# AM/FM Requirements of Geographic Information Systems: A Commentary

*John A. Thorpe,*
President, Analytical Surveys, Inc., Colorado Springs, CO 80132
*Duane M. Gilbert,*
Vice-President, MetroData, Inc., Colorado Springs, CO 80132

## INTRODUCTION

THE AUTOMATED MAPPING/FACILITIES MANAGEMENT (AM/FM) marketplace is generally seen to be the domain of large utility companies which are using computerized graphics to assist in managing their facilities. While the acronym AM/FM was coined by Henry A. Emery, a well-known utilities consultant, over nine years ago to describe utilities' Geographical Information Systems (GIS), the term has grown to be used in city and county disciplines as well. This paper will attempt to describe the uses which some of the large utility companies have for interactive graphics in their AM/FM and GIS systems.

One of the first attempts at building an AM/FM system was made in 1968, when the Public Service Company of Colorado (PSCO), in Denver, started a pilot development project on PSCO's subsidiary, Cheyenne, Light, Fuel and Power Company. The project objectives were to prove that the state plane coordinate system geographic locations could be used as keys to link the facilities' files and mapping systems together in an integrated Information Management System. Maps have been used historically to schematically or accurately display the location, size, material, accounting, and indexing of data for cities, counties and utilities. These maps typically show parcels, streets, gas lines, water ways, sewer accesses, zoning and other features. New technologies indicated that interactive graphics, database managers, telecommunications, reduced computer costs, and computer literacy, had developed to the point that the mapping and data requirements could be managed much more efficiently by combining manual and computer systems into one coordinated computer system. The required computer graphic data model of the PSCO gas and electric distribution systems was designed and constructed along with the proposed connections to a new transformer computer system, a new gas meter computer system and the new customer computer system. Mapping, engineering, planning, marketing, servicing and accounting could all be enhanced with the use of this new system.

In recent years, there have been many major developments in the utilities area. These can be placed in two different categories: 1) conversion of existing maps, where creation of a new and accurate geographic land base is not a requirement (such as in the telephone industry); and 2) the building of new and accurate geographical land bases through the use of photogrammetry. In the second case, database owners hope to defray some of the high up-front costs by sharing at least the land and parcel map base with other members of their communities.

## UTILITY COMPANY NEEDS

Utility companies, just as other companies, need to manage their assets as efficiently as possible. Their most important asset may not be their inventory of plant and equipment, but rather the corporate database of customer and facility records which has been built up over a period of many years. These records reside, in 90% of the large utility companies in the USA, on IBM mainframe computers. Interactive graphics enable the companies to display at least the map data on a computer screen, in order to provide a means of better understanding and accessing the huge databases stored in the computers.

One of the most important requirements is a link from the facility's map files to the customer information file, so that the proper location, accounting and service procedures can be applied. Another major requisite is proper tracking of engineering design and building construction functions. These functions must be linked to the materials ordering system, so that when a new work order is prepared an engineer can sit down at a graphics terminal, design the new service, have the materials automatically ordered, the procedures tracked through the accounting system, maps and design drawings made, and the entire work order process completed in logical computer sequences. When the new service is constructed and in place, perhaps two months later, the design drawing is converted to an as-built drawing and the graphics and attribute data are automatically updated in the central, permanent computer database. Interactive graphics combined with a detailed database can create productivity gains of 2:1 to as much as 20:1 in each area of the repetitive processes for valuable economic and efficiency returns.

## UTILITY MAPS

There are three main phases in the mapping process of an AM system:

- Building of the geographical land base
- Overlaying of the property parcel maps
- Overlaying of the utility structures

### GEOGRAPHICAL LAND BASE

In the case of the telephone industry, there is little requirement for accuracy, so the land base is often digitized from USGS 1:24,000 quad sheets, supplemented by high-altitude aerial photography where the maps are out of date. The land base consists of road centerlines and drainage features, with very little else and an accuracy of plus or minus fifty feet. Cost of digital mapping preparation is minimal, but its usefulness is often confined to the utility company because there is minimal interest in this level of accuracy by others in the community.

Gas, electric, water and wastewater utilities have more stringent accuracy requirements. The PSCO used rectified photoenlargements for their first pilot area. These proved to have limited accuracy in some areas. New subdivisions with good survey accuracy did not fit together properly, requiring PSCO to complete extensive re-mapping. When PSCO commenced its main mapping task in 1984, it insisted on an orthophoto base built to National Map Accuracy standards.

Photogrammetry has proven to be the best mapping tool for building a new land base. Whether the land base is derived from orthophotos or direct digitizing on stereoplotting instruments, the technique of using aerial photographs has many outstanding advantages over other methods (such as digitizing existing maps.) Notably, aerial triangulation techniques allow for high and homogeneous accuracy. In addition, maps prepared will be up to date. However, since the initial cost is high, the typical pay-back period may be five or more years.

