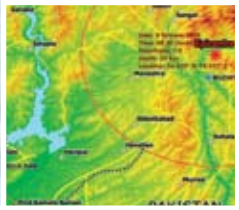
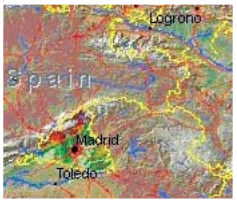
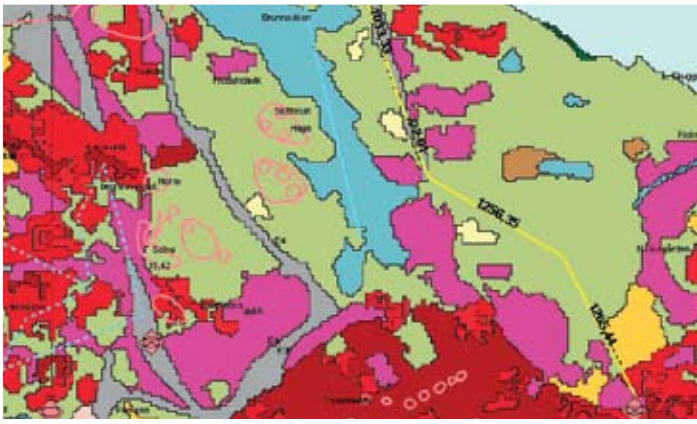
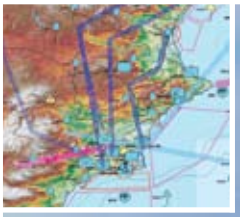
Volume 3

GIS in the Defense and Intelligence Communities









ESRI

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Dear Colleagues:

The first volume of the *GIS in the Defense and Intelligence Communities* book was published two years ago. This third volume brings the total number of user stories to well over a hundred.

Although an impressive testament to your work, it still marks a small fraction of the thousands of implementations of geographic information system (GIS) technology in the defense and intelligence communities over the last 20 years. I look back with pride on some of the early work:

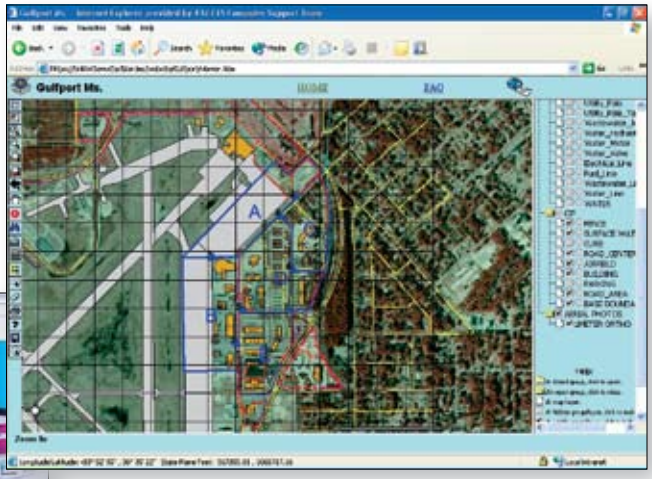
- In the mid-1980s, GIS was used to plan the deployment options for the cold war era rail-based MX missile. The U.S. rail network was analyzed for bridge capacity, rail bed width, and curve radii to figure out where the missiles could be deployed. Of course, with the collapse of the Soviet Union, the MX system was never built.
- Between 1989 and 1992, GIS was used to produce the first global database at 1:1 meter scale—the Digital Chart of the World. During this Defense Mapping Agency program, a 1.7-gigabyte database was created and a new data structure, Vector Product Format (VPF), was designed.
- Camp Lejeune began using GIS for land management in 1988, which included environmental management issues and military training range scheduling and management. In 1992, the Commanding General of Marine Corps Base, Camp Lejeune, gave visionary direction: GIS was to be a basewide resource. This expanded the GIS mission to all business areas including safety and security, facilities and utilities management, and emergency response.

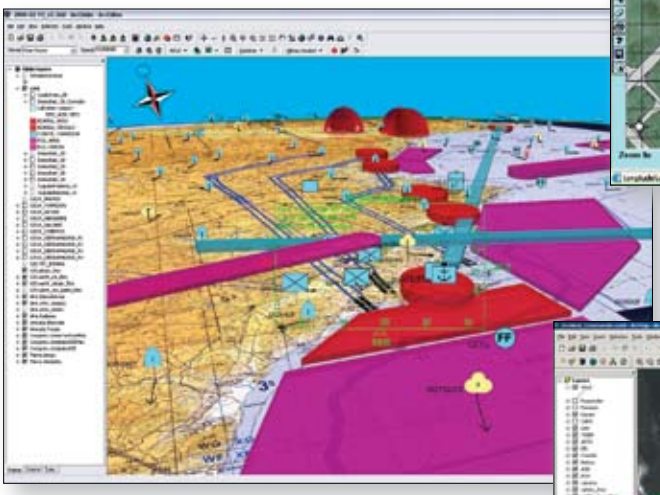
This heritage is important. There is a very direct connection between this pioneering work and the enterprise-wide implementations we are seeing today. GIS concepts and techniques that were tried and tested on the workstation 20 years ago are now being scaled up to underpin the defensewide application and information infrastructures seen in this book.

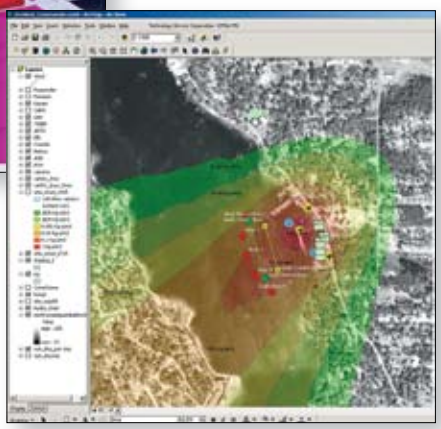
I salute those of you who participated in the early GIS implementations—you laid a strong foundation. Today's work builds on that pioneering activity but also defines the foundation for the work that is to come. That is a significant responsibility and one that we take seriously here at ESRI.

Warm regards,

Jack Dangermond








C/JMTK

Commercial Joint Mapping Toolkit (C/JMTK)

Overview

Northrop Grumman Information Technology's Intelligence Group is the prime contractor for the National Geospatial-Intelligence Agency (NGA) Commercial Joint Mapping Toolkit (C/JMTK) program. The Northrop Grumman team includes ESRI; Analytical Graphics, Inc. (AGI); and Leica Geosystems.

Program Update

As C/JMTK enters its third year of life cycle support, there are now more than 200 command, control, and intelligence (C2I) mission applications within the Air Force, Army, Coast Guard, Marine Corps, and Navy approved for C/JMTK usage. As a result of the 2004 requirements call to DoD services, a number of new capabilities have been added to the toolkit:

- ESRI's ArcGIS® Server provides centralized GIS functionality, sophisticated GIS functions, cartographic-quality maps, capability to offload processing onto a server, and GIS Web services.
- Operating system support is now provided for Windows® XP, Solaris™ 10, and Red Hat® Enterprise Linux® 3 and SUSE™ Linux Enterprise Server 9.
- New capabilities in development include drawing MGRS grids, calculating magnetic variation, inclusion of feature height in LOS, and import of Electronic Navigation Chart (ENC) and Raster Navigation Chart (RNC) data.

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A number of mission applications using C/JMTK have been deployed in the last year; for example, Digital Collection Analysis and Review System (DCARS), STRATGateway, Rifts Automated Trace Locator (RATL), and Maneuver Control System (MCS).

C/JMTK in Action

Northrop Grumman partnered with the Army Corps of Engineers Engineering Research and Development Center (ERDC) Battlespace Terrain Reasoning and Awareness (BTRA) program for participation in the Coalition Warrior Interoperability Demonstration (CWID) '05. Web-based services for movement projection, position of advantage, and line of sight for force protection and concealment using ArcGIS Server were provided as well as data services via a robust, scalable geospatial data store using ArcIMS®.

Northrop Grumman, using C/JMTK, has been performing integration work with the TouchTable™ to demonstrate next-generation C2 capabilities. Through this work, a new extensible and customizable user interface was developed. This was integrated using new and existing GIS Web services within ArcGIS Server. This work has created a richer, more robust environment for making command decisions by allowing commanders more flexibility and better visualization.

C/JMTK Web Portal

The C/JMTK Web portal (www.cjmtk.com) provides valuable information and support capabilities to the customer community. Registered users can search and review requirements, FAQs, and documents; download C/JMTK segments and reference implementation samples; and use the online Help Desk for support.

C/JMTK Configuration Options

Thick Clients

- ArcGIS Engine extended by ArcSDE®, ArcGIS Spatial Analyst, ArcGIS 3D Analyst™, ArcGIS Military Analyst, MOLE™

Thin Clients

- MapObjects®—Java™ Edition

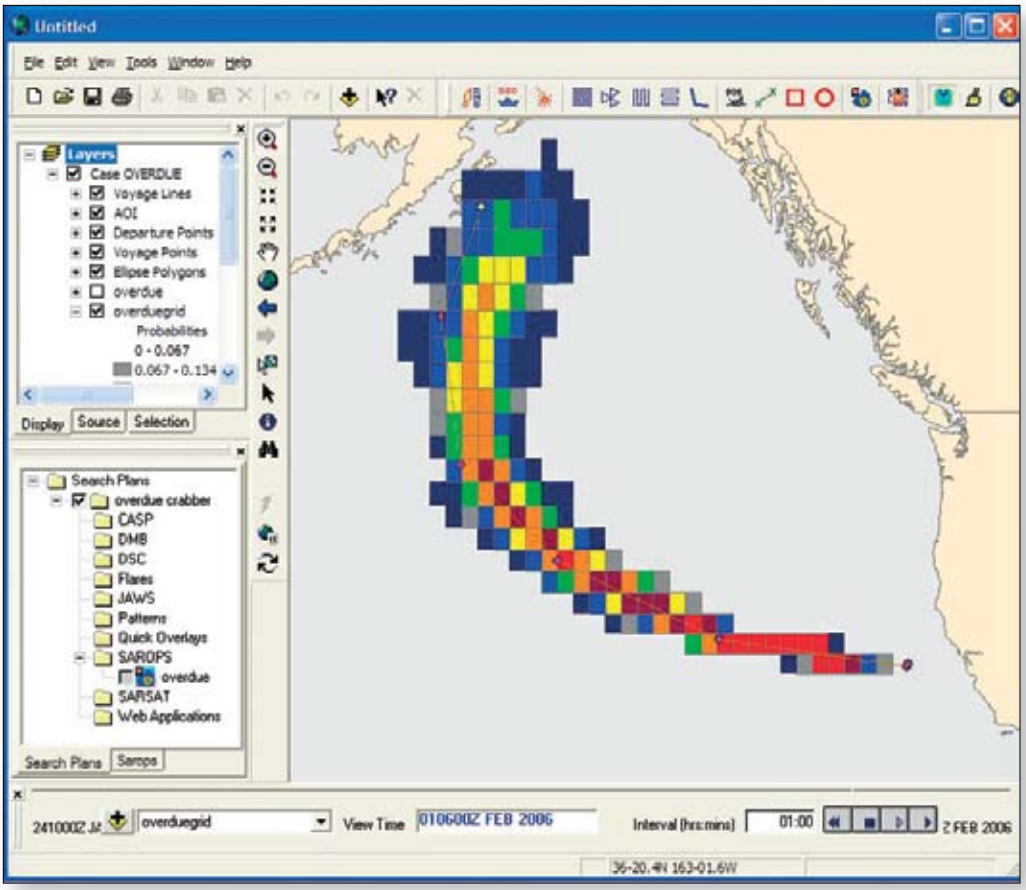
Application Server

- ArcIMS
- ArcGIS Server

Data Server

- ArcSDE

U.S. Coast Guard



An open ocean case with a long drift interval (the time between a search object's last known position [LKP] and the searcher's on-scene time) can easily require the expenditure of hundreds of search hours over thousands of miles.

Where are those keys?

As the analogy goes, searching for missing mariners is like searching for lost keys. Do I check the kitchen first? Do I look there for a minute or an hour? Should the kitchen be ignored completely? Did I even have the keys in the kitchen? To find the lost keys, there is a process of deciding where to look, how long to look, and when to move on. These issues are encountered daily when the U.S. Coast Guard (USCG) is called to search for either an overdue vessel or vessel in distress. Facts and clues are gathered to establish reasonable scenarios as to where the vessel may be. Scenarios are captured and weighted within software wizards, morphed into XML data streams, and fed to particle filters to create temporal data fields. These data fields are rendered on a geographic display as the basis for determining optimal search areas. If all goes according to plan, those persons are located and recovered in the nick of time.

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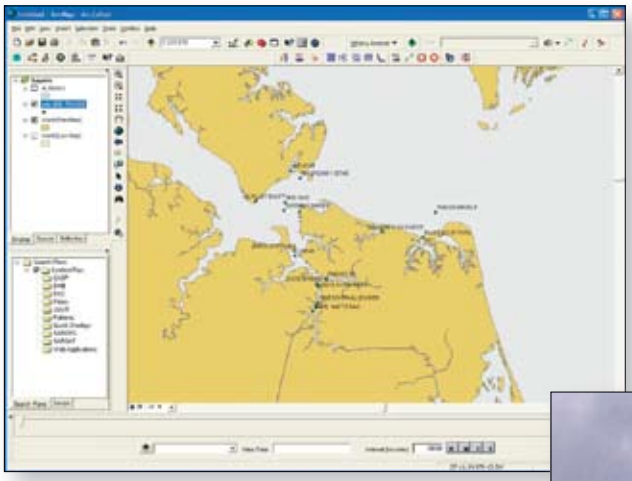
The U.S. Coast Guard has command centers from Puerto Rico to Alaska and from Guam to New Orleans. These command centers are central to a wide range of operations relating to homeland security, law enforcement, marine environmental protection, and search and rescue (SAR). USCG receives no fewer than 30,000 calls for assistance every year, and some evolve into significant SAR events. The Search and Rescue Optimal Planning System (SAROPS) is designed to maximize the potential of bringing these SAR events to a happy ending. SAROPS is a software system built on GIS technology, provided by the C/JMTK. GIS revolutionizes search planning and any mission with a geographic component. This holds whether the goal is to establish an optimal search plan or to geographically scrutinize the curious behavior of an inbound liquid natural gas carrier.



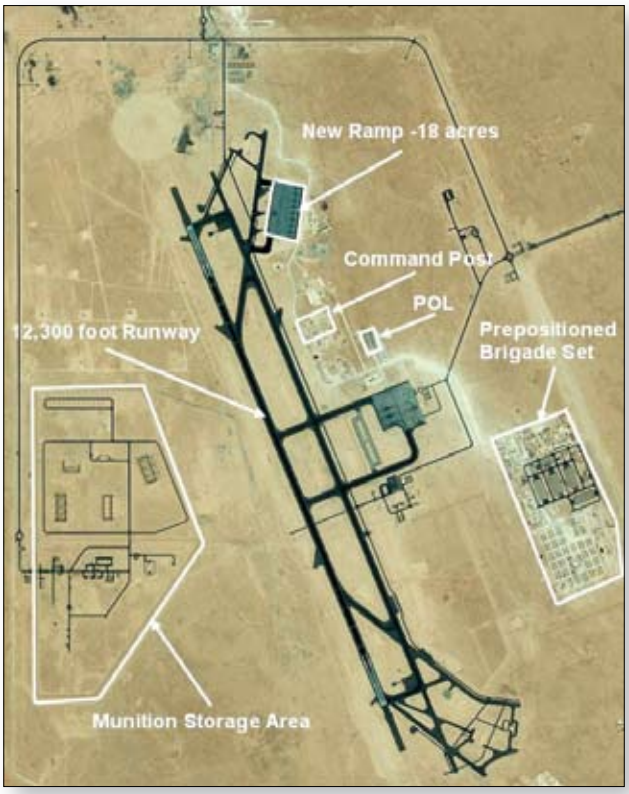
The Coast Guard maintains a constant vigil over who comes and goes from our nation's ports.

The SAROPS architecture has two primary components, a centralized environmental data server and a PC client, running a GIS. The client configuration consists of ArcGIS Desktop with a collection of custom extensions. The extensions provide features to create a tailored ArcGIS Desktop interface, collect user inputs, run simulation models, and build custom layers for static and animated display. SAROPS also uses ArcIMS services for map and data feeds. For example, the Coast Guard has an Internet Mapping Service (IMS) to provide a nautical chart mosaic for a given map extent. Additional services provide areas of responsibility (AOR), critical infrastructure, imagery, and common operational picture (COP) track data. SAROPS also stands ready for future expansion. To support marine environmental protection, business partners have built extensions to model pollutant and hazardous waste drift. The drift models are useful for exercises and in response to actual events.

