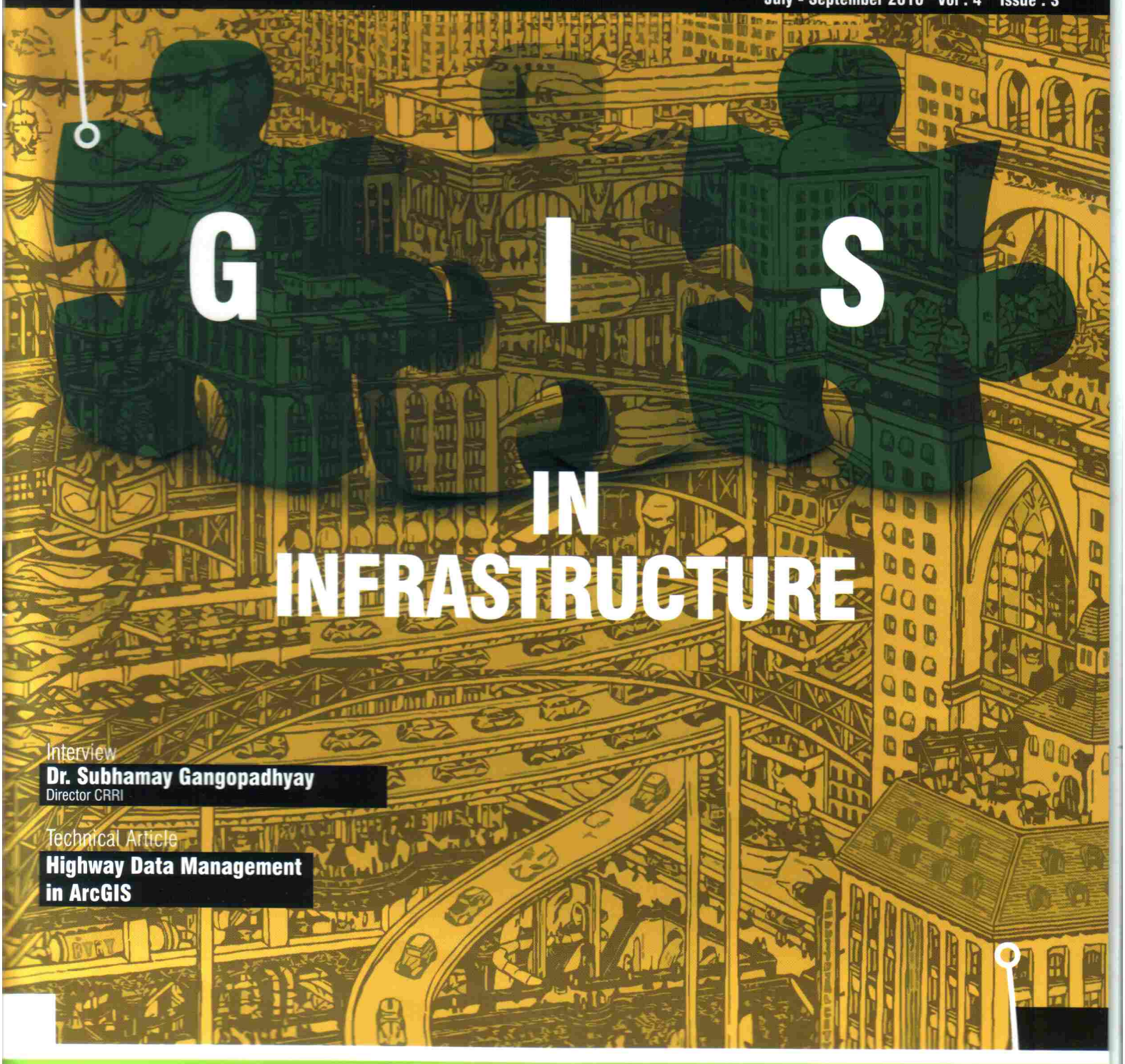
esri India

ArcIndia News

Esri India Magazine

July - September 2010 Vol : 4 Issue : 3



GIS IN INFRASTRUCTURE

Interview
Dr. Subhamay Gangopadhyay
Director CRRI

Technical Article
Highway Data Management in ArcGIS

From the President's Desk

Esri India is taking its stride in rolling out the latest in Geospatial technology through GeoVision Seminars across the country. GeoVision seminars would envisage the platform for sharing our vision for the adaption of Geo Spatial technology and also formally launching the latest release of Esri's path breaking technology- Arc GIS 10. We will also have our esteemed guest speakers who will share their valuable experience in the implementation of GIS solutions in their organizations. I am confident that the sessions will be enormously successful and we look forward to very engaging and fruitful interactions.

The theme of the seminar "GIS- opening the world to everyone" gives a very clear message and the direction for the universal acceptance and widespread deployment of GIS tools. From being used for answering "Where" of a location, the new tools, are now enabling us to answer "Why", " How", "When" and " What" – thus enabling us to take more informed decisions.

With the explosive growth in the communication and computing technologies, combined with the massive strides in hardware related areas means the transformation of the entire map based systems into a much more sophisticated, easy to use tool for day to day lives. Whether one is a business leader, or a head of a department in government, or a common man, the advent and evolution of geo spatial tools, amply demonstrated by the latest Arc GIS 10, have made the spatial information easier to Create, Communicate, collaborate and Consume.

This exciting technology enables us to leverage the entire breadth of technology- from enterprise systems, Web and Cloud as well as mobile devices.

Our world is becoming more complex and the need for more effective decision making is becoming very critical. Today, the advent of Arc GIS 10 has enabled the geo spatial system to be an integral part of any enterprise information system, and aids more informed decision making. It allows better participation in the content creation and dissemination and thus enables a much wider spread of information across the enterprises.

In India, we have seen very rapid deployment and adaption of Geo spatial tools in many spheres- and I am confident the advent of Arc-GIS 10 will usher much wider usage of the technology across different industries and integrate with the day to day decision support systems.

We at Esri India are delighted to be part of this emerging landscape and look forward to continued interaction and collaboration with our customers to enhance the spread and usage of the latest technology in the geo spatial world.

S Sridhar
President & COO

Inside

ArcIndia News

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NIIT GIS showcases @ eIndia 2010

NIIT Technologies showcases jointly with NIIT GIS and NTL's Government Vertical at eIndia 2010 from 4 – 6 August 2010, which was hosted by Government of Andhra Pradesh and organised by Elets Technomedia and CSDMS, along with the Department of IT (GoI), Ministry of Panchayati Raj (GoI), Ministry of Labour & Employment (GoI), UIDAI, Directorate General of Employment & Training, NeGP, and IGNOU. The three-day event was attended by over 5,000 stakeholders from across the development and government sector, including elected members of state Assemblies and the Parliament, senior level bureaucrats, policy makers, academia, NGOs and industry associations.

We participated at the special Urban e-Governance forum which focused on the strategies for leveraging e-Governance in dealing with emerging challenges in the urban governance domain.

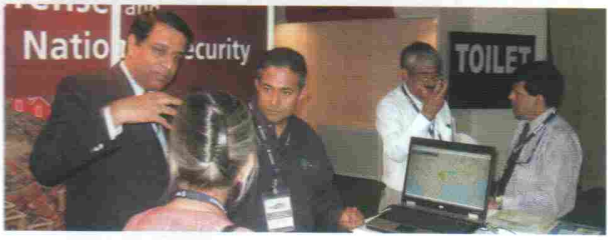
In today's world, management of urban development and governance demands integration and collaboration cutting across different government departments for efficient delivery of services to citizens. Given the complexities of modern urban development projects, tools like GIS can ease the planning and decision making processes. NIIT GIS showcased its capabilities in GIS for e-governance applications such as Property Taxing, Land Records etc. at the exhibition.

Mr. Rajesh C. Mathur, Vice Chairman, NIIT GIS Ltd. during the special session Urban e-governance presented the RoadMap for

using GIS in e-Governance. He emphasised on "GIS brings ease in the planning process, makes it more transparent and acts like a powerful tool in decision making." He stressed that GIS served as a platform for collaboration among government departments, "It's a platform for integration of information collected from various sources."

Esri India Participates In INDESEC 2010 at New Delhi

India has indicated no slowdown in homeland security & defence spend despite the global meltdown. To strengthen its capability against terror, India is investing massive resources on creating a dedicated homeland security department, developing net-centric information command structure, and maritime security upgrade.



Esri India along with its principals Esri Inc. USA participates at the India's only exhibition and conference dedicated to homeland security INDESEC 2010 which was organised in 6-8 September 2010, hosted by ASSOCHAM and supported by Ministry of Home Affairs, Government of India. The conference and exhibition was inaugurated by Mr. Ajay Maken Hon'ble Minister of State, Ministry of Home Affairs, Government of India. The conference addressed the various perspectives of homeland security such as Electronic Surveillance, Border Security Management, Collecting And Sharing Of Intelligence, Countering Cyber Terrorism, Coastal And Maritime Security.

Our defence team from Esri USA and Esri India jointly showcased the various capabilities for Defence and homeland security solutions delivering the Geographic Advantage of geospatial data and maps.

GIS Day 2010

The 12th annual GIS Day celebration will be held Wednesday, November 17, 2010. GIS Day takes place every year during Geography Awareness Week, a geographic literacy initiative sponsored by the National Geographic Society. GIS Day is an international grassroots event; thousands of GIS users worldwide invite guests to attend GIS workshops, tour map galleries, watch hands-on GIS technology demonstrations, learn about educational and career opportunities, hold rallies, and much more. Regardless of the type of event, they have a common purpose—to show others the benefits of GIS and how it is used to improve our world.

"Because of our inventive and dedicated users, GIS Day continues to gain momentum," says Esri president Jack Dangermond. "It's celebrated in more than 80 countries on six continents. The spirit of collaboration is very powerful, and GIS Day is one of the ways we can share geospatial technology and take important steps toward the next generation of GIS."

We invite our GIS users to Share their experiences with us and we will publish them in our Arc India Magazine and on our website. Email: info@esriindia.com

Esri India Announces GeoVision Seminar Series 2010

You're invited to join us for an all-day seminar that shows how GIS can make you more productive and efficient in your job, whether you're working in a desktop, mobile, server, or cloud environment. The GeoVision Seminar will be conducted in 13 cities across the country from October – December 2010.

To envision the path new technology trends, ESRI India brings you the Nationwide GIS Seminar series that will highlight the latest advancements in ESRI technology and a road to applications. ESRI India's Mission is to provide proactive support and assistance, in terms of technology and solution services in GIS domain for improved analysis, and subsequent decisions, aimed at public services and development.

- See new, powerful GIS tools incorporated into tasks and workflows relevant to you.
- Learn practical ways to improve analysis, access imagery, make use of the Web, apply GIS in the field, and more.
- Discover better ways to launch and manage geospatial projects as well as an Enterprise GIS
- Find out how to promote collaboration both inside and outside your organization.
- Hear about ArcGIS cloud-based services and see what's coming in ArcGIS 10 & ENVI 4.8

GeoVision Seminar Series 2010

City	Dates
Hyderabad	28-Oct
Chennai	1-Nov
Bangalore	2-Nov
Delhi	12-Nov
Ahmedabad	16-Nov
Bhopal	23-Nov
Nagpur	24-Nov
Lucknow	29-Nov
Dehradun	1-Dec
Chandigarh	6-Dec
Mumbai	9-Dec
Kolkata	20-Dec
Guwahati	22-Dec

ENVIEX | Orthorectification Workflow

Geospatial imagery is more than just a pretty picture or a backdrop to a map. Today, it is used to provide specific information about a geographic area of interest and can help you make decisions that are important in your line of work.

ENVI EX is the newest addition to the ENVI line of premier image processing and analysis software products. It provides user-friendly tools to read, explore, prepare, analyze, and share information extracted from all types of imagery. Designed specifically for GIS users and fully integrated with ESRI's ArcGIS® software, ENVI EX includes unique step-by-step workflows that walk you through previously complex image analysis tasks.

What is Orthorectification?

Orthorectifi cation is a process that removes the geometric distortions introduced during image capture and produces an image product that has planimetric geometry, like a map. Orthorectified imagery, also known as orthoimagery, is precisely registered to a ground coordinate system and the image scale is constant throughout the entire image. Orthorectifi ed imagery is also free of artifacts, such as leaning objects and crooked linear features, due to relief displacement. These properties make orthoimagery 'map accurate' and the clear choice for applications that require accurate positional information and precise measurement of features.

Orthorectification with ENVI EX

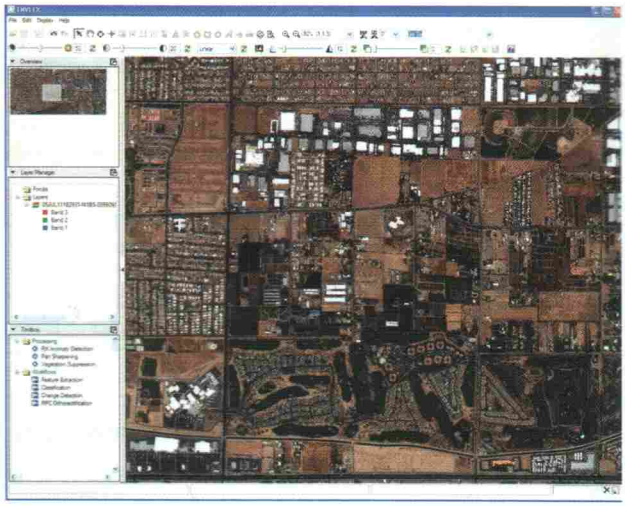
Now, ENVI EX provides an RPC-based orthorectification workflow so you can easily generate accurately orthorectified images for use in mapping applications. Rational Polynomial Coeffi cients (RPC) orthorectification is a common alternative to the more complicated rigorous orthorectification method, which requires the use of specific types of data-rich, high resolution imagery and is used in complex scientific applications.

The automated orthorectification workflow in ENVI EX guides you through each step of the process with intuitive dialog boxes and preset parameters, easily taking you from data ingest to orthorectification and beyond.

The ENVI EX orthorectification workflow simplifies the process for orthorectifying imagery. And, ENVI EX is flexible so you can modify parameters and data at any stage of the process, allowing you to get the specific information you need from your imagery and make more informed decisions.

Select and Input Your Imagery

Select the input image and if available the digital elevation model (DEM), that you would like to orthorectify, from web or local search results, from ArcGIS, or from Windows® Explorer and simply drag and drop them into ENVI EX. ENVI EX supports many different types of input files from today's popular commercial multispectral sensors, such as QuickBird, Ikonos, and NITF.



