Optical Storage
The Future of Long Term Data Preservation

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Today's topics for discussion

Digital Preservation Tier

- Archive
- Long term storage

Optical media

- History
- Use
- Future

Optical storage

- In the data center
- Part of the ecosystem

Keeping data forever – not just a wish

All federal agencies are mandated to archive data anywhere from five to over 100 years, while others, such as the Executive Office of the President, are required to store data forever. To meet such a broad and changing storage mandate, agencies are evaluating the optical technology that HDPP is built upon.

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF MANAGEMENT AND BUDGET
WASHINGTON, D.C. 20503

NATIONAL ARCHIVES AND RECORDS ADMINISTRATION
WASHINGTON, D.C. 20408

August 24, 2012

M-12-18

1.1 *By 2019, Federal agencies will manage all permanent electronic records in an electronic format*
By December 31,2019, all permanent electronic records in Federal agencies will be managed electronically to the fullest extent possible for eventual transfer and accessioning by NARA in an electronic format. By December 31,2013, each agency will develop and begin to implement plans to achieve this transition. Agencies should also consider the benefits of digitizing permanent records created in hard-copy format or other analog formats (e.g., microfiche, microfilm, analog video, analog audio).

What is Digital Preservation

Digital Preservation Refers to the series of managed activities necessary to ensure continued access to digital materials for as long as necessary. Digital preservation is defined very broadly for the purposes of this study and refers to all of the actions required to maintain access to digital materials beyond the limits of media failure or technological change.

The most cost-effective means of ensuring continued access to important digital materials is to consider the preservation implications as early as possible, preferably at creation, and actively to plan for their management throughout their lifecycle.

Source
Digital Preservation Handbook
Digital Preservation Coalition

Today's methodology
Archive to tape

- Make second copy
- Store second copy
- Tape Migration ~every 3 years
  - Media Refresh
  - Tape Drive Refresh

Benefit

- Refresh occurs before potential failure
  - Bit flip
  - Curling
- Well known practice
- Predictable cost
- Newer technology is usually faster and higher capacity

Result

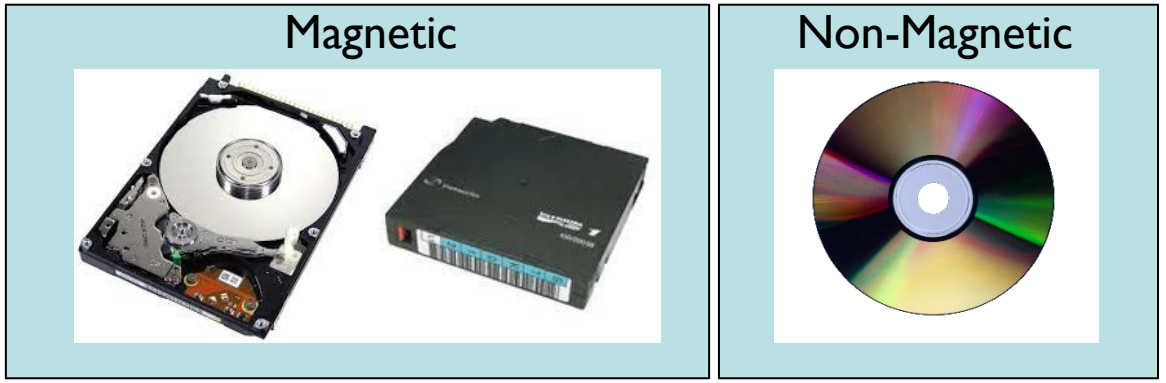
- Continuous process
- Costly
- No inherent benefit
  - Storage needs dictate increase in capacity
  - Needs to keep up with other fast technology
  - Still linear access

Long-term Data Preservation Strategies

- 321 == 3 copies, 2 sites and 1 other technology, *or visa versa*
- 322 == 3 copies, 2 sites and 2 technologies

- Several long-term data preservation strategists are coming to consensus that the 2 recoding technologies used today, hard disks and tape, are considered the same technology – magnetic
  - Similar vulnerabilities

- Long-term TCO is still a key goal
  - Life of the company
  - Life of the republic
  - Life that spans republics



