AN OPTICAL DISK ARCHIVE FOR A DATA BASE MANAGEMENT SYSTEM

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ABSTRACT

This presentation will provide an overview of a Data Base Management System (DBMS) that can catalog and archive data at rates up to 50M bits/sec. However, the detail emphasis will be on the laser optical disk system that is used for the archive.

All key components in the system (3 VAX 11/780s, a SEL 32/2750, a high speed communication interface, and the Optical Disk) are interfaced to a 100M bits/sec 16-port fiber optic bus to achieve the high data rates. The basic data unit is an autonomous data packet. Each packet contains a primary and secondary header and can be up to one million bits in length. The data packets are recorded on the optical disk at the same time the packet headers are being used by the relational data base management software ORACLE to create a directory independent of the packet recording process. The user then interfaces to the VAX that contains the directory for a quick-look scan or retrieval of the packet(s). The total system functions are distributed between the VAX computers and the SEL.

The optical disk unit records the data with an argon laser at 100 M bits/sec from its buffer, which is interfaced to the fiber optic bus. The same laser is used in the read cycle by reducing the laser power. The data is read from the disk at 100M bits/sec and placed in the unit's output buffer at 100 M bits/sec. The distribution rate from there to the user is controlled by the rate the user can accept the data.

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AN OPTICAL DISK ARCHIVE FOR A DATA BASE MANAGEMENT SYSTEM

COMPUTER SCIENCE/DATA SYSTEMS
TECHNICAL SYMPOSIUM
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OBJECTIVE

DEVELOP AND DEMONSTRATE THE TECHNOLOGY REQUIRED TO ACCEPT DATA AT RATES UP TO 50M BITS/SECOND, GENERATE A DIRECTORY OF THE DATA, AND RECORD THE DATA IN A LARGE ONLINE ARCHIVE. THE DIRECTORY AND DATA COULD THEN BE ACCESSED IN NEAR REAL TIME THROUGH A DATA BASE MANAGEMENT SYSTEM.

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PROBLEMS ADDRESSED

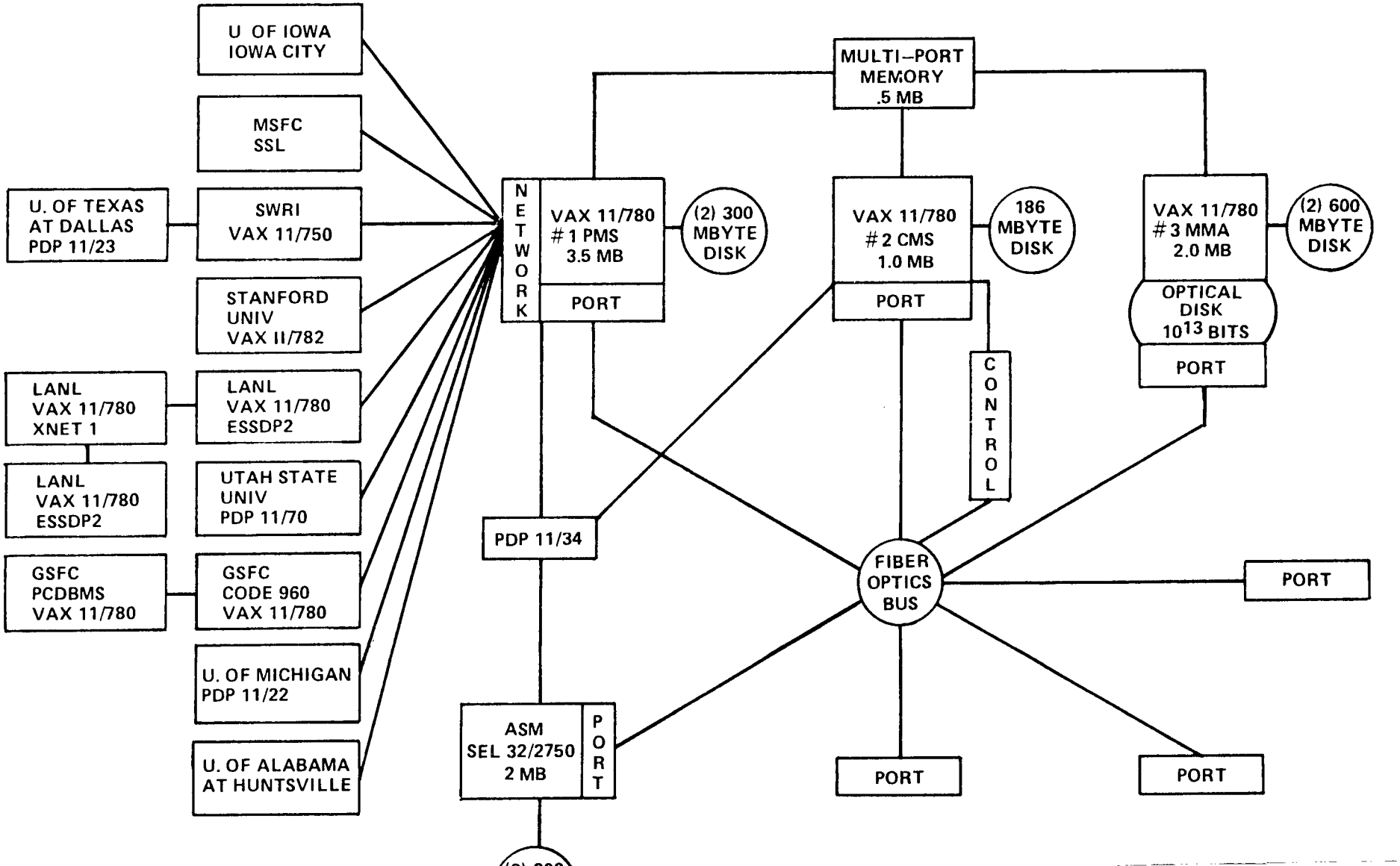
- HANDLING DATA AT HIGH RATES
- ARCHIVING LARGE VOLUMES OF DATA AT HIGH RATES
- REDUCING USER ACCESS TIME TO DATA AFTER IT HAS BEEN RECORDED ON GROUND.

