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DEPARTMENT OF
DATA MANAGEMENT

CITY OF SACRAMENTO
CALIFORNIA

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May 18, 1989

Budget and Finance
Transportation & Community
Development Committee
Sacramento, California

Honorable Members in Session:

SUBJECT: Report Back on Department of Data Management "1989/94 CIP - Hardware"

SUMMARY

This report is in response to Committee Member Tom Chinn's request for a report back on the contents of Data Management's CIP request as well as impacts of the expenditures.

The following information provides the detail of the Department of Data Management's CIP Request for $2,944,062 in hardware expenditures over the next five years. The projected hardware needs are the results of analysis performed on historical data covering the last 16 months of computer resource utilization. Major strategic planning issues resulting in these needs are:

Service levels
Storage requirements
Technology
Disaster Recovery

The purpose of this report is twofold: first, to provide a background on the equipment installed; and second to explain how and why the five year hardware plan was developed. Currently there has been no funding identified for future hardware expenditures which means growth may not be accommodated. If and when funding is identified, the additional hardware does not require additional staffing to run the equipment.

BACKGROUND

In September of 1988 City Council approved the upgrade of the City's IBM 4381 computer to an IBM 3081 KX, which was completed

in November of 1988. This interim upgrade was made to fill the City's projected automation needs for the next two and one-half to three years, at which time a replacement CPU would be purchased to coincide with Data Management's move into expanded facilities.

Although the IBM 3081 KX computer was not on the leading edge of technology, it provided the required growth capabilities, and allowed the City to seize upon new opportunities for automation. Coinciding with the computer upgrade was the completion of the system conversion from the old Sperry computer to IBM technology. The IBM 3081 KX was not the ultimate solution but one that was affordable in the short run. With the installation of the IBM 3081, Data Management was able to continue to support the critical on-line applications, and absorb the additional overhead created by the Sperry to IBM conversion, while still providing expected levels of reliability, and acceptable (.2-.5 second) response times.

The upgrade cost to the 3081 KX was approximately $166,738. Additional annual charges totaling $76,078 were incurred for hardware maintenance, software maintenance and software purchases. See Attachment 1 - IBM Network Hardware Configuration.

ANALYSIS

The continuing growth of the City's on-line systems, data communications networks, hardware and software options are providing enormous improvements in responsiveness, efficiency and user satisfaction, but these terminal-driven applications are demanding significant amounts of on-line storage as well as creating demands on the CPU, and peripheral resources such as tape drives and printer. The growing use and installation of microcomputers is also tending to increase rather than decrease the need for central computer storage, as users require subsets of central files to be kept available on-line to interact with their micro applications. Newer user friendly languages require more system overhead as well as more storage. The nightly processing of file updates is extending to the point that if a failure occurs midstream the processing falls behind and causes the system to be available late in the morning.

In order to continue to provide acceptable service levels and to meet the ever changing demands for service on the computer facilities, Data Management has embarked upon formalizing the performance measurement and resource evaluation process. Examples of service levels are:

1. All scheduled batch jobs completed before 7:00 a.m.
2. Two to three second response time for on-line systems including the test environment.
3. All printout completed by 7:00 a.m.
4. Capacity to provide over 99% of available hardware resources during 8:00 a.m. - 5:00 p.m. shift.

The result of this effort is the proposed Computer Hardware Plan, (see Attachment 2 - IBM Hardware Requirements 1989-94 CIP Request and Attachment 3 - Summary of Existing and Projected IBM Equipment) and is depicted in the following analysis with narrative and graphs concerning utilization of the City's computer resources.

I. Computer Work Load

The current configuration provides services to 300 plus terminal and PC users, who access and update the following software applications:

1. ABS Automated Budget System
2. ALS Animal License System
3. BND Bond Systems 1911 - 1915
4. BUS Business/Rental Tax
5. CAI City Clerk Index System
6. CSS UCIS System
7. DMS DASD Support
8. EMS Energy Management
9. EXP Expense and Revenue
10. FAS Fixed Assets
11. FOC Focus Support
12. GEO Geo Code
13. LGF LGFS
14. OPR Operations Support
15. PAY Payroll Systems
16. PCS Position Control
17. PCS Council Flyers/Labels
18. PEN Pension Payroll
19. SCT Senior Citizens
20. PAR Parcel/Transfer Tax
21. SOS Stockless Office Supp
22. SYS Systems Support
23. TAR Traffic Accident Rtping
24. TBS Telephone Billing System
25. WAN Weed and Nuisance Abate
26. WKC Workers Comp
27. UBS Utility Customer Information System

A typical 8 hour day shows an average of 46,233 transactions being initiated by these users, in their day-to-day business activities.

To help manage this wealth of information the IBM Operating System is supported by the systems software, and third party software packages shown on Attachment 4 - System Software and Operating System Overview.

These MVS/XA components can be used to monitor, analyze, forecast and manage system resources as well as to isolate, diagnose and fix program errors. But as with traditional IBM operating systems, the data is technical in nature, and requires labor intensive manipulation to achieve maximum benefit of the data available.

II. Resource Utilization

With many users running many separate programs means that, along with large amounts of complex hardware, MVS/XA users need large amounts of storage to ensure suitable systems performance.

DASD - Direct Access Storage Device or Disk

Projections made from statistical data covering the period of May 1988 through December 1988, when the conversion was still in process and UCIS had just been placed into production, indicated that the space (DASD) requirements were growing at the rate of 2 - 3380 DASD Units per year or 5 gigabytes. Projections made subsequent to that time indicate a trend that has increased by 5%, requiring an additional 3380 DASD Unit per year. The City's growth in DASD use is not unusual in an IBM environment.

The side effect of this growth is that we are now exceeding the recommended maximum utilization of available storage (DASD). Industry standards indicate that a 15% to 20% reserve margin (capacity corridor) is required to assure that existing resources can satisfy unexpected demand. This reserve margin is unapplied but available resources to satisfy peak or unexpected demand. The term reserve margin is used instead of "excess capacity" which implies, quite incorrectly, that the equipment is for the most part unused.

When projections of work load reach or enter this capacity corridor, the work load is processed "at risk", and action is required. There are two 3380 DASD on order to accommodate growth and provide a backup unit for disaster recovery. (See Attachment 4 DASD Space Occupancy Trend.

