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Article

Highway Data Management in ArcGIS

Interview

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Case Study

**Transportation Network Model and
Network Analysis of Road Network**

Transportation and GIS

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The sector which is very important for keeping the wheels of any economy moving ahead is transportation. It is one of the core sectors for any economy, and its impact on the economic progress of a nation is tremendous.

Whether moving goods and services, or people, or the agricultural produce and commodities to the far flung regions of the country, the importance of an efficient and effective transportation sector is very obvious.

This is one sector which has a major role in the growth of many other sectors- whether it is automotive, agriculture, materials and minerals- any sector we can think of, has a huge dependency on the transportation sector.

Government of India has been focusing on the improvement of this sector, over the past several decades, and, has been investing substantially in the improvement of this sector.

Government of India has identified the inadequacies in this sector with the growing population and a fast growing economy, which include inadequate roads/highways, old technology, saturated routes and slow speed on railways, inadequate berths and rail/road connectivity at ports and inadequate runways, aircraft handling capacity, parking space and terminal building at airports. Today Government aims to modernize, expand, and integrate the country's transport services. It also seeks to mobilize resources for this purpose and to gradually shift the role of government from that of a producer to an enabler. However, the sector has not been able to keep pace with rising demand and is proving to be a drag on the economy. Inadequate survey and feasibility studies, lack of risk sharing, land acquisition, environmental clearances, and inappropriate dispute settlement mechanisms are the major challenges faced by this sector. Major improvements in the sector are required to support the country's continued economic growth and to reduce poverty. With the ever advancement of technology paradigm, the Transportation Professionals, the world over have discovered and embraced GIS as an important tool in managing, planning, evaluating, and maintaining transportation systems. Right from the planning to the operations and maintenance and the expansion of the infrastructure critical for the improvement of the various assets of this sector- like the roadways, sea ports, airports, GIS has been playing a key role across the entire value chain.

The application of GIS to a diverse range of problems has been a boon in Transportation engineering. It is a powerful tool for the analysis of both spatial and non-spatial data solving important problems of Transportation segment.

As the country forges ahead in improving this sector and eliminating the bottlenecks, the role and the deployment of GIS is bound to expand in this critical area.

S Sridhar

President & COO

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Jack Dangermond Selected as 2012 UCGIS Fellow



Jack Dangermond will be recognized as a UCGIS Fellow on May 30.

The University Consortium for Geographic Information Science (UCGIS) has selected Esri founder and president Jack Dangermond as one of its 2012 fellows. Dangermond, who is being recognized for his contributions to the advancement of geographic information

systems (GIS), UCGIS, and conservation, joins Dr. Luc Anselin, Dr. David Cowen, Dr. Max Egenhofer, Dr. Gerard Rushton, and Dr. Waldo Tobler in the 2012 UCGIS Fellow class. The group was formally honored at the UCGIS 2012 Symposium from May 30–June 1, 2012, in Washington, DC.

The grade of fellow is bestowed on those who have had an extraordinary record of accomplishments in any of the spatial disciplines and communities of practice that use spatial information to complement and support their business operations or personal activities.

A landscape architect by training, Dangermond founded Esri in 1969 with a vision that a mapping and analysis framework provides a deeper understanding of our world, enabling people to design a better future. Dangermond's leadership and vision have accelerated the ongoing innovation of GIS technologies that enable people to make insightful decisions and improve the quality of life everywhere. Esri supports a wide variety of global communities using GIS to increase spatial literacy, protect the environment, and assist with disaster response.

India's Top Oil Exploration Company again makes a new headway into GIS

ONGC as we all know is a Fortune 500 Company and is the only and the first ever Indian Company to figure in the Fortune's list of 'World's Most Admired Companies' in the year 2007. Ranked as the number two E&P Company in world (Platt's ranking of top 250 Energy Companies 2011), ONGC remains India's Most Valuable PSU in terms of net profit and net-worth. ONGC has become one of the most prestigious agencies for multidisciplinary synergistic basin scale and domain specific research in exploration. It is equipped with state of the art facilities, soft wares and cutting edge technologies. The organisation caters to the needs of all the basins currently under active exploration and producing Assets, both in India as well as overseas operation by the sister company ONGC Videsh Limited. The state-of-art technological facilities at ONGC include seismic data acquisition, processing and interpretation facilities to Digital image processing and analysis and Data management through GIS. But still ONGC

has a long way to move ahead in the GIS activities where it not only requires GIS for Oil exploration, basin planning, and reservoir analysis etc. using Geospatial technology. Recently ONGC corporate segment incorporated Esri technology that became a de-facto standard for all the geospatial activities and usage viz basin planning, reservoir analysis etc. The enterprise software group of ONGC at Dehradun will host, maintain and scale up the GIS requirement for all future needs of ONGC.

NIIT GIS (Esri India) recommended for ISO 27001:2005 certifications

NIIT GIS Ltd. completed its certification journey for the ISO 27001:2005 accreditation in May, 2012, after DNV conducted the final audit on May 21-22 and made its final recommendation. NIIT GIS has earned the international security standard ISO 27001 certification following a nine-month audit process. The certification audit was conducted in two stages, spanning April and May 2012. The audit coverage included IT services, Information Technology Support, Human Resources, Administration and project.



CGWB undertakes Aquifer Mapping Project to Assess Groundwater Resources

Planning Commission's working group on sustainable groundwater management during the preparation 12th five year plan proposed to take up the Rs. 4800 crore – Aquifer Mapping across the country that will lead to comprehensive groundwater management plans. It was also proposed that the Central Ground Water Board (CGWB) should take the lead in close co-ordination with other organisations including research institutes and civil society organisations.

Central Ground Water Board (CGWB), a subordinate office of the Ministry of Water Resources, Govt. of India, is the National Apex Agency entrusted with the responsibilities of providing scientific inputs for management, exploration, monitoring, assessment, augmentation and regulation of ground water resources of the country. CGWB undertakes this pilot projects on aquifer mapping for accurate assessment of ground water resources, defining aquifer geometry and potential including water quality. This May 2012, The CGWB signed a contract with the Council of Scientific Industrial Research–NGRI to implement a pilot project on using advanced geophysical techniques to map shallow and deep aquifers. The project is being implemented under World Bank-funded hydrology project and would be implemented in Bihar, Rajasthan, Maharashtra, Karnataka and Tamil Nadu over a period of 15 months. CGWB is adopting the new technologies like GIS capabilities based on Esri technology and strengthening Enterprise level of solutions in this vast Project which is being carried out in various states as mentioned earlier.

ArcGIS Online Will Change How You Think about Mapping and GIS

Organizations Can Now Purchase ArcGIS Online Subscriptions and Immediately Unlock Their Geospatial Content

Esri, the global leader in geographic information systems (GIS) has officially released ArcGIS Online for organizations, a groundbreaking service that offers expanded collaboration tools for cataloging, visualizing, and sharing geospatial information.

"ArcGIS Online is a new cloud-based mapping system for organizations that is essentially changing how GIS managers, as well as IT managers, think about mapping and GIS," said Jack Dangermond, president, Esri. "ArcGIS Online works with all types of data and is built on a powerful enterprise mapping platform that lets users simply manage their geospatial content, such as data, maps, images, applications, and other geographic information." Early adopters of ArcGIS Online have realized immediate benefits from extending their existing geographic information to reach more people across the enterprise and the public. The system supports better collaboration among teams and departments by allowing data to be easily integrated and shared. ArcGIS Online provides on-demand, self-serve mapping and is closely integrated with Excel for making maps from spreadsheet data commonly accessible. ArcGIS Online provides new insights and opportunities for organizations to visualize their information spatially and quickly turn these visualizations into web services that can be shared anywhere. Organizations can mash up map services coming from a variety of sources and configure an array of ready-to-use applications that can be embedded and run in browsers and on mobile devices.

Through the purchase of an annual subscription, an organization can obtain a private and secure instance in Esri's cloud that's scalable and ready to use. No additional hardware or software has to be purchased or installed. An organization has access to tools for mapping and location analytics, global basemaps and imagery, demographic information, a library of templates, and applications for browsers and mobile devices.

Users can catalog and discover maps and applications, set up groups to collaborate, and share items with each other, the entire organization, or publicly. For example, without any programming, any user that's part of an ArcGIS Online subscription can quickly share maps by embedding them in a website or blog, through social media, or using a preconfigured web application template. Because ArcGIS Online is integrated with ArcGIS for Desktop and ArcGIS for Server, maps created by GIS professionals can now be made accessible to others in the organization using the same system. Everyone in the organization can view and interact with these maps via a browser, smartphone, tablet, or other mobile device.

Registering ArcGIS for Server services in ArcGIS Online only takes a few steps and puts them into the hands of those who need this information to get their work done. In addition, non-GIS professionals, such as knowledge workers who have a need for GIS, now have a way to quickly create maps from the unstructured information they work with in spreadsheets and text files and share these maps with others who can access them on any device. This type of on-demand and self-

serve mapping frees up GIS professionals from having to respond to constant requests for maps and instead concentrate on making and publishing authoritative information products. An ArcGIS Online subscription also includes access to an API that developers in the organization can use to extend the system or integrate a custom solution with the ArcGIS system.

A flexible, annual subscription plan structured to accommodate different sizes of organizations or departments is available—from small workgroups to an enterprise-wide implementation. What plan to purchase depends on the size of an organization and the online resources it plans to consume. You can purchase separate subscriptions for each department or one large subscription for the entire organization. The subscription plans start as small as 5 users and 2,500 service credits all the way to a multidepartment plan with 1,000 users and 110,000 service credits or even larger for enterprise plans. Regardless of which plan your organization chooses, more users and service credits can be added to the plan at any time.

Service credits are the currency of the ArcGIS Online system. Each service credit entitles your organization to consume a set amount of ArcGIS Online services, such as storing features or tiled map services and geocoding. Providing a pool of credits gives your organization flexibility to use the system to fit your organizational workflows and other needs. Organizations that have an existing enterprise license agreement (ELA) with Esri receive an ArcGIS Online subscription as part of their agreement with a certain number of service credits allocated and unlimited users.

There are three roles in ArcGIS Online: administrators, publishers, and users. Administrators of the ArcGIS Online subscription have the ability to publish and use content and also monitor service consumption through a dashboard. If the dashboard indicates that the service credits are at a low level, more credits can be purchased either online or by contacting Esri. Administrators also have the ability to invite and add users, remove users, assign user roles, delete content and groups, and set and manage the security policy. Administrators also have the ability to customize an organization's ArcGIS Online home page to represent the organization's brand and identity. Customization options include adding a logo and banner, creating a custom URL, and featuring maps and applications important to the organization.

Publishers do not have administrative privileges but can publish content and use content published by others. Users can interact with and consume content but not publish it. It is important to note that organizations retain all the rights and title to, and interest in, any content they publish in ArcGIS Online.

For organizations that didn't have the opportunity to participate in the ArcGIS Online beta program or be part of the early adopters program, a 30-day evaluation is available. To get more details about ArcGIS Online and sign up for the free 30-day trial, visit esri.com/agol.

Build Dynamic Mapping Applications with ArcGIS Runtime

Using ArcGIS Runtime, a new developer technology from Esri, developers can create powerful, lightweight GIS applications that display quickly, deploy easily, and work with the entire ArcGIS system.

ArcGIS Runtime features a new modern architecture for building focused, stand-alone mapping applications for both desktop and mobile devices. Software development kits (SDKs), available from the Esri Developer Network (EDN), make it easy to create compelling custom applications that integrate geospatial data and GIS capabilities. With ArcGIS Runtime deployment can be as simple as plugging in a USB drive.

ArcGIS Runtime on Desktop Devices

Developers can use Windows Presentation Foundation (WPF) or Java to embed dynamic mapping and geospatial applications into existing applications or build new custom ones. Users can author maps, content, and GIS functionality in ArcGIS for Desktop or publish web services, which can be consumed in a custom application. An ArcGIS Runtime application can be a client to ArcGIS for Server or run completely disconnected. Advanced geoprocessing, editing, and analytical capabilities can be integrated into applications built using ArcGIS Runtime.

ArcGIS Runtime will help you

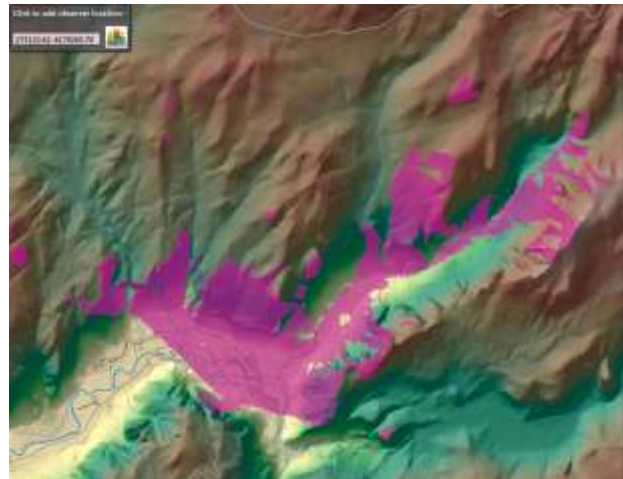
- Rapidly build GIS-enabled applications with out-of-the-box developer controls, templates, and samples.
- Display and navigate maps and data created with ArcGIS for Desktop.
- Create and edit geographic features stored in enterprise and file geodatabases.
- Perform geographic operations that leverage the power of ArcGIS geoprocessing tools.

"ArcGIS Runtime is a new generation of tools for developers," said Rob Elkins, ArcGIS product manager. "It has a very lightweight footprint, meaning it's about the same size as Adobe Acrobat Reader. It doesn't need any administrative privileges to be installed and provides you with very fast capabilities to display maps, do editing, and perform analysis. Developers are able to build an application and leverage it in a focused environment, taking advantage of local hardware to get very fast display performance, for example, with in-vehicle applications."

Here's what you can do with ArcGIS Runtime SDK for WPF and Java:

- Select the capabilities you want, from simple map viewing and navigation to powerful spatial analysis, and create focused applications that are easy to deploy.
- Build touch screen applications for laptops, tablets, or in-vehicle mounted systems.
- Develop location-aware applications that use GPS.
- Create applications using local content, online content, or a combination of both.

ArcGIS Runtime SDK for Java and WPF, for example, provides a set of development tools that allows you to create 2D map applications for deployment onto Windows and Linux platforms. The SDK enables you to integrate remote maps, local maps, and geoprocessing models to create rich



The ArcGIS Runtime SDK for WPF lets developers build GIS mapping applications that take full advantage of the WPF platform.

applications for the desktop.

ArcGIS Runtime SDK for Java and WPF are now in prerelease. All current EDN subscribers, Esri partners, and 2012 Esri Developer Summit attendees can get access to the prerelease version. The official 1.0 release is expected later this summer.

ArcGIS Runtime on Mobile Devices

Esri also offers ArcGIS Runtime SDKs for building and deploying custom mobile mapping applications. These SDKs are integrated with the ArcGIS system and make developing, testing, and deploying applications faster and easier. They combine geospatial data and maps into intuitive mobile applications.

Currently, Esri supports ArcGIS Runtime SDKs on the following mobile platforms:

- ArcGIS Runtime SDK for iOS

Developers can build and deploy applications for iPhone, iPod touch, and iPad. ArcGIS Runtime SDK for iOS is integrated directly with Apple's XCode integrated development environment (IDE) and uses Apple's Objective-C programming language for iOS devices.

- ArcGIS Runtime SDK for Android

Developers can build Java-based mobile applications for the Android platform. ArcGIS Runtime SDK for Android includes a plug-in for the Eclipse IDE that provides a set of tools and a rich, Android-specific API to help developers create custom mobile mapping applications.

- ArcGIS Runtime SDK for Windows Phone

This SDK takes advantage of the Windows Phone application platform, which supports Visual Studio, Expression Blend, Silverlight, and XNA Framework.

Users can access local data and web services in both connected and disconnected environments, collect and report data, perform GIS analysis, and take advantage of the wealth of user-contributed content from ArcGIS Online. After a custom mobile application has been created and tested, it can be distributed through various app stores, marketplaces, or private enterprise networks. Users who have been developing and deploying applications with previously released SDKs for smartphones and tablet devices are already taking advantage of ArcGIS Runtime technology •

Introducing ENVI 5: The Next Generation of Image Analysis

E NVI is the premier software solution for processing and analyzing geospatial imagery. The newest ENVI release makes your image analysis workflow more efficient than ever and allows you to get the information you need more quickly. With a streamlined user interface, a modern high-speed display, new and advanced processing tools, and a flexible API for easy customization, ENVI 5 makes it easier for you to solve problems using geospatial imagery. And, since all ENVI tools are still conveniently accessible from the ArcGIS® toolbox, GIS users can easily add information to their GIS workflow for enhanced mapping applications.

Display Large Data Sets Quickly

As the use of imagery becomes more common in GIS analysis and other scientific applications, the size and volume of the imagery data available to you grows. ENVI 5 has evolved to efficiently process and analyze these large data sets so you spend less time waiting for results, and more time communicating them to the people who matter most.

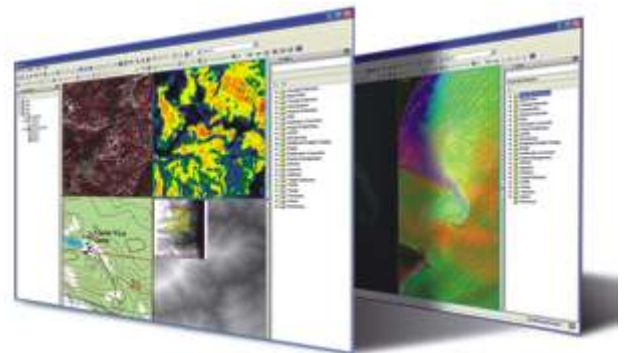
- Rapidly visualize, navigate, and enhance your data with high-speed raster and vector display.
- Display vector data based on attributes to increase your control over visualizations.
- Stretch your image display without the delay of calculating image statistics.
- Define the input stretch parameters based on the full scene or view extent to enhance the display based on your specific needs.