Enhance Your Data

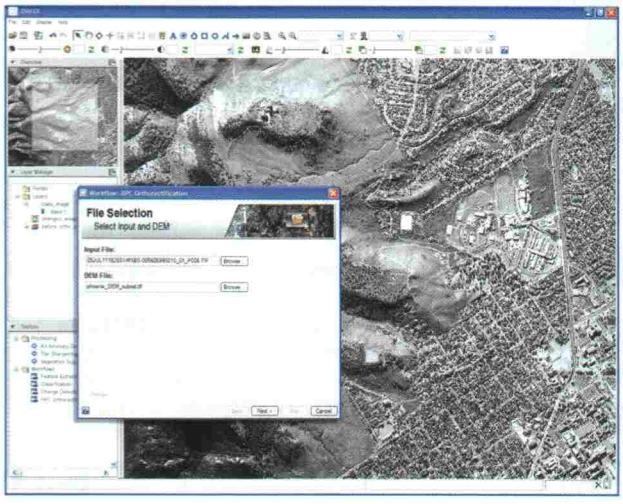
If you have ancillary data about your image, such as a DEM, you can import it in ENVI EX to provide additional criteria when segmenting and defining features. And, you can choose to confine image processing to specific areas of interest and reduce processing time.

Select Output Parameters

Next, specify your output parameters such as pixel size, fi le name, and path based on your needs. At any time, you can also check the ENVI EX preview portal window to view your preliminary orthorectification results without the need to process the entire dataset. This saves you time and gives you the ability to modify results by changing and experimenting with different parameters in earlier parts of the workfl ow.

View, Export, and Use Results

There are many ways you can use your results. Export the orthorectifi ed results as an image or print them, include them as part of a PowerPoint presentation, or save them to your computer, a geodatabase, or directly into an ArcGIS fi le. Additional analysis can also be done using ENVI EX or ArcGIS.



Unlock the information in your imagery. From reading and preparing, to exploring, analyzing, and sharing – you'll get information from imagery quickly and easily with the automated ENVI EX workflows.

ArcGIS Mapping for SharePoint

Change the way we look at our data

Overview

ArcGIS Mapping for SharePoint leverages the framework SharePoint provides to offer interactive and configurable mapping components that can give you a geospatial view of your organization's data. The ability to visualize data geographically can be extraordinarily beneficial, as it has the power to reveal larger patterns and trends. Three main components are included with ArcGIS Mapping for SharePoint:

- ArcGIS Map Web Part- web part that enables rich display of SharePoint lists, ArcGIS Server Services, and Spatial Data Services on an interactive map
- ArcGIS Geocoding Workflow- spatially enables SharePoint lists that contain address data
- ArcGIS Location Map Field - allows adding a column to SharePoint lists that displays the location of each list item on an interactive map

ArcGIS Mapping for SharePoint relies on the Microsoft Silverlight platform to provide a rich and impressive user experience. The following features and capabilities are included:

- Simple administrative interface for configuring map content in a SharePoint web part or list
- Use of ArcGIS Online, Bing Maps, or ArcGIS Server base maps
- Display of SharePoint lists, ArcGIS Server map services, Spatial Data Services, or Microsoft Office document libraries on an interactive map
- Tabular display of and interaction with the data and results shown on a Map Web Part
- Display of SharePoint list item location within a column that hosts an interactive map
- Simple configuration of shared properties using SharePoint lists
- Show map data using simple, value range (class breaks), unique value, heat map, or clustered symbols

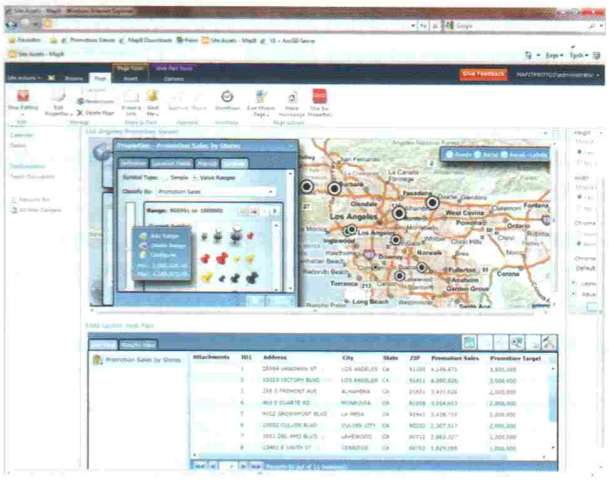
ArcGIS Mapping for SharePoint provides a robust set of geospatial tools that will empower you to better understand and extract meaning from your organization's data.

It helps quickly and easily create, display and share your information on interactive maps in SharePoint.

- Improve IT efficiency by enabling users with on-demand mapping capabilities
- Extend your ArcGIS maps and tools into SharePoint
- No programming required

Key Functionalities

ArcGIS Mapping for SharePoint enables you to access your data and ArcGIS maps and tools in the Microsoft SharePoint environment. Built on the Microsoft Silverlight platform, ArcGIS Mapping for SharePoint provides a rich and impressive user experience.



Easy to use Mapping Components

SharePoint provides a rich and impressive user experience.

- Point and click administrative interface for configuring map content
- Menu of symbologies including: class breaks, unique value, heat maps, and clustering
- Bi-directional interaction between a tabular SharePoint list and the map
- Discover, open, and save maps from ArcGIS.com
- User-friendly setup allows for quick deployment

Leverage your existing ArcGIs investment in SharePoint

- Bring in your basemaps created in ArcGIS
- Easily add ArcGIS Server geoprocessing services
- Source public or your own private maps from ArcGIS.com
- Use Locators from ArcGIS Online and ArcGIS Server
- Leverage the ArcGIS API for Microsoft Silverlight library to extend the application

Incorporate Analytics to understand your data

- Analyze information through heat maps, clustered data, and more
- Intelligently zoom to selected items
- Find items within a specified range
- Add advanced spatial analytics from ArcGIS Server with no coding required
- Dynamically build interfaces to quickly configure geoprocessing services

Updates and Enhancements

The 2.0 release offers many new features and enhancements. These include:

- **New look and feel** - a sleek new look and feel integrates with the SharePoint 2010 ribbon and maximizes the screen area available for your map

- **Extensibility** - The Map Web Part is extensible. Developers can create Silverlight extensions to interact with the map and layers, display Silverlight content inside the web part, and communicate with web services and other external components.
- **Geoprocessing** - ArcGIS Server Geoprocessing services can now be easily added as tools to the Map Web Part, enabling advanced spatial analysis.
- **Theming** - Designers can specify the colors of the pop-ups, dialogs, and panels that are shown within the Map Web Part. They can use the site theme colors or define a custom scheme.
- **ArcGIS.com integration** - a new Map Center is integrated into the Map Web Part and allows you to discover, open, and save maps from ArcGIS.com
- **Basemap gallery** - users of the Map Web Part can now switch basemaps by selecting from a configurable basemap gallery. This gallery includes basemaps from ArcGIS.com and Bing Maps by default, and can be configured to include any number of ArcGIS Server, ArcGIS.com, or Bing Maps basemaps.
- **Search** - the Search side panel allows you to search for places, ArcGIS.com maps, and ArcGIS Server endpoints that are publicly available on the web.
- **Symbol galleries** - the Map Web Part now provides galleries of symbols for you to choose from for your layers. Many symbols are available out-of-the-box, and these are fully configurable.
- **Ribbon configuration** - web part designers can configure the Map Web Part to include or exclude any of the ribbon's controls in run mode.
- **Geocoding enhancements** - a new Locate Addresses workflow provides an easy way to geocode addresses stored in a SharePoint list. The workflow architecture allows for automatic geocoding when a list item is changed or added. At 2.0, users also have the option to select the best address match candidate for each list item interactively with the Location Field, and can track the status of candidate selection with SharePoint tasks that are automatically generated and maintained.
- **Printing** - the Map Web Part now offers print functionality
- **Unique value symbology** - client-side layers in the Map Web Part can now be symbolized using a unique value renderer. This is ideal for symbolizing layers based on textual categories.
- **Map rotation** - the rotation of the map is now persisted when you save the Map Web Part.
- **Select tool** - a new select tool allows you to select features in the Map Web Part by dragging a box on the map.
- **User-friendly setup** - a new installer provides a simple way to deploy ArcGIS Mapping for SharePoint to web applications and site collections in your SharePoint farm.

How to Download

ArcGIS Mapping for SharePoint is available to download from http://resources.arcgis.com/content/how-download-arcgis-mapping-sharepoint

Additional Documentation

ArcGIS Mapping for SharePoint includes a Welcome to ArcGIS Mapping for SharePoint PDF file, which contains instructions for installing the software. The full documentation is available on the ArcGIS Mapping for SharePoint Resource Center at http://help.arcgis.com/en/webapps/sharepoint/

For more information, please review the Introduction to ArcGIS Mapping for SharePoint (http://help.arcgis.com/en/webapps/ sharepoint/ help/index.html) help guide.

For more details, please visit www.esri.com

IDL 8.0 : The Language for Visualization.

IDL is the trusted scientific programming language used across disciplines to create meaningful visualizations out of complex numerical data. From small-scale analysis programs to widely deployed applications, IDL provides the comprehensive computing environment you need to effectively get information from your data.

The newest release of IDL - IDL 8.0 - introduces significant improvements to simplify your data analysis and visualization workflow. New graphic functions are more powerful, making it easy to produce dynamic, presentation-quality, visual representations of your data for display and publication. In addition, the core IDL programming language is now easier to use so you can create programs and applications faster than ever before. And, the IDL 8.0 workbench programming environment has been streamlined so it's easier to create small programs and large-scale applications.

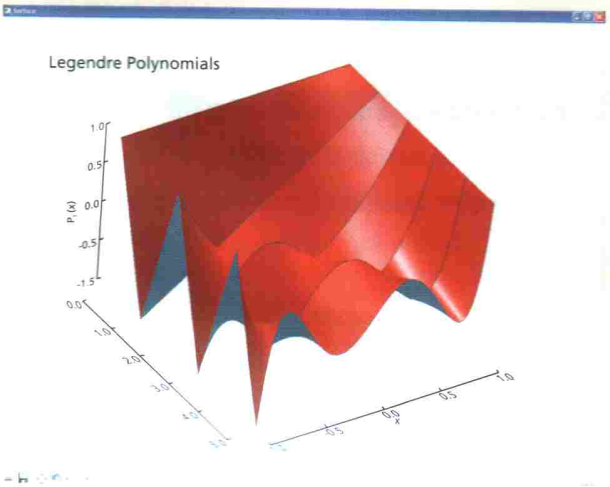
New Graphics System for Data Visualization

To better understand your complex numerical and statistical data, you need a programming tool that allows you to easily produce meaningful, sophisticated visualizations of your data. The IDL graphic functions introduced in IDL 8.0 combine the advantages of the popular, visually appealing object graphics with the programming simplicity of direct graphics, giving you the ability to quickly produce presentation-quality results.

Whether you're creating 2-dimensional plots, graphs, maps, and image displays or complex, interactive 3-dimensional representations, IDL 8.0 allows you to quickly make on-the-fly adjustments to individual graphic elements without reprogramming or regenerating your entire visualization. These interactive and dynamic new capabilities will save you time and effort, while allowing you to produce the high quality output that you need.

The IDL 8.0 graphics include:

- New functions for plots, surfaces, contours, images, maps, and more
- Programmatic ability to create and modify visualizations with an intuitive syntax
- Capability to interactively manipulate and modify properties of visualizations
- Resizable graphics windows that automatically scale the visualization
- Easy-to-use colors, line styles, symbols and annotation, including TeX-like formatting for math and Greek characters
- Easy programmatic or interactive output to a variety of standard formats; e.g., PNG, TIFF, JPEG, GIF, EPS, and PDF

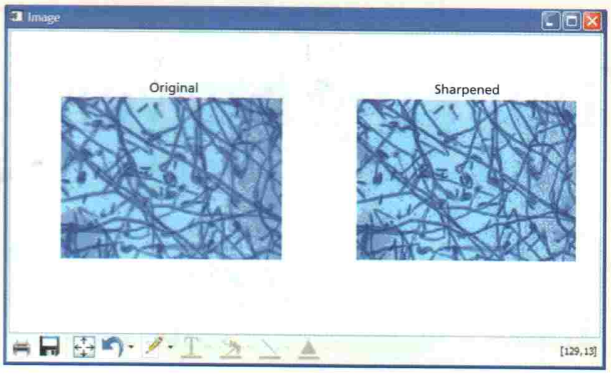


The IDL 8.0 language powering the IDL graphics system makes it easy to create dynamic graphic visualizations, ranging from 2-dimensional plots, graphs, maps, and image displays to complex, interactive 3-dimensional representations. Here, IDL code was used to visualize a 3-dimensional surface plot of Legendre Polynomials.

Enhanced, Expanded Programming Language

IDL has always been a popular choice among scientists and application developers because it's easy to learn, easy to use, and requires fewer lines of code than most programming languages. In IDL 8.0, the core language has been enhanced to make developing programs and applications fast and easy.

The enhanced IDL 8.0 language introduces many improvements to help you get from data to discovery with your complex data easier and faster than before. New programming features, including additional data types, control structures, and a simplified syntax, make it easier to code your programs and applications while requiring even fewer lines of code. In addition, IDL 8.0 is fully compatible with code written in previous releases, so you don't need to recreate your programs or visualizations.




```
; Read an Image from a JPEG file.
file = file_which('n_vasinfecta.jpg')
fungus = read_image(file)

; Sharpen the image.
Sharpended = unsharp_mask (fungus, amount=1.0, radius=3, threshold=0)

; Display the original and sharpened images, side-by-side.
img = image (fungus, layout = [2,1,1], title = 'Original')
!null = image (sharpened,layout = [2,1,2], / current, title = 'Sharpened')

; Save the new visualization to a PNG file in the current directory.
img.Save, 'sharpening_ex.png'
```

In the example above, six lines of IDL code are used to sharpen an image of fungus, display the before and after images, and save the sharpened image to a directory.

New language features include:

- List and hash containers that allow you to manage variables consisting of different data types
- Negative array indices that allow subscripting from the end of an array
- !NULL that provides a null variable or empty arrary, which is useful in array concatenation
- FOREACH operator that iterates over the elements in an array, list, hash or structure
- Automatic garbage collection for simplified memory management
- Operator overloading on object methods that allows for new definitions for IDL operators and routines such as PRINT and HELP

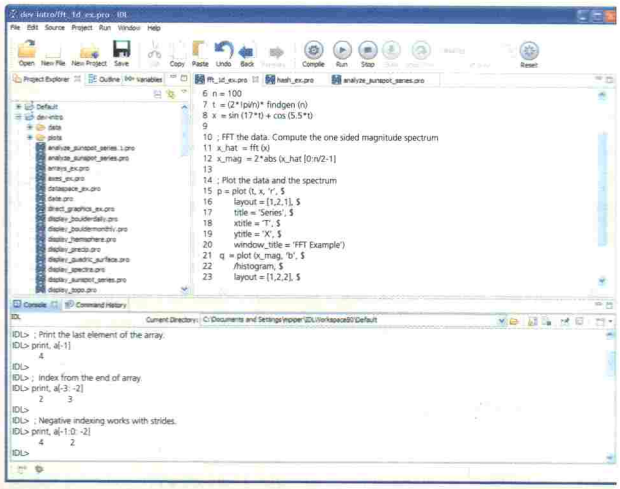
Simplified, More Intuitive Development Environment

If you are creating ad hoc visualizations or engineering large, widely deployed applications, you need a programming environment that is intuitive so you can produce professional results as quickly as possible. The new development environment in IDL 8.0 is simple to navigate and makes advanced, modern programming tools easy to find and readily available.