The storage requirements for these programs and files, based on initial requirements and predicted growth, have grown to the allocations shown in Attachment 5 - DASD Volume Distribution.

III. Controllers

All 3380 DASD units are connected to the IBM through a 3880 Model - 3 Control Unit (AKA Controller). Each controller can support two strings of 3380 DASD, on two I/O (Input/Out) channels. To maximize the use of the standard and special features of the 3880 controller, it is recommended that only three DASD devices be attached to each string, so that for every seventh DASD to be installed, a 3880 controller is required. It should also be noted that additional controllers can be added to the DASD configuration when storage capacity is increased (i.e., upgrading a 3380 to dual density), without this corresponding increase in the ability to access storage, the likelihood of an I/O bottleneck occurring is increased accordingly. Without getting into technical terms, the controller is like a traffic cop which controls conversion between the DASD and the computer.

IV. Tape Drives

The current open reel technology that is installed is over eighteen years old, and its recording speed and need for human intervention hinders our ability to keep pace with the input/output speeds of the CPU, nor does it allow for disaster recovery.

Part of disaster recovery deals with the requirement to off load critical data files to magnetic tape, as a mandatory backup and off-site storage function. Currently this process is taking over

three hours a night, which does not leave any time during the nightly 14 hour production shift to recover from a system/application software failure, thus creating a "CRISIS" mode operation when this situation occurs.

Operations staff are working on Saturdays via overtime to process remaining jobs which could not be completed during the regular production shifts on Friday night. This is due to the increase in data which has to be backed up on a daily, weekly, monthly basis as well as the requirement for backing up operating system files. A new application system added to the processing in November requires a 3 hour backup at the beginning and at the end of processing. If a failure occurs midway through the processing, there is not enough time to restart the application.

The technology of the cartridge tape drive is such, that with each unit installed, its data capacity and data transfer rates (I/O) coupled with its multi-cassette self loading features, will reduce operator intervention and not only the time required to perform critical backup functions, but also reduce the I/O time for all productions job that use and/or create tape output. It is estimated that this saving will eventually buy back five hours of housekeeping time, creating the recommended capacity corridor for peaking processing and disaster recovery requirements.

V. Laser Printer

Printing demands have increased with the completion of the conversion and installation of the UCIS system. There are new requirements for specialized print in different sizes and styles (known commonly as fonts). Print speed and programmable forms storage will represent efficiency and expediency as we gear up to meet our clients' needs. In reviewing the cost to the city for outside laser printer, $60,000 has been spent to-date this fiscal year.

There were 2 printers available on the Sperry computer providing 4,000 lines per minute of print and backing each other up. There is 1 printer on

the IBM providing 2,000 lines per minute and no backup. Thus, Data Management has included a Laser printer in its hardware plan.

VI. CPU

As part of the capacity planning process in forecasting the computer work load, the need for a CPU with greater capabilities than the 3081 KX is anticipated. A 25% compounded growth rate is occurring and this trend is projected to continue through 1995 (See Attachment 6 - Projected Growth). The need for a new CPU with greater capacity will become critical in our clients' perceptions of service levels for response time and job throughput. The need for a new CPU will be evidenced as reduced response time is experienced and Data Management must have a plan in place to address the capacity issue; production processing will become more critical and will require that Data Management establish service level criterion. The vendor (IBM) recommended optimum on-line operating capacity is between 75% - 80%. Beyond 80% utilization clients will evidence highly visible system degradation. We are positioning Data Management to address this need before it becomes a reaction situation; it is therefore a major expenditure in our 89-94 CIP request and it includes the cost of relocating current hardware to a new location.

The proposed 1989/90 Departmental Budget with the additional mandated reduction, does not provide the Department of Data Management with the necessary funds to implement this strategic hardware plan. It was for this reason that the funds are requested through a Capital Improvement Project. (See Attachment 7 - Data Management Budget).

A brief Impact Analysis on a "Spend Nothing" approach can be found in Attachment 8. Further discussion of these issues will be contained in the Master Plan to be completed August 31, 1989.

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FINANCIAL ANALYSIS

The CIP hardware plan calls for expenditures of $2,944,062 over next five years broken down as follows:

Fiscal Year	Cost	Maintenance
1989/90	326,883	23,925
1990/91	212,658	14,016
1990/92	2,094,370	23,020
1992/93	123,658	8,320
1993/94	186,493	14,016
	2,944,062	83,297

To give you a better idea of what this represents, the cost distribution by category of service is as follows:

1.	Service (Processing/Response Time)	
	A. CPU	2,000,000
2.	Storage*	
	A. DASD & Controllers	716,150
3.	Technology*	
	A. Cartridge Tape Drives	164,012
	B. Laser Printer	63,900

* NOTE: "*" includes disaster recovery

The criticality of hardware requirements is driven by our users needs to store, process and retrieve data. The hardware defined here represents the need for fiscal years 89/94 based on our projection of normal growth. It is important to remember that this planning approach does not address major additions of application software and/or major changes in the way the City does business, or in its legal requirement for retaining data.

All of the above issues and strategies require increased processing capabilities, these automation and productivity opportunities drive the need for added hardware resources and larger CPU's at more frequent intervals. Growth in the computer systems and requirements will be closely monitored to keep demands from becoming grandiose; a tempered and well reviewed rate of growth would be assured.

RECOMMENDATION

This report is for informational purposes only. A Master Plan is to be provided at the end of August which will address additional questions raised in the May 23, 1989 Budget Hearing.

