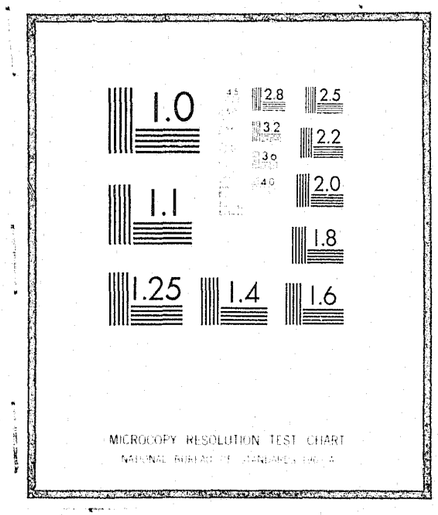

LAW ENFORCEMENT ASSISTANCE ADMINISTRATION (LEAA)

POLICE TECHNICAL ASSISTANCE REPORT

SUBJECT: Assessment of Existing Mini-Computer System In Order to Increase its Performance and Functional Utility.

REPORT NUMBER: 76-211/103

FOR: Arlington, Texas, Police Department

Population:	102,000
Police Strength (Sworn)	150
(Civilian)	32
Total	182
Square Mile Area:	81.8

CONTRACTOR: Public Administration Service
1776 Massachusetts Avenue, N.W.
Washington, D.C. 20036

CONSULTANT: William H. Rawlins

CONTRACT NUMBER: J-LEAA-002-76

DATE: February, 1977

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APPENDIX

FOREWORD

The Arlington, Texas, Police Department requested technical assistance in studying possible improvements to its existing mini-computer system that will increase its performance and functional utility. Key personnel involved in the initiation and processing of the request were:

R.O.: Mr. Herman C. Perry
Chief, Arlington Police Department

P.A.: Mr. Darwin D. Avant
Criminal Justice Division
Office of Governor Dolph Brisco

A.A.: Mr. Fred W. Graffney
Director, Program Development
Technical Assistance Division
Law Enforcement Assistance Administration

On-site evaluation and consultation by William H. Rawlins, the assigned consultant, took place on December 23, 27, and 30, 1976.

I. INTRODUCTION

The Arlington, Texas, Police Department is interested in upgrading its present mini-computer system to provide greater performance and, later, more functional capacity. It desires that the short-term performance of the system be improved in a manner compatible with future expansion of the system. The purpose of this study is to determine what expansion capabilities are available and the economic feasibility of the various alternatives.

In its approach to the above goals, the department has set forth the following precepts:

- Existing equipment will continue to be used if possible.
- Software changes will generally be avoided except where absolutely required.
- New equipment will be evaluated in terms of both long- and short-term goals.

The Arlington Police Department has a current pending grant from the Law Enforcement Assistance Administration for the following:

o Magnetic Disk Drive	$15,900.00
o Line Printer	$15,000.00
o Software	$ 3,000.00
Total	$33,900.00

The primary purpose of the study is to determine how the above grant monies can be used most efficiently. Desired future functional capabilities of the system in order of priority are:

- Addition of one or more CRT's (displays) for inquiry purposes.
- Ability to have multiple users and associated tasks run concurrently.

Persons contacted during this study included:

Mr. Gary Robertson
Arlington Police Department

Mr. K. Giessner
Arlington Police Department

Mr. Denny Walthers
Bell & Howell, Newport Beach, Calif.

Mr. Arnold R. Mireau
Ball Computer Products, Dallas, Tex.

Mr. Mike Miller
Ball Computer Products, Minneapolis, Minn.

Mr. Dave Field
Data General Corp., Dallas, Tex.

II. UNDERSTANDING OF THE PROBLEM

A detailed understanding of the hardware configuration and software programs of the present system is an essential preliminary to any discussion of improvements in performance and utility.

