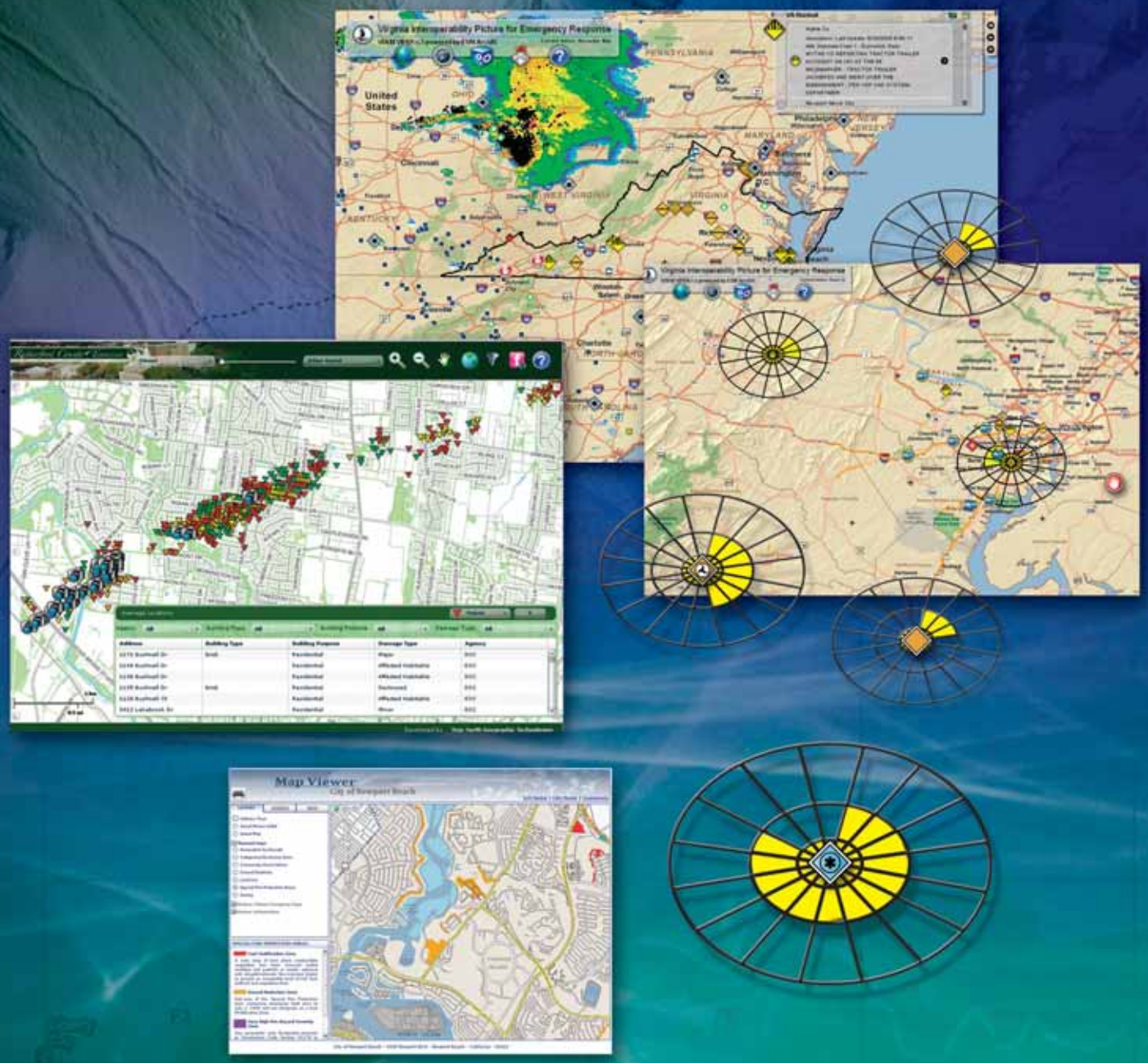
Fall 2009

ArcUser

The Magazine for ESRI Software Users



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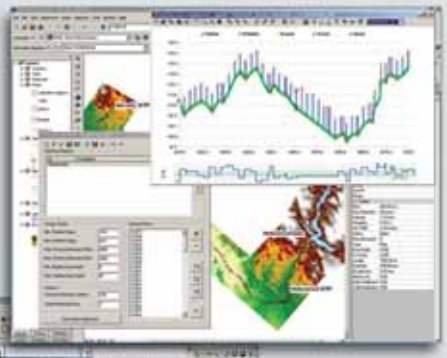

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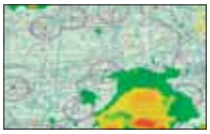
FEATURE

FOCUS



SPECIAL SECTION

29th Annual ESRI International User Conference

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Powering the 21st Century

In his 2008 book *The Big Switch: Rewiring the World, from Edison to Google,* Nicolas Carr likens the revolutionary effect of the centralized generation and distribution of electrical power on manufacturing at the turn of the century to a similar transformation now taking place in the delivery of information.

Until the 20th century, manufacturers of almost anything were required to generate their own power locally. With the development of electric utilities, power generation was separated from its use and commoditized. Utility companies supplied power as a service to many manufacturers, not just one. Because utilities could take advantage of economies of scale, the cost of power plummeted while its availability skyrocketed.

Fairly rapidly, electricity was put to a multitude of uses, uses so common today that we don't even think about them. This happened because electricity was a special kind of technology and because utilities could operate so cost-effectively.

Electricity is a general purpose technology (GPT), one that can be applied to all kinds of things. It is the kind of technology now more commonly referred to as a platform.

Widespread implementation of electric power was possible because electricity was a GPT, but it was the economics—the constant supply of power at low cost—that made the shift to centralized electric power generation happen.

GIS is also a GPT that has found many uses. Although initially created as a tool for land use, GIS has spread across agencies at every level of government and an array of industries. But it has been the economic benefits from "the leap of efficiency" inside these organizations caused by the streamlining processes and eliminating redundant data creation and maintenance that has driven the adoption of GIS.

The other characteristic GIS shares with electricity is that it is amenable to centralized delivery. While GIS is about local things, the data, maps, visualizations, applications, analysis, and models that describe those things don't have to reside locally. Moving GIS resources to central servers, perhaps located in the cloud, can logically be seen as taking the removal of wasteful redundancy to the next level.

Exposing these resources as map services lets them easily be combined and reused in various applications. Simple, task-specific, browser-based applications hide the complexity of geospatial operations from users. Like electricity, GIS is melding into the applications it is used to power. We are entering an era in which people will begin taking GIS for granted—an era in which GIS will be the platform for delivering information for government and business.

Monica Pratt
ArcUser Editor

editor's page

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DEPARTMENTS

Rich, Responsive Web Map Applications

Going beyond simple map display with free Web mapping APIs

The ArcGIS Web mapping APIs are now available for free for all noncommercial use allowing mapping and GIS capabilities to be easily embedded, consumed, and deployed in Web or service-oriented desktop applications.

The Web mapping APIs help organizations deliver rich maps and GIS capabilities that are comparable to desktop mapping applications but with all the benefits of the Web. The APIs provide the tools to generate fast cross-browser and cross-platform dynamic maps, with the ability to interact not only with the map itself but also with its attributes and features. The APIs offer developers several platforms for creating Internet and desktop applications including technologies such as Microsoft Silverlight, Adobe Flex, and JavaScript.

Visit the Web applications section of the ArcGIS Resource Center for ArcGIS Server (resources.esri.com/arcgisserver) for live samples, code listings, and support for the ArcGIS Web mapping APIs.

Often, GIS Web applications need to include geospatial functionality that goes beyond simple map display and interaction. For instance, an appliance repair company could use a geoprocessing task to generate drive-time polygons to estimate the total length of services calls, then use a routing task to calculate the routes and directions before dispatching a vehicle. For these types of functions, the APIs provide a set of task classes to perform GIS tasks. The APIs also allow graphics to be drawn on top of the map (e.g., multipoint, polyline, polygon, and rectangle). In addition, the APIs provide components to display maps that support multiple map projections, as well as both dynamic and cached (tiled) map services. With the APIs, developers can include a variety of tasks in their applications including query, identify, find, address locator, routing, geometry, and geoprocessing.

ESRI offers the following resources for developers to get started using APIs:

- *Live samples*—Developers can simply copy and paste the source code from various samples from the APIs Resource Centers.
- *Recorded training seminars*—Anyone interested in using the APIs can watch demonstrations and view code samples from ESRI experts on how to use the APIs.
- *ArcGIS Online*—With a single URL, developers can leverage maps and tasks published and hosted by ESRI.
- *User community*—Download and share code samples through code galleries and exchange ideas with users on discussion forums.
- *Sample viewer applications*—Users can quickly deploy these sample viewers with a simple modification to the application's configuration file, and developers can use the source code to extend the application.

For more information, see the ESRI instructor-led course *Building Web Maps Using the ArcGIS API for JavaScript.*

ArcGIS Online Sharing

Participate in online data sharing communities

ArcGIS Online Sharing is a new way to work with people in GIS who share a common interest such as conservation or engineering. With this Web-based repository, you can share and locate maps, layers, services, and tools.

To participate, search the more than 600 existing groups for one that addresses your area of interest. If you can't locate a group that fits your needs, you can create a new group to promote content that others can use and encourage others to share their data. The process of creating a group is not elaborate and requires just a few steps: choose a descriptive and specific title, provide your contact e-mail, and write a description of the group that lets others understand the group's purpose and the type of content that will be shared.

The type of group you create, private or public, determines how content can be shared. Public groups that don't accept membership are useful for sharing authoritative content. Private groups are good if you want knowledge of and access to the group to be limited to certain people, perhaps people in your workgroup. If you want to include people you don't know, you can form a public group that accepts members. You will accept or decline requests to join your group. Visit http://www.arcgisonline.com/home/ to learn more about ArcGIS Online Sharing.

Additional Resources for Getting Started

Build an application with the ArcGIS API for Microsoft Silverlight

A step-by-step tutorial on The Code Project Web site demonstrates how to use ESRI's ArcGIS API for Microsoft Silverlight/WPF. "How to Add Maps and GIS into Silverlight Applications" shows how to create a map control and add a geoprocessing task to display drive-time polygons on a map in 1-, 2-, and 3-minute increments. This article, written by ESRI staff member David Martinez, provides code listings in C# and a clear explanation of both the how and why of creating this application. Visit http://www.codeproject.com/KB/showcase/GIS_Silverlight.aspx.

More Sharing Options

Layer packages, new data sources, and presentation tools in ArcGIS Explorer

Take advantage of new ways for sharing data, additional online data sources, and presentation tools available with the new version of ArcGIS Explorer by downloading a free copy today from www.esri.com/arcgisexplorer. This GIS visualization tool provides an intuitive way to explore, share, and present geographic information.

Maps created in ArcGIS Desktop and saved as layer packages can easily be used in ArcGIS Explorer. Layer packages encapsulate ArcGIS Desktop cartography and data in one file that is easily shared as an e-mail attachment; saved on a CD, DVD, or USB drive; or made available through a file share.

ArcGIS Explorer is designed to work directly with maps and layers authored using ArcGIS Desktop without conversion. ArcGIS Explorer can also use geoprocessing tools that have been developed using ArcGIS Desktop. Local data—available as map services, geodatabases, shapefiles, KML/KMZ, GPX, JPEG 2000, GeoTIFF, and in MrSID format raster data—can be combined with the continually updated basemaps and layers, shared maps, and tools from ArcGIS Online.

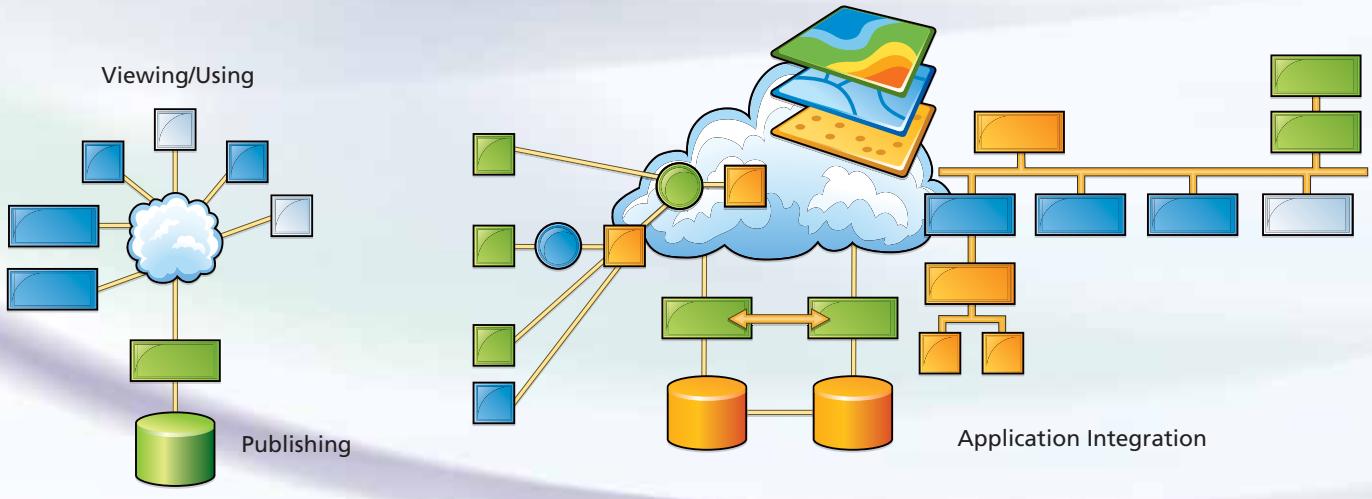
ArcGIS Explorer connects directly with the ready-to-use basemaps, layers, and globes supplied by ArcGIS Online. Hosted by ESRI, ArcGIS Online also provides task services, software developer kits, and other content. For internal or noncommercial use, ArcGIS Online standard services are free. Commercial or external use of standard services and the use of ArcGIS Online premium services require an annual subscription.

If ArcGIS Desktop is installed on the same machine as ArcGIS Explorer, users who are current on maintenance have free access to Bing Maps, a premium map service from ArcGIS Online, as part of an existing ArcGIS Desktop license. Imagery, streets, and hybrid layers can be added from Bing Maps. ArcGIS Explorer users who do not have an ArcGIS Desktop license can evaluate Bing Maps at no cost for 90 days. An annual subscription with no transaction limits can be purchased after the evaluation copy expires.

This version of ArcGIS Explorer includes new presentation tools that can be used for creating compelling slide shows *within* the ArcGIS Explorer environment for briefings, commission meetings, and lectures. These dynamic presentations integrate live GIS data and navigation that a presenter can interact with to illustrate points and answer questions. Titles, pop-ups, documents, photos, and videos can be combined with slides and maps in a full-screen display. In addition to these presentation capabilities, ArcGIS Explorer can change easily between 2D and 3D display.

Imagery, streets, and hybrid layers from Bing Maps can be accessed with ArcGIS Explorer. If ArcGIS Desktop is installed on the same machine as ArcGIS Explorer, users who are current on maintenance have free access to Bing Maps, a premium map service from ArcGIS Online, as part of an existing ArcGIS Desktop license.

To download or view video clips about ArcGIS Explorer, visit www.esri.com/arcgisexplorer. Users outside the United States should contact their ESRI international distributor (www.esri.com/distributors).



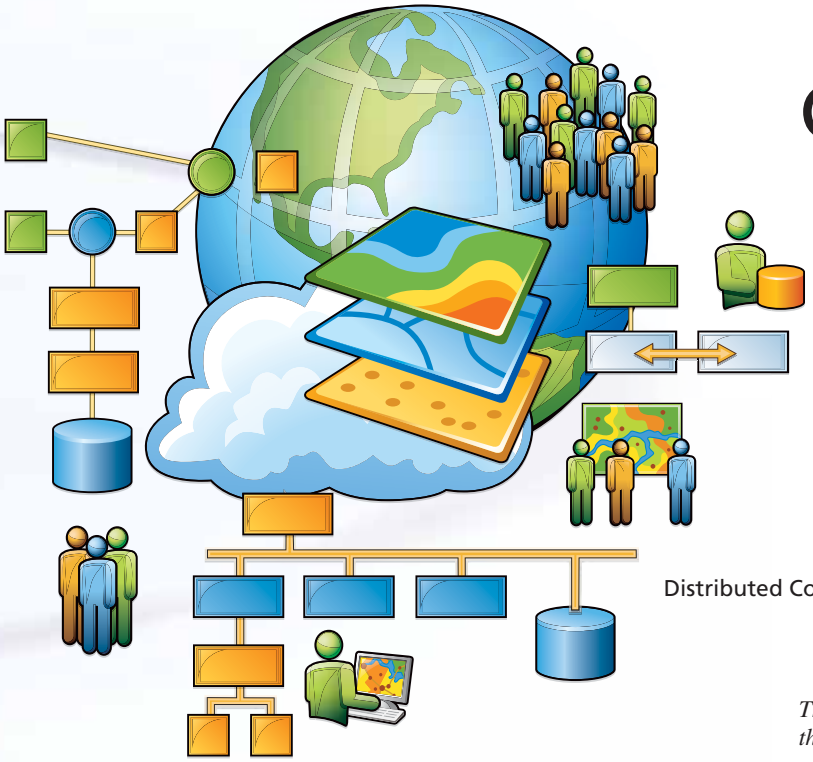
Geospatially
Enabling Information

GIS, the Web, and Better Government

There has rarely been a greater need for better government than at the present. The economic, social, and environmental challenges facing government require innovation and collaboration.

Web 2.0 provides a collaborative environment that has changed the way businesses and individuals interact. Some government leaders have recognized that a Web 2.0 approach could also be used to change the way government and individuals interact. Gov 2.0 is a concept that advocates making government information widely available through Web technology to increase both the transparency of government and the participation of citizens in decision making.

GeoWeb



Distributed Collaboration

The GeoWeb is a vision of Web GIS that incorporates the interactive presentation of Web 2.0.

This movement has support at the highest levels. U.S. President Barrack Obama has said, "We must use all available technologies and methods to open up the federal government, creating a new level of transparency to change the way business is conducted in Washington, and giving Americans the chance to participate in government deliberations and decision making in ways that were not possible only a few years ago."

At the recent Gov 2.0 Summit sponsored by O'Reilly Media and TechWeb and held in Washington, D.C., September 9–10, 2009, it was clear that GIS was the technology best suited for making government more inclusive and responsive. Application after application showed the value and need for real-time location-relevant data. In the words of Andrew Turner, CTO at FortiusOne and a participant in the event, "Geography allows citizens to have one common view of government."

This is not news to GIS users. Most of the information that governments deal with has a strong connection to place—property taxes are assessed by parcel, garbage trucks are routed on city streets, and polling place locations are related to the home addresses of voters. GIS has evolved from a tool for managing projects to a framework that governments use for understanding and responding to problems on scales ranging from local to global.

Not only do governments benefit from considering geographic factors in the decision-making process, but these agencies also use the geographic framework supplied by GIS for organizing, analyzing, visualizing, and displaying all types of data that are germane to solving a problem, making a policy, or improving a process.

Making Government More Available

Using the Web as a means of improving the responsiveness of government is not new either. In its first iteration, the marriage of the Web and government produced e-Government, or e-gov. Designed to improve the level and quality of services that government provided citizens, businesses, and other government agencies, government Web sites quickly evolved from billboards with phone numbers and mission statements to more interactive sites with querying capabilities, online forms, and payment capabilities.

However, providing an intuitive interface for accessing information proved challenging. Governments turned to a relatively new technology that had been used internally for improving processes through organizing and managing information by its geographic location: GIS. In the mid-1990s, in the midst of what has come to be called Web 1.0, online map services were adopted as a way for governments to supply maps on demand for many topics—planning, school district locations, legislative districts, and trash service areas. A single server broadcast map services to many clients.

On the Web, GIS became a tool for collaboration, communication, and service that streamlined interactions between the government and its citizens, businesses, and other government agencies. From a business operations standpoint, Web GIS frees staff from repeatedly answering the same questions about where a polling place is located or which day trash is picked up and allows them to work on other tasks while shortening the time needed to accomplish processes. From a customer service standpoint, Web GIS provides specific information; is available 24 hours a day, seven days a week; and does not require a visit to a government office.

Continued on page 10

Geospatially Enabling Information

Continued from page 9

The Impact of Web 2.0 on GIS

The Web has been evolving from a static, published media to the dynamic, database-driven, collaborative environment now referred to as Web 2.0. Applications for Web 2.0 recognize that value is added by users. The Web functions powerfully because it is both decentralized and collaborative.

In the Web 2.0 environment, there are many new ways to use GIS that empower users and take advantage of the collective intelligence of the Web—collaborative computing, integration of user-contributed content, mashups, and shared distributed data management—to name a few.

Distributed global GIS has been dubbed the GeoWeb by ESRI president Jack Dangermond and described as "a large, widespread, distributed collaboration of knowledge and discovery that promotes and sustains worldwide sharing and interoperability." Instead of providing wide access to a single source of data, the GeoWeb is bringing together vast stores of authoritative, transactional data, much of it maintained by government, and the geospatial services that can be used with it to create new information.

Focused server-side applications supply the benefits of geospatial tools, data, and processes to end users who may be unaware they are using GIS. In this new development environment, Web developers can incorporate GIS functionality in Web applications. ArcGIS Server supplies a strong development environment that includes .NET and Java APIs and hosted mapping APIs for JavaScript, Adobe Flex, and Microsoft Silverlight. This has greatly increased the number of Web applications that use GIS and made the collaboration tools in GIS available to a much larger audience. Many kinds of clients—smart clients, Web clients, and mobile clients—can consume the data, information, and visualizations produced.

Interactive GeoWeb applications are already providing greater access to government data and enhancing government services. The City of Greeley, Colorado, began using GIS in its water and sewer department in 1989. In the intervening decades, GIS use spread to almost every department in the city. To better serve its citizens and more efficiently use its staff, Greeley developed an intuitive and responsive Web application that provides the general public with quick access to a wealth of information about any parcel in the city—from zoning information to school districts to the location of the nearest fire hydrant. The data, maintained by the city, is current and authoritative. Before this application was developed, city planners were spending between three and four hours each day on the phone providing the same information that is now delivered in seconds by this Web application.

Talking about GIS and Gov 2.0

Dangermond was one of more than 80 business, government, and leaders who spoke at the Gov 2.0 Summit. In his presentation, "Geoenabling Gov 2.0," he noted that geospatial data is pervasive at all levels of government—not just in the U.S. but all around the world. This data has been used in many integrated applications that improve planning, management, and decision making. "Actually, as you look across government, I would assert that it is a kind of new information infrastructure," he observed.

Data sharing has been critical to the success of GIS, and the federal government has led the way. Many agencies, such as the U.S. Census Bureau and the U.S. Geological Survey, consider data sharing part of their mission.

While this imperative has led to the creation of data clearinghouses that have improved access to data, it hasn't created a geospatial framework. A national framework is needed for sharing government's authoritative data sources. Currently, ftp download of data is a barrier to many potential users of geospatial information. Removing this impediment requires moving from data file sharing to shared services or geoservices. Combined with easy-to-use clients, deploying geoservices on a large scale would open access to this data to many new users and applications. These services should be "RESTful" and easily discovered, support open standards, and be amenable to being mashed up with simple clients and APIs available to everyone.

The Geoservices Explosion

Widespread development of geoservices would leverage government's huge investments in data and connect government to citizen and government to government. The result would be a geospatial framework for Gov 2.0. In characterizing the effect of geoservices, Dangermond said, "Exposing these services will bring about as much change as

The City of Greeley, Colorado, makes information drawn from geospatial data in many departments instantly available through a responsive Web mapping application.

GIS itself has brought." Existing services could be combined into new services. This would remove impediments between organizations currently using geospatial data and allow them to work in a loosely coupled environment that favors collaborating and encourages synergies.

Examples Emerging

Applications already developed for emergency response and military operations demonstrate the viability and value of loosely coupled environments for providing a common operational picture (COP).

The Virginia Department of Emergency Management (VDEM) uses Virginia Interoperability Picture for Emergency Response (VIPER) to protect the commonwealth's people and property. VIPER supplies a new level of situational awareness by combining data supplied by environmental sensors and gathered from VDEM's crisis management system and other external systems with traditional GIS layers that provide location context.

This system gives a COP to Virginia Emergency Operations Center staff and allied agencies involved in emergency events. Information can be visualized, analyzed, and queried by staff members who are not GIS specialists. It is anticipated that data from VIPER will be shared with other state and local government partners using GeoRSS, .xml, and other widely accepted data formats.

The Foundation Exists

ESRI has been evolving ArcGIS as a complete platform for geoenabling organizations. ArcGIS Desktop provides tools for authoring maps, managing data, building analytic models, and generating metadata. ArcGIS Server publishes that data to a variety of clients, from Web browsers and mobile devices to desktop GIS applications. This has enabled hundreds of government organizations to make data available to businesses, other government agencies, and individuals.

With the creation of ArcGIS Online, ESRI moved from being primarily a software company to a software-plus-services company. Each copy of ArcGIS includes free access to millions of dollars of content services—basemaps, imagery, demographic data, and other resources—that are immediately available from ArcGIS Online. Additional premium content is available from partners such as Microsoft, DigitalGlobe, and GeoEye on a subscription basis.

ArcGIS Explorer is a GIS visualization tool for intuitively exploring, sharing, and presenting geographic information. It can combine locally created data with the continually updated basemaps and layers, shared maps, and tools from ArcGIS Online.

Toward a Societal GIS

As governments have been demonstrating for 40 years, applying geography improves the decision-making processes by addressing problems and evaluating proposed solutions in a holistic, comprehensive, systematic, analytic, and visual manner. With GIS, the analysis of problems can have greater depth, as many layers of data relating to the physical and cultural world can be considered together. GIS is a platform for optimizing systems, whether the system is a utility network, transportation system, or government.

While the the use of GIS by the government, e-Government, GIS applications on the Web, and Web 2.0 are not new, the urgent need to find new ways to deal with old problems combined with increasing geospatial awareness and the desire on the part of government to pursue new technology are new.

The ArcGIS platform—combined not only with the government's authoritative data but also its high-quality maps, visualizations, spatial analysis, models, and other rich applications made available as geoservices—would lead to the creation of government-to-citizen, government-to-business, government-to-education, and government-to-government applications that would integrate all levels of government and support open access, collaboration, and transparency.

Preserving Species Diversity

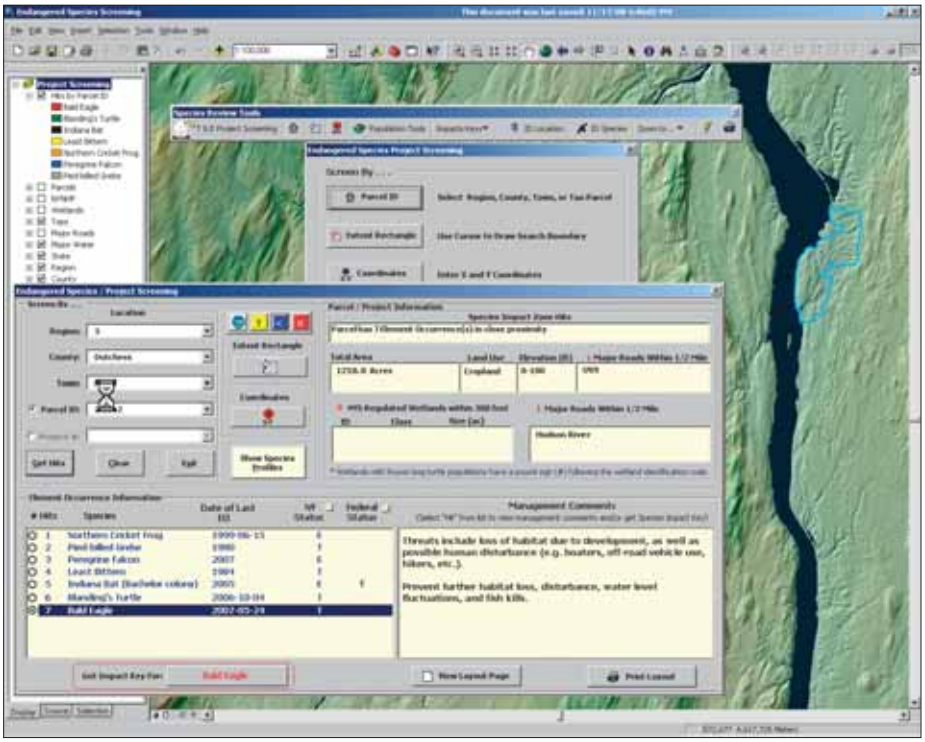
GIS helps New York screen projects for potential impacts

The New York State Department of Environmental Conservation (NYSDEC) has developed a custom GIS application that assists its staff in preserving biodiversity in the state by answering spatial questions related to threatened and endangered species.

There is increasing concern over the loss of biodiversity. Species are declining or becoming extinct at a greater rate than at any other time in the history of life on earth. Today, many species are severely threatened by the reduction of available habitat caused by changing land use. This leads to the isolation of these species' populations and higher mortality rates for them.

This threat has become increasingly problematic in New York's Lower Hudson Valley/Catskill Region. In this unique area of the state, several ecozones are clustered in a relatively small geographic area. The region's diverse habitat types support a correspondingly high degree of wildlife diversity with 90 percent of the more than 400 birds, mammals, reptiles, and amphibians native to New York found in this 4,700-square-mile area. Fifteen of these species are either threatened or endangered and classed as Listed Species.

This extraordinary biodiversity is coupled with a large and ever-increasing human population. With 2.5 million current residents and all seven of the region's counties ranked among the fastest-growing counties in the state, the area is one of the most rapidly developing locations in the northeast. Locations experiencing the greatest human population growth also contain a significant proportion of statewide populations for several Listed Species.



The Search by Parcel ID method returns all hits, zooms the map to the extent of the user-selected location, and adds the search results as a temporary selection layer. When a hit is selected, the user can view management comments or open a species impact key that guides the user through the assessment process.

Incorporating GIS into the Review Process

Conserving and protecting unique natural assets is a core mission of NYSDEC. Biodiversity conservation and the protection of Listed Species are top priorities for the NYSDEC Division of Fish, Wildlife & Marine Resources. NYSDEC relies on its regulatory authority and the environmental permitting program to protect species and their habitats. The department uses GIS and data from the New York Natural Heritage Program (NYNHP) throughout the environmental review process.

The NYNHP database provides detailed, up-to-date information on New York's biodiversity, including documented locations of Listed Species. However, disturbances at sites far from these locations can significantly affect a Listed Species. When considering the impacts of a proposed project, it is important to know not only where the species occurs but also the Impact Zone for that species. This zone is the area surrounding the species location where project-related actions may affect the species.

The NYSDEC Division of Environmental Permits is responsible for administering the jurisdictional permit programs and overseeing the review of proposed projects that may be subject to environmental conservation laws. To determine whether a permitting decision can be reached or if further review is required, permit analysts and biologists must answer resource protection questions such as, Is the project site in close proximity to any Listed Species locations or jurisdictional wetlands? and What habitat features and land uses occur in the surrounding landscape?

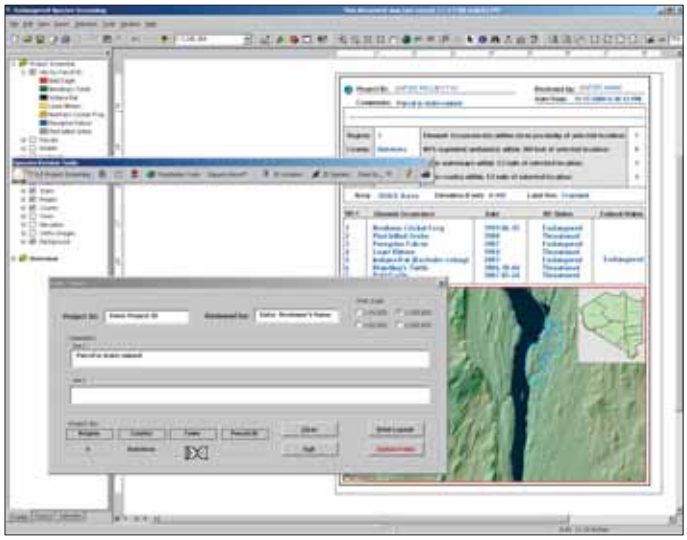
In the not too distant past, these questions were answered using paper maps and transparent sheet overlays. Now the use of ArcGIS software has greatly improved the ability of staff to answer these and other spatially related questions. The region's current rate of development challenges the staff's ability to process an enormous number of permit applications in a manner that is consistent while sufficiently protecting natural resources.