Respectfully submitted,

Barbara C. Weaver
Barbara C. Weaver

RECOMMENDED FOR COMMITTEE INFORMATION:

Solon Wisham, Jr.
Solon Wisham, Jr.
Assistant City Manager

All Districts
May 30, 1989

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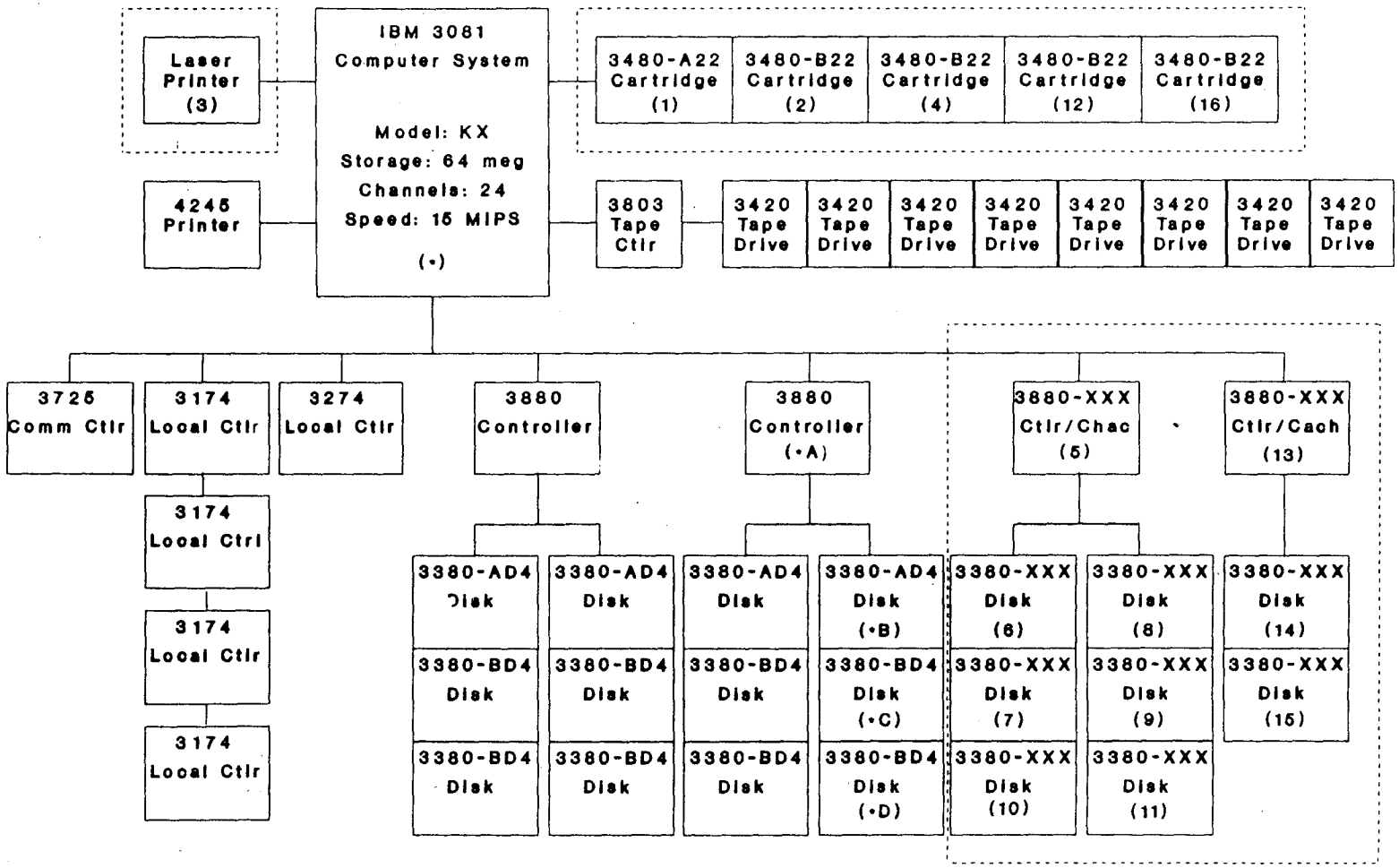
DEPARTMENT OF DATA MANAGEMENT
IBM HARDWARE REQUIREMENTS
1989-94 CIP REQUEST

INSTALL DATE	SEQ	DESCRIPTION		COST	MAINTENANCE
			FISCAL YEAR 89/90		
89/07	(01)	3480-A22	CARTRIDGE DRIVE	46,860.00	5,220.00
89/07	(02)	3480-B22	CARTRIDGE DRIVE	29,288.00	3,300.00
89/09	(03)	9999	LASER PRINTER HS	63,900.00	9,585.00
89/10	(AA)	3880-003	CONTROLLER (UPGRADE)	62,835.00	1,200.00
89/10	(BB)	3380-AE4	DASD (UPGRADE)	40,000.00	1,260.00
90/02	(CC)	3380-BE4	DASD (UPGRADE)	42,000.00	1,680.00
90/06	(DD)	3380-BE4	DASD (UPGRADE)	42,000.00	1,680.00
				326,883.00	23,925.00
			FISCAL YEAR 90/91		
90/07	(04)	3480-B22	CARTRIDGE DRIVE	29,288.00	3,300.00
90/10	(05)	3880-XXX	CONTROLLER (CACHE)	89,000.00	5,696.00
90/10	(06)	3380-AE4	DASD	47,185.00	2,510.00
91/06	(07)	3380-BE4	DASD	47,185.00	2,510.00
				212,658.00	14,016.00
			FISCAL YEAR 91/92		
91/09	(**)	9999	CPU UPGRADE	2,000,000.00	18,000.00
92/02	(08)	3380-AD4	DASD	47,185.00	2,510.00
92/06	(09)	3380-BD4	DASD	47,185.00	2,510.00
				2,094,370.00	23,020.00
			FISCAL YEAR 92/93		
92/07	(12)	3480-B22	CARTRIDGE DRIVE	29,288.00	3,300.00
92/10	(10)	3380-BE4	DASD	47,185.00	2,510.00
93/06	(11)	3380-BE4	DASD	47,185.00	2,510.00
				123,658.00	8,320.00
			FISCAL YEAR 93/94		
93/07	(16)	3480-B22	CARTRIDGE DRIVE	29,288.00	3,300.00
94/02	(13)	3880-003	CONTROLLER	62,835.00	5,696.00
94/02	(14)	3380-AE4	DASD	47,185.00	2,510.00
94/06	(15)	3380-BE4	DASD	47,185.00	2,510.00
				186,493.00	14,016.00
				2,944,062.00	83,297.00

CITY OF SACRAMENTO

IBM NETWORK HARDWARE CONFIGURATION

(EXISTING/PROPOSED)



Proposed Equipment Additions Designated By Numbers In Parenthesis
Proposed Equipment Upgrades Designated By Asterisks In Parenthesis

