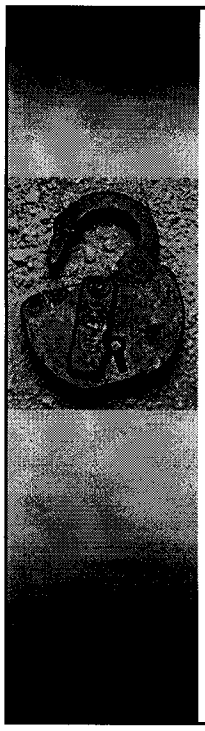


Data Preservation: *What's New?*

Victor McCrary

Convergent Information Systems Division

National Institute of Standards and Technology

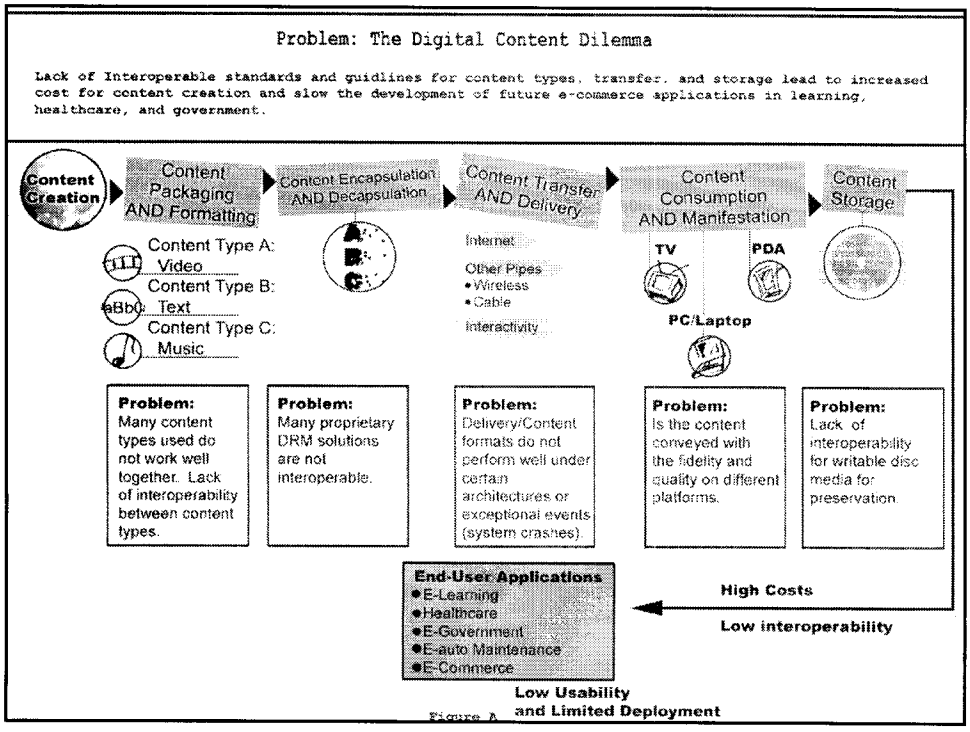
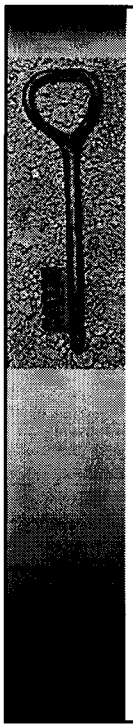


Figure A

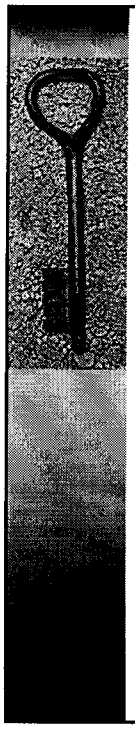


The Digital Dilemma: Issues Facing the Industry for Digital Content

- Guidelines and standards for archiving data & storage media
- Copyright ownership and management
- Standards for content exchange
- Technologies and architectures to provide low-cost anonymity and security
- Fidelity of content manifestation

