

Retro Media: Memory (and Memories) Lost



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Introduction

The past 120 years saw some of the most rapid changes in how we record, collect, and use audio, visual, and now digital information. The pace creates in its wake, a long list of obsolete technologies, some of which, still exist, but for which equipment and storage technologies are not always available. This exhibit reflects this light-speed, developing technology world with a selection of media formats.



Audio Media

Music as a Family Activity

I come from a musical family that had both a large 78 rpm and 33 rpm collection. Before headphones were common place and well before portable, individual music players, listening to records was a family activity. We sit down in front on the big console record player (about 6-7 feet long) and listen with an occasional comment. I learned a lot about music just be listening together and discussing what we had just heard.—A. Ben Wagner, Science & Engineering Library



Timeline

- 1877 – Thomas Edison’s phonograph – first audio recording device with immediate playback.
- 1925 – 78 RPM Shellac Record
- 1930 – 33 RPM Vinyl Record
- 1947 – ¼” Reel-to-Reel Tape
- 1949 – 45 RPM Vinyl Record
- 1964 – Compact Cassette Tapes (possibly 1966)
- 1965 – Eight Track Tapes
- 1969 – Microcassette Tapes
- 1980 – Audio Compact Discs

[Disc Records](#) (78, 33, 45 RPM) [Microcassette tapes](#)

[1/4" Reel-to-Reel Tape](#)

[Audio Compact Discs](#)

[Compact Cassette Tapes](#)

[Minidisks](#)

[Eight Track Tape](#)

Vinyl/Shellac Records

The vinyl record is a type of gramophone record that was most commonly used for mass-produced music recordings. RCA Victor introduced the first 12" 33 rpm vinyl long-playing record in 1930. Marketed as a "Program Transcription" disc, RCA Victor's first 33 rpm was commercial failure for multiple reasons, namely unreliable playback equipment and consumer wariness during the Great Depression. After further developing the technology, in 1948 Columbia Records introduced the 12" Long Play (LP) 33 rpm groove record, launching a commercial rivalry that would continue throughout the good part of the next decade.

A year after Columbia Records introduced its 33 rpm RCA Victor launched what it intended to be a competing vinyl format, the 7" 45 rpm. For a good two years, in what is known as the "War of Speeds," record companies and consumers wavered over which of these formats would prevail. Eventually, the 12" 33 rpm LP (Long-Playing) became the standard format for musical albums while the 7" 45 EP or "single" maintained a niche as a short-duration disc with a playing time of one song per side.

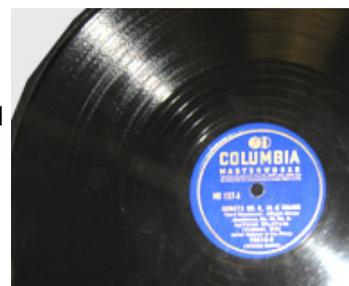
Vinyl production and popularity began to decline with the introduction of four-channel reel-to-reel tapes and 8-track tape cartridges in 1970. By the mid-1970s most record companies had stopped mass-producing LPs.

78 RPM Shellac Records

Original Manufacturer:

Launch Year: 1925

The 78 rpm record was usually 10 or 12 inches in diameter and made from a shellac compound (yes, shellac as in furniture finish). 78 rpm records generally played one song per side. When shellac supplies were limited during World War II, 78 rpm records were pressed in vinyl instead of shellac. Most notable of these vinyl 78's were the six-minute records produced by V-Disc for distribution to United States troops during the war. With the rise of popularity for new formats like the 33 rpm vinyl record, the 78 rpm record slowly dropped from the market. By the mid-fifties very few 78 rpm records were produced.



I remember visiting my grandparents who in the late 1940's and 1950's still had their wind-up Victrola to play 78 (the type) records. It was great fun for all of the grandchildren to have a turn at winding the crank. One of the few records they owned was by the famous opera singer, Enrico Caruso. When my grandparents left their own home, I asked if I could have the Victrola but, unfortunately, someone else took it.—Marcia Zubrow, Law Library

33 RPM Vinyl Record

Original Manufacturer: RCA Victor and Columbia

Launch Year: 1930 by RCA Victor; 1948 by Columbia Records

45 RPM Vinyl Record

Original Manufacturer: RCA Victor

Launch Year: 1949

Following the release of 33 rpm LPs, the 45 rpm record was introduced. The slightly faster turntable speed gave fidelity a slight boost, and the size was "compact" compared with LPs. Though 45s were produced of collections of music, it was their use as a "single" that made them popular. Singles have a hit song on one side, and a second song on the "B" side. This became the ideal way for musicians to sell samples of their works in order to encourage 33 LP album sales.



Reel-to-Reel Tape 1/4"

Original Manufacturer: Telefunken and BASF

Launch Year: 1947

Commercially developed in the late 1940s by American audio engineer Jack Mulling with financial assistance from Bing Crosby though prototypes go back as far as the 1930's. Using Mullin's tape recorders, Crosby became the first American performer to master commercial recordings on tape and the first to regularly pre-record his radio programs on tape. Reel-to-reel remained the preferred professional recording format until the late 1980s when it began to be replaced with digital audio recording techniques. Even today, though, some still prefer the sound quality of analog to digital recordings. Reel tapes were preferred for two reasons—it allowed a performance to be recorded without the 30 minute limitation of a phonograph disc and it permitted a recorded performance to be edited. Seven-inch reels of 1/4 inch-wide recording tapes were used typically for non-professional purposes from the 1950s-1970s. Studios generally used 10 1/2 inch reels. The first pre-recorded reel-to-reel tapes were introduced by RCA Victor Record Co. in 1954.



