TECHNICAL REPORT

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Document management applications — Optical disk storage technology, management and standards

Applications de la gestion des documents — Technologie de stockage sur disque optique, gestion et normes

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

In exceptional circumstances, when a technical committee has collected data of a different kind from that which is normally published as an International Standard ("state of the art", for example), it may decide by a simple majority vote of its participating members to publish a Technical Report. A Technical Report is entirely informative in nature and does not have to be reviewed until the data it provides are considered to be no longer valid or useful.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

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Introduction

This Technical Report specifies the recommendations and provides guidance for maintaining archival optical disk collections. The problem identified 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 might 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.

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.

A list of related standards is given in Annex A.

Document management applications — Optical disk storage technology, management and standards

1 Scope

This Technical Report gives recommendations and provides guidance for maintaining archival optical disk collections. It describes the various services that would be necessary for the management of an optical media-based system to ensure a successful implementation of this technology.

This Technical Report also

— provides guidance in the maintenance of data residing on on-line, off-line, and near-line digital optical storage devices;

— establishes a plan to ensure the migration path of digital information from early and current technology and optical media to future technologies and media;

— provides guidance for the short- and long-term effect of the finite life of digital optical storage devices.

This Technical Report also describes all forms of optical disk media including write-once-read-many (WORM), magneto-optical (MO), compact disk (CD), digital versatile disk (DVD) and newer technologies.

2 Abbreviated terms

2.1
BD
Blu-ray Disc

2.2
CAV
constant angular velocity

2.3
CCS
continuous composite servo

2.4
CCW
continuous composite write-once

2.5
CD-DA
compact disk-digital audio

2.6
CD-R
compact disk-recordable

2.7
CD-ROM
compact disk-read only memory

2.8
CD-RW
compact disk-rewriteable

2.9
CD-I
compact disk-interactive

2.10
CLV
constant linear velocity

2.11
DBF
discrete block format

2.12
DIF
document interchange format

2.13
DVD
digital versatile disk

2.14
DVD-Audio
digital versatile disk-audio read only

2.15
DVD-R
digital versatile disk-recordable

NOTE One of three competing recordable DVD standards; the others are DVD+R(W) and DVD-RAM.

2.16
DVD+R
digital versatile disk+recordable

NOTE One of three competing recordable DVD standards; the others are DVD-R(W) and DVD-RAM.

2.17
DVD-RAM
digital versatile disk-random access memory

NOTE One of three competing recordable DVD standards; the others are DVD-R(W) and DVD+R(W).

2.18
DVD-RW
digital versatile disk-rewriteable

NOTE One of three competing recordable DVD standards; the others are DVD+R(W) and DVD-RAM.

2.19
DVD+RW
digital versatile disk+rewriteable

NOTE One of three competing recordable DVD standards; the others are DVD-R(W) and DVD-RAM.

2.20
DVD-ROM
digital versatile disk-recorded optical media or read only memory

2.21
DVD-Video
digital versatile disk-video

2.22
ECC
error correcting coding

2.23
FAT
file allocation table

NOTE Originally developed for the MS-DOS operating system.

2.24
GIF
graphics interchange format

2.25
HD-DVD
high definition-digital versatile disk

2.26
HFS
hierarchical file system

NOTE Developed for the Apple Macintosh operating system.

2.27
HPFS
high-performance file system

NOTE Developed for the OS/2 operating system.

2.28
INCITS
InterNational Committee for Information Technology Standards

2.29
ISO
International Organization for Standardization

2.30
IEC
International Electrotechnical Commission

NOTE Standards developed jointly between the IEC and the International Organization for Standardization are given the designation ISO/IEC.

2.31
JPEG
Joint Photographic Experts Group

NOTE Used to refer to both the International Standards Committee (ISO/IEC JTC 1/SC 29/WG 1) and the standard(s) they developed for coding and compression of still images.

2.32
JTC 1
Joint Technical Committee 1 on Information Technology

NOTE This is an International Standards development committee jointly operated by ISO and IEC.

2.33
LIMDOW
light intensity modulated direct overwrite

2.34
MPEG
Moving Picture Experts Group

NOTE Used to refer to both the International Standards Committee (ISO/IEC JTC 1/SC 29/WG 11) and the standard(s) they developed for video and audio encoding.

2.35
MO
magneto-optical

2.36
NFS
Network File System

2.37
NIST
National Institute of Standards and Technology

2.38
NSR
non-sequential recording for information interchange

2.39
ODC
optical disk cartridges

2.40
OSTA
Optical Storage Technology Association

2.41
PCX
PiCture eXchange

NOTE A graphics file format.

2.42
PDD
Professional Disk for DATA

2.43
RTF
rich text format

2.44
TC
Technical Committee

NOTE A committee designated by ISO to develop International Standards in a particular area.

2.45
TIFF
tagged image file format

2.46
UDO
ultra density optical

2.47
UDF
universal disc format

2.48
UNIX
trademark used for a computer operating system

2.49
VTP
variable track pitch

2.50
WAV
waveform audio format

2.51
WORM
write-once-read-many

2.52
WORM/MO
write-once-read-many/magneto-optical

3 Optical storage concepts

3.1 General

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, the current generation of optical storage technology can store up to 8,5 GB of data on a 120 mm disk and up to 50 GB of data on a 130 mm disk. The steady increase of storage capacity on removable optical media enables organizations to consider long-term storage of information for archival use taking into account reliability and technology trustworthiness.

3.2 On-line versus 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 of media and often only one particular class, such as CD or DVD.

3.3 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 ISO/IEC 9171.

In the list of currently available industry International Standards (see Annex A), some of these International 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 3.5.2).

See Annex A for a detailed list of relevant International Standards.

3.4 Rotational models

There are two basic rotational modes used by optical disk drives. The first mode is the Constant Angular Velocity (CAV). Within this mode, the media is spun at a constant rate so the angular velocity of the optical media does not change. This simple implementation means that the outer edge of the optical disk rotates faster than the inner edge, storing data further apart toward the outer edge. Since the amount of data stored in each track is constant, the data density is greater on the innermost tracks. With this approach, the amount of data stored is limited by the data rate achieved on the inner tracks.

The second mode is the Constant Linear Velocity (CLV) mode. This mode requires that the disk speed change as the laser head moves from the innermost portion of the optical media to the outermost. The most significant aspect of this mode, in contrast to the CAV, is that the data density does not change throughout the disk. The result of the greater data density towards the outermost edge of the optical device is greater storage capabilities. In addition, since the rotation speeds are slower as the laser head is positioned over the outermost tracks, the data transfer rates are higher than they would be with CAV. Seek times are slightly longer than for CAV because the angular velocity is required to change at the same time as the head moves.

3.5 Physically writing to the disk surface

3.5.1 General

Optical media may be written using several different mechanisms. Some of these mechanisms are write once; that is, the changes made to the surface of the media are irreversible and controlled by the media recording layer, which actually identifies the media type to the optical drive.

3.5.2 Ablative

Originally, data was written onto optical media by physically etching pits into the surface. These techniques have largely been replaced by dye-layer and phase-change recording.