In summary, SAROPS was made for maritime SAR, but its utility goes much further. USCG decision makers, mission planners, and analysts are exposed to GIS through the use of C/JMTK within SAROPS. The core C/JMTK capabilities allow a tremendous amount of data fusion and subsequent domain awareness right out of the box. An added benefit is that the environment follows industry standards and is fully open. This allows talented third parties to contribute specialized features for unique missions. The results are standardized systems to support custom needs—which is the key we've all been looking for.

A lot goes on behind the scenes before the rescue swimmer arrives on scene to save the day.

C/JMTK Enables the GeoReach System



GeoReach (Expeditionary GeoBase)

GeoReach is the name given to the expeditionary site mapping (ESM) capability that involves sharing both classified and unclassified information of potential and actual forward operating locations (FOL). While the intelligence sector has focused on "red force" targets within the battle space, GeoReach fills a key basing niche by allowing airmen with secret access rights to view "blue force" FOL imagery and key infrastructure data. With GeoReach, fewer airmen go forward prior to deployment where they may be exposed to hostile conditions, yet expeditionary site-planning knowledge vastly increases. GeoReach cells within the Combat Air Forces (CAF) Geo Integration Offices (GIO) work with their operational planners to optimize combat support and force deployment.

The GeoReach system is composed of people, processes, doctrine, software, and hardware employing geospatial information to enhance siting and initial bare base bed-down planning activities at FOLs during contingency operations. This system helps shape basing operations through four phases:

- **Locating** the optimal sites for basing through integration with other logistics planning tools
- **Collecting** the most accurate and recent imagery and related data from all available resources and further enriching the site maps through wide use of portable GPS technology by advanced site survey teams
- **Assessing** the imaged sites using planning tools to build aircraft parking, munitions, and other force bed-down plans
- **Enabling** the compiled basing intelligence on the Web via the Secure Internet Protocol Router Network (SIPRNET) to allow this knowledge to be shared with logistics planners, operations, and personnel scheduled for deployment to the site in a netcentric manner

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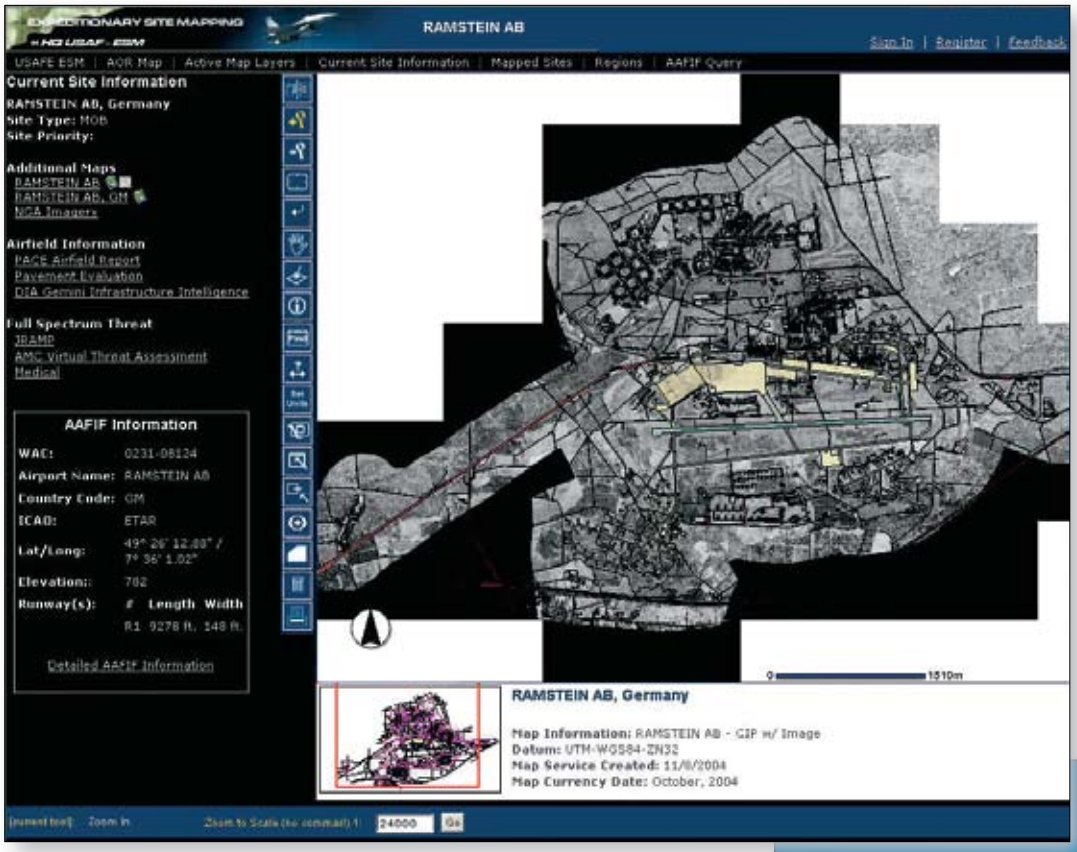

The resulting Common Installation Picture (CIP) serves as the visual rallying point for compiling expeditionary site survey data into a single view.

A cornerstone of this system is integrating C/JMTK segments. This provides interoperability via a common geospatial software development framework for command, control, and intelligence (C2I) mission applications. C/JMTK uses a common services-based software architecture to increase efficiency and improve spatial and analysis capabilities. The use of C/JMTK provides the system format and architecture to manipulate geospatial information that will provide a robust geospatial processing and management capability for joint force operations. As a command and control capability, ESM requires the use of C/JMTK for deployment of mapping applications. Whether aiding in agile combat support or command and control, all USAF organizations are encouraged to consider use of C/JMTK when developing applications and mapping-enabled systems where feasible.

Maneuver Control System

Introduction

The Maneuver Control System (MCS) provides Army users worldwide with tools enabling them to understand the battlefield situation, plan actions, and achieve the commander's objectives. Commanders and planners rely on MCS to deliver accurate information about friendly and enemy capabilities and locations, weather, terrain, obstacles, and other geospatially based data. MCS is designed to assist in reducing uncertainties and making accurate real-time decisions in war and other critical military operations.

Overview

MCS was an early Army adopter of the Commercial Joint Mapping Toolkit (C/JMTK) when DoD designated it as its standard for geospatial information dissemination, management, and visualization support. C/JMTK offers MCS users the power of sharing and visualizing commercial technology integrated with a tactical environment.

In addition to the MCS product for controlling battlefield maneuvers, there is also a version of the system built for the Army Corps of Engineers: the troops that perform construction tasks in both battlefield and civilian environments by building transportation routes and bridges, clearing obstacles and minefields, supporting civilian relief efforts, etc. MCS leverages the potential of C/JMTK to provide engineers with an easy-to-use capability that allows planning, execution, reporting, and visualization on the common operational picture (COP). On the battlefield, the COP provides real-time global positioning system (GPS) data on the locations of tanks, field artillery, missile defense sites, intelligence feeds of satellite imagery, streaming UAV video, etc.

Capabilities

- Provides information about friendly and enemy capabilities and locations, weather, terrain, obstacles, and other geospatially based data
- Integrates commercial technology and a tactical environment
- Allows commanders and planners to share and visualize information
- Offers graphic and geospatial data management and analysis capabilities
- Uses real-time GPS data for tracking
- Enables users to add layers of new data, large amounts of metadata, and georeferenced data
- Provides an easy-to-use capability that allows planning, execution, reporting, and visualization on the COP

Summary

MCS provides potential for a future rich with geographic information system functionality. Prospective plans include efforts to further harness the power of C/JMTK to provide the community of Army users with a Web-accessible COP, a Web-based engineering application, and new geodata interfaces. Also valuable in the near future will be the use of extensive analysis capabilities and support for additional graphical interfaces such as 3D maps and symbols and more complex satellite and UAV imagery.

MCS aids Army users in accurately applying combat response to variable battlefield dynamics. In an era when terrorism is being fought at home and abroad, all the latest technologies are required to keep the tactical advantage and protect the health and safety of U.S. soldiers, friendly forces, and citizens.


AIR FORCE

The United States Air Force Geospatial Information System Support Center: Leveraging GeoBase to "Fight the Base"

GIS has traditionally been a static product for data storage with a geospatial component. By integrating dynamic components (real-time AVL, imagery, etc.), the notion of GIS is changing through the addition of time (the fourth dimension). The originally envisioned GIS was never intended to function in this manner, but technology and requirements are marching along and GIS continues to evolve to meet user needs.

The layered development concept of GIS as it evolves from a static map to a collaborative dynamic map that meets the total vision of the Air Force GeoBase program. The end result is the Commanders Geospatial Decision Support System with a variety of user interfaces meeting the needs of a wide-ranging user community.

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Background

As the birthplace of the USAF GeoBase program, it is no surprise that the USAF Academy (USAFA) continues to push the envelope of GIS development and vision for the Air Force. Here is an abbreviated historical flashback of USAFA's GeoBase program involvement. In 1998, the Institute for Information Technology Applications (IITA) provided seed funding and supported Lieutenant Colonel Brian Cullis during a research sabbatical to explore the concept of "One Installation, One Map." This resulted in the framework for the GeoBase program as well as the GeoBase Simulator briefing presented during the 2000 CORONA conference. This briefing led to the establishment of the Headquarters Air Force Geo Integration Office (HAF/GIO) with Colonel Cullis at the helm. In 2002, the HAF/GIO received plus-up funding as a result of the 9/11 attacks. In 2003, the IITA hosted the first GeoBase Compass Conference, and in 2004, Colonel Cullis' vision spread across the Department of Defense with the establishment of the Office of the Secretary of Defense (OSD) Defense Installation Spatial Data Infrastructure (DISDI) office with Colonel Cullis leading the charge. On July 7, 2005, the HAF/GIO established the Installation Mapping and Visualization (IM&V) council Geospatial Information System Support Center (GISSC) within IITA.

Mission

The GIS Support Center's primary mission is to develop and field a low-cost system leveraging the Air Force GeoBase investment to enhance real-time situational awareness, decision making, and command and control for day-to-day and crisis response operations to "Fight the Base." In addition to this, the GISSC is also tasked to provide technical support for the IM&V council as tasked through the HAF/GIO.

Capabilities

Geographic information systems were originally intended to combine datasets with a geospatial component to provide a visual context to information. This allowed an immediate sense of understanding for users who could rapidly recognize an area (map) and attribute information to specific locations on the map to better understand how information was interrelated. Traditional GIS does an outstanding job of correlating these items and running queries on these respective datasets. The GISSC is further addressing data organization by recategorizing data into two key areas or data streams—asset data (fixed and slow changing such as installation boundaries, utility lines, and cultural areas) and event data (updated real time such as video feeds and sensors that have a temporal component) and incorporating

these two data streams into a traditional GIS such as the Air Force GeoBase program.

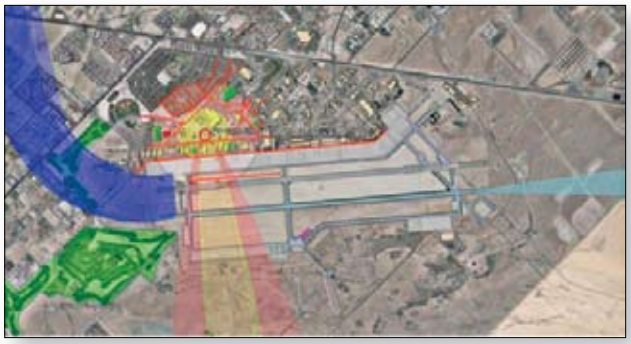
Once the concept of recategorizing data streams is accepted and allowed for in the GeoBase data architecture, the door is open to integrate numerous new capabilities into the GeoBase program. Commercial off-the-shelf tools and capabilities for emergency response and crisis management can be fully integrated into the GeoBase concept of operations. With these items fully integrated into the GeoBase program, a Commanders Geospatial Decision Support System (CGDSS) has been developed. The concept of emergency response tools in GIS is not unique, and several rudimentary systems have been developed with significant downfalls. They have been costly, require excessive training, can't be expanded, haven't fully leveraged available technology, and don't serve the entire installation in an effective manner. A fully integrated system allows for asset and event data streams as well as the push and pull of data to a multitude of users with varying requirements. A wide variety of users will access the system simultaneously from varying locations and publish their actions to the system while collaboratively displaying ongoing actions in response to daily activities or crisis response situations. The new CGDSS has the ability to handle the needs of hard-core analysts (ESRI® ArcGIS Desktop) as well as casual users gaining situational awareness (ESRI ArcExplorer™) concerning, for instance, a traffic accident and lane closures on the installation. This is the forecast of where GIS transforms from a static analysis product to a collaborative, dynamic system on every desktop at the installation and effectively serves a much larger audience.

Benefits

Initiated as a civil engineering-centric program, the GeoBase program is the geospatial foundation on which numerous other Air Force communities can be built. For example, the flying community can use GeoBase as a backdrop for approach and departure corridors on airfields and ranges to enhance training. Similarly, the Bird Aircraft Strike Hazard (BASH) information and commercial air traffic corridors could be added to the system to give a three-dimensional understanding of air traffic in a region. This is only one example of the capability that can be built on the GeoBase foundation. Every community on the installation that has a paper map stuck in a drawer can build on the readily available GeoBase foundation. The Air Force has invested hundreds of millions of dollars in geospatial information systems (GeoBase) to include data capture, software and hardware purchases, network investment, manpower, and training. While this investment saved money in the long run by reducing duplication of effort (One Installation, One Map), the payoff has not yet been fully realized. Now is the time to fully leverage the Air Force investment in the GeoBase program and realize the full payoff. GeoBase serves as an excellent foundation for command and control, decision making, and situational awareness. For example, automated vehicle location (AVL) is being integrated in the GeoBase foundation. This may lead to geospatial-enabled, consolidated emergency response (911) dispatch centers and would naturally follow with fully integrated GIS/GeoBase-enabled command posts that can rapidly hand off information and provide the best support available for the commander and Crisis Action Team (CAT) in response to a real-world crisis. It is only natural that, as leaders in the geospatial community, the Air Force would act as an integrator with local and regional communities by making the CIP available to local and state governments so that crisis and disaster response actions can be handled smoothly and interoperable agencies can communicate clearly.

Summary

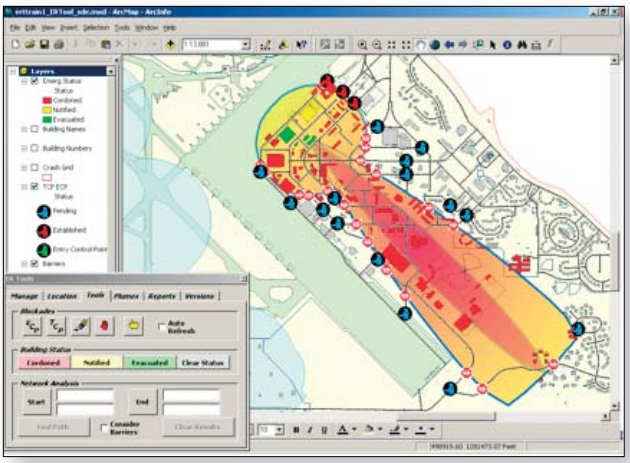
The Geospatial Information System Support Center is an advocate and technology integrator working toward realizing the total vision of the Air Force GeoBase program. The center is located at USAFA in Colorado, and this unique location allows the center to take advantage of a pool of faculty and cadet researchers interested in GIS technologies and integrate them into the Air Force GeoBase program. Further, the Rocky Mountain Front Range is an excellent GIS technology hub, hosting numerous firms with exceptional GIS and associated technology expertise that is leveraged as contractor support and through Cooperative Research and Development Agreements (CRADAs). Lastly, Colorado Springs is a significant military hub hosting U.S. NORAD/NORTHCOM, Peterson AFB, HQ Space Command, Cheyenne Mountain AFS, Schriever AFB, and USAFA. This provides the center with a proving ground to field newly developed applications for local testing prior to large-scale deployment. This all leads back to the center's primary mission to develop and field a low-cost system leveraging the Air Force GeoBase investment to enhance real-time situational awareness, decision making, and command and control for day-to-day and crisis response operations to "Fight the Base."



Notional aircraft incident at Nellis AFB, demonstrating approach and departure corridors, plume modeling, traffic control, and building evacuation status

MacDill Builds on the Initial Efforts by PACAF and ESRI with Emergency Response Tools

MacDill Air Force Base GeoBase and Readiness Team Up to Save Lives and Property



Overview

At MacDill Air Force Base, the incident management process is one of the most critical responsibilities for the base Civil Engineering Squadron's (CES) Readiness Flight. Before 2005, most incident management procedures at MacDill were accomplished using outdated wall maps with transparent grease pencil overlays. The business process was prone to miscommunication and spatial location errors and was a slow manual process.

In 2003, the installation GeoBase Program began implementing the Air Force's standards-based CIP, creating the foundational architecture and data required to implement the GeoBase standard of "One Base, One Map." This provided the foundation to build the incident response Mission Data Set (MDS) and the Emergency Response Tool (ERT) application. These milestones allowed the incident management process to benefit from geospatial technology.