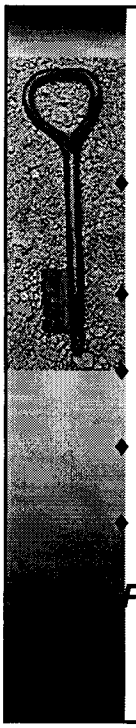
Digital Image File Comparison

File Type	Support	Uses	Advantages	Disadvantages	Interoperability	Bitrate	Standards	Sources
MNG (Multiple-Image Network Graphics)	No browser integration yet, but since the W3C is behind PNG, it is likely not too far in the future	It is the animated version of PNG, just like GIF supports multiple-image animation	All of PNG's advantages; beats GIF compression ratios by factors of 10 to 100; much smaller file sizes compared to GIF due to sprites and loops	Limited support	For a list of apps, including conversion utilities, see http://www.libpng.org/pub/mng/mngapps.html		Developing a subset of MNG – JNEG (JPEG Network Graphics) for single-image lossy compression	http://www.designer.com/focus/articles/web_future_2/web_future_print.htm
PNG (Portable Network Graphics) "ping"	Varies widely among browsers and programs (for a list of apps see http://www.libpng.org/pub/png/pngapps.html)	Designed to replace GIF, as well as TIFF to some extent	Greater compression than GIFs; alpha channels for variable transparency; gamma correction for system-independent color; 2D interlacing; lossless; patent-free	Not widely supported, though the W3C is behind it	Easy conversion to other image formats due to lossless compression	24-bit, grayscale and 8-bit per pixel (where it works best)	PNG Specification 1.2, non-proprietary open-source	http://www.libpng.org/pub/png
SVG (Scalable Vector Graphics)	It is described in XML; Adobe provides a plug-in for Netscape and MSIE, additional programs for viewing/editing; W3C supported	Web, wireless devices (with subsets of SVG called SVG Basic and SVG Tiny)	Very small file sizes with mathematical equations; though vector, gradients are possible, as are a number of other effects like drop shadows through filters	Few programs, but expected to grow	Export from Adobe Illustrator, Corel Draw, in addition to a few non-proprietary conversion apps		SVG 1.0 Specification	http://www.w3.org/TR/SVG; http://www.w3.org/TR/SVGMobile
TIFF (Tagged Image File Format)	Supported by many applications; cannot be embedded into a webpage	Most accepted type for printing	Lossless; colors can be stored in RGB or CMYK and IBM or Mac bit-order	Large files	Very flexible with multiple formats	1 to 64-bit integer signed or unsigned; 32 or 64-bit IEEE floating point	TIFF 6.0	http://home.earthlink.net/~ritter/tiff



Legislative & Government Initiatives:

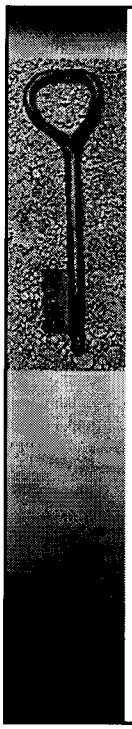
- Health Insurance Portability and Accountability Act (HIPAA) –compliance by April 14, 2003
- National Digital Information Infrastructure and Preservation Program (NDIIPP) – Library of Congress
- ISO-TC 171/SC 1N 20 – Care & Handling of Optical Media



NIST Digital Data Preservation Laboratory

- Partner with industry to work towards voluntary industry standards conformance, and convening the industry to develop sector solutions.
- Development of standard testing protocols for reliability of optical disc media.
- Development of standard testing protocols and software for drive interoperability for writable optical disc formats.
- Research new media candidates for increased optical storage density.
- Evaluate new technology trends for applications at NIST and other Federal agencies.

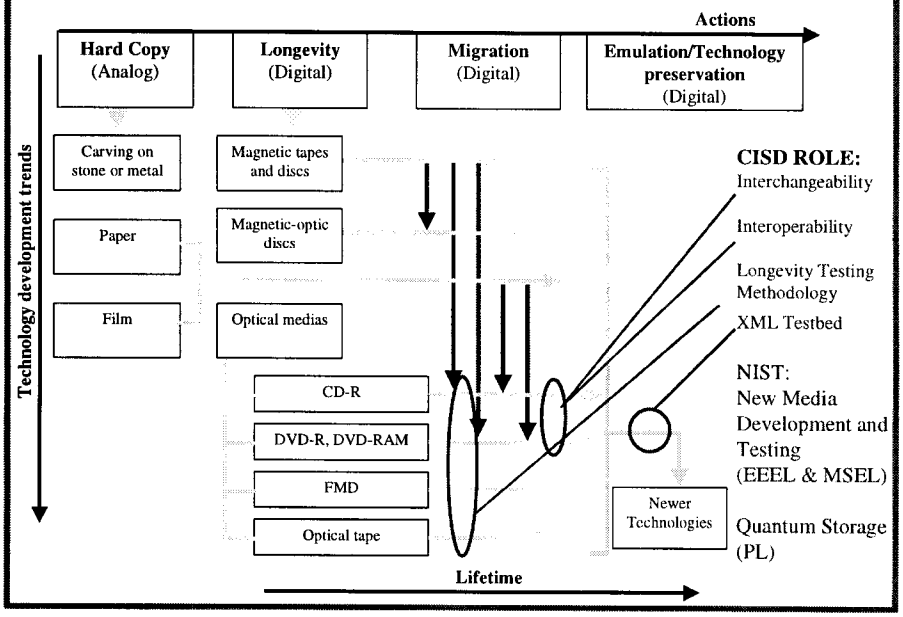
Provide standards, test methodologies, and test beds to ensure content is available now and in the future

