

# Digital Archive Systems

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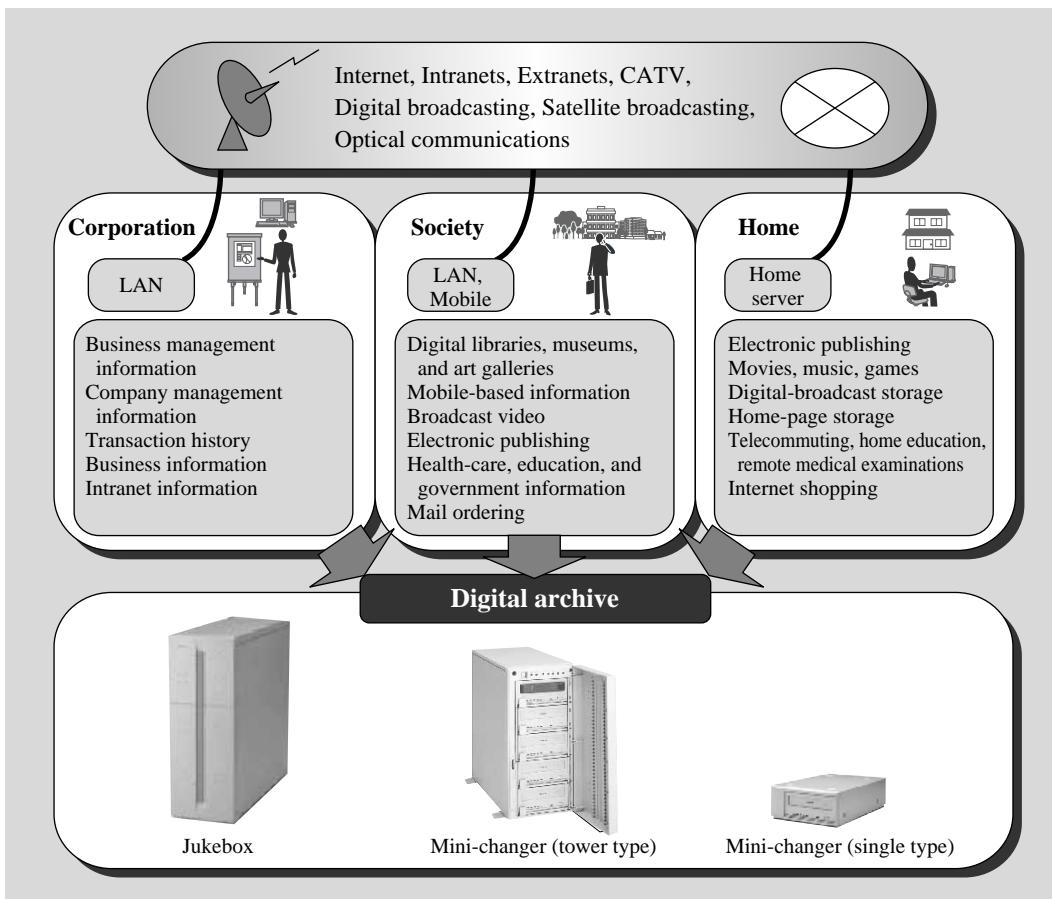
*OVERVIEW: With the spread of digital satellite broadcasting and Internet-based electronic-information services, digital content (information in digital form) is expanding rapidly in society and individual households in the form of text, still pictures, motion pictures, sound, etc. In such a digital-multimedia era, the archiving of this huge volume of data has become a major issue. Against this background, Hitachi, Ltd. has developed a digital archive system equipped with digital versatile disc random access memory (DVD-RAM), which is now receiving attention as next-generation large-capacity universal media. The objective of this “DVD library system” is to enable long-term storage of continuously increasing digital data in all sorts of fields in a secure and easy-to-use manner.*

## INTRODUCTION

OUR society in recent years has become immersed in computers and networks, and digital multimedia information has begun to permeate all facets of our life, from daily living to culture.

On a social level, there has been a dramatic increase in government and community-related information.