MacDill built on previous joint efforts to create ERT-style capabilities. The initial ERT efforts by PACAF and ESRI, along with subsequent efforts by ESRI under contract to the Air Force Center for Environmental Excellence and Air Education and Training Command, resulted in an ArcGIS extension that is simple, powerful, yet easy to use with minimal training. That extension is now known in the Air Force community as the Emergency Response Tool.

By early 2004, a strong partnership had been formed between the Geo Integration Office (GIO) and CE Readiness functions at MacDill AFB. Readiness personnel were quick to recognize the value of the GeoBase architecture and the CIP. The Geo Integration Office quickly recognized the value of sharing information with Readiness. A key element of the GeoBase program in the Air Force is support by contractors that are experts in the GIS industry. An early benefit of the contractor support was a regularly scheduled Science Applications International Corporation (SAIC) teleconference in which MacDill learned about the preexisting ERT. A call to ESRI rapidly got the ball rolling with locating a copy of the tool and additional pertinent information.

Within three weeks, the MacDill GeoBase office and Readiness teamed up to field a demonstration of a solution that met most of the requirements for an incident management tool for the Readiness Flight. The return on investment (ROI) was actualized by reusing existing code the Air Force already owned. The early results showed that a rapid prototype, low-cost solution was attainable. The resulting excitement energized the Readiness community. Working together, Civil Engineering Squadron/GIO and CES Readiness defined additional requirements and addressed enhancements to the

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prototype that would be required. Readiness Flight personnel pursued support from the base commanders to find the resources to migrate the existing manual process to a digital process using the ERT.

The Readiness and GIO partnership along with strong support from wing leadership was the key to success. The shared vision was to improve communication, enhance the emergency response capability, and bring GIS technology and incident management together to automate key portions of the process. The guiding principle was to achieve these capabilities by capitalizing on the Air Force's investment in GIS technologies.

Key Roles

The Readiness function clearly identified the incident management business process and served as the facilitator between the technology implementers (GeoBase) and the end users (Fire and Security Forces).

The GeoBase function created and demonstrated GIS capabilities and shared technical knowledge with Security Forces, Fire, and Readiness, resulting in a good understanding of what is possible.

Results

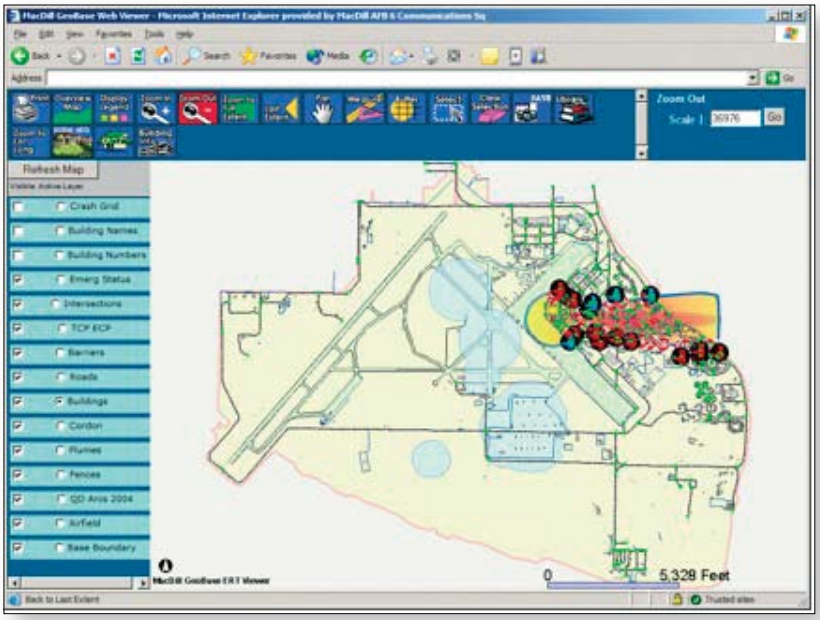
MacDill emergency responders are now using the ERT that is revolutionizing the way information is managed and accessed during an incident. The incident location, cordon, plume models, and entry control point are created and managed by the Fire troops, while the traffic control points and the building evacuation status are managed by Security Forces. Management by both functional areas is simultaneous and capitalizes on the multiuser incident management editing capabilities of a centralized ESRI ArcSDE database.

Situational awareness has reached an unprecedented level by utilizing ESRI's ArcIMS Web mapping services to project the incident and related emergency information on the MacDill local area network via a Web browser live to the command and control (C2) and emergency services personnel. Future plans allow some of the incident information to be made available to general base populace, facilitating rapid notification and response, resulting in a smarter and more timely response to potentially dangerous situations. C2 staff are now able to see incident information in a regional mapping environment faster than ever.

The Web browser allows personnel to overlay or link to other databases, providing an improved situational awareness and access to related information at the click of a button. For example, the installation commander can easily access the facility manager contact information when he or she clicks on a building that is affected by the incident. C2 realizes that the Web-based C2 viewer is powerful because it brings essential information into a unified picture. This allows decision makers to see more options and possible solutions when managing a crisis. The ERT and associated Web-based mapping viewers help focus limited resources to the areas of highest priority and still help personnel not lose the big picture as to how to best use resources to maximize impact during a response.

Conclusion

The improved response time, communication, and state-of-the-art mapping display are helping MacDill prepare for and respond to emergency-related incidents. Improved response is allowing MacDill to protect responders and property and save lives while preserving its ability to carry out its mission.



Langley AFB Deploys Flood-Mapping Tool to Prepare for Ophelia

LAFB Flooded from Hurricane Isabel, September 18, 2003

Staff Members Jennifer Anderson and Jermaine Smith in Map Production Using ArcGIS

Patricia McSherry

On September 14–15, 2005, tropical storm Ophelia buffeted Langley Air Force Base with heavy winds and rain and the threat of flooding that comes with each hurricane season. Prior to the storm, some were reminded of Hurricane Isabel, which came ashore almost two years prior to the day, but this time, Langley had a new weapon in its emergency response and preparedness arsenal.

Isabel was a major hurricane of the 2003 Atlantic hurricane season that made landfall on September 18, 2003, just south of Cape Hatteras. While still over the Atlantic, Isabel's winds peaked at 160 miles per hour, classifying it as a deadly category 5 storm. Clouds associated with Isabel covered an area of 275,000 square miles, roughly the size of Texas.

Hurricane Isabel cut a devastating path across the North Carolina Outer Banks islands, Virginia, and Maryland, leaving behind a wake of destruction. Langley Air Force Base also experienced significant damage from the wind and storm surge.

Armed with lessons learned from the planning for and response to Hurricane Isabel, Langley Geo Integration Office (GIO) chief Patricia McSherry set out to develop a tool that would allow the base to better predict the effects of flooding from storm surges and other occurrences so that emergency preparations could be focused on those areas most vulnerable in any given flooding event. McSherry also recognized that with so many Air Combat Command (ACC) bases located in hurricane-prone areas, Langley AFB would not be the only ACC base that could potentially benefit from this kind of planning and response flood-mapping tool.

To build this FloodTool and provide other support to the GIO, McSherry contracted with Penobscot Bay Media, a Maine-based, service-disabled, veteran-owned small business that specializes in GIS technology and applications, geospatial information security, support services, and training. Penobscot Bay Media worked closely with GIO staff to build and deploy the FloodTool in time for the 2005 flood season, and Ophelia was the first to put it to the test.

The FloodTool is a Web-deployed geospatial application that enables users to dynamically create flood modeling scenarios and provide real-time access to distributed emergency response teams, facilities managers, and command personnel. These scenarios provide accurate, detailed maps of flooded or potentially flooded areas and identify facilities that are affected and/or vulnerable within each event model.

On September 13, Ophelia changed course again and was upgraded to hurricane strength. Within minutes of the hurricane condition declaration, there were the usual requests for maps from base personnel trying to assess the predicted

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effects of the storm and determine where to deploy various protective barriers. In the past, the best the GIO could provide was a printed flood contour map, which could do little more than show rough approximations of predicted flooding using two-foot intervals in ground elevation. While useful, these maps could not provide enough detail to support accurate flood modeling or reliable event planning for the deployment of barriers or evacuation.

With the FloodTool up and running, the GIO had a new type of map, delivered over the LAFB intranet, that emergency personnel and others could use for visualizing the flood conditions in real time and even predicting within inches the extent to which flood waters might go as the storm progressed. Additionally, these personnel could see at a glance the current or predicted threat condition of each and every facility on base in real time from any computer on the network.

As the day progressed, the requests for maps became more numerous and specific. The Hurricane Operation Center called with a request for a set of large maps depicting 10 different flooding scenarios. Battle Staff meeting attendees needed up-to-date prediction maps and reports for their critical decision processes. Various base management personnel requested more than 100 large-format maps of flood scenarios. Traffic at the GIO was extreme with people constantly rushing in and out through the front door to the office where a large chart was posted to keep track of the many incoming map requests. The GIO staff members were operating at their workstations, coordinating scenario map production and updating the flood event views via the Web application. The printer queues were getting longer and longer, and maps now covered every available space. The laminating machine was abandoned except for essential all-weather requests. This was typical of other hurricane events as the crush of map requests resulted in waits of two to three hours or more between request and delivery. But this day would be different from others in the past: The FloodTool was introduced to attendees of the Battle Staff meeting, and the impact was felt immediately.

As building managers moved to secure their buildings, they were able to get real-time information on the event and how it affected their building. The FloodTool interface allowed these personnel to scan a map of Langley AFB for their area of concern or search for a specific building number and magnify the view to see a map image of their building and surrounding area in relation to the flood waters. They could also print out a report of affected buildings with a map image. In record time, sandbags appeared in front of vulnerable building doors, equipment and personnel were prepared for evacuation, and base managers and commanders had a common information picture of the entire installation.

During the Ophelia preparedness event, the FloodTool

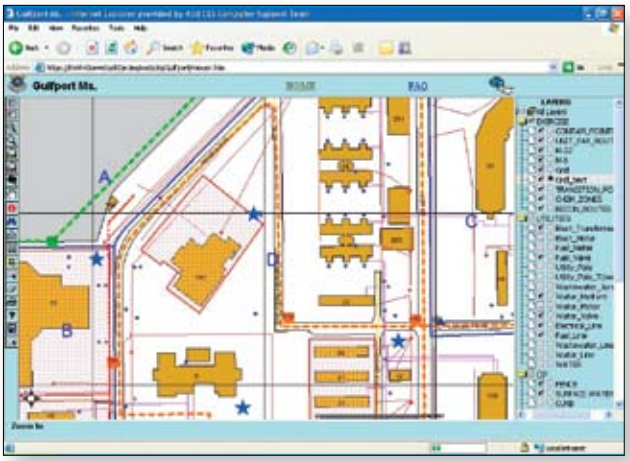
- Addressed ever-changing storm predictions by modeling 10 different scenarios
- Displayed a separate real-time event for most current condition predictions
- Interoperated with GIO's GeoBase GIS to allow for automated, up-to-the-minute map production of varying sizes
- Created an environment for real-time flood modeling, cutting out the usual lag time associated with the map request > map creation > map printing > map delivery process
- Provided a color-coded, graphic threat-assessment view of all facilities along with a call-list-status function indicating the building contact information, contact status, and contact confirmation status

By Wednesday morning, the FloodTool was already having a positive impact by reducing the number of emergency printed map requests coming in to GIO. GIO staff instead focused on creating new flood scenarios they shared instantly with everyone using the FloodTool. Within a few hours of a basewide BSD containing the intranet address for the FloodTool, nearly 3,500 base personnel had accessed the service online.

In the end, Ophelia did not deliver on her threat of flooding at Langley AFB, but she did provide a great test for Langley AFB hurricane preparedness including the GIO staff, personnel from Penobscot Bay Media, and the FloodTool itself. It was a test they all passed with flying colors.

Sr. Airman Valter Goncalvez Updating Map Symbology with FloodTool Event Views

Pope AFB Expeditionary GeoBase Achieves an Air Force "First"



What is Expeditionary GeoBase? Better yet, what is GeoBase? The primary mission of GeoBase within the U.S. Air Force is to enhance command and control by providing one highly integrated high-fidelity installation map in a secure fashion over the base network. GeoBase uses an enterprise GIS as its backbone, allowing Air Force personnel to view and analyze spatially referenced information of the installation infrastructure using easy-to-use point and click tools. The foundation of GeoBase is the Common Installation Picture (CIP), essentially the base layout map provided in a digital environment. Expeditionary GeoBase deals with the use of this innovative concept in deployed contingency environments. It involves sharing both classified and unclassified information of potential and actual forward operating locations (FOL). The CIP again serves as the visual rallying point for compiling all expeditionary site survey data into a single view.

Pope Air Force Base (AFB) was tasked with an Operational Readiness Inspection (ORI) requiring it to deploy to Air National Guard (ANG) Combat Readiness Training Center (CRTC) in Gulfport, Mississippi. An ORI simulates wartime scenarios, ensuring that U.S. Air Force war fighters are properly prepared for today's challenges. Every aspect of a deployment is tested and evaluated, from initial deployment stage to responding to enemy threats or attacks. Situational awareness is paramount during all phases of the ORI or any contingency, for that matter.

Until the Gulfport ORI tasking, the Pope GeoBase office had focused on mapping the main operating base in North Carolina. However, once tasked with the ORI, the engineering career field of the 43rd Civil Engineer Squadron quickly switched gears and treated this as a real-world tasking, thus beginning the GeoReach process. GeoReach provides senior planners and airmen alike with new intelligence, enabling improved FOL selection, time-phased force deployment data (TPFDD) planning, and accelerated bed-down.

The initial phase requires determining what data is available and possibly creating a CIP for the deployed location. During actual deployments, this information is normally available from GeoReach sources, secure data banks of possible forward deployed locations, maintained by three major commands within the Air Force. However, because this deployed location was the CRTC in Gulfport, Mississippi, information was not readily available. There were several roadblocks encountered during the information-gathering stage, but each roadblock was quickly turned into just a detour. The journey ended with a working partnership between Pope AFB and the ANG HQ GeoBase office. The ANG Southeast Regional GeoBase coordinator,

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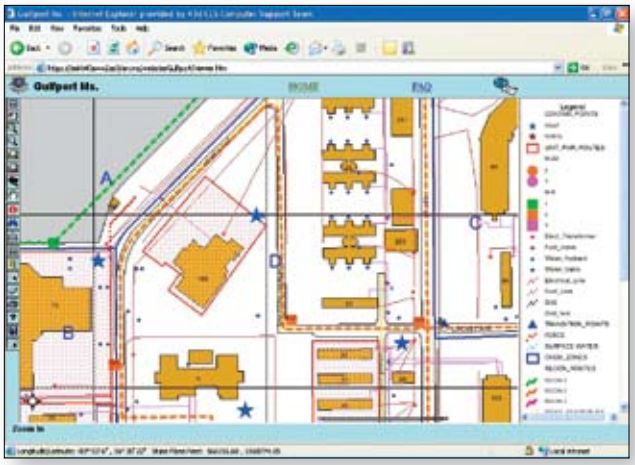


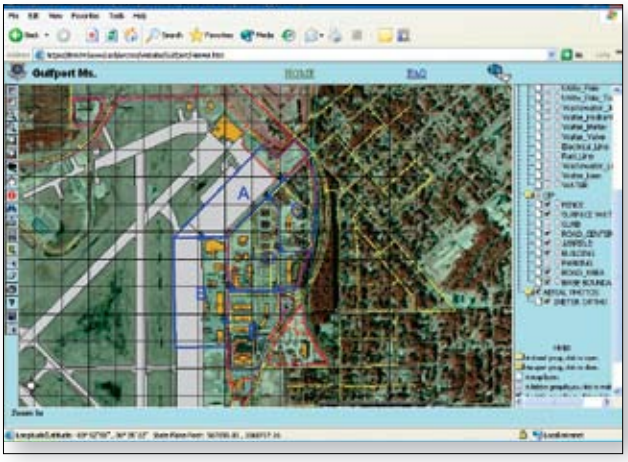
Charlene Rice, provided good points of contact and aided in acquiring aerial photography, site drawings, and other technical assistance. With these documents in hand, the Pope GeoBase office, under the direction of SSgt. Dayne Lewis, began building the CIP for Gulfport and creating ArcIMS services for the contingency site.

