HP StorageWorks Optical Storage

A buyer's guide to understanding and evaluating Optical Storage

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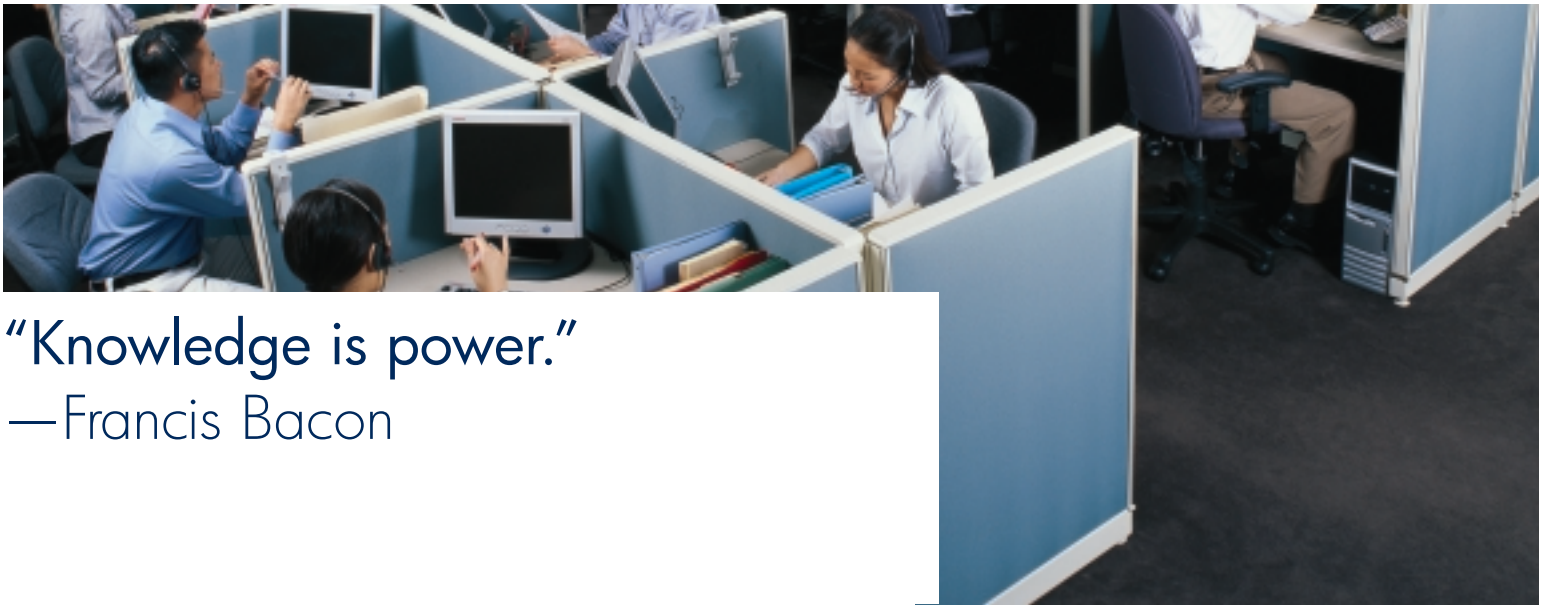

"Knowledge is power."
—Francis Bacon

Storage 101: A beginning

In the Information Age, information is like any other product.

It's bought and bartered every day. It differentiates successful companies from marginal ones. It forms the foundation of every successful enterprise. And when it's transformed from its raw state into intellectual property, its value soars beyond calculation.

Like any other strategic asset, information must be protected from loss, corruption and theft. But how?

This primer is an important first step in evaluating and understanding your options in storage, especially optical storage. It explores the challenges of data proliferation, compares various approaches to data protection, and outlines specific optical technologies that help address the challenges of data storage in the information age.

No single document has all the answers. But with this primer, you can begin to evaluate your options in optical storage, and understand how today's technology can protect your company's most valuable asset into the future.

Dealing with data in the Information Age

Information overload

Remember the one-gigabyte hard disk? A true breakthrough in its day, it's now virtually obsolete. These days, PCs need that much space just for a few e-mails and their attachments.

The fact is, storage requirements are expanding and the pace of data accumulation is speeding up. Increased Internet use, data mining, database access, e-mail traffic and other everyday applications are contributing to information overload on networks worldwide. The problem is especially acute in the service sector, imaging environments, customer service departments and other environments that maintain account information online. And while you continue to need more and more storage space, you also need instant access to that data. In other words, it's not enough to find a place to put it; you have to put it where you can get it back quickly.

Where to put it

There are four broad categories of data storage. Depending on the sensitivity of data, number of data users, frequency of access and your storage budget, you might use one or all of these strategies in your company.

- **Online storage**
  High performance, mid-range to high cost
  An image or document is considered online when you can access it instantly and automatically, without human intervention. Online storage consists primarily of hard disks, where most of today's corporate information is stored. Much of the information stored online is reference data. It has significant value to your enterprise even though it's viewed only occasionally. Some estimates suggest that about 20 percent of all data kept on hard disks is actively used; the other 80 percent is only occasionally used. Although much of this information could be moved to lower cost (and lower performance) storage alternatives, it's left on hard disks because it's hard to predict what you'll need and when. Online storage can be expensive. New forms of disk storage are appearing with lower hardware costs, but overall total solution costs can be high.