The IDL workbench interface is now simplified and streamlined, allowing you to create visualizations on-the-fly or develop feature-rich scientific applications to distribute commercially or to your colleagues. Regardless of your application, IDL 8.0 provides the feature-rich development tools you need, allowing you to easily access the scientific visualization and data analysis power you've come to depend on from IDL.

The updated IDL workbench provides you with:

- A simplified interface with three main views for the editor, project explorer, and integrated console with command line
- New features for inserting code templates in the editor and display of the current working directory
- A redesigned toolbar with buttons for the most important file management, editor, and debug features
- The IDL Help System, now a robust, example-based experience that helps you solve specific tasks. Thumbnail examples, text links, and a visual navigation paradigm all make finding help for your problems fast and easy



IDL 8.0 has an intuitive interface that provides easy access to the programming tools and buttons you use most.

Tracking Server

Real-time Temporal Solutions for GIS

Tracking Server is an ESRI® solutions product for collecting and sending real-time data from many data sources and formats to Web and desktop clients. It was developed to enable the integration of real-time data and geographic information system (GIS) technology. This integration helps users make better decisions and share information quickly, easily, and efficiently.

With Tracking Server, you can collect and distribute real-time data to Web and desktop clients. It is an enterprise-level technology that integrates real-time data with GIS.

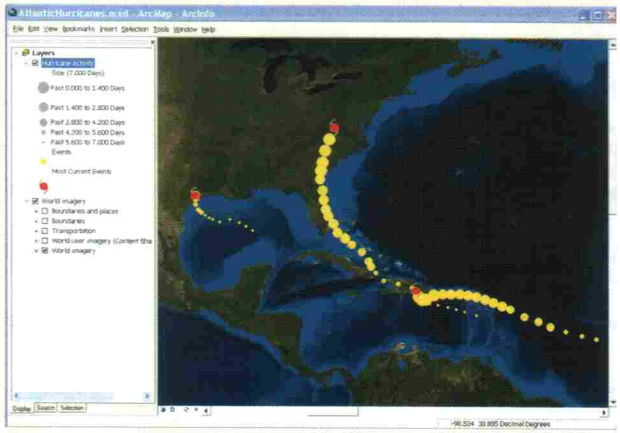
By bringing real-time data into GIS, you can share information quickly, easily, and efficiently and help your end users make better decisions. Tracking Server is used for many different applications including automated vehicle location and real-time tracking of assets.

With Tracking Server, you can

- Receive data in any format and transmit it to distributed clients.
- Perform filtering and alerting based on attributes of the data or spatial positions (geofencing).
- Log data into ArcGIS Server or distribute it directly to clients including ArcGIS Desktop Tracking Analyst extension or Web clients.

For example with Tracking Server, you can

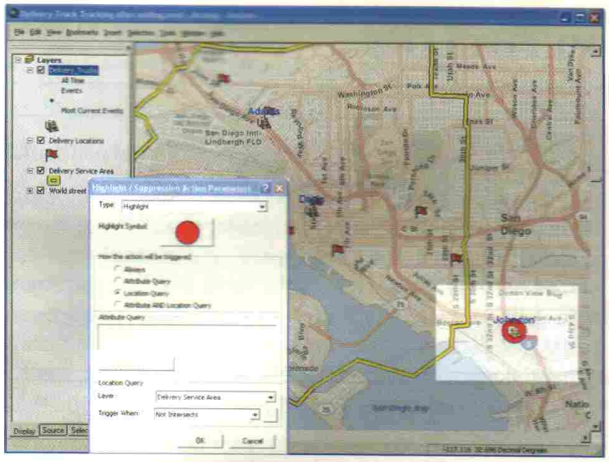
- Track vehicles (e.g., police cars, delivery trucks).
- Track natural resources (e.g., variable stream flow).
- Perform military tracking.
- Track network flows for electricity and gas.
- Look at traffic flows.



Key Features

Tracking Server contains two functional elements. These elements work together to collect and distribute data to the people who access Tracking Server via the Web or desktop clients:

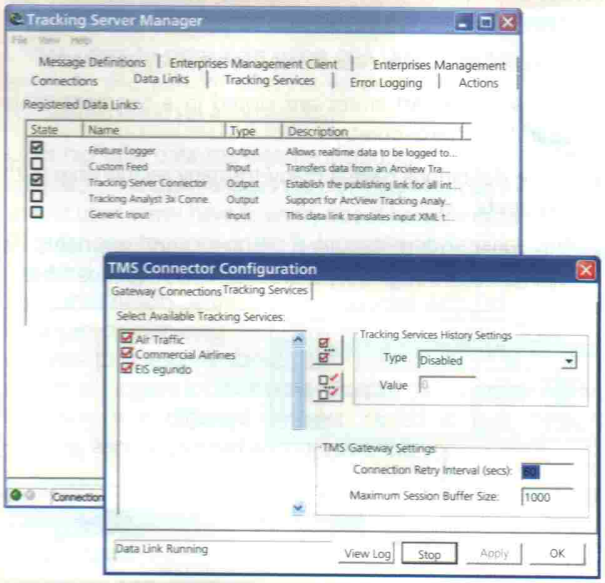
- **Tracking Message Server Component**
  - Offers an extensible architecture
  - Can collect data in any format from external systems
  - Has a multithreaded design, enabling efficient use of system processors
  - Can perform business logic on data as it is being collected
- **Tracking Web Distribution Component**
  - Lets you create new viewer Web sites
  - Is compatible with several Web servers and servlet engines



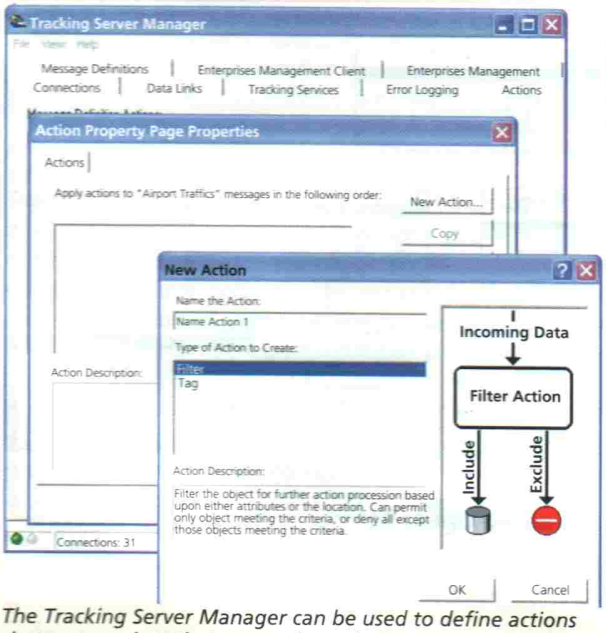
A truck leaving the defined delivery area, fenced in yellow, is highlighted in red.

- Makes it possible to view real-time data from any computer with access to the appropriate network—either intranet or Internet

Tracking Server includes several tools to help you configure your data formats and create customized viewers. For example, you can filter messages by attribute or spatial location. You can also diagnose configuration issues using simulated data streams.



The Tracking Server Manager can be used to control which data feeds are published to clients.

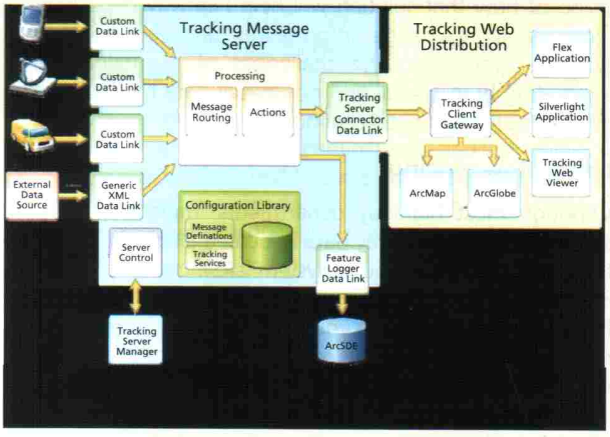


The Tracking Server Manager can be used to define actions that process data that passes through the server.

Functional Architecture

The following figure shows how data is received by Tracking Server and transmitted to any number of client applications. Typical client applications include ArcGIS Tracking Analyst and Tracking Viewer. Tracking Server can integrate data from different types of devices and distribute it to various types of client applications.

Tracking Server uses an extensible architecture that allows it to receive data from new sources and transmit that data to new clients, such as a custom-built ArcGIS Engine client.



Tracking Server lends itself to a host of uses in a variety of environments. Depending on the needs of your organization, you can configure your settings to optimize your collection, display, analysis, and distribution of real-time data.

For more details, please visit www.esri.com

Product Review

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 datasets 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.

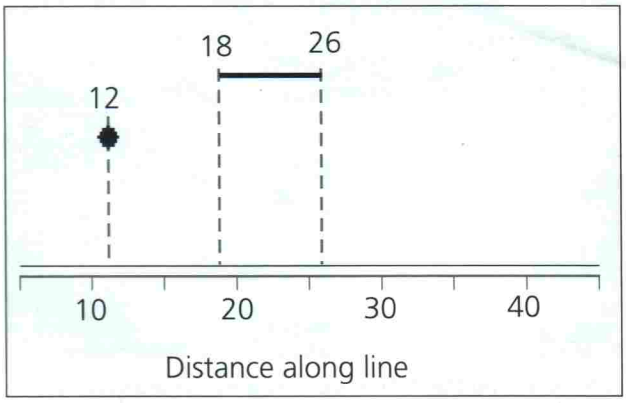


Figure: Linearly Referenced Asset Locations

Esri Transportation Model

The Esri transportation model is a reasonably comprehensive 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.

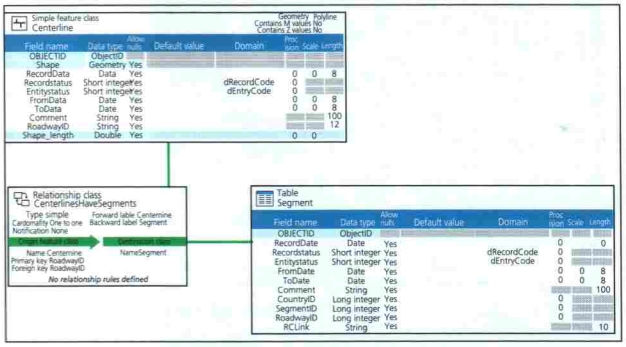


Figure : Centerline Segment Relationships

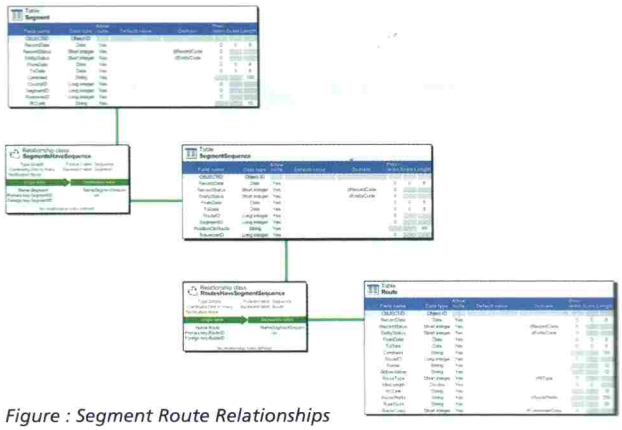


Figure : Segment Route Relationships

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 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.

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.

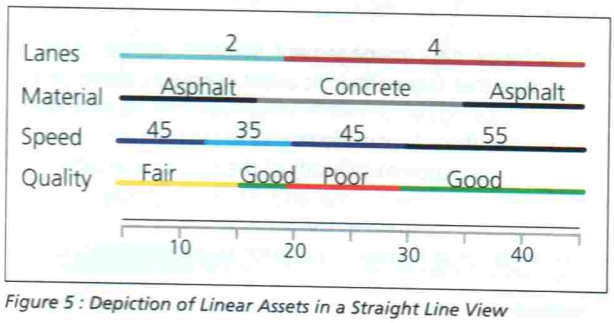


Figure 5 : Depiction of Linear Assets in a Straight Line View

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.

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 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,

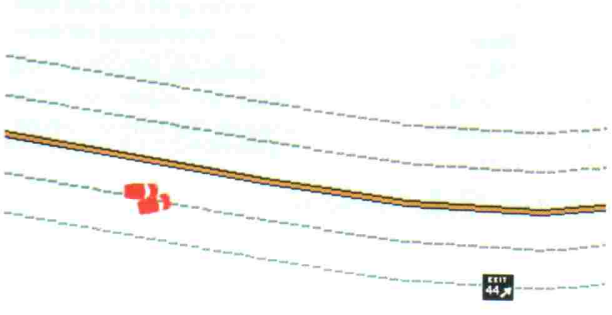


Figure 6 : Lane-Level Asset Location Using Dynamic Routes

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

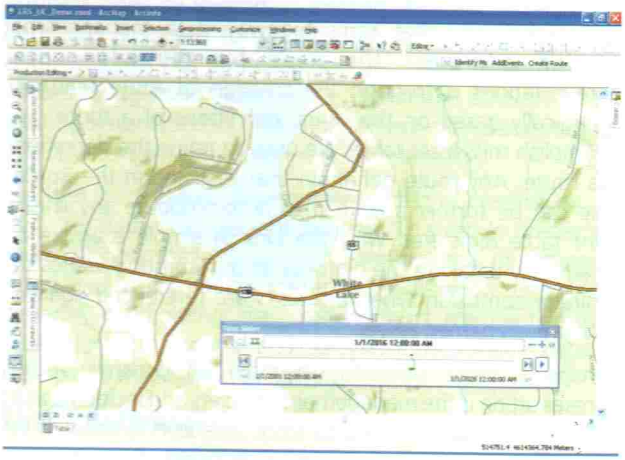


Figure 7 : Original Alignment with Overlapping Highways

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.

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

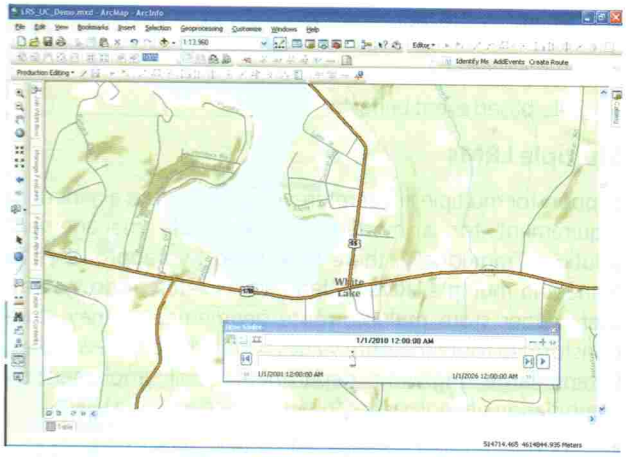


Figure 8 : Future Alignment with an Overpass Replacing the Overlap

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 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 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 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.