During the development of Gulfport CRTC CIP, the Pope GeoBase office exchanged spatial data with other Air Mobility Command (AMC) bases planning exercises at the same location. This allowed these other bases to improve their mapping and situational awareness capabilities. Moreover, it provided Pope with firsthand feedback on required changes to the data. SSgt. Lewis, along with Rice, led a site mapping team to validate existing information and acquire missing infrastructure data. Through the partnership between Pope AFB and the ANG Southeast Regional GeoBase office with inputs from Scott AFB and McConnell AFB engineers, a completely Spatial Data Standard for Facilities, Infrastructure, and Environment (SDSFIE)-compliant CIP was produced. This landmark achievement has been lauded, and the procedure is now being replicated at other locations (e.g., Savannah CRTC). This completed Gulfport CRTC CIP has been turned over to the ANG and will be the first nonactive duty colocated ANG installation and first CRTC to have a completed GeoBase CIP. Rice stated, "This exceeded the projected Gulfport CIP delivery date by more than one year." This is the first CIP ever created entirely by Air Force personnel for a stateside installation; all others have been provided through contract support. The savings to the Air Force are estimated to be $143,000.

Through the efforts of all involved, Pope AFB leadership gained the ability to effectively plan and execute all contingency events through one site picture. Along with CIP development, Mission Data Sets (MDS) were created specific to the contingency environment. A set of related spatial features, such as utility systems, aircraft parking plans, and force protection zones, displayed on top of the CIP is called an MDS. All base units were able to access the ArcIMS site prior to deployment and use one mapping service to plan all bed-down operations. The 43rd Maintenance group commander stated, "This is by far the best heads-up mapping effort I have ever seen for any deployment." Once deployed, GeoBase was used to provide accurate, real-time awareness to the battle staff leadership and other control centers, enabling split-second decision-making capabilities.

The GeoBase partnering success between Pope and the ANG Southeast Regional GeoBase office goes far beyond just the CIP deliverable and an excellent ORI rating. It turned out to be a win-win situation for all involved, already paying huge dividends in many other ways. The Pope AFB engineering career field gained invaluable contingency mapping experience. Through lessons learned during this experience, a number of recommended changes to the Air Force Expeditionary Site Mapping Concept of Operations (CONOPS) have been made. A consortium of training resources between the Southeast ANG Regional GeoBase Office and Pope AFB engineering personnel is being actively pursued. Guard engineering personnel now have points of contact with their active duty counterparts to aid in the problem-solving process. Moreover, other bases within AMC and other commands are now modeling the Pope Gulfport GeoBase experience to train active duty engineering personnel while providing the ANG with an end product.

This was all accomplished simply because the 43rd Civil Engineering GeoBase shop took a contingency exercise opportunity and treated it like a real-world event—once again proving that the best way to succeed is through good partnerships.



Air National Guard: England Air Park and Hurricane Katrina

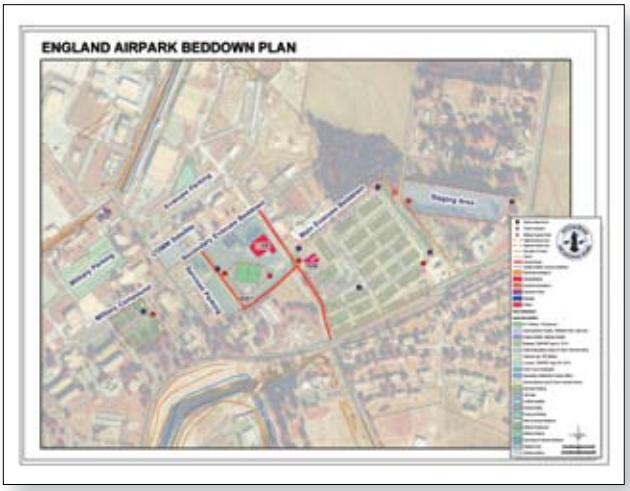


Figure 1

In response to the Hurricane Katrina aftermath, the Air National Guard Readiness Center's (ANGRC) Crisis Action Team (CAT) and the Air National Guard GeoBase program office were tasked to support disaster assessment and relief operations along the U.S. Gulf Coast. One specific task that relied heavily on GIS technology was the bed-down planning for 4,500 evacuees and a military contingent of 500 at England Air Park in Alexandria, Louisiana. The GeoBase application GeoBEST (Base Engineering Survey Toolkit) was utilized to help automate the planning process. This tool provides users with the ability to view the spatial extent of the selected location and match the required deployable resources in a spatial configuration conforming to established siting standards.

Bed-down planning officers from the 179th Civil Engineering Squadron, Mansfield, Ohio, had physically conducted the initial site survey, so they had concise awareness of existing infrastructure including the availability of sanitary sewer, wastewater, commercial power, gas, fuel, abundant parking, staging area availability, and existing hard facilities as well as proximity to essential community services such as fire departments, medical facilities, and schools. The locations of existing utilities were confirmed through the use of georeferenced CAD maps obtained from the England Air Park Authority that were included in the planning process. The planning team's next step involved using GeoBEST to identify and visualize these existing resources within the extent of the airfield site image. Additionally, the planning officers identified critical features such as entry control points as well as existing and planned fences.

Planning for an evacuee bed-down camp rather than a military force proved to be atypical for multiple reasons. Services such as HAZMAT, portable sanitation, and solid waste would be contracted rather than serviced by USAF assets. Additionally, essential materials for bed-down operations would be required beyond standard USAF assets. Based on existing constraints, the bed-down team finalized the tent city layout plan as shown in figure 1.

Although the bed-down plan did not conclude in the actual ANG development of a tent city for Hurricane Katrina evacuees, the bed-down planning process would have been significantly delayed without the use of GeoBEST and GeoBase-provided imagery. GeoBEST enabled bed-down planners to quickly lay out required asset quantities that conform to USAF siting standards and rapidly make changes to the layout based on area constraints. Additionally, ANG GeoBase personnel learned valuable lessons regarding disaster preparedness and response operations. This will help users execute expeditionary site mapping sequenced actions (locate, collect, assess/map, and enable) and address CONUS natural disasters in the future.

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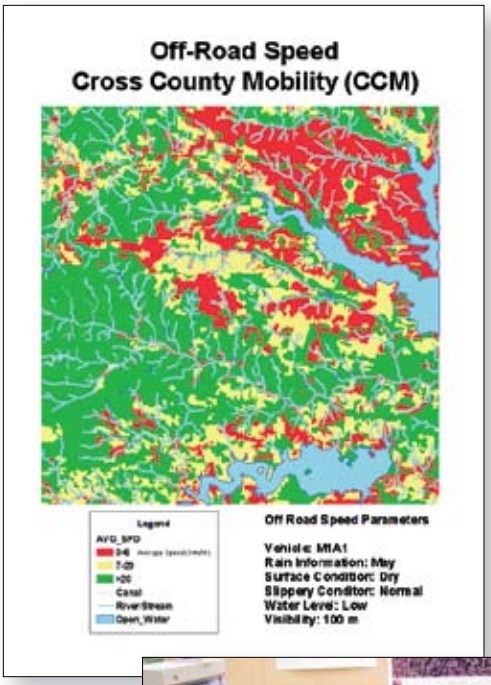
ARMY

Digital Topographic Support System



Project Management Office (PMO) Combat Terrain Information Systems (CTIS) provide war fighters with tools and information necessary to support today's operations in disparate threat environments. The need for soldiers to see as much relevant mission information as possible has created an increase in the demand for specially tailored, high-resolution, detailed geospatial products.

"These products are essential for accurate and timely decision making. An Army that is more geospatially aware and prepared reduces operational risk, especially for the war fighters in theater," said Mark Hainsey, project director for CTIS at the U.S. Army Topographic Engineering Center (TEC), a laboratory of the Engineer Research and Development Center (ERDC).

The systems developed under PMO CTIS provide war fighters with the geospatial information needed to effectively face the asymmetrical challenges of the 21st century battlefield.

PMO CTIS has been a pioneer in the use of commercial off-the-shelf (COTS) technology and in combining such technology with government off-the-shelf technology. CTIS developed and fielded the Digital Topographic Support System (DTSS) using state-of-the-art COTS software and hardware. Current DTSS systems use ESRI ArcGIS, Leica® ERDAS® IMAGINE®, and Skyline TerraExplorer® integrated with the Army Battle Command System (ABCS) software suite.

DTSS provides updated geospatial data and analysis that can be merged with real-time military intelligence to provide mission planners, battlefield commanders, and war fighters with unprecedented situational awareness. According to Chief Warrant Officer 4 Scott Owens, "Without the CTIS Program and the DTSS, we would not have had the tools or the skills to accomplish our mission so successfully." CWO Owens works for the Directorate of Training at the U.S. Army Engineering School, and during Operation Iraqi Freedom, he served as a V Corps terrain analysis technician.

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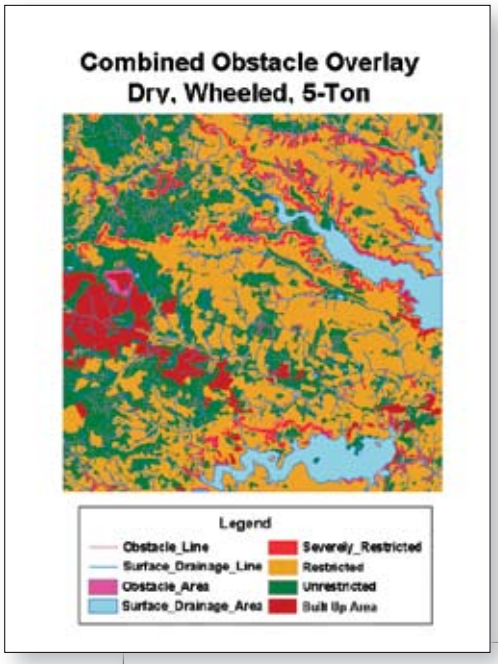
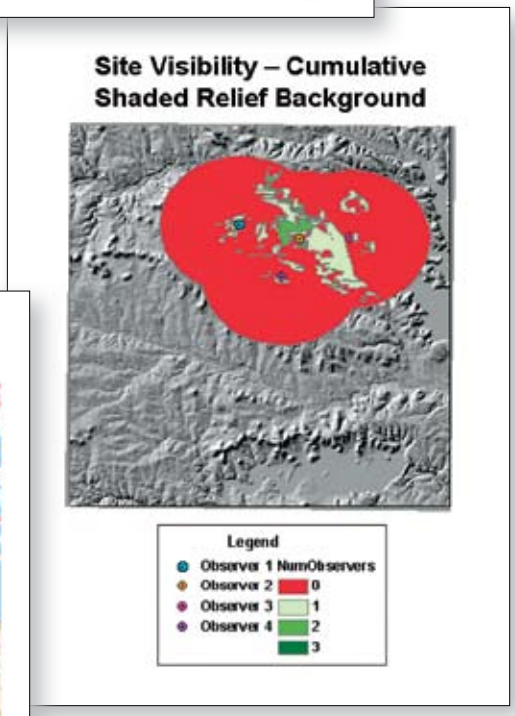
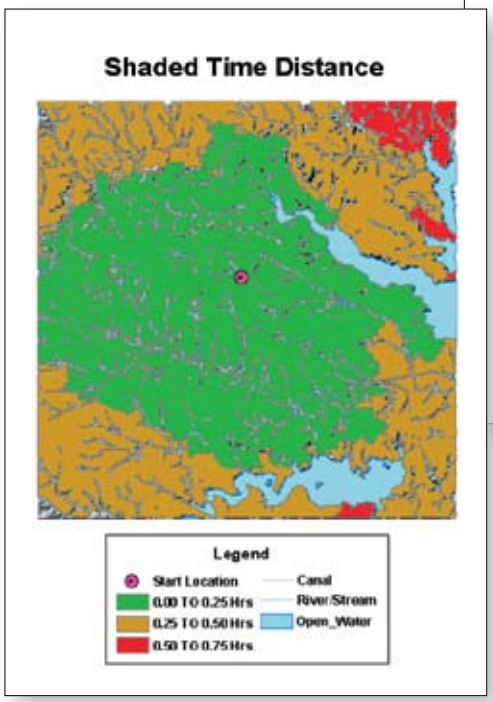
In the past, Army topographers relied on paper maps and manual terrain analysis to help theater commanders plan strategic movements and attacks. The DTSS family of systems provide terrain analysis and visualization capabilities along with terrain database development and management and graphics reproduction. Through a combination of operator workstations, commercial and government off-the-shelf software packages, custom software components, and large-format printing and plotting devices, DTSS enables mission planners to compile information from a multitude of sources. This information is used to create or enhance digital data that provides the common map background for all Army Battle Command Systems.

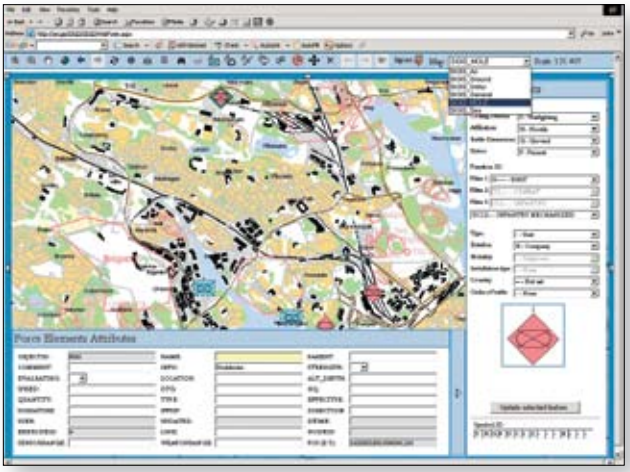
"The DTSS proved to be the right system to support war fighters of Operation Anaconda, aviation units, and division decision makers—it fulfilled its requirements . . . The DTSS is a great system," said Chief Warrant Officer 3 David Kasten. "It works in combat, it works in the field, and it works in garrison."



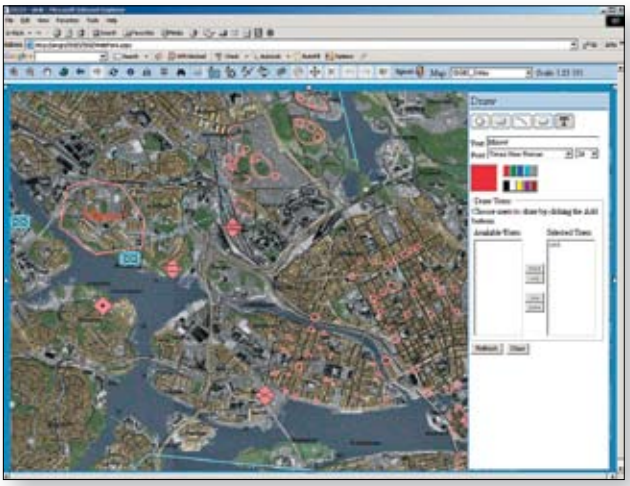




Situation Geographic Information System



Interface from SIGIS Web client that shows editing mode regarding force elements where one object has been selected and its tables of content/attributes are displayed. In the top right corner, one specific view is selected (MOLE).



Interface from SIGIS Web client presenting the draw function when it's activated. In this case, the text "Mines" is put in the left of the situation picture by using the available options in the draw table to the right.

Introduction

Situation Geographic Information System (SIGIS) was developed within the AQUA project at the Swedish National Defence College (SNDC), Department of Military Science, during 2005. The AQUA research and development project is focused on the physical aspects of a generic command post of the future. AQUA deals with questions such as the following: How should information be presented to optimize human perception and understanding in a military or mixed staff? How can a truly common operational picture (COP) be created in relation to Networked Based Defence (NBF) and Effect Based Operations (EBO) concepts? How should communication within the staff and between nodes in the network be supported? How should interaction between the group of people that perform the processes in the command and control cycle (for example, planning, execution, and assessment) and the surrounding IT system be supported? SIGIS was developed to be an effective tool for answering these and other questions. Due to the assumption that most of the information in the future military network will have a relation to a geographic position, SIGIS is a customization of a traditional GIS.

Overview

The purpose of SIGIS is primarily to support experiments, exercises, training, and gaming within the military domain. Optimally, SIGIS can also be a source of inspiration for the Swedish armed forces command and control system development. Perhaps the most important feature of SIGIS is that a new user should be able to handle the system in approximately 15 minutes. That learning curve includes not only looking at data but also managing and editing data in the geodatabase. Each edit made by any client is "pushed" (if wanted) to every other node in the network (autorefresh). Since SIGIS is a Web-based client/server system, no installation other than a Web browser and an operating system is necessary in each client. This technical solution supports distributed activities between nodes worldwide, if requested. The SIGIS command and control support system consists of three main components: the Web-based user client, a simulator/scenario player, and a logging/replay module. The formal symbols used in SIGIS support the NATO APP6A (similar to the U.S. MIL-STD 2525B) military standard.