Navigate Through ENVI Menus and Options Easily

Your image analysis solution should allow you to quickly extract information from your imagery without searching for the functionality you need in multiple interfaces. ENVI 5 consolidates menus and options into one, easy to navigate interface, giving you all the analysis tools you need at your fingertips, in an intuitive, single window dynamic display. Now, you can spend more time interpreting your image analysis results, and less time finding tools.

- Maximize the screen display area with a single window paradigm.
- Navigate through your data with the new picture-in-picture over view window that allows for multiple views at once.
- Create multi-view displays to visualize and geographically link multiple images simultaneously.
- Quickly access common image display manipulations with an interactive toolbar.
- Use the new layer manager to toggle on/off and change parameters of vector and raster layers, similar to the interaction within GIS software applications. Save Time with New Automated Workflows and Enhanced Processing Tools



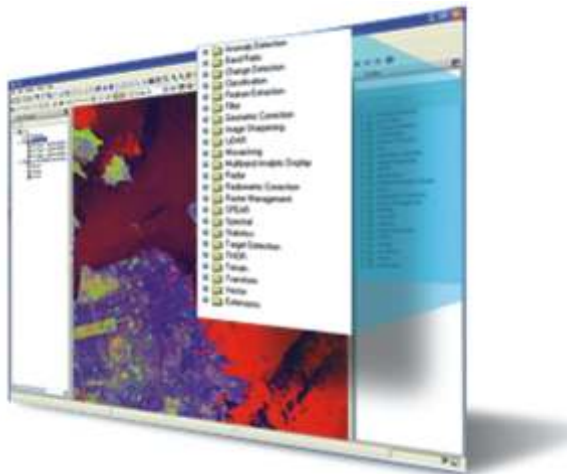
Save Time with New Automated Workflows and Enhanced Processing Tools

ENVI is known for its robust set of image analysis tools and automated workflows that enable you to easily extract critical information from imagery. Now, ENVI 5 includes new automated workflows and enhanced tools that expand your image processing and analysis capabilities so you can quickly get the answers you need from imagery and make more informed decisions.

- Use more input and output parameters in ENVI tools and automated workflows for greater flexibility in your analysis.
- New workflows and enhanced tools allow you to easily create GIS maps and other GIS ready products
- Immediately access the comprehensive suite of tools in ENVI in one searchable and customizable interface.
- NEW classification workflow allows you to classify terrain automatically or with user defined specifications.
- NEW image registration workflow improves georeferencing of your image by tying it to an accurate base map.

using band ratio or feature index techniques.

- NEW feature extraction workflow finds objects of interest using parameters based on user defined rules of spatial, spectral and textural characteristics NEW.
- NEW thematic change workflow performs change detection between image classification results.
- NEW RPC orthorectification workflow corrects imagery to account for terrain and sensor distortion.



Easily Customize Your Image Analysis Functionality

The ability to customize ENVI to your unique project needs has always been a distinguishing feature. Traditionally, customization was only available in the ENVI three window paradigm. Now, with the updated API in ENVI 5, you can

extend all ENVI tools and functionality within the new interface, allowing you to customize ENVI to your specific needs without limitation.

- Access more application elements and batch operations for greater flexibility in ENVI.
- Develop analysis tools and custom projects that are specific to your GIS mapping needs and other scientific applications.
- Gain more control over the look and feel of ENVI with greater ability to define and customize display components and an easy to use data management system.
- Access and use the single window interface or the three window paradigm in ENVI •

ArcGIS 10.1 Simplifies Sharing of Geographic Information

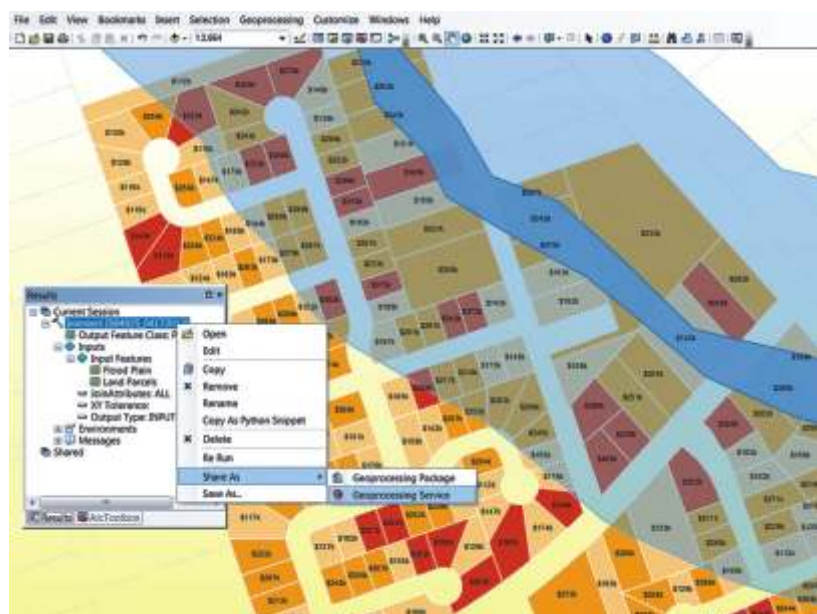
New Tools and Infrastructure Extend the Reach of GIS throughout Organizations

ArcGIS 10.1, the highly anticipated update to ArcGIS, is now available. The new release puts mapping and geospatial analytics into the hands of more people than ever—even those with no geographic information system (GIS) expertise. ArcGIS is a complete system for designing and managing solutions with geographic knowledge.

ArcGIS 10.1 further integrates desktops and servers, as well as mobile and web applications. Users can author maps, geographic information is easier to share within and outside an organization.

Hundreds of Desktop Improvements

Many of the improvements in the new release of ArcGIS make it easier to create and share content, while others improve a user's ability to visualize patterns and trends in complex data. Highlights include the following capabilities:



Use ArcGIS 10.1 to deliver any GIS resource, including imagery, geodata, and tools, as a web service.

- Edit any aspect or component of a map, including feature-level metadata
- Use new spatial analysis tools, such as spatial autocorrelation, to predict outcomes and explain geographic information better
- Find new tools that simplify all aspects of working with large collections of imagery and raster data in ArcGIS
- View lidar Log ASCII Standard files as point clouds, surfaces, and rasters

Fast, Dependable Services

ArcGIS for Server, the primary engine for powering geospatial infrastructure, allows users to turn any location-based resource into a fast, dependable service that can be used in web, desktop, and mobile applications. ArcGIS for Server has the following advantages:

- Available on physical, virtualized, and cloud infrastructures or any combinations thereof
- A native 64-bit application that runs on Windows and Linux

- Much quicker and easier to install
- More versatile and secure

Support for a Spectrum of Mobile Platforms

ArcGIS 10.1 supports a spectrum of mobile platforms—both with open software developer kits (SDKs) that are customizable for developers and end-user applications that can be downloaded from application stores and marketplaces. These applications can be used to access intelligent web maps and share data.

Easy-to-Deploy Applications

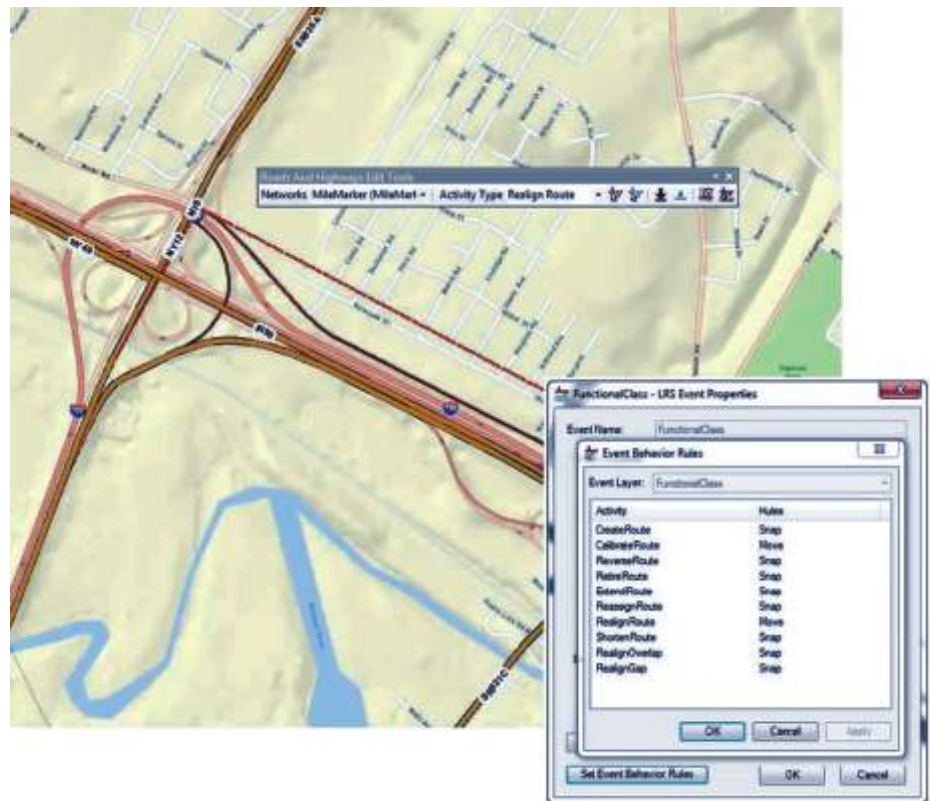
Esri continues to support multiple platforms and APIs for application development. The new ArcGIS Runtime SDKs for WPF and Java, which will become available within the next month, allow developers to build applications that are fast and easy to deploy and have a small footprint.

For more information about ArcGIS 10.1, visit esri.com/whatsnew •

Esri Roads and Highways

Esri Roads and Highways extends ArcGIS for transportation agencies that are responsible for road and highway maintenance and operations. Using Esri Roads and Highways, you can seamlessly integrate roadway data from multiple linear referencing system (LRS) networks to get a comprehensive view of your roadway network for better planning, management, and maintenance. Esri Roads and Highways leverages the capabilities of a geodatabase to provide advanced LRS data management. The solution unifies your existing systems and provides advanced tools and capabilities to simplify operations, without having to add a new system to your technology mix. With Esri Roads and Highways, you can

- Easily manage, visualize, and analyze your roadway networks and associated data to get a clear, complete picture for better planning, management, and maintenance.
- Intelligently manage the location and position of all your business-critical roadway asset data and information.
- Use a workflow-driven process to improve the quality and simplify the management and maintenance of your



Esri Roads and Highways supports desktop and server workflows that leverage intelligent feature location and position management

roadway geometry and associated asset data.

- Integrate with existing roadway data and information stored in disparate data systems throughout your organization.

Esri Roads and Highways includes desktop and server capabilities allowing you to accommodate a wide variety of user types and needs across your agency •

Highway Data Management in ArcGIS

Introduction

Highway departments manage and maintain a broad spectrum of information about their highways. This information is generally distributed throughout the agency, and each dataset is often maintained in its own separate system. Furthermore, these datasets might each relate to the highway in a different way. The public safety group, for example, might maintain crash data based on mileposts located along the highway. The pavement group, on the other hand, may locate pavement sections based on measurements taken from the point where the highway intersects a maintenance district and measured using a distance measuring instrument (DMI).

Any given highway department might have dozens of these datasets, each maintained in a separate system, many with their own methods for referencing locations along the highway. This can create significant problems when different groups within the agency need to access data maintained by other groups. Esri's highway data management solution is a multitiered approach that attacks the problem at three levels:

- Workflows support a wide variety of users from data collection crews to GIS analysts to maintenance crews in the field.
- Applications support multiple clients through desktop, Web, and mobile implementations.
- Maps and reports can be generated that leverage data from disparate data sets across multiple systems.

The implementation of an integrated information and systems framework based on industry best practices and standards is an effective way to support the exchange and integration of information across business units within a transportation organization. This approach can facilitate interoperability between component systems and across business units by leveraging existing data and establishing improved processes to gather, maintain, and analyze that data. Utilizing this approach will also allow agencies with limited budgets to achieve the maximum potential from existing systems and initiatives while leaving the basic purpose and structure of each component system intact. Esri is in the software development phase of creating a new

highway data management solution. This article presents a vision of how that solution will help highway departments more easily, exchange information between users and systems, overcoming the challenges of maintaining and integrating both spatial and nonspatial data that is broadly distributed throughout an agency.

Linear Referencing

Although most highway departments implement GIS on some level, most highway data is located along the highway through a linear referencing system (LRS). Linear referencing is a location method that uses a distance along the highway from a known starting point to locate assets. Linear referencing can be thought of as a nontraditional addressing method where the combination of a measure value, such as a milepost number, and a highway number represent the street address. In this manner, assets can be quickly located along the highway by simply identifying the highway number and moving up or down the highway until you come to the appropriate milepost. Assets that represent a single location are located using a single measure value. Assets that begin at one location along the highway and end at another are located using a from and a to measure value.

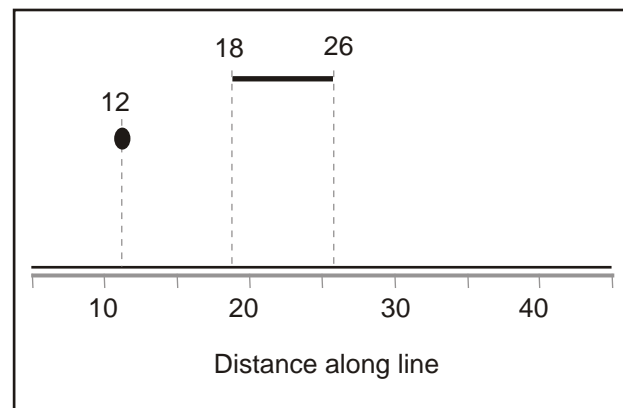


Figure: Linearly Referenced Asset Locations

Esri Transportation Model

The Esri transportation model is a reasonably comprehensive

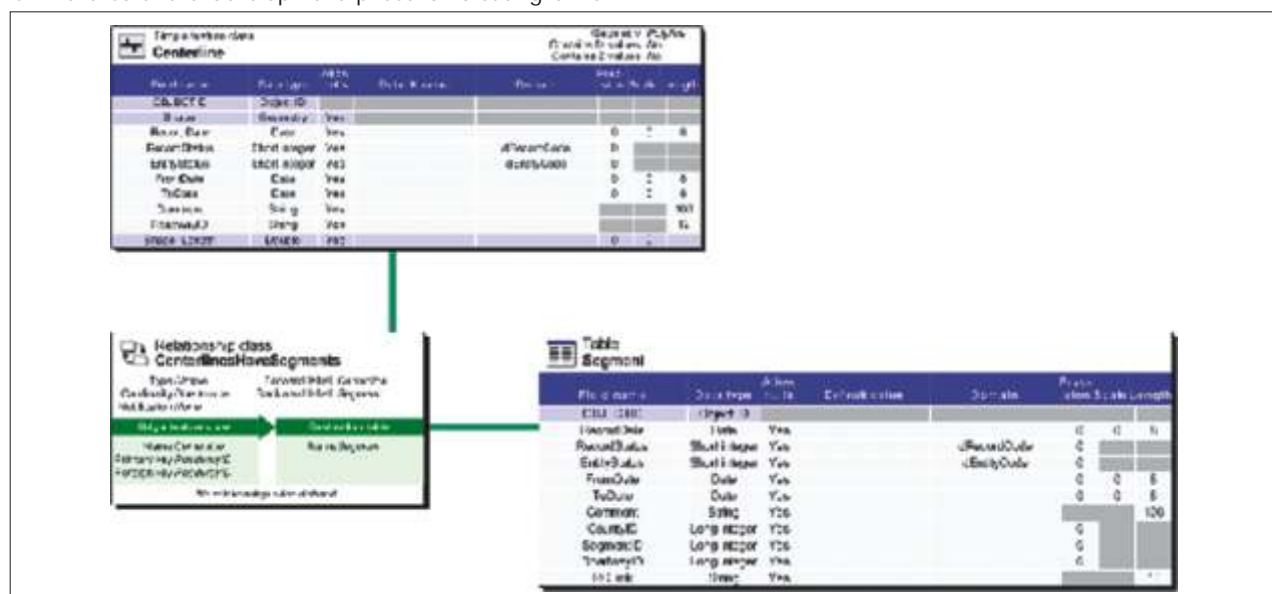


Figure: Centerline Segment Relationships

data structure that implements many key elements of highway information and proposes both a maintenance model and a publication model. There are only a handful of concepts required by the highway data management solution; however, the following are most relevant:

- A single line feature class stores the highway geometry.
- Segment-level attributes are stored in a Segment table apart from the geometry.
- Route definitions have a many-to-many relationship with segments.
- The relationship between routes and segments is maintained through a separate Segment Sequence table.

problematic because many business tables are maintained by non-GIS systems that use a particular LRM. To support the storage of transformed measures, it is necessary to duplicate the business tables and use complex transformation algorithms to keep measure values in sync. This problem is further complicated when incidents are reported using different measuring systems than those being stored.

A third approach that has gained acceptance in the transportation industry is to store a logical linear network in the database using a standard LRM, called a reference datum, and calculate LRM equivalencies on the fly. This approach allows users to store data using one LRM, maintain it using another, and perform analysis of business tables that are referenced using yet another LRM.