- **Nearline storage**
  High performance, mid-range cost
  One step removed from online storage, nearline storage is typically accessed quickly and automatically, in seconds versus milliseconds, and without human intervention. Jukeboxes and autoloaders using optical

or magnetic tape media are considered nearline storage. Companies often use these devices as a complement to online storage. Nearline storage is often found in enterprises with huge amounts of reference data that's stored for long periods of time, and requires easy access. For example, companies needing infrequent and unpredictable access to CAD drawings, invoices, title documents, insurance records, customer service records and transaction histories might choose nearline storage to economically extend online storage. Nearline storage holds stored information permanently and safely.

- **Offline storage**
  Mid to low performance, low cost
  As the name implies, offline storage refers to data maintained offline, requiring human intervention whenever files are requested. Offline storage generally refers to removable disks or tapes that can be shelved for long-term storage or disaster recovery. This strategy offers a partial solution to information overload. Data that's not actively used, or data that's so sensitive it requires duplicate backup in a remote location can be removed from the operating environment and stored offline, sometimes even off-site. Documents that must meet regulatory, legal or audit requirements fit offline storage criteria, especially when there's little value in storing the data online. Offline storage is extremely safe. But retrieving or sharing information involves a service request and a restore operation. These sometimes take hours or days. However, with proper indexing, you can reliably locate data, and when disks or tapes are reinserted in the storage system, files are restored fairly quickly.

- **Human-readable document storage**
  Lowest performance, lowest cost
  Primarily paper and microfilm, human-readable documents are still the most common ways to store and share corporate information. The reasons are clear: data interchange isn't an issue; they require little or no hardware; and you can access them well into the future. Unfortunately, retrieval is painfully slow, filing isn't always reliable, files are easily lost or misplaced, and data sharing gets more difficult as the world becomes increasingly digital and work environments more geographically dispersed.

Three basics of storage

No matter what combination of storage strategies you choose, three basics must be met.

- **Industry standards**
  The data you store today must be readable in the future. That's what industry standards are all about. If you store data on optical disks or magnetic tape, make sure you use formats that are supported by ECMA, ISO, IEC or OSTA. These industry consortiums define standards for hardware, data interchange, media and write procedures. They help protect your data by making sure that the data you store today is readable in the future. They also help protect your budget by letting you choose systems and media from a variety of vendors, so you're not locked into using a vendor with proprietary technology.

- **Accessibility**
  Few people calculate the cost of downtime. But minutes or hours of downtime add up to tens or hundreds of thousands of dollars per year in lost productivity, lost revenue, and increased expenses. Plus, you have a right to expect access. You expect to be able to store and retrieve data quickly, and share and distribute it freely. Any storage solution—especially a storage solution for an increasingly digital and interconnected world—must store data within easy reach, and keep it online virtually around the clock.

- **Data protection**
  If information is important enough to be stored, then it's important enough to be stored accurately. If you're a data user, you expect complete accuracy and protection from loss. When the inevitable disaster happens—facility damage, virus infection, system crash or operator error—you count on data being restored quickly. In fact, the only reason to back up important data in the first place is so you can restore it accurately when you need it. This means any storage solution you choose should include built-in utilities for data protection, overwrite protection, error-checking, and disaster recovery.

Your options in optical storage

How it works

Optical drives, in general, read data by bouncing a laser beam off the recording layer of an optical disk and registering differences in how the light is reflected.

The read-write head contains a laser, mirrors, and lenses to send and receive the reflected light. As the head moves over the disk, it focuses its laser on the disk's data layer and converts reflections into the 1s and 0s of digital data. All optical drives read data in a similar way. But different technologies use different methods to record data.

Recording methods

Many drives record data by putting marks on a disk's recording layer: CD, DVD and Ultra Density Optical (UDO). A finished disk contains non-marked areas, indicated by marks and spaces. Each mark or space represents one bit of data. Marks are non-reflective, spaces are reflective. Since they reflect light differently, the laser reads the recording surface and translate recorded data into 1s and 0s.

Magneto-Optical (MO) technology takes a different approach. Instead of reading the intensity of reflected light, an MO drive reads the direction of reflected light. The recording surface of an MO disk is magnetic, much like a common hard disk. To record data, a laser heats a tiny spot on the disk directly above the recording layer. When the spot on the disk's recording layer reaches a certain temperature, a magnet manipulates the data, moving the recording material in one of two directions. Each direction reflects light differently and allows a low-power laser to read the reflections, and then translate what it sees into 1s and 0s. Unlike other technologies, the MO recording method and MO media support a limitless number of rewrites, with a media shelf life of at least 100 years.

The technologies

Optical drives and jukeboxes aren't used as widely as hard disks, microfilm readers or file cabinets. But computing environments around the world are using them more and more, especially as the importance and quantity of corporate information grows. Optical storage is designed for our increasingly digital world. We need to safely store, globally share and instantly access information—sometimes over vastly distributed networks.

The three basic categories of optical storage are CD/DVD-ROM, rewritable, and write-once-read-many (WORM). All are viable, all have strengths and weaknesses. Here's a quick look at the technologies and the most common recording formats in use today.

1. CD/DVD-ROM

CD-ROM technology is the grandfather of optical storage: It's found in every consumer audio CD player in the world. Most recently DVD-ROM technology has begun to emerge as a dominant player, finding its way into consumers homes in the form of video games and movies. These drives use an optical laser to read marks recorded in a continuous spiral track on the disk's recording layer. The drives don't write data, they only read it—over and over again, with no degradation of disk or data. Handled correctly, these disks have a life-span of 15 to 20 years. This combination of durability and high capacity makes them a popular choice for distributing high volumes of stable data such as computer software, catalogs, technical manuals, reference works, and of course, music and videos.

2. Rewritable optical

Rewritable optical drives not only read, but also write data to optical disks. Unlike WORM disks, a rewritable optical disk can be erased and rewritten many times, just like a hard disk. Three common technologies comprise the rewritable optical arena.