A. Hardware

The present configuration of the "Sidearm" system is:

- Processor -- Data General Nova Model 1210 unit with 16K words of memory (32K Bytes).
- Document Reader -- Bell and Howell Model 8314K-10 MDRA Mark Sense Document Reader, S/N 417.
- Keyboard/Printer -- Diablo character printer with 128-character attached keyboard.
- Magnetic Tape Drive -- 9-Track $\frac{1}{2}$" magnetic tape drive Kennedy Model 8509.
- Magnetic Disk Drive -- Dual Platter Disk Dynex Model DD-6222-T, S/N 1619.
- Teletype -- Western Electric Teletype Model 33 ASR (Automatic Send and Receive).

The system is equipped with the following controller boards:

- 3170 Disk Controller S/N 8837.
- Basic I/O Control B0008.
- Keronix Model P-3-Part #816325 (Memory Board).
- CPU Board 581133.
- A special external I/O controller connects the Document Reader, Magnetic Tape Drive, and Printer with Keyboard.

B. Operating System and Application Software

The operating system software used in the "Sidearm" system is DDOS. DDOS is a collection of disk operating programs consisting of a bootstrap loader,

program loader, and resident I/O disk drives. Decision Disk Operating System was written by Decision Data Corporation, which is now Ball Computer Products, Inc.

The programming language used is a version of Fortran III and is Ball Computer Products release II.

A description of the "Sidearm" system is contained in Appendix "A." However, this description is obsolete because it does not mention the use of the magnetic disk except in a section called "System Expansion."

The present system contains files of data for:

1. Arrest Records (Suspect File)
2. Offense Reports
3. Fingerprints (Selected Group)

The following operator functions are provided:

1. Insert new records
2. Delete existing records
3. Purge records
4. Print records
5. Edit records

1. The Arrest File

Searching the arrest file is time consuming because the file is sequential and the entire file is searched. The file size is currently 10,000 records, and search time is 15 minutes per 10,000 records. Total file capacity is 44,000 records.

Merging new records into the arrest file is also very time consuming, because the file is in alphabetical order by name and new inserts require relocating much of the entire file. This operation requires about 13 minutes per hundred entries.

Generally the Arrest File is searched by name only 85% of the time. It is also searched by:

1. Sex
2. Race
3. Date of Birth
4. Hair Color
5. Eye Color
6. Height
7. Weight
8. UCR Code

2. The Offense File

This file currently (January, 1977) consists of 11,000 records in chronological order by date of report. This file is generally searched by:

1. Date of Report and UCR code
2. Date, UCR, and Grid Area

Edits to this file normally update the disposition and the date of disposition and show property recovered.

Total capacity of this file is 25,000 records, and it is a little less than half full at this time. Rate of growth is about 40 offenses per day.

III. ANALYSIS OF THE PROBLEM

There are basically three general methods to produce improvements in performance, and these are listed more or less in order of complexity and cost.

A. Hardware Upgrading

Usually the easiest and least costly method to improve performance is to simply upgrade to faster equipment. Typical methods are as follows:

1. Substitute a faster disk drive to reduce access time to records.

2. Substitute a larger disk drive to avoid disk changes on removable disk.

3. Use additional disk drives to provide both of the above plus overlapped disk input/output.

4. A faster printer.

5. A faster central processor unit, or additional memory to the existing processor.

6. A CRT display for inquiry to avoid time lost in printing.

B. Software Optimization

Usually there are methods available to improve performance through software changes. Typical methods are these:

1. Construct disk file indices to reduce access time to records. (A "binary" search is an example of this.)

2. Reorganize files to place the most frequently used data into the faster access areas of the disk.

3. Change file type; use random files where data is accessed randomly more often than sequentially.

4. Ensure that the program design allows for maximum overlap of I/O. For example, when searching for records on disk and printing be sure the next record is being searched for while the previous one is being printed.

C. Multi-Tasking or Multiple Users

The system may be configured with the proper software and hardware to allow concurrent operations. Typical methods are:

1. Provide for off-line printer "spooling." This will allow print files to be temporarily stored onto the disk and printed later concurrently while running another program.