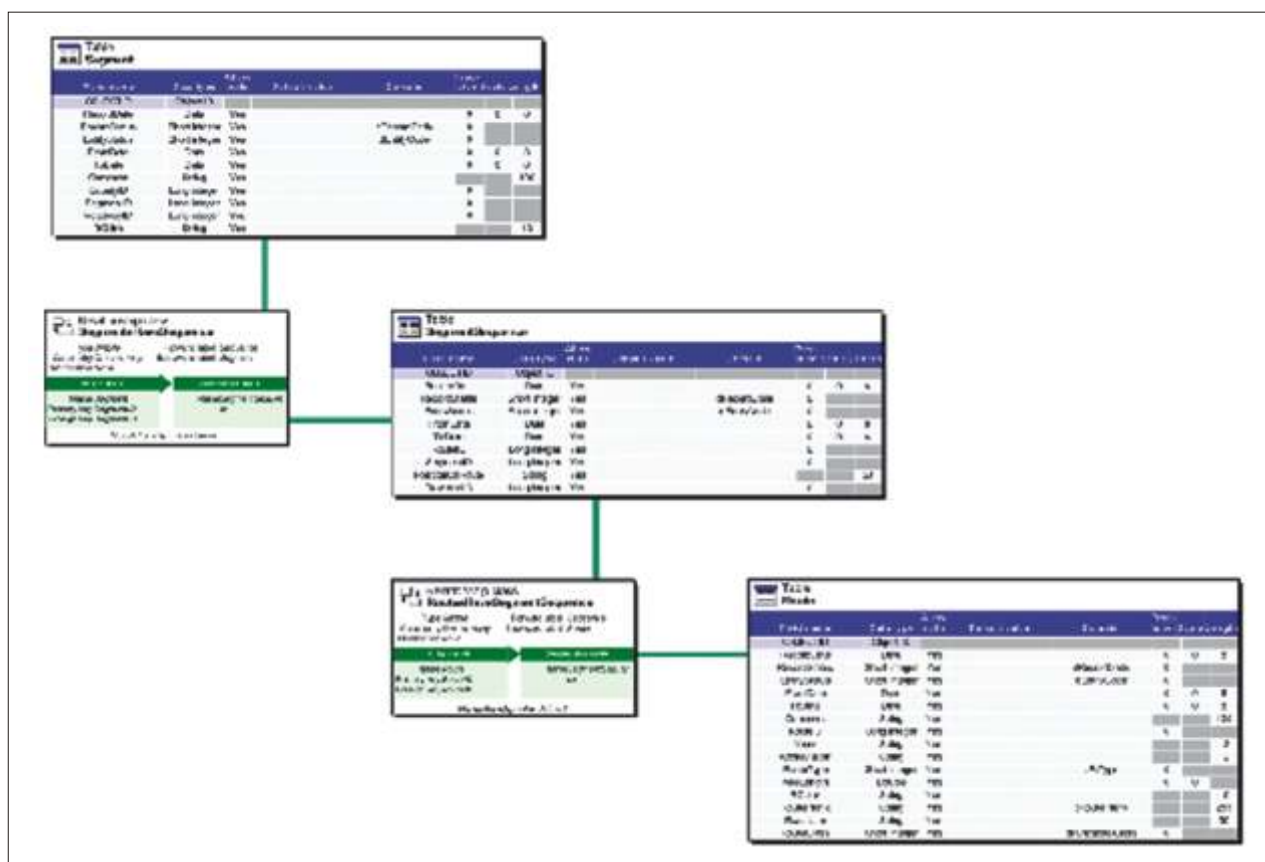


Figure: Segment Route Relationships

Advanced Linear Referencing

The highway data management solution implements advanced linear referencing functionality.

- Multiple linear referencing methods (LRMs)
- Dynamic route representation
- Time-aware LRS
- Rule-based event behavior

Multiple LRMs Support for multiple linear referencing methods is a minimum requirement for a modern highway data management solution. Traditionally, there have been two approaches to managing multiple LRMs within a linear referencing system: users either store multiple route geometries or they store transformed route measure values within the business tables. Often, large highway departments will implement a combination of approaches for addressing multiple LRMs.

Storing transformed measure values in business tables is also

Esri's highway data management solution employs this third approach. The LRS manages the LRM equivalencies for the user so end users never have to worry about how the data is stored. Data can be integrated on the fly for display and analysis without the need to extract tables from their external systems and load them into ArcGIS. If the LRM is registered with Esri's LRS, the data can be displayed and managed. Users can quickly find answers to questions about pavement conditions and traffic counts at incident locations regardless of the fact that they are accessing four different datasets, stored in four different systems, each referenced with its own LRM.

There are two basic types of LRMs, those based on interpolation and those based on a set distance from a known origin. Interpolation LRMs reference a location measure as an interpolated value between the endpoints of a line or between two control features called calibration points. Mile marker and DMI LRMs are based on interpolation. LRMs based on a distance from a known origin are called referent offsets. A referent offset can be an offset from a station

marker, such as those used at the start location of a highway maintenance project, or simply referenced as a distance from some other asset that can be seen on the highway. Nearly all LRMs are a derivative of one of these basic types.

Esri's highway data management solution supports both types of LRM and can support any number of derivatives. Some examples are as follows:

- Project stationing
- Address ranges
- Distance from GPS location
- Road inventory miles
- Kilometer markers

It is not uncommon for incidents to be reported using a referent offset LRM yet be stored and managed using an interpolated LRM. Esri's highway data management solution supports this type of LRM management, transforming LRM values seamlessly.

geodatabase. Using a single piece of geometry, assets can be referenced against any route definition that exists in the database using any registered LRM.

The second way that Esri's highway data management solution addresses the need for multiple route representations is through the creation of route features dynamically based on the users' definitions of a route. To accomplish this, asset tables are used to refine the definition of a route. Any route definition that is stored in the Route table can be further amplified to accommodate any linear event table registered with the LRS. A simple example is dynamically breaking the highway at city limit boundaries to eliminate confusion when incidents are referenced against ambiguously named assets.

Perhaps a more powerful example of dynamic route representation is the management of assets and incidents at a lane level without the need to store lane-level geometry. In figure 6, lanes are stored as a business table having information concerning the number of lanes on the highway, the width of the lanes, and which lanes fall on what side of

the highway. Crashes are stored in the database with a highway number and milepost measure reference along with the number of the lane in which the crash occurred.

The important thing to note here is that this is not simply a cartographic

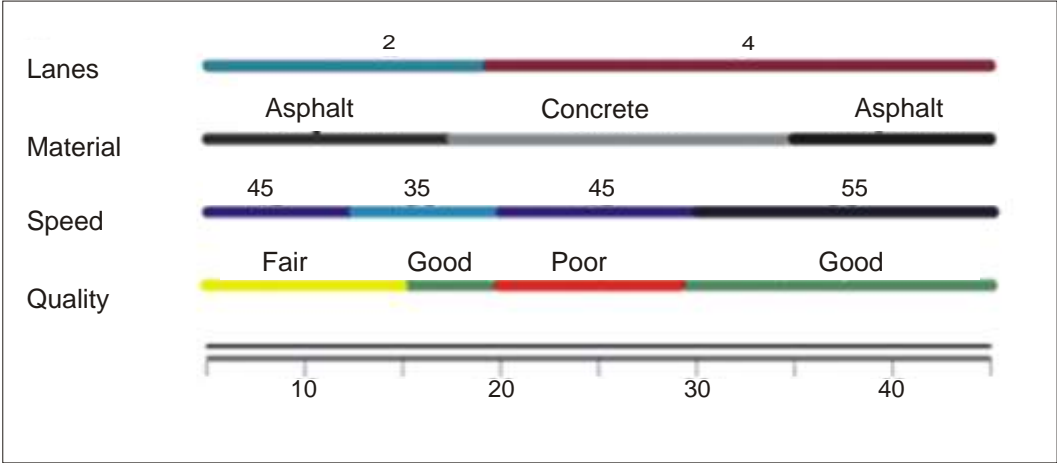


Figure 5 Depiction of Linear Assets in a Straight Line View

Dynamic Route Representation

Another key challenge facing highway departments is that different business units have different definitions of what a highway is. The planning group may look at a highway in its entirety from one end of the state to the other. The maintenance group, on the other hand, may break out highways by maintenance district or county boundaries. In many cases, the way one group describes a highway is meaningless to the other. For example, many highway departments employ an anchor point and anchor section approach to managing highways. One way of creating a unique anchor section identifier is to concatenate a unique state and county code, such as the Federal Information Processing Standards (FIPS) code, to a unique integer value within each county. The number might look something like this: 3605503026. Unless this numbering system has been widely socialized throughout the agency, it is meaningful to only a handful of users within the highway department and completely meaningless to anyone else.

Esri's highway data management solution overcomes this problem in two ways. First, routes are defined in the data model. The Route table supports multiple definitions of a single route and multiple route systems within the same

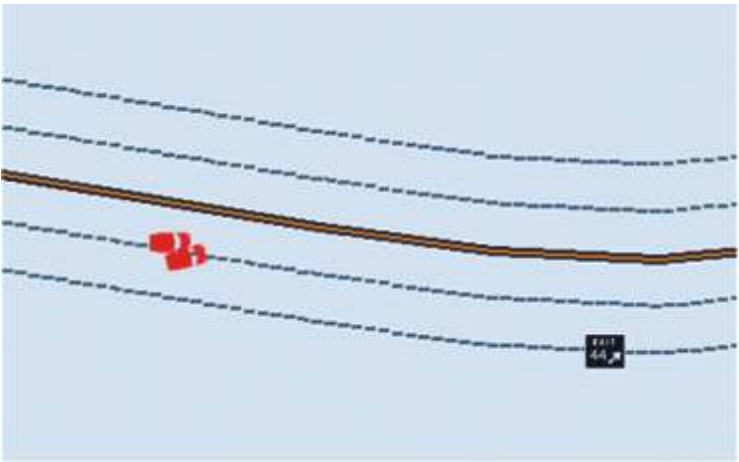


Figure 6 Lane-Level Asset Location Using Dynamic Routes

representation of lane-level data. The lanes are represented in an actual ArcGIS feature class, and each lane is a feature with its own geometry and its own m-values. This means that not only can you visualize data at the lane level, you can also perform spatial analysis and run geoprocesses against lane data. All this is accomplished without the need to store any additional geometry in the geodatabase.

Time-Aware LRS

Temporal awareness is a problem that faces many organizations, not the least of which are highway departments. Storing information using a system date and time stamp is fine for tracking edits in an RDBMS, but this approach captures the state of the database, not necessarily the state of the highway system. Highway departments require the ability to add planned roads and assign assets and incidents to them before they are opened. Departments also need to retire roads while retaining the ability to reference

Figure 7 shows a section of highway as it is currently built with a portion overlapping another highway where the two converge.

Figure 8 shows the same section of highway at a future date when a planned overpass will have been built. Based on from and to dates stored in the database, ArcGIS temporal tools automatically display the overpass as active and the superseded sections as retired based on the date shown on the time slider.

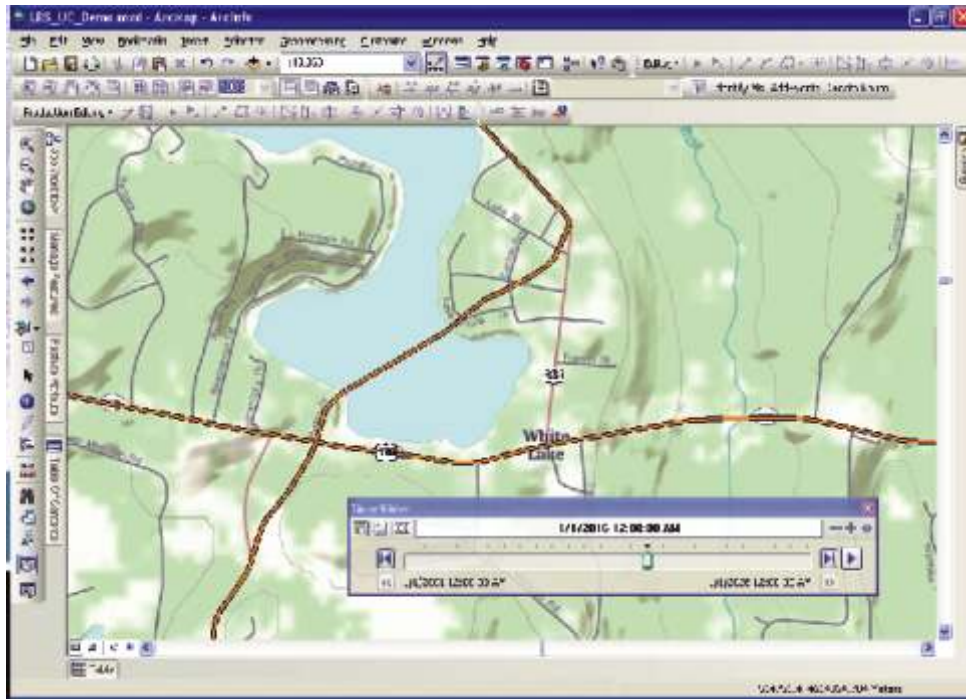


Figure 7 Original Alignment with Overlapping Highways

Rule-Based Event Behavior

Perhaps the most difficult problem facing anyone who uses linear referencing is the unpredictability of event behavior when the underlying route geometry changes. In a typical LRS, when you edit the route and change its length, the event automatically readjusts itself to have the same relative location along the route. In many cases, this is exactly what you want to happen. If a speed limit along Highway 20 is 55 mph from mile marker 14 to mile marker 26, you want that speed limit event to retain its relative location should you make minor

incidents that occurred on those roads at some point in the past.

Esri's highway data management solution leverages the ArcGIS temporal data functionality such that highways can be captured and assets assigned to them before they are actually built. This approach also addresses a common problem of data currency where planned roads are not entered into the geodatabase until they have been opened to traffic. In these cases, it is typical for a certain time lag to occur between the opening of the road and its entry into the geodatabase. By entering the highway during the planning stage, ArcGIS can turn the road "on" and retire any superseded roads automatically at the planned opening date.

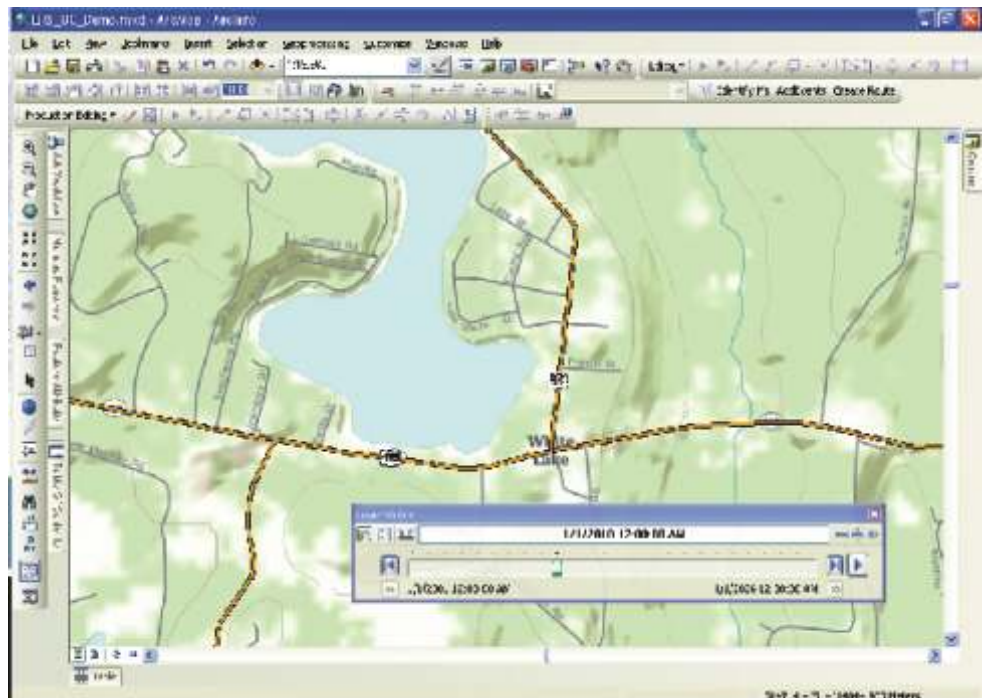


Figure 8 Future Alignment with an Overpass Replacing the Overlap

adjustments to your highway geometry based on more current aerial photography.

In other cases, this is not the behavior you want. What happens, for example, when you shorten a road? In the real world, the portion of the road to be closed is completely destroyed along with any physical assets that reside on it. You want your database to reflect the same conditions, but in a

registered with the LRS, their behavior can be controlled explicitly by linking them to these activities. When a given activity is completed, event measure values are automatically updated according to these predefined rules. The types of event behavior that can occur are as follows:

Assets can move based on changes to the length of the highway, keeping their original measure values.

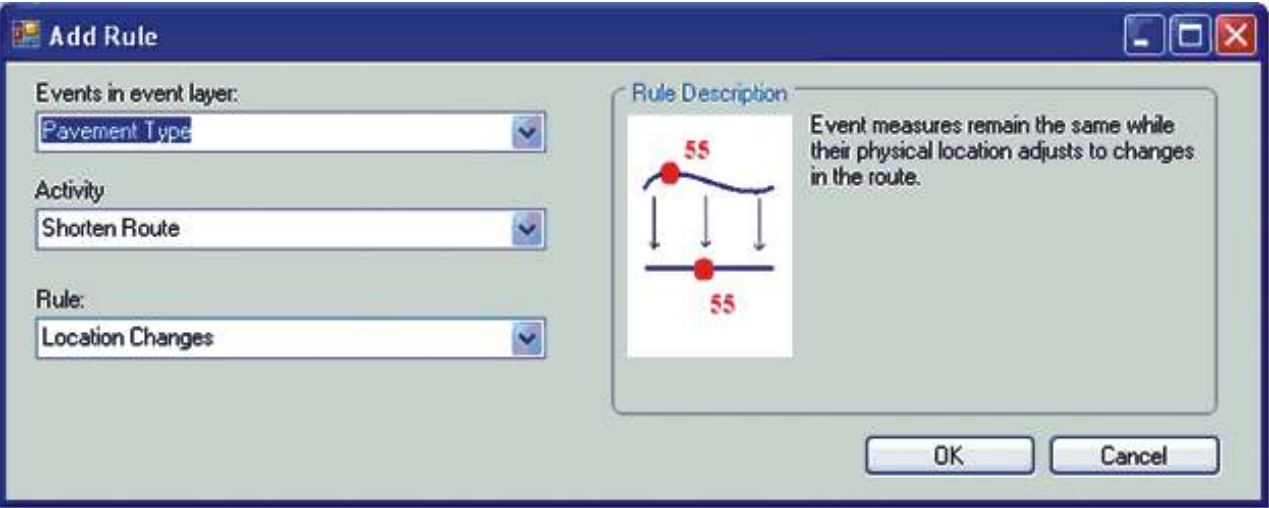


Figure 9 Building Rules for Event Behavior

typical LRS, the events on the closed portion of the highway tend to snap to the end of the portion that is still active. What you really want is for these events to be retired, but it is usually left up to the user to go back and edit the event tables manually after the geometry edits have been completed. Situations such as these can lead to a number of data quality issues that tend to accumulate over time. Esri's highway data management solution solves this problem by allowing the

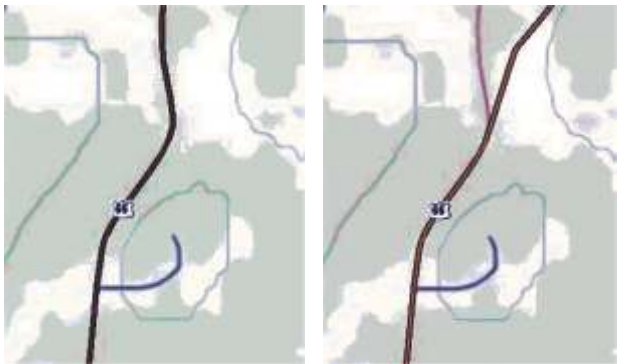


Figure 10 Asset Moves with Change in Length of Highway

user to preconfigure event behavior within the LRS before any geometry is edited. The solution is completely workflow driven, which means that how events behave depends on what it is that you're doing when they are impacted.