- CD and DVD products represent a popular consumer application of rewritable optical technology. CD rewritable technology has been on the market for many years. However, recently it is being superceded by DVD rewritable technology. These disks resemble a giant floppy with some drives providing multi-function capability, giving you rewritable and WORM capabilities. With rewritable DVD you can repeatedly write and rewrite large volumes of data. Speeds have increased over time, but, the writing process with these drives is typically slower than most storage mediums. And, CD technology caps at a capacity of 650 MB, while current versions of DVD provide 9.4 GB per disk.
- Magneto-Optical (MO) technology has been on the market for over a decade. Magneto-Optical technology supports both WORM and rewritable functionality, so an MO drive or optical jukebox provides the permanence of WORM and the flexibility of rewritable. Magneto-Optical disks offer capacities of up to 9.1 GB per cartridge. Additionally, the 9.1 GB drives offer the ability to read all previous generations of MO technology and write to the two previous generations.

- Ultra Density Optical (UDO) technology, released in 2004, also supports both WORM and rewritable functionality. UDO utilizes a writing technology similar to CD/DVD, but with the ruggedness and reliability necessary for an automated IT environment. UDO made a quantum leap in capacity at 30 GB per disk in the first generation as well as increases in transfer rates with sustained reads of up to 8 MB/sec and burst transfer rates of up to 40 MB/sec. Future generations of UDO will have capacities of 60 GB followed by 120 GB.

3. WORM (Write-Once-Read-Many)
Commonly applied in CD-R, DVD-R and MO storage systems, WORM drives can write data to an optical disk, then read the data over and over again. Each sector on a WORM disk can be written just once, and cannot be erased, overwritten or altered. For that reason, WORM technology is perfectly suited to long-term storage of information such as financial records, accounts and medical records that require an unalterable audit trail. WORM drives use one of four proven recording methods:

- Continuous Composite Write-Once (CCW) combines the Magneto-Optical recording process with overwrite protection on the disks and drives.
- Bubble-forming/Dye-polymer Write-Once uses a laser to form small bubbles on the recording surface of a disk.
- Phase-Change Write-Once uses a laser to alter the molecular structure of a disk's recording surface.

Recording Formats
There are many flavors of optical storage. Here's a quick comparison of the most common recording formats in use today.

- **Magneto-Optical (MO)**
  MO drives use a red laser and magnet to record data on optical disks. The write procedure causes no measurable wear on the media, so write cycles are virtually unlimited in rewritable formats. Read/write speeds are fast—just slightly slower than hard disk speeds—and data reliability is extremely high with a hard error rate that's ten times better than half-inch tape. MO disks and drives are governed by industry standards set by ANSI, ISO and ECMA, which define physical form factors, logical sector formatting, registration of bad sectors and more. Industry standards assure backward compatibility among multiple generations of MO disks. Realize, however, that media interchange relies on compatible file systems; MO disks stored under Microsoft® Windows® 98 are accessible only on another Windows 98 or compatible file system.

- **Phase-change (red laser)**
  CD and DVD rewritable drives employ the phase-change recording format, which uses a plastic disk with a metal recording layer to store data. The drive's laser generates heat and focuses it on the disk's recording layer, changing spots on the disk from an amorphous to crystalline state. Whenever a spot is reheated, it changes back to an amorphous state. Writing data consists of heating the desired spots to change their state. When reading, the laser detects differences between the amorphous and highly reflective crystalline spots. Because a high-intensity laser is required to heat the recording layer, the disks are very stable and their data will remain unchanged for a number of years.

- **Phase-change (blue laser)**
  UDO technology employ the phase-change recording format, but with a blue laser instead of red. The blue laser along with improved optics allows the laser beam to be focused into a finer point, allowing more data to be written on the same size of media as with previous red laser technologies. Plus, UDO technology incorporates a metal hub and cartridge with shutters, continuing with standards set for MO, to ensure media is robust enough automated environment demands. Similar to the red laser application, the laser heats spots on the disk changing the property from amorphous to crystalline. Data is read back using the differing reflectivity of the changed spots. The disks are extremely stable and the data once written has a life in excess of 50 years.

- **Dye-polymer**
  CD-R and DVD-R use a dye-polymer recording method. Dye-polymer recording uses a translucent plastic disk with a dye recording layer that absorbs heat from the drive's laser. The laser's heat causes the thermally sensitive dye to turn dark and non-reflective, a difference that's detected during reads.

- **Bubble-forming**
  Bubble-forming devices use a laser to vaporize a disk's dielectric recording surface, causing small bubbles to form. The bubbles change the reflectivity of the disk's recording surface, a difference that is detected during reads.

How to choose

By data requirement

The key to building a long-term storage strategy rests in knowing the role of data within your company and understanding the expectations of those who use it. Here are a few points to consider.

- **Value/sensitivity**
  If your company's data is irreplaceable, or if its loss would threaten the viability of your enterprise, then a combination of online and offline (or even off-site) storage is highly recommended.

- **Volume**
  If you generate medium to large amounts of data, an online storage solution may suffice. For high to extremely high volumes of data, a combination of online and nearline storage is recommended.

- **Accessibility**
  If information is important enough to be backed up then it should be protected from corruption and loss and it should allow a quick restore when the inevitable happens, such as facility damage, virus infection, system crash or operator error. Write-once optical solutions, which include built-in utilities for data protection, overwrite protection, and error-checking are recommended.

- **Longevity**
  If data must be readable and accessible for decades, an optical disk-based solution is desirable since the disks can be stored for 50+ years without maintenance or data loss.