Adding Optical Data Storage to your Data Center

- Supplement magnetic storage with optical media to create a preservation tier
- Magnetic tape is susceptible to environmental conditions such as heat, moisture, dirt and electromagnetic events
  - Example, during Hurricane Katrina and Superstorm Sandy, many government agencies and businesses alike lost magnetically stored data in the widespread flooding, whereas nearly all optically stored data survived.
- HDS's optical solutions have proven survivability and durability
  - optical storage requires only a small amount of energy to maintain
  - Example, for a single rack containing upwards of a petabyte of data, HDPP consumes approximately 1 kilowatt of power, resulting in increased energy efficiency

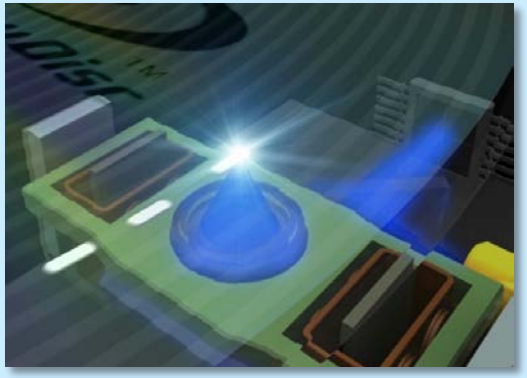
Optical Data Storage Benefits

Longevity

"Optical" recording has been used for over 10,000 years in human data recording history.

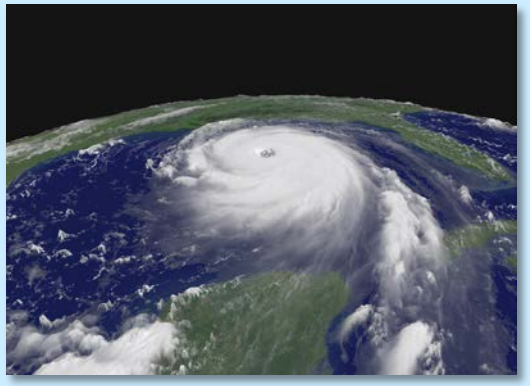
Compatibility

Since BD can be read on general purpose PCs with consumer devices, there is less possibility that media and data will be inaccessible due to obsolete devices.



Contactless

Since there is no contact with the media surface, there is less possibility of abrasion, scratch or other media wear.



Survivability

Only data stored on optical discs survived hurricane Katrina.

Optical Data Storage Benefit

Beyond Speeds & Feeds – the Intangibles

Non-Magnetic

2 recording technologies are needed for a sound data preservation strategy, with magnetic recording being considered as one.

Ubiquitous

Several industries use optical devices which supports a mass volume industry and maintains compatibility. UHD?

Reliable

Since device and media are separated, reliability and replacement of devices doesn't affect the reliability of media.

Green

Almost no electricity nor special environmental condition is needed to store media for a long time.

Optical Recording Throughout History – Digital Data

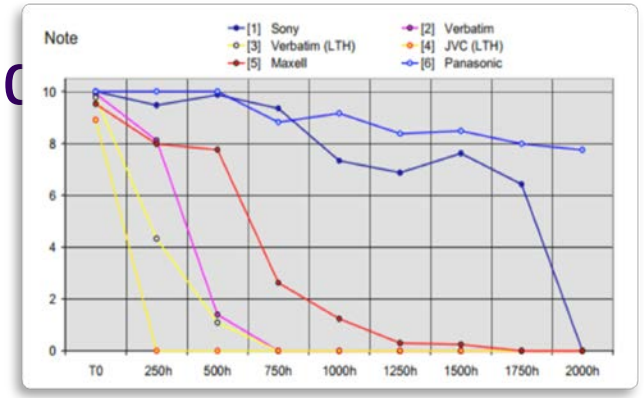
- The first commercially available audio CD is ***Billy Joel's "52nd Street"*** released in Japan on October 1st, 1982
  That's almost 31 years ago!

- 50 titles were also released on CD in those first early years including ***Pink Floyd's "Dark Side of the Moon"*** in May of 1983

- Still plays today on the latest devices supporting the newest formats

Not All Optical Media is Created Equal

- Low-to-High – LTH low cost, organic dye based
  - Dye Change Recording
    NOT FOR LONG TERM ARCHIVING!
  - Gives Optical technology a bad name



Source: http://www.myce.com/news/french-research-avoid-blu-ray-lth-discs-for-data-archival-64265/

- High-to-Low – Normal Blu-ray characteristic
  - Phase Change Recording using an in-organometallic compound
  - Basis for long-term optical archiving