The highway data management solution allows users to create rules that trigger specific event behaviors based on the type of edit being performed. If a highway is being shortened, for example, the solution allows you to set up rules such that the system will automatically adjust the to measures of events that should continue to the end of the highway or retire events that are orphaned by the road closure.

Depending on the type of activity being performed, different things happen to the highway data. Esri's highway data management solution controls this automatically based on a predefined set of rules for event behavior. When assets are

Assets can be retired.

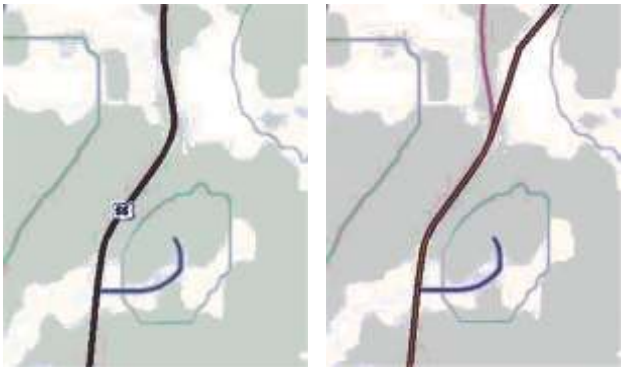


Figure 12 Asset Is Retired

Assets can snap to a new route location.



Figure 13 Asset Snaps to the New Route

Workflows

Workflow is critical to a location management system. Everything that happens to highway data depends on what people are doing and why they are doing it. A workflow is a generalized term that encompasses projects, the various activities that make up those projects, and the individual tasks required to complete the activities. Tasks can be performed with Web, mobile, and desktop applications.

Activities generally assume three generic user roles, but the highway data management solution actually contains five:

- **LRS administrator**—This is a user who has administrative privileges to the geodatabase and the ability to access systems that manage asset data. The LRS administrator configures and manages the LRS.
- **Field supervisor**—A field supervisor is an individual who is typically not a GIS specialist but has the authority to assign work. The field supervisor creates projects, adds activities, and assigns work to field crews. Once field data collection is complete, the field supervisor reviews the data and posts updates to the LRS. A typical activity begins and ends with a field supervisor.
- **Field crew**—The field crew role represents users in the field who collect and validate data against the real world. These are typically not GIS users but have access to and training in the use of

mobile data collection devices such as GPS.

- **GIS analyst**—The GIS analysts are the strong GIS experts who validate data and update the LRS. When a field supervisor posts updates to the LRS, these updates are posted in a redline format, meaning they don't actually impact the underlying LRS until the GIS analyst validates the changes. Once the changes have been validated, the GIS analyst updates the LRS, which causes a series of batch processes to run that resequence route geometry and manage event behavior.
- **Highway engineers**—Highway engineer is a generic role of user who interacts with highway data. This covers a broad spectrum of users across the highway department and represents individuals who need to discover information about the highway but don't necessarily need to update route geometry. Highway engineers may perform such tasks as generating reports, making simple maps, and performing LRS analysis by overlaying assets and GIS data.

When a highway department undertakes a major project, it

involves many agencies and requires a great deal of logistical support to ensure that everything is where it needs to be when it needs to be there. The highway data management solution is no different. Just as highway projects are orchestrated throughout the department, the maintenance of the highway data must follow suit. The highway data management solution handles the logistics of the data maintenance just as the project support team would handle the logistics of the construction project. A typical highway data maintenance workflow follows the pattern of a highway project. Once planning has been completed, work is assigned, data is collected, database updates are redlined, the redlines are validated, and the updates are made to the appropriate datasets.

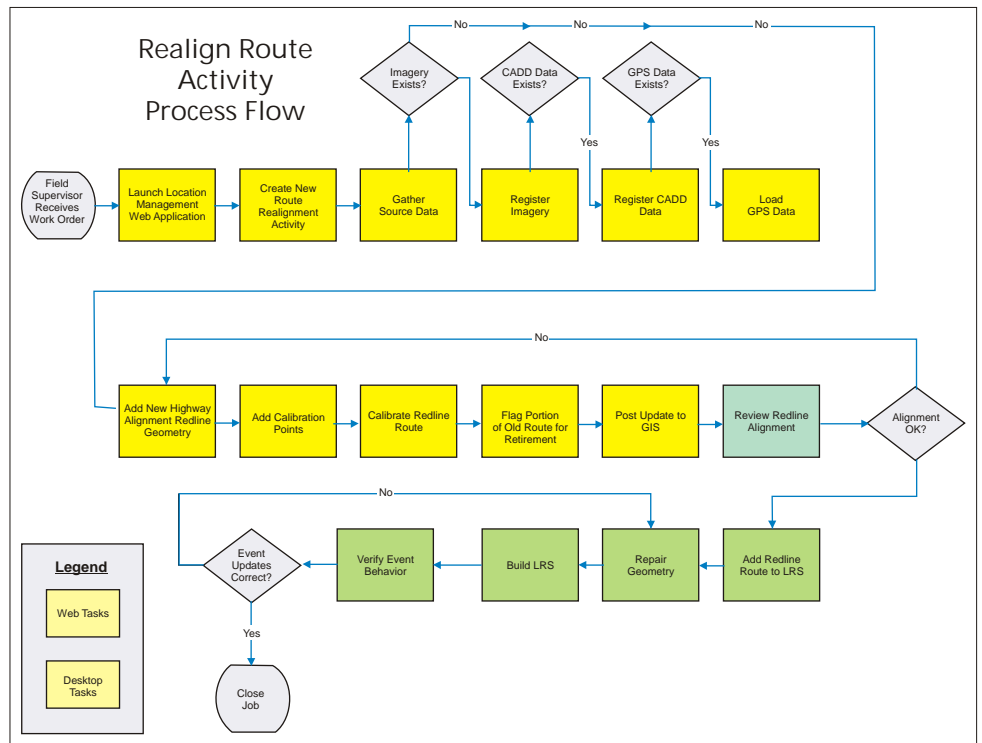


Figure 16 Route Realignment Activity Process Flow

Several generic highway data maintenance activities are preconfigured and provided with the solution.

Collect As-Built Geometry

During this activity, field crews collect the geometry of roads that have already been built but have not yet been added to the LRS. Field collection is typically performed via a Global Positioning System and provided to the field supervisor as a shapefile. Assets along the target roadway are collected at this time.

Collect Asset Inventory

During this activity, field crews collect assets along the roadway. While this can be accomplished with a mobile device, the typical methods for inventory collection will be to use the highway data management Web application. Assets are collected as events using the LRM and route reference of the field crew's choice.

Add Planned Road

During this activity, the field supervisor or appropriate designee adds new highway geometry based on a building plan. The highway geometry is redlined by the field

supervisor, and the redlined route is calibrated so that assets can be added at the same time. Default assets, such as pavement and speed limits, will be automatically generated and populated with default values.

Add New As-Built Geometry

During this activity, field supervisors add new geometry or update planned road geometry based on an as-built drawing. The geometry changes are submitted as redline features and calibrated with a base LRM, and assets are updated and/or added at this time.

Cartographic Realignment of Existing Geometry

During this activity, field supervisors update highway geometry based on new aerial imagery or as-built drawings. A cartographic alignment is a change in the route geometry where no change has occurred in the physical world. Edits may be made to route vertices, and new calibration points may be added during this activity.

Physical Realignment of Roadway Geometry

During this activity, field supervisors update highway geometry based on changes in the physical world. A simple roadway realignment may be part of a larger realignment project. During a physical realignment, new roads are added and portions of the highway that will be closed are retired. A physical realignment may be performed for existing or planned realignments.

Physical Realignment with Overlaps in Routes

This activity is similar to a physical realignment except that it deals with routes containing portions that overlap. The primary purpose for identifying this activity individually is to ensure that events along the overlapping section

Physical Realignment with Gaps in Routes

This activity is similar to a physical realignment except that it deals with routes that have gaps in them. The primary purpose for identifying this activity individually is to ensure that events near the gaps in the highway are managed appropriately by the system when the LRS is updated.

Extend Existing Roadway Geometry

During this activity, an existing highway is lengthened either at the beginning or end of the highway. While it is not common for this condition to occur as a stand-alone process, shortening and extending highway sections may happen frequently as part of a larger realignment project.

Shorten Existing Roadway Geometry

During this activity, an existing highway is shortened at the beginning, middle, or end of the highway. While it is not common for this condition to occur as a stand-alone process, shortening and extending highway sections may happen frequently as part of a larger realignment project.

Retire a Portion of a Highway

During this activity, a portion of a highway is closed and its geometry must be split and retired. This activity may be performed as part of a larger realignment project or as a stand-alone activity when a road is simply closed.

Merge Portions of a Highway

During this activity, two highways are merged into one. Assets assigned to a portion of the highway to be merged are

either assigned to the target highway or retired. While this activity can happen during a large realignment project, it more commonly occurs when highway names are changed administratively.

Change the Jurisdiction of a Highway

During this activity, a highway portion is changed based on its interaction with an administrative or other type of boundary. When business rules indicate that highways are split based on administrative boundaries, portions of the highway and their associated assets must be reassigned when those boundaries change.

Applications

Esri's highway data management solution includes a suite of applications for managing and maintaining highway data. To be fully effective, a highway data management solution has to reach the broadest possible distribution of users. To support a wide variety of users distributed throughout complex organizations, the solution leverages applications on the desktop, on the Web, and on mobile devices. The primary focus is on the Web, leveraging ArcGIS Server and Esri's REST API.

Analysis and Reporting

Esri's highway data management solution offers a broad spectrum of standard and custom reports as well as the creation and printing of simple maps. Road inventory and pavement reports can be generated with a single click of a button from the Web interface. Custom reports and queries can be created by accessing asset data from multiple external systems using a variety of location referencing methods. An example of a custom query might be, "Show me all the crashes since 2005 that have occurred within 1,000 meters of an exit, on pavement type of asphalt, in moderate condition, where the speed limit is less than 65 mph." You simply add the layers you need to your map, turn them on, and select Create Ad Hoc Point Report from the reporting menu.

The Road Ahead

Linear referencing plays a large role in the transportation industry for managing asset inventories, tracking maintenance activities, planning future development, and analyzing incident reports. The highway data management solution is expected to be released in early 2011. At that time, Esri will immediately begin work on the next release. Below are some things being considered for future releases:

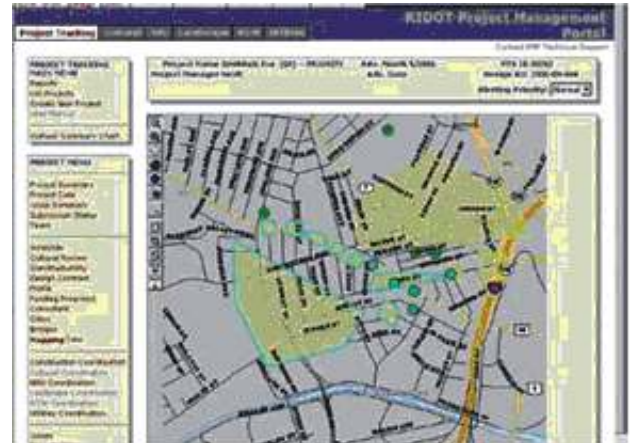
- Robust mobile applications such as asset editing in the straight line diagram on a mobile device
- Advanced query functionality to streamline common queries
- A transit solution including support assets along bus and train routes
- A freight rail solution
- More robust integration with ArcGIS Network Analyst to support mobile assets and movable routes

Source: Compiled from www.esri.com, for more details visit the Esri Website •

GIS for Transportation Infrastructure Management

Being able to visualize your assets and the surrounding environment when you build, upgrade, or repair transportation infrastructure helps you prioritize your work and make the right decisions. A geographic information system (GIS) software platform will allow you to do all this and much more. With Esri's GIS technology, you can build dynamic and rich mapping applications that will keep everyone—from the project team and government officials to field staff and the public—in the know.

Esri's GIS technology integrates with project management software, financial and enterprise resource planning (ERP) systems, and leading-edge maintenance and work order management programs to enhance productivity and help solve complex problems for your organization.



The integration of project management software, project financials, and GIS provides a powerful way to manage the delivery of major infrastructure projects. GIS can provide a single point of entry for all transportation-related documents and files.



Maintain transportation infrastructure data from disparate systems and varying organizations with GIS.

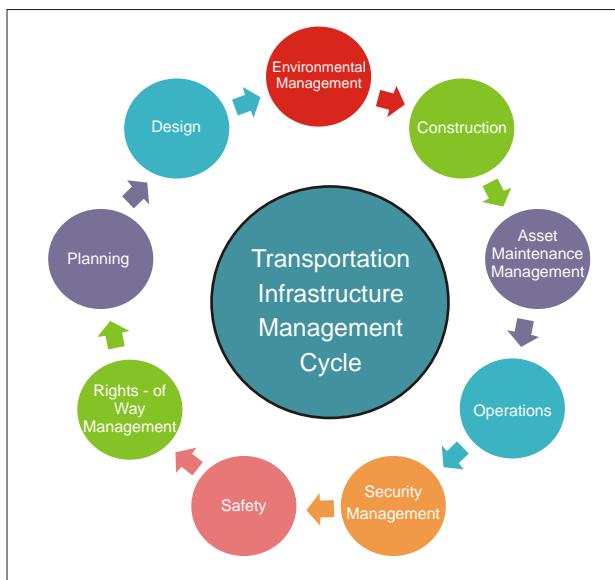
GIS Supports the Transportation Infrastructure Life Cycle

Throughout the transportation infrastructure life cycle, Esri's GIS technology helps you create a seamless flow of information from one stage to the next. With GIS, information from your planning process can be brought into the design process and easily carried over into other areas such as as-built drawings, operations, and maintenance. Gains in both employee productivity and transportation system performance are made possible by the unique ability of GIS to integrate with a wide variety of technologies.

Transportation organizations benefit by making use of the resultant information throughout their enterprise for better decision making.

Planning

Transportation agencies face an enormous challenge in keeping their infrastructure operating smoothly and efficiently. The world's leading travel demand forecasting packages are integrated with GIS technology, helping



Paired with capital investment prioritization models, GIS can help transportation planners determine the best mix of new projects and maintenance activities to most cost-effectively meet future demands and maintain their infrastructure.

transportation professionals conduct the complex analyses required to plan the transportation systems of the future. Increasingly, transportation planners are integrating land-use, environmental, and greenhouse gas considerations, along with energy consumption factors, into their planning processes. In doing so, they have discovered that GIS can bring all these factors together in the type of comprehensive planning models that will be required to help effectively plan the future.

Design



GIS is the commonly accepted framework for georeferencing CAD data.

Transportation engineers are discovering the advantages of integrating GIS into their design processes. By bringing imagery, elevation, and environmental information into the CAD environment, engineers can continue working with familiar software while gaining access to important GIS data. Design files can be brought into a GIS and linked to financial software for better labor and materials and total project cost estimation. With these types of capabilities, GIS is an essential component of the engineering information systems of the future.

Environmental Management

Transportation infrastructure management requires careful



GIS can be used to develop complex, multicriteria models to help define an optimal transportation alignment, accounting for soils, slope, and other environmental constraints.

consideration of the environment. GIS is uniquely capable of assisting transportation professionals in understanding these issues and selecting the most environmentally sensitive

solutions. With GIS, you can understand the impact of land-use decisions and evaluate smart-growth alternatives. GIS integrates environmental factors with land-use, housing, and employment density analysis to help communities address growth issues. The ability to

visualize alternatives on a common platform allows parties that differ to reach a consensus when dealing with environmentally sensitive matters.

Construction Management

When integrated with construction management and financial software, GIS can help track the performance of one or multiple infrastructure projects. GIS makes a wealth of



GIS makes crucial information easily available to project staff using a browser interface

information, such as schedules, estimates, and contracts, easily available from a spatial interface. For project tracking, GIS can help organize all relevant information, from survey data, soils, and geotechnical studies to planning, environmental studies, and engineering drawings. Having quick and easy access to data during construction can greatly increase efficiency and reduce time spent searching for needed information. This type of project transparency and reduced risk can lead to a greater return on investment.

Asset and Maintenance Management

GIS integrates asset mapping with project management and budgeting tools so that construction and maintenance



Aerial and digital photographs, surveys, and satellite imagery can be stored and combined with GIS to provide a comprehensive asset and maintenance management solution.

expenses can be accounted for and centrally managed. A GIS-based maintenance management system promotes efficient scheduling of activities and tracking of work tasks, personnel, equipment, and material usage so managers can track and report maintenance activities. Simultaneously, field-workers can record information, perform inspections, and locate assets with GIS-equipped mobile devices. Deficiencies identified in the field during inspections can automatically prompt the GIS to generate new work orders for maintenance and repair.

Operations

The demand for operational efficiency and increased safety in modern transportation systems requires access to detailed and real-time information. GIS provides management solutions that integrate data from all aspects of your operations. GIS can track and analyze assets over space and



GIS enables a shared common operational picture of transportation hubs and facilities, which promotes interagency communication and coordination of action.

time and provide insight through visualization of information via maps and easy-to-understand reports. GIS gives you the ability to integrate disparate information sources into a common operational picture of all your facilities and transportation systems, with greater power to control your operations and positively impact your bottom line.