Audio Compact Cassette Tapes

Original Manufacturer: Norelco—US/ Philips—Europe

Launch Year: 1964-1966

A convenient way to record and play music, the compact cassette tape was popular for home and car use. Typical recording times ranged from 46 to 120 minutes. However, the slow tape speed (1 7/8 inches/sec) often created substandard audio. The longer recording times were achieved by much thinner tape which was more susceptible to stretching and breaking. Higher quality cassettes used chromium dioxide (often mixed with ferric oxide) rather than ferric oxide alone. These were known as high bias or Type II tapes.

With Sony's release of the Walkman, the cassette quickly overtook LP sales. It was the top-selling music format until Phillips introduced the Compact Disc (CD) in 1993.



I think kids of my generation were the parents of Napster. I remember being about 13 years old and getting my first boom-box with a cassette player. I was so excited to be able to play cassettes rather than "old fashioned" vinyl records. All my friends would come over and listen to the "records" on my boom-box and we'd dance up a storm in my living room. We were all estatic when we found out we could buy blank cassettes and record radio broadcasts off my boom-box. I remember my best friend and I waiting patiently for the "world premier" of the latest Duran Duran song to come on the radio, my blank cassette ready to illegally capture it, my hand poised over the red record button. After it was over we replayed it over and over again trying to write down the lyrics. Eventually I bought the album and we laughed at how off we were, the actual lyrics were not even close to what we were singing! So I'd have to say my generation may have been the first pirateers of copyrighted music, all hail Gen X!—Cindi Tysick,

Lockwood Library

Audio cassettes were amazing. Imagine carrying music with you. Shock resistant so you could jog or play in your car. Both the player and the cassettes were cheap. And you had the choice of pre-recorded music or you could record your own music or voice.—A. Ben Wagner, Science & Engineering Library

Eight Track Tapes

Original Manufacturer: Learjet Corporation/ RCA Victor

Launch Year: 1965

End Year: Wide-spread production ended in the 1980s

This technology used an endless loop tape cartridge using standard ¼ inch magnetic recording tape running at 3.75 inches/second. This design permitted only fast forwarding; rewinding was impossible.



In 1966 Ford Motor Company offered the Learjet Stereo-8 cartridge as optional equipment on 1966 models. The response was exceptional and 65,000 players were installed in that year alone. Eight track tapes were the first tape format to succeed on the national mass market and sales increased from the early 1960s through the 1970s. However, the lack of a rewind feature, the cost and size of tapes and playback equipment, and the desire by recording companies to reduce the number of audio formats meant that compact cassettes and then in turn, compact disks to drive this format off the market.

Microcassette Tapes

Original Manufacturer: Olympus

Launch Year: 1969

Significantly smaller than the cassette tape, the microcassette uses thinner tape and half or a quarter the tape speed at a comparable recording time. Due to audio quality, microcassettes were most commonly used for recording voice in diction machines and answering machines.



Audio Compact Disc

Original Manufacturer: Philips/Sony

Launch Year: 1980

Enter the digital audio/optical era. A compact disc is made from 1.2 mm thick polycarbonate plastic and weighs approximately 16 grams. A laser burns "pits" approximately 100 nm deep by 500 nm wide. Because of the short wave length of light, optical systems offer inherently higher recording densities than magnetic systems.

Did you know?

- The center hole of a CD got its size from a dubbeltje, a Dutch 10-cent piece.
- The recording surface is much closer to the upper label-side so that surface defects on the lower side are not focused on by the laser. So scratches on the underneath side can often be repaired by polishing or refilling the scratches

whereas scratches to the label side are often ruin the disk.

- o The first CD produced was **The Visitors** by Abba.

MiniDisc

Original Manufacturer: Sony

Launch Year: 1991

MiniDisc is a magneto-optical disc based data storage device that stored up to 80 minutes of digitized audio. It was launched by Sony in 1991 as a replacement to audio cassette tapes, but had limited success due to competition with the compact disc.



Additional Links

- o [Audio Timeline](#)
- o Preparing for the brave new world of sound recordings cataloging [excerpts]. by Mary Huismann, University of Minnesota. See the [complete power point presentation](#) and [handout](#) (Word doc) from the 2006 [OLAC](#) Conference.
- o [An Audio Timeline](#) (Audio Engineering Society).
- o The digital compact disc, now commonplace in stereos and computers, was invented in the late 1960s by [James T. Russell](#) inventor of the Compact Disc. Russell was born in Bremerton, Washington in 1931. At age six, he invented a remote-control battleship, with a storage chamber for his lunch. Russell went on to earn a BA in Physics from Reed College in Portland in 1953. Afterward, he went to work as a Physicist in General Electric's nearby labs in Richland, Washington.



Visual Images/Photography

Photography technology and mediums have changed significantly since the first photograph was created in the mid-nineteenth century with a camera obscura and a chemical-coated pewter plate. For decades, scientists experimented with improving and manipulating image quality by altering mediums—glass plates, mirrored surfaces, metal, and salt paper have all been used to display images—and technology.

This display shows a small sampling of cameras and photography mediums popular within the past century but today obsolete due to the rise of digital photography.

[Stereoscope Cards](#)

[View-Master](#)

[Microprint opaque cards](#)

[35mm Film negatives](#)

[35mm Filmstrips](#)

[35mm Slides](#)

[Kodak Instant Photo Camera](#)

[110 Film Camera](#)

Stereoscope

Original Manufacturer:

Launch Year: 1844

The Stereoscope is the forerunner of 3D movie glasses, allowing the illusion of depth using pairs of slightly differing photographs. After Queen Victoria took a fancy to the stereoscope at the Crystal Palace Exposition in 1851, stereo viewing became all the rage in Britain, and common folk travelled the world from the comfort of their own parlors.