Solution Guides Review

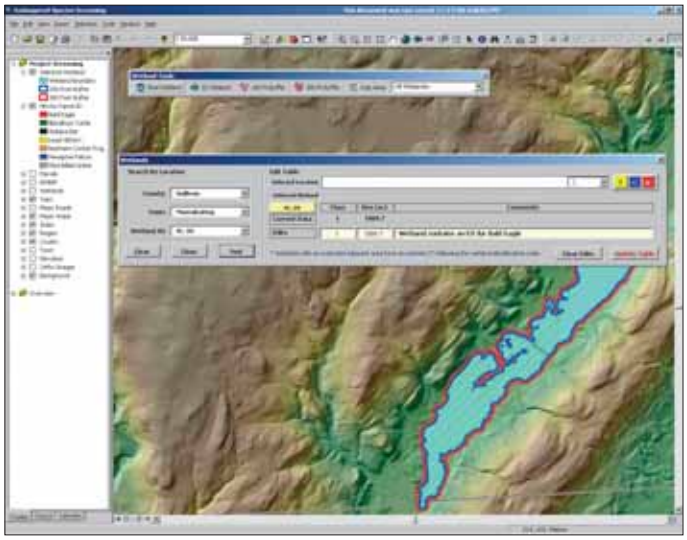
The solution to this situation was a custom GIS application for a screening project that can be used to guide the regulatory review process. The Endangered Species Screening application was developed in ArcInfo 9.3 as a template and enhanced using ArcObjects and Visual Basic for Applications (VBA), the integrated programming environment embedded in ArcGIS software. The template opens with several custom toolbars, tools, and commands, along with all data layers necessary to complete the screening process. The application is designed to

- Enable the user to retrieve the necessary information from the system in as few mouse clicks as possible.
- Eliminate the need for the user to be familiar with details of the underlying databases in order to interpret geographic data.
- Provide the user with custom tools to simplify the decision-making process.

The screening process is initiated by selecting one of the three search methods: Parcel ID, Extent Rectangle, or X Y Coordinates. The



Along with a location map, the search results are displayed in Layout View, which also functions as a screening form for adding other project review information.



The Find Wetland tool returns a list of jurisdictional wetlands that contain element occurrences for the selected species. The display pans to a wetland selected from the search results list. Custom buffer tools can be used to create graphics around the wetland at user-defined distances.

search tools use the obtain element occurrence (EO) polygons for each Listed Species from the NYNHP biodiversity database. Impact Zones are derived from the EO polygons using criteria specific to each species.

Each search tool searches the user-defined location, zooms the map to the extent of the selected location, and expands the form window to display site-specific data. If a search returns one or more hits, the window expands further to show each individual hit as well as the associated attribute information necessary for the screening process.

Selecting a hit displays management comments recorded for the specific EO and location. The entire procedure is done behind the scenes and eliminates the need for the user to conduct an on-screen analysis of the data layers to determine hits associated with a proposed project site.

Along with a location map, the EO and project site information retrieved by the search tool are displayed in the template's Layout View. The Print Results tool opens a dialog box that can be used to enter additional project information or alter the scale of the location map. The print command in the dialog box can be used to send the layout page to the printer or save the document as a PDF file.

Added Support for Users

To assist with the preliminary assessment of the potential for project-related impacts from certain actions, the user can select items from the search results list that opens up a dichotomous impact key. This key contains a series of species-specific Yes/No questions that guide the user through the assessment process. Each branch of a key ends with a Recommended Action section that indicates the next step in the review process. This section also provides links to survey protocols, potential mitigation measures, and additional resources. From this screen, the species' population distribution can also be added to the map as a separate layer.

The Population Tools toolbar contains customizations that are helpful when screening projects involving species that typically exhibit a metapopulation structure *[i.e., populations of the same species that are spatially separated but interact in some way]* and/or species that are particularly vulnerable to fragmentation, or where clustering of individuals may be important. For each species, these tools display a message box indicating the number of known populations within a given search distance from either the location clicked on the map or from user-supplied x,y coordinates. The tool adds the search results to the map as a temporary selection layer.

The Threats to Species button provides a quick reference to the major threats and statewide or local conservation and management efforts associated with each species. The Find Wetland tool returns a list of New York State jurisdictional wetlands that contain EOs for the selected species and location. Selecting a wetland ID number in the search results list of either tool zooms the display to the extent of the wetland. Clicking on the wetland polygon with one of the custom buffer tools creates graphics around the selected wetland at user-defined distances.

Conclusion

The Endangered Species Screening application was developed to more efficiently process environmental reviews by allowing regulatory staff to navigate through the screening process, access all essential data, and make informed decisions about the potential for project-related impacts. In an area of New York State experiencing drastic landscape changes, GIS technology will continue to play an increasingly important role in helping accomplish the conservation objectives of NYSDEC.

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In spring 2008, South Carolina GIS consulting firm and ESRI business partner ROK Technologies (Roktech) saw great potential in Web services for assisting clients that needed to deliver cartographic imagery quickly.

One of its clients, FltPlan.com, serves flight-tracking maps to the general aviation industry. FltPlan.com needed to accommodate sudden influxes of visitors to its site. Instead of making costly investments in hardware to expand the company's capacity, Roktech used a unique combination of ArcGIS Server tile processing and a relatively new type of cloud computing called Hardware as a Service (HaaS).

Because company budgets aren't always in step with the cost of advancing computer technology, the IT industry often creates workaround services that close the gap between what a user needs and what that user can afford. Software as a Service (SaaS) cloud computing is a more well-known example of this strategy. Software licenses are deployed to customers for on-demand use rather than deploying (and paying for) a multitude of individual installations on every device in an organization. In the same way, HaaS is cloud computing that allows organizations to purchase external computer processing power, storage, and data transfer services for a fraction of what it would cost to purchase new computers, servers, and T1 lines to furnish that same capacity. Typically, HaaS vendors charge clients for the services they use rather than a monthly fee.

Tiles on a Cloud

Cloud computing and ArcGIS Server deliver a thrifty solution

By Matthew DeMeritt, ESRI Writer

Significance of the Map Cache

The introduction of the map cache in the latest version of ArcGIS Server greatly enhances the delivery of cartographic imagery. Maps are initially processed and cut into smaller tiles. Map caching increases the speed of GIS applications because it eliminates the need to request data from the database, process it, then send it to the browser on demand. In response to a request, preprocessed tiles fall seamlessly into place and users enjoy a pleasant Internet mapping experience. The strategy of using cached map layers that aren't frequently updated as base layers and dynamic map services for operational layers provides users with a much more responsive Web map.

Since the emergence of map-cached ArcGIS Server sites, user demand has noticeably increased. As a result, many smaller organizations that serve high-quality cartographic imagery are hitting a bandwidth limit fairly quickly as traffic to these sites grows. Since the cost of adding more T1 lines isn't realistic given limited budgets of many businesses and small governments, the result can be imagery that takes eons to render.

Cumulus Business

Roktech noticed many of its clients experiencing this bandwidth problem. "We asked ourselves—why not host our clients' map caches on our own servers and purchase data delivery services through Amazon S3 when we hit our own bandwidth ceiling?" explained Jason Harris, a GIS developer at Roktech. "Bandwidth logjams understandably make clients nervous, and this was a way to relieve their anxiety." Roktech called its new service tile cache hosting.

Tile cache hosting was successfully implemented for FltPlan.com, Roktech's client with the most pressing bandwidth issue. The flight-tracking Web site served a nationwide raster dataset via its new application created using the ArcGIS Server API for JavaScript. In addition to its main flight planning site, FltPlan.com ran sites that served ArcIMS maps and other ArcGIS-based dynamic layers. Even with its multiple T1 capacity, bandwidth for all FltPlan.com's sites became saturated within days of the new sites going live. Roktech moved FltPlan.com's map cache to its own facilities, offloaded the bandwidth draw to its own connection, and solved the problem.

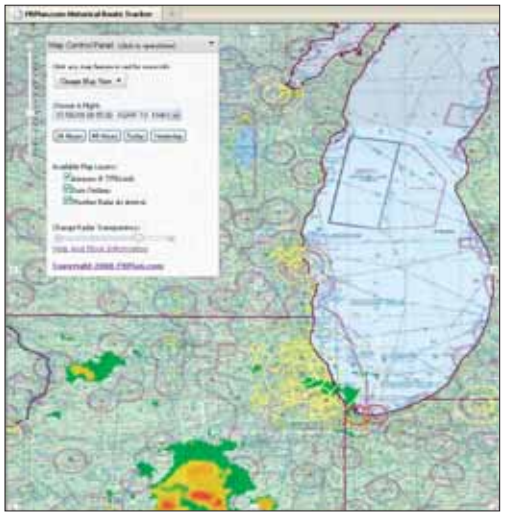
"The issue arises when the ArcGIS Server host machine doesn't have the bandwidth to serve the tiles quickly enough," said Harris. "The site became so popular, and so quickly, that their available bandwidth bottlenecked practically overnight. With ArcGIS Server, we can now create these maps beforehand. When an Internet user requests a map, ArcGIS Server finds the correct tile and sends it. This was a time-saver compared to all the work that ArcIMS had to do before it could send the user a map."

The transfer of the map cache immediately made a huge difference in site performance. As FltPlan.com's site continues to become more popular with the general aviation industry, it scales nicely. As the user base grows, Roktech simply increases the amount of data delivery services it requests from Amazon S3 and charges FltPlan.com accordingly. This is a much cheaper alternative to adding more T1 lines and is just as useful for solving bandwidth problems experienced by other clients.

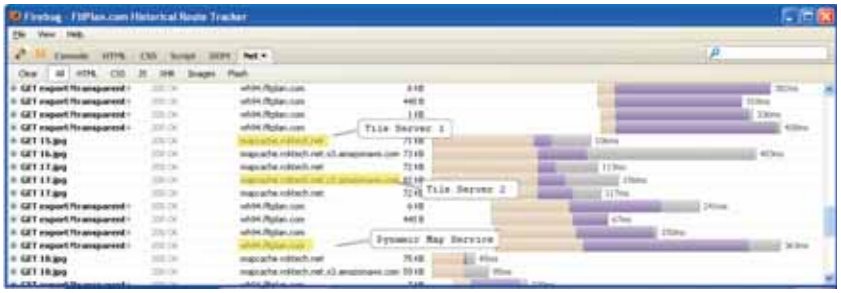
Configuring the Tiles

Both ArcGIS Server JavaScript and Flex APIs allow developers to tell applications to point to different tile servers. Essentially, tile servers are just places where map caches are stored. These tile servers (called "buckets" in Amazon S3 parlance) do not necessarily need to be on the same physical network as ArcGIS Server. Roktech specially processes the tiles and transfers the map cache tiles for storage on both its own fiber network and the Amazon S3 cloud service.

"That's the central concept," said Harris. "As developers, we have the ability to pull data in from multiple servers and locations and use



FltPlan.com serves flight-tracking maps to the general aviation industry.



As the user base grows, Roktech simply increases the amount of data delivery services it requests from Amazon S3 and charges FltPlan.com accordingly.

For more information, take the ESRI free Web training seminar, "Implementing and Optimizing ArcGIS Server Map Caches."

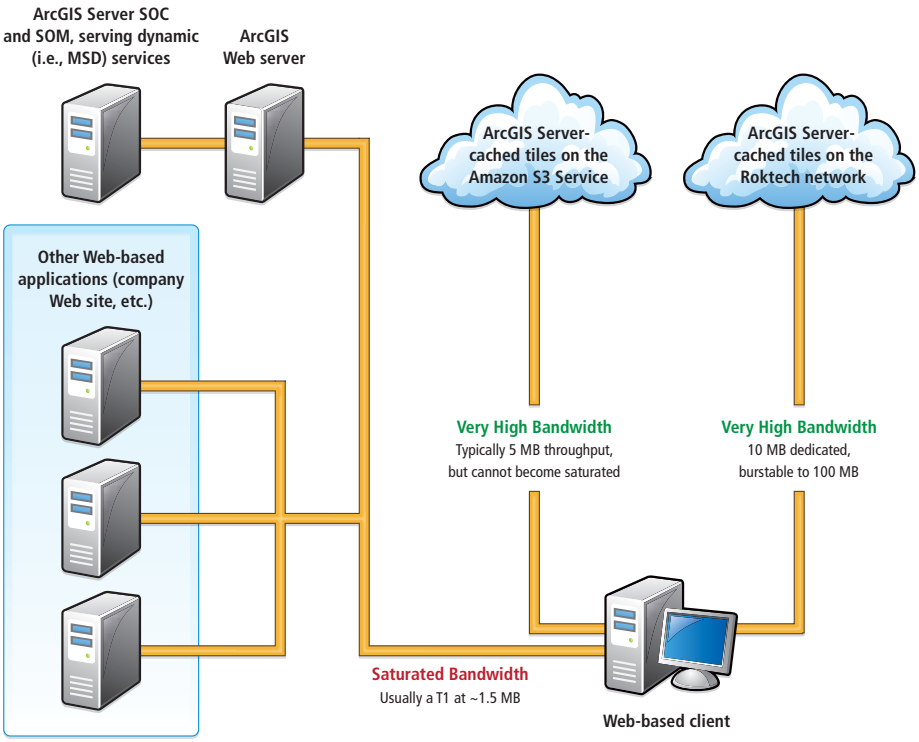
it in the same map. ESRI obviously gave these new APIs some serious thought. The *[ArcGIS]* Server team made it incredibly simple to make engaging, dynamic mapping applications that attract so many users."

Roktech decided to use Adobe ColdFusion to process the tiles and prepare them for the upload to the Amazon S3 service. Harris said ColdFusion was chosen because it's tightly integrated with Adobe Flex and makes Internet application development and deployment quick and easy. It is also a natural fit for creating Web applications with ArcGIS Server.

Once the cache is converted, it is simply uploaded to the Amazon S3 service. Roktech uses Bucket Explorer (www.bucketexplorer.com), an interface for Amazon S3, for uploading the cache because it is extremely easy to use and does the job quickly. According to Harris, uploading the cache takes time and requires patience but is well worth the effort because the payoff is huge.

Sustainable Growth

"Because of the time-sensitive nature of flight planning, we wanted to provide the smooth-scrolling map service for users—like the kind you'd see on the big sites like Google Maps," said Ken Wilson, president of FltPlan.com. "ESRI and Roktech found a way to do that for us, giving our sites the speed of the larger



Comparing the old and new architectures

sites. We could not have sustained the popularity of our sites with slow-rendering maps."

Until the price of adding multiple T1s becomes ridiculously cheap, HaaS cloud computing is an inexpensive solution for the bandwidth bottleneck experienced by smaller organizations. "I don't know the nuts and bolts of it," Wilson confessed. "I do know that ESRI and Roktech helped us meet our goals of immediate mapping at a fraction of the price of expanding our fiber network. In the end, that's all that matters."

Tools for Modeling Water Supplies

Developing tools for decision support with ArcGIS Engine and Java

By Rainer Laudien, Sebastian Brocks, Stefan Weyler, Alexander Christmann, Niklas Köhn, and Georg Bareth, BMBF Project IMPETUS Westafrika at the University of Cologne

The IMPETUS project employs a holistic approach for analyzing and forecasting the effects of the global change on water resources in the Ouémé River, a river catchment in Benin, located in West Africa.

Editor's note: *The IMPETUS research project (Integrated Approach to the Efficient Management of Scarce Water Resources in West Africa) is incorporating GIS in the Spatial Decision Support Systems that are being developed. This lets IMPETUS provide decision makers with a more holistic and interdisciplinary approach when developing scenarios related to present and future problems with freshwater supply. A previous article about this project appeared in the Summer 2008 issue of* ArcUser. *"Visualization, Interpretation, and Evaluation—Building a multitemporal Spatial Decision Support System (SDSS) scenario view with ArcGIS Engine" described the technical SDSS framework of IMPETUS. Although this article focuses on the tools developed for the project, an overview of the use of GIS in the IMPETUS project is included.*

The goal of the IMPETUS project is the development of management options for different components of the hydrological cycle using the SDSS tools. Because decision making requires an exhaustive knowledge of the processes, driving forces, possibilities, and stakeholders, ArcGIS Engine was used in computer-based SDSSs to handle huge amounts of data and provide visually attractive, reliable, and convincing displays of that data to users. Functionality developed for three of the ArcGIS Engine-based SDSSs will be discussed.

Explicitly designed to provide a decision-making environment that enables the analysis of geographic information to be carried out in a flexible manner, SDSSs help researchers and managers make decisions. Modern computer-based SDSSs are comprehensive and complex systems that compile individual decision steps into an overall software structure and include spatial data, quantitative, and/or qualitative models with expert knowledge.

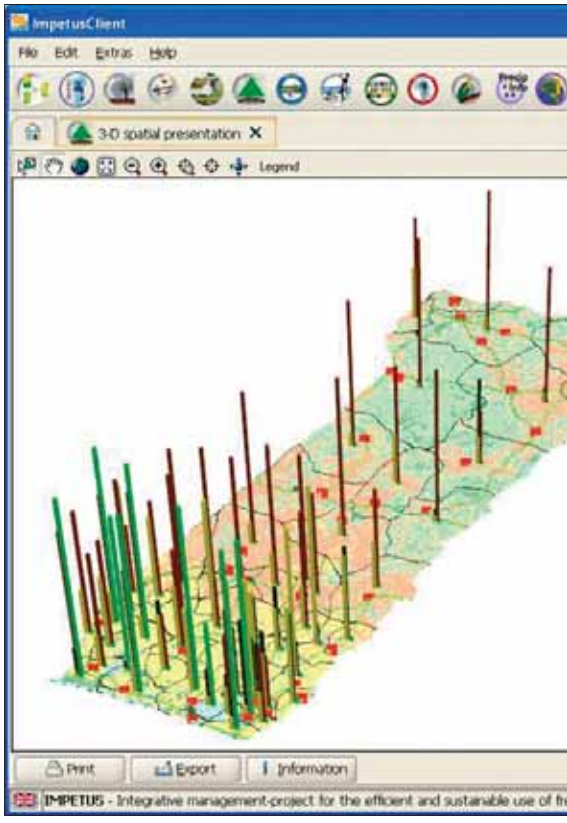
SDSSs can be customized to the needs of individual users based on a given logical decision tree that has been predefined by users and developers during the design process. These systems are developed based on predefined, multifarious logical decision trees focused on a specific question. In the case of the IMPETUS project, that question was how to create an integrated approach to the efficient management of scarce water resources in West Africa.

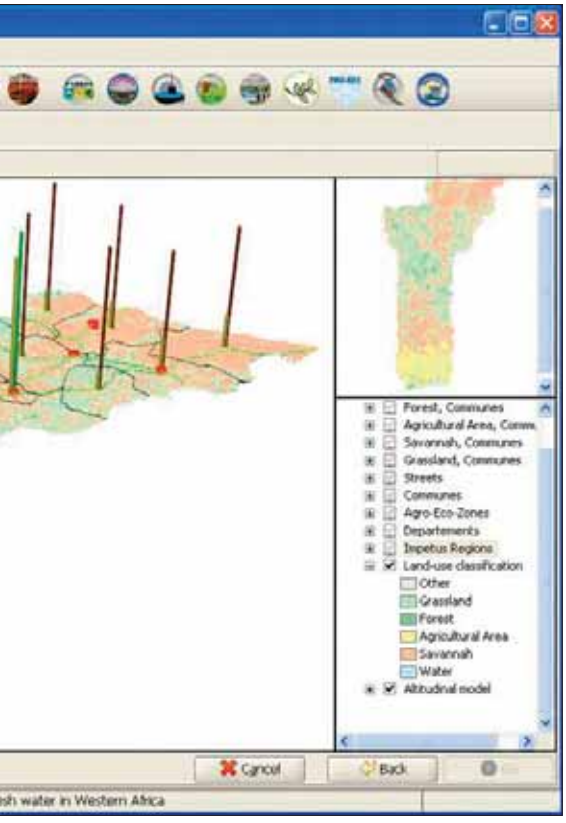
By providing users with access to large amounts of significant spatial data, SDSSs are powerful problem-solving tools that often use a GIS component to add spatial analysis functionality. The ability of GIS to layer spatial and attribute data distinguishes this technology from many other decision support systems.

Materials and Methods

To include GIS and remote-sensing functionalities in the SDSSs, the ESRI developer library for ArcGIS Engine 9.2 was used to program these systems. With ArcGIS Engine, a software developer can implement spatial analysis functions within computer-based spatial decision tools.

To execute these SDSSs, the Java Runtime Environment (JRE) and ArcGIS Engine must be installed on the computer. The SDSSs were developed using the Eclipse software development kit (SDK). During the programming process, specific ArcGIS Engine components and other libraries, such as the POI-HSSF components furnished by Jakarta POI Java API for reading Microsoft Excel '97 file formats, were used in addition to standard JavaBeans *[the reusable software components of the Java 2 platform].* Alphanumeric data and rasters, vector, and





The 3D-ArcGISScenePanel

other geodata for individual SDSSs are stored in ArcGIS 9.2 file-based geodatabases.

Resulting Tools

The ArcGISDoubleMapPanel was specially developed for environmental and social research, which requires the ability to compare different scenarios. With the help of two PageLayoutBeans, two feature layers with different attributes can be displayed and the user can intuitively compare these attributes. A Java slider (JSlider) component located below the two maps allows the user to view changes in the scenario over time. This slider has access to multitemporal feature layers and provides different time increments.

Alternatively, the ArcGISDoubleMapPanel displays feature data classified by only one attribute. The user is able to compare two maps or even a map and a static figure, like an age pyramid, visually. In the latter case, ArcGISDoubleMapPanel provides an easy way to give the user more detailed information, for example, population information for specific communes in the research area for a selected year. Using a specific processor that accesses the specific time step of the layer, both PageLayoutBeans of the ArcGISDoubleMapPanel are updated during run time. Based on the classification applied to the map, layers change color or age pyramids change shape in response to movement of the time slider.

The 3D-ArcGISScenePanel was developed for another SDSS. It is designed to optimize production systems under climate change and visualize eco-volume data within tropical agricultural science. Besides the use of the common ArcGIS tools provided by ArcGIS Engine, this graphical user interface (GUI) provides the user with the opportunity to rotate the 3D map in all directions and get a useful overview of a certain region of interest. In addition, specific 3D objects are included. Hence, within the IMPETUS client, three-dimensional vector and raster layers can be displayed and analyzed with the help of the 3D-ArcGISScenePanel.

In the research area of the Upper Ouémé Valley in Benin, more than 2,000 wells were digitized and included in a comprehensive geodatabase. With the help of ESRI ArcGIS Engine technology, ArcGISMapPanel was developed, which allows the user to visualize a one-to-many SQL-DB selection. This panel is a comprehensive map visualizing GUI, which includes a MapPanel, an overview map, and GIS tools. By using the ArcGISMapPanel and its specific functionalities, it is possible to select specific wells in the geodatabase based on a chosen location, visualize the data in a developed map panel, and save the selection in a vector file.

Continued on page 18

Tools for Modeling Water Supplies

Continued from page 17

Conclusion

ArcGIS functionality can be incorporated into modern SDSSs using ArcGIS Engine with Java, an object-oriented programming language. SDSS developers can code advanced computer-based SDSS tools that are designed and developed to answer a specific question based on the user requirements. These three tools—ArcGISDoubleMapPanel, 3D-ArcGISScenePanel, and ArcGISMapPanel—as well as the overall ArcGIS Engine-based development for the IMPETUS client show that ESRI's technology is feasible and very useful for SDSSs.

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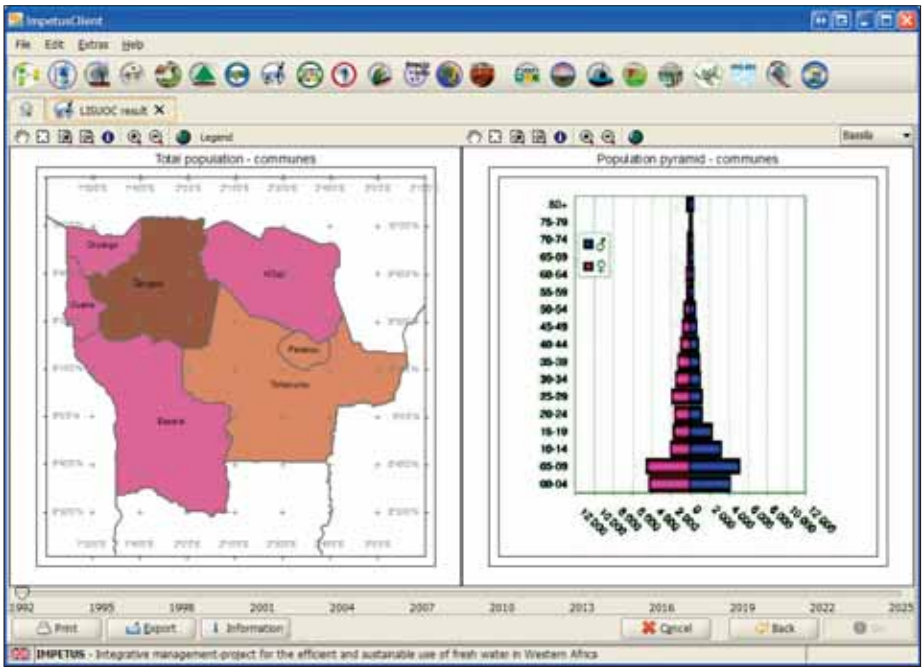
Dr. Georg Bareth, a professor at the University of Cologne, heads the GIS and Remote Sensing Group in the Department of Geography.



The ArcGISDoubleMapPanel visually compares one attribute from a variable map and a static age pyramid showing different time spans.

His major research interests are in mobile GIS applications and location-based services, GIS-based regionalization of N- and C-dynamics in ecosystems; analysis of multispectral, hyperspectral, and radar data for land-use mapping; the application of GIS and remote sensing for agricultural purposes; terrestrial laser scanning; and geographic databases.

Acknowledgments

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Crafting Better Decisions

Creating a link between belief networks and GIS

By Jeff Hicks and Todd Pierce, University of North Carolina, Asheville's National Environmental Modeling and Analysis Center

Considerable research has led to an increased understanding of how human activity influences the landscape and has provided more options for managing forests in an ecologically sound manner. With advances in GIS technology, decision-making techniques, and environmental protection policies, more effective and integrated management approaches are available.

The Comparative Risk Assessment Framework and Tools (CRAFT), one such approach, has been developed by the U.S. Forest Service's Eastern Forest Environmental Threat Assessment Center (EFETAC) to improve the quality of decisions for forest and natural resource managers. CRAFT is designed to help planning teams focus on the most important issues, organize their analyses, and use the right tools and data in a facilitated environment. CRAFT has four phases:

- Specifying objectives: What's the problem?
- Designing alternatives: What to do?
- Modeling effects: What could happen?
- Synthesis: What to communicate?

To better model the effects of different alternatives, CRAFT uses belief networks *[also known as Bayesian networks, Bayes networks, or causal probabilistic networks]* and influence diagrams to model uncertainty about the world by combining both common sense and observational evidence based on the theory of Bayesian statistics.

Essentially, a belief network includes a series of variables that represents real-world attributes and each variable has several states. For example, a variable could be whether a lamp shines and its states could be true or false. An expert on those attributes connects the variables in a graphic network that shows how one or more variables cause a change in another variable (Figure 1).

The primary feature of a belief network is its ability to "learn" and continually refine the extent of a relationship between two variables by using conditional probabilities. Instead of making educated guesses between two factors, a user (or in the case of CRAFT, a group of us-

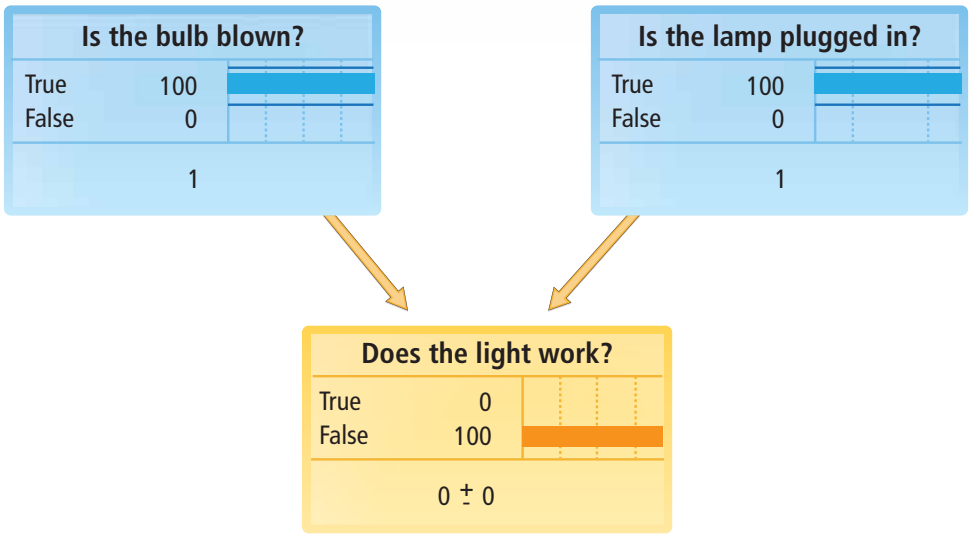

Figure 1: A simple network that predicts the outcome of a light working based on real-world observations

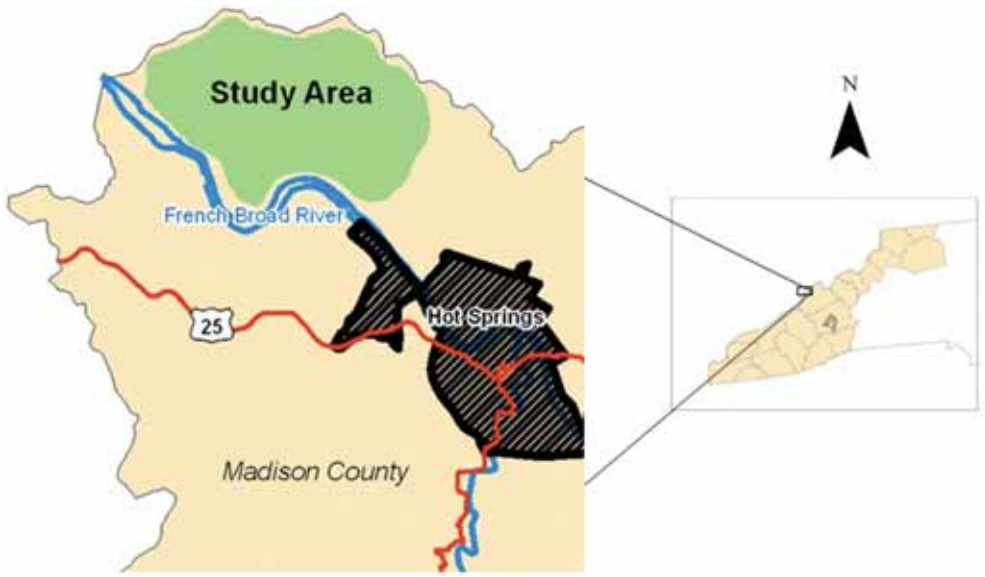

Figure 2: Location map for the study

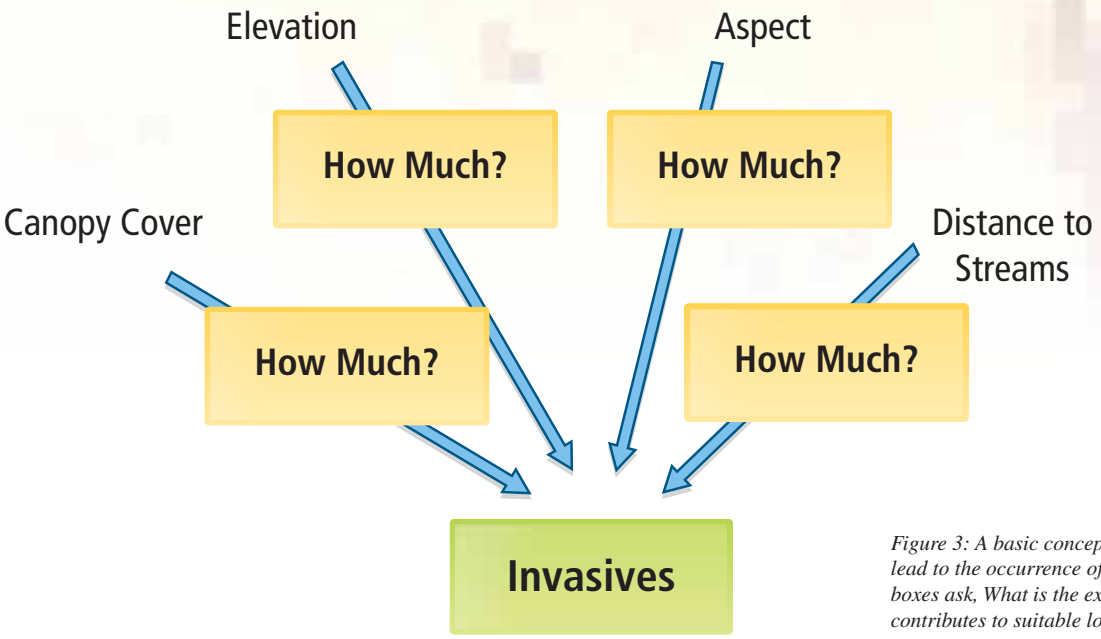

Figure 3: A basic conceptual model showing factors that lead to the occurrence of invasive species. The yellow boxes ask, What is the extent to which each of these factors contributes to suitable locations for invasive species?

ers) can create a network, make observations on those variables, and compile the findings as cases. It is from these cases that the belief network software determines the conditional probabilities between two variables.