2. Multiple Users -- Several terminals can be used to initiate tasks (programs) so that several programs can be running at the same time. This shared use of the computer generally results in greatly improved through-put when configured properly.

IV. FINDINGS AND CONCLUSIONS

A. Hardware Machine Configuration

1. Magnetic Disk

a. What improvement can be expected from a faster disk drive?

A faster disk drive will improve the speed of the system when merging new information into the Suspect File. This is because the merge operation is disk bound and insertion of new records into the file requires existing records be moved to make room.

b. What improvement can be expected from a larger disk drive?

As the files currently do not fill the allocated space on the disk, the primary improvement here would be elimination of the requirement to change the disk packs since the current files cannot reside on a single pack.

c. Can two disk drives be used to operate simultaneously or, rephrased, if a new drive were installed could the old disk drive be used?

The DDOS Operating System cannot use two disk drives simultaneously, although both disk drives could be present on the machine.

d. Could two disk drives share the same controller (utilizing a single slot)?

No, they require separate controllers.

2. Printer

a. What improvement can be expected from a faster printer?

A significant improvement in speed can be obtained from a faster printer. More detailed information on this is provided in V. Recommendations.

3. Programming Language

   a. What are the limitations of the Fortran language used to write the current programs?

      This language is a modified version of Fortran III and is not entirely standard. Therefore, these programs will require modification to run on other systems.

   b. Can the programs be translated to another language or another version of Fortran?

      Yes, a translation to a later version of Fortran should require minimal changes.

4. CRT Display Terminals

   a. What are the implications of connecting a CRT?

      The machine configuration will have to be altered to allow for the installation of a CRT type controller.

5. Multiple User Operating System

   a. What multiple user operating system software is available today?

      There are two available multiple user operating systems. One is the DINOS Operating System of Ball Computer Products, Inc., which is unsatisfactory because it does not support Fortran programs. The other is the RDOS Operating System of Data General Corporation which is unsatisfactory because it cannot operate with the non-Data General peripherals with which the department's machine is currently configured.

6. Central Processing Unit (CPU)

   a. Can the CPU be expanded to accept a larger disk?

      Yes, the larger disk controller can plug into the slot occupied by the present disk controller.

   b. Can the CPU be configured with additional memory?

      Yes.

   c. Will additional memory improve performance?

Yes, by an estimated 5%.

d. Can the CPU be expanded to drive a faster pri

No, because there is no expansion chassis available for the Nova Model 1210. Ball Computer Products, Inc. has proposed to substitute an entirely different chassis and power supply to circumvent this problem.

e. What software program changes are required for the above?

Software changes to connect to a larger disk are trivial. The changes required for a faster printer and to connect a CRT, while not trivial, are not substantial and should require no more than one man-month's effort.

V. RECOMMENDATIONS

1. General Recommendations

Investigation has revealed that the existing CPU (Nova Model 1210) used in the Arlington Police Department "Sidearm" System is at the maximum configuration. Where the existing chassis was designed for four printed circuit boards, the machine has already been configured with two additional boards fitted externally. The original power supply which had a 10 Ampere capacity failed and was replaced with a 15 Ampere power supply. The computer CPU cannot be expanded further.

Ball Computer Products, Inc., has proposed to substitute a seven-slot computer chassis, complete with larger power supply, for the old chassis. This seems to be the reasonable thing to do, since to proceed in this direction is the only alternative to completely outgrowing the system. This will permit a restructuring of the software in order to provide a great deal of expanded capability in the future.

The long-range expansion of the system will require that the "Sidearm" programs be modified to operate with the Data General RDOS Operating System. Unfortunately, the RDOS Operating System will have to also be modified to operate with some of the non-Data General peripheral devices with which the machine is equipped. This software effort is substantial but will allow the system to perform multiple tasks concurrently.

2. Specific Recommendations

It is recommended that the machine be configured immediately with the larger CPU chassis, large disk, and faster printer. A character printer of 120 to 160 characters per second will result in a proportionate increase in speed over the 30 character per second printer now in use. This increase in printing capability will be most evident when generating reports.