- **Security**
  Removable media provides the ultimate security. Optical disks, magnetic tapes, paper files and microfiche can all be removed from a storage system and stored safely offline under lock and key.

- **Legal requirements**
  Information that might be used for audits or legal proceedings should be stored on media that is not easily altered such as write-protected optical disks, magnetic tapes, or film. UDO provides media level WORM capability providing the ultimate in record reliability. Since this type of data is often stored for future reference and therefore is not actively used, removability is desirable.

- **Price/performance**
  It always comes down to these two issues. If price is no object and performance is paramount, go with online storage for all of your company's data. If price is an issue, but performance is still paramount consider a combination of online and nearline storage. If all you care about is low price, and if accessibility and performance truly don't matter, store everything on paper or microfiche. In short, the right solution depends entirely on your budget and expectations, which only you can define.

By application

HP optical products and solutions are used in health care, finance, business, government and a wide range of other industry sectors worldwide. These real-life applications are a strong testimonial for optical technology. They're also enlightening. To understand how optical technology is put to work, go online to view case studies: **www.hp.com/go/optical** or **www.hp.com/go/udo**

With each HP product there is a link to our "information library," you can access case studies, white papers and other resources to help you with your decision making. You will also find what applications and software vendors are available to help solve your data needs, To view a matrix of ISVs (Independent Software Vendors) go to: **www.hp.com/go/udo**

The HP StorageWorks Optical Storage family

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HP StorageWorks Optical Jukeboxes based on high-performance 30 GB UDO drives can store over 600,000 pages of data per optical disk (based on 50 KB file size). The HP family provides a wide range of capacity points, from 30 GB in the standalone product to 7.1 TB in the HP StorageWorks 7100ux model.

Drive performance has also been improved with the new 30 GB drives, which support true fast synchronous burst data transfer rates of up to 40 MB/second.

HP continues to sell and support the current 9.1 GB Magneto-Optical based drives and jukeboxes, which are ISO industry standard and backward compatible with previous generations of MO drives. These drives read and write 9.1 GB, 5.2 GB or 2.6 GB media, and read 1.3 GB and the first-generation 650 MB media.

HP standalone drives
For single-disk storage, the HP StorageWorks 30ux drive offers outstanding reliability with performance to match. The standalone box includes one 30 GB multifunction UDO disk drive. Drivers are included for Windows 2000, XP and Server 2003. Software support from HP.

HP entry-level systems
HP is excited to introduce a new entry-level product for its line of optical jukeboxes, the HP StorageWorks 700ux and 1100ux Optical Jukeboxes. These new products can be rack-mounted in a standard 19" rack, or used as a standalone. In the rack, the unit takes up 7U of space including the rack shelf. The base product starts with one 30 GB UDO drive with 24 slots. Also available are versions with two UDO drives and 24 or 38 slots. Low Voltage Differential SCSI (LVDS) connectivity is standard with Fibre Channel connectivity available through HP's fibre router offerings.

HP mid-range systems
HP StorageWorks 1000ux/1900ux/2300ux Optical Jukeboxes support two or four drives and single-box storage capacities up to 2.3 TB. Systems include dual picker technology, a robotics viewing window, up to four multifunction UDO drives, 6.5 second cartridge exchange, LVDS or fibre connectivity and industry leading reliability of more than 2 million MSBF. And, the 1900ux supports a mixed drive configuration with two MO drives and two UDO drives. This allows users with legacy MO environments an easier migration path.

HP enterprise systems
HP StorageWorks 3800ux and 7100ux Optical Jukeboxes deliver high performance, high capacity and high reliability. Systems include dual picker

HP StorageWorks Optical Jukebox Family

Model number	Product number	Capacity (GB)	Slots	Drives	Recommended media
30 GB UDO (Ultra Density Optical) based					
30ux	AA961A	30	1	1	Q3030A, Q3031A
700ux	AA962A	720	24	1	Q3030A, Q3031A
	AA963A	720	24	2	Q3030A, Q3031A
1100ux	AA964A	1140	38	2	Q3030A, Q3031A
1000ux	AA965A	960	32	2	Q3030A, Q3031A
1900ux	AA966A	1920	64	4	Q3030A, Q3031A
	AA968A	Variable up to 1920	64	4 (2 UDO, 2 MO)	Q3030A, Q3031A
2300ux	AA967A	2280	76	2	Q3030A, Q3031A
3800ux	AA969A	3840	128	4	Q3030A, Q3031A
	AA970A	3840	128	6	Q3030A, Q3031A
7100ux	AA971A	7140	238	6	Q3030A, Q3031A
	AA972A	7140	238	10	Q3030A, Q3031A
	AA973A	7140	238	4	Q3030A, Q3031A
	AA974A	Variable up to 7140	238	10 (6 UDO, 4 MO)	Q3030A, Q3031A
9.1 GB MO (Magneto-Optical) based					
9100mx	C1114M	9.1	1	1	C7983A, C7984A, C7986A
220mx	C1118M	218	24	1	C7983A, C7984A, C7986A
	C1119M	218	24	2	C7983A, C7984A, C7986A
300mx	C1150M	291	32	2	C7983A, C7984A, C7986A
600mx	C1160M	582	64	4	C7983A, C7984A, C7986A
700mx	C1170M	691	76	2	C7983A, C7984A, C7986A
1200mx	C1104M	1165	128	4	C7983A, C7984A, C7986A
	C1105M	1165	128	6	C7983A, C7984A, C7986A
2200mx	C1107M	2166	238	6	C7983A, C7984A, C7986A
	C1110M	2166	238	10	C7983A, C7984A, C7986A
	C1111M	2166	238	4	C7983A, C7984A, C7986A

technology, a robotics viewing window, up to ten multifunction UDO drives, 6.5-second cartridge exchange, LVDS or fibre connectivity and industry leading reliability of more than 2 million MSBF. As with the mid-range systems, the 7100ux supports a mixed drive configuration. The configuration consists of four MO drives and six UDO drives. As with the mid-range systems, this configuration is dependent on ISV support.