Stereoscope cards were often sold in sets and portrayed a variety of cities, countries, famous people, and humorous themes, some rather racy. Great events of the day such as the building of the Panama Canal, the Johnstown flood, and the San Francisco earthquake of 1906 were brought into peoples homes in much the same way television and the internet does today. Popular until the 1920's, the stereoscope faded from the spotlight with the advent of silent films and the Kodak "Brownie" camera.



View-Master

Original Manufacturer: View-Master

Launch Year: 1939

Created by William Gruber, a piano tuner by trade and stereo photographer by hobby, the View-Master was introduced at the 1940 New York World's Fair. It is a direct descendant of the stereoscope. Instead of opaque cards, the newly introduced 16mm Kodachrome color film was used to produce transparent images. Each View-Master disk held 7 pairs of images, producing the illusion of 3D using exactly the same principle as the stereoscope. Even with all of today's electronic technology, the 3D effect of this simple hand-held (no batteries needed) device is remarkable.



One year later View-Masters were sold in stores across the country. Their popularity increased even more after the U.S. government purchased 6 million disks to help train troops in World War II. During the 1950s View-Master disks were used to market a variety of products and services and as souvenir sets at national parks and other scenic places. In 1951, View-Master began producing Disney character sets, very popular in the children's market. Today, they are still a popular children's toy and the brand is now owned by a Fischer-Price, headquartered in near-by East Aurora.



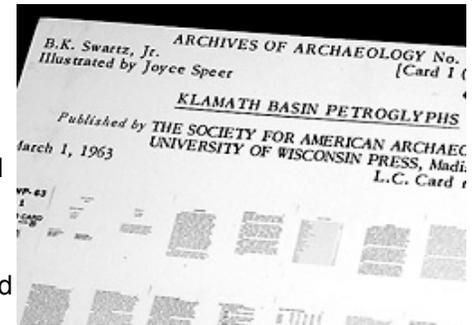
Microprint (Opaque microcard)

Original Manufacturer: Readex Microprint Corp.

Launch Year: Early 1940's

Transparent film-based microforms have remained a viable, truly archival, cost effective, and space efficient storage media that can safely store images for well over 100 years. However, opaque paper-based microprint cards were never as popular and are no longer produced, though viewing equipment is still available. You can still find microprint items in the Capen MultiMedia Center on the second floor.

Most of the content of continuing interest issued on microprint cards has been migrated to microfiche/film or digital formats. There are always market winners and losers in every technology area.



35mm Film

Original Manufacture – Eastman Kodak (Rochester, NY)

Launch Year: 1892

One of the most versatile and long lasting media, 35mm film was introduced by William Dickson and Thomas Edison using stock provided by George Eastman. Though purely digital media has finally eliminated much of the market, 35mm (by width) film was the standard system for over a century for high quality photographic stills, movie pictures, slides, and film strips.



Over its lifetime, this media has been enhanced to include analog and digital synchronized sound tracks, a safer less flammable film base (cellulose diacetate in 1930), and reformulated to capture color. Digital photography has only recently approached the sensitivity, depth, and resolution of 35 mm film.

Travel slides, what an adventure. My grandmother gave my sister and me several boxes of slides from our travels as children. My sister and I will be looking over our treasured memories and selecting those special slides that will eventually be formatted onto a DVD so that both of us can enjoy those early years vacationing with our grandparents in Canada, Virginia, New York City and Pennsylvania. These slides also hold special memories of family and friends. They are truly a joy to behold!

The adventure is compounded by the fact that I was also given an old projector with which we can only view two slides at a time. We have quite a few slides, and it may take hours/days to look them over but what a time my sister and I will have with all of the fond memories.

I just wonder if these new mediums of storing information (DVD's, CD's) are as durable as the old!!! I do plan on keeping the slides "just in case."—**Janice Sypniewski, Central Technical Services, University Libraries**

My father shot over 12,000 slides from about 1962-1995 from our family trips and trips he told with my mother all over the world. I think I got my love of documentation and organization from my father as he carefully documented every slide and arranged them in numbered Kodak carousel trays holding 80 (later 140 slides). Both family and guests frequently enjoyed travelling the world from the comfort of our living room with a running, live commentary by my parents. This was particularly fun to do on a cold winter's evening.—**A. Ben Wagner, Science & Engineering Library**

35mm Filmstrip

Launch Year: Late 1920's

In classrooms of yore, many of us spend hours viewing projected filmstrips with a separate audio recording (33rpm vinyl)

record or audio cassette). Filmstrips were a cost effective alternative to expensive 16mm film projectors. The typical filmstrip had 30-50 images on a long spool of film and ran 10-20 minutes. A beep on the audio track cued the teacher to manually advance the film strip to the next frame. In an era when one had 2-4 channels on TV and movies generally played only in theaters, the film strip, as primitive as it sounds today, was often a welcome break from class lectures and drills.

35mm Slides

Original Manufacturer: Kodak

Launch Year: 1934, but not widely adopted until Kodak changed over completely to safety film in 1949.

The 35mm slide is a positive image printed onto standard 35mm film and placed inside a cardboard or plastic shell. Until the invention of LCD projectors, slides were commonly used to display images for both commercial presentations and social gatherings in halls and homes. A highlight of small town social life was an evening spent viewing slides and listening to commentary by a local traveler fortunate to have returned recently from some exotic place.

The predecessor to 35mm slides were 3.25"x4" glass lantern slides developed by museums and colleges mostly for instructional purposes during the civil war. The 1950s was a period of transition from black and white lantern slides, which had often been hand colored, to color positive film. By about 1995, videorecorders and digital media such as compact disks had almost completely replaced slides.