It may also be desirable to install a CRT display terminal which would be used for inquiry as the "Ilytyper" may currently be used. The addition of a CRT will definitely require an expansion in the memory to provide for buffer space.

The software required to implement the above configuration is expected to involve no more than one to two man-month's effort and should therefore cost somewhere between $2,500.00 and $5,000.00.

When the above reconfiguration is implemented, the present disk drive and printer will not be used. These peripherals should be retained for future use as the system grows.

3. Action Plan

A Request for Proposal should be drafted for bids on the recommendation outlined here. Preferably, the Request for Proposal will be divided so that the hardware and software can be bid separately. Cost of the reconfiguration, including the software, will not exceed the monies allocated.

A reasonable schedule will permit two weeks to draft the Request for Proposal. Recipients should have two or three weeks to respond. Installation should be within 90 to 120 days from receipt of contract award.

APPENDIX A

Description of the

"Sidearm" System

developed by

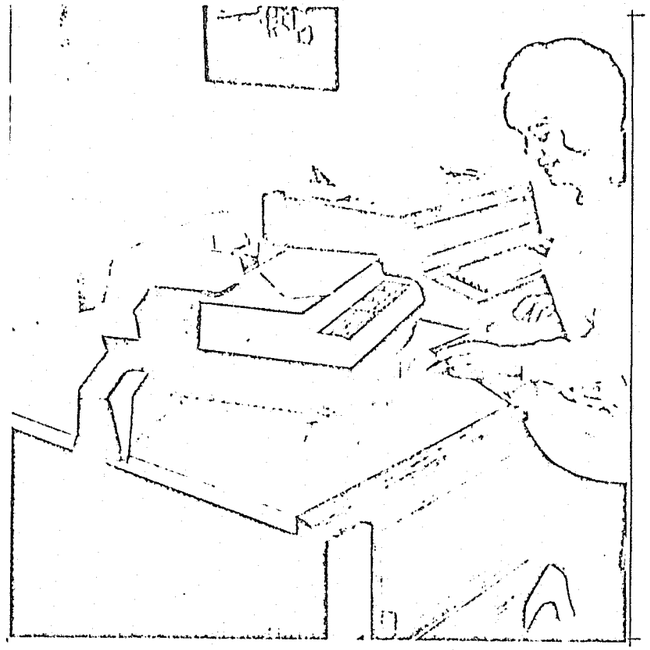
Bell & Howell, Inc.

BUSINESS EQUIPMENT GROUP

6800 McCormick Road Chicago, Illinois 60645 (312) 539-7300

BELL & HOWELL

"SIDEARM" SYSTEM for Law Enforcement



The Bell & Howell "SIDEARM" SYSTEM for Information Storage and Retrieval represents the most sophisticated and versatile approach to a total Law Enforcement Records Management Program.

The "SIDEARM" SYSTEM achieves this level of sophistication and versatility by creating a partnership between a Microfilm Jacket File System and a programmable Control Unit. The Control Unit is used to store, manipulate, and maintain microfilm file, index, and address data. The unit will relate jacket file number(s) or name(s) with one or more topic codes or descriptors.

The "SIDEARM" SYSTEM is a compact, intelligent, stand-alone Information Storage and Retrieval System combining the functions of:

- Automatic Source Data Collection
- Sequential and/or Random Storage
- Automatic Indexing
- High Speed Search and Retrieval

The "SIDEARM" SYSTEM is tailored to the job. The necessary hardware and software have been packaged to perform the above functions as they apply to Law Enforcement applications.

The basic "SIDEARM" SYSTEM consists of the following elements:

- Attractive desk-like enclosure housing the control unit, magnetic tape or disc unit, and data communications interface.
- Bell & Howell Mark Document Reader (MDR) for local input of pencil marked source documents or punched cards.
- Keyboard/Printer - operator's control console and display for local data entry, inquiry/response, and program control.