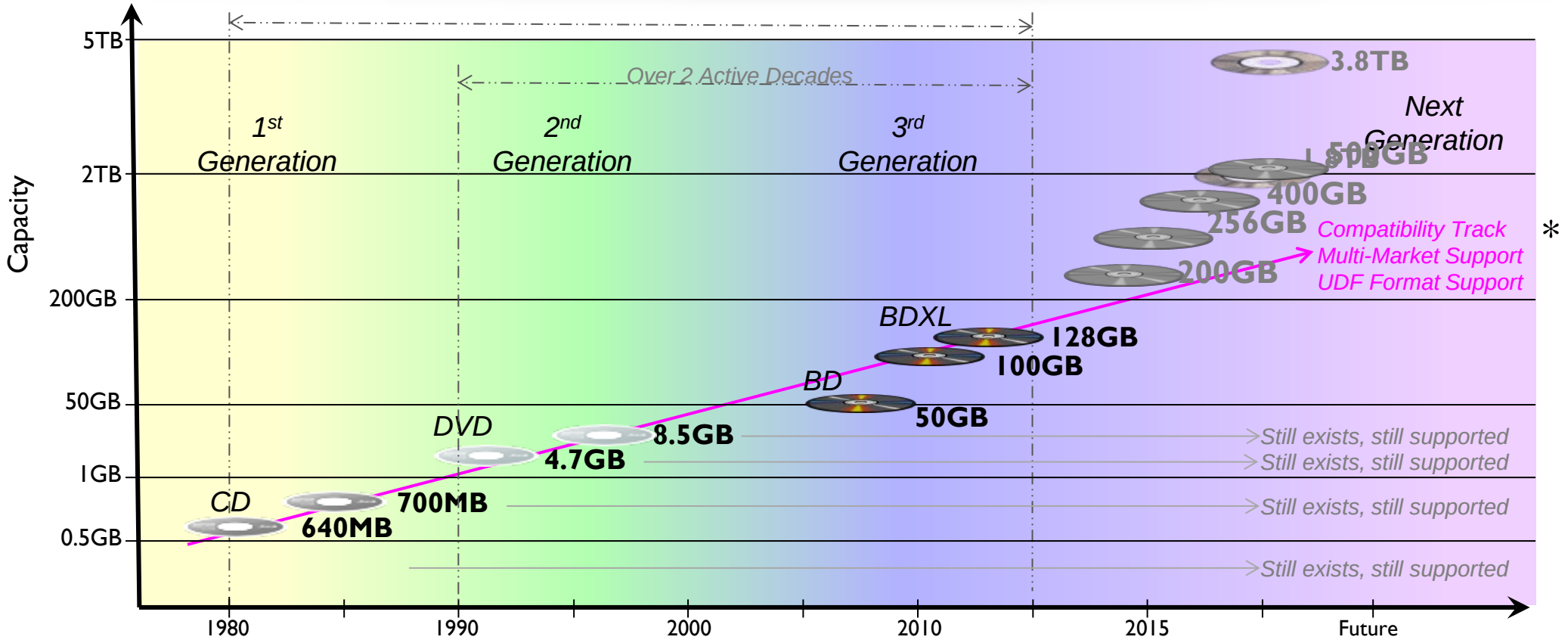
Choices in Optical Media for Data Preservation

Two options for optical archive media

- Blu-ray XL discs
  - 50 Year
  - HTL

- M-DISC
  - Data layer is composed of rocklike materials that can last for centuries. The data is written into the rocklike data layer, providing a permanent physical data record that is immune to data degradation caused by light, heat, humidity and temperature extremes

Technology & Format Longevity – Mass Markets



Historical Casualties

Laserdisc

Ultra Density Optical - UDO

Ultra Media Disc - UMD

Magneto-optical

HD DVD

* *Today, you can buy new standard drives that are compatible with media written over 30 years ago. This trend will continue due to markets for consumer and distribution driven volume*

Research Emphasis
Extremely Long-term Data Preservation

All Optical-based Technologies

- 50 – 100 Yr. BDXL Media, *(100 & 128 GB)*
- Next Gen Blu-ray, *(300 – 500 GB)*
- Holographic Storage, *(1 – 12 TB)*
- M-Disc – 1,000 year media, *(Blu-ray)*
- DOTS – Digital Optical Technology System
- Sapphire Hard Disc – 1M yrs
- 5D Optical Nano-glass memory – 1M yrs
- Quartz glass plate storage technology – 100M yrs

Hitachi areas of R&D

Current Data Center practices and challenges

- Long-term storage is typically addressed using magnetic media technology (disks and tape). Data protection methods have been created to protect data but magnetic media quality will eventually fatally degrade and lead to uncorrectable errors. This technology requires a periodic migration to refresh media in order to avoid data loss due to media degradation and associated "bit rot." For data that must be retained for the long haul, these events can occur 10 to 20 times. Significant costs are incurred with each occurrence of moving data to a new file format or media. This moving or remastering of the data every few years is the single largest cost factor in long-term digital retention.