Camera Instant Photo

Original Manufacturer: Polaroid (shown here a Kodak version)

Launch Year: 1948

The first viable instant-picture camera was introduced in 1948. The Polaroid Model 95, or Land Camera as it was popularly known, produced finished prints from exposed negatives in under a minute. Although initially expensive, the Land Camera's popularity led Polaroid to expand its line with several models. The Model 20 Swinger, introduced in 1965 and targeted to the popular market, remains one of the top selling cameras of all time.



Envious of the Polaroid's success of Polaroid, Kodak attempted to bypass the strong Polaroid patent position and break into the market with its own system introduced in April 1976. Within six days, Polaroid sued for patent infringement winning its case in 1985. Kodak was forced to exit the market immediately leaving all owners of Kodak's instant cameras with a useless paperweight.

110 Film and Camera



Original Manufacturer: Kodak

Launch Year: 1972

110 film was an inexpensive, compact cartridge-based film format introduced by Kodak in 1972 that was especially user-friendly. The small Negative size (13x17 mm) often led to poor quality enlargements. Simple to load and unload, the film did not need to be rewound and came pre-exposed with frame numbers.

110 film cameras were low-cost, compact, and light, making them a popular snap-and-shoot camera option. As of late 2008, only WalMart was still carrying this film.



Audio-Visual



Home & TV Movies

One of our favorite scenes in the home movies from our childhood is seeing my youngest brother eating the sand in the sandbox. For some reason he loved dirt! We'd watch that reel over and over again.

Another fond memory is watching the Wizard of Oz for the first time in color. We gathered at a neighbor's home (the first to have color TV) and were awed by the beauty of Oz when Dorothy stepped out of her house. I am not sure what year this was, but somewhere in the mid 60s (pre-1968 for sure).—

Susan Davis, Central Technical Services, University Libraries

Family TV

Though TV certainly is not yet an obsolescing media, today's viewing experience is nothing like my childhood's experience. While growing up in the late 1950's and early 1960's, we had only three channels (ABC, CBS, NBC) and ABC didn't always come in very well. They signed off about 2 a.m. and did not come back on until 5:30 a.m. Much of our TV watching, given we had a single set, was with the family.

My favorite time was watching the 1-hour Wonderful World of Disney every Sunday evening at 7:00 p.m. with a real fire in the fireplace, popcorn, and my father's home-made grape juice. At that time there were no videotapes or Disney channel. As far as the theaters, Disney movies were released on 7-year cycle. If you missed Cinderella, you had to wait 7 years to see it again. So our only chance to enjoy Disney was one hour a week.—**A. Ben Wagner, Science & Engineering Library**

Kodak, Sony and JVC were the major players in the development of video technologies, introducing motion picture film products, video cameras and video home systems (VHS). They have continued to set the bar high with updates in their innovations in film, video, and equipment. In 1888, George Eastman was quoted as saying, "you press the button, we do the rest." With that motto, Eastman developed the first commercial transparent role film in 1889, which led to the development of Thomas Edison's motion picture camera, the Kinetoscope, in 1891. From here we saw the evolution of motion picture film through the 20th century, from black and white to color, to analog formats such as CINE film and Betamax, and now video via digital optical media such as DVDs.

Here is a selection of popular video media available within the past century but today obsolete due to the rise of digital video capabilities.

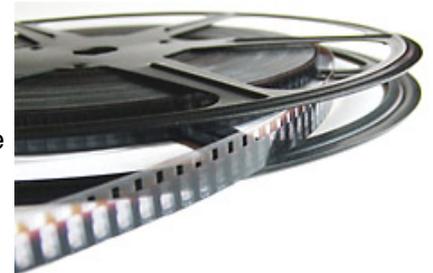
- [16mm Motion Picture Film & Slot load projector](#)
- [8mm Motion Picture Film](#)
- [Super 8mm Motion Picture Film](#)
- [Open reel 1/2" videotape](#)
- [3/4" Videotape](#)
- [Betamax](#)
- [VHS](#)
- [Laserdisc](#)

16mm motion picture film

Original Manufacturer: Kodak

Launch Year: 1923

Amateur silent motion pictures in black and white became practical when Kodak introduced 16 mm reversal film on cellulose acetate base and the first 16 mm camera, the CINE-KODAK Motion Picture Camera. Color motion pictures began in 1928 with the advent of Kodachrome 16mm film, and sound tracks were added in the 1930s. Kodachrome became the first commercially successful 16 mm color film.



16 mm slot load film projector

Original Manufacturer:

Launch Year: 1923/73

Kodak introduced the world's first projector, the Kodascope, in 1923. From this and its many transformations, the 16 mm slot load film projector was born. The camera was named for the nature in which the film was threaded into the machine. Film was loaded edgewise into a slot and was then driven from one reel and picked up by a second reel. These were commonly used in school settings. See US Patent [3734602](#).

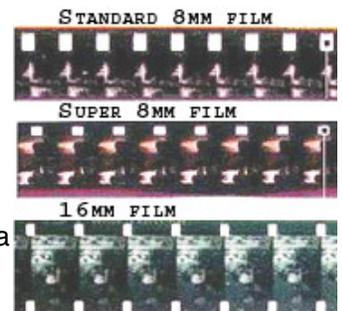
8 mm "home movies" and videocamera

Original Manufacturer: Kodak

Launch Year: 1932

Amateur standard 8 mm film was developed during the Great Depression and offered a more affordable option compared to 16-35mm film for less demanding commercial applications and home movies. George Eastman died in 1932, but his company continued to improve home movie making through film and equipment breakthroughs. Note that the Keystone camera shown here was patented in 1933, has a solid metal case, and weighs

several pounds.