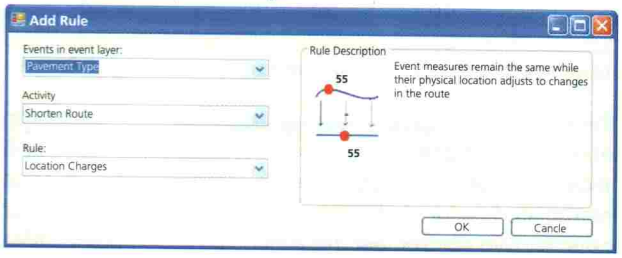


Figure 9 : Building Rules for Event Behavior

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 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.

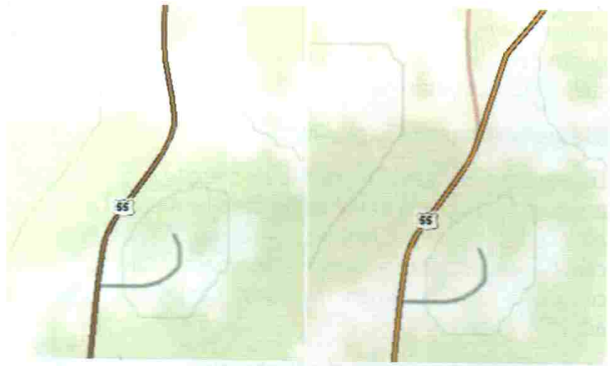


Figure 10 : Asset Moves with Change in Length of Highway

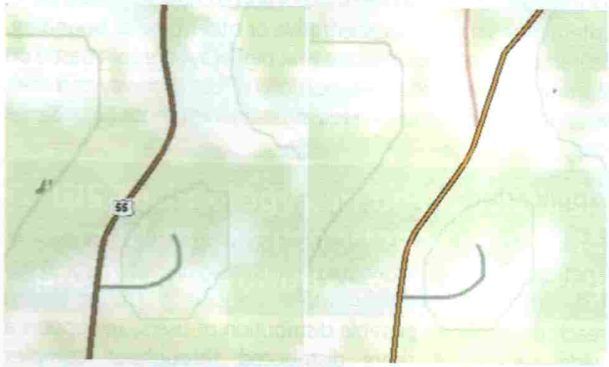


Figure 12 : Assets can snap to a new route location.

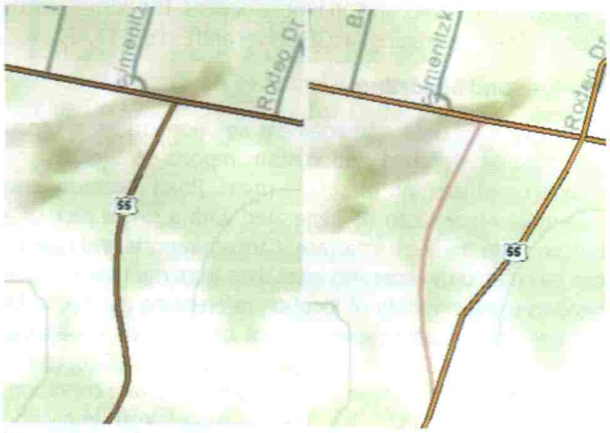


Figure 13 : Asset Snaps to the New Route

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.

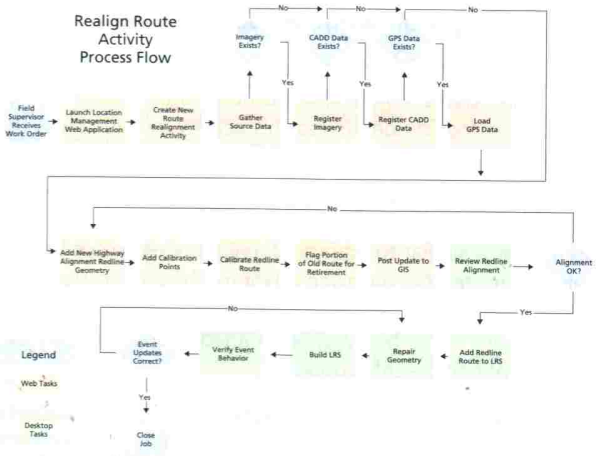


Figure 16 : Route Realignment Activity Process Flow
Several generic highway data maintenance activities are preconfigured and provided with the solution.

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

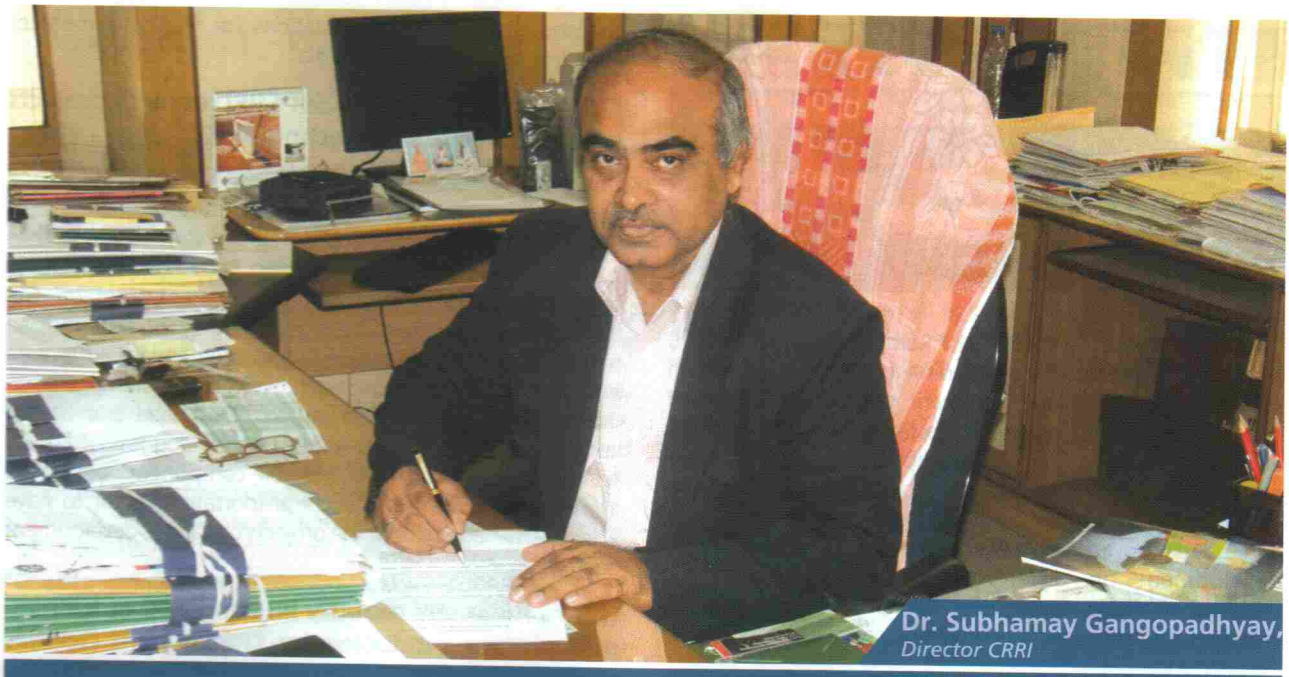
Esri's highway data management solution offers a broad spectrum of standard and custom reports as well as the creation and printing of simple maps. Road inventory and pavement reports can be generated with a single click of a button from the Web interface. Custom reports and queries can be created by 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.



Dr. Subhamay Gangopadhyay,
Director CRRI

"GIS Technology can be an integral component of IT/MIS implementations in road and transportation sector to have effective management of the projects by various development agencies"

The Central Road Research Institute (CRRI) is a premier National research institute in the area of roads and road transport and is a constituent laboratory under the Council of Scientific & Industrial Research. The Institute was founded in 1952 and is situated on Delhi - Mathura Road (NH-2) in New Delhi. The Institute is equipped with modern laboratories manned by highly qualified professionals of different disciplines (engineering, physical and social sciences). CRRI endeavors to develop professional excellence in the area of roads and road transport through world class research and development program, consultancy services and human resources development activities to evolve appropriate solutions to diversified problems faced in the field of roads and road transportation.

The R&D areas of the Institute are on various aspects of roads transport and related activities viz., Pavement Engineering and Materials, Geotechnical Engineering, Bridges and Instrumentation Engineering, Traffic Engineering and Road Safety, Transportation Planning and Environment, Road Development, Planning & Management in addition to state of art computing facilities, infrastructure divisions and administrative sections. The institute has highly qualified and experienced 120 Scientists with PhD/Master degrees in various subjects to undertake interdisciplinary activities. CRRI has carried out extensive in-house, sponsored and contract R&D projects and also continues to provide consultancy services to government, public and private sector organizations. Being a premier national laboratory, CRRI plays an unique role in the preparation of national standards and specifications, code of practices issued by Indian Roads Congress, Bureau of Indian Standards, Ministry of Roads Transport & Highways and National Rural Road Development Agency (Ministry of Rural Development, Government of India) in all road transportation related areas especially on materials, geometric and pavement design of roads, road construction maintenance management, traffic engineering, safety and socio-economic analysis.

CRRI is an ISO accredited institution, and therefore, all the project works are carried out as per carefully prepared quality plans to meet ISO-9001 requirements. Further, as per the established CSIR system, there is in place a Customer Satisfaction Evaluation requirement for the projects.

While acknowledging the success of GIS based National Highways Information System by CSIR-CRRI, Arc India News Editorial Team got an opportunity to have a conversation with the Director, Dr. Subhamay Gangopadhyay. Following are the excerpts elicited for our readers.

Q. What is the Mission of CSIR-CRRI in order to have proper Roads and Highways network connecting the whole nation?

Let me put it this way, Central Road Research Institute (CRRI) is one of the premier national laboratories under Council of Scientific and Industrial Research (CSIR) established in 1948. The mandate of the organization is to engage in carrying out research and development projects on design, construction and maintenance of roads, traffic and transportation planning of metropolitan and medium cities, management of roads in different terrains, improvement of marginal materials, utilization of industrial waste in road construction, landslide control, ground improvements environmental pollution, road traffic safety and analysis & design, fatigue, corrosion studies, performance monitoring/evaluation, service life assessment and rehabilitation of highway & railway bridges.

Being a premier national laboratory, CSIR-CRRI plays an advisory role in preparation of national standards and specifications, code of practices issued by Indian Roads Congress, Ministry of Roads Transport & Highways, National Highways Authority of India and National Rural Road

Development Agency (Ministry of Rural Development, Govt. of India) in all road transportation related areas especially on materials, geometric and pavement design of roads, road construction and maintenance management, traffic engineering, safety and socio-economic aspects. Our contribution for road sector or highway network development is to support all stakeholders including central and state governments with intensive research and development on different aspects of road sector development; and to provide standards of practices to improve safety, efficiency and quality aspects.

Q. Can you please highlight some salient features of GIS Based National Highway Information System?

The 'GIS based National Highways Information System (NHIS) being developed at CSIR-CRRI for Ministry of Road Transport and Highways for about 50,000 km of National highways Data is web based GIS integrated application to view and analyse the road related data for achieving better maintenance management strategies. The system can be accessed by public, engineers and administrators with role based access privileges using any standard internet browser from any location over web. The application has been envisaged with the following modules at large:

- Authentication Module
- Locational Referencing System
- Pavement Construction and Maintenance History
- Pavement Inventory
- Pavement Condition
- Pavement Geometrics
- Pavement Crust Thickness and Strength
- Traffic and Vehicle Information
- Integration with HDM – 4 Software
- Cross-Drainage details
- Environment Condition Information

At functional level, we have exercised unique codification for national highway per km stretch, wherein each stretch holds the entire pavement related parameters.

Q. We understand that CSIR-CRRI is a research institute focused on road sector development, yet it is surprising to acknowledge that your team at CSIR-CRRI has taken up the challenge to execute 'GIS based National Highways Information System', how this has become possible ?

The Project, 'GIS Based - National Highway Information System' being developed at CSIR-CRRI for Ministry of Road Transport and Highways (MoRTH) is a significant contribution by CSIR-CRRI team with the assistance of NIIT Technologies and ESRI India.

I am pleased to mention that noteworthy contributions being made by CSIR-CRRI Team including Dr. P. K. Kanchan, B. M. Sharma, Dr. B. K. Durai and A. Mohan Rao. Their domain expertise and intuitive drive helped our organization to demonstrate the capacity of Our Organisation in a new dimension. Onward, we are very confident to take up challenging IT/GIS implementations for the betterment of road sector development in India.

Q. What are the other CSIR-CRRI research projects that are using GIS as a technology?

Now a day, GIS technology is being used in several applications in the field of road and transportation. We at CSIR-CRRI have adopted and developed various approaches such as GIS in preparation of District Rural Road Plan (DRRP) and core network for rural road development programs, GIS based bridges maintenance and management system, road network planning, estimation of travel demand for urban area including metro projects, traffic congestion management, driving cycle and emission pattern, land slide and hazard zonation mapping, road safety etc. I, suggest that GIS technology can be an integral component of IT/MIS implementations in road and transportation sector to have effective management of the projects by various development agencies.

Q. Are there any capacity building and or training programmes conducted by CRRI, where GIS has been given significance for road sector development?

We organize a regular annual training programme on 'Geo-Spatial Technology (GIS, GPS, RS, etc.) for Roads and Transportation' to the field engineers, consultants and academicians at CSIR-CRRI New Delhi. In addition our scientists deliver lectures on GIS applications in roads to transportation in various organizations. Currently, we at CSIR started a two year Post Graduation Research Programme (PGRP) in Engineering (Infrastructure and Disaster Mitigation

> **"Onward, CSIR-CRRI is very confident to take up challenging IT/GIS implementations as part of our road research initiatives for the betterment of sector development in India."**

(Building/Roads) being conducted at CSIR-CRRI and CSIR-CBRI Roorkee. In which, we have included an elective course on 'Geospatial Techniques for Infrastructure'. We also provide summer training and project work for graduate and post graduate students in engineering and sciences to carry out their work in GIS, GPS, Remote sensing applications related to transportation problems.

Q. You are member of various technical committees of Government of India. Do you think GIS for Transportation Planning can be enforced to all the State Roads Department and generate a single road network data for the whole nation that can be integrated at centralized body?

We have been recommending and ensuring that GIS technology in planning and management of infrastructure can be effectively used to achieve maximum technical benefits to provide better facilities to co-up the currently rate of economic development. PMGSY the flagship programme of the Government of India for rural road development is significantly using GIS technologies for planning and monitoring of the projects. NHAI has also developed Road Information System which has GIS functionalities. We are developing GIS based NHIS for MoRT&H, similarly several urban development agencies adopting GIS for better management of infrastructure facilities including roads and transportation. Yes, if these entire GIS database being developed or generated is put together, we will be in a better position to have an integrated networked data for the entire transportation sector of our country, which can be effectively used for planning, design and management of various projects.