While the theory underlying Bayesian statistics is complex, a software package commonly used for belief network modeling—Norsys Netica—is approachable, graphic, and intuitive. In addition, outputs are not as intimidating as the results generated by many statistical packages.

Belief networks are useful for CRAFT and other risk assessment tools but have not been linked to GIS so variables can be placed in a spatial context. Although some networks, such as ones used to determine a likely disease diagnosis for a given set of symptoms, do not have an appropriate spatial context, for other networks, such as models used to determine likely forest health given a set of threats, spatial context is critical. This information can answer questions like, What areas of forests are most at risk? and Where can mitigation efforts be prioritized to leverage limited resources?

Researchers at the University of North Carolina at Asheville's National Environmental Modeling and Analysis Center (NEMAC) looked for current solutions to tie belief network models to a GIS that would support the use of CRAFT but couldn't find anything that allowed for in-depth risk analysis or had a suitably generic process. It was critical that the process be general enough to apply to any spatial risk assessment from invasive species to wildfires to landslides. Consequently, NEMAC decided to write its own tool using the ArcGIS Desktop application ArcMap and incorporating Python scripts and Netica, a program for working with Baysian belief networks from Norsys Software Corp.

As a test case to develop the method, NEMAC investigated the risk that an invasive species known as Japanese stilt grass, or *Microstegium vimineum* (MIVI), would encroach on an area near Hot Springs in the Pisgah National Forest in North Carolina. Invasive species data was collected by Equinox Environmental (equinoxenvironmental.com), a consulting and design firm.

Within the study area (see Figure 2), Equinox Environmental collected GPS survey paths and marked every MIVI occurrence as a point feature. The paths were locations where MIVI was known to be absent and the points were locations where MIVI was known to be present. With the proposed process, this information could then be used to assess the risk of MIVI occurring in the rest of the study area that had not been surveyed. Simply put, the absence of evidence was not evidence of absence.

First, a conceptual model (Figure 3) was created in consultation with scientists from EFETAC. *[EFETAC, established by the U.S. Forest Service, uses an interdisciplinary approach in developing new technology and tools that anticipate and respond to threats to eastern forests.]* While tracking the factors associated with the location of invasive species is incredibly complex, NEMAC simply sought to test a method for putting geographic information into a Bayesian statistical context and returning the results to geographic space. As a result, the location variables used were based on a trusted data source, *The National Map* Seamless Server, a data resource provided by the U.S. Geological Survey that is publicly available and easily accessed.

The process for preparing data in ArcMap, exporting data to Netica, performing analysis in Netica, and importing the results back into ArcMap is summarized in the following five stages.

Stage 1: Location Data Preparation

1. Obtain elevation, streamline, and canopy cover data from *The National Map.*
2. Derive aspect from elevation.
3. Create a multiple ring buffer around streams and convert the vector layer to raster.
4. Prepare location data so all rasters have the same projection and resolution and that each raster cell snaps to the same grid.
5. Reclassify all data to appropriate classes. Reclassification was an iterative process. (Initially, aspect data was classified equally based on the four cardinal directions. However, an EFETAC scientist pointed out that one class for north (270°–90°) and three equal classes for southeast, south, and southwest, respectively, were more appropriate classifications.)
6. Clip all data to study area boundaries.

Continued on page 22

Crafting Better Decisions

Continued from page 21

Stage 2: Survey Data Preparation

1. Convert vector survey data to raster with the same snap grid as the location data.
2. Reclassify survey data into three classes: known MIVI absence, known MIVI presence, and unknown MIVI presence or absence (i.e., areas not surveyed).
3. Clip the MIVI presence/absence raster to the study area boundaries.

Stage 3: Data Combination and Export

1. Use the Combine tool (Spatial Analyst Tools > Local > Combine) to create an aggregate raster. (The Combine tool visits every cell in the study area. For each cell, it records the value for the presence or absence raster and the values for all location rasters.)
2. Use a Python script written by NEMAC to export this dataset as a simple comma-delimited text data table where every cell in the study area is a single row and each variable—all location rasters and the presence/absence raster—has a unique column.

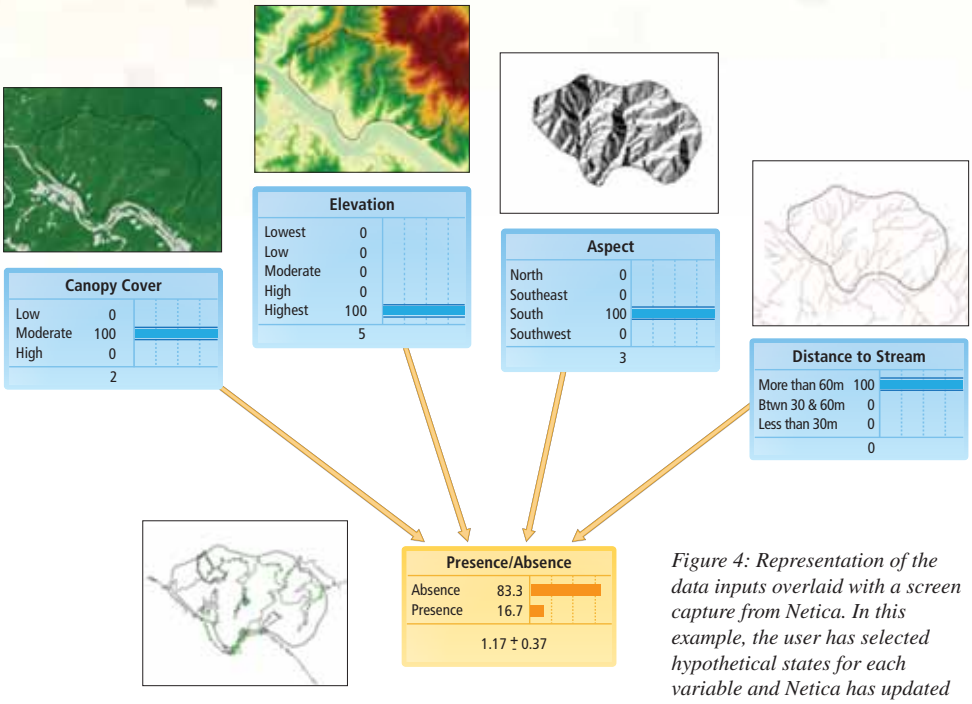

Figure 4: Representation of the data inputs overlaid with a screen capture from Netica. In this example, the user has selected hypothetical states for each variable and Netica has updated the probabilities for the presence/absence node.

Stage 4: Export Data from ArcMap and Import It into Netica

1. Import the comma-delimited text file into Netica. Netica automatically creates one node for every column. Each node represents a single variable for all location rasters and the presence/absence raster.
2. Configure each node so its states correspond to the classification applied to the map in ArcMap. Note that the presence/absence raster has a value for unknown. A state should not be configured as unknown because this represents areas that were not surveyed. Statistics should be generated solely on areas that were surveyed. By not creating a state for unknown values in the presence/absence node, Netica skips all cases that represent areas that were not surveyed.
3. Arrange and connect the nodes to represent the conceptual model.
4. In Netica, select Incorporate Case File to go through the entire data file and record the observations for each row (i.e., every cell in the study area).
5. The case file populates a table in every node, including the presence/absence node, and determines probabilities based on these tables.

For example, the first row might represent a location where MIVI was present, had a moderate canopy cover, was at the highest elevation state, had a south aspect, and was more than 60 meters from a stream. Netica moves on to the next row where the conditions might have been different. After Netica goes through the entire study area, it calculates the probability of each state occurring in the presence/absence node given every possible combination of states in the location nodes. Netica can assert that for the stated combination described previously, there is a 16.7 percent chance that MIVI will occur in places with those conditions.

In Netica, users can interact with the network to model what-if scenarios. As a user clicks on different states in each node and sets them to 100 percent certainty, the probabilities represented in each other node (based on what is known so far) are updated and displayed. These hypothetical situations do not alter the probability tables. Rather, they show how other variables respond when one or more variables are set to certain states.

Stage 5: Export Data from Netica and Import It Back into ArcMap

Netica stores the conditional probability tables as a Netica network file that shows the probability of each state in the response node for every combination of node state combinations.

1. Parse the network file to a text table using another Python script written by NEMAC. Each presence/absence variable and each

```
node Presence/Absence {
        kind = NATURE;
        discrete = TRUE;
        chance = CHANCE;
        states = (Absence, Presence);
        levels = (1, 2);
        parents = (CCover, Elevat, Aspect, Streams);
        probs =
                //   Absence      Presence          // CCover   Elevat   Aspect    Streams
                (((((0.9,         0.1),             // Low      Lowest   North     MoreThan60m
                    (0.75,        0.25),            // Low      Lowest   North     Btwn30and60m
                    (0.8,         0.2)),            // Low      Lowest   North     LessThan30m
                   ((0.9230769,   0.07692308),      // Low      Lowest   Southeast MoreThan60m
                    (0.6666667,   0.3333333),       // Low      Lowest   Southeast Btwn30and60m
                    (0.9473684,   0.05263158)),     // Low      Lowest   Southeast LessThan30m
                  ((0.9411765,    0.05882353),      // Low      Lowest   South     MoreThan60m
                    (0.8333333,   0.1666667),       // Low      Lowest   South     Btwn30and60m
                    (0.75,        0.25)),           // Low      Lowest   South     LessThan30m
                  ((0.9,          0.1),             // Low      Lowest   Southwest MoreThan60m
                    (0.9,         0.1),             // Low      Lowest   Southwest Btwn30and60m
                    (0.75,        0.25))),          // Low      Lowest   Southwest LessThan30m
                 (((0.6666667,    0.3333333),       // Low      Low      North     MoreThan60m
                    (0.5,         0.5),             // Low      Low      North     Btwn30and60m
                    (0.8,         0.2)),            // Low      Low      North     LessThan30m
                  ((0.9565217,    0.04347826),      // Low      Low      Southeast MoreThan60m
                    (0.8333333,   0.1666667),       // Low      Low      Southeast Btwn30and60m
                    (0.8461539,   0.1538462)),      // Low      Low      Southeast LessThan30m
```

Figure 5: The first few lines of the presence/absence node table in the Netica network file. On the right, each node feeding into the presence/absence node has its own column. Each of its possible states is combined so that each row represents a unique combination of the variable states. On the left, the probabilities are represented for each state of the presence/absence node.

state of the location variables has its own column. Each row represents every combination of the states of the location variables and the corresponding probabilities for each state of the presence/absence variable. This script also adds a new column to the aggregate raster, created by the Combine tool, for the MIVI presence probability values.

2. The script then goes through each cell in the aggregate raster, matches the combination of states for each of its constituent variables to that same combination in the Netica output, and inserts the corresponding MIVI presence probability value into the column created in the previous step.

At this point, every cell of the survey raster has a probability for MIVI presence. When this field is symbolized and displayed, the result is a risk map for MIVI presence. Given the simplicity of the variables investigated, this risk map is probably not the most accurate assessment of where one might find MIVI. However, this method allowed NEMAC to successfully take geographic information, use Bayesian statistical analysis, and present the results in a geographic context.

NEMAC is working with EFETAC to refine the belief network-GIS link and use it in other studies and upcoming CRAFT projects. Most significantly, this process is not limited to invasive species risk. NEMAC is investigating other potential uses for the process to ensure its generality and is also working to simplify and automate the process, more tightly integrating ArcMap and Netica.

For more information, visit the NEMAC Web site (nemac.org) or contact the authors, Jeff Hicks at jhicks@unca.edu or Todd Pierce at tpierce@unca.edu.

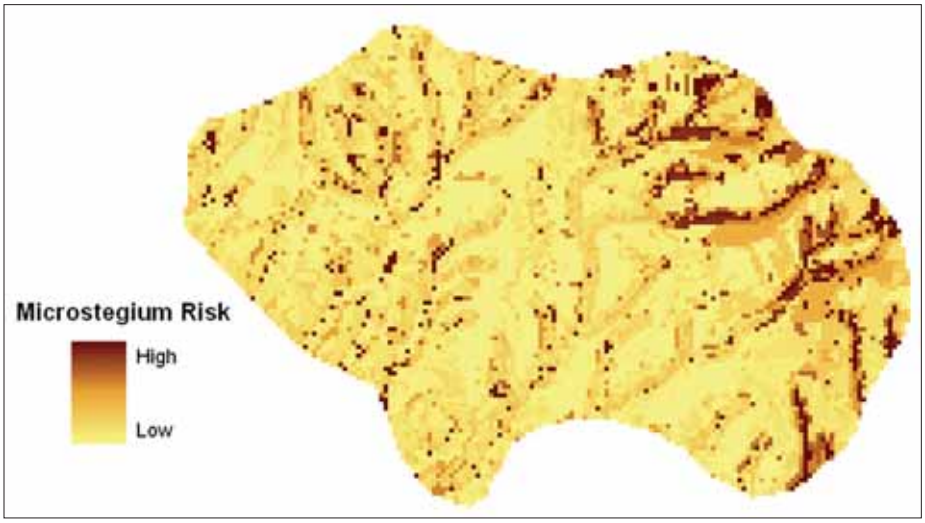

Figure 6: The output of the Python script in ArcMap: the risk map for MIVI presence

Acknowledgment

The authors thank Dr. Danny Lee and Dr. Steve Norman at EFETAC and Karin Lichtenstein, Jim Fox, and Alex Krebs at NEMAC for their assistance and advice.

About the Authors

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Dr. Todd Pierce has worked in GIS for more than 18 years and has specialized in GIS and Web programming for 12 of those years. He holds a B.S.E. degree in electrical engineering from Tulane University and a doctorate in geography from Oxford University in the United Kingdom. He is responsible for linking GIS and databases to the Web at NEMAC, where he leads the development of an online multihazard risk tool for mitigation planning. He also assists with development of geographic decision facilitation processes that use Web applications and data visualization techniques to support public policy decision makers with land-use planning; flood mitigation and response; forest preservation; and other community issues.

5 Strategies for ArcObjects Developers

By Robert Stauder, ESRI Applications Developer

Achieving better enterprise database performance

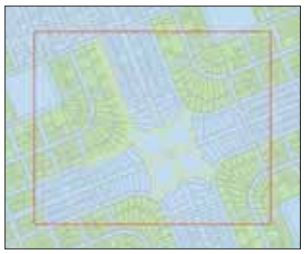
What can ArcObjects developers do to increase performance of an enterprise application that uses data from ArcSDE? While many application developers and database administrators (DBAs) approach database tuning as an exercise in creating missing indexes, updating statistics, adding disks or RAM, and analyzing hardware performance, there are other techniques available. Here are five suggestions, presented in order of increasing difficulty, that will help developers squeeze more performance from their applications.

Using the Code Samples and Data

Each performance-enhancing suggestion is illustrated with a code listing that uses the Parcels features class from the Building a Geodatabase data that comes with the ArcGIS sample dataset. The Parcels feature class resides in the LandBase feature dataset of the Montgomery File Geodatabase. Load the data into an ArcSDE database using ArcCatalog. Register the Parcels feature class as versioned.

Download the code samples from *ArcUser Online* (**www.esri.com/arcuser**). These samples use ArcGIS 9.3.1 and Microsoft Visual Studio .NET 2008. Sample programs are VB.NET and C# console applications that use ArcInfo licenses. The code accesses licenses using the LicenseInitializer classes generated by Visual Studio .NET. Error, pathing, and null reference checking were omitted to make samples as lean as possible and improve readability.

Finally, these console applications require a path to an ArcSDE connection file. Use ArcCatalog to copy an ArcSDE connection file to a directory of your choice and reference this file when running the programs. Because two of the samples will change data, create a new version in ArcSDE and save your connection file referencing that version.



ArcGIS supports combined spatial and attribute queries against enterprise geodatabase data. The query in Code Listing 2 restricts the number of rows traversed because features must be contained in the red box and have an area greater than 121,000. Those features are highlighted in yellow.

Code Listing 1: Use SubFields

What It Does:

The first performance improvement suggestion involves limiting how much data an application fetches. The SubFields property of IQueryFilter, IQueryDef, and ISpatialFilter lists the fields to include in a query. Set this property to just the fields values you need, rather than all the data for each row, and you will fetch less data. The database will search less data and send fewer packets across the network.

How to Use:

Populate the SubFields property of IQueryFilter, ISpatialFilter, or IQueryDef with a comma-delimited string of column names.

When to Use:

Use to optimize read-only queries.

Code Listing 2: Combine Spatial and Attribute Queries

What It Does:

One of the most powerful aspects of ArcGIS is the ability to combine the spatial and attribute components of a query so you can issue fewer queries and make those queries more selective. A single query with two filters—spatial and attribute—limits the number of features searched.

How to Use:

Set the Geometry and WhereClause properties of ISpatialFilter. Set the SearchOrder property to control which query component is applied first. SearchOrder has two choices: esriSearchOrderAttribute sets the search order to attribute first. esriSearchOrderSpatial sets the search order to spatial first. Set SearchOrder to the most restrictive option. If your query geometry is small, choose esriSearchOrderSpatial. If your query's where clause is very selective and your geometry larger, choose esriSearchOrderAttribute. Create a test case and try both options.

When to Use:

Use for any query having both spatial and attribute qualities. Optimize spatial queries by applying an attribute constraint to them.

Code Listing 3: Faster Deletes

What It Does:

Most ArcObjects developers employ either the ITable DeleteSearchedRows() or IRow Delete methods to remove features in bulk from a geodatabase table or feature class. Switch to a low-level interface, ITableWrite, to improve the speed of bulk deletes. During a feature delete, this interface sends fewer (or no) messages and bypasses geodatabase behaviors. This can translate into much faster bulk operations on simple features. Do not use this method with complex features like geometric networks.

How to Use:

Use a query filter and fetch rows into an ISet.
Cast the table or feature class queried to ITableWrite.
Pass the ISet to the DeleteRows method of ITableWrite.

When to Use:

Use to improve the speed of bulk deletes on simple data.

Code Listing 4: Don't Be Too Selective (or Chatty)

What It Does:

Two previous sections discussed how to make queries more selective. However, if queries are too selective, you may need to issue too many of them. Query-intensive applications are called "chatty." Chatty applications do not perform well.

For example, you query a collection of hundreds of Parcel IDs. For each ID, you query the database for other features and process them in some fashion. The excessive round-trips to the server to fetch more data slows your application. To improve performance, issue one query with a where clause containing all Parcel IDs, then store the result set in client-side memory as a Geodatabase RecordSet inside an in-memory table. Using this approach will allow you to requery your data without returning to the server. You'll also have access to geodatabase table functionality and geometries within spatial fields.

How to Use:

Build a where clause containing all items you want to fetch.

- Create a query filter and set the where clause property to the where clause you just created.
- Create a Geodatabase RecordSet and set the source table property.
- Create a new InMemoryWorkspace and save the RecordSet as a table within it.

When to Use:

Use in any situation where you will need to repeatedly query a feature class or table on the same attribute. Instead of using a join, query two different feature classes or tables, fetch the data into client-side RecordSets, then process the data from the feature classes or tables together.

Code Listing 5: Faster Updates

What It Does:

This example combines the previous two to perform faster bulk updates. When you invoke the IRow Update or ITable UpdateSearchRows methods against multiversioned data, ArcSDE creates rows in both A and D tables. You can mimic this by deleting the rows using ITableWrite's DeleteRows, then reinserting them using an InsertCursor. Before deleting the rows, store a copy of them in a client-side RecordSet. This method is faster because ITableWrite will bypass geodatabase behaviors. Use this technique with simple features only.

Employing a delete-insert will impact the versioning reconcile process. Reconcile checks for conflicts between two versions by querying for change types within those versions. One of those change types is update-update, where a row is updated in one version, and that same row is updated in another. If you update your data using a delete-insert, the update-update filter will not find conflicts because your code only removes and reinserts rows. Bulk update workflows usually do not care about conflicts. If your bulk update process must consider conflicts, exercise caution when using this technique.

How to Use:

Query and fetch features into an ISet and a RecordSet.

- Pass the ISet to the DeleteRows method of ITableWrite to remove the features from the database.
- Loop through the features in the RecordSet, inserting features and modifying them as necessary.

This works against both spatial and tabular data.

When to Use:

Improve speed of bulk updates on simple features.

Some Final Words

Improving the performance of an enterprise application means examining all parts of it. Applications using relational data require not only good indexes and up-to-date statistics but also good data access practices. Making queries more selective, caching data on the client to reduce network trips, and changing batch delete and update operations are valid performance tuning tricks. By making the client more efficient, all parts of the enterprise application benefit.

About the Author

Robert Stauder is an applications developer with ESRI Professional Services in Redlands, California. After seeing an ArcView 1.0 demo in 1994, he decided to change his career focus to GIS and joined ESRI in 1996.

Visit *ArcUser Online* (**www.esri.com/arcuser**) to download these listings.

For more information, take the ESRI instructor-led course *Building Geodatabases.*

Remember the User

Four lessons on usability and the GeoWeb

By Brian Noyle and David Bouwman, DTSAgile

The Geospatial Web or GeoWeb is the current darling of location-based technologies and neogeography. As a community, geodevelopers are moving away from exposing lots of complex GIS functionality in the Web browser. The GeoWeb is high-performance maps, mashups, distributed data, game-style navigation, and communal- or user-generated geospatial content. In essence, it is all things Web 2.0 in a map. For ESRI customers, it is REST, JavaScript, Flex, and Silverlight APIs for ArcGIS Server.

Of late, ESRI has been evangelizing on the topic of high-performance Web maps through online training offerings such as *Authoring and Deploying Fast Web Maps* (training.esri.com/acb2000/showdetl.cfm?DID=6&Product_ID=943) and articles such as "Five Steps to Better Performance" (www.esri.com/news/arcuser/0609/files/5forfastmaps.pdf) in the Summer 2009 issue of *ArcUser*.

While quick performance and a killer site skin with an open, uncluttered layout are certainly important in the age of the GeoWeb, they are only part of the equation. Geodevelopers are still challenged on the usability front because the typical application with buckets of data, loads of tools, and an unconstrained workflow is still making it into the market in many cases. Creating great apps for public-facing or line-of-business sites serving non-GIS professionals requires focusing on the user and a mental model of how the user interacts with the functionality that the geodeveloper exposes. These four lessons will help a geodeveloper do this.

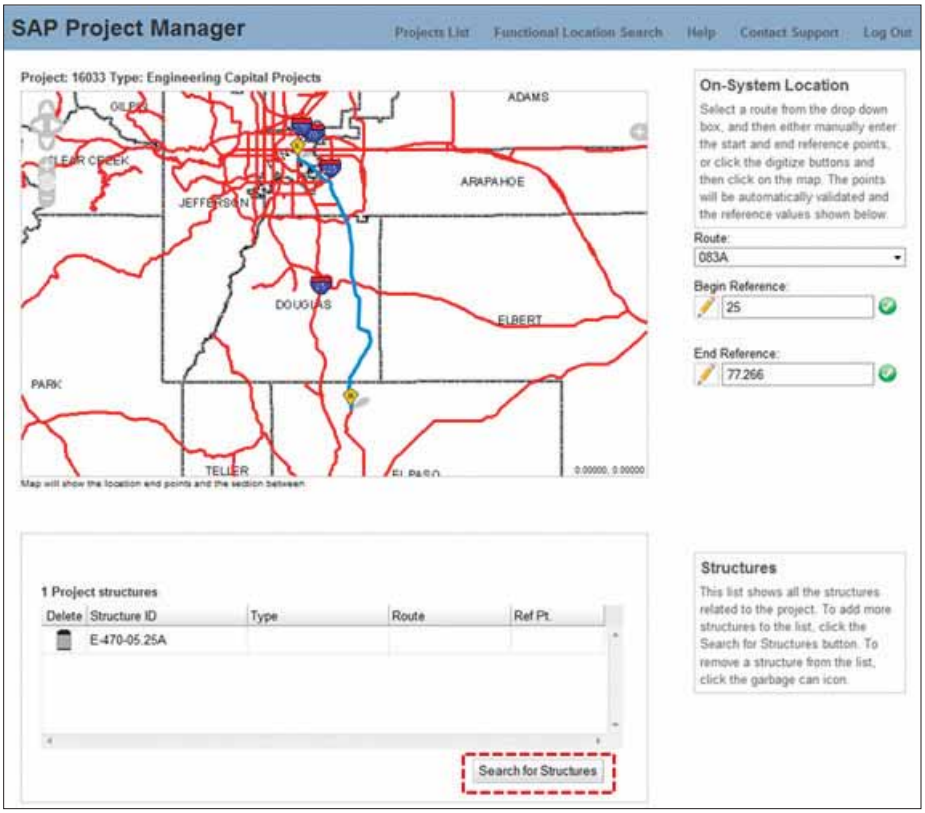


Figure 1: Hide multi-GIS operation functions behind simple interface elements. This eliminates user-facing complexity and provides the opportunity for performance gains in the implementation.

Lesson 1: Always Hide the Details

A forester knows trees. A state trooper knows law enforcement. A county auditor knows real estate assessment. However, none of these users is likely to know much about buffer, intersect, or union operations or Thiessen polygons.

When a roadway project manager asks for all structures near her project (without knowing it), she is really asking to locate point features in the Structures layer that fall within one mile of the section of Route 6A between mileposts 12 and 25. A GIS professional knows that getting this information requires an initial point selection, followed by a buffer, an intersection with a second layer (roads), followed by a buffer of the resulting road segment, followed by an intersection of the second buffer with the structures layer. The roadway project manager does not know this and she shouldn't need to know this.

Consider the application shown in Figure 1. It serves data via the Web Map Service (WMS) capabilities of ArcGIS Server 9.2. Note the minimalist map navigation at the top left of the map and the conspicuous lack of multiple tool buttons, menus, legends, and layer lists. This application is used by state Department of Transportation roadway project managers. To do their job, all these folks need to do is specify what road segment a project is on and list structures along the road (culverts, mast arms) that are impacted by a project.

Highly usable systems hide complex GIS operations from the user and get the desired answer quickly. The selection, buffers, and intersections that get the roadway manager the information she needs to do her job are hidden inconspicuously behind the Search for Structures button in Figure 1. Once the project road segment is selected, this search button becomes enabled. A single click returns a list of affected structures to the user in approximately 0.3 second, allowing her to get back to what's really important.

Highly usable systems hide complex GIS operations from the user and get the desired answer quickly.

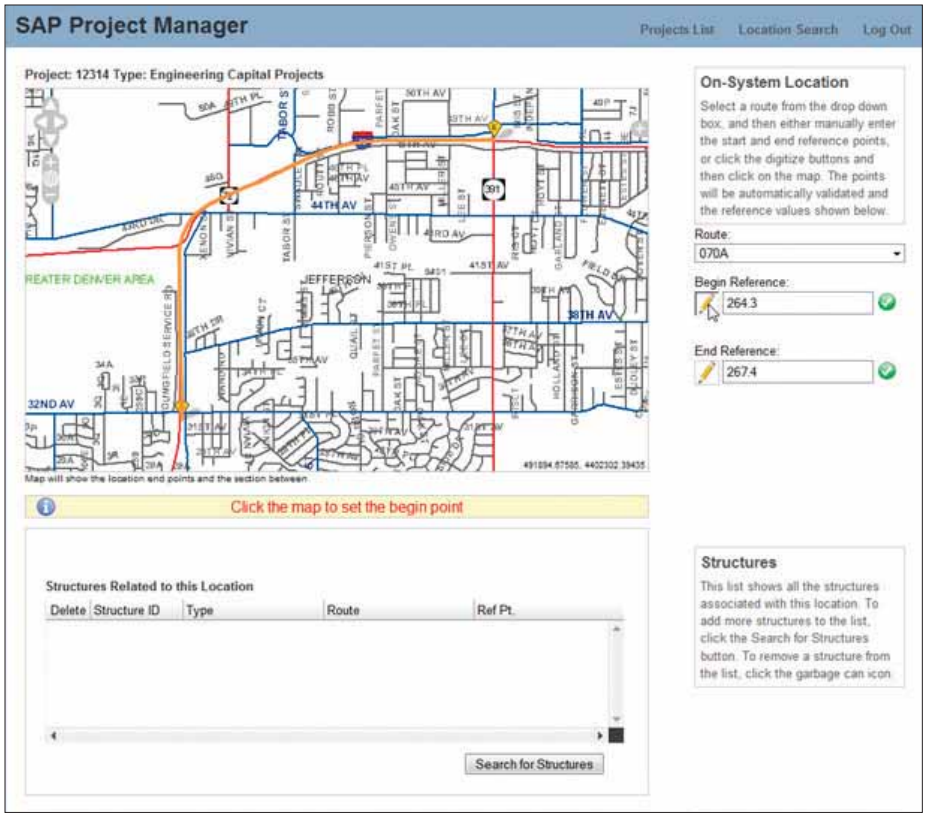


Figure 2: Use simple static content and dynamic feedback to lead the user through the application.

Lesson 2: Provide Your Users with Feedback

Nothing presents a bigger usability hurdle than a mapping application that leaves the user wondering, Well this looks cool, but what do I do?

This is the principal downfall of applications that try to shove GIS into a Web browser. Geodevelopers know exactly what to do with three different toolbars and four menus containing all manner of map navigation, query, buffer, and analysis tools. Line-of-business users and the public find open workflow applications with no guidance intimidating. The Web mapping industry at large must learn to develop applications that satisfy specific workflows and lead users through those workflows in the application with visual cues and feedback in the user interface.

The roadway manager introduced in Lesson 1 uses the interface in Figure 2 to specify the begin and endpoints of a roadway project. First, note the simple information panels that appear in the right-hand column of the site. They explain how to use the features on the page. Second, accept that while a GIS professional knows that clicking a pencil icon will let them draw something on a map, a roadway manager does not necessarily connect these two actions. (Click the map to set the begin point.) For our roadway manager, clicking the pencil icon causes information to appear below the map telling her what to do next. It's as simple as showing or hiding a element in the page, and it is a critical usability feature that is often overlooked. Hold the user's hand and they will love you for it.

Lesson 3: Reassure the User

When GIS professionals execute an attribute query or run an intersect operation, they typically understand that sometimes the resulting set is empty. Non-GIS users get very nervous when they perform an action and are presented with an empty user interface or are redirected to something they didn't expect. Did they delete something important? Is the request still processing? Did the site crash? What happened to the data?

The importance of reassuring the user anytime something out of the ordinary happens cannot be overstated. Continuing with the roadway manager example, Figure 3 illustrates a case in which the roadway manager has selected a project with no location information. Rather than showing her an empty interface and having her worry about what has happened, the map interface is zoomed to the general area of the project (indicated by the text under Location Map). An information dialog box explains that there is no need to worry and provides instructions on how to remedy the missing data issue. There is no need for a complicated exception or null case scenario. A simple modal dialog box addresses the usability issue and keeps the user on the right track.

