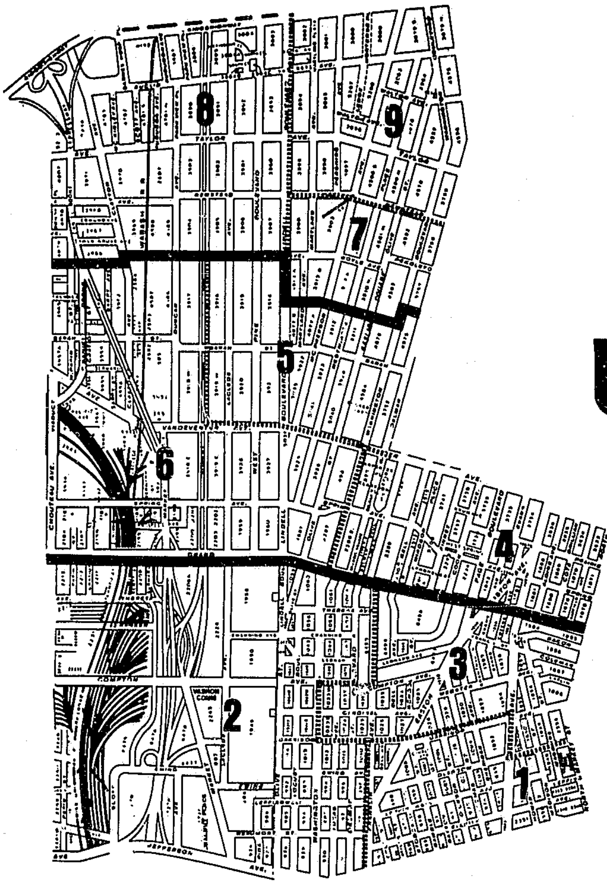
Geographic Base Files: Technical Assistance and Services



GBF USERS GROUP REPORTS

INTERNATIONAL ASSOCIATION OF CHIEFS OF POLICE
ELEVEN FIRSTFIELD ROAD
GAITHERSBURG, MARYLAND 20760

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DECEMBER 1977

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FOREWORD AND ACKNOWLEDGMENTS

To promote the use of geographic base files in law enforcement, the IACP conducted two GBF Users Group Meetings during the current project period. Each Users Group met once to discuss and share practical problems and experiences relating to local geographic base file system(s) operations. The first meeting was conducted May 23-24 in Wasnington, D.C., and the second meeting was held in Dallas, Texas, on August 15-16, 1977. The discussions centered on the issues involved in local GBF System(s) design and applications, GBF system(s) operations, GBF system(s) maintenance programs, and GBF administrative issues (e.g., staffing, training).

The Users Group Meetings provided a valuable opportunity for practitioners to exchange information on many common issues concerning geographic base file use. The group members were operational personnel who have participated in law enforcement geographic base file design operation and maintenance efforts. Data processing directors, systems analysts, and other practitioners involved in daily GBF-related activities lent their knowledge and experience to these proceedings.

The experiences and insights related in these Users Group Reports will benefit other agencies in developing and maintaining automated GBF systems. For their enthusiasum and hard work, I would like to thank the following individuals for making the GBF Users Group Meetings a success and the publication of this book possible.

Mr. Aloysius Au Yeung
Sunnyvale Department of Public Safety

Captain Floyd O. Bartch
Kansas City Police Department

Mr. G. D. Bellamy
Dallas Police Department

Mr. Jerry Bramlett
Huntington Beach Police Department

Lieutenant Gary K. Burgat
Wichita Police Department

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Huntington Beach Police Department

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Dayton Police Department

Mr. Robert Webster
Dade County Public Safety Department

Mr. Barry Weismantle
St. Louis Police Department

Glen D. King
Executive Director

GBF USERS GROUP MEETING I
MAY 23-24, 1977
AGENDA

Introductory Remarks - Norman Darwick, Director, IACP Bureau of Operations and Research

GBF SYSTEMS DESIGN AND APPLICATIONS

Moderator - Captain Michael C. Burkenfield, Commander, Special Operations Division, Huntington Beach, California, Police Department

"Geocoded Base File Development," Richard Grana, Systems Analyst, Rochester, New York, Police Department

"Geographic Base File: Systems Design and Applications," Robert Webster, Electronic Data Processing Unit Administrator, Metropolitan Dade County, Florida, Department of Public Safety

"General Design and Application Considerations," Michael S. Staubes, Senior Analyst, Research and Budget, Savannah, Georgia, Police Department

GBF SYSTEMS OPERATIONS

Moderator - Captain Floyd O. Bartch, Commanding Officer, Crime Information Unit, Kansas City, Missouri, Police Department

"Geographic Base File: Related Applications in the Dayton Police Department," Major Donald E. Tobias, Superintendent, Administration Division, Dayton, Ohio, Police Department

"Description of the Office of the Sheriff's Computer Assisted Dispatching System and its Application of the Geographic Base File," Richard Saig, Senior Systems Analyst, Department of Central Services, Jacksonville, Florida

"Presentation on Empire System/Geocoding Data Base," Les Meszaros, Director of Information System, Erie County, New York, Department of Central Police Services

GBF SYSTEMS MAINTENANCE

Moderator - Major Charles R. Connery, Seattle, Washington, Police Department

"Maintenance of Geo-Based Files," Sandra M. Evoy, Management Information Division, Hartford, Connecticut, Police Department

"Police Department, City of New York, Geographic Data Base," Captain Richard J. Noonan, Commanding Officer, Management Information Systems Division, New York City Police Department

GBF ADMINISTRATIVE ISSUES

Moderator - Major Charles R. Connery, Seattle, Washington, Police Department

"Geographic Base File: Administrative Issues," Sergeant Donald E. Lyon, Computer Systems Division, Kansas City, Missouri, Police Department

"GBF Issues for the Administrator," George T. Steele, Supervisory Computer Systems Analyst, Data Processing Division, Metropolitan Police Department, Washington, D.C.

DISCUSSION LEADERS

Captain Floyd O. Bartch, Commanding Officer, Crime Information Unit, Kansas City, Missouri, Police Department

Captain Michael C. Burkenfield, Commander, Special Operations Division, Huntington Beach, California, Police Department

Major Charles R. Connery, Seattle, Washington, Police Department

Bruce L. Strahan, Geography Division, U.S. Bureau of the Census

Ronald Thies, National Criminal Justice Information and Statistics Service, LEAA

IACP STAFF

Frank D. Roberson, Assistant Director, Bureau of Operations and Research

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Melvin Joppy, Student Intern

GEOCODED BASE FILE DEVELOPMENT

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Rochester Police Department
Rochester, New York

I. The Goals

A. Address the informational needs of the police management and operations staff by assisting in the design and implementation of manpower resource allocation schemes by improving the tools for measuring effectiveness in the investigative process. Supply timely reporting of crime incidence rates for remedial action planning.

B. Provide a comprehensive system for automatically generating geographically oriented data elements for records vital to meeting these informational needs.

C. Develop data entry, file maintenance, and information dissemination techniques that insure complete integration with other modules supplying related data needs.

D. Establish credibility and reliability of the system to gain maximum benefit from the data available.

E. Control those functions capable of eroding the security, validity, and accuracy of all data elements crucial to the success of the system and its purposes.

F. Provide a completely open-ended system capable of meeting future development in new areas, as well as expansion needs in existing systems.

II. The Development

Triggered by an ever-increasing demand for information relating events to location throughout the Police Department, an economic method for meeting this demand was pursued. As a result, the concept and development of a geocoding system began in 1968 when a New York State Department of Transportation file, created during their 1964 transportation study, was obtained.

In principle, this file reflected a grid-oriented geocoding of the Rochester streets, one record for every street and for every intersection. In reality, the file contained numerous midcodings and grid boundaries that were distorted and unreliable. The shortcomings were pointed up early in the planning phase. It was apparent that much would have to be done to the original records before a workable file could emerge.

Through an evolutionary process some five years in length, the following developments occurred:

A. The grid scheme proved questionable after detailed analysis of the inconsistencies in coding and the incongruence of the physical shapes of the grids proved unsuitable for police needs.

B. A coding scheme was formulated which represented the city in terms of geographic blocks whose borders would theoretically never change. Except as restrained by physical or political boundaries, the blocks were constructed so as to include both sides of the streets that formed the perimeter of a given block.

C. A full-scale analysis was undertaken of what it would take, in terms of minimum number of characters, to uniquely identify each street. The purpose of this was to maximize data entry throughput for any record that was to reflect geocoded data, simplify the actual data entry procedures, and standardize the format of data required to access the records.

D. Once the ground rules were established and accepted by the appropriate personnel, the tedious, aggravating, almost endless and certainly important conversion process began. Three man-years were required to rework the records into an accurate, all-inclusive representation of the city's geography.

E. The transformation process developed to create our present record encompassed all the features we considered necessary. The following enhancements were accomplished concurrently:

    1. The grid coding was eliminated and replaced with the block face coding scheme.

    2. The currently effective car territory codes were assigned to all records.

    3. The street names were standardized. Minimum character keys required to identify the streets were generated.

    4. Alternative addressing schemes for special areas such as hospitals, shopping plazas, apartment complexes, expressways, etc., were implemented.

F. Considerable amounts of sweat and tears were expended over city maps designing block boundaries, transferring the appropriate geocoded values to the computer records, and proofreading file update results.

G. Owing to the crucial nature of the file and its importance as a factor in these information collection systems, the latest development provided for controlled on-line updating capability. Appropriate security restrictions allow limited access to the file update functions.

H. Finally, the geocoding module was programmed into each of three major reporting modules. Crime Reporting, Arrest Processing, and Calls-for-Service went live effective July 1, 1973. All three modules are on-line, with input entered via CRT terminal. Access to the on-line geocoded base file during the data entry process is a key advantage in each of them. As an example, the geocoded file made it possible for us to provide an on-line location of crime file, updated as a by-product of data entry, to assist victims of crime and their representatives and provide access for reference by investigators.

III. The Pitfalls

A. The total time required to develop a truly workable system was underestimated.

B. Not enough emphasis was placed on providing inherent flexibility in the alternative addressing methods we used at the very beginning. We could have done a better job of anticipating enhancements.

C. We were understaffed and could not handle the unforeseen problems as quickly as we would have liked.

D. The overwhelming demand for "data now" contributed to promoting a development situation in which we had to inject short-range enhancements for expediency.

IV. Design Highlights

A. First, it must be understood that we designed for the Rochester environment. Our set of environmental characteristics probably gave us some advantages not applicable elsewhere. The important point is that we did the research to uncover them and use them to the best advantage.

B. The major design principles inherent with our system are:

1. A nine-position field (seven for street name and two for street type) accurately identifies each street in the city.

2. The special areas such as cemetaries, hospitals, apartment complexes and shopping plazas are identified by other than street number addressing. Two records are required to represent these exceptions.

3. A given intersection area is completely assigned to one geocoded block and car territory. There are no perimeter intersections split by a geocoded block or car territory.

4. The file characteristics are patterned using the street segment approach, with segment records for every intersection point in a given street.

5. Two files are kept on-line and updated simultaneously via the maintenance system. One is organized by street name, type and street number: the other is keyed by intersecting street names. The latter file serves two purposes. It resolves intersection data entries made in the Calls-for Service reporting module, allowing data entry clerks to enter call location data as it appears on the complaint record. It also allows for recording accident data on the on-line location file as either intersection or non-intersection accidents.

6. Reorganization and audit programs executed daily for back-up purposes keep the two files balanced to each other.

7. The records allow for three car territories to be recorded, one for each tour of duty. At present, only one is used.

V. The Benefits

A. Extraneous manual entry to record geocoded data is eliminated. The only input data required to generate geocoded data on any of the three reporting modules is the house number and street name.

B. The time-consuming and error-prone operations normally associated with conventional data entry methods are eliminated.

C. Location data entered by terminal operators is checked for validity at the time of entry. Errors are stopped before they get into the system.

D. Since the geocoded data elements are computer generated and automatically included in the stored records, the reliability and consistency of the data validity is greatly improved.

E. Necessary maintenance to the geographic base file is done on-line via CRT under security control of the commanding sergeant in the Information Systems Section. He has full responsibility for file updates. This capability guarantees that the fastest possible method for keeping the file current is employed and that it operates under reasonable security restrictions.

F. The far-reaching effects of simply insuring data integrity are measurable and have been proven. Detail reports prepared on demand provide the means for every section commander to audit what the computer says has occurred in his area against the actual copies of reports his section has submitted. These reports do a lot to firmly entrench credibility.

G. When sections and patrol territories are studied for reallocation or reorganization, accurate data is made immediately available for the decision-making process. Geocoding making a tremendously important contribution in this area. Our geocoded blocks represent fixed areas that virtually never change. Combinations of these blocks form car territories and combinations of the car territories form the sections of patrol. The potential for implementing deployment that utilizes the best combinations is greatly increased.

H. After such decision-making processes are completed, the transition time in which the desired computer record modifications are installed and activated have been reduced to a busy eight-hour span over a weekend. This has been our experience in the last two reorganization implementations.

I. Reports utilized as measurements of investigative effectiveness rely as heavily on the "where" of crime as they do on the "what," "when," and "how." The same degree of importance of geocoded data also applies to currently installed programs designed to implement action plans that address high crime areas. Another aid in the investigative process takes the form of inquiry capability into the on-line crime by means of location files. Specifically, when an arrest is made, linking the suspect to other crimes of the same type is greatly simplified and less time-consuming. The investigator can scan the last six months' crime activity by location and type via CRT, extract only the pertinent crime reports by number and interrogate the suspect accordingly.

VI. The Future

A. The way is paved for the development of a Computer Aided Dispatch (CAD) system. The present geocoded base file system has been almost constantly improved since the July 1973 installation date. This experience will be an advantage in the implementation of CAD. It should make it much easier to install CAD by removing a large part of the start-up workload otherwise encountered. Certainly, the implementation period will be considerably shortened, which we feel is directly attributable to having a working automated geocoded base file.

B. Certainly the application of data base concepts to police needs can be viewed as even more advantageous when supported by a geocoded base file. Some of the things we see happening are:

1. Investigators will do a large part of lead follow-up CRTs, scanning arrest history records for possible suspects by criteria including known addresses as well as physical and modus operandi trademarks.

2. Being able to view the entire case history of a given event from the initial call-for-service through its closing, regardless of its degree of involvement in the criminal justice process, is possible.

3. Correlating location of crime, victim's area of residence and perpetrator's area of residence, to levels as detailed as house number and street name, is another potential with intriguing aspects.

C. We have made our Crime and Arrest reporting Systems available to law enforcement agencies countywide. Continued progress in development of a Calls-for Service Reporting System will be made, due in no small part, to the established geocoded base file principles. We will rely on the United States Bureau of the Census GBF/DIME Files and their support programs.

VII. Summary

If there is a point that should be stressed, it is the fantastic importance and attention to detail that must be attached to the seemingly mundane data entry function that, in reality, is the single most important factor in the success of any system. The point of data entry is where the value of collected data is determined. Solid systems work, detailed computer programs and reliable, accurate, up-to-date support files make it a success. To this end, a geocoded base file is certainly a support file not only desired but required.

GEOGRAPHIC BASE FILE SYSTEMS DESIGN AND APPLICATIONS

Robert Webster
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Dade County Public Safety Department
Miami, Florida

DESIGN OF A GEOGRAPHIC BASE FILE FOR MINICOMPUTERS

The design of a geographic base file (GBF) for minicomputers becomes a real hands-on experience which can result in a tailor-made file for your application giving you all the advantages of speed, accuracy, and update capability you care to build into the system. This is in contrast to the file that may result using a larger computer where you are locked into the canned packages for file access provided by the manufacturer. All too often with these larger systems, the limitations of the file access method provided dictates your file design. In the minicomputer world, the selection of a file access method is a result of file design and application requirements.

Two levels of design are required for development of a geographic base file. The first is the design of the file structure and the second is the design of the file access method.

The file structure can take only one of three forms:

1. Exact Address

   This file structure has a record for every address within the jurisdiction.

2. Segmented Base File

   This file structure has a record for every block in the jurisdiction.

3. Span File

   This file structure has a record for each range of addresses on a particular roadway that is in the same grid.

The file access method I will talk about is an Indexed Sequential Method developed by in-house personnel for a DEC PDP 11/70. There are, of course, many others, and the type of file access method should be selected based on the best choice, given the file structure.

DESIGN OF GBF STRUCTURE

The first step in designing a GBF is to develop a grid system. This is done by dividing your jurisdiction into atomic areas which can vary in size from a few blocks square in the downtown area to as much as a few miles across in the less populated areas. In your planning of this layout, you should be aware of how quickly a less populated area can turn into a development. It is important that grids not cross district or municipality boundaries. Grids should follow as closely as possible natural and man-made formations such as rivers and roads. Where feasible, grids should conform to census track boundaries.

Once your grid structure is developed, you are ready to make a choice of file type from the three possibilities described above: (1) Exact Address; (2) Segmented Base File; and (3) Span File.

To select the file type that best fits your department, you will need to weigh these factors:

1. Size of the file versus disk storage available.

2. Accuracy of the file versus need for a response.

3. Adaptability of existing Geo files versus time to develop your own.

4. Availability of a development computer versus doing it on your mini.

As with most decisions, the common denominator and the deciding factor in all four cases will probably be dollars.

There is no easy formula to derive the type of file structure you should use. I may be able to give you some insight by describing the decision process used in Dade County. Dade County, Florida has a population of approximately 2,500,000 and ranks fifteenth nationally. It covers 2,350 square miles and contains 26 municipalities. The primary street structure in the county is laid out on a quadrant basis. There are two named streets which form the boundaries of the quadrants; Miami Avenue, running north and south, and Flagler Street, running east and west. All the rest of the streets and avenues are numbered so that the intersection of First Street and First Avenue occurs in each quadrant, Northeast, Northwest, Southeast, and Southwest, with the numbers continuing out from the center, with streets running east and west, and avenues running north and south. This structure lends itself perfectly to geocoding. Of course, there are exceptions; all of Coral Gables, a major municipality, has named streets. Three municipalities in the county liked this structure so well that they use the exact same system starting from their own named streets, and several roads run diagonally across the county.

Size Versus Storage

An exact address file for an area this large with this populace would take a great deal of storage space, perhaps as much as 200 megabytes. A span file would only require about two megabytes of storage and would seem ideal given our numeric street system. The problem with the span file is that it does not allow for a breakdown by intersection, and since there are so many tourists in Dade County, the intersection is very often the only entry we have to the file.

Need for a Response

The primary responsibility of our Geo File is to support a CAD function. Therefore, our requests against the file come from the complaint officer who is trying to send a police unit to a citizen requesting assistance. Very often the complainant is upset or unfamiliar with Dade County and does not know his exact address. We cannot let the geographic base file return an error of "NO SUCH ADDRESS" and quit. We must at least obtain an address approximation so we can start a police unit. This almost negates the use of an exact address file since there is usually no default when the requested address is not found.

Existing File

In Dade County we were fortunate to have a very accurate DIME File. From this file, we were able to extract a range file and, through an add-match program, append our police grids. We also had an intersection file which was used in support of our Accident Information System (AIS). By extending the blocks between each span in the range file and comparing those against the intersection file, we were able to develop a fairly complete segmented base file.

Conclusion

The best file structure for Dade County was a segmented base file. This file requires 6.5 megabytes of storage. It provides intersection lookup and a default to the closest block face. The file was extracted from the DIME range file and the AIS intersection file and made available in tape form to the minicomputer. As the tape was read onto the disk, the ISAM tables were built.

DESIGN OF A GBF ACCESS METHOD

Most of us with minicomputers program at the assembly language level. This allows us to develop our own file access method, thereby increasing the speed of retrieval and decreasing core requirements. We in Dade County were fortunate to have the systems and programming expertise to develop our own access system. A brief description of our approach follows.

The Dade County Public Safety Department Geographic Base File (GBF) is resident on a DEC RP06 disk with a capacity of 176 million characters of data. The GBF contains 144,000 records of 46 characters each or a total of 6.6 million characters. The file is formatted in 512 byte blocks with each block containing 11 logical records. There is one record for each block in Dade County.

The DEC PDP 11.70 operating system, RSX-11M, provides only straight sequential and random access. Using these two tools we have developed our own indexed sequential access method which contains two levels of indexing. The highest index or rough table, has 75 entries, each of which points to a 2,048 byte section of the fine table. The rough table is entirely core resident and occupies 3,500 characters of memory. The fine table is read in 2,048 byte sections into memory. It occupies 55,000 positions on disk. Each fine table entry points to a 2,048 byte section of the GBF (or there is one fine table entry for every 44 logical records in the GBF). Thus, any request for an address lookup requires only two accesses to the disk—one to retrieve the appropriate fine table section and one to access the data record block.

The GBF access module is 10,000 bytes in size and is linked to the complaint officer module creating an executable load program of approximately 20,000 bytes. The complaint officer has the ability to request an address lookup or an intersection look-up. Later landmarks, abbreviations, and common misspellings will be incorporated. Entries are made in the following format:

address lookup:

low block	.	section	.	primary street name	.	primary street type
(examples)						
5820	.	SW. 45	.	TE (most common format)		
1409	.	Algardi		(this address occurs in a city that does not use section or type)		

intersection lookup:

primary street name	.	primary street type	.	section	.	secondary street name	.	secondary street type
(examples)								
Douglas	.	Rd. SW	.	40. St				
79. St. NW. 27. Ave								

Each of the tables and the data block are searched in the following order; section (or quadrant of the county), primary street name, primary street type, block number. The secondary street name and type is used only for intersection inquiries. If an exact "hit" is not possible, the program returns the closest record. The police grid is extracted from the record and is used as an argument to search a file which contains district, patrol area, and municipality. This data is then returned to the complaint module which displays it on the CRT screen. If the address occurs in more than one city (there are four cities in Dade County that have duplicate numbering schemes), the names of all of them are listed but the police grid, etc., is shown only for incorporated Dade County. An example of the search process is presented as Appendix A, pp. 13-14.

Conclusion

Our experience in Dade County has shown that a segmented base file structure was best for our application. We were fortunate in that we were able to develop our GBF from existing files. In support of this file structure, we developed our own file access method thereby making most efficient use of our minicomputer.

Address Lookup Routine

```
>RUN GLOOK
ENTER ADDRESS

5820.SW.45.TE.

11200050          TE3112          CT000243     Hit on Rough Table
06000046          ST3060          PL015755     Hit on Fine Table
05700045          TE3057          AV1599       Hit on Data Element

NORMAL END OF JOB

>
```

Rough Table

```
DUMP OF DB0:[300,1]GEOBFL.IXR;3 - FILE ID 2316,4,0
                    VIRTUAL BLOCK 0,000004 - SIZE 512. BYTES
```

000000	0	2	8	0	0	F	L	A	M	I	N	G	O			
000020						D	R	2	0	2	8					
000040									S	T	^@	^@	^E	^@	0	0
000060	6	0	0	W	A	S	H	I	N	G	T	O	N			
000100				A	V	2	?									
000120									^@	^@	^I	^@	0	1	1	0
000140	0	0	0	7												
000160		S	T	3	0	1	1									
000200					A	V	^@	^@	^M	^@	0	1	4	0	0	0
000220	1	5														S
000240	T	3	0	1	4											
000260			A	V	^@	^@	^Q	^@	0	3	0	0	1	0	2	2
000300														S	T	3
000320	0	3	0													
000340	A	V	^@	^@	^U	^@	1	0	2	0	0	0	3	0		
000360												S	T	3	1	0
000400	2														A	V
000420	^@	^@	^Y	^@	0	5	5	0	0	0	4	0				
000440										S	T	3	0	5	5	
000460													A	V	^@	^@
000500	^]	^@	1	1	2	0	0	0	5	0						
000520								T	E	3	1	1	2			
000540											C	T	^@	^@	!	^@
000560	0	7	2	0	0	0	5	9								

APPENDIX A

Fine Table

DUMP OF DB0:[300,1]GEOBFL.IXF;3 - FILE ID 2312,12,0
VIRTUAL BLOCK 0,000243 - SIZE 512. BYTES

000000	0	7	0	0	0	0	4	4								
000020						S	T	3	0	7	0					
000040									A	V	^@	^@	Y	^[	1	3
000060	0	0	0	0	4	4										
000100				S	T	3	1	3	0							
000120							A	V	^@	^@	]	^[	0	1	3	0
000140	1	0	4	5												
000160		A	V	3	0	1	3									
000200					S	T	^@	^@	%A	^[	0	8	7	0	0	0
000220	4	5														S
000240	T	3	0	8	7											
000260			A	V	^@	^@	%E	^[	1	2	7	0	0	0	4	5
000300														S	T	3
000320	1	2	7													
000340	C	T	^@	^@	%I	^[	0	6	0	0	0	0	4	6		
000360												S	T	3	0	6
000400	0.														F	L
000420	^@	^@	%M	^[	1	1	9	0	0	0	4	6				
000440										S	T	3	1	1	9	
000460													A	V	^@	^@

Data Element

DUMP OF DD0:[300,1]GEOBFL.DAT;7 - FILE ID 2303,6,0
VIRTUAL BLOCK 0,015755 - SIZE 512, BYTES

000000	1	2	7	0	0	0	4	5								
000020						S	T	3	1	2	7					
000040									F	L	1	5	8	3	1	3
000060	0	0	0	0	4	5										
000100				S	T	3	1	3	0							
000120							A	V	1	5	8	3	0	5	7	0
000140	0	0	4	5												
000160		T	E	3	0	5	7									
000200					A	V	1	5	9	9	0	5	8	0	0	0
000220	4	5														T
000240	E	3	0	5	8											
000260			A	V	1	5	9	9	0	5	9	0	0	0	4	5
000300														T	E	3
000320	0	5	9													
000340	A	V	1	5	9	9	0	8	9	0	0	0	4	5		

GENERAL DESIGN AND APPLICATION CONSIDERATIONS

Michael S. Staubes
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INTRODUCTION

Computer technology as applied to the law enforcement community has made a tremendous impact at local, state and national levels. The computer has demonstrated its utility in manpower accounting and allocation, crime analysis, dispatching and operations. One of the more significant files to be developed applies to the collection of geographic information and the processes which add other variables to determine patterns or conditions. The benefits of this information are shared by investigators, all levels of management, crime analysts, and most importantly, the patrolman.

The management of the Savannah Police Department believes that an accurate, up-to-date computer operation which allows ready access to command personnel increases the efficiency and effectiveness of our operations. The system also affects and responds to community needs,which ultimately is the acid-test for any police operation.

BACKGROUND

The Savannah Police Department consists of 225 sworn positions supplemented by approximately 100 civilians.

The Department has been developing in modular fashion a comprehensive Criminal Justice Information System since the early 1970's. Funds for development and implementation have been provided by LEAA. The system is commonly referred to as SALES (Savannah Area Law Enforcement System) and includes modules related to incident reporting and criminal history, manpower accounting, Uniform Crime Reporting, crime analysis, detective workload and disposition reporting, and geocoding (see Geo-Code Subsystem Overview, p. 19).

The Data Processing Center is owned and operated by the City of Savannah. Hardware includes:

- Honeywell Model 1250 mainframe with a Honeywell Model 716 minicomputer as front-end.
- On-line input is via NCR 796-301 terminals and NCR 260 thermal printers.
- SALES currently is using 96 K-bytes of the total capacity of 256 K-bytes.
- COBOL is used exclusively and documentation is complete.

SALES is limited to the boundaries of the City of Savannah (37 square miles) and plans are drawn to include several other departments in the data base this year. Also included in this year's plan is a Court Management System similar to that developed by the Institute for Law and Social Research entitled PROMIS (Prosecutors Management Information System).

This paper focuses in on design and application considerations as they relate to geographic base files. I will also address the more general problems which one can expect to encounter in the early phases of a project and how to avoid these problems. The professional practitioner is keenly aware that design and application considerations should be examined as they apply directly to using geographic base files and as they apply to the entire system or order of routines. The practitioner should use the following Design and Application Model on both levels, i.e., directly applicable to geographic base files and to the overall system.

GENERAL ASSUMPTIONS

There are several general assumptions (on my part) that are common to the "module" or the "system."

First, regardless of the objectives of the "module" or "system," an essential prerequisite is a general rationalization and improvement of the present system while preparing for a new one, something that can be done only from within the user's office. The reader can find numerous references pertaining to the macro and/or micro planning areas I have mentioned.

Second, specialists or a group of specialists combined with personnel from the user's office should make a detailed analysis of the present structure and system configuration, work flow, task assignments, procedures, forms, documentation and, most importantly, user needs. Regardless of whether the system is semi-automatic or completely automated, system design begins with what currently exists.

Finally, the practitioner must keep in mind two ingredients which are common to any successful program (particularly as they apply to the design and application phases), be it at the micro or macro level. These ingredients are analytical ability and commitment.

> Analytical ability pertains to the people on the job who are familiar with the problems and often the source for good ideas for possible solutions. Analytical ability applies to consultants and personnel outside the organization who have a background in solving complex problems and who do not have their roots mired in tradition. One should never hesitate from, turning to other departments or sources outside of the users agency. Outside help is important because no manager—no one single person—can see all aspects of the system or the opportunities for a solution to a problem.
>
> Commitment from public officials, administrators or the users themselves does not come easily. There is a certain amount of risk-taking involved at both the macro and micro levels. Regardless of who conducts the design, application, or implementation

phases of a project, it will not be a success without the full cooperation, leadership and assistance of the staff and management personnel. Piece-meal, hastily conceived and installed changes or "systems" will most likely result in confusion, retardation of the system, inefficiencies and ineffectiveness of reaching future program goals and objectives.

DESIGN AND APPLICATION MODEL

The following is a rough outline of my appraoch to a GBF design and application project. The reader is requested to expand on this list as necessary. It should serve at both the micro and macro levels of planning and should be considered as a basic starting point for the design of any type file.

Step 1 Conduct overall survey of existing system with particular attention to:

A. Physical facilities, i.e., equipment limitations, file size limitations, design, etc.

B. Staffing, i.e., manpower costs, accuracy, demands on employee time and work methods.

C. Procedures, i.e., duplication, unwarranted methods, correct sequences.

D. Work flow, i.e., practical and simple organizational structure, gaps in responsibility and tasks, adequate reviews and controls for work quality and completeness, adequate backup for key positions in flow.

Step 2 Identify and define functions <u>desired</u> and functions <u>required</u> from the system.

A. Present system or future system function?

B. Types of systems related to GBF development:

1. Dispatch information,
2. Event information,
3. Case information,
4. Manpower statistics,
5. Other information, such as traffic or census data.

Step 3 Identify and define problem areas affecting:

A. Speed, i.e., processing by personnel, processing by computer, interface, etc.

B. Thoroughness or quality of the GBF process. Data base may include misspellings, error lists, invalid messages, file maintenance, etc.

C. Efficiency.

Step 4 Analyze causes of the problems in Step 3 and determine:

A. Whether it is a core problem affecting overall design or application.

B. Effects of this problem on the file, module or systems.

C. Weigh the relative seriousness and

Step 5 Establish priorities relative to design and application schedule and formulate criteria to:

A. Develop alternatives

B. Select alternative by committee, project leader, other.

C. Test where necessary.

Step 6 Install, re-evaluate and modify where necessary. Document thoroughly for the novice and specialist.

SUMMARY

Special information has intentionally been omitted concerning the Savannah GBF System. The reader is invited to examine the attached "Geo-Code Subsystem Overview" for details. The design and application considerations lose their effectiveness if discussed in reference to a single system, i.e., Savannah's. The reader should be aware that, at minimum, one must consider population, geographic area, level of file detail, file maintenance, and funding limitations (Steps 1 and 2). Furthermore, the user must consider uses of GBF such as operational control, crime analysis, manpower allocation or computer assisted dispatching.

GEO-CODE SUBSYSTEM OVERVIEW

The batch process portion of the GEO-CODE Subsystem consists of three (3) batch programs and two (2) Honeywell Utility Disk Sorts. (See flowchart, p. 20.)

The first of the three programs in the system is called BLDGO. This program has as its input 80-column cards which contain all the common place names, intersections, and street address along with the X-Y coordinate for each. The program calculates an index key for each location and creates an output tape containing the name, index key and X-Y coordinate information.

The output tape from BLDGO is input to the two (2) Disk Sorts. The first sort is by record type and index key and the output is used by BLDXY to create the X-Y Index File used by SALES. The tape can also be input to PRTXY to obtain a complete list of the locations sorted by the index key.

The second sort is by record type and location. The sole purpose of this sorted tape is to use it as input into PRTXY to obtain a listing of all the locations in alphabetical order.

PRTXY is the print program in the GEO-CODE Subsystem. This program will accept either of the sorted X-Y index tapes. The program prints a list of all the locations showing the location, index key, and X-Y coordinate. The program will also flag duplicate index keys with an asterisk (*) to the right of the duplicate key.

The last program in the system is called BLDXY and uses the tape sorted by record type and index key to build the X-Y Index File. The X-Y Index File is located in the last 100 records of the Master Name Index File (MNIFIL). The program also places the necessary pointers for the X-Y Index File into the second record of the Fact File (FACFIL). See the detail program documentation for BLDXY below for the details on the X-Y Index File format.

PROGRAM: BLDGO

SYSTEM: SALES, GEO-CODE, SUBSYSTEM

GENERAL DESCRIPTION:

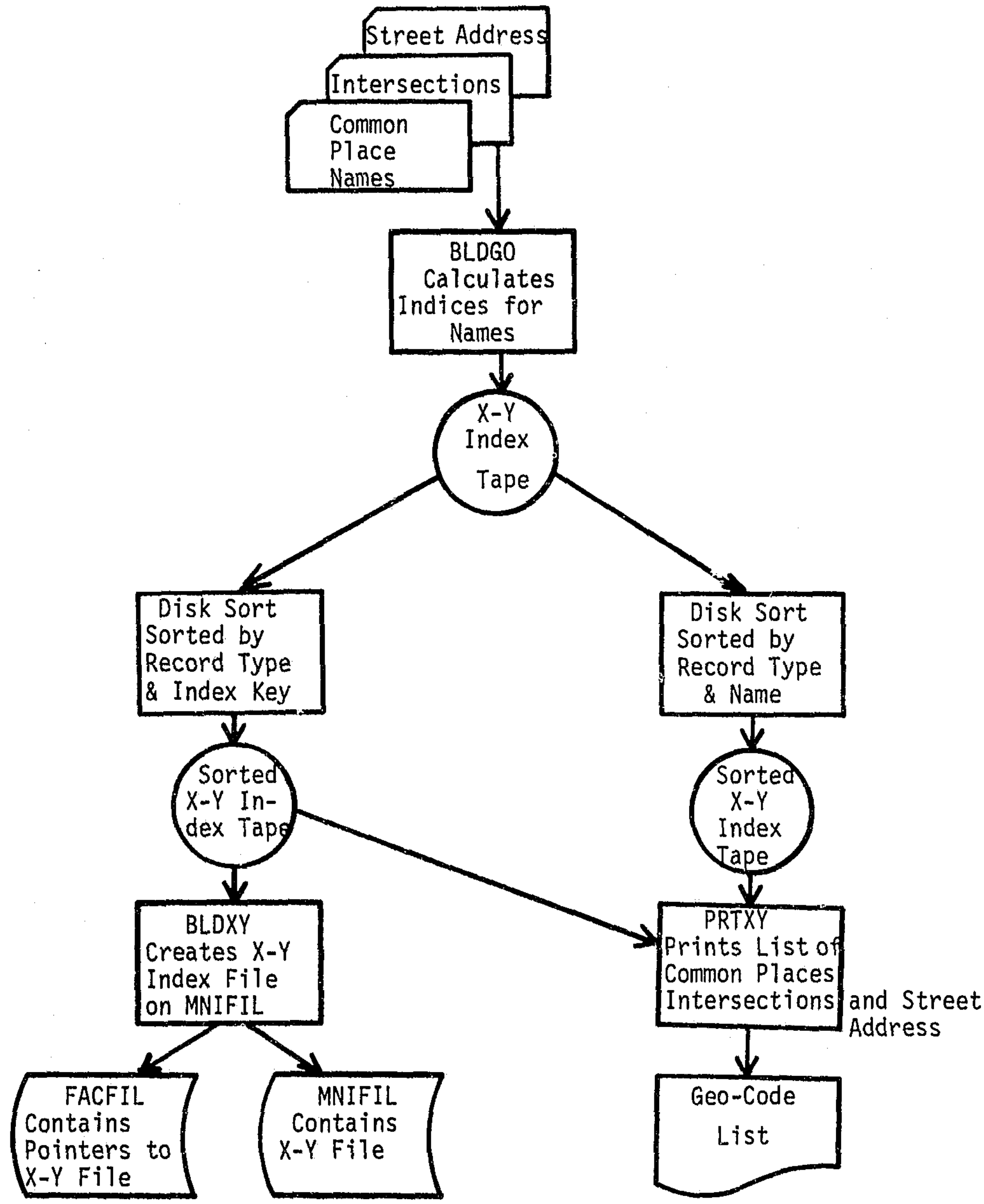
The purpose of the program BLDGO is to calculate the index key for the intersections, common place names, and street addresses in the City of Savannah and create an index tape for Input into BLDXY which builds the X-Y File.

The input to this program is cards containing either an intersection, common place, or street address. Each card contains a card code indicating which type of location it contains: "C" indicates a common place, "I" indicates an intersection, and "S" indicates a street address.

The method for determining the index key for the three types of location is as follows:

GEO-CODE SUBSYSTEM

Batch Process



Common Place: The index key for a common place consists of the first character of the common place name plus up to seven consonants. Vowels and special characters are ignored. If a common place name does not contain seven consonants, the index key is justified left and padded with spaces.

Intersections: Each name which goes to make up an intersection is indexed as follows: the first two letters and/or numbers of the name, but not including special characters; the next three consonants of the name, or the number of consonants remaining, if less than three; the last two characters of the index are the street type, if present. (See list of street types following discussion of street address indexing method.) This brings the total to seven characters for each name in an intersection and up to 14 for the entire index key. If less than fourteen characters are calculated, the index is left-justified and padded with spaces.

Street Address: The index key for a street address is made up of the street direction if present (one character; E, W. N, or S), the first six (6) characters of the street name, excluding special characters and spaces and the street type. The total length of a street index is nine (9) characters. If less than nine (9) are present, the index is left-justified and padded with spaces.

The valid street types are:

Street	=	ST
Road	=	RD
Court	=	CT
Circle	=	CR
Walk	=	WK
Place	=	PL
Drive	=	DR
Extension	=	EX
Parkway	=	PK
Avenue	=	AV
Lane	=	LA
Boulevard	=	BL

SWITCHES AND INDICATORS

Name	Description
SUB-1, SUB-2, SUB-3, SUB-4, SUB-5	Used as subscripts into the name field, index field and to keep count of characters processed.
TOTAL-CHAR	Used in processing an intersection to indicate when a total of 25 characters has been processed. This is necessary because the input cards have a possible 20 characters for each name of the intersection, but only a total of 25 characters are possible for the location on the screen.
SENSE-SWITCH 1	When set by operator, causes program immediately to EOJ.

DATA STORAGE FIELDS

Name	Description
HLD-STRT-NAM	Holds street name of last street address record processed. Used so same street address name will not be processed twice.
INTERSECTION-INDEX	Holds two index keys calculated for each intersection. Intersection processed once in the name order as it comes on the input card and once with names in reverse order.
FIRST-INDX	Holds index key of first name of intersection.
SECOND-INDX	Holds index key of second name of intersection.
HOLD-FIRST-INDX	Temporary hold area used when swapping contents of FIRST-INDX and SECOND-INDX.
HOLD-REC	Holds contains of card input.
NAME-HOLD	Field used to scan name for indexing.
INDEX-FLD	Field used to build index.
STREET-TYPE	Table of valid street types.

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GEOGRAPHIC BASE FILE
RELATED APPLICATIONS IN THE DAYTON POLICE DEPARTMENT

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HISTORY

The Dayton Police Department has been recording data on a geographic basis for many years. Early geographic recording methods were used primarily for making year-to-year comparisons of activity in rather broad geographic areas. These methods had only limited value for the stated purpose and no real value for planning or other related purposes.

These systemic inadequacies were made quite obvious to those of us in the Police Planning Unit some ten years ago when the Chief of Police directed us to conduct a full study of patrol personnel assignments. The assignment included a specification to make supportable recommendations for a totally new patrol beat plan. We began an intensive search for the background data that would be required for this project.

We very quickly realized that the then-current method of recording workload information did not provide the necessary information for our assigned study. The only geographical breakdown of data, other than by the current beat structure, was by large areas called sectors.

These sectors were the result of the overlaying of a square, military-type grid on the city map. Although this did provide area type information, it was not useable information. Few of the city streets run true north-south or east-west, so the grid lines crossed streets at angles and usually in mid-block. This condition, plus the size of the grids, made the information virtually worthless for the task at hand.

The Planning Unit then began a search throughout the city organization for any other agency that was using a geographical breakdown that could be adapted for police purposes. They found that several agencies had geographical area breakdowns, but no two of them were similar and none suited the police needs. Hoping to plan ahead for the future, we contacted the City Plan Board for any projected census tract maps that would be used for the 1970 census. Although the Plan Board personnel could not guarantee that some tract areas would not be changed in the intervening three years, they did provide a census map that was current to that time. Upon analyzing the census map, the census tracts were deemed to be too large for our reporting needs, while the census block level provided too much detail. It was apparent that a mid-level compromise was needed.

We should note at this point that there was a very limited computing capacity available to the Dayton police in 1967, that being a small NCR unit designed specifically for accounting work in the City Finance Department. The first actual computer for local police applications was only two years away, but the planning personnel were not aware of this at the time. Thus, the goal was to design a system that could collect meaningful data, that could generate reports concise enough for operational commanders to understand and that could be processed on the available unit record equipment. This was the basis for the reporting area designed that was developed and which remains quite valid to this day.

The decision was to define permanent reporting areas that were subdivisions of census tracts. The term "sectors" was continued to facilitate understanding by all personnel, only now it meant the smallest defined geographical area rather than its usual meaning. The philosophy was adopted that the designed sectors would be the "building blocks" for all future beat and district designs. With these agreements firmly established, all that remained was the actual sector design.

Rather than attempt to make all sectors equal in size, the decision was made that the sector size would vary with the amount of defined police workload. This required much report-by-report manual research where the data was available and required some estimations based on police experience where the data was lacking. The design was completed with about 145 sectors covering the roughly 37 square miles of the city. The outer boundary of any given group of sectors followed the census tract lines and the boundaries between sectors followed natural or artificial boundaries or main thoroughfares. All sector lines were considered to follow the center line of the street, railroad, river or other boundary.

After the considerable data research required to get address ranges on all street segments within each of the sectors was completed, sector books were printed for all personnel. They were used in determining the proper sector number for location of occurrence for all basic police reports submitted. This manual look-up and recording method was not ideal but it at least allowed us to begin collecting the data that was the basis for our early beat plan recommendations. By necessity, the manual method remained in effect until after our first police computer was installed in early 1969. The sector books became obsolete as we computerized our geographic base file (GBF) applications, although we still keep a few around to help us remember how it used to be.

GBF OPERATIONAL DESIGN

Given our constrained budget and the small computer with which we had to work, it was necessary to store the computer data in compacted and coded form wherever possible and to split our GBF file processing into three routines. The first routine would convert all address information into a coded format for input to the actual GBF routine and for later file storage. The GBF routine would correlate the address code to the proper sector, while the third routine would match the sector to the proper beat number for the work shift of the reported activity.

For simplicity of operation and ease of maintenance, we decided to build separate files for each of the routines. A street code file would contain only the actual street name and the related street code. The actual geographic base file would contain street code, address range and related sector data. A sector-beat file would contain entries for each sector, with the related beat identifier for each of the work shifts. This decision required a need for a coding system for addresses. Each street, and most all public buildings, schools, hospitals, parks and playgrounds were given a distinctive four-digit code for file purposes.

We developed an address code of nine digits, which could be packed into five characters for storage. In this manner, we could store either standard addresses or intersections. The code structure is as shown below:

For Standard Addresses

2257	0	1344
Street Code	Always Zero	Street Address

For Intersections

2257	1684	0
First Street Code	Second Street Code	Always Zero

The file definition of whether the address stored was an actual address or an intersection was based on whether the fifth digit was a zero or some other numeric. Thus file entries would appear as the below samples:

1344 N. Main Street	- 225701344
Room 322, American Bldg.	- 600000322
N. Main & E. Third	- 225716840

The street code file, containing only the street or building name and its associated four-digit code, is maintained in both alpha street name order for address entry and coding and in numeric street code order for later report retrieval and printing. There are presently 2218 records in each of these files.

The actual GBF file, called STRTSCTFIL, contains entries for the address range of the portion of each street (coded) within each sector. Only the beginning and ending address within the sector is used. There is no attempt or need here to define sub-segments, such as blocks, within the sector. Since, as was stated earlier, the sector lines are considered to be on the street center lines, there are separate odd-even entries for those sector-boundary streets. By preserving the philosophy that the sector design will remain constant, only periodic maintenance is required to keep this file current and accurate. While new entries will be made for annexation areas and occasional errors will be found and corrected, this file will remain basically as is without regard to changes in organization or beat structure. There are presently 3285 nine-character (eight packed numeric and one alpha) entries in this file. Only the input validation programs and one file extract program access this file. Random access to this file, as with the street-code file, is facilitated through related index files automatically generated during any file update.

The processing sequence for the validation routines starts with the access to the street code file for picking up the actual street code(s) and formatting the coded total address. Next, it moves to the GBF file for determining the proper sector number, then on to the sector beat file described below, to obtain the beat number. Although some may think the three step process cumbersome, we believe the benefits of this type operation far outweigh any slight degradation of validation time. To maintain only one master GBF file that contained all the data in these three files would require considerably more maintenance time than would be saved through any slight increase in validation throughput.

The mentioned sector-beat file contains four fields for each sector record. Over the years, the Dayton Police Department has utilized several beat plan philosophies. One philosophy had identically structured and numbered beats on each work shift, while another had individual beat plans with distinctive beat numbers for each shift. The third and present philosophy has identically structured beats on each shift with distinctive beat numbering relating to the particular work shift. Thus, it is necessary for present and possibly future purposes that each of these file records contains entries for the sector number and for the related beat number on each of the three work shifts. We have successfully maintained the philosophy over the years that beats and/or districts are composed only of groups of whole sectors. Thus, any change in beat or district design or numbering requires only the easy-to-make changes to this sector-beat file with no disturbance to the GBF file. There is presently one 12-character record for each of the current 160 sectors. Even a total restructuring of all beats in the city would take less than one hour of data preparation, key entry and processing time to completely restructure this file. A similar update to a common master GBF file could require an investment of many times this amount of time.

This GBF concept should be equally as valid in other jurisdictions of varying size, with the possible exception of the very small jurisdictions. The area limitation in these jurisdictions may not allow for enough sectors to provide meaningful data. A high number of sectors in a large jurisdiction should pose no problems in that there would likely be current broad area geographical delineations such as divisions, districts or quadrants. The statistical reports to commanders in those areas should be held to a manageable size by including only data relevant to the given area. Planning units would utilize citywide data for statistical analysis and personnel allocation purposes.

PHILOSOPHY

A geographic base file is merely another in the series of tools available to progressive police administrators. It can be a valuable tool if properly designed. It should provide for serving administrative, operational and planning purposes. The system should be able to serve the identifiable future needs as well as the current needs. It should have the flexibility to continue providing meaningful data in spite of changes in population mix, housing patterns, crime trends, service demands and community priorities. A properly designed and operated system should identify these changes as they begin to occur, enabling departmental response to change accordingly.

The Dayton Police Department GBF system has this flexibility. It has supported the departmental operation for ten years and shows continued promise. Additionally, universities, neighborhood groups, priority boards, social agencies and other community planning groups all make valuable use of the data in the Dayton Police system. The following section presents an overview of the major police uses.

GBF-BASED REPORTS

The three primary data categories processed through the Dayton Police data system are dispatches (calls-for-service), crimes and arrests,in order of volume. Geographical information is valuable in each of these categories and its value will be discussed in the descriptions below. A wide variety of statistical and detail reports, along with statistical maps and shade maps, are available to users. We will briefly discuss each category separately for purposes of clarity.

Dispatch Report System

The dispatch reporting process has provided quite valuable for planning, allocation and administrative purposes. It is in this area that the sector concept is the most valuable. The building block concept of the sectors allows for the structuring of beat plans that provide equitable distribution of workload. It also permits periodic reports to determine any changes that may be occuring that would require a beat-plan restructuring.

A series of codes identifying the various types of calls-for-service allows for determination of service request patterns across the various city areas. This has been a valuable administrative tool as the Dayton Police Department utilizes the semi-independent district concept. This concept requires each district commander to provide the type of service most appropriate to the citizen needs and desires in his district. The combination of call type and geographical information also provides the capability of structuring the proper mix of one-officer and two-officer beat crews throughout the city. The distribution of field officers by time and by area has been based on reports from this system since its inception.

The Dispatch Reporting System has been structured with nearly unlimited flexibility, enabling planners and administrators to make maximum use of the available data. One such application is the series of detail reports, showing all of the pertinent information on each dispatch. All dispatches for a given time period may be selected from the master file by address, sector, group of sectors, beat or group beats and printed for specific evaluative purposes. The date, time, nature and location of the call is shown along with the number of police units on the call and the call disposition.

A hierarchically structured statistical report program (DISPTIME) produces reports showing the number of dispatches and the man-hour time investment in various combinations and sequences. This program allows for the structuring of reports using any six or less of the 14 dispatch data elements in a major to minor priority sequence. Accumulated statistical data is tabulated for the lowest level key and accumulated as subtotals for each of the higher order keys. Three of the 14 data elements contain geographic data.

There are 117 prestructured report formats in this series that may be requested by format number. A request for any other combination of six or less elements can be accomodated with only a minor change to the program call card. Although there is a statistical possibility of nearly 2.5 million permutations of data structure available through this program, the prestructured formats are the ones most requested or most likely to be requested.

DISPTIME was developed in response to the many and varied requests for data from the dispatch file. Obviously, some of the report formats are utilized with greater frequency than others, but the programming time previously required to respond to special requests has been reduced to nearly zero. We now give same-day service to priority requests and a maximum of one-to-two-day service to all others. This quick turnaround has made the data more valuable to the users, since numerous informational needs are triggered by real-time problems. This quick response has also been at least one of the reasons for an increase in demand for the special purpose reports. It should be noted that seventy-five percent of the special report requests specify at least one of the geographical data elements.

The Dayton Police Department's current number one priority is maintaining the fastest possible response time to our citizens' service requests. Reports from this program have been invaluable in providing up-to-date response time data. The ability to make response time comparisons among the various districts and beats has provided the capability to fine-tune the personnel assignment structure for maximum efficiency.

We believe that an efficient police data processing system must be able to respond in a timely manner to all special data requests and that the measure of this efficiency is the number of special requests made. Since we now produce more special request reports than regularly scheduled reports, we believe we have reached a level of efficiency commensurate with current needs.

This special report generation has also become a significant tool in determining the department's informational needs. Certain of these special reports proved to be invaluable to a segment of the operation, while others had departmentwide applicability. Several of the reports have since become a part of the regularly scheduled report package, replacing other less valuable reports.

Crime Report System

The Crime Reporting System had until recently been structured similarly to the Dispatch Reporting System. Statistical reports were available showing crime distribution by specific crime type, by consolidated groupings or by total crimes for the geographical delineations of sectors, beats, districts or citywide. These could be qualified by time periods or date ranges. Detail listings were also available showing the primary elements of date, time, place, nature, method and dollar loss. Although the variety of reports was not as great as in the Dispatch Reporting System, the available formats were adequate for most analysis, planning and allocation purposes.

The police on-line Crime Reporting System was put into operation in April 1976. This system vastly improved the availability and value of crime information. The system provides for on-line entry and distribution of crime reports and for the retrieval of crime data through terminal inquiry. The geographic base file is an integral part of this system, as are the various levels of geographic data obtained through use of the file.

The operating philosophy of the Crime Reporting System calls for the field officer to dictate the details of any crime investigation to a bank of tape recorders in the Data Entry Pool. The dictated report must include a prescribed series of sequentially structured data elements. Certain data elements must contain specific information, while others may be variable-length, free-language narrative. Investigative worksheets are provided to all officers for note taking purposes during the investigation and are designed to assure that no required data element is overlooked.

The terminal operators in the Data Entry Pool transcribe the recorded reports onto on-line terminals for immediate entry, validation and file update. The system then distributes reports to appropriate printer terminals throughout the department. Reports are routed to the district of the crime occurrence, to the office of the designated follow-up investigator and to the Central Records Office. Here again, the GBF is utilized to convert the address of occurrence to the sector-beat-district identifiers that are essential to proper report distribution.

Crime file inquiry capability is provided through inquiry terminals in each district office, in the detective office and in Central Records. The flexibility available for inquiries is extensive and ranges from specific report retrieval through combinations of crime types and M.O. patterns, to administrative data requests. Inquiries may be made using a variety of different keys in combination, including the geographic identifiers of specific address, address range, entire street, sector, beat or district. By utilizing the various crime M.O. keys, investigators may search through the files on previously committed crimes for similarities to the crimes they are currently investigating. The search may be as general or as specific as desired, and may be structured to cover as broad or as limited a geographical area as desired. The number of the various keys in the five crime M.O. categories provide the capability of over 40 million distinct inquiry combinations. If the inquiry were to be further qualified by a crime type code, over 2.5 billion various combinations are possible. Utilizing the nearly unlimited number of area qualifiers would increase the possible combinations to an almost incalculable number. We trust and hope that our crime rate will not be such as to require the utilization of all of these combinations.

Current and past case load for any investigator, including the disposition of all closed cases, can also be retrieved by the investigator's supervisor. This capability allows for effective monitoring of detective efficiency and for determining proper assignment of new cases.

Arrest Reporting System

The Arrest Reporting System is maintained primarily to provide the statistical data required for the UCR reports. The geographically oriented use of data from this system relates more to outside agencies than to the Police Department. After all possible individual identifier information is stripped from each record, the data is made available to various local agencies for research and planning purposes.

