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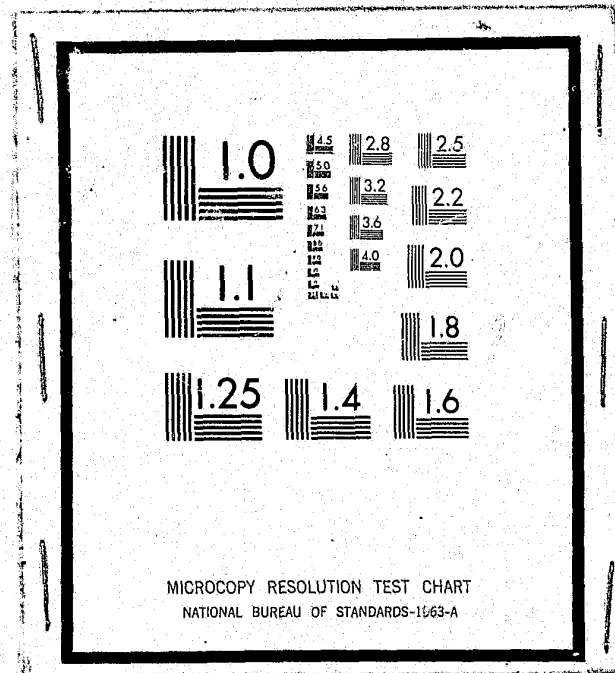
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U.S. DEPARTMENT OF JUSTICE
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WASHINGTON, D.C. 20531

3/30/77
Date filmed

38050

INDIVIDUAL TECHNICAL ASSISTANCE REPORT

In Response to a Request for Technical Assistance

by the

Seattle, Washington, Police Department

June 25, 1973

NCJRS

NOV 30 1976

ACQUISITIONS

Prepared by:

Public Administration Service
1313 East 60th Street
Chicago, Illinois 60637

(Per Contract J—LEAA—015—72)

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I. PRELIMINARY INFORMATION

    A. Consultant Assigned:

        Gerald D. Welch, President
        Northwest Digital Systems, Inc.
        Bellevue, Washington

    B. Date Assignment Received:

        April 19, 1973

    C. Date of Contact with LEAA Regional Coordinator:

        April 20, 1973

    D. Dates of On–Site Consultation:

        May 1, 2, 4, 8, and 16, 1973

    E. Individuals Interviewed:

        Not Applicable

II. STATEMENT OF THE PROBLEM

    A. Problem as per Technical Instruction:

        Define possible alternatives to the "Automatic Call Distribution" being considered by the Department.

    B. Problem Actually Observed:

        As stated.

III. FACTS BEARING ON THE PROBLEM

    Not Applicable

IV. POSSIBLE COURSES OF ACTION

    See attached consultant's report.

V. RECOMMENDED COURSES OF ACTION

    See attached consultant's report.

Review of Alternatives

for Implementation of

an Automatic Call Distributing System

Introduction

This report reviews characteristics and compares costs for alternative approaches to installation and operation of an Automatic Call Distributing System for a city of approximately 500,000 population.

There are two basic alternatives, plus elaborations of the latter one.

Alternative A utilizes equipment leased from the telephone company.

Alternative B utilizes hardware purchased by the city and interfaced with lines leased from the telephone company. The heart of this system is a single chip eight-bit parallel central processor unit.

Alternative B.1 adds full redundancy, or back-up capability to Alternative B.

Alternative B 2 adds a computer-driven clock system with twelve time stamp devices to the basic system.

For cost estimation, it is assumed that the system consists of 35 incoming telephone lines, 10 outgoing lines, 16 Call-Director type consoles, 7 five-button telephones, a supervisory control panel and related force administration equipment.

For the reader unfamiliar with the concept of Automatic Call Distribution (ACD), a description of the system, personnel and procedures can be found in the Appendix, page 11.

Review of Alternatives

Alternative A

All equipment needed for the ACD is leased from the telephone company. The system is reliable, but there is no backup capability. In case of equipment failure the entire system may be down for an indeterminate period.

Force administration data (FADS) is minimal and difficult to obtain. The registers must be read by personnel each hour, and the information manually recorded. The data is later used for report generation. This represents an inefficient use of manpower for data gathering, and the data may not be in a usable form for some time.

Perhaps the greatest weakness of Alternative A is an almost complete lack of system flexibility. Additions or changes to the system require much time, effort and money.

Cost Data for Alternative A:

All costs are estimated. For cost comparison purposes it is assumed that the city now has no operational system.

Capital Cost:

Telephone, one-time installation charge. $9,000.00

Monthly Telephone Cost:

35 incoming, 10 outgoing lines, 16 call directors, 7 five-button phones, FADS equipment and miscellaneous equipment. $4,600.00

Annual Cost:

Telephone charges, $4,600.00 per month.	$55,200.00
Debt service on $9,000 capital cost at 5.75% interest.*	911.59
Total Annual Cost, Alernative A	$56,111.59

* Assumes a 15-year useful life

Alternative B

The heart of this system is an eight-bit computer on a chip. Since this is a programmable device, flexibility is virtually unlimited. .