Cellular Tower Site Selection in a Hilly Terrain Lavasa Case Study

Dr. G. S. Rao
Vice President – Geographic Information Systems, Lavasa Corporation Limited, govindaraju.rao@lavasa.com

Introduction

Lavasa Corporation Limited has been formed to undertake one of the foremost lifestyle developments in India. It is creating a new, planned & integrated township that will redefine the way people live. Based on New Urbanism principles, Lavasa is a visionary project, which will become a benchmark for future new development. Lavasa is located in the picturesque Mose Valley, and is easily accessible from Mumbai (200 kilometers & three and a half hours of driving) and Pune (64 kilometers & one hour of driving). Lavasa is being developed over a sprawling 12,500 acres (approx.) of land with state of the art infrastructure and amenities well integrated with the green zones.

One of the problems encountered in hilly terrains such as Lavasa is the large areas of blind spots which are not covered by cellular towers. It is often assumed, erroneously so, that installing a cellular tower at the highest location would provide coverage over the entire valley. Very often, especially in the lower valley regions, significant tracts of land fall within the blind area and are therefore bereft of cellular signal coverage.

The digital elevation model of the terrain can be effectively used to place virtual cellular towers at various locations and to compute the extent of coverage. By varying the height of the tower and the signal intensity various options can be considered. This in turn helps to identify one location that provides the desired coverage. It must also be noted that one important consideration, particularly in hilly terrain is that the terrain is relatively flat and is amenable to erection of a tower. Another requirement is the availability of a source of power in the vicinity of the proposed location. If it is anticipated that the tower will be supplied by captive power such as a diesel generator set or batteries, accessibility of the site is a prime consideration. If the location is in a remote area, security in terms of preventing vandalism is also a concern.

It is important to note that the coverage of cellular towers is in a parent-child relationship. The major towers maintain contact between one another, encompassing the whole area. These external towers are usually located at higher elevations and have greater horizontal extent due to which they 'talk' to one another and also to the smaller child towers. This coverage is inadequate especially for interiors of structures such as buildings which act as a dampening agent for the signals. In order to produce coverage inside the buildings, child towers should be used, which were of a lesser horizontal extent but of greater power (signal intensity). Thus the signals are strong enough to pass through all obstacles.

Methodology

Step 1: Extract spot heights lying inside land use category of layout open spaces.

Height information was available in point format, which was derived from the contour survey and partially from Total Station survey data. This step ensures that the points do not belong to plots demarcated for development and other critical landuse parameters.

Step 2: Extract points lying inside ownership land only.

The points, apart from lying inside the layout open spaces, should also lie within land owned by Lavasa. In order to achieve this, another location based query was prepared that extracted points which were both in open Landuse and ownership status "belonging to Lavasa".

Step3: Reclassify the slopes to degrees

The slope map was generated to know the location of the points in the various slope categories. It was essential that the points should not lie on sloping lands nor in very inaccessible area, which would create a problem in the erection of the tower.

Step 4: Extract points that are lying in flat land parcels with specified minimum area

The above criteria thus defined the accessibility. Another criterion was the base area. For the tower and the generator room, a base area of 30 square meters was essential.

Step 5: Creating virtual domes of required parameters

The objective of the analysis is to evaluate the intervisibility using 120 degrees horizontal field of view and 7 degrees vertical field of view. Heights of the proposed cellular tower were varied from 30 to 50 meters. Once the conditions for land acquisition, slope and landuse were satisfied, the set of points extracted were subjected to intervisibility analysis using ArcGIS software. Further using ArcGIS, viewsheds were created applying the above mentioned criteria.

Figure 1 shows a virtual "bird-cage" whose shape is determined by the height of the proposed tower and its signal strength. This virtual cage is moved to different locations and the extent of coverage is assessed.

Figure 2 shows the decreasing signal intensity as one moves away from the tower location. The colour-coded concentric arcs represent gradually decreasing signal intensity.

Challenges

This process involved more than 5000 points from spot heights (Points from total station survey of the land whose elevations above MSL are known) out of which around 40 points were selected using the slope, acquisition and landuse constraints. All the points were then visualized for the view ability at restricted heights of 50 meters for outdoor coverage and 30 meters for indoor coverage.

Conclusions

By combining the principles of telemetry with the analytical ability of a GIS, it is possible to identify the optimal location for a cellular tower. The greatest advantage is that evaluation of alternative options can be done rapidly by moving the "bird-cage" in an iterative manner. This eliminates the need for exhaustive field investigations which are cumbersome and require the transport of heavy equipment. The savings in terms of cost and efforts are immediately apparent.

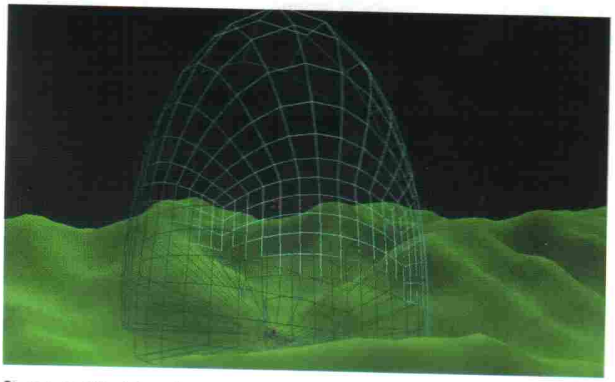


Figure 1: "Bird Cage" representation of virtual cellular tower coverage

Figure 2: Colour-coded concentric arcs showing decreasing signal intensity away from tower location

Case Study

Identification of suitable shelter locations during floods using GIS Technology

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Abstract

India is one of the most vulnerable developing countries to suffer from floods annually. With the tropical climate and unstable landforms, coupled with rapid urbanization and non-regularisable river bed colonization have resulted in the hazardous occupation of the flood plains to an ever increasing extent, Which strike causing a devastating impact on human life, economy and environment. Though it is almost impossible to fully recoup the damage caused by the disasters, it is possible to (i) minimize the grief caused to the affected by setting up shelter / rehabilitation centers timely during floods (ii) assess the damage caused and estimate the relief material required to supply in the affected areas. Geographic Information System (GIS) plays a crucial decision support tool to identify suitable relief/ shelter locations during floods and estimate the submerged areas. The article describes the role of geographic information system in evolving a suitable strategy for identifying suitable shelter locations for carrying relief activities and estimating the flood affected areas.

1.0 Introduction

Floods are the most common and widespread among all natural disasters in India. According to National Flood Commission (NFC, 1980) report about 40 million hectare of area in our country is flood prone. Floods in the Indo-gangetic-Brahmaputra plains are an annual feature and on an average, a few hundred lives are lost, millions are rendered homeless and millions of hectare of crops is damaged every year. With the increase of population, industrial growth and development in flood plains, flood hazard has become ever increasing natural disasters resulting in highest economic damages among all kinds of natural disasters. If losses measured due to floods in terms of lives and property are to be minimized, a comprehensive strategy for flood management is required which is referred to as disaster management cycle. Disaster management cycle consist of the following different phases:

1. Forecasting and Warning phase
2. Relief and Rescue phase
3. Rehabilitation phase
4. Mitigation phase

When a flood event occurs, the first and foremost activity that will be taken up with high priority is the relief and rescue. In case of a flood occurrence, relief activity will be initiated to evacuate the people and movable property, organizing relief camps, air dropping of food and medical facilities etc. This phase is the most critical and actions have to be taken on the spot according to the situation. Timelines, organizing resources and manpower are the essential components. The information required during this phase is extensive and critical since the actions have to race against time. The crucial information required is to identify suitable shelter location for relief camps and providing medical facilities. The objective of the present study is to develop a GIS based methodology that effectively identify suitable shelter / relief camps during flood disasters. In the present study ESRI Arc GIS desktop product is used to show powerful decision making tool in identifying suitable shelter / relief camps during flood disasters.

2.0 Methodology

The flood layer extracted from satellite data is converted into vector format using raster to vector conversion tools. Flood inundation area statistics was extracted integrating flood inundation layer with administrative boundaries like district, mandal and village boundaries using analysis tools available in Arctoolbox. Flood inundation area damage statistics were generated to identify the worst hit districts, mandals and villages in terms of area affected by the floods. The road layer is integrated with flood layer to delineate flood affected roads (Fig.3) and unaffected roads. All the roads not affected by the floods were identified and buffers were generated along the roads for a distance of 500meters, 1000meters and 1500meters (Fig.4). The village point layer is integrated with flood layer to identify flood affected villages and un-affected villages (Fig.2). The flood affected village layer was integrated with road buffer layer to identify the villages that fall within the buffer zones of 500meters, 1000meters and 1500meters (Fig.4). All the unaffected villages by the flood that fall within the specified buffers were categorized into villages very near, near and comparatively near to the un-inundated roads. Buffe were generated around all the village points that fall into very ne near and comparatively near category villages. The buffer layer is th integrated with flood affected village point layer. A summariz statistics is generated to identify the maximum number of flo affected villages falling within the buffers of non-flood affect villages (Fig.5).

A list of villages satisfying all the following criteria is generated:

i) All the villages not affected by floods
ii) Villages that fall within the 500meters, 1000meters a 1500meters road buffers or villages that are categorized in near, very near and comparatively near to roads.
iii) A non-flooded village having maximum number of flood affect villages within its 500meters, 1000meters and 1500mete buffer.
iv) Village near to Worst hit flood affected areas.
v) All the non-flooded villages with better infrastructure (schoc police station etc)

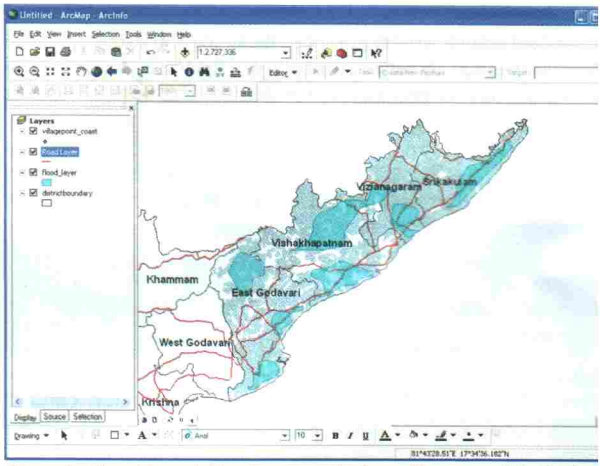

Figure 1: Flood inundation layer overlaid on village, road & district boundary layers

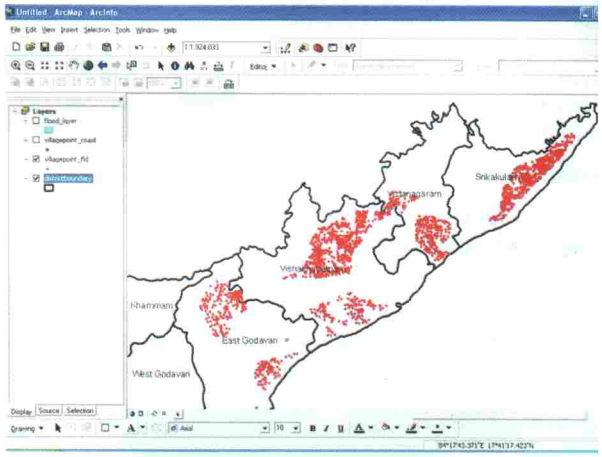

Figure 2: Flood affected villages

The list of villages generated (Table.1) represents the most suita locations to set-up as shelter / relief camps during floods.

3.0 Conclusions

I feel that method of analysis presented here provides need information to identify most suitable locations to set-up shelter / rel camps during floods. Especially, the other means of getting su information is difficult due to disruption of communication lines a transportation networks. The methodology also provides the disas managers the information on how many relief camps has to be set- at village, mandal and district levels. However the criteria used in t analysis need to be refined by incorporating more infrastructu

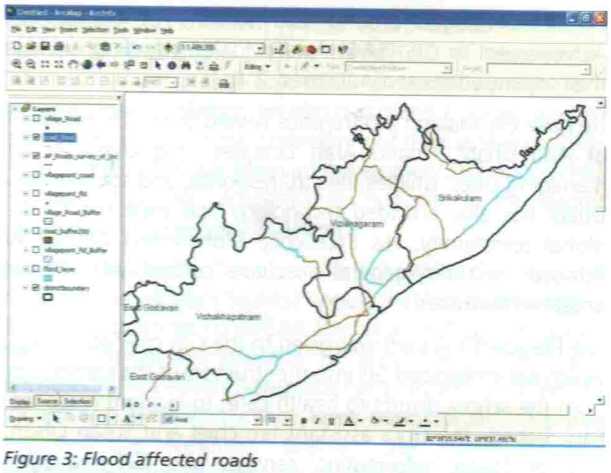

Figure 3: Flood affected roads

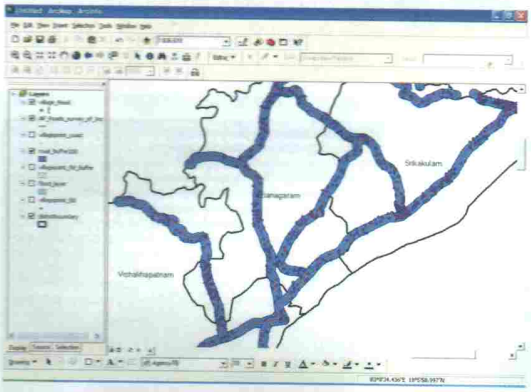

Figure 4:. Villages not affected by floods and falling within specified road buffers

information so that the list of most suitable locations can be narrowed down to the best locations. The scientific based assessment and reliability of information generated makes the GIS technology increasingly important to disaster managers to depend on.The entire process can be automated using Arc objects the building blocks of ESRI suit of products in .NET environment to save time in generating the information as further scope of work.

4.0 Acknowledgements

The author would like to thank Flood unit members, DSC, National Remote Sensing Centre for their support for this study.

