

HOUSTON METROPOLITAN COMMON DATA BASE: *METROCOM*

by S. E. Mangum, Jr.

INTRODUCTION

The Houston Metropolitan Common Data Base, METROCOM, when completed will be an integrated collection of spatially related information shared by agencies of government and the utility companies in the greater Houston area. The data base, kept on mass storage devices such as computer disks, will be available for instant inquiry by the member agencies using on-line and remote computer terminals. Output will include printed reports, video displays with associated hard copying capability, and digital plots. Data stored in METROCOM may be transferred to the computer of a member agency through remote communication links.

COMPUTER SYSTEM STRUCTURE

Distributed computer processing is the cornerstone of the METROCOM concept. The physical size of the file can be kept within reasonable confines, as the contents are limited to those items of common interest. Specific data useful to only one user are stored in that user's satellite graphics system (see figure 1). As required, these satellite systems are connected via remote links to the host METROCOM computer and the attached master file. Each of the satellite systems supports multiple interactive graphics stations. From such a station, users have complete access to the METROCOM file, to any specific files stored in their particular satellite system, and to files maintained on other computer systems.

The METROCOM host computer system manages the master METROCOM file and supplies data upon request to the satellite graphics system. The host system also supports a high-speed digital plotter and line printer. The plotter is used to generate any necessary high precision digital

Mr. Mangum is Team Manager, Strange Unit, Turner, Collie & Braden, Inc., Houston.

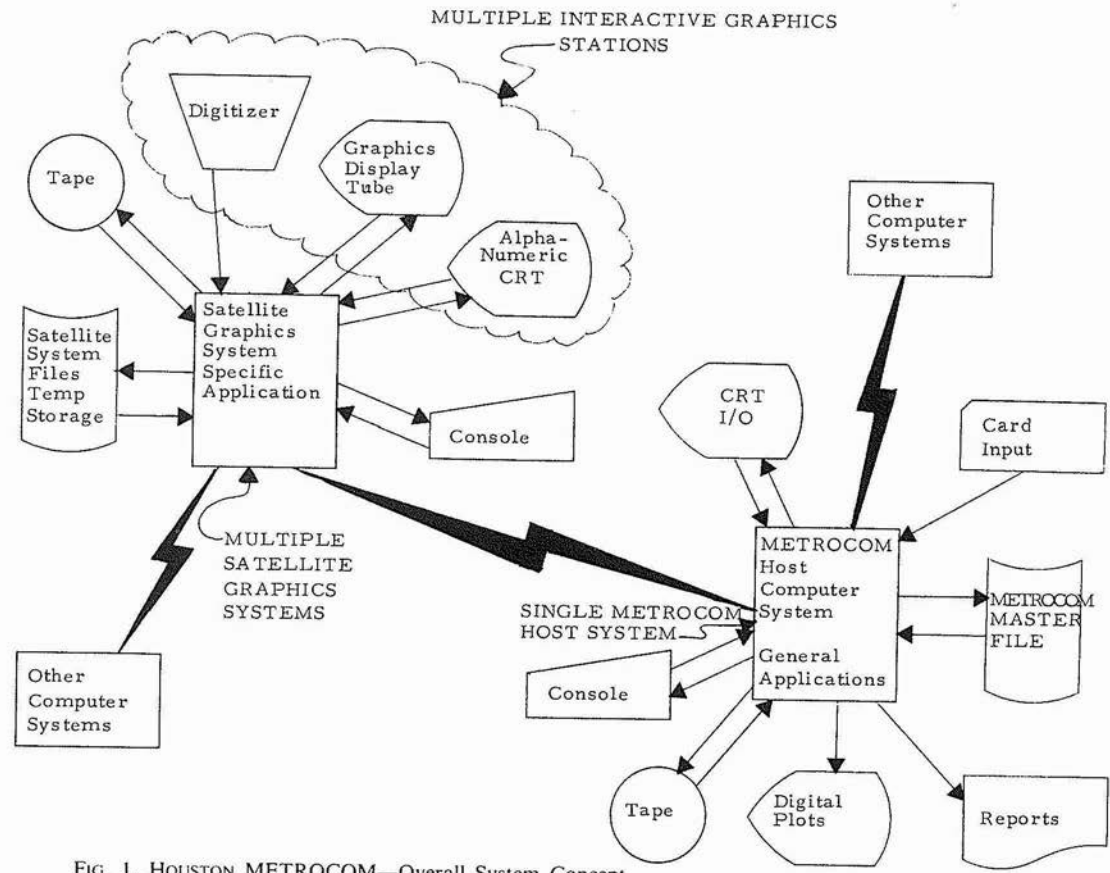


FIG. 1. HOUSTON METROCOM—Overall System Concept

plots of sections of the data base. This is accomplished from tape inputs generated by the various satellite systems. Voluminous reports are generated in a similar manner on the line printer.