SYSTEM HARDWARE

MARK DOCUMENT READER

The resident MDR is capable of optically scanning source documents that have been prepared in the field, e.g. Rap sheets, arrest reports, accident and incident reports as well as internally coded forms, e.g. fingerprint classification sheets. The MDR will read any combination of ordinary pencil marks, punched holes, and printed marks, which have been entered on standard or elongated tab cards or on page-size documents of any length.

MAGNETIC DISC UNIT

For complete random storage and access of data, a Moving Head Disc Cartridge Drive is provided. The disc cartridge drive is available with removable and/or fixed cartridges. The disc drive has two moving heads per disc and the cartridge is IBM compatible. The system has an ultimate capacity of 20 million characters of storage.

KEYBOARD/PRINTER

A heavy-duty keyboard/typewriter device is used for the direct input of variable alpha and/or numeric data, for hard copy printed output, and for on-line error correction procedures. The typer unit includes a standard 94 character ASCII Keyboard, a standard 10-key adding machine format keyboard, and a control keyboard for signaling special functions. It is an impact style printer with 30 characters per second printing speed.

DATA COMMUNICATIONS CHANNEL

The "SIDEARM" communications channel is capable of supporting remote terminal for query and response as well as communicating with a central host computer. The characteristics and codes of the communications interface are compatible with common carrier data transmission equipment. The data rate for transmission and receiving is 1200 bits per second; transmission is asynchronous, half-duplex.

CONTROL UNIT

The "SIDEARM" SYSTEM is physically controlled by a general purpose minicomputer with 8K 16 bit words of core memory. A special I/O subsystem conveniently interfaces the computer to the I/O devices allowing for memory expansion in the CPU to 24K.

SOFTWARE SUBSYSTEM

The "SIDEARM" Software Subsystem includes the complete Operating Executive Program as well as a high-speed information retrieval program for complex queries. All software is based on a conversational, user-oriented, query arrangement. It utilizes a special magnetic digital disc filing package and a custom software routine for communication with the system through the Mark Document Reader or a conventional Keyboard/Printer.

The total software development cost including implementation and debugging is included in the "SIDEARM" package.

Bell & Howell maintains complete unit responsibility for all hardware, software, and supplies.

THE "SIDEARM" SYSTEM COMBINES ALL THE BASIC ADVANTAGES OF COMPUTER AND MICROFILM TECHNOLOGIES!

BACKGROUND

In general terms, we feel that two problems face the

(a) a growing backlog of file storage
(b) a growing indexing problem with the associated growth in the time required to find information.

The first problem can be solved by any microfilming system. However, a problem arises in that information on the system cannot be found quickly. A coding structure superimposed on the microfilm file provides a partial solution but results in much human effort both in preparing updates (splicing and coding) and in using the system due to reel changing and inflexible searching facilities.

It is important that the have a flexible coding structure and fast search capability for:

- Fingerprint Identification
- Event and Occurrence Analysis
- Criminal History Analysis

SOLUTION

The suggested solution is based on mini-computer based system with its own large magnetic storage back-up, which permits for either sequential or random entry of data into the data file. A Bell & Howell Microfilm Jacket System is used in conjunction with the SIDEARM unit for rapid, accurate retrieval of the "suspect" file(s).

PROCEDURE

- Criminal files as well as fingerprint files will be indexed and coded in numeric form to represent physical characteristics, fingerprint classification, and modus operandi. Cross-reference indexing is also possible - simple name-to-number or vice-versa.

- All index information is stored on magnetic tape. The magnetic tape unit is always on-line to the control unit.

- The appropriate search parameters are then marked on the input document or entered through the keyboard. A standard pencil is used along with pre-designed information coding forms. These forms are, in fact, source documents that will replace existing documents, and will allow for accurate, fast entry of data by-passing the time-consuming and error prone "key-in" process.

- The control unit then searches the file comparing coded descriptors in each file record against the known data elements (descriptors) marked on the document or entered on the keyboard.

