CONFIDENTIAL

Staff Study

on

Printing and Photography Divisions

Support to the

Agency Videodisc

Production Requirement

6 May 1983

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I. Purpose

The purpose of this study is to determine the potential use of video/optical disk storage within the Central Intelligence Agency and the production support (if any) required by the Office of Logistics Printing and Photography Division (OL/P&PD)

II. Statement of the Problem

Determine the utilization within the Agency of video/optical disk and the effect of this utilization (if any) on OL/P&PD's production support.

III. Facts Bearing on the Problem

A. OL/P&PD's current micrographics production support will decline if the Agency turns to heavy utilization of video/optical disk for information storage and retrieval.

B. Video/optical disk storage is a relatively new technology with undetermined advantages and disadvantages.

C. In some areas of information storage and retrieval micrographics continues to show cost benefit advantages over video/optical disk.

D. It is unknown at this time what medium will be used for the creation and/or duplication of video/optical disks.

E. There are obvious storage capacity advantages of video/optical disk storage when compared to micrographics or magnetic mediums.

F. In-house video/optical disk production is very costly for low-medium volume data bases with small distribution requirements.

IV. Discussion

A. Over the years, OL/P&PD has been the Agency's central facility for the production and duplication of source document and computer output microfilming. Some industry information experts have predicted the demise of micrographics as an information storage and retrieval medium. They have further predicted that video/optical disk will replace micrographics as a storage medium in the near future. In order to determine if, in fact, video/optical

disk would replace micrographics and if it did, what, if any, impact that would have on P&PD this study was undertaken. Before much of the data gathered during this study is discussed however, a clarification of terms is in order. The following definitions of videodisc and optical disk are currently accepted by industry experts:

1. Videodisc - Used primarily for entertainment, teaching, and publishing. Recorded in an analog signal. Usually used for recording existing photographs, movies, slides, video tape, etc.

2. Optical disk - Used primarily for the recording of textual documents and digital data. Recording is done in a digital mode. Optical disks are used for document/information storage and retrieval.

For a more detailed description of video and optical disk systems, see Attachment A of this report.

B. Although both the video and optical disk systems compete somewhat with micrographics, it's the optical disk system that is currently of concern to the industry. The traditional micrographics marketplace has been information storage and retrieval. The optical disk, with its potential for large data storage capacity, low per page cost, and instant availability is a threat to this marketplace. Optical disk is not only a threat to micrographics however, it is also a threat (and probably a more serious threat) to magnetic disk and magnetic tape.

C. It is difficult to do an analysis of the optical disk technology/market because there are new announcements in the field almost daily. In the past year, 3M/Toshiba demonstrated an optical disk system at the National Micrographics Association (NMA) in St. Louis, Mo., RCA has demonstrated a prototype juke box optical disk system capable of storing and retrieving 150 disks, Storage Technology Corporation (STC) has announced an optical disk system that will be commercially available in late 1983, Panasonic now has a commercially available Direct Read After Write (DRAW) videodisc system (see Attachment A); Library of Congress has completed a one year test bed and has awarded a contract to Sony Corporation for an optical disk system and a major announcement on optical disk recording is expected from Eastman Kodak within the next month.

D. Internally, the Agency has two major optical disk projects underway. The Office of Development and Enginering (OD&E) has a multimillion dollar contract with RCA to develop an optical disk system for the storage and retrieval of satellite imagery information. OD&E is also working with the Office of Central Reference (OCR) on the development of

a program called BIOSTAR, which will be used for the storage and retrieval of biographic information on world personalities (see Attachment B). Additionally, the Office of Information Servcies (OIS) and the Office of Data Processing (ODP) is studying the fesibility of using optical disk as an information storage and retrieval medium.

E. The primary attraction to optical disk is its storage capacity. There are different figures given out by different vendors on the storage capacity of a given disk. One reason for the different numbers on optical disk storage capacity is the amount of bits necessary to store data at various resolution levels. As resolution requirements increase more, bits of information are needed to store the document. Most experts agree however, that a single optical disk will store approximately 4,000 megabytes of information. To put that in proper perspective, an optical disk has the storage capacity of thirteen 300 megabyte magnetic disk drives. Optical disk storage capacity already surpasses magnetic tapes, disks, and microfilm. The storage capacity gap between these mediums will become even greater as the optical disk technology advances. (See Attachment C, for storage capacity data.)

F. Other criteria that should be used when comparing optical disk systems to storage mediums such as micrographics are cost, size, and access time requirements. Most organizations developing or augmenting information storage and retrieval systems have to take into consideration the value of ''instant'' access to data over a given period of time and the cost of storing that data online. As the first chart in Attachment D shows, the value or number of accesses/requests for a given piece of data diminishes as the age of that data increases. Attachment D also shows some typical current and projected costs and access times for different size data bases using differnt storage and retrieval mediums. It appears, from most of the data collected, that micrographics is very cost competitive for data bases up to 1.5 million pages. Access/retrievability with computer assisted retrieval micrographics is comparable to that of optical disk systems.

G. The optical disk storage technology is relatively new and is having its growing pains/problems. There are high bit error rates with the current technology. This problem is overcome by having the computer verify data as it is recorded and then re-record the data if errors are detected, and automatically change the data's address in the system. While this action insures that the correct data is captured, it takes additional disk space to store both the originally recorded and re-recorded data which impacts on the overall storage capacity of usable data on a disk.

H. There is, and has been, an archival problem with optical disk. The usable life of currently manufactured disks is estimated to be somewhere between 4 months and ten years. With new recording mediums being developed and existing recording mediums being improved, industry experts predict that the archival problem will be resolved.

I. Replication of optical disks is a problem and, with the exception of large data bases with massive distribution requirements, is cost prohibitive. No one has addressed the high resolution replication issue. Replication time for one disk currently takes 21-41 minutes. In order to be commercially cost effective, a large optical disk file would have to have a replication requirement in excess of 4000 copies.

J. Another area yet to be addressed by industry experts is the updatable/erasable disk. Currently, on magnetic disks you can delete and replace files/data. On a micrographics file, you simply destroy an entire microfiche (420 pages) or microfilm reel (2000 pages) and replace it with a new updated microfilm at a very low cost. Optical disk, in its current configuration with over 50,000 pages per disk, would be very difficult and expensive to update and/or replace. In order to cut down file management costs, erasable/updatable disks are a must.

K. Recording and playback systems for optical disks are currently very costly. Optical disk data is recorded directly from a computer data base or scanned, digitized, and transmitted from a source document scanner. A single recording and/or playback station can cost in excess of $100,000.00. Replication equipment can run in excess of $1,000,000.00.

L. Attachment E contains excerpts and conclusions of various studies undertaken over the past two years on the optical disk/micrographics subject. These studies are almost unanimous in there conclusions. They all indicate that in the near term (5 years) there will be no serious impact on micrographics from optical disk. In recently completed studies by the Yankee Group (a Boston based high technology market research and consulting firm) and Frost and Sullivan Incorporated, indications are that it is not until 1990 that optical disk will pose any real threat to micrographics. Even then, the optical disk penetration into the micrographics market would be less than 15 percent. The Yankee Group Study also summarized requirements for an imaging system as follows:

(1) Ten year retention capability
(2) Ability to do annual purges
(3) Less than one million images, frequently accessed during the first year.
(4) A cost of less than one cent per image.

There were three additional conditions which must be met in order for document-based optical disk systems to attain parity with current micrographic products. These conditions are as follows:

(1) Comparable image quality
(2) Easy and low-cost duplication capability
(3) Long life generally on the order of twenty years (proven)

M. Some of the studies indicate that optical disk systems are only viable for large mass memory systems. They go on to indicate that micrographics and optical disk systems tend to complement one another. Both can be computer controlled and both have the capability of electronic image delivery.

N. There are only a few known ongoing optical disk applications in operation at the present time. These include the Library of Congress application for storing and printing catalog cards, a U.S. Army testbed for storage and retrieval of technical manuals, and an Information Handling Service system which interestingly enough, scans hard copy documents, digitizes them, records the data on magnetic disk, converts the magnetic data to optical disk, then converts the optical disk data to 16mm cartridge microfilm for mass distribution. With the expection of the two previously mentioned efforts, there are no other internal Agency efforts for converting data bases to optical disk. Those two application are specialized and are not currently supported by micrographics. All the applications listed above are relatively large data bases.

V. Conclusions

A. Based on the information uncovered during this study, and on the results of studies undertaken by micrographics information and technology experts, the following conclusions have been reached as to the projected impact of video/optical disk systems on the Agency's information storage and retrieval needs and OL/P&PD's micrographics production support:

(1) Over the next 3-5 years, there will be an increase in Agency usage of videodisc for training and/or presentation of intelligence information. This action will have no impact on micrographics support.

(2) Development will continue on the two previously mentioned Agency optical disk applications, and will probably result in the implementation of viable systems. There will be no micrographics impact.

(3) DDA/OIS, DDA/ODP, and DDS&T/OD&E efforts on optical disk will probably continue and may result in other applications in the next 3-5 years. Some of these applications may somewhat impact OL/P&PD micrographics production support.

(4) Technology breakthroughs will continue in the optical disk industry and costs per image stored will decline. It will however, be some time before optical disk system costs will compare with micrographics on small to medium volume data bases.

(5) Developements/improvements will continue on computer assisted retrieval (CAR) micrographics data bases.

(6) Over the forseeable future, optical disk will probably have a greater impact on the magnetic storage medium industry than on micrographics.

(7) There are only two areas of optical disk production support that may possibly become a P&PD responbility. The first area would be scanning and digitizing existing hard copy documents. The second area would be disk replication. The implications and possible impact of this support are unknown at this time.

(8) Both the P&PD source document and COM micrographics support functions will be viable entities for the next 5-7 years.

VI. Recommendation

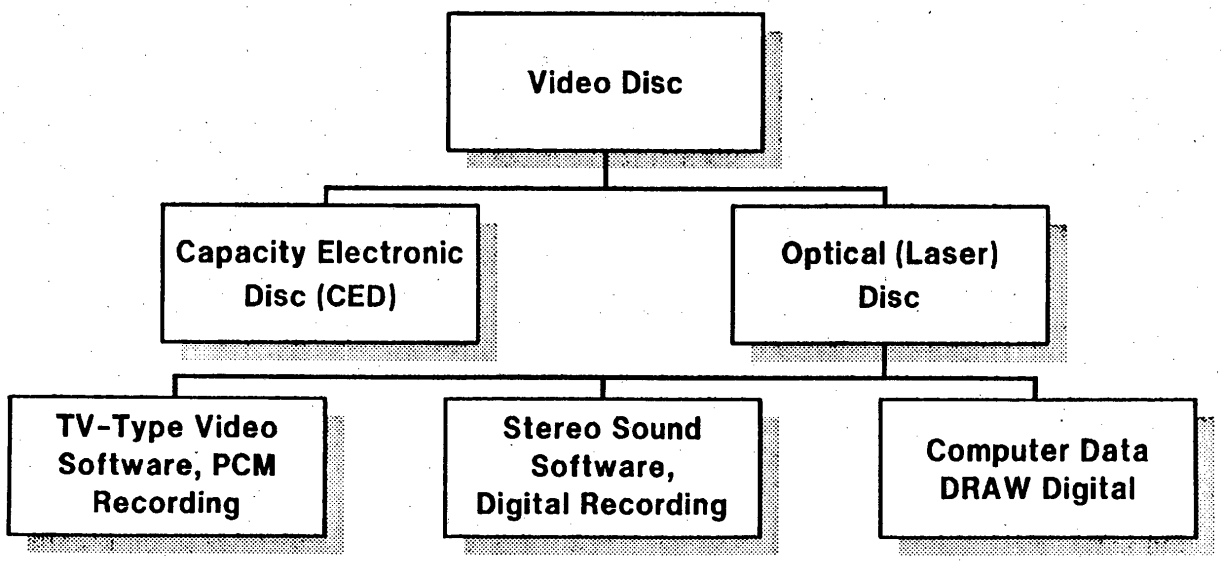
P&PD sould continue to monitor progress with the optical disk technology through technical journals and attendance to seminars and conventions. When it becomes practical, P&PD should be in a position to provide the Agency with optical disk production support for scanning/digitizing existing documents for disk creation and disk replication services. P&PD should also be ready to adjust current production support when it is impacted by the implementation of new optical disk systems. In order to be ready to respond to potential Agency requirements, P&PD personnel should participate, whenever possible, with Agency groups addressing video/optical disk applications.

Attachment A

Video Disc
and
Optical Disk
Descriptions

VIDEO DISC

VIDEO DISC FAMILY



Typical Industrial Video Disc Player - Specifications

- Automatic Selection of
  Constant Angular Velocity (CAV) and
  Constant Linear Velocity (CVL)
- Freeze Frame
- Frame-by-Frame
- Forward, Reverse, Slow Motion
- Frame Number Display
- Individual Frame Access
  Approximately 5 Sec. Search Time
- Selectable Audio
- 525 Lines - 30 Frames/Sec.,
  NTSC Video Format
- Retail Cost $2,500 to $4,000