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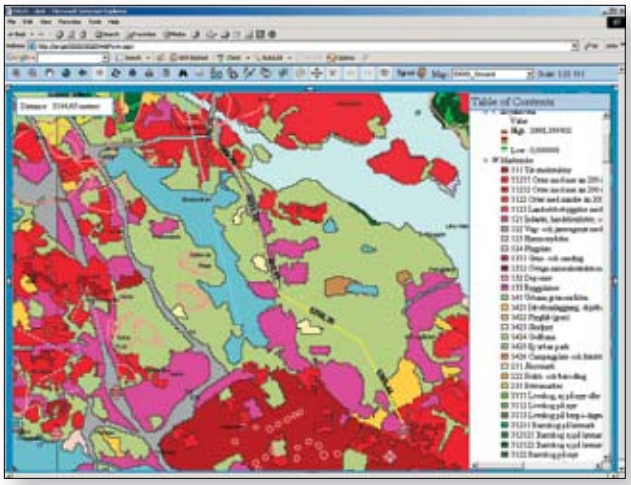


In this view (ground view including its table of contents containing detailed ground data), the user has made an instant measurement with the ruler tool. The result shows as a label in the top left section of the picture and as yellow lines with each leg marked with the distance.

Capabilities

The user client presents an operational/tactical situation picture adapted to different military arenas (e.g., joint, ground, air, and sea). Through the intuitive interface, the Identification tool can be used to learn more about an object´s attributes (for example, force elements and tactical graphic objects with attributes such as speed and direction and sensor and weapon ranges). The user can also measure distances directly in the map interface with the Ruler tool and examine geographic data within the table of contents, where individual data layers can be turned on and off. Another functionality that has been included is the ability to find a specific object or attribute with the Search tool. One important feature in SIGIS is the possibility to support and enhance communication between humans in the network. Therefore, a Drawing tool has been developed, which permits real-time graphic communication in command and control processes. In contrast to other editing in SIGIS, drawn objects are not saved in the geodatabase. The most significant functionality in the SIGIS client is the possibility to create, move, select, and alter military symbols according to NATO standard APP6A. These functions include force elements and three classes of tactical graphics. Elementary functions include zoom in/out, pan, full extent, and return to the previous extent.

The scenario player/simulator is a small program that enables event scheduling in the Web client according to a predetermined timetable. This functionality can be used purely as a simulator-enabling exercise or experiment input from the teacher or researcher to the scenario. Alternatively, the activity leader can use this function to tell the story up to the present time (T=0) in the experiment/exercise.

The logging/replay module is central to assessment after an experiment or exercise. The function supports analysis concerning questions about who did what, when, and where. In the present version of SIGIS, this module is executed in the application environment, not the Web client.

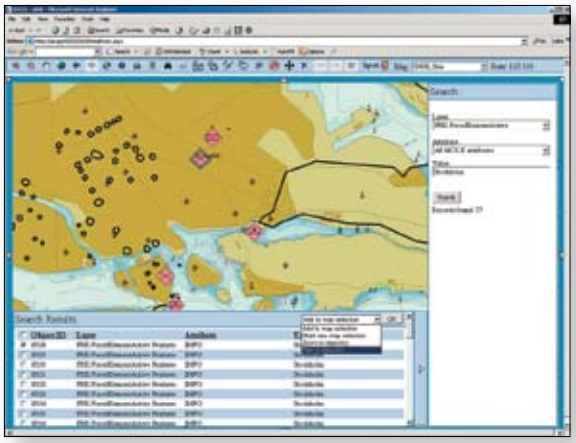
Benefits

In short, the primary benefits of SIGIS are as follows:

- Easy to learn and handle
- Enables realistic scenarios
- Supports demands on interoperability
- Supports current defense concepts (NBF and EBO)
- Makes truly distributed activities possible
- Supports the different functions in the generic command and control cycle model (planning, execution, and assessment)
- Easy technical client administration (needs only a browser)
- Enables automatic push of new input/information within the system

Summary

The SIGIS command and control support system is a Web-based client/server approach to handling presentation and management of the operational and tactical picture. The main purpose is to facilitate experiments and exercises in the domain of military command and control. The primary goal when developing SIGIS has been to make the system easy and quick to use. SIGIS is built on ESRI products: ArcSDE and ArcGIS Server. (ArcInfo® with ArcGIS Military Analyst and MOLE were used to create the scenario class events, and ArcGIS Tracking Analyst was used to execute the logging/replay module.)



In this case, the user has carried out a search operation for the specific attribute value "Stockholm" through the options in the right table using the sea view. The result is displayed as hits in the lower table. The next step in the search process would be to choose one hit and then pan and zoom to the exact object.

ENFIRE

To support the Army's goal of information dominance, an accurate understanding of key terrain and tactical points of interest within mission areas is required. To facilitate the collection of data, PD CTIS, in conjunction with the Program Executive Office, Combat, Control, Communications—Tactical (PEO C3T) and the U.S. Army Engineer School, Maneuver Support Center (MANSCEN), created Engineering Field Planning, Reconnaissance, Surveying, and Sketching Set (ENFIRE).

ENFIRE, a prototype system, is a modern digital toolkit that replaces the current Army Surveying Sketch Set. It is focused on enabling timely and accurate capture, storage, and dissemination of digital information pertaining to route, bridge, and hasty minefield reconnaissance. ENFIRE supplies the soldier with

- Software and hardware tools to gather reconnaissance and reporting information
- Project management tools
- A digital library of field and technical manuals
- Construction project building design software
- Construction site terrain modeling tools
- An inventory management package
- Tools to disseminate information to the Army Battle Command System (ABCS) Battlefield Functional Areas (BFAs)

Soldiers using ENFIRE are empowered to rapidly collect and disseminate accurate, current information that can be used almost immediately by the commander in his or her decision-making process, thus supporting the "every soldier as a sensor" concept. ENFIRE combines commercial off-the-shelf (COTS) and government off-the-shelf (GOTS) hardware and software such as ESRI ArcGIS elements and CAD design/files that aid the soldier in the information-gathering process.

Currently, three ENFIRE prototypes are ready for fielding and evaluation. The long-term goal is to field approximately 2,500 ENFIRE sets over the next five years.

The existing Army Surveying Sketch Set needs the ambitious upgrade provided by ENFIRE. It allows soldiers to conduct surveying and reconnaissance missions with more accuracy and speed than ever before. The tools comprising ENFIRE support a range of tasks from project management and data collection to inventory control. ENFIRE is positioned to incorporate technological advances quickly because it uses a loosely coupled COTS/GOTS-based architecture of hardware and software.

ENFIRE provides ease of use, interoperability, and real-time information exchange, which are key capabilities absent from the current reconnaissance tools. The Army will realize the goal of information dominance as the soldiers incorporate tools such as ENFIRE into daily tasks that will improve accuracy and timeliness of relevant data.

With the availability of new geospatial data sources and types, the Army is learning to become more geospatially aware. "Every mission, every weapons system, and every plan requires the most precise, up-to-date terrain information and analysis available," Mark Hainsey said. "PMO CTIS is tasked with geospatially enabling current and future commanders, soldiers, and war fighters."

Note: PD CTIS is part of the Engineer Research and Development Center's Topographic Engineering Center.

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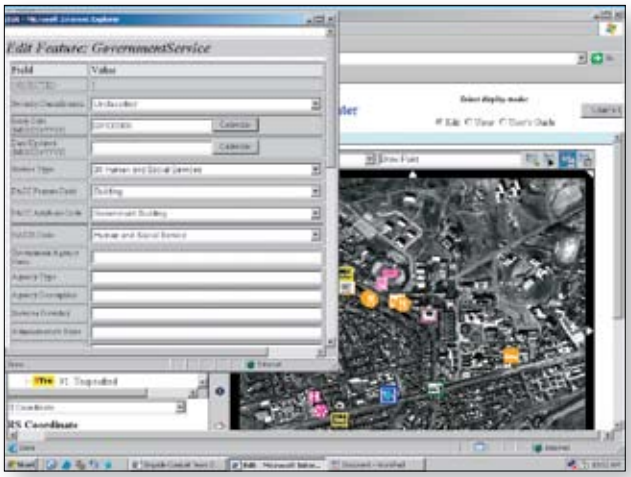
Stryker Brigade Combat Team System



The data input form shows the use of a dual data dictionary for precise classification and default subtype values for quality control.

Introduction

The Stryker Brigade Combat Team (BCT) project addresses the difficulties experienced by the Stryker BCT in preserving geospatial intelligence (GEOINT) data. This project aids in the input, storage, and display of these datasets using a geodatabase. Prior to the development of this application, a spreadsheet stored the GEOINT field-collected data by the Stryker BCT. The soldiers maintaining the spreadsheet were required to interpret, deconflict, translate, and manually enter the data. This was necessary to avoid misclassifying or duplicating data entries.

Capabilities

The Stryker BCT system consists of a Web-based front end, a spatial database, and a Web-based viewer with query and print capabilities. Two standard data dictionaries capture a feature's duality. The DIGEST FACC provides the standard classification, and the North American Industry Classification System (NAICS) provides a more detailed description of a feature's function.

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Features of the Stryker BCT system include

- Web-based data entry form for the direct entry of field data
- Dual standard data dictionary classification
- GEOINT data symbolization using the Federal Geographic Data Committee (FGDC) Homeland Security Working Group symbology set
- Related tables to cross-reference attributes
- Web-based data viewer
- Attribute querying capability
- Map layouts for printing at standard scales

Benefits

Although simple in design, the Stryker BCT system is a powerful tool. It simplifies the workflow by allowing the soldier collecting the data to input directly to the system. It uses default values and subtypes to prevent misclassification of features and domain lists to improve data quality. Its FACC compliancy makes it interoperable with National Geospatial-Intelligence Agency (NGA) products. Additionally, it permits adding to, or analysis with, existing spatial datasets.

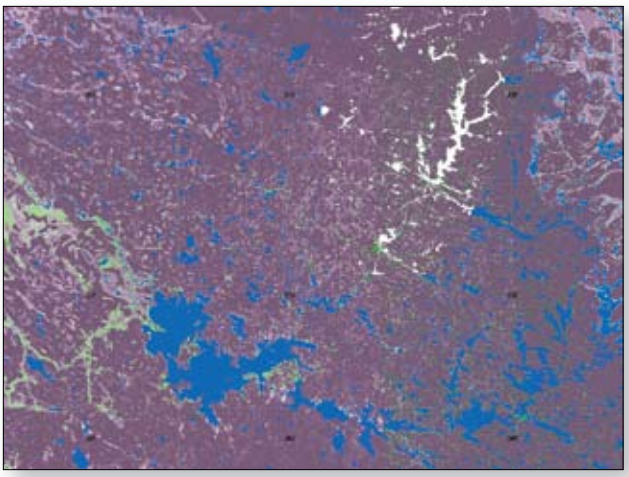
Summary

The Stryker BCT system directly supports the global war on terrorism through the development of an enterprise framework of geospatial intelligence technology for the Army and Joint community. Presently, this capability is fielded in Iraq.

Map Layout at Standard Scale

Military Terrain Analysis II, TERRA II

CCM comparison data for parameters is collected with ATV. Terrain in picture: high-voltage line, rough gravel, snow, etc. Data was collected with GPS, clinometer, auger, load-bearing meters, and ground-penetrating radar.



Wintertime CCM analysis. Lakes are depicted in blue if carrying capacity of the ice is not enough for APC, and white shows areas where ice cover is adequate. Map dimension covers approximately 200 x 120 km.

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Introduction

TERRA II is a second-generation tool for terrain analysis designed for and used by the Finnish Army. TERRA I, developed in 1999, was the first GIS-based terrain analysis used by the Finnish Army. The tool was created to fulfill the requirements of the Finnish Army Engineers.

Since TERRA I, new requirements arose for TERRA II development. The TERRA II requirements included real-time analysis, vehicle parameter control, vector-to-raster capability, and data distribution.

TERRA II, deployed since late 2005, is used by all services in the Finnish Defence Forces.

Overview

Main functions of TERRA II include

- Five different terrain analyses
- Cross-country mobility (CCM)
- Fortification analysis
- Obstruction analysis
- Excavation analysis
- Timber volume
- The creation of thematic raster maps (18 layers) from different data sources and data formats

TERRA II functionality works on ArcGIS 9.x Desktop with the ArcGIS Spatial Analyst extension.

The analyses are based on long-term statistical seasonal data (snow, ice, and frost). Maps are then created for each season. TERRA II is used to make a real-time analysis from Finnish government real-time data (typical vector/point) or terrain data collected by military personnel.

Thematic raster layers used are soil, buildings, land cover, open areas, slope, forest data, and more, categorized for military purposes. All maps, including terrain analysis products, are stored in TIFF file format. All data is standardized during the process. The thematic data collected is used for military and other geographic analysis.

Parameters, weighting coefficients, establishment of vehicles, and other variables are edited with geodatabase tables. All data preprocessing and terrain analysis is completed using ModelBuilder™. TERRA II primarily uses ArcGIS tools. Some new tools were developed using Visual Basic to meet the required functionality.

Capabilities

The most important qualities of the application are

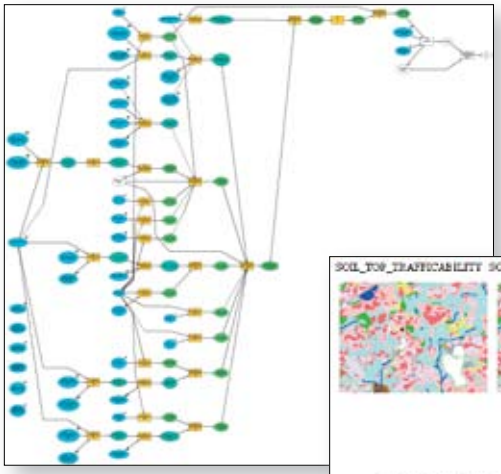
- Raster and vector data combinations overlaid on raster layers
- Parameter handling with user interface
- Map sheet-based area selections
- Multivehicle CCM analysis (statistical for seasons)
- Real-time analyses (seasonal data collected by military personnel)
- Combining raster themes to analysis by batch processing
- Data file renaming by batch processing
- Data distribution for different roles

Main Terrain Analyses

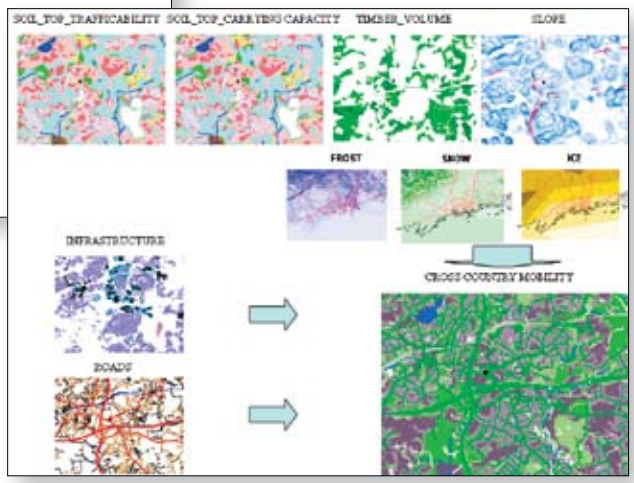
CCM and fortification analysis are the most often used analyses for every branch of armed forces.

CCM is composed of three levels: terrain, infrastructure, and roads. Terrain models include data layers such as soil trafficability, soil carrying capacity, slope, timber volumes, frost carrying capacity (especially on swamps), ice, and snow.

Fortification analysis helps define what kind of shelter the terrain and infrastructure offer against indirect fire, direct fire, aerial bombings, and aerial reconnaissance.



Example of CCM model made with ModelBuilder



Data flow for classified CCM for all military vehicles and all seasons. Dark green indicates the most suitable, and dark purple impossible areas mobilitywise.

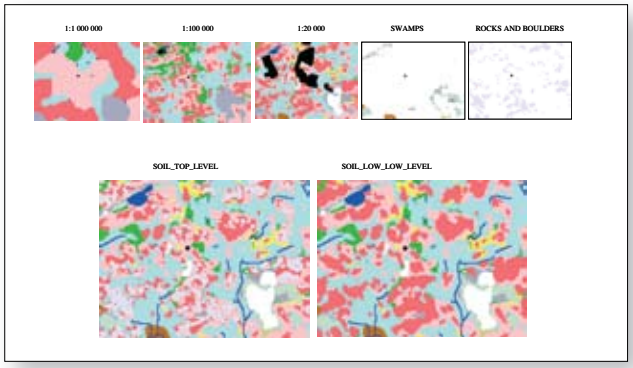
Benefits

Today, the Finnish Defence Forces have the ability to use and test new methods such as Analytical Hierarchy Process (AHP) to evaluate reliability of parameters for geospatial and terrain analysis. The quality of terrain analyses is verified with driving tests and terrain measurements. Future capabilities include using customized ModelBuilder models to develop tactical decision aids for artillery, antiaircraft defense, and other defense applications.

Future

In the next phase, the Finnish Defence Forces will experiment with AHP-oriented parameter definition to fuzzy model-based geospatial and terrain analysis with the aim to create a true velocity-based cost layer for all vehicles for different weather conditions.

Additional challenges include creating seasonal models (dry/wet) for international operations (United Nations and European Union), where climate and terrain are totally different compared to Scandinavia and data availability and quality are limited.



An example of data preprocessing—Mil Soil Combination. Original data comes from National Land Survey of Finland and Geological Survey of Finland.

