the other technologies discussed here expanded the size of the recorded music industry, MP3 compression and peer-to-peer file-sharing had done the opposite: sales went into a nosedive after Napster launched in 1999.[216] Apple's combination of iPods and iTunes helped pull industry revenues out of free fall.[217]

In February 2005, Michael Robertson returned with a new service called MP3Tunes.[218] This had a feature that enabled users to upload their music files to Internet servers so that they could download them from there onto other devices they own.[219]

By the end of the 2000s, Apple had launched the iPhone,[220] and other device makers had introduced mobile phones based on Google's Android operating system.[221] This meant that users could upload their music files to "the cloud" and download them over the air to their smartphones through mobile internet connections, a process that could be automated so that it just happened without any user action. This was easier than the

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[211] Matt Richtel, *Technology; MP3.com Is Confronting Another Copyright Suit*, N.Y. TIMES (Dec. 20, 2000), https://www.nytimes.com/2000/12/20/business/technology-mp3com-is-confronting-another-copyright-suit.html.

[212] *Apple Launches the iTunes Music Store*, APPLE (April 28, 2003), https://www.apple.com/newsroom/2003/04/28Apple-Launches-the-iTunes-Music-Store/.

[213] Mark Wherry, *iTunes Music Store*, SOUND ON SOUND (Nov. 2003), https://www.soundonsound.com/techniques/itunes-music-store.

[214] Evan Hansen, *Steve Jobs' Half Note*, CNET (May 21, 2003), https://www.cnet.com/tech/tech-industry/steve-jobs-half-note/.

[215] *Apple Launches iTunes for Windows*, APPLE (Oct. 16, 2003), https://www.apple.com/newsroom/2003/10/16Apple-Launches-iTunes-for-Windows/.

[216] *See* RIAA Revenue Database, *supra* note 28.

[217] Apple did not use the MP3 codec; instead it used the more recent Advanced Audio Coding (AAC) scheme, developed by Dolby, AT&T, Fraunhofer, and Sony and made part of the MPEG-4 set of standards. AAC, in its variations, has become the most widely used audio codec for digital music.

[218] *MP3.com Founder to Launch New Service*, NBC NEWS (Feb. 4, 2005), https://www.nbcnews.com/id/wbna6914712.

[219] *Id.*

[220] *Apple Reinvents the Phone with iPhone*, APPLE (Jan. 9, 2007), https://www.apple.com/newsroom/2007/01/09Apple-Reinvents-the-Phone-with-iPhone/.

[221] Kent German, *A Brief History of Android Phones*, CNET (Aug. 2, 2011), https://www.cnet.com/tech/mobile/a-brief-history-of-android-phones/.

cumbersome "side-loading" processes that involved connecting cables from mobile phones to PCs and invoking software that was often clunky to use, particularly on devices other than iPhones.[222] The cloud storage feature that Michael Robertson had built into MP3Tunes turned out to be the solution. Apple, Google, Amazon, and others built this functionality – which came to be known as "cloud locker" or "cloud sync" – into their digital music ecosystems.[223]

Digital file downloads raised a few major issues of copyright law, apart from the basic issue of making and distributing copies of content without permission. Most importantly: how culpable is an online service provider for any infringing actions taken by its users with digital files that the online service stores or helps copy and distribute? The other salient issue was the legality of copying one's own digital files for personal use, i.e., digital versions of the use cases discussed for home tape recording above. This functionality also came into the purview of online service providers once cloud locker functionality replaced cables and side-loading.

The first of those questions – known as secondary liability, or in the context of online services, platform liability – had been raised in previous cases, notably *Religious Technology Center v. Netcom* in 1995.[224] *Netcom* was the primary antecedent of the Digital Millennium Copyright Act (DMCA) of 1998. The DMCA, in relevant part,[225] established limitations of liability (safe harbors) for certain types of online services from the infringing actions of their users under certain conditions. Napster raised the DMCA safe harbors in a summary judgment motion in the district court case, to no avail.[226]

U.S. copyright law defines two doctrines of secondary liability: contributory and vicarious.[227] The *Napster* appeals court defined a contributory infringer as "one who, with knowledge of the infringing activity, induces, causes or materially contributes to the infringing conduct of another"[228] and vicarious infringement as "cases in which a defendant has the right and ability to supervise the infringing activity and also has a direct financial interest in such activities."[229]

Napster was found liable under both theories, based in part on findings about the functionality of the Napster server in locating users' files by name and facilitating

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[222] Matt Rosoff, *PlaysForSure Officially Dead*, CNET (Dec. 12, 2007), https://www.cnet.com/culture/playsforsure-officially-dead/.

[223] Bill Rosenblatt, *Music Forecast: Cloudy*, COPYRIGHT AND TECHNOLOGY (April 5, 2011), https://copyrightandtechnology.com/2011/04/05/music-forecast-cloudy/ ("cloud sync"); Kelly Hodgkins, *Amazon Launches 'Cloud Locker' Music Service*, ENGADGET (March 29, 2011), https://www.engadget.com/2011-03-29-amazon-launches-cloud-locker-music-service.html ("cloud locker").

[224] Religious Technology Center v. Netcom On-Line Communication Services, Inc., 907 F. Supp. 1361 (N.D. Cal. 1995).

[225] 17 U.S.C. § 512 (Known originally as the Online Copyright Infringement Liability Limitation Act (OCILLA)).

[226] A&M Records, Inc. v. Napster, Inc., 2000 U.S. Dist. LEXIS 6243.

[227] A third type, inducement liability, will be discussed shortly. Some practitioners consider inducement to be merely a species of contributory liability.

[228] A&M Records, Inc. v. Napster, Inc., 239 F.3d 1004, 1019 (9th Cir. 2001).

[229] *Id.* at 1022.

transfers of copies of them to other users.[230] The court distinguished Napster's functionality from that of the videocassette recorders at issue in *Sony*, where the use case was personal time-shifting; Napster enabled arbitrarily many users to make copies of files for their own use.[231]

MP3.com, meanwhile, raised a fair use defense that centered on the concept of space-shifting (enabling users to listen to music on other devices they own) and a claim that it should be allowable just as time-shifting was under *Sony*. Judge Jed Rakoff disagreed and found MP3.com liable.[232]

Other findings by the *Napster* courts (both district and appellate) turned on details of Napster's ability to acquire knowledge of users' potentially infringing activities.[233] The nuances of "actual knowledge," "red flag knowledge," and "willful blindness" to users' infringing activities have been explored in many subsequent platform liability litigations.[234] But the main *technical* source of secondary liability for Napster was its central server.[235]

In the years following the Napster shutdown, entrepreneurs developed a series of file-sharing technologies that were explicitly designed to sidestep legal arguments that led to findings of liability. For example, the subsequent generation of file-sharing software applications were based on protocols such as Gnutella[236] and FastTrack[237] that were designed without a central server; instead, information about file locations would be distributed on users' machines throughout the network, so that the "knowledge" of potential infringements was confined to users' devices. (The tradeoff was less efficiency in searching for files.)[238]

Some of the entrepreneurs behind these applications also set up shop outside of the United States, making them harder for the law to reach. One of these was Kazaa (based on FastTrack); it was developed in Estonia and eventually owned by Sharman Networks,

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[230] *Id.*
[231] *Id*. at 1016.
[232] UMG Recordings, Inc. v. MP3.com, Inc., 92 F. Supp. 2d 349 (S.D.N.Y. 2000).
[233] A&M Records, Inc. v. Napster, Inc., 2000 U.S. Dist. LEXIS 6243; A&M Records, Inc. v. Napster, Inc., 239 F.3d 1004 (9th Cir. 2001).
[234] *Section 512 of Title 17 2020: A Report of the Register of Copyrights*, U.S. Copyright Office (May 2020), https://www.copyright.gov/policy/section512/section-512-full-report.pdf, 111-128. Although secondary liability is not quite the same thing as (in)eligibility for limitations of liability under the DMCA, the U.S. Copyright Office's analysis, in this 2020 study on 17 U.S.C. § 512, of how these "knowledge" issues have been addressed in many litigations, is comprehensive.
[235] A&M Records, Inc. v. Napster, Inc., 239 F.3d 1004 (9th Cir. 2001).
[236] Marshall Brain, *How Gnutella Works*, How Stuff Works, https://computer.howstuffworks.com/file-sharing.htm (last visited March 10, 2026).
[237] Stephanie Watson, *How Kazaa Works*, How Stuff Works, https://computer.howstuffworks.com/kazaa.htm (last visitedMarch 10, 2026).
[238] *Id.*

a company incorporated in the Pacific island nation of Vanuatu.[239] Another was Grokster, also based on FastTrack, which was based on the Caribbean island of Nevis.[240]