The host computer will eventually be connected to the City of Houston's other main frame computers via remote communication links. In the meanwhile, communication is accomplished by use of magnetic tape as a basic medium. Graphic capabilities are also available on the host computer as an aid to system development and for updating and verifying data. Most of the application software associated with the host system is related to file maintenance, data transfer, and system development.

The METROCOM satellite interactive graphics systems supply a particular user with a complete information storage/retrieval vehicle. For example, from an interactive station connected to a satellite graphics system, users can:

1. Create files of *new* data elements and store them in the METROCOM file, if appropriate, or in the satellite system file.
2. Request that data be transferred from the METROCOM file to temporary storage in their particular satellite system files, merge these with data resident in the satellite system, and operate on the composite data.
3. Alter, add to, or delete data elements and then transfer these updated data to the satellite system files and (under stringent control) to the METROCOM master files.
4. Request digital plots of files that they create.
5. Generate complicated reports based on information gleaned from their files.

These tasks are by no means a complete list, but represent the possibilities available by using the interactive graphics satellite systems in conjunction with the host METROCOM system and, optionally, with other computer systems.

Each interactive graphics station has, at a minimum, a graphic display screen upon which the visual elements of the data base are displayed, an alpha-numeric cathode ray tube upon which the non-graphic attributes associated with the data elements are displayed, a keyboard, and a small digitizer. Some stations also have a large digitizer for large-scale graphic data entry. A copying device is available to provide instant hard copy of the contents of the graphic display screen.

DATA STRUCTURE

The Houston METROCOM has a geographic data base and therefore must rely heavily on the accurate spatial positioning of the individual data elements. The basis for locating the data base elements is the 1" = 100'

planimetric map sheets developed in the Comprehensive Monumentation and Mapping Program. Over 1500 of these map sheets, each approximately 2000' \times 3000', have been prepared during the first ten phases of the program. More than 4000 precisely located survey monuments were used to control the mapping effort. By the time of completion of this ongoing program, more than 1,850 map sheets will have been compiled. Each of these sheets will be digitally encoded into the METROCOM file, providing a precise geographic base map ("geobase") of the entire city.

Most of the utility base maps in present use by the divisions of the Public Works Department and by the publicly owned utilities, such as the gas and light companies, are derivatives of street rights-of-way delineations and show little if any cultural detail. These maps are at varying scales and degrees of cartographic reliability. However, the data contained in these maps must be correlated to the precise geobase provided in the planimetric mapping. It is evident, then, that the second step in the creation of a reliable geographically-oriented data base is to generate the street right-of-way and land parcel information using the best available source fitted to the cultural geobase. At this point, with some additional investment, a true "tax map" can be created. In the system now in use, the attributes associated with each parcel of land are stored at the coordinates of its apparent centroid.

These two levels of detail, the culture and the land occupation, form the basic structure of the Houston METROCOM. Initially, the only other data elements in the file are those associated with the underground facilities under the auspices of the Department of Public Works—the water collection and distribution system, the wastewater collection system, the storm-water collection system, and several other Department of Public Works facilities. Roadway information is also included in the file.

The basic physical structure of the Houston METROCOM has been developed by Turner, Collie and Braden with guidance from the city. The data elements included were determined by various selection techniques, then reviewed with city personnel. A data acquisition plan, delineating procedures for acquiring, organizing, and updating data, was developed with the advice of the city. Data elements are now being acquired according to this plan.

Many other data elements could be included in METROCOM. Obviously, there are limits to the amount of information kept in such a file. Some items are better kept in filing cabinets, in microfilm files, or in separate computer files. One of the most important tasks was to determine which elements belonged in the central file and what cross-references were required. Omitted items and cross-references can be added later as needed. Flexibility is the strength of the system. As a matter of fact, in the data-gathering operation much of the data collected will be phased; e.g., align-

ment information for a utility may be gathered independently, before the capacity, value, maintenance record, etc., are gathered for that utility.