The corporate world, on the other hand, has seen a rapid increase in company-related information, transaction information, and customer information, while the common household has experienced a sharp jump in various types of content due to the spread of digital satellite broadcasting, the Internet, and personal computers.



*Fig. 1—Digital Contents and Archive System. Demand is growing for archive systems that can store the rapidly increasing amount of digital contents (information in digital form) in business, society, and the home.*

To meet the demands of this digital multimedia era, Hitachi, Ltd. has been promoting the development of digital archive systems for long-term storage of various kinds of data in a secure and user-friendly manner.

In this paper, we report on changes occurring in the social environment amidst the rapid increase of digital multimedia information and the need to process it, overview the "DVD Library System" developed by Hitachi, and point out future directions in digital archive systems (Fig. 1).

## DIGITAL ARCHIVES AND THE SOCIAL ENVIRONMENT

Changes in the social environment and in social systems are coming to have a significant impact on the storage and provision (release) of information. The following discusses several important changes that affect digital archives.

### International Standards

Within the international community, much importance has come to be attached to quality assurance and environmental protection on a corporate level, and the number of companies that have gained certification from the International Organization for Standardization (ISO) has increased dramatically. The ISO9000 standard, for example, requires the storage and management of records and documents associated with product development, and ISO14000 stresses the need for reducing paper usage from the viewpoints of protecting the environment and saving resources.

### National Legislation

Recognizing the trend in information storage by electronic media, the following legislation has been recently enacted in Japan.

#### (1) Electronic Record Keeping Law

Records related to national taxes that companies have been obligated to store on paper can now be stored on electronic media (July 1998).

#### (2) Medical Practitioners' Law

Patient records that medical clinics and hospitals have been obligated to store on paper can now be stored on electronic media (April 1999).

In the above manner, the need for digital archives is growing on a social level as well.

## DIGITAL MEDIA AND STORAGE HIERARCHY

### Advances in Optical Discs

The general consensus is that optical discs will

continue to progress and become widely used as large-capacity digital media.

Since the appearance of compact discs (CD) for music playback and laser discs (LD) for movie playback in the early 1980's, optical discs have taken on write-once and rewritable formats, and in addition to increased capacity, they have spread as a storage medium in audiovisual (AV) and computer equipment.

At present, this large capacity (write-once format: 4.7 Gbyte per side; rewritable format: 2.6 Gbyte per side) and a common universal disc format (UDF) are expected to make digital versatile discs (DVD) widely used as interchangeable recording media (universal media), from AV to computer equipment and from household to corporate use.

### Storage Hierarchy

Computer-based information storage can be classified by access performance, storage capacity, and from a cost viewpoint, layered configuration or "storage hierarchy." The first hierarchical layer is main memory, the second is hard disk, and the third is optical disc or magnetic tape.

In a digital archive system, the goal is to achieve high-speed access and large capacity simultaneously with low bit cost by combining such hierarchical storage.

## DVD LIBRARY SYSTEM

Using rewritable DVD-RAM, Hitachi, Ltd. has constructed a DVD Library System having large capacity and low bit cost and featuring random-access and long-term storage properties.

### System Overview

By incorporating a DVD-RAM drive and media in changer equipment, three types of library systems have been developed ranging from small capacity (13

TABLE 1. Overview of DVD Library System

*Comes in three types: jukebox, single mini-changer, tower mini-changer.*

Type	Overview
Jukebox	Drives: 2/4; media storage: 100/150 discs; capacity: 260/390 Gbyte
Single mini-changer	Drives: 1 5-disc mini-changer drive; media storage: 1 5-disc cartridge; capacity: 13 Gbyte
Tower mini-changer	Drives: 1-to-5 5-disc mini-changer drives; media storage: 1-to-5 5-disc cartridges; capacity: 13-to-65 Gbyte