HP Information Lifecyle Management

HP StorageWorks storage devices can form the basis of a company's Information Lifecycle Management (ILM) strategy. HP ILM manages large amounts of information and keeps it real-time accessible, while controlling costs—two key concerns for virtually all businesses. Adding to these challenges is ever-increasing regulations for data retention and retrieval. HP ILM processes effectively manage information from creation, to the time it's no longer needed. And, HP StorageWorks Optical Storage products fit within the ILM framework providing a nearline storage option. This allows easy access to data while at the same time allowing it to be placed on a lower cost medium for long-term archival storage.

HP optical media

HP 5.25-inch UDO and MO disks are engineered for long-term data integrity and are extensively tested in HP StorageWorks Optical Jukeboxes. Rewritable disks can be written, erased and rewritten without data corruption, this is ideal for data management in information-intensive environments. Write-once disks include built-in safeguards for overwrite protection, making them ideal for permanent storage of large volumes of unalterable or highly sensitive information.

HP StorageWorks Library and Tape Tools

All HP StorageWorks Optical Jukeboxes are supported on HP StorageWorks Library and Tape Tools (L&TT). L&TT is a free download from the web and deploys in less than five minutes. Targeted to experienced professionals and the untrained administrators, it is ideal for customers who want ensured product reliability, self-diagnostics and faster resolution of device issues.

Glossary

The following glossary defines key terms from this and other technology documents.

Access time
The time it takes to access a data track and begin transferring data. In an optical jukebox, it's the time it takes to locate a specific disk, insert it in an optical drive, and begin transferring data to the host system. If the disk is already in the drive, then access time is determined by seek time. Otherwise, it's determined by disk swap time, spin-up time, and seek time.

The following glossary defines key terms from this and other technology documents.

Active termination
A type of terminator that provides better signal quality for high speed SCSI signals. Active terminators regulate the TERMPOWER voltage.

Actuator
An electro-mechanical device that moves an object, such as the robotic arm that moves an optical disk within a jukebox, or the device that controls the read/write head on a disk drive.

ANSI (American National Standards Institute)
A standards-setting, independent organization that develops and publishes manufacturing and design standards for the United States.

Arbitrated Loop
A Fibre Channel ("loop-like") topology where two or more ports can be interconnected, but only two ports at a time can communicate.

Archival management
A storage management solution for cataloging files and moving them to long-term storage, where they can be stored and accessed inexpensively.

Archive
A copy of reference data or document images that are stored on optical disks, tape, paper or microfiche. Typically refers to long-term storage of data for later possible access.

Asynchronous data transfer
Data transfer not synchronized to a set timing interval. Asynchronous devices must wait for a signal from the receiving device after each byte.

Autoloader
Usually a single-drive, tape-based backup device that houses a number of tape cartridges. An autoloader is designed to support routine, automatic backup procedures, using a mechanical arm to sequentially load a new tape for daily backup.

Backup
1. A duplicate copy of a program, disk, or data files.
2. A procedure for duplicating key data files, often automatically, and storing them in a safe place for the purpose of file recovery.

Backward compatibility
A design standard that assures new software, hardware, devices and media are compatible with earlier versions. In terms of optical storage, backward compatibility means existing optical disks will be readable on future optical drives. If backward compatibility is not addressed, archived disks may not be readable on future generations of drives.

Block error rate
The average number of errors that occur or can occur while writing or transmitting a block of data.

Buffer
Temporary storage space within a computer's or device's memory. For example, most word processors use a buffer to temporarily store edits as they are being made to a document. When the document is saved, the file is updated and the buffer is cleared.

Burst data rate
The speed at which a specific amount of data is sent or received in one short operation. The rate negotiated during synchronous data transfer is the burst rate.

CD-R (Compact Disk-Recordable)
An optical disk recording format that allows data to write to optical disks. The disks can be recorded just once, but played virtually without limit.

CD-ROM (Compact Disk-Read Only Memory)
An optical disk recording format using disks that carry pre-recorded data, music or software. Data cannot be added or deleted from a CD-ROM.

CD-RW (Compact Disk-Rewritable)
An optical disk recording format that allows disks to record and re-record, much like floppy disks or audio tapes. The disks can be rewritten up to 10,000 times and played virtually without limit.

Client
Typically a desktop computer hooked up to a network, and designed to work with a more powerful server that runs applications and stores data.

Client-server
An environment that allows interactions between "clients" (typically desktop computers) and "servers" (computers that store data and run software programs). In client-server environments, data may be stored on a remote server rather than a computer's hard disk; applications may be stored on a server and delivered to individual desktop computers as needed. The server acts as a gateway to the network, running administrative software controls and providing access to the network and its resources.

Computer Output to Laser Disk (COLD)
An optical storage technology for transferring computer-based information to an optical disk for nearline storage. Typically used as an alternative to paper or microfiche-based storage of computer-generated reports.

Constant Angular Velocity (CAV)
The technique whereby data recorded with a variable linear density can be read on a disk with a constant velocity. Despite the varying density of data on the disk, the disk's rotational speed remains constant during reads.

