

White Paper

The Advantages of Optical Archiving

September 2010

The Advantages of Optical Archiving

I. Executive Summary

There is no question that we live in the age of information. The focus of the world economy has shifted from physical production to the importance of data: statistics, facts, figures, numbers and records. As this shift continues, the importance of information in a business escalates. Nearly all of a professional organization's data exists in an electronic format, and as the value and volume of data increases, so does the demand for adequate storage space to house it.

The solution? **Data archiving.**

Companies have large amounts of data, and a large percent of it needs to be retained. Only 25% of the data within an organization is freshly created; the rest is redundant data, or data that was created in the past and must be preserved for future reuse (refer to FIG 1).

This situation has created a high demand for information storage, a demand that carries both monetary and logistic concerns. Data archiving allows organizations to efficiently retain this mass of redundant data, often for very long periods of time, so that it can be accessed when necessary.

Data Archive:
The active storage and management of digital information

Only 25% of the data within an organization is freshly created; the rest is redundant data, or data that was created in the past and must be preserved for future reuse.

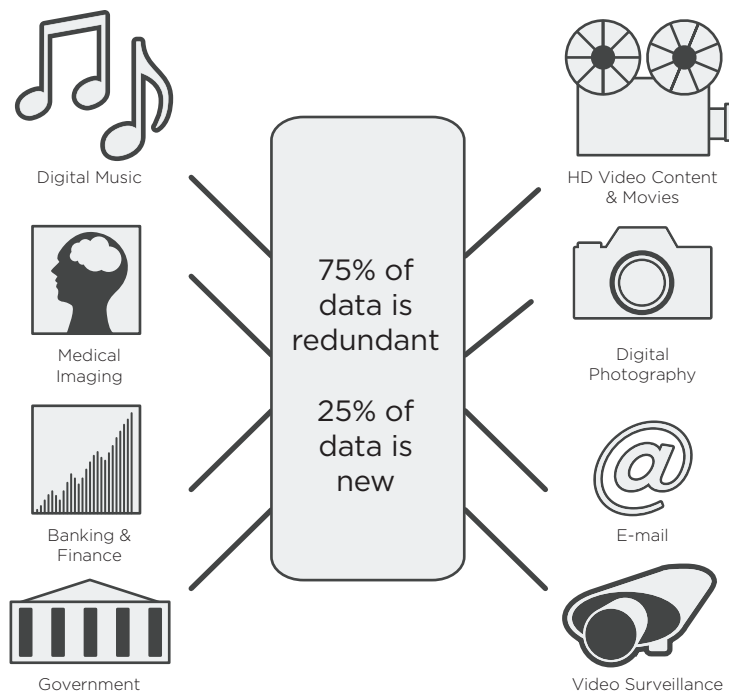


FIG 1. Electronic Data: New and Redundant

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II. Why Archive?

An organization's electronic data is a valuable asset and needs to remain available over time. In today's fast-paced world, data archives are no longer a luxury. Effective, reliable and affordable archiving technology is quickly becoming a necessity for many content-intensive applications.

Data archives help professional organizations achieve three main goals:

- Protect and retain data for the future
- Meet the world's increasing data storage needs
- Live up to the world's compliance and legislation requirements

Protect and retain data for the future

From contracts to medical records, employee documents to client communications, organizations expend a great deal of time and energy on creating, managing and maintaining electronic documentation. As a result, a significant amount of a company's data holds significant value (refer to FIG 2).

In today's fast-paced world, data archives are no longer a luxury. Effective, reliable and affordable archiving technology is quickly becoming a necessity for many content-intensive applications.