Lesson 4: Protect Users from Themselves

Despite a developer's best efforts, users can do strange and unexpected things with the systems. This is precisely why focused apps that support constrained workflows are critical. If a user continually finds it easy or convenient to circumvent application logic or generate bad data, this will impact the utility of the application and affect the willingness of a user or an organization to use the app.

In Figure 4, the roadway manager is specifying the begin point of her roadway resurfacing project by clicking on a point along a road in the map. Note that she has clicked a point

Continued on page 28

Remember the User

Continued from page 27

some distance from the affected roadway. The geodeveloper has a couple of viable options to address this issue.

Code can be written with complex logic to apply scale-dependent buffers and tell the user that an invalid point has been clicked. She must then click again…and again…and again until she gets it right.

The developer can take any user-specified point and simply snap it to the closest point on the affected roadway.

From a usability perspective, the second option is clearly preferable. For the user, any mouse click becomes valid, eliminating the need for repetitive actions. The click operation is simply snapped to the roadway, and the begin point coordinate is displayed to the user in the appropriate text box. If the user is dissatisfied with the result, she can elect to do it again. However, in this scenario, the user is never forced to click over and over again because the input point does not pass muster with a bunch of buffer and intersect logic she should never have to know about in the first place. Validate user inputs as soon as possible, prevalidate whenever possible, and never let users do something they're going to regret later.

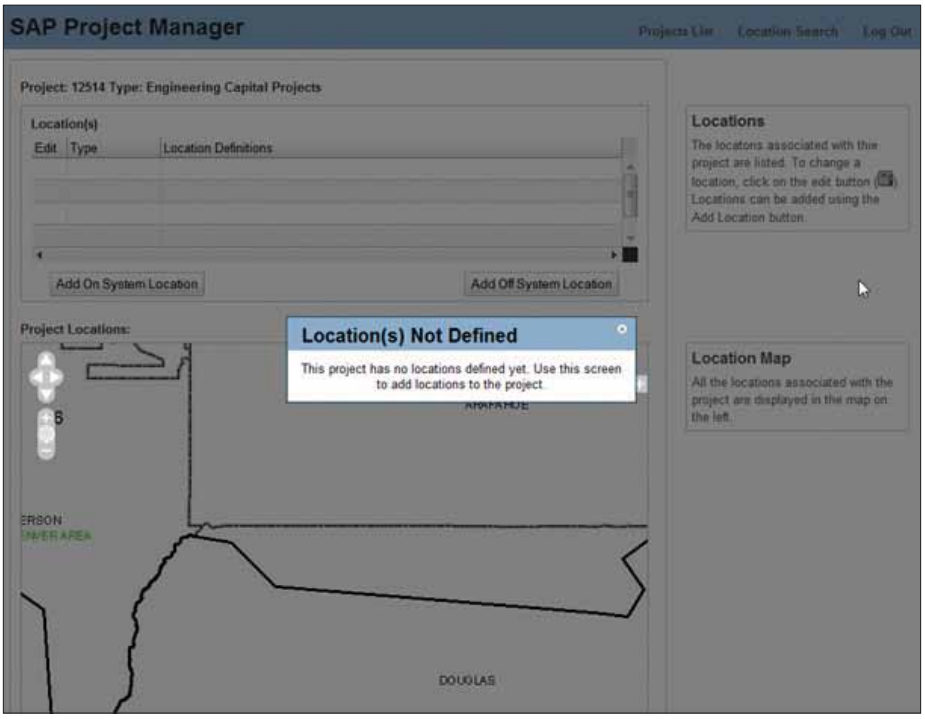


Figure 3: Always handle the null case and provide interface cues that reassure the user in the event of an empty result set or other unexpected system event.

But I Need a Full-Featured GIS

There are few situations that actually call for a Web-based GIS. When these Web applications are built, they are so complex that only GIS professionals understand how to use them. Perversely, the performance and technical limitations of Web development make these applications too limited to be useful for GIS professionals!

Give GIS professionals access to professional GIS tools—desktop GIS applications. Citrix or Terminal Services technologies provide an excellent means to do this in a distributed environment. This allows all the GIS applications and data to be colocated in a single data center while providing a desktop experience at remote locations. Having designed, architected, and developed several large implementations, the authors have seen how it can deliver powerful desktop GIS functionality across an enterprise very cost effectively.

However, if your goal is to serve the public or users in a specific line of business, then you would do well to create focused applications that help users solve specific problems easily. This is exactly what GeoWeb-style applications do. The next generation of spatial applications, now arriving, are starting to leverage real GIS analytic capabilities behind the scenes. The tendency to mimic the indeterminate workflows of desktop GIS packages in a Web browser is

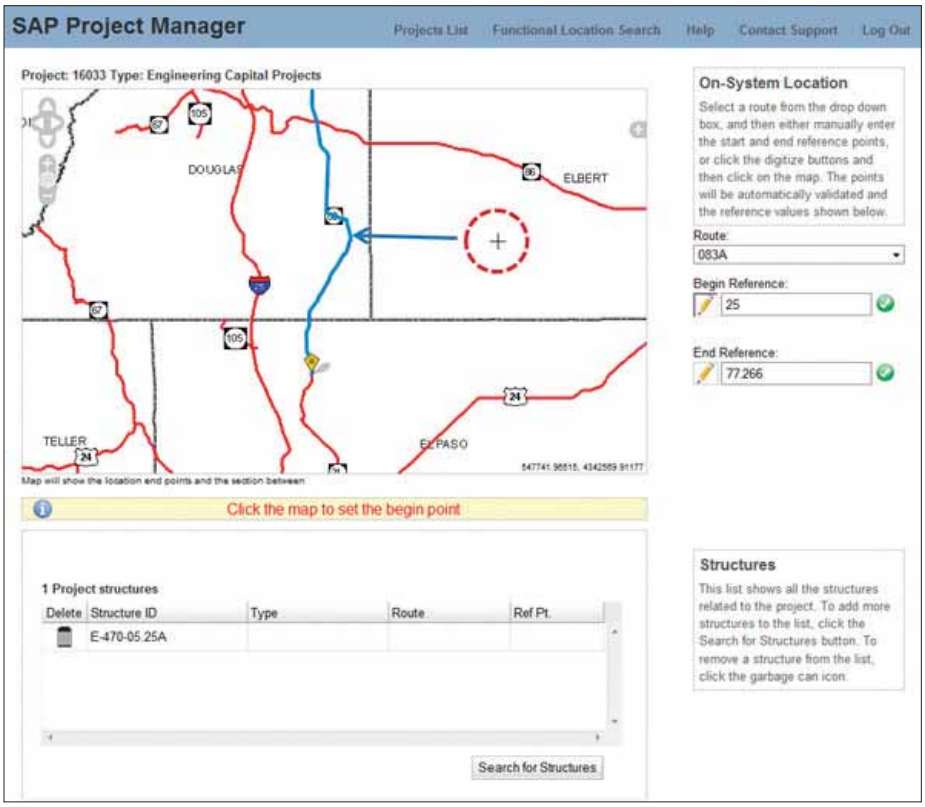


Figure 4: Eliminate complex exception scenarios and the potential for bad data through extensive prevalidation logic and novel approaches to seemingly invalid inputs.

inspired by noble goals. However, implementation, performance, and usability issues usually run rampant and completely overwhelm any cool factor. Instead, focus on solving specific business problems by building tools that are tailored to the actual end user.

Conclusion

Since Internet users now have a myriad of choices for information, geodevelopers should be designing highly usable systems that give users relevant information right now. If we don't, they'll simply go somewhere else. What does this mean for architects, developers, and project managers in the mapping industry? Usability trumps features. Our customers are foresters, real estate agents, state troopers, and roadway managers, not GIS professionals. We need to hide GIS complexity; provide determinate, task-oriented interfaces; and answer users' questions with a minimum of friction and interaction.

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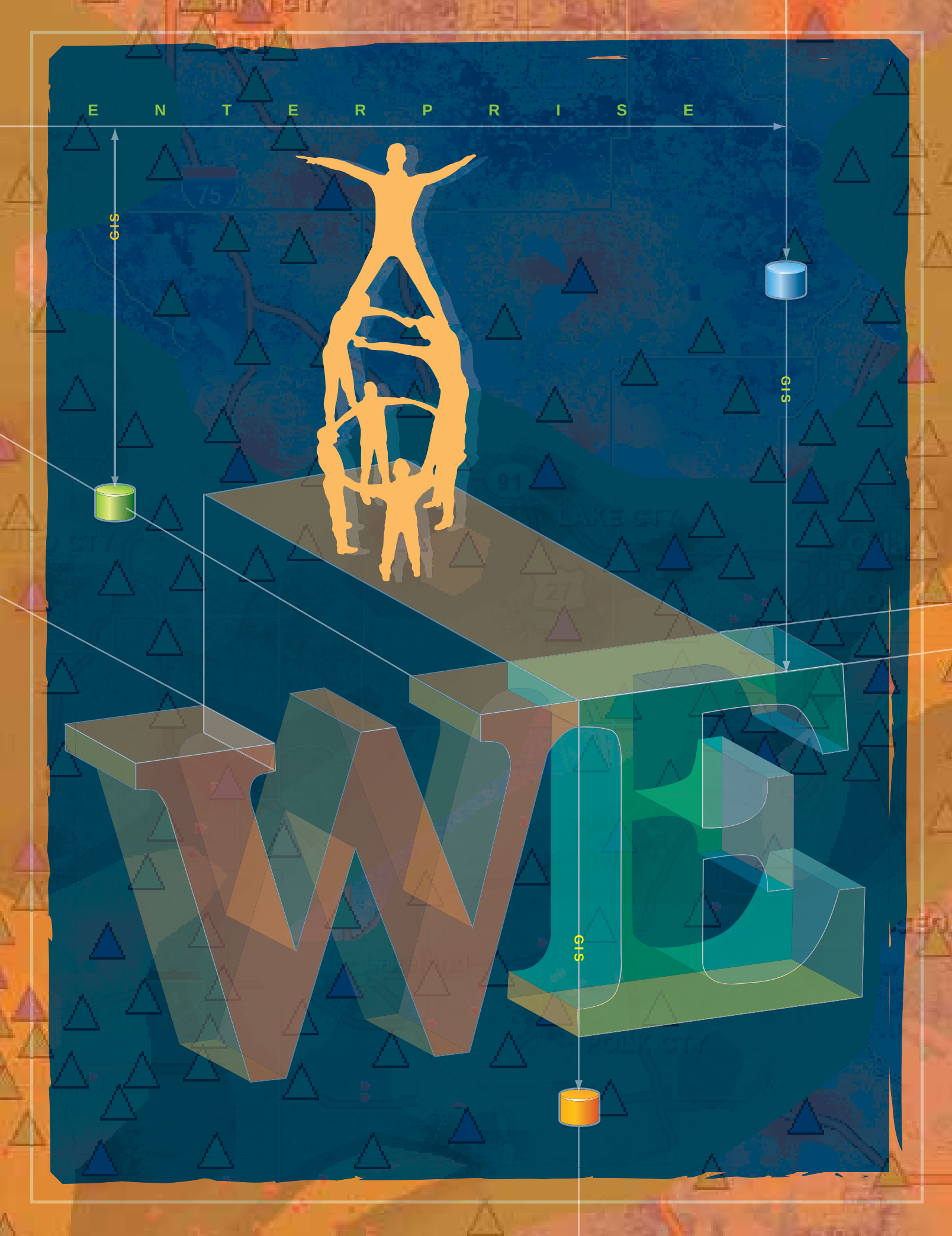
Originally trained as a global change biologist and tundra botanist, Brian Noyle has nearly 10 years' experience as a GIS software developer and architect. His professional and technical interests are primarily focused on moving clients toward more standard architecture and development practices and patterns to facilitate a closer integration of GIS with the standard IT enterprise. Noyle has extensive experience in full software lifecycle management with a focus on delivering through Agile project management methods. When he's not in the office, he can be found on his mountain bike, picking a bluegrass lick on a guitar, or standing in a river waving a stick at amused trout.

Dave Bouwman

Dave Bouwman has been designing and developing GIS software for the last 12 years with projects ranging from small Web sites to statewide enterprise forest management systems. Over the last few years, he has been leading a team of developers in the pursuit of great software built in a sane manner. The combination of an Agile process with pragmatic development practices taken from extreme programming has led to a highly optimized methodology of creating solid software that he and his staff are proud to put their names on. When not attached to a computer, Bouwman is often found mountain biking on the trails around Fort Collins, Colorado.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What's Your Definition?

Looking at what enterprise GIS really means

By Christopher Thomas, ESRI State and Local Government Industry Manager

What is your definition of an enterprise GIS? How do you know when you have maximized your GIS investment? I started to think about this, and I realized that over time, the definition of an enterprise has changed. Just as the technology is evolving so is this notion of an enterprise.

I think Bill Gates said, "We've seen a lot of amazing things so far, but there is much more to come." He said this in 2000, when the Web was a tool we used to look for information. We didn't view the Internet as a complete framework and architecture for the way we do things. This is the way I view the concept of the enterprise GIS.

When have you achieved enterprise status? Is it when you have a centralized database that every department in the organization contributes to, and the GIS department pushes that data back out? In the past, when groups got to this point, we began to see a differentiation between the GIS professional and the professional who used GIS. This was a turning point in defining the enterprise.

At first, the enterprise was all about the back office. GIS professionals generated products used by others in the organization. Then things changed. When the Internet took off, GIS software use started to change in organizations. They now had the ability to deploy the Internet, GIS data, and applications to users within the organization (the intranet), and they could provide data access to external users—the public or other agencies. The dynamic was changing. The enterprise moved from the back office to outside the office, then on to collaboration.

In the early days of GIS technology use, some of the trailblazers toyed with the idea of using it in the field, but the equipment was too bulky to accomplish that. It didn't take long for technology to catch up, however, and with the explosion of mobile devices, the enterprise went into the field. Every time we thought we had achieved a vision of the enterprise, the "cheese moved." Now, I wonder, how will cloud computing change the enterprise concept?

Enterprise GIS has become integrated with disciplines throughout the organization (planning, building, law enforcement) and interdependent on other technologies such as the Internet, mobile devices, and location-based services. The definition of the enterprise is a moving target.

Years ago, I managed a GIS department for a large organization. We were pioneers who were trying to define the enterprise. People came from all over the world to see—firsthand—the groundbreaking work we were doing. Many of them were naysayers. They couldn't imagine that we had accomplished what we said we did.

Instead of doing presentations, I took these people on tours of the various departments that used GIS. I took them to the library and showed them how the public had access to some of our data. I took them to the planning department so they could see how GIS was used for noise abatement projects. I took them to the finance department where staff would explain how they were using the system to recover lost revenue. During these tours, visitors would ask questions. Representatives from the department we were visiting would say something like, "Well, we do the analysis here, and we work with the GIS department to build the data we need."

One day it dawned on me. Everybody said "we." It didn't matter how the department was using the GIS; what mattered was that everybody felt like they were part of the enterprise. They all said "we." Getting to "we" defined the enterprise for me.

"You really don't have an enterprise until you have buy-in—until everybody feels that they are part of it."

When I speak at various conferences, I always ask who in the group has an enterprise GIS. Usually all the hands go up. Most people define their enterprise as having one group that produces maps and analyses for the other groups in the organization. (While I personally don't believe that is an enterprise, I realize "enterprise" can mean different things to different people.)

Recently, I was talking to a group of city government people at a conference. They were all complimenting their GIS staffs, but I realized that most of them did not really understand what they had. One person said, "I ask my guy for a map, and I get one." Another fellow said, "The GIS division is technically under me, but I really couldn't tell you exactly what they do."

However, one person in the group stood out. He said, "Oh, I love you guys. We just deployed our first Web site so that the public can have access to our software. We figure that we have about $850,000 in escaped cost avoidance by using the Internet as a tool to reach the public in off-hours. We just did a trash truck rebalancing using the GIS, and we were able to save $250,000. We went from 39 drivers to 25 drivers and never laid off a single person." He understood what it was about, and that was impressive. The rest of the group was mesmerized.

You really don't have an enterprise until you have buy-in—until everybody feels that they are part of it. When the technology is making a big difference in what people are doing in their jobs, they feel like they are contributing to the program and are not just a recipient, and they can communicate the value of the system. That's when they've gotten to "we."

Illustration design by Suzanne Davis

All about the Geodatabase

Training resources for GIS professionals

The geodatabase is the common data storage and management framework for ArcGIS. Understanding the geodatabase is vital to managing a GIS. These training resources provide GIS managers, administrators, and other GIS professionals with a strong foundation in this central aspect of GIS implementation. Visit www.esri.com/gdbtraining for detailed course descriptions and registration information.

- Instructor-Led Course
- Instructor-Led Virtual Classroom Course
- Virtual Campus Web Course
- Instructional Series Podcast

Data Managers
System Architecture Design Strategies
Geodatabase Design Concepts
Building Geodatabases
QA/QC for GIS Data
Database Administrators
ArcGIS Server Enterprise Configuration and Tuning (for Oracle and SQL Server)
Data Management in the Multiuser Geodatabase
Managing Editing Workflows in a Multiuser Geodatabase
ArcGIS Server: Web Administration Using the Microsoft .NET Framework
Creating Desktop and Workgroup Geodatabases
Best Practices: Loading Raster Data into an Enterprise Geodatabase
Geodatabase Archiving: Introduction to Concepts and Capabilities
Five Best Practices for Maintaining an Enterprise Geodatabase
Administering and Maintaining Desktop and Workgroup Geodatabases
GIS Professionals (Editors, GIS Specialists, Technicians, Analysts, Cartographers)
Building Geodatabases
Introduction to the Multiuser Geodatabase
Data Production and Editing Techniques
Creating, Editing, and Managing Geodatabases for ArcGIS Desktop
Creating and Editing Parcels with ArcGIS Desktop
Working with CAD Data in ArcGIS Desktop
Working with Cartographic Representations
Working with Geodatabase Subtypes and Domains
Geodatabase Archiving: Working with Archived Data
Geodatabase Replication: An Overview
Geodatabase Replication: Working with Replication

Trends, Challenges, and Concerns

GIS industry leaders share their views

Spatial Roundtable (www.spatialroundtable.com), an interactive Web site sponsored by ESRI, promotes the discussion of specific applications of GIS.

For each topic, the main contributor initiates the discussion and invites guests who are topic experts. Topic discussions remain open for six weeks, then are archived for 24 months.

Simon Thompson, business industry solutions manager at ESRI, addressed the inaugural topic Why do so few insurers use GIS? The featured contributor for this topic was Bernard Mageean, managing director of QBE European Operations. The next topic is GIS: Essential Technology for Health and Well-Being.

Visitors to Spatial Roundtable can add comments, submit questions, suggest topics, and subscribe to the RSS feed.

Learning and Sharing

At the ESRI International User Conference

For the 29th consecutive year, thousands gathered for the Annual ESRI International User Conference (ESRI UC), a weeklong event that supplied information, recognition, and inspiration for GIS professionals from more than 100 countries.

Held July 13–17, in San Diego, California, the ESRI UC was the centerpoint of a constellation of industry-specific conferences: the ESRI Education User Conference, 2009 ESRI Survey & Engineering GIS Summit, ESRI Remote Sensing and GIS 2009 conference, Homeland Security Summit, and 2009 ESRI Business GIS Summit.

Information

During the Plenary Session on July 13 and throughout the week, attendees learned about current trends in GIS technology, plans for ESRI software, best practices, and innovative applications of the technology.

The Next Big Thing: ArcGIS 9.4

The Plenary Session highlighted not only what GIS users have been doing in the last year but also previewed GIS technology and ESRI software developments. This year, the dramatic improvements in usability, performance, and functionality that will be available with the upcoming release of ArcGIS 9.4 were in the spotlight. Improvements in editing, the integration of the Python scripting language, the availability of additional analysis tools, and the substantial 3D enhancements are just a few of the ways ArcGIS 9.4 will make GIS a lot easier.

ArcGIS 9.4 will make editing easier, not only for traditional GIS users who do compilation and editing but also for a whole new class of Web editors—users who collect data and share a common map.

Python, the open source scripting language that is evolving into a scientific programming language, will be integrated inside ArcGIS.

ArcGIS 9.4 will extend the quantitative methods available with new spatial analysis tools such as fuzzy overlay modeling and an ecological sampling tool. Math/algebra integration and raster performance for analytic operations will greatly improve. Time will be integrated throughout ArcGIS with the ability to manage time-based data, animate temporal datasets, and publish and query temporal map services.

With this release, ArcGIS is a complete 3D GIS with a more powerful visualization environment for things like virtual cities and support for a complete 3D vector data model. It will support 3D editing, terrain editing, and the integration of real-time video. For more detailed information on ArcGIS 9.4, visit www.esri.com/whatscoming.

GIS Day Every Day

During the plenary, ESRI announced a new program to improve geographic knowledge at the grassroots level. The GeoMentoring program teams GIS professionals with educators at all levels in an ongoing, supportive relationship. What an individual GeoMentor does will depend on an educator's needs. (For more information on this program, see "Can You Do It?—The challenge to improve geographic awareness" on page 62 of this issue.)

Brevity Is a Virtue

Be brief and brilliant (and gone)—these were the instructions given to the participants of a new event at the User Conference—Lightning Talks. These five-minute informal talks demonstrated compelling Web or mobile applications that were delivered in the Map Gallery during the first evening of the conference. Topics ranged from an agricultural monitoring project in Iraq to a public safety application for first responders.

Recognition

The User Conference has always been an opportunity to highlight exceptional work and honor organizations and individuals for their contributions to the GIS industry.

MapAction, a nonprofit, charitable organization based in the United Kingdom, and its founder, Andrew Douglas-Bate, received the first GIS Humanitarian Award. This award recognizes the role GIS is beginning to play in humanitarian relief activity. MapAction's volunteers remove

Continued on page 36

UC Comes to You

Highlights seminar condenses conference

If you missed this year's ESRI International User Conference, you can now learn how to capitalize on new tools, functionality, and resources in ArcGIS 9.3.1, find out what is coming in ArcGIS 9.4, and learn about GeoDesign at a free half-day seminar. Until November 10, 2009, ESRI International User Conference 2009 Highlights seminars will be held in cities across the United States. Visit www.esri.com/uchighlights to register.

Learning and Sharing

Continued from page 35

land mines in areas of civil conflict such as Afghanistan, Pakistan, and Sri Lanka.

Dr. Krishnaswamy Kasturirangan received the Making a Difference Award because "He makes an enormous difference because of the integration of remote sensing into GIS and also the tremendous focus he has created on applications," said ESRI president Jack Dangermond when presenting the award. Kasturirangan, an esteemed space scientist, spearheaded the development and use of Indian Remote Sensing (IRS) satellites. He is also a member of the Indian Parliament and former chairman of the Indian Space Research Organization (ISRO).

For his more than 25 years of involvement in GIS education and project implementation, Dr. Henk J. Scholten received the Lifetime Achievement Award. He was one of the first adopters of GIS technology in the world and is a prolific author of books on spatial analysis.

The extraordinary enterprise system built by CenterPoint Energy was recognized with the Enterprise Application Award. GIS manager Cindi Salas accepted the award. CenterPoint, the third largest public utility in the United States, has built approximately 80 applications that support many different aspects of the company's operations.

The State of Maryland has also adopted GIS as the foundation for its operations, and it received the President's Award for its use of GIS to make government work more effectively. Maryland Governor Martin O'Malley accepted the award on behalf of the state. In his address, O'Malley noted, "Those of us who believe in the progressive power of GIS believe that in using the map, in using smart maps to strengthen our connections to one another, we have the potential to change the course of a city's history, to change the course of a state's history, to change the course of our country's history, and maybe even the course of the planet's history."

Inspiration

This year's conference had two fascinating but very different keynote speakers: Hernando de Soto and Willie Smits.

Called the world's greatest living economist by former U.S. President Bill Clinton, de Soto explained the importance of cadastral systems in the developing world and his belief that land information records are the foundation for a civil society.

The second keynote speaker was Willie Smits, a biologist who chairs the Masarang Foundation, a nonprofit organization that works to restore the forests and empower the local people in eastern Borneo. In 2007, the organization opened a palm-sugar factory that uses thermal energy to turn sugar palms into sugar and ethanol and returns cash and power to the community.

The good works of 150 of the approximately 300,000 organizations that use ESRI software were recognized with Special Achievement in GIS awards presented in a ceremony held on July 16.

These users are improving processes and adding to capabilities in many areas. As Dangermond noted during his address to the Plenary Session, "You're building at the same time a kind of information infrastructure, which is a new chapter I think in the history of the world. It's creating a new kind of information which is powerful that I think will lay down the fabric for creating a more sustainable future."

Share Your Knowledge

Paper presentations benefit you and others

The ESRI International User Conference began 29 years ago as a way for GIS practitioners from all over the world to share knowledge, experience, and ideas. Paper presentations have been an integral part of the conference since its genesis and remains one of the most important reasons people attend each year.

Listening to presentations at the conference and reading papers submitted for publication are terrific ways to find out what is really going on with GIS technology. No matter how you use GIS or how long you have been in the field, you can share insights, best practices, innovative solutions, lessons learned, or tips with other GIS users through a user conference paper presentation.

Why should you consider presenting a paper at the ESRI International User Conference in 2010? The ESRI International User Conference is the largest GIS conference in the world. Presenting at this conference provides a tremendous opportunity for gaining recognition for your work and visibility in the field. Bill Mann, a senior planner for the City of Jacksonville Beach, Florida, was a paper presenter at the 2009 User Conference. His presentation on creating an accurate land base using Cadastral Editor has appeared in some form in four publications.

Being a presenter also provides greater opportunities for networking. David Kunz, another 2009 conference presenter from Newton New Jersey, said his organization was in the process of migrating from a departmental to an enterprise GIS. Many attendees came up to him after his presentation to discuss some aspect of his work in more depth. When asked if he found the experience beneficial, Kunz said, "Definitely. It is always useful to learn more about how other organizations are approaching similar issues. It also helps me gain credibility back in the office with the administration and peers."

Because a limited number of presentation slots are available each year, you need to submit the abstract for your paper by October 16, 2009. Presenters must also register to attend the conference. You will be notified of the status of your paper submission in March 2010. Visit www.esri.com/uc for additional information on becoming a presenter and submitting an abstract.

Visit **www.esri.com/uc** for additional information on becoming a presenter and submitting an abstract.

The theme for the 29th Annual ESRI International User Conference was GIS: Designing Our Future. Here, ESRI president Jack Dangermond explains GeoDesign and its importance.

The Vision

of a Purposefully Designed Future

This year's conference emphasized the interesting relationship between design and GIS, with particular emphasis on the concept of "GeoDesign."

Today, GIS professionals work with geographic information to manage many aspects of our world and disseminate their good works. Design is a discipline and process where people deliberately create. Design is about purpose and intentions; it's about seeing in our mind's eye what could be, then creating it. GIS can also be used to integrate geographic science with design. I like to refer to this as the field of GeoDesign.

One of the big challenges facing our society today is the rapid change that humans are making to our global environment. While there are certainly many amazing advances taking place in areas such as technology, health care, and basic scientific understanding, we are also severely impacting our natural environment—the foundational infrastructure for sustainable life.

These changes are largely the result of uncoordinated, unguided human activities. Our landscapes are becoming more fragmented; depleted; polluted; eroded; and in some cases, actually disappearing, becoming extinct. This is a tragedy for our future, and it's happening largely because we are not consciously designing our future, and we are not evaluating and accounting for the long-term impacts of our actions on our communities, our environment, our society, our climate—our world.

My message is simple. We need to move from a future that simply happens to one that is purposefully designed, with a full understanding of the consequences. This will take many participants and more conscious and collective action; action guided with our best vision, science, and intentions. We need to design our future while fully accounting for the consequences of what we do.

I believe GIS and GIS professionals hold the promise for accomplishing all this. GeoDesign is a systematic methodology for geographic planning and decision making. GeoDesign starts by incorporating all the geographic knowledge that users collectively build and maintain—layers of information, measurements, and analytic models—and plugging it into a new interactive process where one can design alternatives and get geography-based feedback on the consequences of these designs right away. What if we do this here? What is the impact of that alternative versus this alternative? This iterative design/evaluation process is fundamentally how the human brain works.

Geographic Sketching

Geographic sketching is the central GIS tool for supporting GeoDesign. This new capability allows users to quickly sketch their design ideas on top of suitability maps and get immediate feedback on the performance or impact of the design being proposed. The GIS framework provides instantaneous feedback in the form of maps, charts, and statistics and enables rapid testing of multiple design services.

Dr. Carl Steinitz, a professor of landscape architecture at Harvard University, first described how the GeoDesign process worked by posing it in the context of six geographic, or landscape, questions.

The first question is How can we describe geography? This is done in a GIS by abstracting geography into a series of inventory data layers. The second question is, How does this geography actually operate? Here, GIS is used to combine data with spatial analysis modeling to describe geographic processes. Examples include soil erosion, land-use and vegetation change, hydrology, or traffic flows. Process models predict or describe how various spatial phenomena change with respect to time. The third question is, How can we alter geography considering all the factors? GIS uses suitability and capability modeling to answer this question. Various map factors are overlaid and weighted relative to their merits for a particular use.

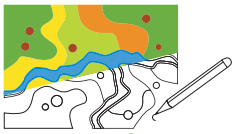
These first three questions describe the world as it is; the following questions describe the world as it could be. What are the alternative scenarios for designing the future? This involves sketching out the options. Then, How can we quickly evaluate the consequences of those changes? Here, GIS can be used to evaluate the impacts of each alternative. Lastly, How should geography be changed? This integrates considerations such as policies and values into the decision-making process.

The concept of GeoDesign integrates all six of these steps, providing us with a rapid, adaptive process for creating a more sustainable future.

GeoDesign Will Extend into Every Field

GeoDesign is an evolutionary step in the GIS field. While very exciting for land use and environmental planning, GeoDesign has broad implications for virtually all professions. This methodology will be applied in many fields—by retailers who want to understand the consequences of opening or closing stores; by engineers who want to locate a road in the right location; by utilities, farmers, foresters, law enforcement, energy companies, and military, to name just a few. This approach will move GIS beyond simply describing the world as it is toward the idea of creating the future, integrating geographic thinking into all the work we do.

GIS professionals will chart out the future using GeoDesign maps. These maps will become a new language for us to communicate and evaluate the future, showing the world as it could be, encapsulating geographic knowledge with purposeful design. This process is about bringing information and science into the way that we make decisions. Our new president is fond of saying he wants to put science in its rightful place. This is where I think its rightful place is—supporting the creation of the future with new kinds of maps that bring it all together.



Meeting on the Future of GIS and Design

The world's first GeoDesign Summit will be held January 6–8, 2010, at ESRI in Redlands, California. A diverse group of GIS professionals and academics will explore methods for advancing the integration of design and GIS technology. The event is sponsored by ESRI, the University of Redlands, and the University of California at Santa Barbara. The list of speakers includes Grant Jones, Bran Ferren, Carl Steinitz, Tom Fischer, Kim Tanser, and Michael Goodchild. Visit **www.geodesignsummit.com** for more information.

Together at Last

Keynote speaker advocates the integration of GIS and remote sensing

"For years, remote sensing has been a technology in search of a problem to solve," observed Kass Green in her Keynote Address at the ESRI Remote Sensing and GIS 2009 conference.

"It *[remote sensing]* has its origins in the defense industry. However, for years there has been a misconnect between technology providers and problem solvers." Green explained why she sees that situation coming to an end in her address, Remote Sensing Comes of Age.

Kass Green, immediate past president of the American Society for Photogrammetry and Remote Sensing, was the keynote speaker for the ESRI Remote Sensing and GIS 2009 conference.

Green is the immediate past president of the American Society for Photogrammetry and Remote Sensing and president of Kass Green & Associates, a firm that consults on geospatial strategy. In numerous articles and book chapters, she has advocated for the integration of GIS and remote sensing to improve environmental and policy analysis.

Twenty years ago, Green said she couldn't imagine using GIS software without remote sensing and vice versa. The two have an intimate and long-standing relationship. Many GIS practitioners don't appreciate the contributions of remote sensing to GIS in the past and its tremendous potential contributions. Green said the perception of remotely sensed data needs to change. "We need to see it more as a database of numbers and less as a pretty picture."