Security Management

Comprehensive transportation facility protection requires the cooperation and close coordination of various agencies and



Combining digital maps with up-to-date data from accident and moving violation databases can speed up the recognition of troublesome hot spots.

the integration of different technologies and information sources. GIS integrates multiple sources of information, displays them on a map or satellite image, and delivers the resultant situational awareness on a secure network. You can combine real-time tracking of assets and vehicles with sources such as live closed-circuit television cameras to deliver a real-time security view of your transportation facilities. These capabilities make GIS an essential technology for managing a transportation security framework.

Safety Management

Accurate records of accident locations frequently hold the key to improving safety for motorists, freight carriers, railways, and pedestrians. GIS maps can display crash records paired

with spatial analysis of congestion, construction zones, and weather, making obvious what can easily be missed in simple tabular data. Spatial analysis, combined with statistical and business intelligence tools, can help pinpoint the root causes of accidents and determine effective countermeasures. Departments of transportation can identify trends, such as increases in oversized vehicle traffic, permit violations, and general commercial traffic route information, using GIS tools—all leading to significant improvements in transportation safety.

Rights-of-Way Management

From property acquisition for new alignments to the disposal of unneeded properties, understanding



GIS links imagery and data to utility, landscape, and maintenance schedules for complete rights-of-way management.

the extent of your rights-of-way is a task enhanced by GIS. By linking parcel, survey, and assessor information, GIS can give rights-of-way managers a better understanding of their properties and a

better way of analyzing which properties may no longer be required. GIS can capture the location

of the various utilities within the rights-of-way, simplifying future construction and relocation

activities and preventing unforeseen construction accidents.

Rights-of-way leases can be managed by a GIS linked to a database-driven lease management solution for more effective property management

In Conversation with...

Dr. Satheesh C Shenoi
Director , INCOIS, Hyderabad



Dr. Satheesh Shenoi who is currently a Director of INCOIS, Hyderabad. Graduated in 1978 with Physics major from NSS College, Chertala affiliated to University of Kerala. M.Sc. in Physical Oceanography from School of Marine Sciences, Cochin University of Science & Technology, Kochi (1980). Ph.D. also from Cochin University of Science & Technology, Kochi (1984). Has more than 28 years of research experience in Physical Oceanography

He played a lead role in Department of Science & Technologies (Govt. of India) Arabian Sea Monsoon Experiment (ARMEX), which changed our traditional view from a passive role for the ocean in monsoonal processes to an active role in the monsoonal air-sea coupling. He showed that the regional optimization of the algorithm coefficients could improve the estimation of Sea Surface Temperature, over the Indian Ocean, using satellite based infrared sensors by 50%.

After the tsunami struck the Indian coast in 2004, he coordinated the research that described quantitatively the tsunami off the Indian coast and enabled an improved estimate of the extent of the tsunami source region.

He was a senior member of the group that carried out hydrographic observations during 1987-1994 to map the seasonal cycle of circulation off the Indian coast. This work facilitated the development of a theoretical framework to explain the seasonal cycle. He also made limited current-meter observations to provide a quantitative description of coastal currents. Prior to joining INCOIS, he was leading a major programme making direct current measurements off the Indian coast to enable a quantitative description of the variability within a season and across years, marking a paradigm shift in our knowledge of the seas around India.

Considering his contributions to the understanding of the physical oceanography of the waters around India, in 2007, he was elected as Fellow of Indian Academy of Sciences. He has authored/co-authored more than 70 research papers in journals of international repute. His professional Interests include Observational oceanography, ocean currents, impact of oceans on monsoons and satellite oceanography. Currently, he is also recognized Ph. D. guide at Goa University along with his current position at INCOIS.

How do you assess the INCOIS's commitment to efforts that reduce the risks from natural disasters and improve chances for recovery?

Indian National Centre for Ocean Information Services (INCOIS) is an autonomous body established under the ministry of Earth Sciences (MoES) with a mandate of providing the services related to ocean to the society to better their livelihood and safety. In addition the services, INCOIS also serves marine data to the scientific community in the country and elsewhere. The Giant Indian Ocean Tsunami in December 2004, underlined the necessity of a tsunami early warning in the country. Accordingly, Government of India asked INCOIS to set up a tsunami early warning system in collaboration with other institutions/organizations in the country. INCOIS established the Tsunami Early Warning System in 2007. The state-of-art 24X7 Tsunami Warning Centre is operational since October 2007. Since then this center is continuously watching the undersea earthquakes and the possible tsunamis in the Indian Ocean region and providing the timely advisories/warnings. The warning centre is equipped with dedicated scientists/engineers/technicians who are constantly working to improve the warning

operations by the use of newer technologies and techniques. For example, in the beginning, we were not prepared to provide location specific warnings/advisories. But, now we have the capability to provide such information. On 11 April, when the large earthquake ($M = 8.5$) occurred off Northern Sumatra, we have issued tsunami warning for three islands in Andaman & Nicobar and for the rest of the coastline, we issued only an alert or watch. This means that urgent action is required only for those three islands and no action, like evacuation, is necessary for the rest of the country. In addition, our tsunami bulletins also indicate the likely wave heights at each location.

Recognizing the capability of the tsunami warning centre at INCOIS, Inter-governmental Oceanographic Commission (IOC)/UNESCO designated this centre as a Regional Tsunami Service Provider (RTSP) for the Indian Ocean region. This certainly shows the confidence of world bodies on the Indian Tsunami Early Warning Centre and its commitment to reduce the risks from the tsunamis in the countries around the Indian Ocean.

To further improve on the warning capabilities and to aid the disaster management, we have also taken up the vulnerability

mapping of the coastal regions of India. This is in progress.

INCOIS recently launched Coastal Vulnerability Index (CVI), an atlas that determines the relative risks of a coast due to future sea-level rise. Can you elaborate on this?

The Coastal Vulnerability Index (CVI) Maps are prepared 1:100,000 scales based on the seven parameters representing geologic and physical processes; namely, coastal geomorphology, slope of the coast, elevation of coastal region, shoreline change rate, sea level change rate, tidal range and significant wave height. All the parameters (except significant wave height) derived from the data available from open source domains. Significant wave height was derived from numerical modeling. Risk ranking of individual parameters for the calculation of CVI was performed within the dynamic range of values of each parameter, encountered within a state. Hence, the CVI estimated in this atlas expresses the relative vulnerability of the coast within a particular state. The CVI expressed in these maps is indicative of relative risks of a coast due to future sea-level rise. For example, for an elevated coast, certain amount of sea level rise is not a risk, but it could be a potential risk for a low lying coast. These maps, thus serve as an input for planning the permanent infrastructure along the coast.

Tsunami Early Warning System that is developed and deployed by INCOIS is based on ESRI GIS technology which is a first of its kind implementation in the mitigation of Tsunamis in and around the region. What's your perspective on this Warning System?

As I had mentioned earlier, the warning centre is equipped with dedicated ICT facility. The centre uses geospatial tools built on the ESRI GIS technology as they are easy to handle and their performance is good. The tsunami early warning system is performing extremely well through enabling data reception, data display and data analysis in real-time and combining that with mathematical model data for the generation of accurate advisories, as per the standard operating procedure, and their timely dissemination. The center has been recognized widely in the country as well as in the Indian Ocean region. The center received several geospatial awards for its best performance as well as for adopting innovative techniques based on modern geospatial technology.

What's your take on how Geospatial Technology is becoming a significant software tool in a Disaster Management Plan?

No doubt, the geospatial technology plays significant role in disaster management. Geospatial technology provides the important platform to integrate various types of data derived from conventional and non-conventional sources including non-spatial data, analysis them and presenting them on geospatial maps that represents the real world. Such representation provides better understanding and decision making capability. The warning centre has been archiving large spatio-temporal data pertaining to tsunami modeling, topography, bathymetry, in-situ observations, etc. This

information enables us to assess the hazard, vulnerability, risk, etc. of coastal zones. Such information becomes vital in the disaster management plans and thereby in preparing the strategies for evacuation.

INCOIS is known for the Tsunami warning system, but lately it is also doing some work for the Fishing community. Please explain how?

It is other way around. In fact we started with preparing and issuing advisories to fishermen on where to look for the fishing grounds and we took up the work on tsunami only after the occurrence of Giant Tsunami in the Indian Ocean in 2004. Today, INCOIS is providing services on (i) Potential Fishing Zone (PFZ) advisories that tells the fishermen where to look for a good fishing ground, (ii) Ocean State Forecast (OSF) that informs them about the condition of sea for the next 5 days or whether it is safe to venture out at sea, (iii) Coral Bleaching Alerts that indicates the damage that may cause to the coral reefs due to increasing temperature of sea water, (iv) High Wave Alerts that alerts the coastal community about the possibility of high waves due to bad weather in the seas adjacent to India or elsewhere, etc. These services are useful for the coastal community including fisherman, industry and any one would like to use sea for any purpose. PFZ advisories are generated using the satellite data representing temperature of sea surface and chlorophyll content in the sea water. Here also, we use software to process the satellite data and geospatial tools to represent the information on maps that are easy to read. Finally we use various ITC technologies and communication tools to disseminate the information to stake holders in different languages. From the feedbacks and independent studies carried out by some agencies, we

understand that the PFZ advisories and OSF are helping the fishermen in better managing the fishing activities, hence, helping them in enhancing their livelihood.

What are the future plans of INCOIS?

INCOIS is moving forward with providing uninterrupted oceanic services to coastal community and thriving to improve its services with the support of best research and ICT facility currently available. At present, we are issuing a general

advisory on potential fishing zones indicating fish availability but not what type of fish is available at that location. We are carrying out research to achieve that target, that is, we want to advice the fishermen not only about the potential location but also about the type of fish that could be available at that location. Towards this, we have already initiated a project to study the environmental preferences of Tuna fish and their migratory patterns by tagging the Tuna with satellite tracked devices. We are hoping that the information that we can collect from this tagging experiment will help us in identifying potential Tuna grounds using satellite data. Another major target is to achieve high-resolution, high-accuracy forecasts of entire water column of the coastal waters of India which are essential for oil industry involved in deep water drilling and for shipping. On the tsunami warning front, we want to achieve the targets of issuing district level warnings with the information on the extent to which the inundation might take place.

"The INCOIS centre uses geospatial tools built on the ESRI GIS technology as they are easy to handle and their performance is good."

Transportation Network Model and Network Analysis of Road Networks

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Abstract:

Network Analysis aims at finding solutions to routing problems related to traversability, rate of flow, and network connectivity. It helps in identifying optimum locations for services to be provided. The current work is basically a pilot project and only free Google data, of not very good accuracy, has been used for this study. In the present study, distributions of ATMs of different banks and Hospitals of a part of South West Delhi Area have been selected for network Analysis. This kind of study is very uncommon for even highly developed metropolitan cities of India like Delhi, Mumbai etc. During field survey it was noticed that SBI (State Bank of India) and Axis Bank ATMs are well distributed while that of PNB (Punjab National Bank) are poorly distributed. There are 5 hospitals in the area and are well distributed, within 3-5 minutes of accessibility. The road network and connectivity in the study area is of appreciable standard.

If this sort of study is undertaken for the area with very high resolution data of fine accuracy level and supplemented with extensive field surveys, which is a very costly enterprise, the study can be of immense applicability to Public Transport Corporations, Health service providers, Emergency Response agencies as well as departments under the jurisdiction of home ministry.

General Introduction

The Transportation System is a critical component of urban infrastructure and the lifeline of the city. It plays a key role in the economic growth of that region. It also displays region's economic condition as well as planners' dedication for their region. An efficient route planning and accessibility facilitate sustainable development. This part of the paper introduces the reader to current status of the transportation system in New Delhi.

Current Status of Delhi Road Networks

Delhi is predominantly dependent on road transport. The road network in Delhi is being developed and maintained by NHAI (National Highway Authority of India), PWD (Public Works Department), MCD (Municipal Corporation of Delhi), NDMC (New Delhi Municipal Council), Delhi Cantonment Board and DDA (Delhi Development Authority). The road network in Delhi was 30985 kms (including 182 kms of National Highways with PWD and excluding highway of NHAI) as of March, 2008. (Economic Survey of Delhi 2008- 2009)

The road network has increased from 8380 km in 1971-72 to

30985 km in 2007-08 (3.7 times), while the number of vehicles has increased from 2.14 lakh in 1971-72 to 56.27 lakh in 2007-08 (26.29 times). The imbalance between growth of vehicles and road network in Delhi emerged in heavy traffic congestion and reduced vehicle speed. (Economic Survey of Delhi 2008- 2009)

Literature Review

GIS has been defined as, "an integrated collection of computer software and data used to view and manage information about geographic places, analyze spatial relationships, and model spatial processes. A GIS provides a framework for gathering and organizing spatial data and related information so that it can be displayed and analyzed." (ESRI)

It provides us a sustainable framework and user-friendly environment for assessment, analysis and manipulation of input and applying output as an application. This paper will focus on role of Transportation Network Model and Network Analysis in transportation system (road network system), a part of GIS workspace. When integrated they can provide a very strong framework to transportation departments to upgrade their techniques and analysis system. The system will not only provide info on the length, type, location and connectivity of roads, but also address complex road network problem, ensure better connectivity, shortest and quickest route etc. Transportation involves the movement of people and shipment of goods from one location to another. Streets are the ubiquitous network. Streets have two-way flow, except for situations such as one-way streets, divided highways, and transition ramps.

They form a multilevel network—while most roads are at surface level, bridges, tunnels, and highway interchanges cross each other in elevation; a simple overpass has two levels, and a highway interchange typically has four.

With geographic information system (GIS) software, you can analyze a transportation network to support planning goals such as relieving congestion, mitigating pollution, optimizing delivery of goods, and forecasting demand for transportation.

Some transportation related GIS tasks include the following:

- Calculating the quickest path between two locations
- Determining a trade area based on travel time
- Dispatching the closest ambulance to an accident
- Finding the best path and sequence to visit customers

- Routing a garbage truck efficiently

Main Aim and Objectives

The main aim of this paper is to develop a coherent methodology for the formulation of transport planning

Problems	Objectives	Research Questions	Expected Output
Present Scenario of Road Network is messy and very complicated to find a good single route.	To identifying most efficient routes or paths for allocation of services. To Finding the shortest or least-cost manner in which to visit a location or a set of locations in a network.	What Factors and constraints were used to come up with the proposed alternatives? What other important criteria should have been considered?	Optimal routings under the considered vision. It'll resolve shortest routing and least-cost routing problems for government, private and common agencies.
GIS is not widely used in India and other second and third world countries. Lack of data, costs and lack of experience might be a reason.	To use remote sensing imagery (or data based on it) to alleviate the problem of lack of spatial information.	Is it possible to compensate for gaps in information by using RS (remote sensing) imagery?	Identification of criteria that can be inferred from RS imagery (or data based on it).
The use of GIS based Network Analysis as a key component of road network is not adequately explored in India.	To use a GIS- based Network Analysis in combination with transportation model to formulate optimal routings.	What will be nominal outputs if transportation department (i.e. NHAI) use this technique in their work?	A pure technical and sustainable digital framework of road networks can be developed for transportation department. And can be use with any other departments.

Table No: 1 Main Aims and Objectives

alternatives. In order to reach this aim the following table of questions and objectives was formulated.

Study Area

The study area for this paper is geographically located in the south-west corner of Delhi (Capital of India) territory between 28.36° N, 77.02°E to 28.28°N, 77.16°E.. It covers an area of 55.20 sq. km., which is almost 3.7% share of Delhi capital area (1484 sq. km.). It shares the Gurgaon boundary in south-

west corner with Delhi Gurgaon Expressway (A major part of National Highway 8) which gives it maximum concentration of traffic. This study area also covers vasant kunj colony roads, mehrauli-badarpur road and other major streets of South-west Delhi region.

Data Description and Methodology:

The data used in this paper can be broadly divided into four

categories:

Remotely Sensed Data: Google Earth Data (Satellite Imageries), Field Collected Data (FCD), Web Collected Data and GIS Datasets (Which consists of data derived from remote sensing and/or field measurements and surveys). The following sub-sections describe this in detail.

-Remotely Sensed Data (Google Earth Data)

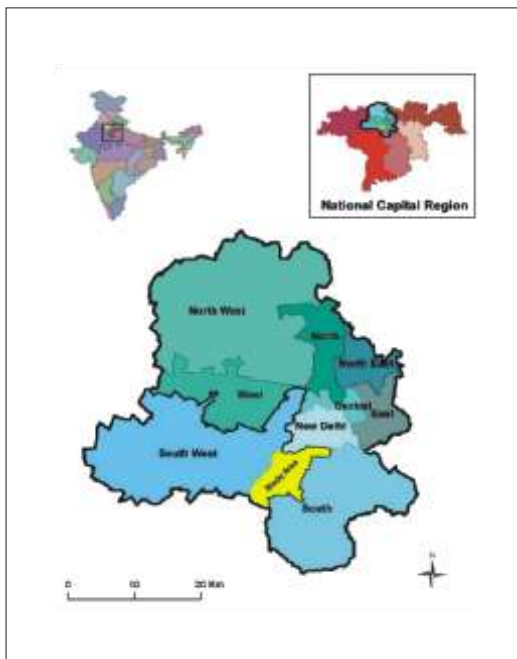


Fig:1 Study Area in New Delhi

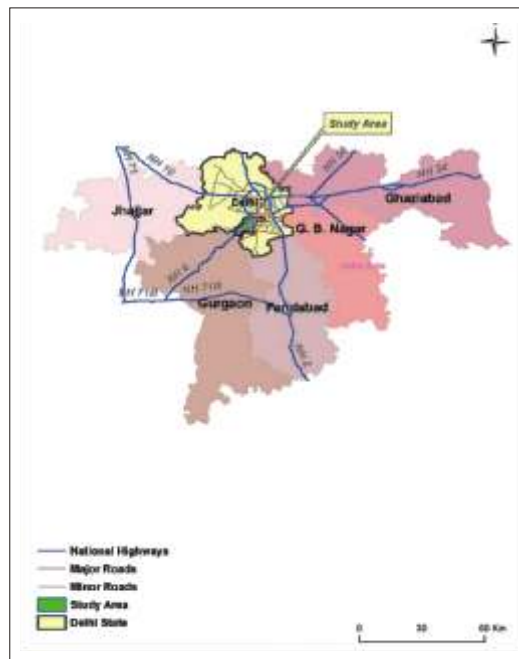


Fig:2 New Delhi Road Network Connectivity with Major Highways

Google earth data is an easily accessible data source worldwide. This Paper being a pilot study, free data has been used.