prc

Panasonic

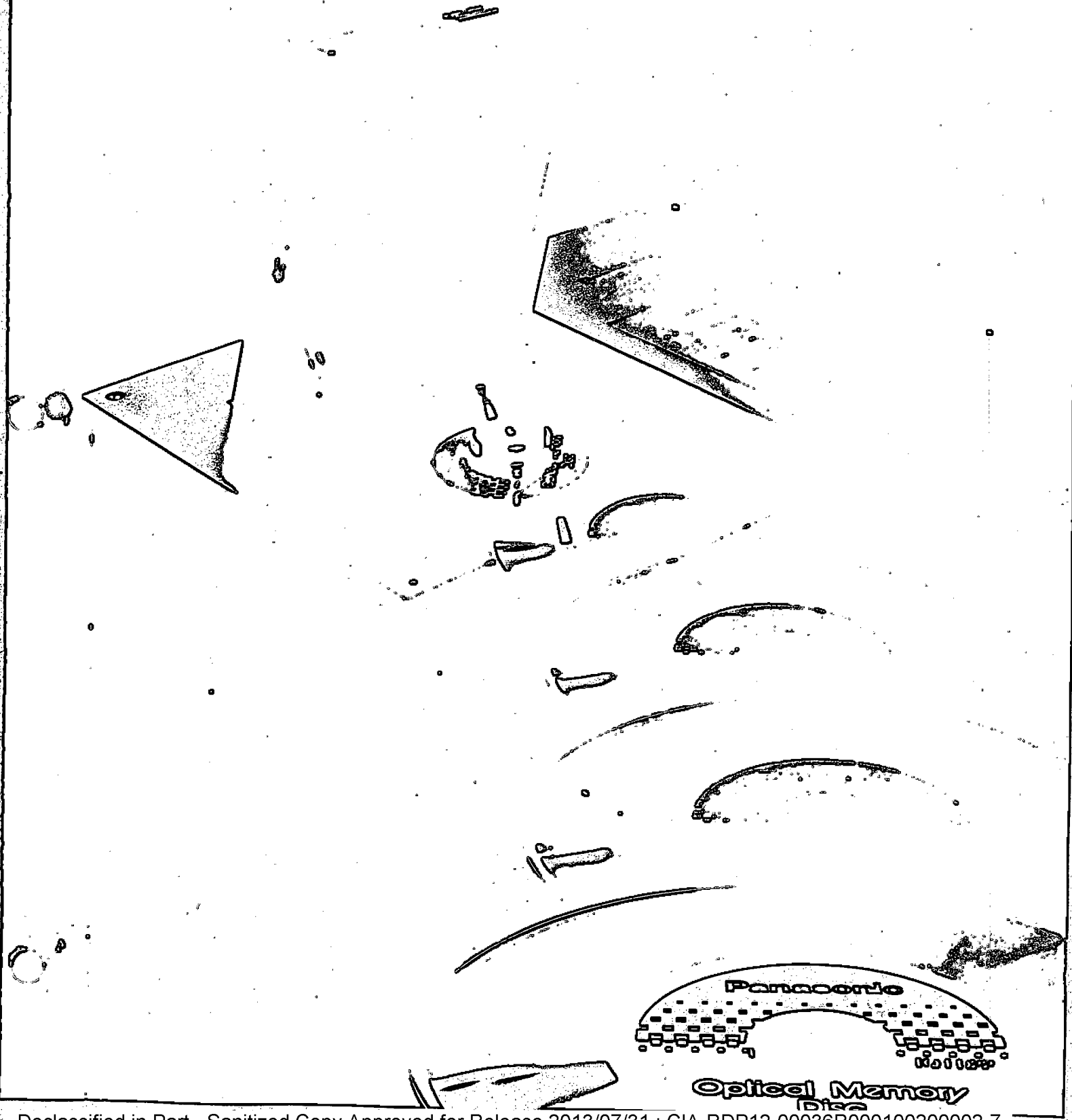
Direct Read After Write

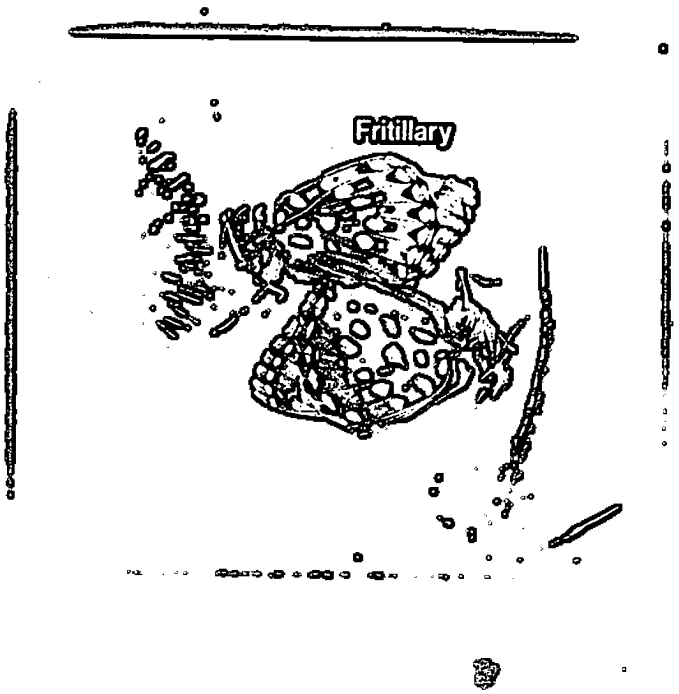
(DRAW) Video Disc System

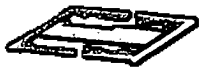
Panasonic

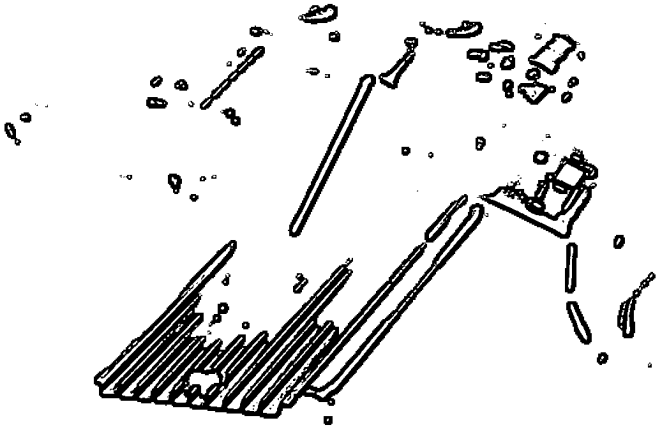
OMDR

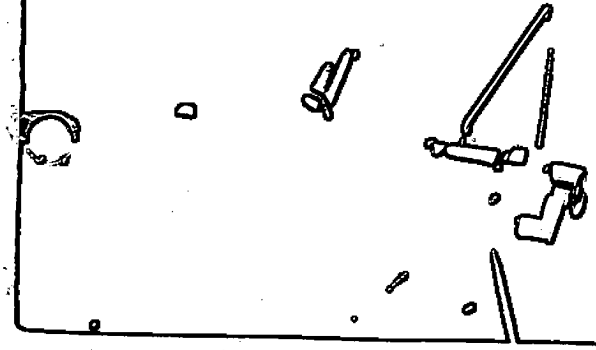
Optical Memory Disc Recorder







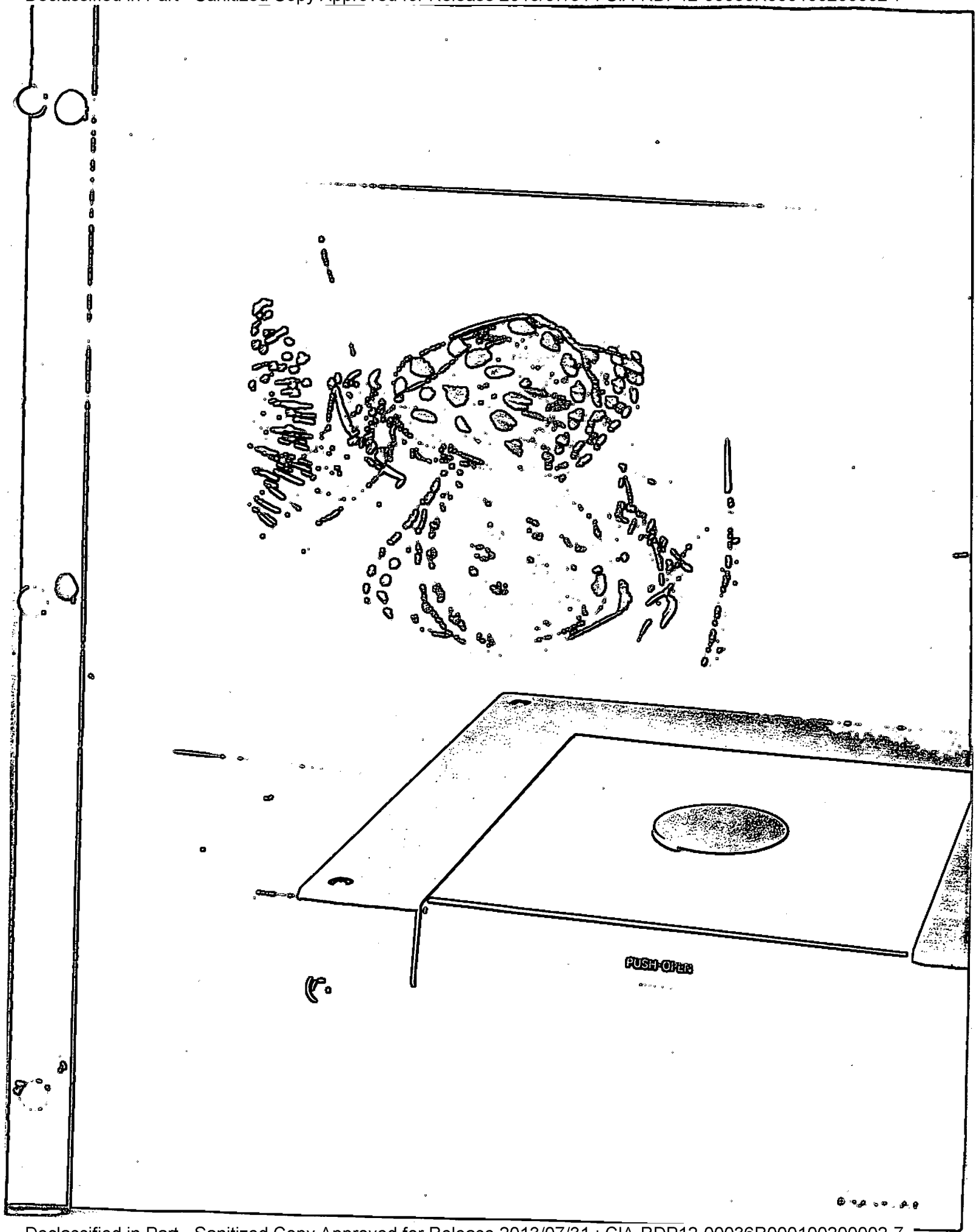




15,000 Color Pictures on One 8" Disc

Panasonic introduces the Optical Memory Disc Recorder, a device for the systematic storage and retrieval of color video pictures. The TQ-2020F is a compact unit employing a single semiconductor laser for recording and playback of up to 15,000 standard NTSC video frames on a single 8" (20cm) disc. Advantages over microfilm and other media are enormous. Using a video camera, VTR or VCR, you can record in real time with instant playback. Access time to any picture is just half a second. The system is ideally suited for use in Government, Industry, Educational and Medical applications. The high quality NTSC video picture can be displayed on an ordinary color monitor.

Also available are the TQ-2022F with Motion Playback, and the TQ-2021FB High Resolution B/W recorder.



Optical Memory Disc Recorder—Original Award Winning Technology

Semiconductor Laser

The Optical Memory Disc Recorder uses a single compact semiconductor laser for both recording and playback. Unit size is thereby dramatically reduced and reliability is improved. During recording, the laser beam is finely focused onto an 8" disc with pre-established concentric grooves. The disc rotates at 1,800rpm. The frequency modulated video input signal controls laser beam intensity, thereby creating a chain of dots having different reflectivity. Specifically, heat from the laser causes a change of the tellurium suboxide, vapor deposited as a film sandwiched between two layers of UV hardened polymer and PMMA substrate. Tellurium suboxide (TeO_x, $x \fallingdotseq 1$) provides high sensitivity and has other outstanding characteristics as a recording medium. The result is high quality *real time recording*—No processing or developing is involved. The recording is permanent and virtually impervious to normal variations in temperature or humidity. The sophisticated laser recording/pickup assembly is microprocessor controlled and employs precision tracking and focusing servo mechanisms to assure fast, reliable operation. The Panasonic Optical Memory Disc Recorder was selected by *Industrial Research & Development* as one of the most significant new technical products of 1981.

0.8 Micron Wide Recording Groove

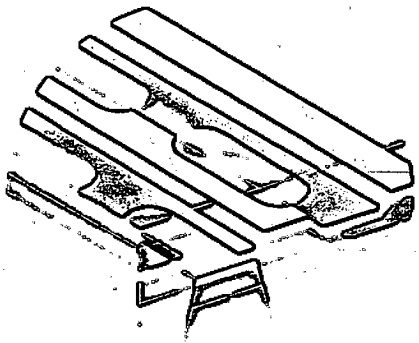
The concentric 0.8μ wide recording grooves appear as protruding ridges which serve as a guide for the microprocessor controlled recording/pickup assembly. Using a triaxial pickup with sensitive light receptors, the mechanism is able to move in all directions to maintain laser beam spot diameter of 0.8μ, exactly matching the recording grooves. Since the disc rotates at 1,800rpm, one revolution is 1/30 of a second—the same as one NTSC video frame. Addresses (1 through 15,000) are prerecorded three times at two points in each groove.

Access Time 0.5 Second

To find a track, simply select the desired picture's address on the keyboard. The digital display provides a 5-digit readout. The microprocessor then calculates the distance from the present pickup location and a linear motor moves the pickup assembly to within 15 frames (tracks or grooves) of the desired address. At this point, the electromagnetically controlled pickup itself starts twisting its "head" back and forth, using the laser beam to look for the precise address. When it finds the address, distance is calculated again and the pickup moves to right under the correct track. All this takes only about half a second, usually less. On-line (computer) control is also possible for recording and playback.

High Quality Picture with Non-Contact Tracking

During playback, laser beam power is about 1/10 of that used for recording so there is no chance of damaging the recorded picture. Since the pickup uses a laser beam there is no physical contact or wear, picture quality is in no way degraded no matter how many times the disc is played. A single track can be played back endlessly without any adverse effect on the recorded information or the pickup. This is a great advantage over video tape which is soon damaged if still picture playback continues for even a few minutes, not to mention the danger of clogging the heads with tape residue.



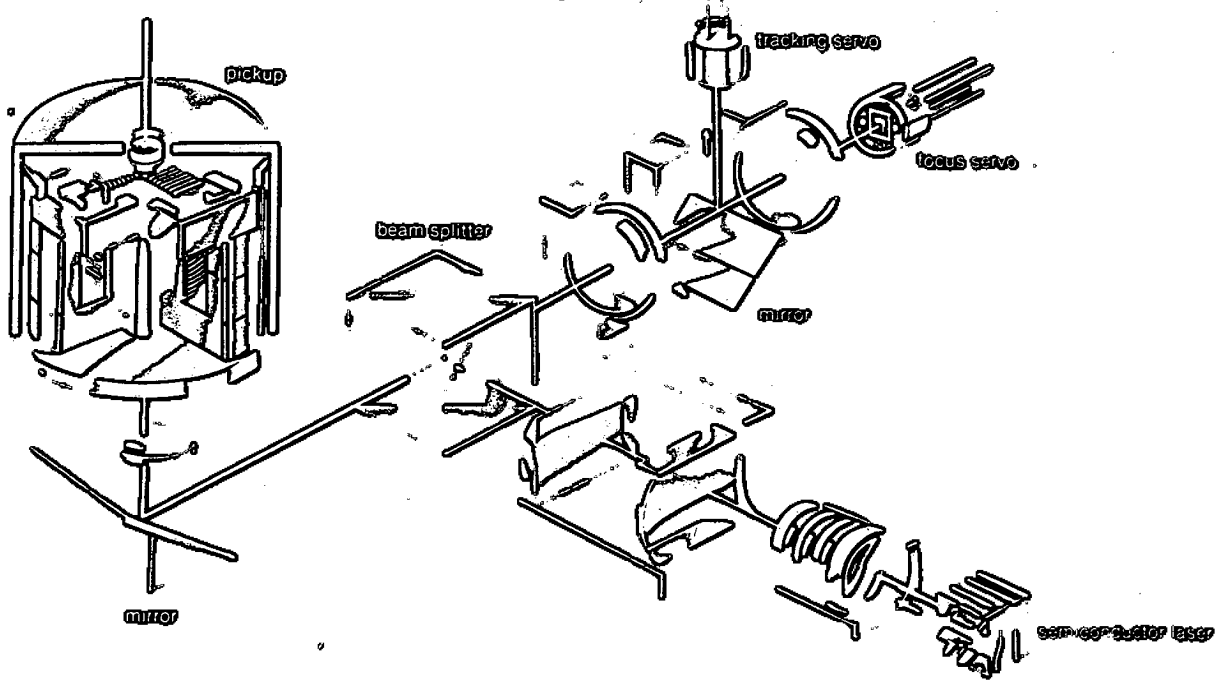
PMMA (Poly Metha Methyl Acrylate) Protective Layer
As a protective layer on both sides of the disc, PMMA has excellent flatness and polarization characteristics. The external surface is coated with a hard polymer for extra durability and long shelf life.

UV Light Polymerized Layer
Grooves are created by a stamper and the special polymer is hardened by ultra-violet light.

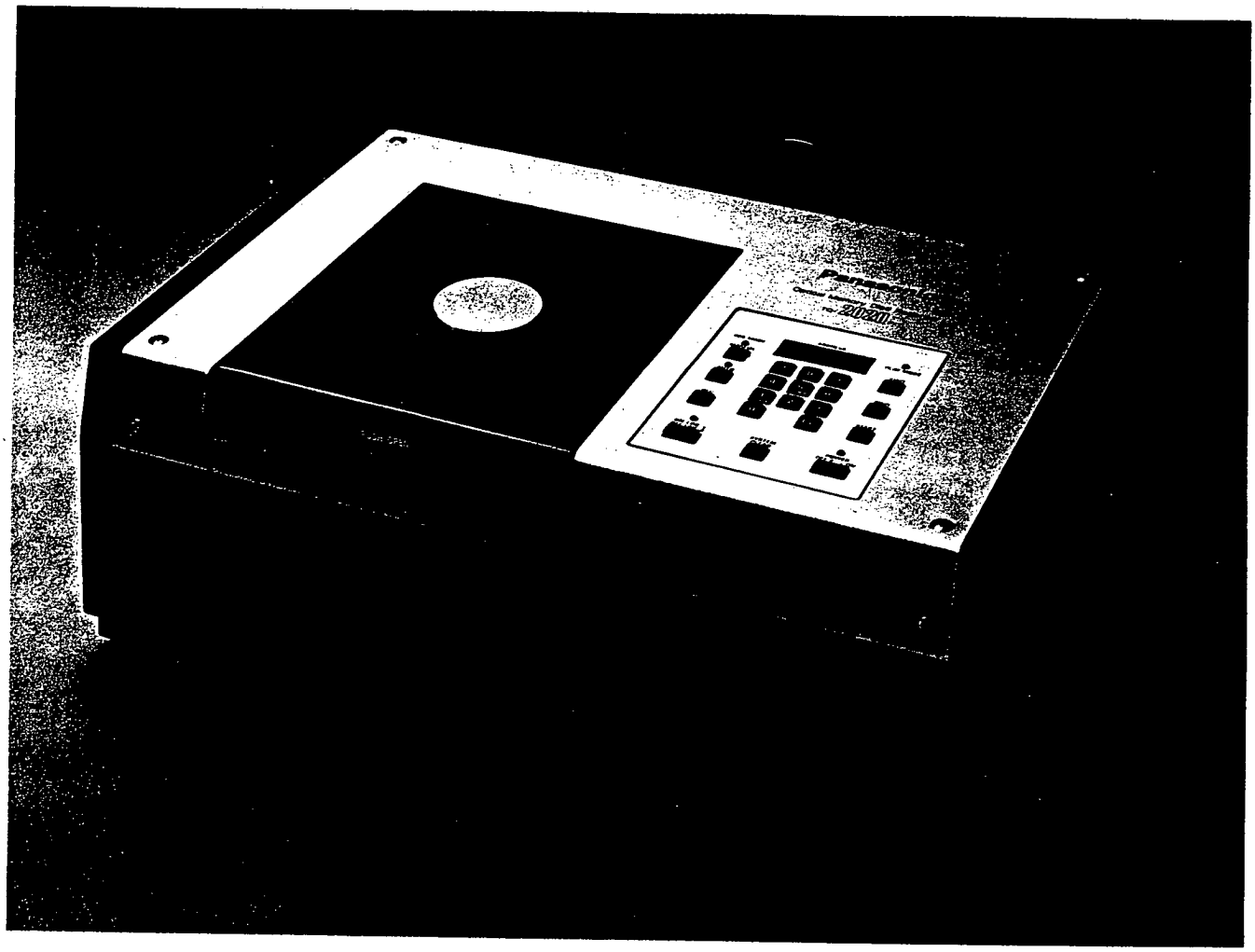
TeOx Recording Layer
Heat sensitive tellurium suboxide film is vapor deposited onto the stamped grooves in the UV polymer layer. This layer stores video signal information in the form of chains of dots.

UV Layer

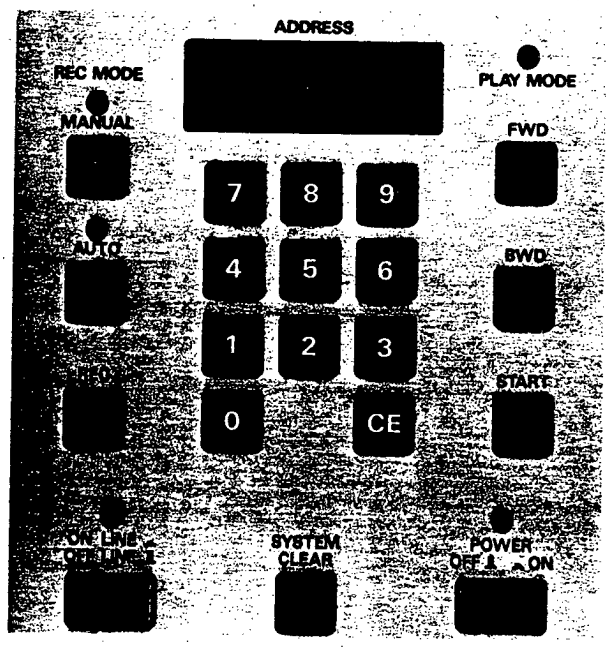
PMMA Layer



TQ-2020F Color Still Video Recorder



The Panasonic TQ-2020F provides a space saving and time saving alternative to conventional picture filing methods such as microfilm. Color picture recording can be made from any standard (NTSC) video signal source such as a video tape recorder, video camera, or video tuner. Both manual and automatic (computer controlled) recording is possible. Recording is in "real time" with no processing required. Picture storage capacity is enormous—up to 15,000 still video frames on a single 8-inch disc. Access time is also astounding—it takes only about half a second to find any picture on the disc. Operation is very easy: Direct address selection keys let you pinpoint any desired frame or you can "manually" cue the pickup in and out. Address and error indications are shown on an easy-to-read 5-digit display. A rear panel terminal port (RS232C) is provided for interfacing with computers and accessory equipment to permit automatic operation, on-line control, and other versatile applications.



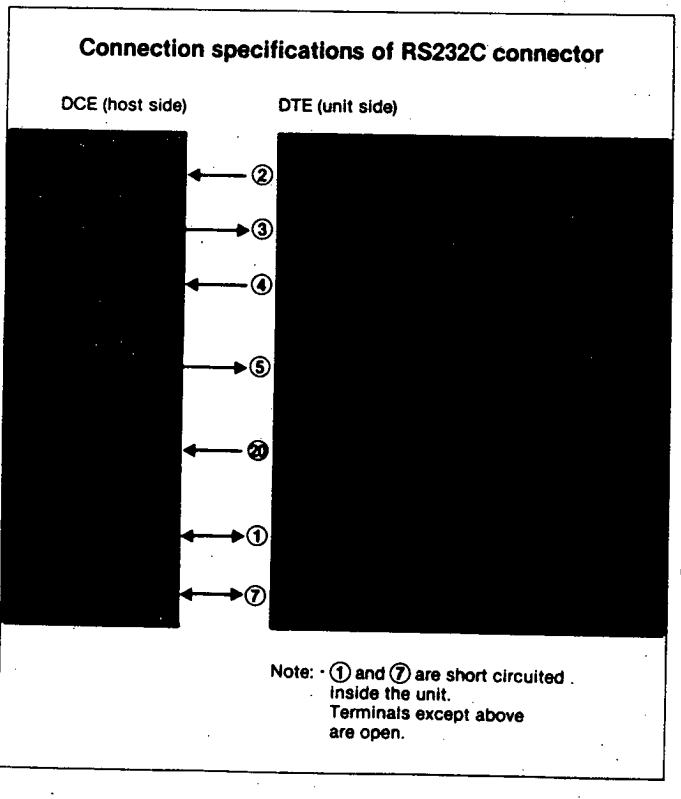
Simple Operation

Recording

After connecting a video input to the rear panel terminal, load a disc, turn on the power, and use the control keys (ten key) to select the address of the track that you want to record on. Touch the start key and the address will be shown on the display. Up to this point, the unit is in the playback mode. Touch the manual key to switch to the record standby mode. This completes preparation.
To begin recording, press the rec key. You can monitor the recorded picture by keeping the key depressed. When you release the rec key, the address number advances one digit. To record at the next address, simply press the rec key again. Using an input control pulse, automatic recording can be performed at a rate of better than one frame per second.