Task	Average hrs per worker per week	Cost per worker per week*	Cost per worker per year*
E-mail: read & answer	14.5	\$ 418.30	\$21,752.90
Create documents	13.3	\$ 333.70	\$19,952.70
Analyze information	9.6	\$ 277.00	\$14,401.90
Search	9.5	\$ 274.10	\$14,251.90
Edit/review	8.8	\$ 253.90	\$13,201.80
Gather information for documents	8.3	\$ 240.00	\$12,481.70
File and organize documents	6.8	\$ 196.20	\$10,201.40
Create presentations	6.7	\$ 193.30	\$10,051.30
Create images	5.6	\$ 162.70	\$ 8,461.10
Data entry to e-forms	5.6	\$ 162.40	\$ 8,446.10
Manage document approval	4.3	\$ 124.10	\$ 6,450.90
Publish to web	4.2	\$ 121.20	\$ 6,300.80
Manage document routing	4.0	\$ 115.40	\$ 6,000.80
Publish to other channels	3.9	\$ 112.50	\$ 5,850.80
Create rich media	2.8	\$ 80.80	\$ 4,200.60
Translate	1.0	\$ 29.70	\$ 1,545.20

FIG 2. The Cost of Information

* Based on average salary of \$60,000 per year plus benefits. Source IDC: Proving the value of content technologies study. Chart courtesy of DISC Archiving Systems.

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Once electronic data and documentation is created, it must be managed and protected. Technologies and practices must be in place that enable an organization to a) defend against data loss, destruction and failures, and b) proceed logically and cost effectively in the event that information is damaged.

Many organizations already have backup systems in place that allow them to save and protect data. So what is the difference between a data archive and a data backup?

Data archives not only offload content from primary, short-term storage to safe, long-term storage, but they retain information for future use and frequent recall—all at a low cost.

A **data archive** is a storage device that is used to house data for long-term preservation. Data archives store and protect historic data that is not needed on a day-to-day basis, but is important and necessary for future reference, such as information that must be retained for regulatory compliance. Data archives are indexed for search optimization—files can be located and retrieved quickly and easily. The technology commonly used for data archives are hard disk drives, tape drives and optical Blu-ray Disc™ media.

A **data backup** is a large repository that is used to store multiple copies of data. The backup is used to restore data in case the original copy is corrupted or destroyed. Typically, backups are not indexed or designed for swift data location and recovery, and the data has a shorter retention period. Tape drives and hard disk drives are commonly used for data backups.

The two key differences between a data backup and a data archive are the length of data retention and the ability to retrieve. Data archives not only offload content from primary, short-term storage to safe, long-term storage, but they retain information for future use and frequent recall—all at a low cost. This ensures that important data remains safe, retrievable and easily accessible for decades. As archives streamline data storage and recovery processes, productivity increases.

Meet the world's increasing data storage needs

In the last five years, the amount of electronic data that needs to be retained has outgrown storage capacities. Data that is stored on local or personal hard drives or online tapes remains static and unprotected (refer to FIG 3).

One significant reason for the lack of adequate storage space is that IT departments have not been able to keep up with the sustained rapid growth of data—they have had limited resources to efficiently and cost effectively manage current storage needs, as well as create new capacities. Many organizations have purchased extra hard disk space or added servers to expand resources, but these methods tend to clog up networks. Duplicate data is often stored and backed up many times over, eating up storage capacities that could be better and more efficiently utilized.

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The need for offline storage is crucial for the bottom line. Data archives can fill the gap that the data race has created, allowing companies to increase efficiency, manage data more effectively and reduce storage costs.

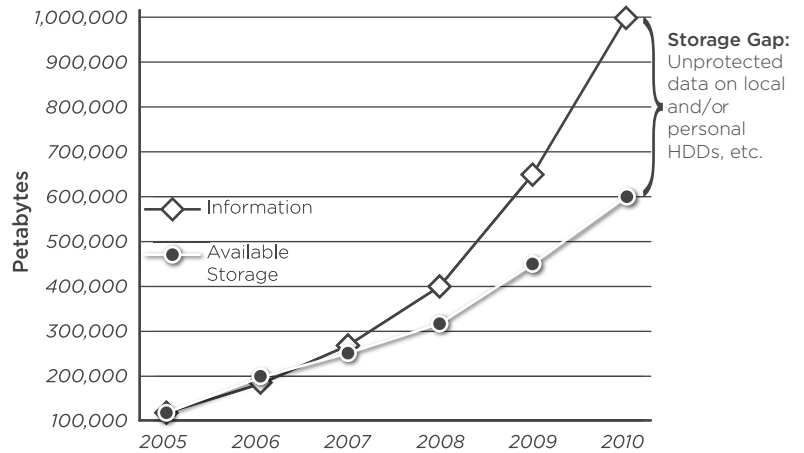


FIG 3. The Growth of Electronic Data and Available Storage

The growth of electronic data is expanding, and space continues to run short. The need for additional storage has become crucial for both cost and efficiency reasons. Data archives can fill the gap that this data race has created, allowing companies to increase efficiency, manage data more effectively and reduce storage costs.

