



# Utility GIS—More Than Just AM/FM

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<b>Contents</b>	<b>Page</b>
Introduction .....	1
Historical Trends .....	1
Evolution of AM/FM/GIS .....	2
The Move to Enterprise GIS .....	4
The ESRI Approach to the Utility Market .....	5
The Need for Payback .....	6
Design Process .....	6
Inventory/Material .....	6
Logistics and Routing .....	6
Underground Locating .....	7
Integration With Operational Systems .....	7
Land Management .....	7
Vegetation Management .....	7
Streetlight Maintenance and Conversion .....	7
Pole Attachments .....	7
Marketing .....	7
Conclusion .....	8



# Utility GIS—More Than Just AM/FM

**Introduction** In the 1970s and early 1980s, computer graphic systems began to be deployed in utility companies. The primary function of these early systems was to record the location of geographically dispersed assets or facilities. Early implementations of these systems typically had two completely separate components—a graphics "engine" and tabular record files. They were typically deployed solely in the engineering or planning department. Most of these early systems were based on a computer-aided drafting (CAD) platform that was linked to a separate database of textual or attribute (nongraphical) information. Lacking a universally recognized name for these systems, the implementing companies just called them computerized mapping systems, and the industry in which they emerged was loosely identified as the computer graphics industry.

It was not until the early 1980s when the name of these specialized computer graphic systems came to be known as automated mapping/facilities management (AM/FM) systems. Today, that name is still quite prevalent in the utility industry. But now the term AM/FM tends to describe a single application among many that are provided by today's geographic information system (GIS).

**Historical Trends** Since AM/FM systems were typically CAD-based, their graphic primitives contained the mathematical expression to create each line and symbol along with their geographic location. Because of these expressions, entities could be programmatically "connected" to one another, using a parent-child relationship or other network model. Therefore, these systems modeled the electrical or pipe network of the utilities well. What they did not do well was handle areas or polygons because there was typically no support for graphic entities other than network elements. Those systems that did provide primitive support for polygons had to create them from the lines representing edges or boundaries.

At the same time, another type of computer graphic system was emerging that handled geographic areas or coverages as their primary component. These also linked graphic entities to nongraphic information stored in flat files or databases. They differed from AM/FM systems in that they dealt with the underlying geography directly, rather than as simply a means to display facilities. That is, they dealt with polygons as well as line and point features and could easily handle more complex spatial relationships of those features. These systems were called geographic information systems. They used a topological data model whose graphic primitives included points, arcs, and polygons. Therefore, these systems modeled the relationship of geographic features to one another well, thus being able to, for example, display point symbols within an area or determine the closest distance between features.

<b>Differences of Early Systems</b>	
<b>AM/FM</b>	<b>GIS</b>
<ul style="list-style-type: none"> <li>– <b>Managed <u>Facilities/Networks</u></b></li> <li>– <b>Used Connected-Network Data Model</b></li> <li>– <b>Strength - Network Tracing &amp; Analysis</b></li> <li>– <b>Generally Project or Departmental Solution</b></li> </ul>	<ul style="list-style-type: none"> <li>– <b>Managed <u>Resources/Coverages</u></b></li> <li>– <b>Used Topological Data Model</b></li> <li>– <b>Strength - Polygon &amp; Thematic Mapping</b></li> <li>– <b>Generally Departmental or Enterprise Solution</b></li> </ul>

Utilities that had implemented pure AM/FM systems found that their use was limited to basic facilities management and could not easily perform spatial analysis. Many had actually implemented both systems—AM/FM in their planning or engineering department and GIS in their marketing or environmental department. By the 1990s, AM/FM software vendors began striving to add GIS functions comprising basic polygon processing to their systems. Conversely, in this same time frame GIS software vendors began adding network tracing and analysis capabilities. This overlap of functionality led to the blurring of the differences between AM/FM and GIS. In fact, the industry began to call all systems that handled facility management and polygon processing AM/FM/GIS (or even just GIS), regardless of their underlying data model.