All of these file-sharing networks were eventually shut down through litigations or as a result of precedents set by other litigations. The most important of these was *MGM v. Grokster*, which initially also involved StreamCast, owner of the Morpheus file-sharing application.[241] The case made its way to the Supreme Court, which in June 2005 reversed the Ninth Circuit's finding in favor of Grokster[242] and found for a long list of plaintiffs that included film studios as well as record labels and music publishers.[243]

The most important outcome of *Grokster* was Justice David Souter's holding, borrowed from patent law,[244] that a company can be secondarily liable for infringement if it "induces" (intentionally encourages for financial gain) its users to commit infringing activities.[245] The Court found such liability through evidence such as marketing materials and internal communications that showed that Grokster profited proportionally to its users' file-sharing activities.[246]

Shortly after the *Grokster* decision, the RIAA sent cease-and-desist letters to several remaining peer-to-peer file-sharing networks, including BearShare, WinMX, and LimeWire.[247] Most shut themselves down, but a few others kept going. One of the latter was iMesh, which was sued in 2003[248] and settled in 2004.[249] Pursuant to the settlement, iMesh eventually launched a new version of its system that detected user uploads of copyrighted music files using audio fingerprinting technology (see below) and blocked them, instead offering DRM-encrypted versions of copyrighted songs to users for 99 cents each.[250] iMesh launched this functionality in 2005,[251] but the service was never very popular. LimeWire, meanwhile, was sued by the major record labels in 2006.[252] Judge

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[239] Todd Woody, *The Race to Kill Kazaa*, WIRED (Feb. 1 2003), https://www.wired.com/2003/02/kazaa/.
[240] Complaint for Damages and Injunctive Relief for Copyright Infringement, MGM v. Grokster, No. 2:01-CV-08541 (C.D. Cal. Oct. 2 2001).
[241] *Id.*
[242] MGM Studios, Inc. v. Grokster, Ltd., 380 F.3d 1154 (9th Cir. 2004).
[243] MGM Studios, Inc. v. Grokster, Ltd., 545 U.S. 913 (2005).
[244] 35 U.S.C. § 271(b).
[245] MGM Studios, Inc. v. Grokster, Ltd., 545 U.S. 913 (2005).
[246] *Id*.
[247] Dawn Kawamoto, *Record Labels Send More Letter to P2P Service*, CNET (Sep. 15, 2005), https://www.cnet.com/tech/tech-industry/record-labels-send-more-letters-to-p2p-services/.
[248] Motown Record Co., L.P. v. iMesh.com, Inc., 2004 U.S. Dist. LEXIS 3972 (S.D.N.Y. Mar. 12, 2004).
[249] *IMesh, Major Labels Settle File-Sharing Suit*, FORBES (July 20, 2004), https://www.forbes.com/2004/07/20/cz_pk_0720imesh.html.
[250] John Borland, *Legal P2P Opens for Business*, ZDNET (Oct. 24, 2005), https://www.zdnet.com/article/legal-p2p-opens-for-business/.
[251] *Id*.
[252] Alex Veiga, *LimeWire Sued for Copyright Infringement*, NBC NEWS (Aug. 4, 2006), https://www.nbcnews.com/id/wbna14188340.

Kimba Wood ordered its shutdown in October 2010;[253] LimeWire eventually agreed to pay the plaintiffs $105 million in damages.[254]

The shutdowns of these peer-to-peer networks did not end file-sharing of unauthorized content, though it did establish that these types of services were unlawful. The development of other file-sharing technologies that could skirt around court precedents continued. But those were offshore and/or based on technologically arcane schemes such as the old Usenet bulletin-board system[255] and BitTorrent[256] that required more technical savvy and weren't very widely used – especially since by that time streaming services (see below) had launched that rendered the download model obsolete for most users and therefore reduced industry concerns over unauthorized file-sharing.[257]

By the early 2010s, Amazon, Apple, and Google had all introduced cloud locker features, of the type pioneered by MP3Tunes, for users of their digital music services, but only Apple had taken a license for this use case.[258] These features were not only convenient for users but also important for tech platforms to offer because they helped keep users inside their "walled gardens" for music listening since the downloaded music market had gone DRM-free in 2009.[259] Questions remained about whether those service providers needed licenses from rightsholders to offer those services.

Capitol Records had filed suit against MP3Tunes in 2007,[260] alleging that several of its features – including cloud locker – violated copyright law. In 2011, Judge William

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[253] Tim Arango, *Judge Tells LimeWire, the File-Trading Service, to Disable Its Software*, N.Y. Times (Oct. 26, 2010), https://www.nytimes.com/2010/10/27/technology/27limewire.html.

[254] Jonathan Stempel, *LimeWire to Pay Record Labels $105 Million, Ends Suit*, Thomson Reuters (May 13, 2011), https://www.reuters.com/article/lifestyle/limewire-to-pay-record-labels-105-million-ends-suit-idUSTRE74B783/.

[255] *See, e.g.,* Perfect 10, Inc. v. Giganews, Inc., 847 F.3d 657 (9th Cir. 2017).

[256] BitTorrent, invented in 2001, is a method of sharing large files among many users over the Internet. It works by breaking the files up into small pieces and sharing a piece at a time through a choreographed protocol that results in all participants having all of the pieces of the file. Its design has evolved over the years to make copyright monitoring more difficult, through tactics such as eliminating central servers, obfuscating information such as participants' IP addresses and metadata about content being shared, and encryption. *See, e.g.*, Bram Cohen, Incentives Build Robustness in BitTorrent (2003); *Proceedings of the 1st Workshop on Economics of Peer-to-Peer Systems (IPTPS '03)*, March 2003; Jon M. Peha, *Policy Implications of Technology for Detecting P2P and Copyright Violations*, 38 Telecomms. Policy 1055-1069 (2014); *See also,e.g.*, BMG Rights Management (US) LLC v. Cox Communications, Inc., 881 F.3d 293 (4th Cir. 2018), Sony Music Entertainment v. Cox Communications, Inc., 93 F.4th 222 (4th Cir. 2024), UMG Recordings, Inc. v. Grande Communications Networks, LLC, 964 F.3d 247 (5th Cir. 2020), UMG Recordings, Inc. v. Frontier Communications Corp., No. 1:21-cv-05050, 2022 WL 14683234 (S.D.N.Y. June 8, 2021).

[257] *Spotify Reduces Piracy, but also Cuts into Digital Track Sales*, Ars OpenForum (Oct. 28, 2015), https://arstechnica.com/civis/threads/spotify-reduces-piracy-but-also-cuts-into-digital-track-sales.1298425/.

[258] Bill Rosenblatt, *iCloud Cuckoo Land*, Copyright and Technology (June 7, 2011), https://copyrightandtechnology.com/2011/06/07/icloud-cuckoo-land/.

[259] This meant that files purchased anywhere could play on iPods, iPhones, or any other media players as long as they were in standard formats; so the online music platforms needed to find other ways of keeping their users inside their ecosystems.

[260] Capitol Records, Inc. v. MP3tunes, LLC, 821 F. Supp. 2d 627 (S.D.N.Y. 2011).

Pauley issued a summary judgment decision holding that the cloud locker feature – which could be thought of as a direct extension of the feature for which Judge Rakoff found liability in *MP3.com* – qualified for safe harbor under the DMCA.[261] As a result, Apple, Google, Amazon, and others could safely offer cloud locker functionality without an additional license for that feature.[262]

Thus it is fair to say that the law settled around digital files with Judge Pauley's 2011 summary judgement ruling in *MP3Tunes*, which clarified the law around the cloud storage features of today's most widely used digital music services. Therefore the timeline for copyright law to settle around file-sharing was **12 years** since the launch of Napster in 1999.

V. INTERACTIVE STREAMING

The idea of a "celestial jukebox" through which a user could call up any song they wished to hear was understood intuitively with the emergence of the Internet in the mid-1990s.[263] But the technology wasn't ready: consumer network bandwidth was neither pervasive nor fast enough,[264] and consumer computing equipment (mainly desktop PCs and Macs) were less than ideal music listening devices.[265]

The first interactive streaming services with significant catalogs of licensed music came in 2001. Two were joint ventures of subsets of the then five major record labels: pressplay [sic][266] and MusicNet,[267] the latter a partnership with RealNetworks. Each of these offered music from their participants' catalogs. Neither of these was very successful, and both had been sold off by 2005.[268]

The third was Rhapsody, from the startup Listen.com. Rhapsody launched in late 2001 with a selection of music from several independent labels and the large classical label Naxos.[269] EMI followed as the first major label licensor shortly thereafter.[270] In July 2002, Rhapsody became the first interactive streaming service to garner licenses from all

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[261] Although Judge Pauley did find liability for other features of MP3Tunes.

