



TECHNICAL REPORT

OPTICAL DISK STORAGE TECHNOLOGY, MANAGEMENT, AND STANDARDS

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Technical Report for Information and Image Management—

Optical Disk Storage Technology, Management, and Standards

Prepared by
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March 18, 2006

Abstract:

This technical report provides information on the various technologies, management, implementation strategies, and industry standards for optical based subsystems. This information and the corresponding techniques described have been provided to enable optical disk system users, as well as other imaging system users, to become knowledgeable in the various techniques currently in use throughout the imaging industry.

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Foreword

This technical report specifies the recommendations and provides guidance for maintaining archival optical disk collections. The problem identified by the members of the AIIM standards committee C27 is one of systems becoming obsolete prior to the expiration of the useful life of the information. Additionally, technology is evolving so rapidly that the systems may be obsolete prior to the storage media reaching its life expectancy. These issues require a considerable amount of planning to occur in the initial stages of the development and implementation of imaging systems to provide a plan for migrating the information from a system utilizing obsolete technology to a system employing advanced technology. This planning is invaluable to the overall success of the system as the information itself might have a lifespan greater than the media and technology combined, resulting in inaccessibility.

Suggestions for improvement of this technical report are welcome. They should be sent to Chair, Standards Board, AIIM International, 1100 Wayne Ave., Suite 1100, Silver Spring, MD, 20910.

This document was developed under the auspices of the Standards Board which approved it as an AIIM technical report. The Standards Board had the following members at the time it processed and approved this technical report:

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Optical Disk Storage Technology, Management, and Standards

1 Introduction

1.1 Purpose

The purpose of this technical report is to recommend methodologies by which optical disk users can understand various optical disk issues, such as implementation, retention, obsolescence, and basic data management. In addition, this report provides information describing the differences between various optical components as well as some basic concepts that should be used when determining which optical solution best fits the users' needs.

1.2 Objectives

The objectives of this report are to:

- Provide guidance in the maintenance of data residing on on-line, off-line, and near-line digital optical storage devices.
- Establish a plan to assure the migration path of digital information from early and current technology and optical media to future technologies and media.
- Provide guidance for the short and long term effect of the finite life of digital optical storage devices.

1.3 Scope

The scope of this technical report is to address the various services that should be incorporated into the management of an optical media-based system to ensure a successful implementation of this technology. All forms of optical disk media will be addressed in this report including write-once-read-many (WORM), magneto-optical (MO), compact disk (CD), digital video disk (DVD), and newer technologies.

2 Acronyms

Acronyms used in this report have the following meanings:

<u>Acronym</u>	<u>Meaning</u>
ACORD	Agency-Company Organization for Research and Development
AIIM	Association for Information and Image Management
ANSI	American National Standards Institute
ARIC	Archives and Records Information Coalition
ARMA	American Records Management Association International

<u>Acronym</u>	<u>Meaning</u>
ASC	Accredited Standards Committee
ASIS&T	American Society for Information Science and Technology
ASTM	American Society for Testing and Materials
CAV	constant angular velocity
CCS	continuous composite servo
CCW	composite write-once
CD	compact disk
CD-DA	compact disk-digital audio
CD-R	compact disk recordable
CD-ROM	compact disk read only memory
CD-RW	compact disk rewriteable
CD-i	compact disk interactive
CGATS	Committee for Graphic Arts Technologies Standards
CIEDIS	Collision Industry Electronic Data Interchange Standards
CLV	constant linear velocity
DBF	discrete block format
DIAG	Digital Image Applications Group
DIF	document interchange format
DVD	digital versatile disk
DVD-Audio	digital versatile disk-audio – read only
DVD-R	digital versatile disk-Recordable
DVD+R	digital versatile disk+Recordable
DVD-RAM	digital versatile disk-random access memory
DVD-RW	digital versatile disk-Rewriteable
DVD+RW	digital versatile disk+Rewriteable
DVD-ROM	digital versatile disk-Recorded optical media or Read Only Memory
DVD-Video	digital versatile disk-Video
ECC	Error Correcting Codes
EMCA	Enterprise Manager Configuration Assistant (EMCA). A tool for creating, deleting, and modifying Enterprise Manager configurations and settings.
EWOS	European Workshop for Open Systems
FAT (DOS)	File Allocation Table (Disk Operating System)
FLI	file level interchange
GIF	graphical interchange format
HD-DVD	high definition-digital video disk

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<u>Acronym</u>	<u>Meaning</u>
HFS (Apple Macintosh)	Hierarchical File System
HPFS (OS/2)	High-Performance File System (Operating System 2)
I3A	International Imaging Industry Association
IDE Alliance	International Digital Enterprise Alliance
INCITS	InterNational Committee for Information Technology Standards
ISO/IEC	International Organization for Standardization /
JFS (AIX)	Journaling File System (An open IBM operating system based on UNIX)
JPEG	joint photographic experts group
JTC 1	Joint Technical Committee 1-Information Technology
LIM-DOW	light intensity modulation-direct overwrite
MPEG	Moving Picture Experts Group
MO	magneto-optical
NAGARA	National Association of Government Archives and Records Administrators
NFS	Network File System
NIRMA	Nuclear Information and Records Management Association—Micrographics Committee
NISO	National Information Standards Organization
NIST	National Institute of Standards and Technology
NIST/NASA	National Institute of Standards and Technology/National Aeronautics and Space Administration
NSR	Non-Sequential Recording for Information Interchange
ODC	optical disk cartridges
ODCR	optical disk cartridge rewritable
ODM	optical disk media
OSTA	Optical Storage Technology Association
PARS	Preservation and Reformatting Section of the Association for Library Collections & Technical Services (a division of the American Library Association)
PCX	PiCture eXchange. A graphics file format
PDD	Professional Disk for data
RAID	Redundant Array of Independent Disks
RLG	Formerly Research Libraries Group
ROM	recorded optical media
RTF	rich text format
SAA	Society of American Archivists
SIGCAT	Special Interest Group on CD-ROM Applications and Technology