As a result of the data-storage gap:

- Inactive and active data is managed and maintained in one ineffective storage bundle
- Stored data can not be recalled or recovered quickly and easily

Data archives can meet storage needs by:

- Moving data from online storage space to offline storage capacities, thereby liberating space for new, more current data
- Reducing storage management costs by implementing affordable, logistical and automated data management systems

Fulfill the world's compliance and legislation requirements

Thousands of regulations and mandatory compliance standards require extensive record retention, and original records must often be reproduced unaltered. From FDA regulations to Sarbanes-Oxley standards, world-wide industries find themselves under a mountain of highly specific, strict and standardized data compliance and legislation requirements (refer to FIG 4). In addition, companies that face tough litigation issues must produce documents and other information to be used as evidence in courts of law.

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Electronic documents and records play an increasingly important role in these areas—contracts, medical records, e-mails, financial records and images are only a few examples of information that organizations may need to recall under compliance and legislation requirements. Innumerable professional organizations must have good archiving architecture in place to store and manage their electronic data, as well as have the capabilities to produce original, authentic information at random and unpredictable times. By nature of their technology, data archives can fulfill this need.

Innumerable compliance and regulation organizations across the globe require companies to produce original, authentic information at random and unpredictable times. By nature of their technology, data archives can help fulfill these requirements.

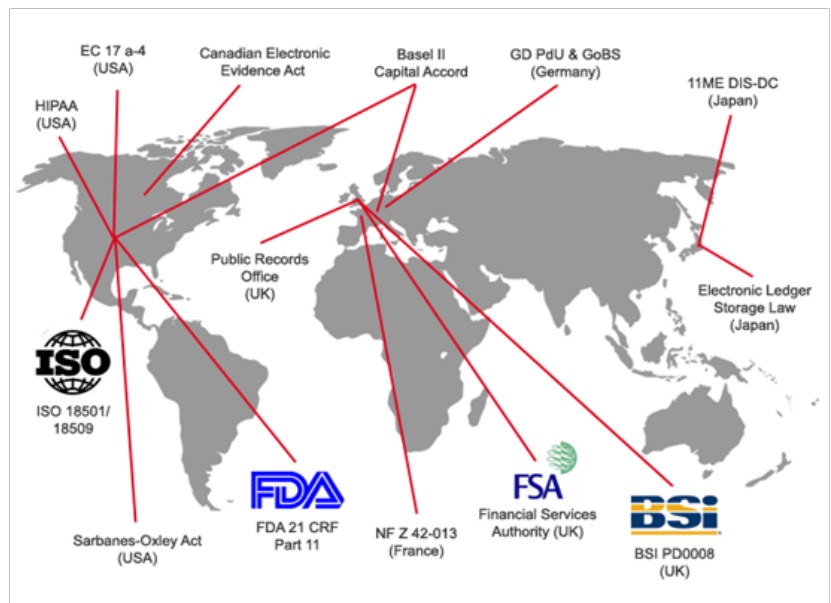


FIG 4. Global Regulations and Compliance Standards

Image courtesy of Disc-Group

Compliance and legislation require companies to:

- Retain vital information for extended periods of time
- Recall data in its original and unaltered form
- Restrict unauthorized access to data
- Quickly and easily navigate and retrieve data

Effective data archives ensure that data is:

- Available for recall for years or decades
- Reliably stored and retrieved in its original form
- Secure from unauthorized access and modification
- Easily recallable with random access

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III. The Technologies of Archival Storage