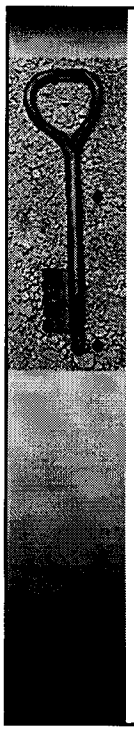


NIST Digital Data Preservation Laboratory: *Customers and Applications*

- Content creators and providers.
- Optical disc & drive manufacturers.
- Archival storage & data preservation.
- High density storage and applications.
- Digital cinema & interactive DTV.
- Digital libraries & electronic books.
- Digital Rights Management.
- End-users.

Data Preservation Strategy





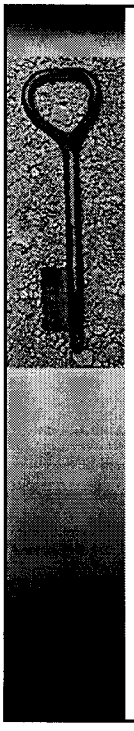
NIST Optical Disc Compliance Test Program

Problem Statement:

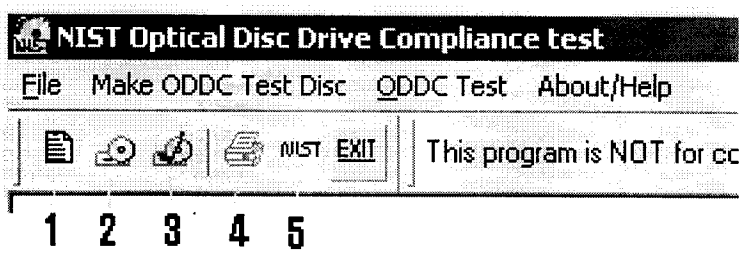
- No mechanism available to the consumer to test their drive for MultiRead compliance

NIST Response:

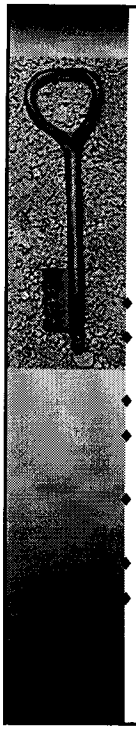
- NIST developed its own test, based on the MultiRead specifications, for customers to test drives for compliance. The test comprises of the following:
  1.) generation of test pattern,
  2.) burn the pattern test disc,
  3.) test drive for MultiRead compliance using test disc and show and print the results of the test.



The NIST Optical Disc Compliance Test:



1.) Create source (pattern) files.
2.) Burn the source files to the test disc
3.) Test for MultiRead compliance using the test disc created (based on MultiRead Test plan).
4.) Prints results outlining where (if any) failures occur.
5.) Help and Information.



Standards and Interoperability

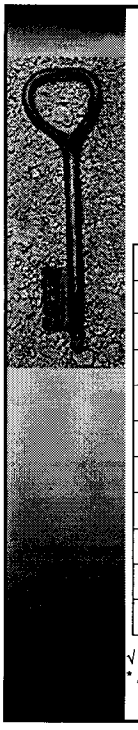
Test Functions

Can drive..

- **Read media of different reflectivity?**
- **Read all User Data Blocks on Data Tracks?**
- **Read different write methods?**
- **Read tracks using different Addressing methods?**
- **Support Multimedia Command set (MMC)?**
- **Access Reading Link Blocks?**
- **Detect and identify errors?**

MultiRead

MultiRead Logo (OSTA)