The various sources of city data to be included in the METROCOM files have been reviewed. These data are found in many places within the Public Works Department and are in a variety of formats, from detailed construction plans to block maps and permit details. In appraising the various data sources and information available, we soon learned that a massive coordination effort was required. There is no common file to refer to, nor are the data cross-referenced in any logical way. For example, connections made to the storm sewer for a private project (office building) are not recorded with the original facility plans. The most efficient and effective method for handling the data acquisition for METROCOM file creation is to inventory the available data and make a common index, including the following information:

1. Construction plans for all facilities
2. Proposed wastewater infrastructure improvements
3. Proposed water supply improvements
4. Proposed drainage and storm sewers
5. Wastewater facilities installed by permit for 1977 and 1978
6. Storm sewer facilities installed by permit for 1977 and 1978
7. Correct street address data
8. City property data from Right-of-Way Engineer's files
9. City gas facilities and distribution systems
10. Field survey data.

An inventory is being made in the first implementation phase of METROCOM and will be available to the Department of Public Works. When the data inventory and building of the index is complete, information in the METROCOM Data Base can quickly be located, retrieved, classified, and used. A method for updating and revising the index file is being developed by the research and development team so that new data (in the form of building and site development plans) can be added.

SYSTEM USES

Houston METROCOM includes pictorial representations of facilities and associated descriptions. For instance, the type of material, size, depth of pipe, etc., can be associated with the graphic representation of water lines. For any given polygonal area, data may be retrieved selectively, keyed to some attribute or combination of attributes of the stored data. For example, all of the storm sewer system made of reinforced concrete pipe with a diameter between 15 and 30 inches may be displayed for the watershed of Little White Oak Bayou. Within the system, the drainage areas of all the

streams in the Houston Metropolitan area can be defined as a series of polygons; any data stored within Houston METROCOM can be retrieved by watershed, combinations of watersheds, or portions of watersheds. Stored data for any typical polygon (drainage area) can also include soils data, slope, ground cover, land use, and all other information typically used as input for stormwater management models.

An index of the entire City of Houston vicinity is stored as an integral part of the Houston METROCOM. This index contains the freeway system, the major and minor arterials, the drainage areas, various political boundaries, principal railroads, and other landmark features. Users of the system can enter the data base with this index as a guide. To do this they indicate the "window" into the data base that is needed and this information is then transferred from the master METROCOM file. Only the data that a user requests are actually transferred to a remote terminal.

Figure 2 shows a representation of stored information about cultural details as it appears on a screen at a satellite terminal. Each major item shown here is stored individually and can be retrieved on demand. Some of the important items called "culture" are the buildings, roadways, driveways, sidewalks, parking lots, railroads, drainage systems, and fences. Non-graphic attributes are stored for each of the data types. Graphic and non-graphic elements can be retrieved in a logical fashion. For instance, only those streets that have curbs on both sides could be picked out from the set of roadways. Or, if the user desires, only the residential buildings could be pictured. Attributes of the data elements can be combined in various ways, and reports on them generated using the line printer.

At times the property description and rights-of-way must be displayed. Figure 3 shows this level of detail superimposed on the cultural information of figure 2. Notice the small dot near the middle of each land parcel. This is the "apparent centroid" and the attributes for the parcel are stored in association with the coordinates of this point. The information in the file concerning any parcel can be retrieved by moving the crosshairs to its centroid as it is displayed on the graphic screen. Any or all of the elements can be retrieved and displayed, if they have logical connections within the data base and meet the user's requirements. For example, only parcels of unoccupied land varying in area between 1.2 and 3.7 acres could be retrieved.

Figure 4 shows the entire contents of the METROCOM file for a specific area, including all cultural detail, the property description and rights-of-way, and the city-owned utilities. Any element shown can be retrieved individually or collectively.

There are, moreover, other items that may be associated with the file as the need arises. These items are typically in the form of polygons with an associated centroid. For instance, the drainage areas of streams within the metropolitan area can be added to the file in a straightforward fashion. The