[262] To complete the circle, if you buy a CD on Amazon today, in most cases you will also get MP3 files of the songs from that album delivered to your Amazon cloud storage at no additional charge, which you can stream or download to any of your devices with Amazon Music apps installed.

[263] *See, e.g.,* PAUL GOLDSTEIN, COPYRIGHT'S HIGHWAY: FROM GUTENBERG TO THE CELESTIAL JUKEBOX (Hill & Wang, 1994).

[264] FALLING THROUGH THE NET: TOWARD DIGITAL INCLUSION, 23 (2000), https://www.ntia.gov/files/ntia/publications/fttn00.pdf.

[265] Smartphones would not appear until Apple introduced the iPhone in 2007, as discussed above.

[266] Jim Hu, *Pressplay Comes to Life After Long Wait*, CNET (Dec. 19, 2001), https://www.cnet.com/tech/services-and-software/pressplay-comes-to-life-after-long-wait/.

[267] *RealOne Shakes, Rattles, Rolls Out MusicNet*, CNN (Dec. 5, 2001), https://www.cnn.com/2001/TECH/internet/12/05/realone.subscription.idg/index.html.

[268] Saul Hansell, *Private Investment Firm Buys MusicNet Venture*, N.Y. TIMES (April 13, 2005) https://www.nytimes.com/2005/04/13/business/media/private-investment-firm-buys-musicnet-venture.html.

[269] Gwendolyn Mariano, *Listen.com Launches Rhapsody Service*, ZDNET (Dec. 2, 2001), https://www.zdnet.com/article/listen-com-launches-rhapsody-service/.

[270] *Listen.com Enters into License Agreement with EMI Recorded Music*, LISTEN.COM (Jan. 8, 2002), https://web.archive.org/web/20030214043925/http://www.listen.com/about.jsp?sect=press&subsect=release&page=emi_010802.

of the major labels – a year before Apple launched the iTunes Music Store.[271] Rhapsody still exists today, though it was rebranded as Napster in 2016.[272]

Various similar services launched in the early-mid 2000s, but the limitations on playback equipment and network bandwidth[273]—not to mention consumer unfamiliarity with the $10/month subscription model[274]—limited that type of service's popularity for the first decade of its existence.

Just as with cassettes, it took two later technological innovations to put interactive streaming on a path to market dominance. Apple released the iPhone in June 2007;[275] this enabled digital music playback on portable devices via streaming over mobile networks instead of on PCs over home network connections. And by the end of the decade the major mobile telecommunications network operators had completed their buildouts of 3G mobile data infrastructures, with sufficient bandwidth to support good-quality audio streaming to those devices.[276]

Spotify had attracted a lot of attention with the launch of its interactive streaming service in Europe in 2008[277] (with mobile apps for iPhones and Android phones introduced the following year),[278] resulting in a tsunami of hype and anticipation leading up to its U.S. launch in July 2011.[279] Spotify's most important features, compared to older

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[271] Listen.com Licenses Universal Music Group Catalog, LISTEN.COM (July 1, 2002), https://web.archive.org/web/20030207230804/http://www.listen.com/about.jsp?sect=press&subsect=release&page=umg_070102. The deal with Universal Music Group was the last of Listen.com's major label deals for Rhapsody. All of the (then) five major labels had previously invested in the startup. *See All Five Major Music Labels Invest in Listen.com®*, LISTEN.COM (Feb. 4, 2000), https://web.archive.org/web/20030222160253/http://www.listen.com/about.jsp?sect=press&subsect=release&page=major020400.

[272] The Napster brand name survived after the file-sharing network's shutdown in 2001. For several years it was attached to a service from the company Roxio that was based on the pressplay infrastructure after that service was discontinued. That service was acquired by Rhapsody (by then an independent company) in 2011, and the two services merged under the Napster banner in 2016. *We Are Napster*, NAPSTER (July 14, 2016), https://web.archive.org/web/20160717135243/http://blog.napster.com/2016/07/14/wearenapster. None of these included technology from the original Napster file-sharing network.

[273] For example, smartphones did not appear until 2007 and mobile broadband service was not widely available until after that time. See below re interactive streaming services.

[274] This was a genuinely new model for consumers. It was like neither a record store (such as iTunes and other paid download services) nor radio (early Internet radio services); and although you got access on demand to a huge library of music, your access disappeared when you stopped paying the subscription fee.

[275] *Apple Reinvents the Phone with iPhone*, APPLE (Jan. 9, 2007), https://www.apple.com/newsroom/2007/01/09Apple-Reinvents-the-Phone-with-iPhone/.

[276] Keith Winstein, *A Tedious and Personal History of 3G*, GIZMODO (Aug. 21, 2010), https://gizmodo.com/a-tedious-and-personal-history-of-3g-5618307.

[277] Bruce Houghton, *Spotify Launches In EU With Majors, Merlin & More*, HYPEBOT (Oct. 8, 2008), https://www.hypebot.com/hypebot/2008/10/spotify-launche.html.

[278] *Spotify Launches iPhone and Android Mobile Services*, THOMSON REUTERS (Sep. 7, 2009), https://www.reuters.com/article/business/media-telecom/spotify-launches-iphone-and-android-mobile-services-idUSL7549443/.

[279] Charlie Sorrel, *Spotify Launches in the U.S at Last*, WIRED (July 14, 2011), https://www.wired.com/2011/07/spotify-launches-in-the-u-s-at-last/.

services like Rhapsody, included its "freemium" model, where users could listen to music on demand for free with some restrictions instead of having to pay for any access at all,[280] and its mobile-friendly user interface.[281] Spotify's U.S. launch helped put interactive streaming on a rapid growth trajectory for the ensuing several years; interactive streaming is by far the most popular mode of music consumption today.[282]

The copyright problems posed by interactive streaming were twofold. First, as explained above, it was established that digital radio broadcasts were public performances. But what about digital transmissions of music to individual users? They were also public performances that had to be licensed, based on language in the DPRA of 1995 (see above) that established this for compositions as well as for sound recordings.[283]

Second concerned mechanical (reproduction) licenses on the musical compositions performed on sound recordings that the services made available for streaming. Licensing the sound recordings themselves was always a matter of negotiating agreements with record labels. But licensing the underlying compositions was a more complex problem, which arose out of a combination of the framework for compulsory mechanical licenses under § 115 and music publishers' historic lack of direct relationships with digital music services.

For physical media such as LPs and CDs, record labels obtain mechanical licenses from music publishers for the musical works being performed on sound recordings. The same is true for licensed music download services, such as Apple's iTunes, via so-called passthrough licenses.[284] But the labels did not do the same for interactive streaming. Labels fed recorded music, along with information about it (metadata), to streaming services, but they typically did not feed information that would enable the services to determine which musical works were embodied in the sound recordings and which songwriters and music publishers should be paid royalties (and in what proportions). Instead, this information had to be determined after the fact.

The other problem was that while compulsory mechanical licenses were available, § 115 required that they be obtained for one composition at a time; no bulk licensing facility (analogous to the § 114 blanket license on sound recording performances per the DPRA) was available. This had become a challenge because of the sheer volume of music being submitted to the streaming services. The number of record releases per year had increased from tens of thousands per year during the CD era to tens of thousands *per*

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[280] Jacqui Cheng, *Spotify's US Launch: Three Tiers, Free is Currently Invite-Only*, ARS TECHNICA (July 14, 2011), https://arstechnica.com/information-technology/2011/07/music-service-spotify-finally-to-launch-in-us-on-thursday-morning/.

[281] Older services such as Rhapsody had user interfaces that had been designed for PCs, not mobile devices.

[282] *See, e.g.*, RIAA Revenue Database.

[283] "[A]n interactive service may not publicly perform a sound recording unless a license has been granted for the public performance of any copyrighted musical work contained in the sound recording: Provided, [t]hat such license to publicly perform the copyrighted musical work may be granted either by a performing rights society representing the copyright owner or by the copyright owner." 17 U.S.C. § 114(d)(3)(C).