**Evolution of AM/FM/GIS**

By the late 1990s, most AM/FM/GIS software systems still were somewhat constrained in their functionality due to having one of the two underlying data models mentioned previously at their core. Because of their underlying network model, AM/FM-based systems tended to be implemented only on a departmental basis. Because of their topological data model, GIS-based systems tended to be more interdepartmental or usable throughout the enterprise. The capabilities (or limitations) of these two models had become more prevalent as utilities demanded more efficient access to spatial corporate data from all departments. This indicated a need for less restrictive core AM/FM/GIS capabilities and more open access to data stored in these systems.

<b>Trends in AM/FM/GIS</b>		
<b>AM/FM or GIS</b>	⇒	<b>AM/FM/GIS</b>
<b>Project/Department</b>	⇒	<b>Enterprise Solution</b>
<b>Proprietary DBMS</b>	⇒	<b>Commercial RDBMS</b>
<b>Proprietary Scripts</b>	⇒	<b>Open Programming</b>
<b>Custom Programs</b>	⇒	<b>Component Objects</b>
<b>Procedural Rules</b>	⇒	<b>Object Behavior</b>
<b>Custom Data Model</b>	⇒	<b>Standard Data Model</b>

In this time frame, ESRI® products evolved to the most advanced functionality available using its core GIS-based architecture. AM/FM functionality was addressed with third

party applications that handled the connected network logic required. The limitations mentioned above in both traditional GIS and AM/FM systems were due to the separation of spatial content in a file-based spatial storage and attribute data stored in a relational database. This architecture was commonly referred to as georelational. Because of its separate storage, this architecture limited scalability and use of relational database features such as replication and backup/recovery.

In 2000, ESRI introduced a new architecture that could easily handle both AM/FM and GIS requirements. This is built on a client/server architecture using standard computer and networking technology. The server piece of this architecture uses commercially available relational database management systems (RDBMSs) for data storage, which have been extended to accommodate spatial data (geographic content). The clients run on standard Windows operating systems and address the traditional AM/FM or GIS functions in addition to newer functionality such as map publishing on the Internet and automatic vehicle routing. While this basic architecture handles the more traditional functions typically needed by utilities, it also can be extended with add-on products by ESRI and its thousands of business partners. This line of products is called ArcGIS™.

ArcGIS is object oriented but does not use proprietary platforms or development environments. It is built on and uses the latest in integration platforms and standards and is truly open. What open GIS really means is the ability to interoperate with other non-GIS systems by seamlessly passing data to and from these systems. Being open also means being scalable and able to operate on different platforms and on different database management systems. Finally, an open GIS can expose objects to allow for customization and extension of functionality through industry-standard development tools.

In addition to its use of programming and platform standards, in conjunction with the ArcGIS architecture, ESRI has been instrumental in the establishment of standard object data models for use throughout the industries it serves. Driven by customers and business partners, several standard data models have been developed for the electric, gas, water, pipeline, and telecommunications markets. In some cases, such as in the electric market, there are transmission and distribution models for large American utilities, small (municipal and cooperative) utilities, and European utilities. Not only are these open and driven by the user community, but they are published and, in most cases, downloadable from the ESRI Web site.

Another important feature of being component-based, ArcGIS objects can be embedded in other non-GIS applications. Use of components to add mapping capabilities and the corporate dissemination of mapping applications within existing information technology systems will drastically increase the benefits for GIS implementation. The streamlining of job functions through the use of these mapping applications will allow efficiencies not seen before. Quick access to maps and spatial analysis from within any corporate computer system will change the way most users of those systems do their job.

**The Move to Enterprise GIS**

For years, AM/FM/GIS technology has been used to reduce plant records maintenance costs and increase engineering productivity. Traditionally used by outside plant or distribution engineering departments, newer implementations integrate AM/FM departmental functions with other GIS applications and interface with other operational systems such as mobile dispatch, customer service, outage management, and other distribution automation systems as well as enterprise resource planning (ERP) systems. Integrated object-oriented facilities management, network analysis, modeling, and work order design all contribute to increased productivity and help justify the costs of these systems.