Constant Linear Velocity (CLV)
A storage technique that adjusts the speed of a spinning disk so the large outer tracks (which normally spin faster) are slowed during writes, and thus can hold more data than the smaller inner tracks. Typically used in CD-ROM, CLV results in a constant data delivery rate.

Continuous Composite WORM (CCW)
An optical disk storage technology that uses MO media to support both rewritable and write-once operations in a single drive. CCW is governed by industry standards that specifying multi-layer data protection measures, including procedures for overwrite protection and blank-checking.

DAT (Digital Audio Tape)
A storage technology using magnetic tape to record data. DAT is similar to an audio tape, but instead of recording data linearly along the length of the tape, data is recorded at an angle called helical scan format. Up to the fourth product generation recorders use media referred to as DDS. Starting with the fifth generation, the media is referred to as DAT.

Data compression
An automatic utility that reduces the size of a data file by removing redundant bits of information. An algorithm built into the hardware, firmware or software handles compression and decompression.

Data migration
See Hierarchical Storage Management (HSM).

Data transfer
The movement of data from one point to another within a computer system, for example, from an optical disk to a computer's hard disk.

Data warehouse
A large centralized database designed to hold and manage a company's information over a long period of time. Data warehouses are often used to mine key data records to detect trends, spot new market opportunities, and monitor business results.

DDS (Digital Data Storage)
The recording format and recognized industry standard used by all major DAT drive and media manufacturers up to the fourth product generation. Starting with the fifth generation, the format is referred to as DAT.

Differential
An electrical protocol that communicates individual signal values (ones or zeros) by the difference between two driven signals, as opposed to the single-ended method, which uses one drive signal in relation to ground. Differential signals reduce susceptibility to electrical interference and increase the allowable length of the SCSI bus.

Disk swap
The act of swapping one optical disk for another. To complete a swap, a jukebox autochanger mechanism must remove a disk from the drive, put it away, retrieve a new disk, and insert it in the drive. The drive then spins-up the new disk and the operation is complete.

Distributed network
A network that divides data processing, storage, and other functions into separate units rather than having them all handled by a single computer.

DLT (Digital Linear Tape)
A data storage technology that uses half-inch magnetic tape cartridges and longitudinal recording methods to store data.

Document Image Management (DIM)
A storage management solution for converting paper documents, photos and receipts into an electronic format that can be accessed from a computer.

Driver
A software component or set of file commands that allow an application to communicate with another application, driver or hardware device. A driver is what allows a computer to communicate with a disk drive, tape drive or printer.

DVD (Digital Video Disk)
A disk that closely resembles a standard CD in size, color and physical format, but holds more data. A typical CD holds about 650 MB of data, whereas today's DVD-ROM disks hold 4.7 GB (9.4 GB double sided), with a target capacity of about 23 GB in the future. DVD formats caused problems early on in the development of the technology. However, many DVD drives on the market today are multi-function and work with different formats in one drive.

DVD-RW/+RW/RAM (DVD-Rewritable)
Technologies that support multiple writes and subsequent playback on DVD disks.

DVD-R/+R/ (DVD-Recordable)
The technology that allows writing to the DVD disk only once with virtually unlimited reads.

DVD-ROM (DVD-Read Only Memory)
A DVD format using disks to carry pre-recorded data, music or software. Data cannot be added to or deleted from a DVD-ROM.

Dye-polymer technology
An optical disk storage technology using a translucent plastic disk and thermal-sensitive dye recording layer to store data. Heat generated by the drive's laser causes the dye to darken wherever the laser is focused, causing a change in reflectivity that is detected during reads. Used for CD-R and DVD-R.

ECC (Error Correction Code)
An embedded code that allows detection of a mismatch between transmitted and received data in a communications system, or between stored and retrieved data in a storage system. The ECC can correct errors, but within limits.

ECMA (European Computer Manufacturers Association)
An international organization founded in 1961 and dedicated to the standardization of information and communication systems.

Effective access time
The actual time it takes to access data. In an optical jukebox, it involves variables such as disk swap time, disk spin-up time, seek time, and transfer rates of the host computer and software application.

Encryption
A security method in which electronic data is scrambled and decoded using a software or hardware algorithm.

Enterprise network
A system of network connections that links all of a company's LANs, allowing enterprises to communicate across many geographic locations and sites.

Error detection
A software or firmware algorithm that looks for inconsistencies or errors in a data file as it is being stored. More advanced levels of error detection will not only detect problems, but also correct errors or inconsistencies automatically.

Error rate
The ratio of data that is incorrectly recorded or read relative to the entire amount of data written or read. Note: Error rate is most commonly associated with reading.

Extended storage
Storage that is added to a computer or system after the purchase, rather than shipped with the system.

Fabric
A Fibre Channel topology that has one or more fabric (switch) elements that interconnect more than two N_Ports.

File recovery
The process of using backup files to replace lost files after a power failure, facility damage, virus infection, system crash or human error.

Form factor
The physical size of a device or mechanism that is installed in a PC, workstation, jukebox or other system. For example, a 3.5-inch floppy drive has a 3.5-inch form factor. The dominant optical format is 5.25-inch form factor.

Formatting
The preparation of storage media for recording. Usually involves the complete erasure of existing files, checking for bad sectors, and rewriting the file directory.

Full Duplex
A communication protocol that permits simultaneous transmission in both directions, usually with flow control.

Gigabyte (GB)
A unit of measurement for high-capacity data storage. One gigabyte equals approximately one billion bytes, or 1000 megabytes, of information.

Half Duplex
A communication protocol that permits transmission in both directions, but only one direction at a time.

Hard disk
A magnetic storage device, usually the primary storage device, for a PC, workstation or server.