Standards and Interoperability

Current Interoperability Status

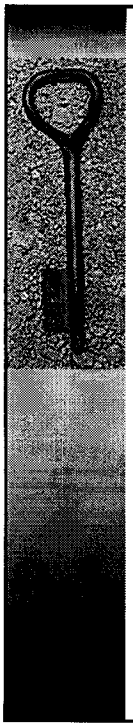
	Driver								
Media	**CD-ROM**	**CD-R**	**CD-RW**	**DVD-ROM**	**DVD-R**	**DVD-RAM**	**DVD+RW**	**DVD-RW**	**PD**
CD-ROM	√	√	√	√	√*	√	√	R	√
CD-R	√	√	√	√*	√*	√*	√	R	√
CD-RW	√*	√*	√	√*	√*	√*	√	R	R
DVD-ROM			R	√	√	√	√	√	
DVD-R				R	√	R	R	R	
DVD-RAM				R	R	√	R	R	
DVD+RW				R	R	R	√	R	
DVD-RW				R	R	R	R	√	
PD						O			√

√ = YES R = RECOMMENDED O = OPTIONAL
* ACHIEVED BY DRIVES WITH "MULTIREAD" CAPABILITY

OSTA (www.osta.org)

Organization	Standard/Collaboration	NIST Role/Deliverable	Status
Optical Storage Technology Association (OSTA).	MultiRead: defines the parameters necessary for optical devices to read discs created in CD formats.	Develop test to ensure MultiRead compliance.	MultiRead test (CISD website), MultiRead 2 (DVD) test under development.
DVD Association (DVDA).	Promotion of DVD technology and standards	Member. Host 2002 joint NIST/DVDA conference.	Conference in June 2002.
High Density Storage Association (HDSA).	Promoting Automated Storage for high density applications.	Member.Testing facility to test storage systems and to guide industry.	NIST/HDSA Data Preservation laboratory development in 2002.
Joint Technical Commission: Care and Handling of media.	ISO TC 171/SC 1N 120 "Verification of information on CD's".	Member of Commission. Provided help and feedback on proposal.	ISO working draft.
JTC: Care and Handling of media.	Care and Handling of Optical Media – General Standard.	Member. Provide input and testing capabilities.	Began April 2002.
Warner Advanced Media Operations (WAMO).	Reflectance Measurement for DVD.	CISD measured the reflectance to an accuracy of 1%.	Result used as the standard reflectance for all DVD discs.
Library of Congress (LOC) / National Archives.	Promotion of importance of Data Preservation for Archival purposes.	Proposed establishment of Data Preservation Lab at NIST.	In proposal phase.

ITL INFORMATION TECHNOLOGY LABORATORY



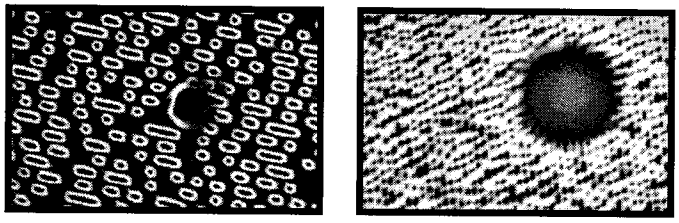
Preservation of Digital Data

Preservation of Digital Information

- **Digital discs have large capacity, fast access rate, longer life expectancy and lossless information transfer.**
- **Lifetime of media is limited due to deterioration of material.**
- **Longevity of media also determined by the obsolesce of playback hardware and software.**
- **Compatibility and interchangeability of content on different disc types.**
- **This effort is very important for long-term preservation of digital information for archival purposes as well as for National Security.**

Preservation of Digital Data

Example of Result:



Defect Detection and Analysis

With some hardware improvement this method can be used to accurately characterize DVD discs.

Preservation of Digital Data

NIST effort

Independent measurement of life expectancy:

- **Chemical deterioration/aging.**
- **Physical damage.**
- **Content loss in operation.**

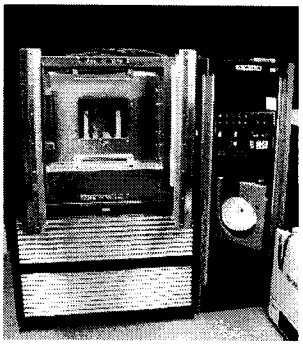
Rating of media (EOL).

Development of universal software for reading various digital formats.

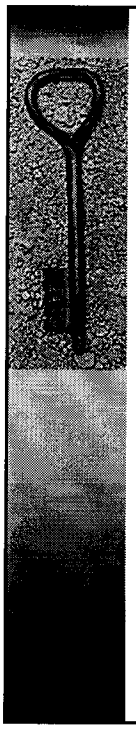
Promote the development of standards for digital storage in digital discs.

DVD Reliability/Compatibility study.

MultiRead test.