Playback

Playback procedure is like preparation for recording. You put on a disc, turn on the power, and use the control keys to select the desired track address. While the disc is getting up to rated speed of 1,800rpm, the monitor will show a test signal. When the desired track is reached, the picture will be displayed on the TV monitor. If the selected track has no recording, gray pattern will appear on the monitor TV screen. To see the pictures on nearby tracks, use the FWD and BWD keys. Addresses begin from the innermost track. If a problem occurs (during recording or playback), the appropriate error code will appear on the display.



Applications

Government

- Identification
- Signature collation
- Face collation
- Finger-print collation
- Document collation

Industrial

- Real estate guides
- Travel guides
- Product catalogs
- Employee training
- Office automation
- Personnel records
- Store guides
- Leisure guides
- Building construction
- Graphic arts
- Information map
- Design example
- Sightseeing information
- Journalism
- Document storage

Educational

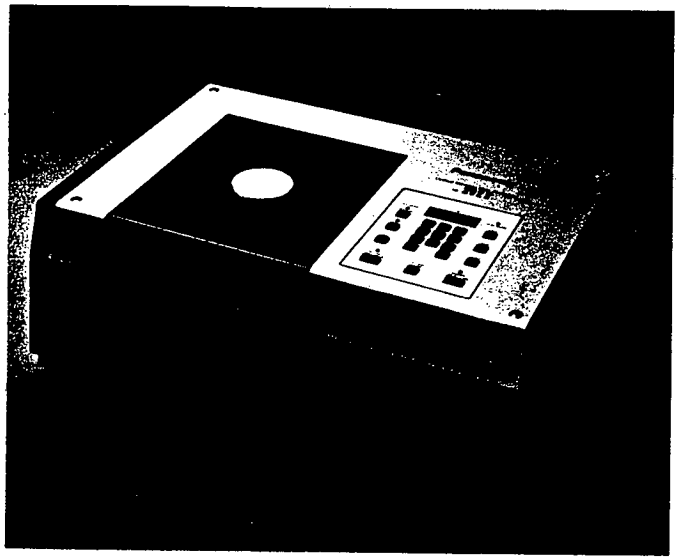
- Interactive
- Self-instruction
- Library picture files
- Language teaching
- Student records
- Meteorological record storage

Medical

- Medical training
- Diagnostic reference
- X-ray image
- Radioisotope image
- Computer tomography
- Echocardiography
- Acoustic image
- Microscope photograph

TQ-2022F

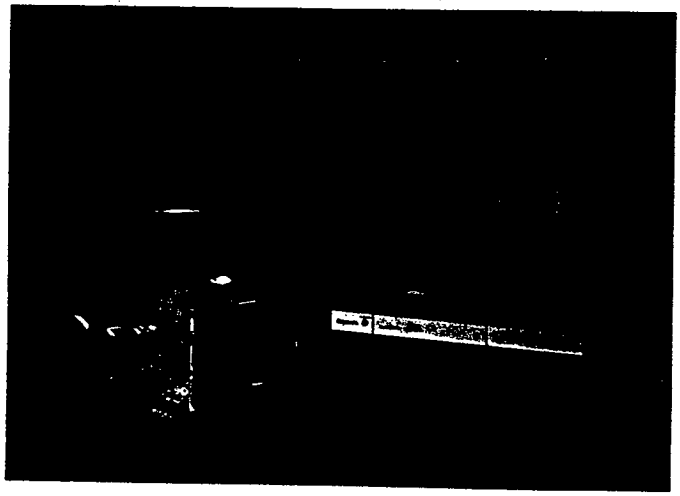
Color Still Video Recorder with Motion Playback



The Panasonic TQ-2022F has all the features of the TQ-2020F plus the capability for motion playback through an external time base corrector. Although frames are recorded individually as still pictures (as with the TQ-2020F) they can be played back sequentially at a rate of 30 frames per second to produce a normal moving video picture. This capability is useful for scanning discs at high speed. It also lends itself to animation study and other applications that require motion playback of still frame recordings. Motion playback of an entire 15,000-frame disc is completed in 8 minutes.

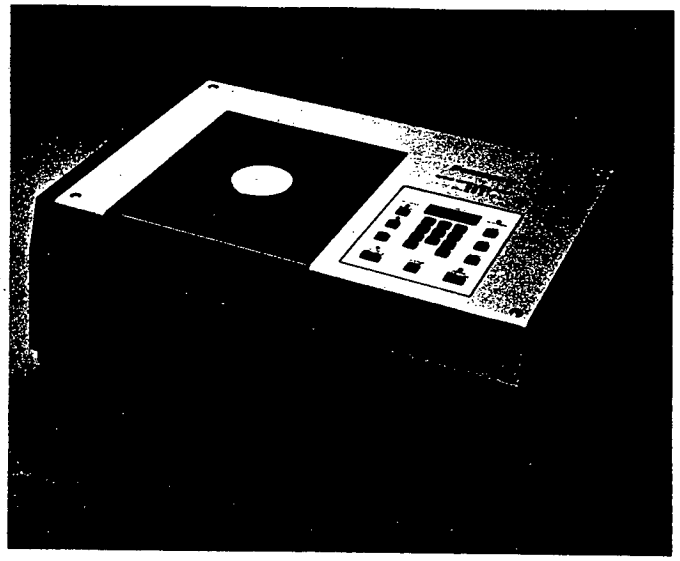
Features

- Fast 0.5sec. access time.
- Real time recording without processing.
- Compact size.
- Rugged, dependable construction.
- Interfacing capability with computers and other equipment with RS232C port.
- Convenient direct access keys.
- Complete compatibility with TQ-2020F.
- Easy-to-read 5-digit frame display.



TQ-2021FB

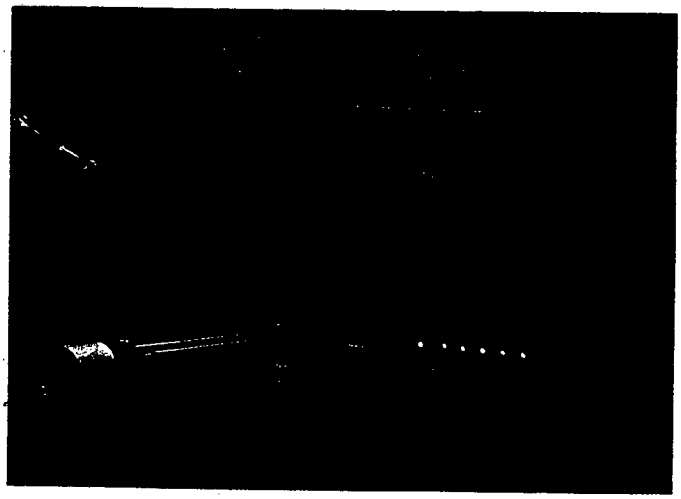
High Resolution B/W Still Video Recorder



Highly suited to document filing applications, the TQ-2021FB has very high picture resolution of 450 TV lines. Up to 10,000 black-and-white still pictures can be stored on a single 8" disc. Using a high resolution B/W video camera for recording and a high resolution monitor for playback, you can expect extremely fine reproduction of detail. As with other Panasonic Optical Memory Disc Recorders, you enjoy the convenience of real time recording and split-second access time.

Features

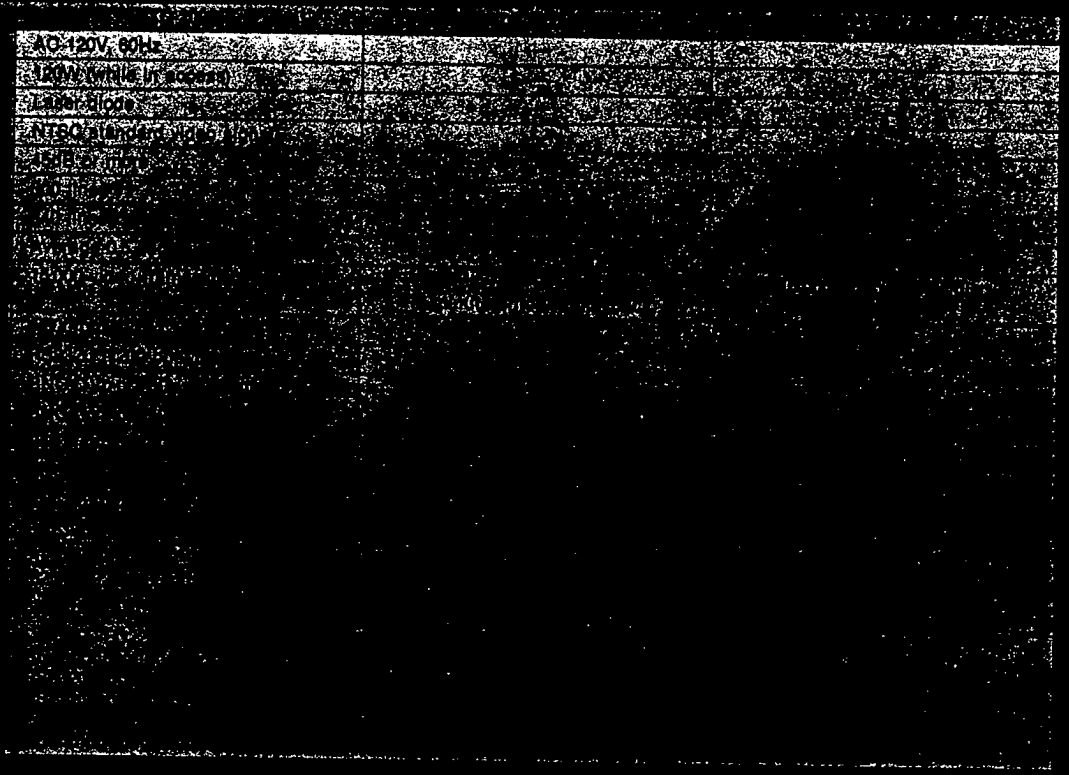
- High resolution of 450 TV lines.
- Ideal for document storage.
- RS232C terminal port for computer interfacing.
- Convenient control keys for direct access.
- Large digital display.
- Space saving compact dimensions.
- Rugged, reliable construction.



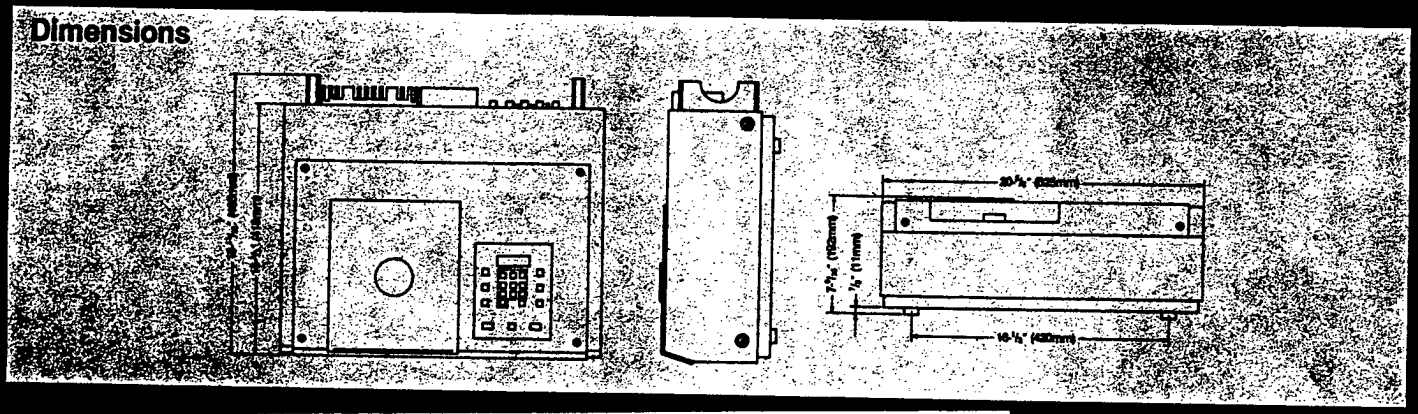
Panasonic

Declassified in Part - Sanitized Copy Approved for Release 2013/07/31 : CIA-RDP12-00036R000100200002-7

Specifications

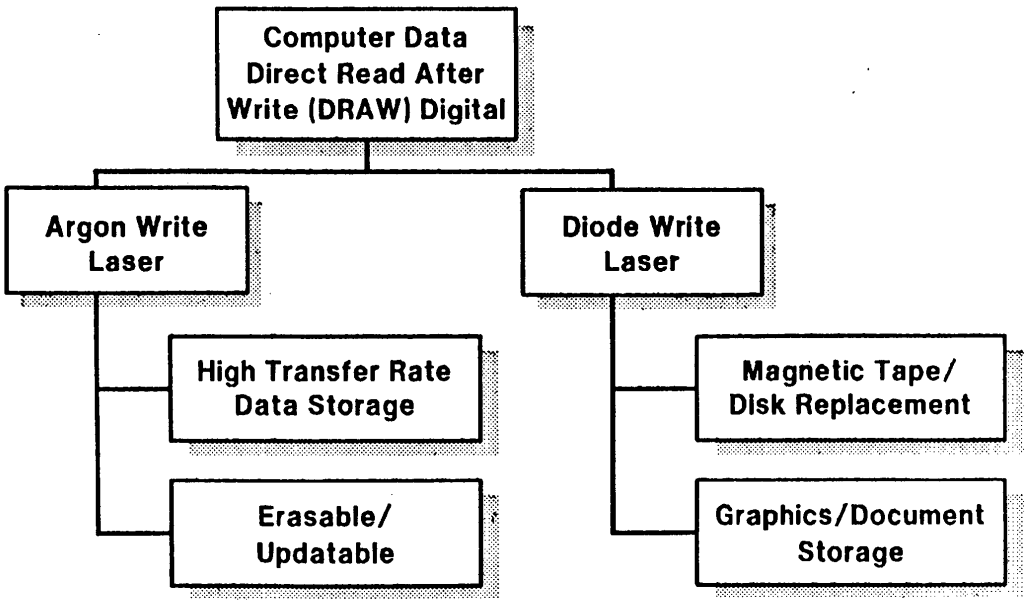


Dimensions

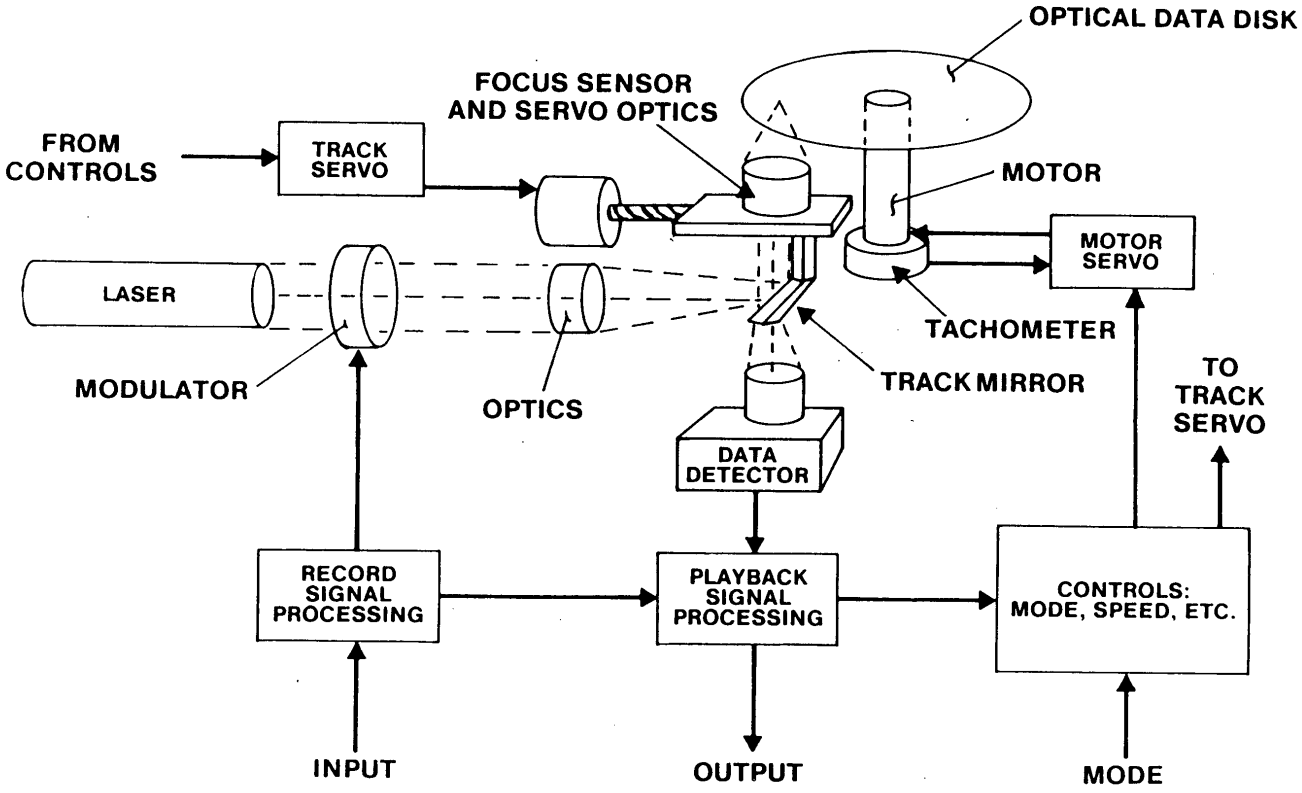


OPTICAL DISK

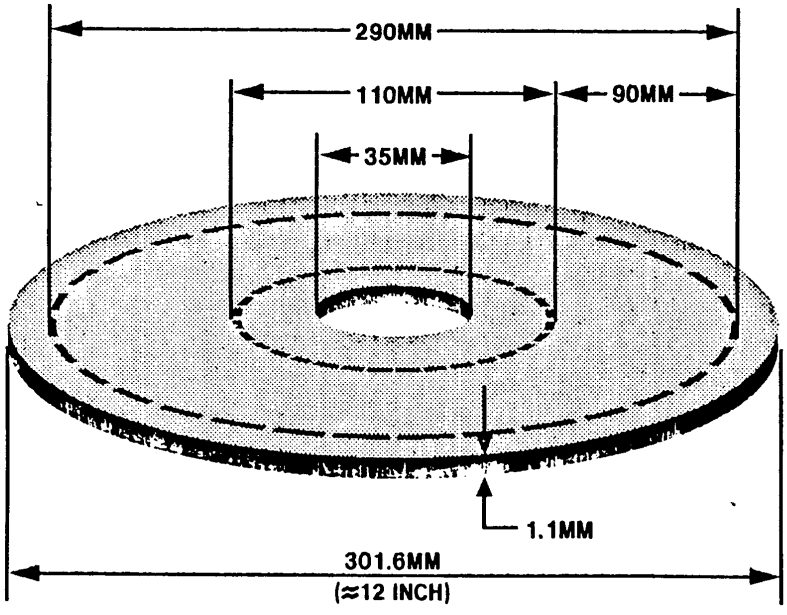
COMPUTER DATA DISC



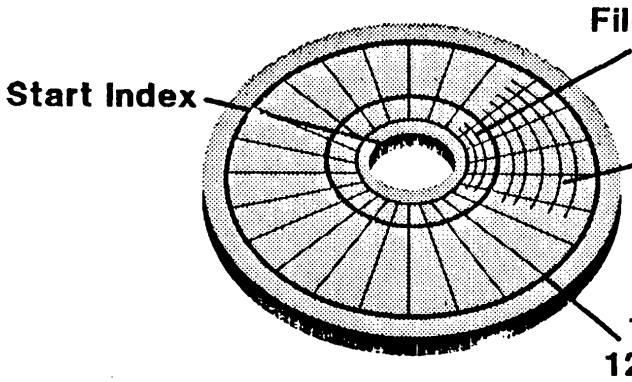
BASIC BLOCK DIAGRAM
OPTICAL DATA DISK SYSTEM