[284] BOB KOHN, KOHN ON MUSIC LICENSING, 707-708 (Wolters Kluwer, 5th ed. 2018).

day by the late 2010s.[285] Each of these required a separate mechanical license, or at least the filing of a Notice of Intention to obtain a compulsory license.[286]

To solve this problem, the major labels developed a process for mechanical licensing for interactive streaming in conjunction with their launches of pressplay and MusicNet in 2001. Through the RIAA, they made an agreement with the National Music Publishers Association (NMPA), in which the Harry Fox Agency (HFA), then an NMPA subsidiary, would administer mechanical licenses for the tracks offered on those services.[287] HFA had been the go-to source for mechanical rights clearance for decades, through the eras of physical recorded media.[288] By the time interactive streaming services were ready to launch, HFA had amassed a database of information about the compositions being performed on millions of recorded music tracks and the songwriters and music publishers that owned the rights to them;[289] HFA used this database to match the tracks being streamed on those early services with compositions and their rightsholders, and to pay out royalties accordingly.[290]

When Rhapsody achieved major-label licensing in 2002, it made its own arrangement with HFA to match recordings to musical compositions and clear the mechanical rights following a process modeled on the one specified in the 2001 RIAA/NMPA/HFA agreement.[291] By the mid-2010s, HFA and other rights clearance services[292] were processing tens of thousands of newly submitted tracks per day for each of their music service customers—the vast majority of which were redundant (the same

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[285] Tim Ingham, *Nearly 40,000 Tracks Are Now Being Added to Spotify Every single Day*, Music Business Worldwide (April 29, 2019), https://www.musicbusinessworldwide.com/nearly-40000-tracks-are-now-being-added-to-spotify-every-single-day/.

[286] This was a feature of 17 U.S.C. § 115 prior to the enactment of the Music Modernization Act, *infra*.

[287] Joint Statement of the Recording Industry Association of America, Inc., National Music Publishers' Association, Inc., and the Harry Fox Agency, Inc. In the Matter of Mechanical and Digital Phonorecord Delivery and Compulsory License, No. RM 2000-7.

[288] *100 Years of Rights Management*, Harry Fox Agency, https://www.harryfox.com/history (last visited March 10, 2026).

[289] *SongFile,* https://web.archive.org/web/20010627183533/http://www.songfile.com:80/ (last visited March 10, 2026).

[290] Joint Statement of the Recording Industry Association of America, Inc., National Music Publishers' Association, Inc., and the Harry Fox Agency, Inc. In the Matter of Mechanical and Digital Phonorecord Delivery and Compulsory License, No. RM 2000-7.

[291] Lance Fiasco, *Listen.com and The Harry Fox Agency License Digital Music Subscription Service*, Idobi (Nov. 15, 2001), https://idobi.com/news/listencom-and-the-harry-fox-agency-license-digital-music-subscription-service/; *see also Listen.com® and The Harry Fox Agency Announce Agreement to License Rhapsody™ Digital Music Subscription Service*, NMPA, https://web.archive.org/web/20011214231432/http://www.nmpa.org/pr/listencom.html (last visited March 10, 2026).

[292] Such as Music Reports, Inc. and RightsFlow *See, e.g.*, https://web.archive.org/web/20091123154415/http://accounting.musicreports.com/news.php?number=2&news=newsupdate (Music Reports); https://web.archive.org/web/20100713020413/http://rightsflow.com/ (RightsFlow).

sets of tracks for each service). Yet none of these services had databases of rights owner information that were entirely complete, accurate, and up to date.[293]

This situation continued without much complaint through the early 2010s while interactive streaming was only a single-digit percent of the market by revenue.[294] But as interactive streaming grew in its share of industry revenue after that,[295] rights ownership data problems rose in importance.

Matching recordings to compositions and obtaining rights ownership information on the latter is sometimes not straightforward. The songwriter(s) are often not the same as the performing artist(s) on a sound recording. Most of today's hip-hop, pop, and country songs have multiple songwriters working with multiple music publishers; and occasionally a song will be released before they all agree on the "splits"—the ownership share percentages. There are old or obscure recordings where the songwriter credits are lost in the mists of time. And there are many other cases where composition rights holder information is missing or inaccurate due to various sorts of data errors that can creep in along the way.[296]

An early attempt at a legislative solution to this problem was the Section 115 Reform Act (known as SIRA) of 2006.[297] SIRA would have set up an infrastructure for mechanical licensing modeled on the one for performance licensing through the PROs: each streaming service could take a blanket license for mechanicals instead of having to license each composition individually, and an entity known as a "designated agent" would handle collective licensing and ensure that payments would be made to the proper rights holders.[298] But the various factions involved couldn't come to agreement on various details, and the legislation failed; the sense of urgency wasn't there yet in 2006.[299]

But by the mid-2010s, as streaming began to become the dominant source of revenue in music,[300] more songwriters and music publishers began to notice that their mechanicals weren't being paid properly, and the royalties involved became significant enough to motivate action. Songwriters and music publishers began filing lawsuits against Spotify, Apple Music, and other streaming services for unpaid mechanicals.[301]

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[293] This lack of a complete database of rights information motivated projects such as the Global Repertoire Database (GRD) in the early 2010s. None of these projects succeeded. *See, e.g.*, *The Failure of the Global Repertoire Database*, HYPEBOT (Aug. 31, 2015), https://www.hypebot.com/hypebot/2015/08/the-failure-of-the-global-repertoire-database-effort-draft.html (analysis of the failure of the GRD project in 2015).

[294] *See* RIAA Revenue Database, *supra* note 28.

[295] *Id.*

[296] *See, e.g.*, Dani Deahl, *Metadata is the Biggest Little Problem Plaguing the Music Industry*, THE VERGE (May 29, 2019), https://www.theverge.com/2019/5/29/18531476/music-industry-song-royalties-metadata-credit-problems.

[297] H.R.5553,109th Cong. § 115 (2006).

[298] *Id.*

[299] Downloads and CDs both exceeded interactive streaming in revenue until the mid-2010s. *See* RIAA Revenue Database, *supra* note 28.

[300] *Id.*

[301] *Infra* note 303.

In 2016 the NMPA and Spotify announced a settlement agreement with a mechanism to address the problem.[302] Many publishers opted into its terms, but several did not and instead pursued lawsuits, including proposed class actions, over the next couple of years.[303] Meanwhile, in 2015 the Copyright Office had issued a report on music licensing in the U.S. that characterized the existing system for digital mechanicals as "administratively daunting—if not Sisyphean" for licensees.[304] Among the report's set of proposals for reforming music licensing in the U.S. were recommendations for collective and blanket licensing for streaming mechanicals in place of the track-by-track licensing requirement.[305]

The Copyright Office's recommendations are not binding on Congress, which did not act in the short term. The industry began casting about more seriously for solutions. A few attempts were purely technological.[306] These were eventually superseded by the Music Modernization Act (MMA), a legislative solution fashioned by the NMPA and the Digital Media Association (DiMA, the trade association for streaming services). The MMA became law in 2018.[307]

Like SIRA, the MMA made available a blanket license for digital mechanicals that replaced the onerous track-by-track licensing requirement under the old scheme. This alone was a significant savings in administrative overhead for the streaming services. The MMA implemented collective licensing for streaming mechanicals[308] by calling for the creation of a mechanical licensing collective (MLC), a nonprofit entity that would be designated by the Copyright Office, overseen by publishers and songwriters, and paid for

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[302] Ed Christman, *Spotify and Publishing Group Reach $30 Million Settlement Agreement Over Unpaid Royalties*, BILLBOARD (March 17, 2016), https://www.billboard.com/music/music-news/spotify-nmpa-publishing-30-million-settlement-unpaid-royalties-7263747/.

[303] *See, e.g.*, Lowery v. Spotify USA Inc., No. 15-CV-09929, 2016 WL 6818756 (C.D. Cal. May 23, 2016); Lowery v. Rhapsody Int'l, Inc., 75 F.4th 985 (9th Cir. 2023); Ferrick v. Spotify USA Inc., No. 16-CV-8412, 2018 WL 2324076 (S.D.N.Y. May 22, 2018); Gaudio v. Spotify USA, Inc. No. 17-CV-01052 (M.D. Tenn. July 18, 2017); Wixen Music Publishing, Inc. v. Spotify USA Inc., No. 17-CV-09288, 2017 WL 6663826 (C.D.Cal.); Bluewater Music Servs. Corp. v. Spotify USA Inc., No. 3:17-CV-01051, 2019 WL 6894517 (M.D. Tenn. Feb. 22, 2019); Thomas Morgan Robertson v. Spotify USA, No.17-CV-01616 (M.D. Tenn. Dec. 29, 2017); Bryan Eich v. Apple Music, No. 17-CV-09857 (E.D.N.Y. Dec. 17, 2017).

[304] MARIA A. PALLANTE, U.S. COPYRIGHT OFF., COPYRIGHT AND THE MUSIC MARKETPLACE: A REPORT OF THE REGISTER OF COPYRIGHTS 162 (2015).

[305] *Id*. at 162-170.

[306] Most of these attempted to use blockchain technology to support semi-public ledgers of music plays and associated royalty transactions. *See, e.g.*, Bill Rosenblatt, *The Future of Blockchain Technology in the Music Industry*, 66 J. OF THE COPYRIGHT SOC'Y 271 (2019). Such solutions were determined to be infeasible due to scale constraints and other technical limitations.