### PROPERTY PARCEL MAPS

Most utility company maps show property boundaries in the form of parcels and lotlines. In some communities the utility

PHOTOGRAMMETRIC ENGINEERING AND REMOTE SENSING,
Vol. 53, No. 10, October 1987, pp. 1403–1404.

0099-1112/87/5310–1403$02.25/0

maps are the best available source of property records, often being better than the city or county maps. Property lines are important to the utility company which must be aware of the existence of easements, frontage lines and other similar features. Positioning of facilities such as poles and underground pipes with reference to land ownership is critical.

It is important to realize that in the western United States the cadastral system is based on section corners which in many cases have limited accuracy and are often not linked to the appropriate State Plane Coordinate System. When sub-divisions were laid out, they were often on local coordinate systems, and until recently there was little or no requirement for precise description by metes and bounds or an accurate connection to adjacent cadastral boundaries. The result is that property records often cannot be converted into computerized graphical form by coordinate geometry or calculation. The only practical method of constructing the property parcel base layer may be to best-fit each block of parcel lots to the land base, and then digitize the lot-lines to make maps which fit the accurate land base map as well as possible.

### Utility Structure Overlays

Utility lines are converted to their computerized form by superimposing the old utility maps over the new digital land base maps, and digitizing the graphical information of poles, power lines, and under-ground pipes, together with the attribute information (e.g., type of pole, existence of a transformer, pipe size, etc.). Connectivity between the graphical and attribute files, which is the life-blood of any utility system must be maintained.

It is in this phase of the map-making process that the most innovative techniques are being introduced. Because map-making is traditionally labor-intensive, some data conversion companies continue to use labor-intensive "scrubbing" (an industry term, meaning to gather all available data to be converted from existing manual maps and records and preparing them for coordinated graphics and attribute files) procedures to manually draft the new maps before digitizing them into the computer. Other conversion companies develop elaborate software to allow the computer to do much of the "scrubbing," thereby optimizing the digitizing process.

The utility services must be connected to the customer information system by some means, and here the use of the Geographic Base Files/Dual Independent Map Encoding (GBF/DIME) file has proven to be of great value. Methods have been developed to automatically connect the graphical depictions of buildings with street addresses with an 85% confidence factor. Exception reporting of those not matched, combined with field checking, is necessary to achieve 100% correlation.

## COMPUTER SYSTEMS

GIS and AM/FM systems have been built on many different computer hardware/software systems, but currently the market is dominated by Intergraph, Synercom, Environmental Systems Research Institute (ESRI) and International Business Machines (IBM). Each of these systems has its strong and weak points (which will not be discussed here). The critical issues in evaluating a system are graphics display, computer response time, the ability to handle huge amounts of stored information, database structure and connectivity, and the ability to access the corporate databases which already exist. It has been said that mapping is only 20% of a utility AM/FM system. If this is true, then the proper design of the database structure and its interaction with the stored attributes is far more important than an elaborate graphics display.

### Summary

In an AM/FM system, just as in any GIS, it is important to remember that a computerized map is only one report from the system and is not the final requirement. The AM portion is a very important basic function. However, the largest return will come from the FM portion of the system. We live in the age of **information**, and interactive graphics is merely an efficient tool with which we can create, maintain and access that information. . .a means to an end.

---

# CALL FOR PAPERS

## The First Special Workshop on Videography

### Indiana State University, Terre Haute, Indiana

### 19–20 May 1988

This Workshop—sponsored by the American Society for Photogrammetry and Remote Sensing and approved unanimously at the Eleventh Biennial Workshop on Color Aerial Photography in the Plant Sciences Including Applications of Videography—will provide an excellent opportunity to gain insight and share experiences in the rapidly growing field of videographic remote sensing. This special workshop will focus on all aspects of remote sensing which have a videographic element. Thus, any application of videography, algorithm development suitable for analysis of videographic data, videographic sensor systems, image processing of videographic data, use of videographic data in GIS applications, etc., are among the topics of interest in this workshop.

An intensive half-day workshop, with demonstrations of video sensors and video data processing, will be taught by experts in this field for those with little or no experience in videography, thereby providing a foundation in this technology upon which one can build. The remaining day and one half will be devoted to paper sessions and demonstrations which will provide insight into (1) current videographic research applications; and (2) advances in sensors, hardware, and software.

Those wishing to present a paper should submit an abstract not to exceed 300 words by *15 January 1988* to

Paul W. Mausel
ISU Remote Sensing Lab (ISURSL)
Dept. of Geography and Geology
Indiana State University
Terre Haute, IN 47809