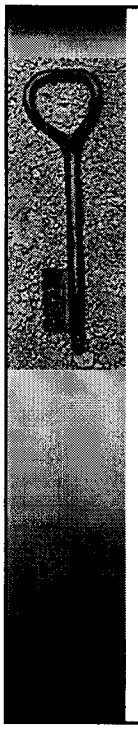


Environmental Chamber for Reliability of DVD Media



Optical Disc Reliability Testing

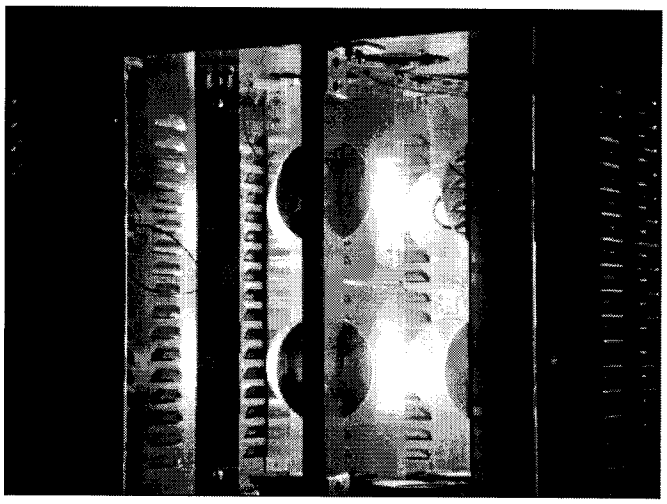
- **Stimulate the use of Optical Discs for Preservation:**
  Much of the **original** digital information produced today is placed on CD-R and DVD-R media (valuable experimental data from a scientist, for example) and therefore that is where we concentrate our efforts.
- **Identify the discs that are suitable for archiving:**
  This recommendation can be used by archivists and librarians as a disc selection guide.
- **Develop a methodology to test existing discs:**
  Allow archivists and librarians (and others) to test the valuable discs already in their collection.



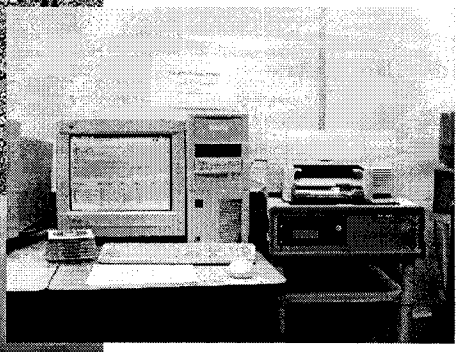
Tools Used For Testing

- Temperature/Humidity and Light Chambers
  - CISD developed light chamber is one of the only of its kind in the world.
- Optical Disc Microscope Testbed
- CATS SA3 Compact Disc Analyzer
- CD Associates DVD Analyzer

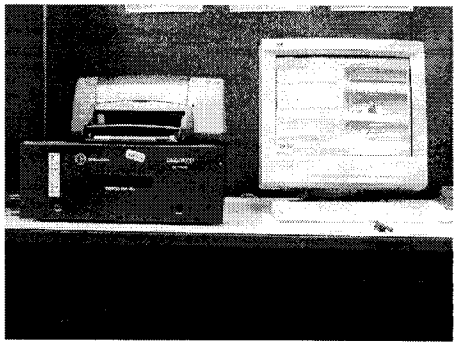
NIST/CISD Light Chamber



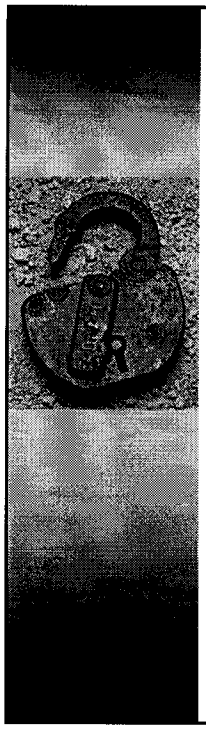
Optical Disc Test Equipment



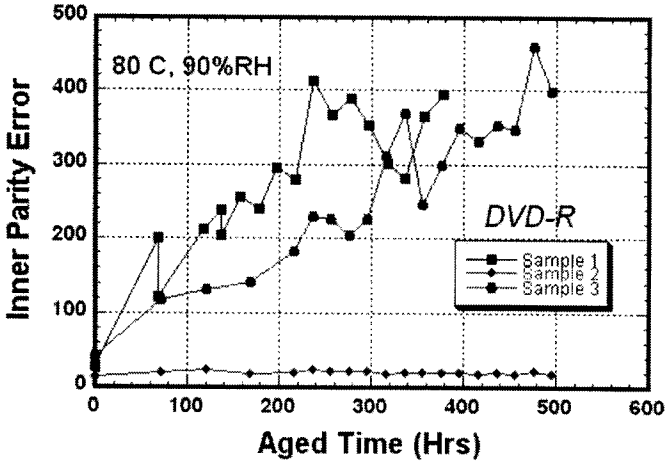
CATS SA3 Compact Disc Analyzer
Provides CD parameters after
ture and/or humidity effects