One of the outside agency uses we believe to have the most potential is the identification by sector of the geographical distribution of residence location of arrested persons. This has been used to direct the efforts of local agencies concentrating on providing jobs, improving skill levels of disadvantaged persons and improving housing conditions. The data has also been used for other social and recreation planning purposes. Visual displays of this and other activity distribution patterns are available through the mapping routine described below.

Computer Mapping

We stated earlier that the Dayton Police Data System was started prior to the 1970 census. This fact, plus the information we were receiving about the size of the computer requirements that would be needed to process the Census Bureau computer mapping routines, convinced us that we would have to write our own mapping program if we wanted the capability at all.

The original goal for our mapping routine was to develop a computer program that would structure patrol beats based on sector data. The program was to first print a map of the entire city, showing all sector delineators and identifiers, plus the sector activity distribution for the entered data. The program would then structure the required districts based on an equal distribution of workload, then structure beats within the districts based on the same premise. It would then print a map showing the district and beat boundaries.

During the development of this program, we saw the possibility of the addition of routines that would also utilize the same input data to print a shade map, giving a visual display of the data distribution across the city. These routines would utilize the same basic map structure for the detailed display. By organizing the printing sequence so that the detail maps printed first, followed by the shade map, we had a graphic display of the workload distribution along with the actual count before we started the beat building routine.

This program has been quite valuable to us over the years and has been utilized each time a need was identified to restructure any or all of the patrol beats. A feature of the program is the ability to print maps for individual districts, as opposed to the entire city. These district maps could also show the relative activity distribution in the shaded map structure, for activity only within that district.

The program will accept either dispatch, crime or arrest data. Various types of shade maps can be produced through the use of discriminative selection routines on the various data files. All crimes or specific categories of crimes can be selected for the visual display printing. The same is true with data from the dispatch and arrest files. The variety of shade maps that can be printed is limited only by the imagination of the user.

While the beat build mapping routine has been utilized extensively within this department, the shade maps have been used for many and varied purposes, both within the department and by outside groups. These shade maps have been posted in the patrol assembly areas to show the relative distribution of auto thefts, residence burglaries, commercial burglaries or other crimes that present a current problem. Maps showing the distribution of various crimes have also been used for presentation purposes to the City Commission, priority boards and neighborhood improvement groups. Dispatch and crime maps have been used to refute the claims of various neighborhood groups that their area was either not getting their fair share of police service or was not being adequately protected. A use alluded to earlier was the preparation of shade maps showing the residence location distribution of arrested persons. These maps continue to be used for these and other purposes and are in constant demand.

SUMMARY

The key to the success of the Dayton Police Department's data operation has been the continuation of the census subdivision called sector as the geographic base unit of data collection, storage and retrieval. The progress of the total system development has not been rapid and has taken many years to bring to its present level of efficiency. We are not a large size department nor do we have a large data processing operation. Many of our systems were developed as a result of seeing the applications in the larger, more advanced police departments. Our progress was necessarily limited to our size and strict budget limitations. Only the on-line crime reporting system has been developed with any federal funding. All of our data applications were developed for, and are running on, an NCR Century computer. The programs were originally written in NCR's NEAT/3 language, although some of the routines are now being converted to COBOL.

We believe that we have an efficient and effective data processing system that is adequate to the needs of a department and a city of our size. We offer to share whatever knowledge and experience we have accumulated in the same spirit that others have shared their knowledge and experience with us.

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DESCRIPTION OF THE OFFICE OF THE SHERIFF'S COMPUTER ASSISTED DISPATCHING SYSTEM AND ITS APPLICATION OF THE GEOGRAPHIC BASE FILE

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Jacksonville, Florida

The city of Jacksonville, Florida merged with Duval County in 1968 to form the Consolidated City of Jacksonville. The purpose of this consolidation was to merge all governmental agencies, thereby eliminating duplication of effort and also reducing the cost of government. The land area which this consolidation encompasses is 841 square miles with a population of 577,900 persons, according to a 1975 estimate. This population figure places Jacksonville as the 23rd largest city in the United States while it is the largest city in land area. Of the total population, approximately 22.1 percent is black, while another 1.5 percent is Spanish.

The type of government which Jacksonville has is a Mayor-Council form with an elected Mayor and a 19-member Council. The chief law enforcement officer of the city is the Sheriff, which is also an elected office. The Undersheriff is appointed by the Sheriff, who also appoints the directors of each division within the structure of the Sheriff's Office. The division in which most of the information processing is controlled is the Services Division. Within the Services Division, the Communications Center is the area which contains Computer Assisted Dispatching (CAD).

The manpower resources of the office was one of the primary reasons for progressing so rapidly in the data processing area. The Sheriff's Office employs 1,543 persons, of which 937 are sworn officers with the other 606 civilian personnel. The civilians handle most of the clerical positions but are also the mainstay of the Communications Center. The 937 sworn officers for the population averages to 1.62 officers per one thousand persons, which is below the national average.

On an operational level, the organization of the Sheriff's Office is set up in a fairly standard form. The city is divided into four quadrants or zones, each with its own radio frequency and dispatcher. The boundaries of these four zones are determined by many of the natural boundaries within the city, e.g., the St. John's River and the three interstate systems which run through the City. Each zone is broken into approximately 25 beats with a patrol unit responsible for each beat. There are actually 98 beats throughout the city. Each beat is subdivided even further into reporting areas which are used mainly for statistical purposes by the Patrol Division and the Planning and Research Section. There are a total of 329 reporting areas in the city.

The Information Systems Division of the city of Jacksonville is the agency of the consolidated government which provides computer service for all using agencies. The city is equipped with three Burroughs B6700 virtual memory computers. Attached to the system are approximately 300 terminals of which 22 are directly associated with CAD, with another 18 associated with data input, booking, and other criminal justice systems. There are 17 on-line systems which contain property appraisers, hospital, tax collector, school board, electric authority and many other diverse applications. There are also another 2,000 or more batch programs which run on the three computers.

The primary stimulant for systems development in Jacksonville was the 1968 consolidation. The reasons for initiating a program for CAD were many and varied. Because of consolidation, the areas which the officers rode as their beats were much less familiar as former county patrolmen were now riding city beats and vice versa. The response time became slower due to this unfamiliarity, thereby creating a major problem. Another reason for improved information processing was to enhance the communication operation to afford flexibility, while at the same time improving the area of command and control to help overcome the low policeman/population ratio. The third major reason for increased mechanization was to upgrade officer safety through the introduction of a method of control which would minimize lost records, human error and overlooked activity.

The CAD system is divided into four general areas; receiving section, dispatching section, review section and administrative section. The geographic base file (GBF) is the heart of the CAD system because it is the common denominator linking the addresses of incidents to a beat which is recognizable to the Sheriff's Department. Since implementation in April 1973, activity into the dispatch system has grown to over 2,000 calls handled per day with an average of 14 transactions to and from the computer per call, amounting to over 25,000 transactions per day.

The receiving section consists of six CRT terminals, each with the capabilities of entering data pertaining to a call for police service. Starting with an empty formed screen, the nature of the incident and address are entered on the screen and transmitted to the mainframe. The application program does a look-up on the street file and transmits back to the terminal the correct beat and reporting area if a match is found. Or, if no match is found, an error message is returned and the operator has an opportunity for a retry. The receiving officer then gathers any other pertinent information, such as complainant name, address, phone number and any additional information pertaining to the incident. The call is then sent back to the application program, which then assigns a generated sequential number to the call. This transmission also routes the call to the appropriate dispatcher station, based on the beat, and returns an empty formed screen back to the receiving officer who is then ready to receive another call.

The dispatching section consists of six stations with two CRT terminals at each station. Four of the stations are in use as dispatching stations with the other two stations maintained as backup for equipment failure, either terminal or radio. One of the two backup stations serves as the supervisory station which monitors the activity in the Communications Center by the communications supervisor.

The dispatching cycle is initiated at the point when the call is received from the receiving station. The dispatcher, through the system, monitors the activity of all on duty units so that the system recognizes which units are handling calls and which units are available to handle calls. As the call comes into the dispatching station, the application program suggests to the dispatcher the closest available unit, though the dispatcher has the override capability of assigning another unit. At the time the unit is assigned through the CRT, the dispatcher contacts the unit through voice communications and advises the unit of the pending call.

Another way in which a call can be initiated is by the officer riding the beat. The type of incident and address are given directly to the dispatcher over the radio and the information is entered by the dispatcher and verified by the system. On officer-initiated calls which involve stopping a vehicle, the license tag number is also entered by the dispatcher. The system automatically sends the tag inquiry to FCIC (Florida Crime Information Center) and forward to NCIC via a system-to-system direct interface between the city's computer and the FCIC computer in Tallahassee. The status of the call is constantly updated by the dispatcher as to the arrival time by the officer and any other information that the officer considers pertinent to the call. When the call is completed, the officer contacts the dispatcher and assigns a disposition to the call based on the action taken using a series of codes. The call is then written to a history data base disk file which contains all information on the call. At this time, the system determines if the call requires a report by translating the disposition code and, for audit accuracy, logs all calls which require reports.

The audit function is accomplished through the Review Section which consists of two sworn officers, each with a CRT terminal. As reports are gathered from the beat officers, the first point of entry is the Review Section. The review officer verifies the report by checking the written document against the history base obtained using the CRT terminal. The accuracy and completeness of the report is verified and then cleared through the Review Section in the system. The report is then sent to the Records and Identification Section which enters the report, through the common data input area, to the Uniform Crime Reporting, Traffic Records, and Master Name Index Systems.

Another function of the Review Section is one of secondary receiving officer. If, upon receipt of a call for police, the receiving officer in the Communications Center determines that the call does not require an officer's presence, the call will be directed to the Review Section. An officer will then handle the call through a phone conversation and complete any necessary reports, thereby allowing the beat officer to avail himself to more critical calls.

The last area of the CAD system is the Administrative Section. The function of this area is to input into the system which officers are to be covering which beats before the officers come on duty, thereby allowing the dispatcher early access to the information.

The data base which is captured in the system provides many valuable tools. Each officer's activity is captured through the system and is printed monthly as a management medium. Many comparative statistical reports are also produced from the system which are extremely helpful in the planning process within the department. Finally, manpower allocation reports are a basic derivative of the system which help determine correct allocation of resources.

As mentioned previously, the GBF is the heart of the CAD system, for, without a geographic file of some sort, the CAD system would not be possible. The GBF which is used in Jacksonville is a derivative of the DIME file. After consolidation in 1968, the county area was divided into reporting areas using a grid system which followed census tract boundaries. The DIME file, which at the time contained the entire city and most of the county, was corrected and updated using the telephone cross-reference index, an available street index and a concentrated field street survey. With the assistance of a federal grant, this updated version of the DIME file was then modified to create the GBF which was needed for CAD. For every blockface in Jacksonville, geocodes were provided which identified the type of street, the range of addresses for both odd and even sides of block, reporting area and beat. In addition, further refinement provided for incorporating a landmark file into the primary street file. Any and all updates, deletions or additions into the current file are accomplished in cooperation with the Streets and Highways Department of the city, which provides the Sheriff's Office with all modifications.

The GBF, as it pertains to the Sheriff's Office, provides two main resources. Through CAD, the beat and reporting area are assigned to all calsl using the GBF. The beat is used in an operational capacity mainly by pointing out the correct path to follow in responding to a call. The reporting area is used primarily in the statistical reports which are normally run later to point the planning and patrol units in the right direction.

The current access method into the GBF is one which was developed when the file was created. The street file actually consists of four interactive disk files. Two files are indices into the third or primary street file and the fourth file contains any added streets. The first index is a file which contains one record for each street name and type throughout the city. The file contains 8,192 records of 30-character length, organized in an ascending alphabetical order blocked 10 (see file layout below). The second index file contains one record for each street name in the city. This file also contains 8,192 records, 30 characters in length blocked 10.

SHERIFF'S DEPARTMENT

INDEX DISK LAYOUTS 8,192 Records 30 Characters Blocked 10

ELEMENT	NO. CHARS.
STREET NAME	20
STREET TYPE	4
NOT USED	6
	30 CHARS.

INDEX 2 8,192 Records 30 Characters Blocked 10

ELEMENT	NO. CHARS.
STREET NAME	20
NOT USED	10
	30 CHARS.

The third file is the primary street file which contains one entry for each block-face, both even and odd sides, for every street in the city. The file is organized alphabetically by street name and street type, then, within each street name and type, the organization is numerical by low address. The file contains over 48,000 records which are 70 characters in length (see file layout next page). Each record contains these elements; street name, street type, direction, low address of block, high address of block, intersection, reporting area and beat. Also contained in this file are the landmarks throughout the city which include schools, hospitals, shopping centers and major buildings. The fourth file contains any street entries which are added to the street file in a data capture mode. This file contains 2700 records which are also 70 characters in length.

SHERIFF'S DEPARTMENT

PRIMARY STREET FILE 48,210 Records 70 Characters Blocked 10

ELEMENT	NO. CHARS.
STREET NAME	20
STREET TYPE	4
DIRECTION	1
ODD/EVEN	1
LOW ADDRESS	5
HIGH ADDRESS	5
INTERSECTION	17
REPORTING AREA	3
BEAT	3
NOT USED	11
	70 CHARS.

ADDED STREET FILE 2,700 Records 70 Characters Blocked 10

SAME LAYOUT AS ABOVE.

The access method into the street file is fairly simple, although it sometimes requires many disk accesses. When the address is entered in a free-form format, it is split into the numeric portion and the street name/type portion. The street name and type are then used to access into the first index file. The program performs a binary search on the first index file, trying to match on street name and type. This points out the significance of the index file containing 8,192 entries, as in a binary search mode, the maximum number of searches required would be thirteen. When an exact match is found on street name and type, the index file contains a pointer to the first record in the primary file with that street name. The program then reads sequentially through the primary file, scanning low and high address until it finds the correct block number which corresponds to the entered address.

When an exact match is found, the associated beat and reporting area are returned to the requesting CRT, along with the closest intersection. If no exact match is encountered, the system returns the closest blockface with the associated beat and reporting area but also an error message indicating that an exact match has not been found. If no match is found on street name and type, the system then attempts to locate a match on only the street name by performing a binary search on the second index. The system will then return the closest block that it encounters but will also indicate that no exact match was found.

The additions, deletions and updates are also accomplished in an on-line environment through the system. The additions are gathered in a data capture mode and placed into the fourth GBF disk file. The deletions are entered through the system and the records to be deleted are flagged accordingly. The updates are entered into the system to correct any errors which may be contained in the records. As noted, the updates are really the only true on-line modifications, while the additions and deletions are not incorporated into the primary file until a batch program is run against the files combining them.

The improved access method into the GBF is one which utilizes the Burroughs-developed package called XRAM. XRAM is basically an index sequential accessing method which has been adapted to the GBF. The disk file developed for this purpose will be one file of 1,800 records with each record containing 3,600 characters (see file layout below). The file is organized into three general areas; the rough table directory, the rough tables and the fine tables. Each fine table in this system consists of the 3,600 character record which is actually 60 street entry occurrences of 60 characters each. Each occurrence contains street name, type, direction, beat, reporting area, intersection and low and high addresses, with street name, type and high address maintaining the sequence of the file.

SHERIFF'S DEPARTMENT

XRAM STREET FILE LAYOUT 1,800 Records 3,600 Chars. Blocked 1

LOGICAL STREET RECORDS OCCUR 60 TIMES WITHIN EACH PHYSICAL RECORD.

ELEMENT	NO. CHARS.
PREFIX	1
STREET NAME	20
STREET TYPE	4
DIRECTION	1
ODD/EVEN	1
HIGH ADDRESS	6 PACKED
INTERSECTION	17
BEAT	3
LOW ADDRESS	6 PACKED
REPORTING AREA	3 PACKED
NOT USED	5
	60 CHARS.

NOTE: THE 1ST RECORD IS THE ROUGH TABLE DIRECTORY, WITH THE NEXT 30 RECORDS ACTUALLY ROUGH TABLES.

The rough table directory locates the correct rough table to use by means of a binary search. The correct rough table is then accessed and a binary search on it points to the fine table which contains the desired entry; in this case, the street file record. A binary search on the fine table returns the exact entry, if present, or an indication to the program that the desired entry is not present.

The basic method for entering the address through the CRT will remain the same with very few modifications. There will still be three modes of access into the street file; direct address, intersection or landmark. There are also future plans for expanding the GBF so that prior call information would be attached to the blockface record, thereby offering more data to the officer responding to a call.

There are many advantages to the current access method and file organizations, with the primary advantage being the small amount of memory used in the program. The largest of the four files has a record length of only 70 characters, thereby allowing for only a small amount of save core while the program is running. The other main advantage is that only one binary search is performed, although many disk accesses may be generated.

The advantages of the XRAM method of access are more pronounced. There is only one file defined, as compared to the four files defined in the old method. Each record is much larger but, overall, the method is much quicker with far fewer errors. The single largest advantage derived from implementing the XRAM access method is the capabilities of on-line additions, update and deletions to the street file.

In conclusion, the technological and software advances achieved since the time the original GBF was developed has pointed out many deficiencies in the current access method. These problem areas have been addressed and the method derived appears to approach these problems in a rational manner, providing for the best possible solutions.

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THE EMPIRE SYSTEM AND GEOCODING DATA BASE

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THE EMPIRE SYSTEM

History and Background

Erie County, situated in Western New York, is comprised of 44 municipalities covering over 1000 square miles, with a population exceeding 1.1 million people. The area is served by 29 local police agencies including the Sheriff's Department and state and federal law enforcement agencies. The implementation of the EMPIRE System (Erie Municipal Police Information Retrieval Enhancement) represents the culmination of four years concerted effort on the part of Erie County. Its intent was to provide all the local police agencies with a modern computerized law enforcement information network capable of facilitating rapid information on wants and warrants, stolen property and vehicles, motorists and vehicles identification, message switching among the law enforcement agencies and timely receipt of criminal histories from the statewide criminal history repository. Additionally, the system provides a variety of local applications to meet the day-to-day operational needs as well as the statistical reporting requirements of user agencies.

The history of the systems development involves two distinct efforts in the area of criminal justice information services, one by the County of Erie and one by the City of Buffalo. In 1968, voters in the County of Erie defeated a referendum calling for the creation of a countywide police force. As a result, in 1970, a Special Project Committee on Law Enforcement was formed to develop alternatives to metropolitan police. The major thrust of the committee's efforts dealt with examining the expensive technical services which might be provided, first on a countywide basis and second on a regional basis. As a result of a Division of Criminal Justice Services (DCJS) grant award, the committee commissioned a consultant study to examine the record keeping functions of all the local police agencies. The recommendation of the consultant called for the creation of an independent agency to spearhead the development of information needs which would rectify the record keeping deficiencies.

Concurrent with this process, the City of Buffalo Police Department, the largest police agency in the county, was developing a computerized information system. In 1969, the Buffalo Police Department acquired a small size computer and developed various batch systems including parking tag, incident reporting, accident record systems and a limited geocoding data base file. In 1970, a major grant award from DCJS allowed the city to develop on-line systems for the storage and retrieval of arrest records and warrant/wants, and provided for the enhancement of the incident reporting and analysis system. The resulting system was called Compudata and became operational in December 1971.

In April 1972, the Special Projects Committee recommended centralization of key services on a countywide basis, including records and information, and the committee endorsed the consultant's recommendation that the countywide computer system be based upon expansion and enhancement of Buffalo's Compudata system. Thus, the two efforts were merged: the county created a Department of Central Police Services and the Buffalo Computer System was transferred to the county. The effective date of the transfer was April 1, 1973.

The EMPIRE System was designed as a modular system made up of subsystems. Each subsystem was designed to serve a particular function in the criminal justice process. Recognizing the need for a geocoded data base on a countywide basis, the plan called for the expansion and the implementation of the GEO-File to provide jurisdiction of political and geographic reference information within the EMPIRE System. Information provided by the Geocoding Subsystem is currently used within the Event Subsystem which includes incident and/or crime reporting and accident analysis. The file, however, is designed in a much broader scope to permit its use by all the other applications within the EMPIRE System and also by any other county departments; e.g., Mental Health Department, Fire Department, Social Services, etc. An overview of the EMPIRE System is presented on p. 42.

THE GEOCODING DATA BASE

Software Environment

This subsystem was designed around UNIVAC CLEAR II communications-oriented interactive data base system, which is available under VS/9 COS and maintained and supported by SPERRY-UNIVAC corporation. It is designed specifically for rapid response to inquiries and real time maintenance, while maintaining a full-time message switching and general broadcast environment.

Organization of Geocoding Data Base

Structurally, the Geocoding Data Base consists of four files; the Street Address Index File, the Street Segment Index File, a Telephone Number Index File and the Geocode Primary File. (See Geocoding Data Base, p. 43.) The Geocode Primary record can only be accessed through one of the index files. The index files are structured as CLEAR II indices. As such, they may be easily searched in an on-line situation by CLEAR II transaction programs or for batch purposes by utilizing CLEAR II COBOL interface. The index files are accessed by means of user defined CALC and SEARCH routines. The CALC routine defines an algorithm which uses the key to obtain a block number on the file. The SEARCH routine defines the criteria necessary to find a matching record. Once the correct index record is found, a pointer is available by which to access the Geocode Primary File.

Street Address Index File. The Street Address Index File has as its key the street house number, the street name and the locality (if available). The street names are condensed by means of SOUNDEX routines to conserve space and to eliminate some variation in spelling. This routine is also facilitates the SEARCH routine in identifying close matches. The locality entered is the city portion of the address. If entered, the city will be used to pick up a locality code which is used on the file to standardize locality designation in accordance with the United States Bureau of the Census. (See Example Query, p. 44.)

The fields carried on this file pertain to the individual address such as:

1. Property Class - This code indicates the type of property, e.g., parking lot, single family dwelling, apartment building, etc.

2. Dangerous Premise - These are provided by the police agencies and/or fire department to flag trouble on Special Service Households.

3. Street Code - This is used to conserve storage on the history files and to provide an access method back into the Segment Index File.

4. X and Y Coordinates - These are provided to pinpoint the property on a grid map. This field will also be used to produce density mappings.

5. Pointer to Telephone Number Index - This allows us to pick up the telephone number of handicapped individuals so they could be alerted in case of emergencies, e.g., fire in building, etc.

Street Segment File. This file has as its key a house number range and the street code. Unique street code numbers have been assigned by Central Police Services for each street within Erie County. These code numbers, in addition to the house numbers, are used to access the file. The CALC routine uses the street code number to calculate the block number in the file and the SEARCH routine looks through the block to find a segment range into which the house number fits. The pointer from that record is then used to access the geocode information.

The street code is carried on this file to reduce storage space necessary to identify a street. This code is also necessary to interface with the existing application history files which carry street code instead of name.

The street name is carried on this file to change the street code to a street name for reporting purposes.

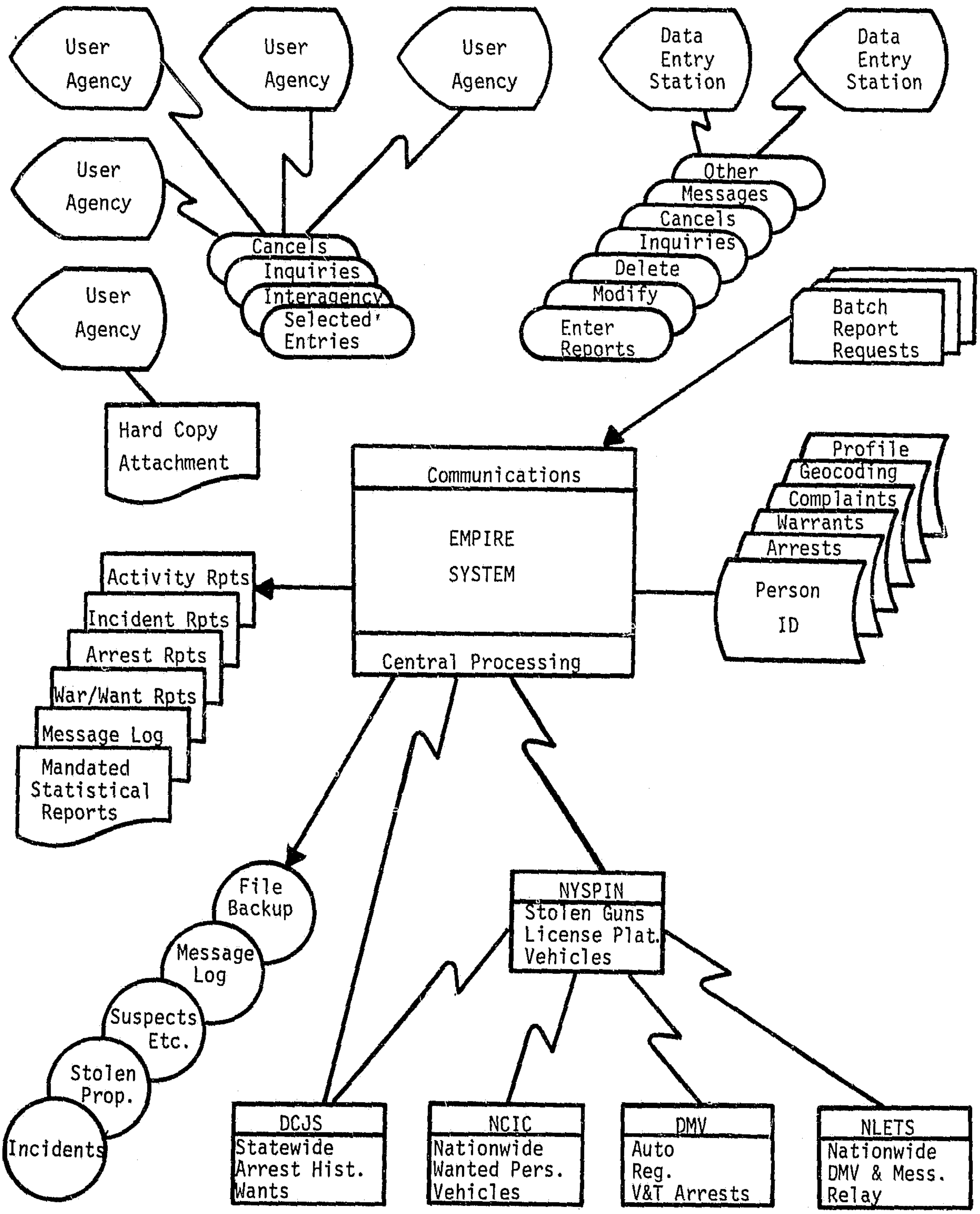
Telephone Number File. This file has as its key a telephone number. Central Police Services anticipates carrying on this file all public telephone numbers as well as those of handicapped or elderly citizens who would require special services.

We carry a telephone type to indicate whether it is a public phone or, if private, what type of handicap the individual has (e.g., blind, elderly). The telephone identity number is the number by which the Telephone Company identifies the phone and this number is used for updating the file. The full address is carried for dispatching purposes and the originating agency is carried to alert the responsible agency. The primary pointer is also available to access into the Geocode Primary File if necessary.

The main purpose of this file is twofold. First, it provides a telephone index which can be queried by Command Control personnel (911 center) in those cases where a witness and/or victim cannot provide adequate address information, as in the case of a public phone book. The individual can give the dispatcher and/or the complaint writer the telephone number on the phone and, with that, the dispatcher will query the file and come back with the address. The other purpose is to enable handicapped and elderly citizens to list their phone numbers with Central Police Services. This provides a method of identifying that address and that phone number. Whenever a call is made from that address, the dispatcher will be made aware that this is a special service household so that he can alert the responding officers.

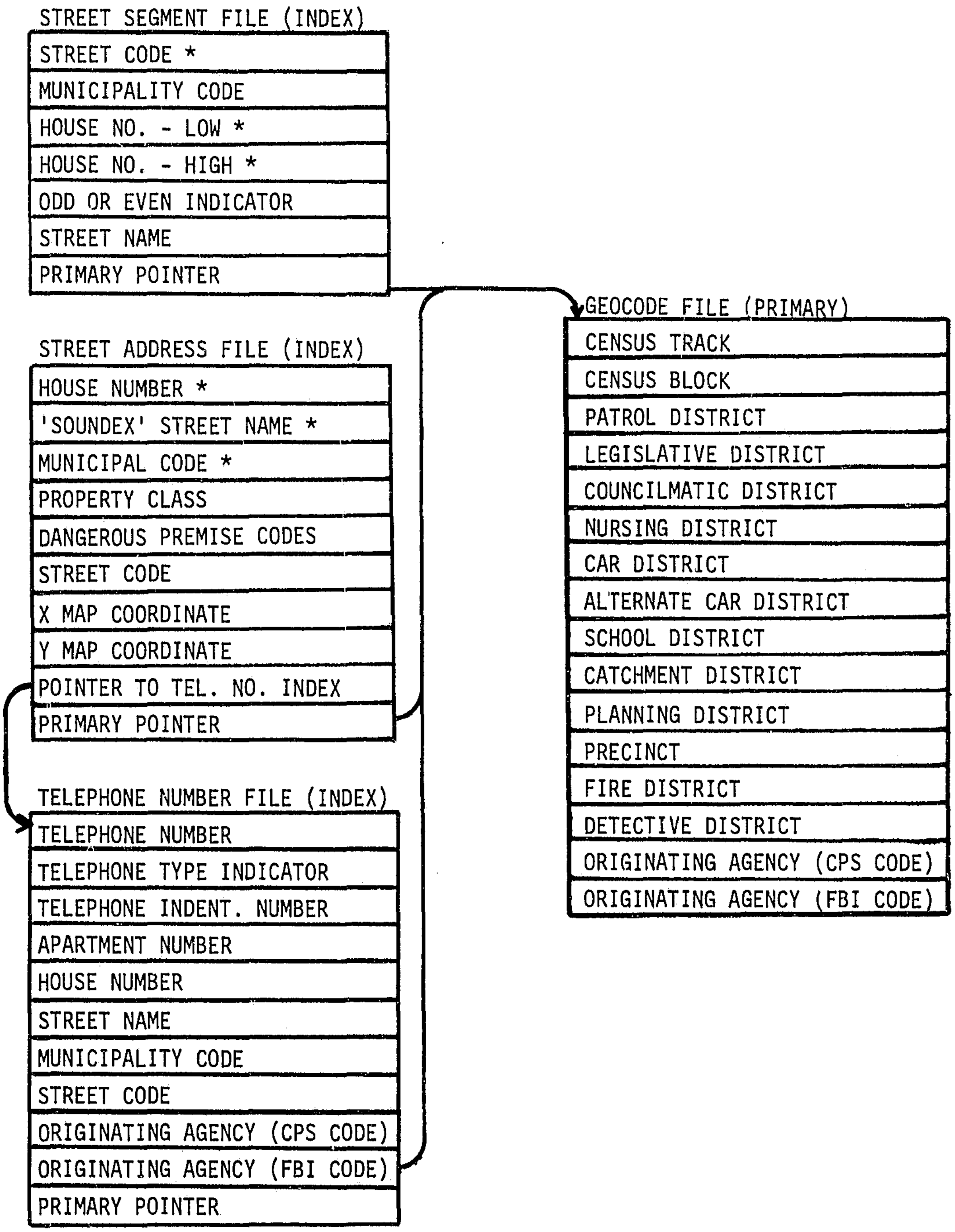
THE EMPIRE SYSTEM

Overview

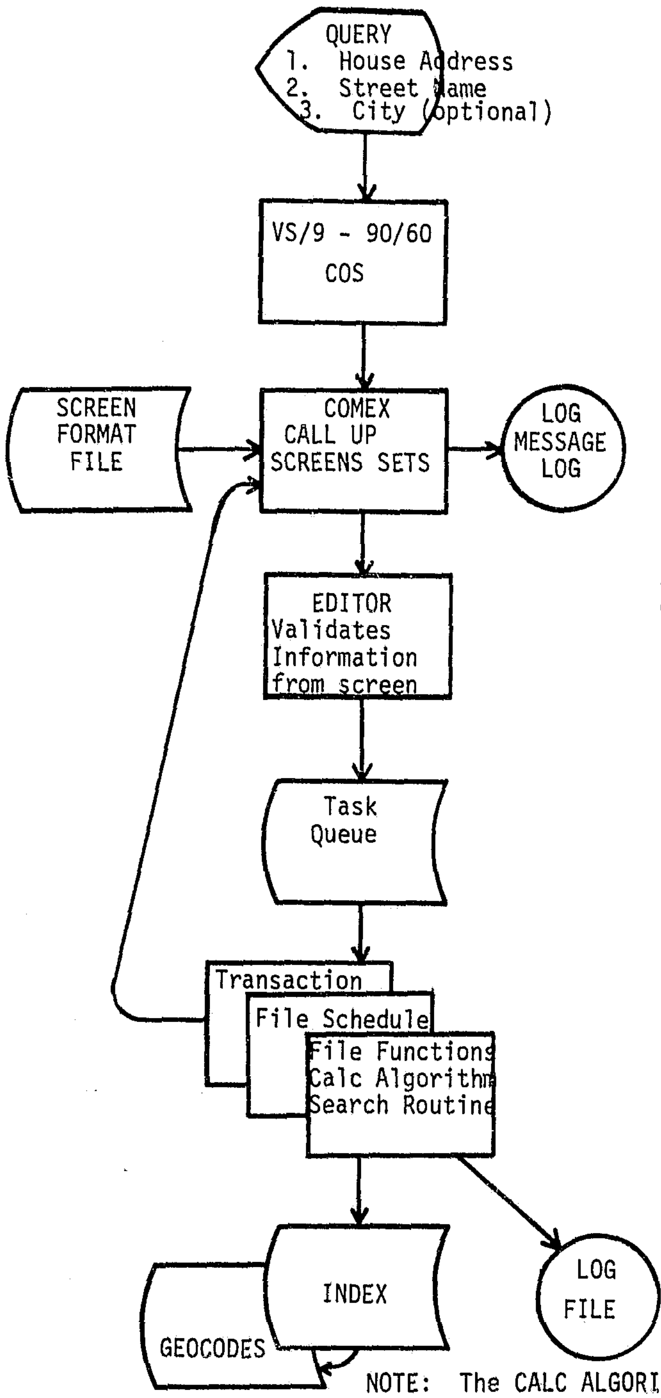


EMPIRE SYSTEM

GEOCODING DATA BASE



EXAMPLE OF QUERY OF GEOCODE DATA BASE BY ADDRESS



NOTE: The EDITOR will reject the query if house number is not numeric, it will SOUNDEX the street name, and if a city is present it will search the table for the corresponding locality code.

Log updates (Additions, modifications and deletions).

NOTE: The CALC ALGORITHM converts the SOUNDEX street name to a block number, that block is then read. The SEARCH routine searches thru the records on the block and send back to the screen those that have a match on house numbers, a close match on street and an exact number on locality (if present).

<u>Geocode Primary File.</u> This is strictly a reference file accessible through one of the three index files. On this file we carry census information, agency districts, political information, etc. as follows:

1. Census tract and block - This is as defined by the Census Bureau for the 1980 Census. We currently produce general and specific crime reports by these areas.

2. Patrol District - This field is made available for rural agencies to subdivide the census block.

3. Legislative and councilmatic districts are included to provide the capability of special request reports.

4. Nursing districts, school districts, catchment (mental health) districts and planning districts are used by other county/city agencies. We carry these codes to provide these agencies with street segment reference lists or any other requirements they may have.

5. Car districts and alternate cars are used by the system to assist the dispatcher in assigning cars to the needed locations.

6. Precinct is, at this time, used only by Buffalo. At present, there are 14, but precincts are not limited to any number.

7. Fire district - Currently this field has a very limited use but it is designed to aid the planned CAD system.

8. Agency codes are used by the dispatcher to alert the responsible agency for that activity by existing systems for reporting purposes.

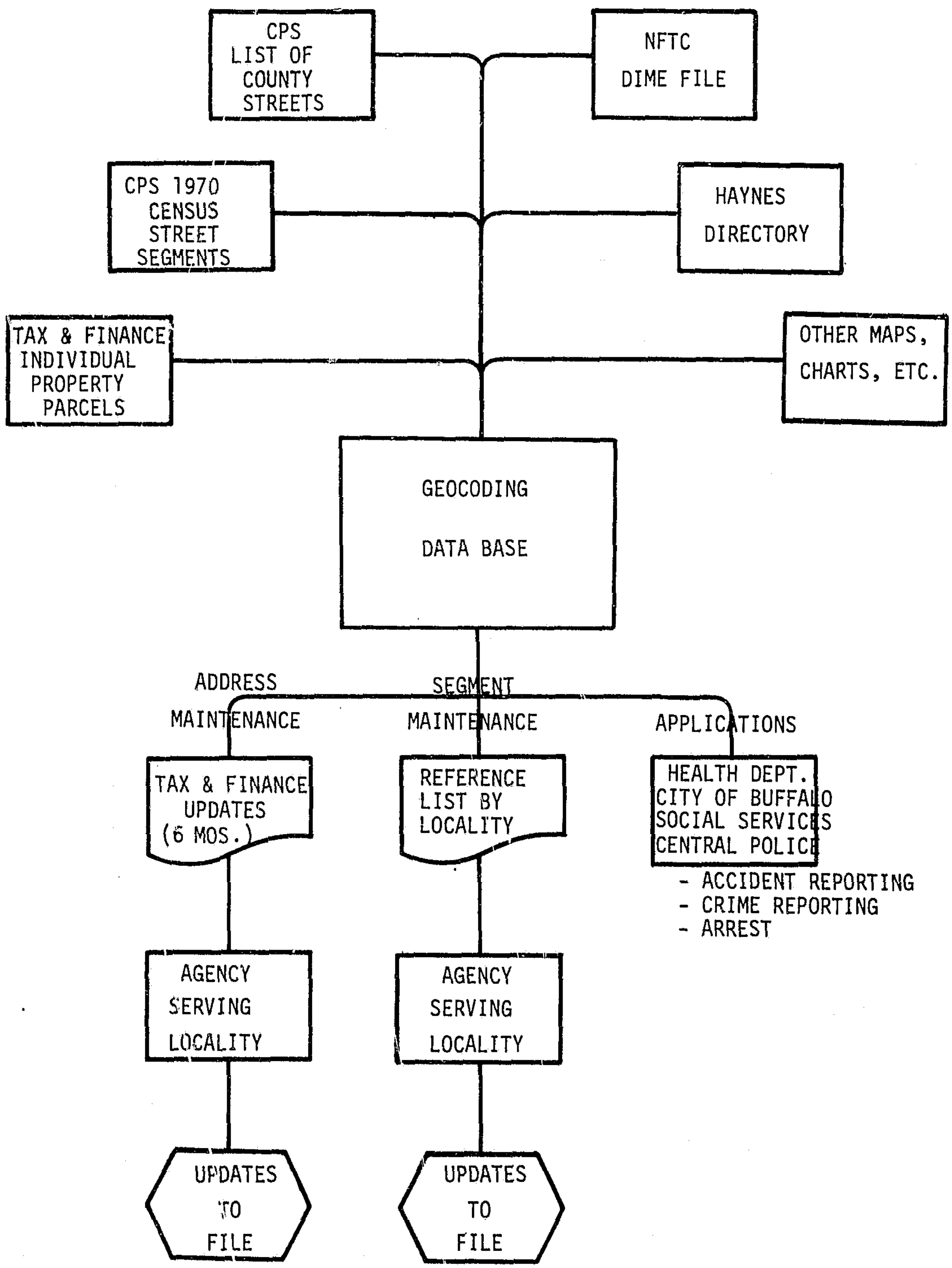
<u>Geocoding Maintenance</u>

The Street Segment Index File was made available by NFTC (Niagara Frontier Transportation Committee), who coded the area under a grant from the United States Bureau of the Census. The list of street segments for each jurisdiction was sent to the responsible agencies of planning unit where the geocodes were added and streets were verified.

Whenever a change is made or a new street is registered with the Erie County Planning Department, that change will be sent to the police agency servicing that area for adding the appropriate geocodes for their community files. This method will assure that the file will be continually up-to-date.

The Street Address Index File was made available by the Erie County Tax and Finance Department, which maintains a record for every piece of property in the county (approximately 315,000). This department will continue furnishing additions, deletion and modifications on a periodic basis. These modifications will be sent to the police agency servicing that area for verification and adding the appropriate geocodes to the file. (See Overview of Geocoding, p. 46.)

OVERVIEW OF GEOCODING



Space Allocation

FILE	RECORD SIZE	NO. OF RECORDS	NO. OF CHARACTERS	NO. OF CYLINDERS
Primary Record	47	60,000	2,820,000	18
Address Index	41	315,000	12,915,000	80
Street Code Index	44	60,000	2,640,000	18
Telephone Number Index	80	12,000	960,000	6

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MAINTENANCE OF GEO-BASE FILES

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MAJOR MAINTENANCE FUNCTIONS

The maintenance of a geographic base file (GBF) consists of three interrelated major functions categorized as follows:

1. Manual maintenance
2. Automated maintenance
3. System enhancements

The scope of the specific maintenance task will determine the necessity for function interrelation and integration. The functions are summarily defined according to the following criteria:

A. Manual Maintenance

Periodic verification requires the visual scanning of the computer file and comparisons of the data with information sources to include:

1. certified street maps of recent vintage
2. recent address directories
3. customized police district and beat maps

By use of a well-defined schedule for verification and maintenance, the file integrity can be virtually guaranteed.

B. Automated Maintenance

The logical extension of the manual maintenance function is the capability to automatically update the file. These programs can be used to change, add or delete records on the file. Because of the capabilities of these programs, it is essential that the software be designed in such fashion that editing and verification routines are sufficiently complex and comprehensive so as to preclude the possibility of erroneous substitution or modification of existing records.

C. System Enhancements

This function is substantially different from the previous because it implies that a developmental process will occur as part of the maintenance task. Clearly, the demand for new applications, expanded services or access limitations will rise as the system grows. To a large degree, this function mandates that the traditional steps in systems analysis and design be employed. Specified areas that must be addressed include:

1. Preliminary Investigation

   - Statement of the problem
   - Potential for improvement of services
   - Review of current system

2. Detailed Analysis

   - Determine user requirements
   - Develop alternatives

3. Systems Design

4. Systems Development

   - Testing
   - Scheduling
   - Documentation

5. Implementation

   - Operator training
   - Procedures
   - Evaluation

While not all enhancements will require that each of these steps be detailed, those that will substantially impact the operations of other systems must be thoroughly considered. Consequently, it is this last maintenance function that will require the most extensive analysis and the most dedicated personnel services. To attempt to utilize the manual and automated maintenance functions as a "band-aid" to serious system deficiencies will, in the final analysis, prove that design is the key to the entire GBF maintenance process.

DATA COLLECTION

The GBF maintenance function is keyed to the availability and accuracy of source data used to support, modify or expand the file. While small systems may require only limited modifications, larger applications may have more difficult data control problems. This section will deal with the potential sources of geographic base information in detail. However, there are three major elements in GBF data collection that should be considered:

A. Accuracy

Since most attempts at collecting geographic information are not undertaken solely for that purpose (especially with outside agencies), it is critical that the information be accurate. Verification of the data can be accomplished by the intervention of some very basic control principles. Summarily, they can be outlined as follows:

- How old is the data?
- What other applications is it used for?
- Was the information verified scientifically?
- What were the goals of the "collectors"?

Basically, any information that is of recent vintage, has been scientifically tested and verified, and was captured in a meaningful format and sequence may be worthy of analysis and transfer as source data for a revised GBF system or as a maintenance resource. Often, outside data may be successfully utilized as a test of the accuracy of an existing file.

B. Comprehensive

Since "sampling" is often used in lieu of a complete data collection process, it is critical that summary GBF information obtained from outside sources be comprehensive for the particular area. This area definition may act as a test module for a particular GBF application that might not otherwise be possible due to time and resource limitations. For example, special sections of many cities have been targeted as focal areas for research. That research often involves the collection of substantial amounts of geographic information. Consequently, the enhancement possibilities available on a modular approach may prove worthwhile as an experimental endeavor. The fact that source data may not be citywide is not as critical as the need for a solid definition of the geographic area for which the information exists.

C. Compatibility

Any data collection process that is potentially compatible to a GBF should be structured in such fashion that assists in the conversion to a medium that is machine readable. The overwhelming majority of geographic information collection efforts have used a computer to assist in the processing of the results. While many of these efforts will contain a substantial amount of data that is not relevant to the GBF enhancement, the time spent on selecting the "appropriate" information will be cost effective when compared to an independent collection effort.

POTENTIAL SOURCES OF GBF DATA

A. Internal

The particular user is often in the best position to provide additional geographic information for the file. The organization is also in the best position for detection of errors in the existing file. While this process is generally informal, it is essential that lines of communication be established between the user and the personnel assigned to the GBF function.

Police organizations are undergoing a great deal of change that directly affects the maintenance function. With the introduction of such conceptual policing techniques as random patrol, deterrent runs, team policing and no beat organization, the need for direct interaction between the data user and the processing facility becomes critical. Internal changes, such as the shifting of a district boundary, can substantially affect the integrity of the GBF system. One potential solution to this problem is the establishment of user committees that meet regularly to discuss maintenance items, as well as short and long-range enhancements.

B. Local Government Agencies

The use of a geo-base file is not exclusively limited to the police function. Many cities have implemented such universal systems which include a complete land base that records information on buildings, traffic patterns, tax assessments, licenses, permits, commercial and residential activity, etc. While such a comprehensive network is rather expensive, the potential utilization of such information may justify such an effort. In addition, much of the information that would exist in a centralized file may already exist in varying formats and mediums. These potential sources should be tapped for both the minor and the major maintenance functions. Clearly, the charge of such agencies as the Housing Department or Building Inspection lends itself to their being active users of GBF information. In addition, maps produced by city or regional engineering departments can serve as both a verification and new data collection tool.

C. Commerce Department

The Census Bureau of the Commerce Department has traditionally been the largest collection agency of GBF information. While the information that it collects is somewhat basic, it is an excellent resource for the development of new GBF systems.

D. Private Sector

The private sector is a major collector of GBF information on commercial buildings in particular, and on real estate in general. Some of the businesses involved in this collection process include:

- Dunn and Bradstreet
- City Directory publishers
- Marketing research firms
- University and college research

THE HARTFORD EXPERIENCE

The history of the development of a geographic base file in Hartford typifies the maintenance process outlined in the first section of this paper. In December 1973, the Hartford Police Department (HPD) initiated a project to develop a GBF for use with the NCR Century 50 computer. That task was divided into three major phases:

Phase One - Data Collection

Early in 1974, the Census Bureau of the Commerce Department provided a magnetic tape file of the city of Hartford streets and corresponding census tracts and blocks. An EBCDIC to ASCII conversion program was used to write this to the NCR disk pack. Concurrently, a program was developed to convert the street codes used by the Census Bureau to the codes used by the Hartford Police Department.

Phase Two - Data Verification and Maintenance

In June of the same year, the newly created GBF was visually scanned for manual verification of accuracy. This review detected several major inconsistencies in the

Census Bureau data. Errors consisted of missing streets, incomplete street number ranges, and, in some cases, inaccurate tract/block assignments. As a direct result of this process, a maintenance program was written to add, delete or change the GBF records. The NCR GBF was structured so that there was one record for each street segment. Each GBF record contained the following information:

1. parity - an indicator that denotes whether the street number is odd or even.

2. street code - the four-byte numeric identifier for every street in the file. Special street codes have been established for adjacent cities and buildings with large amounts of activity.

3. status flag - an indicator that denotes whether the record is active or inactive.

4. relative record number - the sequential number formerly used as the key to the file.

5. street name - the alphabetic description of each roadway in the file.

6. low street number - the low street number is the first numbered record on each street.

7. high street number - the high street number is the last numbered record on each street.

8. census tract - a scientifically aggregated group of blocks joined for the purposes of equalizing population levels.

9. census block - one real block of land within a census tract.

10. From node - an intersection descriptor that begins at one end of the street span.

11. To node - an intersection descriptor that ends at one of the street span.

This newly developed maintenance program sequentially accessed the GBF using as a unique record key, the relative record number developed during the IBM/NCR conversion.

Phase Three - Additional Maintenance and Applications

The final stage in the original GBF project resulted in the introduction of the Case Incident and Calls-for-Service batch load programs of a routine which verified input addresses for accuracy and assigned a tract and block to each accurate record. Programs to sort and print the file were also developed.

During 1975, with the advent of team policing in Hartford, the need to be able to assign a team policing district to Case Incident and Calls-for-Service records emerged. Because this was an experimental project and the district lines were not static, the decision was made to assign these districts from tracts and blocks on the data files rather than have them assigned directly from the GBF. A program was developed in which cards are input containing census tracts and blocks and a corresponding police district. An error check is made against a file containing all valid tracts and blocks and the data file is read. Each record is assigned a district based on the tract and block contained on that record and then rewritten. This gives us the ability to dynamically change district assignments on our data base and use it for a multitude of requests and purposes.

In early 1976, several events occurred which made modification of the GBF system imperative:

1. The City Council made a policy decision that all city departments would operate in a shared computer environment. As a result, the dedicated NCR 50 was replaced by an RJE terminal to a Burroughs 3700.

2. In addition, since police was the only department utilizing geocoding, we began receiving requests to share our GBF data base.

3. The development of an on-line Case Incident Reporting System was initiated and, as a result, access time to the GBF became a more pressing issue. Coding of street codes was eliminated.

At this point, because we were approaching a hardware conversion effort, the decision was also made to totally redesign the GBF system. The basic GBF records were changed to consist of one pseudo variable length (PVL) record for each street in the city. This PVL record consists of a header record and a variable number of trailer records (one for each street segment). (See Data Record Example and Physical Record Layout. pp. 55-56.)

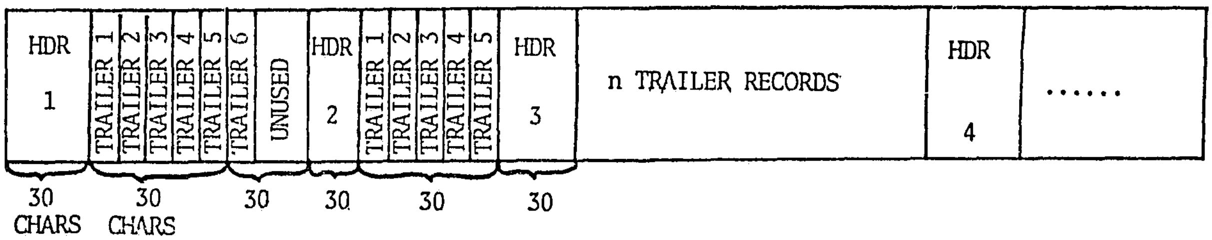
The basic file design allows for random reading, using either street code or street name as accessing keys. The actual key is developed by first searching a rough table which contains relative record pointers to all of the fine tables in the file. The keys to the fine table entries are the highest street name or street code contained in that fine table. The next step is a search of a fine table which contains one entry for each street name/street code contained in the file. The appropriate fine table entry will point to the relative record number and the relative position within that physical record that the header record of the desired street resides. (See GBF Physical File Structure, p. 56.)

In the event that no match is found in the fine table, a search is made of an exception table. This table was originally created because when the file is in sequence by street name, it is not totally in sequence by street code, and some valid street codes would have fallen through in error on a search of the rough and fine tables.

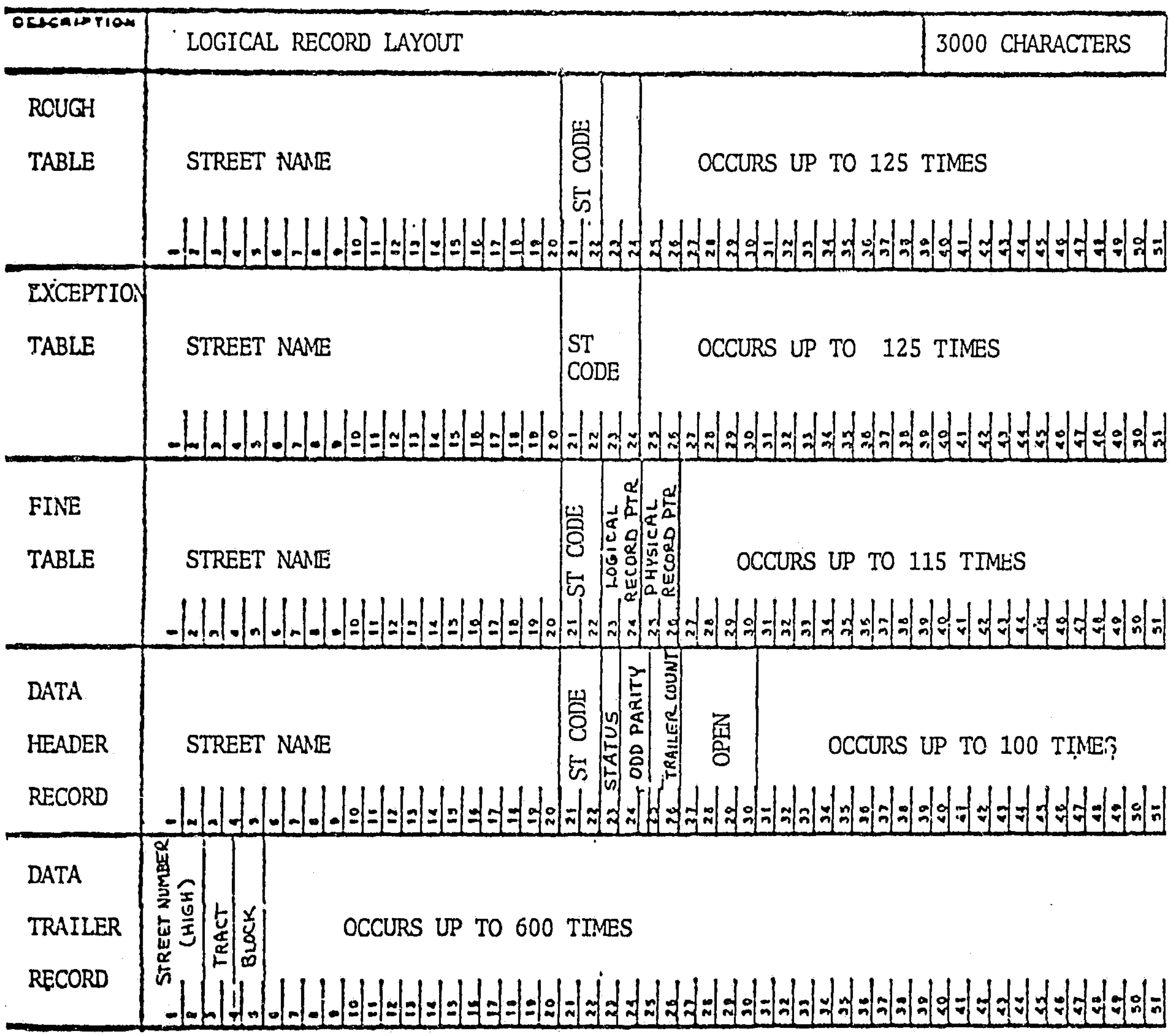
As we began to input data records that contained street names rather than street codes, the need for some flexibility in the spelling of these names emerged and the exception table usage was expanded to that of a misspelling and abbreviation table also. We tried to accommodate the needs of other city departments by incorporating all of the file descriptions, working storage entries and procedure division statements necessary to access the GBF into copy libraries so that they could easily insert them into their programs and use them much the same as one would use a subroutine. (Burroughs does not provide its users with the option of using subroutines.)