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ATTACHMENT 1

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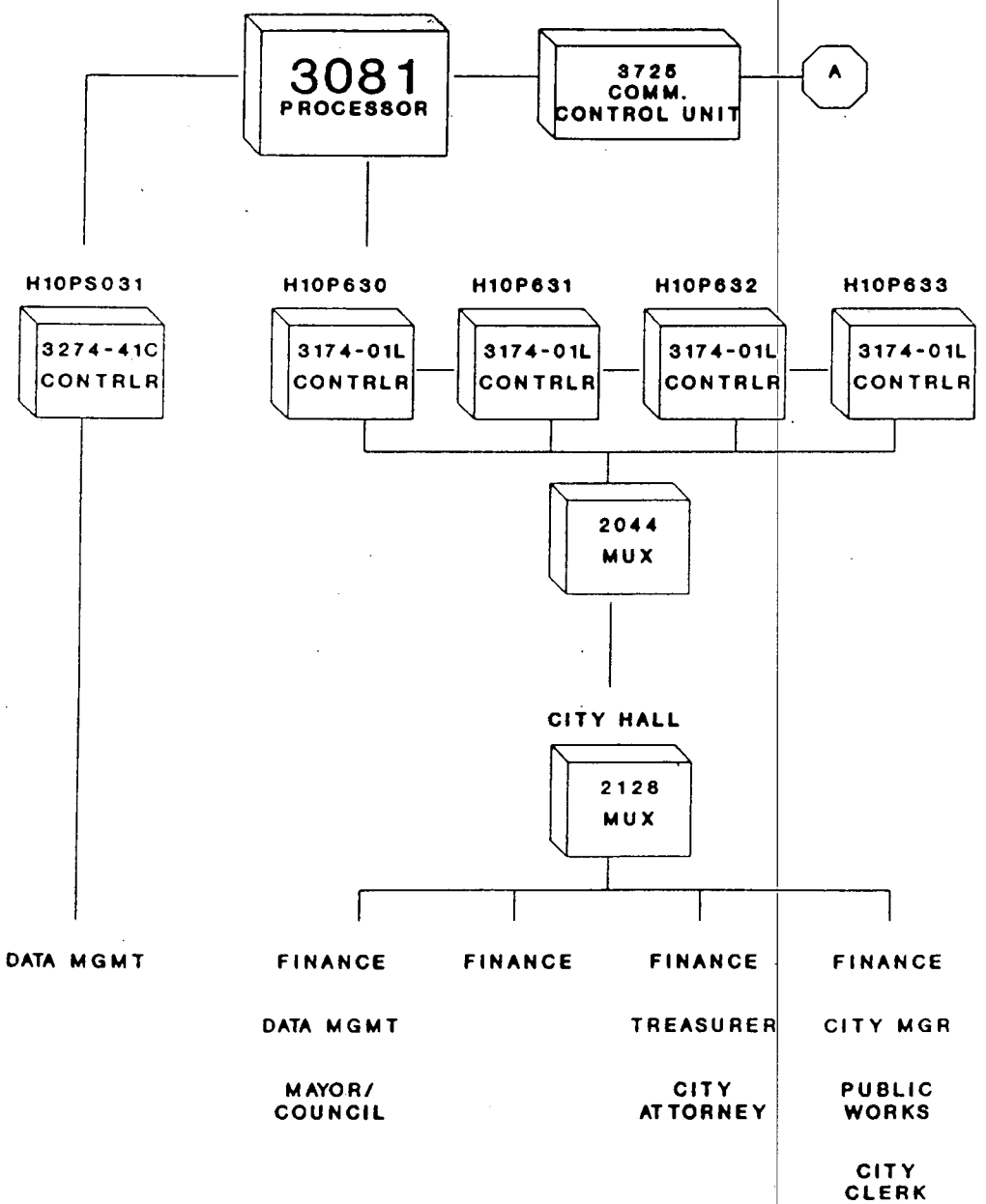
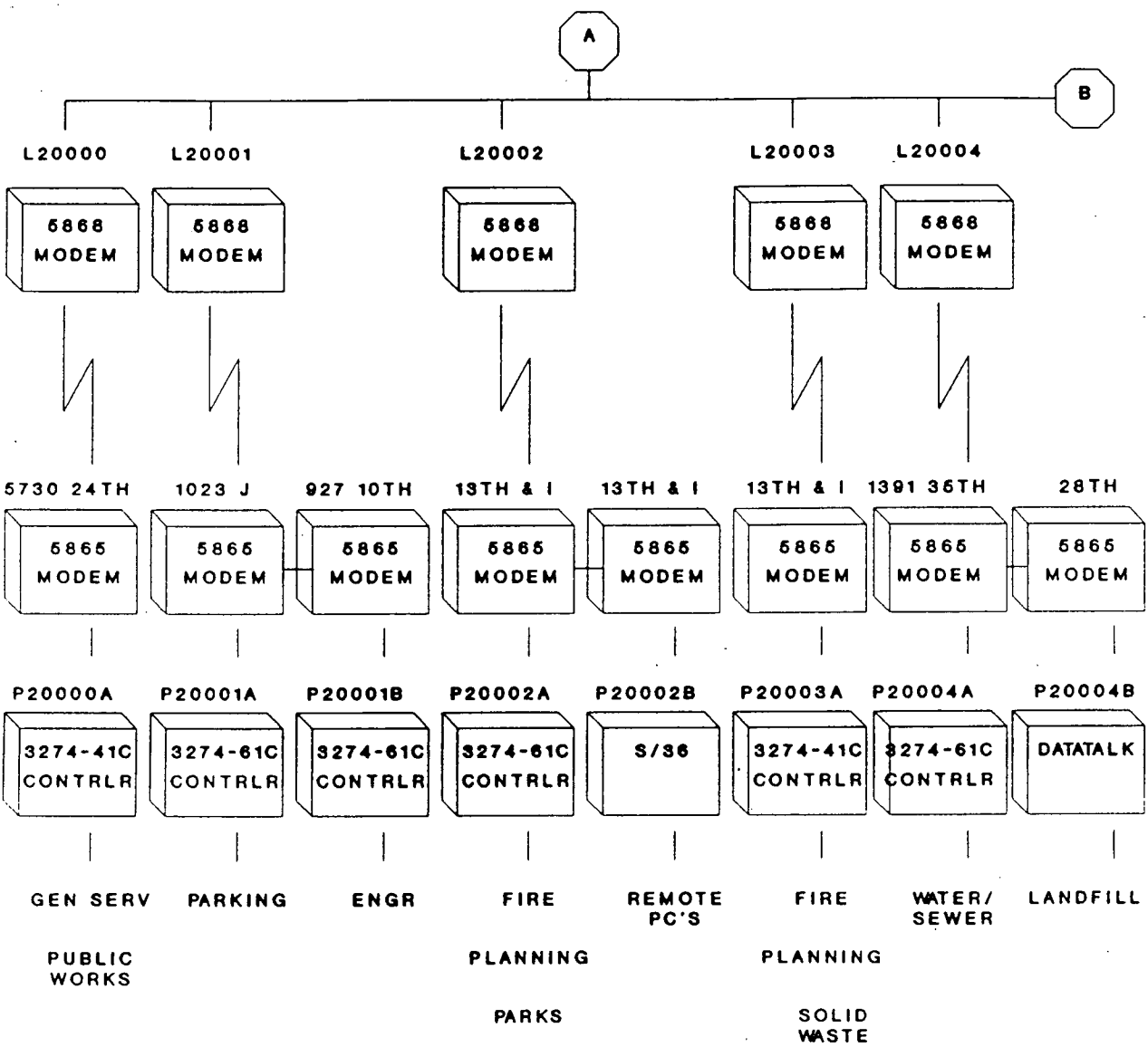
CITY OF SACRAMENTO