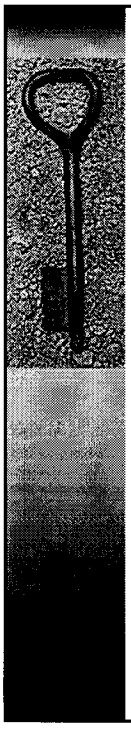


CD Associates DVD Analyzer
Provides DVD parameters after temperature and/or humidity effects

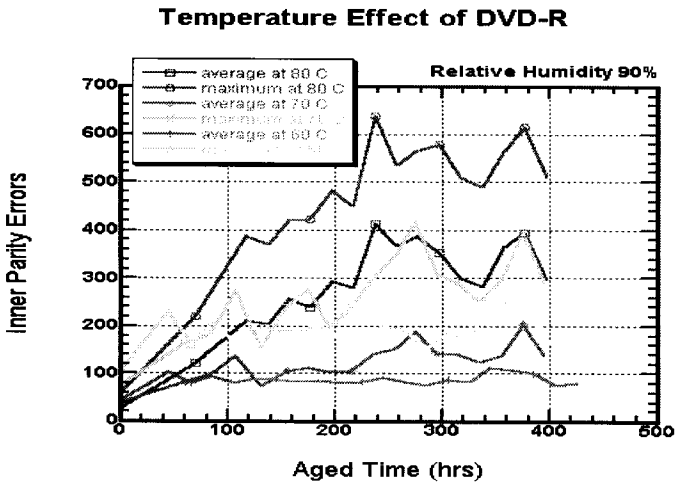


Different Manufacturer's Media Response to Temperature & Humidity

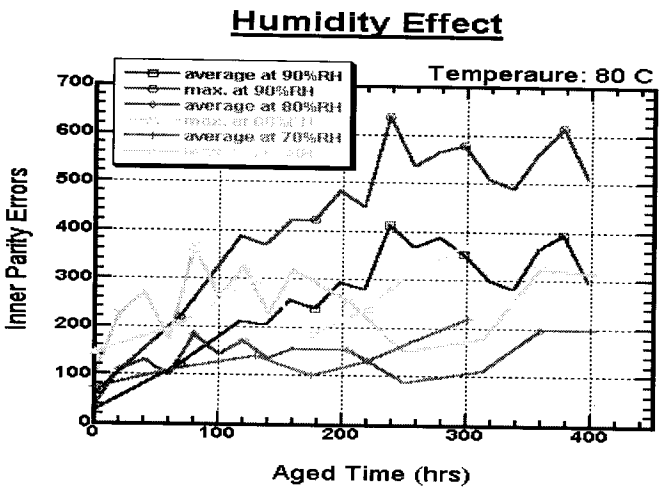




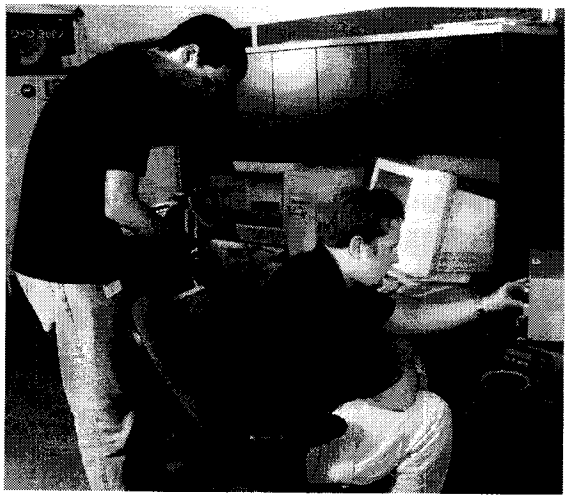
Temperature Effects on Optical Discs



Humidity Effects on Optical Discs



HDSA/NIST
Data Preservation Lab

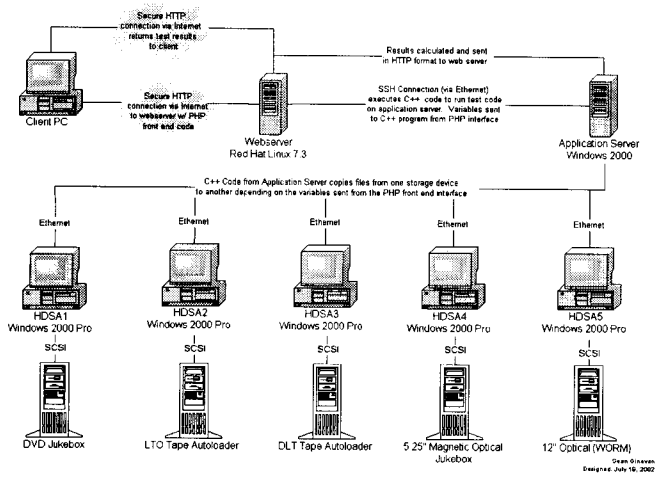


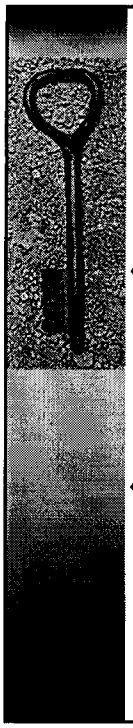
HDSA/NIST
Data Preservation Lab

- **Goal:** Create a real life demonstration facility for present and future end users of these systems.
- **Goal:** Highlight the capabilities and limitations of different jukebox types and systems.
- **Goal:** Improve jukebox and library interoperability, performance and transfer rates.
- **Goal:** Study interchangeability between storage systems, media types, and storage management.
- **Goal:** Work with industry (HDSA) to create a Storage Technology Tool that evaluates different storage media.

Overview of HDSA/NIST Lab

Layout of the NIST/HDSA High Density Storage Laboratory

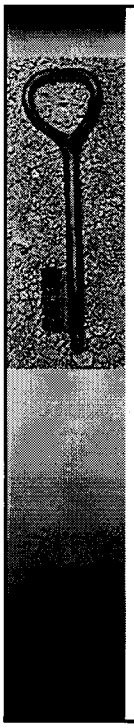




Research and Services