Ongoing developments in the remote-sensing industry and in GIS technology have made classification a more automated process and limited the time between the capture and use of imagery.

GIS practitioners now have more imagery and imagery that is more current and consistently available to them than ever before. In addition to imagery supplied by new commercial satellites that offer higher resolution, more spectral bands, and short revisit periods, some imagery, from programs such as Landsat and the National Agriculture Imagery Program (NAIP), is available at little or no cost.

"However, with all this progress, some problems still remain," said Green. Imagery is still hard to use and large imagery files are still cumbersome. Perhaps more worrisome is that the United States is still uncommitted to continuous observation.

Now more than ever, there is a need to integrate GIS and remote sensing to handle the challenges of making policy and locating and evaluating resources. This requires making data more accessible to more people more quickly.

In closing, Green urged attendees to effect change. "You have the education and experience that empower you to make a difference. Use the data and software at your fingertips to deliver truth, not conjecture. We don't get a second chance to do this right."

Note: The second edition of *Assessing the Accuracy of Remotely Sensed Data,* coauthored with Russ Congalton, is featured in the GIS Bookshelf section of this issue of *ArcUser.*

More than a Pretty Picture

Remote sensing summit stresses the importance of imagery

"This UC is the world's biggest imagery conference," quipped Lawrie Jordan, ESRI director of imagery enterprise solutions, referring to the ESRI International User Conference (ESRI UC) as he welcomed attendees to the ESRI Remote Sensing and GIS 2009 conference held in conjunction with the ESRI UC. His comments underlined the importance ESRI assigns to remotely sensed data in the GIS enterprise. In its second year, the event was held July 12 in San Diego, California. Attendance more than doubled last year's conference.

"Imagery is a core component of a modern GIS," said Jordan. He noted that speed matters in decision support, and imagery is driving GIS because there is now a flood rather than a dirth of imagery. As he sees it, the challenge now is not the availability of imagery but making it accessible because data must be both timely and authoritative.

"People want imagery now and in the format they want," Jordan also noted. With the focus on serving the enterprise, people want an application that is simple and science based. Jordan asserted that GIS and imagery belong together and always have, although people didn't always realize this. "They are two sides of the same coin."

ArcGIS provides a comprehensive platform for managing imagery via an information-centric workflow. Unlike traditional imagery workflows that are subject to bottlenecks and suffer from latency, ArcGIS combines processing and serving in a workflow that can grow and scale with user requirements.

ESRI staff members Peter Becker and Lindsay McGreevy detailed the components of the ArcGIS information-centric workflow for imagery as well as unveiled the new functionality related to image management available in ArcGIS 9.4.

With the release of 9.4, ArcGIS becomes an image analyst workstation with the new Image Analysis window, better support for large images and more formats, and better access to Image Services as mosaics and catalogs. In the geodatabase, there are a new mosaic raster catalog and improved geoprocessing tools.

ArcGIS Server will be optimized for serving imagery and rasters with improved API access and server-based rendering. The ArcGIS Server Image extension can serve mosaics, has improved APIs, allows download of dynamic properties, and can serve JPEG2000 format data as JPIP streams.

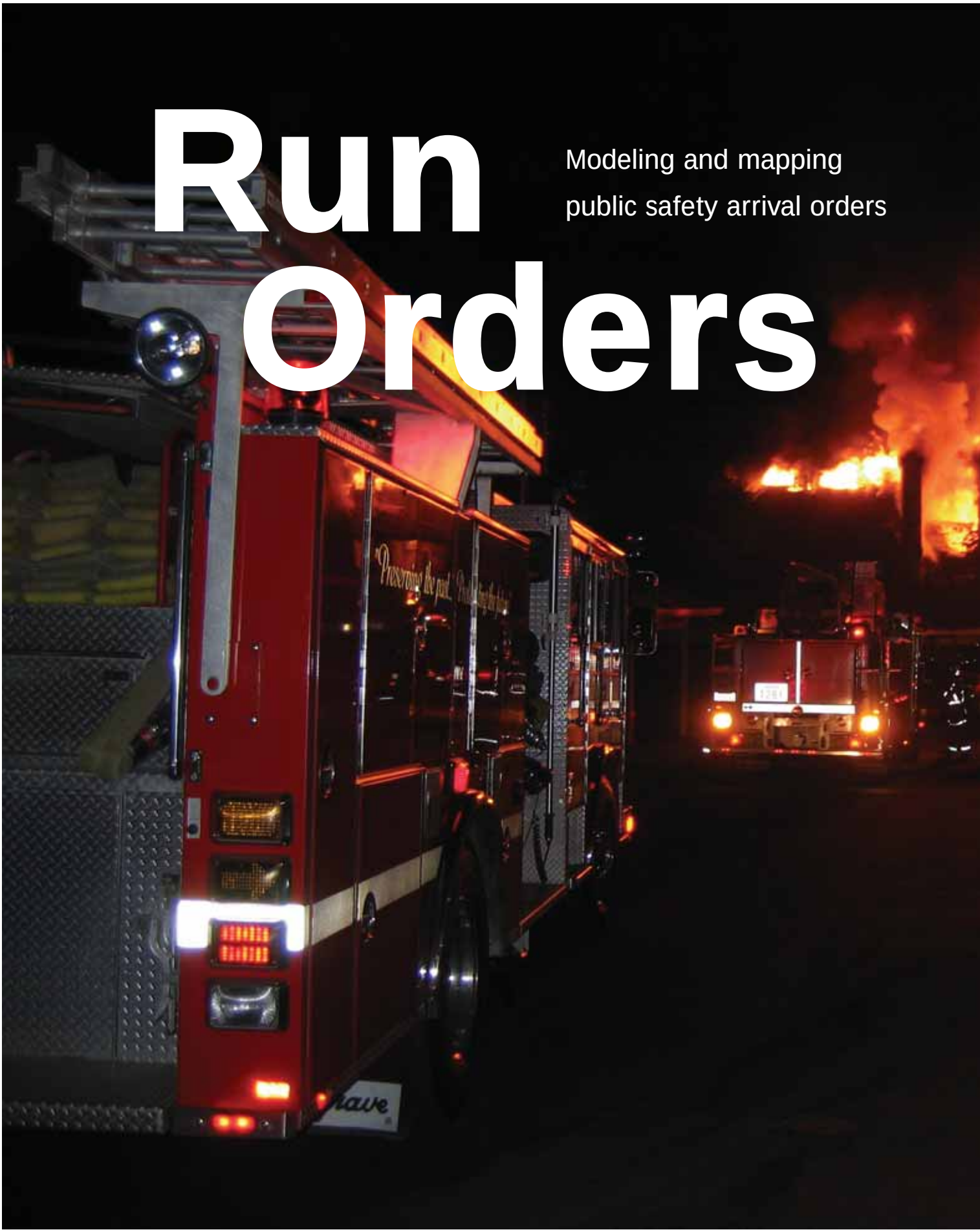
Following this presentation, two case study speakers addressed the conference. Aurelie C. Chapiro, a remote-sensing specialist for World Wildlife Fund, spoke of her work with conservation. Lilian Pintea, director of conservation science for the Jane Goodall Institute's Africa Program, described how satellite imagery is being used for great apes conservation.

Marten Hogeweg, ESRI senior project and product manager, outlined the special challenges of geoportals that primarily provide imagery data. In his presentation, Improving Access and Use of Imagery with Interoperable Off-the-Shelf Technologies, Hogeweg advocated a solution for geoportals based on using an assortment of services rather than one application. This avoids isolating data and reduces the latency between collection and availability. These strategies enhance the value of geoportals for imagery by extending the use of observation data, information services, and products beyond the use originally intended.

In response to comments by last year's attendees, an additional panel discussion was added this year. A panel of imagery data providers that included John Auble of DigitalGlobe, Joel Campbell of GeoEye, Russ Cowart of i-cubed, Roger Mitchell of MDA Federal, and Gerry Kinn of ESRI fielded questions that had been submitted by the audience.

Run Orders

Modeling and mapping public safety arrival orders



What You Will Need
- ArcGIS Desktop (ArcView, ArcEditor, or ArcInfo license)
- ArcGIS Network Analyst extension
- Sample data downloaded from *ArcUser Online*
- 500 MB of free disk space

By Mike Price, Entrada/San Juan, Inc.

Timely integrated response to emergencies limits suffering and damage. GIS helps responding agencies provide better service. This is the last in a series of articles, which began in the October–December 2006 issue of *ArcUser* magazine, that have demonstrated how fire departments can model service areas and response using the ArcGIS Network Analyst extension.

Run orders allow a public safety agency to predict and map the arrival sequence and times for responders traveling to an incident from multiple locations. Previous exercises in *ArcUser* used optimized travel areas generated using the ArcGIS Network Analyst extension to identify the station from which the first responders (i.e., First Due) will arrive for a given location. By sequentially remodeling each First Due provider, Second Due coverage areas can also be mapped.

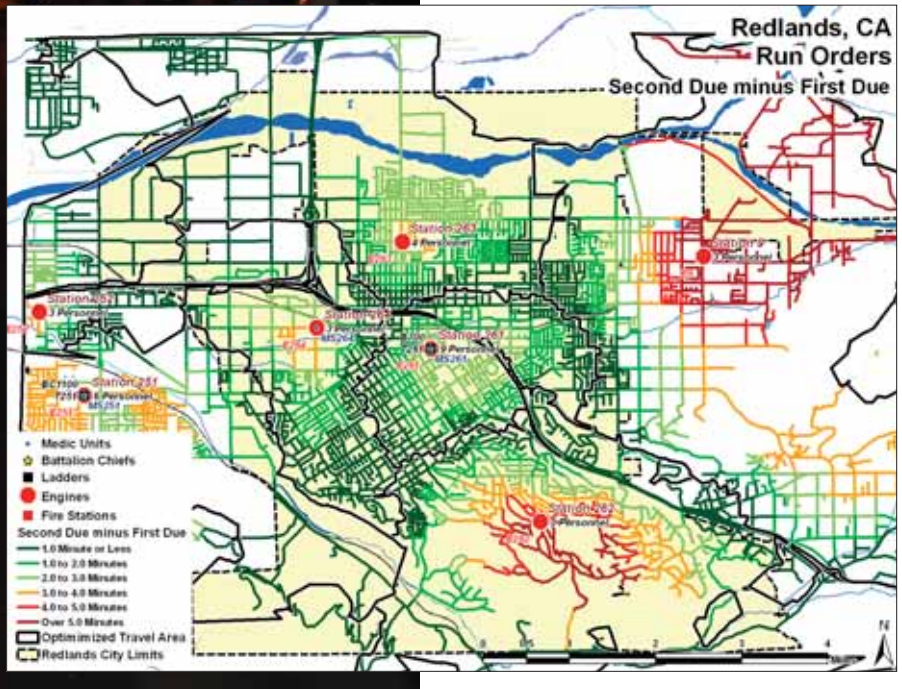
Response modeling beyond Second Due coverage areas has always been difficult. In "Do It Yourself—Building a network dataset from local agency data," which appeared in the Summer 2009 issue of *ArcUser,* a sample dataset for the city of Redlands, California, was modified so it would support time-based travel modeling with ArcGIS Network Analyst 9.3.

Working this exercise requires a basic understanding of ArcGIS Desktop and the ArcGIS Network Analyst extension. To review modeling travel networks with ArcGIS Network Analyst, including information on distribution and concentration, and to work other exercises in this series, visit the Learn How to Model Networks page (www.esri.com/news/arcuser/avmodel.html).

This exercise extends the street data that was enhanced in the previous exercise to include information about arrival orders and times for up to five emergency responders. In addition, areas where First Due coverage is within national standards will be identified and backfilled response analyzed when the nearest provider is already on a call. To ensure safe, quick entry into a structure by responders, the time lapse between arrival of the first and second units will be determined.

This tutorial shows how to model and map arrival orders for four fire stations near ESRI's headquarters in Redlands, two western stations in the nearby city of Loma Linda, and one station to the east of Redlands in Mentone. It involves a complex workflow that includes definition queries, tabular joins, field and geometry calculations, and data exports. It requires great attention to detail.

Instead of using the dataset produced when working the 2009 Summer issue exercise, use the sample dataset for this tutorial available from *ArcUser Online*. It has been converted from shapefiles to a file geodatabase and contains several additional fields that support run orders, and the network dataset used will be built inside a geodatabase feature dataset. Even though the sample dataset is small, you will need at least 500 MB of hard drive space to complete this exercise. Also note that the Closest Facility solution is complex and will take some time to solve.



Run orders model response scenarios. This map shows the approximate time interval that the first crew on scene will wait for the second crew to arrive.

Getting Starting

Download the sample dataset, Redlands.zip, from *ArcUser Online,* which contains all the data necessary to perform this tutorial. Unzip Redlands.zip near the root of your project folder and open its contents in ArcCatalog. Navigate to the Redlands folder, expand the Redlands_Fire geodatabase, and preview the Run_Order_Model feature dataset in Geography and Tablemodes. As in the previous exercise, the projected coordinate system is North American Datum (NAD) 1983 California State Plane Zone V, and the unit of measure is the U.S. Survey Foot.

Preview the feature class named Network_Streets, as shown. Notice this street data is very similar to the street data used in the exercise in the last issue. With Network_Streets selected, switch to table view and explore the table structure. Scroll to the fields on the right side

Continued on page 42

Run Orders

Continued from page 41

and note the new fields: INDEX, CENT_X, CENT_Y, STAT_01, and TIME_01. All fields contain zero values but they will soon be populated with the arrival order and times for the five closest stations.

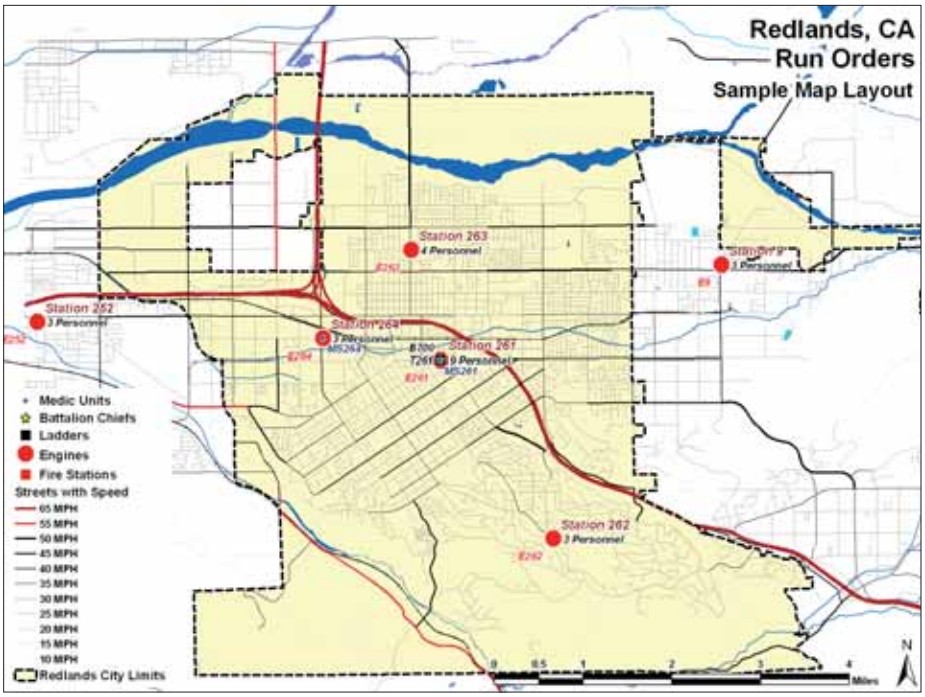
Building the Network Dataset

The next step is building the Redlands Network_Dataset in ArcCatalog.

1. Right-click on Run_Order_Model and select New > Network Dataset. Accept the default name, Run_Order_Model_ND, for this feature class.
2. Continue through the Network Dataset wizard, accepting defaults until you get to the wizard pane for specifying attributes for the Network Dataset. With Minutes selected, click the Add button. In the New Attribute dialog box, add a new attribute named Length_Mi and set its units to Miles and the Data Type to Double. Click OK.
3. Reselect Minutes. Click the Evaluators button and select the Default Values tab. Right-click the Turn and choose Type > Global Turn Delay. Click Apply.
4. Press F12 to open the Global Turn Delay Evaluator and type in the delay parameters shown in Table 1. Click OK and OK again to return to the dialog box for specifying attributes.
5. Click Next to continue and accept the directions defaults.
6. Click Next, select the summary text, copy and paste it to a WordPad document, and save that document with the project.
7. Click Finish and build the network. Inspect it when ArcCatalog has finished processing.

Creating Indexes, Generating Centroids, and Exporting Data

1. Close ArcCatalog and open ArcMap. Navigate to the \Redlands folder and open Redlands01.mxd. Switch from Layout View to Data View.
2. Open the attribute table for the Streets with Speed layer. Scroll to the right, study the fields, and locate the INDEX, CENT_X, and CENT_Y fields.
3. Right-click on INDEX and open the Field Calculator. Double-click on OBJECT_ID1 to add it to the formula box. Click OK to populate this field with a sequential index.
4. Right-click on the header for CENT_X and select Calculate Geometry. Choose X Coordinate of Centroid to perform this calculation. Use the data frame coordinate system (NAD 1983 StatePlane California V FIPS 0405) and Feet US as the units for this project. Click OK.

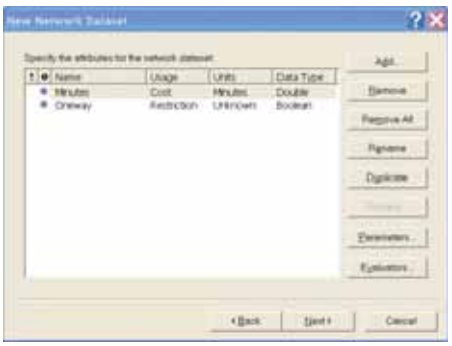


This tutorial models response from fire stations in and near ESRI's headquarters in Redlands, California.

Direction	Description	Seconds
Straight	From Local to Local Road across No Roads	0
Straight	From Local to Local Road across Local Road	1
Reverse	From Local to Local Road	30
Right Turn	From Local to Local Road	2
Left Turn	From Local to Local Road	4

Table 1: Delay parameters

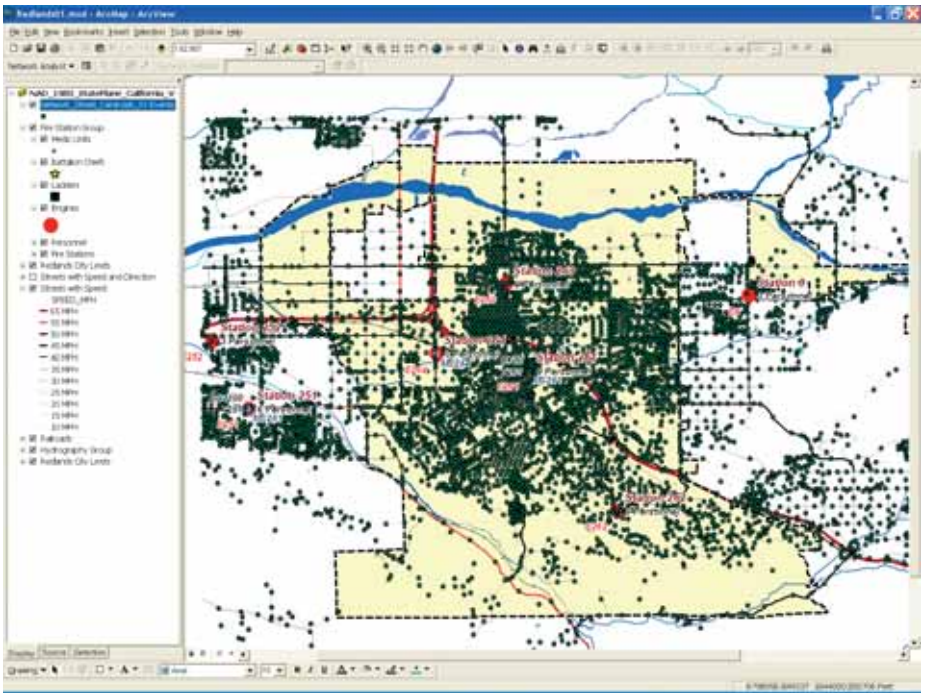
Specify another attribute for the network dataset called Length_Mi. With Minutes selected, click the Add button and set its units to Miles and the Data Type to Double.



5. Repeat this procedure for CENT_Y to calculate values for the Y Coordinate of Centroid field. Inspect the calculations and save the project.
6. Now, export this table to a dBASE file so these points can be used to map street centroid points. In the Attributes of Streets with Speed table, click the Options button and select Export. Specify All Records and save the table in the \Redlands\DBFFiles folder as Network_Street_Centroids_XY.dbf. Click on the Source tab of the table of contents (TOC) and add the table to the map.

Mapping Incidents

The ArcGIS Network Analyst extension Closest Facility solver requires two input datasets: Locations and Facilities. To build run orders, load Fire Stations as Facilities and the street segment centroids as Incidents. Determining the five closest facilities to each centroid Incident will involve considering seven possible Facilities and almost 6,500 Incidents, so this model might take some time to run. On the Source tab of the TOC, right-click on Network_Street_Centroids_XY.dbf and select Display XY Data. In the Display X,Y dialog box, set the X Field to CENT_X and the Y Field to CENT_Y. Click OK. After processing is complete, open the



Use the Network_Street_Centroids_XY.dbf to create an XY Event layer that will be the input for Incident Data needed when calculating Closest Facility.

Network_Street_Centroids_XY.dbf and inspect the location of these centroid points. Save the project.

Loading Facilities and Incidents

With the XY event theme created, it is time to add the network dataset, load Facilities and Incidents, and define the Closest Facility rules.

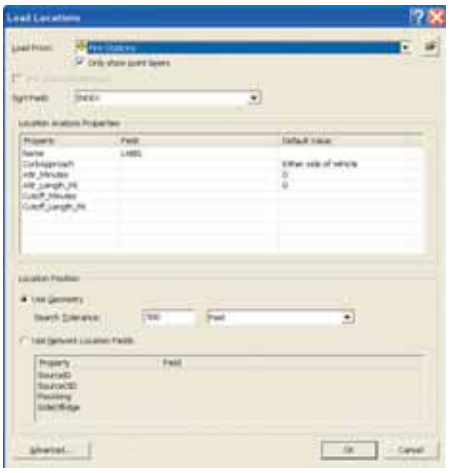
1. If necessary, make the Network Analyst extension active, load its toolbar, and open a Network Analyst window.
2. Click the Add Data button and navigate to the Run_Order_Model_ND, located in the Run_Order_Model feature dataset, and add it. Don't add all the feature classes that participate.
3. In the TOC, place Run_Order_Model_ND just below Streets with Speed layer and make it not visible.
4. Click the Network Analyst drop-down and select New Closest Facility. The Closest Facility group is added at the top of the TOC and the Network Analyst window. In the TOC, move the Closest Facility to a location just above the Redlands City Limits layer at the bottom of the TOC.
5. In the Network Analyst window, right-click on Facilities and select Load Locations. Specify Fire Stations and Load From source. Carefully apply the loading parameters listed in Table 2 and click OK. Save the project.
6. Right-click on Incidents and choose Load Locations. Carefully apply the loading parameters listed in Table 3 and click OK. This may take considerable time, so be patient. If the process hangs, close ArcMap, reopen the last saved project, and load it again. Inspect the loaded incident data. If it is correct, save the project again.

Parameter	Value
Load From:	FireStations
Sort Field:	INDEX
Location Position:	Use Geometry
Name (under Location Analysis Properties):	LABEL
Search Tolerance:	500 Feet

Table 2: Facilities loading parameters

Defining the Closest Facility Solver Parameters

1. In the TOC, right-click on Closest Facility layer and choose Properties.
2. In the General tab, rename it to Run Order Closest Facility. In the Analysis tab, set Impedance to Minutes, Default Cutoff Value to 20, and Facilities to Find to 5. Change Travel from to Facility to Incident. Accept defaults for all other parameters.
3. In the Accumulation tab, check the Length_Mi and Minutes attributes. Click Apply to save these parameters. Click OK. Save the project. In the TOC, right-click on Closest Facility and choose Solve. Now it's time to take a break. There are literally thousands of routes in this solution so this process may take more than 20 minutes. Close Warning Message that lists the centroid points not reached in 20 minutes. Once the process has finished, save the project.
4. Open the Routes table. If it contains approximately 32,000 routes and everything else looks OK, save the project again. The ArcMap document has just increased in size from about 2 MB to more than 100 MB.



Carefully fill out the dialog box when loading Fire Stations for Closest Facility analysis.

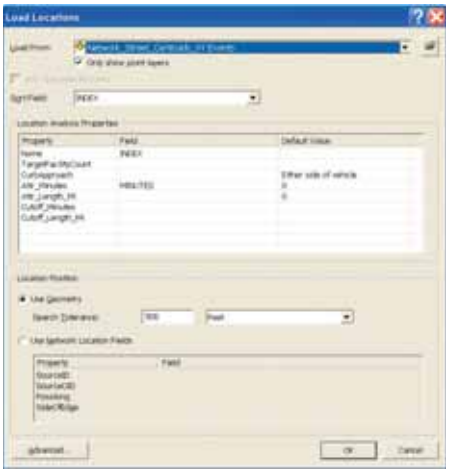
Joining Station Information to Each Route

Carefully study each field of the Routes attributes. This data will be used to build run orders for each street segment. Notice that the FacilityID field corresponds to the Index field in the Fire Stations table. The IncidentID field connects to the Streets Index. The FacilityRank

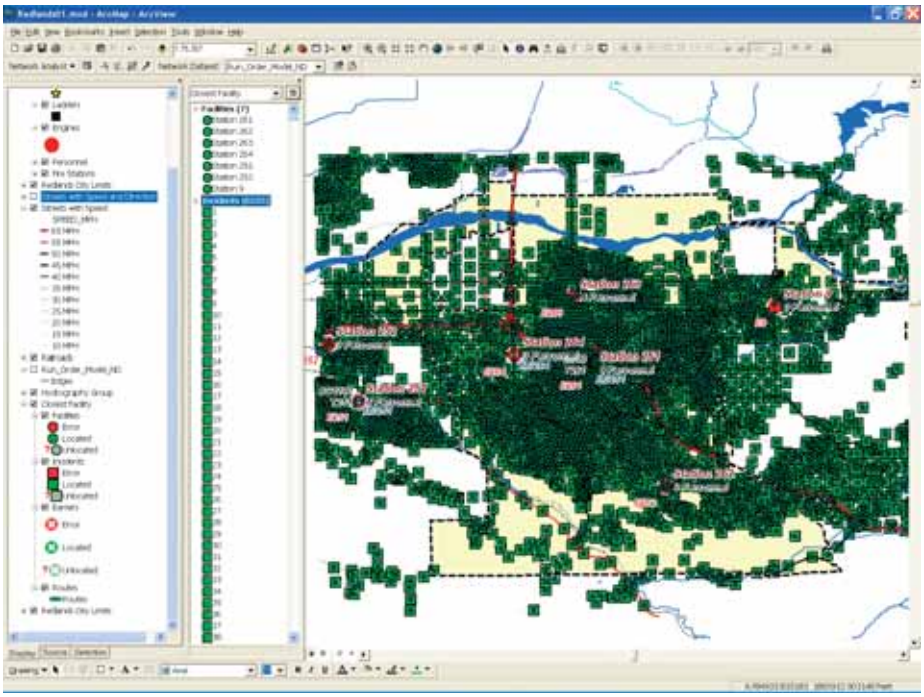
Continued on page 44

Run Orders

Continued from page 43



Carefully fill out the dialog box when loading the Network_Street_Centroids_XY.dbf for Closest Facility analysis.



Be patient while several thousand centroids load.

lists arrival order, and Total_Minutes contains the travel time for each station to each centroid. Open the Fire Stations table and place it above the Routes attributes.

1. Before exporting arrival data for First through Fifth Due, join station names, apparatus, and personnel to each route.
2. To join Fire Station data to the Routes, right-click on Routes in the TOC and select Join.
3. In the Join Data dialog box, choose Facility ID as the field in this layer that the join will be based on, choose Fire Stations as the table to join to the layer or load the table from, and choose INDEX as the field in the table to base the join on and choose Keep all records.
4. Click OK, allow indexing, and inspect the Routes table.

With the Station Number (STATION_N) for up to five responders for each modeled street segment, the next step is the crux of this entire procedure.

Parameter	Value
Load From:	Network_Street_Centroid_XYEvents
Sort Field:	INDEX
Location Position:	Use Geometry
Name (under Location Analysis Properties):	INDEX
Search Tolerance:	500 Feet

Table 3: Incident loading parameters

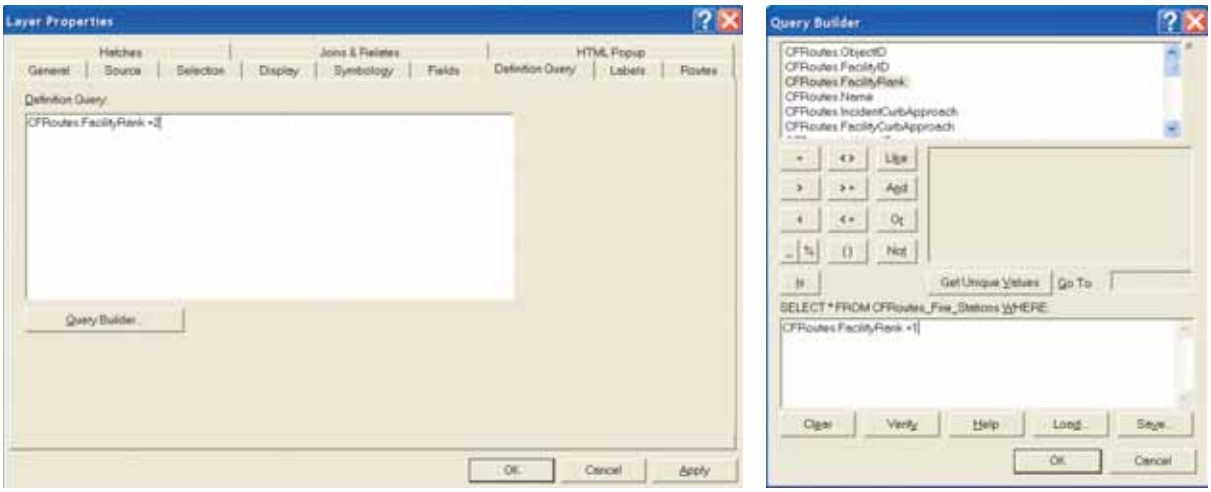
Carefully set the Closest Facility Solver parameters.

Join the filtered dBASE files to the Street with Speed layer to calculate values, then remove the join.

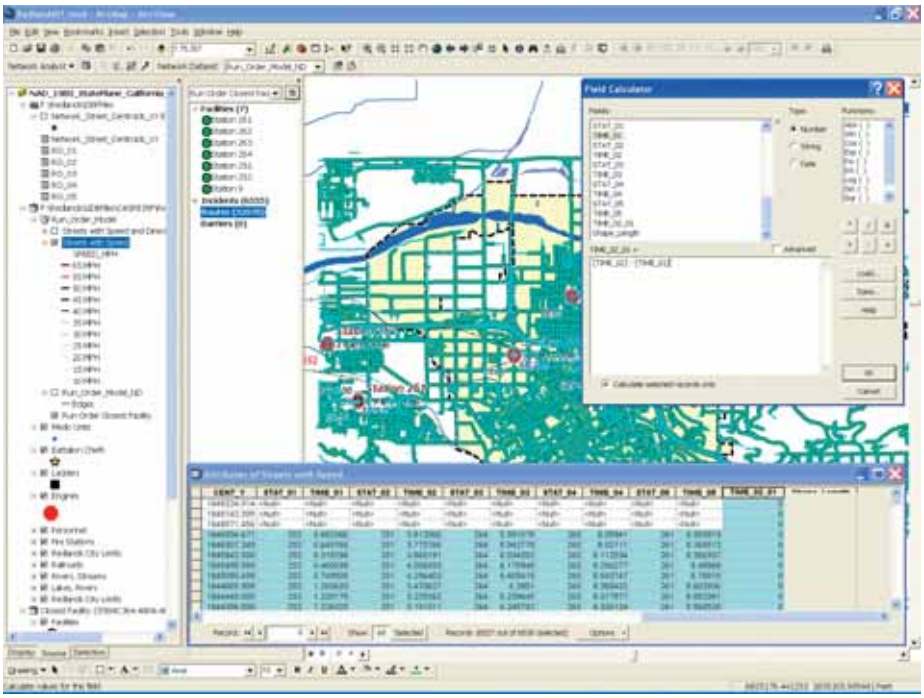
Exports and Joins

Now to export the five tables, one for each arrival order, individually join each table to the streets, and calculate station and travel time for each arrival. After successfully joining Routes to Fire Stations, the next step is to apply a definition query to filter the Routes attributes by arrival and export each subset to a separate dBASE table.