Combined Artillery System

Enhanced Command and Control as well as Fire Control via Decision-Support Systems

Modern command and control is characterized by providing a comprehensive and precise representation of the situation via networking; this includes the interchange of the situation with all troop elements involved in the operation. In the artillery arm of the services, a command, control, communications, and intelligence (C3I) system—using digital data transmission—unites command and control, reconnaissance, and weapon systems and ensures the flow of information via data radio link. The resulting problems are a large amount of messages received, increased operational dynamics, and a lack of transparency. Additionally, the high mobility of the weapon systems, vehicles, and equipment limits the response times for "just-in-time" target engagement. To fire for effect, the fires must hit the target within a time window of approximately five minutes after target detection. This includes the times for command and control, preparation, and projectile flight time.

Staying in control of such complex situations places high demands on the problem-solving skills of the fire control officer whose task is to filter relevant messages out of the available information and assess their relevance to target engagement and the tactical situation, then develop appropriate target engagement proposals and decide on their execution.

Therefore, it is important to support the command and control process in all phases using a decision-support system enabling the fire control officer to automatically process just-in-time target messages into fire commands and get target engagement proposals generated as alternative operations.

The decision-support system then extracts or generates the most important information from the overall set of information and provides the decision-making officers with proposals for action and target engagement so that they can make decisions on a factual basis within the time constraints with an optimized employment of forces and resources.

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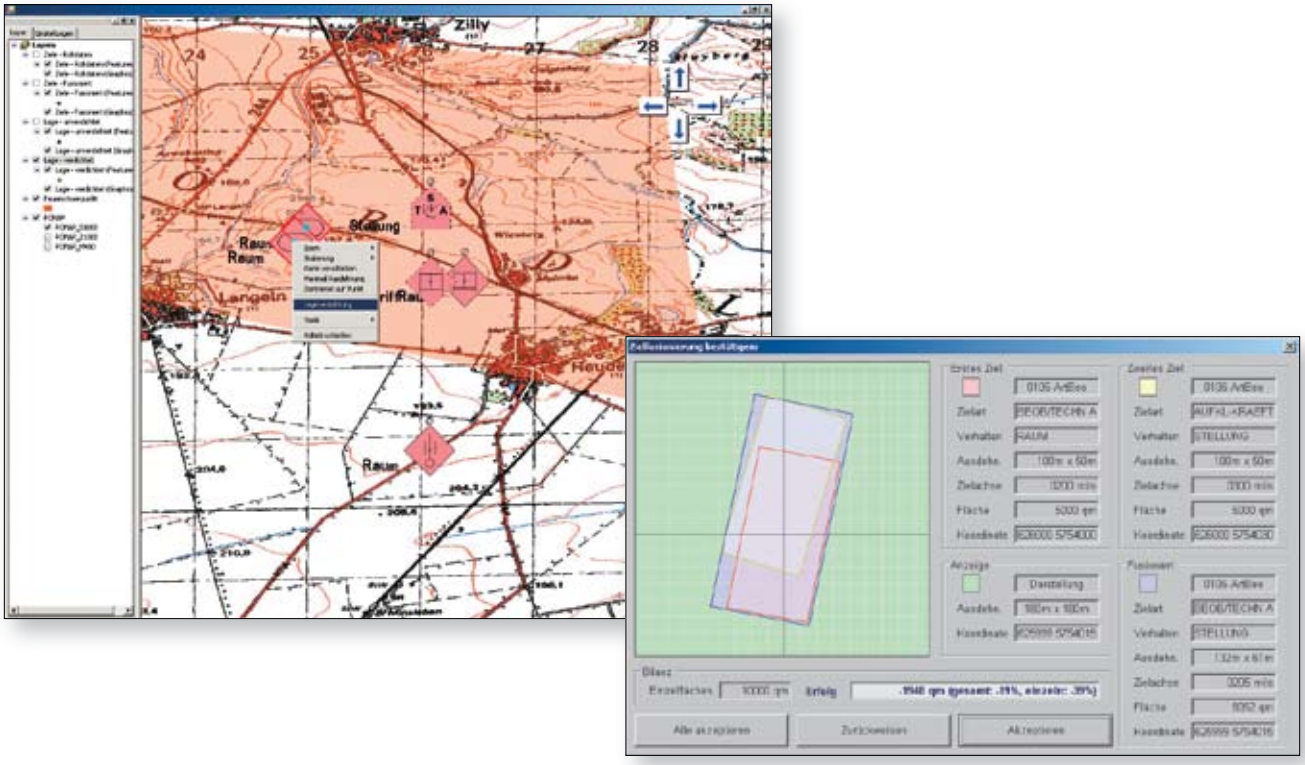


The decision-support system is a tool to support the artillery regiment and artillery battalion staffs within the framework of tactical fire control using the ADLER command, control, communications, and intelligence system. Krauss-Maffei Wegmann (KMW) is implementing a software component for the ADLER C3I system to support the command and control process in the situation definition, planning, and command and control phases.

The decision-support system aids in target fusion, target prioritization, and situation compression processes as well as the generation of target engagement proposals. The implemented target fusion heuristics identify dual messages, using them to generate one enriched, upgraded target message. Furthermore, a situation compression function is carried out to generate a clear situation; selected units can be combined into hierarchically higher-level units by the decision-support system generating compression proposals based on the enemy organizational structure. This requires an effective GIS that supports military symbols in accordance with APP6A. A planning tool was developed on the basis of the artillery fire plan per AArtyP-1 (artillery procedure). It allows the user to create target engagement proposals both manually and through automation.

The Drag & Fight procedure developed with the School of Artillery of the German Army (ArtS) is already implemented by KMW. It enables the user to quickly and effectively engage a sequence of targets with optimum allocation to the available munitions.

In implementing the decision-support system, modern, agile development processes were used to provide intensive collaboration between the ArtS experts and KMW as contractor. The result was a system architecture for knowledge-based systems translating the knowledge of experts into optimized heuristics/algorithms.

The set of rules of the decision-support system can be modified at any time and thus adapted to the specific tactical mission and current situation.

The development approach and system architecture used are applicable to similar problems within other service branches and command and control levels.

This decision-support system was developed in collaboration with the German Artillery School—Artillery Development Group and the Krauss-Maffei Wegmann company.

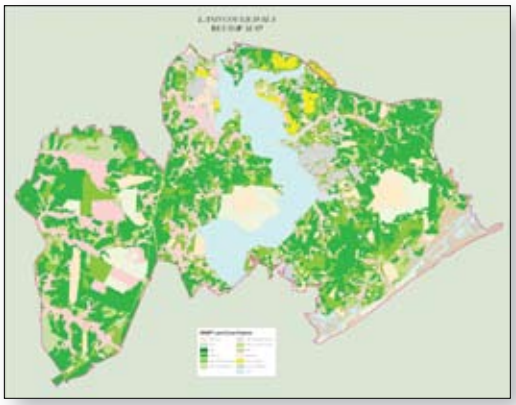

MARINES

Facilities Management and Planning

GIS is used extensively in support of facilities management and planning activities at Camp Lejeune Marine Corps Base. By combining data and imagery from the GIS database with other databases such as the Naval Facilities Assets Database (NFADB), several maps and derived data can be produced to visualize information leading to better decisions and a more dynamic master planning process.

Site Planning Using GIS Data Layers and Aerial Imagery

GIS data layers represent future project areas in a Web-based mapping session.



GIS structure data, rendered with NFADB color codes, allows the user to update land-use data.

Updated Land Cover Theme Created from Timber Stands, Wetlands, Streams, Soils, and Imagery Data Layers

GIS data is color coded by major command occupant to display the geographic spread of facilities utilization.

Contact Information

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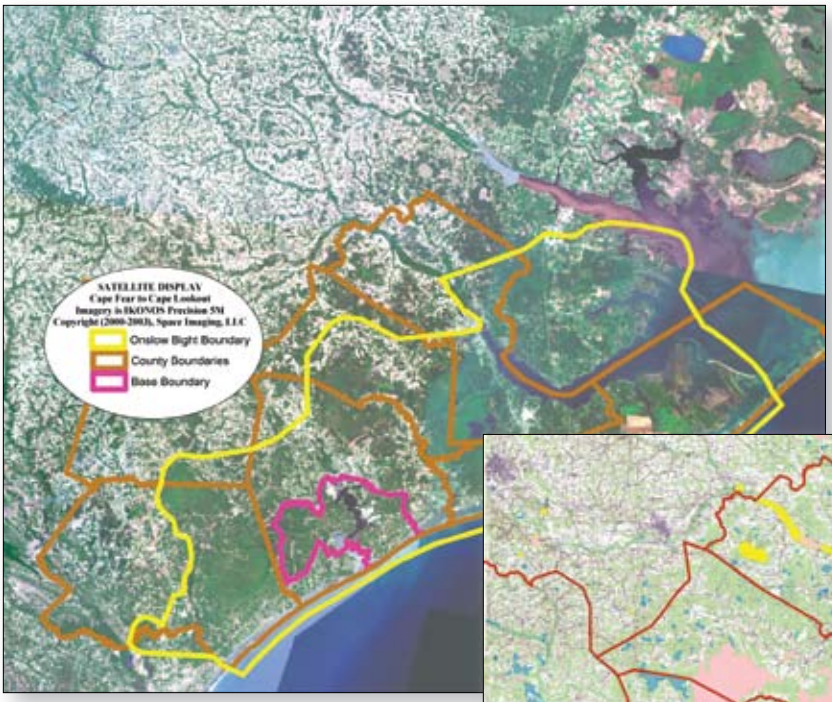
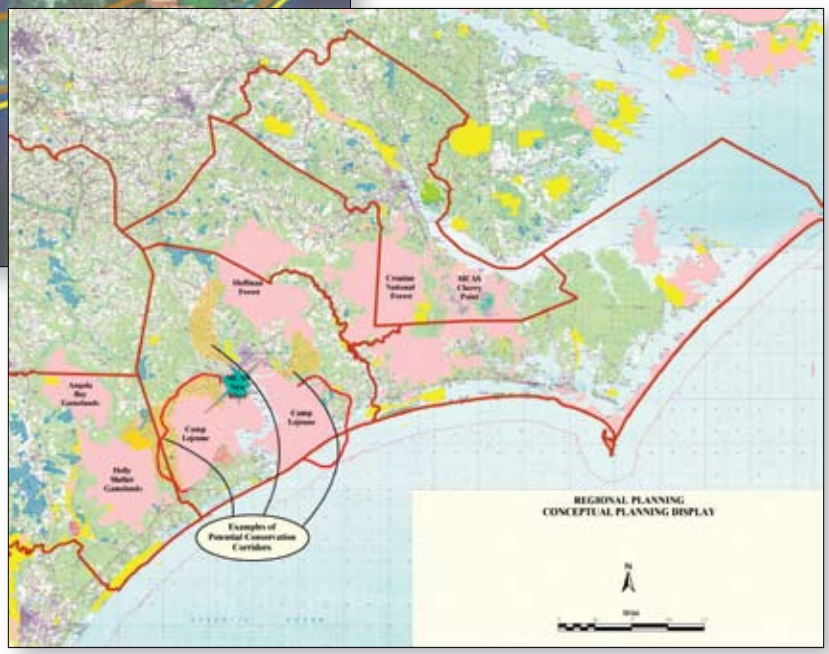
Regional Planning



Satellite Display of the MCB Camp Lejeune Region (figure 1)



Regional Planning Analysis (figure 2)

To ensure the continued success of Camp Lejeune's training mission, it is necessary to look beyond the Installation boundary and recognize the challenges posed by its surroundings. GIS has proven to be an ideal platform to view and analyze data from many different sources to visualize the surrounding area and subsequently generate meaningful information. In these examples (figure 1 and figure 2), data was combined from state, county, and nongovernmental databases along with Camp Lejeune's extensive GIS database to provide a visual information display in support of regional planning initiatives.

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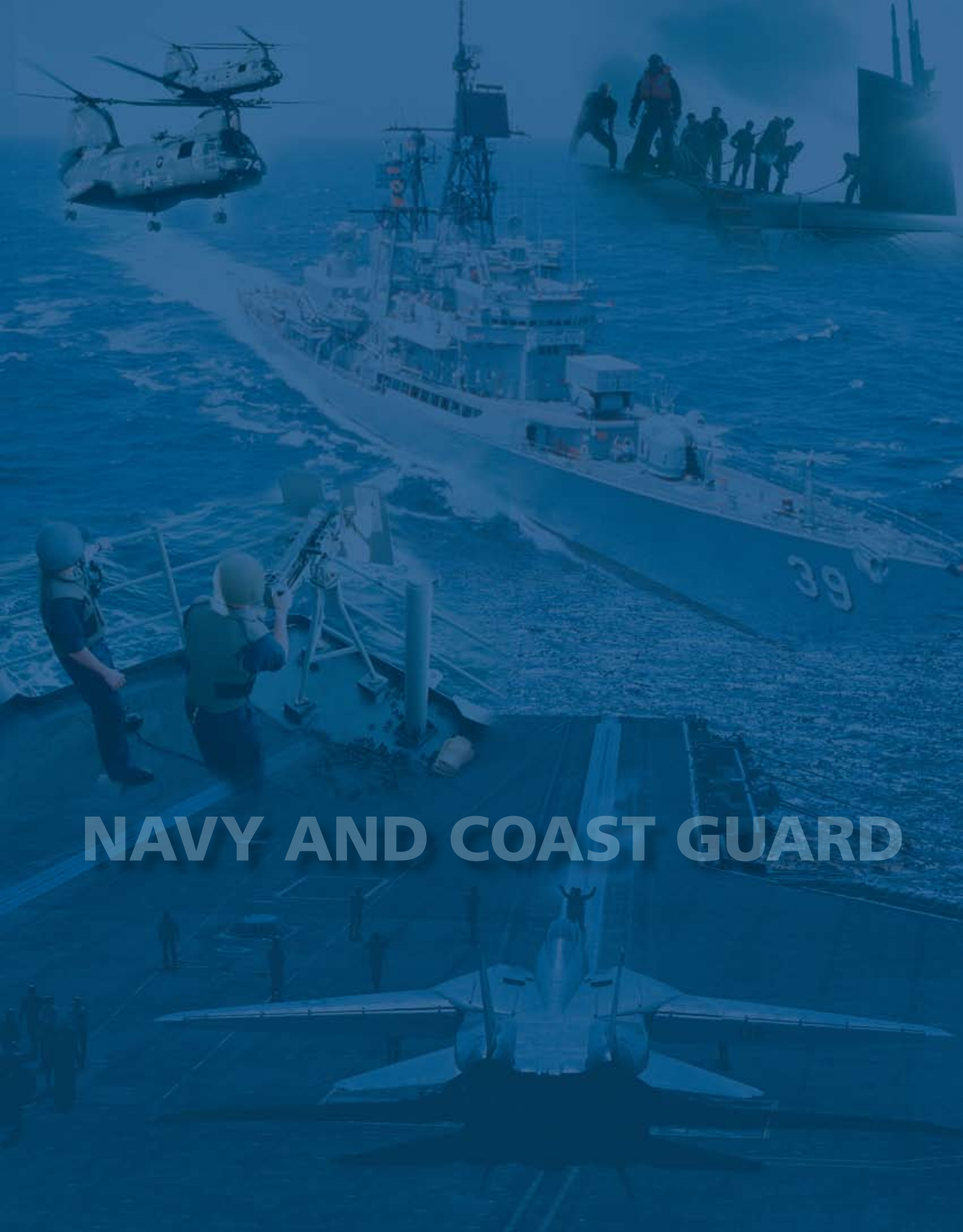
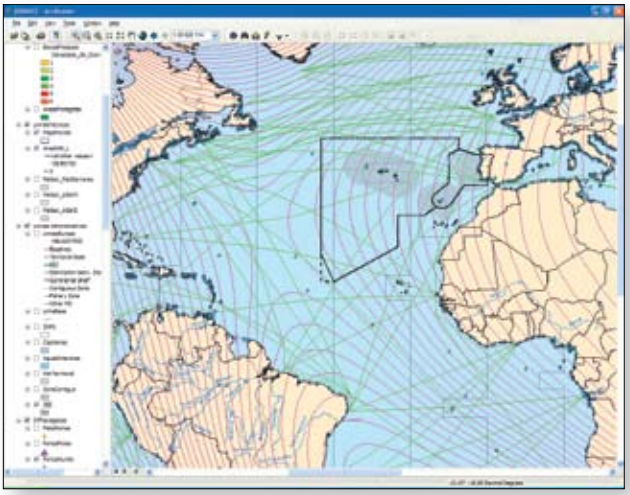
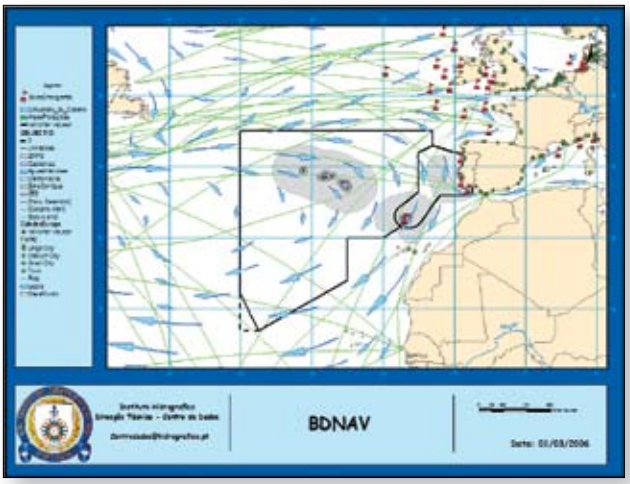


NAVY AND COAST GUARD

A GIS for Navigation Planning



ArcReader™ Interface



Layout for Plan Print

Navigation officers are in charge of planning for safe maritime navigation. Most data and information related to this task is spread among several publications and media. A GIS was developed to centralize most relevant information and help navigators be aware of what is available for specific areas of interest. Data coverage of the system's layers varies from worldwide to local Portuguese areas of interest. Layers were stored in a personal geodatabase in six thematic datasets: environment, basemap, administrative limits, technical limits, chart coverage, and navigation information. More than 50 layers of thematic data were collected including several chart folios (paper, ENC), EEZ, territorial waters, baseline, underwater cables, magnetic declination, search and rescue areas, main seaports, main ocean routes, sea climatology, major ocean currents, bathymetry, sea gazetteer, political boundaries, and satellite images of main ports, among others.