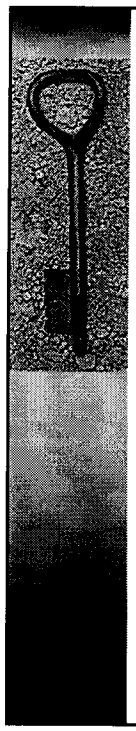
Future Projects

- Evaluation of new technology such as FMD:
  - **Fluorescent Multi-Layered Disc-uses dye polymer as storage medium**
  - **Storage system player & media compatibility**
  - **Expected lifetime measurement when exposed to sun/ambient room light.**
- Standardization of Mass Storage:
  - **Promote mass storage systems/sub-systems interoperability**
  - **Develop testing protocols for performance of mass storage systems and data exchange**



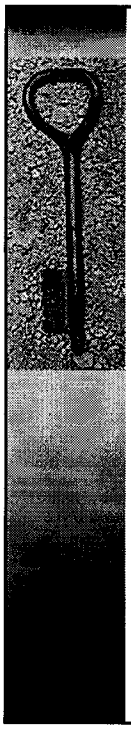
Advanced Coding for Data Preservation

- Problem Statement:
  - To evaluate the performance of error correction codes in the recovery of information lost on optical media due to aging or some catastrophic event.

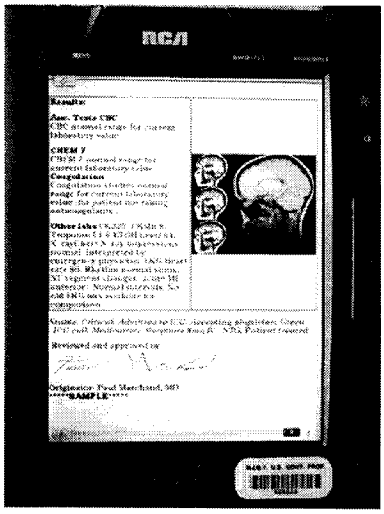


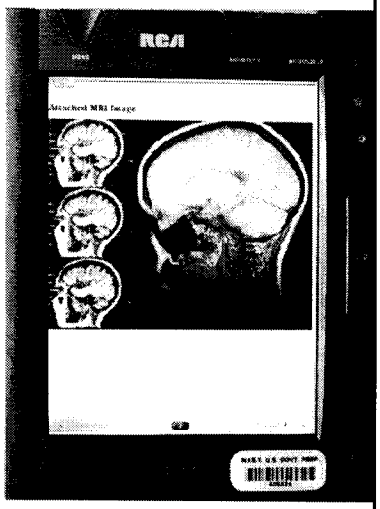
Advanced Coding for Data Preservation

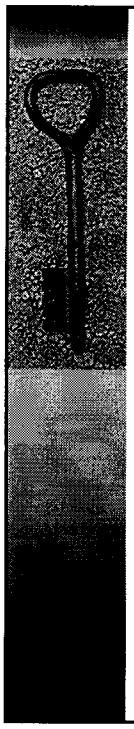
- Identify the parameters related to data error on optical discs.
- Measure these parameters before and after accelerated aging.
- Process the data by both conventional ECCs and more advanced ECCs.
- Develop standardized formats for long term preservation of valuable data.