[307] The MMA contained multiple parts; the relevant one here is Title I, the Musical Works Modernization Act. Other parts included the CLASSICS Act, described above. *See*, *e.g.*, *The Music Modernization Act*, COPYRIGHT.GOV, https://www.copyright.gov/music-modernization/ (last visited March 10, 2026) ("MMA").

[308] And for "limited downloads," i.e., downloads to users' devices for "offline listening" that would only play as long as the user's subscription remained valid.

by the digital streaming services.[309] This meant that streaming services, instead of having to engage a service such as HFA to clear composition mechanicals for their incoming sound recordings and disburse royalties to rightsholders, simply paid royalties and annual fees to a single outside entity that would do this for all streaming services[310]—and because the vast majority of this repertoire is identical for all services, this would also eliminate an enormous amount of overhead.[311]

The MLC[312] managed to meet its launch deadline in early 2021,[313] despite having to build out its systems on an aggressive timeline in the middle of the COVID-19 pandemic. It chose HFA as its initial database provider.[314] The MLC accepts play data feeds from music services and composition rights ownership data from publishers and songwriters, matches recordings to compositions, and pays mechanical royalties to the composition rights holders.[315]

Thus, the timeframe for copyright law to settle around interactive streaming was **17 years**—from the launches of MusicNet, pressplay, and Rhapsody in 2001 to the passage of the Music Modernization Act in 2018.

VI. USER-GENERATED CONTENT SERVICES

By the mid-2000s, high-speed Internet connectivity was spreading throughout the country;[316] so entrepreneurs started to build content-sharing services for a type of content that would make use of all that bandwidth: video. In addition to bandwidth, more consumer devices—webcams and digital cameras—were becoming available that could capture video and store it on the increasingly capacious hard drives available on PCs.[317]

In that timeframe, several startups built services that would enable users to upload video from those devices through their PC web browsers to Internet servers, from which

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[309] MMA.
[310] *Id.*
[311] *About the MLC*, MECHANICAL LICENSING COLLECTIVE, https://www.themlc.com/our-story (last visited March 10, 2026).
[312] The Mechanical Licensing Collective (The MLC), based in Nashville, is the entity currently serving a five-year term as the mechanical licensing collective specified in the MMA. *The Mechanical Licensing Collective*, https://www.themlc.com/ (last visited March 10, 2026). It must apply for redesignation in 2026.
[313] *The Mechanical Licensing Collective*, https://www.themlc.com/ (last visited March 10, 2026).
[314] *Id.*
[315] *The Mechanical Licensing Collective*, https://www.themlc.com/ (last visited March 10, 2026).
[316] The percent of U.S. adults with broadband Internet access rose from less than a quarter in February 2004 to 30% in March 2005 and then 42% by March 2006. John Horrigan, *Home Broadband Adoption 2006: Part 1. Broadband Adoption in the United States*, PEW RSCH. CTR. (May 28, 2006), https://www.pewresearch.org/internet/2006/05/28/part-1-broadband-adoption-in-the-united-states/. On the other hand, mobile broadband connectivity at speeds high enough to support streaming video didn't come until the early 2010s with the major mobile operators' buildouts of their 4G networks.
[317] *See, e.g.*, *2005 Buyer's Guide: At The Camera Counter*, PC PHOTO, https://pcphotomag.com/buyerrsquos-guides/cameras/2005-buyers-guide-at-the-camera-counter.html (last visited March 10, 2026) (digital cameras available in 2005); ads for PCs in 2005 issues of *PC Magazine* showing PCs with hard drives in the 40-60GB range.

any user could stream it. The resounding winner of the resulting horse race was YouTube.[318] YouTube went into public beta in May 2005.[319]

YouTube leapt ahead of its competition by focusing on one task—enabling users to upload, search, browse, link to, and stream videos to web browsers (and eventually mobile apps)—and making it as simple as possible for everyday users.[320] YouTube's initial growth was the stuff of Internet legend: by the time Google acquired the company in November 2006, YouTube had an estimated 50 million users worldwide and accounted for almost half of all video traffic on the Internet.[321]

Of course, YouTube was not designed to be a music service per se; but music was integral to YouTube from the very beginning. One of its very earliest successes was "Lazy Sunday," a hip-hop parody music video that originally aired on NBC's *Saturday Night Live* in December 2005.[322] Several users posted (unauthorized) copies of the video to YouTube.[323] It garnered over seven million views—despite the fact that the site had officially launched a mere two days before the clip aired on broadcast television.[324]

By the end of 2006, the top 10 most-watched videos on YouTube included three music videos.[325] A 2008 study found that almost 20% of the 78 million videos on YouTube by then were categorized as Music (one of 13 categories at that time).[326] To put that figure in perspective, the Apple iTunes Music Store in 2008 had 8 million songs in its catalog.[327]

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[318] Others included Vimeo, MetaCafe, and DailyMotion, all of which survived to this day. Todd Spangler, *Will YouTube 'Killers' Dethrone the Video King? Don't Bet On It*, Variety (July 23, 2014), https://variety.com/2014/digital/news/youtube-dominance-not-threatened-yet-1201266203/.

[319] Faisal Al Zaabi, *YouTube turns 20: Video Platform's Evolution from a 19-Second Zoo Clip to MrBeast's 300 Million Subscribers*, The National News (Feb, 13, 2025), https://www.thenationalnews.com/arts-culture/pop-culture/2025/02/14/youtube-history-timeline/.

[320] Anders Bylund, *Flash Flood: the (Very Short) Story of YouTube*, Ars Technica (Dec. 6, 2009), https://arstechnica.com/tech-policy/2009/12/how-youtube-changed-everything/.

[321] Andrew Ross Sorkin and Jeremy W. Peters, *Google to Acquire YouTube for $1.65 Billion*, N.Y. Times, (Oct. 9, 2006), https://www.nytimes.com/2006/10/09/business/09cnd-deal.html.

[322] Saturday Night Live, *Lazy Sunday - SNL Digital Short*, (YouTube, Aug. 17, 2013), https://www.youtube.com/watch?v=sRhTeaa_B98.

[323] John Biggs, *A Video Clip Goes Viral, and a TV Network Wants to Control It*, N.Y. Times (Feb. 20, 2016), https://www.nytimes.com/2006/02/20/business/media/a-video-clip-goes-viral-and-a-tv-network-wants-to-control-it.html.

[324] Nate Anderson, *Did "Lazy Sunday" make YouTube's $1.5 billion sale possible?*, Ars Technica (Nov. 23, 2008), https://arstechnica.com/uncategorized/2008/11/did-lazy-sunday-make-youtubes-1-5-billion-sale-possible/.

[325] Tom Whitwell, *Top 10 YouTube Videos of 2006*, The Times (Dec. 30, 2006), https://www.thetimes.com/culture/tv-radio/article/top-10-youtube-videos-of-2006-j8nvgfpxzcn.

[326] Michael Wesch, *YouTube Statistics*, Digital Ethnography @ Kansas State University (March 18, 2008), https://web.archive.org/web/20140723075938/http://mediatedcultures.net/thoughts/youtube-statistics/.

[327] *iTunes Store Tops Over Five Billion Songs Sold*, Apple (June 19, 2008), https://www.apple.com/newsroom/2008/06/19iTunes-Store-Tops-Over-Five-Billion-Songs-Sold/.

YouTube became likely the biggest online music service in the world by user base.[328] In 2014, it began a series of attempts to launch paid subscription services, culminating in the launch of YouTube Music in 2018.[329] Consumer research shows YouTube Music as the second most popular subscription music service today, behind Spotify.[330]

The relevant aspect of YouTube is that it enables users to upload content to a cloud-based service—Internet servers from which users anywhere can stream the content. It was inevitable that such user uploads would include copyrighted content, which became the heart of the copyright problems posed by YouTube and similar services. The copyright issue was the extent of the service provider's liability for user-uploaded files that anyone – not just the users who uploaded them – could stream. For the music industry, this led to the issue of how or if such content should be treated differently, from a licensing perspective, from content offered by services to which only rightsholders submit content, such as Spotify.

By the time YouTube got started, processes for handling takedown notices pursuant to the DMCA[331] had become established among online service providers, as were "three strikes" policies for terminating repeat infringers.[332] YouTube supported these mechanisms.[333]

However, other aspects of the DMCA were less clear-cut regarding online service providers' responsibilities. The statute stated that online services would not be required to affirmatively monitor their services for copyright infringements to qualify for DMCA safe harbors[334] but suggested that they did have some culpability through knowledge of infringements taking place on their services.[335] But the contours of such knowledge were rather vague, despite various early attempts to clarify them in the courts.[336]

The major record labels did not initially test YouTube's platform liability in court. Instead they began making deals with YouTube, starting in 2006 with Warner Music Group (WMG), whose deal predated (and in part motivated) Google's acquisition of the

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Though it bears mentioning that not all of those 15 million videos contained distinct songs; there was much duplication.