Super 8 film, movie camera, & Magi cartridges

Original Manufacturer: Kodak

Launch Year: 1965

Ceased production in 1997

Super 8 film is still just 8mm wide, but had sprocket holes half the width of regular film, allowing a larger image. Super 8 came in preloaded Kodachrome cartridges making for quick broad daylight loading. Cartridges first held 50 feet of film, and later 200 feet. Its original release was a silent format. However in 1973, a sound version became available. In-flight movies used Super 8 from 1971 until the videotape era. Though cartridges are no longer manufactured, Kodak still makes the film. The film shown here has been developed and placed on a reel for viewing via a home projector.



For classroom purposes, Super 8 film was placed in a small, square plastic cartridge with raised circular top. The Magi cartridge was inserted into a projector, running on a continuous loop. However the very short duration, much less than 10 minutes limited its usefulness.

My father who was 50 when his only child was born, was very keen to record her development but never could get the hang of Super 8 filming. So after seeing that the first 4 yrs produced less than an hour's worth of viewable (and that's defined broadly) film, he hung it up.—Renee Bush, Health Sciences Library

½" open reel B/W videotape

Original Manufacturer: RCA/Sony

Launch Year: 1953 (professional)/1965 (home)

In the 1950's, a variety of videotape recording formats were developed using tape from ¼" to 2" wide. RCA demonstrated ½" recorders as early as 1953. In 1956, Ampex introduced the first practical professional machine, Quadruplex which used 2"inch tape and became the industry standard for the next two decades. In order to broadcast early TV shows in different time zones, they were recorded on videotape. However, the videotape was so costly that it was usually erased and reused thereby destroying much of the record of early TV.

Nobutoshi Kihara, a noted Sony engineer, developed the first home videorecorder, Sony's CV-2000. Though not cheap at \$695, it was 1/10 of the price of any other existing device. The recorder featured two rotary heads, capturing both audio and video from B&W television broadcasts. The B&W Sony recorder shown here is professional grade and predates the CV consumer machines.

With the introduction of VCRs in the early 1970s, the CV recorders soon became a thing of the past. However, the CV led Sony into perhaps the most famous consumer format war ever: Sony's Betamax vs. JVC's VHS.

¾" videotape

Original Manufacturer: SONY

Launch Year: 1971

In 1971, Sony changed the course of videotape by introducing the first mass market videocassette. The composite U-matic system was based on ¾" tape. Its success was partly due to carefully working out industry standards with other manufacturers, a lesson it should have remembered for the home video format wars. Due to the cost of equipment and tapes, this technology was typically used in industry and educational institutions.

Betamax Videotape

Original Manufacturer: Sony

Launch Year: 1975

Ceased production: 2002

Think of it. A home machine that can be programmed to record a TV show onto affordable, removable, and reusable cassettes. In addition to home recording, pre-recorded movies are released for rental and sale.

What's in a name? The term Betamax developed from multiple meanings. First, the manner in which the signals were recorded onto the tape resembled the Japanese word "beta." In addition, as the tape ran through the transport, it looked like the Greek letter "Beta." The suffix "-max" derives from maximum suggesting "greatness." The Betacam, the first consumer camcorder, was later released in 1983.



VHS won the fierce format war with Betamax during the 1980s. Betamax's superior picture quality was defeated by VHS's longer playing times and cheaper tapes & equipment.

The Betamax tape is an example of a great product that was not sold properly. The Betamax format gave a clear and vivid

picture, especially compared to its rival, the VHS tape. Both tapes were available in the early 1980s. The VHS tape is still around because the manufacturer sold it as able to make longer recordings for the same price. Even though the quality was worse, the general consumer most often chose what they thought was the better deal. The manufacturer of Betamax never really tried to sell the quality and clarity of their tapes, they just tried to match their competitor's price and eventually let the product go obsolete because of poor sales.—Rich Burke, Multisorb Technologies

VHS Videotape & Camcorder

Original Manufacturer: JVC

Launch Year: 1976

The Victor Company of Japan (JVC) introduced VHS home recorders in 1976 as a direct competitor to Betamax. Four-hour tapes were soon introduced, an important milestone as one could now for the first time record and time shift an entire NFL football game.

Like Sony, JVC also launched their camcorder in 1983, retailing for about \$1,500. Its bulk required shooting from one's shoulder. In the mid-1990's, camcorders went digital, shrinking in size and cost. In October 2008, the last significant manufacturer of VHS tapes stopped production.

As with all technology, something better always comes along. VHS conquered Betamax, but by June 2003, DVDs overtook VHS rentals. And newest kids on the block, Blu-Ray DVD and digital video recorders (DVR) are coming on strong. Or will on-demand video replace all physical media?

12" laserdisc

Original Manufacturer: MCA & Phillips

Launch Year: 1978

Ceased production: discs - 2000 (North America)/2001 (Japan); players - 2009

In 1978, two years after the VHS VCR and four years before the compact disc (CD), the first laserdisc was released to the market in Atlanta, Georgia. A partnership ensued, with Phillips producing the disc players and MCA producing the discs. Although the partnership did not last, it introduced a format that lasted over 30 years, and was the forerunner to the DVD technology we enjoy today. Somewhat pricy as a home system, it was often used for training materials in industry and education.



The laserdisc itself was comprised of two single-sided aluminum discs layered in plastic. Initially all analog in nature, the discs eventually evolved to include digital stereo sound. The first laserdisc title released in North America was *Jaws* in 1978; the last titles were *Sleepy Hollow* and *Bringing Out the Dead*, both in 2000. The players continued to be produced by Pioneer until January 2009.

Blu-Ray Disc

Original Manufacturer: Blu-ray Disc Association (BDA) a group of 180 leading AV/Computer manufacturers.