OPTICAL DATA DISK DIMENSIONS



PROPOSED RCA OPTICAL DATA DISK DATA FORMAT



User Data:

Per Track	8.8×10^5 Data Bits
Per Disk	4.4×10^{10} Data Bits

DATA CAPTURE & STORAGE
- INSURANCE RECORDER
- ARCHIVING
- RECORD-KEEPING

IMAGE EXPLOITATION
- TACTICAL/STRATEGIC
- EARTH RESOURCES
- METEOROLOGICAL
- MEDICAL
- GEO-PHYSICAL

TEXT & GRAPHICS
- SOCIAL SECURITY FILES
- CORPORATE FILES
- FINGER PRINT
- LAND FILE RECORDS
- GOVERNMENT LIBRARIES
- MAPS
- DRAWINGS

SCIENTIFIC COMPUTING
- INTERACTIVE TERMINALS
- HEURISTIC MODELING
- IMAGE SIMULATION
- LARGE ALGORITHMS

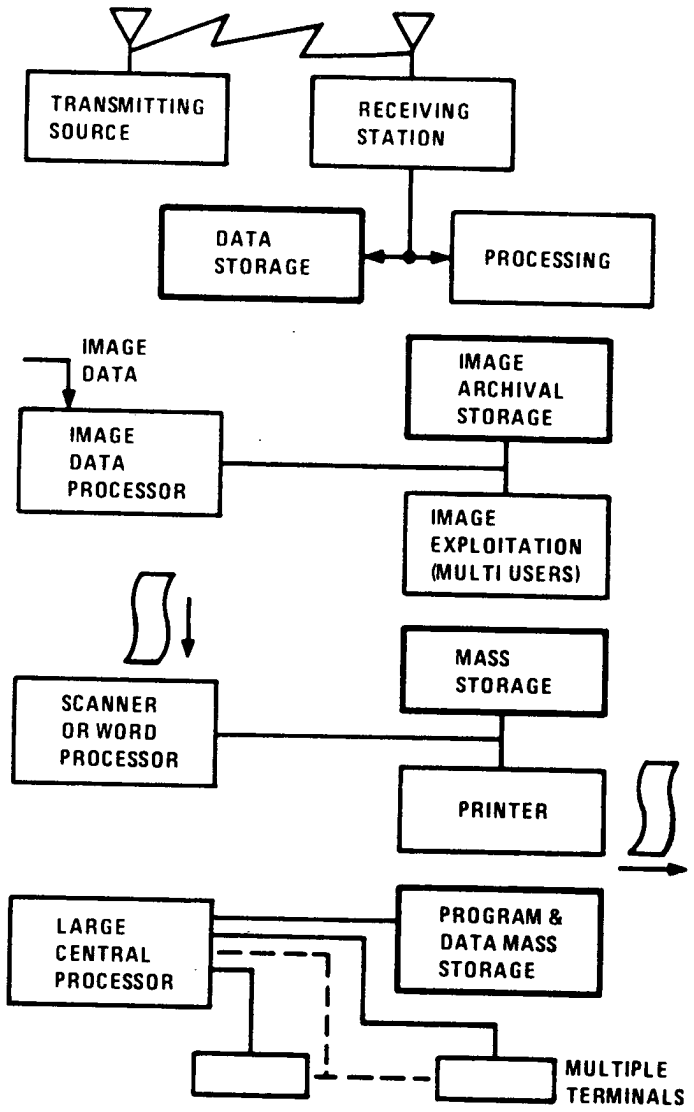


FIGURE 1. PRINCIPAL AREAS OF INTEREST.

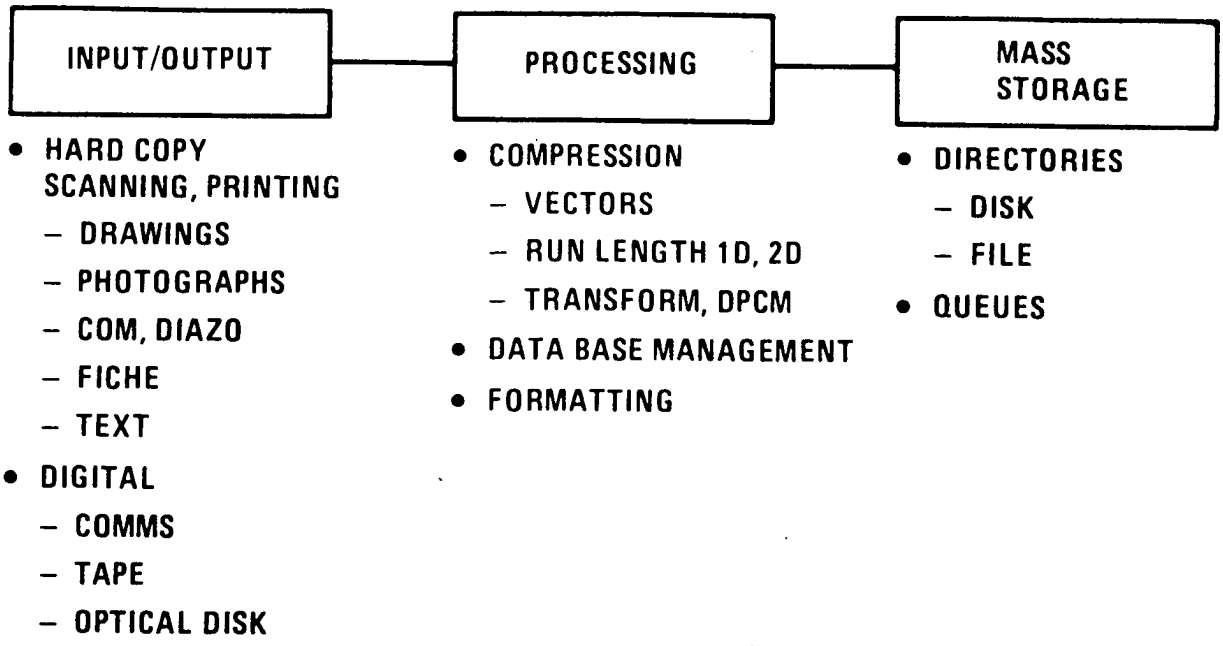


FIGURE 10. GENERALIZED DOCUMENT STORAGE AND RETRIEVAL SYSTEM.

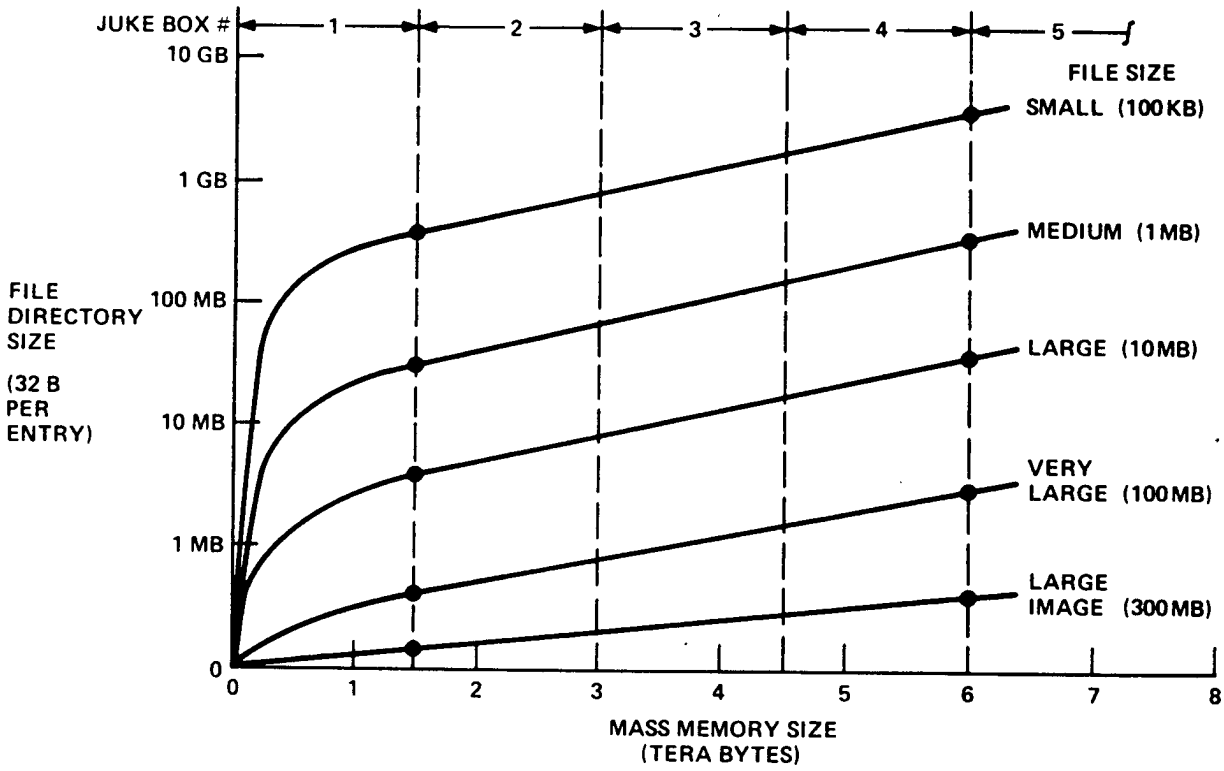


FIGURE 11. TYPICAL FILE DIRECTORY SIZES.

Typical Read-Write Optical Data Disk Specifications

- Removable Single Platter
- Storage Capacity =
  10^{10} Bits - 1250 Million Bytes
- Direct Read After Write (DRAW)
- Write Once, Read Often
- Data Rates = >8 Megabit/Seconds
- Corrected Error Rates:
  $<10^{-8}$ = <90 Days
  $<10^{-7}$ = >90 Days <5 Years

prc

Typical Read-Write Optical Data Disk Specifications II

- 54,000 Tracks of 1.85×10^5 Bits Each
- Average Track Access Time: 5 Seconds
- Local Track Access Time: 60 Microseconds/Track
- Projected Costs in 1985:
  Drive $\approx$ $120,000
  Storage Medium $\approx 10^{-4}$ Cents/Bit

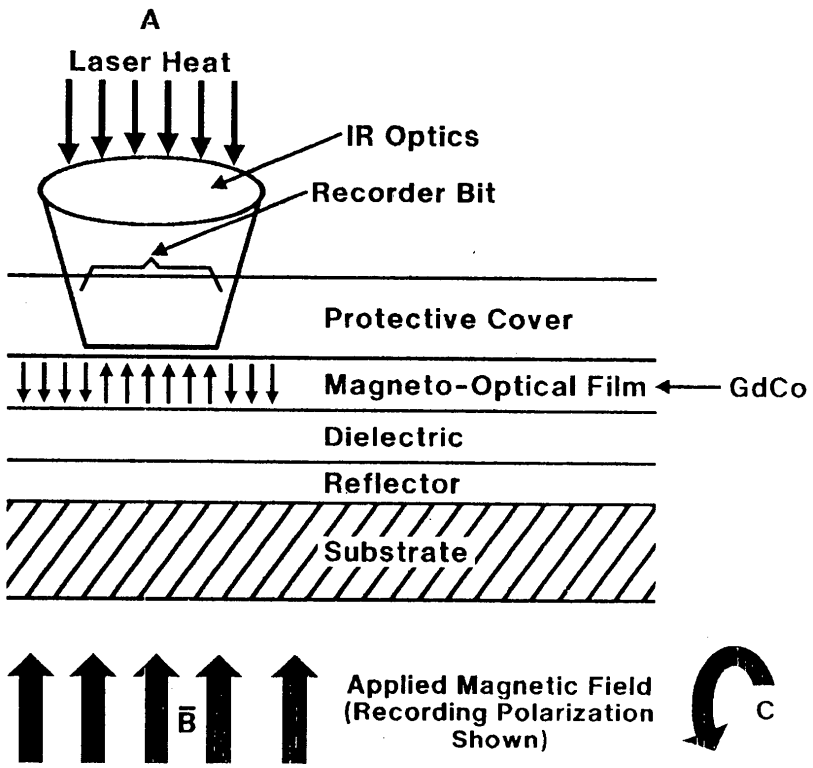
prc

Erasable Magneto-Optic Storage Medium II

- Erasable and Re-Recordable
- Magnetic Domains Rotate Polarization of Light Passing Through
- Direction of Domain Field Is Changed by Laser Heating to Critical Temperature and Applying External Magnetic Field
- Magneto-Optic Effect Is Relatively Weak, Requires Somewhat More Complex Optical Detection Circuitry

prc

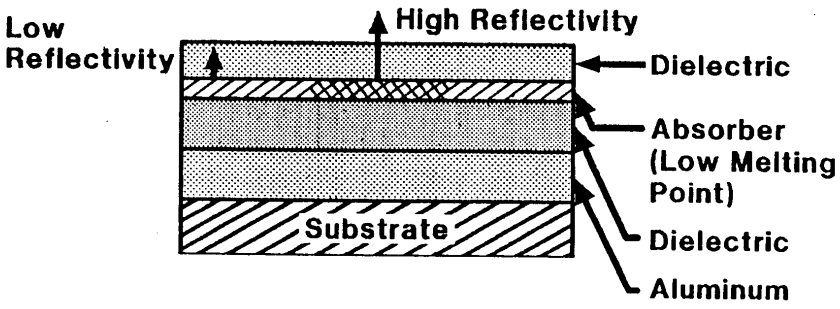
Erasable Magneto-Optic Storage Medium



prc

Trilayer Recording Media

C.) Reversible Non-Ablative Laser Recording Laboratory Experiments

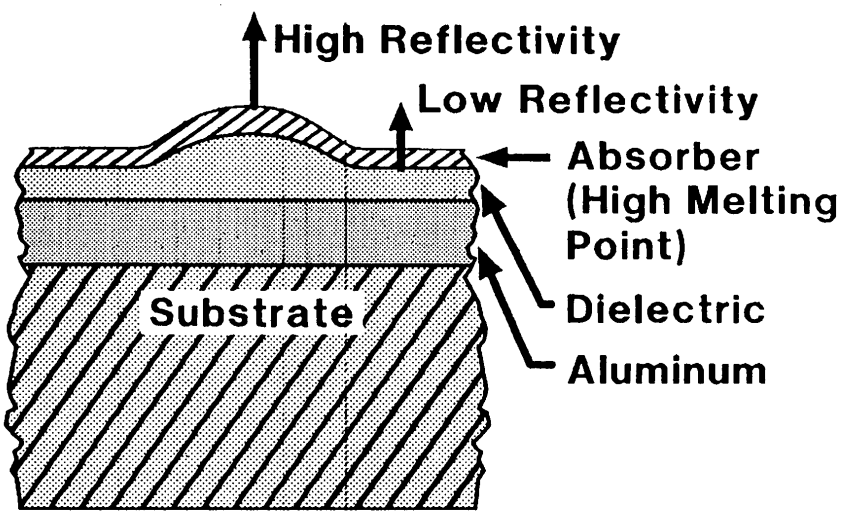


Recorded Region Can Be Restored by Light Energy. Up-to 50 Record/Erase Cycles Have Been Recorded.

prc

Trilayer Recording Media

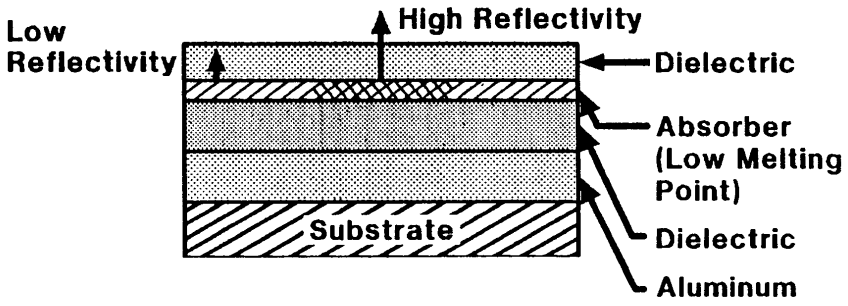
B.) Bubble-Forming Non-Ablative Laser Recording



prc

Trilayer Recording Media

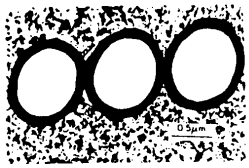
C.) Reversible Non-Ablative Laser Recording Laboratory Experiments



Recorded Region Can Be Restored by Light Energy. Up-to 50 Record/Erase Cycles Have Been Recorded.

prc

OPTICAL DATA DISK SURFACE
SCANNING ELECTRON MICROSCOPE IMAGE OF 3 DATA BITS



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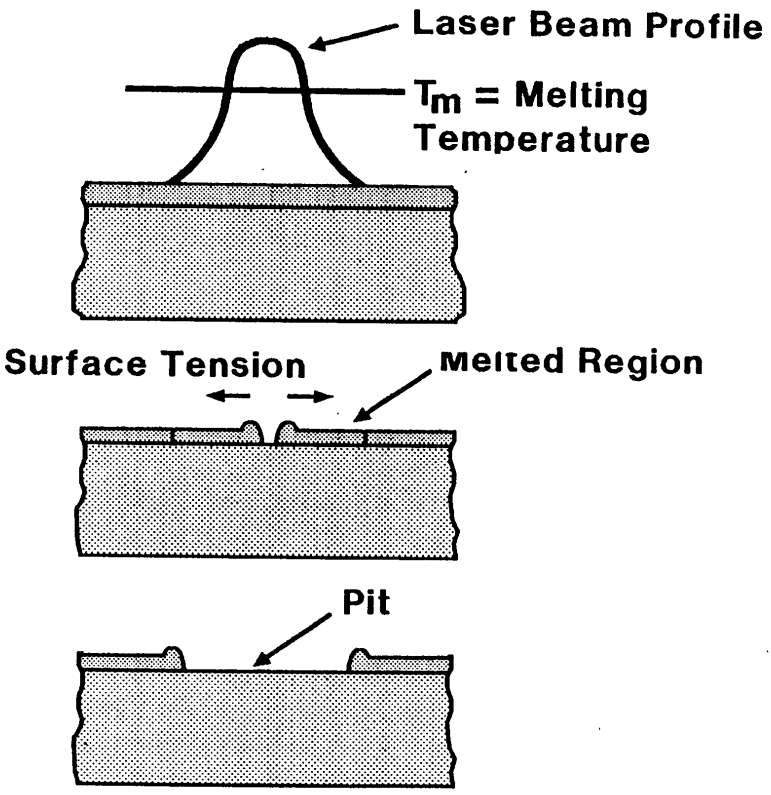
Media Thermal Recording Process