The three technologies that are currently available for data archiving are:

- Hard disk drives (HDDs)
- Tape drives
- Optical media

Hard disk drives – successes and failures

Hard disk drives are routinely used in online or **near-line storage** archives, which have a role in nearly every aspect of the digital world as we know it today. Individuals and organizations keep significant amounts of data on various versions of HDDs—MP3 players, cell phones, personal business computers, web applications and corporate storage systems are some examples of disk drives used around the world. HDDs are manufactured with affordable magnetic drives that have large individual capacities, which are used to store significant amounts of space-hogging data, such as music, records and video. Although hard disk drives can be effective means of data storage, they are not the perfect archive. When it comes to HDD archiving, there are successes and failures.



Near-line Storage:

The on-site storage of data on removable media

Successes:

- **Accessibility.** Data on HDD archives can be rapidly accessed. Whether a hard disk drive is being used as primary or secondary storage, data can be retrieved in a matter of seconds.
- **Affordability.** Over the years, the cost of near-line HDDs has been driven down, making them more affordable in terms of acquisition than higher-performance HDDs used in primary storage.
- **Compliance.** Hard disk drives have the basic capabilities needed to meet compliance and regulatory requirements, ensuring that data can be recalled in its original, intended format.

Failures:

- **Long-term retention? Not likely.** It's true that HDDs have the basic archiving capabilities to meet storage needs. However, HDDs are normally designed for a three to five year lifespan. For organizations that need to reproduce data ten or fifteen years down the road due to compliance and legal regulations, this does not bode well.

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HDDs are manufactured with large, affordable drives that meet basic archival storage needs. However, HDDs are normally designed for a three to five year lifespan. For organizations that need to reproduce data ten or fifteen years down the road due to compliance and legal regulations, this does not bode well.

- **Out with the old.** Hard disk drives are not designed for unpowered shelf storage—they are designed to heat up only when powered on and tend to fail more rapidly when sitting unpowered on a shelf. Offline management of old information is simply not possible with this form of archive technology.
- **What goes up stays up.** Power and air conditioning consumption are significantly high contributors to HDD operating costs (refer to FIG 5). Furthermore, as a result of their short lifespan, migration to new disk drives is necessary every three to five years. This means that time and money must be spent on reliability issues, and organizational and environmental costs go up, just when they need to go down.

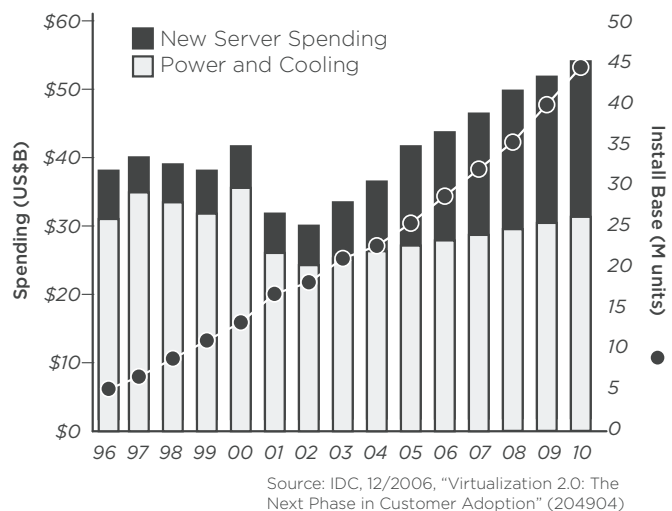


FIG 5. HDD Power and Cooling Costs

- **To err is the nature of HDD.** Mistakes happen, which is why humans often rely on technology to perform certain automated tasks with both added speed and reliability. So what happens when technology fails? When it comes to HDD archives, this is an important question. While hard disk archives can be made readily accessible, they are also subject to two types of readability errors: operational and latent failures (refer to FIG 6).

Hard disk drive readability failures

HDDs readability errors are either operational or latent in nature. Both types hinder the ability of HDDs to reliably archive data, yet the two failures behave differently.