KEY SYSTEM ELEMENTS

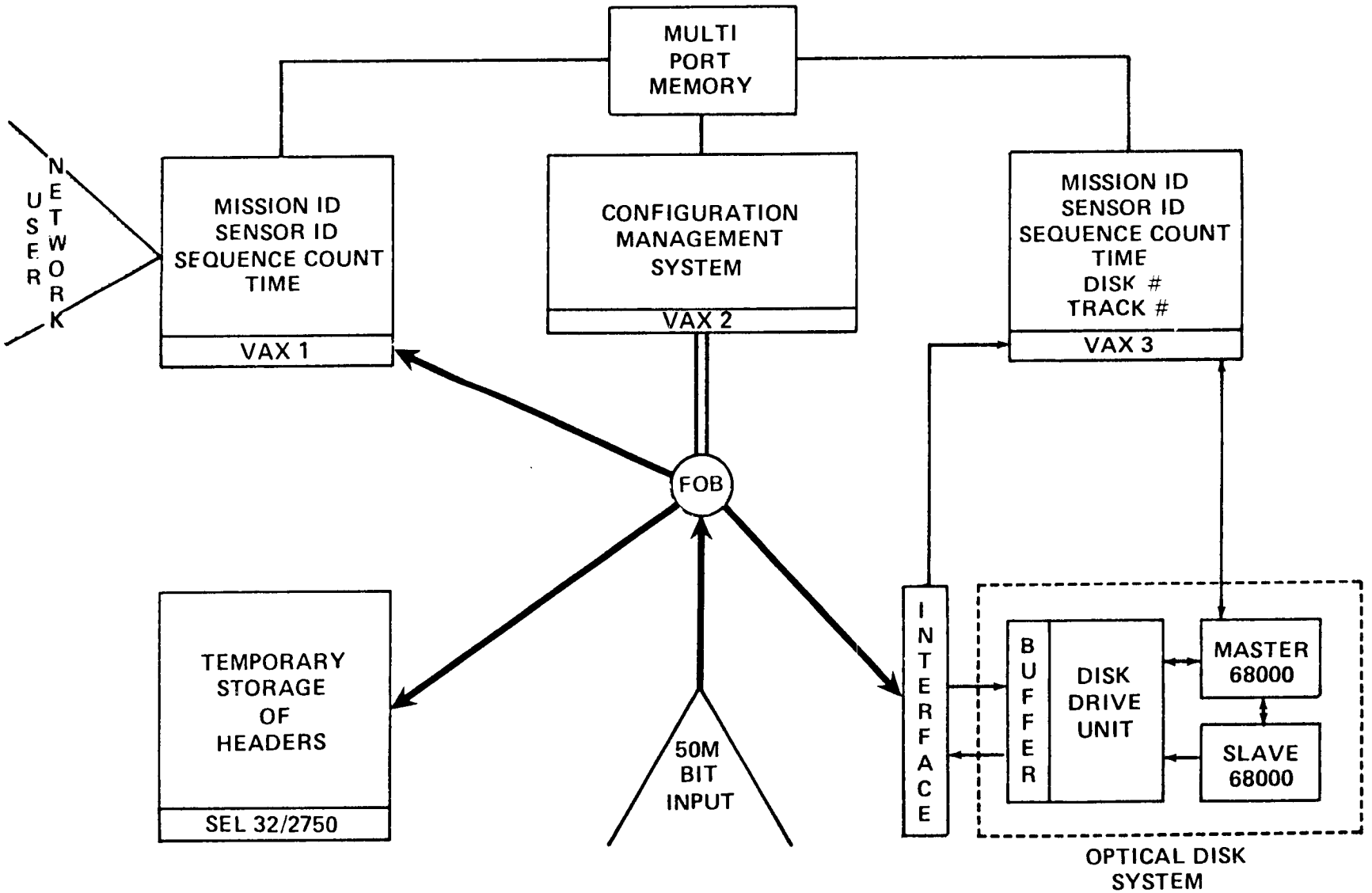
- AUTONOMOUS DATA PACKET
  - MISSION AND SENSOR INDEPENDENT
- 16–PORT FIBER OPTIC DATA BUS
  - BY–PASS CONVENTIONAL COMPUTER I/O TO ACHIEVE HIGH DATA RATES
- OPTICAL DISK RECORDER
  - USE OF ARAGON LASER TO ACHIEVE HIGH DENSITY RECORDING AND AN AUTOMATED "JUKEBOX" TO PROVIDE A LARGE ONLINE ARCHIVE.