Ablative Laser Recording



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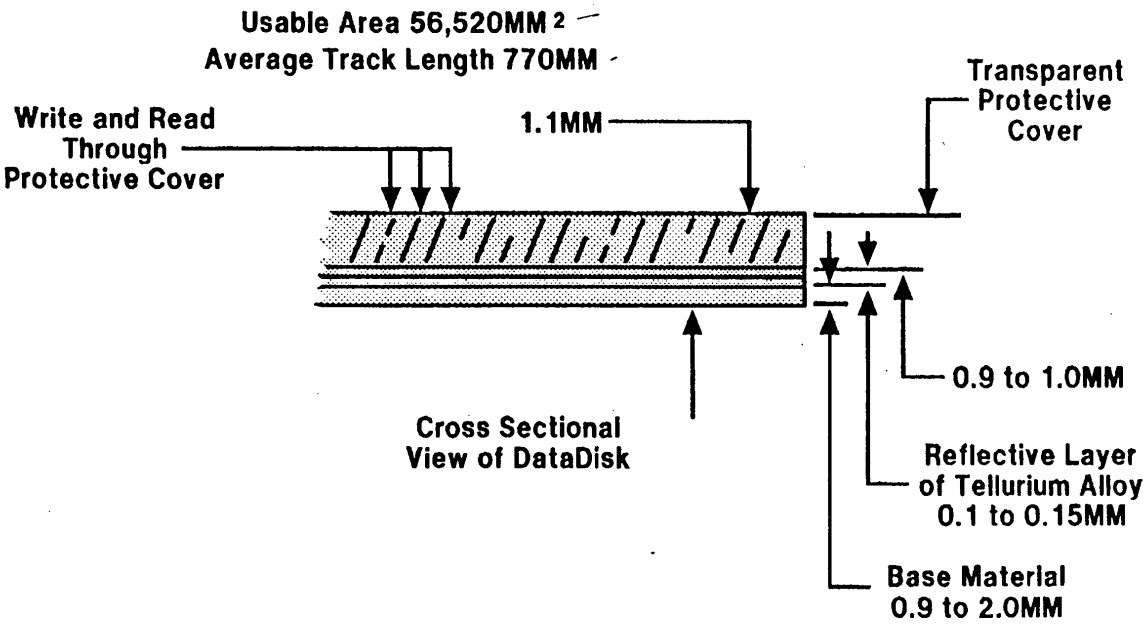
OPTICAL DATA DISK DIMENSIONS
(CONTINUED)



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Attachment B

OCR

BIOSTAR

PROGRAM

BIOGRAPHIC SIORAGE & RETRIEVAL (BIOSTAR)

A PROGRAM TO AUTOMATE THE OFFICE OF CENTRAL REFERENCE'S (OCR) BIOGRAPHIC INFORMATION FILE

- o CONVERSION
- o INITIALIZATION
- o STORAGE
- o RETRIEVAL

CIA

OCR PROBLEM

CONFIDENTIAL

FEBRUARY 198

- MAINTAIN BIOGRAPHIC FILES ON 3 MILLION PEOPLE WORLD WIDE
- FILE NOW CONTAINS 14 MILLION ITEMS
- FIVE GEOGRAPHIC DIVISIONS (225 PEOPLE)
- ADDING 650,000 ITEMS PER YEAR (2000 DAY)
- EVERY OPERATION IS MANUAL
- FILE NOW CONSUMES 72,000 CU. FEET IN HQ

PROPOSED SOLUTION

CONFIDENTIAL

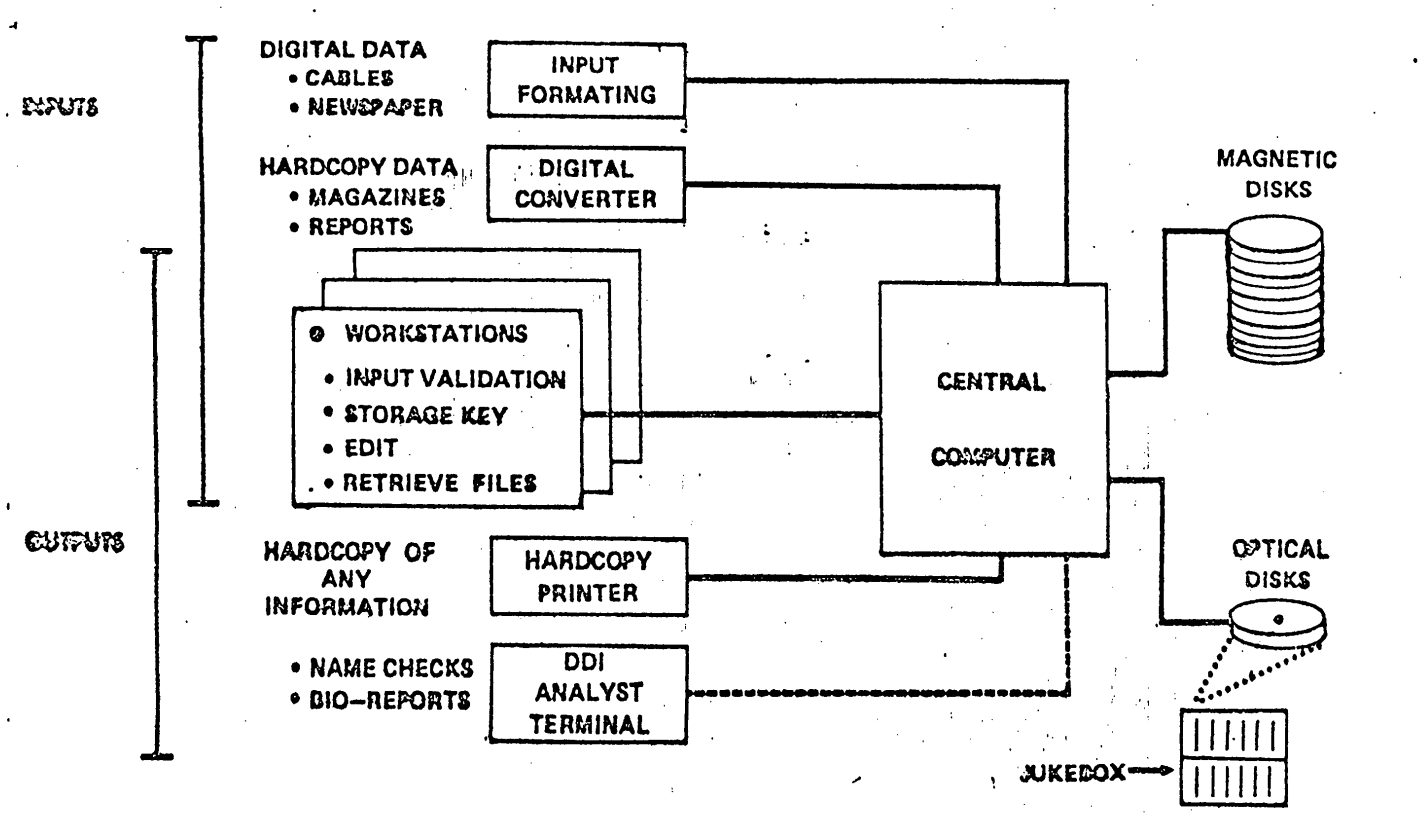
FEBRUARY 1983

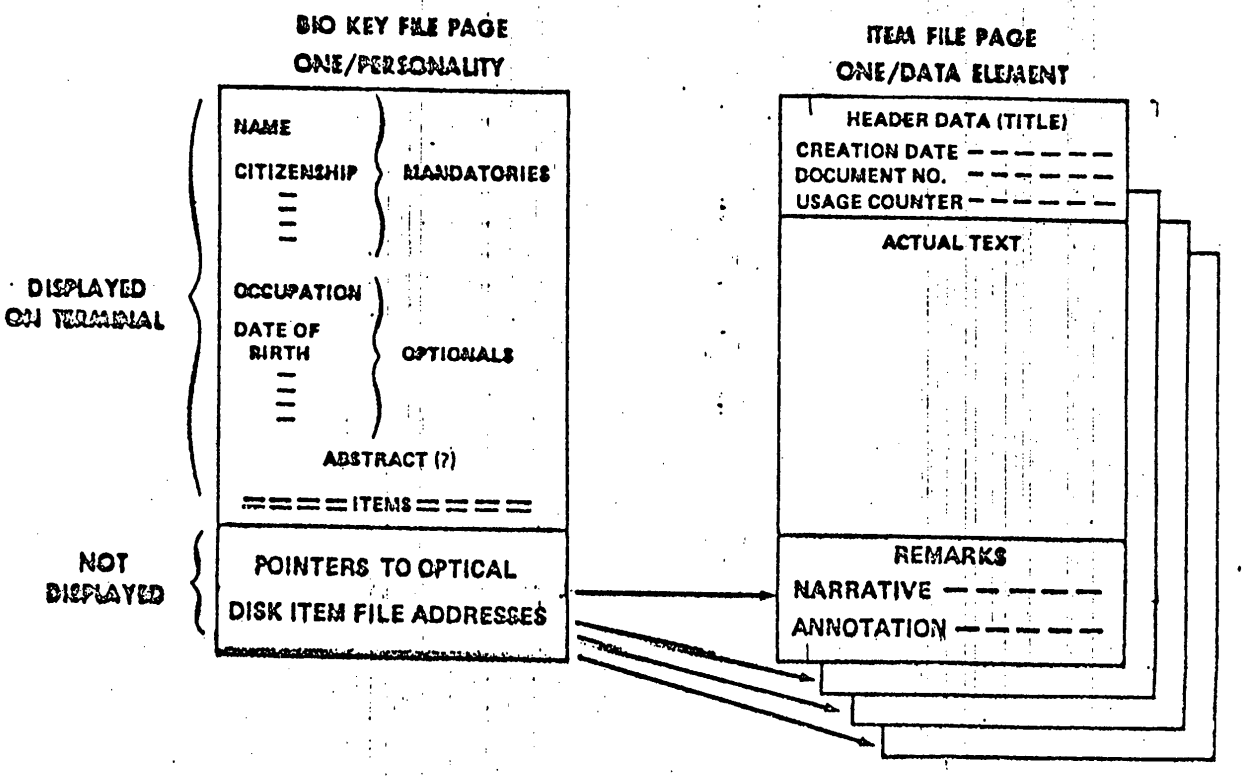
- o INTEGRATED SYSTEM
- o DEVELOPED BY DDI/ODE TEAM
  - BIOSTAR WORKING GROUP
  - OD&E
  - CONTRACTOR(S)
- o PHASED APPROACH WITH BUILT-IN TESTING AND DECISION POINTS
- o DDI APPROVAL OF REQUIREMENTS
- o CAPITALIZE ON OD&E AND NSA PROGRAMS

Proposed Solution

CONFIDENTIAL

FEBRUARY 1983





PROGRAM WILL CONTAIN TWO STUDIES LEADING UP TO MULTIPHASED ACQUISITION

- o PHASE I ($800K)
  - EVALUATE DIGITAL CONVERSION AND COMPRESSION ALGORITHMS
  - DEVELOP A UTILITY TEST BED
    - oo CONVERT HARDCOPY TO DIGITAL DATA
    - oo COMPRESS AND DISPLAY BY DIFFERENT METHODS
    - oo DETERMINE DISPLAY REQUIREMENTS BY OCR TESTING
  - EVALUATE WORKSTATION DESIGN
  - GENERATE PRELIMINARY INTEGRATION/CONVERSION PLAN
  - ROM COST FOR BUDGET INPUT

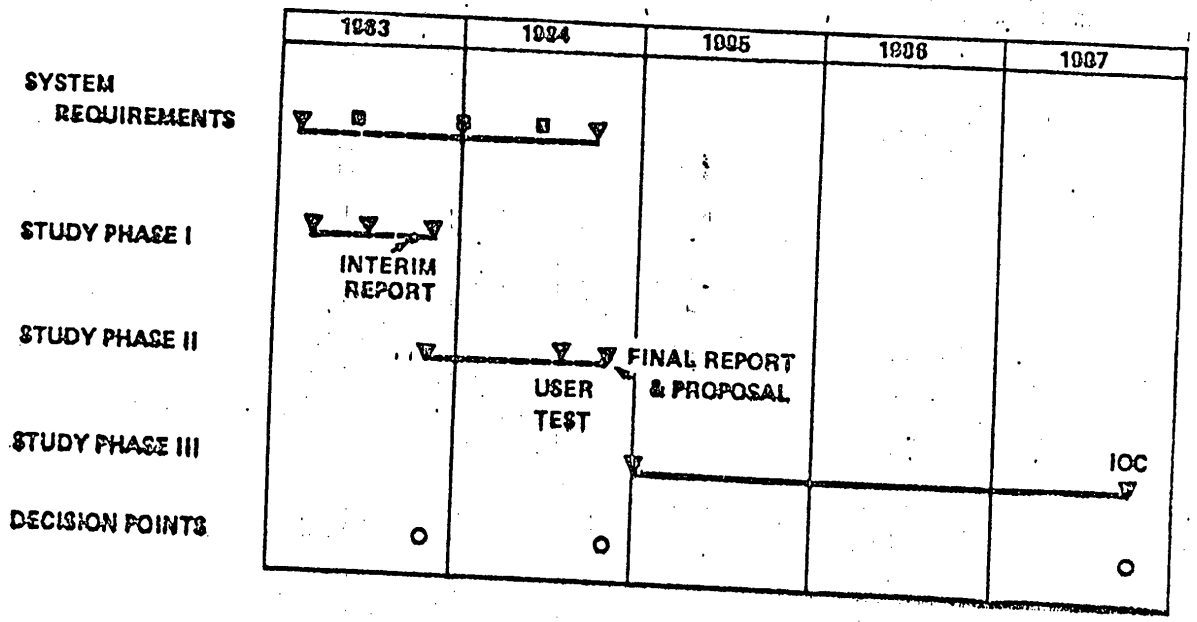
- PHASE II (1,200)*
  - IMPLEMENT ENGINEERING MODEL
    - DEMONSTRATE AND TEST COMPLETE OPERATIONAL CONCEPT
  - DEFINE FINAL WORKSTATION DESIGN
  - EVALUATE COMPUTER REQUIREMENTS
    - HARDWARE
    - DATA BASE MANAGEMENT SYSTEM
  - DEVELOP PROGRAM DOCUMENTATION
    - SPEC
    - ICD'S
  - GENERATE PROPOSAL
    - TECHNICAL
    - COST

* ASSUMES 1.2 MILLION NOW BUDGETED .5 MILLION

- PHASE III (10-15 MILLION DOLLARS)
  - ACQUIRE SYSTEM FOR ONE DIVISION
  - INTERFACE WITH HQ RESOURCES
  - START OPERATION IN ONE DIVISION
  - TEST FOR FUTURE GROWTH TO OTHER DIVISIONS
- PHASE IV (5-10 MILLION TOTAL)
  - IMPLEMENT OTHER FOUR DIVISIONS

Schedule

CONFIDENTIAL
FEBRUARY 1983



COORDINATION POINTS

PROGRAM BENEFITS

CONFIDENTIAL

FEBRUARY 1983

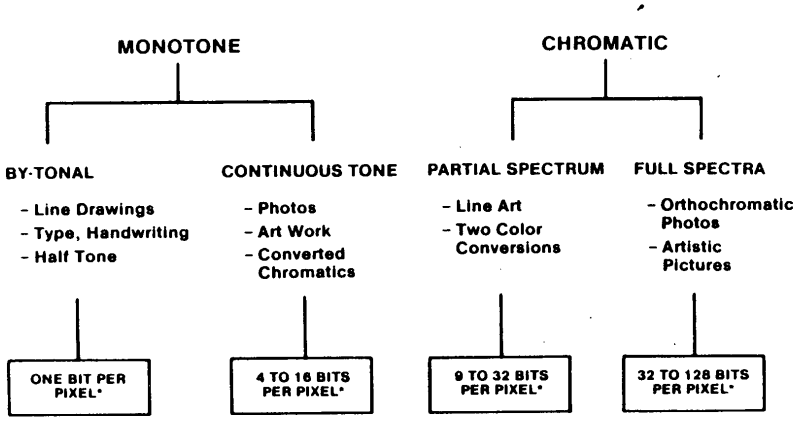
- o REDUCTION OF FLOOR SPACE
- o IMPROVE WORKING CONDITIONS
  - REPLACE THE MENIAL LABOR INTENSIVE JOBS
- o REDUCE HIGH COST OF PURGING
- o ELIMINATE MISFILES
- o POSSIBLE REDUCTION IN LABOR FORCE
- o IMPROVE RETRIEVAL
  - BY KEY
  - ACROSS NATIONALITIES
- o ELIMINATE MULTIPLE FILING
- o FOIA RETRIEVAL SORTING
- o FILE SURVIVABILITY

Attachment C

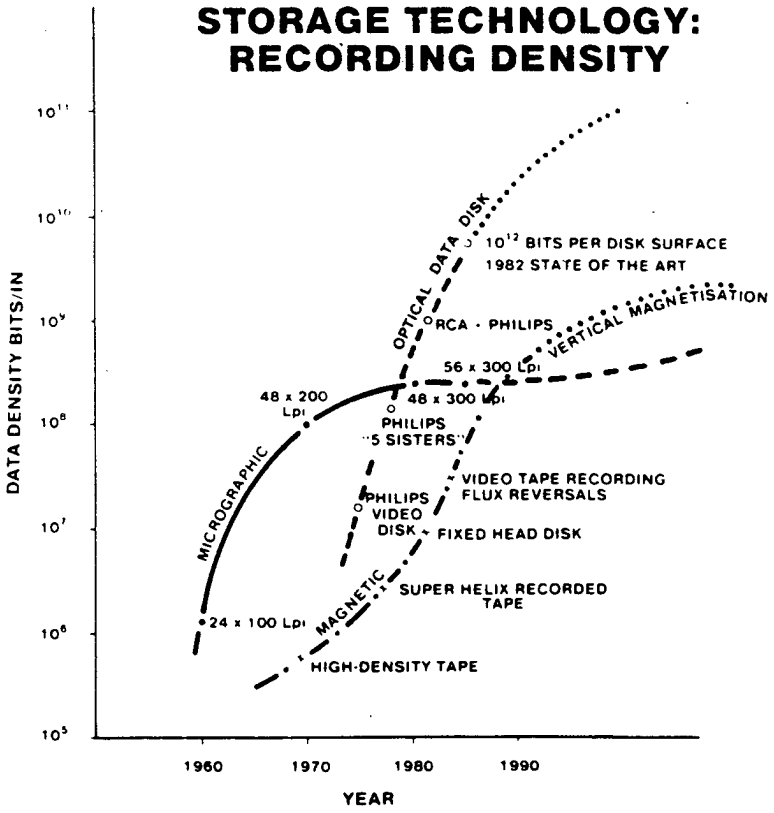
STORAGE CAPACITY/

ACCESS TIMES

TYPES OF IMAGES



* PIXEL = PICTURE ELEMENT



COMPARISON OF MEMORY SYSTEMS

TYPE	MILLION CHARACTERS (MEGA BYTES)	NUMBER OF BITS
Human Brain	125,000,000	10^{15}
U.S. National Archives	12,500,000	10^{14}
RCA Optical Data Disk Mass Memory System	1,250,000	10^{13}
IBM 3850 Magnetic Cartridge Mass Memory System	250,000	2×10^{12}
Encyclopedia Britannica Text Only	12,000	10^{11}
Optical Data Disk One Side	4,000	5×10^{10}
IBM 3380 Magnetic Disk Drive*	1,200	10^{10}
Hard Magnetic Disk Pack	313	2.5×10^{9}
Floppy Disk	2.5	2×10^{7}
48 X COM Microfiche	1.6	1.3×10^{7}
Book, Text Only	1.3	10^{7}