- File search can be conducted on the basis of equal to, equal to or greater than, equal to or less than, or not equal to. This is accomplished by weighing the value of every data element descriptor as to its relative importance in a specific search function.

- With each new data element descriptor entered, the number of "hits" is reduced and a type out of the number of hits is automatically generated.

- All file records that match all known descriptors, or match with a variance against a defined threshold, are then printed out, including microfilm jacket file number and frame of film where the information is stored.

- At any time during the procedure, the search may be terminated and the file of "hits" may be examined. Examination includes simple manual retrieval of the identified microfiche record and the viewing of the associated microfiche image.

- Additions to the system or updating an existing data file will be run in the same conversational mode through the MDR or keyboard. Each data element descriptor required by the system will be entered in turn, and those which do not require an entry can be by passed.

The system proposed uses a simple fixed length numerical code structure. The system can be expanded at a future date to accept natural language queries and entries.

It must be emphasized that the system is to be provided as a turn-key operation. Establishing the magnetic files in the first instance will be done in the same way as future file updating. Thus, no special arrangement is required.

Addition of cross referencing dictionaries may be handled at a later date to establish compatibility with other systems.

The total software system for SIDEARM will be run under control of an operating "executive" program which is developed and maintained by Bell & Howell. This will insure that additional peripheral equipment or software changes can be added to the system as painlessly as possible.

SYSTEM EXPANSION

The "SIDEARM" SYSTEM proposed is capable of expansion to cope with any future needs of the

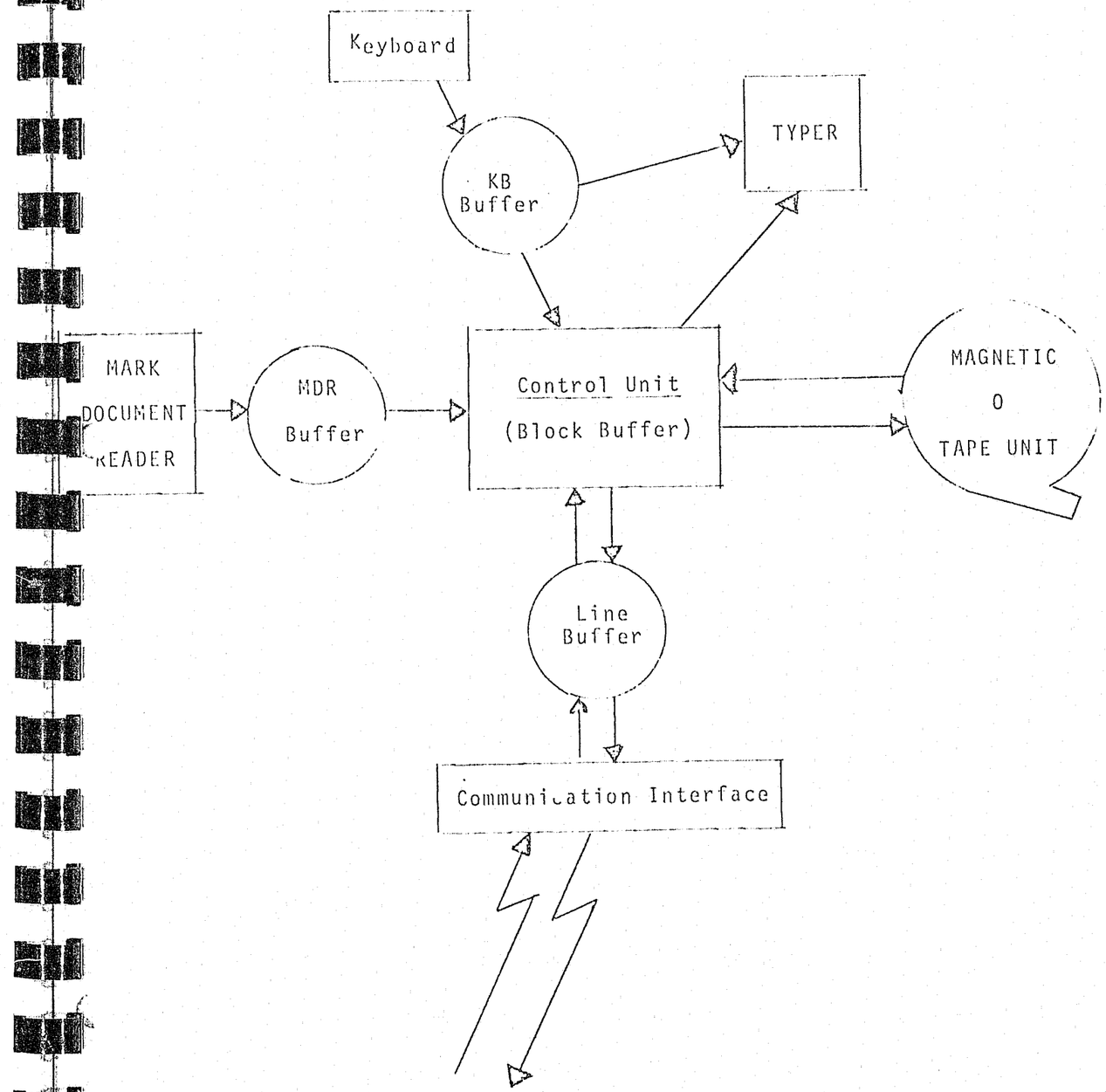
The system may be expanded to include all types of criminal records. The digital storage may be expanded by adding reels of magnetic tape. It is also possible to upgrade your system by adding a fully operational Disc Operating System. This would become valid as your files increase in size and the complexity of the index or search parameters become greater. Through such expansion the system would achieve an ultimate capacity of 20 million characters of storage.