SPACE–PLASMA COMPUTER ANALYSIS NETWORK (SCAN)

DATA BASE MANAGEMENT SYSTEM/MASS MEMORY ASSEMBLY (DBMS/MMA)



PRIMARY INPUT DATA FLOW



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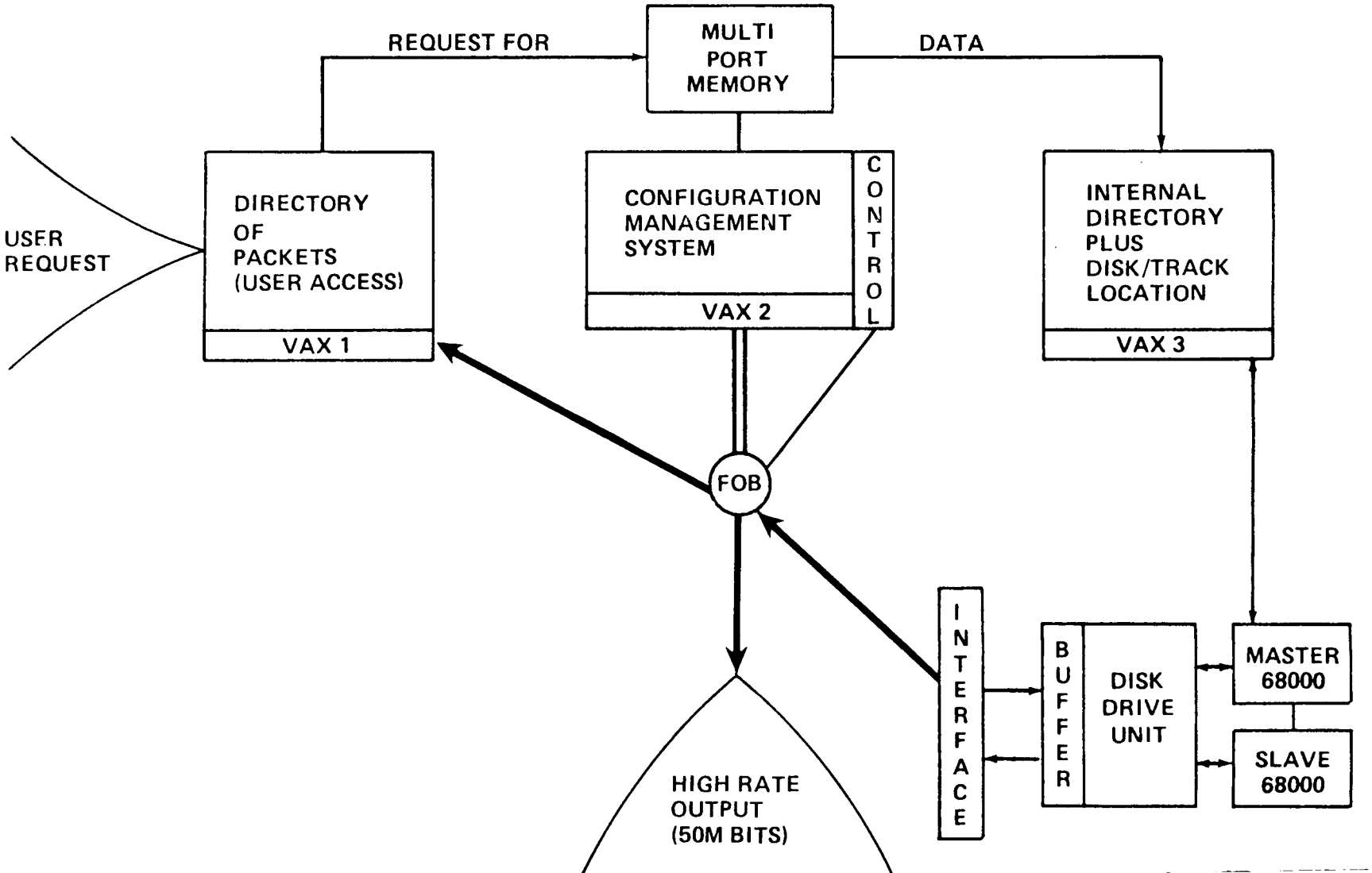
USER ACCESS TO DATA