Helical Scan Recording (HSR)
Used widely in VHS formats for video recording, HSR tape recording writes at an angle across the width of a tape, allowing higher storage densities on half-inch tape.

Hierarchical File System (HFS)
The file management system in which directories have sub-directories and sub-sub-directories. In Microsoft Windows and Macintosh operating systems, the directories and sub-directories are represented as folders nested within other folders.

Hierarchical Storage Management (HSM)
Also known as data storage migration. HSM is a storage management solution where files are moved to the appropriate storage device based on a set of user-defined parameters, including how often the files are used. For example, if a file is not used within a certain period of time, it may be migrated from expensive primary storage to lower cost extended storage, thus reducing storage costs with only minimal impact on accessibility.

HVD (High-voltage differential)
Allows cable lengths up to 25 meters (approx. 82 feet) with up to 15 devices attached. The devices must be Ultra2 SCSI HVD devices to take advantage of the HVD signalling. HVD is a high-power, high-performance bus and requires an HVD host bus adapter.

IEC (International Electronics Commission)
Founded in 1906 to promote international standards in electrical and electronic engineering.

ILM (Information Lifecycle Management)
The solutions and processes surrounding managing records and data from inception to destruction.

Industry standards
Rules or guidelines, established by independent consortia, to control the development and manufacture of products and devices in the electronics industry. Industry standards for audio CDs, for example, are what assure consumers that any audio CD will work in any CD player.

Integrated Document Management (IDM)
Combines COLD, DIM, data management, workflow and jukebox management into a single integrated application, allowing data users to control a vast amount of information from a single user interface.

Interchangeability
The ability to use one brand or type of storage media in a variety of drives. For example, manufacturers of audio tapes and tape players support industry standards for interchange-ability, so any tape will work in any player.

ISO (International Organization for Standardization)
A worldwide organization that develops, publishes and promotes international industrial and technical standards. The term ISO is not an acronym, but a derivative of the Greek word isos, which means “equal.”

Jukebox
A standalone cabinet that holds multiple optical disk drives and cartridges for high-speed, high-capacity storage. It includes a robotic arm to pick an optical cartridge from its storage slot, move it to one of several drives, then return it to the slot when it is no longer needed. Sometimes called an optical disk library.

Kilobyte (KB)
Approximately one thousand (actually 1,024) bytes.

LAN (Local Area Network)
A communications network used to connect computers and other electronic devices within a confined geographical area. For example, a LAN can connect users within a single site, allowing them to share data, exchange e-mail, and share peripherals.

Link
An inbound and outbound fiber pair connected to a port. These may be optical fibers or electrical cables.

Live trial software
Fully functioning evaluation software installed and used prior to purchase.

LVD (Low Voltage Differential)
Allows cable lengths of up to 12 meters (approximately 39 feet) with up to 15 devices. The devices need to be Ultra2 SCSI LVD devices to take advantage of LVD signaling. LVD has two advantages over HVD: it consumes less power, and it automatically senses single-ended devices on the bus and reverts to single-ended signaling.

Magazine
A removable chamber that holds multiple optical disk cartridges or magnetic tapes, often used for high-volume automated backup.

Magneto-Optical (MO)
An optical disk storage technology using a magnet and laser to alter the magnetic flux directions on a disk's recording surface, much like the operation of a magnetic hard disk. The laser heats a small point just above the disks' recording surface. Above a certain temperature, the disk's recording surface can be altered with a magnet, causing a change in reflectivity that is detected during reads.

Mean swaps between failure (MSBF)
A measure of reliability specific to optical jukeboxes, usually determined in benchmark testing. MSBF refers to the average number of disk "swaps" a jukebox and its internal mechanisms can be expected to deliver before maintenance is required.

Mean time between failure (MTBF)
A measure of reliability for electronic equipment, usually determined in benchmark testing. The higher the MTBF, the more reliable the equipment.

Mean time to repair (MTTR)
A measure of the complexity of design in electronic equipment. Highly modular designs—i.e., those that use interchangeable, hot-swappable components—typically have a low MTTR since failed components can be replaced with functioning components.

Media
A physical storage medium. Includes optical disks, CDs, DVDs, magnetic tapes, hard disks, and other technologies used to store computer-based information.

Megabyte (MB)
A unit of measurement for data storage. One megabyte equals approximately one million bytes of information.

Megabytes per hour/second
Units of measure that describe the speed at which data is transferred from one device to another, for example, from an optical disk to a computer's hard disk. Often abbreviated to MB/h and MB/s.

Mission-critical data
Data or information considered to be so important that its loss would have grave consequences for all or part of a business. For example: customer account information at a bank, or patient information at a hospital.

Multimedia
The combination of several media formats used for the delivery of information. Many commercial CD/DVD-ROMs use a multimedia format, combining text, photos, audio, animation and video on a single disk.

Nearline storage
A cross between online and offline storage, usually consisting of data stored in optical jukeboxes. Nearline storage is less expensive, more durable, and takes only slightly longer to access than online storage kept on high-speed hard disks. It is significantly faster and easier to access than offline storage.

Networking
The ability to interconnect a number of PCs, workstations, servers and peripherals for the purpose of sharing, sending, receiving and managing information, files, e-mail and other data.

Node
A hardware device (server, disk drive, etc.) where one or more ports reside.

Offline storage
Infrequently accessed data stored offline in a tape archive or file cabinet. Offline storage is the least expensive and slowest storage method, consisting primarily of tape, microfiche and paper media. Restoring offline data to an online environment must be handled manually.

One big disk
A seamless, transparent combination of hard disks, optical jukeboxes, and other storage technologies integrated into a single system. The net effect for data users is a virtually infinite storage solution that looks like one big disk, but is, in reality, a mixture of online and nearline storage.