Operational failures often occur when data cannot be written to the disk drive because the HDD itself has stopped working. Latent failures occur when the disk drive works—data can be written to the HDD—but electronic or mechanical errors prevent the content from being retrieved (refer to FIG 6). Latent errors are the dominant source of errors in HDD archiving.

The Advantages of Optical Archiving

Latent failures are a little more complex than operational failures, simply because there are several factors that can cause them to occur, and these factors are often lurking, unseen and undetected, until it's too late.

HDD latent failures

Latent failures cause hard disk drives to be unreadable and unstable. Causes of latent failures include:

- **Thermal instability and self-demagnetization.** When an HDD's thermal energy, or the internal energy created by the HDD system and components, is at room temperature, the bits stored on the drive are slowly disordered and thermal decay occurs. Unpowered hard disk drives are more susceptible to areas of data loss due to thermal decay.
- **Corrosion.** The internal components of the disk drives are subject to corrosion, including the media, motor parts and connectors. The most severe type of corrosion occurs on the media itself. If corrosive sites develop on the disk platter, data loss could result.
- **Particulate infiltration or contamination.** It is simpler than it sounds—airborne contamination settles on the disk surface, often rendering it unreadable. This phenomenon can either create a site for possible corrosion or data loss.
- **Out-gassing.** This term usually refers to the release of detrimental vapor from the HDD cartridge's internal parts or hard case over time. Out-gassing can deposit detrimental films upon the disk platter, which leads to a loss of space or a severe chemical reaction. This process ultimately results in data loss.
- **Adhesive breakdown.** Some HDD components, such as the filter and desiccant inside each disk, are mounted with adhesives. This adhesive might break down due to time, temperature or humidity, causing the filter to loosen. In turn, this can cause the internal components to rub or make contact with the disk, resulting in areas of non-recoverable data.

Research shows that HDD latent errors increase over time. In one study, 3.45% of 1.53 million disks developed latent errors, and this percentage increased super-linearly.

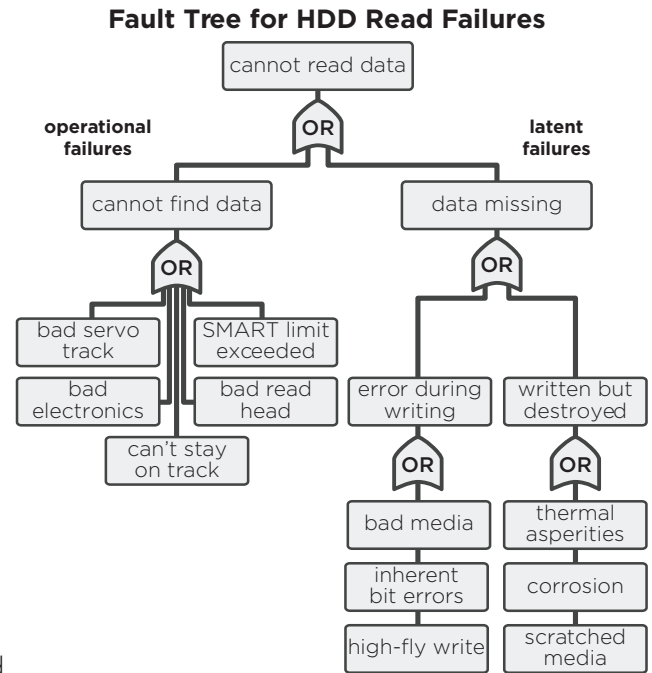


FIG 6. HDD Readability Failures

The Advantages of Optical Archiving

Due to the increased volumes of electronic data, the ever-growing demands of data archives are beginning to outpace the industry's ability to create adequate HDD storage capacities.

Significant research shows that HDD latent errors increase over time. In one study, 3.45% of 1.53 million disks developed latent errors, and this percentage increased super-linearly for near-line disk drives. Furthermore, drives that have experienced errors are more likely to develop additional errors in the future.