-Field Collected Data

Field data has been collected through walks and through two/four wheeler rides. -Web Collected Data

Apart from field survey, data from web sources has been used for this study. Mainly POI names, Street Names and road width have been taken out from the web resources.

-GIS Data

Due to the cross disciplinary nature of the methodology, a diverse variety of data sources were accessed. A brief description of the datasets is given herein. Road Network Dataset- With the help of web/field collected data and basic imagery, digitization of road network has been done.

POI (Point of Interest) - POIs also collected from same resources.

Network Dataset- Network dataset has been created with the help of network data and its attributes in ArcCatalog.

Software Used:

The study has been implemented using ArcGIS software. Digitization, calculations, attribution, removal of topological errors, modeling of digitized data, building of network dataset and network analysis of the data have been done with the help of ArcGIS software and its useful resources. The softwares used in the study are as follows,

-ArcGIS 9.3-Used for digitization, topology and network analysis of the data.

-Google Earth 6.0.3.2197- Used for downloading the data.

-Global Mapper (Evaluation copy)- Used for merging of downloaded data.

-Erdas Imagine 9.2- Used for georeferencing of the merged data.

-MS Excel 07- Used for making of attribute table of collected data through web survey and field survey.

-MS word 07- Used for write up of the Paper.

Results:

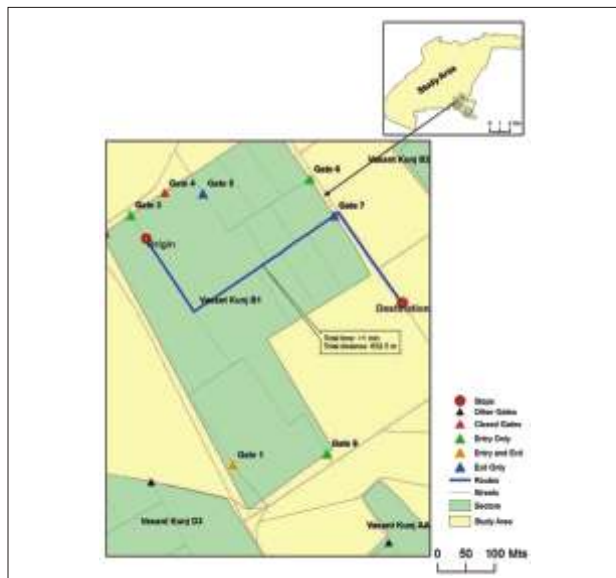


Fig: 3 A four wheeler takes ~1 min to cover ~625m distance to reach destination from origin without any barrier or obstacle.

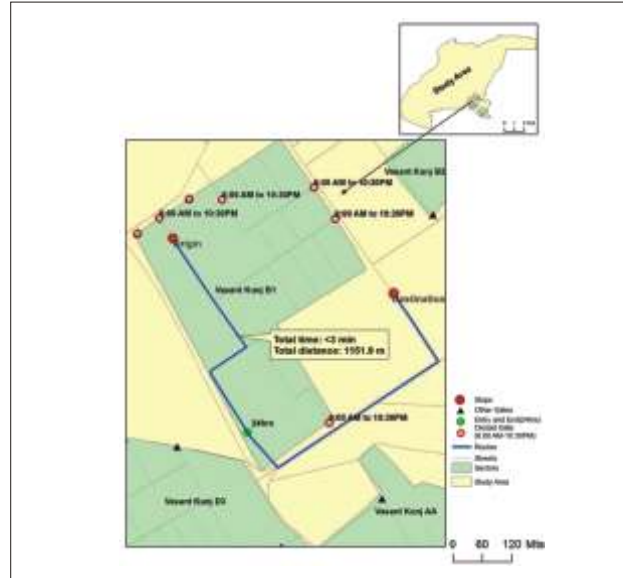


Fig: 4 Same destination after 10:30 PM then the result would be different, takes ~3min to reach same destination cause of barriers.

Result No.1

Result of New Route Analysis

Problem- To find out new route with barrier and without barrier?

Solution- With the help of New Route Analysis option of Network Analyst option available in ArcMap problem has been solved. Figure is given below.

Description- In fig: 3 solution has been made without barrier while fig: 4 solution found with barrier.

In fig: 3 you can see it takes ~1 min to cover ~625m distance to reach destination from origin without any barrier or obstacle. While same destination after 10:30 PM then the result would be different, takes ~3min to reach same destination cause of barriers.

Note: These data has been collected through field survey, so these analyses are very reliable and can be function with other analysis.

Result No.2

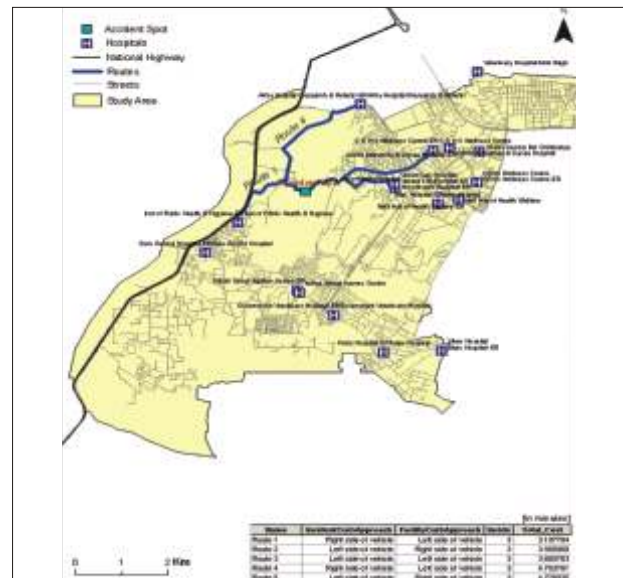


Fig:3 Closest Hospital Facility from an Accident Spot

Result of Closest Service Analysis

Problem- Shortest Route Analysis from an Accident spot for a hospital

Solution- With the help of closest service facility of Network Analyst option available in ArcMap problem has been solved. Figure is given below.

Description- The given problem is very common in urban areas e.g. road accident are very common in urban traffic. In that condition this technique saves patient's life and other people's valuable time.

In given below figure with the help of New Closest Facility option of Network Analyst solution has been found.

Name of ATM Services	Total Available ATMs
Axis Bank	15
ICICI	11
Punjab National Bank	14
State Bank of India	14

Table No: 2 Numbers of ATMs services

Result No.3

Result map of Accessibility of services Problem- To compare ATMs' accessibility services of four banks Axis Bank, ICICI Bank, Punjab National Bank and State Bank of India.

Solution- With the help of New Service Area option of Network Analyst available in ArcMap problem has been solved. Figure is given below.

Description- In corporate section everyone wants to be winner, so this option also tells them about their product or services condition in respective area.

In this example ATMs services have been taken for their accessibility analysis.

In above table the maximum numbers of ATMs services

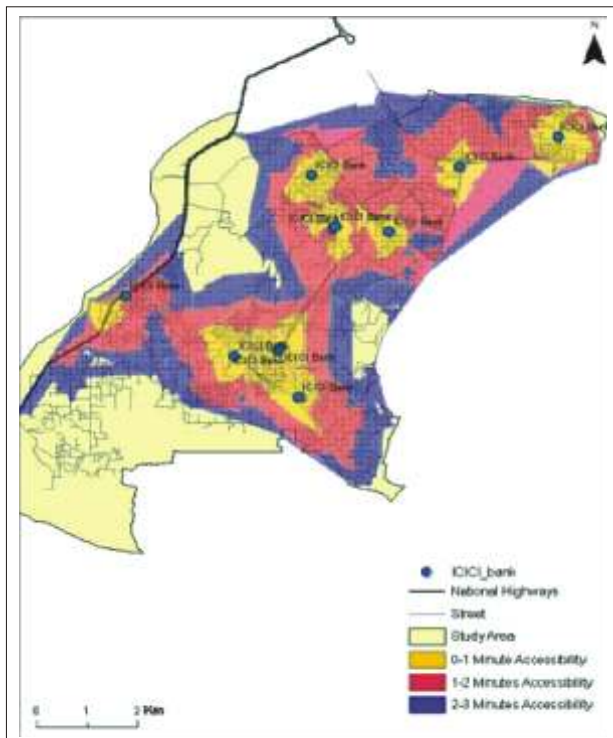


Fig:4 Accessibility area of Axis Bank's ATM

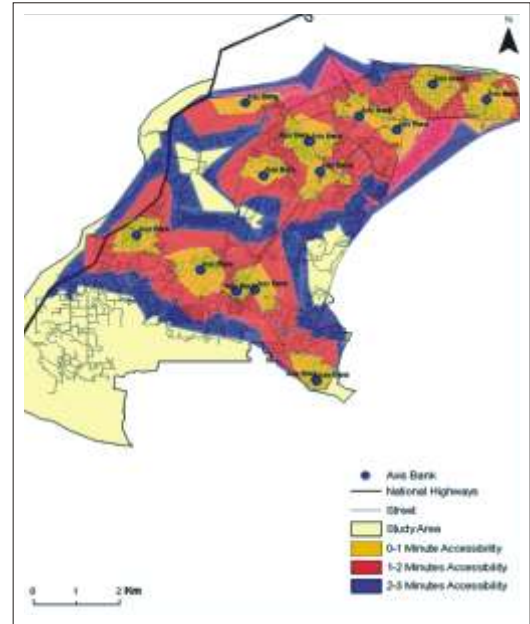


Fig:5 Accessibility area of ICICI Bank's ATM

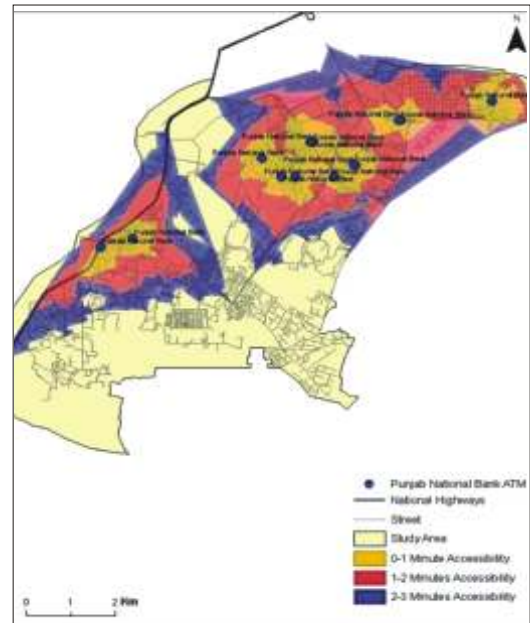


Fig:6 Accessibility area of SBI ATMs

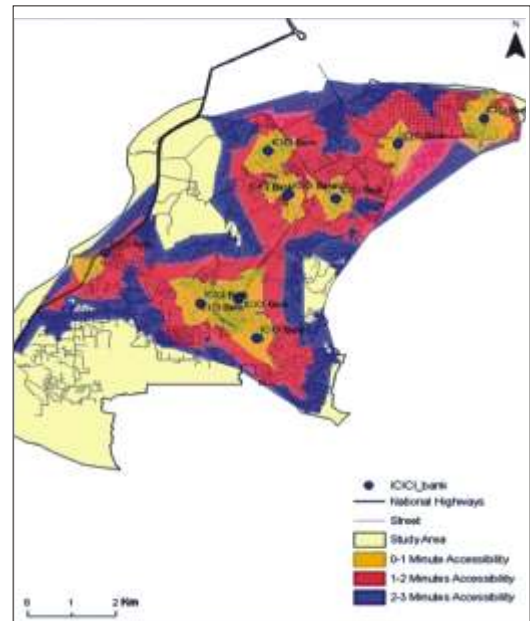


Fig:7 Accessibility area of SBI ATMs

available of Axis Bank is 15 while other has 11, 14 and 14 simultaneously.

The map is made on the basis of cut off value 1, 2 and 3 minutes cost in term of polygon features.

But after looking on result map we can see the actual services of ATMs' services on the ground. Where axis bank's ATMs are not distributed well as distributed of SBI's ATMs. SBI's ATMs are well distributed and covering almost whole study area within maximum three minutes distance.

In other services ICICI Bank's ATMs comes on second spot because in only 11 ATMs it is covering 75% of the total area.

Poor distributions of PNB's ATMs mark it on fourth spot in the race.

Conclusion:

Basically whole study for this paper has been done with the help of field surveyed and web sourced data. With these free costs of data this paper provided 85% accuracy in its resultant analysis. All parameters and methodology has been used according to the current road network problem and their condition. Because of the limited time and scope of this paper, only the most important criteria, that were available, were considered in the analysis. This paper also proves that the use of remote sensing, GIS and Network Analysis techniques can readily yield the oft-repeated (but as yet, unsatisfied) demands of professionals associated with

transportation planning and development, of effective planning tools and funding for a more effective network dataset which can provide enormous benefits for urban planning.

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Esri India attends 6th Ge



As the Indian Defence Forces and Homeland Security needs are growing, there is an enhanced momentum in the vision of GIS technologies being used for the betterment of any nation. Today GIS has become an important tool of national importance and support significant tactical decision making. Technology enablement and extensive analysis can support critical decision making by providing the right information to the right place at the right time. A two daylong conference and exhibition Geointelligence Asia 2012 was organised from 14 – 15 June 2012 in the national capital. Esri India along with its principals Esri who was a Platinum Sponsor attended the event. The event was attended by all the forces of the Indian Defence, homeland security. GIS industry and defence research organisations of the nation. The conference witnessed around 350 delegates and above 50 speakers who discussed and debated on various technological and policy issues pertaining to defence and security. The conference was organised by Geospatial media in association with DRDO labs(CAIR, DEAL, DTRL, ISSA, SASE), ITBP and CRPF.

The theme of the Conference was “Building a Credible Geointelligence Infrastructure”, that was well addressed and all the speakers deliberated upon building a sustainable geospatial infrastructure which would enable intelligent flow of information among all the organisations and the importance of data for an efficient geospatial setup. The conference kick started with the an inspiring address by the chief guest Lt. Gen K SurendraNath, PVSM, AVSM, VSM,

ointelligence Asia 2012

GOC-in-C, Army Training Command (ARTRAC) who mentioned "Geospatial technology revolution will continue at a faster pace in future", stressing the need to build defence spatial data infrastructure and geotech prospects in the country. Addressing the August gathering Mr. Shankar Agarwal, Additional Secretary, Ministry of Defence Govt. of India said "Technology is changing the nature of wars. Due to advancement in IT and migration towards C4ISR structures, future wars will be fought on digitized battle zone". Speaking on the occasion Lt. Gen Anil Chait, GOC-in-C, HQ Central Command, Indian Army mentioned how important Geoint is in the armed forces and their lack of accurate intelligence can cost a soldier's life, thus data sharing problem can improve the capabilities of the forces involved in counter-insurgency operations effectively. Mr. John Day, Director - Defence, representing Esri Inc., USA who discussed about the different GIS applications in various sectors of defence and how Esri technology can aid different solutions to the Indian Security agencies. Eminent Speakers deliberated at the various Plenary Sessions on GeoTech: Essential Requirement of Modern Warfare; Building GIS Ready Intelligent Data Infrastructure; Collaborative Approach to Common Geoinfrastructure. The second day of the conference continued with the Technical Sessions on the various aspects of Geospatial technology for the different segments of defence and homeland security. Along with this a parallel exhibition was running where there was niche sector participation from the top GIS companies from the industry.



Centre for Disaster Management Studies

Guru Gobind Singh Indraprastha University, New Delhi.



Guru Gobind Singh Indraprastha University was established by The Government of NCT of Delhi under the provisions of Guru Gobind Singh Indraprastha University Act in 1999. The University is recognised by University Grants Commission (UGC), and has been awarded the ISO 9001:2000 Certification by Standardization, Testing and Quality Certification Directorate, Department of Information Technology, Ministry of Communication and Information Technology, Government of India. University is also accredited "A Grade" by NAAC during Feb - March 2007.

Guru Gobind Singh Indraprastha University (GGSIPU) awards various degrees both at Masters and Undergraduate level. In addition to this, University also runs weekend programmes in MBA (Disaster Management), MBA, LLM, MJMC (Master of Journalism & Mass Communication etc.

Centre for Disaster Management Studies

Realising the importance of Disaster Management in the Country, Centre for Disaster Management was established by the university in the year 2005 to provide specialized training to the personnels engaged in Disaster Management in Government, Public Sector Undertakings, Corporate sector, NGO's, UN agencies and teachers etc. Presently, CDMS runs four semesters weekend MBA (Disaster Management) and plans to conduct short-term courses in future. These courses are with a special focus on to Geo-Informatics. It is planned to develop the centre as one of the leading institution to provide teaching, undertaking research and carry out consultancy in the emerging areas of disaster management.

MBA (Disaster Management) Course

The course has been structured to build trained manpower in the area of disaster management particularly in emergency planning, risk assessment, rehabilitation and community development, capacity building and for associated professionals desirous of enhancing their professional qualifications and gain an improved understanding of contemporary issues in disaster management. The course is designed to accommodate the ongoing professional commitments of practitioners and to equip them with the research skills, knowledge and management expertise to deal with future crisis, emergencies and disasters.