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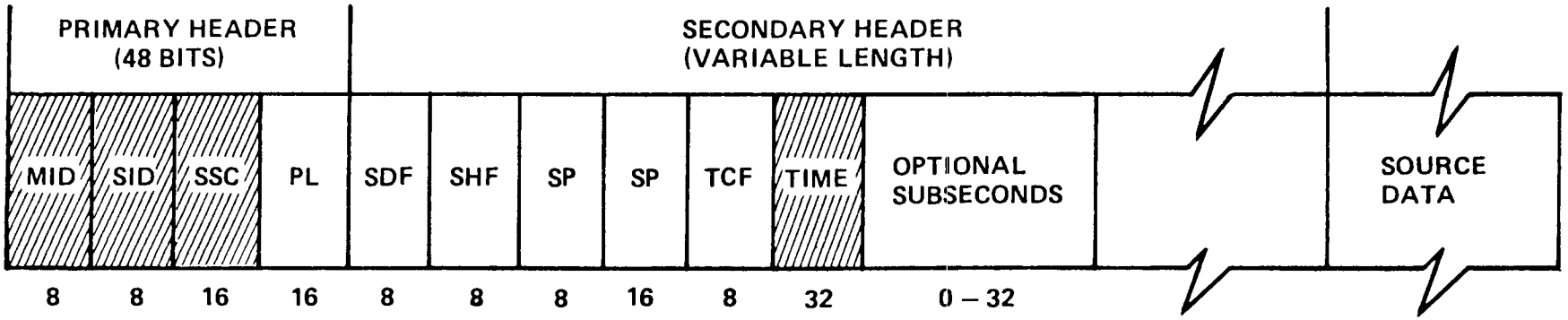
DBMS PACKET FORMAT



MID — MISSION ID

SID — SOURCE ID

SSC — SOURCE SEQUENCE CONTROL
BITS 15 – 14: SEGMENT FLAGS
BITS 13 – 0: SOURCE SEQUENCE COUNT

PL — PACKET LENGTH (NUMBER OF 16 BIT WORDS IN THE PACKET – 1. THIS LENGTH DOES NOT INCLUDE THE PRIMARY HEADER)

SDF — SOURCE DATA FORMAT. THIS FIELD IS USED TO IDENTIFY THE INTERNAL FORMAT OF THE DATA WHICH IS CONTAINED IN THE SOURCE DATA FIELD OF THE PACKET.

SHF — SECONDARY HEADER FORMAT. THIS FIELD SPECIFIES BY WAY OF AN EXTERNAL LOOK–UP PROCEDURE THE FORMAT AND LENGTH OF THE SECONDARY HEADER.

SP — SPARE FIELD

TCF — TIME CODE FORMAT. BITS 0 – 3: TIME CODE ID
BITS 4 – 7: OFFSET VALUE

TIME – USER DEFINED TIME

////////– PRIMARY SORT KEYS

OPTICAL DISK SYSTEM

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OPTICAL DISK STATISTICS

	DESIGN GOALS	MEASURED DATA	UNITS
ON LINE CAPACITY	10^{13}	$.975 \times 10^{13}$	BITS
ACCESS TIME			
ANY DISK	6.0	6.8	SEC
LOADED DISK	0.5	0.66	SEC
DATA RATES	0–50	0–50	MBPS
BIT ERROR RATE	10^{-8}	10^{-8}	MICRONS
SPOT SIZE	.5	.5	MICRONS
SPOT SPACING	1.25	1.25	
DATA STRUCTURE	TRACK = REVOLUTION	TRACK = REVOLUTION	

- MASTER/SLAVE 68000 BASED CONTROLLER
- 14 INCH ALUMINUM DISK IN PROTECTIVE CARTRIDGE

SYSTEM UNITS

1. DISK DRIVE UNIT (DDU)

   - PERFORM ALL ELECTRO/OPTIC/MECHANICAL FUNCTION REQUIRED TO RETRIEVE DATA
   - WRITES TO AND READS FROM DISK
   - RETRIEVES AND STORES DISK IN JUKEBOX

2. HARDWARE/SOFTWARE CONTROLLER

   - INTERFACE TO HOST (VAX)
   - CONTROLS AND MONITORS ALL FUNCTIONS
     - TWO MOTOROLA 68000
   - DUAL INPUT BUFFERS – COMPENSATE FOR VARIABLE RATES