When it comes to archiving and hard disk drives, the good does not always outweigh the bad. Due to the increased volumes of electronic data, the ever-growing demands of data archives are beginning to outpace the industry's ability to create adequate HDD storage capacities. The progressive amount of digital data stored on the internet, as well as the growing amounts of information being stored on personal computers and servers, has created a demand for additional offline storage capabilities that prohibit HDDs from becoming an effective archiving tool. In addition, readability failures, as well as high operational costs and the inability of HDDs to retain data for the long-term, significantly compound the issue. The long-term storage deficiencies of hard disk drives make this technology a less than optimal archiving option.

Tape drives – good for backup, bad for archive

A tape drive is a data storage device that uses magnetic tape to read and write data. The tape itself is primarily packaged in a cassette or cartridge, which is then loaded into the drive. Individual drives can be connected to computers via cable connections, such as SATA, USB or FireWire, while multiple tape drives are often housed in autoloaders or large tape libraries. These devices often include built-in barcode readers that identify the tapes and an automated system that loads the tapes into drives—no human intervention is necessary.



The greatest benefit of tape drives is that they are able to store tremendous amounts of data. Tape drive capacities can range from a few MB to over 100 GB, well exceeding the storage capabilities of hard drives and network storage. However, this benefit comes with one large drawback: their accessibility rates are slow. Tape typically offers sequential data storage (versus the random storage capabilities of disk drives), and access to data on tape can take anywhere from a few seconds to two or three minutes. Despite their bulk and slow retrieval times, tape drives are capable of transferring linear streams of large amounts of data at once. It is for this reason that tape drives are most commonly used for **data back-up**.

Data Back-Up:

The duplication of data for restoration processes

The Advantages of Optical Archiving

Here is the good and bad news about tape archives:

The good news:

- **Low incremental cost.** Most organizations already have some form of a tape drive in place for data back-up purposes, which means little additional costs if the same drive were to be used in place of primary storage. In addition, the power consumption of tape is low, resulting in low operating costs.
- **Long-term retention.** Old information can be removed and stored off-line, and the average lifespan of tape is seven to ten years.

The bad news:

- **Incompatibility.** Because tape technology changes every decade or sooner, tapes that store data now may not be accessible or readable when the next technology turn comes around. More out-of-pocket costs are required to keep up with tape's demanding equipment and software upgrades.
- **Rewritable technology.** By design, tape is extremely rewritable, and additional technology is required to force tape drives to be alteration-resistant or **WORM** (Write Once Read Many). Although tape's decade-long lifespan ensures that data is stored for a significant period of time, a long storage life does not guarantee that the original data can be recalled unaltered in the future.
- **Slow access times.** For all intents and purposes, data stored on tape drives is accessible, but tape is still best suited to sequential access. Due to tape's need to spool, data retrieval times can be slow and unpredictable.
- **Vulnerability.** Although old data can be removed from the drive and stored off-line, tape is vulnerable to electromagnetic radiation, requiring regular maintenance to prevent tapes from adhering together. Support staff needs to be on-hand in order to condition the tapes on a consistent basis.

WORM:

Write Once Read Many

Tape standards and technology change every decade or sooner—tapes that store data now may not be accessible or readable when the next technology turn comes around.

As an archiving technology, the discussion of tape drives is nearly a moot point. Over the years, tape has been a reliable data backup source, one with little user intervention. In addition, tape system speeds have advanced and capacities have grown. However, in the face of recent Internet developments and the current global economy, tape backup and restoration times remain too slow, inhibiting this technology from keeping pace with the growing demand for effective and efficient archives. Furthermore, this technology has been outmatched by the lowered cost and increased availability of hard drive storage.

The Advantages of Optical Archiving

Blu-ray Disc:

A high-capacity, high-definition disc format that uses multi-layer disc technology and blue laser to store and display a variety of data

A Blu-ray Disc is the same physical size as a standard CD or DVD. A standard Blu-ray Disc contains up to 50 GB of data, and disc manufacturers have announced plans to create 100 GB discs.