The system is deliverable on CD-ROM and has a Web version running on a local network. Besides the regular GIS capabilities to explore the system, users are also able to add data of their own. This is achieved by including in the system several empty datasets that are customized through an external batch-run independent application. This functionality provides navigators the means to include planned routes, exercise areas, and features of interest in the layout and perform basic overlay and integration analysis (e.g., which paper charts will be needed to cover a particular route plan).

Major identified benefits are navigator awareness of the wealth of available information for navigation planning; flexibility for data query, especially considering that data can be locally added; and the ability to have the big planning picture on a single flexible interface.

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INTELLIGENCE
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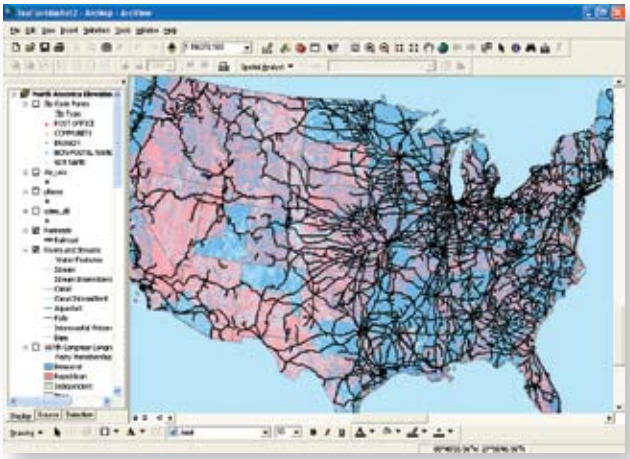
Filtering GIS Displays with Semantic Lenses



Standard Layer View

View data using semantic lenses.

Overview

GIS displays typically contain many data layers ranging in type and level of detail that often result in dense, cluttered, and occluded map displays. An alternative to toggling layers on and off is semantic lensing, which is a localized, "detail-on-demand" filtering strategy. Semantic lenses are a more efficient and desirable approach than traditional layer filtering.

Capabilities

Types of semantic lenses:

- A filter lens allows the user to select any combination of layers to display in the lens to either rapidly augment (add layers to) or declutter (remove layers from) the scene.
- A label lens allows the user to restrict labels to the lens to reduce visual clutter in the global scene.
- A query lens allows the user to query the attributes of a layer and present the results inside a lens as opposed to the global scene.

Multiple lenses can be added simultaneously and are flexible in terms of resizing and dragging.

Benefits

Semantic lenses are used by GIS analysts to understand relationships between multiple layers of data simultaneously. The use of semantic lenses has been shown to improve analytic performance compared to the traditional approach of toggling layers on and off to manage clutter. The semantic lensing capability is currently a plug-in to ESRI ArcView® 9.x.

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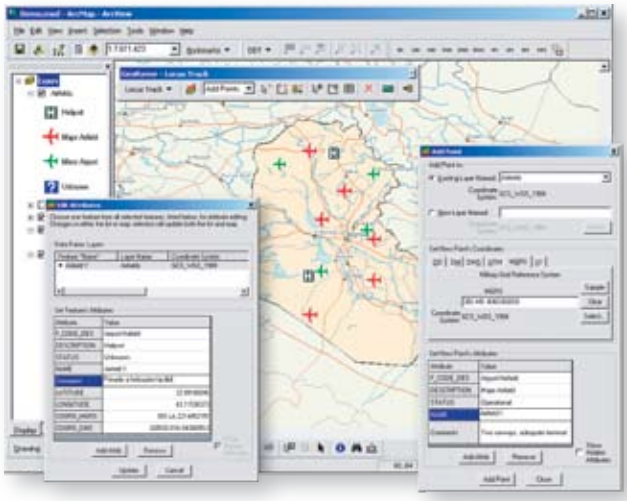
GeoRover Tools for ArcGIS

The Digital Data Tracker extension downloads GPS receiver track logs and waypoints as layers in ArcGIS Desktop. Using the downloaded GPS information, data collected in the field (digital images, video clips, digital audio, etc.) can be automatically georeferenced and plotted in the ArcGIS Desktop display. Click on the points to access the data. Hours of field data collection can be processed in seconds.

Overview

GeoRover® Tools for ArcGIS is a powerful suite of extensions developed by SAIC for ESRI ArcGIS 8.x/9.x Desktop. GeoRover Tools for ArcGIS streamlines the process of creating, importing, editing, and sharing GIS data while empowering the field data collector to perform real-time or postcollection processing of data from GPS receivers and a variety of data collection devices (digital cameras, voice recorders, and more). In addition to importing text files, spreadsheets, and databases, these tools create interactive Web pages, spreadsheets, and slide shows of your GIS and collected field data—enabling sharing of information with those who do not have GIS. GeoRover Tools for ArcGIS consists of three extensions:

- Digital Data Tracker—Field data collection tools
- Locus Track—Interactive editing, importing, and exporting tools
- Zoom Tools—Quick zoom to scale or coordinate



GeoRover tools provide the capability to create self-contained Hypertext Markup Language (HTML) documents, Excel spreadsheets, or complete PowerPoint presentations in a matter of minutes for dissemination of geospatial information to those not equipped with GeoRover and ArcGIS software. The HTML product can be used for interactive briefings or to use as an HTML link on a Web site.

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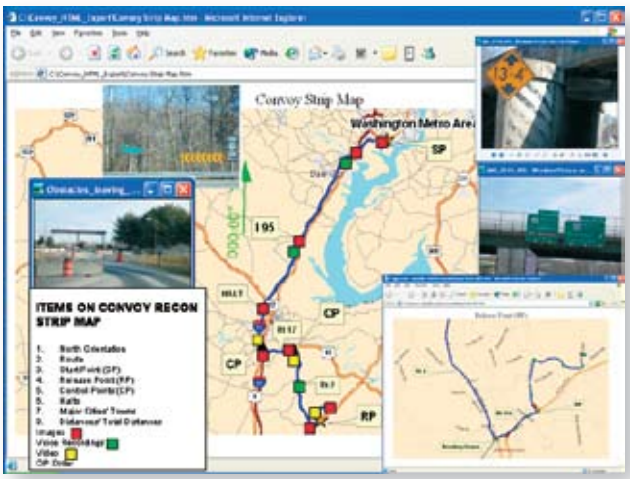


The HTML product is easily created using the GeoRover Digital Data Tracker (DDT) Export HTML tool. Once the product is created and displayed, click any of the colored icons on the browser display to view the collected data (i.e., videos, images, text documents, audio files). There is also a pop-up message that displays the name of the point and the coordinate (in whichever coordinate system the exporter chooses) when the mouse pointer rests above the points.

Applications

- Data Import: Import wizard rapidly and flexibly ingests nonspatial data from many different data sources (spreadsheets, text, databases) and in many different coordinate formats into ArcGIS Desktop.
- Data Editing: Edit features with a streamlined, interactive interface to the ArcGIS Desktop.
- Data Export: Export wizard generates powerful products in standard formats (HTML, PowerPoint® slide shows, Excel® spreadsheets) from ArcGIS data.
- Field Data Collection/Visualization: Plot routes and collected field data as layers in ArcGIS Desktop. Field data is collected with commercial GPS receivers and other components (digital cameras, voice recorders).

GIS provides a natural overview or common operational picture (COP) for a wide variety of applications. GeoRover software gets the user's real-world data into the GIS to immediately convey meaning with points, lines, and areas of interest including linked documents or Web pages.

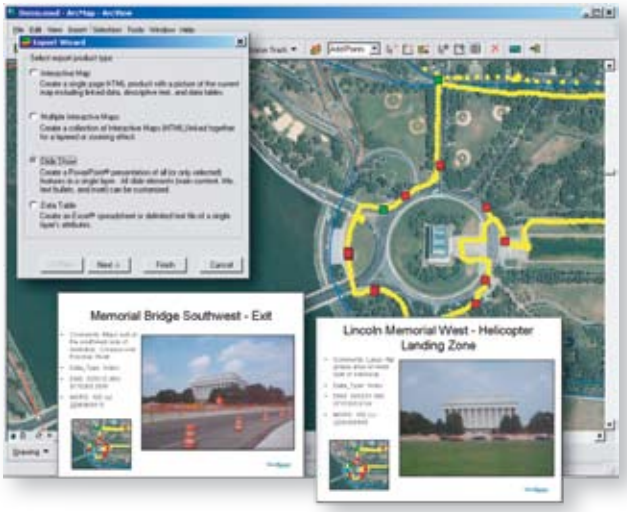
- GIS Desktop Use: GeoRover software is ideally suited for command and intelligence centers.
- Route Reconnaissance: Show the route and critical points of interest with links to details.
- Site Surveys: Show ingress and egress, utility junctions, functional zones, and deployment locations.
- Prepare Convoy Plans: Conduct convoy reconnaissance and prepare convoy strip maps.
- Vulnerability Assessments: Interactively present the vulnerabilities and remedy recommendations.
- Intelligence Plans and Collections: Clearly show status of each target and link collected data to target.
- DoD Crime Scene Investigation: Show overall scene with precise locations and photo evidence.
- Counterterrorism: Conduct reconnaissance for direct action on terrorist cells. GeoRover software can be integrated with SAIC Pathfinder to perform complex analytical queries.
- Emergency Response: Prepare detailed emergency response plans of key facilities with linked images, video clips, and voice recordings.

GeoRover Tools for ArcGIS

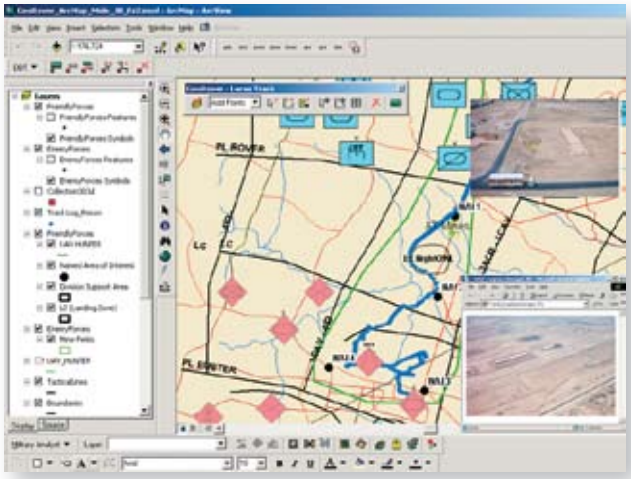
GeoRover software enables soldiers, field agents, scouts, HUMINT/CI teams, emergency responders, defense attachés, combat engineers, civil support teams, and others to gather and disseminate actionable intelligence in a geospatial context. Intelligence data can be quickly imported from multiple sources and displayed in ArcGIS. In the field, multimedia intelligence data in the form of pictures, video clips, and sound recordings can be linked on digital maps for subsequent intelligence analysis.

Capabilities

GeoRover software is fully compatible with all ArcGIS Desktop levels of licensing (ArcView, ArcEditor, and ArcInfo).



Use Digital Data Tracker extension's new real-time track log capability in the field with a laptop or Tablet PC. Moving map display shows current position and always keeps the map in front of the current position, allowing for reaction time when navigating. View real-time heading and current position in preferred coordinate format. GPS data is loaded into an ArcMap layer in real time, showing a record of travel. Using the new geolocation wizard, data collected in the field can be georeferenced in real time.



A COP can be displayed in ArcGIS (with MOLE), and elements of field data/HUMINT data/reconnaissance data collected with the GeoRover Digital Data Tracker extension can be displayed over tactical graphics to give the commander, staff, and analysts the complete picture of unit locations. This can be layered with the collection deck, mission platform tracks, and field-collected data that resulted from intelligence requirements in the collection plan. Multiple MGRS, DMS, DD, DM, and UTM coordinates can be easily imported from operations orders, intelligence summaries, and intelligence databases with the GeoRover Import wizard.

Key Features

- Downloads track logs and waypoints from GPS receivers into new or existing GIS data layers.
- Supports Garmin® (serial and USB), Magellan® (serial), and NMEA GPS protocols.
- Real-time track log with moving map display for navigation including heading and current coordinate readout.
- Geolocates and plots field data (digital images, video clips, audio recording, etc.) by correlating the data with the GPS information.
- Wizard-driven import of points, lines, or areas from any delimited text (.csv, .txt, .tab, etc.), Excel spreadsheet, database (Access, Oracle®, Microsoft® SQL Server, etc.), or typed/pasted text with coordinates.
- Interactive (point and click) and coordinate-based tools for creating, editing, and deleting features from shapefiles and geodatabases (personal and enterprise ArcSDE).
- Ability to create complete PowerPoint presentations for all (or selected) features from the user's GIS data. All slide elements (main content, title, text bullets, and insets) are automatically generated and user customizable.
- Ability to export GIS display into interactive HTML files with hyperlinks and user-defined pop-up labels.

Benefits

GeoRover software streamlines many processes in ArcGIS for both new ArcGIS users and experienced GIS professionals. GeoRover software is mobile and can make use of practically any data collection device.

- Discrete collection capability with no connection required in the field between the GPS and data collection devices.
- Significantly reduces training time for fundamental ArcGIS editing operations.
- Field data collection tools are compatible with almost any digital device.
- Coordinate-based tools support MGRS, which is identical to U.S. National Grid.
- No proprietary hardware required.
- Flexible data collection options
  - GPS receiver and digital camera (or other device) required in the field. No PC or cable connections are required.
  - Real-time with laptop/Tablet PC.

The Locus Track extension Export wizard can export GIS data from ArcGIS Desktop into many useful data sharing formats. Create interactive Web pages complete with custom pop-up labels, hyperlinks to data, and data tables. Export any layer into an Excel spreadsheet, complete with coordinates for every feature. Use the slide show export to create an entire PowerPoint presentation from all or selected features of a layer. A slide can be created for each feature containing linked data, overview maps, or both. Additionally, slide titles and text bullets are automatically generated and can be customized based on information within the attribute table. Create entire presentations with just a few clicks of the mouse.

GeoRover

SAIC
From Science to Solutions™

The Use of New Technology to Meet the Challenges within Geospatial Support

Article V-scenario

Protection of economic interests

Global war on terrorism

The Norwegian Military Geographic Service (FMGT) and the Norwegian Armed Forces area of interest (AOI) has increased dramatically throughout the years. The AOI has changed from an anti-invasion perspective through protection of Norway's economic interest to also include the global war against terrorism.

To meet these demanding challenges, FMGT had to find smarter and more efficient ways to do business. The vision was to use new technology to ease the burden on the staff and, at the same time, meet the ever-increasing demands for efficiency and fast response.