[328] *See, e.g.*, Brian Dean, *YouTube Stats: How Many People Use YouTube?*, BACKLINKO (Dec. 29, 2025), https://backlinko.com/youtube-users; it is unknown what portion of YouTube use is for music.

[329] HOWIE SINGER AND BILL ROSENBLATT, KEY CHANGES: THE TEN TIMES TECHNOLOGY TRANSFORMED THE MUSIC INDUSTRY 309-311(Oxford University Press, 2023).

[330] *The Infinite Dial 2026*, EDISON RSCH. https://www.edisonresearch.com/the-infinite-dial-2026/.

[331] 17 U.S.C. § 512(c).

[332] 17 U.S.C. § 512(i). The number three was never specified in law, but the baseball analogy had a certain ring to it and became conventional, if not standard, among online services.

[333] *Submit a copyright removal request*, YOUTUBE HELP, https://support.google.com/youtube/answer/2807622 (last visited March 10, 2026); *Understand Copyright Strikes*, YOUTUBE HELP, https://support.google.com/youtube/answer/2814000/copyright-strike-basics (last visited March 10, 2026).

[334] 17 U.S.C. § 512(m).

[335] 17 U.S.C. § 512(c).

[336] *Supra* note 234.

company.[337] This deal relied on a recently-developed technology known as acoustic fingerprinting or automated content recognition (ACR).

A fingerprint is a numerical representation of a digital content file (in this case, a music recording) that is intended to be independent of the file's technical characteristics and various types of noise or distortion. A rightsholder, such as a record label, submits its catalog of content to an online service's fingerprinting system, which calculates the fingerprints of all of the files and stores them in a database. Then when a user uploads a file, that file's fingerprint is calculated and compared with the fingerprints in the database. If the system finds a match, the online service can take some appropriate action. ACR systems use fingerprinting (and possibly other methods) to identify content such as sound recordings.[338]

YouTube runs its own content recognition system, called Content ID.[339] The fingerprint match enables it to show users ads targeted to the music, which command higher rates than non-targeted ads. Warner Music agreed to feed its music catalog to YouTube's fingerprinting technology so that YouTube could identify the content and earn more revenue from contextual ads; the record label would share in the enhanced ad revenue.[340] This deal became the blueprint for many subsequent arrangements between rightsholders (of several types of content, not just music) and online services since then.[341]

Yet YouTube's position was that it was identifying user-uploaded content not as a legal obligation but voluntarily as a business opportunity. The first company to test this in court was not a music company per se but the giant entertainment company Viacom, owner of properties such as MTV, Paramount Pictures, and Nickelodeon. Viacom filed suit in March 2007.[342] The district court found that the DMCA limited YouTube's liability.[343] YouTube appealed to the Second Circuit, which reversed and remanded the case to the lower court for further fact-finding.[344] In 2013, the lower court held that

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[337] Jeff Leeds, *Warner Music Makes Licensing Deal with YouTube*,N.Y. Times (Sep, 19, 2006), https://www.nytimes.com/2006/09/19/business/media/19tube.html.

[338] *See, e.g.*, Brais, *Audio Fingerprinting – How We Identify Songs*, BMAT https://www.bmat.com/audio-fingerprinting-songs-identification/ (last visited March 10, 2026); *Pex ACR Identification Capabilities*, PEX, https://pex.com/technology/ (last visited March 10, 2026).

[339] *How Content ID Works*, YOUTUBE HELP, https://support.google.com/youtube/answer/2797370?hl=en (last visited March 10, 2026).

[340] Nate Anderson, *Warner Music Coming to Youtube*, ARS TECHNICA (Sep. 18, 2006), https://arstechnica.com/information-technology/2006/09/7764/.

[341] YouTube provides other options to rightsholders besides ad revenue sharing when its content recognition system finds a match, including the option to block the upload. *See, e.g.*, Stephanie Mlot, *YouTube Inks Licensing Deal With Music Publishers*, PC MAG (June 6, 2012), https://uk.pcmag.com/web-sites/63184/youtube-inks-licensing-deal-with-music-publishers.

[342] Viacom Files $1 Billion Lawsuit Against YouTube and Google, N.Y. TIMES (March 13, 2007), https://www.nytimes.com/2007/03/13/business/worldbusiness/13iht-viacom.4892466.html.

[343] Viacom International, Inc. v. YouTube, Inc., 718 F. Supp. 2d 514 (S.D.N.Y. 2010).

[344] Viacom International, Inc. v. YouTube, Inc., 676 F.3d 19 (2d Cir. 2012).

YouTube did qualify for the relevant DMCA safe harbors;[345] the case ultimately settled the following year.[346]

Various subsequent cases have been brought that tested the boundaries of platform liability for content-sharing services under the DMCA.[347] The U.S. Copyright Office was asked to consider and report on whether the DMCA had lived up to Congress's initial intent to strike a balance between the interests of rightsholders and online service providers. In 2020, the Office's resulting report concluded that the balance had been tilted through many court cases towards the interests of online service providers, and among other things, it recommended that Congress consider tightening the "knowledge requirement" issues alluded to above.[348] Congress has not taken up these recommendations as of this time of writing.

The related copyright problem posed by YouTube and similar services is to what extent content that ordinary users upload to these services should be licensed differently from content provided to services like Spotify, which can only be submitted by rightsholders or their appointed representatives.[349] The International Federation of the Phonographic Industry (IFPI), the global trade body for recorded music, came up with a succinct phrase to summarize these differences: "value gap."[350]

From the music industry's perspective (and leaving aside the question of video vs. audio), the essential difference between services like Spotify and services like YouTube is that while the former only accept content from and pay royalties to rightsholders under executed agreements, the latter will offer any user-uploaded content by default and will only manage rights on that content if a rightsholder notifies the online service and requests it.[351] We refer to these arrangements as "opt-in" and "opt-out" respectively.[352] YouTube's business arrangement around ACR, as mentioned above, is such that it pays royalties because it needs help from rightsholders to maintain its fingerprint databases so that it can earn more ad revenue, not because it is legally obligated to do so.

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[345] Viacom International, Inc. v. YouTube, Inc., 940 F. Supp. 2d 110 (S.D.N.Y. 2013).

[346] Jonathan Stempel, *Google, Viacom Settle Landmark YouTube Lawsuit*, THOMSON REUTERS (March 18, 2014), https://www.reuters.com/article/technology/google-viacom-settle-landmark-youtube-lawsuit-idUSBREA2H112/.

[347] *See, e.g.*, UMG Recordings, Inc. v. Shelter Capital Partners LLC, 718 F.3d 1006 (9th Cir. 2013), Capitol Records v. Vimeo, *972 F. Supp. 2d 537 (S.D.N.Y. 2013),* IO Group, Inc. v. Veoh Networks, Inc., 586 F. Supp. 2d 1132 (N.D. Cal. 2008).

[348] *Section 512 of Title 17 2020: A Report of the Register of Copyrights*, U.S. COPYRIGHT OFFICE (May 2020), https://www.copyright.gov/policy/section512/section-512-full-report.pdf.

[349] *E.g.,* independent digital distributors such as TuneCore, CD Baby, and Symphonic.

[350] *Rewarding Creativity: Fixing the Value Gap*, INTERNATIONAL FEDERATION OF THE PHONOGRAPHIC INDUSTRY (IFPI) (2017), https://web.archive.org/web/20190221033533/https:/www.ifpi.org/downloads/GMR2017_ValueGap.pdf.

[351] *Qualify for Content ID*, YOUTUBE HELP, https://support.google.com/youtube/answer/1311402?sjid=4322908620647794807-NC (last visited March 10, 2026).

[352] *See, e.g.*, HOWIE SINGER AND BILL ROSENBLATT, KEY CHANGES: THE TEN TIMES TECHNOLOGY TRANSFORMED THE MUSIC INDUSTRY 304-305 (Oxford University Press, 2023).