Optical media – a reliable data archive choice

Most people are familiar with the Blu-ray Disc's high-quality ability to store video, games and other interactive content. However, this form of optical media is also a superior choice when it comes to data archiving. Optical archives use Blu-ray Disc technology to record a wide array of data and store it in near-line or offline capacities. While HDD storage is a good option for short-term information storage, and tape drives are efficient at backing-up data, these technologies do not consistently meet the most critical needs and requirements of data archives: safe, long-term data retention and easy accessibility. Not only is optical media designed for the demands of today's video industries, it also serves as a durable, reliable and sustainable data archiving solution now and into the future.



The primary benefits of optical media archiving include:

- Reduced risk of data loss
- Reduced storage costs
- Long-term data retention, durability and compatibility
- Low cost, low power and minimal carbon footprint over time

Reduced risk of data loss

Blu-ray media is 100% WORM, meaning that while the original data stored on the disc cannot be altered, it can always be accessed. This is great news when it comes to compliance and legislation requirements. Optical technology's standard, built-in features ensure that information cannot be erased, altered or accessed without proper authorization—the original file will be there when you need it, with its integrity intact, guaranteed.

Reduced storage costs

A Blu-ray Disc is the same physical size as a standard CD or DVD. The differentiating factor between the three types of optical media is that Blu-ray Disc technology uses a blue-violet laser, which is a shorter wavelength than the standard red laser used with CDs and DVDs. This enables a standard Blu-ray Disc to contain up to 50 GB of data, and disc manufacturers have announced plans to create 100 GB discs. In addition, Blu-ray technology has built-in support for multi-layer/extended format features, meaning that as storage capacity requirements grow, so can a single piece of Blu-ray media.

The Advantages of Optical Archiving

Long-term data retention, durability and compatibility

The lifespan of a Blu-ray dual-layer 50 GB disc is 20 to 100 years. Two physical factors contribute to the superiority and dependability of this type of optical media.

First, Blu-ray Discs contain a protective hard-coating on the outside surface, making scratches and fingerprints a non issue. In addition to the built-in WORM support, Blu-ray's advanced coating technology helps to protect the disc itself from physical damage.

Second, optical media is created in industry-standard formats: ISO 9660 and **UDF**, both of which are backwards compatible. These formats are supported in all major operating systems: Windows, Linux, UNIX and MAC OS. In other words, optical media is highly compatible, assuring that both now and years ahead, Blu-ray Discs can be utilized and read by a standard PC. (Further proof: CDs from 25 years ago are still readable today by a standard PC.) The long lifespan and highly standardized compatibility of Blu-ray media guarantees that original data can be recalled from storage, and files on the disc can be randomly accessed at any time, without having to spend resources on software and technology upgrades.

UDF:
Universal Disk Format

Low cost, low power and minimal carbon footprint over time

Over time, Blu-ray Discs are more economical than hard disk drives (refer to FIG 7). Blu-ray ownership costs are low because:

- Blu-ray Discs can hold a significant amount of data, and additional layers and content can be added at a low cost.
- Blu-ray media has the longest shelf life of all data archive solutions.
- Blu-ray's wide capabilities and platform support drastically reduce the need to migrate to new technology.

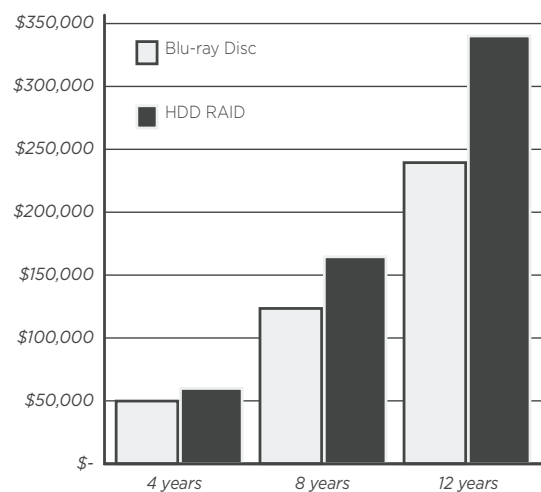


FIG 7. Total Cost of Ownership - Blu-ray and HDD

The Advantages of Optical Archiving

Optical media is highly compatible. The lifespan of a Blu-ray dual-layer 50 GB disc is 20 to 100 years. If that seems impossible, just think that CDs created 25 years ago are still readable by a standard PC today.