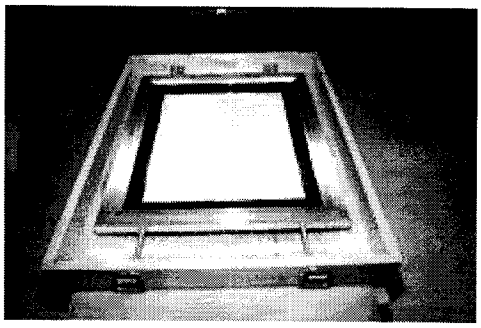
Medical Image Quality





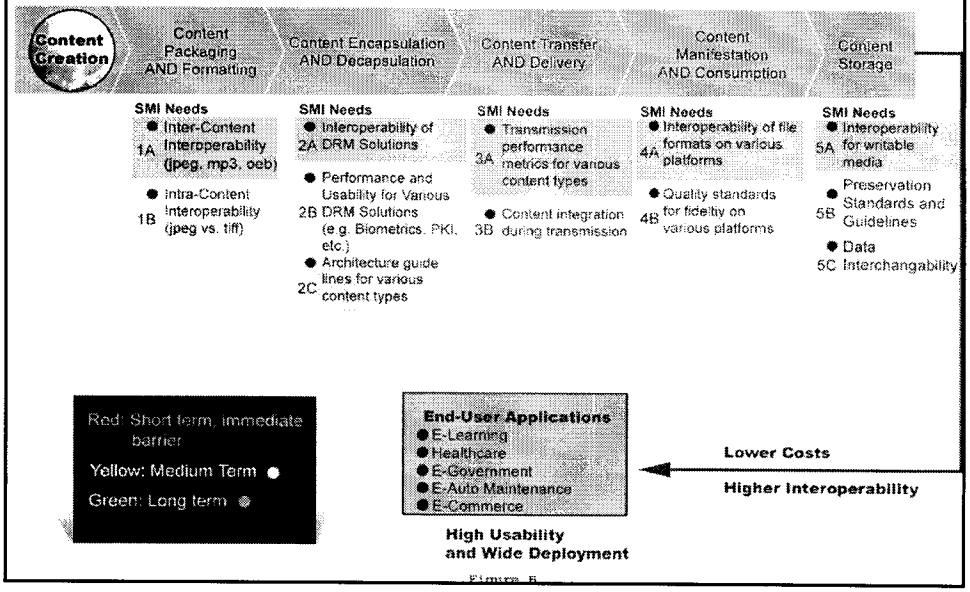


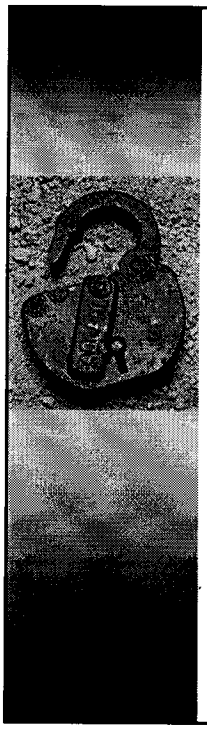
Analog Preservation: Preserving the Constitution



The second page of the Constitution is securely displayed in a new, titanium-framed encasement made at NIST

Solution: CISD Provides Interoperable Tools and Guidelines for Content Management (Standards, Measurements, Interoperability needs)





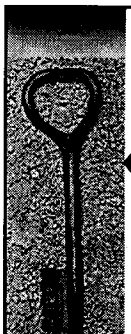
NIST Industry Collaboration in Data Preservation

NARA

High Density Storage Association
Promoting Automated Storage

DVDA

-OSTA.org-



Conclusion

- NIST has an extensive program involvement in digital data preservation:
  - media reliability & interoperability
  - storage system performance metrics
  - member of National Digital Strategy Advisory Board for NDIIPP
- For more information:

victor.mccrary@nist.gov
Phone: 301.975.4321
www.itl.nist.gov/div895

NIST