<u>Acronym</u>	<u>Meaning</u>
SLA	Special Libraries Association
TAG TC 171	Technical Advisory Group Technical Committee 171
TC	Technical Committee
TIA	Telecommunications Industry Association
TIFF	Tagged image file format
UDO	ultra density optical
UDF	Universal Disc Format
UNIX	(yoo-n-ix) A trademark used for a computer disk operating system
VOC	volatile organic compound
VTP	variable track pitch
WAV	Waveform Audio Format
WORM	write-once-read-many
WORM/MO	write-once-read-many/magneto-optical

3 Optical Storage Concepts

Optical storage has been used for data storage for over 20 years. Data is recorded on reflective media using a laser-powered head. The preciseness of the laser and the properties of the media combine to allow data to be stored at very high densities. For example, a typical 3.5 inches magnetic floppy disk holds about 1.44 MB of data, while the current generation of DVD technology can store up to 8.5 GB of data on a 120 mm disk.

3.1 On-line vs. Off-line Storage

The storage components within any computer system directly affect the overall system operation. There are several different types of storage components that can be attached to any of these systems. Before discussing each of these components, let us consider the various storage groupings, including on-line storage, near-line storage, and off-line storage.

- **On-line storage** is considered to be any storage device that is always available to a system user. An example of this type of storage is a fixed hard disk either attached directly to a computer or available across a local area network. Removable storage media, including removable hard disks and optical media, are considered to be on-line storage devices when they are *mounted*, or in other words, can be accessed by a user without any system intervention other than reading or writing the requested data.
- **Off-line storage** defines any storage media that is removed from the system and typically stored in a separate area for archival purposes. Removable optical devices and magnetic tapes that are not mounted fall into this category.
- **Near-line storage** devices are stored in a mechanical library, which can be defined as a hardware component consisting of media drives, such as optical or tape, and numerous storage slots or bays to store the media. These libraries are often referred to as *jukeboxes* for their mechanical similarities to musical jukeboxes. These systems typically contain a robotics arm, which is used to store and retrieve the optical media. In addition, most optical libraries also provide a *mailbox slot* which is used to insert and/or remove optical media from

the system for offsite storage or simple removal from the system.

The most important aspect of the optical library is its ability to store numerous platters or other types of media as well as multiple drives in a single storage cabinet. Libraries typically only support one form factor of media and often only one particular class, such as CD or DVD. Optical drives with dual-headed mechanisms dramatically increase the overall throughput of the optical storage system because no robotics are required to turn the media over to access data on both sides of the platter.

3.2 Data Layout Formats

There are three different data formats used in the manufacturing process of 130 mm optical disks. These formats are not compatible, and media can only be read by optical disk drives supporting that particular format. Two of these formats, Format A and Format B, are described in the International Standard ISO 9171. Format A is referred to as the *continuous* format. With format A, the disk has a separate groove or track for the storage of servo (disk control) data that the system uses to maintain the tracking and focus of the recording and read heads.

Format B is referred to as the *sampled* format. With Format B, the system's synchronization bytes (for tracking and focus) are stored inside a particular sector. The head samples data in different parts of the sector, and then reads and understands the data to maintain its tracking and focus. Unlike the continuous format, there is no groove in the sampled format. Discrete Block Format (DBF) is the newest implementation of Format B and has been developed for the 3.5 inches rewritable category.

The third format, Variable Track Pitch (VTP), varies the pitch (depth of one track to the next) on the disk. This VTP format is necessary for a servo system that exists in some optical disk drives. It is described in a separate ANSI standard prepared by the B11 committee of the InterNational Committee for Information Technology Standards (formerly the X3 committee).

In the following list of currently available industry standards, some of these standards refer to continuous composite write-once capability (CCW) while others refer to WORM. The CCW media uses MO disks to emulate a WORM-like function. The recording technology used for this emulation is the same as that used for rewritable media. The references to WORM refer to ablative or permanent change write-once media (see section 3.4.1).

There are several standards that define optical disk formats and characteristics. Some of these standards are:

- ANSI INCITS 191-1991 (R2002), *Recorded Optical Media Unit for Digital Information Interchange – 130-mm Write-Once Sampled-Servo RZ Selectable-Pitch Optical Disk Cartridge* (formerly ANSI X3.191-1991 (R1997))
- ANSI/INCITS 200:1992 [R2002], *356 MM Optical Disk Cartridge – Write Once, Parts One and Two* (formerly ANSI X3.200-1992 (R1997))
- ANSI INCITS 211-1992 (R2002), *Information Systems – 130-mm Write-Once Optical Disk Cartridge Using Continuous Servo RLL 2,7 Encoding and LDC* (formerly ANSI X3.211-1992 (R1997))
- ANSI INCITS 213-1994 (R1999), *Information Technology – 90-mm (3.54-in) Optical Disk Cartridge Rewritable and Read Only Using Discrete Block Format (DBF) Method for Digital Information Interchange* (formerly ANSI X3.213-1994 (R1999))
- ANSI INCITS 214-1992 (R2002), *Information Systems – 130-mm Write-Once Optical Disk Cartridge Using Sampled Servo and 4/15 Encoding* (formerly ANSI X3.214-1992 (R1997))