The cost benefits of optical media ultimately translate into environmental benefits. Optical media is the data archiving technology with the lowest energy consumption, fulfilling another major requirement of today's data storage needs: environmental sustainability (refer to FIG 8). Here's why:

- Optical media is a passive storage device, requiring no energy over decades of storage—it does not consume any power when it is not being utilized to access data and information.
- The energy consumption required to operate and run Blu-ray media is extremely low due to the use of shared resources.
- Blu-ray media generates no heat, which in turn means that little to no energy is spent on cooling during storage.

When it comes to data archiving, optical media storage is a robust and reliable option. Blu-ray Discs are specially formatted for the wide demands of the ever-growing video industry—a clear advantage over disk drives and tape drives. Second, optical archiving technology is dependable, durable and will be available for the long haul. The low operating costs of optical media ensure that an organization's data archive leaves a small carbon footprint and more money in the bank.

As a result of its robust nature, optical media fully supports the increasing demands of compliance and legislation requirements:

- Long-term record retention
- Reproduction of original, unaltered records
- Quality archiving architecture for compliance and legislation requirements

Blu-ray media is the data archiving technology with the lowest energy consumption. It does not consume any power when it is not being utilized, and due to shared resources, the energy consumption required to operate and run Blu-ray media is extremely low.

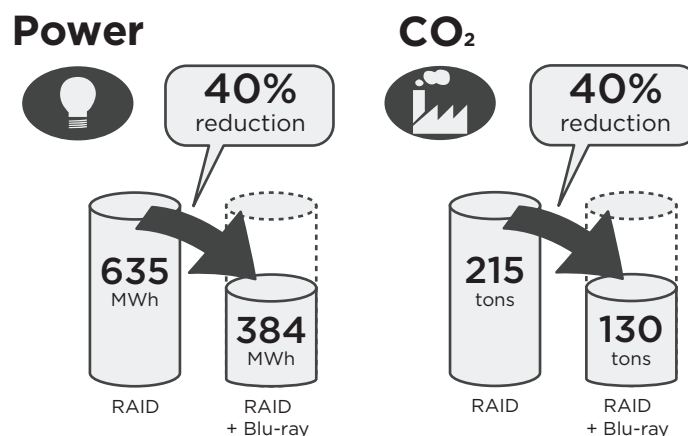


FIG 8. Optical Media's Low Power = Low Carbon Footprint

The Advantages of Optical Archiving

V. Conclusion

Electronic data permeates and dominates business industries across the globe. As our world economy continues to be more information-based, mass amounts of electronic data continue to accrue at a rapid pace.

As a result, the world's need for data archiving is ever-growing, placing more and more demand on professional organizations to ensure reliable archiving technology is in place to save and protect their electronic data.

The primary technologies that are available to perform archiving tasks are hard disk drives, tape drives and optical Blu-ray media. The question is: Which archiving technology provides the financial and organizational benefits in one trustworthy package? The answer is: **optical media**.

HDDs are effective in the short term, but are prone to operational and latent failures that make this technology an unreliable and unsafe data archiving tool. Tape drives have been exceedingly effective in the data back-up industry, but their high-maintenance and technology turnover do not make them an effective data archiving option. Hard disk drives and tape drive technologies do not meet the most critical archiving need: **long-term retention** (refer to FIG 9). Blu-ray Discs are durable, specially formatted for the popular media industry and have a 20 to 100-year lifespan. Optical media meets all data archival needs while also fulfilling cost and efficiency demands, surpassing the capacities of both tape and hard disk drives.

Optical archiving technology is dependable, durable and will be available for the long haul. Blu-ray media has low operating costs and fully supports the increasing demands of compliance and legislation requirements.

	Optical	HDD	Tape
Long-term Retention	+	=	+
Recall	+	+	=
Total Cost (Acquisition & Operation)	+	=	+
Compliance	+	+	+

FIG 9. Optical Media Provides Financial and Organizational Benefits

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White Paper

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