IBM NETWORK CONFIGURATION



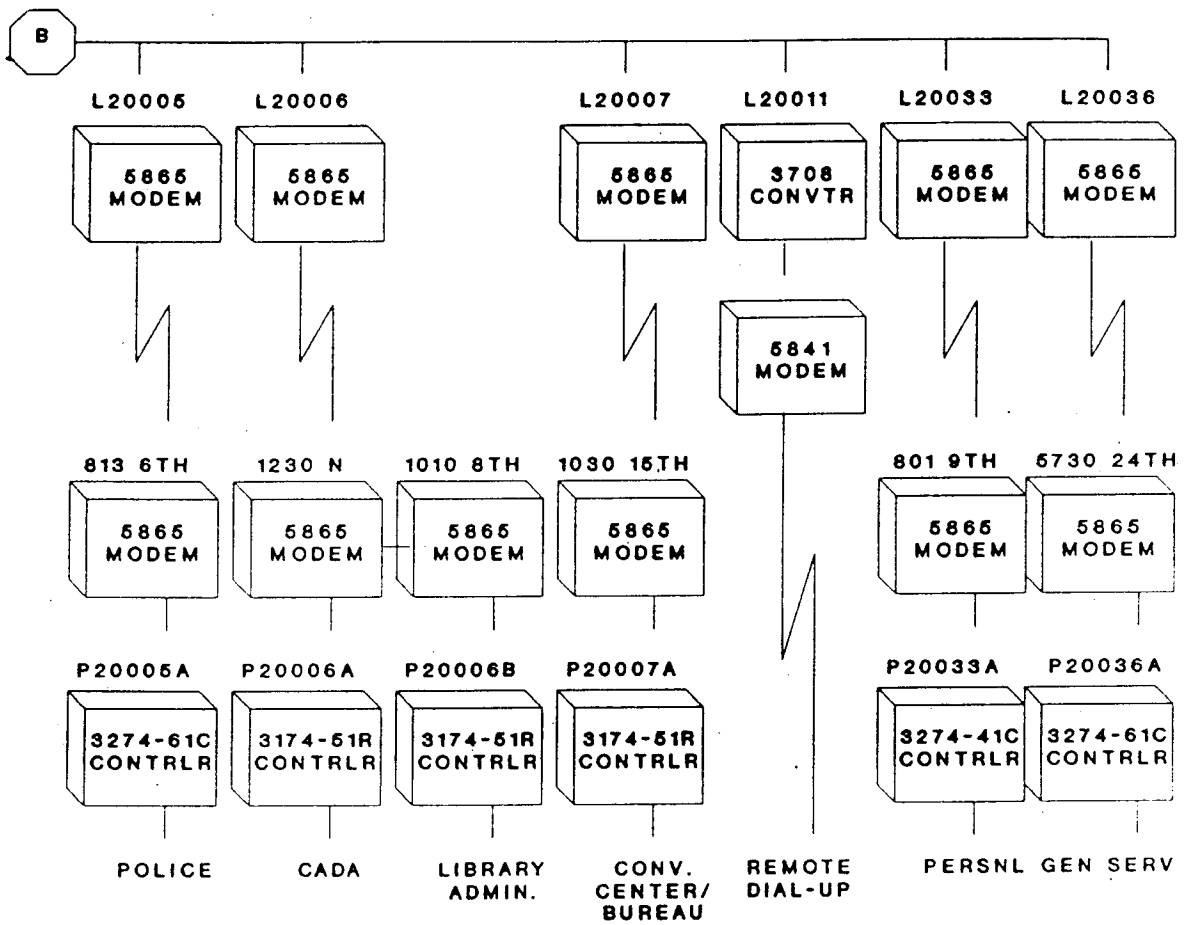
CITY OF SACRAMENTO

IBM NETWORK CONFIGURATION



CITY OF SACRAMENTO

IBM NETWORK CONFIGURATION



DEPARTMENT OF DATA MANAGEMENT

SUMMARY OF EXISTING AND PROJECTED IBM EQUIPMENT

Description	Total Devices Existing	Five Year Acquisition					
	88/89	89/90	90/91	91/92	92/93	93/94	Total
3081-KX CPU	1			-1			0
30XX-000 CPU				1			1
3380-AD4 DASD	4			1			5
3380-AE4 DASD			1			1	2
3380-BD4 DASD	8			1			9
3380-BE4 DASD			1		2	1	4
3880 003 DASD CONTROL	2		1			1	4
3420 008 TAPE DRIVE	8						8
3480 A22 TAPE DRIVE		1					1
3480 B22 TAPE DRIVE		1	1		1	1	4
3803 003 TAPE CONTROL	1						1
3725 002 COMM. CONTROLLER	1						1
3274 41C LOCAL CONTROLLER	1						1
4245 020 PRINTER	1						1
LASER PRINTER		1					1