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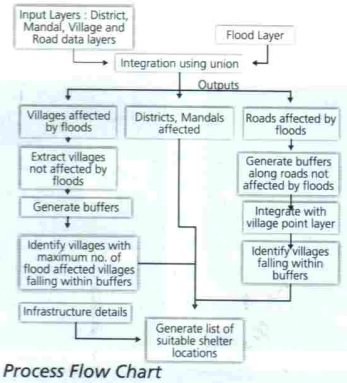
Figure 5: Identification of flood affected villages falling within specified buffers of villages not affected by floods



Process Flow Chart

Table 1 : Summarized list of most suitable shelter locations based on the criteria

Shelter Location Names	State Name	District Name	Mandal Name	Households	Tot_Pop	Tot_Mpop	Tot_Fpop
Bayyavaram	Andhra Pradesh	Visakhapatnam	Makavarapalem	396	1662	824	838
Valasapalle	Andhra Pradesh	Cuddapah	Yerraguntla	205	933	492	441
(Shro) Thirumalapuram	Andhra Pradesh	Anantapur	Tadimarri	137	709	344	365
Agayalanka	Andhra Pradesh	Krishna	Nagayalanka	2215	8824	4523	4301
3Ondolu	Andhra Pradesh	East Godavari	Addateegala	206	777	381	396
8Akkalapadu	Andhra Pradesh	East Godavari	Y. Ramavaram	6	28	14	14
8Andakonda	Andhra Pradesh	East Godavari	Addateegala	6	20	12	8
8Aritala	Andhra Pradesh	Krishna	Kanchikacherla	1834	8894	4595	4299
9Ukarai	Andhra Pradesh	East Godavari	Addateegala	59	280	1 38	142
A. Chintamakulapalle	Andhra Pradesh	Chittoor	Chowdelalle	299	1630	835	795
A. Kathigudem	Andhra Pradesh	Khammam	Venkatapuram	0	0	0	0
A. Kothakota	Andhra Pradesh	Chittoor	Chowdelalle	426	2183	1112	1071
A. Kothapalle	Andhra Pradesh	East Godavari	Thondangi	1667	7704	3880	3824
A.Veeravaram	Andhra Pradesh	East Godavari	Devipatnam	146	557	267	290
A.Vemavaram	Andhra Pradesh	East Godavari	Amalapuram	966	3582	1777	1805
A. Burdipadu	Andhra Pradesh	Mahbubnagar	Manopadu	191	1066	551	515
A. Channamambapuram	Andhra Pradesh	Cuddapah	Pullampeta	79	469	239	230
A. Duppala Palle	Andhra Pradesh	Nalgonda	Thipparthi	266	1479	749	730
A. Gokulapadu	Andhra Pradesh	Kurnool	Kallur	454	2514	1271	1243
A. Gonehal	Andhra Pradesh	Kurnool	Alur	46	326	161	165
A.I. Bheemavaram	Andhra Pradesh	West Godavari	Akiveedu	1099	4730	2376	2354
A. Kothapalle	Andhra Pradesh	Cuddapah	B.kodur	18	98	54	44

Note: Tot_Pop: Total Population.Tot_MPop: Total Male Population; Tot_FPop: Total Female Population

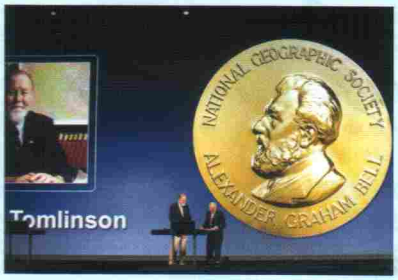
The 30th ESRI International User Conference 2010 witnessed the august gathering of the GIS community worldwide. The conference witnessed Esri user representatives from 134 countries representing 6,000 organizations and heard how GIS infrastructure is changing collaboration for doing work and managing the enterprise.

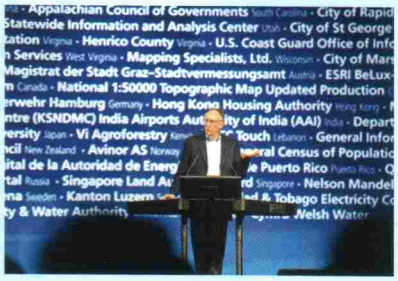
Jack Dangermond, ESRI Founder & President, welcomed the attendees by encouraging us to get to know each another as a community and recognized outstanding contributions in the field of GIS. In his Plenary address he related the significance of geography and GIS in opening geographic knowledge to everyone. Also reviewed how ArcGIS 10 provides exciting new capabilities to empower a variety of user communities. Later he was joined by the Esri staff continuing the discussion of ArcGIS 10 with an in-depth look at the ArcGIS 10 system, highlighted through a series of informative demonstrations and presentations.

He acknowledged around 200 winners of the Special Achievement in GIS (SAG) Award for outstanding work in their organizations and industries.

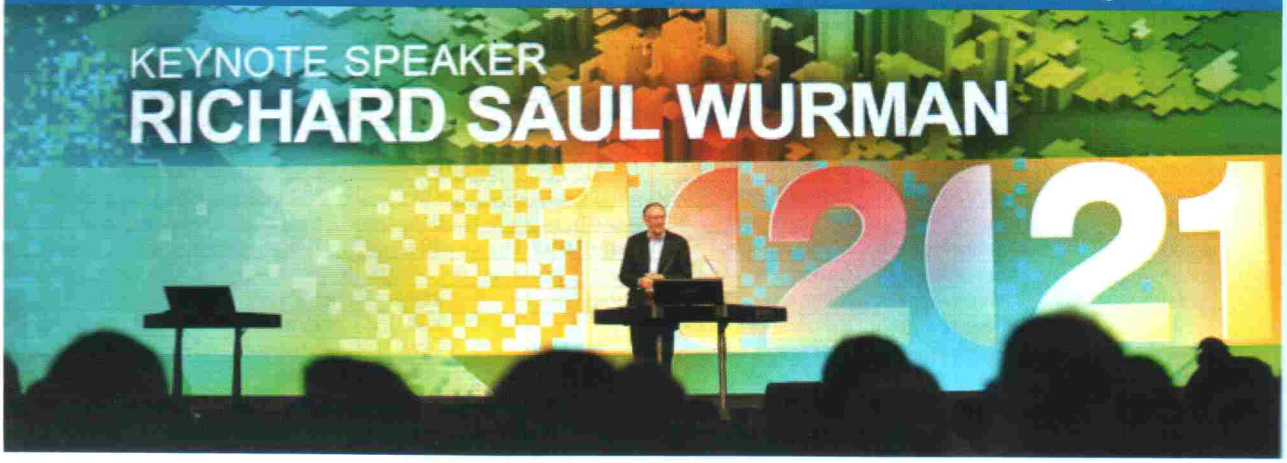
He gave the Making a Difference Award to the Government of Abu Dhabi, United Arab Emirates, that uses GIS for managing cities, utilities, health, response, and science. Abu Dhabi has also provided technology and expertise to the global community. His Excellency Mohammed Ahmed Al Bowardi, secretary-general executive council, Abu Dhabi, accepted the award.

The President's Award was given to the City of Frisco, Texas, which has embedded GIS into the structure of the community from the school district to health care, to incident response. Paul Siebert, the city's assistant fire chief and Susan Olson, City of Frisco, information services and GIS manager, accepted the award.





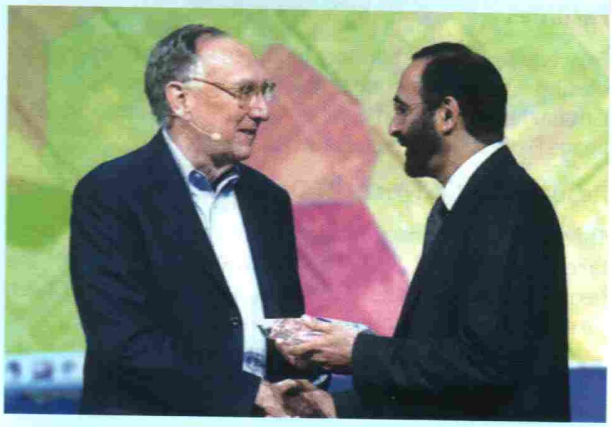
Esri International User Conference 2010
GIS opening the world for everyone

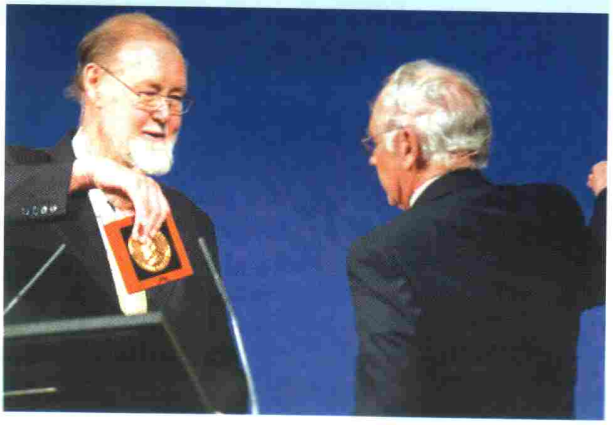


The Lifetime Achievement Award was presented to Carlos Salman Gonzalez, the president and CEO of Sistemas de Informacion Geográfica S.A. (SIGSA). He brought modern mapping tools to Mexico. He also purchased a nursery and led a movement that has planted millions of trees in that country. After working for the Mexican government, Carlos opened his own mapping company, which today is the largest mapping company in South America.

National Geographic Society's board chairman Gil Grosvenor awarded the society's highest honor, the Alexander Graham Bell Medal to Roger Tomlinson, the father of GIS. "The award honors Tomlinson's qualities of great innovation," said Grosvenor. "His efforts have made geographers out of people who didn't even know they were geographers." He also awarded the Alexander Graham Bell Award to Jack Dangermond for his innovations that are transforming the world of geography, bringing the use of geographic information to every part of the globe.

Jack Dangermond also acknowledged the work of the United Nations, especially its cartographic and statistical unit that has diligently worked to bring standards and templates to build a foundation for GIS users throughout the world.





During the Plenary Talk Mr. Jack Dangermond talked about his vision of GIS opening the world for everyone--the theme of the conference. "GIS already organizes our geographic information; it is time to share this with the world. Can this be done on a global scale?" he asks. "Converging forces of advancements in computers, the Web, mobile devices, real time measurement and GIS software are making this possible. A Web-based geospatial platform is emerging that is a distributed network of data and services."

The newly formed business City Sourced showed its creation of apps that enable people with location devices to see and report information, allowing them to become involved in their communities and for cities to interact with their citizens.

"Everyone is getting more involved in crowd sourcing and social media," noted Jack. "For example, Twitter tweets can now be georeferenced. There are huge opportunities to bring in new types of real time information from citizens. Responding to these opportunities takes collaboration for sharing data and technology. The geospatial platform is emerging to handle this. In terms of technology, we are about there."

Reviewing the capabilities of ArcGIS Jack informed the users, "ArcGIS 10 is a complete system for geographic information, for pervasive GIS that is in the cloud, in the office, and in the field. Intelligent maps simplify the complexity of GIS (tables, metadata, workflow, etc.) and hide it behind a map. Geographic information is more than the data--it's all the pieces behind the maps that enable us to share our stories and get our ideas across to others."

"ArcGIS has hundreds of improvements such as fast display, templates, template-based editing, integrated parcel management, map books, and online resources," Jack said. "This makes way for a stronger scientific platform for time awareness, advanced spatial analysis, integrated scientific programming, and 3D GIS."

ESRI technology experts demonstrated how ArcGIS is a system that can be used in a wide collaborative effort wherein the enterprise is connected to everyone else. These include demonstrations on community maps, ArcGIS Online, ArcGIS.com, IOS for iPhone and iPad, productivity in ArcGIS 10, the integration of Python scripting, imagery, GIS processing integration, ArcGIS Network Analyst, and analysis using 3D and new space and time enhancements.

A special Keynote presentation was made by Richard Saul Wurman, author of 80+ books and founder of the renowned TED conferences. Wurman discussed the project 19.20.21 and how GIS is used to answer the questions--where is a city's center, where does it end, and how do we determine its edge? The way we ask the question is extremely important. He talked geospatially about five factors for analysis: concrete density, geopolitical area, transportation basin, metropolitan statistical area, and city lights. Wurman hopes to eventually develop a standard for measuring cities so that they can be analyzed and compared around the world.

The four day extravaganza also included various Technology workshops/ User Presentations and Exhibitors from various countries showcasing the state-of-art GIS technology in form of various applications and solutions. NIIT GIS Ltd. (Esri India) also participated in the exhibition. The Esri UC 2010 concluded with an extensive question answer session moderated by Jack Dangermond and various Esri Directors. The closing session addressed queries such as Roadmap of ArcGIS and its various new versions to K-12 software product in Future. With this the 30th Esri International UC 2010 concluded with a hope to meet again in July 2011 for the 31st Esri International UC

Geospatial Activities At Indian Institute of Technology, Delhi

Introduction

The geospatial activity at IIT Delhi has a long history. It started way back in 1990 when the first ESRI product had been introduced in the country on PCs. In 1993, a short course was offered by the Civil Engineering Department and was overwhelmly received by the participants taken from a wide spectrum. Subsequently, in 1995 an elective course on GIS was floated for the post graduate students. Two years later on demand from the undergraduate students, an introductory course on GIS was introduced at the undergraduate level. Both these courses are very popular with the students.

Since then there have been a large number of activities that have been taken up for the manpower development in the geospatial technologies. Special courses have been conducted for many organisations. For instance, in 2003 a Training Workshop on Geographic Information Systems was conducted for the officers of National Thermal Power Corporation. Fourty of their officers in four batches were trained. There have been national and international level activities that have been conducted around the geospatial activity.

Courses at IIT Delhi

The course known as "Geographic Information System" is an elective course for the undergraduate and post graduate students. The course runs every semester.

Recently, IIT Delhi has started a new scheme called Professional Development Courses under which any professional can decide to take any course of his/her liking from anywhere in the institute. The candidate shall attend the semester long course along with the other students and shall get the certification on the course. The GIS course is part of this new scheme of Professional Development Courses.

Department has also conducted various Special Training Programs in GIS in focused domains for Sponsored candidates from various Government departments across the country such as:

- Remote Sensing & GIS Applications in Hydroelectric Projects
- GIS and Its application in Civil Engineering
- Workshop on Geographic Information Systems for NTPC
- Stakeholders Assessment of GIS Tools and Data Sets for RWC Activities for Rice Wheat Consortium
- GIS-Based Water Resources Management

Facilities

Fully equipped GIS laboratory has been setup at Department of Civil Engineering under the supervision on Prof. A. K Gosain. The laboratory has all the needful hardware and GIS & Image Processing Softwares such Esri's ArcGIS.

Research Initiatives at IIT Delhi

There have been many academic initiatives that have been taken up by the IIT Delhi to showcase the potential of the geospatial technologies. One such initiative that has been taken up at the national level such as

- Integrated Water Resources Framework for India
- Web Mapping Application for accessing Hydrological Information
- Web based Interface applications based on the SWAT hydrological modeling.

(For Detailed of these Research Initiatives see Unique Applications sections)

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Visualizing Temporal data in ArcGIS 10

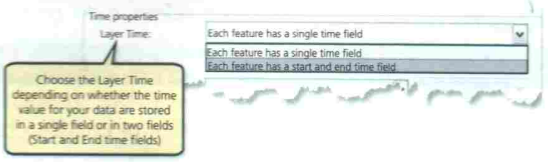
This topic takes you step-by-step through the process of enabling time properties on your data. The time properties of your temporal data can be set using the information stored in the data source. The temporal information can be stored in attribute fields for feature classes or raster catalogs.

You can set the time properties of your data on the Time tab of the Layer Properties dialog box. The time properties available on the Time tab vary depending on the dataset. For feature classes and raster catalogs, you have the option to specify one field (time field) or two fields (a start time field and [optionally] an end time field).

Steps:

1. Double-click the temporal dataset in the table of contents to open the Layer Properties dialog box.
2. Click the Time tab.
3. Check Enable time on this layer.

   The Time properties and Advanced settings controls are now made available. Also, some of the controls are populated for your convenience. You can choose to change these depending on your needs.
4. Based on whether the time stamps for the data are stored in a single field or in two fields in the attribute table, you can choose one of the following options for defining the value for Layer Time.



5. If the time values in your data are stored in a single field, set Time field to reflect these time values.

6. If the time values in your data are stored in two fields, set Start time field and End time field to these time values.

7. If the time values are not stored in a date-formatted field, set the field format. Set the field format if the field specified is a string or numeric field that contains date strings such as 2000/01/01.