A true enterprise GIS implementation takes the above-described integration further by providing spatial query and geographic visualization to virtually every employee. Utility companies' local and wide area networks have enabled access to corporate spatial information by using desktop GIS client machines. Although necessary for traditional GIS users, the media that has enabled this to occur much more efficiently is the Web. More specifically, it is the ability to publish or serve corporate AM/FM/GIS data via a map server product or extension to the GIS. Standard Internet browsers can be deployed as no-cost clients for the casual user to access corporate spatial information. The ESRI Internet Map Server product that works in conjunction with ArcGIS to publish spatial data on the Web is called ArcIMS®.

Enterprise GIS means the use of spatial technology in virtually every department of a utility, but not as individual islands of spatial implementations. It means that spatial applications must be linked throughout the enterprise, and corporate data must reside in a spatially enabled database, accessible by all those departmental applications. The ESRI product that enables relational databases is ArcSDE®, which is an integral part of the ArcGIS suite. ArcSDE can store data in relational databases in several different ways. For instance, it uses the default binary schema for Oracle and Structured Query Language (SQL) Server, which is fully compliant with the OpenGIS Simple Feature Specification for SQL's binary geometry. ArcSDE also provides support for additional GIS data types such as *z* values, measures, annotation, and support for raster and survey data that extend beyond the Open GIS Consortium (OGC) specification.

For a GIS, the key to being enterprise capable is its ability to provide functionality across the broadest range of applications. No other GIS company comes close to ESRI in its range of applications offered and number of markets served. In addition, no other GIS company natively supports as many relational databases and spatial data formats as ESRI. These facts, coupled with its market leadership position and its extensive collection of business partner applications position ESRI as the most capable enterprise GIS provider.

## The ESRI Approach to the Utility Market

ESRI is the leading provider of core GIS technology worldwide. However, since AM/FM is still the primary GIS application for utilities, ESRI must address the requirements of this fundamental application as well as core functionality. ESRI's vision is to address AM/FM utility requirements with the most robust and open core GIS, then provide add-on AM/FM functions through business partner products. The leading ESRI business partner for AM/FM is Miner & Miner, Consulting Engineers, Inc., with its ArcFM™ product line. Being ArcGIS software-based, ArcFM provides all the geospatial tools utilities need to become more competitive, more customer oriented, and better equipped to meet the challenge of deregulation and other market drivers.

ESRI addresses many of the other utility GIS applications described above, without add-on business partner products. These applications are handled by core GIS functionality available in ArcGIS and other more specialized products such as ArcLogistics™ Route for street-level fleet routing and ArcGIS Schematics for generating schematics directly from the geodatabase (the corporate data repository for all spatial information in an RDBMS). ArcGIS offers a complete enterprise solution when combined with ArcSDE and ArcIMS. ArcSDE is the spatial database engine, that handles multiuser access to the corporate geodatabase and supports versioning and long transactions (essential for utility work order management and storage). ArcIMS is the Internet Map Server, which completes the enterprise solution by offering an Internet browser interface to the corporate geodatabase.

Unlike other AM/FM/GIS vendors, ESRI does not offer products outside its core competency such as outage management or mobile dispatch. By concentrating on core GIS functionality and offering an open, Component Object Model-based extensible architecture, ESRI can team with other technology leaders to offer a best-of-breed approach to a complete operational utility software offering. Most of the leading vendors of these complementary software products, such as outage management, work management, engineering analysis, mobile data dispatch, and SCADA, are ESRI business partners and have either interfaced to or built their applications with components of ESRI technology.

ESRI is committed to open systems and interfacing standards evidenced by the many standards organizations to which it belongs. As the leader in the industry, ESRI has set many of the standards in GIS and continues to be active in organizations such as the Open GIS Consortium, the International Organization for Standardization (ISO), the Federal Geographic Data Committee (FGDC), and the International Hydrographic Organization (IHO). ESRI products are developed and can be customized with standard, object-oriented development languages such as Visual Basic, C++, .NET, and Java. ESRI employs many Web standards such as XML, Simple Object Access Protocol, UDDI, and WSDL. Web application programming interfaces, such as WFS, WMS, XML, and GML, are also supported.

