

Baltimore City, Maryland

U-View

(2005—Single Process)

System Summary

Baltimore is an old East Coast city that is diverse not only in its population but also in its infrastructure. The Department of Public Works—Bureau of Water and Wastewater Bureau is responsible for maintaining three of the four city-owned and city-operated utilities. These include the water distribution, storm water, and wastewater collection systems. While the storm water and wastewater collection systems are confined to the city's corporate limits, the water distribution system extends well beyond and services a large portion of neighboring Baltimore County.

With systems as complex and extensive as Baltimore's, there is a continuous need to provide large amounts of information to maintenance crews, engineers, designers, consultants, contractors, and the public. This effort has at times been both frustrating and time-consuming for employees, professionals, and homeowners alike. The fact that each utility had its own map scales, naming conventions, and tiling schemes only compounded the problem. With more than a quarter million documents to manage related to the utility infrastructure, records research and timely access to accurate information required for proper decision making have been difficult to provide.

Change was needed. Technology and time were the keys to that change. Utility-related Geographic Information System (GIS) development began in earnest in the late 1990s with the typical aerial photography, stereo compilation, and conversion of paper records. This effort was completed in early 2000. At that time, ArcIMS development and system-support requirements made any application development unfavorable.

Finally, in 2003, funding and network infrastructure came together, which permitted the establishment of servers running ArcIMS and Oracle/SDE. With the development of "U-View," the city can now take advantage of GIS and Internet technologies to provide available tabular, geographical, and image-related data to any user at any PC within the city. No longer are employees tied to their respective offices where the information resided. The loss

in productivity resulting from staff having to travel to dispersed locations to retrieve paper records is being eliminated.

As an unexpected bonus to the development effort, the application has been found to work exceptionally well with wireless technologies, which will add significant value to the city's investment by allowing maintenance managers, complaint scouts, engineers, and other city managers access to the vast infrastructure data sets in real time, in the field, at the site where timely and accurate emergency decisions, based on real information, need to be made.

What makes U-View exemplary and unique within the region is its ability to deliver a variety of utility-related information to a multitude of users at varying levels of city government. From information desk attendants, permit reviewers, and maintenance crews through engineers and appointed decision makers, U-View provides easy and timely access to the information needed for making better decisions related to utility infrastructure management.

Motivation for System Development

As with most governments, both large and small, in today's economic environment, the biggest motivation is cost and the need to reduce those costs for our constituents. The resounding theme heard in nearly every discussion of budgets is "do more with less"—less equipment, less staff, less money, but not less services. Given these "orders," the natural solution becomes greater use of automation and technology when performing routine manual tasks. The general reduction in man-hours related to records research and retrieval while maintaining or improving records access was the motivation and goal related to the development of U-View. An additional motivation was the need to replace an obsolete version of a desktop-based system that is no longer supported by the vendor. The level of effort to maintain the desktop application for more than 70 users had become burdensome and impractical. The opportunity to go to an intranet-based applica-

tion alleviates a large portion of this effort. Also, to upgrade to the current, fully supported version of the desktop application, it would be necessary to provide a commercial GIS software license (ArcView) with every desktop application license. This was determined to be severely cost-prohibitive.

System Benefits Achieved

- The best way to say this is, we were lucky!
One of the unexpected benefits was the ability to access the application in the field. We had hoped that access times, while a bit long, would allow limited access during extreme emergencies; imagine our surprise when our wireless field tests of the finished product produced access times nearly equal to those of PCs hardwired to the network. This additional value will help to reduce the travel between offices for data access. It also presents a number of potential benefits for improved communications among office personnel and field crews with obvious implications for improved customer service.
- A boost in employee morale occurred.
Much time and thought were given to implementation and training. If staff members were going to use the application, they would need reasonable training for most were not PC-literate. Our training efforts were geared towards hands-on help. The rich reward was seeing people from all backgrounds working to help each other and learn from each other. In addition, we felt that “power users” should be identified and enlisted as trainers so that everyone understood the local references to documents. This gave recognition to those who worked at becoming power users.