   When using a date field, you do not need to specify a field format. For improving performance, it is highly recommended that you should store your time values in a date field.
8. Click Calculate to calculate the time extent of your data.

   The layer time extent is reported. The time extent of your data is stored with the layer properties, which is then used by the Time Slider to define the full time extent of the Time Slider. This also helps you in checking for any erroneous date values in your data.
9. Based on how you want to visualize your data, ensure that Time step interval is set appropriately. If not, specify the appropriate time step interval and units that is used to display your data.
10. If your data changes frequently because of constant edits or updates, check Data changes frequently so automatically calculate time extent. If checked, the time extent of your layer is recalculated based on the current extent of the time values in your data. Each time you click the Full time extent button on the Time Slider, the full time extent will be calculated based on the most current time extent of the layer.

    For historic data that does not change, you can leave this unchecked.
11. Optionally, set the time zone in which the data was collected. If no time zone information is provided, the data uses the default time zone of the Time Slider.

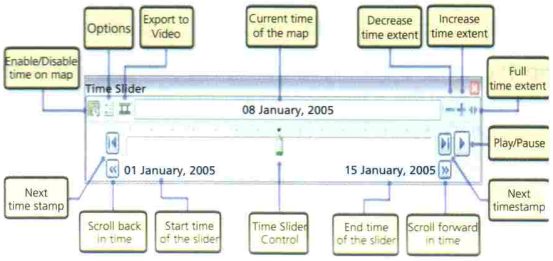
Setting the time zone on your time-enabled layers allows you to visualize data from different time zones at the same time.

12. Optionally, check Values are adjusted for daylight savings.
13. Optionally, you can set a Time offset value for your data. This allows you to align and visualize multiple temporal datasets in time.
14. Optionally, check Display data cumulatively.

The Display data cumulatively option enables you to retain data in the display that has been drawn or, in other words, to draw data in the display that has a start time field value less than or equal to the current display time for each time slice. Use this option if, for example, you have data displaying a fire perimeter burned each day. The accumulation in the extent of the fire can be displayed by checking this option.

Visualizing temporal data using the Time Slider

The Time Slider window provides controls that allow you to visualize your temporal data in the ArcGIS Desktop applications (ArcMap, ArcGlobe, and ArcScene). You can open the Time Slider window by clicking the Open Time Slider Window button on the Tools toolbar. The button is unavailable if you do not have a time-enabled dataset in your map, globe, or scene.



Creating and Sharing Notes using ArcGIS Explorer

Creating notes in ArcGIS Explorer is an easy way to make maps even more dynamic and interactive by adding non-geographic content such as videos, photographs, documents, HTML links, and embedded Web sites.

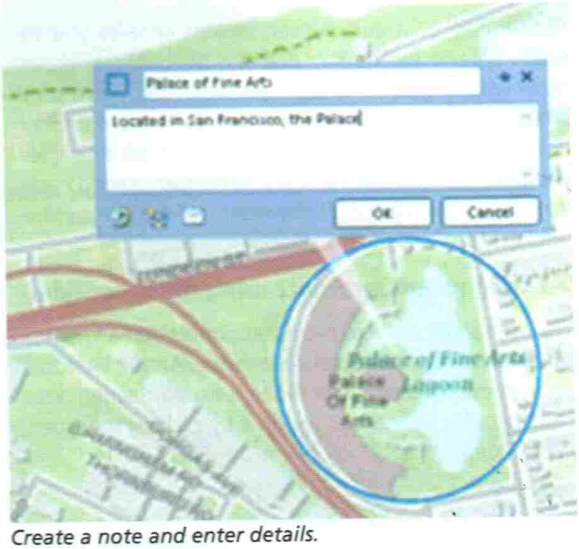
Notes include a title, text, and an associated shape or symbol. While in other ArcGIS applications, you usually use HTML pop-ups to display additional information about features on the map, ArcGIS Explorer uses notes. Notes can be created anywhere on the map, independent of features.

Notes you create in either the online or the latest downloadable version of ArcGIS Explorer can be shared with other applications such as the ArcGIS Desktop ArcMap application by converting the notes to a layer package, a process that takes just a few steps. You can only share notes from ArcGIS Explorer to ArcGIS Desktop, not the other way around, since creating and exporting notes is exclusive to ArcGIS Explorer.

How to Create and Share Notes

Say, for example, that you want to create notes for a presentation in ArcGIS Explorer that includes links to photos, reports, and Web sites and then use them in the ArcGIS Desktop ArcMap application. How do you do this?

Step 1: Create a note in ArcGIS Explorer by establishing the geographic location the note will reference. To do this, choose the Target, Point, Line, or Area button or, with the new version of ArcGIS Explorer, an arrow, circle, or rectangle from the Create group on the Home tab. Click a location on the map where you want to place the note, then enter content in the pop-up window. To edit the note's location, you can now use the Move button (located in the Edit group on the Note tab) rather than deleting and re-creating the note.

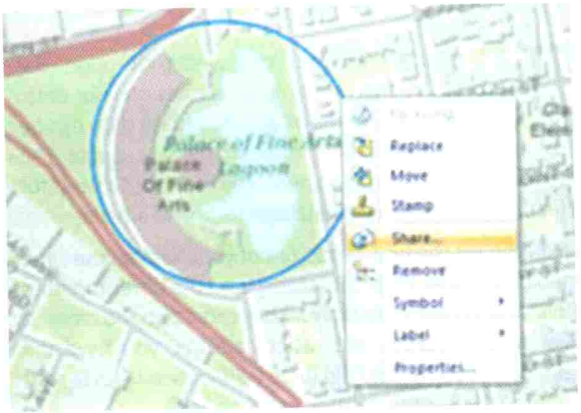


Create a note and enter details.

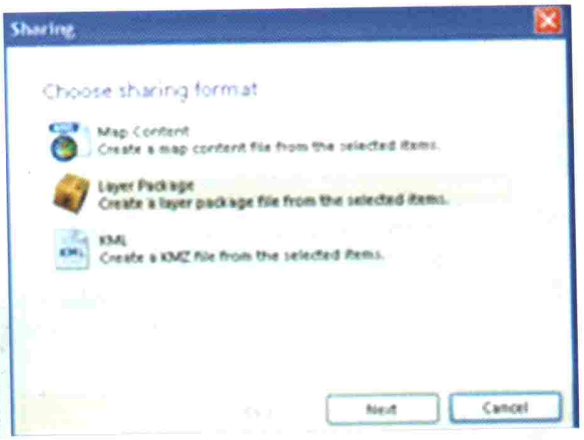
Step 2: To make notes available to other applications such as ArcMap, export the note by right-clicking on each one in either the map or the table of contents and select Share.

Step 3: Choose a sharing format: an ArcGIS Explorer map content (.nmc) file, a layer package (.lpk) file, or a KML file. In this case, choose a Layer Package.

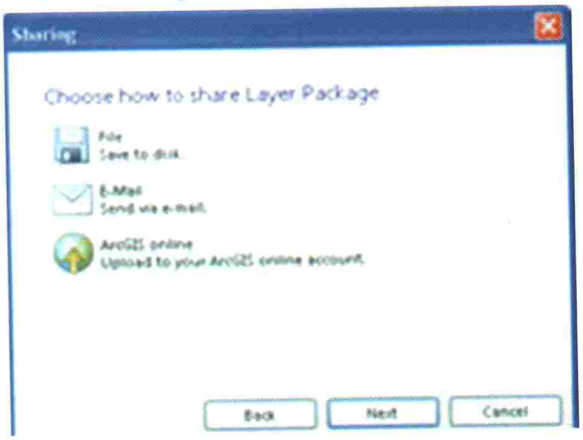
Step 4: You can save your note as a file, e-mail it, or add it to ArcGIS Online. Choosing ArcGIS Online makes the note available to anyone anywhere, anytime. You will be



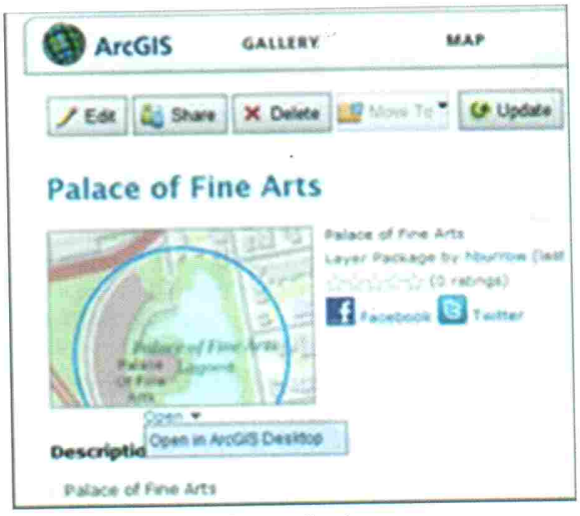
Share the note.



Choose the sharing format.



Choose how to save your note.



Open the note in another application.

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Tips & Tricks

GIS Research Initiatives @ IIT Delhi for Hydrological Applications.

There have been many research initiatives that have been taken up by the IIT Delhi to showcase the potential of the geospatial technologies. One such initiative that has been taken up at the national level such as Web based Applications - Integrated Water Resources Framework for India

Integrated Water Resources Framework for India

Integrated water resource management planning is a comprehensive planning process, involving all stakeholders within the drainage system, who together as a group, should cooperatively work towards identifying the water resource issues and concerns, as well as developing and implementing plans with solutions that are environmentally, socially and economically sustainable at various levels of connectivity of the drainage system.

It is important to understand that integrated water resource management should not merely imply the maintenance of an inventory of different activities to be undertaken within a hydrological unit. It also requires the collation of relevant information needed to evaluate the cause and effect of all the proposed actions within the drainage basin. The watershed is the smallest unit where the evaluation of man induced impacts upon natural resources becomes possible.

Since a watershed is considered as the smallest unit of a drainage basin, a hydrological framework that can keep track of the inter-connection of these units is essential. The impact resulting from action taken at the watershed level will be experienced at a higher level within the drainage basin, and the assessment of these impacts will require the availability of the framework. Such a framework will require regular maintenance and updating to reflect fully the most accurate ground truth data and the infrastructure requirements for planning and management of the relevant planning departments.

The development of Hydrologic Information System component is logical response to meet the specific information technology needs of the various endusers. A hydrologic information system consists of a hydrologic information database coupled with tools for acquiring data to fill the database and tools for analyzing, visualizing and modeling the data contained within it.

Web Based Applications

This GIS portal (http://gisserver.civil.iitd.ac.in/natcom), for the general user, exposes Web Mapping Application for accessing Hydrological Information and Web based Interface applications based on the SWAT hydrological modeling.

Arc Hydro a Specific Hydrologic data model

The Arc Hydro data model developed at the University of Texas, USA, enables a watershed to be described in a single Geodatabase which can be used by GIS based hydrologic and hydraulic model to simulate watersheds. Arc Hydro, provides a means for linking simulation models through a common data storage system. Thus, a schema that reflects temporal and geospatial hydrologic data was created to support surface water hydrology and hydrography modeling at any scale. The Arc Hydro data model divides water resources data into five components:

- Network – connected sets of points and lines showing pathways of water flow.
- Drainage- drainage areas and stream lines defined from surface topography.
- Channel- A 3-D line representation of the shape of river and stream channels.
- Hydrography- the base data from topographic maps and tabular data inventories.
- Time series- Tabular attributes data describing time varying water properties for any hydro feature.

Data Storage, Sharing and Protection

In the present study it is proposed to store the GIS data in a geodatabase using ArcSDE and Microsoft SQL server. ArcSDE can be phased in as a spatial data access server that allows administering spatial data stored in a relational DBMS and shall provide access to data required for client applications. By transferring almost all GIS data into the ArcSDE geodatabase, a centralized resource for geospatial data is created that can be accessed through the intranet and internet by various GIS applications and functionalities designed to serve its many GIS users.

Distributing Data and GIS Functionality

Historically, most typical data requests for geospatial and tabular data are provided through manual processes such as phone calls or on-site visits. Traditionally, these requests would be handled by office personnel. This would require intermediate steps, discussions, and often multiple revisions before the final product was created. The advent and subsequent rise in Internet use opened new avenues for data requests as well as a whole new group of data requestors. Now, with the help of built-in functionalities and customized ArcGIS Server applications that use .NET technology and Active Server Pages(ASP), allows enterprise GIS applications to be built that can be centrally managed and accessed via Web-based interfaces, custom applications, or traditional desktop GIS. Built on ArcObjects, ArcGIS server can provide all the strength of advanced GIS functionalities in a distributed multiuser setting. A user can generate custom maps and tables in real time. The data delivery mechanism is streamlined, user friendly, and cost-effective.

Major Elements of Framework

The common framework for water resources planning and management requires creation of base layers at different scales so as to cater to the relevant problems at the respective scales. However, it is imperative that all these scales should merge through the GIS environment for aggregation and integration to be possible. It is intended to provide this framework at the State level and with implementation at various departments connected with water resources. The major elements of the framework include as show in the figure 1

Arc Hydro data model could only meet the basic information. The Geodatabase was extended to capture the information related to administrative area, landuse, soil feature class and non spatial data related to socio-economic.

Model Base to Hydro Data Model

Arc Hydro data model structure could not support the SWAT model output which was essential for the present study. The Arc Hydro data model was further extended to support SWAT model output.

Web Base GIS Interface for Analysis of Model Results

The web based Interface is available at the URL http://gisserver.civil.iitd.ac.in/natcom.

Figure 2 shows the user view of the mail page. The user can zoom in further to view the catchment, sub-catchment and to the watershed level. The standardization of this drainage area was done by giving the unique identification number at different levels. These unique identification number along with sub-catchment name where used as reference for further analysis.

With this web based interface the user is given the option of analysis the Catchment or Sub-Catchment or Watershed by selecting it respectively. The user is also given the option to select the analysis of the SWAT model results with the different data set like India Meteorological Department (IMD) for the period of 1971 to 2005. The impact of climate change on water resources of the country has also been quantified

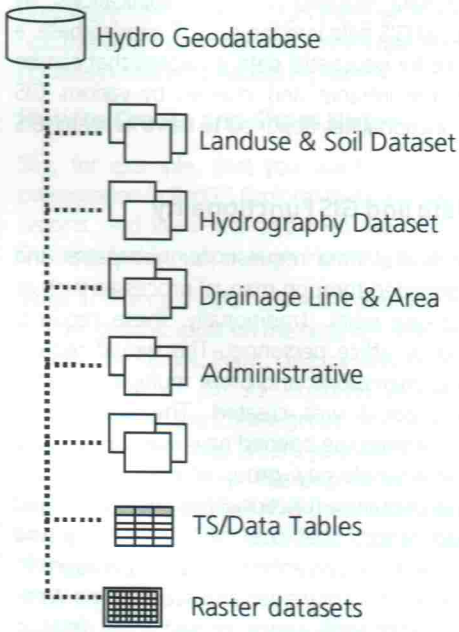

Figure 1: Framework of Hydro Geodatabase

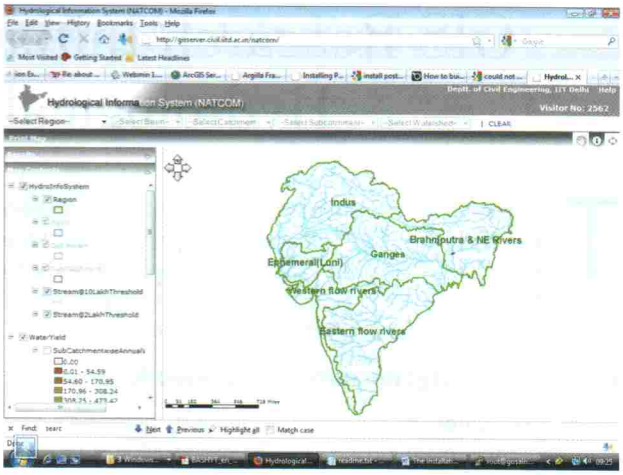

Figure 2: User view of Interface

using various popular IPCC scenarios and presented to a very large community of water users. It is important to assess the behaviour of the drainage area with and without man made intervention, so the web based interface is also designed to account for this concern. SWAT model gives many outputs parameters but only few parameters like Water Balance components, Flow, Water Quality parameters like Nitrite, Nitrate, Ammonium, Organic Nitrogen, Organic Phosphorus, Mineral Phosphorus, CBOD and Dissolved Oxygen, are given as option to user for analysis.