**The Need for Payback**

All GIS implementations within utility companies must be cost justifiable, especially in today's economic environment. More systems and projects are competing for the same discretionary dollars. The relatively slow adoption of pure AM/FM systems in the past had been due to the high cost of conversion of facility information. A departmental-based GIS, on the other hand, by its nature of dealing with more pure geographic content, typically enjoyed shorter payback periods, especially when commercial map data sources are readily available.

Today, most utilities that have not considered AM/FM/GIS in the past are now doing so because of the threat of competition and being able to respond to public, regulatory, and legislative inquiries that are geographic in nature. A GIS can arm utilities with the tools to compete efficiently, identifying where revenue is coming from compared to where facilities are located. With the merging of these two disciplines, utility companies have to look to increased benefits to offset the costs of these systems.

Increased benefits come from increased functionality or completely new capabilities. Most GIS system benefits are derived from additional or enhanced add-on applications. As much as core GIS capabilities can enhance productivity and provide insight to corporate data, the real payback producers are the add-on applications. Some of the applications that significantly contribute to payback are listed below.

***Design Process***

The largest single area of savings is probably in the planning and design of engineering work orders. With a set of applications that automate the design process and optimize the individual designs, the result will be a substantial reduction in the average price per work order. Analysis and design packages are geared at reducing material and field labor costs of construction, resulting in a potential 5 to 10 percent reduction in the annual capital budget. These savings are in addition to the reduced labor costs involved in streamlining the actual design process (engineering and drafting labor). Typically, with an AM/FM design application implemented in the design/drafting process, a 10 to 20 percent work force reduction can be realized.

***Inventory/Material***

As a result of optimizing the design process indicated above, there are also savings in the areas of inventory, material handling, and carrying costs. Typical savings are 8 to 10 percent of current material handling costs.

***Logistics and Routing***

Another large area of savings is the use of an automated routing application. Routing done manually or even by automated systems that just use grids or aerial point-to-point methods do not yield the savings of a street-level routing system as used in ArcLogistics Route. Using this system, typical results indicate an 8 to 10 percent reduction in miles driven. Add this to the reduction of overall drive time and the reduction or elimination of overtime by field technicians being routed, and an additional 1 or 2 percent off the entire Operations and Maintenance (O&M) personnel budget is probable.

***Underground  
Locating***

Depending on the process used to locate underground facilities, with the use of an integrated GIS, this process can be significantly streamlined and, therefore, reduce operating costs. In a specific example of this process, a major electric and gas utility saved an estimated \$1 million in its first year by streamlining the locate process using GIS. Savings of just a few percent in the O&M budget by this process can result in the large savings indicated by this example.

***Integration With  
Operational Systems***

One of the areas that can yield labor reduction is in the integration of GIS with systems such as work management, outage management, SCADA, mobile dispatch, and customer information systems. The amount of integration will determine the actual workforce savings that can be realized, but if output from one system is now being input to one or more other systems, then it is obvious that that process can be eliminated.

***Land Management***

Management of land and rights of way can be a daunting task to a utility. The ability to manage these real property assets from the desktop can significantly reduce the labor costs involved. One utility saved an estimated \$80,000 per year using GIS in this process.

***Vegetation  
Management***

Similar to land management, another application that can yield savings by using GIS is vegetation management. This is the process of scheduling tree trimming to keep rights of way clear. Utilizing GIS to analyze growth and schedule crews when needed, rather than on a periodic, manual basis, can achieve cost reductions of 10 percent or more off the tree-trimming budget.

***Streetlight  
Maintenance and  
Conversion***

By integrating GIS access in the customer service office, the process of pinpointing burned out streetlights becomes much easier. Also, systematic conversions of streetlights can be handled more efficiently. One utility achieved annual savings of \$40,000 with its GIS-initiated automatic work sketch application.