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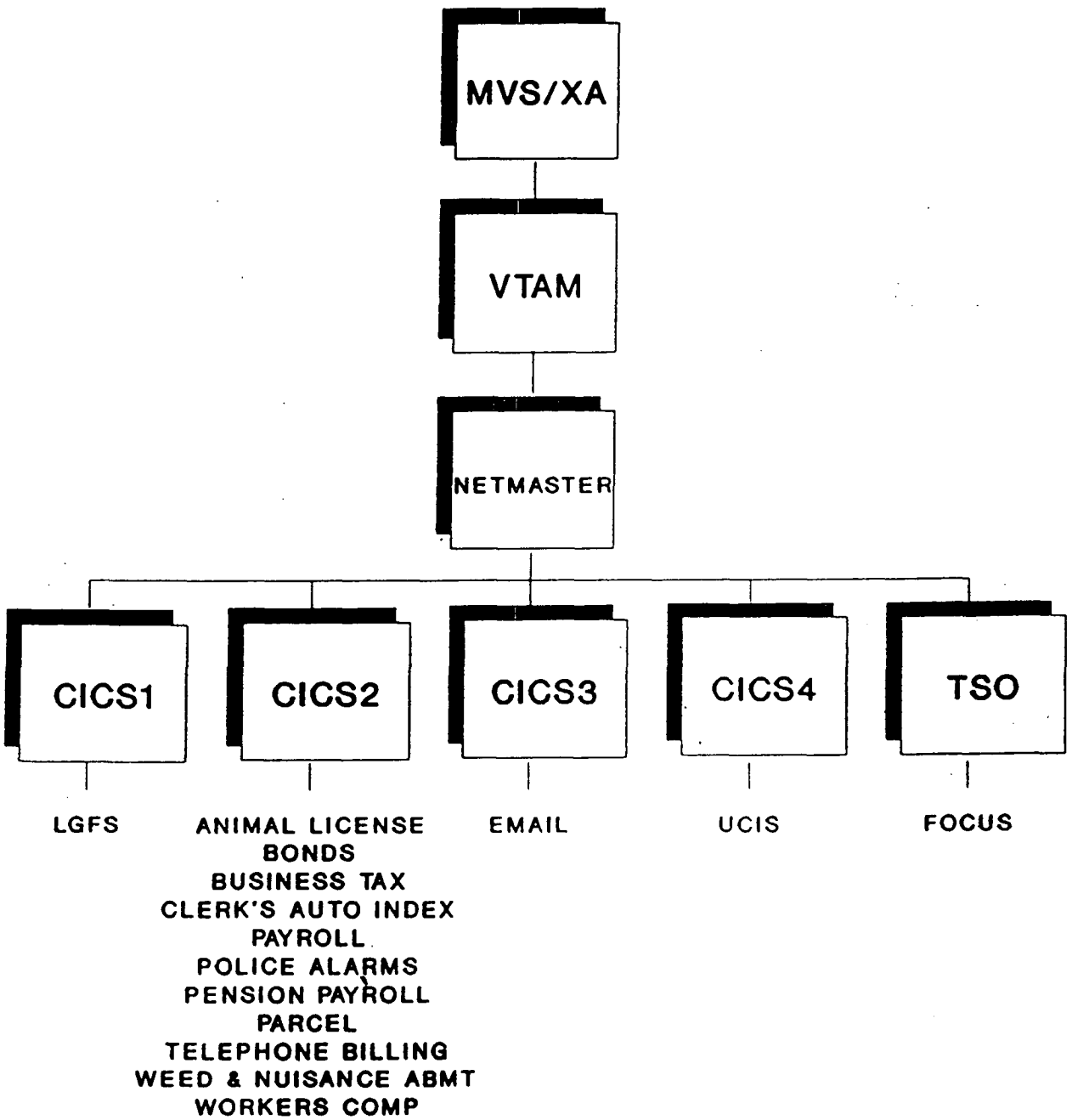
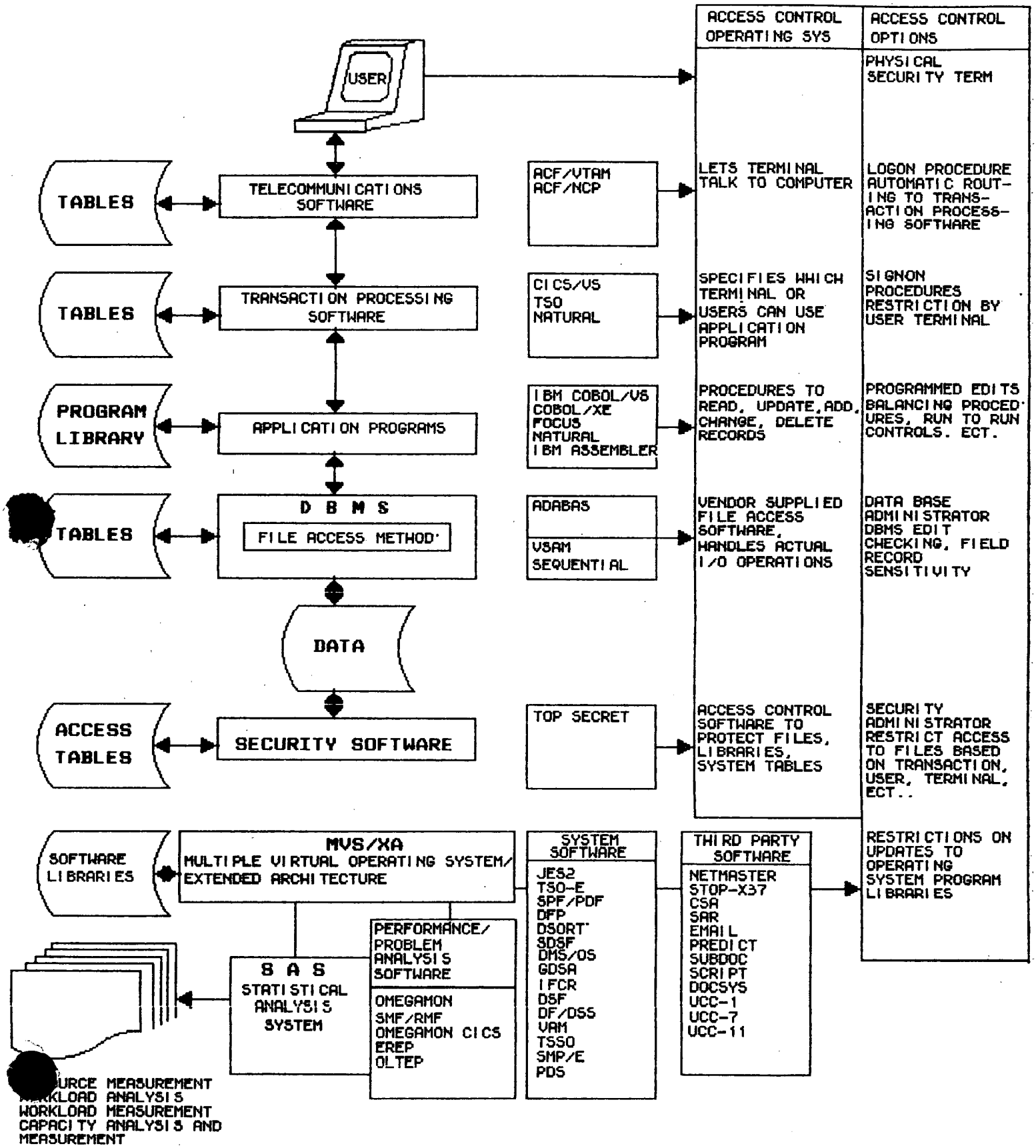
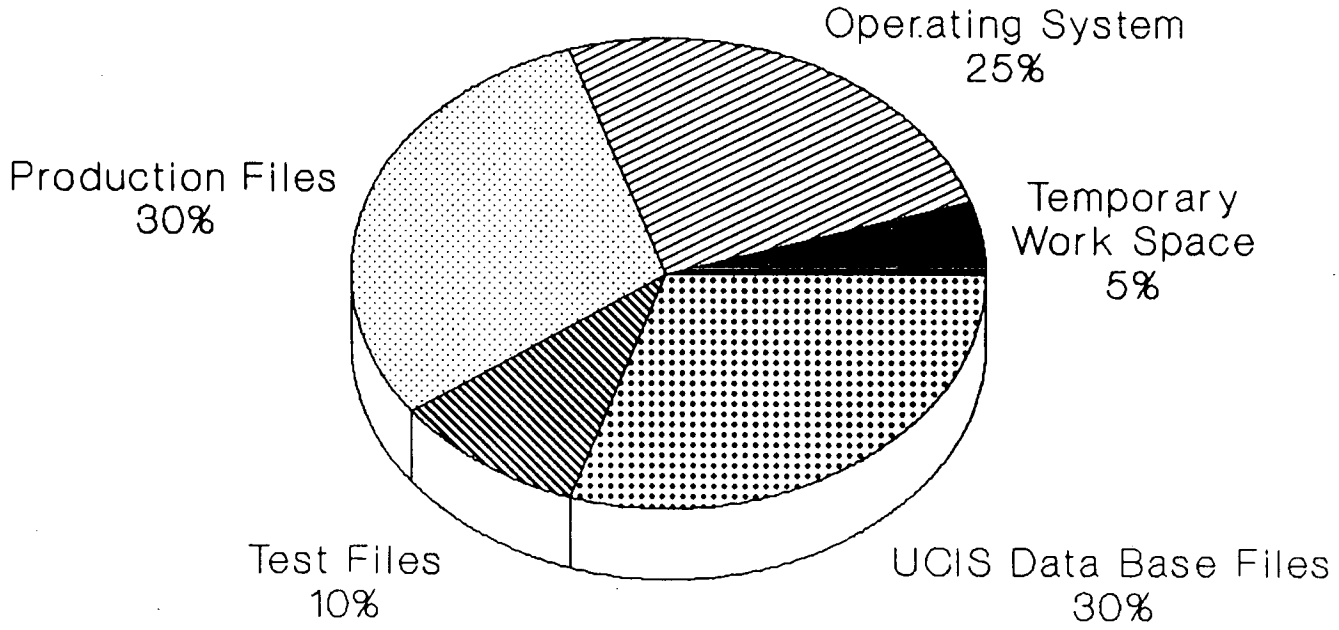
SYSTEM SOFTWARE