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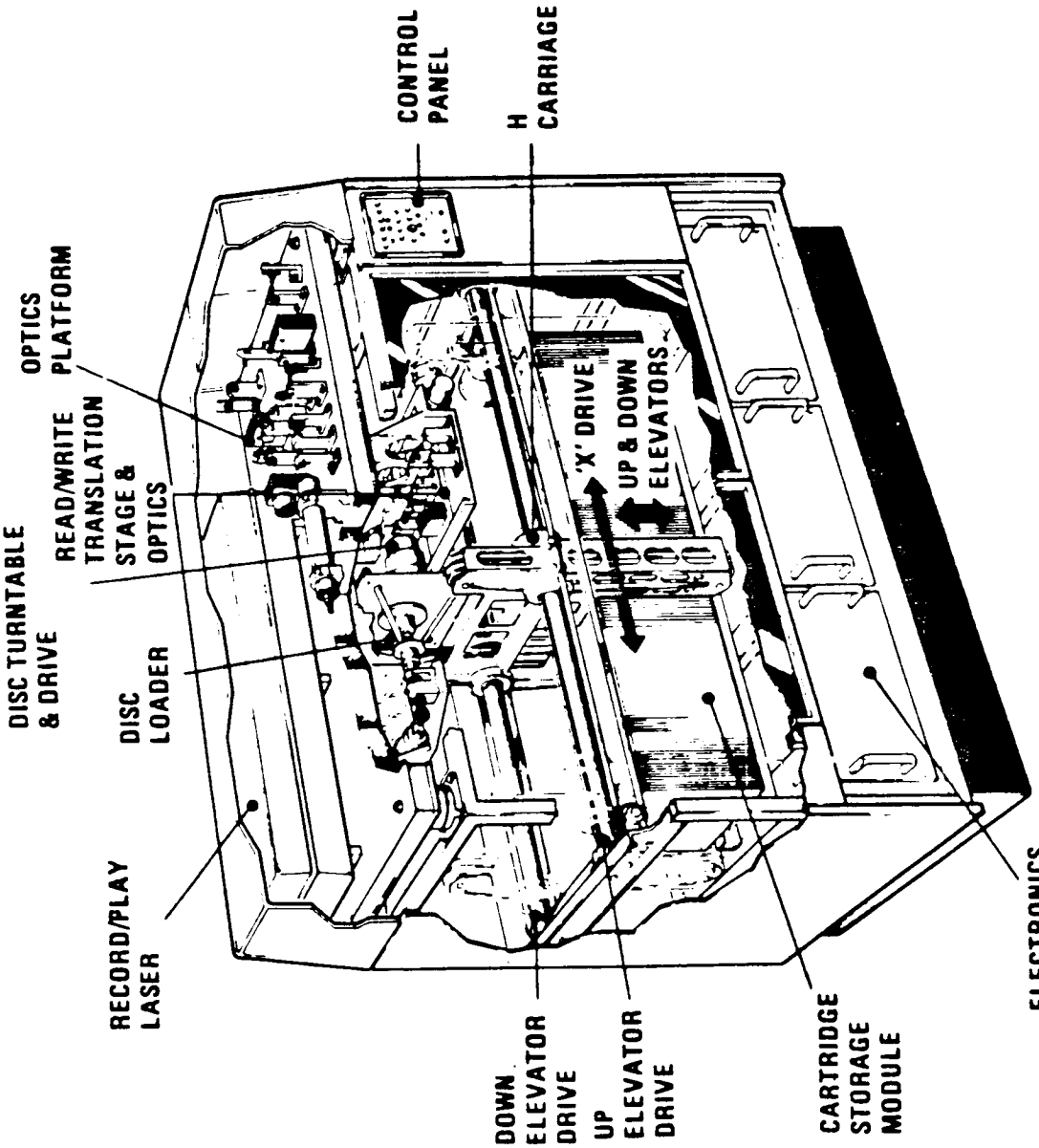
OF POOR QUALITY