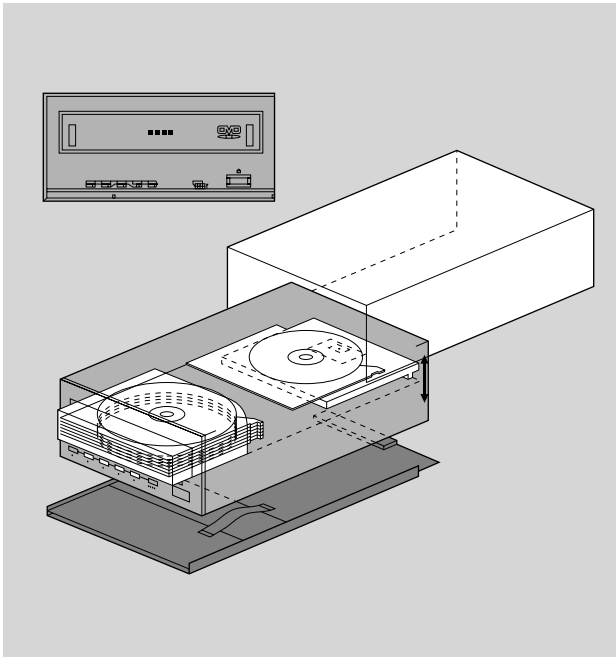


Fig. 2—Perspective View of the Single-type 5-disc Mini-changer. A special cartridge enables 5 DVD-RAM discs to be inserted or removed at once.

Gbyte) to large capacity (390 Gbyte), as summarized in Table 1.

The mini-changer was developed as a compact DVD Library System, and it comes in two forms: a single type and a tower type that combines five of the single types (Fig. 2).

### Filing System

Up to now, magnetic tape (MT) library equipment and magneto-optical (MO) disc-library equipment have been used as storage equipment for computer systems. For the future, Hitachi proposes DVD libraries as low cost and highly accessible large-capacity storage systems.

#### (1) User interface

This system supports UDF, DVD-RAM's basic format, as a filing system. The user interface for this filing system when using the mini-changer is shown in Fig. 3. Here, each disc of media is represented as a virtual folder. The user need only click on a desired folder to initiate automatic mounting of the disc needed.

#### (2) Cache support

The effective use of hard disks raises the processing performance of this library system. For example, to achieve high-speed access of virtual folders, file-directory information is stored on a hard disk. In addition, by first saving write data on hard disks and

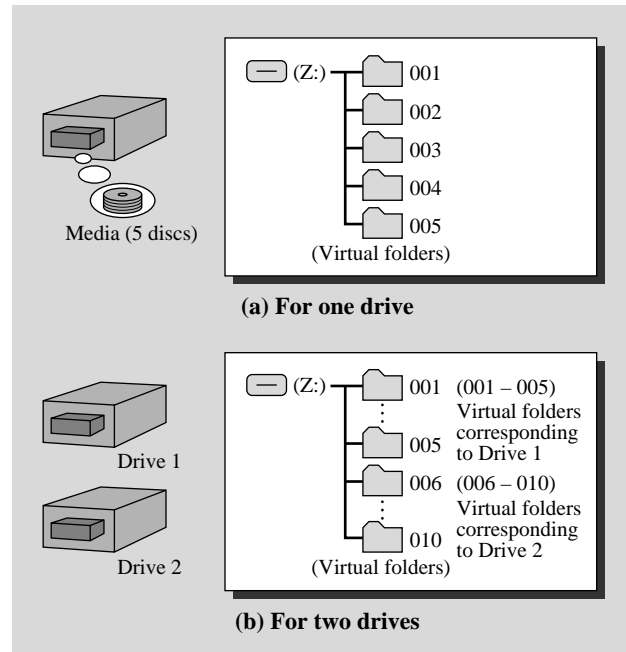


Fig. 3—User Interface for Filing System.

Clicking on a desired folder automatically mounts the media corresponding to that folder. A virtual folder represents one DVD disc as a sub-folder.

writing it at a later time to disc media, write speed can be improved significantly.

### Backup System

Recent computer systems have come to incorporate Digital Audio Tape (DAT) as standard for backing up server data.