The single chip eight-bit parallel central processor unit (CPU) has the following characteristics:

1. 2 micro-second instruction cycle.

2. directly addresses 65K bytes of memory.

3. unlimited nesting of subroutines.

4. maximum of 256 input ports and 256 output ports.

5. can be used with any type or speed semiconductor memory in any combination.

6. contains seven 8-bit registers.

7. 74 basic processor instructions.

8. multiple interrupt handling capability.

9. Direct Memory Access (DMA) capability.

10. all basic control signals produced by the processor.

11. packaged in 40-pin Dual Inline Package (DIP)

The central processor unit controls and performs the Automatic Call Distributing function as reliably as, and much more quickly than the leased equipment. In addition, report data can be generated and printed very quickly. For example, the unit can be instructed to automatically print reports on the output printer at desired intervals. Data can also be printed on demand. In addition to the data reported by the system in Alternative A, this system can record the clock-time of every call

entering the system, as well as the time each call is answered by the operators. The advantages in terms of staffing and control are obvious.

System programs are stored in a non-volatile, solid-state, high speed read-only memory (ROM). Data is stored in a solid-state high speed, read-write, random-access memory (RAM).

As noted above, this system offers a maximum amount of flexibility. When desired, the system can be interfaced with other computer systems. Existing ROM can be reprogrammed, or additional ROM and RAM can be added.

Cost Data for Alternative B:

Capital Cost:

Telephone, one time installation charge;
35 incoming lines, @ $35.00	$1225.00	
10 outgoing lines, @ $30.00	300.00	
Subtotal (telephone installation)		$ 1,525.00

Computer equipment cost;
CPU, 8 interrupts, 2000 words RAM	$1,000.00	
2,2000 word ROM @$1,000	2,000.00	
Line printer, 14" paper 100 lines per minute, and interface	2,500.00	
60 Hz clock, related clock board	750.00	
Switch input interface	250.00	
6-Contact output relay boards, 24 per board	1,500.00	
Battery and charger	500.00	
Miscellaneous CPU equipment	500.00	
Subtotal (computer equipment)		$ 9,000.00

Telephone equipment cost;
5 10X10 crossbar switch, @ $500	$ 2,500.00	
Solid state dc powered ringing supply	500.00	
16 call directors, @ $700	11,200.00	
7 phones, 5-button, @ $400	2,800.00	
20 tone decoders, @ $100	2,000.00	
Supervisor's display board	2,000.00	
Miscellaneous telephone equipment	1,000.00	
Subtotal (telephone equipment)		$22,000.00

Labor cost (including software) $ 7,000.00

Total Capital Cost for Alternative B: $39,525.00

Monthly Telephone Cost:

35 incoming lines, @ $46.90	$ 1,641.50	
35 interface units, @ $5.75	201.25	
10 outgoing lines, @ $16.00	160.00	
Total monthly telephone line charge	$ 2,002.75	

Annual Cost for Alternative B:

Telephone line charges at $2,002.75 per month	$24,033.00
Debt service on $39,525 at 5.75% interest*	4,003.39
Maintenance (5% of $39,525)	1,976.25
Total Annual Cost for Alternative B	$30,012.64

* Assumes a 15-year useful life

Alternative B 1

Configuration of this system is the same as Alternative B, with the addition of full redundancy for the CPU and related equipment. Hardware and software to accomplish automatic transfer to the stand-by system will be provided.

To provide the above capability, an additional $8,000 for equipment and an additional $1,000 for programming is necessary. Total capital cost for Alternative B 1 would then be $48,525.00.

Annual Cost for Alternative B 1:

Telephone line charges at $2,002.75 per month	$24,033.00
Debt service on $48,525 at 5.75% interest*	4,914.98
Maintenance (5% of $48,525)	2,426.25
Total Annual Cost for Alternative B 1	$31,374.23

*Assumes a 15-year useful life

Alternative B 2

This configuration adds the following to Alternative B 1: a computer-generated time-drive signal which will key the time stamp units. Units which are used with leased telephone equipment are not in sync, and print time only to the nearest minute. The computer system allows installation of time printing units (hours, minutes and seconds). The units will always be in sync. To provide that capability, an additional $6,000 for twelve clocks, $750 for computer interface equipment and $700 for labor will be required.

Total capital cost for Alternative B 2 would be $55,975.00.