FLOWCHART	System: IBM 3081 MVS/XA	Chart No.: MVS/XA 1	Page No.: 1 OF 1
	Procedure: OPERATING SYSTEM OVERVIEW	Author: ORTIZ, A. S.	Effective Date: MAY 10, 1988



DASD Volume Distribution



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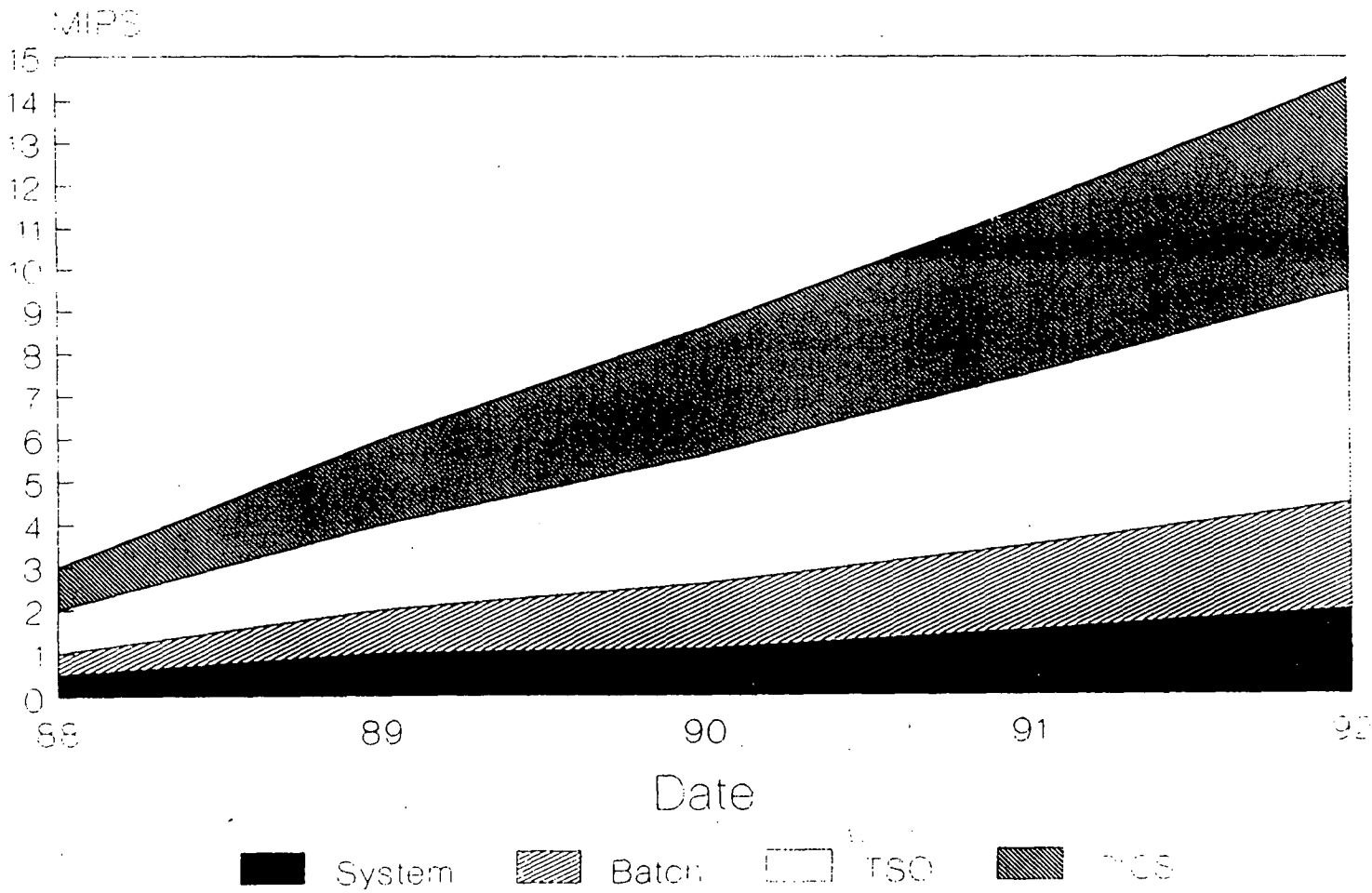
ATTACHMENT 5