1. In the TOC, right-click on Routes and choose Properties. Click the Definition Query tab. In the formula box, request all records where CFRoutes.FacilityRank = 1. This subset represents travel records for first-on-scene stations. Times should be short, especially near fire stations.
2. The next step is to export the First Due records. In the filtered Routes attribute table, click Options and select Export. Save the exported table to Redlands\DBFFiles and name it RO_01.dbf. Do not add the table to the map yet.
3. Reset the definition query to CFRoutes. FacilityRank = 2 and export again, saving as RO_02.dbf. Again, don't add the table to the map.
4. Repeat this procedure for RO_03, RO_04, and RO_05. Now, add all five RO files to your map. Save the project again.



In the TOC, right-click on Routes and select Definition Query. In the formula box, request all records where CFRoutes.FacilityRank = 1.



Use the Field Calculator to calculate the delay time between First Due and Second Due.

Populating Station and Time Fields with Joined Table Data

The final analytical steps include five separate joins, each followed by two quick calculations. Perform each operation carefully and check the data!

1. Open and inspect the attribute table for Streets with Speeds. Locate the STAT_01 and TIME_01 fields. Open and position RO_01.dbf below the streets attributes.
2. Right-click on Streets with Speed layer in the TOC and select Joins and Relates. Verify that there are no active joins for this table. (If there are any joins, remove them.) Next create a Join with RO_01, using INDEX as the Streets with Speed join field, RO_01 as the table to join, and IncidentID as its join field. Click OK to continue. Do not index this table. Open the table and verify the join.
3. In the joined table, navigate to STAT_01 and right-click its header. Select Field Calculator and populate the RO_01.STATION_NO field with values from Network_Streets.STAT_01.
4. Next, use the Field Calculator to populate the TIME_01 field with the values from the RO_01.Total_Minu field. Check the work. Null records represent streets that were not traversed within 20 minutes.
5. ***Now for a really important step. In the TOC, right-click Streets with Speed, select Joins and Relates, and remove the RO_01 join. Do not skip this step.***
6. Create new joins on Streets with Speed to the other RO tables using INDEX as the field the join is based on, the RO table (e.g., RO_02, RO_03), and IncidentID as the field in the table to base the join on. Populate the station (STAT_0x) using the formula Header = STAT_0x, the field to populate = Network_Streets.STAT_0x, and the value to use is RO_0x.STATION_NO. Populate the arrival time fields using the formula: Header = TIME_0x, the field to populate = Network_Streets.TIME_0x, and the value to use is RO_0x.Total_Minu. Be sure to remove the join each time.

Calculating Delay Time

Now, calculate the delay time between arrival of the first and second responders. A fire engine typically includes three or four firefighters. To safely conduct rescue and initial interior operations, more firefighters are often needed. Subtracting the First Due arrival time from the Second Due time will produce the approximate time interval between when the first on-scene crew arrives and a second crew arrives. Right-click on TIME_02_01 and choose Field Calculator. Enter the formula [TIME_02] – [TIME_01] in the formula window and click OK. Inspect this calculation and save again.

Mapping Run Orders—The Bonus Round

Now it is time to make some maps. The Redlands folder in the sample dataset contains a Bonus folder with several Layer files for symbolizing the various responders (First Due, Second Due, etc.). Load all these Layer files and create a Group Layer for them named Run Order Group. Place the group just below Fire Stations in the TOC. Collapse the legends for Second, Third, Fourth, and Fifth Due.

Notice that data links to all Run Order layers are missing. To fix this, right-click on First Due in the TOC and choose Data > Repair Data Source. Navigate to \GDBFiles\CASP835F\Redlands_Fire.gdb and select Network_Streets inside the Run_Order_Streets feature dataset. Fix all layers in the Run Order Group in a similar manner. Turn off all Run Order layers except First Due. Switch to Layout View and study the

Continued on page 46

Run Orders

Continued from page 45

colors. These First Due polylines seem to cluster around their home stations.

Verifying Relationships

To verify First Due relationships, click Add Data and navigate to \Bonus_Files\SHPFiles\CASP835F and load Optimized Travel Area.lyr. Place it at the top of the Run Order Group. This response area optimization was built from the same Redlands Streets using the functionality in Network Analyst to optimize service areas. Notice the alignment of First Due Streets and optimized response area boundaries, providing visual confirmation of the First Due run orders.

Turn off First Due and turn on Second Due. Look closely at the home area for Redlands Station 261 and observe how Station 264 arrives second from the west, 263 comes in from the north, 262 fills in from the south, and Mentone 9 just reaches the eastern response area for Station 261 as Second Due. Check the Third, Fourth, and Fifth Due layers.

Finally, let's map the arrival time difference between First and Second Due. Turn off all Due layers and make the Second Due minus First Due layer visible. Study the color relationships. Green lines represent short time intervals and red lines represent long intervals. Notice the large time differences for each station are in closest proximity to that station.

Study the attributes to understand that the green lines in fringe areas are not entirely good. Even though the arrival difference is small, the First Due times often exceed five minutes. Look inside the City of Redlands. The time difference throughout much of the populated city is small, except in the most southern areas near Station 262 where all supporting responders must come from the north.

As a bonus exercise, create thematic legends for all layers in the Run Order Group and design a separate map for each. Load these maps into Microsoft PowerPoint to create an informative slide show.

Run Order Benefits and Limitations

Run orders provide emergency responders with an accurate, reliable way to model complex responses with travel from multiple locations. This workflow counts on response from fixed facilities with all responders who are dispatched simultaneously. This method works well for a static, districtwide model that includes automatic and mutual aid. As mobile dispatching and automated vehicle locators (AVL) become widely deployed, this workflow will need to be simplified to speed up individual event dispatching.

In more complex scenarios, appropriate lag times are applied to manually requested resources and volunteer responders to reflect additional time necessary for their departures. Also, unavailable units may be removed from the response stack. Apparatus types and personnel counts may also be included. As a word of caution in rural areas: when modeling long stretches of country roads, be sure to break street segments into appropriately short intervals.

Acknowledgments

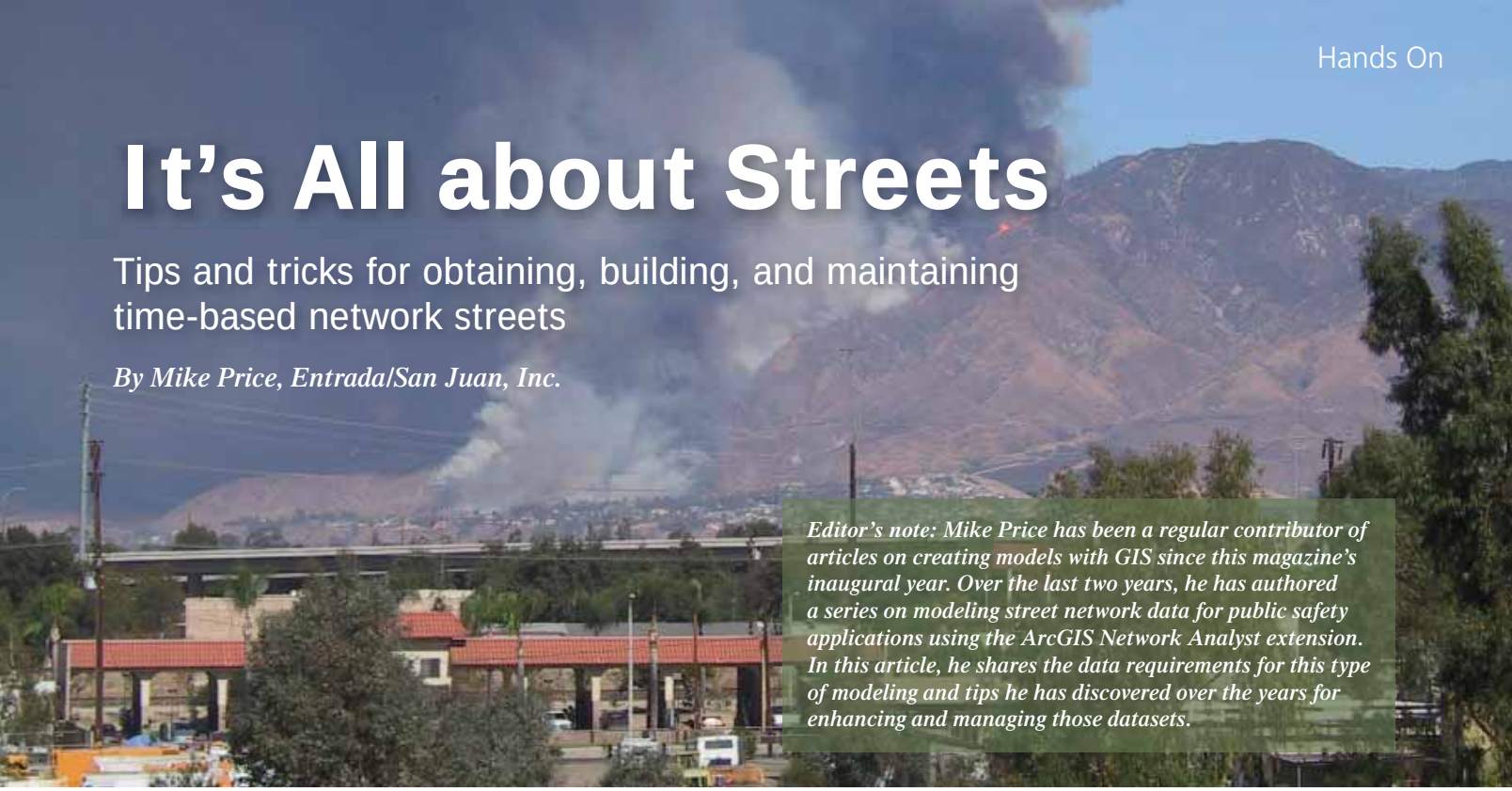
Thanks to Chief Jeff Frazier and his staff at the Redlands Fire Department for providing fire station apparatus and personnel information and the staff of the City of Redlands GIS for the use of their excellent data. Special thanks to Tom Patterson and Russ Johnson at ESRI for helping make this exercise a reality.

For more information, take the ESRI instructor-led course *Working with ArcGIS Network Analyst.*

It's All about Streets

Tips and tricks for obtaining, building, and maintaining time-based network streets

By Mike Price, Entrada/San Juan, Inc.



Editor's note: Mike Price has been a regular contributor of articles on creating models with GIS since this magazine's inaugural year. Over the last two years, he has authored a series on modeling street network data for public safety applications using the ArcGIS Network Analyst extension. In this article, he shares the data requirements for this type of modeling and tips he has discovered over the years for enhancing and managing those datasets.

It's often said, "Time is of the essence." This is certainly true when it comes to modeling networks for public safety response.

I now believe that finding/creating and supporting an accurate, reliable street network is the single most important part of building and using any public safety model. Unfortunately, locating or creating a network-ready street set that is current, is complete, and contains the necessary attribution is not easy.

Here are some tips and tricks that I use to find, enhance, and maintain a quality network street dataset. If you are new to modeling networks with ArcGIS Network Analyst or would like a refresher course on time-based response modeling, visit the Learn How to Model Networks page at *ArcUser Online* (www.esri.com/news/arcuser/avmodel.html).

Finding Street Data

When I model networks, I may use one of four different street data sources: simple Census TIGER streets, StreetMap in the ESRI Data & Maps DVD set that comes with ArcGIS, commercial network products, and customized datasets that are often built by a local jurisdiction or its GIS partner. Here is a brief summary of these data types.

Census TIGER Streets

TIGER streets, part of Census 2000 TIGER/Line Data, is a free source for streets. County TIGER streets may be downloaded from ESRI's Free Data Web page (www.esri.com/freedata). The Census 2000 TIGER streets are outdated, and I'm waiting for the Census 2010 update. TIGER spatial geometries are approximate and they do not directly contain time impedance. The Census Feature Class Code (CFCC) may be joined to the streets to obtain typical speeds. For an early tutorial on using Census TIGER streets, see "Taming TIGER Data," an article on the *ArcUser* Web site at http://www.esri.com/news/arcuser/0103/files/tiger.pdf.

ESRI Streets

For years, ESRI has provided StreetMap in *ESRI Data & Maps,* which ships with ArcGIS. To see these streets, locate the StreetMap DVD on a current *ESRI Data & Maps* DVD set. These streets do include speed limits but compare this information with local signage. You may want to clip your favorite areas and save them as shapefiles or file geodatabases. ESRI also sells StreetMap Premium (www.esri.com/data/streetmap), which provides streets that readily support geocoding and routing. Point-to-point routing is also available through the ArcGIS Online routing service at www.esri.com/agotasks.

Commercial Streets

Tele Atlas and NAVTEQ are the two major commercial network street providers in North America. Commercial streets are available by subscription and include periodic updates. Vendors of street data also encourage users to provide current content.

Tele Atlas provides digital maps and dynamic content that power essential navigation and location-based services. The company provides several products, including its MultiNet geocoding and routing dataset. MultiNet streets incorporate a full suite of capabilities, allowing users to locate the people and services they need quickly; reach their destinations via safe, reliable, and customizable routes; and use the clearest, most visually compelling maps available. Check out the MultiNet streets at www.teleatlas.com/OurProducts/MapData/Multinet/index.htm.

NAVTEQ provides high-quality street data to partner developers that incorporate it into many applications. Visit NAVTEQ Map online at www.navteq.com or contact NAVTEQ and find a partner vendor that can provide data for local needs.

Custom Street Datasets

Local agencies often create their own street centerline and travel lane data using a variety of sources including orthophoto digitizing, GPS data collection, and engineering drawings. These datasets are typically customized to meet local needs. They may be good for either geocoding or networking, but not both. Since they are supported locally, work with these providers to extend the capabilities of these datasets. To see several local datasets, check out the article, "Do It Yourself—Building a network dataset from local agency data" at www.esri.com/news/arcuser/0609/files/doityourself.pdf and "Managing Volunteer Firefighter Response—Using the OD cost matrix to model personnel availability" at www.esri.com/news/arcuser/0507/files/odmatrix.pdf.

Continued on page 48

It's All about Streets

Continued from page 47

Enhancing Street Data for Networks

Here comes the really important stuff! When you are sourcing (or have already obtained) a street dataset, what important network issues should you address? In a recent *ArcUser* article, "Do It Yourself—Building a network dataset from local agency data" (referenced above), I introduced several important issues you should consider when preparing a dataset for network modeling. Here are key issues that can be tackled by spatial and attribute editing.

Impedance—Distance

To properly calculate travel time, you need accurate distances. In a well-defined and documented model, distance-based impedance is easy to calculate. If your streets are registered in a standard projected coordinate system, you can readily calculate and verify distances between intersections in the native coordinates. If you are careful, you can calculate distance in a geographic data frame or across the metric/imperial measurement divide.

I use a field named Length_Mi to store travel distance. Since this is not a reserved field name, you must specify this field and its units when you build a network. I do not use the field name Length, as I often store length in multiple units of measurements (both metric and imperial) and certainly do not want to confuse these systems. As you edit your network dataset, recalculate segment lengths frequently, especially before you rebuild a network.

Impedance—Speed

A reliable time-based impedance (or speed) field is essential. Many agencies start with posted or ordinance speeds and factor them up or down, depending on policy, persistent travel constraints (such as slope and turn radius), and variable travel factors (weather, traffic, and disruptions, to name a few). Measured travel times allow a user to fine-tune speed-based impedance. Once directionality and connectivity issues are resolved, the segment length in miles and travel time in minutes can be calculated. If you use a field named Minutes, Network Analyst will recognize it immediately. Remember to recalculate segment length, then travel times on all street segments (or at least the ones edited) each time you finalize an edit session and before you rebuild your network. Be sure to edit or remove all zero-time segments in the dataset before you rebuild.

Crossing Relationships

Overpasses and intentionally nonconnecting crossings are two of the most difficult and important issues to address. Commercial streets use an integer code or Z elevation/Z level to manage crossing geometries. The Z elevation fields (from and to) specify whether traffic may turn at an endpoint intersection. To turn or traverse through an intersection, the endpoint of the traveled segment must match the start point of the new segment. Most simple networks will use only Z values of 0 and 1. However, a Los Angeles County commercial dataset that I recently modeled included Z elevation values up to 4. If you add new streets to a dataset that uses Z elevations, be sure to correctly populate this field.

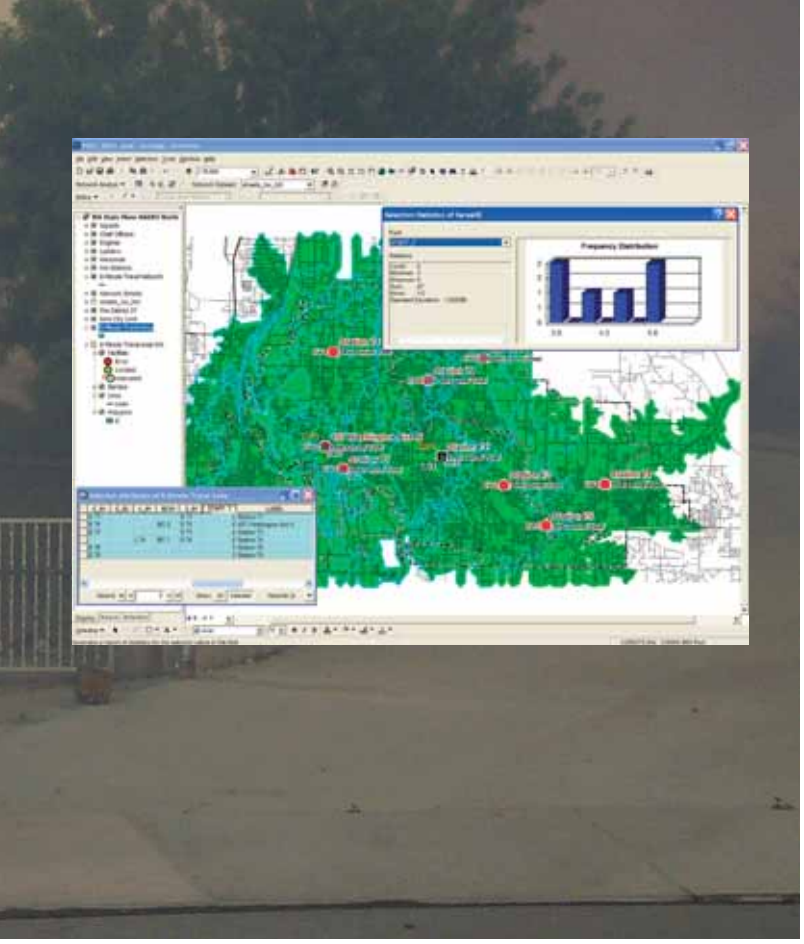
A simpler way to manage crossing relationships, especially streets not also used for geocoding, is to build nonintersecting crossing geometries and apply endpoint connectivity. These streets are much easier to edit and visually inspect, and they perform much better if you are using lidar terrain to define slope impedance.

Connectivity

Connectivity defines how an individual element in a network relates to its neighbors. Simple connectivity options include endpoint and any vertex. I strongly recommend that you use endpoint connections. See Crossing Relationships, in the previous section, for more information.

Simple single-layer networks must have exact endpoint connections to function properly. I find that nonconnecting segments are the most common issue that will cause a network to fail. Use visual inspection, polyline topology, editing, and/or old-fashioned trial and error to define, repair, and maintain connectivity.

If you use a multimodal network that includes several feature classes, connectivity between participants is defined with special rules. Remember that you must place all participating feature classes in a single feature dataset to build multimodal models.



Directionality

Travel direction is critical when modeling one-way travel on divided highways, boulevards, one-way streets, and even individual travel lanes.

When streets are digitized, the digitizing direction creates an underlying street direction. To manage travel along or against this direction, a two-character text field named One_Way provides an effective way to flag travel direction relative to digitizing. Simple FT (from-to) and TF (to-from) codes define the course along and against the digitized direction. To check directionality against digitized direction, place small arrows at the terminating end of the street segment. Code a selected segment FT if travel is along the elements direction; use TF if travel opposes. In an edit session, also watch for the segment's red endpoint; it also represents the terminating end.

If your street network will not support address geocoding, you may also flip the street direction to reflect actual travel. Again, check out "Do It Yourself—Building a network dataset from local agency data" to learn this workflow. If you do use streets for geocoding, you may still reverse its direction, but you must reassign the left/right to/from values to respect the new orientation. This difficult task requires attention to detail, and I do not recommend it for beginners.

When you build a network dataset, Network Analyst will recognize the One_Way field and create the appropriate rules. When using the network, you will have the option to globally turn the One Way property on or off.

Turns and Turn Relationships

In a time-based network, turns and intersection slowdowns are very important. Global turns may be quickly applied throughout a network. As you build your network, use actual field times to calibrate them throughout your jurisdiction. You will probably find that travel times under constant low volume will vary slightly throughout your area. Experiment with global turns to achieve a best average. Field testing is described in "Convincing the Chief—Proving that time-based networks really work," an article that appeared in the Spring 2009 issue of *ArcUser* and that is also available from the Network Modeling, Learn How to Model Networks Web page (www.esri.com/news/arcuser/avmodel.html). These Hands On articles build skills.

If you want to model individual turn penalties for many or all intersections, you can create individual rules for all intersections. This is a complex procedure that I do not recommend for people who are new to working with networks.

Dont Give Up

Stay with it. As you refine your network, you will be amazed with the possibilities. Building a reliable time-based network is not an easy task, and tuning and maintaining it are even tougher. Do not be discouraged. There are probably many potential partners in and around your jurisdiction that might want to help. In addition to finding some help in creating and maintaining your network data, here are some strategies for making the job easier.

- **Start Small**
  Build a small network in an area that you know well. Experiment and tune it to match field tests. Carefully watch how the network behaves as you build small service areas and test routes. If impedance, connectivity, geometry, and travel direction misbehave, practice fixing and rebuilding them. Test, and test, and test!

- **Think Big**
  Ultimately, your network will probably support the response efforts of many jurisdictions. Talk to your neighboring jurisdictions and develop partnerships. Collectively decide to obtain/create and maintain just one network dataset.

- **Keep Both Eyes Wide Open**
  Continually monitor your network's behavior. Repair problems individually or in small groups. Rebuild and retest problem areas. Do not be discouraged if fixing one problem just reveals another.

- **Document Your Work**
  Develop a method to track edits and network builds, especially when adding new segments and modifying attributes. When you build the network for the first time, before you click the Finish button, save your parameter summary to a text file with a date stamp. If you ever have to present and defend your work, you will be glad you did. I have presented network models to the legal community, and this information is priceless.

- **Back Up and Try Again**
  Occasionally, a network dataset becomes quirky or even corrupt. Do not hesitate to delete the problem set and rebuild using the same parameters. If you use a standard naming convention, you might be able to reuse the same dataset in an existing ArcMap document. Be very careful with this, though. You might have to remove the repaired dataset from an existing ArcMap document and rebuild all the solvers. I have had mixed success with replaced datasets and consider the jury to still be out on this strategy.

Modifying Values in ArcPad

Letting field-workers "have it their way"

By Craig Gallant, LJB Inc.

Every good form for field data collection needs some user input. However, no matter the amount of front planning, that field crew worker is always going to want one more choice.

With the release of ArcPad 8.0 (which now includes ArcPad Studio), it is a good time to optimize existing code or begin planning more efficient code for new projects. This article assumes you already have a project and want to improve the interaction of users with your form using combo boxes and simple INI files.

A ComboBox is a commonly used graphical user interface that is a combination of a drop-down list and a text box. It allows the user to either directly type a value in the field or choose a value from a list.

A ComboBox could be used on a form for locating fire hydrants. The names of several types of fire hydrants could be stored in a ComboBox so the user chooses rather than enters the name. Values are added to the ComboBox using the List Values tab. The downside to this approach is that every time a new item needs to be added to the combo box, that change must be made in the office, then saved to each field unit.

Another solution might be to use an external list from a database. The advantage with this approach is that values aren't added to the form. Any database table can be used as a list for the combo box. However, with both approaches, values can't be easily changed in the field.

However, storing all ComboBox values in a list in an INI file will allow users to change the ComboBox values in the field. An INI file is a simple text file with a header in brackets and a list of items. This type of file has been around for a long time. While it might be considered out of date, especially given the popularity of using XML files, an INI file is particularly beneficial in this situation because the end user can open a simple text file editor, such as NotePad, and simply add to the list. The end user doesn't have to worry about the nodes and structure of an XML file.

While being able to edit the combo boxes outside ArcPad has its merits, there needs to be a way to edit the values inside the program too.

The Solution: Add a Preference Form

One way to edit values in ArcPad is to add a preference form to the application. Here's how to do it.

Open an existing applet or create a new applet. Click the Forms button on the main toolbar.

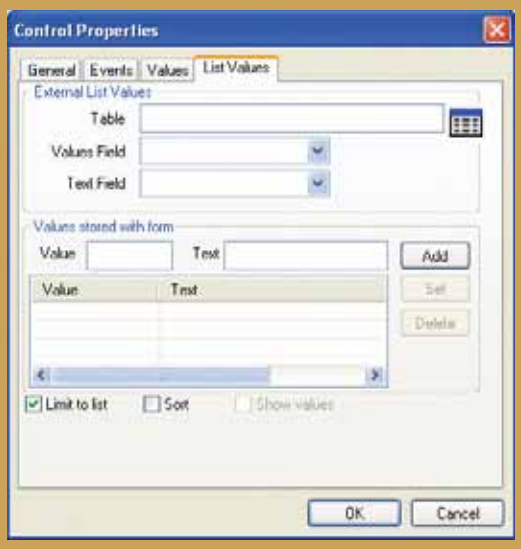
When the Forms dialog box opens, click the Add button to add a generic form to the applet that is not associated with any layer. Because this form isn't associated with a layer makes it good for a preference form that can be used for several different applications.

On the new form, place a label, combo box, check box, text box, and three buttons. This format can be used for multiple pages to help keep a consistent look and feel for the preference dialog box. Now that the controls are on the form, events can be wired up for each control.

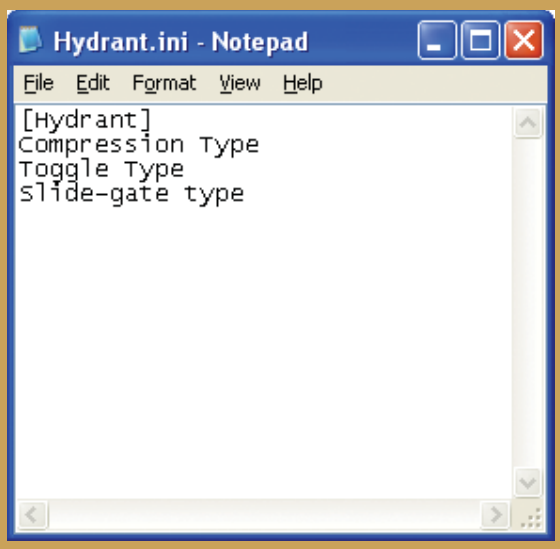
Onload Event for the Form

Let's start with the onload event of the form. (Refer to Listing 1.) First, add a global variable with a value of true. This will be used throughout the form to tell the ComboBox whether to read the INI file every time this control gets the focus.

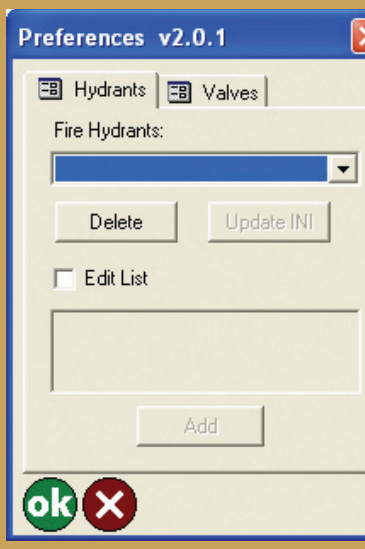
Set the initial status of the controls as shown in Listing 1. Set the enabled property for the Add button, update button, and text box values to false. Then set the check box value to 0. This is the unchecked value.



The properties of the ComboBox controls are shown on the List Values tab.



The Hydrant INI file from the sample application is shown in Microsoft Notepad.



The completed Preferences dialog box.