DISC DRIVE UNIT



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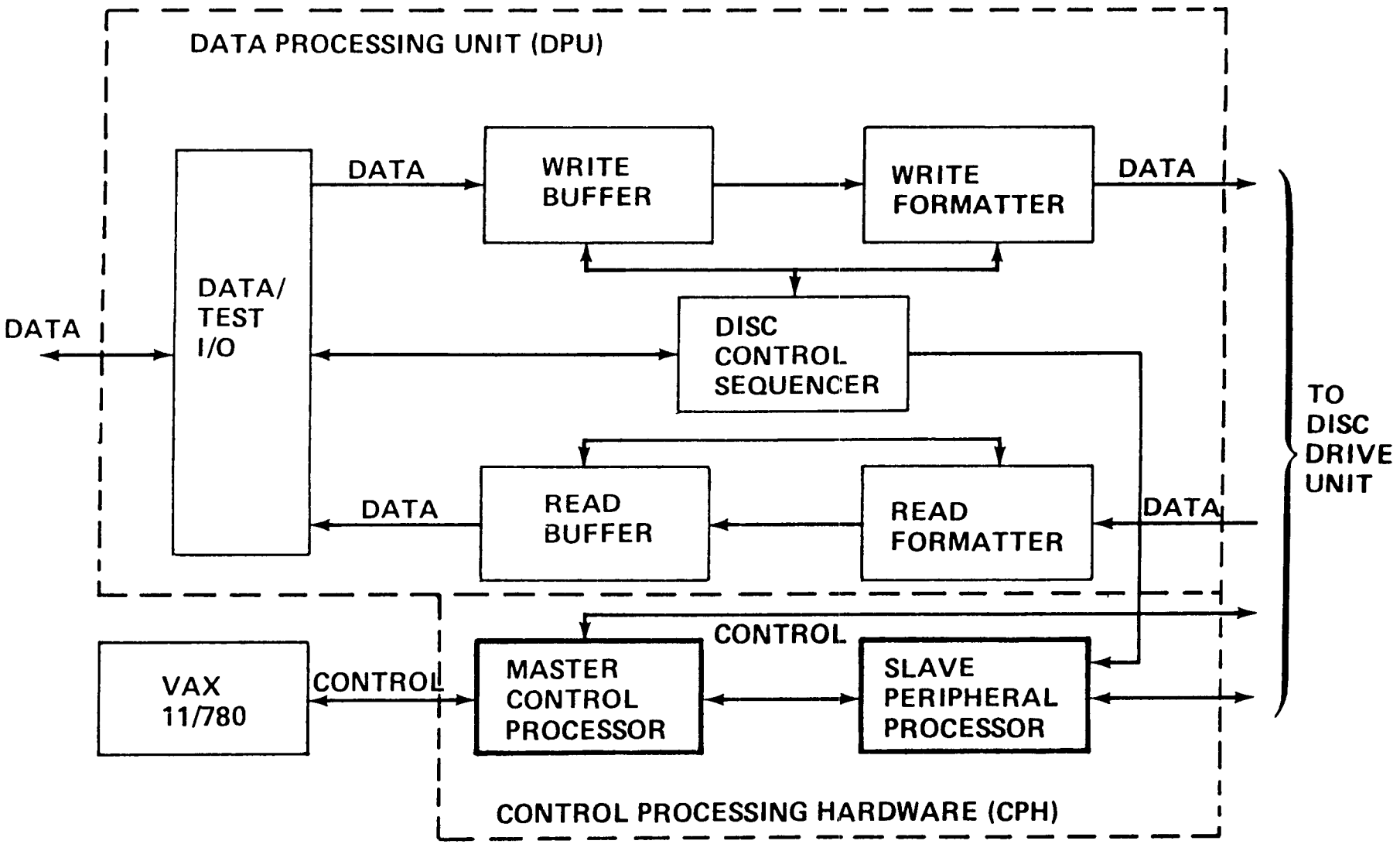
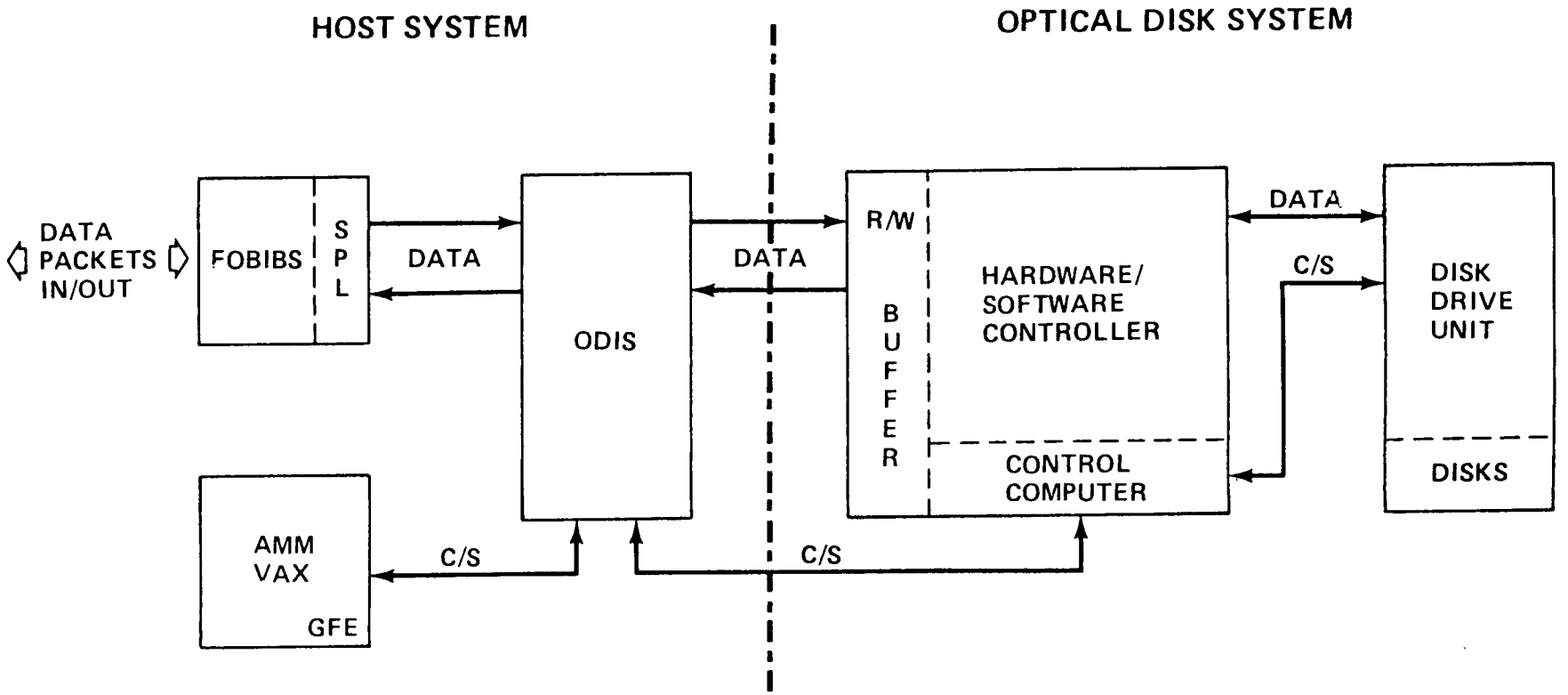
HARDWARE/SOFTWARE CONTROLLER