Data Record Example

3000 Characters



GBF Physical Record Layout



GBF Physical File Structure

RECORD # 1	ROUGH TABLE
# 2	EXCEPTION TABLE
# 3	DATA RECORD
.	"
.	"
# n	FINE TABLE
# n + 1	DATA RECORD
.	"
.	"
# n + m	FINE TABLE
	EXCEPTION TABLE
	EOF

GBF Sample Output

0005	*	0017	ACTON ST	1	0001	0069	5013	105	0003	0772
0005	*	0018	ACTON ST	0	0002	0070	5013	101	0003	0772
0010	*	0019	ADAMS ST	1	0001	0085	5037	204	0019	0011
0010	*	0021	ADAMS ST	1	0087	0199	5037	105	0011	0003
0010	*	0020	ADAMS ST	0	0002	0086	5037	205	0019	0011
0010	*	0022	ADAMS ST	0	0088	0198	5037	104	0011	0003
0015	*	0023	ADDISON ST	1	0001	0049	5011	109	0019	0011
0015	*	0024	ADDISON ST	0	0002	0050	5011	108	0019	0011
0020	*	0025	ADELAIDE ST	1	0001	0075	5024	105	0746	0002
0020	*	0027	ADELAIDE ST	1	0077	0145	5024	104	0002	0001
0020	*	0029	ADELAIDE ST	1	0147	0215	5024	104	0001	0720
0020	*	0031	ADELAIDE ST	1	0217	0247	5023	102	0720	0748
0020	*	0026	ADELAIDE ST	0	0002	0076	5024	101	0746	0002
0020	*	0028	ADELAIDE ST	0	0078	0102	5024	102	0002	0001
0020	*	0030	ADELAIDE ST	0	0104	0216	5024	103	0001	0720
0020	*	0032	ADELAIDE ST	0	0218	0248	5023	101	0720	0748
0021	*	0033	ADMIRAL ST	1	0001	0039	5046	104	0808	0038
0021	*	0035	ADMIRAL ST	1	0041	0081	5045	104	0038	0037
0021	*	0034	ADMIRAL ST	0	0002	0026	5046	104	0808	0038
0021	*	0036	ADMIRAL ST	0	0028	0082	5046	104	0038	0037
0025	*	0037	AFFLECK ST	1	0001	0033	5028	201	0899	0898
0025	*	0039	AFFLECK ST	1	0035	0067	5028	201	0898	0013
0025	*	0041	AFFLECK ST	1	0069	0101	5028	201	0013	0011
0025	*	0043	AFFLECK ST	1	0103	0137	5028	201	0011	0003
0025	*	0045	AFFLECK ST	1	0139	0211	5028	203	0003	0934
0025	*	0038	AFFLECK ST	0	0002	0034	5027	102	0899	0898
0025	*	0040	AFFLECK ST	0	0036	0072	5028	109	0898	0013
0025	*	0042	AFFLECK ST	0	0074	0108	5028	106	0013	0011
0025	*	0044	AFFLECK ST	0	0110	0138	5028	105	0011	0003
0025	*	0046	AFFLECK ST	0	0140	0212	5028	204	0003	0934

This whole modification effort brought about a need for a very different type of maintenance program from the original one, in which the GBF was sequentially accessed, a unique relative record number matched and the change made. We now had to consider the fact that any change could result in a change to the rough table, the fine table, or the exception table, as well as the actual data record.

Maintenance Program Narrative

The Hartford Police Department GBF maintenance program was designed to create the new GBF as well as to make changes to it. A sequential GBF which contains the same information as the original HPD GBF is stored on a disk pack. This file is used solely during the maintenance procedure. It is read in, the updates are made to it and the new random access rough table, fine tables, exception (misspelling) tables, and data records are created. (See Flowchart, p. 58.)

The maintenance program performs several functional options:

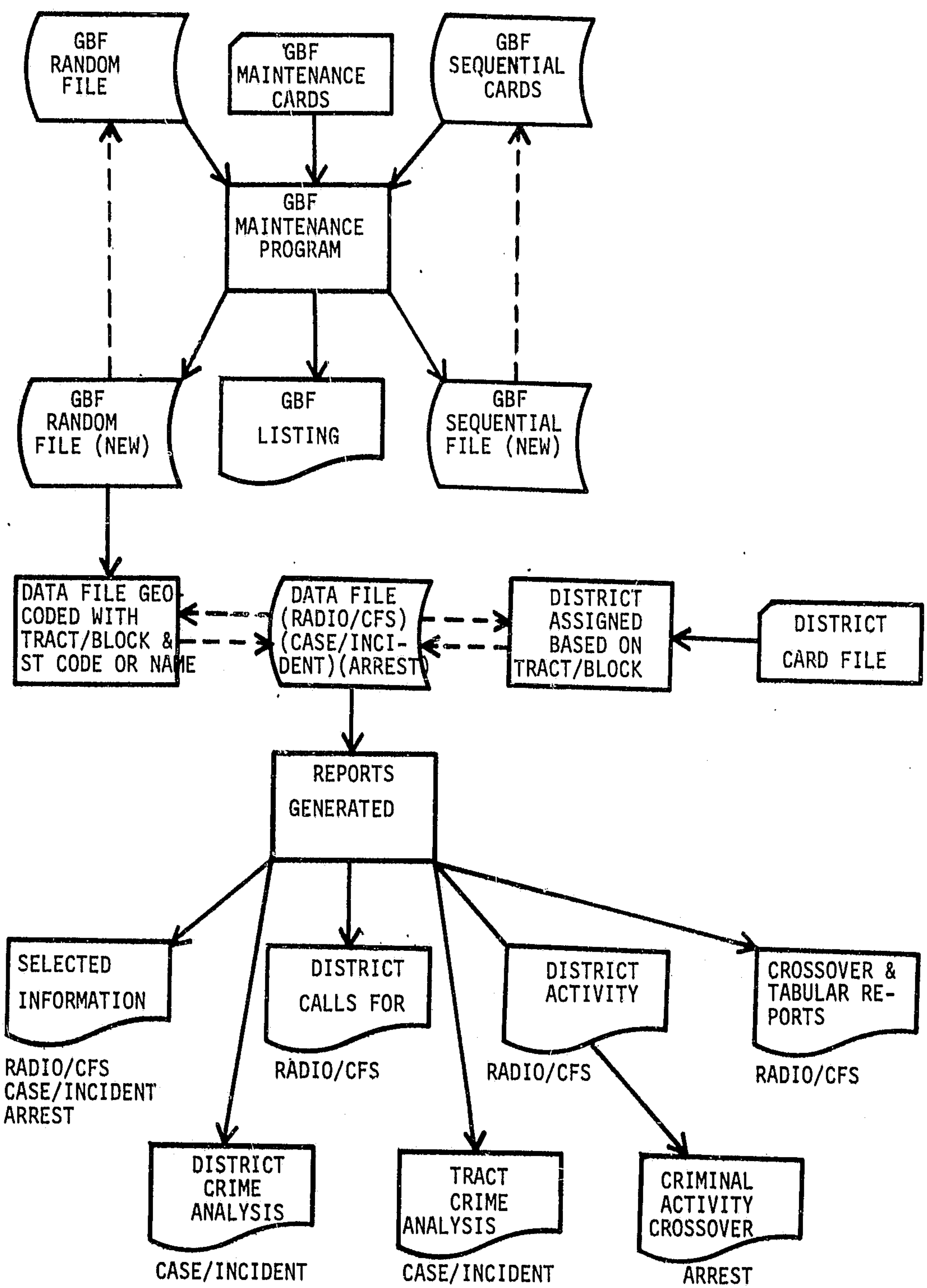
1. The sequential master file is sorted in ascending sequence by street name, odd/even parity and segment high street number.
2. The change card input file is sorted in ascending sequence by street name, odd/even parity and segment high street number.
3. The sequential master is changed as dictated by the maintenance card input.
4. A new sequential master file is created if changes are being applied to the existing sequential master file.
5. The random disk file containing the rough table, fine tables, exception/misspelling tables and data records is generated.
6. Printed output in the form of a listing of all records on the sequential master is generated. (See sample output, p. 56.)

The functions to be performed are dictated by switches that are set through the use of a value statement in the execute control card. Several types of GBF maintenance functions can be accomplished by this program:

1. Basic street segment records can be added.
2. Any element on a street segment record can be changed.
3. Basic street segment records can be deleted.
4. Street name changes can be made.
5. Additions can be made to the misspelling/exception table.

Changes which precipitate additions or deletions to the sequential master file cause major adjustments to the random file. For example, an added street will cause the addition of a header record and multiple trailer records, and the odd trailer pointer must be set to indicate where, in the trailer records, the first odd street segment resides. All of the data records following this street are pushed down, the fine table and the rough table logical and physical record pointers are adjusted from this street on.

GBF Maintenance Process



SUMMARY

The maintenance function can be summarized as those transactions which are necessary to maintain the integrity, credibility and reliability of the geo-base file. Consequently, two major issues evolve from such a summary definition:

A. Administrative Priority

B. Personnel Requirement

A. Administrative Priority

The importance of the GBF in the systems department will, to a large measure, be determined by the number and priority of application programs which utilize the file. GBF systems which are low level and not extensively used will rate substantially lower priorities within the organization. The critical administrative issue, however, rests with the priority for scheduling enhancements to the file in a logical and well-structured fashion. The impact of a solid GBF on a systems plan should rate a top consideration for the data processing manager.

B. Personnel Requirements

GBF maintenance is keyed to accuracy and file integrity. It is essential that one individual with a thorough understanding of the operations of the GBF be responsible for this process. The specific tasks assigned to this individual should include:

1. coordination of the modifications

2. quality control over the inputs

3. verification of the proof listings

While these tasks will not require the full-time attention of a single individual in most GBF systems, large networks may require such an assignment.

In conclusion, the priority which management places on the GBF maintenance function will ultimately determine its relative success or failure.

NEW YORK CITY POLICE DEPARTMENT GEOGRAPHIC DATA BASE

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OVERVIEW OF THE NEW YORK CITY POLICE DEPARTMENT

The New York City Police Department is comprised of over 31,000 members, 25,000 uniformed personnel and 6,000 civilians. The patrol force utilizes more than 2,000 marked radio cars to handle calls for service in the five boroughs. The patrol force is divided into 73 police precincts. The New York City Police Department serves 7,500,000 people and patrols 320 square miles and 6204 street miles.

The Communications Division directs the patrol force by dispatching radio cars to locations of calls for service. The Communications Division, prior to 1967, operated on a boroughwide basis, i.e., a Communications Division in each borough. In 1967, these boroughwide commands were centralized with the institution of the 911 Emergency number. In 1968, a computer assisted dispatch system, SPRINT (Special Police Radio Inquiry Network) was implemented (see SPRINT Overview, p. 62).

SPRINT became the first real-time system utilized by the New York City Police Department. Prior to SPRINT, the data processing consisted of batch type functions (Arrest and Complaints Statistics, Uniform Crime Report data, etc.). Now there are several systems which operate in a real-time mode. Some of these are the fingerprint search, search of wanted persons or warrants, inquiry to other files such as New York State Police, National Crime Information Center, State Department of Criminal Justice, Department of Motor Vehicles, etc.

DEFINITION OF TERMS

In order to discuss a system that may be unfamiliar to users of other data processing systems, certain terms which may or may not be unique to the host system should be defined. Some terms used by the New York City Police Department in referring to the geographical data base files are as follows:

Acme Number - a sequential number generated by off-line programs to control processing of the data base.

Alias Name File - contains alternate street names for those streets that are referred to by more than one name; e.g., Avenue of the Americas and 6th Ave.

Blockfront - one side of a city block from the low intersecting street to the high intersecting street.

Coterminality - a legally mandated project to change the make-up of the city into fifty coterminous districts.

Dispatcher - terminal operator with the responsibility for dispatching radio cars.

Fire Alarm Box File - contains the numbers of all the fire boxes in the city with a pointer to its appropriate Street Name File entry.

Internal SPRINT Format - Street names in the On-Line System are truncated to a maximum length of ten (10) bytes, alphanumeric, left-justified. Street name prefix and suffix are one (1) byte each and endings are four (4) bytes, also alphanumeric. House numbers are four (4) bytes in packed decimal format. Hyphens, when appearing in an address, are converted into a code "7" and placed in front of the house number (e.g., 29-55 becomes 7029055, 133-05 becomes 7133005). The entire field is then compressed into four bytes, packed decimal.

Location File - contains the main data base records having all the necessary jurisdictional data pertaining to each blockfront.

N.Y. Comprehensive Addressing Index Tape - the off-line street name file. This tape is updated with any new data and is used to create a pilot tape for loading the on-line system.

Ordinal Number - a member associated with each record of all on-line files. By providing an on-line program (File Address Computer Program) with this ordinal number, the file address for the record can be computed.

Place Name File - contains the names of locations that might be referred to by a caller by its name; e.g., Empire File record whose address the place name is located on.

Resource - a resource in the SPRINT system can be any one of the following units; sector car, scooter, footman, sergeant's car, lieutenant's car, highway patrol car, emergency service car, police launch, police helicopter, special car.

Similar Name File - contains the street names that create the most input problems (misspellings) for the terminal operators.

Street Name File - contains all street names, misspellings and aliases with pointers to the beginning of the individual street in the street index file.

Turrent Operator or ACD Operator - receives calls for service from the public and initiates incidents by inputting a message into a computer terminal.

SPRINT OVERVIEW

SPRINT is the heart of the New York City Police Department's computer assisted dispatch system. The system utilizes a sophisticated computer-driven telecommunications network to handle the massive volume of calls for police assistance that pour into the Police Department's Communications Division every day.

The Communications Division receives between 15,000 and 30,000 calls-for-service per day. From these calls, 6,000 to 15,000 radio runs are broadcast to police units. At busy times of the day, the SPRINT system may handle as many as 2,000 calls per hour. Some of these calls are complaints of crimes. There are 1,250,000 crime complaints per year. In order to maintain control and integrity, each crime complaint requires a Central Complaint Number generated by the system, a Complaint Report Number entered by field commands and a Complaint Report subsequently forwarded by the field.

How does the SPRINT System work?

Incoming calls to the Police Department are intercepted by an Automatic Call Distributer (ACD), which automatically channels a call to an available operator. There are currently 68 ACD operators. The ACD operator determines the caller's location, the nature of his complaint, and its incidental details. Utilizing a combination of coded messages and regularly spelled words, the information is fed into a computer terminal. This device is the ACD operator's link with the SPRINT computer and the radio dispatcher who will ultimately assign a patrol unit to investigate the complaint. The message is edited initially. If any errors are encountered, the ACD operator will be notified and he will be allowed to correct the message. SPRINT then builds an output display for the radio dispatcher. This is done by gathering system data on the location, resource availability and any other pertinent information. From the display, the radio dispatcher will assign a resource. While on assignment, the system will monitor the time the officer is on the job and will notify the dispatcher if a time limit is exceeded. When the assignment is completed, the dispatcher will enter a final disposition, thus making the resource available for the next assignment. It should be noted at this time that the SPRINT system will allow multiple assignments; that is, more than one job may be assigned to a resource and/or more than one resource may be assigned to a job.

To allow for the volume and variety of messages received, and considering future expansion of the system, the New York Police Department selected the Airlines Control Program (ACP) as the nucleus of its SPRINT system. ACP is a transaction-oriented teleprocessing system with the ability to handle simultaneous input from large clusters of terminals at a high rate of speed. ACP is able to handle large data bases without significantly impairing the speed of response time. The SPRINT system's response time (time from initial input of the message until the display is formatted on the dispatcher's terminal) is less than three (3) seconds.

The SPRINT system currently includes an IBM 370/158 (another IBM 370/158 is used for back-up and system development purposes), two IBM 3705 Communication Controllers, a series of data modems, splitters and eliminators, a series of IBM 2948 concentrators (4), and Raytheon concentrators (5). These are linked directly to the Communications Division's terminals (29 Raytheon split screens, 100 IBM 2915 CRTs, 25 1980 printers and 7 1977 terminals) and indirectly through the Action front end, a mini-computer, to precints and outside agencies (Housing Authority, Health and Hospital Administration, Fire Department, etc.). The files reside on a bank of 3330 disk drives (7 modules). We also have four tape drives to handle logging of transactions and system errors. The ACP system includes approximately 700 real-time program modules in 1055 byte segments. All files residing on disk are duplicated on a different disk pack.

NEW YORK POLICE DEPARTMENT LOCATION DATA BASE

When the decision was made to go ahead on the SPRINT system, a task force was formed to analyze and design the needs of the New York City Police Department. A special Data Gathering Unit was formed to undertake the task. In a quest for data, other New York City agencies were queried. The City Planning Commission had tapes which contained most of the blockfronts in the city. These unedited tapes were the first step in the creation process. The tapes were printed and the printouts given to members of the unit who went out to the locations to check for accuracy. When the field work was completed, the task of gathering precinct maps and coding in the jurisdictional information commenced. Programs were written to add, delete, update and edit records. When the main file was complete, the auxiliary files were created.

Some of the problems encountered in generating the data base included odd and even house numbers on the same side of the street, house numbers that were fractional (e.g., 1/4, 1/2), streets that wrap around and intersect themselves, etc. These problems were eventually solved by a combined effort on the part of data base experts and programmers.

Design did not stop here. The methods of access had to be flexible and simple enough for the layman (operators) to handle. Input message formats were designed in order to create minimum error rate. Routines to aid the operators were designed; e.g., if an operator enters a wrong street name, the system will send a list of similar street names for him to choose from, thus eliminating the need to re-key the entire message.

In time, enhancements were added to this package. These include: notifications to outside agencies by flagging the appropriate data base record; indicating a hazardous or sensitive location by flagging the appropriate record; subdividing geographical areas to allow flexible reallocation of manpower on-line and faster response time by backup units.

The Location Data Base consists of four separate files:

	# of Records
BLOCK SIDE FILE	161,500
ALIAS FILE	7,050
PLACE NAME FILE	13,000
FIRE BOX FILE	30,000
TOTAL RECORDS	221,550

FILE CREATION

The Location Data Base Creation Package (LC) is the set of programs used to create the collection of files which make up the Location Data Base. These programs convert the New York City address information provided on input tapes into the files which are used by the On-Line Location Data Base Processing Package (LA). The files contain address information and jurisdictional information which has been converted to internal SPRINT format. The following list briefly describes the functions performed by the package:

Address Conversion - Here we must either convert directly or use a translation table to convert incoming information into internal SPRINT format.

Building Indices - Here we create the indices which will provide access information for each record in the Place Name and Street Name File.

Building the Street Name File - Here we create the file which will provide the name of every New York City street in internal SPRINT format and provide information for accessing records contained in the Location File.

Building the Location File - At this stage, we create the file which will contain jurisdictional information for each blockfront in New York City.

FILE ORGANIZATION

Street Name File

The Street Name File is an index to the Location File which contains data for street name recognition, street name prompting (when a name cannot be recognized), and house number verification. Each record in this file contains data for several street names: each name may be an actual street name or an alias for an actual name (an alternate name or a common misspelling of a name). (See flowchart p. 71.)

All messages with an address as input data require use of the Street Name File to find the detailed information in the Location File. There are actually five Street Name Files, one for each borough.

Type of Data:

a. Header
b. A standard 80 byte SPRINT header is used in each record.
c. Data Area

For each street contained in a record, there are two entries; a Name Entry and a Data Entry. The former contains the common data (fixed length), while the latter contains the individual data (variable length). All information for a particular street name is located in one record; i.e., never split between records. Name Entries are in alphabetical order, while Data Entries are located at the end of the record in reverse alphabetical order.

A Street Name File Record contains the following data areas:

a. Street Name Header - This contains basic information about the record which allows general routines to use the record. The four 1-byte fields are the header length (=4), name entry length (=22), name entry count, and a free byte. There is one Street Name Header per record.

b. Name Entry - The fields of this entry are the street name (formatted for ease of processing), a free byte, a control byte, a Similar Name List pointer, and pointer to the Data Entry associated with this Name Entry. The basic street name, which is truncated to 10 characters (padded with blanks on the right if necessary), is evenly divided into an upper (SNU) and lower (SNL) half. After these halves are one byte for the prefix (e.g., E, W), one byte for the suffix (e.g., N, S, X), and 4 bytes for the ending (e.g., St, Ave, Pkwy). A total of 22 bytes.

The control byte indicates whether or not the preceding and succeeding Name Entries have the same Street Name Upper (characters 1-5) and what type of street name is in this Name Entry (thereby defining the format of the associated Data Entry). For an alias entry, a bit is also set if the SNU of the actual name is the same as the SNU of the alias. The Similar Name List pointer is normally zero, but contains an entry number and record number (in the Similar Name List File) when a street name is in a Similar Name List. A 'similar name' list is a list of homonymous names. All names in a Similar Name List are presented to the terminal operator when a given street name cannot be uniquely identified, but is similar to a name in the List.

c. Data Entry - There are two types of Name Entries corresponding to the two types of street names (actual and alias) for which there are Name Entries. A Data Entry for an alias contains the lo-byte correct name of the street, and a Data Entry for an Actual Name contains information used to find a Location File record for a given address. This information consists of: (1) the count of Location File records for the street, (2) the ordinal number (in the borough's Location File) of the first Location File record for the street, (3) the (coded) highest house number on the street, and (4) the (coded) lowest house number on the street for each of the street's records in the location file.

Location File

This file is the lowest level of the SPRINT Location Data-Base. It contains police information for the individual blockfronts of all streets. The file is organized by borough. (See flowchart p.71.)

Type of Data:

a. Header
b. Standard SPRINT Header (8 bytes).
c. Data Area
d. Street Header Entry - These are 24-byte header entries which define the blockfront entries contained in each record.

Fields:

a. Blockfront Basic Street Name - 16-byte coded prefix, 1-byte coded suffix and 4-byte ending.

b. Blockfront Entry Count - Count of blockfront entries contained in this SPRINT record for this street name.

c. Header Entry Count - Number of header entries in this SPRINT record. This field is used only in the first header entry.

d. Blockfront Entry Pointer - Two-byte pointer to the first blockfront entry for this street name relative to byte zero of the Location File Record.

e. Flag Byte - If set to hexidecimal 'FF', indicates that additional blockfront entries for this street name are contained in next Location File Record.

Blockfront Entry - The 62-byte blockfront entry of a Location File Record contains the police information provided by the New York City Police Department for an even/odd blockfront. Included in this police information are the even and add side acme numbers, precinct numbers, sector numbers, divisions and ambulance codes.

Fields:

a. Low, Even and Odd House Number - Four-byte coded low address or mile marker, right-justified.

b. Low Intersecting Street Name - 16-byte street name composed of a 10-character truncated basic name, 1-byte coded prefix, 2-byte coded suffix and 4-character ending.

c. Flag Bytes - See Detailed Organization.

d. Precinct Number - Three-digit precinct number for the even and odd side of the blockfront.

e. Sector Number - Three-character sector number for the even and odd side of the blockfront.

f. Division - One-byte binary number giving the division of the odd and even side of the blockfront.

g. Ambulance District - Three-character ambulance code for the even and odd side of the blockfront.

h. Acme Number - Four-byte coded acme number. The acme number consists of a character borough code and three bytes in packed decimal.

Place Name File Data Specifications

The Place Name File which contains address information as: house number/street name type, intersection type, or actual name type for a given place name. The file is used when a place name is given in a message. The file supplies the address information which is to be used by other programs in the Location Data Base package. (See p. 74.)

Place Index Data Specification

The Place Index is an index to the Place Name File (which contains the location of places in house number of intersection format). The Index contains the first five characters of the first place name in each record of the file, giving an indexed - sequential file organization. Since there is a one-to-one relationship between entries in the Index and records in the file, the position of an entry will correspond to the ordinal number of a record. Hence a search of the Index will yield the ordinal number of the file record which contains the place name given in a message (if the place name is in the file).

Logically speaking, there is a separate Place Index for each borough; however, the records for the five indices are combined into one physical file.

Fire Alarm Box File

The Fire Alarm Box File is a file which contains address information for each fire alarm box in New York City. Each entry may contain actual address information or an indication that the fire alarm box number is unused. All messages with fire alarm box numbers as input data require use of the Fire Alarm Box File to find the address where that fire alarm box number is located. (See flowchart p. 74.)

Similar Name List File

This file is used for suggesting correct street names to a terminal operator when a given street name cannot be positively identified but is similar to one of more names on the file. The primary data are lists of homonymous street names with a borough. There are separate Similar Name List Files for each borough. (See flowchart p. 73.)

DATA BASE MAINTENANCE

The maintenance of the files that contain the SPRINT Data Base is a continuous task. New York City is a dynamic city, always changing, adding and deleting structures, seemingly overnight. In order to accommodate these changes, SPRINT data base personnel must know of the changes in advance. There are many ways that modifications in city geography are brought to the attention of the SPRINT Section. Those city agencies that have responsibilities to monitor changes notify the New York City Police Department when a change has been approved. Some of these agencies are the City Planning Commission, the Borough President's Office, the Fire Department and the Department of Buildings. We maintain close liaison with these agencies to prevent a change in city geography without a corresponding change in the SPRINT data base. A delay in responding to an incident due to an unknown or unrecorded change could mean the difference between life and death.

A frequent initiator of modification in the data base is feedback from our Communications Division. Because of the vast size of the data base, errors or omissions sometimes occur. When a ACD operator has difficulty entering a message and the data base is suspect, his supervisor will investigate and fill out a feedback report. This report is forwarded to the SPRINT Section which will investigate and determine the cause of the problem. Should the data base be in error, it must be updated to reflect the correction.

Last year, we modified our SPRINT Data Base files as follows:

		# of Changes
Block Side		10,000
Alias		350
Place Name		1,000
Fire Box		5,000
	Total Modifications	16,350

One type of change to the SPRINT data base can be a result of a legal mandate. For example, in 1976, a proposition was passed by the people of New York City calling for the redistricting of New York City into 50 coterminious districts. This means that the boundaries of almost every precinct in the city must change to accomodate these new areas of responsibility. This represents a tremendous task, estimated at 12 man-years. Another example of change due to mandate was the legalization of gambling in New York State. When gambling became legalized in New York, off-track betting parlors sprung up all over the city. Each of these parlors had to be put into the Place Name File with pointers to the blockfronts on which they are located.

Modifying the Data Base

Whether an update is a result of notification from another city agency, internal feedback or mandated by law, the data processing techniques used to make these changes remain the same. All data base changes are initially made off-line. The data base tape files are maintained by a special data gathering group whose sole responsibility is data base. The normal procedure for update is as follows:

1. Analyze reports requesting change.
2. Obtain maps of area in question.
3. Overlay new information on old maps.
4. Determine what Block Side Records in old area are now changed.
5. Obtain printout of area in question.
6. Analyze printed information and make corrections on coding sheets.

   Possible changes include:

   New Street Name
   New Address
   New High & Low Intersect Streets
   New Block Number
   New Police Info (Pct., Sector, Sub-sector, Scooter Post, Footpost AMB Zone)
   Similarly code changes are required on Alias, Place Name and Fire Box files.

7. Keypunching.
8. Verification of keypunching.
9. Update tape files.
10. Update write-off area and re-check changes.
11. Create new pilot tape for load onto SPRINT Development System.
12. Test new pilot on SPRINT Development System.
13. Load new pilot on-line (SPRINT).
14. Test new data on SPRINT live.

Sometimes, data base updates are of such magnitude that it is inefficent to use keypunch personnel. In those cases, special optical scanner forms are utilized. Changes are made by filling in areas that are devoted to jurisdictional data.

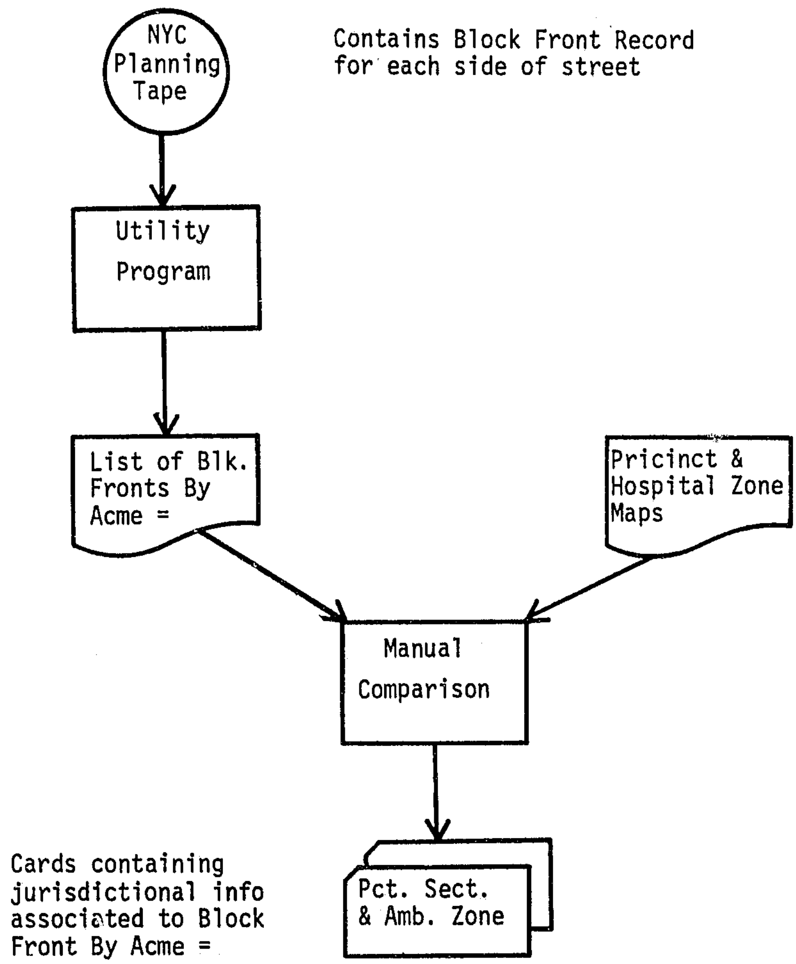
Hazardous/Sensitive Location File

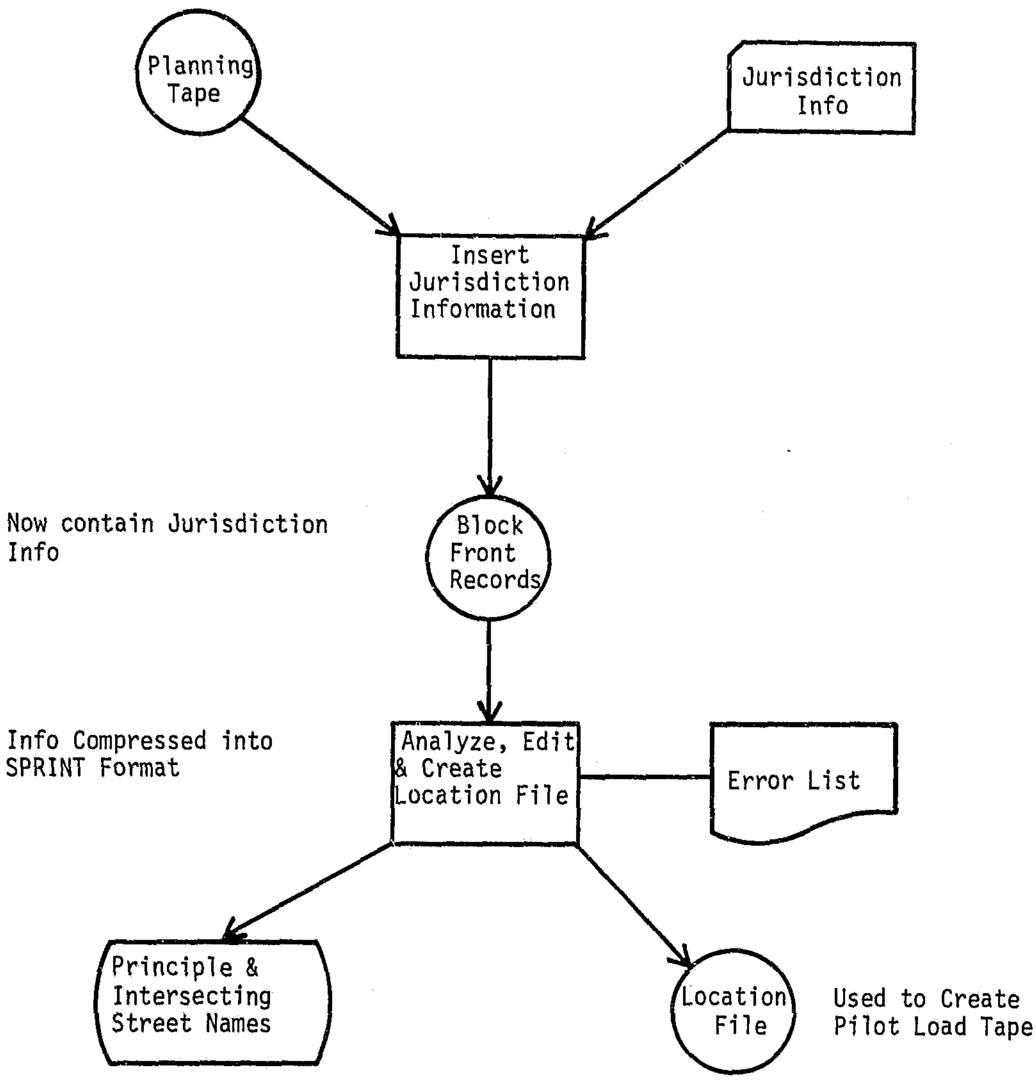
One of the features of the SPRINT system is the monitoring of hazardous or sensitive locations through the data base. In order to inform the patrol officer that the location he is responding to may be prone to volatile conditions, SPRINT displays a formatted message to the radio operator to be broadcast to the responding officer. SPRINT classifies these locations as hazardous (e.g., terrorist activities) or sensitive (e.g., foreign embassy).

When a location that can be classified as hazardous or sensitive becomes known to a precinct commander, he will notify the New York Police Department Operations Division. The Operations Division will investigate, and, if in agreement, will notify the SPRINT Section to add the location to the Hazardous/Sensitive File.

The Hazardous/Sensitive Location File is unlike the other data base files in that it is maintained strictly on-line. Records are added, deleted and/or changed through on-line function messages entered only by authorized personnel. The message entered will flag the blockfronts in the Location File that contain Hazardous/Sensitive Locations.

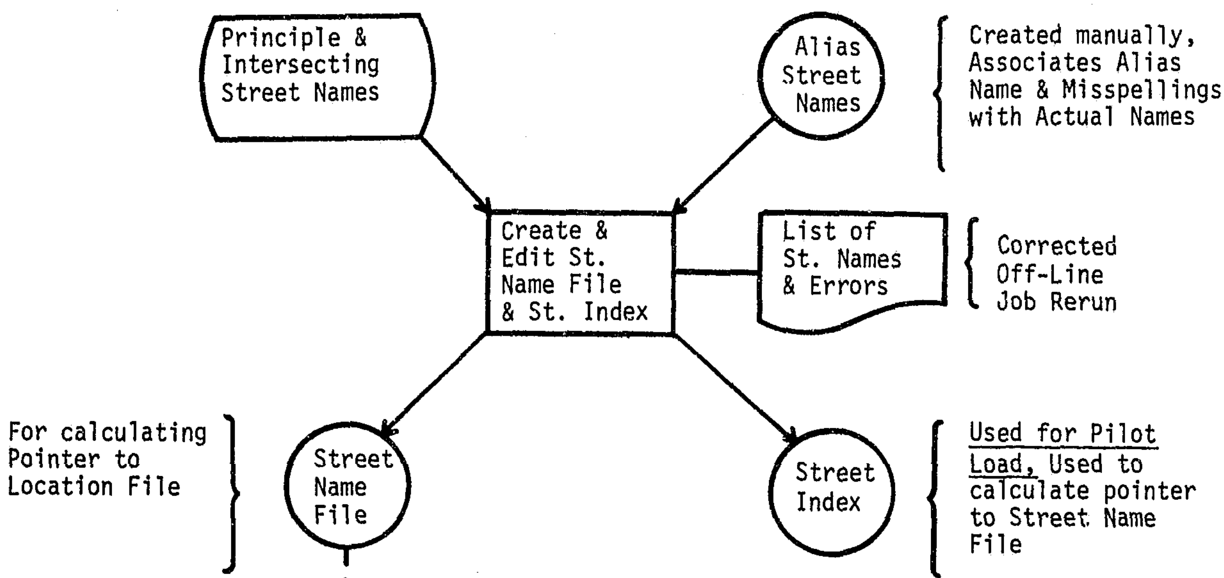
DATA BASE CREATION-LOCATION FILE (A)



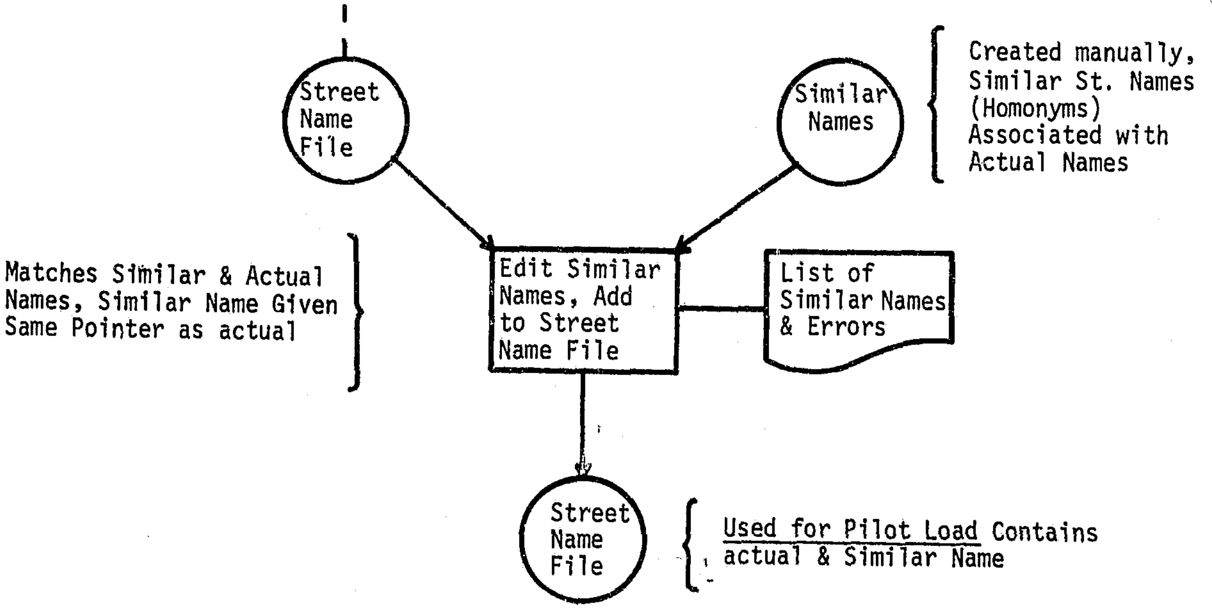

Planning Tape
Jurisdiction Info
Insert Jurisdiction Information
Now contain Jurisdiction Info
Block Front Records
Info Compressed into SPRINT Format
Analyze, Edit & Create Location File
Error List
Principle & Intersecting Street Names
Location File
Used to Create Pilot Load Tape

DATA BASE CREATION

Street Name & Index

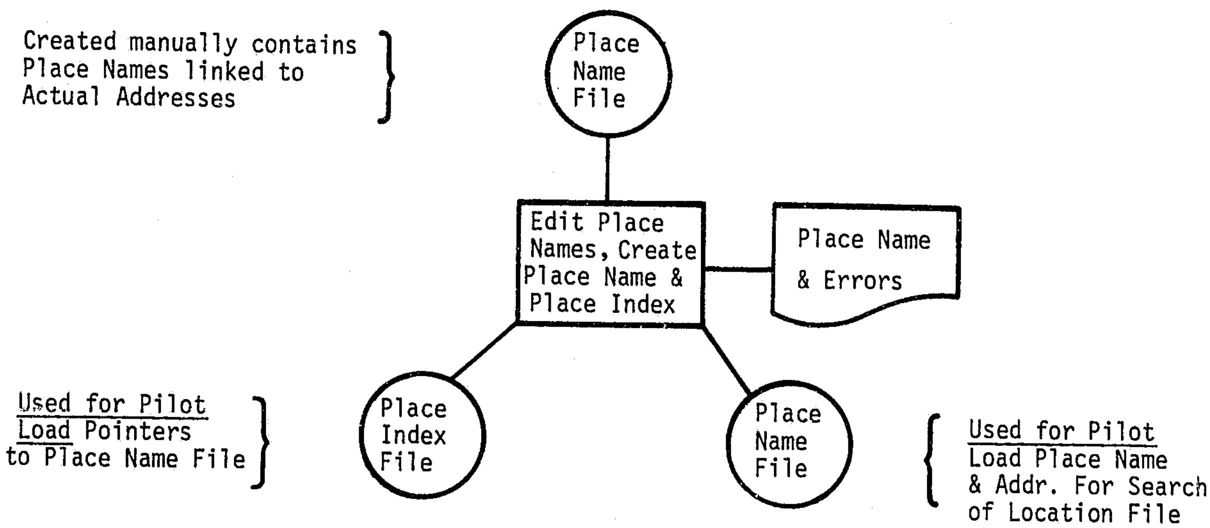


Alias Street Names

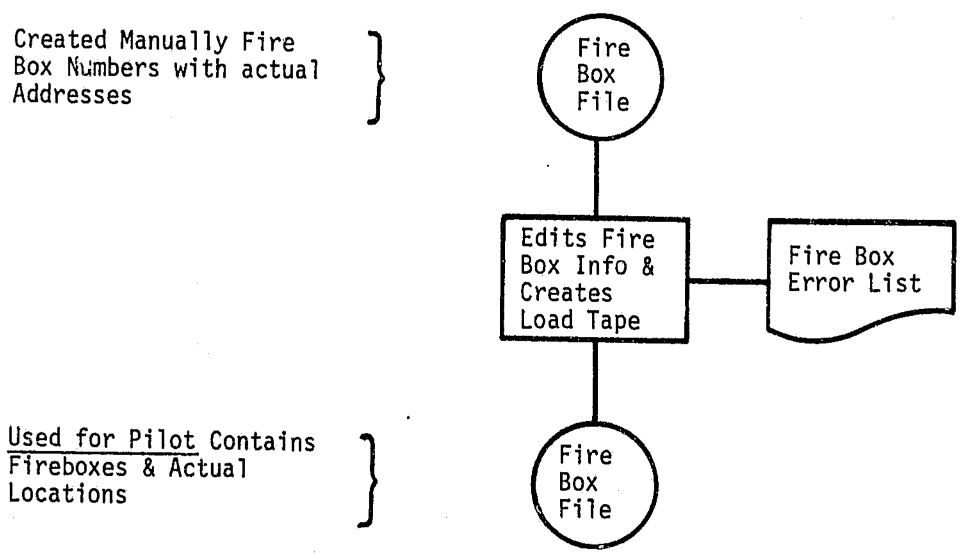


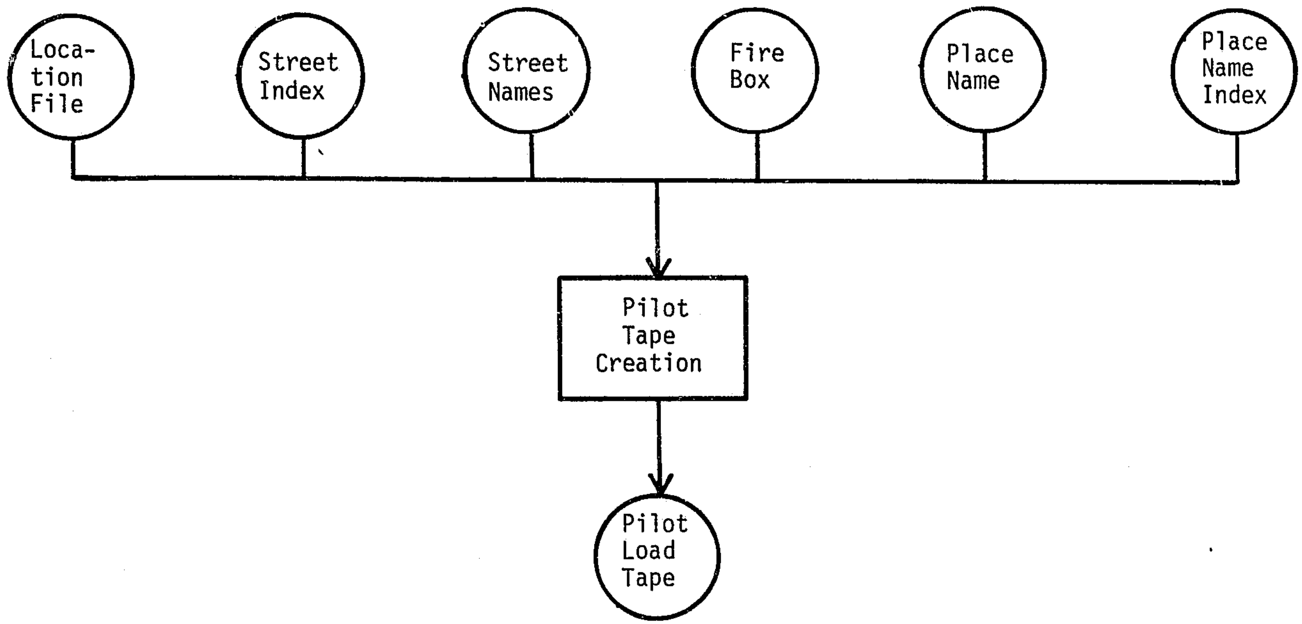
DATE BASE CREATION

Place Name



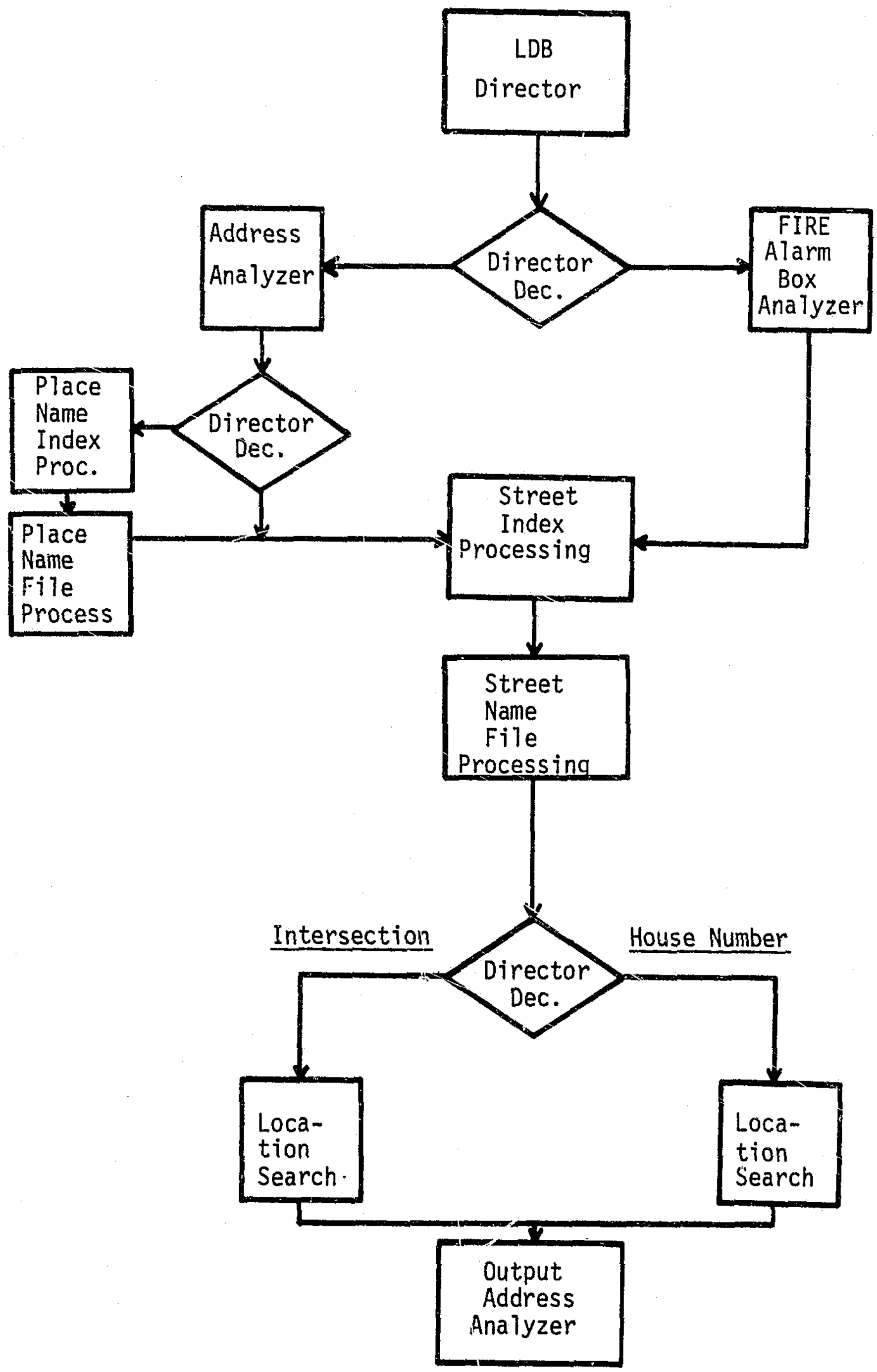
Fire Alarm Boxes

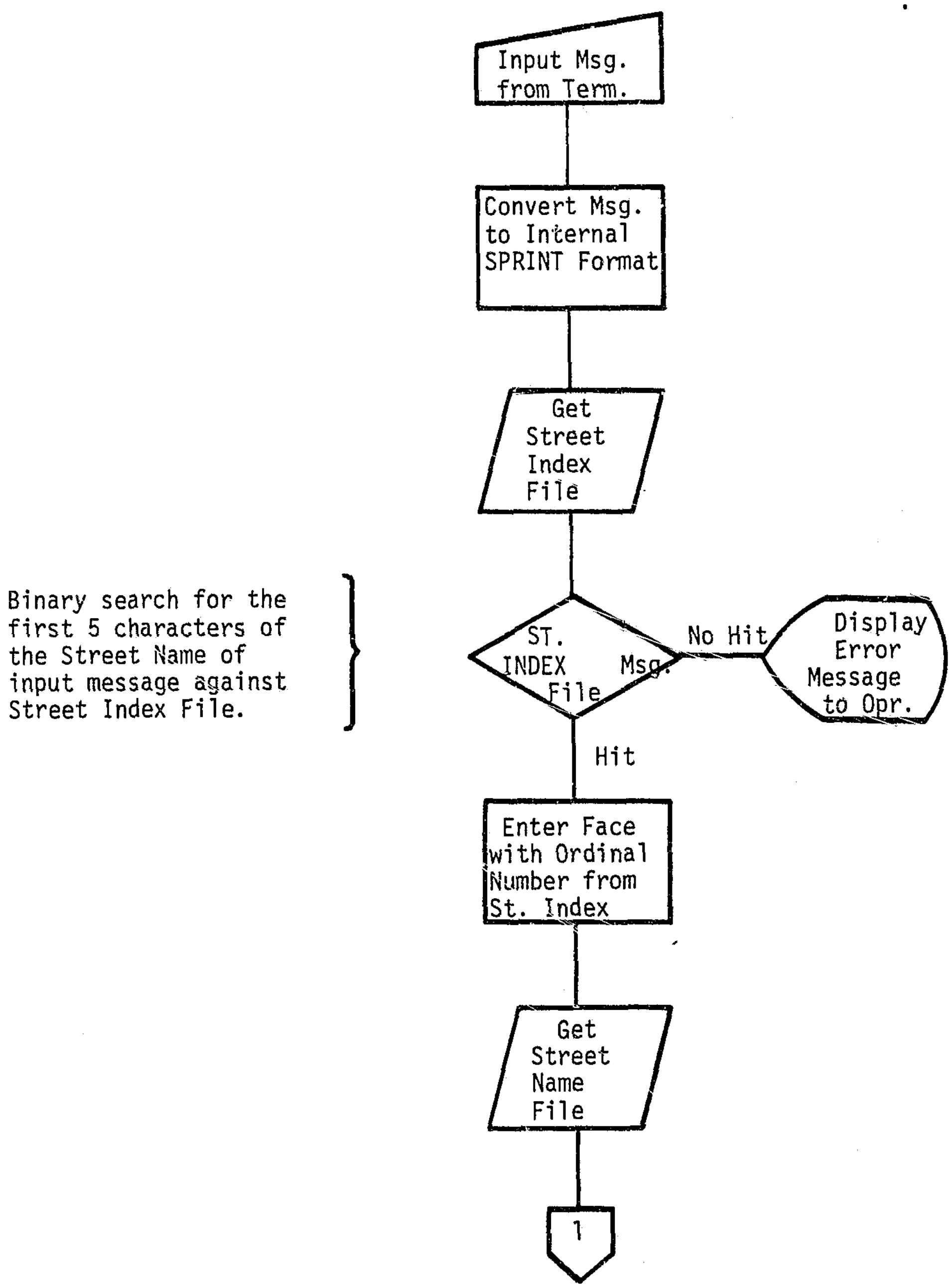




Pilot Tape is loaded to SPRINT Development System and tested prior to being loaded to On-Line System.

