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DATA STORAGE

Data Storage Lifespans: How Long Will Media Really Last?

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Digital media has been with us for a very long time. The first high-speed, entirely electronic memory was developed at Manchester University and tested in 1947. It used a cathode ray tube—much like an analog TV picture tube—to store bits as dots on the screen's surface. Then, in 1951 UNIVAC introduced the first tape storage device for a commercial computer, offering relatively low cost, portability, and unlimited offline capacity. Magnetic disks took four more years to arrive on the scene with IBM's RAMAC 305, the world's first computer based on then-new hard disk drive technology.

While we've made tremendous advances in data storage technology, tape and disks are still widely used, along with newer data storage formats like flash. Of course, these storage technologies have also been improved over time. While each may have advantages, nothing lasts forever—including data storage devices. And new storage technology advances will continue in concert with computing advances—overcoming quantum information storage challenges is one example—so it's more than likely we'll still see significant changes in data storage in the future.

Back to today. **You may have asked yourself how long your favorite storage method will last. Remember, just because a manufacturer claims a media device will last a long time doesn't mean it will.** It just means it can. Whether it's under warranty or not, all bets are off, and any storage method can fail for several reasons.

Lifespan depends on everything from environmental factors to usage rates to component quality to manufacturing. The only sure way to protect data is to employ the 3-2-1-1 backup strategy and invest in a backup and disaster recovery solution that meets your requirements. Let's look at the various media used today and what you can expect regarding lifespan.

Magnetic Tape

Magnetic tape has been a core data storage component for decades, used primarily for large-scale data backups and archiving today. **That staying power comes from its high capacity, low cost per megabit, and durability under optimal conditions.** Data loss in magnetic tape happens either because the media loses its magnetic charge (any magnetically charged storage medium will eventually lose its magnetic charge and subsequently its data) or when the layers of the tape start to separate.

Some manufacturers claim that tape can last up to thirty years, making it a suitable medium for archiving. The problem with that number is that magnetic tapes only last that long under absolutely optimum environmental conditions. That means storing magnetic tapes in environments with stable humidity and temperatures. A more realistic lifespan for magnetic tape is about ten to twenty years. And it's important to note that tape is more susceptible to wear and tear if used frequently.

The arrival of Linear Tape-Open (LTO) technology has reignited magnetic tape's appeal because it offers greater capacities and improved data integrity features. Tape backup software has also gotten more sophisticated and simpler to use. Given tape's overall benefits, it will likely be an ongoing and growing presence in IT infrastructures well into the future.

Cassette Tape

Cassette tapes, while primarily associated with audio recordings, employ the same magnetic storage principles used for data storage. Since cassette and magnetic tapes are similar, their lifespans are about the same. Some have been known to wear out quickly due to excessive use. Others last over thirty years (pull out an old music cassette from the 80s and give it a shot—if you can still find a cassette player—and listen for yourself). **Lifespan depends on the same factors we've mentioned. A safe bet is that a cassette tape lasts between ten and twenty years.**

Floppy Disk

Predicting a floppy disk's lifespan is tricky. **Floppy disks were never very reliable, and some didn't even work correctly right out of the package.** Some manufacturers claimed the lifespan of floppy disks was three to five years, while others said they could last ten to twenty years. Of course, since floppy disks utilize magnetic storage (not unlike tape), it's safe to say that eventually, the magnetism will wear out around the same time a tape would (ten to twenty years). That's if the cheap, flimsy casing on the disk survives that long. It seems that some floppy disks have lasted for a considerable time. However, this storage method was largely replaced by other technologies before the degradation of the magnetic field became much of an issue.

CD and DVD

Introduced in the 1980s and 1990s, CDs and DVDs represented a significant leap forward in optical storage, substantially increasing storage capacity and data access speeds. Both have very similar lifespans. **Generally, unrecorded (blank) CDs and DVDs have five to ten years of shelf-life.** The actual life expectancy of recorded CDs and DVDs is between two and five years, though based on manufacturer claims, ten to twenty-five years or even longer isn't unprecedented. In any case, using very conservative numbers will reduce the risk of losing data. These numbers also depend on environmental factors and how often you use the disc. Advances in manufacturing and data encoding technologies have improved their durability, but any optical media is highly susceptible to damage because there is little protection on the readable surface. All it takes is a scratch on the surface, and some data can be lost.

Blu-Ray
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Blu-Ray discs are built upon the same storage principles as CDs and DVDs, offering more storage and faster data transfer rates and making them suitable for high-definition video and data-intensive applications. **Writeable Blu-ray disks come with a lifetime warranty, though we couldn't find any reliable info on how long they are expected to retain data.** Under ideal environmental conditions, they supposedly last quite a bit longer than CDs and DVDs because the method for recording data results in more durable storage. But even though they likely last quite a bit longer, they're still optical media, which means they're susceptible to scratching, high temperatures, and sunlight.