OPTICAL DISK INTERFACE SYSTEM



THREE LEVEL ERROR CHECK

- READ–AFTER WRITE FOR RECORDING
  - PERFORMED ON EACH INTERNAL BLOCK (512 BITS)
  - UP TO 40 REWRITES PERMITTED PER TRACK
- 3ϕ7 EDAC FOR OUTSIDE ENVELOP
  - CORRECTS FOR BURST ERROR
  - ENVELOP IS 32K BITS = 1 SECTOR
- 3ϕ7 EDAC FOR INSIDE ENVELOP
  - CORRECTS FOR RANDOM SINGLE BIT ERRORS
  - ENVELOP IS 512 BITS = 1 BLOCK

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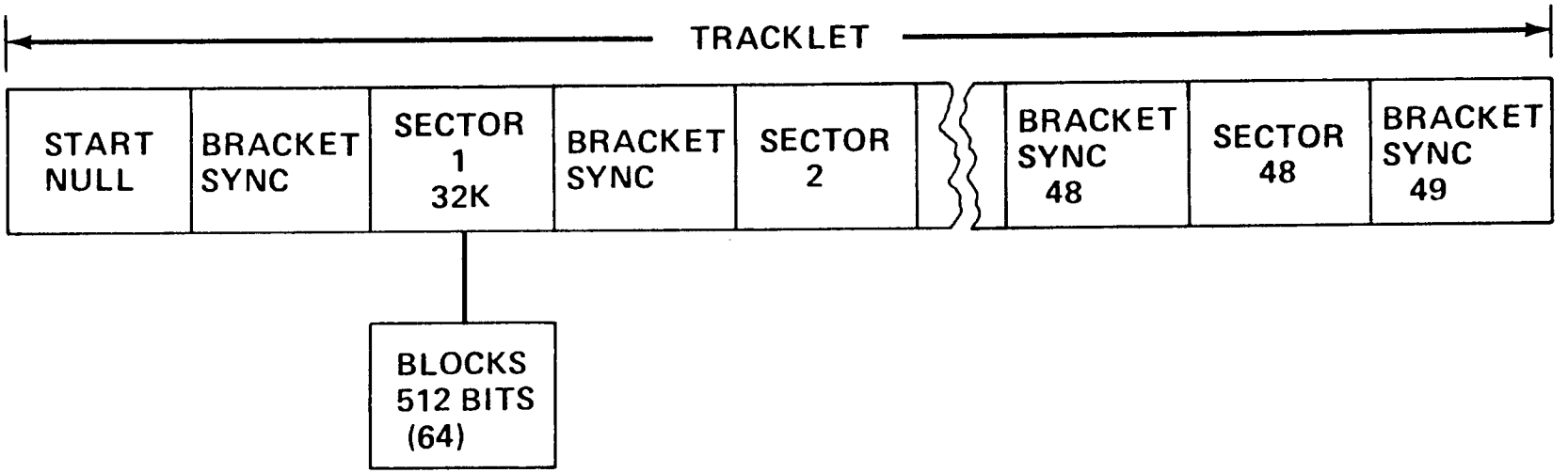
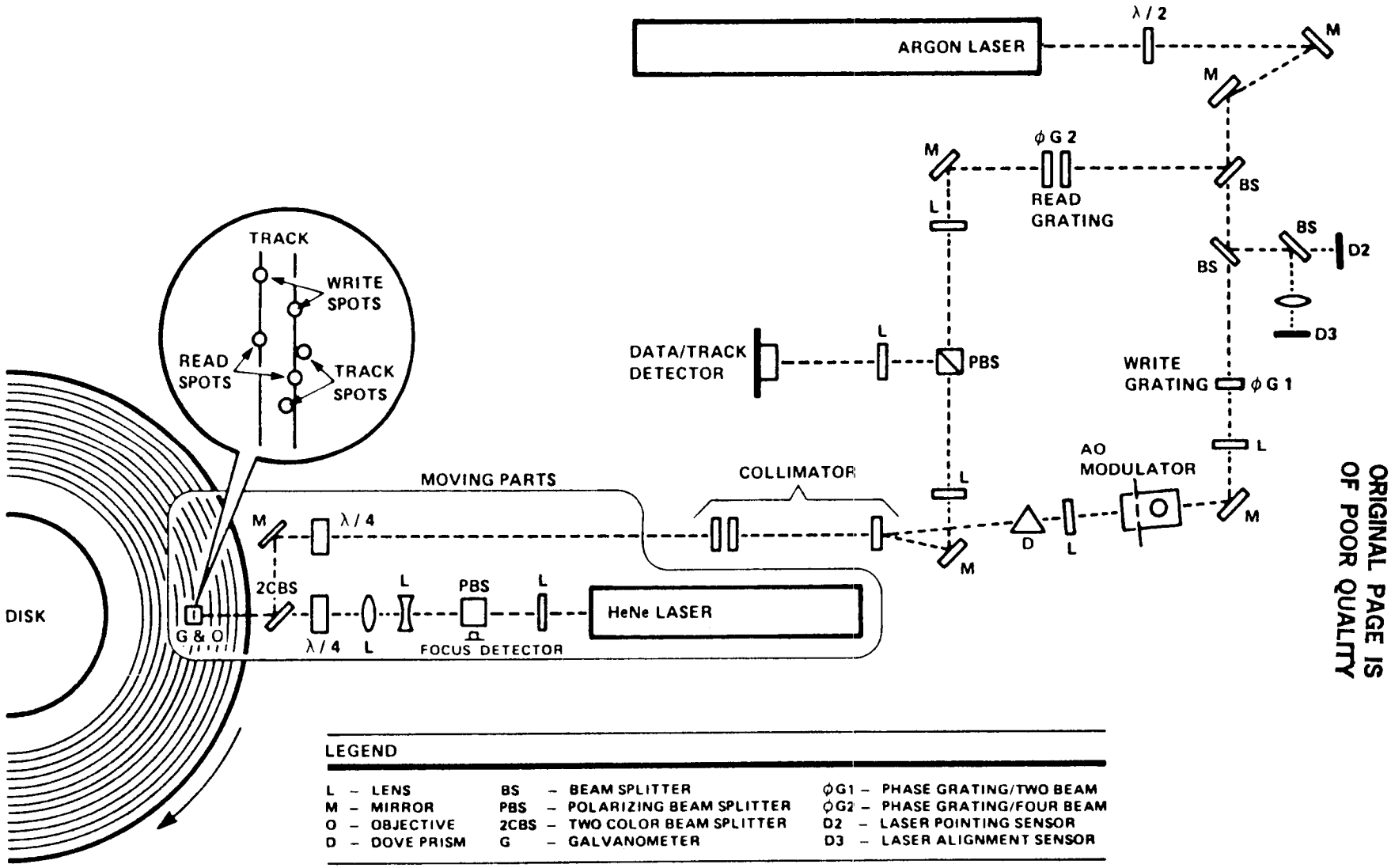
DATA FORMAT ON DISK