As a result, YouTube pays royalties (for its regular service) on what rightsholders consider to be a "take it or leave it" basis[353]—royalties that have been shown to be much lower than those from opt-in services (including the YouTube Music paid subscription service); that difference is IFPI's value gap.[354] In addition to the magnitude of royalty payments, this also gives rightsholders less control over royalty rate structures than they would have in opt-in arrangements.[355] Rightsholders have also expressed concerns that the large presence of YouTube and its royalty structure drags down royalties available from opt-in services.[356]

Rightsholders have been pushing for legislative remedies that give them more control. One scheme proposed in the U.S. was called "notice and staydown," embodied in legislative proposals such as the Digital Copyright Act of 2021.[357] This would replace the DMCA's notice-and-takedown provision in § 512(c) with one in which digital service providers would be required to maintain lists of copyrighted works for which they had received notices so that they could block from future uploads.[358] This failed in 2021 amid opposition from the tech industry as well as ambiguities and concerns about how such a scheme would operate.[359]

A subsequent attempt was the Strengthening Measures to Advance Rights Technologies (SMART) Copyright Act of 2022.[360] This was an attempt to leverage existing language in the DMCA that requires online service providers to "acccomodate[] and not interfere with standard technical measures," where "standard technical measures"

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[353] *Rewarding Creativity: Fixing the Value Gap*, International Federation of the Phonographic Industry (IFPI) (2017), https://web.archive.org/web/20190221033533/https:/www.ifpi.org/downloads/GMR2017_ValueGap.pdf.

[354] Soundcharts Team, *What Music Streaming Services Pay Per Stream (And Why It Actually Doesn't Matter)*, Soundcharts (Dec. 31, 2018), https://soundcharts.com/blog/music-streaming-rates-payouts.

[355] For example, ACR systems like YouTube's Content ID only identify the content itself, such as a sound recording; but users from any country in the world can upload different videos containing that sound recording, including videos with lyrics (which may implicate copyright in the lyrics), videos that disparage artists, and so on. ACR systems can't differentiate among these.

[356] *Rewarding Creativity: Fixing the Value Gap*, International Federation of the Phonographic Industry (IFPI) (2017), https://web.archive.org/web/20190221033533/https:/www.ifpi.org/downloads/GMR2017_ValueGap.pdf

[357] *Digital Copyright Act of 2021*, Thom Tillis U.S. Senator for North Carolina, https://www.tillis.senate.gov/services/files/0B0551E3-4CA2-4B49-9896-56427B7B7F77 (last visited March 10, 2026).

[358] *Id.*

[359] *Compare, e.g.*, Elliot Harmon, *"Notice-and-Stay-Down" Is Really " Filter-Everything"*, EFF (Jan. 21, 2016), https://www.eff.org/deeplinks/2016/01/notice-and-stay-down-really-filter-everything *with, e.g.*, Devlin Hartline, *Attacking the Notice-and-Staydown Straw Man*, GM Antonin Scalia Law School (Feb. 3, 2016), https://cip2.gmu.edu/2016/02/03/attacking-the-notice-and-staydown-straw-man/. The Copyright Office's study on 17 U.S.C. § 512 (note 214 *supra* at 54-55 and 186-193) considered notice and stay down and concluded merely that it merited further study.

[360] Smart Copyright Act of 2022, S. 3880, 117th Cong. (2022).

(STMs) are those "used by copyright owners to identify or protect copyrighted works."[361] The Act would have required the Copyright Office to designate STMs and required online services that host publicly available content to "use reasonable efforts to accommodate and not interfere with" such STMs.[362] The STMs that the proposers had in mind here were essentially the kinds of content recognition technologies that YouTube had already been using, as described above.[363] This too failed amid tech industry opposition.

Thus, the law in the United States around user-generated content can be deemed to have settled in 2013 with the district court's decision on remand in *Viacom v. YouTube*.[364] Thus the timeline is **8 years** from the launch of YouTube in 2005.

Note, however, that for many countries outside the U.S., the timeframe can be said to extend at least to the enactment of the European Union Digital Single Market Copyright Directive of 2019 (i.e., **14 years**),[365] or to 2024 when its transposition into the national laws of all 27 EU Member States was completed (i.e., **19 years**).[366] Article 17 of that Directive was specifically intended to address the "value gap" issue. It imposes responsibilities on services like YouTube to take licenses to copyrighted material in user uploads before making it available to other users.[367] Within the EU, the main result of Article 17 has been higher royalty rates for rightsholders in license agreements with YouTube and other online services that were made around the time of the Directive's enactment.[368] Article 17 is also said to have resulted in new licensing deals with YouTube and similarly situated services in India and other countries around the world; thus its

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[361] 17 U.S.C. § 512(i).

[362] Smart Copyright Act of 2022, S. 3880, 117th Cong. (2022); *see also id.*

[363] *See, e.g.*, Kevin Madigan, *SMART Act Opposition Draws from the Tired Anti-Copyright Playbook*, Copyright Alliance (April 7, 2022), https://copyrightalliance.org/smart-act-opposition-tired-anti-copyright-playbook/; *Myths v Facts: SMART Copyright Act*, re: create (Sep. 13, 2022), https://recreatecoalition.org/myths-v-facts-smart-copyright-act/.

[364] Viacom International, Inc. v. YouTube, Inc., 940 F. Supp. 2d 110 (S.D.N.Y. 2013).

[365] Directive (EU) 2019/790 of the European Parliament and of the Council of 17 April 2019 on copyright and related rights in the Digital Single Market and amending Directives 96/9/EC and 2001/29/EC, 2019, O.J. (L. 130), 92.

[366] *EU Copyright Directive & Article 17 Completed - ICMP comments*, Record of the Day (Sep. 20, 2024), https://www.recordoftheday.com/news-and-press/eu-copyright-directive-article-17-completed---icmp-comments.

[367] Isabel Agnew, EU Copyright Directive Spells Major New Responsibilities for ISPs, Lutzker & Lutzker (June 14, 2019), https://www.lutzker.com/insights/eu-copyright-directive-spells-major-new-responsibilities-for-isps/.

[368] *EU Copyright Directive & Article 17 Completed - ICMP comments*, Record of the Day (Sep. 20, 2024), https://www.recordoftheday.com/news-and-press/eu-copyright-directive-article-17-completed---icmp-comments; *see also* John Phelan, Director General of the International Confederation of Music Publishers (ICMP), Remarks at the 2025 Copyright Society International Conference in Dublin (Oct. 20, 2025).

impact can be considered to extend beyond Europe.[369]

CONCLUSION

Our findings are summarized in Table 1, which shows the technologies; the companies, products, or services that made them into mass media for music, and the year they appeared; the last significant development in copyright law to affect them and the year they took place; and the span of time between those two years.

[369] John Phelan, Director General of the ICMP (International Confederation of Music Publishers) (ICMP), Remarks at the 2025 Copyright Society International Conference in Dublin (Oct. 20, 2025).

Technology	Mass Medium	Year	Last Legal Event	Year	Timeline
Phonograph Records	Cylinder and disc volume manufacturing (Edison, Victor)	1901	Sound Recording Act	1971	70 years
Radio	Nationwide networks (AT&T)	1924	Digital Performance Right in Sound Recordings Act	1995	71 years
Home Taping	Cassettes for home music duplication (Philips)	1966	*Sony v. Universal*	1984	18 years
Digital Files	Napster	1999	*Capitol v. MP3Tunes*	2011	12 years
Interactive Streaming	MusicNet, pressplay, Rhapsody	2001	Music Modernization Act	2018	17 years
User-Generated Content Services	YouTube	2005	*Viacom v. YouTube* (SDNY remand)	2013	8 years

Table 1: Summary of timelines for each technology from mass medium to settlement of copyright law.

Figure 1 below depicts the lengths of time shown in Table 1. As teachers of university courses on data analysis, we will be the first to caution against drawing conclusions from a very small number of data points. Nevertheless, the pattern is clear, if rough: the timelines have shrunk over time.

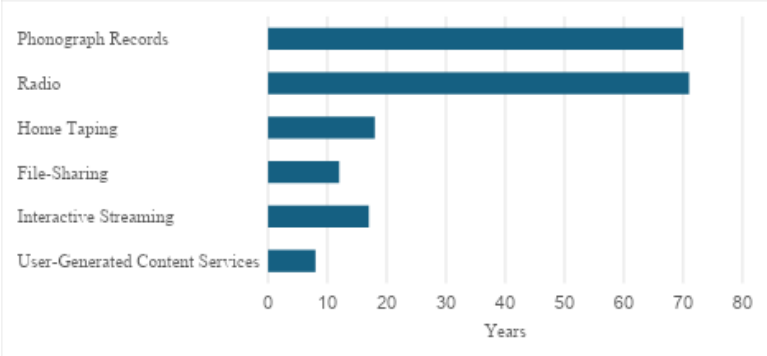

Figure 1: Timeframes from the launches of disruptive technologies to the settling of U.S. copyright law around them.