The DVD Library System includes a DVD-RAM tape-emulator driver so that data backup can be achieved in the form of a tape image when using the backup utility provided as standard with Windows NT 4.0\*. The user can then restore backed up data using the DVD library in the same manner as restoring from tape.

Hitachi, Ltd. employs a DVD library as backup equipment for personal-computer servers.

### SYSTEM APPLICATION EXAMPLES

A wide variety of applications can be considered for an archive system that stores digital data, including the storage of multimedia contents and broadcast video, medical and health care information, and corporate and business data. Among these, we outline a Document Management System and a Telephone-

\*Windows NT is a registered trademark of Microsoft Corp. in the United States and other countries.

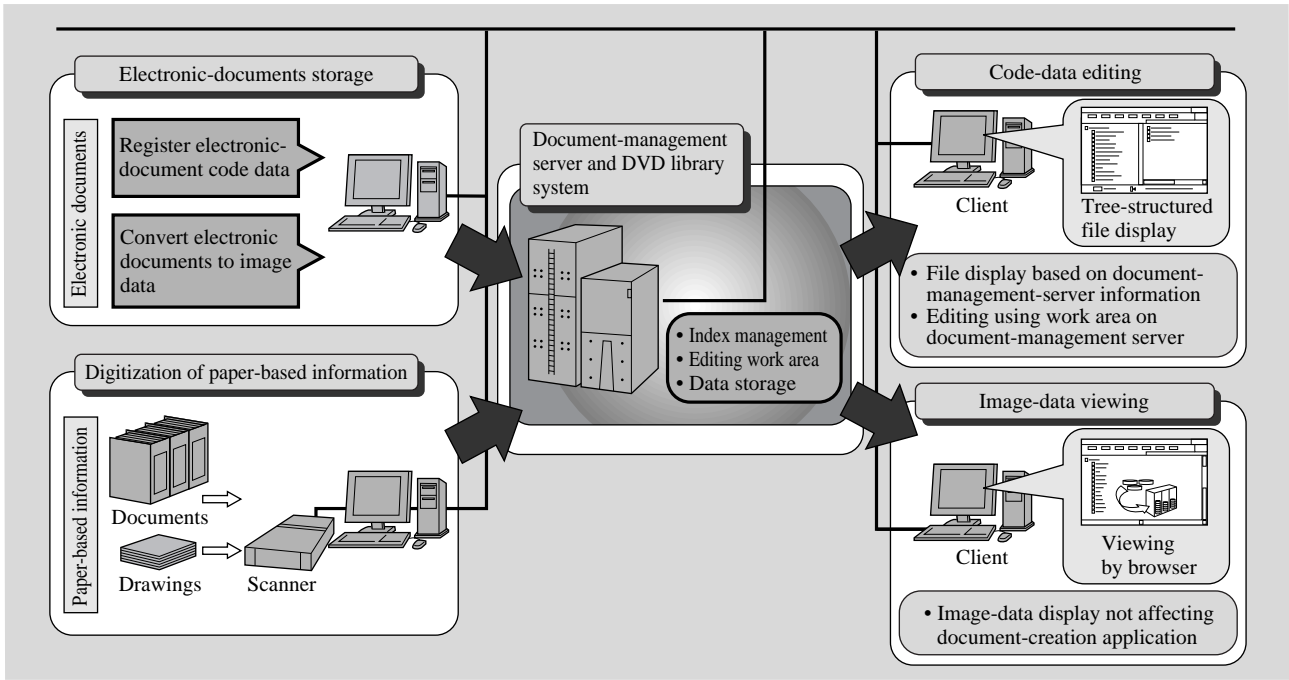


Fig. 4— Application Example: Document Management System.  
The DVD library system connects to a document-management server for use as a large-capacity document archive.