* Introduction Expected by Fall 1982

PROJECTED ALPHA/NUMERIC STORAGE CAPACITY OF OPTICAL DATA DISK SYSTEMS

Year	System Type	Gigabytes	Alpha/Numeric Text Pages
1980	Current Disk	2.5	4,120
1982	Laboratory Disk	25	41,200
1985 -1987	Projected Disk	250	412,000
1990	Optical Disk Pack	2,500	4,120,000
1990 -1994	Optical Juke	25,000	412,000,000

INDUSTRY ACCEPTED STANDARDS

For 216 x 280mm (8½ x 11-Inch) Documents

TYPE OF DOCUMENT	MIN PIXEL SIZE (INCH)² MM²	LINES PER DOCUMENT DEPTH	DIGITAL BI-TONAL		DIGITAL 16 SHADES	
			BITS/ LINE	BITS/ DOCUMENT	BITS/ LINE	BITS/ DOCUMENT
TELEPHONE DIRECTORY	.2 (.008)	2750 (250/INCH)	2125	5.84 M	8500	23.4M
COM PRINT-OUT	.25 (.010)	2200 (200/INCH)	1700	3.74 M	6800	11.6M
BUSINESS LETTER	.32 (.013)	1760 (160/INCH)	1360	2.4 M	5440	7.4M
"B"-SIZED ENG. DRAWING REDUCED TO "A"	.32 (.013)	1760 (160/INCH)	1360	2.4 M	5440	7.4M
"A"-SIZED ENG. DRAWING	.5 (.02)	1100 (100/INCH)	850	.94 M	3400	2.9M
HANDWRITTEN DOCUMENT	.7 (.03)	748 (68/INCH)	578	.433M	2312	1.4M

STORAGE DEVICE	CAPACITY (G BYTE)	SIZE (GB/FT^3)	ACCESS TIME (SEC)	ACCESS TIME (MS/GB)
MAGNETIC DISK (WINCHESTER)	.001 – 0.5	.03	.02	40
SINGLE OPTICAL DISK DEVICE	2	0.6	0.5	20
3850 MASS STORAGE	35 – 472	0.5	2.5	5
MULTI DISK OPTICAL DEVICE	1250	10	5	4

FIGURE 4. PARAMETRIC COMPARISONS OF FOUR MASS MEMORY STORAGE DEVICES.

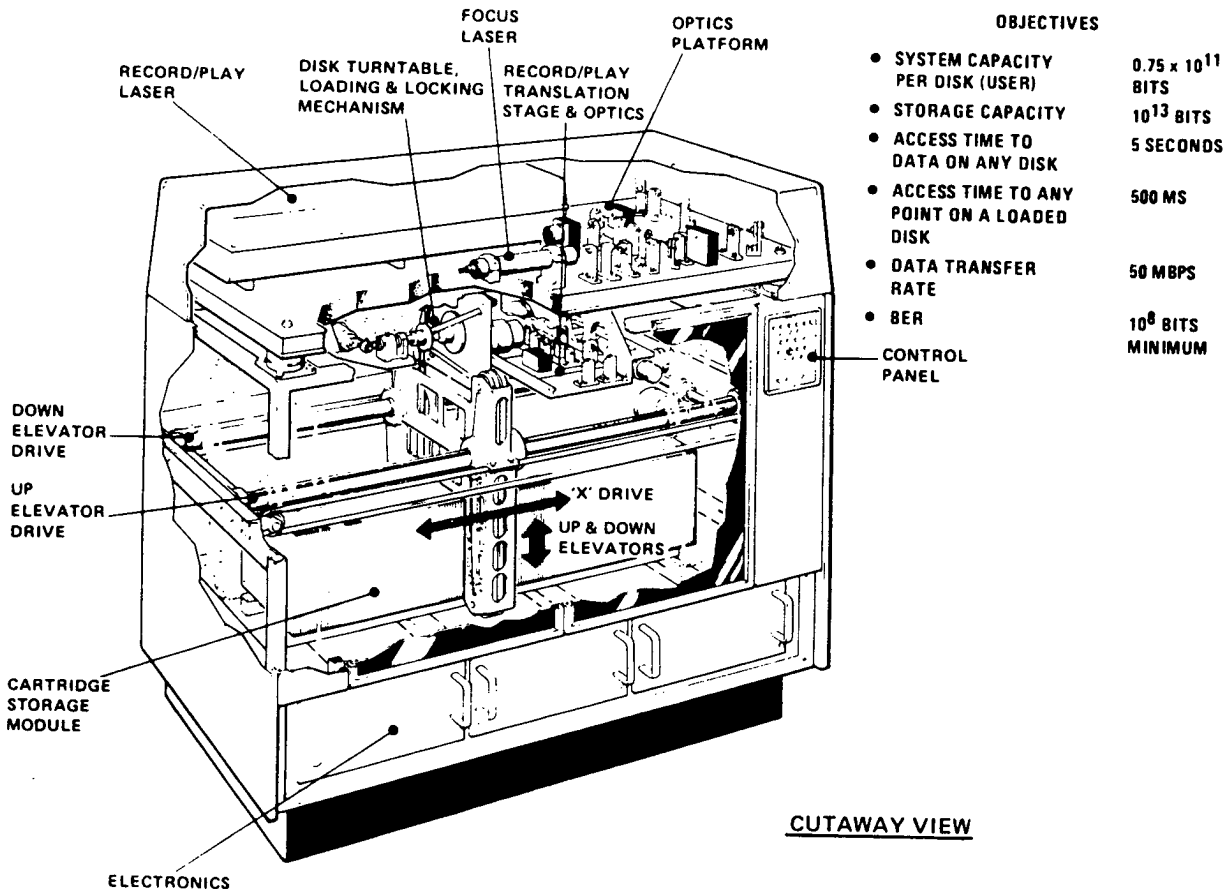


FIGURE 5. 'JUKEBOX' MULTI DISK DRIVE.

COMPETITIVE STORAGE TECHNOLOGIES

A	B	C	D	E	F	G	H	I	J
TECHNOLOGY	COST PER MEGABYTE 1980	1983	1985	1990	STORAGE BASE (MEGABYTES)	ACCESS TIME (SECONDS)	VOLATILE OR NON-VOLATILE	STORAGE LIFE (YEARS)	READ-WRITE OR READ ONLY
SEMICONDUCTOR	$15,000	$7,500	$3,750	$2,500	1	$1X10^{-7}$	V	0	R-W
EBAM	NA	NA	12,500	12,500	8	$1X10^{-5}$	NV		R-W
CCD	16,000	4,300	2,400	800	1	$1X10^{-4}$	V	0	R-W
BUBBLE	10,000	2,900	1,250	400	1	$1X10^{-3}$	NV	1	R-W
MAGNETIC DISK	41	20	10	5	570	$2X10^{-2}$	NV	1	R-W
MAGNETIC TAPE	4.21	3.61	3.25	2.52	5000	$7X10^{1}$	NV	1	R-W
MAGNETIC MASS STORE	5.60	4.80	4.33	3.35	462,500	$1.6X10^{1}$	NV	1	R-W
OPTICAL DISK	NA	8.00	8.00	8.00	2,500	$3X10^{-1}$	NV	10	RO
OPTICAL DISK PACK	NA	NA	1.60	1.60	125,000	$7.5X10^{-2}$	NV	10	RO
OPTICAL DISK MASS STORE	NA	NA	NA	0.008	25,000,000	$3X10^{0}$	NV	10	RO
COM 48X	0.67	0.65	0.64	0.61	250	$1X10^{1}$	NV	100	RO
COM 48X	0.09	0.09	0.08	0.08	2,500	$1X10^{1}$	NV	100	RO
COM 96X	NA	NA	0.23	0.23	1,000	$1X10^{1}$	NV	100	RO
COM 96X	NA	NA	0.03	0.03	10,000	$1X10^{1}$	NV	100	RO

1) STORAGE COSTS BASED ON END USER PURCHASE PRICE.
2) STORAGE COSTS INCLUDE HARDWARE COST DIRECTLY ASSOCIATED WITH STORAGE MEDIA.
3) NA - NOT AVAILABLE COMMERICALLY.

Attachment D

COSTS

ACCESS TIMES

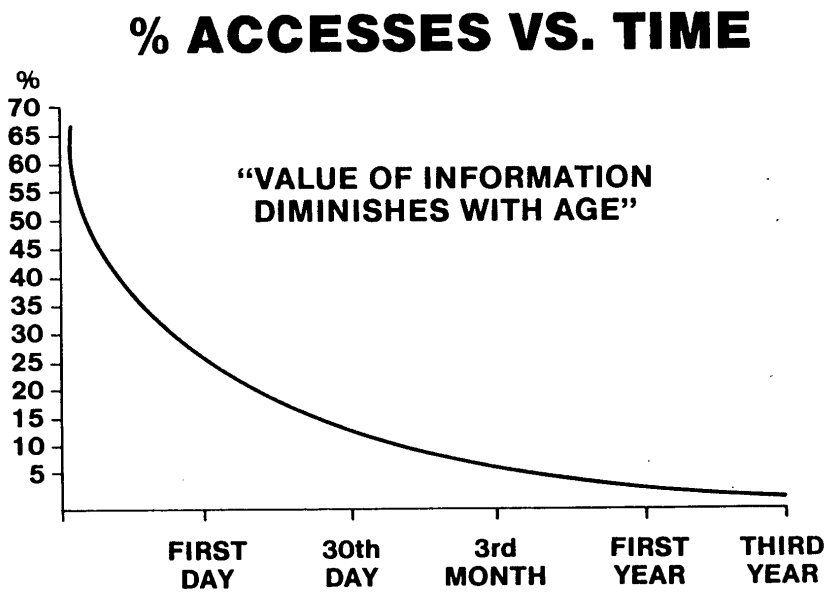


Figure VI/1.

Media Cost Comparison

For Year 1985

Storage of 10,000 Monotone Binary Images (All Costs Are in 1982 Dollars)

prc

Estimates for 1985

Media	Amount	Cost $
Magnetic Disk	8 Disk-Packs, 200 Mbytes/Packs	$4,000
Magnetic Tape	9 Tapes/2400-Ft. 6250 bpi, 8 Tracks	$ 135
High Density Magnetic Tape	One 2400-Ft. Roll of 2-Inch Tape	$ 22
Microfiche 48x	20 Fiche 4 x 6-Inch	$ 40
Optical Data Disk	One 12-Inch Disk	$ 85

The access time is an important attribute of CAR-ADSTAR systems. It depends on various systems engineering factors. A comparison of "free-standing" image data bank access time indicates very little difference between the possible implementation modes.

ACCESS TIMES FOR IMAGE DATA BANKS

	Shared	Distributed
Storage Medium	Microform or OVD	Microform
DBMS Search Time	Max. 15 Sec.	Max. 15 Sec.
Retrieve	Automatic Average 5 Sec.	Manual Average 4 Sec.
Display First Page	Average 3 Sec.	Averager 4 Sec.
Total to First Page	8 Sec.	8 Sec.
Next Page	Average 2 Sec.	4 to 8 Sec.

The cost comparison of a typical CAR-ADSTAR system in the three different modes of implementation shows that at the present time and until Workstations and communication costs are substantially reduced, only very special circumstances would prompt an implementation other than in the distributed image data bank-microform mode.

COST COMPARISON

5-Year Cost of 1.5-Million-Page Image Data Information System
1% Per Month Document Updates
8 User Workstations

Optical Video Disk, Shared	$ 480K
Microform, Shared	$ 362K
Microform, Distributed	$ 146K

COMPARISON OF MATERIAL COST

for a 1.5 Million Pages System with a 12% Per Year Volatility (1%/Month) Over a 5 Year Operating Period

One Shared (Central) Image Data Bank						8 Local Image Data Banks		
Optical Video Disk			Microform			Microform		
Initial 1.5 Million Images								
Mode	# Disks	$	Mode	# Cassettes	$	Mode	# Cassettes	$
200 LPI 1:8	14	3,640	16MM 48x	194	1,316	16MM 48x*	752	8,159
200 LPI 0	112	28,000	16MM 24x	375	5,250	16MM 24x*	3,000	34,650
5 Year Updates = 60% = 900,000 Pages								
200 LPI 1:8	9	2,250	16MM 48x	57	342	16MM 48x	456	2,437
200 LPI 0	68	17,000	16MM 24x	225	1,350	16MM 24x	1,800	9,619
Total 5 Year Material Cost								
200 LPI 1:8	23	5,750	16MM 48x	151	1,658	16MM 48x	1,208	10,596
200 LPI 0	180	45,000	16MM 24x	600	6,600	16MM 24x	4,800	44,269

* One Silver Original .875/3.50 per M and 7 Diazo Copies in Cassettes at .65/2.80 per M

** Film Cost Only, Cassettes Reused: Silver $6/100 Ft., Diazo $5.25/100 Ft.

APPROXIMATE COST

For Image Data Bank System, Excluding DBMS (1.5 Million Pages on Line, 8 User Stations)

Items	Shared				Distributed	
	# Micrographic	$	# OVD	$	# Micrographic	$
Data Bank	2 @ 80,000	160,000	2 @ 120,000	240,000	8 @ 250	2,000
Communication System	1 LACN (12 Ports)	36,000	1 LACN (12 Ports)	36,000	8 Modems @ 550	17,000
Workstations	8 @ 20,000	160,000	8 @ 20,000	160,000	8 @ 12,000	96,000
Material Cost from Fig. VI/2 for 5 Year Operation		6,600		45,000		44,000
Total		$362,600		$481,000		$146,000

The image data bank in the central (shared) CAR-ADSTAR system can be implemented in the following ways:

- Microforms, converted to digital data on-demand, or
- ODD's, with digitally converted graphic data.

The image data bank implementation represents but a small fraction of the cost of the total system. The cost of the Workstations and the communication network are the largest part of the system cost and are the same for either microform or ODD implementation.

STORAGE MATERIAL COST

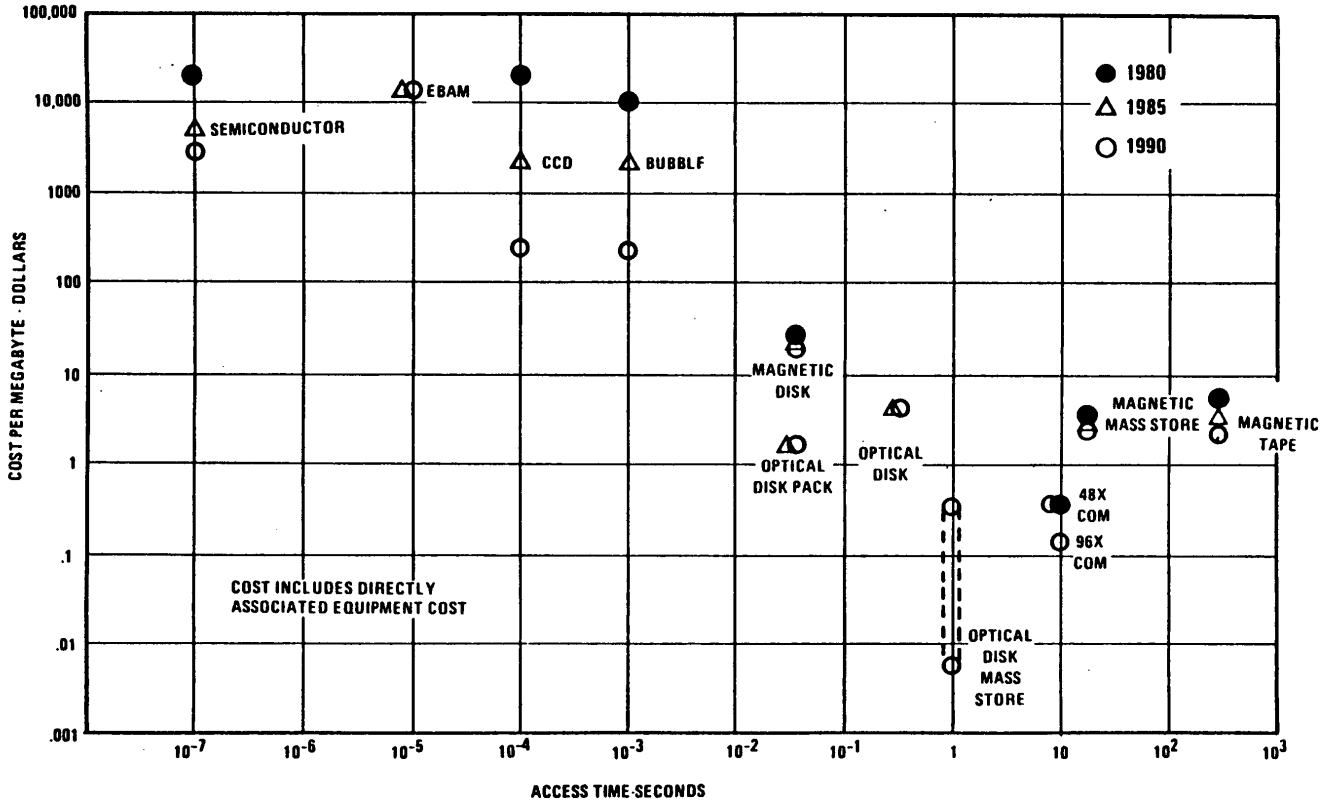
for the Storage of Office Documents on Photosensitive Material

Resolution Lines/Inch	Data Compression Ratio	Average Bits/Page	Number of Pages Stored					Cost ($) per 1000 Pages				
			OVD	Microform				OVD	Microform			
				16MM		4" x 6"			16MM		4" x 6"	
				24x	48x	24x	48x		24x	48x	24x	48x
100	1:4	2.34×10^6	214,000	4,000	16,000	96	420	1.166	3.50	0.875	3.072	0.714
200	1:8	4.68×10^6	110,000	4,000	16,000	96	420	2.272	3.50	0.875	3.072	0.714
300	1:10	8.42×10^6	59,000	4,000	–	96	–	4.237	3.50	–	3.072	–
100	0	9.36×10^6	53,400	4,000	16,000	96	420	4.681	3.50	0.875	3.072	0.714
200	0	3.74×10^6	13,400	4,000	16,000	96	420	18.657	3.50	0.875	3.072	0.714
300	0	8.42×10^6	5,940	4,000	–	96	–	42.088	3.50	–	3.072	–