Annual Cost for Alternative B 2

Telephone line charges at $2,002.75 per month	$24,033.00
Debt service on $55,975 at 5.75% interest*	5,669.57
Maintenance (5% of $55,975(	2,798.75
Total Annual Cost for Alternative B 2	$32,501.32

*Assumes a 15-year useful life

Cost Comparison

Capital Cost:

Alternative A	$ 9,000.00
Alternative B	$39,525.00
Alternative B 1	$48,525.00
Alternative B 2	$55,975.00

Annual Telephone Charge:

Alternative A	$55,200.00
Alternative B	$24,033.00
Alternative B 1	$24,033.00
Alternative B 2	$24,033.00

Annual Maintenance Charge:

Alternative A	$ 0
Alternative B	$ 1,976.25
Alternative B 1	$ 2,426.25
Alternative B 2	$ 2,798.75

Total Annual Cost:

Alternative A	$56,111.59
Alternative B	$30,012.59
Alternative B 1	$31,374.23
Alternative B 2	$32,501.32

Conclusion

It is clear that the computer based system offers significant cost savings over leased equipment. But of equal importance, the computer system offers impressive technical advantages. The system described is at the edge of present technology. It is fast, reliable and flexible. Since the system is modular in nature, excess capacity for future growth need not be paid for until it is needed. The system can be expanded at any time to handle future needs.

A p p e n d i x

Automatic Call Distributing System (ACD)

This system automatically distributes incoming calls to the primary operators. If all operators are busy, the system stores the calls and releases them in the order of arrival.

The ACD provides sixteen operator positions with Call Director type consoles for the Sergeant, six primary operators, two primary/secondary operators and seven secondary operators.

A "calls waiting" light indicates all positions are busy and that unanswered calls await. The light appears at the four primary, two primary/secondary and the sergeant's positions. A supervisory lamp cabinet contains lamps for each incoming trunk, and lamps indicate which operator positions are busy or available. This gives the sergeant a visual indication of the traffic pattern, and aids him in the supervision of the operators' work.

Primary Operator

The primary operator answers all emergency calls. When in service the operator hears a tone indicating a party is on the line. After finishing the call (sequence explained below), the operator touches his release button and is then ready to receive another call. The ACD automatically distributes the work load evenly to the primary operators.

The primary operator is often the person the public first contacts in the police department. This initial contact is extremely important, not only in terms of professional image for the department, but also in terms of calming the caller if necessary so that vital information can be gathered quickly. Speed,

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accuracy and sensitivity are important attributes in a primary operator, and candidates for those positions must be carefully screened.

To give the reader a "feel" for the ACD, some typical operating sequences are presented below.

Incoming call to primary operator. Headset must be plugged in and "In" key depressed to make the position available for an incoming call.

1. "In" key lamp lights.

2. "ZIP" tone is heard.

3. Answer with identifying phrase, "police emergency operator number XX."

4. Complete necessary contact.

5. Depress "RLS" key.

6. Depress "In" key to make position ready for another call.

Transferring call to secondary operator. After primary operator has answered the incoming call:

1. Depress "TRN" key; incoming call automatically held.

2. Listen for dial tone.

3. Dial transfer code "2" (consoles are actually touch-tone); ringing signal heard.

4. Announce call to secondary operator if desirable. Calling party cannot hear this conversation.

5. Depress "In" key (transfers the call, but leaves all three parties on the line).

6. Depress "RLS" key, which removes primary operator from the circuit, leaving the caller and secondary operator connected.

7. Depress "In" key, which makes primary operator ready to receive another call.

Transferring emergency calls to outside agency

1. Depress "EMER TRN" key. Call is automatically held, and operator can still talk with the caller.

2. Listen for dial tone.

3. Key appropriate transfer code, e.g., "4" for the fire department. Ringing signal heard. Operator maintains voice contact with caller during transfer.

4. Agency answers.

5. Depress "RLS" key, leaving caller and called party connected.

6. Depress "In" key to receive another call.

Transferring dispatch calls.

1. Depress "DISP" key. Call is automatically held, and allows voice contact with caller.

2. Ringing heard.

3. Dispatch answers. Operator stays on throughout call.

4. Depress "RLS" key.

5. Depress "In" key to receive another call.

In the case of a crime-in-progress, the operator transfers the caller to the chief dispatcher, alerting him as to the nature of the call. The chief dispatcher elicits information necessary for immediate broadcast to all police units. As this occurs, the primary operator, still on the line, writes down pertinent information, such as descriptions. After the chief dispatcher has finished with the call the primary operator completes necessary

information for routing to the area dispatcher for regular dis-
patch.

Secondary Operator

The secondary operator's major responsibility is to be
available for the disposition of transferred non-emergency calls
from a primary operator. The transfer allows the primary operator
to quickly free himself for the next call.

The secondary operator's time is spent largely in writing
of reports and giving information to citizens.

Should all secondary operators be busy, the primary operator
will fill out a "call-back" card and deliver it to a primary/
secondary operator.

Primary/Secondary Operator

These operators perform a dual function in the control
center, with their duties duplicating some of those performed by
the primary and secondary operators. The P/S operator's major
duty is to handle overload emergency calls which surge into the
communication center.

Though not directly on the Automatic Call Director System,
the P/S operators do have "call waiting" lights on their consoles.
Should the light remain on for more than approximately five
seconds, the P/S operator can enter the system and handle the
primary call. At other times he performs the duties of a secondary
operator.

END