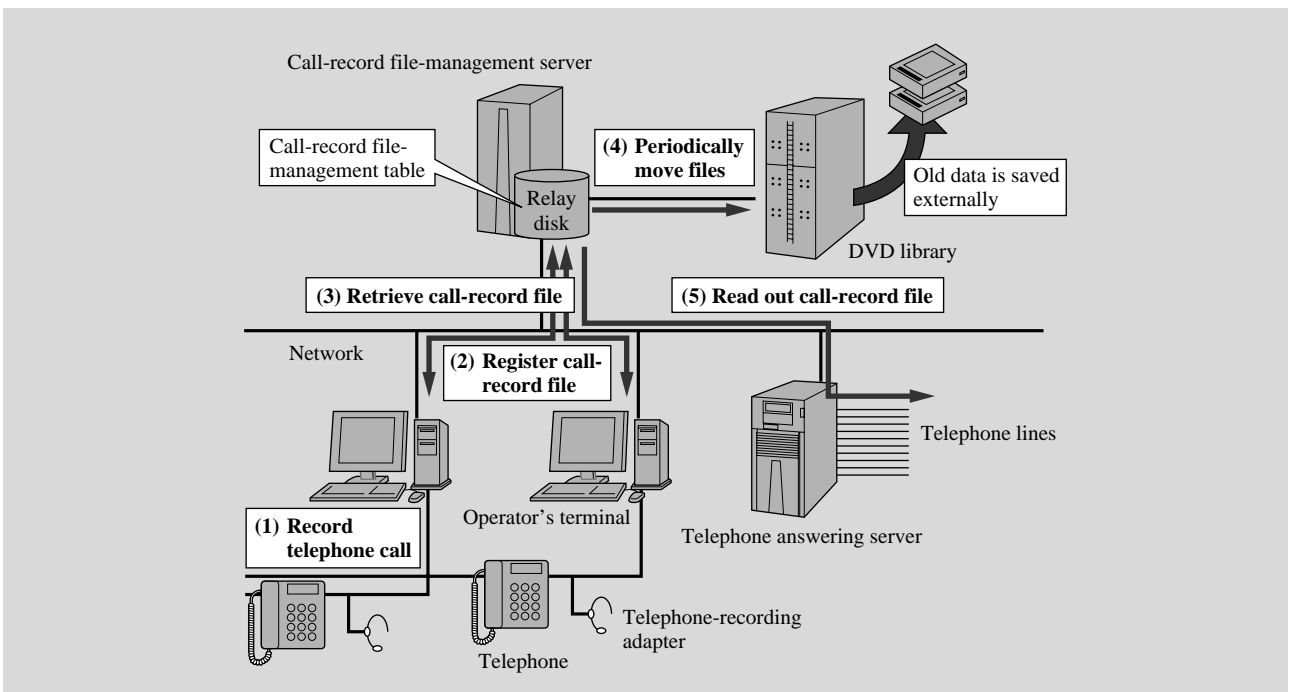


Fig. 5— Application Example: Telephone-call Recording System.  
The DVD library system connects to a call-record file management server for use as a large-capacity secondary archive.

call Recording System.

### Document Management System

This system makes it possible to save documents and drawings created daily in an office in an efficient

and space-saving manner. An example of how this system might be configured is shown in Fig. 4. The system stores each document as text data and image data, and enables speedy retrieval, viewing, and editing of documents to be performed.

### Telephone-call Recording System

This system digitally records the contents of calls and manages call-record files in the form of a database. An example of configuring this system is shown in Fig. 5.

The system uses hard disks as primary storage of call-record files and periodically moves the files to the DVD library that acts as secondary storage. When retrieving call-record files, new files will be searched for on the hard disk while old files will be searched for on the DVD library.

### CONCLUSIONS

This paper has discussed the importance of digital archive systems and has introduced the DVD library system using DVD-RAM media.

As society moves into the 21st century, we can expect the digital home appliances to become widespread and digital multimedia information to increase all the more. In parallel with these developments, we can also expect the use of DVD-RAM to spread across a wide range of fields, from computing to home-information appliances.

In the future, Hitachi, Ltd. plans to improve the functions, performance, and reliability of library systems using DVD-RAM, and to make further proposals for archive systems that can store digital information dependably and facilitate the use of this information as a means of social communication.

### REFERENCES

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### ABOUT THE AUTHORS

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