What You Will Need
- ArcPad 8.0
- ArcPad Studio 8.0
- Microsoft Notepad
- Sample dataset downloaded from *ArcUser Online*

```
Dim pAppPage
Set pAppPage = Application.Applets("Demo.apa").
       Forms("frmPref").Pages("pgPage01")

'Global variable for ComboBox
Application.UserProperties("strCboUpdate1") = _
       "True"


pAppPage.Activate
pAppPage.Controls("btnAdd1").Enabled = False
pAppPage.Controls("txtEdit1").Enabled = False
pAppPage.Controls("txtEdit1").Text = ""
pAppPage.Controls("chkEdit1").Value = "0"
pAppPage.Controls("btnWrite1").Enabled = False
```

Listing 1: onload event

OnSetFocus Event

The OnSetFocus is next. (Refer to Listing 2.) This event reads the INI file and fills in the ComboBox list associated with it. In the OnSetFocus event, add an if statement that checks to see if the global variable is true or not. If the variable is true, then call the LoadCombos subroutine inside the VBScript in the applet and pass the values for the combo box.

```
'Check to see whether to read INI file or not
If Application.UserProperties("strCboUpdate1") = _
       "True" Then
   'Call the LoadCombos sub and pass arguments
   'Form name, Page name, Control name, INI file
   'name
       Call LoadCombos("frmPref", "pgPage01", _
              "cboHydrant", "Hydrant")
End If
```

Listing 2: OnSetFocus event

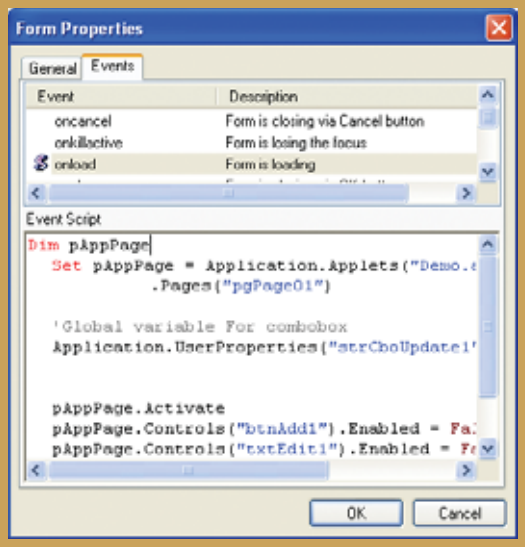
OnClick Event of the Delete Button

The OnClick event of the delete button has an if statement that checks to see if the combo has a value selected. (Refer to Listing 3.) If a value is selected, the item is removed from the ComboBox list and the update button is enabled. The last thing to do is set the global variable to false so the ComboBox will not reread the INI file and add back the item that was just deleted.

```
Dim pTheComboBox , pWriteButton, strDeleteValue
Set pTheComboBox = Application.Applets _
       ("Demo.apa").Forms ("frmPref") _
              .Pages("pgPage01") _
                     .Controls("cboHydrant")
Set pWriteButton = Application.Applets _
       ("Demo.apa").Forms("frmPref")_
       .Pages("pgPage01").Controls("btnWrite1")

'Check to see if ComboBox has a value selected
If pTheComboBox .value <> "" Then
       strDeleteValue = pTheComboBox .Value
  'Remove selected value from combo box
       pTheComboBox .RemoveItem strDeleteValue
       pTheComboBox .ListIndex = 0
```

Continued on page 52



The onload event as it appears on the Events tab of the Form Properties dialog box

The toolbar dialog box

Modifying Values in ArcPad

Continued from page 51

```
        'Enable the save button
        pWriteButton.Enabled = True

        'Do not reread INI file
        Application.UserProperties _
               ("strCboUpdate1") = "False"

End If


'Clear variables
Set pTheComboBox = Nothing
Set pWriteButton = Nothing
Set strDeleteValue = Nothing
```

Listing 3: OnClick event of the Delete button

OnClick Event for the Update Button

The update button writes the INI file from the list in the combo box. (Refer to Listing 4.) In the OnClick event of the update button, add the call to the WritePrefs subroutine in the applet's VBScript to pass it the values for the INI file. Next, set the update button to enabled and its value to false. This is done so the event cannot be called again until something changes.

```
Dim pWriteButton
Set pWriteButton = Application.Applets _
       ("Demo.apa").Forms("frmPref")_
              .Pages("pgPage01")_
                     .Controls("btnWrite1")

'Call the WritePrefs sub and pass arguments
'Form name, Page name, Control name, INI file
'name, Header title
Call WritePrefs("frmPref", "pgPage01", _
       "cboHydrant", "Hydrant", "Hydrant")


'Disable the save button
pWriteButton.Enabled = False


'Clear variables
Set pWriteButton = Nothing
```

Listing 4: OnClick event for the Update button

OnClick Event for the Check Box

The check box OnClick event enables the text box to be editable. (Refer to Listing 5.) Modify the check box by adding an if statement to verify if the value has been checked. If the value is checked, the enabled value is set to true for the text box and the add button. If the value is false, the enabled value is set to false for the text box and the add button.

```
Dim pTheCheckBox, pTheTextBox, pAddButton
Set pTheCheckBox = Application.Applets _
       ("Demo.apa").Forms("frmPref")_
              .Pages("pgPage01") _
                     .Controls("chkEdit1")
Set pTheTextBox = Application.Applets _
              ("Demo.apa").Forms("frmPref")_
                     .Pages("pgPage01") _
                        .Controls("txtEdit1")
Set pAddButton = Application.Applets_
       ("Demo.apa").Forms("frmPref")_
              .Pages("pgPage01") _
                     .Controls("btnAdd1")


If pTheCheckBox.Value =
   'Enable the textbox and the add button
       pAddButton.Enabled = True
       pTheTextBox.Enabled = True
Else
   'Disable the textbox and the add button
       pAddButton.Enabled = False
       pTheTextBox.Text = ""
       pTheTextBox.Enabled = False
End If


'Clear variables
Set pTheCheckBox = Nothing
Set pTheTextBox = Nothing
Set pAddButton = Nothing
```

Listing 5: OnClick event for the check box

OnClick Event for the Add Button

The last thing on this form is the OnClick event for the add button. (Refer to Listing 6.) Add an if statement to verify if the text box has a value. If the text box contains a value, add that value to the list for the ComboBox and clear the value from the text box. Next, enable the Update button and set the global variable to false so the ComboBox will not reread the INI file and erase the value that was just added.

```
Dim pTheComboBox , pTheTextBox, pWriteButton, _
       strAddValue
Set pTheComboBox = Application.Applets _
       ("Demo.apa").Forms("frmPref")_
              .Pages("pgPage01") _
                     .Controls("cboHydrant")
Set pTheTextBox = Application.Applets _
       ("Demo.apa").Forms("frmPref")_
              .Pages("pgPage01") _
                     .Controls("txtEdit1")
Set pWriteButton = Application.Applets _
       ("Demo.apa").Forms("frmPref")_
              .Pages("pgPage01") _
                     .Controls("btnWrite1")


'Check to see if textbox has a value
If pTheTextBox.Value <> "" Then
       strAddValue = pTheTextBox.Value
       'Add textbox value to combo box
       pTheComboBox .AddItem strAddValue, _
              strAddValue
       pTheComboBox .ListIndex = 0
```

```
        pTheTextBox.Text=""

        'Enable the save button
        pWriteButton.Enabled = True

        'Do not reread INI file
        Application.UserProperties _
              ("strCboUpdate1") = "False"
End If

'Clear variables
Set pTheComboBox = Nothing
Set pTheTextBox = Nothing
Set pWriteButton = Nothing
Set strAddValue = Nothing
```

Listing 6: OnClick event for the Add button

That is all that needs to be done to the preference dialog. If you have multiple combo boxes on a form, add more pages to the preference form. With very little change to the code above (e.g., renaming buttons and INI files), the code can be used for many different combo boxes. The final thing to do is add some code to the script file of the applet.

Combos Subroutine

By putting the code in subroutines, this code can be accessed and (mostly) reused by multiple forms. First, add the Update global variable in the script file to tell the ComboBox to load the first time it gets the focus. Second, add the variable INIPath. (Refer to Listing 7.) The INIPath variable saves the location where the INI files are stored on the computer. It is a good idea to keep all INI files for a particular application together. This allows the use of only one variable, and it makes it easier to locate them outside of ArcPad.

```
Application.UserProperties("strCboUpdate1") _
       = "True"

Dim INIPath
'Path for the INI file
INIPath = "C:\temp\Water\INI\"
```

Listing 7: Update the global variable.

Next, add the subroutine LoadCombos. (Refer to Listing 8.) This subroutine is the major component of this project. It is called by all combo boxes to fill in the list for each combo box from INI files. This subroutine is passed four values: the form name that is calling it, the page the ComboBox is on, the name of the combo box, and the name of the INI file to read.

After the values are passed to the subroutine, the subroutine reads each line in the INI file and adds it to the list in the combo box. When the end of the file is reached, the subroutine closes the file and erases the variables.

```
'Generic sub to fill ComboBoxes from INI files
'arguments(Form name, Page name, Control name,
'INI file name)
Sub LoadCombos(strForm, strPage, strControl, _
       strINI)
       Dim AplFile, INIvalue

       'Open INI file
       Set AplFile = Application. _
             CreateAppObject("file")
       AplFile.Open INIPath & "\" & strINI _
             &".ini", 1

  Dim pTheComboBox
  Set pTheComboBox = Application.Applets _
       ("Demo.apa").Forms(strForm) _
             .Pages(strPage) _
             .Controls(strControl)

  'Clear contents of the combo box
  pTheComboBox .Clear

  INIvalue = AplFile.ReadLine

  'Add values from INI file to ComboBox
  Do While Not AplFile.EOF
       INIvalue = AplFile.ReadLine
       pTheComboBox .AddItem INIvalue, INIvalue
  Loop

  'Close INI file
  AplFile.Close

  'Clear variables
  Set AplFile = Nothing
  Set pTheComboBox = Nothing
  Set INIvalue = Nothing


End Sub
```

Listing 8: Add the subroutine LoadCombos.

The last thing to be added to this script is the WritePrefs subroutine. (Refer to Listing 9.) This subroutine is passed five values—the name of the calling form, the page the ComboBox is on, the name of the combo box, the name of the INI file to write to, and the header for the INI file.

This subroutine begins by opening the INI file to write in all the values from the ComboBox. Then it writes the first line of the INI file (which is the header). Next, it goes through each item in the ComboBox and writes the value to the INI file. When it gets to the end of the list, the INI file is closed and the variables are erased. This is all that needs to be added to the script file.

```
'Generic sub to write INI file from ComboBox
'arguments(Form name, Page name, Control name,
'INI file name, Header title)
Sub WritePrefs(strForm, strPage, strControl, _
       strINI, strHeader)
  Dim AplFile, pTheComboBox , a

  'Open INI file for output
  Set AplFile = Application. _
       CreateAppObject("file")
```

Continued on page 54

Modifying Values in ArcPad

Continued from page 53

```
    AplFile.Open INIPath & "\" + strINI + _
        ".ini",2

        Set pTheComboBox = Application. _
              Applets("Demo.apa") _
                    .Forms(strForm)_
                    .Pages(strPage) _
                    .Controls(strControl)

    'Write the header of the INI file
    AplFile.WriteLine("[" + strHeader + "]")

    For a = 0 To pTheComboBox .ListCount - 1
        'Move to each item in ComboBox
        pTheComboBox .ListIndex = a
        AplFile.WriteLine(pTheComboBox .Value)
    Next

    pTheComboBox .ListIndex = 0

    'Close INI file
    AplFile.Close

    'Clear variables
    Set AplFile = Nothing
    Set pTheComboBox = Nothing
    Set a = Nothing


End Sub
```

Listing 9: Add the WritePrefs subroutine.

One last piece of code needs to be added to the applet for the preference dialog to work. If there is already a toolbar in the applet, all that needs to be done is add a button to the toolbar. If not, add a toolbar to the applet first, then add the preference button to the toolbar. On the OnClick event of the button, add the code

```
Applet.Forms("thePreferenceFormName").Show
```

This code will display the preference dialog when the button is pressed on the toolbar.

Conclusion

In summary, there are two parts to this strategy. The first part creates a preference dialog that allows editing of the INI files that the combo boxes use for values inside the applet. This allows a simple option to add choices to the combo boxes in the field, when needed, by just pressing a button on the toolbar. Plus, it still allows users to edit the INI text file outside of ArcPad.

The second part is adding the LoadCombos subroutine. This is the subroutine called by all combo boxes, either on the preference form or any form, which has a ComboBox with values stored in an INI file. If you didn't want to create the preference form, you could just add the LoadCombos sub and the OnSetFocus event. The combo boxes will still read the INI files for their values, and the user can still edit the INI file outside of ArcPad with a simple text editor. The disadvantage of reading INI files for combo boxes is that it takes far more programming to get a list of values for a combo box. But, it does add the most flexibility for adding new values.

This is just another choice to pick from when using a ComboBox and is not perfect to use in every instance. Sometimes, just filling in the list values is the best choice when you know all the items and you know the list won't change. This is why a well-planned application is always a good first step to any new project.

For more information, contact
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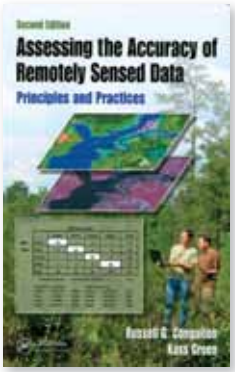
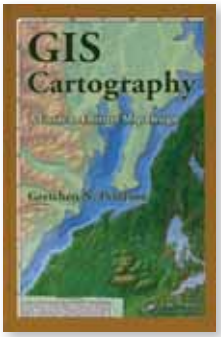


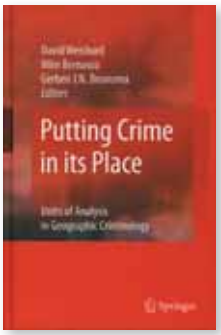
Assessing the Accuracy of Remotely Sensed Data—Principles and Practices, Second Edition
By Russell G. Congalton and Kass Green

GIS has helped promote the use of maps for decision making. Consequently, assessing the accuracy of the remotely sensed data used in creating those maps has become more important. Assessing map accuracy deals with positional accuracy (is the feature located correctly?) and thematic accuracy (is the feature identified correctly?). *Assessing the Accuracy of Remotely Sensed Data—Principles and Practices,* Second Edition, which provides a complete guide for designing and conducting an accuracy assessment, deals with both types of accuracy. Originally published in 1999, this edition contains several new chapters. One chapter furnishes a complete presentation on assessing positional accuracy and its effect on thematic accuracy. New chapters were also added on the use of fuzzy accuracy and assessing accuracy for change detection maps. Finally, a case study on accuracy assessment for the National Oceanic and Atmospheric Administration (NOAA) next-generation C-Cap Pilot project covers the design of the accuracy assessment, data collection, and analysis. The clear explanations of the development and use of primary positional accuracy standards are particularly useful. CRC Press, 2008,183 pp., ISBN-13: 978-1420055122



GIS Cartography: A Guide to Effective Map Design
By Gretchen N. Peterson

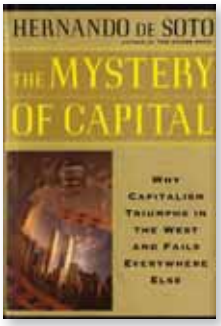
This is first and foremost a practical book for GIS professionals who manage geospatial data, perform analyses on a daily basis, and must produce maps that truthfully portray information in an accessible and (hopefully) artful way. The author, like many readers of this book, came to her position with some design experience but no formal training in cartography. *GIS Cartography: A Guide to Effective Map Design* is not a how-to book in the classic sense and is not tied to a specific GIS software package. While the tone is relaxed and at times humorous, the author is serious when she stresses the importance of taking the time and making the effort to design better maps. The bulk of the book systematically explains cartographic conventions and explores strategies for solving specific mapmaking challenges as they relate to layout design, color, features, and media. Throughout, Peterson urges readers to carefully consider the map viewer whenever designing a map and to continue learning, observing, and experimenting. CRC Press, 2009, 246 pp., ISBN-13: 978-1420082135



Putting Crime in Its Place: Units of Analysis in Geographic Criminology
Edited by David Weisburd, Wim Bernasco, and Gerben J. N. Bruinsma

Although the first crime map, showing the distribution of crime in France, was published in 1829, the selection of the appropriate unit for this analysis has not been systematically addressed. The problem of choosing the level of geography for a study is not unique to the analysis of crime. More commonly referred to as the modifiable area unit problem (MAUP), it has two aspects: scale and aggregation. Geographically based crime studies most often suffer directly from the effects of the second aspect because only aggregated data is available. Choice of scale is indirectly affected because data and the geographic tools available have typically worked at national, provincial, or regional levels. The second section of this volume discusses more recent work showing the value of micro-level studies at the census block or street level. The third section supplies empirical examples of crime place studies.

Contributors to this collection, who come from Europe, the United States, and Canada, were participants in a workshop on the unit of analysis for crime studies held in Leiden, the Netherlands, in 2006. Springer, 2009, 256 pp., ISBN: 978-0387096872



The Mystery of Capital: Why Capitalism Triumphs in the West and Fails Everywhere Else
By Hernando de Soto

Peruvian economist Hernando de Soto posits that it is not lack of wealth or entrepreneurial spirit or some other cultural deficiency that has kept people outside the West from developing capitalism. It has been the lack of the foundation necessary to turn "dead" assets into "liquid" capital: a cadastral system and a network of laws that makes mortgages, common stock, and the rest of the infrastructure that underpins civil society. One of the keynote speakers at the 2009 ESRI International User Conference, de Soto has been an advocate of creating cadastral systems in the developing world and organizing land information. His work, described in *The Mystery of Capital: Why Capitalism Triumphs in the West and Fails Everywhere Else,* has challenged perceptions of how democracies work. Basic Books, 2003, 288 pp., ISBN-13:978-0465016150

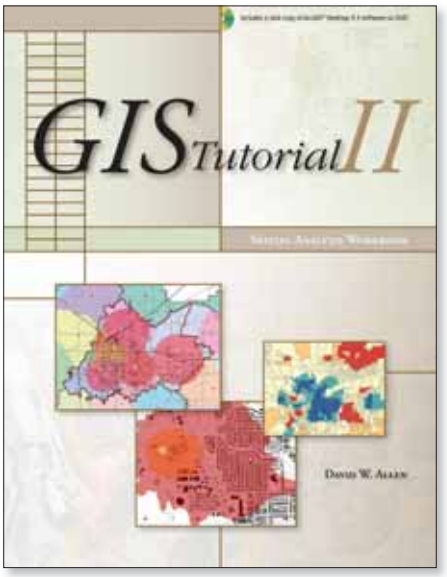
gis Bookshelf

Taking the Next Step

Build analytic skills through realistic exercises

Intermediate GIS users have a way to continue building their skills, specifically in the area of GIS analysis, with *GIS Tutorial II: Spatial Analysis Workbook,* the most recent workbook from ESRI Press. This book is the sequel to *GIS Tutorial, Workbook for ArcView 9,* Third Edition, a popular introductory text for ArcGIS. Other workbooks released by ESRI Press in recent years were targeted at users in specific industries such as health and homeland security.

This text assumes a basic knowledge of ArcGIS Desktop applications and teaches spatial analysis techniques in the context of solving the kinds of problems encountered in the real world. It applies the concepts explained in the two-volume series *The ESRI Guide to GIS Analysis* by Andy Mitchell. Chapters in *GIS Tutorial II* not only correspond to specific chapters in the Mitchell books but also share the same titles.



"Spatial analysis is the problem-solving aspect of GIS," writes David W. Allen, author of *GIS Tutorial II.* "With this book, the reader will not create any new data, but will generate new files based on existing data. That's because analysis isn't about creating new data; it's about making existing data say new things." The topics covered in the book include classification, assessing quantities and densities, location analysis, change detection, value comparision, geographic distribution, pattern analysis, and cluster identification.

Allen is the GIS manager for the City of Euless, Texas, and has worked with GIS in the public and private sectors for more than 25 years. Longtime readers of this magazine may remember Allen as the author of "Fire Hydrant Maintenance Using GPS and GIS," an article that appeared in the January–March 2000 issue of *ArcUser*.

For the last eight years, Allen has also been a GIS instructor at Tarrant County College in Texas and has helped develop the GIS degree program there as well as establishing a state standard for GIS degree programs in Texas.

This book benefits from Allen's real-world experience. The tutorial data was derived from GIS datasets used by local governments, and the scenarios that are the basis for the exercises reflect tasks GIS practitioners are often called on to perform.

In addition to the sample data for completing the exercises in the book, a 180-day evaluation copy of ArcGIS Desktop 9.3 is also provided. *GIS Tutorial II* can be purchased from online retailers, at www.esri.com/esripress, or by calling 1-800-447-9778. Outside the United States, visit www.esri.com/esripressorders for complete ordering options or contact a local ESRI distributor. ESRI Press, 2009, 408 pp., ISBN: 978-1589482012

Getting the Help You Need

Take advantage of ESRI's expanded and enhanced technical support

Beginning in 2008, ESRI focused on improving its technical support with the goal of connecting ESRI users with the help they need as quickly as possible. ESRI significantly expanded its Technical Support Division and continues to make significant investments in people, processes, and technology to deliver a better level of service.

Not only has ESRI hired more technical support staff members but also provides ongoing training for all staff. A training team in Technical Support proactively educates new employees and existing staff on all aspects of ESRI's technology and is highly integrated with the development of new ESRI technologies. This training program has dramatically improved the ability of ESRI staff to support new and emerging technologies.

To more quickly replicate the problems that users may experience, Technical Support recently created a virtual machine repository of the top 80 configurations across all supported versions of ESRI software. Support analysts use this repository, as well as various third-party troubleshooting tools, to reproduce or closely match almost any environment.

The new technical support center in Charlotte, North Carolina, opened in 2008 to better serve the needs of users living on the east coast of the United States. This has extended Technical Support's hours of operation significantly. Support analysts are now available from 8:00 a.m. to 8:00 p.m. Eastern time.

With investments in more staff members, integrated training, and longer hours of operation, the level of service has improved since 2008. Now 95 percent of callers requesting technical support are directed to support specialists the first time they contact ESRI. Typically, callers wait less than a minute before talking with an analyst. ESRI encourages users to call Technical Support directly. For 65 percent of all technical support issues, the first contact results in resolution of the issue in an average time of 46 minutes or less. For issues not resolved with an initial contact, the average resolution time for domestic support requests is one day and for international support requests, the average resolution time is just under two days.

Requests for technical support don't have to be made by phone. Help can be requested by filling out the Web form at support.esri.com or sending free-form e-mails to support@esri.com.

ESRI also has a comprehensive library of self-help resources available at support.esri.com that includes product documentation, discussion forums, and technical articles. The Customer Care Portal and Bugs Online were created as additional self-help resources that let users check on the status of software defects. The User Advocacy Group (UAG), composed of senior technical support and product development staff, meets regularly to identify, prioritize, and address software defects for inclusion in service packs and new product releases.

Customer feedback drives software innovation at ESRI. Many features in new releases of ESRI software come directly from user requests. ESRI encourages users to submit software enhancement requests using the Web form at support.esri.com or by calling Technical Support at 1-888-377-4575.

Do You Want to Be a GISP?

Practical advice on how and why to get certified

By Christa Campbell

Although I have been in the GIS profession off and on, it has always been my goal to focus my career in the GIS realm. That has not always been easy.

After three years away from GIS, I decided to jump back in and get up-to-date. The first obstacle I faced was how to present myself as a professional. While I have a diverse background with strong GIS skills, relying on just a resumé, especially in today's economy, didn't seem sufficient so I decided to get involved again. I enrolled in seminars, went to classes, connected with past colleagues, and attended local user group meetings.

It was at a meeting of the Inland Empire GIS User Group in June 2009 that I first heard about certification as a GIS Professional (GISP). The Southern California Urban and Regional Information Systems Association (URISA) hosted a lunch immediately after the meeting and following lunch, a GISP certification workshop was held. I was curious enough to stay after the meeting and participate in the workshop.

However, even after attending the workshop, I had lots of questions. I was still unsure about GISP certification and decided to find out more.

Some Questions and Answers

What is a GISP? The official definition: "A GISP is a certified geographic information systems (GIS) professional who has met the minimum standards for ethical conduct and professional practice as established by the GIS Certification Institute (GISCI)."

Okay. Now that we know that, what is the GIS Certification Institute? According to the GISCI Web site (www.gisci.org), it is "a tax-exempt not-for-profit organization that provides the geographic information systems (GIS) community with a complete certification program."

This wasn't enough for me. Why waste my time and money on a certification that might not mean anything? My first step was to do a little research.

There are four member organizations in GISCI: the Association of American Geographers (AAG), the National States Geographic Information Council (NSGIC), the University Consortium of Geographic Information Science (UCGIS), and URISA. The GISCI Web site states that certification is endorsed by California, Ohio, New Jersey, Oregon, and North Carolina.

In addition, the National Association of Counties (NaCo) has given its support for GISCI and recognition of GISP certification. As of May 25, 2009, there were 4,492 GISPs. It sounded legitimate.

The Bottom Line

My next step was to find out if GISPs found certification to be a benefit. Have employers started recognizing GISP certification? Do employers require or prefer GISP certification when recruiting for a GIS position?

The answer to all these questions was yes. For many of us, the most significant benefit is in the paycheck. Although none of the GISPs I asked reported an increase in pay, URISA's most recent salary survey (2007) revealed that employees with GISP certification had higher average salaries than their counterparts who lacked certification. Most GISPs I spoke with reported their employer reimbursed them for the application fee.

In addition, GISPs reported they felt going through the application process was beneficial. Many GISPs have testified that the GISP certification helped advance or redefine their careers. They are proud of the accomplishment and believe certification will continue to become more valuable.

Looking for a Job?

Is GISP certification beneficial when you are looking for a new GIS position? I found GISP certification is just beginning to be integrated into the recruitment process when employers are filling a GIS position. While researching job postings, I found only a small number of employers who use GISP certification as a tool to find qualified candidates. Although it was not the norm, I did find several employers that listed a GISP as a requirement to qualify for the position, or desirable.

For example: The City of Raleigh, North Carolina, advertised a GIS technician position that required strong editing skills and GPS field data experience and stated that GISP certification was

preferred. HNTB Corporation in Chicago, Illinois, posted a senior GIS developer position that stated candidates with a GISP were preferred. Axis Geospatial of Easton, Maryland, required GISP certification for its senior GIS specialist/project manager position.

The knowledge I gained from this research made me feel I had a chance to do something significant by getting involved in an important part of the GIS community. I was convinced GISP certification would be an asset so I decided to take the plunge and begin the application process.

More Questions (and Answers)

This decision led to many other questions: What would I need to do? How much would it cost? How long would it take? Is it a lifetime certification?

This is what I found out. To apply for your GISP, you need to put together an application packet containing the Application for GISCI Certification 2009, the GISCI Procedures Manual 2009, the GISCI Code of Ethics & Rules of Conduct Acknowledgment Form, and the Application Packet and Payment Form. Application materials can be downloaded from the GIS Certification Institute Web site (www.gisci.org).

The Application Process

Downloading application materials is the easy part! If you have Adobe Acrobat Professional, you can fill out the application electronically. If you do not, I suggest filling out the application in pencil first. The Application Packet and Payment Form should be the first document you review. It contains

- A letter from Wendy Nelson, the interim executive director
- GISCI Application Checklist
- Payment Form (By the way, it will cost you $250 to submit your application.)
- GISCI Information Questionnaire
- Employer Letter Form

The Employer Letter Form can be used if you would like a congratulatory letter sent to your employer once you have received the certification. You also have the option of participating in the GISCI mentoring program.

Next, you will need to read the GISCI Code of Ethics & Rules of Conduct Acknowledgment Form. This 12-page document explains the GISCI code of ethics and rules of conduct. You are required to sign an acknowledgment form and include it with your application.


Christa Campbell

Reading the GISCI Procedures Manual should be your next step. The 40-page manual tells you step by step what you should be doing to prepare for the application process. The first few pages contain some great tips. The rest of the document walks you through each component of the application. There are three components: Educational Achievement, Professional Experience, and Contributions to the Profession. You will want to have your application available at the same time so that you can review both documents. Most of the work involved in filling out this application will be gathering your data. You will need to be able to answer, in detail, questions about your education, professional experience, and professional contributions. In addition, you will need to provide documentation that supports the information you included in the application.

In total, I spent approximately six hours on the application, not including the time spent requesting documentation from various employers and educational facilities or time spent making copies and compiling the information so that it could be submitted.

Keeping Certification Current

Once you have received your GISP certification, you will be required to recertify every five years. To renew your certification, you will need to show that you have continued working and participating in the GIS industry. The components of the renewal application, very similar to the original certification application, are Course and Conference (educational), Contributions to the Profession, and Work Experience. The requirements for recertification, less than for initial certification, shouldn't be a problem for someone who has remained an active GIS professional.

My Experience

So, here are my thoughts about applying for a GISP. It takes patience and dedication to complete the application process. You have to be willing to give up more than a couple hours of your time. It's not a quick and easy way to get an acronym after your name. My advice: Be sure that you review the point requirements for each section before beginning to fill out the application. It is a lot of work just to find out that you do not have enough points in one of the components. If you review the documentation and have a good idea that you do not meet the minimum requirements for a specific component, you can work on obtaining additional points in that area while gathering your data for the others.

Is it worth it? I think so—for personal and professional reasons. After years of experience with GIS, it is nice to see a certification program that gives GIS professionals some kind of recognition. It is a great way for employers to know that an applicant has a certain level of knowledge. In addition, the application process is a journey through your professional past. It was a great experience for me because it was an opportunity to review what I have done and focus on what I want to do in the future. For more information, contact

Christa Campbell
Tel.: 909-223-8617

About the Author

Christa Campbell has worked in the GIS field for more than 10 years. She began her career working on Digital Nautical Charts for ESRI. Over the next 10 years, she worked in several GIS positions: as a quality control manager reviewing GIS data conversion for the Naval Defense Mapping Agency; as a supervisor in charge of geocoding for Thomas Bros. Maps; and as a technology coordinator responsible for GIS hardware/software, data integrity, data interoperability, analysis, and mapping for the City of San Bernardino (California) Municipal Water Department.

Jump-start 2009 GIS Day Planning

More ways to participate in this worldwide event

GIS enthusiasts around the world unite!

Each year a shared interest in GIS technology is the basis for a global celebration called GIS Day. This year, GIS Day will be held Wednesday, November 18.

Since 1998, GIS users have been sharing their passion for this technology with people in their community who know little or nothing about it. Map galleries, product demonstrations, presentations, training sessions, school assemblies, and geocaching events are all GIS Day activities. Here are a few suggestions to jump-start 2009 GIS Day planning whether this will be the first GIS Day celebration or the eleventh annual event.

GIS Day Has Jumped on the Social Media Bandwagon

Follow GIS Day on social networks for real-time information on new GIS Day materials, recently added events, or quick tips and tricks.

Learn interesting facts, get ideas for events, and find new materials on Twitter.

- To follow GIS Day, search Twitter for the hashtag #gisday (www.twitter.com).
- GIS Day also has a community on Facebook. Supporters upload photos and videos, share ideas, and participate in group discussions. Become a fan today (www.facebook.com).
- View the 2009 GIS Day video, videos from years past, and new footage posted by fellow GIS Day participants at the GIS Day YouTube channel (www.youtube.com/gisdaytv).

Celebrating Can Be Cost Efficient

You can educate others about GIS with little to no budget if you are creative. The GIS Day Web site (www.gisday.com) offers many materials to help with GIS Day planning efforts. Get event ideas from reading success stories on the GIS Day Web site. Here are two suggestions:

- Give a GIS demonstration at a lunchtime brownbag forum for coworkers.
- Host a virtual GIS Day event so participants can attend without leaving their offices.

Get an Early Start

Start by registering your event on the GIS Day Web site to make your event searchable to site visitors. For more information about GIS Day, visit www.gisday.com or e-mail gisday@esri.com.

Learn from the Best

Last year, nearly 1,000 organizations from more than 75 countries celebrated GIS Day. The San Juan County, Washington, GIS Department organized a successful GIS Day event for other county employees and the public. Attendees learned about sources of ready-to-use GIS data as well as low-cost GIS applications that could improve their current business practices. This event provided the perfect opportunity for the county to get feedback about its new interactive mapping application and publicize the county's new map book. Following a presentation, GIS staff answered questions, provided technical support, and demonstrated GIS applications. The day concluded with a seminar specifically for county employees that provided tips for improving workflow efficiency and accessing data quickly and easily.

Can't Leave?

New remote learning options help you keep up with GIS technology

Want to keep up your GIS knowledge and add to your skills despite the curtailed travel budgets and no-travel policies that are becoming common? ESRI has two new ways to deliver high-quality course content to you: on-site training and coaching and video teleconferencing.

Client Site Training and Coaching

For companies that order any ESRI instructor-led training course for a group of 12–15 students, coaching can be purchased. This additional time with an ESRI instructor can be used to address specific team needs or review concepts from coursework and apply them to the organization's workflows using its data. Coaching days are available either immediately prior to or following a training class. No need to worry about having the necessary equipment and software when hosting an instructor-led training class. ESRI can provide a mobile lab with a classroom setup and laptops preloaded with ESRI software for each student.

Instructor-Led Remote Classroom Training

Students at a local ESRI learning center, an ESRI satellite location, or other video-conferencing-enabled facility can interact with an ESRI instructor and fellow students through the use of two-way, interactive video conferencing. Classes are broadcast from an ESRI location in the United States to one or two remote locations. Students can see and hear the instructor lecture, speak with other students, ask questions, and share experiences. The instructor can see students' computer screens and assist them with class exercises. Classes run eight hours per day.

Other Options

Instructor-led Virtual Classroom courses are taught by an experienced ESRI instructor over the Web in real time and are supplied directly to the student's desktop. Students can listen to lectures, interact with the instructor and classmates, and work on exercises through Web-based desktop conferencing.

Instructor-led Virtual Classroom courses, a more recent addition to remote learning offerings, join other options such as Virtual Campus Web-based training (self-paced, independent study courses); Web training seminars (free hour-long presentations and demonstrations focused on a specific technical topic); Instructional Series podcasts (audio presentations on specific software topics); and ESRI Press self-study books on ESRI software, GIS technology, cartography, and spatial analysis.

To register for courses or learn more about ESRI training, visit www.esri.com/taketraining. For training outside the United States, contact your local ESRI distributor.

Increase Efficiency, Productivity, and Knowledge

With new ESRI courses

Six new courses will help keep you current with developments in GIS technology and provide you with strategies for working more efficiently. These courses teach workflows, best practices, and skills to help you become more productive when using different data types, working on mobile or Web platforms, creating maps, or performing analyses. To learn more about these courses and to register for them, visit www.esri.com/schedule.

Authoring and Serving ArcGIS Mobile Projects—
Instructor-Led Course

This course teaches a recommended workflow for successfully creating and deploying an out-of-the-box ArcGIS Mobile project. You will learn how to adapt existing data, maps, and GIS workflows to the mobile environment.

Building Web Maps Using the ArcGIS API for JavaScript—
Instructor-Led Course

This course teaches how to create Web maps that are attractive, fast, and easy to use by their intended audience. You will learn how to build a lightweight, focused Web map that uses internal and external ArcGIS Server Web services.

Creating and Publishing Maps with ArcGIS—
Instructor-Led Course

This course teaches how to employ the elements of good cartography as part of a standard process that you can apply each time you make a map. You will learn to create maps that are easy to interpret and properly designed for their audience and delivery medium.