512 BIT = 1 BLOCK
64 BLOCKS = 1 SECTOR
48 SECTORS = 1 TRACKLET
2 TRACKLETS = 1 TRACK
22886 TRACKS = 1 DISK (7.8×10^{10})
125 DISK = $.975 \times 10^{13}$

OPTICS SCHEMATIC



LEGEND

L – LENS	BS – BEAM SPLITTER	φG1 – PHASE GRATING/TWO BEAM
M – MIRROR	PBS – POLARIZING BEAM SPLITTER	φG2 – PHASE GRATING/FOUR BEAM
O – OBJECTIVE	2CBS – TWO COLOR BEAM SPLITTER	D2 – LASER POINTING SENSOR
D – DOVE PRISM	G – GALVANOMETER	D3 – LASER ALIGNMENT SENSOR

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CAPACITY SUMMARY

	BITS	MAGNETIC DISK (300 M BYTE)	MAGNETIC TAPE (1600 BPI)	MAGNETIC TAPE (6250 BPI)
1 OPTICAL DISK	7.8×10^{10}	34	263	66
125 OPTICAL DISK ONLINE	$.975 \times 10^{13}$	4250	32,875	8250

PROGRESS/STATUS

- INSTALLATION, CHECKOUT, AND TESTING COMPLETE.
- OPTIMIZING OF SOFTWARE CONTINUES.
- HARDWARE CHANGES BEING MADE TO DISK DRIVE UNIT.
  - AUTOMATE BEAM ALIGNMENT WITH A SERVO.
- HIGH SPEED INTERFACE TO FIBER OPTIC BUS BEING DESIGNED FOR HIGH RATE INPUT
- LIMITED USE DUE TO UNAVAILABILITY OF DISK.

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FUTURE OBJECTIVES

- INSTALL MULTIPLE TURNTABLES (MINIMUM OF TWO)
  - PROVIDE CONTINUOUS RECORDING
  - USER ACCESS TO PREVIOUSLY RECORDED DATA
- MODIFY SYSTEM TO PROVIDE CAPABILITY TO READ DATA SIMULTANEOUSLY FROM SAME DISK THAT IS BEING RECORDED ON
- REPLACE ARAGON LASER WITH LASER DIODE
- MODIFY TO RECORD/READ ERRASABLE MEDIA