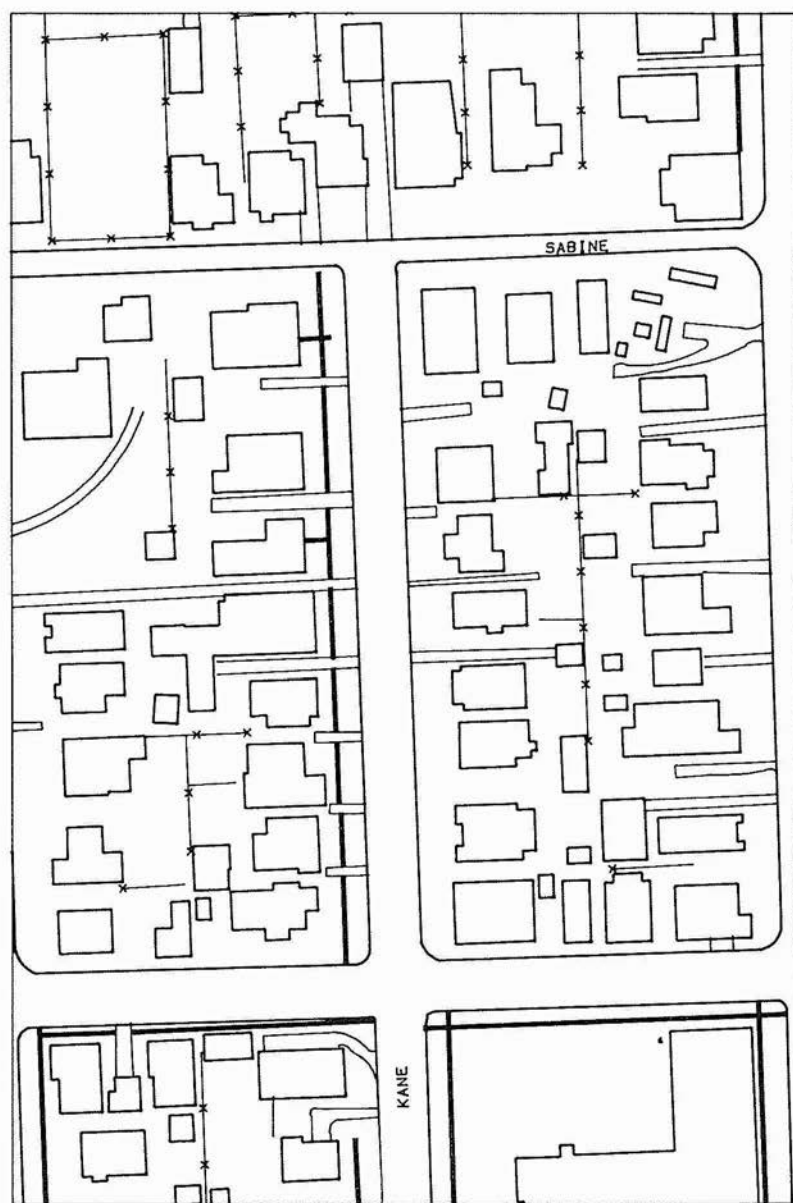
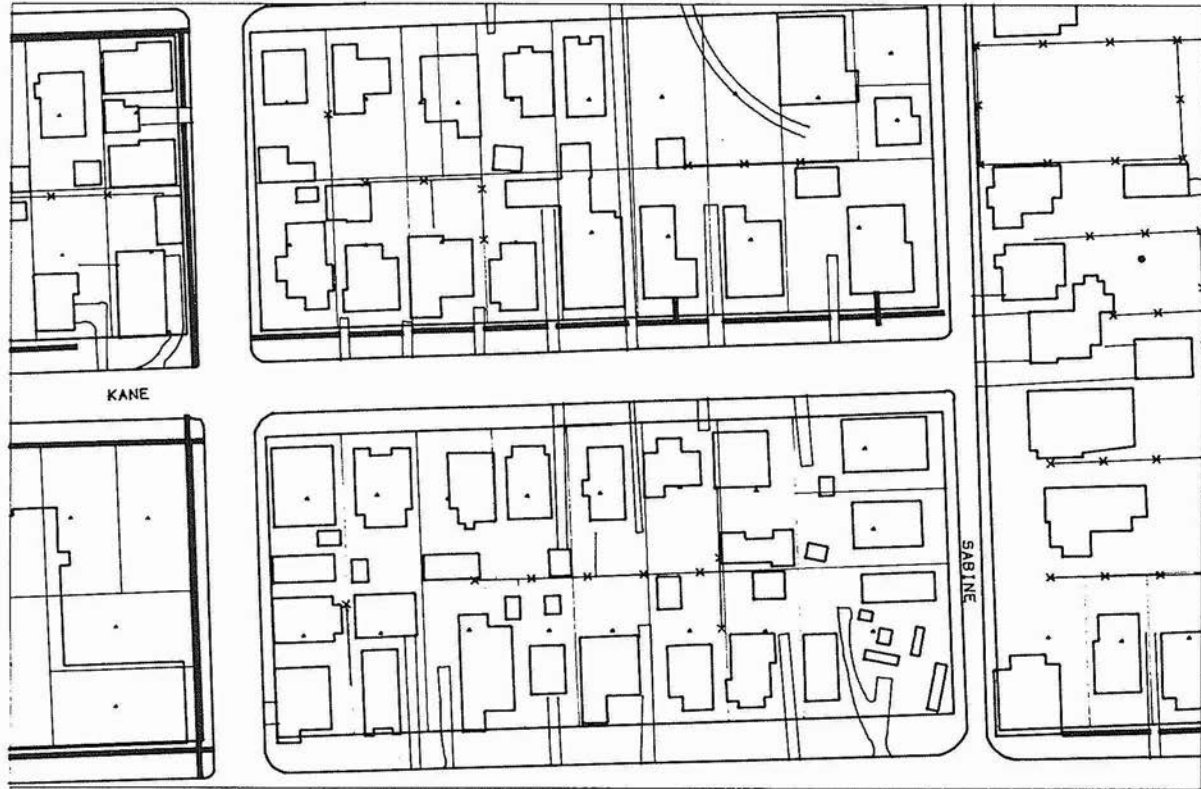