ON-LINE DATA BASE ACCESS

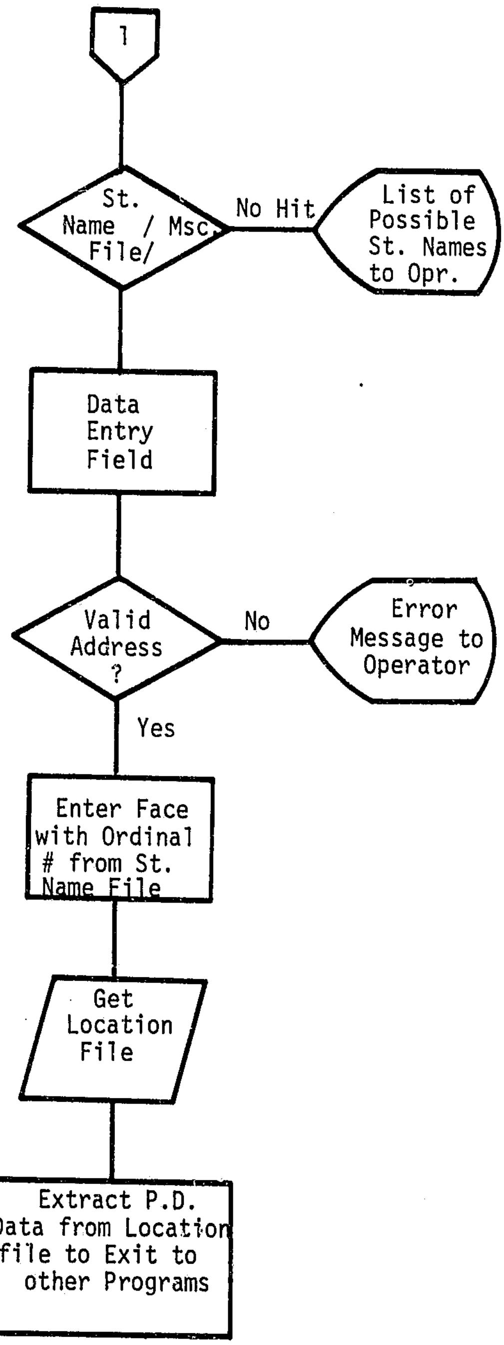



Input Msg. from Term.
Convert Msg. to Internal SPRINT Format
Get Street Index File
Binary search for the first 5 characters of the Street Name of input message against Street Index File.
ST. INDEX File
No Hit
Msg.
Display Error Message to Opr.
Hit
Enter Face with Ordinal Number from St. Index
Get Street Name File
1

The entire Street Name is compared against the name entry field of the Street Name File.

Once the correct name entry field has been located, a 2 byte field points to the first data entry field for that Street Name.

Each Data Entry Field contains an ordinal number pointing to the first Location File Record for that street.



INCIDENT CODE TIME SURVEY 120275

LIST OF OVER 5 MINUTE JOBS

BORO	DIV	PCT	JOB #	TER ADD	INCIDENT TIME	INCIDENT CODE	RMP ASSG.	FINAL DISP	DISPATCH TIME	INTERVAL TIME
5	14	90	T09806		2321	20	B	99	2337	0016
2	6	28	T09904		2336	31	C	99	2343	0007
1	3	18	T09924		2340	20	K	98	2358	0018
4	12	71	T09974		2349	11	C	90	0010	0021
7	2	122	T09980		2352	11	A	99	0019	0027
3	8	43	T09986		2352	11	D	99	0007	0015
4	11	84	T09993		2354	39	A	93	0011	0017

PART I

INC CODE GROUP A 11 13 20 30 31 32 33 34 39 51 66	TOTAL	LESS THAN 1 MIN	1to2 MIN	2to3 MIN	3to4 MIN	4to5 MIN	5to10 MIN	10to20 MIN	OVER 20 MIN	AVERAGE TIME
	1145	151	413	169	92	43	143	72	62	4

PART II

INC CODE GROUP B 21 THRU 29	TOTAL	TOTAL TIME	AVERAGE TIME
	962	10821	11

PART III

INC CODE GROUP C	TOTAL	TOTAL TIME	AVERAGE TIME
	5029	30182	6

PART IV

DAILY CODE SIGNAL ANALYSIS

072576

CODE SIGNAL

10	11	12	13	14	15	16	17	18	19
1452	810	458	47	0	0	0	0	0	0

CODE SIGNAL

20	21	22	23	24	25	26	27	28	29
233	575	760	0	346	0	0	0	0	727

CODE SIGNAL

30	31	32	33	34	35	36	37	38	39
46	168	78	14	94	0	0	0	0	53

CODE SIGNAL

40	41	42	43	44	45	46	47	48	49
0	0	0	0	0	0	0	0	0	0

CODE SIGNAL

50	51	52	53	54	55	56	57	58	59
537	0	1054	549	735	234	283	0	0	317

CODE SIGNAL

60	61	62	63	64	65	66	67	68	69
0	0	0	0	1	36	1	68	403	44

CODE SIGNAL

70	71	72	73	74	75	76	77	78	79
0	0	0	0	0	0	0	0	0	0

SIGNAL TOTAL
10123

CONTINUED

1 OF 3

6 PCT. SPRINT HOURLY JOB DISTRIBUTION WEEK OF NOV. 24, 75

HOUR	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	TOTAL
MON.	3	2	2	4	3	2	1	2	3	3	3	3	3	4	3	6	5	8	2	9	9	6	5	9	100
TUES.	5	2	1	5	1	1	1	5	5		5	5	4	3	5	3	3	1	9	6	3	2	2	3	80
WED.	4	3	2	4	1	3	3	1	4	5	4	6	4	6	3	4	2	8	1	7	8	4	7	7	101
THUR.	4	3	7	2	3	1	1	2	4	4	3	3	3	3	3	5	6	6	3	2	3	3	8		82
FRI.	3	6	4	4	5	2	1	3	5	4		5	5	2	3	4	8	12	3	6	6	12	6	6	115
SAT.	5	6	9	2	3	1	1	2	5	5	3	4	2	4	3	2	8	9	8	3	10	7	6		108

MON. TOTALS TOUR 12X8 TOT 19A/S TIME 32.6 TOUR 8X4 TOT 27 A/S TIME 23.1 TOUR 4X12 TOT 53 A/S TIME 20.1
MON. A/S TIME 23.4
40% UTILIZATION 6 UNITS 5 UNITS 9 UNITS 19 UNITS

TUES. TOTALS TOUR 12X8 TOT 21 A/S TIME 23.5 TOUR 8X4 TOT 31 A/S TIME 17.5 TOUR 4X12 TOT 29 A/S TIME 25.2
TUES. A/S TIME 21.9
40% UTILIZATION 4 UNITS 5 UNITS 7 UNITS 15 UNITS

WED. TOTALS TOUR 12X8 TOT 21 A/S TIME 29.0 TOUR 8X4 TOT 35 A/S TIME 26.4 TOUR 4X12 TOT 43 A/S TIME 28.3
WED. A/S TIME 28.3
40% UTILIZATION 7 UNITS 7 UNITS 14 UNITS 26 UNITS

THUR. TOTALS TOUR 12X8 TOT 24 A/S TIME 10.9 TOUR 8X4 TOT 28 A/S TIME 13.5 TOUR 4X12 TOT 32 A/S TIME 23.5
THUR. A/S TIME 16.6
40% UTILIZATION 2 UNITS 3 UNITS 7 UNITS 11 UNITS

FRI. TOTALS TOUR 12X8 TOT 27 A/S TIME 23.0 TOUR 8X4 TOT 29 A/S TIME 25.1 TOUR 4X12 TOT 59 A/S TIME 21.6
FRI. A/S TIME 22.8
40% UTILIZATION 5 UNITS 6 UNITS 11 UNITS 22 UNITS

SAT. TOTALS TOUR 12X8 TOT 27 A/S TIME 41.1 TOUR 8X4 TOT 30 A/S TIME 24.3 TOUR 4X12 TOT 51 A/S TIME 28.2
SAT. A/S TIME 30.4
40% UTILIZATION 11 UNITS 6 UNITS 13 UNITS 29 UNITS

SPRINT JOB SUMMARY

WEEK OF JULY 19/76

COMMAND	CURRENT WEEK TOTAL RUNS	CURRENT WEEK AVG SERVICE TIME	AVG OF PREV 4 WEEKS TOTAL RUNS	AVG OF PREV 4 WEEKS AVG SERVICE TIME
1 PCT	505	29.6	582	29.0
5 PCT	513	27.4	465	28.0
6 PCT	706	25.1	682	25.3
7 PCT	494	29.3	485	28.8
9 PCT	921	27.8	895	28.9
13 PCT	815	27.2	832	27.2
1 DIV	3954	27.6	3943	27.8

123 PCT

SPRINT ASSIGNMENT EXCEPTION LISTING

WEEK OF JULY/19/76

DATE	TYPE	TIME RECD.	TIME ASSG.	TIME OF DISP.	CODE SIG.	SECTOR OF OCCUR	ASSGMT	FINAL DISP.	TIME EXP.	SPRINT JOB #
7/19	R	0102	0103	0111	54S2	122 C	E1	99	8	M00512
7/19	DR	0104	0111	0115	11C4	122 R	H1	98	4	M00527
7/19	R	0558	0559	0632	54S1	122 G	E1	99	33	M01869
7/19	T	0707	0709	0824	21R	E	D	99	75	M02148
7/19	R	1019	1019	1030	54S2	120 B	H1	98	11	M02990
7/19	TR	1029	1030	1144	531	120 B	H1	93Q	74	M03056
7/19	R	1431	1432	1455	54S1	120 A	E1	99	23	M04945
7/19	TR	1545	1602	1829	531	120 H	H1	93Q6	147	M05539
7/19	R	1545	1603	1604	531	120 H	E1	98	1	M05539
7/19	TR	1545	1611	1751	531	120 H	ST9	98	100	M05539
7/19	D	1559	1627	1637	11C4	B	G	90Y	10	M05645
7/19	TR	1604	1604	1730	10Q2	122 B	E1	91Q	86	M05682
7/19	TR	1751	1751	1919	12	122 M	ST9	99	88	M06772
7/19	TR	1919	1919	2056	10Q2	122 B	ST9	90Y	97	M07765
7/19	T	2124	2138	2343	12	F	D	99	125	M09092
7/19	T	2124	2157	2343	12	F	SP1	99	106	M09092
7/19	TR	2346	2348	0050	54	120 U	E1	90Z	62	M10559

5 PCT

SPRINT WORK LOAD SUMMARY

WEEK OF NOV/24/75

SECTOR OF OCCUR	DAY TOUR	MON. 1	MON. 2	MON. 3	TUES. 1	TUES. 2	TUES. 3	WED. 1	WED. 2	WED. 3	THUR. 1	THUR. 2	THUR. 3	FRI. 1	FRI. 2	FRI. 3	SAT. 1	SAT. 2	SAT. 3	SUN. 1	SUN. 2	SUN. 3	WKS TOT 1	WKS TOT 2	WKS TOT 3	WK GT	% OF W.L. CURR	% OF W.L. PREV.
A	TOTAL JOBS	4	4	6	1	8	5	1	5	10	4	4	10	1	2	7	3	2	4	3	4	12	17	29	54	100	18.4	16.8
	RESP BY SECT	6	8	6	3	7	2	4	3	7	6	3	12	2	8	7	6	4	8	6	3	10						
	IN SEC RESP	3	2	1	1	3	1	1	2	4	3	0	8	0	0	5	1	1	2	2	2	6						
B	TOTAL JOBS	2	2	2	0	1	1	1	0	0	1	0	1	2	2	4	0	2	2	0	1	1	6	8	11	25	4.6	5.2
	RESP BY SECT	1	0	1	0	1	6	0	4	0	0	0	0	0	0	0	0	10	0	0	4	7						
	IN SECT RESP	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0						
C	TOTAL JOBS	1	2	5	1	3	2	1	4	5	0	5	6	3	1	3	1	5	6	4	3	5	11	23	32	66	12.1	10.2
	RESP BY SECT	5	6	9	4	4	5	4	3	6	3	12	14	4	4	7	0	6	3	2	6	4						
	IN SECT RESP	0	1	3	1	2	0	0	1	2	0	2	4	1	0	0	0	2	2	2	2	1						
D	TOTAL JOBS	2	6	7	0	1	2	1	0	3	3	1	3	5	7	8	4	3	1	0	4	4	15	22	28	65	11.9	15.9
	RESP BY SECT	6	6	7	0	2	2	3	0	9	0	5	0	0	6	12	7	0	0	4	4	0						
	IN SECT RESP	2	3	4	0	1	1	0	0	2	0	0	0	0	3	6	3	0	0	0	3	0						
E	TOTAL JOBS	3	5	7	2	1	9	3	4	6	4	4	6	4	2	5	4	2	2	3	2	5	23	20	40	83	15.3	13.7
	RESP BY SECT	4	5	5	2	1	10	0	4	6	2	3	5	7	3	5	3	4	6	5	3	5						
	IN SECT RESP	2	2	3	2	0	5	0	3	4	2	0	3	3	1	1	1	1	2	2	1	3						
F	TOTAL JOBS	7	8	7	6	1	7	6	7	3	5	8	7	3	5	7	4	7	8	4	5	4	35	41	43	119	21.9	20.7
	RESP BY SECT	5	5	10	5	4	8	8	5	7	5	6	9	8	9	9	8	7	6	5	4	6						
	IN SECT RESP	4	3	3	4	0	3	4	4	3	2	1	4	2	3	2	3	3	5	2	3	4						
G	TOTAL JOBS	1	6	6	1	5	3	3	5	7	3	0	4	1	5	6	3	8	6	3	3	5	15	32	37	84	15.4	16.5
	RESP BY SECT	4	6	7	2	0	0	0	3	2	5	0	0	0	0	8	0	0	5	0	0	5						
	IN SECT RESP	1	1	2	1	0	0	0	1	0	2	0	0	0	0	3	0	0	2	0	0	1						
5 COMMAND TOTALS																												
	TOTAL JOBS	20	33	40	11	20	29	16	25	34	20	22	37	19	24	40	19	29	29	17	22	36	122	175	245	542		
	RESP BY SECT	31	36	45	16	19	33	19	22	37	21	29	40	21	30	48	24	31	28	22	24	37						
	IN SECT RESP	12	12	16	9	6	11	5	11	15	9	3	19	6	7	17	8	8	13	8	11	15						

5 PCT % OF COMD TOTALS-JOB WORKLOAD

CURR	3.6	7.3	3.6	2.9	6.2	4.0	3.6	7.3	5.3	3.1	6.6	32.2	
PREV	2.4	6.1	4.2	2.1	6.3	6.2	3.6	8.0	3.7	3.3	4.1	34.6	
CURR	6.0	2.0	5.3	4.6	3.6	6.8	4.4	3.5	5.3	4.0	22.5	45.2	98.9
PREV	6.2	2.7	6.2	4.9	3.6	6.5	5.7	3.2	6.4	3.4	21.4	43.8	98.8

GEOGRAPHIC BASE FILES ADMINISTRATIVE ISSUES

Donald E. Lyon
Administrative Aide
Kansas City Police Department
Kansas City, Missouri

The Kansas City, Missouri computer system was set up under the dynamic leadership of Chief Clarence M. Kelley who felt the system would greatly advance the efficiency and effectiveness of the police function.

The metropolitan area of the city is broken down into five divisions. Within each of the divisions are sectors (a sergeant and a squad of four or five men) and then each officer is assigned a beat within a sector. Each division has at least one mobile squad which is not assigned a beat or sector. These resources are used in areas of crime concentration. The basic traffic enforcement function is carried on by a separate division that operates citywide.

Each Operations Division has been assigned the resources it needs to operate almost independently of the rest of the department. The idea behind this is that each division has problems that are unique to it. So, the division commander may use his resources in any way which he believes will be effective in accomplishing his mission, as long as he operates within certain rather general parameters which are set up as a matter of department policy.

One of the Operations Divisions is using what we call Directed Patrol in its operation. Under this system, the division is furnished a number of SYMAPs weekly. They cover offense by sector, arrest by sector, and calls-for-service by sector. Along with this, a manpower allocation report is furnished. From the maps and the manpower allocation report, the officers are assigned.

From the manpower allocation projection report, it is determined how many officers will be needed to handle called-for-services on the day being planned. These officers are then assigned to the areas indicated on the calls-for-service SYMAP as being the location of the highest concentration. The balance of the officers are assigned to other duties such as Operation Identification, residence inspection for security, attending area meeting, crime prevention programs in shopping centers, and contacting people along streets with heavy pedestrian traffic as safety watchers. As can be seen, the tactical deployment of manpower resources in this plan depends upon reports produced by the computer system from the geographic base files. Other divisions use different plans of deployment: some depend on computer reports and some do not.

Each of the assigned beats in Kansas City was designed from calls-for-service data. Each beat was adjusted to have as near the same calls-for-service workload as was possible. These beat boundaries were drawn without regard for census tract or block. However, only five undeveloped blocks were divided by this procedure.

In Kansas City we have 69 beats, which because of the deployment methods used, may be considered as reporting districts. Due to the way manpower is now being utilized, while there is not one car per beat, in many cases, the assigned officer will only answer calls in the beat and spend the rest of his time in another area on a special assignment. Given this type of organization, it may readily be seen that each division has different data requirements.

The Kansas City ALERT System was developed primarily to serve the needs of law enforcement officers and has, since its original design, been expanded to serve other criminal justice agencies. Such a system provides rapid access to information needed by the police department and other participating agencies in order to provide a more effective and efficient service to citizens and give management and operations an insight into the crime situation.

The need for a geographic data base for the Kansas City, Missouri Police Department was recognized by the first planners of the ALERT System in the late 1960's. While not requested or its need recognized by the department as a whole at the time, a census tract and block file was developed. Development was accomplished by a team of police officers, programmers who were responsive to police needs and part-time college students who gathered the necessary information about every street within the incorporated area of Kansas City, Missouri.

While the system was developed by the Computer Systems Division, police officers were used in its development. The first file that was developed contained address ranges, street names, suffixes, directions, census tracts and blocks, block ranges and block front information. Later, in order to make the file more useful to the police, intersection data and police beats were added to the file. Non-street features were eliminated and common places were assigned addresses. The system was placed on-line so that users would have direct access to it.

The file that was developed is in many respects similar to the United States Census Bureau Address Coding Guide developed during the same period. It is similar to the Address Coding Guide in that it is primarily a block face file and uses tracts and blocks as primary geocodes. Another similarity is that both were coded using the United States Census Bureau Metropolitan Map Series.

While sharing similarities with the Address Coding Guide, the Kansas City, Missouri Police Department census tract and block file has unique attributes inspired by the street network of the city. The file is a block face file. This level of detail was desired by the department to perform analysis using census subdivision. In addition to the census information, the file contains geocodes for police beat.

To take advantage of the street numbering convention of the area, the address records in the file each represent a one-hundred block in Kansas City. Many of these one-hundred block address ranges are subdivided by intersecting streets. To maintain block face records by the hundred block designations, Kansas City decided to provide subsegments (where they occur) as part of the address record, using high address range as an indication of termination. These subsegments (space for three segments - counting both the even and odd sides of the street are-provided in the block face record) indicate alleys or other segmentations occurring within the hundred block.

The prime users of the reports generated by the census tract and block file in Kansas City, Missouri are the Crime Information Unit, Traffic Analysis Unit, the Operations Resource Unit and the Administrative Analysis Division. An on-line system of inquiries, called Crime Data Base Inquiries, provides immediate census tract and block information on both Part I and Part II offenses and accident information. Along with many other search parameters, information can be obtained by an individual tract and block, multiple tracts and blocks, by police beats or sectors and for the total city.

Along with the system's on-line capability, when the original source document is entered on the CRT, it automatically geocodes arrest, traffic offense, dispatch and accident records with police beat, census tract and block information. It can verify addresses within the incorporated boundaries of Kansas City, Missouri and can flag an invalid address.

At the present time, through the SYMAP program, the x-y coordinates have been developed in a separate file for the census tracts and the x-y coordinates by block are being tested. These are expected to be operational by the end of the year.

Kansas City serves a total of fifty-three criminal justice agencies in two states. The agencies have a total of 242 terminals. Each agency has the responsibility of entering, updating and cancelling its own data. The only agency using the geographic base file at the present time is the Kansas City, Missouri Police Department.

The Computer Systems Division now produces about 57,500 reports per year from over 500 programs. About 18,500 of the hard copy reports produced are for the Kansas City, Missouri Police Department and about 39,000 are for outside agencies.

By utilizing the geographic base census file, we are able to produce reports or make on-line inquiries on as little as one block of the city or as large an area as desired. If, for instance, we wanted crime information on a controlled area or a specific area's civic group, it can be extracted by selecting the census tracts and blocks that are encompassed by that area. This saves the lengthy process of determining address ranges, names and intersections to compile the desired information.

Sworn officers who use the system do not have formal training but are instructed in how to retrieve information. The Crime Data Base provides line officers with the information they need for the department monthly plan of beat and sector reporting.

With the increasing use of information contained in the census file, it became apparent that a full-time employee would be needed to maintain accurate files, rather than have file maintenance absorbed by a variety of people in the Input Control Unit. The difficulty came in getting the department to fund this additional position. It was not until after a series of meetings pointing out the inaccuracies in the census files and the problems involved in getting corrections made properly that the full-time census clerk position was funded.

Certain qualifications were felt to be necessary in considering persons for this position. A discussion of these qualifications follows:

1. A fairly thorough knowledge of the city.

   While Kansas City, Missouri is laid out geographically in a grid pattern with the east/west streets being numbered and the north/south streets being named, there are many areas which do not conform to this pattern. This is particularly true of the areas which were annexed by the city. Street names and numbers must be translated to tract and block data. In a sense then, the census clerk is working with two sets of books; i.e., one concerning police beats and one dealing with census tract and block data.

2. Ability to work well with detailed information.

   When given an address, the police officer in Kansas City thinks of how many blocks the address is east or west of Main and how many blocks the address is north or south of the River. The census clerk must look at an address much differently. The address is first translated into a police beat, then to a census tract and then to an address range on the street in that tract. This is then coded to a particular one-hundred block and further broken down to the even or odd side of that particular one-hundred block address range. It can readily be seen that attention to detail is very important here if the address is to be placed in the master file correctly.

3. Accurate work habits.

   If a correction is to be made, it should be made accurately. One of the things that was discovered in the Kansas City, Missouri system before the full-time census clerk was hired was that, when errors were found and a clerk was to correct it, the error was no longer evident where it was first discovered but merely moved to another place. This turned out to be the wrong place 80 percent of the time. A 20 percent correction factor is hardly acceptable and, if allowed to continue for any length of time, will introduce into the system enough errors to completely destroy its value.

4. Ability to use or be trained for use of a CRT for on-line entry of additions and changes to the census files.

   Once it is determined that an addition or change must be made in the master file, it becomes imperative that the correction be made properly. If the on-line entry is not correct, nothing will be gained.

5. Ability to work well with people in providing liaison with various city officers and in conducting demonstrations on the Crime Data Base Inquiry System as well as the Resource Projection System.

   In order to keep the file updated with valid addresses it is necessary to obtain information from other offices such as the City Planning and Development Department, Parks and Recreation Department and any other agency that has access to the developments that change the geography of the area. In some cases this takes a very special personality in order to get the information on a current basis. In many cases, the first indication of a street addition is when the census clerk finds it on an error sheet as an invalid address. It then becomes necessary to do quite a bit of work to find out where the street is and what one-hundred block it represents, as well as the odd and even sides of the street in some cases.

New people are coming into positions which require knowledge of the Crime Data Base and the Resource Projection System. The census clerk is the best qualified to teach these people how to obtain the information they will require as well as give them an insight into what the systems will and will not do. The census clerk, then, must be a good teacher, as well as a careful and accurate worker.

After a person was chosen for the position of census clerk, it was imperative that procedures be set up to maintain the census file. The first problem considered was that of training.

The clerk was first instructed on the full impact of the position and the base files and was then shown, step-by-step, how to make each type of correction and how to establish that the correction had been made properly. Procedures were established and documented for processing error listings and the following priorities of work were established to accomplish the prime objective:

1. Processing of the daily listings from the crime reports, arrests, traffic tickets, and parking tickets where addresses listed on the source documents do not match the on-line census file.

   The census clerk will receive each morning a listing of all addresses from the previous day which could not be geocoded by the master file. If the error is found in the address data on the report (e.g., the wrong suffix or direction being entered by the entry clerk), the record is corrected in the master file. If the reference file is found to be in error, the census clerk checks plot maps provided by the city engineers, as well as the Metropolitan Map Series of the Bureau of Census, to which the department has added additional geographic data. The corrections or additions are thus coded and put into the on-line system. Only two persons can update the census master file at the present time, the Data Clerk and Input Control Supervisor.

2. On-line entry of items not on the census file.

   As new streets are added or old ones are changed, the census clerk will update the system as soon as the information required is available. This is where the liaison with outside agencies becomes very important to an accurate and up-to-date file.

3. Review each individual census tract in the file against the census maps to insure inclusion of all existing streets and intersections.

   This requires a routine run of each census tract which is then checked a block at a time against the most up-to-date maps and information available.

4. Review of the entire census file, performing necessary updates after the new census data is published.

In addition to routine updating schedules, procedures should be established for making changes in the base files as identified through use in the system. New applications and demands for new services may require modifications in the systems' structure, output and processing activities. Some will be minor, but others may require major programming efforts. When these requests are made by users, they are an indication of the system's acceptance and success and should be accommodated as soon as possible.

Training user personnel in the system use and notifying them of system changes should be done as often as possible to provide an awareness of new capabilities and also inform those who may be interested that the system is available for their use. Personnel directly affected by the system's operation should be automatically alerted when major changes are implemented and the information on the change should be incorporated in all training manuals and materials. In other words, system-to-user contact should occur as often as possible.

Systems, as originally designed and implemented, will normally be "deficient" in the sense that "what we have now is fine and certainly better than nothing but if we could get...". This is a common user reaction. In these cases, systems personnel should strive to introduce the recommended changes, if possible, and thus enhance the use and the usefulness of the entire operation. Sometimes, of course, it turns out that the problem lies in the lack of full understanding of the system on the part of the user, and education and/or explanation is the answer. The important point is that the systems should not be projected as fixed and unalterable but should be pictured as flexible and subject to change based on user needs.

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GBF ISSUES FOR THE LAW ENFORCEMENT ADMINISTRATOR

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INTRODUCTION

Washington, D.C. has a population of approximately 725,000 people, comprised of a broad mixture of ethnic and economic groups. The City occupies an area of 69.2 square miles, of which 9.1 square miles is water and 60.1 square miles is land area. Using an average of over 800 scooters, cars, cranes, motorcycles and service vehicles on the street daily from a fleet of over 1,100, the Metropolitan Police Department (MPD) responds to more than 6,500 requests for service for a combined total of more than 19,000 event and administrative dispatches daily. We patrol 1,525 streets, comprising 4,256 city blocks, with 118 Scout Car Beats and 362 Reporting Areas contained in seven police districts.

Viewed by many as only a city, Washington, D.C. must serve its population as if it were a state and county, as well as a city. Responsibility for the registration of vehicles and granting of vehicles operator permits rests with the Department of Transportation. Similarly, the Department of Human Resources is responsible at the state level for all social welfare and health programs normally administered at the state, county and city level.

Geographical elements which are contained within the Federal Cities boundaries include city and federal parks, military reservations, federal property, the federal enclave, a multitude of embassies, legations and chanceries belonging to foreign governments, universities and colleges, national monuments and historical buildings, as well as several rivers and waterways.

Law enforcement agencies, in addition to MPD, having principal enforcement responsibilities within the city include:

1. The United States Park Police, an agency of the Department of Interior, is responsible for a number of major streets, parkways and all federally owned park land within the City.

2. The United States Capitol Police are responsible for the United States Capitol Building, House of Representatives and U.S. Senate Office Buildings and surrounding grounds.

3. Library of Congress police personnel are responsible for all buildings and grounds within the Library of Congress complex.

4. The U.S. Supreme Court Police are responsible for the protection of Supreme Court Justices, courtroom security and general law enforcement activities within the Court building and grounds.

5. The executive Protective Service, a branch of the U.S. Secret Service, is responsible for security of the White House and foreign Embassies and Missions.

6. The Federal Protection Service, an agency of the General Services Administration, responsible for all federally owned buildings and grounds.

7. The National Zoo Police is responsible for all buildings and grounds within the National Zoological Park.

8. The Metro Transit Police are responsible for all tunnels, track right-of-ways and vehicles of the Washington Metropolitan Area Transit Authority.

9. Various campus police forces have principal responsibilities on university and college grounds.

MPD GEOGRAPHIC BASE FILE OVERVIEW

Starting in July 1971, MPD began development of a comprehensive geographic base file (GBF), not related to the Census Bureau Dual Independent Map Encoding (DIME) files. MPD chose to develop its GBF to provide immediate operational benefits to the department, with eventual integration into a compatible DIME format as a secondary goal. Initial application of the MPD GBF was made to the offense reporting system of the department used in generation of the Uniform Crime Report. The offense system was chosen since it already contained precoded (manual) 10-digit addresses, along with a limited amount of modus operandi information useful to the department in establishing patterns of events. Studies of the value of retrieval by geographic area, or address, indicated that not only would the department benefit from such a capability operationally, but also for purposes of community relations. Initial short range goals of the MPD GBF were:

Crime Analysis - Ability to retrieve crime information by specific geographical areas. These areas may be predefined, such as Police District, Scout Car Beat or Reporting Area as well as special, one-time study areas within special geographic boundaries.

Investigation - Afford investigators the opportunity to retrieve data from department automated "event" files based on specific locations, time event codes, property attacked, method of attack and various combinations of these parameters.

Manpower Deployment - Develop methods of standardizing addresses in order that manpower may be concentrated within high areas of occurrence. Example: Groups all outstanding parking warrants by city block of occurrence indicating highest concentration of scofflaw patterns in sequence by specific address for tactical saturation of towing and booting manpower.

Community Information - Be prepared to respond to special requests concerning police resources or reported events within specific areas. Example: Present statistical summaries of police activities within community defined boundaries such as an area represented by a civic association.

Report Auditing - Classify proper reporting responsibility for each district based upon address of the event.

Traffic Analysis - Support Traffic Division activities by providing location statistics of high accident locations and areas of high citation, traffic control, etc.

Special Statistical Requests - Provide information relative to request from public service agencies. Example: Department of Permits and Licenses requests information concerning vendor violations of police regulations along Constitution Avenue from Second to Seventh Street, N.W. which occurred between December 1 and February 2.

During the development phase of the short-range GBF goals, all initial information retrieval was done using batch processing. The growth in requests for information pertaining to specific geographic parameters soon indicated a growing need for on-line GBF retrieval capability. In addition, as investigators, managers and analysts placed a greater emphasis upon retrieval according to exact location, the reliability of the address itself became more important. Address information, first manually coded onto coding sheets, then keypunched and verified, presented numerous error opportunities for miscoding, such as digits transposed or misread during machine entry. In June 1974, the department entered into several long-term projects to develop on-line, real time GBF data entry, verification and information retrieval. Based upon experience gained during implementation of the initial batch processing GBF system, additional applications using on-line retrieval capability were planned. A terminal was located in the Public Information Section of the Identification and Records Division to assist in locating reports of events where only approximate times and locations were known by the citizen. (This application now is used more than 700 times weekly in providing this public service.) All radio run dispatches are now entered on-line (however, not in real time) to provide operational elements of the department with up-to-date statistics of events, as well as detailed information concerning high areas of activity. All new on-line data entry systems require incorporation of standard GBF software for verification of the accuracy, as well as the existence, of each location. Department long-term plans for extending GBF usage include Computer Assisted Dispatching, Computer Plotting and Vehicle Location Systems.

In the creation of its internal GBF, the department was faced with the fundamental issues found in the establishment of any new system; project funding, short and long-term goals, design of applications, operation of the system, staffing for implementation and use, training of user and management in problems and benefits, security and privacy, and projecting into the future the impact of new technology upon the system. As the department exploited its GBF in providng information for community relations, the attention of various city administrators was focused upon MPD as a leader in GBF technology. The concept of a municipal GBF information system had long been discussed among various agencies of the District of Columbia, but the success of MPD's GBF gave the final impetus to the creation of a multi-agency committee to study the implementation of such a system. A "DC Inter-Agency Geographic Data Base File Committee" was established in November 1976 and was directed to study the creation of a standard GBF coding system, build a municipal GBF and study feasibility of GBF software technology transfer. Based upon the experience of MPD in dealing with the creation of its own GBF, the committee has assigned the responsibility for the design and creation of the District of Columbia Geographic Base File (DCGBF) to the department.

New administrative issues in the creation of a municipal GBF system must now be addressed by the MPD staff. Multi-jurisdictional roles and needs of the users, systems design and file maintenance responsibility, expanded roles of security and privacy, coordination with federal agencies (Census Bureau, DOT, etc.) and avoidance of the public interpretation of the DCGBF as being the product of "Big Brother" must be dealt with. Furthermore, the need to establish a formal interagency agreement for the continued funding of staff and equipment costs after implementation of the DCGBF are the most immediate administrative issues now facing not only MPD, but also every department of the city government participating in the project.

As municipal information systems are implemented, law enforcement agencies will be in the forefront of applications development and GBF maintenance. This role is dictated by the increased usage of automation for GBF administrative and operational systems, such as computer assisted dispatching and resource allocation. No municipal agency has a greater daily operational need for up-to-date and reliable information based upon geography than does law enforcement. As such, administrators must be aware of issues that may have short and long-range potential for assisting their organizations in completing its mission, as well as those issues which may have an adverse impact upon the political and budgetary areas of the department.

Design of Application

As users become more familiar with the capabilities of the computer and programmers mature in their abilities, the generality of programs and information use becomes possible. By appending location or GBF information to what had previously been a little used file, the potential for increased functional importance to other users is dramatically increased. Geographical integration was designed into all MPD files in order that we may relate operational and investigative information from exact addresses to city activity.

Since our long-range plans specified implementation of Computer Assisted Dispatching (CAD), we knew that multiple beat configuration would be required for maximum efficiency of resource allocation. City blocks were designated as the lowest component for construction of beats. Just as a child uses building blocks, we are able to construct modular scout car beats having already pre-determined boundaries which take into consideration existing physical barriers (e.g., rivers and military reservations) which would impede the scout car from providing a timely response.

Another consideration programmed for quite early in our application design was the inclusion of a street synonym dictionary. This dictionary has allowed for easier training of terminal operators, as well as creating an extensive vocabulary used in matching the MPD GBF with the other District of Columbia files containing street names. Currently, up to 25 variations of a street name are carried in the dictionary and we are adding approximately 100 new variations for each new agency file matched.

When designing for our internal use, we failed to appreciate the value of other data elements for geographic integration with non-MPD files. For example, we failed to consider the need to identify proper streets in order to assist the tourist who is looking for a street which does not exist. We failed to consider identifying private streets from which a citizen may have a need for police assistance but which appears nowhere on maps or in the District Highway and Traffic street index. Bike trails are becoming more and more popular and efforts are being made to include them as an integral part of the new CAD GBF. Finally, we found a need to create a location remarks file for the inclusion of information pertinent to some specific street or place, such as temporarily closed, under repair, military reservation, etc.

Project Funding

The department's development of a GBF had never been considered as a "project": instead, it was an integrated part of every application programmed. The initial construction of the base dictionaries was done by several programmer/analysts, on their free time, who envisioned the capabilities of a GBF. Once constructed, the various dictionaries were included as an essential part of any project.

By requiring the programmer/analyst to include the GBF in his design, we were able to familiarize him with essentials of a quality GBF. Once presented in the output, the user became dependent upon location as a standard data element. This familiarity eventually led the user to conceive of new applications of his file using geography as a reference point rather than type of report, time of day, etc. Today, each department's operational file has at least one CRT display or batch list program dealing specifically with location information such as reporting area, census track, scout car beat, city block or exact location. This location information is highlighted so that the user may easily "tally" up activity at any of several geographic locations.

Only since the department has begun participation in the DCGBF have we experienced any real identifiable costs. Presently, we are spending an estimated $800 per month in programmer and GBF data base personnel costs. One cruiser is used approximately four hours per day in verifying addresses and $400 in machine time has been used per month for the past three months in matching and standardizing city agency files. We expect these costs to remain static for approximately six months, then decline after verification of the DIME file. Current costs should resume after CAD becomes operational. The estimated rise in field verification will be required due to new features being added to the CAD/GBF, such as place name file and location remarks.

Long-range systems maintenance will be included as a regular cost of doing business within the Data Processing Division's budget. Dependency upon source data automation and user involvement in the daily operational use of detail information ensure a high degree of system integrity.

Operation of the System

Within the department, GBF maintenance is the responsibility of the Data Processing Division. With the advent of computer assisted dispatching and the Communications Division having all GBF maintenance software embedded within its system, it is anticipated that even then, the Data Processing Division will maintain complete control over the GBF.

As a service organization, Data Processing is responsible for providing information of the highest integrity. The widespread application of administrative and operational files based upon geographic data elements implies that strict control over every facet of the GBF be in an environment which upholds the vested interests of all users. Often, it is difficult for individuals to fully conceive or appreciate the entire spectrum of diverse uses to which one piece of information may be put. In the instance of a GBF element, lack of verification prior to either inclusion or deletion from a file may have severe consequences. Where the Communications Division may have an immediate need for the insertion of a new street or alley for dispatching, the verification of the proper surveyor block, census tract and political ward is of little consequence to the communications shift commander. These data, however, take on added significance as the disposition of the service call cascades within multiple reporting systems where such information is of significance.

Currently, it is advocated that MPD be responsible for the maintenance and operation of the DCGBF. Prior to making a final determination to accept or reject this responsibility, several administrative questions must be answered. How large a staff will be required? What will machine time cost? How will notices such as new streets opening and old ones closing be coordinated? What will the public think if they find out that information when properly sorted, correlated and listed could present an almost complete economic, political and educational profile of individuals by location? Who is going to pay for field verification of addresses?

These are only a few of the questions to be considered concerning law enforcement's role in the operation of a citywide, multi-file GBF. Certainly, in considering the final answer of involvement, we must be assured that law enforcement's role in the operation of a GBF is in the highest morale interests of the public and department.

Short-and Long-Term Goals

The internal short and long-term goals of MPD for our GBF have already been expressed. However, as a participant in the creation of a citywide GBF, our long-term goals could have been radically changed by the requirements of other city agencies. The goals of MPD were based on the need for operational, administrative and investigational information. Many other city "line" organizations share a similar information need; however, some social agencies of the city are not operationally involved in GBFs down to the same "exact address" level that law enforcement agencies require. Consequently, their priorities are quite separate and distinct.

The Council of Governments (COG) and the Municipal Planning Office of the Executive Office of the Mayor are involved in socio-economic indicators and demographic analysis. Therefore the bulk, if not all of their goals and priorities, are directed toward the creation of an up-to-date DIME file to be used in the study of social indicators and regional planning projects. Although line and staff organizations have the same final goal, the method of approach and priority vary considerably.

Within the District, the design and implementation of the DCGBF is being constructed from the operational files now in existence, working toward the creation of an up-to-date DIME. Since the majority of data processing capability resides at the operational level where the integrity of the information is a daily necessity, it was felt that this approach would serve several purposes. First, no formal method of tracking or auditing the changes going on in the city street network has been established. By placing the GBF maintenance function with a "user" organization such as a police or tax revenue agency, the daily activity against the file will serve to assure some file integrity being built into the system. Second, the development of software and maintenance routines for a "technology transfer" within city EDP shops is facilitated. Finally, the need for a total rewrite of current software is not necessary, as organizations may continue to use an existing system that will not cause an immediate impact upon the user nor a radical change in the short or long-term plans of the department's EDP budget.

Security and Privacy

General security and privacy guidelines, as published in LEAA regulations on confidentiality of research and statistical data, has become a primary consideration to every system analyst and aprogrammer. Those of us dealing with OBTS/CCH are fully aware of the stringent requirements that have been implemented at the federal level and their impact locally on January 1, 1978. However, even information within the legally defined boundaries of dissemination need security and privacy. As an example, our department has an extensive sex M.O. system which would be quite embarrassing to the victim if the information were inadvertently left lying around. Also, the name of victims of sex offenses, when blended into a composite listing of participants in Operation ID and compared to reported victims by location, could also be abused in use by being disposed of improperly. To avoid this type of disclosure, our normal operating procedure is that the name of sex offense victims not be provided on CRT's nor hardcopy produced for units of the department other than the Sex Squad. Naturally, certain exceptions are made after justification is presented in writing to the Director of Data Processing.

The District of Columbia has one of the country's most stringent gun registration laws and since registration is automated and under the control of MPD, we must exercise care in retrieval of lists of guns by location. Once again, only within the Gun Registration Unit is the owner's name and address displayed. If a weapon is being checked for registration, only the fact that it is registered and the registration number is returned in the inquiry. Additional information is available only via telephone or in person.

These procedures have not caused any disruption to investigators or Patrol Division personnel. They have served to ensure the citizen that every effort is being made to protect his privacy in police files. What decision will be made regarding inclusion of registered firearms by address in the hazardous location file for CAD is yet to be determined.

CONCLUSION

A great many more administrative issues remain that have not been addressed due to a lack of time. Issues dealing with the internal administration of a GBF, as well as those faced by inter-department, city, county and state use. Unfortunately, documentation on these questions is almost non-existent due to the youth of GBF technology.

Perhaps the most complete documentation on the entire GBF concept, not only for law enforcement but also the general practitioners, is the IACP workbook entitled, "Geographic Base Files for Law Enforcement Workshop." Hopefully, the IACP will continue its leadership role in GBF technology and will see fit to update and maintain this workbook as a reference document.

Metropolitan Police Department administrators working with the MPD GBF have found that the increasing role played by geography is only one product of the application of automation by law enforcement. The technology of computer assisted dispatching, automatic vehicle location and computer plotting are soon to be felt by society as law enforcement's contribution of today's technology to serve as a public need for improved service. The rate of transition of these technologies, all of which are founded upon geographic base files, will require administrators who are generalists in nature and specialists in action: generalists to be able to comprehend the vast applications of a GBF and specialists to understand its design, programming and maintenance requirements. Armed with these abilities, administrators will be able to deal effectively with the issues brought about in the creation of new, and improvement of old, GBFs.

GBF USERS GROUP MEETING II
AUGUST 15-16, 1977
AGENDA

Introductory Remarks - Executive Assistant Chief J. F. Dahman, Dallas, Texas, Police Department

GBF SYSTEMS DESIGN AND APPLICATIONS

Moderator - Garland D. Bellamy, Director, Data Processing Division, Dallas, Texas, Police Department

"Automation of Police Incident Handling with Special Emphasis on Geographic Base File Applications," Jerry Bramlett, Data Processing Manager, Huntington Beach, California, Police Department

"San Antonio Police Department Geographic-Location System (GEO-LOC)," Jacques W. Hardy, Commander, Communications - Data Systems Bureau, San Antonio, Texas, Police Department

"Design of an Address Verification File for the City of Portland/County of Multnomah Police Computer Assisted Dispatch System," Robert R. Harms, Portland, Oregon, Police Department

"Geographic Base File System in the Sunnyvale Public Safety Department," Aloysius Au Yeung, Administrative Assistant, Sunnyvale Department of Public Safety, Sunnyvale, California

GBF SYSTEMS MAINTENANCE

Moderator - Dr. James W. Stevens, Institute of Urban Studies, University of Texas at Arlington, Arlington, Texas

"The Wichita Police Department Application of Geographic Base Files," Gary K. Burgat, Computer Services, Wichita, Kansas, Police Department

"Dallas Police Geographic Base File Development and Maintenance," Armando Rodriguez, Systems Analyst, Data Processing Division, Dallas, Texas, Police Department

GBF SYSTEMS DEVELOPMENT/ADMINISTRATIVE ISSUES

<u>Moderator</u> - Major Charles R. Connery, Seattle, Washington, Police Department

"City of Houston Police Department Geographic Base File," Sergeant B. E. Camp, Crime Information Center, Houston, Texas, Police Department

"Development of an Operational CAD Geo File Using a GBF Service Center," Jo Ann Moore, San Jose, California, Police Department

"A GBF Checklist," Calvin A. Lopes, New Orleans, Louisiana, Police Department

"The Los Angeles Police Department Emergency Command Control Communications System and its Planned Use of Geographic Base Files," Marshall Levinson, Senior Data Processing Analyst, Los Angeles, California, Police Department

OVERVIEW OF IACP GBF TEST SITE PROJECTS

<u>Moderator</u> - Samson K. Chang, Senior Staff Analyst, IACP Technical Research Division

"GBF Development - St. Louis, Missouri, Police Department," Barry Weismantle, Supervisor, Systems Development

"GBF Development - Tucson, Arizona, Police Department," Keith Grossnickle, Supervisor, Data Services Section

DISCUSSION LEADERS

Mr. Garland D. Bellamy, Director, Data Processing Division, Dallas, Texas, Police Department

Major Charles R. Connery, Seattle, Washington, Police Department

Dr. James W. Stevens, Institute of Urban Studies, University of Texas at Arlington, Arlington, Texas

Mr. Bruce L. Strahan, Geography Division, U.S. Bureau of the Census

IACP STAFF

Mr. Samson K. Chang, Senior Staff Analyst, Technical Research Division

Mr. Allen L. Pearson, Senior Staff Analyst, Technical Research Division

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AUTOMATION OF POLICE INCIDENT HANDLING WITH SPECIAL EMPHASIS ON GEOGRAPHIC BASE FILE APPLICATIONS

Jerry Bramlett
Data Processing Manager
Huntington Beach Police Department
Huntington Beach, California

INTRODUCTION

This paper primarily addresses police automated systems in the city of Huntington Beach, California, with special emphasis applied to geographic base file (GBF) implications. Two major and related systems fit within the scope and purpose of this paper; Emergency Command and Control (ECC) and Police Management Reporting System (PMRS).

Emergency Command and Control (ECC) was developed in three component phases:

Phase I: Computer Aided Dispatching System (CADS)

- defined by the Huntington Beach Police Department
- created by Motorola as a turnkey computer software/hardware package

Phase II: Computer Aided Dispatching System (CADS)

- defined by the Huntington Beach Police Department
- created by Motorola and the City's Data Processing Division

Phase III: Automated Vehicle Locator (AVL)

- defined by the Huntington Beach Police Department
- created by Hoffman Electronics

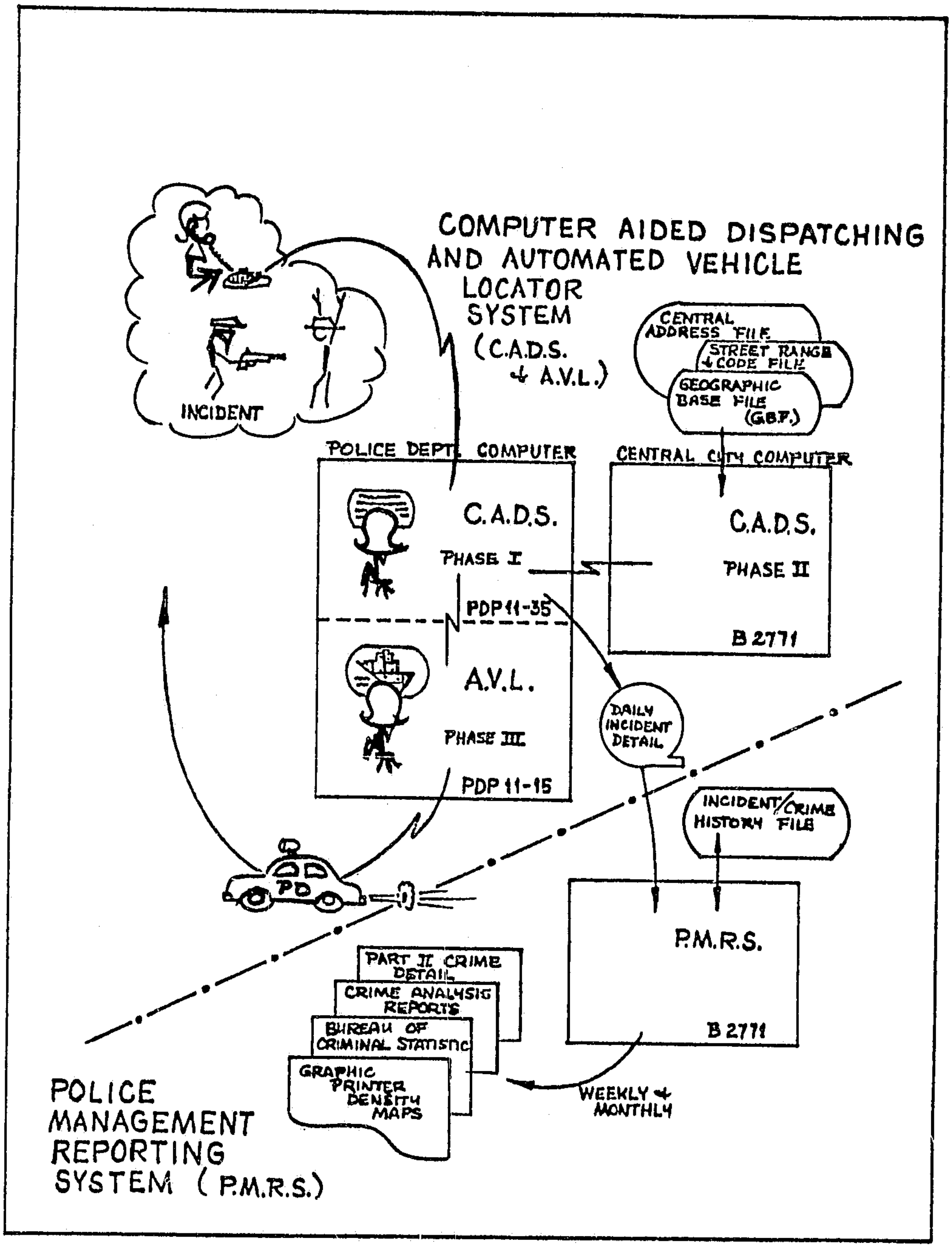
Police Management Reporting System (PMRS)

- defined by the Huntington Beach Police Department
- created by City Data Processing Division

Figure 1, p. 102, diagrams the overall system.

SYSTEM DESIGN CRITERIA

The design criteria of CADS (Phase I and II), AVL and PMRS addressed some common problem areas of on-line and geo-based applications.


COMPUTER AIDED DISPATCHING AND AUTOMATED VEHICLE LOCATOR SYSTEM (C.A.D.S. + A.V.L.)
INCIDENT
CENTRAL ADDRESS FILE
STREET RANGE + CODE FILE
GEOGRAPHIC BASE FILE (G.B.F.)
POLICE DEPT. COMPUTER
CENTRAL CITY COMPUTER
C.A.D.S.
PHASE I
PDP 11-35
A.V.L.
PHASE III
PDP 11-15
C.A.D.S.
PHASE II
B 2771
DAILY INCIDENT DETAIL
INCIDENT/CRIME HISTORY FILE
PD
P.M.R.S.
B 2771
PART II CRIME DETAIL
CRIME ANALYSIS REPORTS
BUREAU OF CRIMINAL STATISTIC
GRAPHIC PRINTER DENSITY MAPS
WEEKLY + MONTHLY
POLICE MANAGEMENT REPORTING SYSTEM (P.M.R.S.)

Four major design criteria are discussed in the following pages. The first two are slanted more towards on-line design criteria while the following two are considerations of geo-based, X-Y systems.

Theory of Front-end Automation

The design and implementation of CADS/AVL/PMRS purposely occurred in that general sequence to reap the benefit of paying for data entry only once. By capturing the proper data at the operational front-end of a major function, and by capturing that data as a necessary function to the initial function, the expensive (time-consuming) edit error correction loop can be eliminated.

CADS is the operational foundation upon which AVL and PMRS could cost effectively be borne.

Indices Free Accesses

One of the critical factors of evaluating an on-line system is the timeliness of the computer response time. One of the major saving areas in keeping is reduction of I/O's between the processor and mass storage and this fact becomes most important during the conventional processing which occurs in the CADS Phase II handling.

It was decided early in CADS Phase II development to perform conventional file accessing free of indices. This approach forced the need for a concise, well tested randomizing algorithm which would yield synonyms of less than 30 percent.

The three major conventional file accessing routes possible in the CADS Phase II handling (depending on the incident location input) all operate free of indices to get the desired records of the:

- street address file (ECFMF)
or - street range and code file (ECFSG)
or - ACG-DIME file (ECFAG)

These algorithms can be furnished upon request.

ADMATCH Bypass

The important function of ADMATCH, or its Huntington Beach equivalent, is a critical step necessary to provide geo-based X-Y coordinates to geographic locations. The city of Huntington Beach chose to access, calculate and append, approximate X-Y coordinates to records within the street address master file (ECFMF) at "load time" as opposed to accessing them at "incident time." This decision was made for important and every clear reasons as shown below:

- ADMATCH core memory overhead and time delay in computer response time was unacceptable

- AVL demands a greater degree of accurate, to parcel level

Timeliness and Accurate Constraints of a GBF

The city originally began design and implementation of CADS and AVL by using the 1970 ACG-DIME master file obtained from the Census Bureau through Orange County. The file was somewhat inaccurate and out-of-date at that time in 1973, with some of the file data being four to five years out-of-date. We understand that the current automated file is much improved.

During the initial development stages of AVL, we found the accuracy of the Huntington Beach tailored ACG-DIME file to be inappropriate. The Census Bureau ACG-DIME file was digitized from the Metropolitan Map Series (MMS) at a scale of 1" = 780' or 800' (some controversies exist as to scale) and the intended Huntington Beach application required a scale of 1" = 200'.