- Tape storage imposes additional resource demands for media migration, which adds to the long-term operating costs. New and upgraded facilities must be designed to handle the more demanding storage infrastructure requirements. The facilities must provide and track components such as power, floor space, cooling, maintenance, and serviceability logistics in order to handle the growth for powering and cooling the newer technology additions.

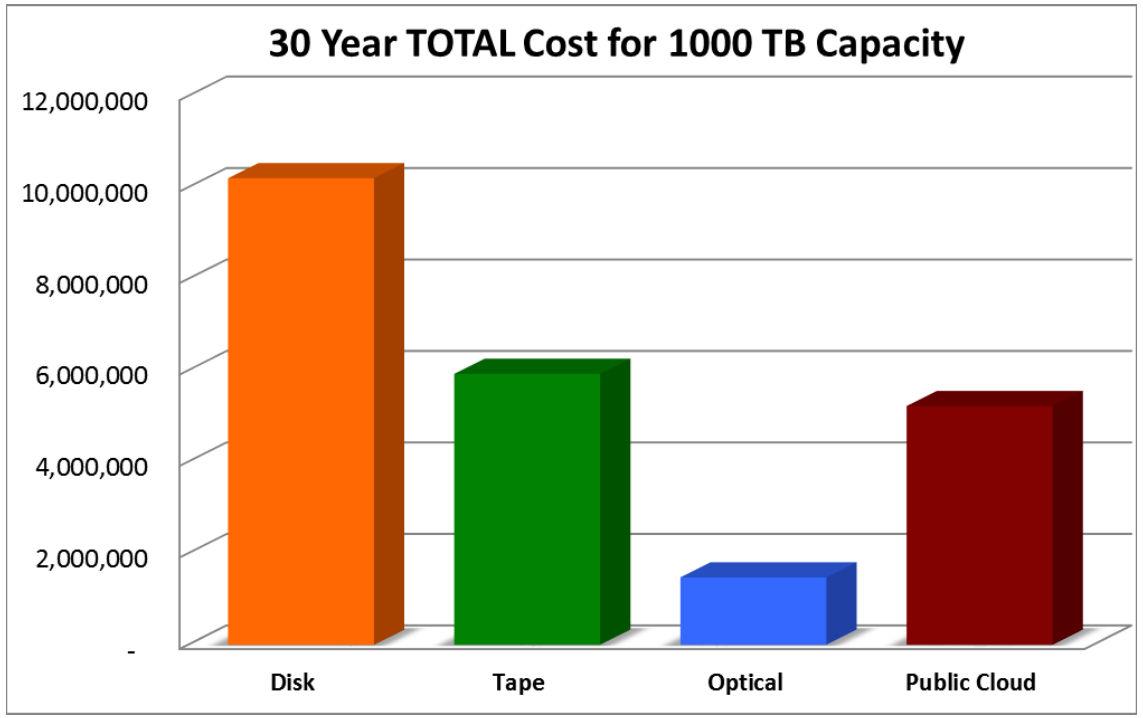
Data storage using optical media libraries

- Optical media and libraries does not eliminate the need for migrations, instead, using optical discs allows IT managers to avoid forced migrations, moving data around an environment when they want to, not when the media dictates. This saves money and allows for more strategic long term planning.

- We understand that solutions, data formats and other technologies will advance over the years. Roadmaps for technologies, drives and data formats assist in planning for technology upgrades accordingly.

What are the saving and benefits?

HDS study of TCO for different storage types



TCO – Total Cost of Ownership

How are these new cost savings achieved?

- Optical migrations occur less frequently
- Faster access to data
- Better utilization of media compared to tape
- Power and cooling is similar to tape, much better than disk
- No usage penalty, on-boarding or off-boarding compared to cloud

Summary and Points to Takeaway

- Commercial optical storage is over 30 years old and still compatible today in modern mass produced equipment.
- Attempting to break or elongate the migration cycle.
- More R&D and investment is happening with optical storage technologies
- Enterprise archive media life in the 50, 100 to 1,000 year timeframe
- Different value proposition
- Careful, all media are not created equally