Launch Year: 2006

The Blu-Ray disc format was developed to enable recording, rewriting and playback of high-definition video (HD), as well as storing large amounts of data. The format offers more than five times the storage capacity of traditional DVDs and can hold up to 25GB on a single-layer disc and 50GB on a dual-layer disc. The format uses a blue-violet laser instead of red. Using shorter wavelengths allows data to be packed more tightly and stored in less space, so it's possible to fit more data on the disc even though it's the same size as a CD/DVD. For more information on Blu-Ray, see their [FAQ page](#).



Currently, Blu-Ray discs have a life expectancy of 10-12 years.



Computer Data

Timeline

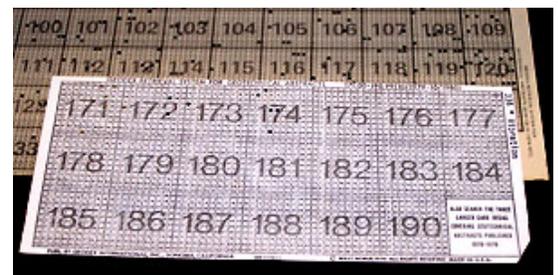
Before 1960 — Data was mostly stored on punch cards and punched paper tapes.

1951 — UNIVAC 1 used the first magnetic tape for storage.

1956 — IBM introduced the first commercial hard disk drive, RAMARC.

1963 — IBM introduced the first storage unit with a removable disk, the IBM 1311.

1971 — IBM introduced the 8-inch floppy disk with 100KB storage capacity.



- 1976 — Macintosh released Apple 1 [only 200 were made]
- 1976 — Shugart Associates introduced the 5 ¼-inch floppy disk with 100k storage capacity.
- 1977 — Tandy releases TRS-80, its first home computer
- 1980 — Sony introduced the 3 ½-inch floppy disk with 400k storage capacity.
- 1984 — Apple Macintosh (first successful commercial PC with a mouse, operating system and graphic interface system) introduced.
- 1984 — Digital Equipment Corp. introduced DLT tape cartridges
- 1985 — CD-ROM's were introduced, the start of the optical era.
- 1985 — Windows 1.0, the first DOS-based operation system, released.
- 1988 — CD-R released by Philips and Sony.
- 1989 — DDS tape cartridges introduced by Sony.
- 1994 — Iomega introduced the Zip disk, initially with 100k (later 750 k), which dominated the market until 1998.
- 1997 — CD-RW was introduced.
- 2000 — IBM started to sell USB flash drives with 8 MB storage capacity.
- 2002 — About 1 billion personal computers have been shipped world wide since 1977.

Storage Media

A flexible magnetic disk (or floppy disk) was the most popular medium for computer data storage for personal computer users in the 1980s and 1990s. Before the invention of commercialized operating systems such as Microsoft's Windows and Apple's Mac, these magnetic disks were often used to store or backup a computer's operating system.

As Windows and Mac became more commonly-shared computer operating systems at home and office, floppy disks were used to carry, distribute, store and share data by computer users.

Magnetic tapes have been used since the early days of mainframe computers. As computers became smaller, they migrated from open reel to data cartridges. At least 37 different formats of magnetic tape have been marketed.

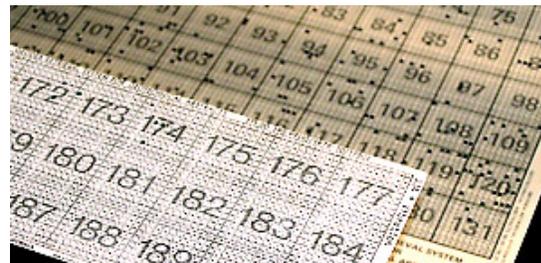
As computer software applications developed and needed to store more complex and sophisticated high-density rich data such as databases, sounds, and images, users turned to portable and high-capacity storage media like CD-R/CD-RW, Zip disks, and USB flash drives.

Formats

- o Punch cards
 - o [Hollerith Card](#) (punch card)
 - o [Geodex](#) (small & large with printed index)
- o [Reel-to-reel 1/2" magnetic tape](#)
- o [Cassette tape](#) (same media as audio, but used for data storage),
- o [Floppy Disc](#) (various sizes: 8", 5.25", 3.5")
- o [Magnetic Tape Cartridges](#) (DDS DAT (1990), DLT tape IV)
- o [Compact Disc](#) (CD-ROM)
- o [Zip disc](#)
- o [Jump drive](#)

Hollerith Card (punch card)

- o First used around 1725 to control textile looms in France
- o By 1937 IBM had 32 presses at work in Endicott, N.Y. creating 5-10 million punched cards every day.
- o Into the 1950s, punched cards were the primary medium for programming, data entry, and storage.
- o Earliest readers used mechanical means to sense holes. In 1960's, optical readers made the process much faster and reliable.
- o During the 1960s, the punched card was gradually replaced as the primary means for data storage by magnetic tape.
- o Became obsolete in the mid-1970s



Punch Cards and Perforated Paper

Nothing wasted paper like the punch cards and 11x14 perforated paper that spewed from line printers in the 70's. Made one typo? throw out the card and type a new one. When the system got slow and backed up, students camped overnight waiting for listings to come out. Desperate students would try to get your listing before you and steal your code. If you divided by zero (which was surprisingly easy to do), your program bombed and you got a core dump—almost more paper than you could carry.—Mark Ludwig, Library Systems

My first experience with computers was in the late 1960's, early 1970's when I worked as a clerk in the Arizona State Museum Library at the University of Arizona. My boss wanted to create a database of journal titles (I am fuzzy on the

exact details) and I did some of the data entry on punch cards. If anyone thinks that computers are frustrating now, just imagine dealing with cards that often did not feed through the punch card equipment correctly and, if you made a typing error, the entire card had to be retyped. Although punch cards had only space for 80 characters, including spaces, it was still possible to create separate fields for specific data elements, just as it is now. When the data entry was completed, the cards were brought across campus to the Computer Center and the job printout picked later that day or the next.—**Marcia Zubrow, Law Library**

I started using computers back in 1963 at Harvard. We would write the programs by hand on graph paper in the morning. Punch out the "ibm cards" using a card punch machine in the early afternoon. Submit the job through a "card reader" in the late afternoon and receive the output back from the main frame the next morning. When "turn around" time decreased to one day-input in the morning and output in the afternoon, we thought it was a major innovation.