The likelihood of receiving an updated ACG-DIME file from Orange County on even six month boundaries appears very unlikely and, even if possible, the possibility that brand new or recently changed street nodes will appear is slim. This statement is not made to criticize any individuals or entities but only to state that it is a problem with geo-based emergency service systems.

In light of the accuracy and timeliness problems discussed above, Huntington Beach implemented and accomplished the following:

- redigitized the entire city using up-to-date building department maps at a scale of 1" = 200'
- established an update procedure to ensure the timely integrity of streets even prior to final construction, complete with address ranges, nodes and proper codes.

The effort is not an expensive process to maintain and redigitizing was only moderately expensive.

A "WALK THROUGH" OF THE SYSTEM

At Incident Time:

When an incident occurs, the Police Department is informed usually via the telephone and usually the primary contact is with the complaint writer. The contact from the incident is either an informant or the victim.

The Complaint Writer

The complaint writer establishes basic information concerning the incident in a pre-determined sequence, keying the data into the computerized CADS via an alphanumeric keyboard and computer display screen (terminal).

Mass Storage Look-up

The complaint writer initially enters the incident street address (or location) in the complaint writer function. As soon as the street address is entered and while additional incident data is being input, an automated look-up is occurring to provide various dispatching codes, X-Y coordinates and detail residence information. This ancillary data is displayed by the computer onto the complaint writer screen and is subsequently available to the "dispatcher" to be used in the dispatching process.

The Dispatcher

The complaint writer releases a given incident to the dispatcher after all the appropriate data is either keyboarded or computer displayed on the complaint writer's screen.

The dispatcher has access to three computer display screens and one hard copy printer to aid in the dispatching function:

- The AVL screen aids the dispatcher in visually determining the physically closest patrol unit.
- The status screen aids in visually determining patrol unit readiness.
- The case screen is the scratch pad used in the actual dispatching process.
- The hard copy printer provides documented data of all computer supplied information via the mass storage lookup mentioned above.

Unit Assignment

The dispatcher selects the appropriate unit after using the tools shown above and assigns (keyboards) the proper unit as well as using standard verbal communications. The automated dispatching provides electronic status records available on-line as well as hard copy data of the incident in the assigned police unit. The police units report their status to the computer without voice communication via digital encoders (MODATS) which reside in each patrol unit.

After the Fact:

Magnetic Tape Interface and Processing

The history of this "incident loop," (from "incident" through "unit assignment") is captured by the CADS computer and stored on magnetic tape. Daily the magnetic tape is physically transported to the city's central data processing site and undergoes a data reduction and error editing process by the computer which handles the PMRS.

The magnetic tape is the primary vehicle used to provide transaction input into the PMRS. After the input is edited and error free, the data become records within a managed conventional data base stored on disk mass storage at the city's central data processing site.

Management Reporting

The organized, methodical ordering of incident data (operational transactions) to an automated data base allows subsequent access to aid police management in better analyzing and controlling department policy.

The reports produced are tabular as well as graphic. Reports include categories of:

- Monthly Bureau of Criminal Statistics reporting
- Crime Analysis reporting
- Crime and Activity of Part II incidents
- Graphic printer character density maps

produced on weekly and monthly basis.

THE SYSTEMS MODULES: INPUT, FUNCTION, OUTPUT

At Incident Time:

Input: Some action is initiated to classify as requiring police department involvement or notification.

Function: The act requires notification.

Output: Some form of communication with the police department, primarily via telephone by either the victim or an informant.

The Complaint Writer

Input: A telephone communication with either an incident victim or informant.

Function: A display terminal is the basic tool used by the complaint writer to entry new incidents into the CAD system. No paper work is required to enter a complaint into the system. A trained operator can type twice as fast as he/she can write and there is no legibility problem with a keyboard/display terminal.

The complaint writer functions are defined below in chronological sequence:

1. receipt of incident notification

2. input keyboarding of the full address or location of the incident

3. transmits the above data to the central processor unit (CPU) which in turn completes a computer-to-computer transmission to the city's central computer for automatic lookup of applicable dispatching data

4. continues input keyboarding of incident data involving the informant's name, address and telephone number and general remarks, etc.

5. while performing Step #4 above, the complaint writer's screen is supplemented with detail data initiated by Step #3 above

6. the complaint writer uses the bottom half on his/her screen to avoid dispatching twice to an identical incident as it provides a reference to a chronological listing of previous complaints.

Output: The complaint writer functions are completed by releasing the complaint to the dispatching function. This is accomplished by transmitting all pertinent incident data (filled-in as described on the previous page) to the CADS CPU. The dispatcher receives the new complaint instantly and there is no time lost waiting for a messenger, conveyor belt or gravity chute.

Mass Storage Look-up

Input: The on-line computer-to-computer interface passing a formatted full incident address or location.

Function: The mass storage look-up function permits automated and automatic access to conventional data processing files to provide critical data necessary to allow accurate and timely dispatching.

A computer-to-computer interface is the avenue by which the CAD system passes an incident address to the city's central computer facility and serves as the key to provide data in three general areas:

1 - dispatching codes:

RD - reporting district
PB - police beat
ST - micro-fiche access number
FD - appropriate fire department
FB - fire box
GEO-DATA - referencing directional information from the closest crossing arterial streets

2 - approximate X-Y coordinates of the incident. Used in the AVL and management reporting function described later in this paper.

3 - real address verification supplemented with summary and detail data concerning one or any of the following categories:

a. emergency notification
b. medical history
c. hazardous condition
d. criminal history
e. sex registrant
f. gun registrant
g. outstanding warrants
h. general comments

Output: This data is passed back into the CAD system at the complaint writer function and is passed automatically to the dispatcher when the complaint is released to be dispatched.

The Dispatcher

Input: A queued-up complaint awaiting assignment to an appropriate unit appearing visually in summary form on the bottom portion of the dispatcher incident screen.

Function: The dispatcher is assisted by four tools to aid in selecting the closest and proper unit to dispatch:

1. The Vehicle Unit Status Screen

   The CADS controlled display terminal provides the dispatcher immediate visual reference as to the operational status of all units. The integrity of the status per unit is maintained via a digital encoder device in each unit termed a MODAT, which reports changes in status via UHF transmission directly into the CADS computer.

2. The Address-file Hard-copy Detail

   This device displays data stored in the city's central computer in a detail decoded format regarding stored data linked to an incident address for any of the eight possible categories:

   1. emergency notification
   2. medical history
   3. sex registrant
   4. gun registrant
   5. hazardous condition
   6. criminal history
   7. outstanding warrants
   8. general comments

   This information is used to further assist a dispatched unit in proper precautions and handling upon arrival at the scene of the incident.

3. The Dispatcher's Complaint Screen

   This screen is used to assign complaints, send teleprinter messages and access OCATS, CLETS and NCIC. To dispatch or assign a complaint the dispatcher must evaluate the priority and location of the unassigned complaint with the availability of a field unit.

   The dispatcher calls up a complaint by case number, selects a field unit and assigns an appropriate field unit by unit number and the CAD computer automatically updates internal status records and immediately transmits the complaint text via teleprinter to a field unit.

4. Automatic Vehicle Locator System (AVL)

   The AVL system provides the dispatcher with visual reference to the up-to-the-minute location of incidents and field units per their geographic position in reference to, and superimposed over, a city map displayed on a color computer display terminal.

   A computer-to-computer interface exists between the CAD system and the AVL system to:

   - allow AVL to maintain up-to-date displays
   - allow the passing of the central computer supplied approximate X-Y coordinates

AVL tracks the location of field unit via a unique system of permanent and stationary field located sign-posts which continuously report field unit locations.

The AVL system allows the dispatcher to zoom in to near block level if necessary.

Over and above the very clever, unique and innovative capabilities of AVL, its viability ultimately relies on the availability and accuracy of an incident X-Y coordinate. The X-Y coordinates derived from the city's GBF data base are critical to CADS and paramount to AVL.

Output: A visual reference to selecting the proper field unit to assign to a given complaint.

Unit Assigned

Input: The receipt of a UHF teleprinter message in the field unit directing him to an incident.

Function: Provides documented hard copy reference for the field officer of all pertinent data concerning an incident allowing him immediate response capability without having to physically write down information.

Output: The officer dispatched is merely required to depress the appropriate "acknowledged-enroute" MODAT button and proceed to the incident. The MODAT will automatically interface with the CADS computer and update the field unit status.

After the Fact:

Magnetic Tape Interface and Daily Conventional Processing

Input: All operational CADS data related to a case number or incident recorded in a standard, compatible, machine readable format.

Function: Provides the vehicle for passing vital operational automated data to a conventional computer to serve as input and the back-bone for weekly and monthly Police Management Reporting System output. Capturing operational data as it occurs and bypassing the costly and often too populat route of redundant data entry, is the intent of this approach.

The magnetic tape delivered to the city's central computer facility is processed daily to perform data reduction, blocking, and editing before clean records are added to the Police Management Reporting Systems managed data base.

Output: Daily error-free automated updates to the reporting system data base free of expensive human entry costs.

Management Reporting

Input: A conventional Data Base Management System (DBMS) which is primarily created via the magnetic tape interface previously described. Residing at the city's central computer facility, the DBMS, is managed by the generative COBOL tool "Forte2," a licensed program product of the Burroughs Corporation.

Function: The primary objective of the Police Management Reporting System (PMRS) was twofold:

- to automate statistical gathering efforts currently performed by hand and in the process produce a more accurate, less costly product
- to gain access to information of a nature which was too costly to produce by hand previously

The reporting system is run weekly, monthly and upon request. The system is designed to address different levels of information needs:

from detail output to serve as a tool on an operational, day-to-day level

to summary output to top police management level policy decisions

Output: The output can be categorized in four forms:

Bureau of Criminal Statistics (BCS) reporting. The PMR system produces the monthly BCS reports in the format specifically mandated by BCS and is designed to eliminate costly human statistic collection and massaging.

Crime Analysis reports are created by collecting and sorting crime classifications, etc. and massaging such to aid in trend interpretation, pattern recognition, etc.

Part I and Part II crime detail reports offer an ordered visual reference to all DBMS records.

Graphic printer character density maps. This form of output of the PMRS data base, is the most glamorous. The maps are created by a parameter driven software mapping tool first implemented in Huntington Beach during a HUD 701A Federal grant. Since the CAD/AVL/PMR systems all handle or pass incident X-Y coordinates, the use of a mapping package became a natural approach to output. City Data Processing is currently changing mapping software to the GRIDS package which was created and is supported by the U.S. Census Bureau.

AVL Technical Overview

The CADS and AVL Systems provide a total capability for command and control of the entire Huntington Beach Police vehicle fleet.

The AVL System incorporates a direct RF signpost technique to provide, automatically, the most current location of each AVL-equipped vehicle when requested by the AVL system computer. The AVL system automatically makes use of the existing CADS street address data base and GBF DIME file to generate the location, in X-Y coordinates, of both vehicles and cases. These locations and identifying text are graphically displayed on TV monitors, on which are also shown appropriate maps of the City.

Several modes of operation of the AVL system are available to dispatchers. Each mode is selected and controlled directly throughout the existing CADS keyboards. The AVL system also automatically monitors the CADS printers and makes use of certain information which the central City Computer generates during CADS normal operation.

Digital AVL communication to and from vehicles is affected by sharing (digital AVL data between voice) the existing HBPD "green" radio channel. The AVL system is also connected directly into the emergency button in each vehicle AVL equipped and automatically goes into an emergency mode when a vehicle declares an emergency.

The interface between the CADS and AVL systems has been affected so as to allow the AVL system to function when the central City computer is inoperable. For example, when the central city computer is inoperable, the AVL system can still be operated to automatically show the location of vehicles; however, the location of cases would default to an X-Y of the center of the Reporting District. When the AVL system is inoperable, a manual switch provides for operation of CADS in its normal configuration.

The AVL system also provides a set of special microfilm maps and schematics of schools, shopping centers, TAR's, etc. These may be displayed on either dispatcher's AVL display. This unit also includes small 1/16 square mile maps which show street addresses.

Graphic Maps

The CAD system forces X-Y coordinates which are mandatory to the effective operation of AVL. Therefore, since all incidents are "location" based or oriented, management reporting via PMRS can rather easily be displayed on graphic printer character density maps.

The use of printer density map technology allows a visual and meaningful representation of tabular data providing an accurate representation of data which does not require mental massaging, etc.

THE SYSTEMS MODULE DETAIL

Computer (PDP 11/35)-to-Computer (B2771) Interface

Line Discipline:

The handling of transactions between the PDP 11/35 and the B2771 is handled in a "Point-to-Point Dedicated Contention" mode. Each central processor essentially treats each other as a terminal, with each central processor assuming the master-slave relationship by contention. Different timeout and wait intervals are used by each processor to insure staggered reattempts to gain the master status should an initial simultaneous attempt not have broken contention.

The standard data-comm glitch characters used in the protocol include "transmission numbers" as shown below:

S	A	A	T	T	T	S		E
O	D	D	#	#	#	T	TEXT	T
H	1	2	1	2	3	X		X

transmission
number

The transmission number serves the synchronizing key to flag any logic or hardware system malfunctions. The fact that a transmission number has not been incremented by one from the previous transmission will indicate a sequence problem. The transmission number will then serve as a key to re-synchronize the PDP 11/35 and the B2771.

Format:

After proper handshake and protocol, the format of the data elements which comprise the "TEXT" area of the "incident address" send, is shown and defined below.

	Field Name	Description	Field Position
(A)	LOCATOR	Originating CADS terminal address	1,2
(B)	HOUSE NBR.	-	3-7
(C)	STREET NAME	or intersect street	8-21
(D)	INTERSECT STREET	if at an intersection	22-35
(E)	APT. or SUITE	-	36-39
(F)	CITY CODE	fire dispatching only	40-41
(G)	SERVICE CODE	F - fire, P = police, C = combined	42

Subsequent reference to the data elements of the "TEXT" described on the previous page will be referred to by the capital letters shown.

Contentions:

Three separate variations of the format discussed previously under Complaint Writer Format are allowed.

(1) 1 2 3 4 5 C O L U M B U S ; - ; A

standard entry for a specific incident address

(2) C O L U M B U S I N D I A N

intersection entry for an incident occurring at a given intersection

(3) 1 2 3 B L C O L U M B U S

100-block entry for incidents at other than a specific address but defined by a 100-block

The standard entry, (1) above, field (D), should not contain any pertinent data; Field (D) is ignored by the B2771 when Field (B) is n-meric and without the letters "BL" in the tens and units position of the address (left justified if less than five numeric positions). Field (C) is passed against the on-line street guide/microfiche file for validity:

- if the street name is valid, control will pass to Full Address Verification

- if the street name is invalid, the B2771 sends back to the PDP 11/35 the appropriate LOCATOR field and the canned error message "STREET NAME INVALID." Control will then switch to neutral as if no PDP 11/35 transmission had occurred. This error message returns to the PDP 11/35 within six seconds from the initial address transmission and while an informant is still on the telephone, and immediately places the error text on the appropriate CRT.

The intersection entry, (2) above, fields (B) and (E), should not contain any pertinent data; both fields will be ignored by the B2771 when field (B) is blank. Field (C) will be passed against the on-line street guide/microfiche file for validity:

- if the street name in field (B) is valid, then a subsequent street guide/microfiche search will begin to verify the validity of field (D).

    - if a valid hit is not encountered for field (D), then the B2771 will send back to the PDP 11/35 the appropriate LOCATOR and the canned error message "SECOND INTERSECT STR-NAME INVALID." Control will then switch to neutral as if no PDP 11/25 transmission had occurred.

    - else if a valid hit had also occurred on the street name in field (D), then "summary Phase II data" will be transmitted to the PDP 11/35 along with its appropriate LOCATOR. The detailed discussion of "summary Phase II data" is itemized under Full Address Verification.

- if the street name in field (C) is invalid, the B2771 will send back to the PDP 11/35 the appropriate LOCATOR and the canned error message "FIRST INTERSECT STR-NAME INVALID." Control will then switch to neutral as if no PDP 11/35 transmission had occurred.

The 100-block entry, (3) above, fields (D) and (E), should not contain any pertinent data; field (D) and (E) will be ignored by the B2771 when field (B) is numeric in the hundredths position and the letters "BL" are present in the tens and units position of the address (left justified if less than five numeric positions). Field (C) will be passed against the on-line street guide/microfiche file for validity.

- if the street name in field (C) is valid, then a subsequent street guide/microfiche search will begin to verify the validity of the 100-block, e.g., if field (B) = "123BL", then search will verify whether the 12300 hundred block exists within the address ranges of any of the possible road segments on the street defined by field (C).

    - if a hundred block figure does not exist, the B2771 will send back to the PDP 11/35 the appropriate LOCATOR and the canned error message "100-BLOCK OF NNNOO -- INVALID." Control will then switch to neutral as if no PDP 11/35 transmission had occurred.

    - else if a valid hit had also occurred on a valid 100-block for field (B), then "summary Phase II data" will be transmitted to the PDP 11/35 along with its appropriate LOCATOR.

- if the street name is invalid, the B2771 will send back to the PDP 11/35 the appropriate LOCATOR and the canned error message "STREET NAME INVALID." Control will then switch to neutral as if no PDP 11/35 transmission had occurred.

Multiple word street-names (C and D) are bound by the conventions shown below, keeping in mind that the street name fields are all 14 positions in length and are entered excluding the suffix LN, CR, DR, etc.

1. Street names consisting of more than one word must be entered as one word. Internal spaces must be removed, e.g., "VISTAȸDELȸSOLȸLANE" shall be entered "VISTADELSOL."

Three special variations of multiple-word names also follow:

1. An incident reported on a frontage road must be entered to distinguish it from its primary by following the street name with a dash and the letters "FR"; e.g., ADAMS-FR.

2. A county numeric street name within Huntington Beach which conflicts with an identical numeric street name under the city number scheme must be made unique by following the street name with a dash and the letters "CO"; e.g., EIGHTH-CO.

3. Any street name containing the prefix word "SAINT" will be abbreviated as "ST" followed by a space; e.g., "STbANDREWS." This will be the only exception to the "VISTADELSOL" convention discussed above.

CADS Phase II Handling (B2771)

Design Criteria and Logic:

The primary objectives of Phase II is to provide automated support to CADS by providing:

1. specific dispatching codes (RD, ST, BT, FB, FD)
2. geo-data of closest crossing arterials
3. approximate X-Y coordinates
4. indicator flags of applicable sub-file linkage*
5. detail data of applicable sub-file records*

As mentioned previously, there are three general incident location or address inquiries handled by Phase II:

- the standard entry
- the intersection entry
- the 100-block entry

The standard entry will return all five levels of data shown above to the dispatcher.

The intersection and 100-block entry will return only the first three.

The three major file components of the Phase II CADS were all designed to be accessed with as little disk I/O as possible so none of the files are accessed by indices but rather by a rigorously formulated access algorithm.

Computer (B2771)-to-Computer (PDP 11/35) Interface

Format:

The data sent back from the B2771 computer is accomplished via computer-to-computer in summary and computer-to-thermal printer in detail.

The specific definition of the character string defined as "summary Phase II data" is the 98 character text shown below. It is understood that the reader realizes the line discipline previously mentioned is in force for the computer-to-computer handshake/protocol and only the "text" of the message is shown here.

Field Name	Description	Field Position
LOCATOR	Originating CADS terminal address	1,2
RD	reporting district	3-5
ST	police microfiche access nbr.	6-7
BT	police beat	8-9

*Emergency notification, medical history, hazardous conditions, criminal history, sex registrant, gun registrant, outstanding warrants and general comments.

Field Name	Description	Field Position
FB	fire-box	10-11
FD	fire-department	12,13
GEO-DATA-1	closest crossing	14-23
GEO-DATA-2	arterial streets	24-32
SUB-FILE-FLAGS	indicator of detail on file	33-44
X-COORDINATE	approximate calculated at address	45-51
Y-COORDINATE	load time	52-58
FIRE-ASSIGNMENT	for first, second, third and fourth alarms	59-98

Upon a successful completion of a "full address verification" and subsequent transmission of the "summary Phase II data" to the PDP 11/35, the B2771 will access all appropriate sub-file data elements linked to the address record. The sub-file detail data is field separated, decoded and passed to the appropriate Fire or Police (or both) hard copy thermal printer which is solely dedicated to list element display.

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THE SAN ANTONIO POLICE DEPARTMENT GEOGRAPHIC-LOCATION (GEO-LOC) SYSTEM

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In order to fully appreciate the magnitude of designing and implementing our geographic base file (GBF), I would like to give you a brief history and description of San Antonio, its founders, citizens and geography.

San Antonio lies at the southern edge of the Texas Hill Country in South Central Texas, approximately 280 miles south of Dallas. It was founded by Spanish missionaries in 1718. At the end of World War II, its city limits encompassed 76 square miles. Since then, the city has experienced rapid growth in population, area and suburbs. Today, we have a population of 802,092 covering 263 plus square miles and 22 incorporated bedroom cities, seven of which are completely surrounded by San Antonio. The city's average daily population is estimated at more than a million.

San Antonio is often called one of America's four unique cities. I will give you some of the lesser known reasons for this title. There is no known reason for the manner in which streets were, and are still, being laid out. Some speculate that old cattle paths through the South Texas Brush were simply paved. Others claim that would have resulted in straighter streets and contend that rattlesnake trails were used instead. Still other, less charitable, people blame the founders' love of the grape,and, that love was passed on to their descendants. Regardless of the reason, street patterns are not geometric. A map of the city resembles a giant spiderweb, constructed by a paranoid spider.

Over the years, planners have shown both a lack of imagination and an over-abundance of it in naming streets. Some streets change names three times in six blocks, while some names, such as Park, are given to as many as nine different streets.

Planners have been indecisive. Streets are often renamed, then the old name reused. Residents often do not accept the new name and continue to use the old street name for years. Even some city agencies have not updated their records to reflect street name changes made 20 years ago. There is also some doubt as to whether the San Antonio River or Main Avenue should divide East-West streets. This has resulted in several house renumbering projects.

Coordination and standardization of street names appear to have been neglected in years past. We found many, many instances where two streets separated by several miles had the same name with only a suffix such as Road or Avenue to distinguish between the two. An example is Callaghan Road and Callaghan Avenue. They are about 12 miles apart, yet they have the same beginning house number ranges. In attempting to put the GBF together, we found that even within the same agency's file, addresses which were actually on Callaghan Road were carried as Callaghan Avenue and vice-versa. Many address records contained only "Callaghan." To further complicate matters, the same situation exists for street signs. Many residents do not know whether they live on Callaghan Avenue or Callaghan Road.

I would go on for the next two days in the same vein. I hope with this background, you can imagine all sorts of potential problems in developing a GBF, especially one to support Computer Assisted Dispatching (CAD) and a wide range of other applications.

During the conceptual design of our GBF System, I had great visions of building a system which would satisfy the needs of a wide range of city and other governmental agencies. I was sure they would immediately recognize the great potential of a GBF and would eagerly and enthusiastically support and contribute to such a system. I began contacting agencies such as Fire, Planning, Engineering and Zoning. I found their response underwhelming in most cases.

Now that the data is available and the work is completed, the light has dawned. Outside agencies which have requested to use our system included the Alamo Area Council of Governments (a supporter from the beginning) for traffic transportation and car pooling studies; Bexar County for voter precinct lists and verification; City Transit Authority; City Human Resources for service distribution studies, location of service center studies and other purposes; and the City Manager's Officer for a wide variety of geographic studies. I have also received inquiries from other local agencies.

The lesson to be learned is: don't believe other agencies when they tell you they don't need a GBF. They do, and as soon as you get one, they will want to use it.

With little knowledge or respect for the aforementioned problem areas, we began to design a Geographic Base File System which would meet the following broad requirements:

1. Contain sufficient detail to support:

   Computer Assisted Dispatching
   Manpower Allocation
   Work Load Distribution
   Crime Trend Analysis
   Crime Pattern Analysis
   Automatic Vehicle Monitoring
   Other Future Projects

2. Provide as much flexibility as possible in order to:

   Rapidly and easily reconfigure patrol districts.
   Utilize multiple patrol district configurations to maximize manpower allocation techniques.
   Preserve historical activity.
   Geocode data from other agency files for comparison to police files.
   Provide a means of selecting historical data for study based on changing and not previously defined geographic areas.
   Meet future needs of the department and other agencies.
   Adequately handle street name changes, renumbering projects and other data inconsistencies.

3. Provide for file maintenance and integrity by:

   On-line inquiry utilizing various selection criteria.
   On-line update from selected terminals.
   Capturing update data at its source.
   Making manual operations in other areas dependent upon the system.
   Obtaining a broad and varied base of system users.

We felt from the beginning of the project that any GBF design should be based on an X,Y Grid Coordinate System. We began a survey to determine local sources of coordinate-based geographic data and other files containing address information. We located two coordinate-based files and three other automated address files.

There was in existence a GBF DIME File for San Antonio. Considerable work had been done by the local Council of Governments in traffic/transportation studies and car pooling utilizing the GBF DIME File data. The results were inconsistent due to several factors. The DIME File had been created in 1970 with no subsequent updating. Digitizing was done from maps drawn in 1967 which made the data eight years old. The street names were riddled with errors and misspellings. When plotted, it was obvious that the digitizing of nodes was also inaccurate, with the North-South axis shortened by approximately 20 percent and the East-West axis elongated by about the same percentage. Individual records had coordinate keypunch errors which moved the location 10,000 feet or more.

After spot-checking the accuracy of the statements made to us by others who had worked with the data and by examining it ourselves, we decided that it would be easier to build a DIME File from ground zero than to attempt to update and correct the existing file. We then looked to the other available coordinate-based files.

The San Antonio City Public Service Board (CPSB) suppliers of electricity and natural gas, has maintained their customer file, at the address level, for a number of years. Included in the customer record are the X,Y Coordinates of the meter tap and other useful items such as the number of dwellings (single, apartments, etc.) building structure type, standard industrial class and the city in which the location lies. In addition, this file had been constantly purified over an eight year period and was felt to be in excess of 95 percent accurate.

Early analysis of broad requirements for present and future systems seemed to call for an address level GBF. This would allow us to verify the existence of specific addresses in our on-line Jail Booking System, Criminal Index, Computer Assisted Dispatching System (CADS) and other systems all deemed desirable if the price was right. The existence of the CPSB File and a Data Base Management System combined to make an address level GBF feasible, relatively inexpensive and irresistably attractive. We decided to build the system at the address level using the CPSB File as a base.

We also located other automated address files such as the City Tax files, City Water Board customer files and the Polk Directory file for San Antonio. We utilized these files to verify addresses and add to the basic file. While the City Tax file was quickly discarded because of outdated, incomplete and inaccurate data, the other files proved useful.

When we began analyzing the specific needs for CADS, we found several problem areas we wanted to address. Patrol units were being dispatched to non-existent locations for several reasons, among which were intersections of parallel streets, non-existent house numbers on sound-alike streets, house number errors caused by number transposition, missing street directional indicators and suffixes, etc. Officers were also wasting time trying to locate complainants in apartment complexes when telephone clerks did not ask for apartment numbers. There was a need for the capability to dispatch based on names of public places. Field officers also had difficulty in locating addresses, even with existing commercial maps and street guides.

After the CADS analysis, we refined the requirements to include:

1. Capability to handle alias street names.

2. Conversion of names and public places to street addresses.

3. Conversion of public coin-operated telephone numbers to street addresses.

4. Validation of the existence of specific locations to include house numbers, block numbers and intersections of street with street, street with stream, street with railroad and railroad with stream.

5. Notification to operator of insufficient data to identify specific locations.

6. Indication of existence of multiple dwellings at specific addresses.

7. Determination of city of occurrence.

8. Determination of patrol district of occurrence.

9. Upper and lower cross streets.

10. Previous addresses (to handle house renumbering).

11. Pertinent data about the location.

Since the City Public Service Board customer file did not contain intersection records, it was necessary to create them. This was accomplished by obtaining a copy of their base maps (500 feet to the inch) and assigning each intersection a sequential node number. A commercial firm was contracted to digitize these nodes and plot their value on a transparent overlay which was checked against the map for accuracy. We created punch card records containing intersection street names from the DIME File and added the node number to the record. We had to correct street names in approximately 40 percent of those records. Less than 70 percent of the intersections had DIME File records. Upon completion of the intersection records with their node numbers, we matched them with the magnetic tape record from the digitizer and added the X,Y coordinates. From this point on, it took 20 months to gather, manipulate and purify the remainder of the data.

Twenty calendar months seems like a long time. Actually, well over 100 man-months of clerical labor was expended on data purification after we received existing automated address and street name files. An additional 36 man-months had been spent by the Alamo Area Council of Governments on the Street Name Directory which we used as a starting point. The existing data was a mess and source documents were conflicting.

Source documents, files and resources utilized during the project were:

- Automated Address Files
  - City Public Service Board's Customer File
  - City Tax Assessor's File
  - Polk Directory File
- Published Documents
  - Kriss Kross Directory
  - City Directory
  - Commercial Street Guides
  - Zip Code Directory
- Maps
  - City Public Service Board's Base Maps
  - Various Commercial Maps
  - Texas Highway Department Maps
  - City Planning Department Maps
  - Bexar County Planning Department Maps
  - National Geodetic Survey Maps
- Mr. Beaulieu

One could mistakenly believe that these source documents would be adequate. In reality, the more sources of information, the more conflicting data we obtained. I could talk on this subject for hours. Some of the inconsistencies we found were:

- Incomplete street names, i.e., missing directional indicators, suffixes, etc.
- Streets non-existent on one map, existing on another.
- Streets bearing different names on different maps.
- Different street names used in different files for the same street.
- Failure to update records involved in renumbering projects.
- Maps beating erroneous street names or outdated names.
- Duplicate street names on the same map.
- Inconsistent street name spelling.

Resolution of these conflicts is a tedious, time-consuming process which is necessary in order to have a viable GBF. We utilized all of our reference material and even made telephone calls to residents and on-site inspections.

We had been working on data purification for about a year when a gentlemen walked into my office carrying an armful of dog-eared notebooks and asked if I could use them. They turned out to be a handwritten, sight-verified, block level, geographic base file. It seems that his wife had given him a police radio scanner for Christmas and he had spent considerable time listening to police calls. He became disgusted with our field officers receiving erroneous directions on how to get to specific locations. He purchased the best commercially available maps and street guides, the same as we were using, and personally checked out directions we were giving officers in the field when the officer stated the map was wrong. He found that the maps and street guides were inaccurate. Since he had retired from the military and had little to do in his spare time, he decided to compile a new street guide. During the next year, he drove over 10,000 miles on city streets compiling his street guide. He has since sold it to a commercial firm and it is now available on the market. He was kind enough to allow us to use his notes in our project. They have proven to be the most accurate and reliable source for resolving conflicts. Since his notes were compiled from driving, the street names reflect the name on the street signs. This pointed out other inconsistencies, as the street signs did not always coincide with the legal street names.

Compared to data purification, design was a snap. During 1975, we had surveyed the market for a Data Base Management System for present and future applications. We selected Software Ag's ADABAS and began the procurement process. ADABAS appeared to be well suited for our GBF application so system design began utilizing ADABAS.

In order to provide maximum flexibility, the GEO-LOC System is composed of three separate, though closely related, files containing the following data elements:

Street Name Directory/Street Identification Number

- Uniquely identifies each street record and is system assigned.
- Preferred Street Name.

  Usually the legal street name complete with directional indicator and suffix.
- Alias Street Names (99 maximum)

  Alias Names common misspellings, previous names, partial names (preferred without directional indicator, suffixes, etc.)
- Relationship Indicator

  Identifies street name as preferred, an alias unique to one street only or an alias of multiple streets.
- File Size

  12,000 Records
  5 Indices, including Phonetic
  13 Total Cylinders (3330 Mod II)

Geographic Location File

- Location Identification Number

  System assigned record number
- Record Type

  Address, Block, Intersection
- House or Block Number

- Street Identification Number
- Intersecting Street Identification Number

  (If record type is intersection)
- Town Code

  Identifies governmental jurisdiction, one of 27
- Census Tract No.
- Number of Dwellings
- Standard Industrial Class
- Structure Type
- X,Y Grid Coordinates
- Zip Code, Mail Route and Sequence Number
- Lower End of Block Cross Street

  (Block number and Street Identification Number).
- Upper Cross Street

  (Block number and Street Identification Number).
- Previous Address
- Other Addresses

  Side entrances, etc.
- Location Names

  Names of public places, buildings, etc.
- Coin Operated Telephone Number
- Location Nodes

  Occupant data, officer hazards, etc.
- File Size

  500,000 Records
  12 Indices
  525 Cylinders (3330 Mod II)

Polygon File

- Polygon Name
- X,Y Coordinate of Centroid
- Area
- Sequence Number and X,Y Coordinates of each Point Defining the Polygon in Clockwise Rotation.
- High X Value
- Low X Value
- High Y Value
- Low Y Value

System operation and maintenance utilizes programs to provide the following functions:

- Street Name Directory

  On-line inquiry by preferred street name or alias street name using exact spelling or a portion of the name (1st character or more); phonetic name, or street identification number; on-line updates and additions.

- Geographic Location File

  On-line inquiry by address, intersection, block number, location name, location name with street name, coin operation telephone number, second (side entrance) address, previous address and location identification number; on-line updates and additions; batch updates and additions.

- Polygon File

  Batch updates point-in-polygon/GEO-Coding program.

GEO-LOC Sub-System Hardware/Software Description

- Hardware

  - IBM 370/158/3 2 MB Real Storage
  - IBM 370/158/3 3 MB Real Storage
  - 3270 Video Display System (CRT and Printer).
  - 3330 Mod II Disk Drives

- <u>Software</u>
    - Systems Software
        - OS/VS1 Release 6.0 (MVS by 1, October 1978).
        - BTAM (Vtam 1, January 1978)
        - CICS/VS Release 1.3 (DC)
        - ADABAS Release 3.2 (DB)
    - Applications Software
        - Batch - ANS Cobol
        - On-line - CICS/Cobol

In this paper, I have attempted to describe our GBF, some of the rationale for the design and some of the problems encountered along the way. San Antonio is a unique city, as every city is unique. Our problems will not necessarily be your problems, our system requirements were undoubtedly different from your requirements and your system will be different from ours. However, there are some broad statements I believe apply in general to anyone contemplating or designing a GBF.

Thorough analysis of present and future needs is a must. Don't overlook other users of your GBF. Anticipate possible users and dream a little in the early stages of analysis and design. Rank the requirements from "essential" to "nice to have."

Conduct an in-depth survey of the locally available data sources. You may be pleasantly surprised to find an abundance of readily usable data. Analyze, compare and evaluate the various data sources.

Redefine the system requirements in light of the availability, reliability, and detail of the source data. Some "nice to have" items may become practical.

Don't neglect file maintenance procedures. A tremendous amount of time, money, effort and frustration will be spent in creating a GBF. In all probability, it will be outdated the day it becomes operational and will deteriorate rapidly. Reliable procedures to obtain street name changes, house renumbering, new subdivisions, annexations, etc., must be in place before data gathering and purification begins.

Detailed procedures should be worked out for data gathering and purification prior to beginning that process. This could be the most difficult and time-consuming part of the entire project.

I hope our experience will be of some value to you. The attached file descriptions and examples of system input formats (pp. 126-130) are provided for further information.

FILE 1

ALIAS STREET NAME FILE

ELEMENT DESCRIPTION	FIELD CODE	MNEMONIC	EXT SIZE	INT SIZE	FORMAT TYPE	RECORD POSITION	FDT
LAST UPDATE GP	AA	LUP	16	16			01,AA
DATE	A1	DLU	6	6	N		02,A1,6,U
TIME	A2	TLU	4	4	N		02,A2,4,U
AGENCY	A3	ALU	4	4	A/N		02,A3,4,A,FI
OPERATOR NO.	A4	OLU	2	2	A/N		02,A4,2,A,FI
STREET NAME	BA	SNG	15	15	A		01,BA,15,A,MU,.
STREET CODE	CA	SNC	5	5	N		01,CA,5,U,MU,1
	B1	SNR					B1=BA(1,1)
	B2	SNA					B2=BA(2,15)
	PN	SNP					PN=PHON(BA)

CADS

GEOGRAPHIC BASE FILE

ELEMENT DESCRIPTION	FIELD CODE	MNEMONIC	EXT SIZE	INT SIZE	FORMAT TYPE		RECORD POSITION	FDT
Descriptive Group	AA	DSG						01,AA
Town Code	A1	TNC	2	2	N	ZF		02,A1,2,U
Grid Coordinate	A2	GRD	12	12	N	ZF		02,A2,12,U
Census Tract	A3	CST	4	4	N	ZF		02,A3,4,U,DE
Number of Dwellings	A4	NOD	4	4	N	ZF		02,A4,4,U,NU
Standard Industrial CL	A5	SIC	4	4	N	ZF		02,A5,4,U,NU
Structure Type	A6	STT	1	1	A			02,A6,1,A,NU
Lower Street	BA	LST						01,BA
Block Number	B1	LSB	5	5	N	ZF		02,B1,5,U,NU
Street ID Number	B2	LSN	7	7	N	ZF		02,B2,7,U,NU
Upper Street	CA	UST						01,CA
Block Number	C1	USB	5	5	N	ZF		02,C1,5,U,NU
Street ID Number	C2	USN	7	7	N	ZF		02,C2,7,U,NU
Record Type	DA	RCD	1	1	A			01,DA,1,A,FI,DE
Last Update	FA	LUP						01,FA
Date	F1	DLU	8	6	N			02,F1,6,U
Time	F2	TLU	4	4	N			02,F2,4,U
Agency	F3	ALU	4	4	A/N	LJ		02,F3,4,A,FI
Operator	F4	OLU	2	2	A/N	LJ		02,F4,2,A,FI
Address/Place/Intersection	GA	CAD						01,GA,19,A,NU,DE
House/Block/Number	G1	CHB	5	5	N	ZF		
Street ID Number Place	G2	CSN	14	14	A/N	LJ		G2=GA(6,19)
Old Address (HS# Chgs only)	KA	OAD						01,KA,12,U,NU,DE
House/Block/Number	K1	OHB	5	5	N	ZF		
Street ID Number	K2	OSN	7	7	N	ZF		
Zip/Route/Sequence	LA	ZRS						01,LA
Zip Code	L1	ZIP	5	3	N	ZF		02,L1,5,U,NU
Route	L2	RTE	3	3	N	ZF		02,L2,3,U,NU
Sequence	L3	SEQ	5	5	N	ZF		02,L3,5,U,NU
Hazardous Location	MA	HZL						01,MA,PE
Assignment Number	M1	HZA	8	8	N			02,M1,8,U,NU,DE
Date of Assignment	M2	HZD	8	6	N			02,M2,6,U,NU,DE
Remarks	M3	HRM	100	100	A/N			02,M3,100,A,NU
Last Update	M4	HUP						02,M4
Date Last Update	M5	HLD	8	6	N			03,M5,6,U,NU
Time Last Update	M6	HLT	4	4	N			03,M6,4,U,NU
Agency	M7	HLA	4	4	A/N			03,M7,4,A,NU
Operator	M8	HLO	2	2	A/N			03,M8,2,A,NU
	AX	GRX						AX=A2(7,12)
	AY	GRY						AY=A2(1,6)

CADS

GEOGRAPHIC BASE FILE

ELEMENT DESCRIPTION	FIELD CODE	MNEMONIC	EXT SIZE	INT SIZE	FORMAT TYPE	RECORD POSITION	FDT
	SA	TCA					SA=A1(1,2),DA(1,1),G/ (1,19)
	SI	TCI					SI=A1(1,2),DA(1,1),G/ (6,19)
	SR	RCA					SR=DA(1,1),GA(1,19)

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                         PA1 OR SELECT A,F,P, OR UPDATE WITH PGLU     PAGE

             G E O G R A P H I C     L O C A T I O N     F I L E
LOCATION LOC          ADDRESS              INTERSECTING STREET        TN    CNCS  HZD
 ID   NO   TYP HSE/BLK  STREET NAME         BLOCK    STREET NAME       CD    TRCT  LOC
.......    .   .....  ..............       .....   ..............     ..    ....   .

 NBR       SIC   STR  GRID COORDINATE      MAIL  INFORMATION        LAST UPDATE
 DWELL            TYP    X          Y       ZIP    ROUTE    SEQ     DATE   TIME AGNY OP
 ....     ....    .   ......     ......   .....    ...    ..... ..-..-.. .... .... ..

   LOWER CROSS STREET        UPPER CROSS STREET           PREVIOUS ADDRESS
  BLOCK    STREET NAME      BLOCK   STREET NAME         HSE/BLK  STREET NAME
  .....  ..............     .....  ..............        .....   ..............

                        PLACE NAMES OR LOCATION ALIASES
              HSE/BLK  STREET/PLACE              HSE/BLK  STREET/PLACE
               .....   ..............             .....   ..............
               .....   ..............             .....   ..............
               .....   ..............             .....   ..............
               .....   ..............             .....   ..............
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                    ,PA1,PA2 OR SELECT A,F,P OR UPDATE  WITH PGLU    PAGE

             G E O G R A P H I C     L O C A T I O N    F I L E
      H A Z A R D O U S / M I S C E L L A N E O U S    I N F O R M A T I O N
        ASSIGNMENT        OCCURRENCE                     DATE OF ENTRY OR UPDATE
          NUMBER             DATE                        DATE      TIME  AGENCY  OP
        .. .......        ..-..-..                     ..-..-..    ....   ....   ..

          DETAILS:  ...............................................
                    ...............................................
        ASSIGNMENT        OCCURRENCE                     DATE OF ENTRY OR UPDATE
          NUMBER             DATE                        DATE      TIME  AGENCY  OP
        .. .......        ..-..-..                     ..-..-..    ....   ....   ..

          DETAILS:  ...............................................
                    ...............................................
        ASSIGNMENT        OCCURRENCE                     DATE OF ENTRY OR UPDATE
          NUMBER             DATE                        DATE      TIME  AGENCY  OP
        .. .......        ..-..-..                     ..-..-..    ....   ....   ..

          DETAILS:  ...............................................
                    ...............................................
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PA1 FOR NEXT PAGE OR SELECT LINE NUMBER PAGE

G E O G R A P H I C L O C A T I O N F I L E

LN NO	HOUSE BLOCK	STREET NAME	LOWER CROSS STREET	UPPER CROSS STREET	TN CD	LOCATION ID NO
..	.....	....	....	....	..	....
..	.....	....	....	....	..	....
..	.....	....	....	....	..	....

PA1 FOR NEXT PAGE OR SELECT LINE NUMBER PAGE

G E O G R A P H I C L O C A T I O N F I L E

LN NO	BLOCK	INTERSECTING STREETS STREET	BLOCK	STREET	TN CD	LOCATION ID NO
..	.....	....	.....	....	..	....
..	.....	....	.....	....	..	....
..	.....	....	.....	....	..	....
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DESIGN OF AN ADDRESS VERIFICATION FILE FOR THE CITY OF PORTLAND/COUNTY OF MULTNOMAH POLICE COMPUTER ASSISTED DISPATCH SYSTEM

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BACKGROUND

The need for an address verification file was created when the City of Portland Police Department was selected as one of several agencies to share in LEAA-IMPACT funding. During the initial planning for disbursement of this funding, it became apparent that the existing police communications system could not support the additional demands of special missions. Radio coverage was poor, and in some cases non-existent, equipment was obsolete, dispatch procedures slow and cumbersome, and the two radio channels were reaching 90 percent saturation of available air time. A decision was made to use a portion of these funds to improve the police communications system by implementing a Computer Assisted Dispatch System.

A Public Safety Communications Project was organized and a project staff consisting of a Director (police sergeant), Steering Committee (management, technicians, administrators), Police Coordinators (county and city police officers), Administration (clerk, budget analyst), and a Design and Implementation Contractor (BCS). The project became a combined city/county effort when officials from both agencies realized the need to combine two separate communication operations into one.

During the design phase of the total system, one goal appeared foremost; a way to improve the call processing through the system. The manual system that both agencies were using was not efficient, especially in the area of address location verification. Therefore, the design and implementation of an automated verification system (AVF) became a basic requirement.

DESIGN SPECIFICATIONS

To facilitate the design phase of this sub-task, a AVF Project Team was organized consisting of a supervisor (police officer), clerical staff (clerks, work study students), and a design and implementation contractor (BCS). It proved of great benefit to the project to have selected a contractor who had prior experience in the design and implementation of a AVF system. There are many hidden problems and expenses in developing a file of this type which can be identified and solved by an experienced contractor.

The first task undertaken by this team was to develop a pert schedule, flowchart, and milestone listing to track the progress of this effort and to insure that all work is completed within the time schedule.

The first and most important design decision was the selection of a Geo File upon which to base the AVF file. The United States Census Bureau's Dual Independent Map Encoding (DIME) File was selected for the following reasons:

1. Software and procedures for correction, update, and extension (CUE) were available.

2. Training material for procedures were available.

3. File, maps, and coding material were available.

4. File contained the majority of data needed such as street names listing, address ranges, state, county and city codes, and the x,y coordinates for street intersections.

5. Programs were available to add unique information to the file.

One negative aspect to the use of this file was the fact that it had not been updated for approximately seven years and required a substantial clerical effort to improve the data. The Census Bureau provided an estimate of the update workload which assisted in planning for this effort.

After selection of the DIME File, work commenced on production of the system specifications. These specifications were written in two documents. The first described the building of the file and the second the system functions.

FILE CONSTRUCTION

The initial step in file construction was to obtain the file tape, programs, and material from the Census Bureau. All programs supplied were written in COBOL (ANS) and required the use of a large computer for processing. An attempt was made to contract this processing on a city or county computer system but the cost and turnaround process time proved excessive. All processing was accomplished on an IBM-370 through a contract with the contractor.

Upon receipt of the DIME File tape, it was found to contain many extraneous records for areas not included in the city/county police jurisdiction. To reduce the clerical effort, a program called EXTRACT was written which removed these extra records from the file. This program compared city and county place codes and only selected those within our jurisdiction for inclusion in the file. The corrections were made to this EXTRACT file using the Census Bureau edits and programs as follows:

1. Name Consistency Listing (FIXDIME II)

2. Single Side Segment Listing (FIXDIME II)

3. TOPO-EDIT (FIXDIME II)

4. ADD-EDIT (FIXDIME II)

All of these edits and corrections required an extensive effort of the entire clerical staff for approximately three months.

The next step in file creation was to update the base file maps. The maps used were the Metropolitan Map Series (MMS) sheets supplied by the Census Bureau for the metropolitan area. These maps did not cover the entire area so new maps had to be drawn for those areas. The map updating was then accomplished using the following:

1. New streets drawn onto maps

2. Tracing and digitizing to assign node numbers and x,y coordinates

3. Coding, keypunching, and (FIXDIME II) programs to add data

4. New coordinates added (FIXCORD)

Once the maps were updated, the next step was the addition to the file of police unique data, patrol districts and jurisdictions. An attempt to use a Census Bureau POLYGON program proved to be costly. This program was abandoned and the majority of the information was coded and entered by using a program SHORT FORM FIXDIME, which was supplied by the contractor. This program was a derivative of the Census Bureau FIX-DIME II program and allowed for the entry of data by using codes.

The completed file was then reformatted into a shorter version by an UNLOAD program supplied by the contractor. This program only retained data needed by the address verification program.

Other miscellaneous files were created to enhance this address verification file, including:

1. Route and Box File

2. Landmark File

3. Alias File

The Route and Box file is a separate file which contains route and box data. It was necessary to create this file because the Census Bureau DIME File System does not accommodate this type of address information. This file was created using a program supplied by the contractor. The input data was supplied largely by the rural fire districts, and consisted of street names (associated with box number); distance and direction to the address from the nearest cross street, side of street box located, and any other special information to assist in the location of the address.

The Landmark File was created using a contractor-supplied program. This file contains any unique location or building that is considered permanent and well known.

The Alias File was created also using a contractor-supplied program. This file accommodates street names that have two or more aliases and those common misspellings that are not covered by the soundex system.

The completed UNLOAD file, with Route and Box Landmark, and Alias Files added, was then loaded into the computer system. The configuration allows for this file to be entered off-line on the secondary computer, which allows the system to function without disruption.

OPERATIONAL FUNCTIONS

The Operational Address Verification Software Program was contractor-supplied and is a derivative of a program that is operational for another agency. By using this operational program, developmental design was kept to a minimum. Throughout the design of this software program, the basic goal was to make operator tasks as simple as possible.

The basic function of the system is to verify addresses. This system does not verify individual address but only verifies that a legitimate address range does exist for tne entry data. The operator displays an incident format on the CRT and the cursor is automatically positioned to the location field. The operator then enters location information in one of four different ways:

1. Street Address

2. Street Intersection

3. Landmark Name

4. Route and Box

A minimum character search feature allows the operator to enter only enough data to uniquely identify the location.

A Soundex feature allows for misspellings and will search the file and return a list of possible names so the operator can make the necessary changes.

Once the location has been entered by one of the four methods, the AVF system then searches the file and verifies the location, returning to the operator the address, quadrant, street name, street type, hundred block, and nearest cross street (name, type, and hundred block). Also supplied to the operator is the agency jurisdiction, map code for microfilm display and police patrol district for the location entered. If more than one location matches the entry data, a multi-hit will occur and the system will display a list of possibles. The operator will then select the desired line for entry.

After the address or location has been verified, the system will then search for nearby incidents and temporary situations. The search criteria for both of these features is 1,500 feet for the metro area and 3,000 feet for rural area. Whenever this information is appended to the incident verification, it only contains enough information to allow the operator to make comparisons. Location verification is also accomplished for other system files as follows using this same procedure:

1. Alarm File

2. Ambulance File

3. Tow File

Address verification response time is approximately six seconds.

The entire AVF File is microfilmed and supplied to all operators for reference or for use in case the system fails and manual operation is required.

FILE MAINTENANCE

AVF File maintenance is ongoing and updates to the file are made semi-annually. The same procedures and programs as used in the initial update effort are used. Update data comes from two sources, agency planning boards and annexations. A trouble log is supplied to each operator to record any problems or changes to the data. The Address File Coordinator then verifies the update and processes the corrections.

CONCLUSION

The AVF File as designed and implemented has accomplished the basic goal of reducing location verification process time from two or three minutes to approximately six seconds. The file is simple to maintain and the operators have a system which supplies more information faster and is easier to operate than the old manual system. The AVF effort was greatly enhanced by using the Census Bureau DIME File and programs and selecting a contractor with previous experience in the development of a similar project. The utilization of a proven software system reduced the design effort and the implementation of the AVF system.

GEOGRAPHIC BASE FILE SYSTEM IN SUNNYVALE DEPARTMENT OF PUBLIC SAFETY

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Sunnyvale Department of Public Safety
Sunnyvale, California

In order to increase managerial effectiveness and improve decision-making involved in planning, program development, control and other management processes, the Department of Public Safety (DPS) of the city of Sunnyvale joined with other major departments in the city and implemented an Environmental Information File (EIF) of which the geographic base file (GBF) is the central part of the system to supplement the city's Integrated Management Information System (MIS).

The Public Safety module of the Sunnyvale MIS is a complex on-line event oriented system. Each event to which the department responds is recorded, and its related data including time, location, personnel assigned, work-hour expended, premises involved, persons connected to the incident and other pertinent information. Similarly, each activity performed by an officer is also captured with the pertinent data. While these data are also cross-referenced to each other, there was no practical method of relating these data to the overall demographic and physical characteristics of the city.

Since the implementation of the EIF system, with the capability of the geographic base files, many relationships essential to informed decision-making involved in planning, problem definition, program development, performance measurements and evaluation of program impact were identified. This report gives a brief overview of the structure of the geographic base files in the Sunnyvale DPS and some of its major applications.

BACKGROUND

The Sunnyvale Department of Public Safety is one of the unique departments in the country where the delivery of both police and fire services are combined together. The department employs approximately 168 sworn personnel and 54 civilians. The sworn personnel are trained as both policemen and firemen.

The city itself covers an area of 20 square miles with a population of 106,000. The major industry in the city is electronics and food processing. The city is located approximately 40 miles south of San Francisco and 10 miles north of San Jose. Being a part of the greater San Jose metropolitan area, the city shares many of the common problems of law enforcement in urban areas in spite of its size and population.

The city started computerization in 1969. Over the years, the DPS had developed one of the most sophisticated MIS in the law enforcement area. In view of the need of further improvement of its assessment of the information relevant to the delivery of services to the community, the EIF system was initiated as a joint project between several major departments in the city in 1973. The project was completed in 1975.

The city has always contracted for computer services from computer utility companies from the first day of its computerization. Being a pioneer in the field of municipal MIS, the city started to utilize the latest advances in minicomputer technology and started to convert the entire city MIS, including the GBF system, to run on minicomputers. Today, except for the mapping capability which still requires the usage of a large computer in the service bureaus, the entire city MIS, including the Public Safety Module and the geographic base files, are running on a set of Digital Equipment Corporation PDP 11/70s. The department also implemented a Motorola Computer Aided Dispatch (CAD) System in 1976.

GEOCODING

There are basically two ways in which the Sunnyvale DPS geocodes its information. The first way is a reporting district approach which parallels the traditional GRID approach. The second way of geocoding is through street address by applying the Dual Independent Map Encoding (DIME) technique developed by the United States Census Bureau.

Reporting District Approach

The entire city is divided into some 500 plus reporting districts. Each generates an approximately equal number of calls-for-service. Then neighboring districts are grouped together to form reporting sectors. Each reporting district is represented by a four-digit number in which the first two digits stand for the reporting sector (e.g., Reporting District 4502 is in Sector 45).

As the need arises, districts with dramatic increases in the number of calls-for-service are split. Also, under this system, special premises that usually require a relatively high number of responses are given a reporting district all by themselves, e.g., city parks, schools, massage parlours, etc.

All events that can be geographically identified are encoded with the reporting district number manually before they are entered into the computerized data base. This simple geocoding scheme facilitates a very quick and handy way for aggregating information by geographical areas for routine operational reports as well as management reports in which the level of geographic precision is not that important.