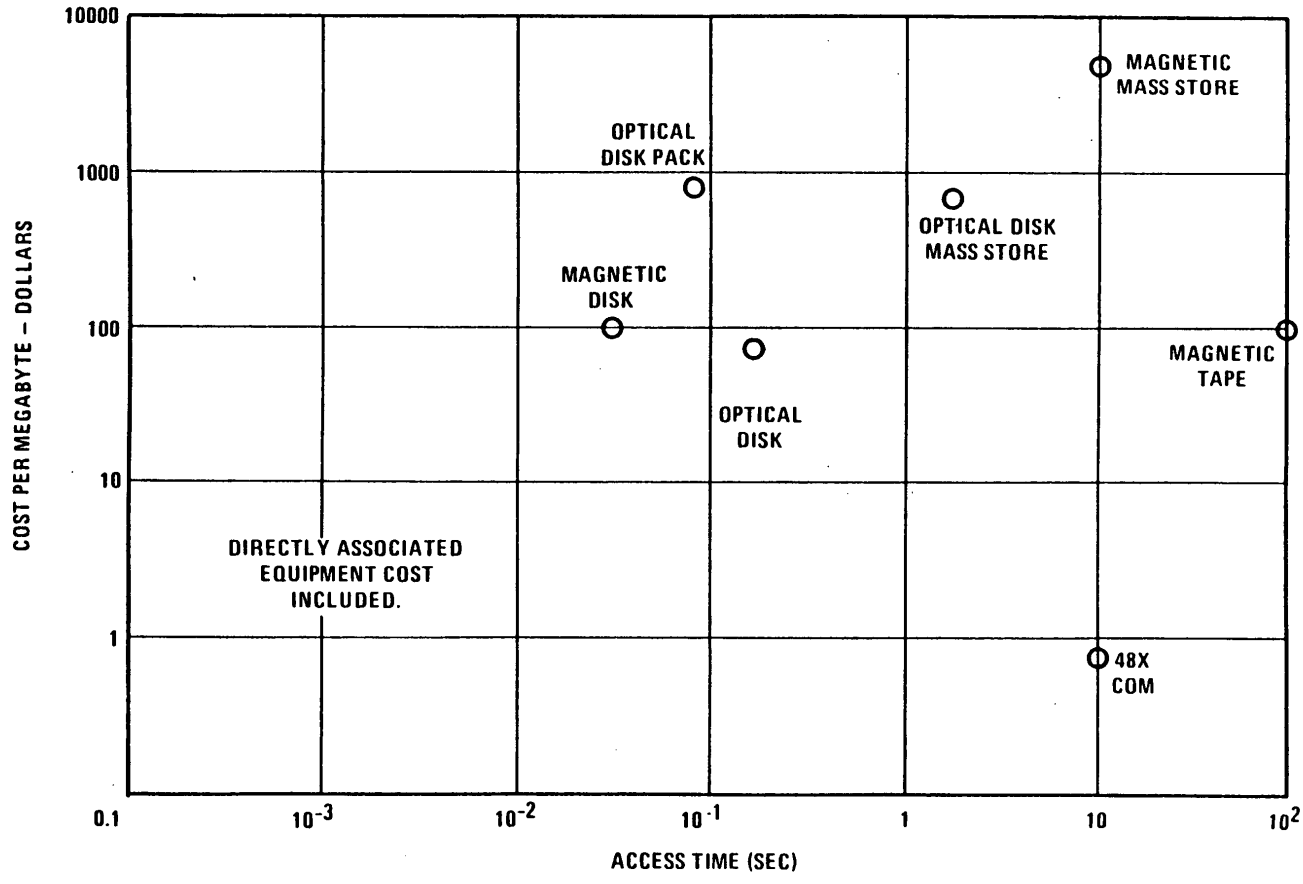
Notes: OVD with 5×10^{10} user bit storage. Cost of OVD $250.- per surface

Microfilm: Chemical processing cost is included at $1.- per 100 ft. 16mm and $4.- per 100 ft 105mm.
For each 100 ft. 16mm roll the cost of one cartridge/cassette at $8.- has been included.
16mm/100 ft. plus processing and cartridge/cassette costs of $14.-
105mm/100 ft. plus processing costs $26.- and yields 200 microfiche. Each microfiche costs $.30.

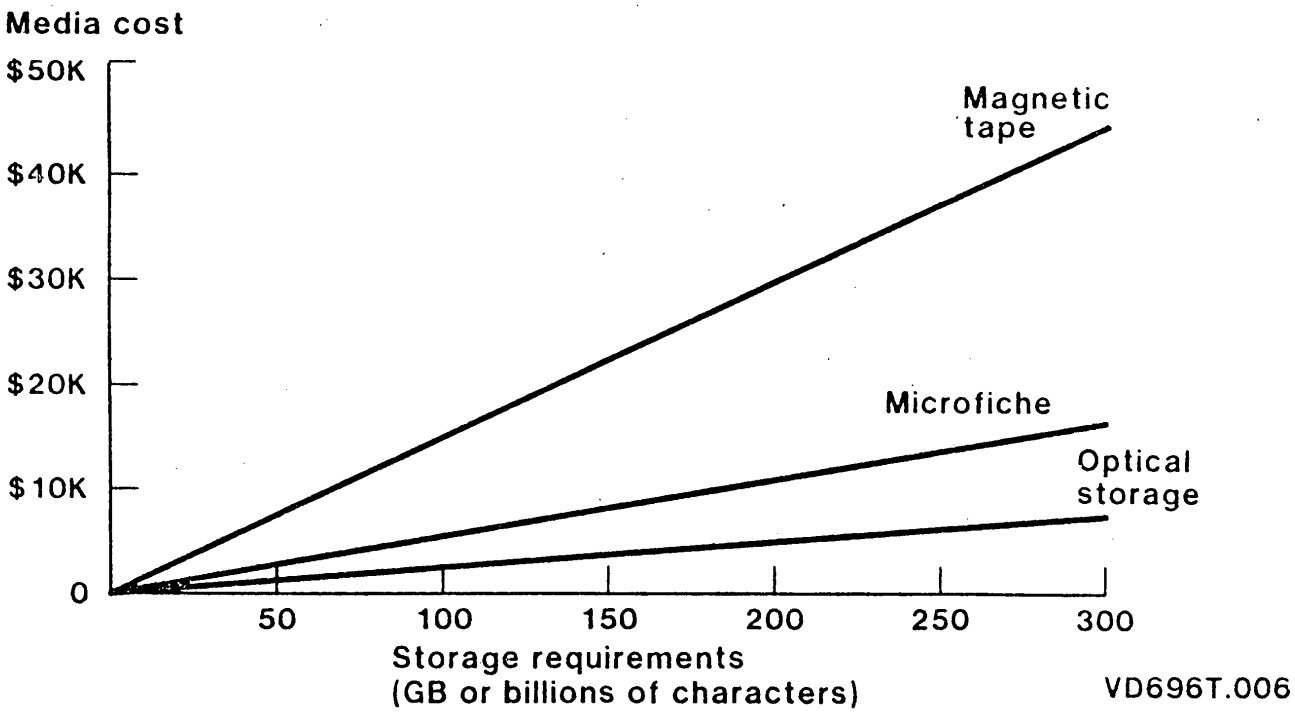
COMPETING STORAGE TECHNOLOGIES
COST
VS
ACCESS TIME
1980, 1985 AND 1990



COMPETING STORAGE TECHNOLOGIES
COST VS ACCESS TIME
FIXED 250 MEGABYTE DATA BASE
1990



Off-line Storage Costs



Comparison of image storage media costs by Walter[9]

Material	Unit cost ($)	Images per unit	Cost per stored image–Mbit ($)
Microfiche COM 72x	3.00– 5.00	670	.0045–.0075
Microfiche COM 48x	2.50– 4.00	270	.01 –.015
Microfiche 24x	2.50– 4.00	98	.026 –.041
Microfilm (100 ft)	12.00– 16.00	3,000	.004 –.0053
Magnetic disc pack	400.00	640	.625
Magnetic tape 2400-ft roll	24.00	1,400	.017
Tellurium optical disc	200.00–350.00*	20,000	.0125–.0175
Silver halide optical disc	50.00– 80.00*	10,000	.005 –.008

* Projected costs

Comparison of image storage systems costs by Walter[9]

Attribute	Microform system	Optical disc system
Availability	Now	By 1985/86
Equipment cost per 1 million pages	$40,000–$60,000	$50,000–$80,000
Material cost per 1 million pages	$ 4,500–$41,000	$ 5,000–$17,500
Recorder (camera) cost	$ 2,000–$10,000	$12,000–$25,000
Access speed, average	10–15 s	6–10 s
Workstation (monitor) cost	$10,000–$15,000	$ 6,000–$15,000

It will be seen that there is not a great difference in the cost ranges and the deciding factors in choice will no doubt relate to the origin of the source documents, the importance or otherwise of digital format as against human-readable format in the store and similar criteria.

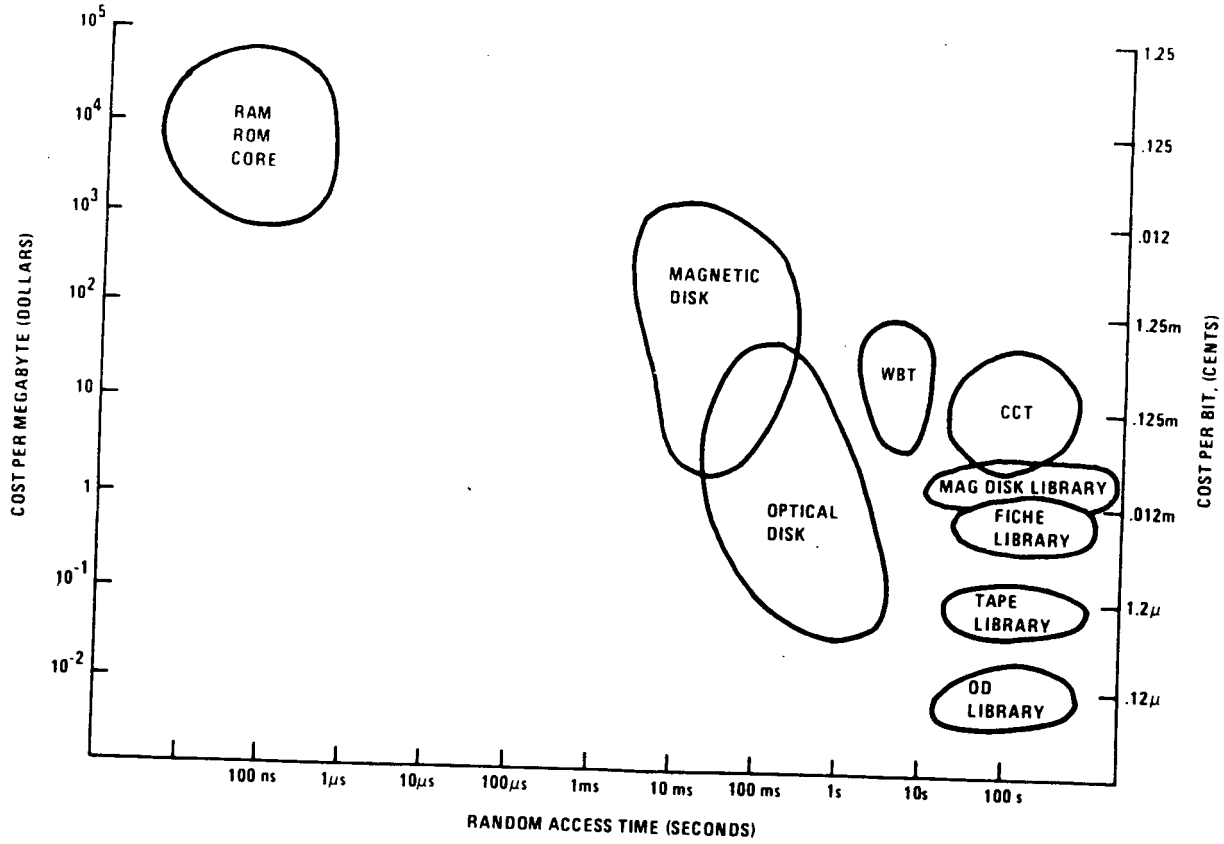


FIGURE 2. STORAGE SYSTEM AND MEDIA COST VS. ACCESS TIME.

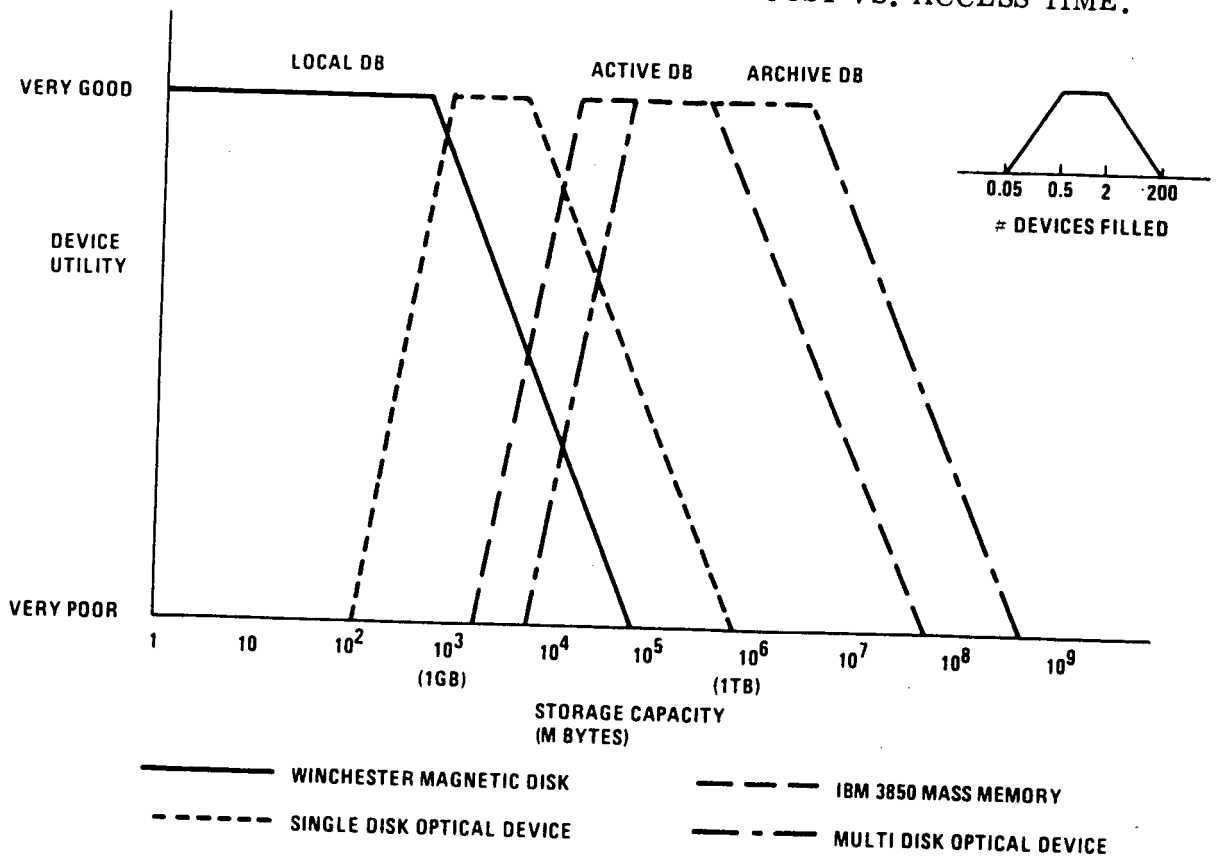


FIGURE 3. STORAGE DEVICE UTILITY VS. STORAGE CAPACITY.

Attachment E

RESULTS OF
PREVIOUS STUDIES

The British Library

RESEARCH & DEVELOPMENT

Reports

Developments in optical disc technology and the implications for information storage and retrieval

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R Barrett

Report No. **5623**

Date **June 1981**

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9 PROSPECTS FOR THE MEDIUM AND LONGER TERM

There is no doubt that the developments in optical disc technology will have a significant impact on the general field of information storage and retrieval over the next decade. This statement is made on the assumption that the two current major problems affecting thin film discs will be solved, namely the non-archival nature of present disc surfaces and the short life of semiconductor lasers having the required beam power.

The optical video disc is already well established and, in applications where the conventional video format is acceptable, notably education and training and pictorial reference such as the NLM experiment on knowledge bases, it will play an important part. Providing the error rate due to dropouts can be improved it will also form a useful means of distributing replicates of digitally coded video discs. MCA is already prepared to produce discs from video tapes or 35-mm film of customers' material (in American 525-line, 60 Hz format). Philips is setting up a production facility at Blackburn, UK, for mastering 625-line, 50 Hz discs by the cast and cure process and is agreeable in principle to offering the same service at a future date.

The current charge for production by MCA is $2,500-3,000 with the cost of replicates depending on volume but getting down to under $10.00.

It appears that the use by Philips of the clean room sandwich approach to disc construction will result in a viable reasonably economic DOR disc by 1986, by which time also the laser diode problems will have been solved. The advantages of the diode over the gas laser, apart from size, lies in the ability to modulate it by voltage or current control, rather than optically. However, at present 100 h life at the required power can only be achieved at a 2 Mbits/s writing rate and it will be some time before a corresponding life at the desired 10 Mbits/s rate can be achieved.

The restriction in writing rate also affects the rate at which multiple copies of a disc can be produced by this means. Writing 10^{10} bits on to a disc at 2 Mbits/s takes almost an hour and, in cases where multiple copies are required, it may be more economic to use the mastering and replication process. At present Philips thinks the cross-over between replicated discs and DOR may be around 100 copies.

Philips is keen to collaborate with potential customers for the DOR and Megadoc systems in an evaluation and feasibility study phase. It must be remembered that the costs are going to be significantly higher than for the replicated disc system, being quoted as $25,000 in 1983 for a basic recorder/reader with each disc costing $250. Economics will thus depend very much on applications.

Other companies are being less conservative in their marketing and, as has already been said, Toshiba has announced its document filing system. It remains to be seen whether the 'semi-permanent storage' nature of its disc provides an acceptable medium, and of course the system uses a gas laser.

The ultimate system will provide an erase and re-write facility, but it is doubtful if a viable system will be made available before the end of the decade, even though Matsushita is alleged to claim that it will have an erasible disc within two years and Corning is working on photo-chromic materials. There could well be a political influence here, since the advent of a re-writable optical disc could seriously affect the present massive investment in magnetic disc systems.

The most likely forecast at the present time is that digital optical recording systems using thin film discs will be viable by 1985/1986 and will be presenting major competition to COM and magnetic tape storage systems by 1990.

The optical disc systems based on the use of silver halide photographic film should not be dismissed lightly, however. Although they will not be capable of the same storage capacity and must be written in one stage prior to developing, they are based on a well proven medium and, in the case of the ARDEV system, use conventional illumination for reading rather than a laser. In any case ARDEV appears to be going for the education and training market, where multiple copies of material produced in-house are desirable. Harris is hoping to develop a dry process for its MASTAR system in order to provide sequential write and read facilities.

9.1 Stop press

As this report was going to press Pergamon International announced the development of a new information system combining on-line computer searching with video display of drawings and illustrations stored on optical video discs.