The system may be linked to other computer criminal record files through the standard telephone communications interface. With a telecommunications interface, the system can access records maintained by city, county, state, or federal crime file systems.

Addition of extra data entry and inquiry/response terminals at various stations throughout the Police Department, the city, and the county is also feasible.

"SIDEARM"

SYSTEM CONFIGURATION



SUMMARY OF BENEFITS

The Bell & Howell "SIDEARM SYSTEM" provides the following advantages:

* Reduction of manpower costs. It is easier and more economical to hire clerical personnel than utilize skilled police officers. The entire system is maintained by one clerk, allowing the police staff to remain in the field where they are most effective.

* Off-line operation -- requiring no expensive computer time for operation.

* Information is compressed at maximum practical "packing" density. Textual information on microfilm; indexing on magnetic tape.

* Response time is at electronic, computer search speed.

* Updating the files is simple and fast - Mark or key in new data -- film, process associated images, mount into jackets.

* The Mark Document Reader provides an accurate, efficient, and simple means of inputting new information as well as serve as the interrogation vehicle when a file search is required.

  Additional MDR benefits:

  - Versatile forms design capability.
  - Speed to read more than 6000 documents per hour to magnetic tape.
  - Specially engineered feed system, designed to accept documents that have been subjected to improper handling, e.g. Rap sheets, arrest reports, burglary reports, accident and incident reports, that have been prepared out in the field.
  - Operational simplicity -- requires no special skills or training.
  - Proven hardware -- over 1200 MDR users attest to this.

* Index coding is erasible -- changes can be made in seconds, using the MDR or keyboard.

* Deletions are made under program control in seconds. Microfilm material becomes de-activated and purged.

* Unlimited descriptors may be linked in one pass.

* Statistical analysis is performed on every search by weighing the descriptors and computing a variance against a defined threshold of acceptance.

* Complex statistics are programmable in one step operation.

* Satellite stations for file data entry and inquiry/response are feasible.

* System is compatible with all other police forces.

* Conversion is simple, fast, and low cost.

* No wear and tear on stored information due to mechanical abrasion or handling.

* Cost of back-up magnetic tape is low ($20).

* Can expand to accomodate future applications.

"SIDEARM" combines all basic advantages of computer and microfilm technologies!

END