About 10 years ago I finally threw out about 5 file cabinets specially made for ibm cards and the cards they contained. They contained archaeological data (mostly type and location of artifacts). I no longer could find a machine to read the cards.—**Dr. Ezra Zubrow, Anthropology Department**

One of my greatest fears was dropping the box of punch cards since they had to be fed into the reader in the exact order - had nightmares about it—**Renee Bush, Health Sciences Library**

Information Retrieval Punch Cards (GEODEX)

- o A system of optical coincidence cards where holes represent a document number.
- o Each card represents a particular subject heading or category.
- o Single-term searching was accomplished by placing a card over a light source and recording the document numbers.
- o Multiple-term searching (Boolean AND) was accomplished by superimposing several term cards over the light source.
- o Document numbers were looked up in the printed references book.

- o Basic idea for an optical coincidence card system patented by Horace Taylor in 1915.

Open Reel 1/2" Magnetic Tape

- o Magnetic tape was first used to record computer data in 1951
- o The IBM System/360 9-track tapes shown here were introduced in 1964 stored data as 8-bit characters across 9 parallel tracks.
- o Widely used throughout the industry through the 1980s
- o Generally magnetic tape is now only used for storing back-ups.

Compact Cassette (cassette tape)

- o Introduced for audio recordings in 1963
- o First used to store computer data in the early 1970s
- o In the 1970s and 1980s, audio Compact Cassettes were frequently used as an inexpensive data storage system for home computers. They are strictly sequential requiring rewinding to the beginning to use the tape.
- o While still used for audio, cassettes were no longer viable for computer data after the early 1990s

Floppy Discs

- o First introduced in 1971
- o Nearly ubiquitous media for data storage into the late 1990's
- o Named for the thin, flexible ("floppy") magnetic disk encased in a plastic shell.
- o Capacity ranged from 79 KB for the 1st 8" floppy to 240 MB for the short-lived LS super 3.5" floppies.
- o Largely superseded by flash drives and optical media like CD-R.



Magnetic Tape Cartridges

DLT Tapes

- o DLT Tapes were invented in 1984 by Digital Equipment Corp.
- o Data is linearly recorded on the 12.6 mm tape in multiple tracks.
- o The DLTtape IV cartridge shown here was introduced by Quantum in 1994 stores 40 GB.

DDS Tapes

- o Sony introduced the DDS tape cartridge (73x53mm) in 1989.
- o The 60-meter tape stored 1.3 gigabytes of data. Data is written diagonally across the width of the tape using different heads to read and write.
- o The 6th generation DDS **DAT 160 stores 80 GB.**

Zip disc

- Introduced in 1994 by Iomega as a removable magnetic disk storage system.
- The capacities ranged from 100 MB to 750MB.
- Though this was the most popular of the “super-floppy” media, never supplanted the 3.5-inch floppy disk.
- Rewritable CDs and DVDs largely replaced this medium.
- Complete obsolescence expected by 2020



Compact Disc

- Introduced in 1982
- Still the standard for sale of audio recordings
- With the introduction of CD-ROM in 1985, came their use for computer data storage, the first mass optical medium.
- Still in use, but now often replaced by flash drives, DVDs, and internet downloads.

USB Flash Drive (Jump Drive)

- First sold in 2000
- Uses solid-state flash memory integrated with a USB interface.
- Storage capacities now range up to 64 GB with 10-year data retention
- Has replaced floppy drives due to capacity, no moving parts, and speed
- Nearly all computer support USB as of January 2009.
- But what will replace flash drives?



Which of these media will be readable in 10 years? 50 years? 150 years?
3.5” floppy drive (Introduced 1980)

Less than 3% of computers sold today have a floppy drive. Expected data life: 5-6 years or less

mp3 Player (Introduced 1998)

All the rage now, but will Vorbis, WMA Pro, AAC, or ?? supersede it?
Expected life of device: 3-5 years, but what does a 1-year warranty imply?



Flash Drive (Introduced 2000)

USB ports are ubiquitous, for now. Expected life of data: 10 years (assuming you don't lose it.)

DVD-Blue Ray (Introduced 2006)

Regular DVD format introduced less than 10 years ago. The descent to obsolescence has already begun.
Expected life of data: 10-12 years

Printed book (9th century China wood block, 1140 CE moveable type)

Expected life of data: 1,000 years

Shoe box of family photographs and computer hard drive

Will your grandchildren be able to find any pictures of you? Photographs can last over 100 years depending on storage. Hard drives last 5-8 years at best.



Role of Libraries in Preservation and Migration

Introduction

From ancient days, libraries have served a dual purpose in society. The first purpose was to provide the information needed by current patrons. The second was to be the long-term memory; i.e. archive, for their society by preserving information for generations to come. Though the storage media continues to change starting with stone tablets right up to Blu-ray DVD, libraries and archives still take a very long term view, saving as much as we can for those that will come hundreds of years after us.



Electronic-based media has made the task much more challenging, a point we make throughout this exhibit. When you think of it, those stone tablets from thousands of years ago are still with us and still readable.