M-Disc

The M-Disc is an optical archival media storage media that the company says can "preserve photos, videos, music, and documents for 1,000 years or more." That's quite a claim and is clearly only theoretical. The M-Disc can be used with any standard DVD drive to read information, but since the data is engraved into advanced metals, an M-Disc-ready drive is required to write it.

Hard Disk Drives

Hard disk drives (HDDs) have been a foundational component of IT infrastructures for offering a balance of capacity, speed, and cost-effectiveness. Most hard disk drives (HDD) last three to five years before some component fails. That doesn't always mean the drive is irrecoverably broken. But three to five years is still about how long they last, whether you're talking about an internal drive for a server, desktop, or an external HDD. With all of the moving parts inside, something will eventually stop working.

As with any media storing essential data, investing in high-quality drives makes sense. Interestingly, a Forbes article points out that HDD shipments dropped 8.2% between the second and third quarters of 2023. One executive from Pure Storage went so far as to predict that no more HDDs will be sold after 2028 because of electricity costs and availability combined with the decline in NAND (Flash) storage cost per terabyte.

Of course, since Pure sells solid-state drives (SSDs), that may be a biased perspective. At the same time, c**ontinuous improvements in HDD technology, including helium-filled enclosures and advanced recording techniques, have enhanced their reliability and storage density.** Those improvements likely mean HDDs will remain relevant in data storage ecosystems for some time.

As noted, flash storage costs continue to decline. These days, flash is used in enterprise data center servers, storage, and networking technologies. It's also ubiquitous in consumer devices like USB flash drives, SD cards, cell phones, digital cameras, and more. **All these uses rely on solid-state flash memory for persistent data storage.** At the physical cell level, flash storage cells retain data by trapping and keeping electrons in a floating gate. **Each cycle of inbound electrons (programming) and outbound electrons (erasing) wears out the tunnel oxide, weakening the cell structure over time. At some point, the cell can't reliably hold the charge.**

TechTarget says most enterprise-grade solid state drives (SSDs), which typically rely on NAND flash memory, are designed to last between three and five years, with cell density playing a significant role in endurance rates. SanDisk—one of the early innovators in flash memory—offers product warranties that range from a single year to a lifetime.

The reality is that your flash storage will last somewhere between these periods. This is how Emerson's Test & Measurement business group explains the life expectancy capabilities of flash storage available for use in one of its systems:

"Selecting the right flash-based storage device for your application often demands a tradeoff between cost, capacity, and robustness. For instance, Single-level Cell (SLC)-based drives offer the most durability and longevity, but they are also more expensive per GB than Multi-level Cell (MLC)-based drives. However, MLC-based drives have a much shorter life span than SLC drives, which can be particularly problematic when stored at elevated temperatures. To help determine which type of flash memory to use, we need to understand the life expectancy of each option and compare that to the requirements of the application."

The Future of Storage

Quantum Computing's Potential

Quantum computing has the potential to revolutionize data storage and storage media. TechTarget notes that quantum computers can't use conventional memory and data storage. They require quantum memory. (Learn about quantum computing and quantum encryption in this recent post.)

The primary advantage of quantum memory or storage is that it can hold vast amounts of information. For comparison, 100 bits of conventional storage would accommodate only 12.5 bytes of data, while 100 quantum computing storage bits could contain more states—and therefore more data—than all of the world's hard drives combined.

This nascent technology is years, if not decades from becoming mainstream. But its potential can't be ignored.

Holographic Storage:

Microsoft's Project HSD is developing a cloud-first holographic storage system. Microsoft writes, "Holographic optical storage systems store data by recording the interference between the wavefronts of a modulated optical field, containing the data, and a reference optical field as a refractive index variation inside the storage media."

"It is this information containing refractive index variation that is the “hologram.” modulated optic The stored data can then be retrieved by diffracting only the reference field off the hologram to reconstruct the original optical field containing the data. In Project HSD, we are exploring the use of holographic storage in rewritable electro-optic materials for warm data storage to see if this technology makes sense in the cloud era."

This is another area worth watching as we continue to generate ever-growing mountains of data, especially with the advent of AI.

Conclusion

Regardless of the storage media you use in your infrastructure, ensuring your data is protected, backed up, and recoverable is always your top priority. To learn how Arcserve products can help you do just that, choose an expert Arcserve technology partner. To learn more about our products, contact us.

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