The development of a Geospatial Web Portal is proposed as the viable solution to address the water resources issues of the country that is becoming more complex with the increasing water demands as well as on account of the climate change. This effort shall go a long way in addressing these issues in a scientific way and creating methodologies to evaluate the sustainability of the actions by the society.

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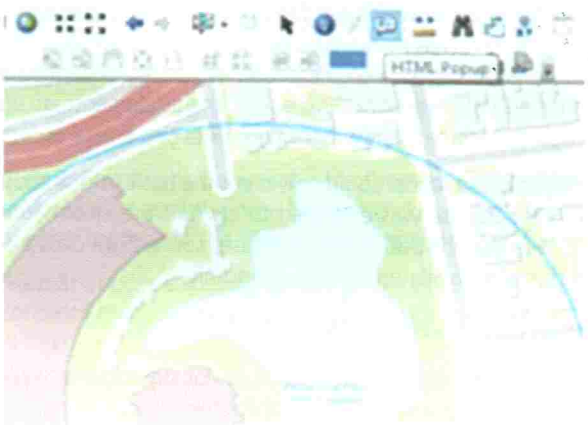
prompted to sign in to your Esri Global Account before uploading the note and adding a description of it.

Step 5: Once you have shared all your notes on ArcGIS Online, you can open the notes in the ArcGIS Desktop ArcMap application by visiting your online account and clicking on each note in your Content list. Choose Open in ArcGIS Desktop from the drop-down menu under the thumbnail on the Details page for each item.



Use the HTML Popup tool to see the note in ArcMap.

Step 6: Once ArcMap is open and your notes displayed, choose the HTML Pop-up tool—introduced in ArcGIS 9.3.1—from the main toolbar and click the notes to display their contents. (To e-mail the file or save it locally, you will need to drag and drop the layer package into ArcMap, because layer packages are not yet supported using the Add button.)

Creating New Workflows

Notes give you flexibility and interoperability with the ways they can be created, saved, shared, and converted between different formats. With the latest version of ArcGIS Explorer, you can share notes to ArcGIS Online, layer packages, and KML. KML can also now be converted to notes and, therefore, to layer packages. A Create Note tool has been added to the feature pop-up window, enabling users to create notes directly from any feature on the map, then convert them to KML or layer packages.

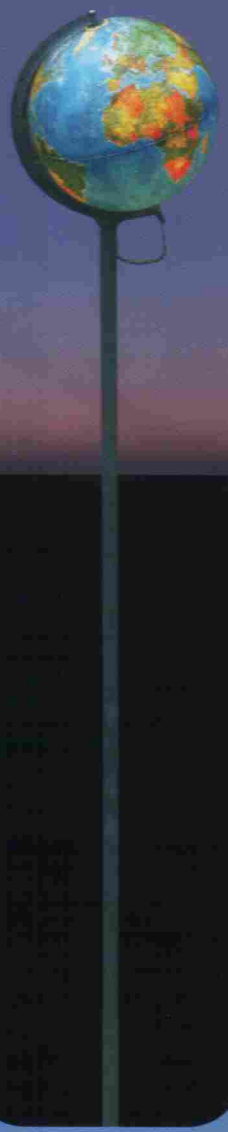
For more details, please visit www.esri.com

Feature Hyperlink

The following code snippet attaches a hyperlink to a selected feature dynamically. If a hyperlink is already existing in the feature attribute, the new hyperlink will be appended to the existing hyperlink. When the feature is identified, the attribute information will be displayed and the Hyperlinks will be displayed against the link attribute.

```
// Declarations
ESRI.ArcGIS.ADF.Web.DataSources.IMapFunctionality mapFunctionality = null;
ESRI.ArcGIS.ADF.Web.DataSources.ArcGISServer.MapFunctionality agsMapFunctionality;
ESRI.ArcGIS.ADF.Web.UI.WebControls.Map Map1;
ESRI.ArcGIS.ADF.Web.DataSources.ArcGISServer.MapResourceLocal gisresource = null;
ESRI.ArcGIS.Geodatabase.IWorkspaceEdit workspaceEdit = null;
int fieldPosition;
ICursor pUpdateCursor = null;
//Initializations
mapFunctionality = (ESRI.ArcGIS.ADF.Web.DataSources.IMapFunctionality)Map1.GetFunctionality(Map1.PrimaryMapResource);
agsMapFunctionality = (ESRI.ArcGIS.ADF.Web.DataSources.ArcGISServer.MapFunctionality)mapFunctionality;
gisresource = mapFunctionality.Resource as ESRI.ArcGIS.ADF.Web.DataSources.ArcGISServer.MapResourceLocal;
serverContext = gisresource.ServerContextInfo.ServerContext;
ESRI.ArcGIS.Carto.IMapServer mapServer = serverContext.ServerObject as ESRI.ArcGIS.Carto.IMapServer;
ESRI.ArcGIS.Carto.IMapServerObjects mapServerObjects = mapServer as ESRI.ArcGIS.Carto.IMapServerObjects;
// Get a reference to the map underlying the map service
ESRI.ArcGIS.Carto.IMap aoMap = mapServerObjects.get_Map(mapServer.DefaultMapName);
// Loop through the layers in the map until the service calls feature class is found
ESRI.ArcGIS.Carto.IEnumLayer enumLayer = aoMap.get_Layers(null, true);
enumLayer.Reset();
ESRI.ArcGIS.Carto.ILayer aoLayer = enumLayer.Next();
ESRI.ArcGIS.Carto.IFeatureLayer aoFeatureLayer = null;
while (aoLayer != null)
{
if (aoLayer.Name == lyrName)
{
aoFeatureLayer = aoLayer as ESRI.ArcGIS.Carto.IFeatureLayer;
break;
}
aoLayer = enumLayer.Next();
}
// If the layer was not found, adding the feature was unsuccessful, so return -1
if (aoFeatureLayer == null)
return "";
// Get the ArcObjects feature class and dataset underlying the service calls layer
ESRI.ArcGIS.Geodatabase.IFeatureClass featureClass = aoFeatureLayer.FeatureClass;
ESRI.ArcGIS.Geodatabase.IDataset aoDataset = featureClass as ESRI.ArcGIS.Geodatabase.IDataset;
workspaceEdit = aoDataset.Workspace as ESRI.ArcGIS.Geodatabase.IWorkspaceEdit;
ITable table = featureClass as ITable;
if (fieldName == "Link")
{
fieldPosition = featureClass.FindField(fieldName);
}
else
{
fieldPosition = featureClass.FindField("Link");
}
ESRI.ArcGIS.Geodatabase.QueryFilter pFilter = null;// new
pFilter = serverContext.CreateObject("esriGeodatabase.QueryFilter") as ESRI.ArcGIS.Geodatabase.QueryFilter;
pFilter.SubFields = fieldName;
pFilter.WhereClause = fieldName + "='" + fieldValue + "'";
IRow pRow = null;
string fName = System.IO.Path.GetFileName(fileName);
string virtualName = "http://localhost/VistualDirectory"
string strUpdate = "<a href=" + virtualName + fname + " target=_blank>" + fname + "</a>";
string fieldText = "";
if (!(workspaceEdit.IsBeingEdited()))
{
// Start the edit operation
workspaceEdit.StartEditing(false);
workspaceEdit.StartEditOperation();
pUpdateCursor = table.Update(pFilter, false);
while ((pRow = pUpdateCursor.NextRow()) != null)
{
fName = pRow.get_Value(fieldPosition).ToString();
if (fName.Contains("href"))
{
pRow.set_Value(fieldPosition, fName + "," + strUpdate);
fieldText = fName + "," + strUpdate;
}
else
{
pRow.set_Value(fieldPosition, strUpdate);
fieldText = strUpdate;
}
pRow.Store();
}
workspaceEdit.StopEditOperation();
workspaceEdit.StopEditing(true);
return fieldText;
}
else
{
return "File not uploaded";
}
```

Esri Global Page



Esri Joins Microsoft Effort to Improve Workflows for the Oil and Gas Sector

Esri is now participating in the Microsoft Upstream Reference Architecture initiative, an endeavor to enhance applications integration and interoperability for the upstream oil and gas sector.

The initiative supports Microsoft's ongoing effort to enable collaborative workflows and multivendor data accessibility across the full exploration and production business life cycle. Esri will provide a spatial foundation for geoscience applications interoperability.

Esri's geographic information system (GIS) platform is used by petroleum companies and vendors throughout the world, and Esri has established a long track record of providing the spatial data management foundation for oil and gas users. In collaborating with other Microsoft Upstream Reference Architecture solution providers, Esri brings its geospatial expertise and GIS capabilities to the initiative.

Leveraging technologies from several partners, many of which are already using Esri's ArcGIS products and services, the project combines data, systems, and workflows from exploration, production, operations, finance, and other critical business areas. "Management of the oilfield life cycle demands complete integration from subsurface interpretation to production," said Ali Ferling, managing director of Worldwide Oil and Gas Industry at Microsoft. "A flexible and open IT foundation is critical in delivering a common, integrated approach to digital oilfield operations. With its sole focus on providing spatial data management capability, Esri will play an important role in the realization of the Microsoft Upstream Reference Architecture initiative, bringing the capability for full GIS integration to initiative-enabled operations and production systems."

The initiative will provide participating organizations with an invaluable road map to streamlining the implementation of integrated, workflow-oriented, smart field operations technologies.

"Esri welcomes the growing Microsoft Upstream Reference Architecture initiative and is pleased to join its ranks," said Geoff Wade, Esri's global petroleum industry manager. "We look forward to providing a solid spatial data management foundation for the integrated upstream solutions platform of tomorrow. Esri's ArcGIS system, the leading GIS platform in the industry, will provide the stability and performance for initiative participants to leverage with ease. We are confident that this groundbreaking initiative will allow a more flexible, open approach to integrating cloud-capable, domain-specific applications, and by so doing, considerably improve operational workflows."

Esri StreetMap Premium Advanced Now Available with NAVTEQ Data

Advanced Version Includes Address-Level Geocoding, Historical Traffic Data, and Trucking Restrictions

The latest release of Esri StreetMap Premium with NAVTEQ map data includes both an expansion of coverage to include Mexico and an advanced version with new data and functionality. The advanced version provides users with a greater level of precision for geocoding for the United States and additional routing capabilities for the United States, Canada, and Mexico.

StreetMap Premium Advanced incorporates historical traffic data to generate the most efficient route.

StreetMap Premium is an enhanced, ready-to-use street dataset that provides geocoding, routing, and high-quality map display. The software works with Esri's ArcGIS software, an integrated collection of geographic information system (GIS) software products that provides a complete platform for spatial analysis and data management and access to cartographic information throughout any organization. StreetMap Premium Advanced takes geocoding and routing to the next level for users who need to geocode down to the point level or more efficiently route their vehicles.

"With the release of StreetMap Premium Advanced, we can now offer the geocoding precision and professional-grade routing capabilities that GIS professionals have come to expect," says Christophe Charpentier, ArcGIS content product manager, Esri.

Users of StreetMap Premium Advanced can now

- Geocode to the door level—Points adjusted to the road provide a precise address location, enabling door-to-door accuracy. This allows positioning of a geocoded point on a main building or the centroid of a parcel.
- Leverage historical traffic data—Incorporating average speed of travel for specific sections of roadways results in more accurate arrival time estimates and avoidance of congestion based on day of the week and time of day.
- Manage transport restrictions—Detailed road attributes, such as physical or legal restrictions, hazmat warnings, and points of interest specific to the transport industry, help leverage the efficiency of turn-by-turn navigation and route optimization for trucks and other large vehicles.

"The integration of NAVTEQ Traffic Patterns™, NAVTEQ Transport™, and Point Addressing into Esri's StreetMap Premium Advanced product increases efficiencies and enhances the user experience by providing accurate address geocoding match rates, efficient routing, and superior basemaps," states Roy Kolstad, vice president, Enterprise Americas, NAVTEQ.

Careers at esri India

1. Role: Business Executive

Experience: Should have 2+ years experience in sales

Skill Set:

- Good understanding of IT Products & Services
- Understand customer's requirement and translate it into business.
- Exposure to GIS industry would be an added advantage.
- Good experience in selling software products.
- Proven track record to meet and exceed targets.
- Should have good exposure to government sales.

Soft Skill:

- Ability to work independently as well as team-oriented.
- Excellent Communication, Presentation & interpersonal skill.

2. Role: Application Sr. Developer

Experience: Should have 3+ years experience in GIS Application Development.

Skill Set:

- Knowledge of .Net/Java/ J2EE/Flex/ Desktop customization using .Net technology database as backend.
- Proficient in designing/developing multi-tiered secured business applications for high availability, scalability and of high performance
- Should have experience EJB, Servlet, JPA, JNDI, JMS, JMX, web services, XML.
- Should have knowledge in GIS domain with specifically ESRI Technologies i.e. Arc GIS Object/Arc Engine/Arc GIS Server/ArcFM.

Soft Skill:

- Very good oral and written communication skills
- Strong team player with team management skill, flexible yet results-driven.
- Ability to Multitask and be able to balance multiple priorities and alert clients & team to project scope changes

3. Role: Team Lead

Experience: Should have 5+ years experience

Skill Set:

- Plan, organize, delegate, track and coordinate team activities.
- Provide technical direction for the team.
- Ability to work under pressure and aggressive deadlines.
- Knowledge of .Net/Java and J2EE.
- Should have knowledge in GIS domain with specifically ESRI Technologies i.e. Arc GIS Server/Arc FM

Soft Skill:

- Very good oral and written communication skills.
- Ability to Multitask and be able to balance multiple priorities and do time management.
- Excellent team management skills.

e-mail your resume to gistalent@esriindia.com or send it through post to:

Head, Human Resource, ESRI India
B-1/H-9 Colosseum, MCIA, Mathura Road, New Delhi - 110044, INDIA.

Kindly mention the position applied for and your current location in the subject line.