The new system, known as Video Patsearch™, provides on-line access to the 700,000 US patents issued since 1971, permitting computer retrieval of patent drawings and illustrations of chemical structures along with patent abstracts and other textual information. The unique capability to integrate the computer retrieval of graphic and textual material is expected to have a major impact upon traditional patent searching. The system consists of a powerful microcomputer display terminal, a DiscoVision PR 7820 video disc player and a set of eight video discs. The terminal is used to make the on-line search of the patent database and controls the video disc player, automatically selecting the drawings of the retrieved patents. Drawings are accessed and displayed in a time claimed to be less than three seconds, permitting the user to scan patent drawings one after the other in rapid succession.

Pergamon International will offer the complete system, including computer hardware and software, video disc player, file of eight video discs and video disc updates on an annual subscription basis for $6,000, commencing in July 1981.

Henry A. de Cillia
Information Management
Consultant

DE CILLIA ON INFORMATION MANAGEMENT

Optical Disk Systems: The Yankee Group Study

Product Features Required by Potential Users

The widespread availability of products to support image storage is several years away, according to the Yankee Group.

"The requirements of the majority of survey respondents for an imaging system can be summarized as:

- a ten-year retention,
- annual purges,
- less than one million images, frequently accessed during the first year, and
- a cost of less than one cent per image.

If their requirements are met, over 50% of the respondents indicated they would purchase a system."

"However, three additional conditions must be met for document-based optical disk systems to attain parity with current micrographic products:

- comparable image quality,
- easy and low-cost duplication capability,
- long life, generally on the order of 20 years; *proven.*"

"Each of the micrographic compatible features must be built into a successful optical system, in addition to the performance requirements implied by survey respondents. Compared to micrographic capabilities, the Yankee Group does not believe that digital optical disk technology has yet achieved the performance requirements for successful market penetration... Unless optical disk vendors recognize the basic needs of micrographics users and develop products accordingly, only specialized applications (and a very small market) will exist."

The report goes on to describe specific product development opportunities for optical disk in the document/image market; namely the CAR, COM and general micrographic imaging applications.

In conclusion, if the prospective optical vendors overcome the problems previously discussed, then the Yankee Group would project revenues for optical storage of documents/images of close to $1 billion by 1990. This figure, if achieved, would represent a 15% penetration of the micrographics industry revenue at that time, according to Mack.

So, the road ahead is not necessarily paved with gold for the optical disk vendors. A better understanding of end users' needs and present magnetic and micrographic technologies is needed before optical technology can make substantial inroads in the data and document storage markets. Further, the hope for optical disk and the *integrated* management of information resources will have to wait for the technology to establish a foothold — most likely in the electronic document filing environment. Records and micrographics managers, as well as other information professionals would do well to keep abreast of optical

Despite optical disk, don't count micrographics out

Contrary to reports of its early demise, micrographics has a future and should not be counted out — optical disk notwithstanding, concludes a recent 324-page study by Frost and Sullivan.

Though optical disk and cheaper digital storage may reduce its market growth, micrographics will still be important, particularly among smaller users, in hybrid applications, and within specialty areas, such as micropublishing. "Micrographics will expand with certainty through mid-decade at least," says the study, entitled "The European Market for Micrographic Equipment, Related Information Storage and Retrieval Systems, and Supplies."

Expressing such sentiments in concrete terms, the F&S report projects that the micrographics market in Europe will increase at an eight percent rate compounded annually in real terms through 1985.

Myriad reasons account for the optimistic outlook. For one, micrographics can be integrated with digital and other technologies as opposed to just being ousted by them. Hybrid storage systems, for example, that combine both magnetic and microfilm techniques provide an optimal solution where large files need to be both active and archival.

Micrographics is also benefitting from the microprocessor, where, in COM equipment, for example, the chips do the indexing and filing and handle the output from different host computers. In computer-assisted-retrieval applications, the microprocessor executes random filing, multiple indexing, and high speed retrieval, thus metamorphasizing micrographics into an active medium.

Other technology advances are also coming into play to keep micrographics "alive." This includes dry processing and the use of updateable film that puts micrographics "on a par with photocopying," according to F&S project director Joseph Savino.

Markets are also becoming more diverse, F&S points out. While the financial sector dominates at the moment, manufacturing and commercial users are increasingly turning to micrographics. The use of small office microfilm systems, in particular, is singled out as a major growth area. Any office having about 20 workers, or so will be able to justify such a system, F&S believes.

Other growth markets include engineering drawings, previously static, that will now benefit from the intense interest in computer-aided-design. "This is an area of great potential for COM!" says Savino.

What all of this adds up to is a micrographics market in Europe that will expand as follows:

- Hardware: $146 million last year, increasing to $200 million in 1985, paced by COM recorders.
- Consumables: $161 million last year, increasing to $252 million by mid-decade, paced by dry silver type camera film.
- Services: $113 million in 1981, increasing to $175 million by 1985.

It is not until 1990, the F&S study forecasts, that optical disk will pose "a very real threat to micrographics." By then, the size of the market in Europe alone could exceed $700 million, depending on when optical disks are actually introduced.

For further information, contact Customer Service, Frost & Sullivan, Inc., 106 Fulton Street, New York, NY 10038, (212) 233-1080.

NATIONAL MICROGRAPHICS ASSOCIATION
The Image Processing People

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OPTICAL DISK: INFORMATION STORAGE AND RETRIEVAL APPLICATIONS

May 4, 1982

St. Louis, Missouri

Instructor:

Dennis R. Neary
Manager of Marketing
Spin Physics

- The computer industry is waiting for a major peripheral or mainframe manufacturer to get involved to make optical read-write discs and players viable for digital data applications.

- When perfected, laser optical discs will probably replace computer-compatible tape for digital applications, as they occupy only 1% as much space and offer potential cost per megabyte at a fraction of what magnetic media does.

- Erasable/reusable read-write discs will be available in the near future, but are now considered unnecessary in the majority of applications.

- Read-only optical discs are expected to be a boon to microcomputer usage and sales.

- As a spin-off from videodiscs, PCM audiodiscs with much higher sound quality will be offered by almost 30 companies, with initial product introductions expected by 1981.

- An announcement in late April 1980 disclosed that Thomson-CSF and Xerox will cooperate on joint development of a recorder-player using optical discs for data processing applications requiring direct read after write capabilities. The recorder-player and optical discs will be sold in the OEM marketplace, as well as incorporated into future Xerox products.

SECTION I
EXECUTIVE SUMMARY

- Attracted by the lure of the multibillion dollar consumer entertainment market potential, at least 30 companies are expected to compete for the market which Magnavox's DiscoVision has had to themselves since the late 1970s.

- Despite the technological superiority of laser optical systems, it is expected even by laser optical disc system manufacturers that the cheaper capacitance systems will rapidly take over the consumer market, with RCA and Matsushita vying for supremacy with incompatible systems.

- To give their marketing efforts greater clout, manufacturers are licensing hardware and software suppliers to do battle over which of five different incompatible systems will gain supremacy.

- Though the capacitance system entertainment application gets most of the press attention, there is general consensus that the laser optical systems will dominate the educational-institutional, image and data processing applications.

- Two different educational-institutional systems are already on the U.S. market with at least four more expected during 1980, all except Thomson compatible with each other.

- Image processing using read-write optical discs to store 10,000 documents on a single disc is being introduced in 1980 and will impact the future of microfilm, microfiche and filing cabinets.

- Alphanumeric read-write data processing applications will be the last to be introduced because the bit error rate and archival storage characteristics are not yet up to minimum desired standards.

WILL OPTICAL DISK MEMORY SUPPLANT MICROFILM?

by DR. GERARD O. WALTER, PRC Image Data Systems Company

Declassified in Part - Sanitized Copy Approved for Release 2013/07/31 : CIA-RDP12-00036R000100200002-7

A Document Storage System Based on Optical Disk Memories

Undoubtedly, ODMs will take their place in the arena of archival storage of digital data. Since one ODM can hold the amount of digital data that is now stored on 20 to 25 reels of 2,400-foot magnetic tape, the ODMs price and volumetric superiority is quite evident. In addition, ODMs, unlike magnetic storage materials, do not ever have to be refreshed. The cost savings of eliminating the half-yearly refreshing requirements of stored magnetic tape alone make ODMs an excellent technological supplanter to stored magnetic tape.

In the general image-management area, which is now dominated by micrographics, the early applicability of ODMs is questionable. This may change with time and will have to be reexamined if and when erasable materials for optical disk memories become available.

Several different concepts of jukebox-like mechanisms have been proposed for storing and retrieving optical disk memory platters. Projecting five to eight years downstream, ODMs that hold up to 5,000 one-megabit (10^6) compressed data representations of document pages per side will be developed. A double-sided platter can then hold 10,000 pages. To construct a usable document storage subsystem, a jukebox for a one-million-page (10^{12} bit) storage and retrieval (SAR) unit must hold 100 platters. If only one side of the ODM platter is used, which has a number of systems advantages, the jukebox must store 200 platters. No doubt such a jukebox can be built. The storage and retrieval mechanism is probably comparable in complexity and reliability to today's microform mass image storage and retrieval units, such as the Ragen System 100 or Infodetic's System 410/50.

The advantages of a mass storage and retrieval system for source documents (MSAR/SD) are: storage of 1- to 16-million pages on-line, retrieval of any page in less than 20 seconds, transmission of images to remote work stations and closed-loop operation (in which the image master never leaves the system), However, unless most of these attributes are present, the relative high cost of a MSAR/SD system cannot be justified. Such systems represent less than 10 percent of the micrographic source-document management market today and will represent only 15 to 20 percent by 1985.

The main differences between the microform-based information resource management system and the ODM-based information resource management system are:

- Microform systems store data in human-readable form, which is easy to quality control and is preferred by records management personnel. Typical access time is about 10 seconds.
- Optical disk memory systems will store data in digital form, which requires sophisticated computer-type equipment and is preferred by data-processing personnel. Typical access time will be around six seconds.

A comparison based on a number of projections and assumptions regarding the optical disk memory, is given below in Table 4.

All other attributes of the two systems appear to be equal. And it can be seen that the differences are not really very big. However, it is important to remember that the optical disk system must still be proven workable. All projections have been made by assuming that the many still-to-be-solved problems will, in fact, be solved ideally by 1985/1986 and also that the present abilities of micrographic SAR systems will not have been improved by 1985/1986. Neither of these projections is realistic, but they have been used to give ODMs the benefit of the doubt.

Conclusions

The new optical disk memory technology is a most interesting development and will have an impact on the methods of archival and interim storage of digital data, probably starting in 1983/1984. In its presently projected form, it will compete with mass storage data banks for source-document images in the narrow segment of the active source-document SAR systems market by 1985/1986 and will probably get a share of this specialized market. ■

Will the Optical Disc Kill Microfilm?

Utimately, digital technologies will probably supplant photographic ones for storing information. What, however, can be expected in the near future?

BY DONALD L. GERBER

Office use of microfiche will continue to grow

There appears to be a real need in today's offices for a cost-effective, computer-controlled microfiche filing/storage/retrieval/display system. It should accept the users' indexes and cross indexing, as well as be kept in the same automated file as microfiche images of all kinds and sizes of documents.

Access time to any image or group of images should be within a second or two, allowing a user to browse through the file more conveniently than is possible with a paper-in-a-folder file. It should allow for selective purging of the file according to the users' administrative requirements. It should be available as a standalone system or controlled by [illegible] information to be combined in the same computerized system. The technology to build such equipment has existed for years, but nothing on the market meets those requirements. If such hardware had been available for the past few years, there might be less interest now in optical discs.

Within the next five to ten years various optical disc systems will reach the market, but with little impact in most offices. They appear to be inherently unsuitable for general office files. Office use of microfiche will continue to grow because in-house recording for reductions up to 48:1 is now practical and the medium is cheap. Use will grow much faster if computer-controlled display systems reach the market that are reliable, adaptable, and cost effective.

Optical disc systems will be offered providing real competition to very large automated microfiche systems where the cost of special cabling to transmit images from a central file is not prohibitive, and where frequency of referral to a particular image does not decrease significantly as time passes. An example might be the file of documentation and engineering drawings for a power plant.

Optical discs are potential competition for certain kinds of microfiche publishing, particularly for library materials. It is not feasible to automate "library standard" microfiche, which has only 98 images per fiche. One can easily visualize service firms offering optical discs containing entire specialized libraries, with each optical disc accompanied by a floppy disk containing a detailed index.

Ultimately, digital technologies probably will not supplant microfiche any more than microfilm files have supplanted papers-in-a-folder files. We will have to wait for a different recording medium, one that has not yet been developed to the point of public announcement. □

Donald L. Gerber is a vice-president of Management Research Foundation, San Francisco, Calif., a nonprofit organization charted "to improve the operations of local government units through innovative applications of advanced technology." His career has concentrated on productivity enhancement in offices and factories through commonsense application of various technologies, industrial engineering, and the behavioral sciences.

Productivity and Records Automation

Robert J. Kalthoff*
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Read: ARMA meeting, Washington, D.C.
April 15, 1982

Conclusions:

1. Document control problems today are a vital issue to white collar productivity.

2. Their mastery can provide a major productivity growth spur in the output of the knowledge worker, the manager, the specialist, the technician--all who must rely on stored information in the performance of their work. This group has the highest impact on the corporate mission.

3. If a records automation system is productivity-justified, it will be cost-justified.

4. Productivity-enhancement goals, if realistically set, will be achieved within 12 months of installation.

5. Productivity enhancement in the well-devised system, will continue to grow each year after installation as a result of user-driven systems, software, people changes; new input and products from the vendor, and human factors: attitude, motivation, higher goal-setting.

6. Typically, productivity-enhancing, records automation systems will prove more justified in retrospect than in prospect.

7. It is incumbent on records management no less than on key management to understand the productivity issues and the growing liabilities of continuing the stranglehold on status quo document control methods particularly as they apply to the effectiveness of the knowledge worker.

8. Today's optical mass memory technologies can solve these problems. Their continued evolution gives promise of applying new technology to an ever increasing number of applications of smaller as well as larger scope.

Article for the
NMA Daily, 1982

A Look at Document-Based, Optical Mass Memory Systems for the 1980s

by

Robert J. Kalthoff*
President
ACCESS Corporation

Optical Mass Memories as they apply to the control of document-based information is an emerging set of technologies that have three things in common:

--Each uses an optical pathway in the course of recording or retrieving the document/image.

--Each operates under total computer control.

--Each has, as one output modality, the electronic delivery of the document/image to a high resolution CRT or its equivalent.

Two subgroups of optical mass memory technologies are now either in or moving toward the marketplace as the decade evolves. With the recent announcement of electronic image delivery capability from roll film (Ragan) and fully automated, unmodified microfiche (ACCESS Corporation), micrographics has taken its place as one of these. The second group makes use of the laser to record the image as bits on the reflective surface of an "optical" disc (Philips, Thomson-CSF, Optimem), or its rectangular equivalent (Omex).

Optical Mass Memory Systems appear to have the greatest likelihood of dominating the $2.0 billion plus market for document automation systems in the decade 1982 to 1992. This figure is derived from the recent MacIntosh Consultants Ltd. report on that subject. Inherent drawbacks must be overcome for magnetic memories to make inroads into this market as the decade progresses. These include: cost, archivability, and the question of the acceptability of an erasable memory for vital, signatured source documents. Open-loop computer controlled (CAR) micrographics-based systems should remain a significant and growing factor in records automation, however.

*Dr. Kalthoff is chairing the IGC Conference "Document-Based Optical Mass Memory Systems and their Application in the 1980s", Andover, Massachusetts, May 25, 26, 27, 1982.

The biggest problem with disc changing is one of time. When one goes image to image on a single disc, the time can be a small fraction of a second. To move from an image on one disc to an image on another is quite another matter and an issue about which the literature is almost mute. There is the onmipresent problem of stopping a high speed disc, replacing the disc with another and bringing the new one up to read speed. One manufacturer talks of 15 seconds to do each. Add to this the time of disc changes, which itself is significant, image-to-image time could prove unacceptably long in many applications where the premium is on immediacy of image delivery.

Conclusions:

1. Document-based optical mass memory systems will dominate the $2.0 billion plus growth in the records automation market anticipated by 1992. Some of these have already entered today's market.

2. "Optical Mass Memory" technologies include both laser write/read technologies on either the "optical" data disc or on rectangular equivalents; and automated, image delivery systems where the optical mass memory medium is roll film or fully automated microfiche.

3. All optical mass memory systems share completely automated computer control and the capability of electronic image delivery.

4. Micrographics-based mass memory systems are uniquely both man readable and machine readable. When the memory is fiche-based, there is the added dimension of automatically copied fiche as a low-cost system output in addition to electronic image delivery. This adds substantially to system flexibility and to cost control.

5. The learning curve is well on its way with micrographically-based optical mass memory systems. This may also apply to the rectangular slide version of laser write/read optical mass memory. It is doubtful, however, that the customer-installation learning curve with the optical disc can move off ground zero before mid-decade at the earliest since market penetration is not anticipated until then or later.

Dr. Kalthoff is the author with Colonel Leonard S. Lee (ret.) of Productivity and Records Automation, a 1981 Prentice Hall publication.

MICROGRAPHICS NEWSLETTER

the news report for executives who market or use micrographic services and equipment.

November 1981 Issue I
Volume 13 Number 20

VIDEODISC: COMPETITION OR COMPLEMENT TO MICROGRAPHICS?

There's no doubt that the trend to digital storage and transmission, plus the superiority of optical processes for high-density storage, guarantee a place for videodisc in the archival storage of digital data. However, the high cost of converting existing microforms or paper records to digital format means that videodisc storage will likely be used mainly for creation of new massive data banks --and for conversion from magentic tape storage. Dr. Joseph Shepard, manager-COM and Engineering products, 3M Micrographic Products Division puts it this way. "Pioneering DRAW System installations....could be in place early in the 1980s. These would be applications typically involving a million-page file where immediate access is essential. The cost will probably be in the million dollar range."

If that is the market most likely to be affected, most micrographic users/suppliers can rest for the next decade. Of all present microform storage systems, COM seems to be in the most vulnerable spot. However, the fact that most COM-generated files are relatively small -- in the less than 150 dupe range -- means that economics will be with COM for a long time.

What it seems to add up to is that micrographics will be a viable storage system and a prosperous industry for some time to come. There will be more interfacing with other systems --including videodiscs-- but these will be complementary, not replacement.

Tutorial:

The Optical Data Disk and the Office Information System

Prepared for the

National Micrographics Association
by
Dr. Gerard O. Walter

Spring, 1983

Planning Research Corporation
McLean, Virginia

Conclusions: The increased awareness of the importance of information management represents greater opportunities for the *appropriate* information management system.

PROBLEMS AWAITING SOLUTIONS

- Stability and Life of Recording Medium
- Residual Error Rate
- Erasability
- Complexity of Drive Mechanics

Conclusions

- Price/Performance Rules
- Optical/Digital Mass Memories
  - For Computer Data: YES
  - For Documents: EXCEPTION
- Cost Reduction Needed:
  - High-Resolution Displays
  - Communication Systems
- Commercial, Off-the-Shelf Availability: Late 1984

Information Management Technologies in the 80's and 90's

prc

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