City of Sacramento
Projected Growth



MIPS=Million Instructions Per Second

ATTACHMENT 6

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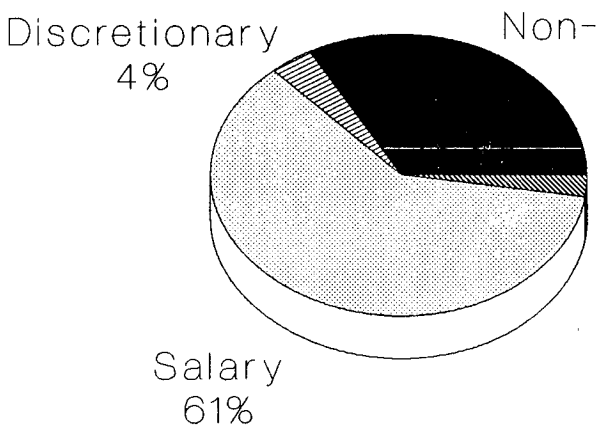
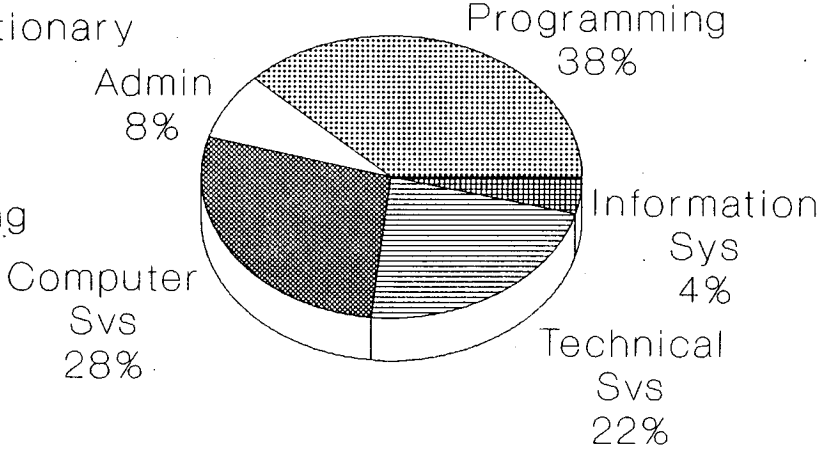
Data Management Budget
Fiscal Year 89-90



Total Budget
$2,852,278



Salary
$1,732,618

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ATTACHMENT 7

ATTACHMENT 8

Impact Analysis

During any year that funding is not available for the normal projected growth of disk space usage, the following will take place:

1. Review and reduction of the amount of history retained on line by the various application systems.
2. A moratorium on enhancements to application systems requiring additional disk space will be effected.
3. Turn around for special reports requiring disk work space will be queued and scheduled instead of immediate processing.
4. Some application systems will be offloaded to tape while nightly processing takes place.
5. More programmer intervention will be required to maintain systems which fail due to lack of disk space during nightly processing.
6. Due to the gyrations required to run the nightly jobs with sufficient disk space, the application systems might not be available over seven hours a day.

After 1989-90 an additional disk controller must be acquired prior to disk additions.

Cartridge Tape Drives

The impact of not adding tape drives is:

1. The City will remain with old tape drive technology over 18 years old and half as fast. The plan to phase out the older drives will be slowed.
2. Less time will be available for recovery of long running nightly processing with the slower speed drives.
3. The City will continue to deal with the failure of the tape drives and of the reels of tape. Reruns and restarts will increase as failures increase requiring more human intervention.
4. It is very likely some application systems will be available less than 8 hours a day.
5. Limited disaster backup and recovery capabilities.

CPU

A computer can process a limited amount of work each day. When program code becomes more complex, more overhead to process data with that code is added. In the life of a computer a saturation point is reached where it can no longer accommodate daily peak processing times. If it were decided that the current 3081KX remain as the primary processor for the City:

1. As the equipment got older, less expertise would be readily available to repair the CPU immediately.
2. Response time would increase to an unacceptable level.
3. People would have to work longer to get the same amount of work completed. Weekend work would require more overtime.
4. Reports would not be timely due to processing backlogs.
5. The older equipment would not support state of the art software.

Printer

A high speed laser (100 dual sided printed pages per minute) was configured to serve as the primary printer. If this did not occur the following are consequences:

1. Continued use of large greenbar computer printouts requiring more storage and paper.
2. No backup in the event of failure.
3. Less flexibility if print volume grows.
4. Reports may not have nightly turnaround.
5. More operator intervention to force the important printouts to the front of the queue.
6. Heavier load on a single printer causing more failures.