Street Address Approach

The second method of geocoding is that each event with an address is matched against the GBF files for verification and encoding of a street code. Each valid street and common location in the city has a numerical identification code. Only the street code together with the street number and apartment or suite number is physically stored in the data base instead of the full street name.

The street address serves as a common key that can allow a user to go through the entire city base. It is a very powerful tool that allows unlimited capability of aggregating data for detail analysis and research.

FILE STRUCTURE

The major files in the Geographic Base Files subsystem in Sunnyvale include:

(1) Common Locations and Spellings
(2) Street Master File
(3) Intersection Control File
(4) Street Cross Reference File
(5) Geographic Base File
(6) Parcel File

The first three files are mainly used for on-line street address editing and encoding. The fourth file is primarily used for on-line inquiry and on-line analysis. The fifth and sixth files are mainly used in a batch environment for geocoding a collection of data for in-depth analysis or mapping.

Common Locations and Spellings

This file contains all the valid streets and common locations in Sunnyvale together with their common spellings and abbreviations. This file is used as an on-line verification against all data entry that involves a street address. Data that involves a street address will be rejected if it does not match at least one record in this file. Each common spelling and abbreviation is a record by itself. The major data elements in this file are:

Street or location name
Street type
Street direction
Identification code

Street Master File

This file consists of all the valid street addresses in the city with the official spelling according to the Planning Department. The data in this file is identical to the Common Locations and Spellings File except that the Identification Code is the key with an additional data element of street number. The street number is provided for the common locations, such that when the operator inputs the name of a common location, the exact address can be retrieved (e.g., Macdonald Hamburger is on 750 N. Main St). This file is primarily used for display of street name during on-line inquiry or for the printing of address in a report.

Intersection Control File

This file consists of all the legitimate street intersections in the city. It is also primarily being used for on-line address entry editing when the data entered involves a cross street. The data entered will be rejected if the street address and the cross street entered do not check against at least one record of this file. The major data elements in this file include:

Control street code
Control street type
Control street direction
Intersecting street code
Intersecting street type
Intersecting street direction

Address Cross Reference File

This file cross-references address to address and address to events. All addresses that had any contacts with the department are indexed and cross-referenced to the event and other associated addresses. The file is basically used for on-line inquiry or on-line analysis on the history of department activities in certain address. The major data elements in this file are:

Main street code
Main street number
Apartment number
Cross street code
Record type
Cross reference key
Cross reference type

Geographic Base File

This file consists of the major geocoding information. It is primarily used as a master reference file in a batch environment for geocoding and for in-depth analysis or mapping. The major data elements in this file are:

Street code, high address range, odd or even code
DIME record number, Right or Left code
From node, From map, From state Plane Y, From state Plane X
To node, To map, To state plane Y, To state plane X
From segment, To segment, High address, Low address
Block number, Zip, Census tract, Annex number

Parcel File

This file also consists of major geocoding and land use information. Like the previous file, it is primarily also being used as a master reference file in a batch environment for geocoding and analysis. The major data elements of this file are:

Assessor's parcel number
Centroid X and Y, School district
Census Tract and Census block
Planning Zone, Zoning, Tax code, Use code
Detail land use code primary and secondary
Detail occupant use code primary and secondary
Number of structures, Acres
Land value, Improvement value
Personal value, Tax exempt value

CURRENT APPLICATIONS

Management Reports

The primary use of the geographic information is management reports. The department's Management Information System (MIS) consists of various data regarding events that the department responded to and the activities conducted by the officers. The major files of the MIS are Dispatch Incident, Offense, Accident, Fire, Arrest, Name, Citation, Vehicle and their corresponding cross-references such as Offense Xref, Name Xref, Vehicle Xref, Arrest Xref, and Address Xref.

In addition to the daily complaint log and the weekly officer activity report and citation log, the Sunnyvale DPS computer reporting is on a demand basis. Officers and supervisors, as well as commanding officers, must request these selective management reports.

These management reports usually have a wide range of selective capability and geographical selection by reporting district is standard on any address-relevant data. The major management reports available include:

Selective Alpha Listing, Officer Availability Report,
Officer Activity Report, Dispatch Selective Report,
Investigative History and Case Control,
Periodic Crime Clearance, Arrest Selective Listing,
Citation, Time spent and number of calls by R.D.,
Selective Offense, Accident by type.

Crime Analysis

The second major area of application is crime analysis. Periodic in-depth reviews are prepared for all major crimes. The data base is run against the master GBF in a batch environment for geocoding of data. Major areas addressed in these periodic reviews include spatial and time distribution, identification of hazard areas, departmental responses in terms of resources and effectiveness, and socio-economic profile of arrestees including distribution of distance between crime scene and offender location. All these relationships could not be addressed without the support of the GBF system.

Computer Mapping

The GRIDS program developed by the U.S. Census Bureau is being used for computer mapping in Sunnyvale. Various computer maps of crime pattern for different level of interest can be produced through control of the grid size. This program produces shaded maps which indicate number as well as density. The computer mapping is primarily generated for the in-depth crime analysis reports.

PLANNED ACTIVITIES

Computer Aided Dispatching

Sunnyvale DPS just completed its implementation of a Computer Aided Dispatch (CAD) system in October 1976. At present, the system recommends available patrol unit by the order of a pre-entered list. The dispatcher is still required to look up fire run cards and enter the beat number as well as the address of the incident. The department hopes to eventually link up the computers such that the geographic base files can be accessed by the CAD system. Thus, the CAD system should be able to verify the validity of the address of incidents and call up beats and fire run cards, as well as recommend both police and fire units for dispatching.

Beat Design and Resource Allocation

At present, the beat design and resource allocation is basically addressed as two separate questions in Sunnyvale. The beat design is also only contructed through data coded by reporting district only. The department plans to use its address geocoded data to assist in management decisions on beat design and resource allocation through computer simulation that addresses both the deployment and allocation question simultaneously.

CONCLUSION

The DPS in Sunnyvale has used the support of its GBF subsystem to the MIS for several years to assist in both management and operational decision-making. It has proved to be essential to the identification of many environmental relationships for planning, problem definition and program development. The department realizes that there is virtually no limit to the potential application of their GBF files support. It is looking forward to expand it to more sophisticated applications.

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THE WICHITA POLICE DEPARTMENT APPLICATION OF GEOGRAPHIC BASE FILES

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INTRODUCTION

City Overview

The city of Wichita, located near the center of the continental United States, incorporates an area of 98 square miles. Once the northern terminus of Texas cattle drives, Wichita has grown to a major agricultural, trade and cultural center of the midwest.

During World War II, Wichita grew to a population of 122,000, supporting a military aircraft industry that supplied ten percent of all military aircraft produced in the United States. During recent years, Wichita has continued its growth in population and aircraft production. With a current population of 265,503, Wichita produces a majority of the private and light commercial aircraft sold in the United States today.

The citizenry of the community are served by a highly respected police department of 409 sworn officers and 133 civilian employees. The citizens are accustomed to a rapidly responding, efficient police force.

Seeking to maintain and improve this service level, the Wichita Police Department has employed computer based geographic information for deployment of response units. This technology has enabled the department to remain effective with a decreased officer to population ratio.

System Development

The Wichita Police Department has employed automated data processing methods for the past ten years. The department maintains, at present, a complete incident recording and reporting system. Designed as an on-line real-time system, the computer assists officers daily in allocation and investigative problems.

A geographic base file (GBF) system was implemented as a portion of the SPIDER (Special Police Information, Data Entry and Retrieval) System. In order to solve allocation problems, all incidents and requests for services are automatically geo-coded upon entry into the computer. The GBF system encodes all addresses and intersections. Retrieval or reporting requests cause the GBF system to decode the same information into readable forms.

Training

The data processing staff of the department provides training to officers and supervisors of the department so that they may be aware of the capabilities and methods of the computer system. Patrol officers are encouraged to utilize computerized information to assist them in their day-to-day patrol.

Extensive data entry and user manuals were prepared to assist in using computer terminals.

Operating Environment and Staffing

The computer used by the police department is city owned and operated. It is shared with all other city users.

The police department maintains a staff of three programmer/analysts for design, programming and maintenance of all police programs. The computer operating system and teleprocessing monitor is maintained by the City Department of Administration.

Approximately 85 percent of the police application is on-line and real-time. Incident records are computerized immediately after the occurrence if possible. Recording of the event soon after the occurrence reduces the incident of errors, loss of data, and makes the information available on a timely basis.

Future Development Plans

The Wichita Police Department is desirous of obtaining a mini-computer to be dedicated to the police function. The GBF portion of SPIDER as it now exists is small enough to be utilized on a mini-computer with little change.

At the present time, a concerted effort is being made by the department to implement an effective team policing system. The computerized GBF system has played an integral part in determination of the team areas.

Computer Hardware

The city-owned CPU is an IBM 370/155 II with 1.5 megabytes of real main storage. The current operating system is OS/VS2 and the teleprocessing monitor is INTERCOM. INTERCOM provides the interface to terminals and the VSAM data files.

Computer peripherals include five high speed tape drives, 16 3330 tape drives, as well as the normal support equipment such as high speed printer (1403) and a card reader/punch (2540). The police department has 11 on-line terminals (IBM 3277 mod II) and two on-line printers (IBM 3284 mod II). Also attached to the police portion of the system are three terminals utilized by the Sedgwick County Sheriff Department.

With the exception of the on-line terminals and data files, all computer resources are shared with other city departments. Access to police files is restricted to the law enforcement function.

GEOGRAPHIC BASE FILES DESIGN AND APPLICATION

The Wichita Police Department's SPIDER system is designed around two control files. These files are the address file (SPIGA) and the name file (SPIIN). Each of these files is structured to maintain pointers to associate records in other subfiles that are related to a particular name and/or address. Each name or address record will accumulate additional pointer keys as the entry of the same name or address occurs.

The GBF portion of SPIDER, as outlined in Figure 1, p. 146 verifies and encodes each address or intersection entered into the system and locates previous references to the same location, if any. The new incident is then attached via a pointer record to the address record. At the same time, the incident record is categorized by type and keyed so that it will reside in a group of other associate keys of the same type for that location.

SPIGA contains address segment records derived from the DIME file (See Figure 2, p.147). SPIGA provides match capabilities for street name spelling and address range verification. SPIIN (See Figure 3, p. 147) contains valid intersections within the city limits. SPIIN is also a direct derivative of the DIME file. SPIIN, of course, provides the match capability for intersections. In addition, SPIIN locates the intersection in relation to the high range address of the two intersecting streets. This is necessary for the extensive address inquiry capability of SPIDER.

SPIGX (See Figure 4, p.148) provides the decoding of geocoded information for display purposes.

Address Event Recording

SPIAD is the system address event recording file. SPIAD contains addresses of occurrence and pointer records to the event record. The file is structured as follows:

ADDRESS RECORD
ACTIVITY POINTER RECORD
•
•
•
ADDRESS RECORD
ACTIVITY POINTER RECORD
•
•
INTERSECTION POINTER RECORD (CONTAINS KEY TO INTERSECTION RECORD)
ADDRESS RECORD
ACTIVITY POINTER RECORD
•
•
•
INTERSECTION RECORD
INTERSECTION ACTIVITY POINTER RECORD
•
•
•
INTERSECTION RECORD
•
•

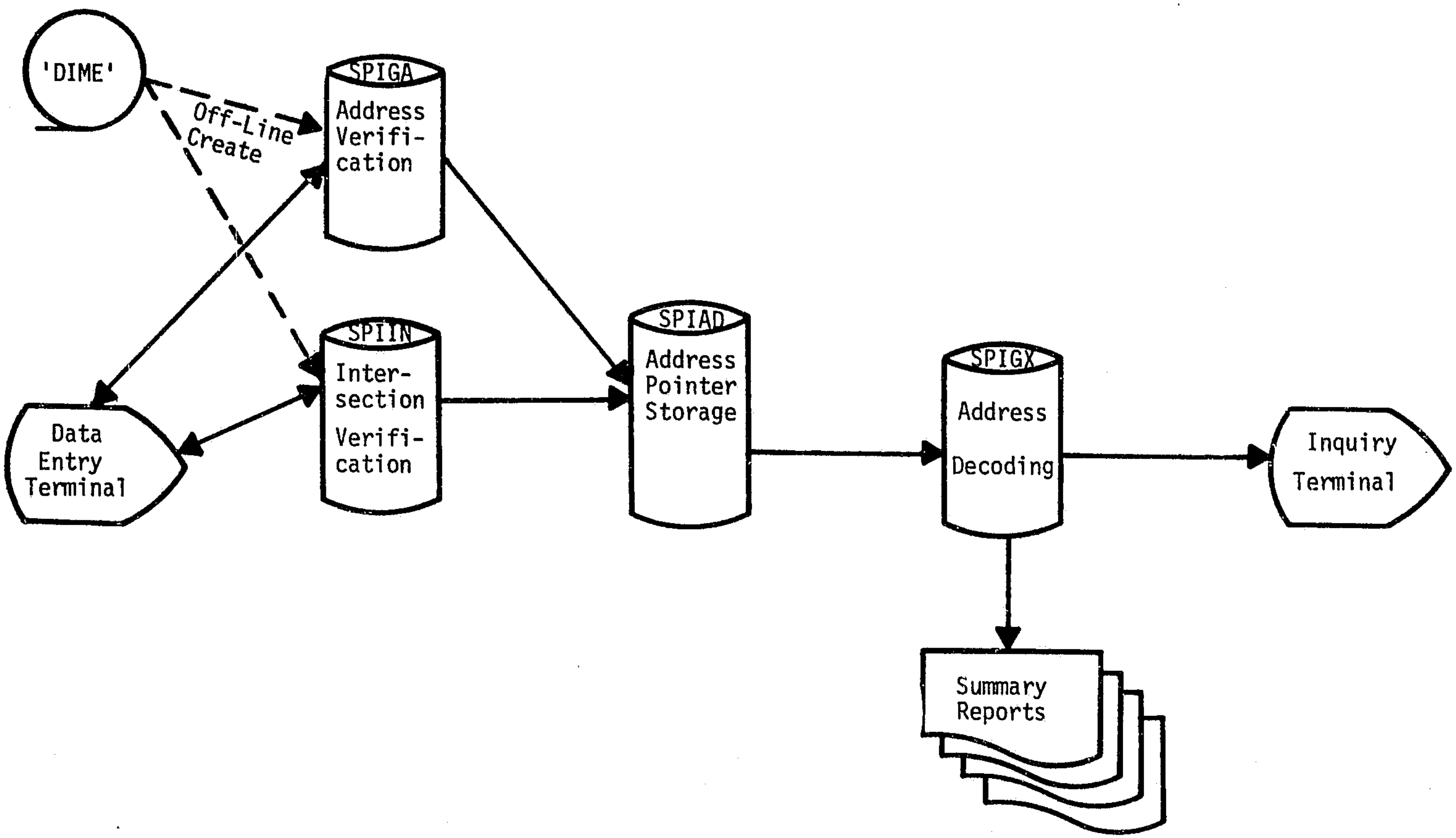

Figure 1. GBF System Outline

Figure 2. Geo-Address Verification File

SPIGA

GEO-ADDRESS VERIFICATION AND CODING FILE

POSITION	DESCRIPTION	LEN	USAGE
1	Record availability	1	Binary
2	Street direction	2	Displ
4	Street name	16	Displ
20	High range address	5	Displ
25	Low range address	5	Displ
30	Street code	5	Displ
35	Reporting area	3	Displ
38	Zip code left	5	Displ
43	Zip code right	5	Displ
48	Unused	7	-----

Figure 3. Intersection File Description

SPIIN

INTERSECTION RECORD

POSITION	DESCRIPTION	LEN	USAGE
1	Record availability	1	Binary
2	St 1 Direction	2	Displ
4	St 1 Name	16	Displ
20	St 2 Direction	2	Displ
22	St 2 Name	16	Displ
38	St 1 Code	5	Displ
43	St 2 Code	5	Displ
48	Reporting area	3	Displ
51	St 1 High address range	5	Displ
56	St 2 High address range	5	Displ

Figure 4. Geo-Address X-Ref File

SPIGX

GEO-ADDRESS CROSS REFERENCE

POSITION	DESCRIPTION	LEN	USAGE
1	Record availability	1	Binary
2	Street code	5	Displ
7	Street direction	2	Displ
9	Street name	16	Displ
25	Unused	3	-----

The address records are keyed in address range order with the intervening intersection pointer records keyed to fall in order of the placement of the intersection within the address range. This arrangement of the file allows a sequential read of the file to pick up all activity within a given range of addresses, and the activity at any intervening intersections.

The activity pointer records are group keyed so that an individual group or particular type of activity may be selected or bypassed. Each activity pointer record is a pointer to a master record in a master data file.

Outlined in Figures 5 and 6 (p. 150) are detailed descriptions of the key structure used for address and intersection records. In addition to this described portion of the key are three bytes (binary) that provide a sequence number of the activity.

Current Applications

Virtually all computerized records of the department are geocoded and therefore become a part of the reporting systems based on an address or area related reports. On-line applications allow retrieval of information based on a single address, a range of addresses including the intervening intersections, and by reporting area. Included in the capability of the address inquiry system is the ability to selectively retrieve all the activity pertaining to a particular address or only particular portions or types of activity. For example, it is possible to retrieve only arrest information or arrest and warrant information as desired.

The example on p. 151 is a typical address inquiry response for an address range. After identifying the particular item(s) needed this line can be selected for a "blow up" of all information about the activity.

Batch Reporting Systems

The batch reporting system provides a wide variety of reports, most of which are reporting area oriented. Reporting areas are pre-defined areas to which all address information is associated at the time of the entry of the information into computer files. Each address, or more correctly address range, and each intersection is coded within one of the reporting areas depicted in Figure 7, p. 152.

Figure 8 on p. 153 is a summary report generated for a reporting area (in this case 144) for statistical totals for the year 1976. The report defines occurrences by type, hour of day, day of week, and by the individual watch. The same report can and is generated for each reporting area within the city or any group of reporting areas desired. The example on p. 154, Figure 9, is the same report but based on city-wide totals.

Figure 10 on p. 155 is an example of another area report which displays incidents by type and watch, but in this case percentages of the total crime for the area and the city are displayed also. Both reports are used for manpower allocation needs. The latter is currently being used to establish team areas for the forthcoming team policing effort of the department.

Figure 5. Geo-Coded Key Structure of Address Records

SPIAD GEO-CODE FORMAT

ADDRESS FORMAT

ABASUGOA (ABAS user geo-address)

1 2 3 4 5 6 7 8 9

BYTE 1 = high order byte of street code (first four bits are zero)

BYTE 2,3,4,5 = Binary equivalent of:

$C^2\ C^3\ C^4\ C^5\ A^1\ A^2\ A^3\ A^4\ A^5$

C = Street code (low order four bytes)

A = Street address

BYTE 6,7,8 = Apartment number (display

BYTE 9 = Reporting area (binary)

Figure 6. Geo-Coded Key Structure of Intersection Records

SPIAD GEO-CODE FORMAT

INTERSECTION FORMAT

ABASUGOA (ABAS user geo-address)

1 2 3 4 5 6 7 8 9

BYTE 1 = High order position of street code 1 (high order four bits always '1111')

BYTE 2,3,4,5 = Binary equivalent of:

$C_1^2\ C_1^3\ C_1^4\ C_1^5\ C_2^1\ C_2^2\ C_2^3\ C_2^4\ C_2^5$

C_1 = Street code 1

C_2 = Street code 2

BYTE 6,7,8 = Always 'INT'

BYTE 9 = Reporting area (binary)

ADRE *** SPIDER RESPONSE TO ADDRESS INQUIRY *** PAGE 07
(CONT) 14? N OLIVER
RO 0404040000 2520 OTH TRF VL 06-22-75/0905

150 N OLIVER 09-15-76 NON-RESIDENCE
*CATEGORY 2
RO P103180000 2679 VANDALISM 06-24-76/1830
RD 76075997 150 N OLIVER 06-25-76 0928 052 BURGLARY
RD 75075047 150 N OLIVER 11-11-75 1632 025 INJURY ACC
*CATEGORY 3
SR 00150 N OLIVER DATE-09-03-76

OLIVER & 1ST ST N 06-14-77 NON-RESIDENCE
*CATEGORY 1
AR H60822 001 112773 VIOL RDL FRAZIER, CHARLES A J NTA SERVED
AR P17694 001 080176 VIOL RDL LOPEZ, NESTOR A OFFICER CO???
AR P62391 001 042077 VIOL RDL BRUNSTON, MARJORIE M OFFICER CO???
*CATEGORY 2
RO P176940000 2310 VIOL RDL 08-01-76/1621
RO P623910000 2390 VIOL RDL 04-20-77/0020
RD 75007375 OLIVER & 1ST ST N 06-19-75 1535 021 NONINJ ACC
RD 75011431 OLIVER & 1ST ST N 06-28-75 2209 021 AUTO THFT
RD 75027305 OLIVER & 1ST ST N 08-04-75 1643 022 MISC SER

ADRE *** SPIDER RESPONSE TO ADDRESS INQUIRY *** PAGE 12
(CONT) 200 N OLIVER
RO P050550000 2679 VANDALISM 05-27-76/2135
RD 75012794 200 N OLIVER 07-01-75 2247 022 VANDALISM
RD 75030379 200 N OLIVER 08-10-75 1118 022 VANDALISM
RD 76010306 200 N OLIVER 01-22-76 1219 052 VIOL RDL
RD 76023951 200 N OLIVER 02-21-76 0841 052 MISC SER
RD 75083916 200 N OLIVER 12-02-75 0956 022 MISC SER
RD 75084873 200 N OLIVER 12-04-75 0906 022 VANDALISM
RD 75084949 200 N OLIVER 12-04-75 1313 021 PRK VIOL
RD 75035020 200 N OLIVER 08-19-75 1608 022 NONINJ ACC
RD 76113688 200 N OLIVER 09-08-76 2225 042 SUSP CHAR
RD 76117058 200 N OLIVER 09-17-76 1712 052 NONINJ ACC
RD 76134504 200 N OLIVER 10-25-76 0122 052 SUSP CHAR
RD 76152593 200 N OLIVER 12-10-76 1524 052 INJURY ACC
RD 77012809 200 N OLIVER 02-04-77 1306 052 NONINJ AC
*CATEGORY 3
TT B5162676 SPEEDING 090376/0805 200 N OLIVER CO???
TT B5162476 SPEEDING 090376/0817 200 N OLIVER CO???
TT B5162576 SPEEDING 090376/0825 200 N OLIVER CO???
TT B5162076 SPEEDING 090376/0830 200 N OLIVER CO???
TT B5162776 VEH-LIC VIOL 090376/0840 200 N OLIVER CO???
TT B5162876 SPEEDING 090376/0850 200 N OLIVER CO???

Figure 7. Wichita Reporting Areas

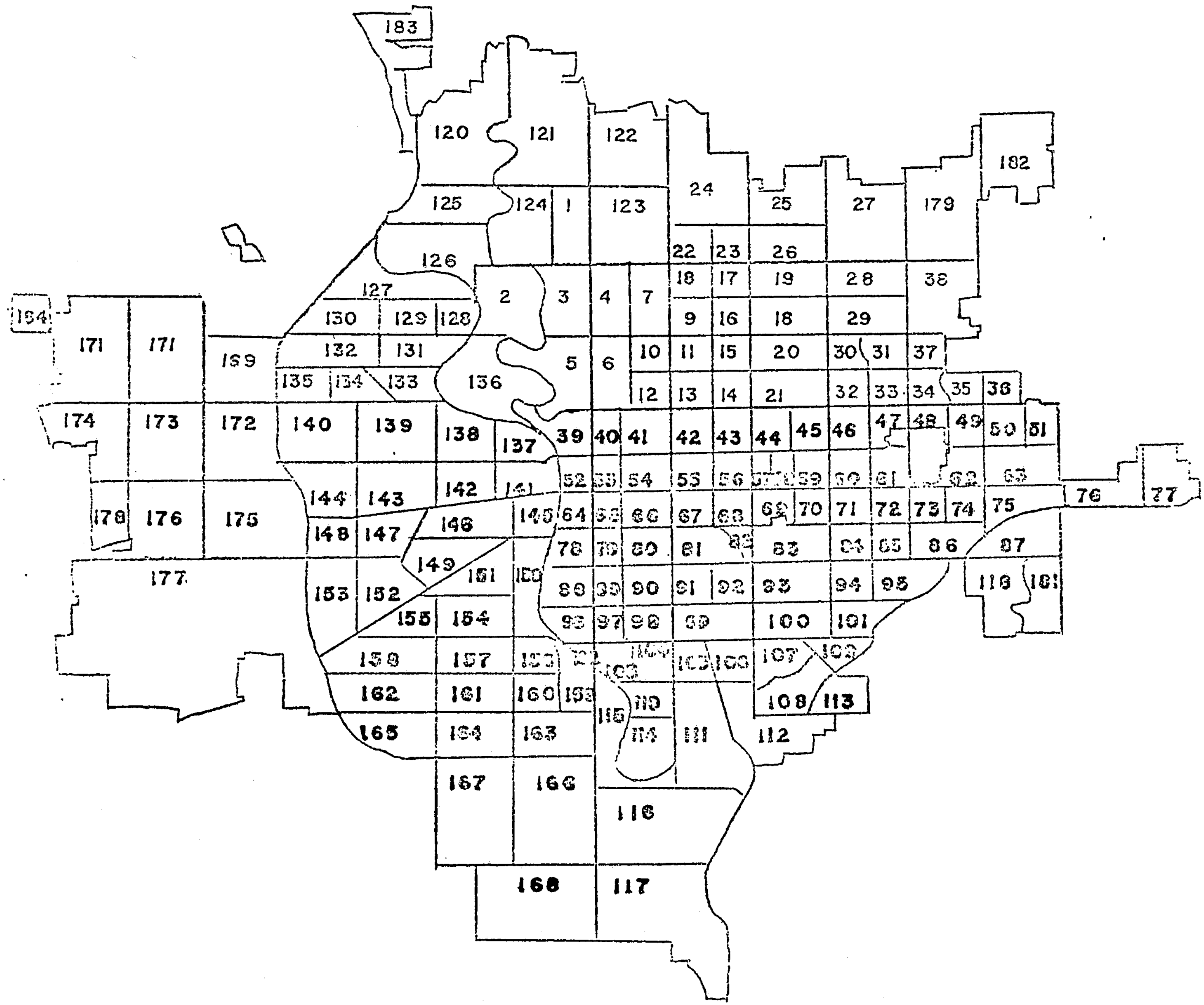

Figure 8. Reporting Area Summary Report

WICHITA POLICE DEPARTMENT

FROM 01-01-76 THRU 12-31-76

CASE LOAD SUMMARY FOR REPORTING AREA 144

BY DAY OF WEEK AND HOUR OF DAY

	SUN	MON	TUE	WED	THU	FRI	SAT
0000-0100	2			1	1	2	1
0100-0200	1		1		1		
0200-0300			3		1		
0300-0400						1	
0400-0500	1					2	1
0500-0600		1			1		1
0600-0700		1					
0700-0800		1	2				2
0800-0900	1		6	1		2	2
0900-1000			2	2	1	1	3
1000-1100	1	1		2		4	2
1100-1200	2			4	1	1	1
1200-1300	4	1		1	3	2	4
1300-1400	1	1	1		4	3	2
1400-1500	2	2	4	2	5	4	2
1500-1600	3	2	2		3	6	7
1600-1700	2	1	2	2	2		3
1700-1800	3	1	2	3	3	1	5
1800-1900	1		2		2	2	2
1900-2000	1		1	3		3	3
2000-2100	1	1	1	1	2	3	
2100-2200			1	1	2	2	3
2200-2300	1			1	1	1	
2300-2400	1	2	1		1	1	3
1ST WATCH	11	6	15	12	14	17	18
2ND WATCH	12	5	11	11	15	18	23
3RD WATCH	5	4	5	1	5	6	6
GRAND TOTAL	28	15	31	24	34	41	47

BY CRIME CLASSIFICATION AND HOUR OF DAY

	MURD	RAPE	ROBB	ASLT	N-BUR	R-BUR	LAR-A	LAR-B	AUTO	PT-1	PT-2	TOTAL
0000-0100			1			1	1		1	4	3	7
0100-0200					1					1	2	3
0200-0300											4	4
0300-0400											1	1
0400-0500					2				1	3	1	4
0500-0600					1				1	2	1	3
0600-0700							1			1		1
0700-0800					2		2			4	1	5
0800-0900					1		1		1	3	9	12
0900-1000					1		3	2		6	3	9
1000-1100							2		2	4	6	10
1100-1200							1	2		3	6	9
1200-1300						1	1	7		9	6	15
1300-1400							2	7		9	3	12
1400-1500							1	8	3	12	9	21
1500-1600					1		2	9	1	13	10	23
1600-1700							2	6		8	4	12
1700-1800						1		9	1	11	7	18
1800-1900					1			4		5	4	9
1900-2000								7		7	4	11
2000-2100								5		5	4	9
2100-2200							1	4		5	4	9
2200-2300											4	4
2300-2400					2	1				3	6	9
1ST WATCH					4	1	13	26	6	50	43	93
2ND WATCH					2	1	5	44	2	54	41	95
3RD WATCH			1		6	2	2		3	14	18	32
GRAND TOTAL			1		12	4	20	70	11	118	102	22[illegible]

FOR THE PURPOSES OF THIS REPORT

* TIMES ARE BASED ON: TIME CALL RECEIVED

* DATES ARE BASED ON: DATE CALL RECEIVED

* AREAS ARE BASED ON: AREA OF OCCURRANCE & DO NOT INCLUDE 21 PHONED IN REPORTS

BY CRIME CLASSIFICATION AND DAY OF WEEK

	MURD	RAPE	ROBB	ASLT	N-BUR	R-BUR	LAR-A	LAR-B	AUTO	PT-1	PT-2	TOTAL
SUN							1	13	2	16	12	2[illegible]
MON					1	1	2	2	1	7	9	1[illegible]
TUE					1	1	5	6	1	14	17	31
WED					1		1	7	1	10	14	2[illegible]
THU					2		5	11	2	20	14	3[illegible]
FRI			1		1	1	3	11	3	20	21	4[illegible]
SAT					6	1	3	20	1	31	16	4[illegible]
TOTAL			1		12	4	20	70	11	118	102	22[illegible]

Figure 9. Citywide Summary Report

WICHITA POLICE DEPARTMENT

FROM 01-01-76 THRU 12-31-76

TOTAL SUMMARY FOR ALL REPORTING AREAS LISTED

BY DAY OF WEEK AND HOUR OF DAY

	SUN	MON	TUE	WED	THU	FRI	SAT
0000-0100	[illegible]	230	304	311	342	329	450
0100-0200	399	[illegible]	249	206	259	278	389
0200-0300	[illegible]	134	156	170	198	199	327
0300-0400	[illegible]	104	137	131	153	154	282
0400-0500	146	73	76	96	92	112	160
0500-0600	125	63	67	59	80	84	127
0600-0700	91	83	104	104	80	109	99
0700-0800	173	155	257	225	226	235	178
0800-0900	144	254	352	291	343	352	261
0900-1000	247	[illegible]	355	342	327	358	315
1000-1100	270	371	346	356	391	362	303
1100-1200	255	360	365	392	346	344	331
1200-1300	259	325	347	342	296	346	312
1300-1400	299	307	368	350	373	350	322
1400-1500	264	312	325	354	352	328	376
1500-1600	347	512	512	522	531	571	454
1600-1700	501	519	564	525	459	493	426
1700-1800	553	514	494	507	545	599	425
1800-1900	511	479	454	430	428	457	492
1900-2000	327	439	421	400	419	421	412
2000-2100	331	438	452	493	457	459	431
2100-2200	350	441	432	430	419	448	442
2200-2300	273	370	367	323	373	418	389
2300-2400	[illegible]	414	420	414	414	523	554
1ST WATCH	[illegible]	[illegible]	2751	2683	2654	2695	2328
2ND WATCH	2640	[illegible]	3656	3628	3641	3776	3451
3RD WATCH	2211	1219	1509	1491	1618	1788	2388
GRAND TOTAL	[illegible]	7586	7956	7799	7913	8259	8167

BY CRIME CLASSIFICATION AND HOUR OF DAY

	MURD	RAPE	ROBB	ASLT	N-BUR	R-BUR	LAR-A	LAR-B	AUTO	PT-1	PT-2	TOTAL
0000-0100	3	5	30	36	46	163	142	77	69	597	1791	2388
0100-0200	1	10	35	20	79	131	100	76	57	508	1446	1954
0200-0300	3	8	21	33	56	95	81	72	48	417	1102	1519
0300-0400	1	13	23	23	69	75	59	40	42	345	894	1241
0400-0500	1	10	14	20	56	37	39	25	26	228	547	775
0500-0600		8	13	5	92	25	27	22	30	222	[illegible]	[illegible]
0600-0700	3	5	9	5	100	39	114	30	70	375	295	[illegible]
0700-0800	1	2	10	3	248	73	301	93	116	877	566	1443
0800-0900	3	3	10	4	289	94	393	146	120	1067	1052	2119
0900-1000	2		13	4	195	123	431	165	127	1030	1317	2347
1000-1100		3	14	11	121	107	261	203	108	920	1499	2427
1100-1200	3	6	25	18	82	116	237	235	76	900	1513	2413
1200-1300	2	6	13	13	63	135	229	238	66	864	1402	[illegible]
1300-1400		4	14	6	72	143	305	312	76	932	1525	2457
1400-1500	8	5	19	19	39	122	237	286	66	800	1443	2243
1500-1600	4	1	24	25	55	222	341	407	81	1160	2289	3449
1600-1700	3	3	17	21	46	239	325	359	80	1093	2244	3337
1700-1800		2	21	26	42	207	284	314	56	1102	2242	3344
1800-1900	2	5	24	23	38	208	230	310	61	901	2090	2991
1900-2000	3	3	32	15	26	171	191	237	51	791	2066	2857
2000-2100	5	4	42	34	31	205	177	272	53	825	2196	3021
2100-2200	4	3	66	27	32	213	189	192	60	786	2196	2982
2200-2300	2	9	47	35	43	219	177	147	64	747	1806	2553
2300-2400	4	4	37	44	60	284	182	149	85	849	2222	3071
1ST WATCH	19	29	113	78	1108	913	2700	1678	755	7393	10317	17715
2ND WATCH	23	30	273	210	313	1764	1914	2360	506	7393	17131	24524
3RD WATCH	16	63	182	186	557	849	750	511	427	3541	8683	12224
GRAND TOTAL	58	122	573	474	1978	3526	5364	4549	1688	18332	36131	54463

FOR THE PURPOSES OF THIS REPORT

* TIMES ARE BASED ON: TIME CALL RECEIVED

* DATES ARE BASED ON: DATE CALL RECEIVED

* AREAS ARE BASED ON: AREA OF OCCURRANCE & DO NOT INCLUDE 5727 PHONED IN REPORTS OR 1921 RPTS OCCURRING AT 455 N MAIN

BY CRIME CLASSIFICATION AND DAY OF WEEK

	MURD	RAPE	ROBB	ASLT	N-BUR	R-BUR	LAR-A	LAR-B	AUTO	PT-1	PT-2	TOTAL
SUN	7	17	70	89	277	567	639	489	247	2402	4381	6783
MON	10	15	82	44	342	589	836	636	231	2785	4931	7586
TUE	3	11	82	51	267	518	825	658	219	2634	5322	7956
WED	12	22	83	65	242	495	831	629	247	2626	5173	7799
THU	5	17	87	58	300	516	774	683	213	2653	5260	7913
FRI	7	16	84	74	305	459	778	726	241	2690	5569	8259
SAT	14	24	85	93	245	382	691	728	290	2542	5625	8167
TOTAL	58	122	573	474	1978	3526	5364	4549	1688	18332	36131	54463

Figure 10. Case/Accident/Call Load By Area And Watch

WICHITA POLICE DEPARTMENT
FOR OFFICIAL USE ONLY

CASE/ACCIDENT/CALL LOAD BY AREA AND WATCH

FROM 01-01-76 THRU 12-31-76 INCLUSIVE
PAGE 26

	CASE LOAD									ACCIDENT LOAD									CALL LOAD		
	PT-1	A%	C%	PT-2	A%	C%	TOTAL	A%	C%	INJ	A%	C%	NIA	A%	C%	TOTAL	A%	C%	CALLS	A%	C%
[illegible]																					
1ST	12	42.33	.06	11	50.00	.02	24	46.15	.03				1		.01	1	33.33		37	39.78	.02
2ND	10	33.33	.04	9	40.90	.02	19	36.53	.03	1	50.00	.02				1	33.33		37	39.78	.02
3RD	7	23.23	.03	2	9.09		9	17.30	.01	1	50.00	.02				1	33.33		19	20.43	.01
TOT	28	100%	.14	22	100%	.05	52	100%	.08	2	100%	.04	1	100%	.01	3	100%	.02	93	100%	.05
[illegible]																					
1ST	3	37.50	.01	3	42.85		6	40.00											13	28.26	
2ND	2	25.00		3	42.85		5	33.33											14	30.43	
3RD	3	37.50	.01	1	14.28		4	26.66		1		.02				1			15	41.30	.01
TOT	8	100%	.03	7	100%	.01	15	100%	.02	1	100%	.02				1	100%		46	100%	.02
[illegible]																					
1ST																					
2ND				1			1														
3RD																					
TOT				1	100%		1	100%													
CITY SUMMARY																					
1ST	[illegible]	27.62	27.62	11550	28.18	28.18	17390	27.99	27.99	1345	30.58	30.58	3072	35.53	35.53	4417	33.87	33.87	47018	29.59	29.59
2ND	[illegible]	45.56	45.56	19721	48.13	48.13	29352	47.25	47.25	2369	53.87	53.87	4371	50.56	50.56	6740	51.68	51.68	68855	43.33	43.33
3RD	[illegible]	26.81	26.81	7701	23.67	23.67	15369	24.74	24.74	633	15.53	15.53	1201	13.89	13.89	1884	14.44	14.44	43006	27.06	27.06
TOT	21129	100%		40872	100%		62111	100%		4397	100%		8644	100%		13041	100%		158879	100%	

On-Line GBF Maintenance

All GBF files are maintained on-line by the department programming staff. Several programs provide for the addition, modification and deletion of address base information. A special program allows for the addition and deletion of intersection pointer records in the SPIAD file.

Address system maintenance is performed on an "as needed" basis. This task usually requires less than an hour per week.

Since all of the files were created as extractions of the DIME file, when update becomes necessary, the city planning department provides the material necessary for the update.

DIME File Extractions

Several programs provided the extraction routines necessary for the creation of the SPIDER files. Strip/sort programs provided the segment record necessary for the SPIGA and SPIGX files.

The remaining programs utilizing dual coordinate sorts provided the intersection records for SPIIN.

Should addition of new street information be necessary before the planning department has classified it, a temporary street code is assigned until the classification is made.

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67258

DALLAS POLICE GEOGRAPHIC BASE FILE DEVELOPMENT AND MAINTENANCE

Armando Rodriguez
Systems Analyst
Dallas Police Department
Dallas, Texas

An effective geographic base file (GBF) must be dynamic in structure. It must be flexible enough to accept new records when the city boundaries change. It must be user-oriented by being able to accept slang names for streets or commonly misspelled street names. All of these capabilities must be considered in the update and maintenance of the GBF. This general maintenance of the Dallas Police Geographic Base File will be the topic of my talk.

The City of Dallas does have an operational GBF/DIME File at the current time. This file is fairly new and is maintained by the Department of Urban Planning. It is accessible to all other city departments. This particular GBF/DIME file is not being used by the Police Department at the present time, although we plan to utilize it in the future. The file that I will be discussing is a police-oriented geographic base file. It is called the Street Locator File. I would like to give you some idea of the structure and usage of this file.

For the purpose of patrol deployment, the Police Department divides the city into five geographical areas called divisions. Each division works out of a substation and is commanded by a Patrol Deputy Chief. All calls-for-service that come from an area are answered by that area's officers. There is some crossover of boundaries for assistance when there is an overload of calls, but generally the workload is decentralized.

Each division is further broken down into smaller geographical areas called Sergeant Sectors. Each division is under the direct supervision of a sergeant, which seems logical since they are called Sergeant Sectors.

Next, the sectors are divided into smaller geographical areas called patrol beats. Although the assignments change for the different watches, during the high activity hours of the day one patrol officer is assigned to each beat. The size of the beats was originally determined by summarizing the workload for the area. During the years, if the workload changes, the beat size may decrease or increase.

Finally, the beat is divided into the smallest geographical area used by the department. It is called a reporting area. The boundaries of reporting areas are well defined by main streets, railroads, or natural terrain. For all practical purposes, the reporting areas were originally designed to follow the city's census tracts.

At the present time, the City of Dallas has 363 square miles. The police department divides this into five patrol divisions, 25 sergeant sectors, 158 beats, and 987 reporting areas. On the average, there are 5 sergeant sectors to each division, about 7 beats in each sergeant sector and about 6 reporting areas for each beat.

As I mentioned, the reporting area is the smallest geographical area used by the department and it is the geographical area indexed by the Street Locator File. The beat is also indexed in the street locator file. For any given street address, the Street Locator File will index a reporting area and a beat.

Our own police version of a geographic base file was developed in 1969 as part of the Computer Assisted Dispatch System. The Street Locator File is actually made up of different files. There is a file to keep all the non-intersection streets, one for the intersections, and another to maintain correct street spellings.

The Non-Intersection File is composed of different record types. The records would differ only in the way the street name is spelled. A master record would have the complete spelling of the street with the proper abbreviated suffix. For example, we have a street here named Harry Hines Boulevard. A master record would have Harry Hines Blvd. A different type of record, called suppressed records, would have the suffix removed. A suppressed record for this street would thus be Harry Hines. Finally, the last record type is a slang record. Many people call Harry Hines Boulevard just Hines or Hines Boulevard, so the slang record is Hines Blvd.

All streets in Dallas have been assigned a unique identifier, a street code. All types of records (master, suppressed or slang) pertaining to the same location are assigned the same street code, beat and reporting area. These different record types give the user more flexibility. The user does not have to enter the correct spelling with the proper suffix. Record examples of the Non-Intersection File and the Correct Name File are as follows:

RECORD NAME	TYPE	STREET NAME	CODE
Master records	M	HarryHinesBlvd	H192
Suppressed records	S	HarryHines	H192
Slang Name records	W	HinesBlvd	H192
Correct Name File		Harry Hines Blvd	H192

Although the entry of suppressed and slang records will increase the chance of finding a match in the Street Indicator File, it will cause a discontinuity if we are trying to enter these matched records in the computer records. For example, if we found a match with a name of Hines Blvd., then that name would go in the record. We would then have records with names of Hines Blvd., Harry Hines, and Harry Hines Boulevard. The Correct Name File in our case takes care of this problem. The suppressed and slang records both have an identifier. When the search program makes a match against one of the slang or suppressed records, it goes to the Correct Name File, and by using the street code, picks up the correct spelling of the street and puts that name in the computer record. In this case, all our computer records will have the same spelling of the street name. This option enables us to search records more easily when we enter the street name.

Since the smallest geographical area in the Street Locator File is the reporting area, each record contains a segment of a street within that reporting area. If the complete street is only a few blocks long, all of the street could be in the reporting area. The street could also be the border between two reporting areas. In this case, the odd block numbers of one street are in one reporting area and the even block numbers are in the other. The following is an example of a non-intersection record:

NON-INTERSECTION

RECORD DISPLAY

DYSON ST	STREET NAME
	STREET DIRECTION
L	FILE CODE L, D, OR V
02200	FROM BLOCK
02500	TO BLOCK
2191	REPORTING AREA NUMBER
334	BEAT
M	TYPE CODE M, W, D, S
D795	STREET CODE

If the segment of the street is entirely within a reporting area, a code "L" is used. A code "D" indicates that only the odd block numbers are in the reporting area, while a code "V" indicates that only the even block numbers are in the reporting area.

In the maintenance of the Street Locator File, a standard method of entering the street suffix name such as avenue, drive, lane, square, etc. had to be developed. For the Street Locator File we use the following table:

STREET DESIGNATION CODE

IF IT IS A:	USE:	IF IT IS A:	USE:
Avenue	Ave	Levee	Levee
Alley	Alley	Parkway	Pkwy
Block	Blk	Place	Pl
Boulevard	Blvd	Plaza	Plaza
Circle	Cir	Railroad	RR
Club	Clb	Road	Rd
Court	Ct	Row	Row
Creek	Ck	Street	St
Drive	Dr	Square	Sq
Expressway	Expwy	Terrace	Terr
Freeway	Frwy	Tollway	Tollway
Garden	Garden	Trail	Tr
Highway	Hwy	Turnpike	Tnpk
Lake	Lake	Viaduct	Viaduct
Lane	Ln	Way	Way

Prefix all Shopping Centers with "S C"

All maintenance of the Street Locator File is done on-line. Only one terminal has been validated to add, modify, or delete records in the file. For new non-intersection records, two record types are usually entered—a master record and a suppressed record. Modifications to records already in file can be done through the video terminal by changing the affected fields. If a record needs to be deleted, a type code of "D" is entered in the record. User phase programs that access this file will disregard these records. Periodic listings of the Street Locator File are generated for manual reference. These listings are distributed to all users. There are approximately 35,000 non-intersection records in the file.

The Intersection File allows the entry of two street names. Like the Non-Intersection File, it indexes a reporting area and a beat. The intersection streets are entered without a suffix; also, the first street entered follows an alphabetical order. For example, Harry Hines Boulevard would be entered as Harry Hines. If it intersected with Central Boulevard, the record would be entered as Central/Harry Hines. Although the users are instructed to inquire into the intersection file by alphabetical order, some programs automatically do two searches on the file. In this case, if the user searches for Harry Hines/Central, no record would be found. If no record is found, the program would interchange the streets to Central/Harry Hines and initiate another search. The street name code used in the intersection record is a combination of the two codes for the streets involved. There are approximately 20,000 intersections in the Intersection File. An example of the fields in the Intersection File is given below.

INTERSECTION RECORD

CENTRAL	FIRST STREET
HARRY HINES	SECOND STREET
334	BEAT NUMBER
2191	REPORTING AREA
C795H247	STREET CODE
M	TYPE M, W, D

The Street Locator File has proven to be a strong foundation for the development of the Computer Assisted Dispatch System, the Calls-for-Service File, the Offense Reporting System, the Criminal System, and other police reporting systems that utilize geographical reporting and statistics. The Street Locator File has been used by non-police departments. The Water Department and Tax Department have used this file in the initial development of their system.

It took a group of six men approximately three months in 1969 to edit, index, and document all the streets in Dallas into the Street Locator File. Their work would have been futile, however, if no further maintenance had been performed on the file. New developments in the city and annexations constantly keep this file growing. The responsibility of keeping this file current has been given to the Police Department; more specifically, to the Police Data Processing Division.

Our division has many areas of input to maintain the file. First of all, the Communications Division, through the Computer Assisted Dispatch System, keeps us informed of any street that is not in the file. If a call-for-service is received for a street that is not in the file, the operator can still enter the street name through an override code. Any time a street name is entered through an override code, we automatically receive in our area a printed message of the block number and street name. We later verify that this is a new street and enter it into the file. Another input for new streets is through the Maps and Plats Section of the Department of Building Inspections. We receive the maps, names, and block numbers of any new dedicated streets in the city. These new streets are indexed by beat and reporting area and are entered into the file. We also get input from our Police Report Division, from the Tax Department, and from the Water Department. All the users of the file help us to keep it current.

Another type of maintenance that needs to be done when the workload of different areas changes is the reconfiguration of beats. This task is usually done at the beginning of a new year in order to keep uniform yearly statistics. Since the configuration of beats is determined by workload, an attempt is made to also change the beats when the workload changes. The Police Planning and Research Division generates periodic manpower and workload studies. It is that division which recommends new beats and designs new beat boundaries. No attempt is made to change the boundaries of the reporting areas. Thus, in any beat reconfiguration, some beats may gain and others may lose reporting areas. A batch program is available to change the beat configuration in the Street Locator File.

The Street Locator File and all other police systems are programmed and supported by the City's Department of Data Services. Data Services currently leases two IBM 370/145's with 3350 disk drives. The Police Department has approximately 120 terminals. This includes both videos and printers. The system responds to approximately three and one-half million transactions per month, of which about 75 percent are from the Police Department.

The record size of thirty-four (34) of the Street File and forty-two (42) of the Intersection File provides for fast access and reference by other systems. This fast access keeps the system response time to five (5) seconds or less for the Computer Assisted Dispatch System. Although the small record size has enhanced our response time, it has caused a problem in the future development and applications of the Street Locator File.

One of the problems that we are currently encountering is applying the Street Locator File to one of the new police projects—the Automatic Vehicle Monitoring System (AVM). This system will keep current information using a TV-like screen of vehicle ID, location, and status. The dispatchers will have on their screen a maze outline of their streets. This system will need to access the X,Y coordinates of any given street. Currently, the Street Locator File is not adaptable to the AVM project because the smallest street segment can be several blocks long. For this particular project we will use a combination of the Street Locator File and the GBF/DIME file.

Since its implementation in 1969, the police Street Locator File has remained a police-oriented geographical file. This file has proven to be a necessary foundation for the Dallas Computer Assisted Dispatch system. The street-to-patrol beat indexing capability seemed more than adequate for that time. The potential for geographical analysis seemed endless. Since 1969, the technology in law enforcement has advanced to a degree that a need for a broader geographical base file seems evident. Projects such as the Automated Vehicle Monitoring System are being undertaken by this department and require a geographical base file with an X,Y coordinate system. Also, citizens' awareness of crime problems and involvement in crime reduction programs is creating demands for crime analysis that differs from the standard patrol beat. Crime statistics are being requested by neighborhood communities by census tracts and by economic areas. In Dallas, these needs will be met by either expanding the Street Locator File or adapting the DIME file. The DIME File may be the geographic base file used by all the Dallas city departments in the future, including the Police Department.

CITY OF HOUSTON POLICE DEPARTMENT GEOGRAPHIC BASE FILE

Bobby E. Camp
Sergeant, Houston Crime Information Center
Houston Police Department
Houston, Texas

CITY DESCRIPTION

The City of Houston presently covers 509.04 square miles in Harris County. The 1970 census figures showed Houston to have a population of 1,232,802 as compared to the present 1977 estimate of 1,501,000, which ranks Houston as the fifth largest city in the United States. The 1970 census also showed 73.4 percent of the population was White, including Spanish origin, 25.7 percent Black and .9 percent Indian and Oriental. It was estimated that 12.1 percent of the 73.4 percent White population indicated, were of Spanish origin, either through heritage or marriage. The Houston Chamber of Commerce advised that the 1970 census also indicated that 32,977 families out of 307,939 were thought to be below the poverty level, based on an annual income of $4,000.00. Unlike many cities, Houston's population continues to grow. According to a projection by the Houston Chamber of Commerce, the projected population for the Houston, Harris County area by 1980 will be 2,417,000.

At the present time, the Houston Police Department has a sworn force of 2,815 officers and 805 civilians.

GEOGRAPHIC BASE FILE SYSTEM: HISTORY AND OBJECTIVES

Implementation of the GEO Base File was started in 1956 by the Data Processing Unit of the Houston Police Department. The Data Processing Unit at that time was made up entirely of civilian personnel, under direct police supervision. The unit consisted of a supervisor, assistant supervisor, machine operators, keypunch operators and coding clerks.

The GEO File was implemented in order to capture Accident Data such as location, street name, block number, district, and a four (4) digit street code; beat information was not captured at that time. Due to the rapid growth of the city, by 1965 the GEO File consisted of approximately 10,000 records and it was felt that the four (4) digit street code would no longer suffice. At that time, a sort was made of the GEO File alphabetically assigning a five (5) digit code leaving space for inserting new street names with codes. As new accident reports were processed, new streets and codes not on file were added.

Updating of the GEO File was originally done by keypunch card up until 1970. Since that time, the Planning and Research Division of the Police Department has assumed the responsibility of coding streets, via Houston Light and Power Company utility maps. After street coding they forwarded the GEO information to the City M.I.S.

Department for update. In 1970, the file was updated by keypunch cards and also on-line, via a UNIVAC DCT 500 Terminal. Also in 1970, the Police Department began capturing the GEO File for statistical and analytical reporting by district and street location.

In 1971, the GEO File was expanded in order to capture police beats, census tract information, coding of odd and even sides of streets, radio zones, low intersection, and high intersection information. During this time, updated information was entered into the system by punching paper tape.

Beginning in August 1975, the Houston Crime Information Center (HCIC) Division of the Police Department assumed the responsibility of updating the GEO File which was installed at that time as a full blown on-line automated file, capable of being inquired on by any CRT Terminal within the Police Department network.

At the present time, the geographic base file is being further developed and updated by a police sergeant and eight (8) police officers. The geographic base file (GBF) system presently contains in excess of 178,277 records. Miscellaneous files in the GBF system that are presently being developed or proposed include the following; Soundex File, common place name file, misspelling file, street name and abbreviation file and hazardous location file.

In addition to our department uses of the geographic base file system that have been mentioned, the Houston Police Department also currently uses the GBF system for Crime Trend Analysis, Investigative Support, Research Statistics, Resource Allocation (Manpower Deployment) and Traffic Analysis.

Other proposed uses of the GBF system include implementation of a Computer-Aided Dispatch (CAD) System and an Automated Records System (ARS). The Houston Police Department, in conjunction with the System Development Corporation and the City M.I.S. Department, has just completed a feasibility, conceptual and detailed design study in order to implement these two systems. As a result of this study, it was determined that our existing hardware, Dual UNIVAC 418 III's, would not accommodate the new system implementation efforts; therefore, bid specifications for new hardware have been released and the responses from vendors are presently being evaluated. The time frame projected for the hardware conversion and the implementation for the CAD System and ARS System is from twenty-four (24) to thirty-six (36) months.