Performing Analysis with ArcGIS Desktop—
Instructor-Led Course

This course teaches a proven process that can be applied to all types of spatial analysis projects. You will learn strategies for planning an analysis project and techniques for solving a variety of spatial problems.

Working with CAD Data in ArcGIS Desktop—
Instructor-Led Virtual Classroom Course

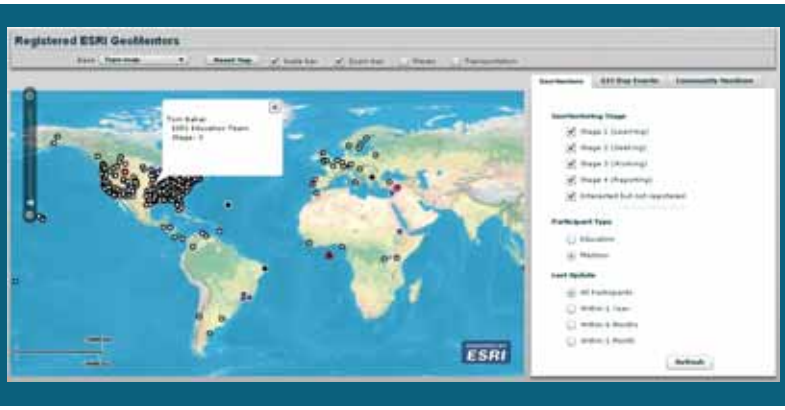
This course teaches fundamental concepts of CAD data integration within ArcGIS. You will learn methods and best practices for working with native CAD data in ArcGIS and converting CAD data to GIS data as well as options for converting GIS data to CAD formats.

Managing Lidar Data in ArcGIS—Web Course

Designed for data managers and GIS analysts, this course teaches how to transform large lidar datasets and prepare them for three-dimensional visualization, modeling, and analysis in the ArcGIS Desktop environment.

Can You Do It?

The challenge to improve geographic awareness



After registering at the GeoMentoring.org site, your location will be placed on the worldwide GeoMentoring map so nearby potential Mentees can contact you through the Web site.

What would it be like if every day was GIS Day?

In the 11 years since its inception, the popularity of this global event has grown and led to celebrations that span many more days than the official observance on Wednesday during Geography Awareness Week. The same impulse that inspired both GIS Day and Geography Awareness Week is behind a new initiative: the GeoMentoring program.

Although geospatial information continues to play a larger and more critical role in analyzing conditions and making decisions in many professions, the level of geographic knowledge and spatial thinking skills of students continues to fall. The GeoMentoring Program goes beyond an annual event that heightens awareness of the importance of geographic knowledge and establishes a resource for improving this type of knowledge all year long.

"The rate of geoliteracy in the United States—meaning the number of people who can synthesize geographic information from a variety of sources and draw a sound conclusion—is frighteningly low," said Daniel C. Edelson, vice president for education, National Geographic Society. "If it is allowed to continue, the inability of most Americans to do even basic analysis of geographic information will have a profound impact on our ability to compete economically, maintain our security, and sustain our environment in coming decades."

What Is the GeoMentoring Program?

The GeoMentoring program is a global answer to this growing need for geoliteracy. Part resource center and part matchmaking service, the GeoMentoring program helps people who know and use geography in their professional lives join forces with educators who want to incorporate activities that teach geography and geospatial technology into the daily curriculum of students from elementary through college levels.

A key part of the program is the GeoMentor Web site, which has tools for seeking a partner, finding activities, acquiring resources, and sharing stories.

The GeoMentoring program was announced by its cosponsors, the National Geographic Society (NGS) and ESRI, on July 13, 2009, at the Plenary Session of ESRI's 29th Annual International User Conference. During the conference, Charlie Fitzpatrick, who is leading the GeoMentoring program for ESRI, and Anne Haywood of the National Geographic Society made several presentations about the program that elicited a lively response from attendees. More than 900 people at the conference indicated their interest in the program by having their conference badges scanned so they could be sent additional information.

On stage at the 2009 ESRI International User Conference, the achievements of Joppatowne High School, Joppa, Maryland, were lauded (left to right: Jack Dangermond, Eric Cromwell, Matt Kelly, Joey Hightower, and Jacqueline Smith).

Who Can Be a GeoMentor?

People from any occupational field who use geography and recognize its importance are welcome to participate in the program. GeoMentors adopt a classroom or run an after-school program that helps both teachers and students see the world around them—at scales large and small—geographically. Activities GeoMentors might engage in range from exercises for younger students that involve paper maps and crayons to long-term GIS projects for older students that benefit the community.

What Does It Take to Be a GeoMentor?

There are four important qualities that a potential GeoMentor should possess: vision, commitment, willingness to learn and share, and a sense of excitement.

Vision

GeoMentors need to share the belief that youth are the future and that understanding geography will help them (our future leaders) make better decisions.

Commitment

While this program carries on and expands the spirit of GIS Day, GeoMentoring is a relationship, not an event. There is no minimum number of sessions or activities required, but the partnership between the GeoMentor and the educator needs time to develop.

Willingness to Learn and Share

GeoMentors listen to the educators they are working with to learn—specifically—what they need to support geographic learning in their classrooms.

Excitement

GeoMentors need to remember why they became interested in geography in the first place so they can convey this excitement to students and teachers.

What Do GeoMentors Do?

The only thing a GeoMentor must do is get to know the needs of the educator-partner. The list of activities a GeoMentor can do is long, varied, and constantly growing. The needs of the educational partner will largely determine which activities an individual GeoMentor undertakes. These activities will evolve with the relationship. These suggestions are just a few examples:

- Lead a very local field trip (around the room, building, or neighborhood) highlighting examples of mappable phenomena.
- Provide maps to hang in the classroom.
- Do a presentation about geography for a classroom or youth group.
- Provide subscriptions to publications like *National Geographic* magazine.
- Bring the class or youth group on a field trip to your work site.
- Help a class/group learn to make maps with GIS.
- Lead an activity using the Geography Action! materials from the National Geographic Web site (www.nationalgeographic.com/geography-action).
- Provide prepackaged lessons that use GIS (www.esri.com/ourworldgiseducation).
- Host a GeoCareers event for a high school class about careers that engage geography.
- Help an educator get to a professional development event—online class, local workshop, regional user group meeting, or ESRI Education User Conference.
- Be a judge at a school or youth group geo event.

More suggested activities are listed on the GeoMentoring.org (edcommunity.esri.com/geomentor) Web site under Activities. Many more ideas can be found on the Web sites linked to the GeoMentoring site.

How Do I Get Involved?

The first step in becoming a GeoMentor is visiting the GeoMentoring.org Web site (edcommunity.esri.com/geomentor) and registering so you can be contacted by potential Mentees. This process requires nothing more than an ESRI Global ID and lets you indicate how you wish to be contacted. Once completed, your location will be placed on the site's map so educational partners near you can contact you through the GeoMentoring.org site.

Making an Impact

Enthusiasm and dedication change students' lives

Sharing geographic knowledge through mentoring can start a chain reaction that enriches the lives of many people. Just ask Eric Cromwell.

During the Plenary Session of the 2009 ESRI International User Conference, Cromwell explained how a chance encounter 13 years ago with a local engineer, who was also a GIS user, ignited his interest in teaching GIS. Now, not only does Cromwell use GIS in his environmental science classes, but he has also had a tremendous impact as a GeoMentor for Joppatowne High School in Joppa, Maryland.

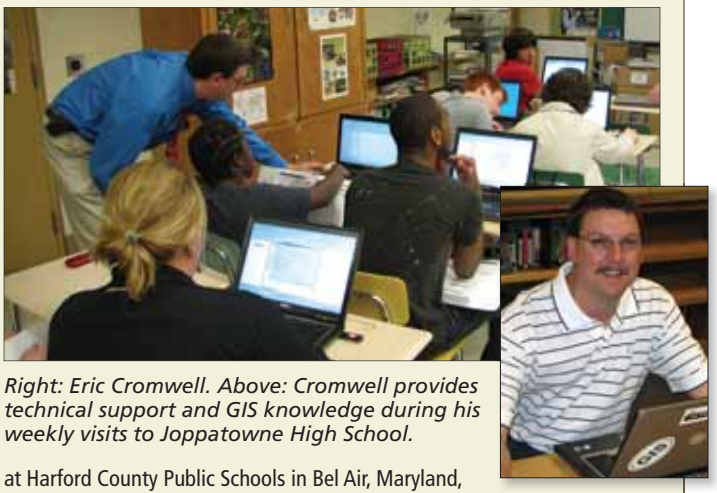
Jacqueline Smith, the science department chair at Joppatowne High School, was inspired by Cromwell and enamoured with GIS despite having no previous experience with the technology. Smith, who already had a busy schedule teaching five classes and coaching three sports, mastered the GIS course content and added it to the school's career path program.

Clearly, Smith feels the results made this effort worthwhile. "The coolest part about this course is the amount of time and energy students are willing to invest on their projects," said Smith. "On many occasions, they would get passes out of their scheduled classes to come to my room to do work—not because they were behind, but because they wanted to do more—they wanted to get ahead."

Using the STARS Curriculum from Digital Quest and ArcGIS software, the 16 students in the Joppatowne High School program have acquired a range of geospatial skills.

Two students from Smith's program class, Joey Hightower and Matt Kelly, joined Cromwell and Smith on stage at the 2009 ESRI International User Conference. They described the projects they have worked on during the past year. By year's end, they will have earned their spatial technology and remote-sensing certifications and hope to intern with local government agencies using these new skills to solve local problems.

Cromwell, who is now the coordinator of Accelerated Learning Programs at Harford County Public Schools in Bel Air, Maryland, visits Joppatowne High School on a weekly basis to supply technical support and GIS knowledge. He continues to wrestle with a temperamental network and an assortment of other less-than-ideal conditions.



Right: Eric Cromwell. Above: Cromwell provides technical support and GIS knowledge during his weekly visits to Joppatowne High School.

In his closing remarks at the Plenary Session, Cromwell challenged the audience to support the GeoMentoring program. "That chance encounter led to what you see here on stage. Imagine what we could do if we were intentional about this. My charge to you is this: first, believe in the kids. Believe that they can use these tools. Second, find teachers willing to say 'I don't know' in front of the kids. That's frightening. Find teachers willing to go beyond what is written on the test. Ladies and gentlemen, let us make every day GIS Day."

Passionate about GIS

T3G Institute develops role models for teaching with GIS

"The opportunity to meet so many different GIS users who had such a variety of uses for GIS was the best thing for me to see. The entire focus for the institute was to learn about GIS and unique ways to present to various learners. It was an outstanding learning experience that will enable me to bring new and extremely useful lessons back to my school and state."

Peter Stetson, Science Teacher, Coventry High School, Rhode Island

"I arrived with doubts about my ability to conduct professional development in GIS, but now I have the confidence to get out there and share how powerful GIS can be in the classroom. The instructors emphasized teaching with GIS versus teaching GIS, and that is what it is all about for me."

Lori Hare, Professional Development Associate, Center for Science Teaching and Learning, Northern Arizona University

Thirty educators who participated in a unique training event held at ESRI this year were challenged to become tireless role models, mentors, spokespersons, and advocates for the infusion of geospatial technologies in educational systems.

In June 2009, educators from across the United States gathered at ESRI headquarters in Redlands, California, for a week of training called the Teachers Teaching Teachers GIS Institute (or T3G Institute). The participants—teachers from middle schools, high schools, community colleges, and universities and those involved in informal education settings—shared a common desire to enhance their ability to use GIS and GPS technologies in their own educational programs as well as learn better methods for teaching and encouraging other educators to do the same.

T3G Institute instructors were Anita and Roger Palmer from ESRI business partner GISetc, GIS education consultants Lyn Malone and Kathryn Keranen, and ESRI instructors Charlie Fitzpatrick and Joseph Kerski from the ESRI Schools and Libraries program and Laura Bowden from ESRI Educational Services.

Success as a GIS educator role model requires skills in three different areas: GIS knowledge and skills, teaching and professional development skills, and supporting technical skills. The institute provided training in all three areas.

"It's great that educators who are passionate about teaching with GIS are equally passionate about sharing their expertise with others," said Malone. "It takes more than good software skills to train teachers to incorporate this powerful tool into educational programs. Educational trainers need to be able to support teachers in the development of projects and data that address both curriculum content and rigorous curriculum standards. They also need to be able to address technical issues such as software installation in a range of computer lab configurations."

T3G Institute participants were selected from a pool of applicants several months before the event. An application process ensured all participants possessed fundamental skills using ArcGIS software and had experience teaching GIS to other teachers.

On Sunday evening, T3G Institute began with an event that allowed participants to meet in a casual setting and let instructors set expectations for the week. Two paper map games, "Topo Match" and "Topo Bingo," got everyone interacting and having fun. (Instructions for these games can be found at edcommunity.esri.com/arclessons.) These games were the first of a variety of instructional strategies for teaching GIS and spatial thinking that would be modeled by institute leaders in days ahead.

Monday morning was the beginning of an intensive week. In general, hands-on GIS lessons began with structured, step-by-step examples from the Our World GIS Education books from ESRI Press and moved to less-structured explorations and investigations as the week progressed.

Participants were encouraged to think about multiple levels of their experience simultaneously. Throughout the week, while enhancing their own GIS software skills, participants also reflected on how they might incorporate different approaches into their workshops or classes. What approach is being modeled? Is this an effective way to learn? How might this strategy strengthen the outcomes of my own workshops? These questions and others were topics of discussion in both small and large groups.

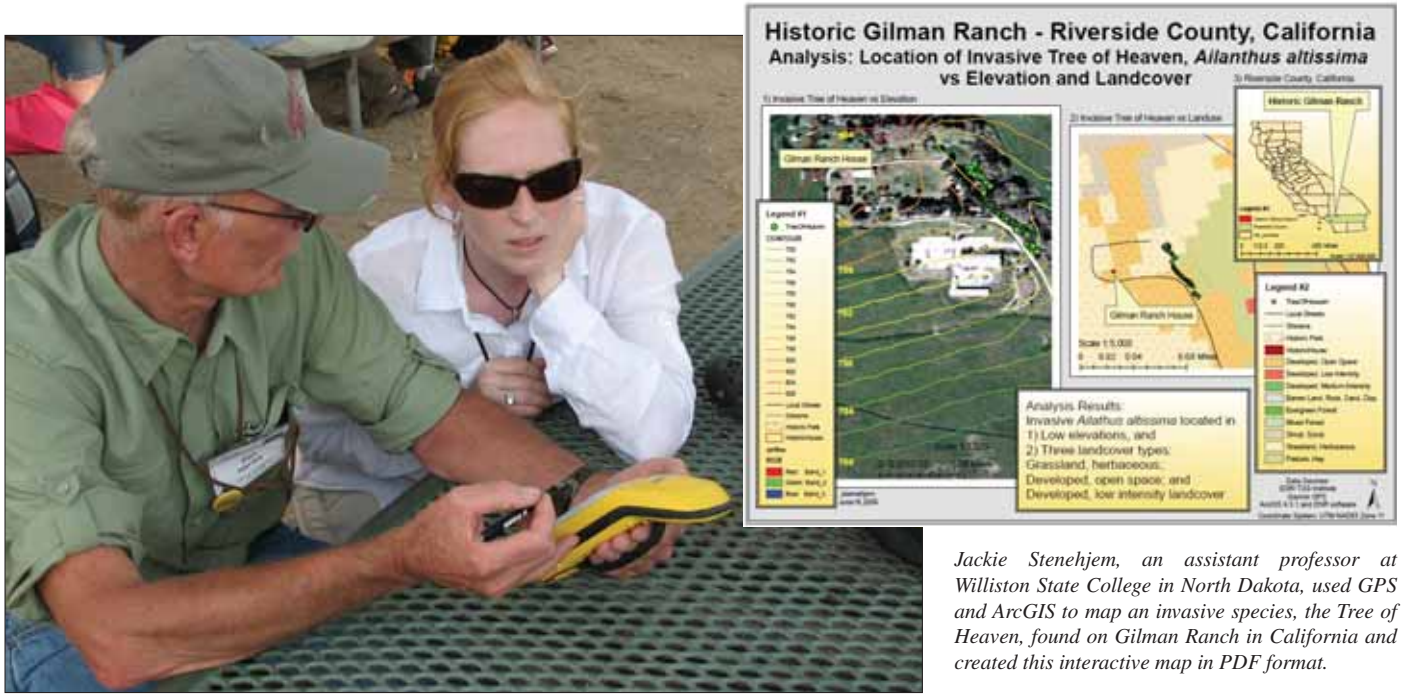
The notion of transfer was also emphasized. For instance, participants were asked, "How can the GIS skills presented in this lesson about earthquakes be transferred to another subject? To another set of data?" Because prebuilt lessons can never fit every teaching need, these teacher-trainers must help other teachers see that out-of-the-box GIS lessons are a starting point. They can modify, expand, and adapt materials to meet their own objectives.

ArcGIS Desktop 9.3.1 software was used for most of the activities. In addition to covering topics, such as creating and populating a file geodatabase, handling map projections and coordinate systems, performing GIS analysis using the ArcGIS Spatial Analyst extension, and exporting maps as PDF documents, participants created mashups in ArcMap using imagery, topographic maps, and layers from ArcGIS Online.

Participants also tried out the new release of ArcGIS Explorer using an early-adopter beta version. They practiced using ArcMap as an authoring tool for symbolizing data and creating layer packages for display in ArcGIS Explorer. They created presentations

"I consider the T3G to be the official start of my career teaching GIS to my students. This was an exceptional institute and was extremely well organized."

Rich Schultz, Assistant Professor of Geosciences and GIS, Elmhurst College, Illinois



Jackie Stenehjem, an assistant professor at Williston State College in North Dakota, used GPS and ArcGIS to map an invasive species, the Tree of Heaven, found on Gilman Ranch in California and created this interactive map in PDF format.

and views, toggled between 3D and 2D map displays, and experimented with other new ArcGIS Explorer functions.

A project incorporating several skill-building activities was centered around a midweek field trip to Gilman Historic Ranch and Wagon Museum, a local park in nearby Riverside County, California. In the classroom, the historic and geographic context of the park was presented using ArcGIS Explorer. Then participants created basemaps of the park using ArcGIS and readily available data. On the field trip, they collected GPS waypoints and tracks and at each point collected data on a variety of phenomena such as roads, trails, extent of invasive species, fruit tree inventory, bird sightings, and temperature measurements.

Back in the classroom the next day, participants downloaded the GPS data into ArcView for display on their basemaps. Using the topic of the data collected as a starting point, each person created map documents, ArcGIS Explorer presentations, or maps exported as PDFs. The resultant maps could become the basis for a class or workshop lesson. Afterward, an impromptu "gallery walk" through the classroom left everyone amazed and inspired.

At the end of each day, participants completed a daily questionnaire that enabled the instructor team to adjust the schedule or fine-tune its approach for the next day to meet the needs of the participants. An evaluation for the full week was given on the last day of the event, followed with a short online survey a month later.

T3G Institute participants are also required to make a presentation, conduct a hands-on GIS workshop for educators, and develop a lesson and post it to the ArcLessons Web site within six months of the class. Toward that end, each participant was required to develop a personal action plan with goals and supporting tasks. They presented these action plans to the group on the final afternoon of the institute. This was seen as a valuable exercise—several participants had revised existing plans or had been inspired to take a new approach to a previous goal.

Fitzpatrick said, "We do not expect attendees to become full-time trainers. We do want them to have new skills, a more vigorous vision for how GIS can be used in instruction, a set of best practices, and support to enhance and expand what they are already doing."

By the end of the week, everyone involved had built a network of enthusiastic peers whom they can call upon for assistance, moral support, and collaboration.

An online group for all T3G Institute participants and instructors was established for ongoing communication and exchange of information and ideas. Follow-up Web meetings to cover additional topics and discuss participant progress and challenges are planned monthly through the end of the year.

During a midweek field trip to a local county park, participants collected GPS waypoints and tracks and at each point collected data on a variety of phenomena such as roads, trails, extent of invasive species, fruit tree inventory, bird sightings, and temperature measurements.

Second T3G Institute

The **2010 T3G Institute** sponsored by ESRI will be held June 13–19, 2010. Apply before Nov. 30, 2009. Forms and information are available at the ESRI Education Community Web site (edcommunity.esri.com).

New ESRI Authorized Instructors

The Authorized Training Program (ATP) is pleased to acknowledge the newest class of ESRI Authorized Instructors. These candidates have passed all ATP requirements and have been granted authorization to teach the specified ESRI courses within the United States. These instructors join a network of more than 400 ESRI Authorized Instructors. For a complete listing of ESRI Authorized Instructors in your area, please visit www.esri.com/atp; contact the ATP by e-mail at atp@esri.com; or call 909-793-2853, ext. 1-2111.

Abbreviations for each course authorization are listed in the table. The course authorizations shown with each instructor listed indicate only the most recent authorization(s) received by that instructor. Visit the ATP Web site for complete information on all authorizations held by an instructor.

Course Abbreviations

AAV	Advanced ArcView 3.x
AG1	Introduction to ArcGIS I (for ArcGIS 9)
AG2	Introduction to ArcGIS II (for ArcGIS 9)
AGD1	ArcGIS Desktop I
AGD2	ArcGIS Desktop II
AGD3	ArcGIS Desktop III
AGSA	Working with ArcGIS Spatial Analyst
AIMS	Introduction to ArcIMS
AV3	Introduction to ArcView (3.x)
BGDB	Building Geodatabases
IAGS	Introduction to ArcGIS Server
LGAD	Learning GIS Using ArcGIS Desktop
MGDB	Introduction to the Multiuser Geodatabase
PAO	Introduction to Programming ArcObjects with VBA
PAOJ	Introduction to Programming ArcObjects Using the Java Platform
PAON	Introduction to Programming ArcObjects Using the Microsoft .NET Framework
PYTH	Geoprocessing Scripts Using Python

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Almost nine months of intensive work was required to digitally restore the Lienzo de Quauhquechollan *to its original appearance by eliminating stains and blurs.*

The lienzo was worn; faded; discolored; and, in places, torn. Identifying locations and deciphering the pictographs were difficult, but trying to physically repair the map's fragile cloth would likely damage it.

Web Map as Time Machine

An ancient story of conquest is heard again

By Monica Pratt, ArcUser *Editor*

Lienzos are maps that tell the story of a place. The story of the *Lienzo de Quauhquechollan,* one of the oldest of these maps, is being told on the Web 500 years after the events it records occurred. A responsive and intuitive Web site developed by the Universidad Francisco Marroquín (UFM) and Geosistemas y Tecnología Avanzada, S.A. (Geosistec), ESRI's distributor in Guatemala, using the recently implemented ArcGIS API for Microsoft Silverlight, has made sharing this cartographic treasure with potentially millions around the world possible.

The Original Multimedia Experience

For the peoples of Mesoamerica, place and past were inseparable. Lienzos not only recorded the details of a geographic location but also communicated what happened there in a form of mapping now described as historical cartography. Graphic symbols designate people, places, and dates while stylized images of plants, animals, rivers, roads, and other features indicate

Continued on page 68

Web Map as Time Machine

Continued from page 67

where the story took place.

Lienzos were not meant to be studied silently by individuals but were performed aloud for groups by a narrator who brought to life the events shown on the map. The story was recited to audiences assembled at market days and other community gatherings.

A Uniquely Important Map

Dating from circa 1530 to 1540, the *Lienzo de Quauhquechollan* tells a story of great adventure—the Spanish conquest of Guatemala. It is an important historical document for many reasons. Not only is it the first known map of Guatemala, but it also provides the only firsthand account by indigenous people of this military campaign.

This account changed previously held beliefs about the conquest of Guatemala. The lienzo illustrates how the Quauhquecholteca of central Mexico, who viewed the arrival of the Spanish conquistador Jorge de Alvarado as an opportunity for enhancing their own power base, allied with his forces to conquer Guatemala.

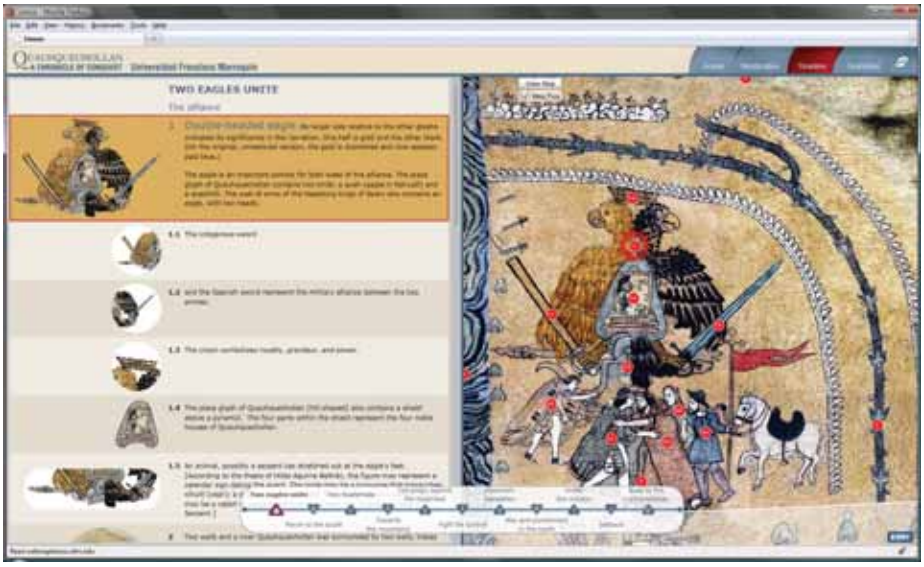
The Quauhquecholtecan artists recorded this triumph on 15 rectangular pieces of cloth. Together, these panels show selected elements, both events and locations, that these artists felt would help listeners best experience the story. The existing map is 10 feet, 6 inches wide by 8 feet, 5 inches long. However, the lienzo did not survive intact. A portion of the right side of the lienzo—perhaps as much as one-third of the original—was cut off.

A Hidden Treasure

The original *Lienzo de Quauhquechollan* had been for many years (and remains) part of the collection at the Museo Casa de Alfeñique in Puebla, Mexico. However, its significance was not initially appreciated because the location of the events depicted had been misidentified. While its pictographs clearly show the activities of Spanish conquistadors, it is Guatemala—not an unidentified area in central Mexico—where these events occurred. Florine Asselbergs, a Dutch archaeologist working on her doctoral thesis, correctly located these events. Her 2004 book, *Conquered Conquistadors: The Lienzo de Quauhquechollan: A Nahua Vision of the Conquest of Guatemala,* is based on her thesis and recounts her findings.

Understanding this type of map with its nonlinear representation of events was difficult for western researchers. Identifying locations and deciphering the pictographs were also challenging because the lienzo was so worn; faded; discolored; and, in places, torn. However, attempting to physically repair the map's fragile cloth would likely distort or destroy it.

The Swipe tool shows the Lienzo de Quauhquechollan *as it appears now and as it did when it was first painted nearly half a millennium ago.*



The Flip tool exchanges the display of the modern map with a scene-by-scene description of events on the lienzo without requiring users to open another window or leave the current one.

Restoring without Destroying

As part of its Explorations on History program, the UFM, in Guatemala City, Guatemala, gathered a team drawn from many disciplines to digitally restore the *Lienzo de Quauhquechollan.* The project, cosponsored by Banco G&T Continental, brought together experts in anthropology, archaeology, epigraphy, ethnobotany, various digital technologies, graphic design, history, lighting, photography, storytelling, and textiles. The project's goal was not limited to restoring the original map digitally. Using the Internet and GIS, the project would make the lienzo accessible to both researchers and the public so its secrets could be unraveled.

Almost nine months of intensive work has resulted in four digital layers that progressively restored the map to its original appearance by eliminating stains and blurs, reproducing the textures of the original canvas, restoring the colors produced by the natural dyes, and reinstating the black outlines of pictograph elements.

From these restored layers, the team created several vehicles for telling the map's story. Embodying the spirit of the original lienzo performance, a narrated and animated feature adds movement and sound to the images of the pictographs. It features an original score based on pre-Hispanic and 16th century Spanish music. An exhibit about the map has attracted more than 18,000 visitors to UFM's

cultural center. An exhibit catalog, *El Lienzo de la Conquista Quauhquechollan—A Chronicle of Conquest,* describes both the map and the project.

Sharing the Story

Although thousands of people have viewed the exhibit and the animated feature, a Web site could potentially share the map's story with millions of people worldwide. UFM approached Luis Fernañdez, president of Geosistec, about making the lienzo project accessible to more people.

"Our goal was to find a way to merge modern cartographic tools with the concept of 'living geography' through which the Mesoamerican peoples communicated stories, legends, and traditions based on collective experience and which had a narrator as the key component," said Fernañdez.

Founded in 1994, Geosistec provides geodatabase management, thematic mapping, and geographic analysis to governments and companies in many fields. The creation of a comprehensive geographic database for Guatemala, El Salvador, and Honduras has positioned the company as a leading provider of geographic content for automated vehicle location (AVL) applications in the Central American region.

Geosistec had created dynamic Web applications for environmental monitoring, telecommunications services, and emergency response. However, the lienzo project was the company's first experience making historic documents and maps dynamically available over the Web. Geosistec has a history of adopting cutting-edge technologies.

After following the development of Microsoft Silverlight technology, the company chose it for this project rather than Adobe's Flex, a more mature technology, believing it to have more potential for rapid evolution. Silverlight has proved to be a strong platform for providing rich functionality and good user interactivity. The responsive, intuitive, and dynamic Web map built by Geosistec uses the ArcGIS API for Microsoft Silverlight.

Although this was the first time Geosistec had used Silverlight, the team of three staff members took just two months from conception to completion—working on a part-time basis. Developing the conceptual design and innovative tools for the site took half the time spent on the project. VisualSVN (Subversion for Visual Studio), a plug-in for the open source version control system Subversion, helped manage the project by sharing multiple versions of the code for easy integration and deployment of the application.

Relating this ancient pictographic map to a modern map presented certain challenges because the lienzo lacks a spatial reference and map units. In addition, its emphasis on the story line meant that a single location might appear several times if more than one significant event occurred there.

Using a timeline handles these problems and performs the function of the traditional narrator. It relates the events and images selected on the lienzo with locations and attributes on a smoothly scaling modern map.

Developing new tools for exploring the lienzo and related geographic content was among the most challenging aspects of the project. The Flip and Swipe tools promote unstructured exploration of the map's information. The Flip tool exchanges the display of the modern map with a scene-by-scene description of events on the lienzo without requiring users to open another window or leave the current one. With the Swipe tool, the user can explore the *Lienzo de Quauhquechollan* as it appears now and as it did when it was first painted nearly half a millennium ago.

Optimizing the user experience while exploring the lienzo and geographic content it depicts and incorporating information compiled by Universidad Francisco Marroquín on the places, symbols, clothing, and plants shown in the lienzo tested the team's mettle. The resultant Web application marries technology and tradition so the story the *Lienzo de Quauhquechollan* tells can be "heard" by people from around the world.

Conclusion

It is often said that maps tell as much about the mapmaker as the landscape. The *Lienzo de Quauhquechollan* project has given modern viewers, used to the conventions of western cartography, a different way of looking at geography—one that is intertwined with history. Deciphering this map has also provided new insights into the historical events surrounding the conquest of Guatemala. The Web site (lienzo.ufm.edu) created by the UFM and Geosistec is retelling the dramatic story of one of the oldest and most striking lienzos to a 21st century audience.

Lienzo de Quauhquechollan at User Conference

Visitors to this year's ESRI International User Conference in San Diego, California, had many opportunities to learn about and meet the people who were involved in the lienzo project. For those who did not attend the User Conference, these resources are available online.

- The Web site A Chronicle of Conquest—Quauhquechollan at lienzo.ufm.edu/cms/en/home.
- Giancarlo Ibárgüen, president of Universidad Francisco Marroquín, gave a paper presentation. A link to his paper is in the online version of this article at www.esri.com/arcuser.
- Ana Lucía Ortíz of the Universidad Francisco Marroquín and Luis Fernãndez, president of Geosistec, gave a presentation on the map restoration project during the Lightning Talks session held at this year's conference. Listen to Living Geography with ArcGIS Server. *Lienzo de Quauhquechollan:* a Chronicle of Conquest at http://www.esri.com/events/uc/agenda/lightning_talk.html.

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