System Design Issues Encountered and Overcome

- Acceptable symbology
Under the initial system design, the symbology for the various features was very complex. For example, the geodatabase for wastewater features includes a large number of subtypes based on a range of pipe diameters. The initial design called for each of these subtypes to be shown with its own unique symbology. This resulted in a table of contents and map display that was difficult to read and, thus, of reduced value to the end user. To alleviate this problem, a more generalized symbology scheme has been employed to reduce the “clutter” and create a more useful interface. Specific information regarding any given pipe’s diameter can be obtained by selecting the pipe using the Information tool.
- Faulty hardware components (memory issues on both Web and database servers)
During some of the initial testing of the application, users within the test group began to experience problems maintaining connections to the network. This resulted in continual interruptions in the utilization of the application. We requested that the staff of the Department of Public

Works Computer Center (DPWCC) investigate this problem. They discovered that the culprit was some faulty memory chips. Once these memory chips were replaced, the problem disappeared.

- Image Viewer application for Internet Explorer
One of the most critical uses of the U-View application is the ability to access, view, and manipulate raster images of construction drawings, utility plats, and wastewater house connection cards. Initially, the functionality in U-View to open and view these images utilized standard Windows image-viewing tools. However, we soon discovered that in some instances with certain image file types, this tool became counterproductive for two major reasons. First, when a user accessed an image, the user would be presented with a list of options for action to be taken, including opening the image or saving the image. The intent of this functionality within the application is to open the image only. Second, the default viewer would only allow limited zoom functionality with no pan functionality. This was equally unacceptable, for the user requires the ability to pan and zoom interactively around the image.
To solve this issue, we incorporated some custom Java code into U-View that replaced the default viewer and allows the user to open the image and interactively pan and zoom.
- ActiveX Connector
The ArcIMS ActiveX connector is not so conducive to a high concurrent user volume as a multithreaded connector such as .Net Link. Because of the user-specific nature of this application, a custom connector would have had to be written to utilize .Net link. Instead, a modified ActiveX connector environment was set up to be able to handle multiple concurrent requests, which would be the norm.

What Differentiates This System from Other Similar Systems?

In general, there are no similar systems that could meet our general and specific requirements. If there had been, we would have purchased a commercially available system and implemented it.

System Hardware, Software, and Data

Hardware

The host system for U-View is a Dell PowerEdge 1750 server with four processors. The server is connected to the department’s storage area network (SAN) data storage system and is accessible to users throughout city government.

The databases that support U-View are ArcSDE/Oracle geodatabases. The ArcSDE and Oracle software run on a Dell PowerEdge 3550 server. This server, like the Web server, is connected to the department’s SAN data storage system.

Software

The primary system software components for U-View are:

- ESRI ArcIMS version 9.0
- ESRI ArcSDE version 9.0
- Oracle version 9i
- ASP.net
- VB.net
- JavaScript

Data

Using U-View, our system users can access a variety of data sets, including:

- Planimetric data such as buildings, roads, railroads, bridges, tunnels, vegetation, piers, hydrography, etc. (in ArcSDE/Oracle enterprise geodatabases)
- Color orthophoto from 2000
- Black-and-white orthophoto from 1997
- Utility data including conduit, water, wastewater, and storm water (in ArcSDE/Oracle enterprise geodatabases)

A number of application tables also serve the following main purposes:

- Lookup tables: Because ArcIMS does not utilize ArcGIS domains, domains had to be replicated as separate RDBMS tables.
- Layer control tables: Define which layers are displayed in the Table of Contents, in what order they are displayed, what symbols are used to represent those layer entries in the TOC, what fields can be queried from and displayed as results, and in what order the fields are displayed.
- User table: Table that defines each of the users in the application user group and in what group they reside (e.g., water, wastewater, etc.). Also logs user stats pertaining to log-in and log-out times.
- Print layout table: Defines parameters of map elements on PDF files that are generated using the print tool in the application.