<u>Geographic Base File Operations</u>

The GEO-File record elements are as follows:

DESCRIPTION	MAX # CHAR	TNP
Major Street Name	16	AN
Low Intersect Street	16	AN
High Intersect Street	16	AN
Side of Street (O-Odd-E-Even)	1	AN
Street Code	5	N
Block Number	5	N
Police Radio Zone	1	N
Police District	2	N

DESCRIPTION	MAX # CHAR	TNP
Police Beat	4	N
Reporting District	6	N
City Code	2	N
County Code	1	N
Census Tract Number	4	N
Map Number	6	N
Date of Last Update	6	N
Time of Last Update	6	N

As previously stated, the geographic base file is being further developed and updated by a police sergeant and eight (8) police officers. These officers are in the field on a daily basis, constantly updating any changes in the GEO File that they observe or that has been reported to them. Changes reported to the GEO Section occur by several means. Examples of how these changes occur are as follows:

(1) City Secretary's Office forwards street name changes and new ordinance street information.

(2) Houston Light and Power Company utility maps are used to compare information that is on file.

(3) A printout is prepared on a monthly basis whereby the five (5) digit street code is converted to the major street name in order to eliminate the misspelling of major street names in file.

(4) An edit list is prepared on a monthly basis between major street names and block ranges that do not match.

(5) Police Dispatchers Division advises discrepancies found in the file as the result of that office inquiring into the file for each call for service that is received.

(6) GEO Officers personal observations of discrepancies in file while working in the field.

As the result of information received from these various resources, the GEO Officers are making approximately 10,000 updates to the GEO File per month.

At the present time, there are 178,277 records and 11,715 major street names in the GEO File.

SYSTEM DEVELOPMENT

The Houston Police Department, as it has been indicated, began utilizing Automated Data Processing equipment and techniques in the 1950's. During that time numerous applications were developed, such as geographic information as previously discussed; accident reporting, ambulance call reporting, fleet statistics, burglar alarm calls, courts information such as cases filed and disposed, printing of warrants and warrant notices, parking ticket billings, and bicycle registrations.

In the late 1960's, the Police Department became linked to the Texas Crime Information Center (TCIC) in Austin, Texas and the National Crime Information Center (NCIC) of the FBI in Washington, D.C. In addition to the access to data provided by these information systems, the Police Department is aided by several on-line files that are operational at this time. They include a Stolen Vehicle File, Fleet Accounting System, Master Name File, including a Want/Warrant File, Alias Name File and a pointer to Vehicle File, and the on-line Geographic Base File.

TRAINING

Police personnel within the NCIC Division of the Police Department have the responsibility for training supervisory personnel as well as civilian personnel so that they are aware of what information can be retrieved from the system and how to retrieve the information in such a way as to be valuable to their operations. The Houston Police Academy has begun in-service training sessions in order to familiarize patrol officers, as well as detectives, with the value and potential of the Computer Information Center. Efforts are also being made to encourage all officers to learn system operation and to use the data available to determine how their patrol areas compare with other parts of the city. At the present time, the HCIC Division is preparing a training program for approximately 300 civilian employees. All data processing personnel (Technical Support) is provided by the City Management Information Systems Department. These development people are civilians and have received formal data processing training.

CONCLUSION

It is apparent that law enforcement agencies, which have or are in the process of implementing computerized operations will require a geographic base file in order to properly support their system. It is also apparent that law enforcement agencies which have installed a viable GBF System will improve their agencies effectiveness in responding to community needs.

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DEVELOPMENT OF AN OPERATIONAL CAD GEO FILE USING A GBF SERVICE CENTER

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The City of San Jose encompasses 152 square miles with a population base of 575,100. The city is served by a Police Department with a complement of 779 sworn personnel, responding to 349,670 demands for service annually. In order to provide effective and efficient service at a level that meets the community expectations, department management is concerned with the viable use of this limited manpower resource.

Prior to 1970, the administration and management of the department's resources relied, for the most part, upon historical patterns. The concept and utilization of a geographic base file as the heart of an operational and management information system was virtually unknown to the San Jose Police Department.

Scant attention was given to the periodic activity reports submitted by organizational units. Their primary use was to satisfy mandatory statistical reporting requirements and in preparation of the Department's Annual Report. No rationale existed for allocation of field forces and, resultantly, no evaluative efforts could be undertaken.

The initial exposure of the department to a geographic based file system occurred in 1970. In cooperation with the federally funded Criminal Justice Pilot Program, the department participated in the development of an experimental project. That project, entitled CAPER (Crime Analysis Project Evaluation Research), was designed to encode data elements from police offense reports. One of the elements encoded was event location. Using a computerized geographic base file (GBF), the street address was translated into an x,y coordinate. Reports generated by the CAPER System were reviewed and analyzed by the department. The value of analysis of reported activity by geographic distribution was quickly realized.

However, in reviewing the reports generated by the CAPER System in relation to samples of total field activity, it was revealed that only 34 percent of the department's expended field efforts could be accounted for. The department realized that it must quickly look to technological applications to aid in capturing additional information to address the numerous problems related to effective manpower deployment.

Following the experience gained through use of CAPER, the department entered into a Joint Studies Agreement with the IBM Corporation. The department's objective was to use a newly developed Geographic Analysis and Display System (known as GADS) to redesign the geographic allocation of police resources to equalize workloads and meet demands for police service. Working with IBM technical personnel, the staff developed the basic beat block (BBB) concept. Simply stated, the BBB is the primary area for assignment of service demands, allocation of resources and evaluation of efforts. The BBBs then can be aggregated into beats, districts and areas. The initially defined BBBs were then evaluated by collecting a sample of calls-for-service from existing manual dispatch records and imposing it upon the basic configurations. Based upon that effort, necessary realignments of beat structure were made.

At the same time, the department participated in a citywide data processing needs analysis. This effort was directed towards identification of candidate applications for automation. Highest priority, growing out of this effort, was assigned to the acquisition of a command and control system that would:

- accurately, expeditiously, effectively and efficiently direct the delivery of police services;
- capture and generate records of geographically related service delivery data for analysis, planning, resource allocation and evaluation;
- provide day-to-day management information;
- meet the current department workload and provide growth capabilities to cover the next ten years of expected city expansion.

COMMAND AND CONTROL SYSTEM DESCRIPTION

Following two years of research and design effort, the department selected a vendor to provide a turnkey computer assisted dispatching system known as CAPS (Computer Assisted Public Safety). This system became operational in September of 1976 and is installed at the Santa Clara County GSA-Communications Center, which provides dispatching services for the city of San Jose. The host system is comprised of three subsystems which are capable of independent operation:

- Police subsystem
- Fire Subsystem
- Geo-reference Subsystem

The police and fire dispatching systems will be described briefly with detail devoted to the design, operation and problem areas encountered in the development of the Geo-reference Subsystem. The Computer Assisted Dispatching System is supported by dual DEC PDP 1145 mini-computers with 96K memory for each system. The system configuration is designed to provide required redundancy. Peripheral equipment consists of two 20 megabyte discs (one houses the Geo-file), two mag tape drives, two high speed printers, two operator consoles and 35 CRTs. The operational system software is RSX11D. Programs are developed by the system vendor, Kustom Data Communications, Inc.

Police Dispatching System

The Police System is an event tracking, unit status keeping system which provides for real-time control of demands for service, field activity and data capture of where, when and how police services were delivered to the community. It is supported by the

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Geo-reference File but is not dependent upon that file for operation. Dispatching for San Jose Police is accomplished in a dual stage system. Nine complaint-taking positions provide intake of citizen demand for service. The system automatically generates police case numbers and provides for automatic transfer of calls to predesignated dispatch positions responsible for assignments to the geographically located units. Additional system capabilities provide for recommendation of police units for assignments as well as tracking each police activity to field disposition. Seven dispatching positions provide the capability of either voice radio or digital transmission to field units.

Fire Dispatching System

The Fire Dispatching System can operate either in a single stage or dual stage mode providing for call handling and status keeping of fire equipment in the city's 25 fire stations. The Fire Subsystem is equipped with two dispatching positions, one standard complaint position, and the capability of adding two emergency complaint positions should the demand dictate.

Geo-reference Subsystem

The Geo-reference File has as its inherent design concept the requirement to help insure that:

- public safety resources (police, fire, etc.) are assigned to clearly defined locations.

- complaint operators clarify ambiguous or misleading citizen information relative to location of need for service.

- statistical data is provided as a by-product which will support police and fire management studies relating to patrol deployment, fire station locations, response time predictions, etc.

In the public safety arena, geo-reference has been most commonly referred to as address verification. Strictly speaking, geo-reference is much larger in scope than just validating addresses. As used in an operational CAD system, geo-reference is a global title which describes computer hardware, software and data file collection. All of these elements are structured to support the above described goals.

There are four steps in utilizing the CAPS Geo-reference Subsystem:

1. Location validation. The operator enters a premise address, intersection or common place name.

2. Processing and displays. The system translates the entered data into necessary support elements (address match or other geo-information).

3. Recommended unit support. When needed, the system uses the support elements, together with user-defined algorithms, to generate recommended units to handle an activity.

4. Tape processing. Sufficient data is collected and logged to the system journal tape so that location, police or fire areas, x,y coordinates, etc., are written as statistical records for later batch analysis.

The other key capabilities which are a by-product of the Geo Subsystem are:

- Special deployment information, known as special notes, are keyed to intersections and displayed when an address falls within the sphere of the intersection.
- Map coordinates are displayed in the call record. This information is relayed to responding units providing common geographic reference.
- "Significant information" capability. This capability advises of dead end, restricted access streets, private property, etc.

GEO-REFERENCE FILE SYSTEM LIMITATIONS

While the CAPS Geo-reference System is an extremely beneficial tool, it is not omnipotent. The system does not possess sufficient information to determine the validity of a particular premise. Instead, the system does contain "address range" sequences to ascertain that the number in the premise address is within the range of valid addresses for that street. The Geo-system is important to the users of the system in determining area of responsibility (e.g., police beat, fire first due station, etc.); however, there are times when the Geo-system is bypassed in the complaint/dispatch process. This may be due to errors in the files, non-accessibility of the files, etc. The CAPS dispatch mission must function with or without geo-support.

SYSTEM PHILOSOPHY

As stated in the previous discussion, the Computer Assisted Dispatching portion of the CAPS System must always proceed. This is, then, a first statement of philosophy:

- The role of geo-support is important, yet subordinate, to the accomplishment of the dispatch action.

Since the Geo-system may be completely in error (due, for example, to an infrequently validated address having an incorrect block sequence number), a second statement of philosophy is:

- A CAPS operator must be able to override or ignore the information retrieved from the Geo-subsystem.

In line with the above, a real design philosophy was adopted:

- Even on "perfect matches" in the Geo File, the complaint operator must see the inquiry and the results of the match and "accept" the results.

Another important system philosophy is found in the fact that no "perfect" approach to location verification is possible when "overlaid" on the complaint/dispatch function. Therefore:

- the use of the Geo-subsystem should not appreciably delay complaint taking. The final approach to accessing and displaying information is a compromise reached between operational needs and validation needs with the above as a guiding point of view.

The last point addresses the dual utility of the Geo-subsystem. It is designed to serve police and fire needs, and, since the same operating personnel are manning police and fire:

- The architecture of the Geo-subsystem had to be such that it was the same to operate regardless of which public safety department it is being called upon to support.

File Description

The following file overview may be of help in understanding the architecture of the system. There are three basic files:

- Street Dictionary. The Street Dictionary record is the address segment record. The order of entries in the Street Dictionary is alphanumeric. The record is 80 characters in length and contains the record key, street name, prefix and suffix, police, fire and corporate jurisdiction, an odd-even parity check, the low, middle and high address ranges and the low and high intersection record keys.

- Intersection Segment Record. The Intersection records are stored in alphabetic sequence. Each intersection is listed once. The intersection record contains the record key, the on-street name suffix and direction, the cross street, suffix and direction, corporate jurisdiction for the intersection, together with a flag for mixed jurisdiction, and the low and high address range for the on street.

- Intersection Detail Record. The Intersection Detail Record contains the record key, the map index coordinates, the Police District Beat, the Police Beat Building Block, the fire run card information and the x,y coordinates of the intersection.

An inquiry of the file by premise address accesses the Street Dictionary record, chains to the Intersection Segment record, and then chains to the Intersection Detail record. An intersection argument posed against the file will access the Intersection Segment record and the Intersection Detail record.

Typical Use of the Geo-Subsystem

Upon receipt of a call for the particular public safety service, the complaint operator is presented with a blank event mask. The operator collects and enters (minimally) the location, type and nature of the call. A keyboard function key is depressed and the mask on the CRT is read. The system returns control of the cursor to the operator in the field where data collection was suspended to invoke the Geo-reference System support. Thereafter, the operator may continue to collect additional call data such as details, reporting party, etc.

During the time when the operator has the caller on the phone collecting the additional data, the Geo-file Subsystem software is accessing the appropriate files to validate the location data. When an address match (or failure) occurs, a message is returned to the operator on the lower half of the CRT. If the result of the access was an address match, the operator reviews the address data returned and enters an accept command. The completed event is automatically routed to the appropriate dispatcher. When presented to the dispatcher, the full geographic support information is contained on the complaint mask.

If the return from the geo-file to the complaint operator is an address failure notification, the reasons may be either no match in the files or a list of possible matches presented. For no match returns, the geo-file must be bypassed and the event location handled manually. Manual street-to-beat listings are provided for system backup. If the address failure return was a list of possibles, the operator merely selects the proper location from the list of possibles and the update to the complaint mask occurs.

Other capabilities exist as a by-product of the geo-support process. For the Police Subsystem, if the priority of the call indicates urgency, an information copy of the call data is sent to all dispatch and supervisory positions. In addition to the information copy being sent, the x,y coordinate of the incident is measured against the historical x,y coordinate of available units, and the probably nearest in-service units are recommended to handle the call.

At the close of the call, the entire information including the geo-support information is logged to a journal tape for later analysis.

DEVELOPMENT OF THE GEO DATA FILE

Existing within the County of Santa Clara is the Center for Urban Analysis, which was established under Federal funds as the local repository for geo-base file and demographic data. The Center for Urban Analysis was identified as having the most suitable geo-base file for development of an operational file. The area to be included in the file was identified by the system users (i.e., police and fire). The identified area comprises all addresses falling within the corporate sphere of the City of San Jose, all county pockets lying within that sphere, and that area surrounding the city limits to which the Fire Department responds under automatic aid agreements.

Once this area was defined and data withdrawn from the DIME file, Center-developed software was applied to create the file structures as previously described. These file structures were specified by the CAPS System vendor. As both departments involved had previously worked with the Center for Urban Analysis in geocoding research projects and in the geocoding of police offense reports, the assumption was made that the transition from the base file to the operational file would be an easy process. This assumption undoubtedly reflected the inexperience of both Departments in the complexity of geo-base information.

The resultant file was delivered to the Santa Clara County Communications Department, loaded on the CAPS System, and at that point police and fire were presented with the problem of file acceptance for operation purposes. It is properly the decision of the operating departments. rather than Communications, as to whether the file validity is such that it can be used in an operational environment. Procedures and techniques for structured testing of the file had not been developed by the department. The Fire Department had worked extensively with the Center for Urban Analysis, using a graphics display system, to verify the accuracy of their fire boundaries. The Police Department had not taken this step.

Police Department personnel quickly realized that we were at the beginning of a long learning curve in new technology. Various "hit and miss" approaches were attempted to test the file. High police response areas were used for establishing validity of police beat, jurisdiction, cross street, etc. information. Budgeting of police and fire resources for Geo File support had not occurred.

As the Police Department's geographic experience had heretofore been related to simple street-to-beat listings, encountering such things as segment records intersecting with non-street features (i.e., start points, curve points, railroad tracks) was an entirely new problem. Removal of all non-street features from the file would not mitigate the problem as certain geographic points are required for dispatching of emergency services. However, leaving such records in the file and receiving an address verification with a cross street of "curve point" certainly does not assist the officer in locating the assignment. Therefore, some methodology needed to be developed to establish what additional landmark points were required in the file.

Streets that change names at an intersection, thus creating multiple intersections records, were an additional problem. A further conflict which occurred was where street names had been legally changed and the Center was properly carrying the legal street name on the file but the calling citizens and police officers were still referring to the historical name. Creation of an alias file then became an issue. In addition, street name changes and the overlapping of that name change for a specified address range became a new area of concern. To explain a little further, numerous streets in the City of San Jose will change names at a given intersection; however, our concern was that a citizen would use the last street sign name that they had seen to report a fire or an accident. Creating overlapping segments without overlapping a real address then becomes a problem.

The development and institutionalization of procedures to provide ongoing and routine tests of file validity have consumed a large amount of unbudgeted personnel time, requiring that other projects be set aside. A most critical administrative consideration is the level of expertise necessary to effectively solve the aforementioned multitude of system related operational problems. In order to effectively accomplish the development of an operational geo-file, the commitment must be to gain an in-depth understanding of geo-base file technology and construction, validation and maintenance procedures. Personnel with sufficient training and experience in systems development and associated subsystems should be utilized if a lengthy and costly process of trial and error is to be avoided. In order to approach the problem of file validity and ongoing maintenance, the department has recently increased the staff for geo-file development from 25 percent manpower commitment of one person to add two more full-time personnel.

File development and maintenance efforts for the San Jose CAPS geo-base file began in November of 1976. The original target date for operational use of the file was July 1, 1977. We have not reached that goal. We are looking for a file with 95 percent validity on a weighted scale. Our major concern is that intersections are valid, that address segments are complete and that the correct jurisdiction is indicated. Elements of lesser importance that do not relate directly to dispatching operations will be approached at a later date.

The aforementioned points illustrate some of the problems we have encountered. They must, and have been, addressed to the best of our ability. Acceptable resolutions require a unique application of problem solving techniques.

Our entry into the field of computer-related technology has been recent and rapid. At present we view our utilization as still in a developmental stage. We are dedicated to maintaining that perspective and reflecting that attitude in increased and improved application of our newly acquired technology.

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A GBF CHECKLIST

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The site for the City of New Orleans was chosen because of its proximity to the Mississippi River delta and the surrounding water bodies, namely, Lake Pontchartrain to the north and the Gulf of Mexico to the east. The Mississippi River provides both a west and south border to the city, giving New Orleans the name "The Cresent City." This ready access to the city by water contributed greatly to its early growth following its founding in 1718. However, these bodies of water have also limited the growth potentials for the city and generally dictate the modes of transportation and the suburban growth that it faces. In its early years, New Orleans grew very little in area, being limited to only a few square miles that were not under water. Growth took place only after levees were built and drainage systems were installed and today most of New Orleans is reclaimed land. Present growth patterns are concentrated at the extreme eastern and western edges of the metropolitan area simply because these are the only areas that are above water.

Population growth, industry migration, and suburban migration are all affected by the sparsity of land. A visitor to New Orleans is sometimes confused by our street pattern. At times, there appears to be no pattern at all. Our east-west streets follow the river and the intersecting streets run between the Mississippi River and Lake Pontchartrain to the north. Within the French Quarter area, streets are straight but narrow. Our widest streets are those that were originally open drainage canals, most of which have been covered over and are today classified as "boulevards."

This brief introduction may help you understand why we need a viable geographic base system in the New Orleans area. Since the New Orleans Police Department upgraded its tab oriented computing system of the sixties to one on-line in early 1970, address handling was, and still is, a major undertaking. Present needs require verifying addresses on outstanding warrants, verifying arrest locations for crime analysis purposes, motor vehicle registrations for investigations, validating incident locations for dispatching, and having valid addresses for victims and witnesses to support the judicial system. These needs are in no way unique to New Orleans, but when one considers them in the total picture it becomes obvious that unverified addresses are of little use. While we do not believe we have the only answer nor that our answer will survive for more than one or two decades, we must find a better way. Computerization is the only method we as a group have found to meet this need.

This paper addresses an approach to this problem, an approach which limits its scope drastically to the police needs. While it is conceivable that various New Orleans agencies other than the N.O.P.D. may be able to apply our solution, the immediate need is with the police and that's why we have been the vanguard in our city.

Early in 1972, the New Orleans Police Department began looking for methods to handle our particular GBF problem in computer systems. Several current systems at that time looked promising and the better system of those studied was the Long Beach, California LOCUS system. It was based on the DIME files from the 1970 Census and had the features that we wanted. We attempted without success to apply this system to New Orleans. It wasn't that LOCUS wasn't good enough, but rather it was DIME File accuracy and problems in project staffing.

The New Orleans SMSA was riddled with errors from every conceivable angle. Street names were misspelled, whole segments were missing or numbered incorrectly, data from one side of the street was coded for the opposite side of the street. The file, as it existed then, could not be used for the purposes for which we wanted to use it. A major cleanup effort was started. The obvious errors were taken out. Edits were run locally and at the Census Bureau's Geography Division.

There were problems within our city government making it impossible to hire the necessary personnel to accomplish the much needed work to massage the file into something useful. With severely restricted personnel resources, we spent over two and a half years working on this system, cleaning DIME, and generating LOCUS. Applications that we were holding back to use LOCUS, e.g., on-line booking, were started without it because of the delays. Other applications that were scheduled to begin after LOCUS were started and completed and still no LOCUS. The small staff we did have went on to bigger and better things with other agencies. In short, LOCUS died.

Not until the New Orleans Police Department began planning a Computer Aided Dispatch System in late 1974 and early 1975 did the impetus again grow for a GBF. Delays, changes in design, and a lack of responsive bids tabled the CAD Center. We began to look closely at the Communication Center's needs in the way of GBF data before we again went out for another RFP this year. By that time, another study had been undertaken in-house, and we are now developing our own GBF system to meet our needs.

Our analysis was shocking. We reflected address data repetitively in 35 separate places in both the on-line and the batch systems. After overcoming this initial shock, we looked further and found that field sizes were not standard in size, shape, usage, or formation. Again we looked at this as a hopeless cause. Where before, a GBF system was only a fad, a nicety, we now found ourselves with a definite need, a requirement. The decision was to develop our own system using what we had available to make do. After reviewing the prior work done for the LOCUS project and studying an existing numeric coding scheme within the police files, we decided to combine only the data elements from the DIME file and this internal coding scheme that we needed. Where LOCUS consisted of five distinct files of over 50 million characters, our system, tagged the Street Edit Verification System (SEVS), uses four record types which may or may not be combined wtihin one file of less than six million characters. We are using a single virtual storage access method(IBM VSAM) file which may be accessed from both a batch system and on-line.

The SEVS has four record types. It has, as its first record type, an index type function. It contains all acceptable spellings and all common place names. This record is the basis for accessing the entire file.

The second record type is accessed through the numeric key, from record type number one, which allows access to all records for a given street name, direction, and suffix. By comparing the actual address ranges of these records it is possible to find the one record that matches, and thus, the address is verified. The correct spelling is available, the police reporting zone is provided, and the census tract/ node is available.

The third record type contains intersections and is referenced by obtaining two access keys from record type one. It also contains the x,y coordinates from the DIME file.

The fourth record type is a tract/node cross-reference record. It is keyed on tract and node providing the capability to find an intersection based on a given address. This is especially useful when the distance from one point to the next is needed.

These four record types can handle not only the city of New Orleans but will handle any address within the New Orelans SMSA.

To understand the utility of the SEVS, we must look at the different ways to store addresses and the accesses that are required. While it is possible to numerically code every address within a given jurisdiction, it is not possible to code locations outside that area. If a given data file contains both coded (local) and non-coded (out-of-town) addresses, then the space requirements to hold these addresses must be available and space is often wasted. For example, for an address consisting of a street name, house number and city and state, a minimum of 41 characters is required. By coding such an address, only 14 characters are required at a substantial space savings. If every address is coded, the conversion file must always be maintained. In the total coded environment, obsolete records must be retained in a conversion file for decoding historical files from the past five years or more. Thus, total unadulterated coding is not the answer either: verification is the answer. Whether you use a system like ours or a design of your own, verify what records you can and be aware of the confidence level retained. In the New Orleans SEVS, we are doing just that. We are planning to edit every address we handle within the SMSA and flag those not verified for manual review the next day. This approach is necessary because of the unique police needs. We cannot hold a dispatch call because the edit won't pass it to the dispatcher where rapid response is required. These addresses, though not verified, must be allowed. It is also imperative that these addresses be verified at a later time when the time element is no longer critical. It is also conceivable that some address input could be so adulterated through gross misspelling that the edit fails completely. These addresses, though part of the file, cannot be verified at the time and must be allowed, but again, reviewed later.

There are pecularities in New Orleans that can tax any verification system, but forethought and a good system design can minimize these problems. One particular example exists in our uptown residential area. We have three streets that parallel each other with the same name. The only obvious difference is the street suffix type. Luckily, this problem can be handled. These streets, though spelled the same, do not have the same address number scheme and can be separated by street name and address range editing. A good file design can incorporate some assumptions which will limit the amount of manual review necessary with a viable edit system.

Anyone just starting out with a GBF system should consider staffing. This doesn't appear too enlightening nor does it appear to be an unobtainable. Yet this was and still is the case in New Orleans. Only one person has had the task to do this work at any given time. A task force of one can accomplish the impossible GBF system but it will take much longer than planned because the returns are so slow in coming. The duties are so diversified that one person cannot properly divide his time to accomplish the varied tasks within any given time frame. I recommend a minimum staff of three to include:

Project manager - coordinate, schedule, standardize, document

Prog/analyst - clean, update, create, maintain the edit files, standardize

Programmer - change existing programs, write new applications, standardize

Standardization is the one element which may make or break a system and should be a common goal of the entire team.

After the edit system is functioning, coordinate updates and corrections among those using the system. The police officer on patrol is the first one to notice a change: encourage him to report it. City Planning, the Streets Department, and the subdivision contractor are all aware of new streets and street deletions and sometimes they even know when they're to be added or deleted, but the patrol officer is our first line effort for changes. He sees small changes evolve, he deals directly with the public, he knows what nicknames the streets have, and most important of all, he's the one who has to find the street in a pinch. He has to know.

After facing the problems above, one may wonder—why attempt it. Only one thing makes it worthwhile and that's the payoff—the ability to find addresses, the ability to serve warrants, the ability through analysis to limit crime. These are the benefits.

THE LOS ANGELES POLICE DEPARTMENT EMERGENCY COMMAND CONTROL COMMUNICATIONS SYSTEM AND ITS PLANNED USE OF GEOGRAPHIC BASE FILES

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The Emergency Command Control Communications System (ECCCS) is a planned computerized system utilizing advanced technology to provide the fastest possible response to citizen calls for service and enable the street police officer to operate more effectively.

OVERVIEW OF ECCCS

The existing Los Angeles Police Department (LAPD) communications system is confronted with a series of critical communications and dispatch problems in its effort to keep pace with ever increasing demands. The level of service provided by the Complaint Board and radio communications operations will deteriorate under projected workloads without the significant addition of both personnel and equipment. The high cost and limited capabilities of an incremental expansion of the existing system make such expansion fiscally and operationally undesirable. Additionally, heavy communication loads saturate existing radio channels during critical hours and emergencies. Voice radio communications between field units and the Central Dispatch Center are slow and field officers are now out of touch with Communications Division when away from their vehicles.

The ECCCS will alleviate these problems and significantly improve community safety by enabling more rapid response to citizen calls for service. The increasing public safety demand created by growing crime rates and the limited financial resources available to meet that demand necessitate combining advanced technology with available police manpower to maximize operational effectiveness.

The following specific benefits will be derived from the ECCCS program:

1. A Computer-Aided Dispatching (CAD) System to quickly process calls for police service;

2. An increase in the efficiency and safety of field officers by faster responses to their inquiries through the use of the Mobile Digital Communications System;

3. Increased efficiency and safety for field officers with the implementation of the Remote Out-of-Vehicle Emergency Radio (ROVER) System;

4. A reduction in radio frequency congestion with the implementation of the Master Radio Plan;

5. Improved security of law enforcement messages through the use of digital communications;

6. An increased cost effectiveness, with a resultant improvement in service to the public;

7. Crime reporting will be integrated with the digital dispatching function to allow for the correlation of original calls for service and their ultimate disposition; and

8. Data for tactical and management decisions will be available on a timely basis.

Preliminary development of an advanced command and control communications system began nearly ten years ago. In a report to the City Council in September of 1968, a City Communications Advisory Committee identified the need for ECCS and recommended the establishment of a Technical Steering Committee to conduct, with contractual assistance, a system study to develop a Master Plan for upgrading police communications. In December 1969, the Hughes Aircraft Corporation began such a study and in January 1971 published a six-volume Conceptual Design Report of findings and recommendations.

Because of the complexity and cost of the system, as well as its potential applicability to other law enforcement agencies, the Law Enforcement Assistance Administration (LEAA) financed a Risk Reduction Study by the Jet Propulsion Laboratory (JPL). This plan prioritized the implementation of the ECCCS subsystems based upon considerations such as funding, state-of-the-art, and interdependence of one to another.

The ECCS project as designed today is essentially as envisioned by the Hughes and JPL studies. Because of its scope and complexity, the system was divided into several major components, including the Remote Out-of-Vehicle Emergency Radio (ROVER), the Master Radio Plan (MRP), and the Computer-Aided Dispatching (CAD) and Mobile Digital Terminals (MDT).

In September 1973, a $2 million grant was provided by the LEAA to accomplish three primary goals;

1. Complete a Preliminary Total System Design;

2. Prepare a Master Radio Plan (MRP) for police communications; and

3. Prepare specifications for purchase and implementation of 200 mobile digital terminals (MDTs) in one police operations bureau.

All of these objectives, with the exception of the purchase and implementation of MDTs, were achieved. The city and LEAA mutually agreed to postpone procurement of MDTs because the then available models did not provide all of the operational capabilities defined as necessary for Los Angeles Police Department use. A Phase II grant, now being executed, will result in detailed design of ECCCS and implementation of a significant portion of the fixed radio system necessary for the support of ROVER. The city is evaluating proposals for this effort.

In June of 1975, the City Council approved the Communications Advisory Committee's recommendation to adopt the Master Radio Plan (MRP) prepared by the Jet Propulsion Laboratory. Because of the uncertainty of future grant funding, the significant city investment already in the program, and an urgent need for a modern communications system, it was imperative that the city make a commitment to construct the system and that sufficient funding be provided. After an extensive public relations campaign, the voters of Los Angeles, in May of 1977, passed a $39.85 million tax override to finance the completion of ECCCS.

ECCCS SUBSYSTEMS

ECCCS is not a simple expansion of existing dispatch/communications capabilities. It is not merely a set of improvements to alleviate noise, lighting, space, or other environmental problems. Nor is it a simple upgrading of the existing system to relieve congested communications links. Instead, ECCCS represents a new total system approach that will significantly improve all present LAPD emergency command control and communications and meet the anticipated needs of 1990 and beyond. It will also provide the means for planned growth of additional operational capabilities.

ECCCS is a comprehensive system that consists of many parts, components, and subsystems. As depicted in Figure 1, p. 182, ECCCS is the central focal point for dispatch/communications as well as the interface between the public, field units, stored information, and the management of the LAPD.

The ECCCS consists of several highly sophisticated subsystems:

1. Remote Out-of-Vehicle Emergency Radio (ROVER) and the associated fixed sites in the Master Radio Plan (MRP).

2. Mobile Digital Terminals (MDT).

3. Computer-Aided Dispatching (CAD).

ROVER

The Remote Out-of-Vehicle Emergency Radio (ROVER), manufactured by Motorola, is the first subsystem of ECCCS to become operational. In October 1976, police officers in Central Area began using ROVER devices on a daily basis.

Upon citywide implementation, each officer will be equipped with a small lightweight portable radio. When in the police vehicle, ROVER is placed in a dash-mounted vehicular charger that connects ROVER to an external antenna making it an effective mobile radio. When out of the vehicle, it is a powerful portable radio. ROVER enables a field officer to leave the police vehicle while maintaining continuous communications with all elements of the Department including the helicopter fleet. This new flexibility has provided a major increase in overall effectiveness, especially when used between air and ground units. The officer is also able to monitor field activities while conducting assigned tasks and the Central Dispatch Center is able to contact an officer on a non-emergency call away from the police vehicle and reassign the officer to a higher priority call. With ROVER, an officer who would normally return to the police vehicle to request information from data banks (i.e., Want and Warrant checks, Stolen Vehicle System, Department of Motor Vehicles, etc.) is able to request this information remotely, saving valuable field unit time.

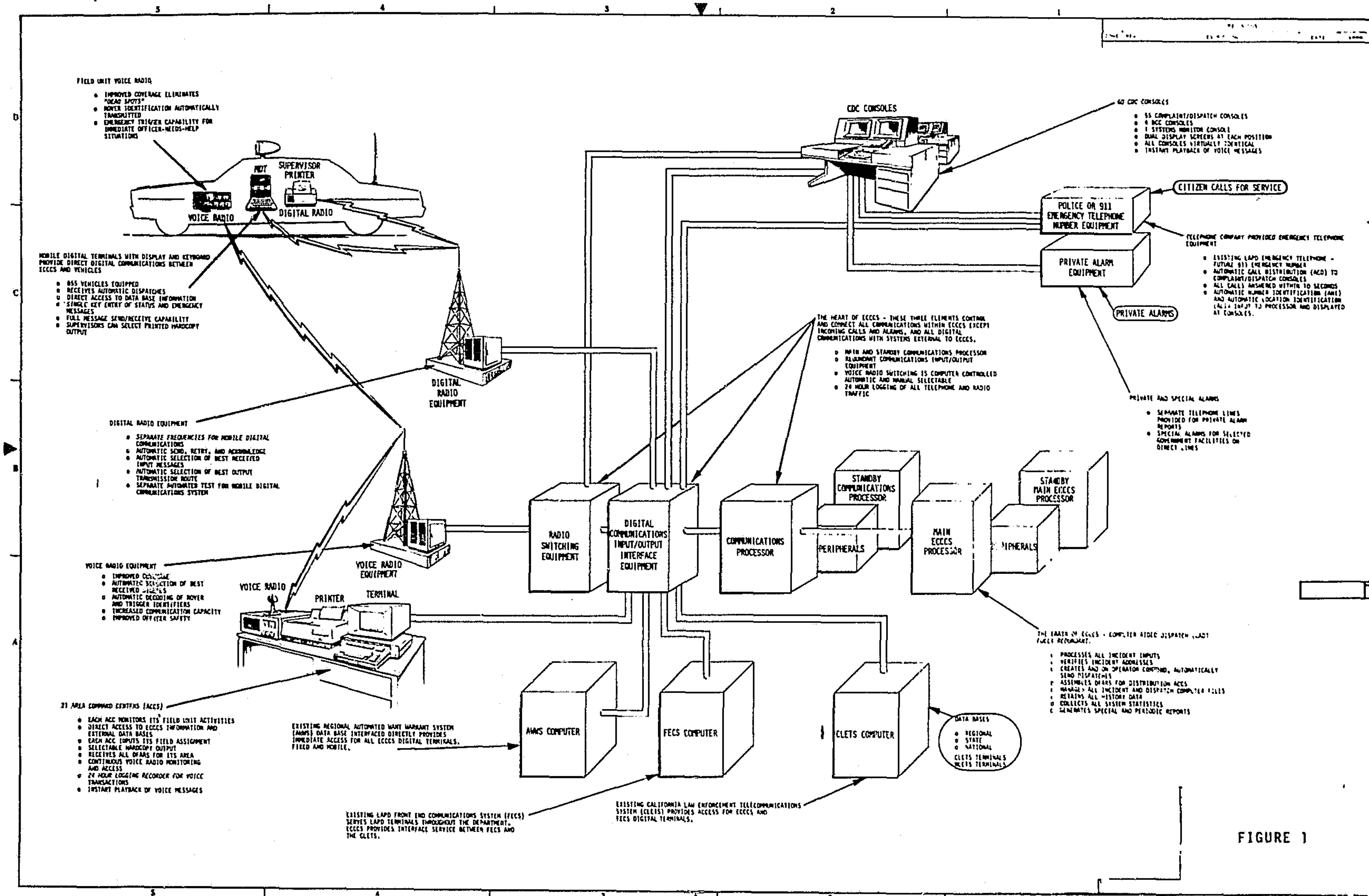

FIELD UNIT VOICE RADIO
IMPROVED COVERAGE ELIMINATES "DEAD SPOTS"
ROVER IDENTIFICATION AUTOMATICALLY TRANSMITTED
EMERGENCY TRIGGER CAPABILITY FOR IMMEDIATE OFFICER-NEEDS-HELP SITUATIONS
MDT
SUPERVISOR PRINTER
VOICE RADIO
DIGITAL RADIO
MOBILE DIGITAL TERMINALS WITH DISPLAY AND KEYBOARD PROVIDE DIRECT DIGITAL COMMUNICATIONS BETWEEN ECCCS AND VEHICLES
855 VEHICLES EQUIPPED
RECEIVES AUTOMATIC DISPATCHES
DIRECT ACCESS TO DATA BASE INFORMATION
SINGLE KEY ENTRY OF STATUS AND EMERGENCY MESSAGES
FULL MESSAGE SEND/RECEIVE CAPABILITY
SUPERVISORS CAN SELECT PRINTED HARDCOPY OUTPUT
DIGITAL RADIO EQUIPMENT
DIGITAL RADIO EQUIPMENT
SEPARATE FREQUENCIES FOR MOBILE DIGITAL COMMUNICATIONS
AUTOMATIC SEND, RETRY, AND ACKNOWLEDGE
AUTOMATIC SELECTION OF BEST RECEIVED INPUT MESSAGES
AUTOMATIC SELECTION OF BEST OUTPUT TRANSMISSION ROUTE
SEPARATE AUTOMATED TEST FOR MOBILE DIGITAL COMMUNICATIONS SYSTEM
VOICE RADIO EQUIPMENT
VOICE RADIO EQUIPMENT
AUTOMATIC DECODING OF ROVER AND TRIGGER IDENTIFIERS
INCREASED COMMUNICATION CAPACITY
IMPROVED OFFICER SAFETY
VOICE RADIO
PRINTER
TERMINAL
21 AREA COMMAND CENTERS (ACCS)
EACH ACC MONITORS ITS FIELD UNIT ACTIVITIES
DIRECT ACCESS TO ECCCS INFORMATION AND EXTERNAL DATA BASES
EACH ACC INPUTS ITS FIELD ASSIGNMENT
SELECTABLE HARDCOPY OUTPUT
RECEIVES ALL DFARS FOR ITS AREA
CONTINUOUS VOICE RADIO MONITORING AND ACCESS
24 HOUR LOGGING RECORDER FOR VOICE TRANSACTIONS
INSTANT PLAYBACK OF VOICE MESSAGES
CDC CONSOLES
60 CDC CONSOLES
55 COMPLAINT/DISPATCH CONSOLES
4 DCC CONSOLES
1 SYSTEMS MONITOR CONSOLE
DUAL DISPLAY SCREENS AT EACH POSITION
ALL CONSOLES VIRTUALLY IDENTICAL
INSTANT PLAYBACK OF VOICE MESSAGES
CITIZEN CALLS FOR SERVICE
POLICE OR 911 EMERGENCY TELEPHONE NUMBER EQUIPMENT
TELEPHONE COMPANY PROVIDED EMERGENCY TELEPHONE EQUIPMENT
EXISTING LAPD EMERGENCY TELEPHONE - FUTURE 911 EMERGENCY NUMBER
AUTOMATIC CALL DISTRIBUTION (ACD) TO COMPLAINT/DISPATCH CONSOLES
ALL CALLS ANSWERED WITHIN 10 SECONDS
PRIVATE ALARM EQUIPMENT
PRIVATE ALARMS
THE HEART OF ECCCS - THESE THREE ELEMENTS CONTROL AND CONNECT ALL COMMUNICATIONS WITHIN ECCCS EXCEPT INCOMING CALLS AND ALARMS, AND ALL DIGITAL COMMUNICATIONS WITH SYSTEMS EXTERNAL TO ECCCS.
MAIN AND STANDBY COMMUNICATIONS PROCESSOR
REDUNDANT COMMUNICATIONS INPUT/OUTPUT EQUIPMENT
VOICE RADIO SWITCHING IS COMPUTER CONTROLLED AUTOMATIC AND MANUAL SELECTABLE
24 HOUR LOGGING OF ALL TELEPHONE AND RADIO TRAFFIC
PRIVATE AND SPECIAL ALARMS
SEPARATE TELEPHONE LINES PROVIDED FOR PRIVATE ALARM REPORTS
SPECIAL ALARMS FOR SELECTED GOVERNMENT FACILITIES ON DIRECT LINES
RADIO SWITCHING EQUIPMENT
DIGITAL COMMUNICATIONS INPUT/OUTPUT INTERFACE EQUIPMENT
COMMUNICATIONS PROCESSOR
STANDBY COMMUNICATIONS PROCESSOR
PERIPHERALS
MAIN ECCCS PROCESSOR
STANDBY MAIN ECCCS PROCESSOR
PROCESSES ALL INCIDENT INPUTS
VERIFIES INCIDENT ADDRESSES
RETAINS ALL HISTORY DATA
COLLECTS ALL SYSTEM STATISTICS
GENERATES SPECIAL AND PERIODIC REPORTS
AWWS COMPUTER
FECS COMPUTER
CLETS COMPUTER
DATA BASES
REGIONAL
STATE
NATIONAL
CLETS TERMINALS
EXISTING REGIONAL AUTOMATED WANT WARRANT SYSTEM (AWWS) DATA BASE INTERFACED DIRECTLY PROVIDES IMMEDIATE ACCESS FOR ALL ECCCS DIGITAL TERMINALS. FIXED AND MOBILE.
EXISTING LAPD FRONT END COMMUNICATIONS SYSTEM (FECS) SERVES LAPD TERMINALS THROUGHOUT THE DEPARTMENT. ECCCS PROVIDES INTERFACE SERVICE BETWEEN FECS AND THE CLETS.
EXISTING CALIFORNIA LAW ENFORCEMENT TELECOMMUNICATIONS SYSTEM (CLETS) PROVIDES ACCESS FOR ECCCS AND FECS DIGITAL TERMINALS.

FIGURE 1

A unique part of the ROVER System is the digital identifier/emergency trigger capability. In the event an officer needs help, whether in or out of the vehicle, a press of the emergency trigger button on the ROVER device digitally identifies the officer's unit and transmits an "officer-needs-help" message to the Central Dispatch Center. This trigger has already been used effectively in operational situations by field officers assigned to Central Area.

Mobile Digital Terminals

With a complete two-way digital communication system augmenting standard voice communications, radio frequency congestion will be reduced because digital radio messages take much less on-the-air time than voice messages. A significant percentage of messages will not require voice communications and will be sent via Mobile Digital Terminal (MDT). The MDT is easy to operate and requires pressing only one button to send the most frequently used messages, such as "clear," acknowledge," "request Code 7," (dinner), etc.

For more complex messages, such as suspect, vehicle or property inquiries, the MDT is equipped with a typewriter keyboard. This will allow the field officer to make direct inquiries into such police information files as the city's Automated Want/Warrant System, DMV, and Stolen Vehicle System without going through the Radio Telephone Operator. Routine radio calls and informational messages from Central Dispatch Center to field officers will also be sent digitally and be received in the field unit's MDT, eliminating the need for voice transmissions. In addition to improving frequency utilization, the MDT is expected to save significant patrol unit time each year, eliminating delays in accessing existing data bases.

Although digital communications are most effective for some messages, there remain items of real-time urgency or unusual content that are best handled by voice. Additionally, voice communications are essential whenever an officer is away from his vehicle. Accordingly, the two-way voice link with the Central Dispatch Center will be retained and improved. Digital communications will provide additional capabilities to field officers, not replace existing radio capabilities.

Computer-Aided Dispatching

Computer-Aided Dispatching (CAD) will provide several direct benefits. Among these benefits will be an increase in officer safety and faster, more accurate handling of citizen calls for police service.

When a citizen telephones the Central Dispatch Center with a request for police service, the information provided by the citizen will be input directly into a computer by a police officer working the Complaint Board. The computer will verify the location given by the caller to ensure it is a valid address within the city and also, with the assistance of the 911 Emergency Telephone System, verify that the telephone number and address from which the citizen is calling is in the same area as the dispatch. This may help eliminate spurious calls, possible "set-ups," bomb threats, and will also aid in recontacting the caller if additional information is needed.

After verifying the address and telephone number, the computer will indicate hazardous locations near that address so that an officer may know what to expect when he approaches the location. The entire ECCCS project is compatible with the State of California's mandated 911 Emergency Telephone System.

ECCCS GBF REQUIREMENTS

Before entering a meaningful discussion of geocoding in Los Angeles, let us first look at a Demographic and Jurisdictional Area Summary Tables to gain an insight into the scope of the work to be accomplished.

Los Angeles Demographic Summary Table

ITEM	NUMBER
Square Miles	466
Landmarks	1,000
Miles of Streets	6,500
Streets	10,000
Intersections	50,000
Individual Addresses	1,300,000
Population	2,800,000
Police Jurisdictional Areas	
Bureaus	4
Areas Command Centers	17
Team Policing Areas	51
Reporting Districts (most aligned to Census Tracts)	1,360

Add to these figures the projected 1990 LAPD resources of approximately 3,785 field officers available for patrol, 1500 black and white field units, almost 3,000 ROVERs, 855 MDTs and a projected citizens demand of 420 calls-for-service per average hour, a peak hour call load of 840, and it is apparent that the task of keeping track of that many people and that much equipment in as widely a dispersed areas as Los Angeles will be enormous.

The task of drafting operational requirements to meet this challenge was long and difficult. The following is a list of GBF requirements extracted from the ECCCS Request for Proposal (RFP). They have been included to aid agencies which, in the future, may write proposals of their own or simply want to organize their own GBF requirements. In either event, here are some ideas and words which may save someone some time.

Each requirement is preceded by an implementation priority number in parentheses: "(1)" is a mandatory requirement; "(2)" is a highly desirable requirement; "(3)" is a desirable requirement. This scheme was used as a shopping list. Most "(2)" and "(3)" priorities were dropped for economic reasons.

Central Dispatch Center (CDC) Automatic Data Processing Requirements:

(1) Los Angeles City street names and block numbers correlated to LAPD Reporting Districts (RD). Block numbers at each RD boundary intersection shall be identified. (All Los Angeles city street names shall include their common abbreviations and AKAs (Also-Known-As), e.g., Interstate 5, AKA Golden State Freeway, Pacific Coast Highway, AKA "101" and PCH).

(1) Street names and block numbers correlated to outside concerned jurisdictions for streets up to 500 yards outside Los Angeles City limits.

(3) Current street condition and road hazards of significance for all roadways within Los Angeles City.

(2) Los Angeles City address file for up to 1.3 million addresses.

(1) Provide random access cycle time into the street index file for street name inquiries and for street name and block number inquiries so the overall CDC file search response, when street name and block number are given, shall include information of the nearest intersection and referencing by a standard map book page, including X-Y coordinates for utilization in pertinent intelligence information.

(1) Provide (for the street index file) the data processing capability to select area maps at the operator's work position by one or more of the following methods:

a) (1) Map book page and street cross coordinates.

b) (2) Automatically projected microfiche map at the operator's console.

c) (3) Graphics capable of identifying streets and intersections.

d) (3) Graphic display capable of identifying the desired street, intersections, direction of traffic and available field units in the vicinity.

Maintain a directory of selected residences and businesses as follows:

a) (1) Pertinent intelligence information by address, including recent incidents. (It is intended that each dispatch message will be automatically checked against this file prior to being issued to a field unit. In the event that a dispatch address is within one (1) block of any location in this file, the file information shall be displayed to the dispatcher, who will determine if the information will be transmitted to the field unit.

This file will be accessed when each dispatch order is input to determine if any pertinent information exists, e.g., last unit dispatched to the location was assaulted, the location is a dangerous location such as a gun shop, or the last call at the location was a phoney call.

b) (2) Owner by address.

c) (3) Address by owner.

d) (3) Salient structure features for selected businesses and dwellings.

(1) Provide the data processing capability to interface operators' positions to the telephone company Automatic Number Identification (ANI) and Automatic Location Identification (ALI) systems. (To be implemented when ANI/ALI available).

Existing City Street Index Files

Although geocoding the GBFs is not new to the City of Los Angeles, for various reasons, centering around the lack of funding and manpower, there has been a lack of centralized planning. City departments with existing GBFs have failed to recognize the geocoding needs and capabilities that may be valuable to other agencies or departments. Hopefully, ECCCS will be a foundation for future citywide GBFs.

The following is a brief description of several of the geographic base files which are currently being used within the law enforcement area of the City of Los Angeles. They were included in the ECCCS Request for Proposal (RFP) as a guide to prospective contractors who may find it feasible to extract data from existing city files.

1. The Fire Command Control System (FCC) File was originated and is currently maintained by the Los Angeles Fire Department (LAFD) for dispatching. The disk file contains over 50,000 intersection records. For each intersection record there are two street records, each containing the beginning street address, type of street (St., Pl., Ave., Fwy., etc.), street direction, map and X-Y coordinates to the LAFD master map book, a 15-character comment field, a community code indicating a geographical area, an assignment code indicating location environment (residential, tall buildings, mountain area, etc.) and dispatch points.

2. The Dual Independent Map Encoding (DIME) File is maintained by the County of Los Angeles. The DIME system is a geographic base file technique and series of software packages with capabilities for computer mapping, adding local area codes to a DIME file, adding DIME file codes to local files, address matching, network, mode and adjacency analysis, X-Y coordinate and intersection plotting. Significant data elements of the DIME file are segment name and/or description, node numbers, block codes, address ranges, area codes, census tract codes, and codes for non-street features. Maintenance of the Los Angeles City areas of the DIME file was approximately three years behind; however, the file is now being brought up-to-date for the 1980 census.

3. The Automated Deployment of Available Manpower (ADAM) File was extracted from the DIME file. The main addition to ADAM is the Police Reporting District and the Team Policing boundaries.

Hopefully, some combination of these files will provide, in machine readable form, most of the data elements required for the generation of the ECCCS GBF.

The planned approach to producing the ECCCS operational geographic data base will include three major steps:

a. Convert existing files and encode new data
b. Generate the operational data base
c. Maintain the operational data base

Figures 2A and 2B, pp. 188 and 189, give an overview of the activities involved in file conversion and generation. File conversion will include extracting data from existing files, obtaining and encoding any necessary new data, converting to a uniform format, verifying consistency and completeness, and correcting erroneous data. The result of this step is called the Geographic Base Raw Data Files. Generation of the Operational Geographic Data Base will transform the raw data files to a form that is optimized for the retrieval and updating functions of ECCCS operations.

File Conversion. The first major step of producing the geographic data base will be to convert and verify data from existing files and new data which is to be manually collected. The approach to performing this task is diagrammed in Figures 2A and 2B, pp. 188 and 189.

Existing machine readable files containing data which may be useful for the ECCCS geographic data base will be studied during the design phase to determine the primary source for each element of the data base. If the information required for a data element is available from more than one source, secondary sources will be used for consistency checks by the verification programs.

Data elements which cannot be obtained from existing machine readable files will be identified during the design phase and forms will be prepared for manual collection of this new data.

The edit and verification operations will be performed in a repeated cycle until all errors discovered in the verification checks have been corrected. On the first iteration of the conversion cycle, the edit programs will extract data relevant to ECCCS from existing files, combine it with manually collected data, format it for use by the verification programs and generate programs. The result of this operation will be the first instance of the geographic base raw data files. On later iterations of the conversion cycle, editing operations will consist of incorporating manually prepared corrections to the raw data files.

The verification programs will check the raw data files for consistency, completeness, and correctness. The outputs of verification will be error reports for manual analysis and a refined instance of the raw data files. Upon analysis of the verification error reports, the ECCCS contractor will prepare corrections for the next conversion cycle where the correct data is readily apparent from the data at hand. Where correction requires new data or field checks, forms will be provided to the city for collection of the correct data.

At the end of the last repetition of the conversion cycle, the raw data files will constitute the input to the next step which will generate the operational data base.

Data Base Generation. The second major step of producing the geographic data base will be to generate the operational data base files and indices from the verified raw data files produced by the file conversion step. The generated programs used in this step will also be used in data base maintenance.

The structure of the operational data base will be determined in the design phase. This design will be most heavily influenced by the requirement for efficient retrieval on the basis of several types of key data including: street intersections, addresses, and place names. Further, the retrieval must work with a significant degree of misspelled or incomplete key values. This requirement implies extensive indexes to the data base. The primary tasks of the generate programs will be to construct eht indexes to the data base, to order and link the data base records for most efficient retrieval, and to encode the data for efficient memory utilization without degrading processing speed.

Data Base Maintenance. The third major step of geographic data base production will be to maintain the data base. The function of the maintenance process is to make changes (both additions and corrections) to the data base with the same level of verification as in the conversion step and with regeneration of optimized indexes to the data base as in the generate step. The maintenance process will be performed off-line on the city's IBM 370 computers.