***Pole Attachments***

One of the revenue streams for an electric utility is that received for pole attachments. Yet, in many cases, the typical utility does not have a good way of assuring that what it is receiving in pole attachment revenue is what it should receive. A GIS can manage this process with ease. In many cases, a comparison of attachment billing records with pole records in the GIS yielded hundreds or even thousands of unbilled attachments.

***Marketing***

Few traditional GIS applications have an effect on the income side of the books, but coupled with demographic data, a marketing application can. Depending on the deregulation environment and competitive situation, utilities must now consider competing for new customers. The best way to target top customers is through the use of GIS. In addition, the GIS can consider new customers' proximity to existing plant facilities, which would yield a more effective cost-benefit analysis tool.

**Conclusion** Even though GIS and AM/FM systems grew from different roots, their mission was the same—to streamline map drafting and automate previously manual functions to achieve bottom-line savings. Older systems were implemented on a project or departmental basis. Today's systems tend to be interdepartmental with many different classes of users. The real payback in geospatial systems comes from the applications they provide in addition to the mapping of facilities. But access to spatial data is the key to achieving payback across the enterprise. True enterprise GIS for utility companies means access by virtually every employee through every corporate information system that deals with geographically dispersed assets or customers. The ESRI approach to enterprise GIS, with its tiered, open architecture, breadth of applications, and best-of-breed integration strategy, makes it a natural choice for those wishing to make their utility GIS much more than just AM/FM.



For more than 30 years ESRI has been helping people manage and analyze geographic information. ESRI offers a framework for implementing GIS technology in any organization with a seamless link from personal GIS on the desktop to enterprisewide GIS client/server and data management systems. ESRI GIS solutions are flexible and can be customized to meet the needs of our users. ESRI is a full-service GIS company, ready to help you begin, grow, and build success with GIS.

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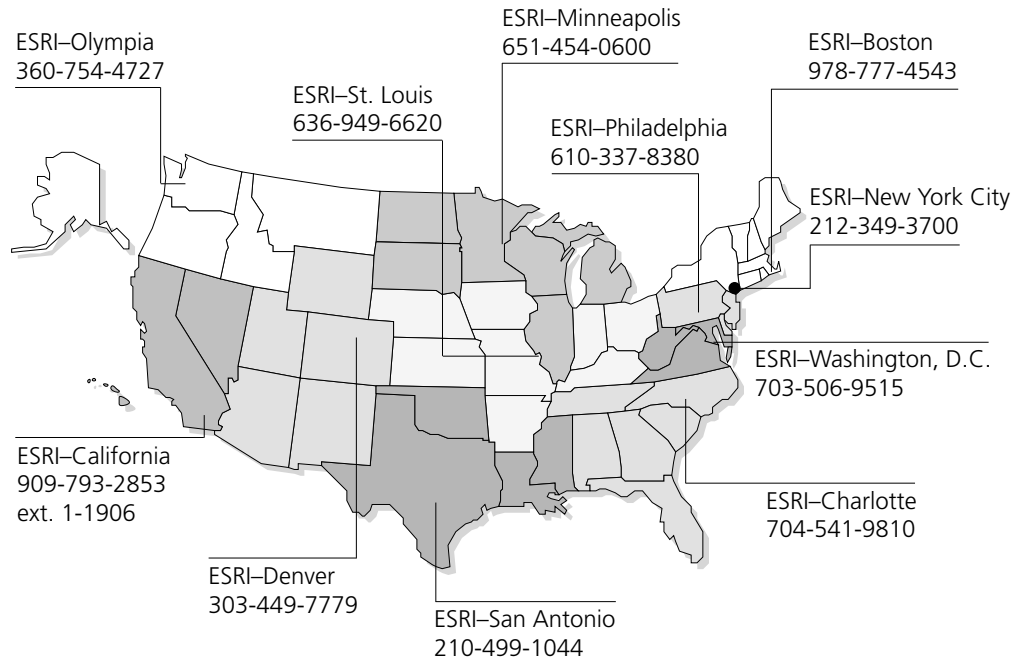
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