Where Are We Now? Future Direction

Upon return to Baltimore from the 2005 URISA Conference, the Project Team presented the ESIG Award to our director, George L. Winfield. At that time, we also demonstrated the application to many of the department's division chiefs. The net result of this activity was a 25 percent increase in our user community over the past two months of 2005. This growth phenomenon is expected to continue into the first quarter of 2006.

Given our unexpected growth in the user population and that our IMS Application, U-View, is not quite a year old, application training and user support have been our number one priority, so little time has been spent making changes in the deployed application. This is not to say that we haven't had an eye on the future potential enhancements for the application, as well as the

potential for additional IMS development.

One change that is currently being worked on involves a collaborative effort with the Bureau of Water and Wastewater's Facility Division. The Facility Division has been working on a prototype intranet site for pumping stations owned and operated by the Bureau. This site provides access to various types of engineering drawings, reports, and analytical data.

U-View now provides, at least in prototype form, a spatial interface by which pumping stations (and other types of facilities in the future) may be located using routine GIS tools for database and spatial queries. Once the appropriate feature is located, the detailed information can be accessed through a simple Web link into the division's intranet site. The Development Team will continue to search for other suitable "low-hanging fruit" for short-term enhancements to U-View's functionality and integration into the Bureau's business processes.

Longer-term development/enhancement plans for U-View include modifications to the user interface. The most noticeable change will be the elimination of the "Results Area" directly below the map display. We have found through use and user input that a larger map display is of significant interest since the original deployment. Therefore, the Results Area will be transformed into a separate pop-up window that will allow the map display to be increased by more than 30 percent.

These enhancements are planned to be completed during calendar year 2006, along with revamping training manuals to reflect the enhancements as well as user refresher training. Also during 2006, strategic planning for application development and growth will continue, with focused interest in the areas of data dissemination for Environmental Protection Agency (EPA) Consent Decree Reporting and Sewershed Study Activity Progress, Capital Improvement Project Monitoring, and Engineering Document Access for underground infrastructure. Ultimately, the vision is to grow U-View from a "single process" application into a more robust utility enterprise application that addresses multiple areas of interest within the Bureau of Water and Wastewater and potentially the city's Department of Public Works.

About the Author

E. Scott Harris, Engineering Associate Supervisor
Abel Wolman Municipal Office Building, Room 314
200 North Holliday Street
Baltimore, MD 21202
(410) 396-1317
Fax: (410) 545-3649
E-mail: scott.harris@baltimorecity.gov

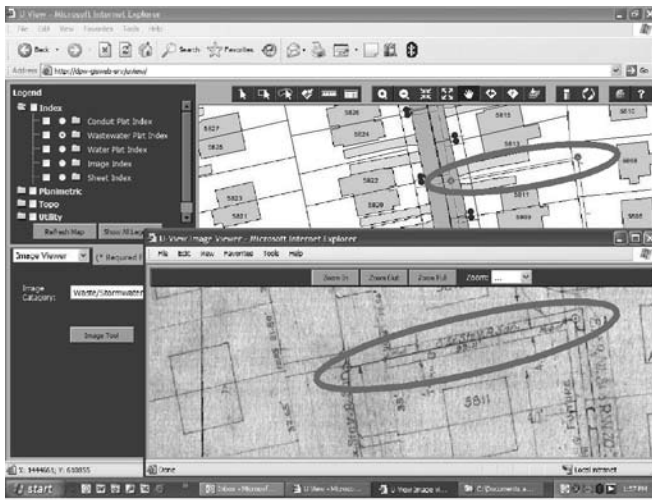


Figure 1. U-View display shown with original record plat image

These figures illustrate one of U-View's original requirements that included access to select historic documents that contain handwritten details. At the time of our original conversion effort, the details contained on these documents were identified as too costly to convert. Through the use of the Image Viewer, many bits and pieces of information have been retained and may be retrieved without further damage to the original documents.