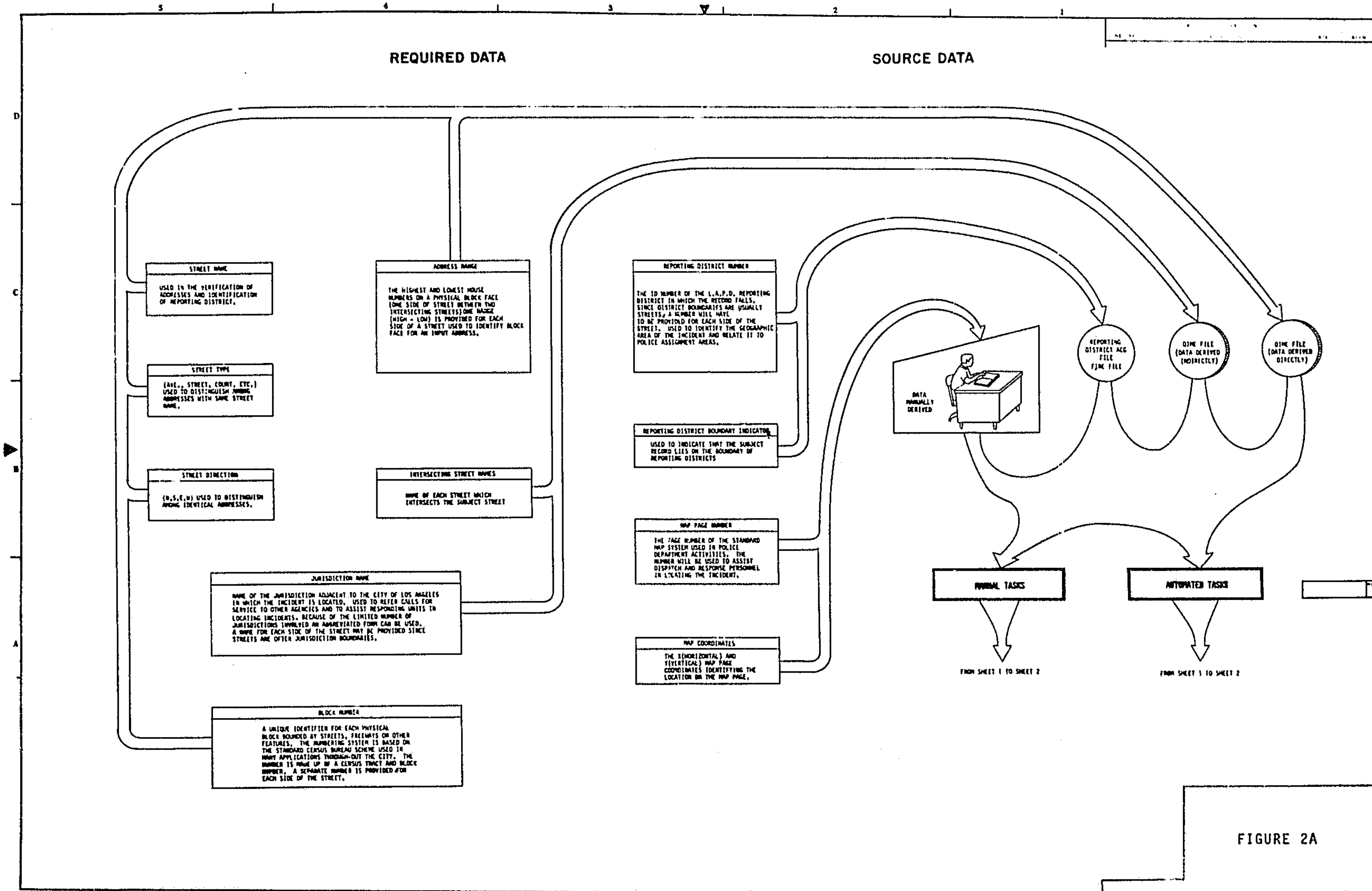

REQUIRED DATA
SOURCE DATA
STREET NAME
USED IN THE VERIFICATION OF ADDRESSES AND IDENTIFICATION OF REPORTING DISTRICT.
STREET TYPE
(AVE., STREET, COURT, ETC.) USED TO DISTINGUISH AMONG ADDRESSES WITH SAME STREET NAME.
STREET DIRECTION
(N,S,E,W) USED TO DISTINGUISH AMONG IDENTICAL ADDRESSES.
ADDRESS RANGE
THE HIGHEST AND LOWEST HOUSE NUMBERS ON A PHYSICAL BLOCK FACE (ONE SIDE OF STREET BETWEEN TWO INTERSECTING STREETS) ONE RANGE (HIGH - LOW) IS PROVIDED FOR EACH SIDE OF A STREET USED TO IDENTIFY BLOCK FACE FOR AN INPUT ADDRESS.
INTERSECTING STREET NAMES
NAME OF EACH STREET WHICH INTERSECTS THE SUBJECT STREET
JURISDICTION NAME
NAME OF THE JURISDICTION ADJACENT TO THE CITY OF LOS ANGELES IN WHICH THE INCIDENT IS LOCATED. USED TO REFER CALLS FOR SERVICE TO OTHER AGENCIES AND TO ASSIST RESPONDING UNITS IN LOCATING INCIDENTS. BECAUSE OF THE LIMITED NUMBER OF JURISDICTIONS INVOLVED AN ABBREVIATED FORM CAN BE USED. A NAME FOR EACH SIDE OF THE STREET MAY BE PROVIDED SINCE STREETS ARE OFTEN JURISDICTION BOUNDARIES.
BLOCK NUMBER
A UNIQUE IDENTIFIER FOR EACH PHYSICAL BLOCK BOUNDED BY STREETS, FREEWAYS OR OTHER FEATURES. THE NUMBERING SYSTEM IS BASED ON THE STANDARD CENSUS BUREAU SCHEME USED IN MANY APPLICATIONS THROUGH-OUT THE CITY. THE NUMBER IS MADE UP OF A CENSUS TRACT AND BLOCK NUMBER. A SEPARATE NUMBER IS PROVIDED FOR EACH SIDE OF THE STREET.
REPORTING DISTRICT NUMBER
THE ID NUMBER OF THE L.A.P.D. REPORTING DISTRICT IN WHICH THE RECORD FALLS. SINCE DISTRICT BOUNDARIES ARE USUALLY STREETS, A NUMBER WILL HAVE TO BE PROVIDED FOR EACH SIDE OF THE STREET. USED TO IDENTIFY THE GEOGRAPHIC AREA OF THE INCIDENT AND RELATE IT TO POLICE ASSIGNMENT AREAS.
REPORTING DISTRICT BOUNDARY INDICATOR
USED TO INDICATE THAT THE SUBJECT RECORD LIES ON THE BOUNDARY OF REPORTING DISTRICTS
MAP PAGE NUMBER
THE PAGE NUMBER OF THE STANDARD MAP SYSTEM USED IN POLICE DEPARTMENT ACTIVITIES. THE NUMBER WILL BE USED TO ASSIST DISPATCH AND RESPONSE PERSONNEL IN LOCATING THE INCIDENT.
MAP COORDINATES
THE X(HORIZONTAL) AND Y(VERTICAL) MAP PAGE COORDINATES IDENTIFYING THE LOCATION ON THE MAP PAGE.
DATA MANUALLY DERIVED
REPORTING DISTRICT ACG FILE FJMC FILE
DIME FILE (DATA DERIVED INDIRECTLY)
DIME FILE (DATA DERIVED DIRECTLY)
MANUAL TASKS
AUTOMATED TASKS
FROM SHEET 1 TO SHEET 2
FROM SHEET 1 TO SHEET 2

FIGURE 2A

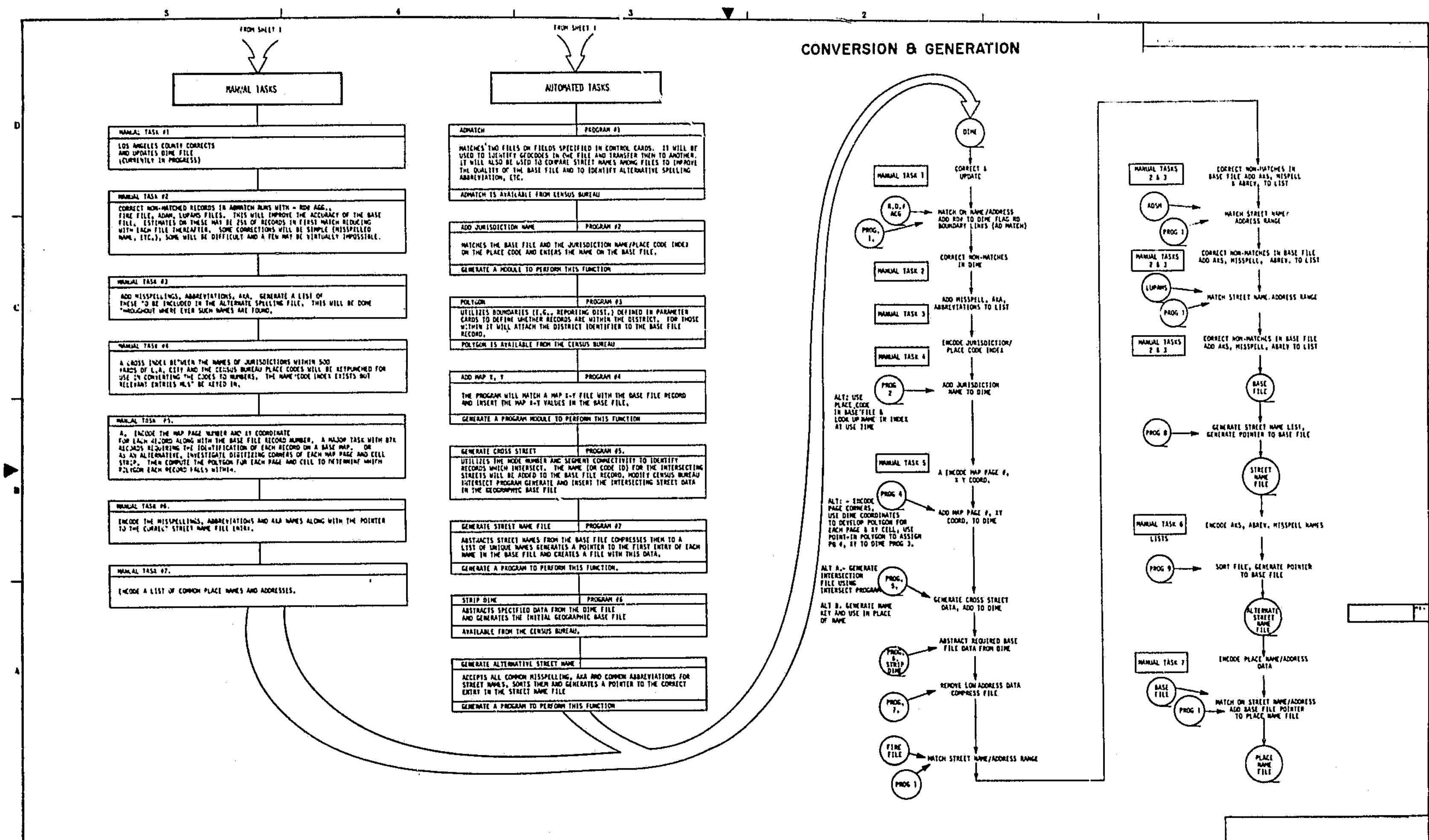

CONVERSION & GENERATION
FROM SHEET 1
MANUAL TASKS
FROM SHEET 1
AUTOMATED TASKS

FIGURE 2B

The approach to the maintenance process is diagrammed in Figure 2B, p. 189.

In the first operation of the maintenance process, edit programs will use the raw data files corresponding to the current baseline design and change specifications to produce updated raw data files.

Next the updated raw data files will be checked by verification programs for consistency, completeness, and correctness. If errors are discovered, the change specifications may be corrected and the edit and verification operations repeated.

Next, the verified raw data and the operational data base files of the current baseline design will be processed by the generate programs to produce the new version of the operational data base files and indexes. The old version of the operational data base is used as input because it contains some data which is not present in the raw data files (e.g., road hazards).

When these activities have all been completed for a maintenance cycle, the verified raw data files and the new operational data base file with their indices may be installed as a new baseline.

GBF SYSTEM FILES

To meet the operational requirements, the ECCCS staff, in conjunction with a prospective contractor, have defined the following major files which will make up the GBF subsystem. Once again, the detailed design structure and access methodology will be finalized during the baseline design phase. Figure 3, p. 192, is an illustration of how and in what sequence both the files described and others will be accessed.

Street Index File

The Street Index File is one of the major geographic files. It is one file that contains the correct representation of every street name in the ECCCS area of coverage. This file is comprised of several subfiles including common misspellings of streets, common abbreviations, and AKAs.

This file and its associated subfiles provide the mechanism for isolating a street or intersection provided to a Complaint Board Operator (CBO). It will provide a significant degree of tolerance insofar as the correctness of the input is concerned. For a correctly identified street name, an index is provided into the geographic base file providing a range of entries to interrogate for the street address or intersection.

Geographic Base File

The Geographic Base File is the primary file used in the processing of incident address verification. It contains definitive data on every block face in the ECCCS area of coverage and is used to isolate the block (or intersection) on which an incident address exists. Once the geographic base file entry is isolated, it identifies the geographic area (Reporting District) from which police/team field unit coverage is subsequently determined. The latter information is provided in the form of the Reporting District identification. This value will be used to determine the entry in the Reporting District File.

Place Name File

The Place Name File contains entries for such locations as conspicuous landmarks that might be used by citizens when complaints are being given to a CBO. Or it may contain establishments that might be frequent scenes of incidents. An index table will be contained in core memory to facilitate rapid access to this file.

The Place Name File can be updated on-line. Entries can be added, deleted or modified within the constraints of the file definition.

Reporting District File

The Reporting District (RD) File is the basic file through which all information required for incident dispatching is derived once address verification is complete. Information is obtained directly from the RD File (e.g., Team, Area, Bureau, adjacent RDs, etc.) or from other system files that are accessed based on Reporting District or Area. Other system files accessed based on Reporting District or Area include the Team/Unit Assignment file, Road Hazard file, Hazardous Location, Unit Status file, and Incident Status file.

The Reporting District File can be updated on-line. Entries can be added, deleted or modified within the constraints of the file definition.

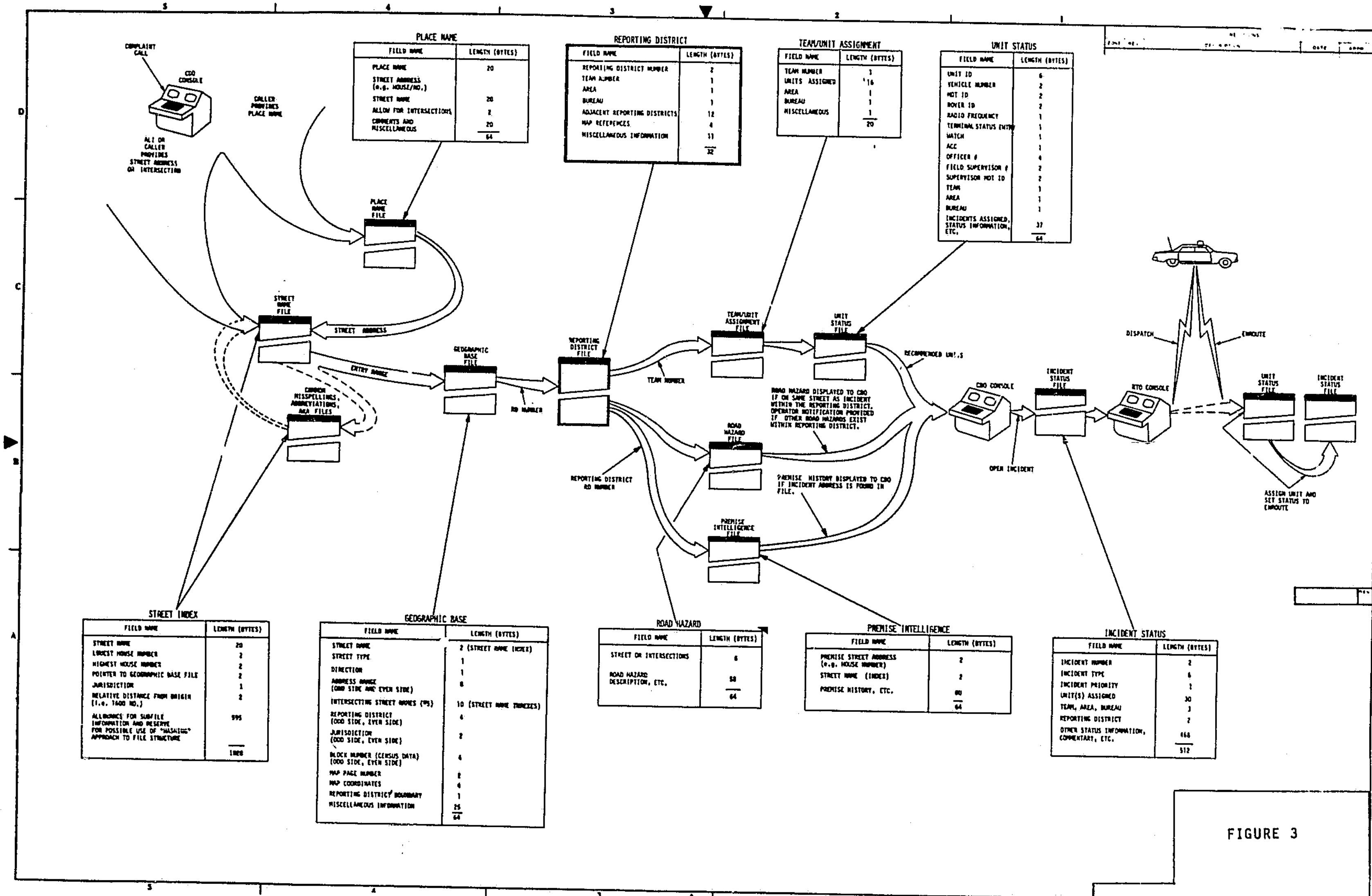
Team/Unit Assignment File

The Team/Unit Assignment File defines the units assigned to each team within an Area. The file is structured by area and team. Once the incident address has been verified, the area and team will be obtained from the Reporting District file. The Team/Unit Assignment file will be accessed first by area. Units will then be obtained by accessing the proper team within that area. The Team/Unit Assignment File can be updated on-line. Entries can be added, deleted or modified within the constraints of the file definition.

Road Hazard File

The Road Hazard file contains information on closed streets, street work, detours, street damage, etc. Information in this file may be useful for alerting units of area road conditions at the beginning of watches or when being dispatched to a specific incident. Road hazard information is keyed to a Reporting District and each entry will be part of a linked list pertaining to a specific Reporting District. Each road hazard entry will be identified by the street on which it exists. If the street is identical to the one on which an incident occurred, the road hazard information will be displayed to the CBO. The comments to the CBO will provide definitive information on the area affected by the hazard. Road hazard information may be requested for a Reporting District, Team, or Area.

This file can be updated on-line. Entries can be added, deleted, or modified within the constraints of the file definition.



PLACE NAME

FIELD NAME	LENGTH (BYTES)
PLACE NAME	20
STREET ADDRESS (e.g. HOUSE/NO.)	
STREET NAME	20
ALLOW FOR INTERSECTIONS	2
COMMENTS AND MISCELLANEOUS	20
	64

REPORTING DISTRICT

FIELD NAME	LENGTH (BYTES)
REPORTING DISTRICT NUMBER	2
TEAM NUMBER	1
AREA	1
BUREAU	1
ADJACENT REPORTING DISTRICTS	12
MAP REFERENCES	4
MISCELLANEOUS INFORMATION	11
	32

TEAM/UNIT ASSIGNMENT

FIELD NAME	LENGTH (BYTES)
TEAM NUMBER	1
UNITS ASSIGNED	16
AREA	1
BUREAU	1
MISCELLANEOUS	1
	20

UNIT STATUS

FIELD NAME	LENGTH (BYTES)
UNIT ID	6
VEHICLE NUMBER	2
HOT ID	2
ROVER ID	2
RADIO FREQUENCY	1
TERMINAL STATUS ENTRY	1
WATCH	1
ACC	1
OFFICER #	4
FIELD SUPERVISOR #	2
SUPERVISOR HOT ID	2
TEAM	1
AREA	1
BUREAU	1
INCIDENTS ASSIGNED, STATUS INFORMATION, ETC.	37
	64

STREET INDEX

FIELD NAME	LENGTH (BYTES)
STREET NAME	20
LOWEST HOUSE NUMBER	2
HIGHEST HOUSE NUMBER	2
POINTER TO GEOGRAPHIC BASE FILE	2
JURISDICTION	1
RELATIVE DISTANCE FROM ORIGIN (i.e. 7400 NO.)	2
ALLOWANCE FOR SUBFILE INFORMATION AND RESERVE FOR POSSIBLE USE OF "HASHING" APPROACH TO FILE STRUCTURE	995
	1024

GEOGRAPHIC BASE

FIELD NAME	LENGTH (BYTES)
STREET NAME	2 (STREET NAME INDEX)
STREET TYPE	1
DIRECTION	1
ADDRESS RANGE (ODD SIDE AND EVEN SIDE)	8
INTERSECTING STREET NAMES (#5)	10 (STREET NAME INDEXES)
REPORTING DISTRICT (ODD SIDE, EVEN SIDE)	4
JURISDICTION (ODD SIDE, EVEN SIDE)	2
BLOCK NUMBER (CENSUS DATA) (ODD SIDE, EVEN SIDE)	4
MAP PAGE NUMBER	2
MAP COORDINATES	4
REPORTING DISTRICT BOUNDARY	1
MISCELLANEOUS INFORMATION	25
	64

ROAD HAZARD

FIELD NAME	LENGTH (BYTES)
STREET OR INTERSECTIONS	6
ROAD HAZARD DESCRIPTION, ETC.	58
	64

PREMISE INTELLIGENCE

FIELD NAME	LENGTH (BYTES)
PREMISE STREET ADDRESS (e.g. HOUSE NUMBER)	2
STREET NAME (INDEX)	2
PREMISE HISTORY, ETC.	60
	64

INCIDENT STATUS

FIELD NAME	LENGTH (BYTES)
INCIDENT NUMBER	2
INCIDENT TYPE	6
INCIDENT PRIORITY	1
UNIT(S) ASSIGNED	30
TEAM, AREA, BUREAU	3
REPORTING DISTRICT	2
OTHER STATUS INFORMATION, COMMENTARY, ETC.	468
	512

FIGURE 3

Hazardous Location File

The Hazardous Location file contains information on specific locations that may provide background information and result in added safety for assigned units. Hazardous Location information will be keyed to Reporting District or within 500 yards of each dispatch using X-Y coordinates. The premise address is contained in each entry of the file.

This file can be updated on-line. Entries can be added, deleted, or modified within the constraints of the file definition.

ECCCS/GBF-HOW WILL IT INTERFACE WITH THE CITIZENS?

While discussing the real world usage of the system, let us first describe briefly the Complaint Board Operator (CBO) console and functions. It should be noted, however, that the CBO console and dispatch philosophy being described may undergo considerable refinement and/or expansion during the baseline system design.

The primary function performed at the complaint board position is the receipt of calls-for-service via the existing seven-digit emergency numbers and, ultimately, the common three-digit emergency number 911. CBO positions also will have the capability to receive dial alarm calls; alarms received by P lines from private alarm companies such as ADT, Wells Fargo, and Morse, and calls transferred or relayed from other public safety agencies.

When units are available, the CBO will have the capability to dispatch digitally to the MDT. When units are not available or the dispatch requires voice radio communications, the CBO will transfer the completed incident to the ECCCS computer. The ECCCS computer will queue the incident until a unit is available or, if the call is high priority, it will pass it on to a Radio Telephone Operator (RTO) with voice radio capabilities. Follow-up of an incident after initial dispatch is performed by the RTO.

A wide range of capabilities are provided to the CBO, including incident entry, address validation, duplicate incident checking, dispatch recommendations, digital dispatching, incident history inquiry, unit history inquiry, operator assistance, geographic file browsing, administrative message origination and receipt, service directory assistance, data base inquiry/response, and ability to enter retroactive incidents following a period of manual operation.

CBO consoles are equipped with two CRT screens and a single keyboard in addition to telephone control equipment as shown in Figure 4, p. 196. This figure also illustrates typical displays that would be presented to a CBO. The right-hand screen is the entry screen; it is used for input of all commands, including incidents, administrative messages, incident history inquiries, and data base inquiries. The left-hand screen is the display screen which is used for the display of messages that require significant space, such as hazardous location, unit and incident status for an Area, geographic assistance, incident code assistance, telephone directories, incident histories, administrative messages, and data base responses.

The right-hand screen in Figure 4, p.   illustrates a complaint entry involving the full use of 911 Automatic Number Identification (ANI) and Automatic Location Identification (ALI). When the CBO is ready to receive a call, he presses a function key on the keyboard to bring up the incident mask (format), and then presses the IN key on his telephone set to indicate to the Automatic Call Distributor (ACD) that he is available to service a call. Concurrent with the receipt of a call in the operator's headset, ANI/ALI information is received by the ECCCS computer from telephone company equipment and is displayed at the top of the entry screen.

Based on information obtained from the calling party, the CBO fills in the fields of the mask. If the incident location provided by the caller is the same as the ALI information, the operator presses the ALI transfer key with the CRT cursor positioned at the location field. This provides the capability for address validation to begin while the CBO is obtaining the entering additional information. The fields on the incident mask are in the order in which information is normally acquired from the caller. Since the proposed CRT/keyboard terminal includes both forward and backward field tab capabilities, the cursor can be rapidly positioned to any field with several key strokes.

On pressing the Enter key, the incident is transmitted to the ECCCS computer and processed. If the street entered (the address field may have been entered earlier) does not uniquely define a street within the city, the computer displays a set of possible streets from which the operator can choose. Thus, for example, the entry of 16432 WASHINGTON would result in the following non-unique address display:

```
1/    WASHINGTON BLVD - WIL   (Wilshire Area)
2/ E  WASHINGTON BLVD - WIL
3/ W  WASHINGTON BLVD - WIL
4/    WASHINGTON CT   - WIL
5/    WASHINGTON PL   - VEN   (Venice Area)
6/    WASHINGTON ST   - VEN
7/    WASHINGTON WY   - VEN
```

Based on conversation with the caller, the CBO would then select the correct street by typing the index number on the left and entering it into the computer. In the above example, the street name itself existed in the file and the non-uniqueness resulted from a difference in street direction and type. To provide flexibility, the CBO may enter a command requesting that all streets that start with the same first two or three characters be displayed.

In addition to the basic house number and street name format, the CBO may also enter in the location field a street and cross-street, a common place name, or an AKA street name. The AKA street name can be used for common misspellings and abbreviations; thus, EXPOSITION BLVD could have EXPO BLVD as an AKA, and PACIFIC COAST HIGHWAY could have PCH as an AKA.

Once the location has been validated, determination of possible duplicate incidents is performed on the basis of geographic proximity. Proximity may be determined either by X,Y coordinates, incidents in the same or adjacent Reporting Districts, or incidents on the same or intersecting streets. The use of X,Y coordinates raises considerable question as to whether the California State plan coordinates contained in the DIME file have sufficient reliability for use for this purpose. The final determination of the method to be used for determining possible duplicate incidents will be made during the preliminary Phase II design.

In the example shown in Figure 4, p. 196, two possible duplicates were determined and displayed to the CBO. The CBO would immediately observe that one of these possible duplicates is an exact address match to that just called in, and that unit 9A12 has been dispatched and has been enroute for four minutes. It should also be noted, in Figure 4, that Hazardous Location data is displayed to the CBO on the left-hand screen.

Based on the displayed information, the CBO would inform the caller that a unit is on its way and should be there shortly. The CBO then enters a command to select the duplicate incident (#1), resulting in the information on the current call supplementing the existing incident. At this point, the CBO has completed his handling of the incident and can request a new incident mask, release the telephone call, and be ready to receive the next call.

Figure 5, p. 197, shows what a status screen may look like while the CBO is determining what field unit to dispatch to the incident entered on the working screen.

CURRENT STATUS OF ECCCS

As stated earlier, contractor proposals are now being evaluated. Although it is uncertain as to who will build ECCCS, what is for certain is that the City of Los Angeles now has over $40 million to begin building the largest centralized computer aided dispatch and mobile digital communications law enforcement system ever attempted. The LAPD intends to make it the model for future similar systems.

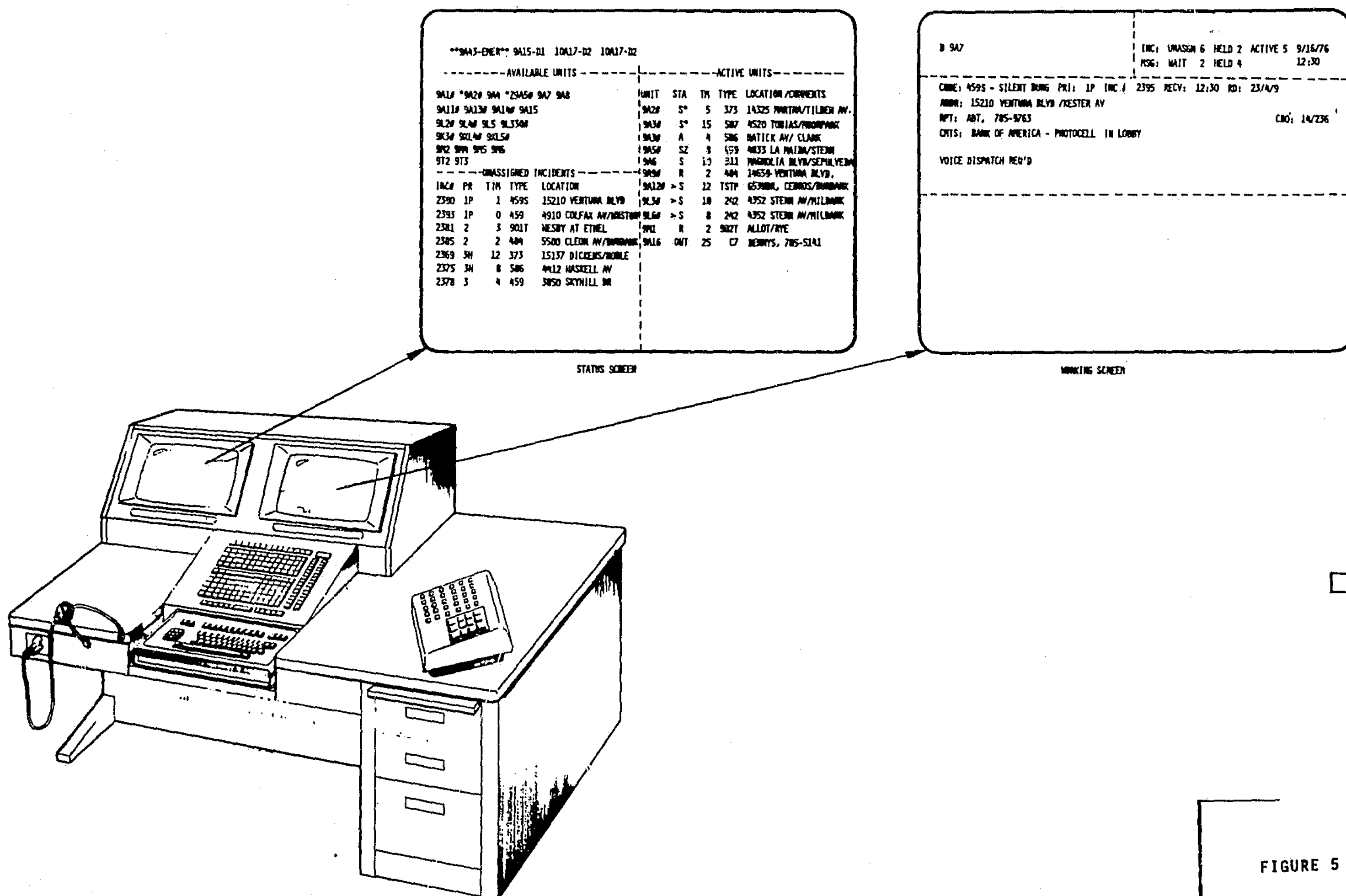

AVAILABLE UNITS
ACTIVE UNITS
9A11# 9A13# 9A14# 9A15
9T2 9T3
UNASSIGNED INCIDENTS
PR TIM TYPE LOCATION
UNIT STA TM TYPE LOCATION/COMMENTS
2390 1P 1 459S 15210 VENTURA BLVD
2393 1P 0 459 4910 COLFAX AV
2381 2 3 901T NESBY AT ETHEL
2385 2 2 5500 CLEON AV
2369 3H 12 373 15137 DICKENS
2375 3H 8 586 HASKELL AV
2378 3 4 459 SKYHILL DR
NATICK AV/ CLARK
4352 STERN AV
ALLOT/RYE
STATUS SCREEN
INC: UNASGN 6 HELD 2 ACTIVE 5 9/16/76
MSG: WAIT 2 HELD 4 12:30
459S - SILENT PRI: 1P 2395 RECV: 12:30
15210 VENTURA BLVD /KESTER AV
ABT, 785-9763
BANK OF AMERICA - IN LOBBY
VOICE DISPATCH REQ'D
WORKING SCREEN

FIGURE 5

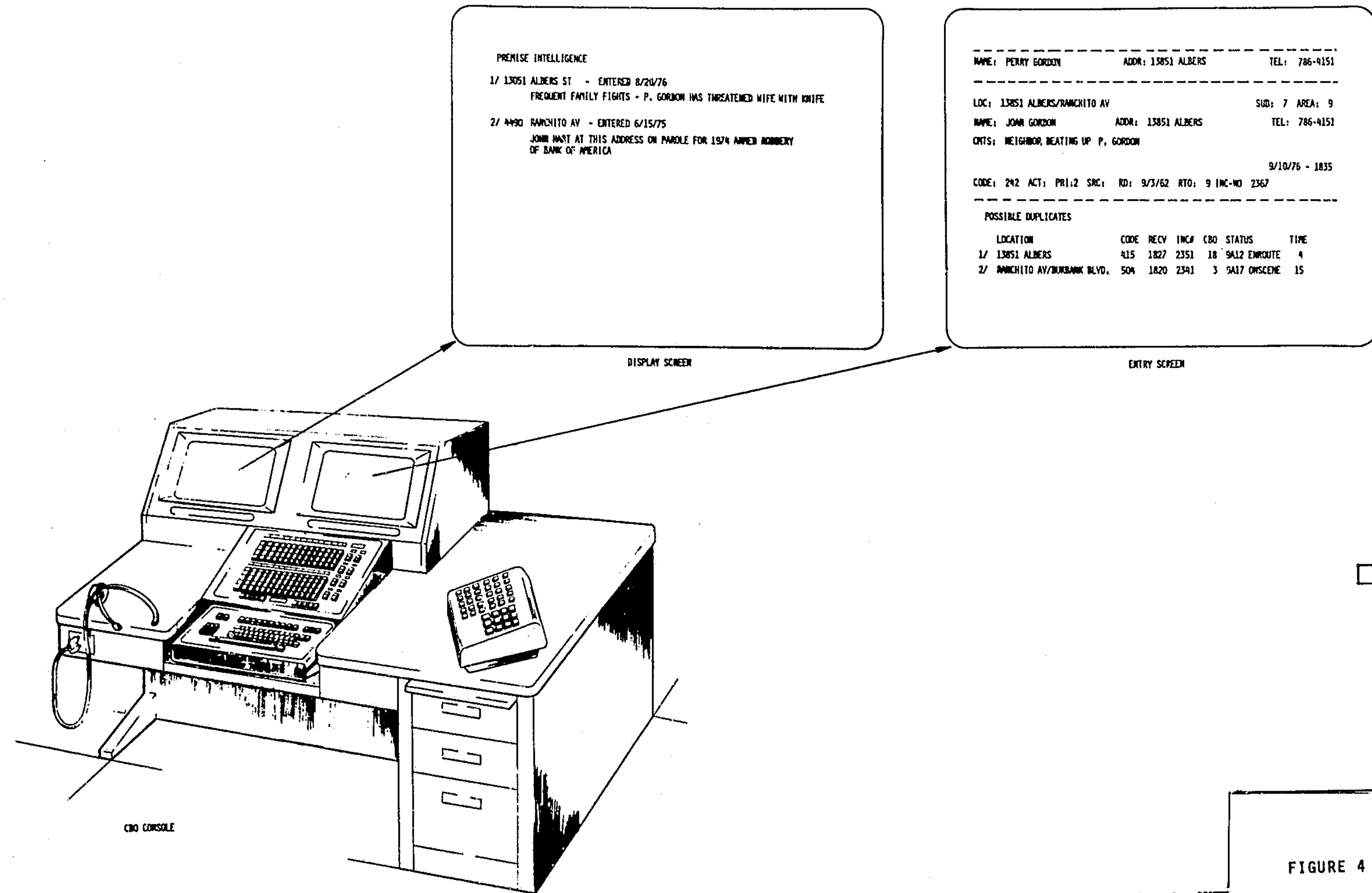

PREMISE INTELLIGENCE
1/ 13051 ALBERS ST - ENTERED 8/20/76
FREQUENT FAMILY FIGHTS - P. GORDON HAS THREATENED WIFE WITH KNIFE
2/ 4490 RANCHITO AV - ENTERED 6/15/75
JOHN HART AT THIS ADDRESS ON PAROLE FOR 1974 ARMED ROBBERY
OF BANK OF AMERICA
DISPLAY SCREEN
NAME: PERRY GORDON ADDR: 13851 ALBERS TEL: 786-4151
LOC: 13851 ALBERS/RANCHITO AV SUD: 7 AREA: 9
NAME: JOAN GORDON ADDR: 13851 ALBERS TEL: 786-4151
CMTS: NEIGHBOR BEATING UP P, GORDON
9/10/76 - 1835
CODE: 242 ACT: PRI:2 SRC: RD: 9/3/62 RTO: 9 INC-NO 2367
POSSIBLE DUPLICATES
LOCATION CODE RECV INC# CBO STATUS TIME
1/ 13851 ALBERS 415 1827 2351 18 9A12 ENROUTE 4
2/ RANCHITO AV/BURBANK BLVD. 504 1820 2341 3 9A17 ONSCENE 15
ENTRY SCREEN
CBO CONSOLE

FIGURE 4

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IACP GBF FOR LAW ENFORCEMENT PROJECT

- A SHORT SUMMARY OF THE ST. LOUIS TEST SITE -

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BACKGROUND

The St. Louis Law Enforcement Computer System which started with the St. Louis Metropolitan Police Department has evolved into a Regional Justice Information System covering four counties and the City of St. Louis. This system is now referred to as REJIS (Regional Justice Information Service) which serves law enforcement, courts and corrections.

This type of environment requires the exchange of information on a geographic basis for such areas as:

a. Field Interview Reports
b. Arrests
c. Crime
d. Calls-for-service

The problem is that each major police agency had developed their own methods of aggregating data. For example:

City of St. Louis - Pauly Blocks
St. Louis County - COGIS Areas
St. Charles County - Census Tracts
Franklin County - Quadrant
Jefferson County - Three large reporting areas

A geographic base file (GBF) was needed to cover all of the above areas, not specifically now, but in the future. To make a long story short, the DIME File best meets the requirements to serve all areas.

A common geographic area which will cover all areas in Region 5 is the census tract. Smaller police reporting areas will then be utilized which respect the boundary lines of the census tracts.

a. City of St. Louis is thinking of using census block groups.
b. The remaining counties will use subdivisions of the census tracts which are physically visible in the field.

IACP GBF TEST SITE PROJECT

Like Tucson, Arizona, St. Louis was chosen as one of two test sites to field test the series of programs which can assist law enforcement in the development of a GBF using the DIME file. Both Tucson and St. Louis found some program bugs which were solved either by their own staff or the Census Bureau. St. Louis still has one problem with the POLYGON program when one of the police districts is run through the program. It appears to be an isolated problem because all other geocoded areas have been accepted by the programs.

The program series allows the user flexibility in creating a GBF to meet the user's needs. For specialized file design, the user will still have to design and program his own file loading and access programs. The REFORMAT Series can also be supplemented with system utility programs which allow even more flexibility in the positioning of data fields within the records.

Another objective of the Test Site Project was to recommend improvements in the user documentation. In most documentation, the programmer makes certain assumptions that are not always clear to a user. When reviewing the documentation, notes were made on documentation that was not clear. Based on these notes, the documentation has been revised.

CONSIDERATIONS BEFORE USING DIME FILE

Before deciding to use DIME, check with the local CUE agency to determine the completeness and accuracy of the current DIME File. As an example, in St. Louis, the CUE agency just completed updating and correcting the City of St. Louis portion of the DIME File. The remainder of the file on the Missouri side of the SMSA had not been updated. Also, all corrections and updates were not digitized, which slowed down our use of the file. It is also a good idea to check the completeness of the base maps. These are needed to identify the census tract boundaries and node numbers. If up-to-date reproductions are not available, the coding process is more difficult because coding must then be done from computer listings of the street nodes.

Another area to check out is the completeness of the X,Y coordinates in the DIME File. If coordinates are missing, then the POLYGON program series will not work. This program assumes that a clean file is used as input to this program. The number of coordinates missing can be a determining factor as to whether the DIME File can be used. If manpower and the technical expertise is available, the missing coordinates can be calculated and added to the file.

When deciding on the geocodes to be incorporated into the DIME File, consideration should be given to the size of the areas. The smaller the areas, the more coding and work involved.

If the user has decided to build an intersection file, there is a record length limitation in the INTERSECT program that does not apply to the other programs in the series. This can affect the design of the record layouts.

Another item to check out with the local CUE agency is the time frame under which updates and corrections are added to the file. In most cases, the CUE agency is not as concerned as law enforcement about when a street addition or correction is made.

Law enforcement must be concerned with geocoding on a daily basis where the CUE agency is not. This, therefore, puts law enforcement agencies in the position of performing their own updates.

CENSUS TRACT BOUNDARY CHANGES

Depending on land and population changes, it is a practice of the Census Bureau to change census tract boundaries periodically. Up to now, this occurred once every ten years. In the future, this may occur every five years. If geocodes were added to the DIME File by the use of the POLYGON program and the node coding method was used, the change in census tracts will cause recoding of the parameter cards for the POLYGON program. Depending on the number of census tract boundary changes and the areas affected, this could cause a considerable recoding effort.

As a public or government agency, the user can arrange to attend the Census Committee meetings and inject an opinion as to possible census tract boundary changes.

GENERAL SYSTEM DESCRIPTION

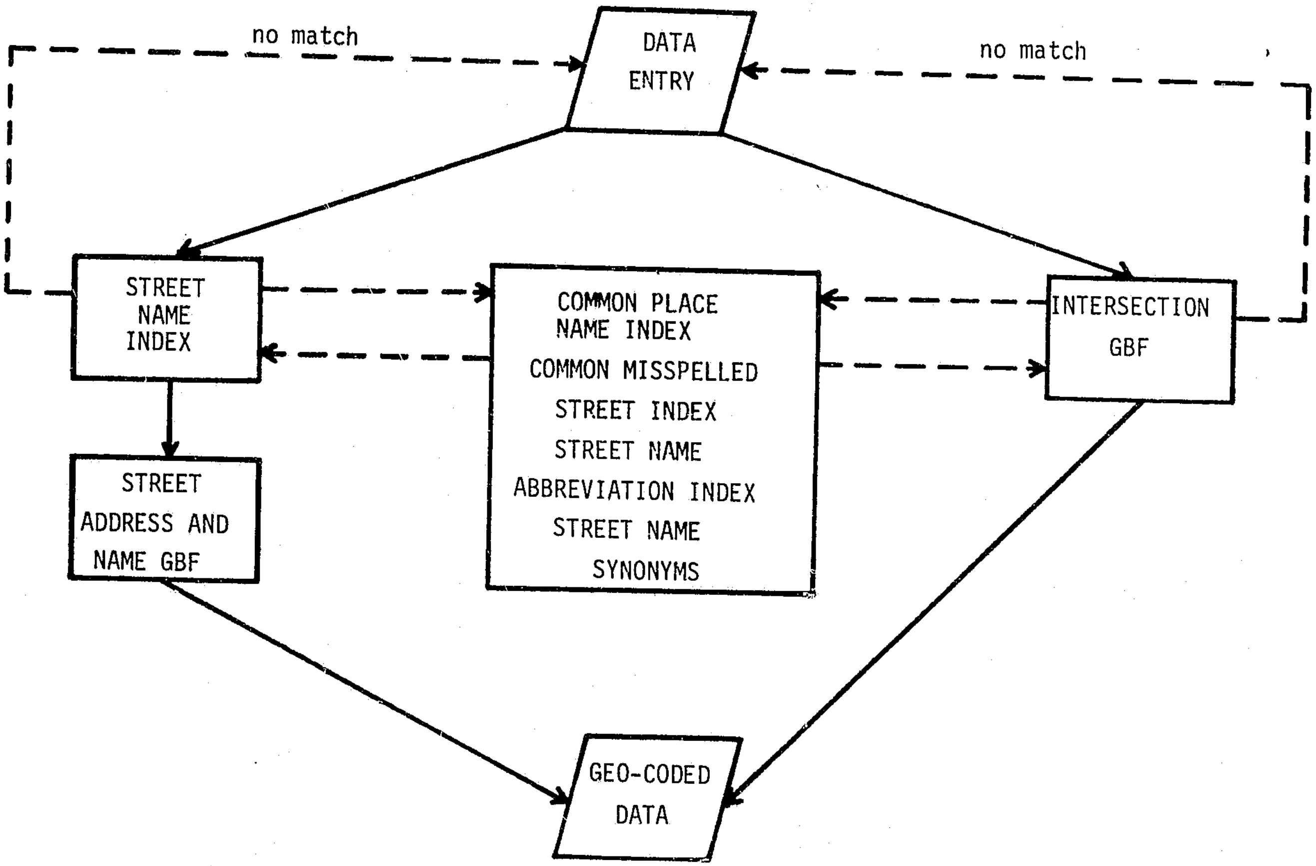
The proposed GBF that will be implemented in the St. Louis area will be a street segment file. The total GBF system will consist of four files:

1. Street Name Index File
2. Main Street Segment File (address ranges and geocodes)
3. Intersection File
4. Subsystem File which will contain:
    a. Common Place Names
    b. Common Misspellings
    c. Street Name Abbreviations
    d. Street Name Synonyms
    e. Public Phone Number Location (must still be researched). This file will then be cross-indexed to the Street Name and Intersection Files.

Due to local r quirements, the GBF is designed for a direct access environment. See Figure 1, p. 202 for system overview.

Figure 1

Regional Geographic Base File System



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OVERVIEW OF THE IACP GBF TEST SITE PROJECT IN TUCSON, ARIZONA

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DEPARTMENTAL/CITY OVERVIEW

A. The City of Tucson is situated in Pima County in Southern Arizona.

B. Population
   1. Pima County - Approximately 450,000
   2. City of Tucson - Approximately 330,000

C. Area
   1. Pima County - over 9,000 square miles.
   2. City of Tucson - 92.8 square miles
      a. Divided into four teams, each with a lieutenant and a radio frequency.
      b. Each team divided into five, six or seven beats for a total of 23.
      c. Each beat contains three to thirty grids or reporting areas; 529 are assigned, some reaching into the county.

D. Staffing
   1. Commissioned
      A. Authorized - 531
      B. Current - 526
   2. Civilian
      A. Authorized - 189
      B. Current - 181.5
   3. Total
      A. Authorized - 720
      B. Current - 707.5

E. Calls-for-service
   1. 1975 - 135,159
   2. 1976 - 134,332

F. Part I crimes per 1,000 population
   1. 1975 - 93.1
   2. 1976 - 103.16

DATA PROCESSING

A. History

The Tucson Police Department has keypunched offense, arrest, property, traffic citation and collision, and radio call data since the early 1960's. Police grids have been manually entered on these source documents at the point of origin.

Computerized reports of a tabular nature have been produced during this time consisting of numerous format and sequences (crime class, day of week, time of day, police grid, beat, team, etc.).

The Data Services Section of the Tucson Police Department also is responsible for operating and maintaining a regional message switcher providing service to ten criminal justice agencies and three remote computer systems. We also maintain the local stolen vehicle and master name index files.

B. Equipment

The Tucson Police Department utilizes a pair of in-house Digital Equipment Corporation PDP 11/40 mini-computers with 96K bytes memory, four RK05 disk drives on each computer. Also, one computer has one TU10 tape drive; the other has two A card readers and a printer is shared by both computers.

The Department of Computer Services makes available an IBM 370/158 operating under VM 370 DOS/VS and Power/VS with 1.5 megabytes memory for batch processing and on-line files using CICS.

C. Data Captured

The Tucson Police Department captures the following data for batch reporting:

1. Offenses reported
2. Stolen and recovered property
3. Arrests
4. Radio calls
5. Citations and collisions.

D. Computerized Reports

The Tucson Police Department produces many reports and listings for submission to UCR and for internal use. We are eliminating many regularly produced bulky listings by executing programs through parameters to obtain only requested information as requested. Since our users are also more comfortable working with graphs and maps, we are producing more reports of this type.

GBF INVOLVEMENT

The Tucson Police Department became involved in the GBF/DIME file effort in early 1974. The early study and design of computer assisted dispatch (CAD) indicated the need for a geographic base file for its use.

A GBF/DIME file had, at that time, existed for the Tucson Metropolitan area for several years. In 1974, the informal "Tucson/Pima County GBF Consortium" was formed, consisting of persons and agencies interested in the creation, maintenance, and use of the GBF/DIME file. Logically, the Tucson Police Department has participated in the consortium since its creation. The Tucson/Pima County GBF Consortium currently consists of the following agencies:

Catalina Foothills School District
City of Tucson, Departments of Budget & Research, Computer Services, Fire, Planning, Police
Metropolitan Utilities Management
Pima Association of Governments
Pima Community College
Pima County, Departments of Assessor, County Attorney, Data Processing, Juvenile Court, Planning, Sheriff's Office
Tucson Gas & Electric
Tucson School District One
University of Arizona Computer Center

All of these agencies have contributed to the GBF/DIME file effort.

Police grids have been manually coded into the GBF/DIME file and maintained at Police Department expense. The master GBF/DIME file resides at the Department of Computer Services on magnetic tape. Copies of the file are made available to users upon request. The file contains approximately 30,000 records, of which approximately 20,000 pertain to the Tucson Metropolitan area.

Tucson has an abundance of Spanish-named streets which, to some degree, complicated add-matching when police grids were assigned in the early 1960's. Most but not all police grids had boundaries defined by the center of streets. Problems were created by the grids having imaginary boundaries.

In an effort to utilize the GBF/DIME file to define grid boundaries for input to SYMPA, it was necessary to create a file of imaginary segments and nodes for some grid boundaries. This file is merged with the master GBF/DIME to create a file containing enough information to close all police grids to produce a base map using SYMAP.

IACP GBF/TEST SITE INVOLVEMENT

The Tucson Police Department became aware of the IACP/GBF Test Site Project in September 1976 at a time when we were analyzing methods to recreate the GBF utilized by CAD on the PDP 11/40's. The files had originally been created by a consulting firm off-site from an older version of the master GBF/DIME.

The Tucson Police Department responded to the IACP questionnaire and received notification of acceptance on November 15, 1976 with arrival of the programs and the agreement December 3, 1976. By December 17, 1976 we had defined the goals of the Tucson Police Department for the Test Site Project. They were to:

Exercise all programs against test files provided with programs.
Exercise all programs against the live GBF/DIME.
Recreate CAD blockface and intersection files.
Add police grids to the 1975 census data header records for crime analysis.
Add police team and beat to the GBF/DIME file.
Accumulate street miles for each police grid.

A. Program Tests

The IACP programs were easily retrieved from the distribution tape and inserted into the City of Tucson Librarian Master file.

Problems did arise in compiling the five REFORMAT series programs, STRIP DIME, STRIP INTERSECT, INDEX DIME, INDEX INTERSECT and HEADER RECORD. These programs were written to run under OS, requiring modifications to the select clauses to run under DOS.

All programs were first run against the test files provided. Output from the tests was listed and checked manually. A few bugs did arise during testing and were corrected by Tucson Police Programmers or Census Bureau personnel.

All programs were also run against the live GBF with output spot-checked for accuracy. Once each program reached normal end-of-job the output was found to be correct.

B. Application Goals

The other goals were achieved by executing various IACP programs to produce subfiles or work files and then executing in-house application programs against the subfiles on both the IBM 370/158 and PDP 11/40.

C. IACP Programs

For the most part, the programs were not as flexible as we would prefer. For example, all programs process every record in the GBF/DIME input file. We have occasion to process only records within the city limits of Tucson or within the metropolitan area. We included and omitted selected records through IBM sort program parameters.

The INTERSECT and POLYGON programs were found to be the most useful and would be the most difficult to duplicate in-house.

1. STRIP and INDEX Programs

These programs produce output records of selected fields, but, in order to access user fields contained in positions 300-400 of the GBF/DIME, dummy parameters must be prepared to pad to the desired location. The parameter card edits could be more comprehensive. If the field length specified on the parameter cards exceeds the maximum allowable for that field, the programs will abnormally terminate. We prefer to use IBM utility programs instead of the STRIP programs for the above reasons.

The INDEX programs have the potential to drastically reduce file space depending on the size of the master GBF/DIME and the fields needed for the subfiles.

2. HEADER RECORD Program

This program runs very slowly and produces a file of variable length records. File space reduction is not as significant as is the case with the INDEX programs.

3. POLYGUIDE

This is a useful program to collapse address ranges along street features having the same polygon codes and to split records having different left and right polygon codes. The output from POLYGUIDE may contain more or less records than the input file depending on the size of polygons used.

4. INTERSECT Series

This is a very useful set of five programs requiring two user-supplied sorts. The only complaint is the lack of a provision for nonstandard files and user codes.

5. POLYGON

This pair of programs is extremely useful to add polygons to a GBF/DIME file. The POLYGON programs require an accurately digitized file to operate successfully.

REVIEW

The largest problem faced during the Test Site Project was inaccurate and/or lack of digitizing. An accurately digitized GBF/DIME file is a prerequisite to using the POLYGON programs or utilizing the GBF/DIME file for mapping or plotting. Unfortunately, digitizing is an expensive and cumbersome process requiring an accurate file to start with.

It should be stressed to future users that any GBF will be expensive and time-consuming to create and maintain but benefits can far outweigh expenses.

The GBF/DIME file format deserves detailed consideration by agencies planning a GBF. The DIME file is the most common GBF in use, therefore, invaluable assistance and experience is readily available from the United States Bureau of the Census, the IACP, and other agencies and users both inside and outside law enforcement. The potential for GBF/DIME file applications are limited only by an agency's imagination and resources.

The experiences of the Tucson Police Department throughout the Test Site Project have been enlightening to say the least. We have found the Bureau of the Census cooperative in the few instances we have come in contact and are appreciative of their services.

During the Test Site Project, the Tucson Police Department has enjoyed constant interaction with the IACP which we found most knowledgeable, cooperative and patient. The Tucson Police Department extends special thanks to Mr. Samson Chang of the IACP for his personal efforts to assist the Tucson Police Department throughout the Test Site Project. Without his expertise and assistance, the Tucson Test Site Project would have never been completed.

We are looking forward to the successes of the IACP/GBF clearinghouse and continued efforts of the IACP and other agencies.

Last, but not least, our thanks to LEAA for making the funds available to the IACP for the GBF Project.