Recognizing the increasing demands and need for education, the course is designed specially with focus on to the use of Geo-Informatics in the field of Disaster Management. The centre provides training in the field of various sectors of

Disaster Management and the utility of advance techniques such as remote sensing GIS (Geo-Information System), and GPS (Global Positioning System) Center for Disaster Management Studies has included these fundamentals in its syllabi of MBA Disaster Management. These course provide an opportunity to different organizations to train their professionals in GIS for resource management and infrastructure in general and disaster management in particular. Till now about 200 professional have been trained from Defence Services (Army, Navy and Air Force), Paramilitary Forces (CISF, ITBP, BSF, SPG, CRPF), Railways, Fire Department, Delhi Jal Board, Municipal Corporation of Delhi, NDMC, Delhi Police, Ministry of Agriculture, Ministry of Health, Delhi Metro, UNDP, Delhi Disaster Management Authority, ONGC, WHO, Delhi Administration, private industry etc in the above area.

Infrastructure

CDMS has access to the State of Art technology infrastructure at the University. The Centre is equipped with relevant software and hardware for the State of art GIS and Remote Sensing laboratories such as -ArcGIS/ ArcInfo (GIS package); Erdas Imagine (Image Processing Package), Geomedia Professional, GPS, Scanner, Plotter. Environment Management Lab: Facilities for monitoring and analysis of sample of water, air and soil and facilities for study of chemical hazards. Analysis laboratories. In addition, Labs of USCIT are also equipped with labs to the students for gaining knowledge about issues related to cyber crimes, Internet facilities, , Class Rooms and University Information Resource Centre (UIRC)

Faculty

Center for Disaster Management studies has highly experienced and dedicated faculty in the different areas of Geo-informatics and Disaster Management, Besides full time faculty, centre also invites several prominent people from the academia, industry, and government on to deliver lecture on specialized topics.

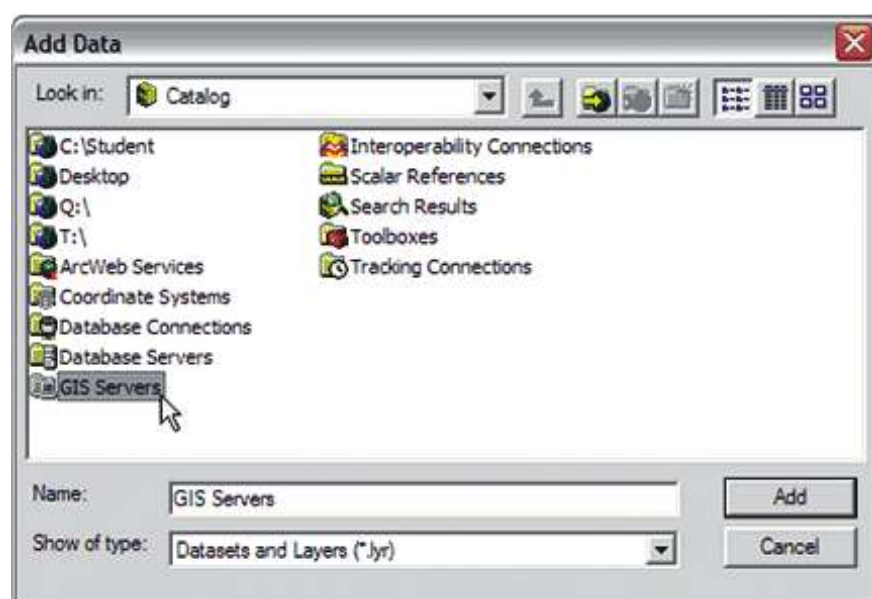
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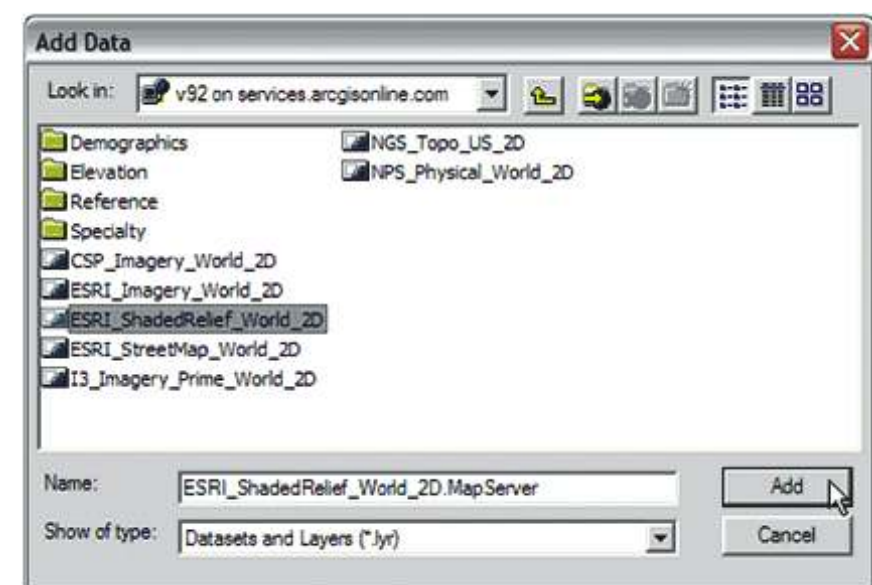
Connecting to ArcGIS Online

ESRI Provides some data sets ready for your consumption via their ArcGIS Online service. These maps and layer files include street maps, physical maps, and imagery for all over the world. To see a complete list of all the data sets available, you can visit <http://www.esri.com/arcgisonline> . You can connect directly to these datasets via ArcMap, and this article will show you how.

1. In ArcMap, click the Add Data button .
2. Select GIS Servers from the Catalog tree.



Double-click on Add ArcGIS Server.



4. In the wizard, choose to Use GIS Services and click Next.
5. Select an Internet server connection and type in the following address: <http://services.arcgisonline.com/v92>
6. Use the following credentials and click Finish:
User Name: use your esri global id
Password: Pwd for esri global id

7. You now have a new connection in your GIS Servers.
8. Double-click the new connection and browse the many available datasets.
9. When you have chosen one that you wish to use, select it and click Add.
10. The data will then be added to your map as a layer or group layer.

How do you use “traditional” editing at ArcGIS 10.0

You can modify the editing framework so that you are using the old editing toolbar etc., through the Advanced ArcMap

Settings. In ArcGIS 10, this is stored by default in C:\Programfiles\ArcGIS\Desktop10.0\Utilities. You must have all Esri products turned off before you open this program. Go to the Editor tab and turn off the checkbox for “Create features using templates” – this will revert to the old toolbar. You can set a number of things here, notably the default colour scheme in the Symbols/Graphics tab. Click Apply before closing the Advanced ArcMap settings, remembering you can reset all values to default later (if required).

Tips For Migrating To ArcGIS For Server 10.1

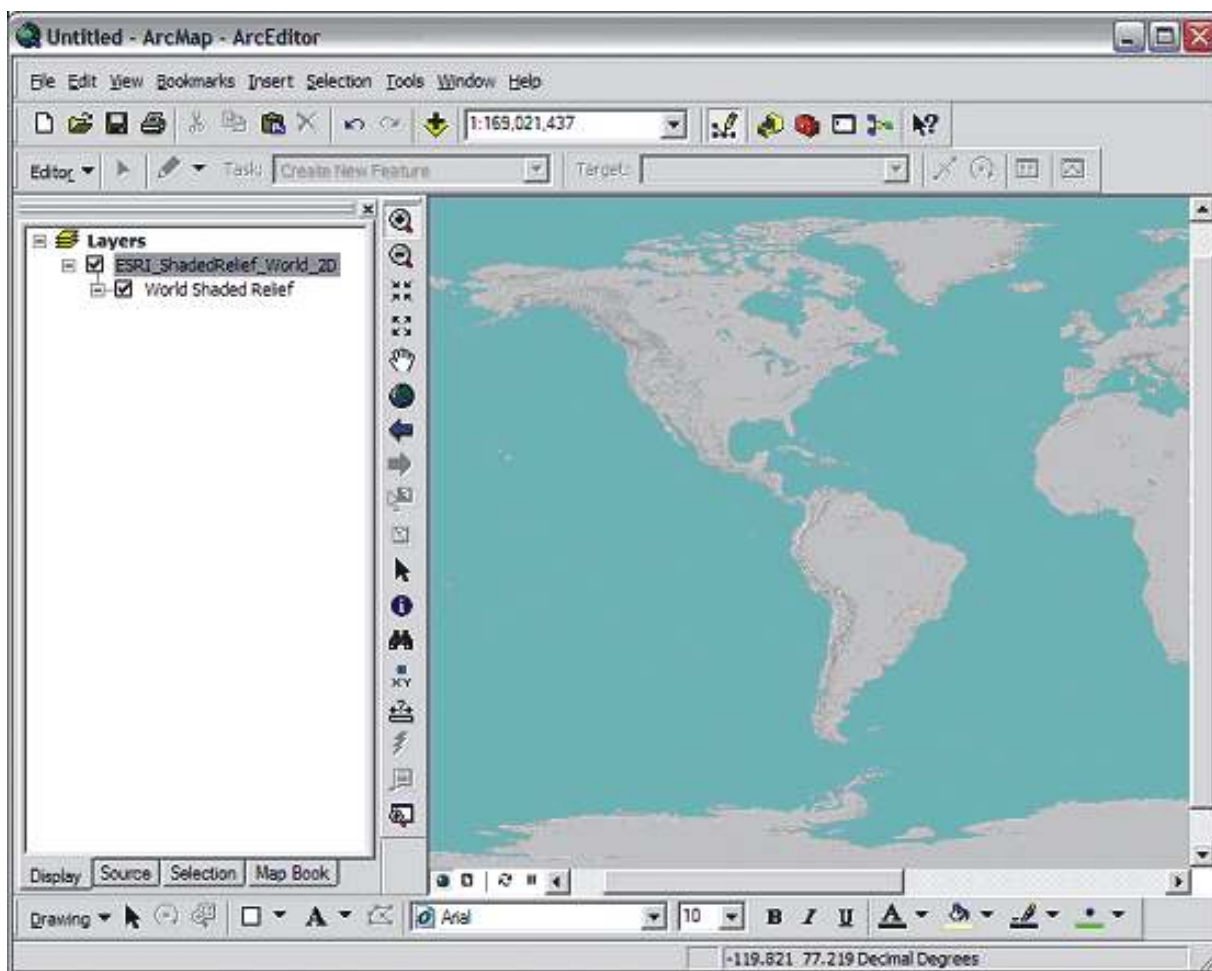
Are you working to put together a migration plan for the transition to ArcGIS for Server 10.1? Because

there are significant changes in the software architecture at ArcGIS for Server 10.1 a number of hints and tips have been put together to help you through the process.

Good to Know's

- At ArcGIS Server 10.1, service configuration files from previous versions will no longer work. (At previous releases, service configuration files would remain valid.) Version 10.1 uses a different mechanism for map services called the Service Definition (SD), which is not a text configuration file as it was in previous versions. Previously created map caches will remain valid.
- ArcGIS Server 10.1 no longer uses SOM and SOC. At 10.0, you had to manage accounts for each, but at 10.1, you'll only have to manage one account.

- The concept of a distributed installation with multiple SOC machines attached to one or more SOM boxes is also going away. Each GIS server is its own installation. GIS server machines and services may be clustered together using tools available in ArcGIS Server Manager



You can use this service for a variety of datasets to use as base maps. Keep in mind, however, that you cannot save or export this data. It is only for display purposes in ArcMap.

- to offer better computing power, but each ArcGIS Server machine is effectively autonomous.
- There is no longer a differentiation between the Java and Net versions of ArcGIS Server. Now it's just ArcGIS Server. The product installs with its own application server; this server should be dedicated to ArcGIS Server and nothing else. Esri has created applications, called "Web Adapters," that link your current server of choice (IIS or a J2EE application server) to the GIS server instance. These applications are small broker components that basically forward requests from your web server to the internal server used with ArcGIS.
- When you create an administrative connection to ArcGIS Server 10.1, you'll have the option to package and copy data in the Service Definition and push the whole package up to a GIS server. This means that an SD is portable – a user in one location can create a service definition and ship it to the GIS server owner without having to worry about an account having access to data in the remote location.

Letters to Editors

Dear Readers,

This section of Letters to Editors has been an important section of Arc India News and your comments/suggestions are valuable to us. We would like to have the opinion and feedback of all our readers with respect to the content being published and how it has been useful to them in day to day GIS advancement. You may also let us know what you expect to see in terms of application and technology in the magazine.

Letters to Editors may be edited for length and/or clarity and may be published or republished by us in any format or medium and /or licensed to others for publication. If we publish your letter, we may attribute it to you and may include your name and city, unless you expressly request that you remain anonymous. Please share your thoughts with us at info@esriindia.com.

Editorial Board

Web Method Name: ArcGIS Table of Contents with WPF

Environment: Windows

Version: C#.Net, WPF, ArcGIS 10, ArcObjects

Description:

This module demonstrates the implementation of WPF controls inside ArcMap TOC. The same logic can be applied for ArcCatalog also.

Code Snippet:

```
using System;
using System.Drawing;
using System.Runtime.InteropServices;
using System.Windows.Forms.Integration;
using System.Windows.Controls;
```

```
using ESRI.ArcGIS.ArcMapUI;
using ESRI.ArcGIS.Geodatabase;
using ESRI.ArcGIS.ADF.CATIDs;
Namespace Sample
```

```
{
    /// <summary>
    /// Implementation for
    <c>TOCWithWPFContent</c> for
    <c>Table of Control</c> in ArcMap.
    /// </summary>
    [Guid("54DFD0AF-6264-4449-8024-4B7D8449D920")]
    [ClassInterface(ClassInterfaceType.None)]
    [ProgId("Sample.TOCWithWPFContent")]
    public class TOCWithWPFContent : IContentsView3
    {
        #region Private Member Variables
        /// <summary>
        /// Indicates whether the Tab is initialized or not.
        /// </summary>
        private bool _initializeTab = false;

        /// <summary>
        /// Context menu item reference.
        /// </summary>
        private object _contextItem = null;

        /// <summary>
        /// Used for hosting the WPF control in ArcMap TOC
        /// </summary>
        private readonly ElementHost _wpfHost = new
        ElementHost();
        /// <summary>
        /// WPF user control object represents Tab
        /// </summary>
        private ContentControl _wpfControl = null;

        /// <summary>
        /// Indicates whether the ContentsView is visible
        /// </summary>
        private bool _isVisible;
        #endregion

        #region Constructor
        /// <summary>
        /// Initializes <c>TOCWithWPFContent</c> Class.
        /// </summary>
        public TOCWithWPFContent()
        {
            //Make the Graphics Tab visible
            _isVisible = true;
        }

        #endregion

        #region COM Registration Function(s)
        [ComRegisterFunction()]
        [ComVisible(false)]
        static void RegisterFunction(Type registerType)
        {
            // Required for ArcGIS Component Category Registrar
            support
            ArcGISCategoryRegistration(registerType);
            //
            // TODO: Add any COM registration code here
            //
        }

        [ComUnregisterFunction()]
        [ComVisible(false)]
        static void UnregisterFunction(Type registerType)
        {
            // Required for ArcGIS Component Category Registrar
            support
            ArcGISCategoryUnregistration(registerType);
            //
            // TODO: Add any COM unregistration code here
            //
        }

        #region ArcGIS Component Category Registrar generated code
        /// <summary>
        /// Required method for ArcGIS Component Category
        registration -
        /// Do not modify the contents of this method with the
        code editor.
        /// </summary>
        private static void ArcGISCategoryRegistration(Type
        registerType)
        {
            string regKey = string.Format
            (" HKEY_CLASSES_ROOT\\CLSID\\{{{0}}}",
            registerType.GUID);
            ContentsViews.Register(regKey);
        }

        /// <summary>
        /// Required method for ArcGIS Component Category
        unregistration -
        /// Do not modify the contents of this method with
        the code editor.
        /// </summary>
        private static void ArcGISCategoryUnregistration
        (Type registerType) {
            string regKey = string.Format
            (" HKEY_CLASSES_ROOT\\CLSID\\{{{0}}}",
            registerType.GUID);
            ContentsViews.Unregister(regKey);
        }

        #endregion

        #region IContentsView3 Members
        /// <summary>
        /// Gets executed when the Contents view is activated
        i.e. tab clicked for the first time after ArcMap opened.
        /// </summary>
        /// <param name="parentHwnd">Handle of
        application</param>
        /// <param name="Document">Reference to the
        current map document</param>
        public void Activate(int parentHwnd, IMxDocument
        Document)
        {
            Try
            {
                //Initializes the WPF Control and load the favorites
                if (_wpfControl == null || !_initializeTab)

                //Create Wpf graphic control
                _wpfControl = new ContentControl();
                //Add some controlo
                _WpfControl.AddChild
                (new Button(Content=" Test"));
            }
        }
    }
}
```

```

        //Assign child to element host
        _wpfHost.Child = _wpfControl;

        //Indicates that the TOC is loaded successfully
        _initializeTab = true;
    }
}

catch (Exception ex)
{
    //Log error
}
}

/// <summary>
/// Not currently implemented for this tab
/// </summary>
/// <param name="item">Item to be added to selection in
TOC</param>
public void AddToSelectedItems(object item)
{
}

/// <summary>
/// Not currently implemented for this tab
/// </summary>
/// <param name="parentHwnd">Handle of
application</param>
/// <param name="Document">Reference to the current
map document</param>
public void BasicActivate(int parentHwnd,
ESRI.ArcGIS.Framework.IDocument Document)
{
}

/// <summary>
/// Bitmap displayed for tab in TOC
/// </summary>
public int Bitmap
{
    get
    {
        //Read the bitmap and return its handler using
GetHbitmap().ToInt32() on Bitmap image
        return 0;
    }
}

/// <summary>
/// Item on which user performed right click in TOC
/// </summary>
public object ContextItem
{
    get
    {
        return _contextItem;
    }
    set
    {
        _contextItem = value;
    }
}

/// <summary>
/// Executed when TOC Tab is deactivated
/// </summary>
public void Deactivate()
{
}

/// <summary>
/// Unique Name of the Tab that is displayed in ArcMap TOC
/// </summary>
public string Name
{
    get
    {
        return "SampleTOC";
    }
}

/// <summary>
/// Indicates whether the events should be processed or not
    }

    /// </summary>
    public bool ProcessEvents
    {
        set { }
    }

    /// <summary>
    /// Not implemented currently
    /// </summary>
    /// <param name="item">Object to refresh</param>
    public void Refresh(object item)
    {
    }

    /// <summary>
    /// Not implemented currently
    /// </summary>
    /// <param name="item">Object to remove from
selection</param>
    public void RemoveFromSelectedItems(object item)
    {
    }

    /// <summary>
    /// Object selected in Graphics Tab TOC
    /// </summary>
    public object SelectedItem
    {
        get;
        set;
    }

    /// <summary>
    /// Indicates whether to display lines or not in the TOC
    /// </summary>
    public bool ShowLines
    {
        get;
        set;
    }

    /// <summary>
    /// Tooltip displayed for Tab
    /// </summary>
    public string Tooltip
    {
        get { return Name; }
    }

    /// <summary>
    /// Indicates whether to Tab is visible or not
    /// </summary>
    public bool Visible
    {
        get
        {
            return _isVisible;
        }
        set
        {
            _isVisible = value;
        }
    }

    /// <summary>
    /// Handle of the Elementhost control
    /// </summary>
    /// <remarks>
    /// The ElementHost control holds the WPF control as child
    /// </remarks>
    public int hwnd
    {
        get
        {
            //Returns the handle of the ElementHost that has
WPF control as the chid. Note that a WPF control itself can have
childs
            return _wpfHost.Handle.ToInt32();
        }
    }

    }
}
#endregion
}

```

Esri Supports USAID Crowdsourcing Event

USAID Provides International Development Data on ArcGIS Online for Exploration and Analysis

Esri will closely support the US Agency for International Development (USAID) at the agency's first-ever crowdsourcing initiative to make international development data accessible and transparent. The initiative will kick off at the USAID Innovation Lab in Washington, DC, at noon on Friday, June 1, 2012, and continue virtually until Sunday, June 3. Esri will participate in the event and provide a platform via ArcGIS Online that USAID can use to openly map the data after the event.