Online storage
The fastest and most expensive storage alternative, consisting of frequently accessed files found on a computer's hard disk.

Operating system
Software instructions that tell a computer how to operate. For example: MS-DOS, Windows XP, Windows NT, and HP-UX.

Optical disk
A storage medium that generally uses a laser to write and read data. See WORM, CD, DVD, MO and UDO.

Optical storage
A storage alternative to hard disks that provides random-access capability like hard disks. Compared to hard disk storage, optical storage offers lower cost, higher capacity, higher reliability and a higher degree of removability and transportability. However, optical disk access times are slower than hard disks, due primarily to the weight of the optical head that reads and writes data. Most optical storage technologies use a read/write laser to store data. To write, the laser heats the recording surface of the media, causing a physical change that is detected during reads.

Optical Storage Technology Association (OSTA)
An international trade association founded in 1992 to promote the use of writable optical technologies and products.

Peer-to-peer architecture
A network of two or more computers using the same programs or types of programs to communicate and share data.

Phase-Change technology
An optical disk storage technology that uses a plastic disk and metal recording layer to store data. Heat generated by the drive's laser changes the molecular structure of the metal, transforming it from an amorphous to highly reflective crystalline state. The changes in reflectivity are detected during reads. Used in consumer applications as CD and DVD RW and in commercial applications as UDO.

Plug-and-play
The ability to plug devices into a computer and begin using them immediately, without having to install special drivers.

Point-to-Point
A Fibre Channel topology connecting two N_Ports using a single link.

Port
An access point in a device, which transmits and receives Fibre Channel data over a link. Often seen as N_Port, NL_Port, F_Port and FL_Port.

Portability
The ability to move storage media from one point to another. Tapes and optical disks are highly portable since they can be easily moved from a working environment to a different location for storage.

Primary storage
Online storage of electronic data, typically found on a computer's hard disk. This includes frequently used data, work in process, or data that is not frequently used but must be immediately available at all times.

Random access
The ability to skip randomly from track to track on a storage medium. Optical disks, magnetic hard disks and audio CDs allow random access to data tracks. By comparison, audio tapes allow only sequential access (i.e. fast-forward or reverse) to locate stored data.

Restore
The act of copying files or data from a backup storage device to their normal location on a computer's hard disk, often to replace files or data that were accidentally lost or deleted.

Robot
A machine that can sense and react to input, and cause changes in its surroundings with some degree of intelligence, ideally with no human supervision.

Robotics
The "guts" of an optical jukebox, usually consisting of a mechanical arm that automatically transports optical disks inside the jukebox cabinet.

Seek time
The time it takes for the read/write head on a disk or tape drive to find a specific track.

Server
A computer that provides access to a network and its resources, runs administrative software controls, and provides services (such as file storage and retrieval) for desktop computers.

Slot
A physical location inside an optical jukebox, where optical cartridges reside when not being used by an optical drive.

Small Computer System Interface (SCSI)
An industry standard for connecting peripherals such as printers, scanners, optical drives and tape drives to a microprocessor. SCSI covers both hardware and software standards for allowing computers and peripherals to communicate with each other.

Storage capacity
The maximum amount of data that can be stored on a given medium.

Sustained Data Transfer Rate
A rate of data transfer defined for continuous operation at a maximum speed level.

Synchronous data transfer
Data transmission synchronized to a defined time interval. Synchronous transfer is faster than asynchronous transfer (think SCSI devices) because the receiving device does not wait for acknowledgment of each byte. Prior to transmission, the SCSI host adapter and the SCSI device agree to a transfer rate that both support.

Target ID
The SCSI ID of a device attached to a host bus adapter (HBA). Narrow and wide SCSI HBAs have 7 and 15 target IDs, respectively. One SCSI ID is used as the address of the HBA itself.

Terabyte (TB)
A unit of measurement for high-capacity data storage. One terabyte equals approximately one trillion bytes, or 1000 gigabytes, of information.

Termination
A physical requirement of the SCSI bus. The first and last devices on the SCSI bus must have terminating resistors installed, and the devices in the middle of the bus must have terminating resistors removed.

Throughput
A performance measurement indicating the volume and speed of data as it flows from one point to another through a data pipeline. High throughput indicates a system architecture that can carry high volumes of data at high speeds, resulting in high system performance.

Transfer rate
The rate of speed at which data travels through a bus or device, typically measured in bits, bytes, kilobytes or megabytes per second.

UDO (Ultra Density Optical)
An optical disk storage technology based on blue laser technology. Heat generated by the drive's laser changes the molecular structure of the metal layer in the disk, transforming it from an amorphous to highly reflective crystalline state. The changes in reflectivity are detected during reads.

Workflow
In imaging, a software program that queues, tracks and manages documents and collections of documents as they progress from entry into the system, through the various departments in the organization, to their final destination.

WORM (Write-Once-Read-Many)
A storage technology that allows optical disks or tape cartridges to be written just once, but read without limit. WORM drives write directly to the media from a host computer. Both the drives and media include built-in safeguards to assure that data, once written, cannot be erased, overwritten or altered. Sometimes referred to as "write-once".

Write protect
The use of various safeguards to prevent a computer system from overwriting a storage medium. Floppy disks have a sliding tab for "physical" write protect. Hard disks support "logical" write protect in software. Optical disks often use a combination of physical and logical write protect safeguards.

For more information

HP is a leading provider of Optical Jukebox products. To learn how these products can increase the productivity and efficiency of your organization, contact your nearest HP optical storage representative.

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