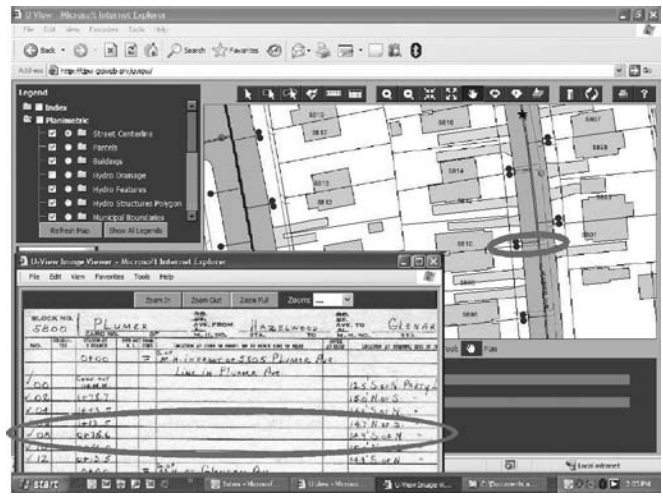


Figure 2. U-View display shown with connection card image

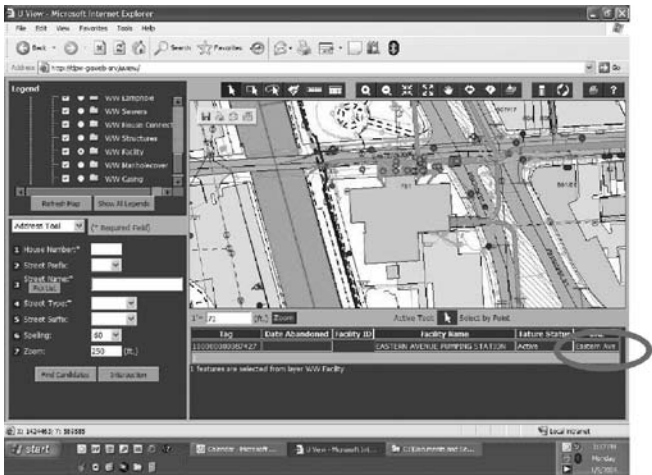


Figure 3. Prototype U-View interface for Facility Division

Prototype development for Facility Division interface with U-View application. A simple "click" on the table in the results window launches the facility's intranet Web site that provides detailed information on the selected facility.



Figure 4. Facility Division's intranet based document access Prototype

The facility's intranet Web site provides detailed information such as contract documents, reports, operations and maintenance manuals, and even photos for the selected facility.

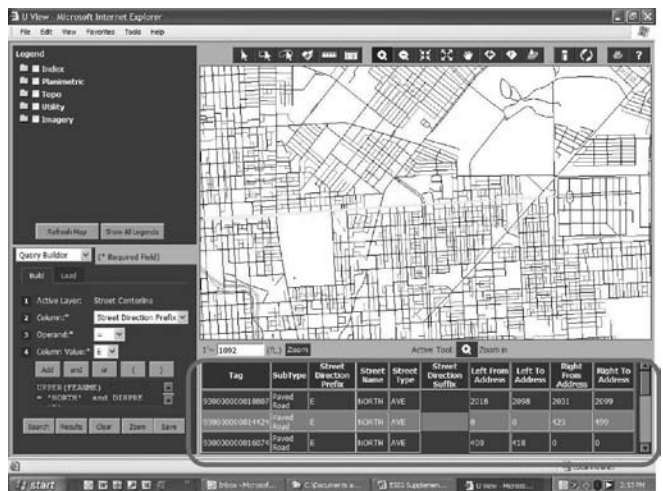


Figure 5. U-View "Results Area" slated for transformation into separate display window