Of course, the forces that cause laws to change or not change – court cases, settlements, agreements, lobbying, legislation – are event-driven and can depend on many external contingencies. But it is reasonable to identify a couple of factors that have made these timelines shrink. One is the continuing economic relevance of a technology to copyright owners: often they will stop pushing for legal remedies if their revenues migrate to a newer technology.

This was first apparent with home taping. The peak of the music industry's concern about home taping came in the late 1970s with the spread of mid-priced home cassette

decks that could record LPs with good audio quality,[370] followed by the 1979 downturn in industry revenue.[371] But by the time of *Sony* in 1984,[372] the music and electronics industries had already introduced the CD,[373] a format that drew consumers away from cassettes through better sound quality and durability but (at least initially) no recordability. Music industry revenue from cassettes virtually disappeared by the early 1990s.[374] In other words, the music industry – in close cooperation with consumer electronics makers – found a technological rather than a legal solution to home taping.

The situation with digital file downloads was similar. Around the time of the *MP3Tunes* decision in 2011,[375] Spotify was launching in the United States. Over the ensuing half-decade, interactive streaming skyrocketed in popularity while interest in downloads declined.[376] Legislative efforts to address online infringement shifted from file-sharing per se to broader tactics such as website blocking, search engine de-listing, and enhanced law enforcement against offshore operators with the Stop Online Piracy Act (SOPA)[377] and Protect IP Act (PIPA),[378] both of which were defeated after tech industry opposition in 2012.[379] By 2016, revenue from streaming had increased more than fivefold, while revenue from downloads – which never amounted to much anyway[380] – declined by almost half. Again, a technological solution rather than a legal solution prevailed.[381]

More recently, the emergence of a new technology caused rightsholders to "move on" in their legal efforts primarily because its expected disruptive effects became a higher priority. That technology, of course, is generative AI.

The last significant attempt that the creative industries made to address the issues around user-generated content services discussed above through legislation was the SMART Copyright Act of 2023, a reintroduction of the SMART Copyright Act of 2022 in the House of Representatives that met a similar fate.[382] Meanwhile, the first generative

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[370] *See supra* note 152.
[371] *See supra* note 163.
[372] Sony Corp. of America v. Universal City Studios, Inc., 464 U.S. 417 (1984).
[373] *See supra* note 29.
[374] *See* RIAA Revenue Database, *supra* note 28.
[375] Capitol Records, Inc. v. MP3tunes, LLC, 821 F. Supp. 2d 627 (S.D.N.Y. 2011).
[376] *See* RIAA Revenue Database, *supra* note 28.
[377] Stop Online Piracy Act, H.R. 3261, 112th Cong. (2012).
[378] PROTECT IP Act of 2011, S. 968, 112th Cong. (2012).
[379] Somini Sengupta, *Big Victory on Internet Buoys Lobby*, N.Y. Times (Jan. 26, 2012), https://www.nytimes.com/2012/01/27/technology/victory-on-antipiracy-issue-buoys-internet-lobby.html.
[380] Bill Rosenblatt, *The Short, Unhappy Life Of Music Downloads*, Forbes (May 7, 2018), https://www.forbes.com/sites/billrosenblatt/2018/05/07/the-short-unhappy-life-of-music-downloads/; *See* RIAA Revenue Database, *supra* note 28.
[381] One could argue that a significant difference between the solutions for home taping and file-sharing was that record labels participated actively in the former (the CD, *supra* note 29) while the tech industry introduced a solution for the latter (subscription streaming), especially since the major record labels had divested their commercially unsuccessful streaming joint ventures by the mid-2000s. But the existing laws ultimately gave rightsholders enough leverage to force services such as YouTube and Spotify to negotiate with them; and that is the main point.
[382] SMART Copyright Act of 2023, H.R. 9541, 117th Cong. (2022).

AI music platforms for general consumers with large output volumes, such as Mubert[383] and Boomy,[384] launched in 2021-2022;[385] OpenAI ushered in the current generative AI boom with its public launch of the text-generating ChatGPT in November 2022.[386] Since then, for copyright industry advocacy groups and major rightsholders, it has been "All AI, All the Time."

Of course, the surfeit of litigations brought by copyright owners against generative AI platforms since November 2022 – over 90 at this writing across all creative industries[387] – reflects the disruptive potential of generative AI on content creation. Which leads one to ask how long it will be before the next highly disruptive technology appears.

The pace of introduction of transformative technologies into the music industry is instructive. Figure 2 (which includes the compact disc[388]) shows the lengths of times between these introductions. For analog-era technologies, the intervals have been at least a generation. The timeline shrank dramatically after the advent of the Internet and file-sharing, but then it increased. And the time lag from YouTube's launch in 2005 to those of Mubert and Boomy is virtually identical to the time lags from cassettes to CDs and CDs to Napster.

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[383] *AI Music Pioneer Mubert Generates 100 Million AI Tracks*, GLOBENEWSWIRE (July 12, 2023), https://www.globenewswire.com/news-release/2023/07/12/2703841/0/en/AI-Music-Pioneer-Mubert-Generates-100-Million-AI-Tracks.html.

[384] Anna Sczepanski, *Boomy Launches Revolutionary AI Music Technology to Empower a New Generation of Social Music Creators*, BUSINESSWIRE (May 12, 2021), https://www.businesswire.com/news/home/20210512005635/en/Boomy-Launches-Revolutionary-AI-Music-Technology-to-Empower-a-New-Generation-of-Social-Music-Creators.

[385] Earlier generative AI music technologies, such as Amper Score from Amper Music, which launched in 2019, were designed for business-to-business and not general consumer use.

[386] *Introducing ChatGPT*, OPENAI, https://openai.com/index/chatgpt/ (last visited March 10, 2026).

[387] The Copyright Alliance maintains a comprehensive list of federal court cases. *See Federal Court AI Cases Involving Copyright Claims*, COPYRIGHT ALLIANCE, https://copyrightalliance.org/artificial-intelligence-copyright/court-cases/ (last visited April 23, 2026).

[388] The compact disc was *transformative* but not *disruptive* to the music industry. *See supra* note 29.

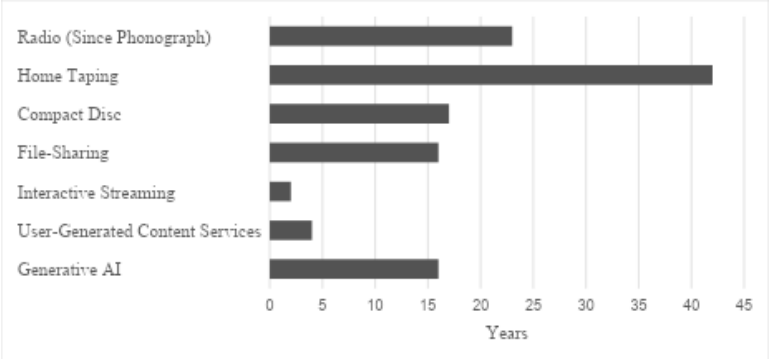

Figure 2: Years since introduction of previous disruptive technology.

This may be because the advent of the Internet was – as was frequently proclaimed – the most disruptive moment in technology in recent history.[389] And perhaps subsequent innovations based on Internet technology were not as disruptive as the Internet itself was, so that it has taken longer to improve meaningfully on those technologies that were introduced in the 1990s for distribution of music to the public. Generative AI is being heralded as the most disruptive technology since the Internet itself;[390] thus if the recent past is any guide, the next technology to truly disrupt the music industry may be well off into the future.

This, in turn, suggests that the developments that cause the music industry to "move on" may be legal actions and business deals rather than another technology to supplant generative AI. Yet although the pace of legal change has accelerated, litigations – with their appeals, petitions for certiorari, remands, etc. – still take years to resolve, while some cases may settle – which creates precedents for business arrangements but not in law. Technology has made litigation processes more efficient,[391] but not remotely at the pace of the creation, reproduction, and distribution of digital music. And as for the possibility of legislative reform, we are not in a position to offer any sort of prediction at all.

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[389] *See, e.g.*, Brad Spurgeon, *CYBERSCAPE : Information Super-Thing:How Close Are We Really?*, N.Y. TIMES (Jan. 2, 1995), https://www.nytimes.com/1995/01/02/business/worldbusiness/IHT-cyberscape-information-superthinghow-close-are-we.html.

[390] *See, e.g.*, *20 Tech Experts On The Tools And Trends That Will Dominate 2024*, FORBES (Jan. 8, 2024), https://www.forbes.com/councils/forbestechcouncil/2024/01/08/20-tech-experts-on-the-tools-and-trends-that-will-dominate-2024/.

[391] *See, e.g.*, Manuel A. Gómez, *The Digitalization of Litigation*, 38 EMORY INT'L L. REV. 819 (2024).