FIG. 2. CULTURAL DETAILS STORED IN METROCOM

CULTURE



CULTURE AND PROPERTY

FIG. 3. PROPERTY AND RIGHT-OF-WAY ADDED TO CULTURE

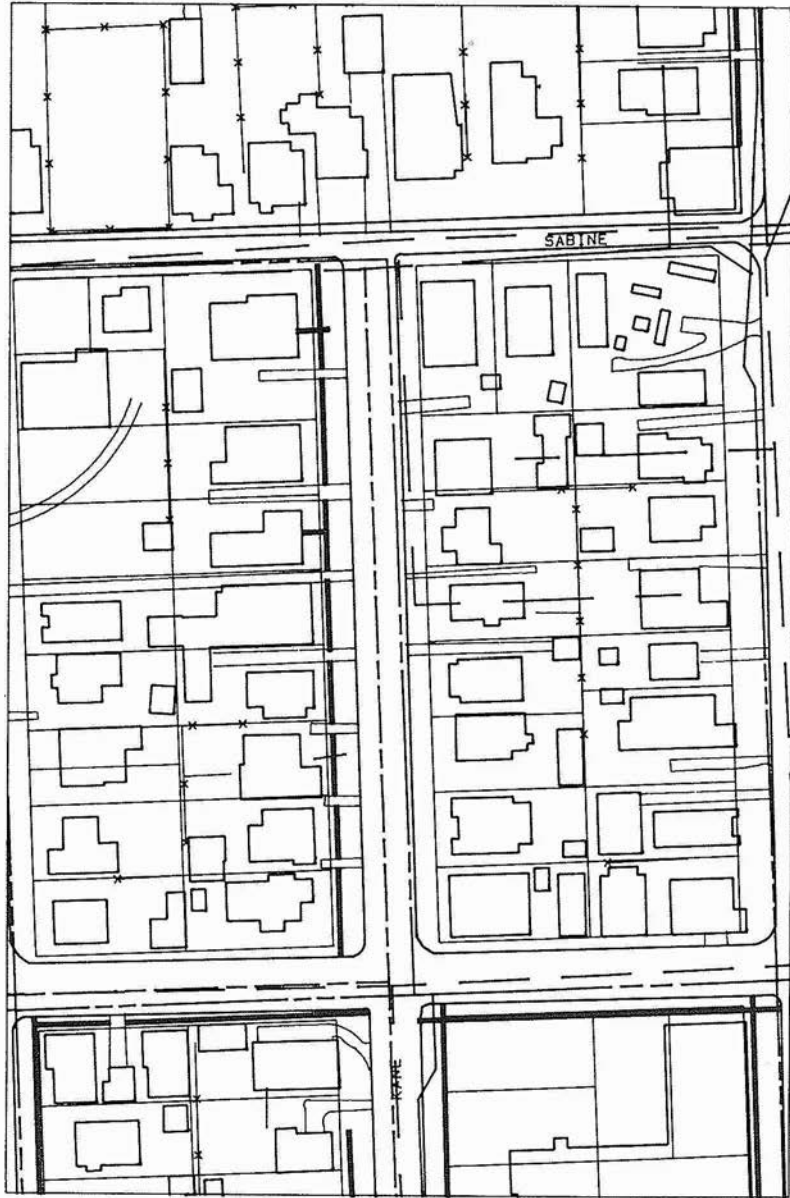


FIG. 4. ALL DATA ITEMS STORED IN METROCOM

UTILITIES

area limits must simply be plotted on a reliable map, then digitized into the system. Similarly, land-use data from other sources and police and fire districts will be added when needed.

All of these data items will be stored independently. However, the same logic can be performed on them as is performed on any other element in the data base. This capacity makes possible very specific, sophisticated inquiries.

With such a system at hand, designers and planners can thoroughly investigate development alternatives, since the required information can be provided quickly and graphically. When it is in full operation, Houston METROCOM will become the standard source of background material for any projects or improvements undertaken by the member agencies.