Our University Archives and Special Collections

Do you know the University Libraries is responsible for the official [University at Buffalo Archives](#)? Our archives are inside the Capen Libraries on the 4th floor and are open from 9 a.m. to 5 p.m. Monday through Friday. The University Archives was established in 1964.

In addition to collecting the records of all academic department and UB and student publications, it actively pursues the private papers of administrators, faculty members, and other individuals closely associated with the University. It also acquires and organizes many special collections, including its world-renown James Joyce, Love Canal, and Frank Lloyd Wright collections. More information is available at: <http://library.buffalo.edu/archives/>



How are libraries coping with the electronic age? By pursuing two paths for digital preservation - Migration and Emulation

Migration

Migration is the process of transferring data from media/platforms that is in danger of becoming obsolete to currently used formats. Problems include:

- Data loss due to defects and deterioration of the media
- Copy protection technology and copyright restrictions that may prevent making even a single legal copy even where the intent is to rescue the information from oblivion.
- Loss of functionality or the 'look and feel' of the original material, especially with computer file formats.

Think of this as you:

- *Open old Word files in the latest version of Office or find an old Wordstar or WordPerfect file.*
- *Burn the files from your floppy disks onto DVDs before you get rid of your floppy drive.*

And think of the challenges of migrating and verifying the integrity of information originally recorded on 1/2" magnetic tape migrated to DigiBeta tape (Betamax) to DVD as our archives staff has done over the years with the item displayed here. In 15-25 years, the content will need to be migrated yet again as DVD players presumably will become obsolete and the physical media begins to deteriorate.

Objects: 1/2" commercial magnetic tape reformatted first to DigiBeta tape and then to DVD

Emulation

Emulation means accessing or running older data formats/software on a current platform via software or special circuitry that mimics or translates the information so that the current platform can use it. However, it is extremely difficult to verify that the emulation is perfect, that every feature, aspect, and visual display of the information is identical to being run on the original hardware and software.

Think of this as writing software that lets you play video games from the 1980s on your new computer.

What else are libraries doing? Thinking long-term: special archival media, storage, and research

1. Special Archival Media: Real Gold disc (not simply gold colored)

Traditional optical media uses an aluminum film and an azo or cyanine dye as the recording layer which is sandwiched between two layers of plastic. All of these materials can degrade or oxidize over time resulting in a loss of data. This "disc rot" is accelerated by heat, light, humidity, manufacturing defects and poor quality materials.

Archival Gold utilizes the inert stability of 24 karat gold and special dyes along with high quality manufacturing processes to achieve data storage as long as 300 years. However, in even 25 years, will we have software and hardware that's able to

read the files on this gold disc?

2) Providing security and environmental controls to protect the materials in their collections.

Our University Archives has climate-controlled rooms and high security areas. Control of temperature and relative humidity is critical in the preservation of library collections—particularly fragile magnetic media—because unacceptable levels of these contribute significantly to the breakdown of materials.

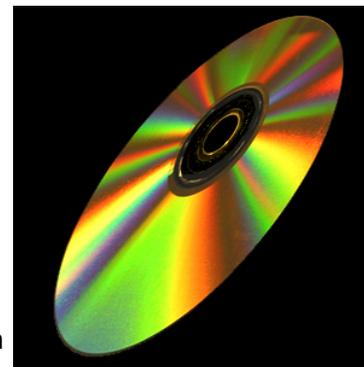
3) Developing and testing digital preservation strategies

Libraries and government agencies are in the forefront of researching and testing preservation strategies for both traditional and digital media. No one knows how much and how quickly valuable content is lost every day. However, we can estimate that content equivalent to 1.5 billion gigabytes is created in all media every year, and that the half life of digital content might be as short as 3 years. Even if a small percentage of that has lasting value, it is a daunting task.

To cite one small example, 10 to 20% of NASA's Mars data collected by the Viking landings three decades ago and carefully stored on magnetic tape in vaults is now a useless pile of iron oxide powder and scraps of polymer film. Interestingly, much of that data was finally recovered by digitizing paper printouts, a time consuming and expensive process! Electronic records are being sent to the U.S. National Archives at 100 times the rate of paper records. The National Archives has awarded a \$308 million contract to develop an electronic preservation system with a robust, flexible technology to retrieve any file stored in it hundreds of years from now.

Library, governmental, and private efforts are far too numerous to itemize here. However, here are a few examples of some prominent archival projects.

- Web sites (Internet Wayback Machine <http://www.archive.org/web/web.php>)
- Journal articles (Portico <http://www.portico.org/>)
- Book via mass digitization projects (Google Books <http://books.google.com/>)
- Historical material (Library of Congress American Memory <http://memory.loc.gov/ammem/index.html>)
- [Caring for Your Own Archival Collection](#) (Archives of Canada).



Webography

[View and read](#) (PDF) these resources.



Exhibit Team

A. Ben Wagner, Sciences Librarian, Chair
Amanda Kuhnel, Graduate Assistant, Arts & Sciences Libraries
Jill Tarabula, Central Technical Services
Karen Walton Morse, University Archives

Contributors

Judy Adams-Volpe, Director, Communications, University Libraries
Becky Berke, Teaching and Learning Center
David J. Bertuca, Science & Engineering Library
Jill Hackenberg, Science & Engineering Library
Will Hepfer, Lockwood Library
Michael Kankiewicz, Capen Multi Media Center
Mark Ludwig, Library Systems
Terry McCormick, Koren Center for Clinical Legal Education, Law Library
Ruth Oberg, Science & Engineering Library
Rose Orcutt, Communications Office, University Libraries
Kathleen Quinlivan, Communications Office, University Libraries
Fred Stoss, Science & Engineering Library
Rena Tuohy, Systems Office, University Libraries



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This online edition of the exhibit was compiled by [David J. Bertuca](#).