During the event, interested individuals, including volunteers from the online technical communities Standby Task Force and GIS Corps, will structure data on certain USAID economic growth activities and then geocode the data. After the event, USAID will release the complete geocoded dataset in line with the agency's commitment to make development assistance information more available. As part of this commitment, USAID will map this data on ArcGIS Online so that anyone can explore and analyze the data.

"The US government is committed to opening data and increasing aid transparency; this pilot is an example of this commitment," said Eric Postel, assistant administrator for



Economic Growth, Education and Environment at USAID. "By enabling the crowd to help us sort through and clean nonconfidential data, we are able to release information that we never previously thought was possible."

Providing public access to this information increases the possible use and value that the data will provide to USAID's many stakeholders. With an appropriate basemap and the addition of other content found on ArcGIS Online, such

as world demographic information, organizations and citizens can create, save, and share maps and web applications. These will enable further discussion, analysis, and action about important development strategies.

"I am excited to continue partnering with my colleagues at USAID to improve communication and collaboration for development activities," said Jack Dangermond, president of Esri. "Using ArcGIS Online, anyone can leverage this data to better understand the important work that is being done around the world to address social, economic, business, and environmental concerns."

Join Esri in supporting USAID in this crowdsourcing event by signing up at tinyurl.com/USAIDCrowdSource. For more information on ArcGIS Online, visit arcgis.com.

HUD's New Map Application Built on Esri Technology

GIS Platform Designed for Affordable Housing and Community Development Decisions

The US Department of Housing and Urban Development (HUD) Office of Community Planning and Development (CPD) has released CPD Maps, a web application of HUD's enterprise geographic information system (GIS) platform, which is built on Esri's ArcGIS system the world's leader in GIS.

CPD Maps is a component of HUD's eCon Planning Suite, a set of tools designed to help state and local government grantees make better decisions about affordable housing and community development.

"This technology that we're providing is going to be really revolutionary in helping all our grantees work smarter," said HUD secretary Shaun Donovan.

HUD's enterprise GIS platform makes applications, geospatial services, and data available to HUD staff, grantees, and customers, as well as federal, state, and local agencies. CPD



Maps is the flagship application on this platform. It includes several features, such as detailed reporting, dynamic thematic mapping, and multivariate querying that are supported by shared REST services that can be leveraged by other applications on the HUD enterprise GIS platform.

ArcGIS for Server enables HUD to create, manage, and distribute GIS services to its staff through the HUD platform. Using ArcGIS API for Flex, HUD creates easy-to-use custom web applications for local and state grantees as well as the public.

To support government transparency and informed public participation, HUD built a map application that locates programs and projects. Moreover, the platform provides a portal for sharing GIS information with

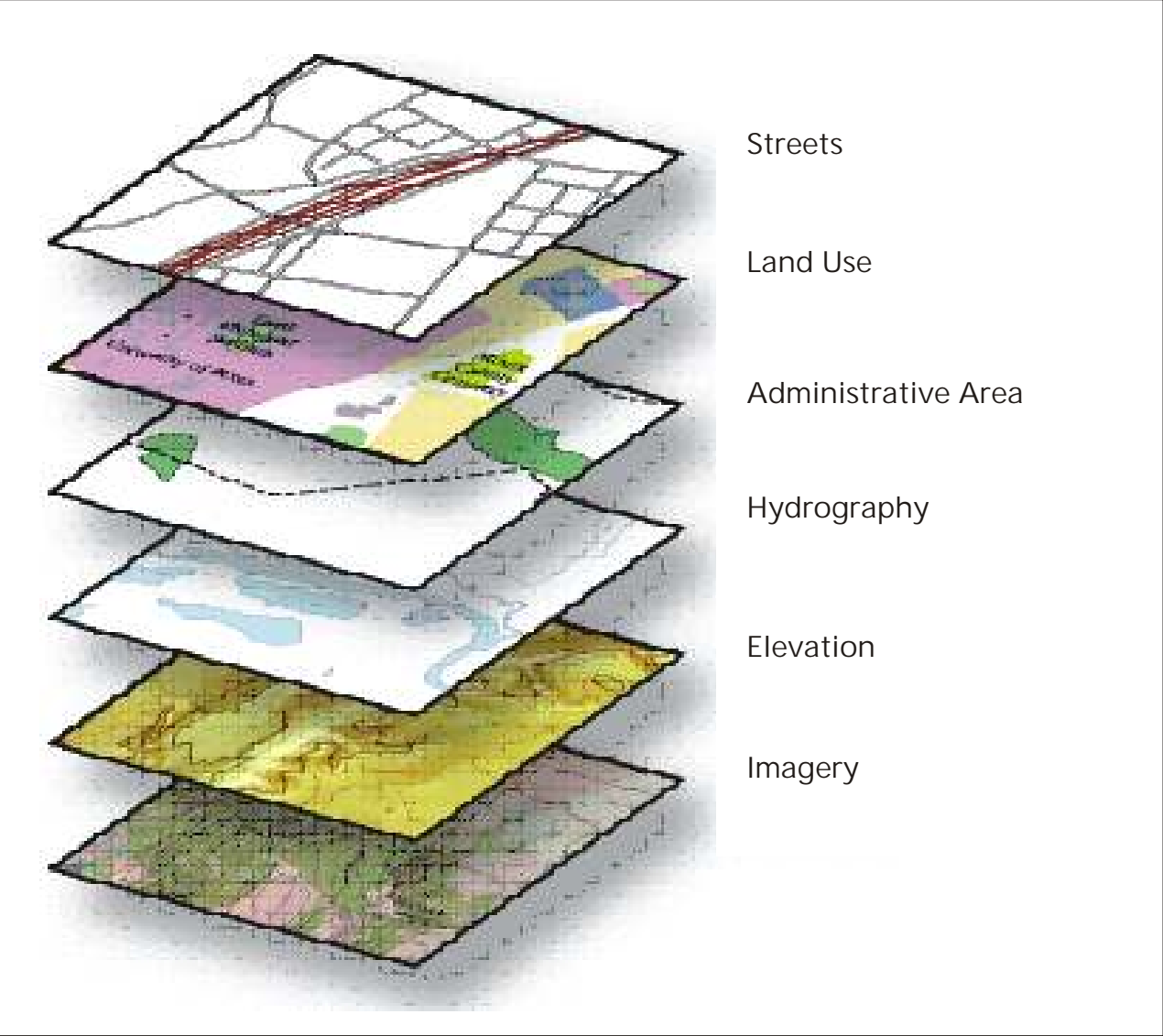
other federal agencies such as the Federal Emergency Management Agency (FEMA) and US Environmental Protection Agency (EPA).

Did you know that.....

Key Aspects of GIS ArcGIS models geographic information as a logical set of layers or themes.

As you get started using ArcGIS, it will be important to understand a few GIS fundamentals and how ArcGIS brings these to life when you use the system. In this section, you will read topics about some key aspects of GIS and how geographic information models are based upon a series of key map concepts.

- Parcel polygons representing landownership
- A surface used to represent elevation and terrain
- An aerial photo or satellite image for an area of interest



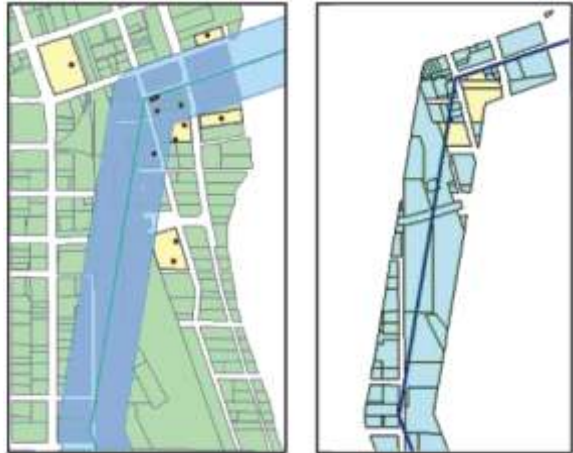
A GIS utilizes a layer-based geographic information model for characterizing and describing our world

ArcGIS models geographic information as a logical set of layers or themes. For example, a GIS can contain data layers for the following:

- Streets represented as center lines.
- Land-use areas that represent vegetation, residential areas, business zones, and so forth.
- Administrative areas
- Water bodies and rivers

Feature Class Table

Shape	ID	PIN	Area	Addr	Code
	1	334-1626-001	7,342	341 Cherry Cl.	SFR
	2	334-1626-002	8,020	343 Cherry Cl.	UND
	3	334-1626-003	10,031	345 Cherry Cl.	SFR
	4	334-1626-004	9,254	347 Cherry Cl.	SFR
	5.	334-16260005	8,856	348 Cherry Cl.	UND
	6.	334-1626-006	9,975	346 Cherry Cl.	SFR
	7.	334-1626-007	8,230	342 Cherry Cl.	SFR
	8.	334-1626-008	8,645	342 Cherry Cl.	SFR



Geographic information layers such as those described here are represented using a few common GIS data structures:

- **Feature classes:** Each feature class is a logical collection of features of a common type (such as the four feature types shown here).
- **Raster datasets:** Rasters are cell-based datasets used to hold imagery, digital elevation models, and other thematic data.
- **Attributes and descriptive information:** These are traditional tabular information used to describe features and categories about the geographic objects within each dataset.

Like map layers, GIS datasets are geographically referenced so that they overlay one another and can be located on the earth's surface.

See Overview of geographic information elements for more information about modeling and representing geographic information.

A GIS uses maps to visualize and work with geographic information

Each GIS includes a set of intelligent, interactive maps and other views (such as 3D globes) that show features and feature relationships on the earth's surface. Various map views of the underlying geographic information can be constructed and used as windows into the geographic database to support query, analysis, and editing of geographic information. Maps can also be used to access

geographic modeling tools that are used to derive new information.

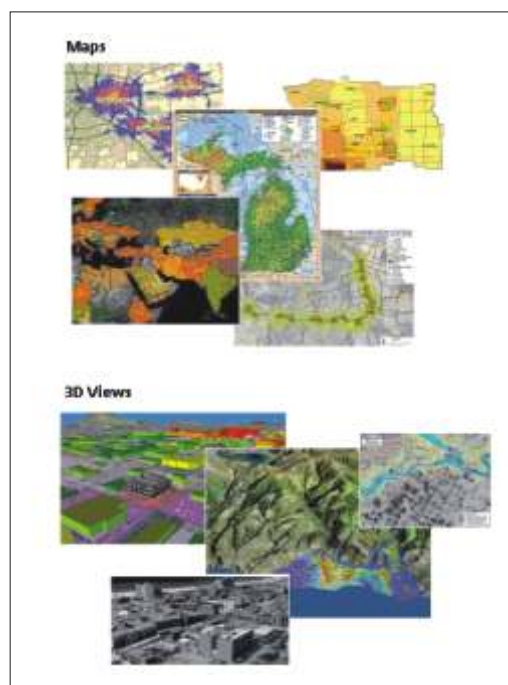
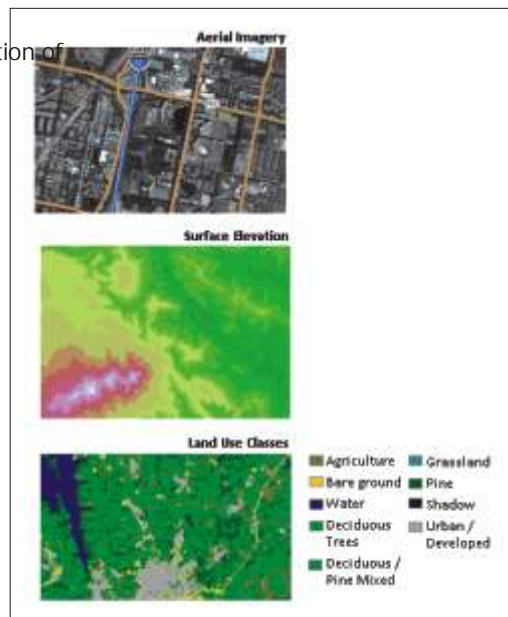
GIS maps are interactive and help to communicate vast amounts of information. You can reach through an interactive map to present any set of information that helps your end users meet their missions and do important work.

See How maps convey geographic information for more information about mapping and visualization.

A GIS has a comprehensive set of analytic and data transformation tools to perform spatial analysis and data processing.

GIS includes a large set of geoprocessing functions to take information from existing datasets, apply analytic functions, and write results into new result datasets. There are numerous spatial operators, such as the Buffer and Intersect tools shown here, that can be applied to GIS data.

Each geoprocessing tool takes existing information as input and derives a new result, which can be used in subsequent operations. This ability to string together a logical sequence of operations so that you can perform spatial analysis and automate data processing—all by assembling a model—is one of the key elements of GIS.



ArcGIS Online - FAQs

How do I open ArcGIS Explorer Online?

To open a specific map from ArcGIS Online, first find the details page of the map using the ArcGIS Online website, click the arrow next to the Open button to show a list of choices, and choose Open in ArcGIS Explorer Online.

You can also open Explorer Online directly from www.arcgis.com/explorer.

What are the system requirements, and which browsers can I use with ArcGIS Explorer Online?

To run ArcGIS Explorer Online, you must install the Silverlight platform from Microsoft, and use a browser which supports Silverlight; for example, current versions of Microsoft Internet Explorer or Google Chrome browsers on the Microsoft Windows platform, or the Safari browser on the Macintosh platform. Explorer Online currently requires version 4 of the Silverlight runtime, specifically a minimum of release number 4.0.60310.0. If you do not have the appropriate Silverlight runtime installed, you will be informed when you try to open ArcGIS Explorer Online, and a link to install the correct runtime will be displayed.

What kind of data can I add to ArcGIS Explorer Online?

You can add ArcGIS Server map, image and feature services, Open Geodata Interoperability Specification (OGIS) web mapping service (WMS) data, and KML/KMZ files. You can also import shapefiles and point data in comma-separated value (CSV) format. If you wish to work with other local data in a free client application, you may wish to consider using ArcGIS Explorer Desktop.

Which version of ArcGIS Server services can I use with ArcGIS Explorer Online?

It is recommended that you use services published by ArcGIS Server version 9.3.1 and forwards.

Can I use geoprocessing services in ArcGIS Explorer Online?

No, ArcGIS Explorer Online cannot run geoprocessing services directly; however, if your geoprocessing service creates a map service or feature service, you can add that to ArcGIS Explorer Online. If you wish to run geoprocessing services, you can use ArcGIS Desktop, ArcGIS Explorer Desktop, or a web client.

Can I save my maps elsewhere than ArcGIS Online?

ArcGIS Explorer Online always saves maps to the ArcGIS Online account you have signed in with; there is no option to

save maps elsewhere.

Can I open maps saved by older versions of ArcGIS Explorer Online?

You can open maps saved to ArcGIS Online by previous versions of ArcGIS Explorer. Items in the map which are not supported or presented in the same way may be converted:

Notes are converted into an editable layer called Map Notes, and the pop-up window content for each feature in the layer is preserved as far as possible.

Changing the color of the symbols used for point features is not supported. If you changed the symbol color of note features in a map created with the previous version, then that symbol will be drawn black when opened in the current version. There are several color variations of each symbol you can choose from to update it.

Links are now supported in-line with pop-up window content description text, and are no longer a separate property set

when configuring pop-up window content. You can define as many links as you like in a description. If you open a map that had a Related Link property set in the previous version, that link is automatically added to the end of the description in the pop-up window content when the map is opened in the current version.

Embedded videos are not supported in pop-up windows in this version of ArcGIS Explorer Online. The best strategy for including videos is as a hyperlink to the video; this link could be associated with an image in the pop-up window content. If you have problems opening a map you have previously saved with ArcGIS Explorer Online, share the map and report the problem on the Esri forum for ArcGIS

Explorer Online. At the top right of the screen, click the drop-down arrow next to Help, then click Forums to open the forum in a new browser window.

How can I run ArcGIS Explorer Online in a different language?

ArcGIS Explorer Online supports eleven different languages. If your web browser is configured to use one of the supported languages, this will automatically be detected by Explorer Online, and the text captions in the application on buttons, tabs, tooltips and other items will be shown in the selected language. Also, numbers and dates will be formatted according to the rules used by that language.

You can override the browser setting by signing in to your ArcGIS Online account and setting the Language value to one of the supported languages. Restart ArcGIS Explorer to see the new language.



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