FMGT carried out the following key actions to meet the challenges:

- Standardized user software
- Established a digital geographic information (DGI) management system to gain control with all DGI systems and deliver ready-to-use data
- Established a map service (atlas) to meet the demand for briefing and planning maps
- Established a catalog service to automate the ordering process

The DGI management system is designed to manage all DGI systems used in the Norwegian Armed Forces. It contains automated and semiautomated routines for

- Importing DGI from different formats, products, and sources
- Handling security issues (e.g., availability, disclosure, and releasability)
- Disseminating information to most systems used in the Norwegian Armed Forces online or on electronic media

Contact Information

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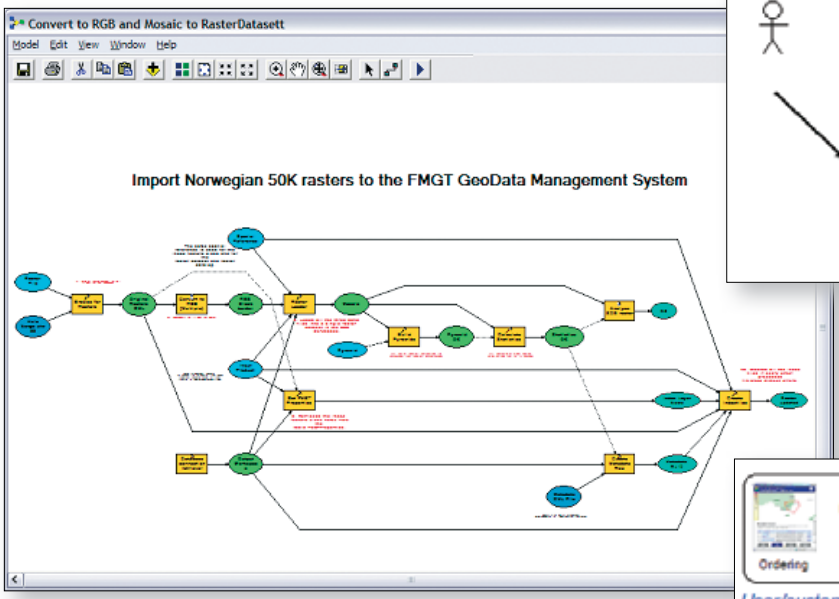
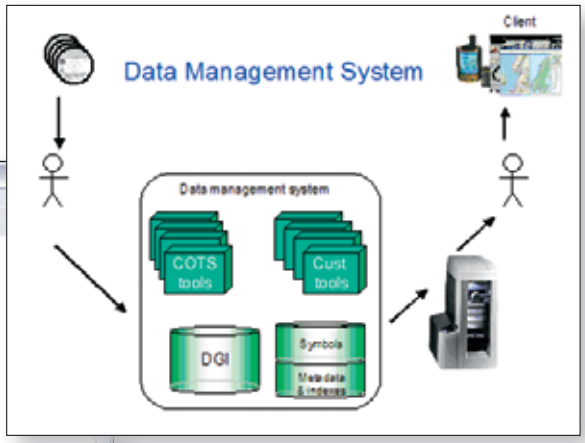
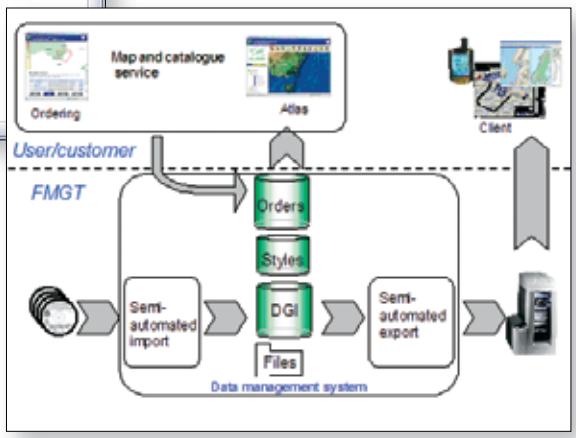


Easy-to-use models to improve workflow



System overview



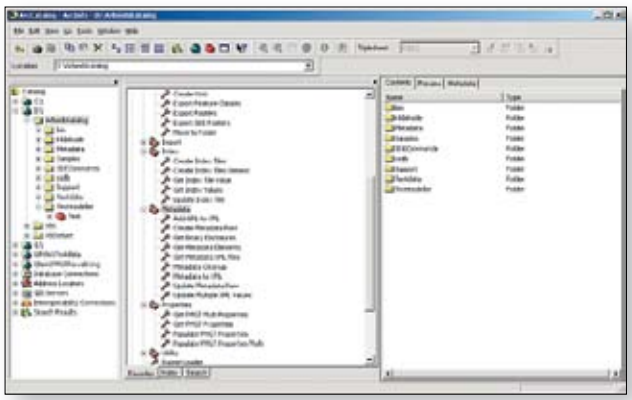
System workflow

Following are the benefits of the new system:

- The flexible solution makes it possible to deliver ready-to-use data to more systems without increasing the number of personnel.
- Data is stored in a standard format, regardless of the original format, and export and delivery capabilities are unlimited.
- There is better control of data coverage, metadata, and user restrictions when all data and indexes are stored in a common database.
- Access is easy to all DGIs for internal use and production.
- It is an open and future-oriented solution based on geoprocessing models. This will make it easy for FMGT to implement new functionality.

To summarize, FMGT has applied new technology to meet the increased demands for DGI, with the following benefits:

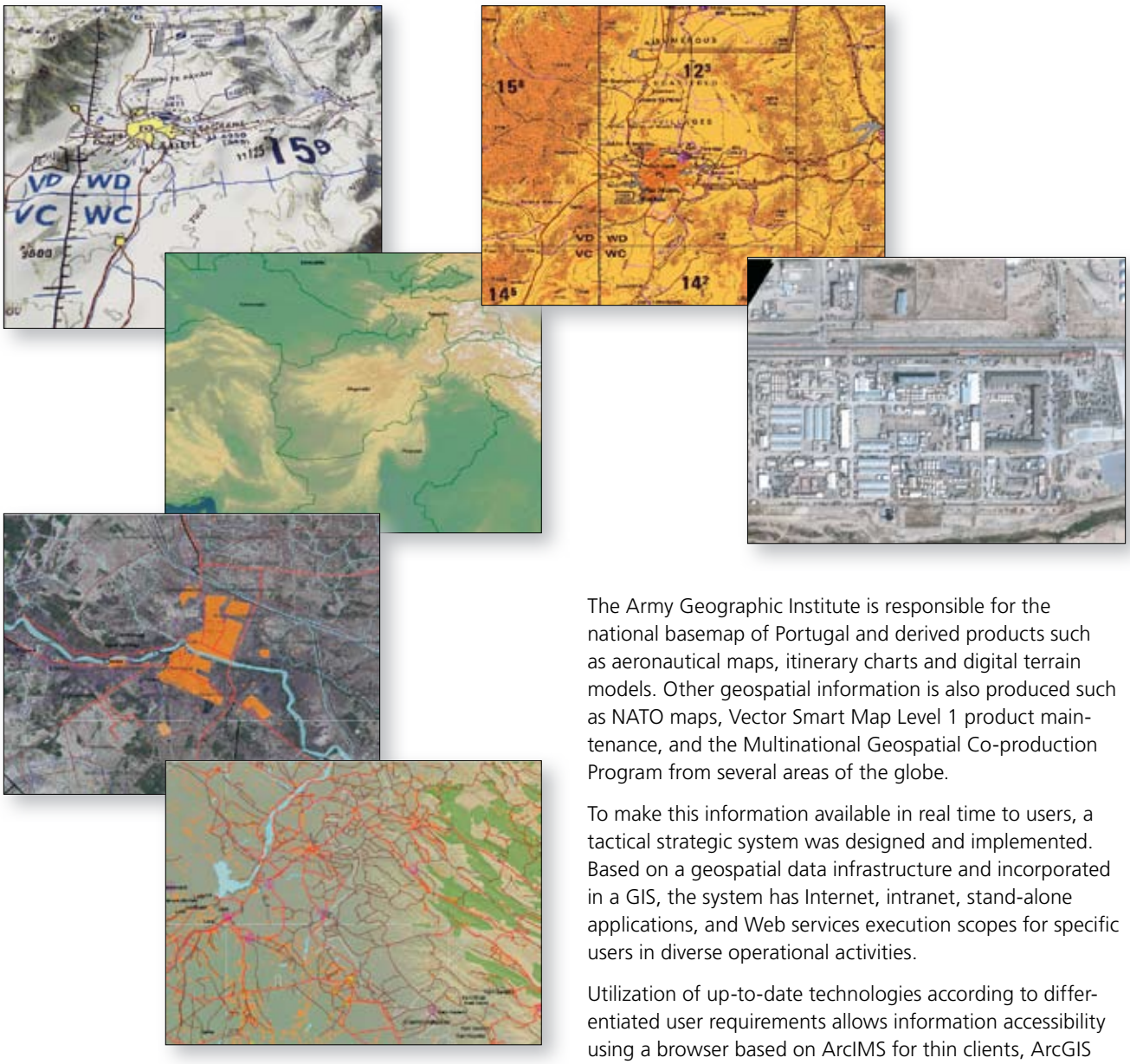
- Being able to deliver more data to users
- Supporting more user systems
- Easier user access and ordering of DGI
- More efficient order handling process
- Improved and more efficient DGI management
- And all this without increasing the number of staff members



Tools and management


JOINT

Multirole Geospatial Data Infrastructure



The Army Geographic Institute is responsible for the national basemap of Portugal and derived products such as aeronautical maps, itinerary charts and digital terrain models. Other geospatial information is also produced such as NATO maps, Vector Smart Map Level 1 product maintenance, and the Multinational Geospatial Co-production Program from several areas of the globe.

To make this information available in real time to users, a tactical strategic system was designed and implemented. Based on a geospatial data infrastructure and incorporated in a GIS, the system has Internet, intranet, stand-alone applications, and Web services execution scopes for specific users in diverse operational activities.

Utilization of up-to-date technologies according to differentiated user requirements allows information accessibility using a browser based on ArcIMS for thin clients, ArcGIS Desktop connections to Web services for thick clients, a browser in an ArcGIS Server environment for common clients, and a stand-alone application developed in MapObjects for disconnected users.

Design, implementation, and modeling of a relational geographic database and analysis tools were key to the project, which allows optimization of battlefield study (the Intelligence Preparation Battlefield [IPB]), involves the military decision process, and enables distribution and publishing of citizenship information to the World Wide Web, with geospatial information from national and global zones where Portuguese forces are deployed.

Contact Information

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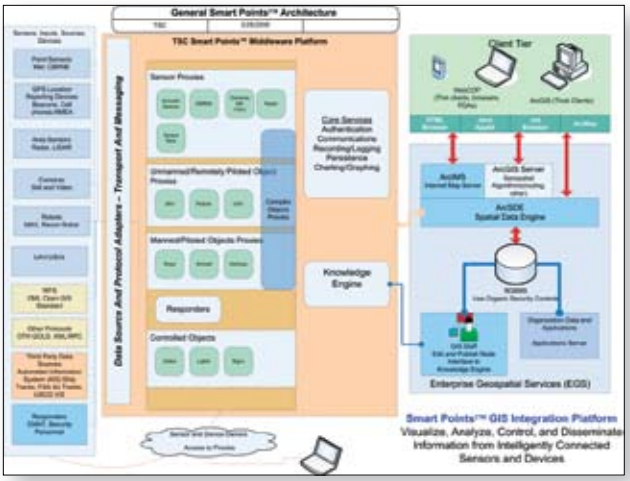
Smart Points



Smart Points platform

Introduction

The purpose of the Smart Points™ GIS integration platform, coupled with ESRI's GIS software components, is to provide an inclusive information framework for integrating, controlling, visualizing, analyzing, connecting, and disseminating information among intelligently connected sensors, devices, objects, and personnel.

The Smart Points platform was created in response to experience gained during Defense Threat Reduction Agency (DTRA) Integrated Technology Demonstrations (ITDs) conducted from early 2003 to the present. These ITDs required the integration of multiple sensors, robots, responders, and other objects, developed by many different sponsors, into a common operational picture (COP). Smart Points evolved as a technology platform to accommodate this wide variety of heterogeneous systems and provide a means for them to operate within an ESRI client environment and interact with each other and the system users.

Architectural Support

The TSC Smart Points architecture augments and operates within the ESRI ArcGIS Server, ArcSDE, and ArcIMS back-office framework. This implementation ensures that these objects can not only operate but also interact with other elements within the geospatial context of an operation as well as with other sensors or objects that are integrated in the system.

Each sensor or object is connected to this back-office framework through Java connectors and software proxies of these objects. This implementation provides the necessary abstraction of the physical device so that it can be assigned behaviors and interactions with other sensors or devices in the information system. Once in the information system as addressable objects, the sensors and devices can operate and persist, providing continuous support and updates to their clients. As information elements, the sensors and devices can operate as smart objects so that, for instance, a chemical agent sensor could alarm, transmit a message to personnel or organizations that need to know that the alarm has occurred, prompt the reading of local meteorological sensors, and trigger the creation of a chemical plume model that is introduced to the system with little or no manual intervention.

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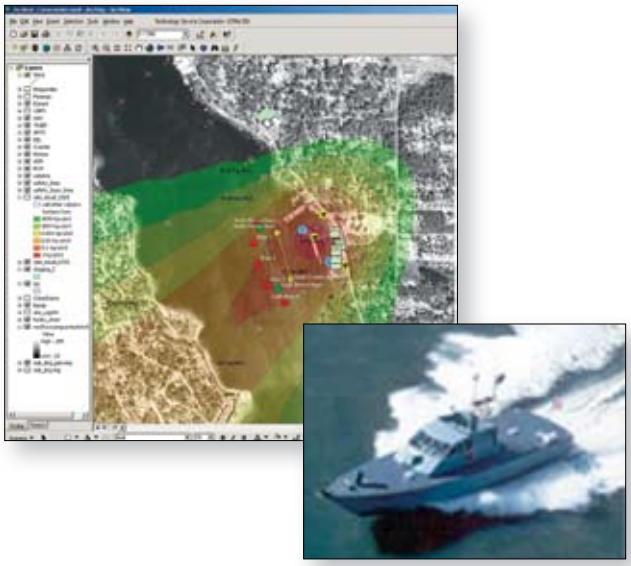
DTRA Integrated Technology Demonstrations

The Smart Points framework was developed over time as part of the DTRA ITD process that began in late 2002. A hallmark of these ITDs was the necessary integration of a wide variety of devices and sensors within a COP. Smart Points served as the integrating component used to make the various systems operate together for the customer. The success of this implementation was proven as part of the Joint Warrior Interoperability Demonstration 2004, the political conventions of 2004, the Super Bowl and Inauguration in 2005, and the Coalition Warrior Interoperability Demonstration in 2005.



Navy Center for Asymmetric Warfare

The Navy Center for Asymmetric Warfare is implementing a shore-based ESRI geospatial infrastructure that will be used to support its asymmetric warfare initiatives. The geospatial infrastructure will be augmented with Smart Points to connect to a fast patrol craft with multiple sensors and potentially unmanned vehicles launched from the boat.

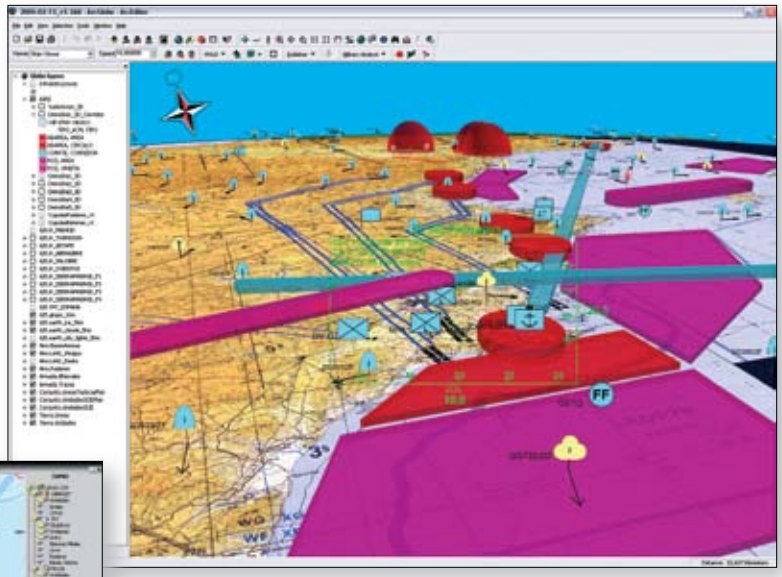
Airport Security Display Processor

TSC is building an airport perimeter security system that takes advantage of the Airport Surface Detection Equipment (ASDE) radar to track anomalous objects within the radar's field of view. This radar, coupled with Smart Points, provides system capabilities that can accommodate new sensors such as video, acoustic, and motion detection. Each of these sensors can be cued by the ASDE radar.

Department of Energy SensorNet

During the DTRA ITD 4 activity of June 2005, the Smart Points team integrated DoE SensorNet components via the DoE Web Feature Service (WFS) implementation into the ITD systems. This capability utilized the SensorNet framework to discover and display physical location, detection, and alerts from a variety of networked sensors into an enterprise GIS architecture.

Prototype of a Basic Capability Common Operational Picture for the Spanish Armed Forces



The definition of common operational picture (COP) is the capability to get a common vision of the land, air, and naval situation within a unique display. This spatial representation is at the disposal of the respective commands to improve their knowledge of the battlefield and situational awareness at a strategic and operational level and eventually at a tactical level.

COP constitutes an integrated representation of the cartographic information along with the allied, neutral, and enemy units of the army, navy, and air force. It is also complemented with information related to targets and tactical graphics. All this information is collected from other command and control (C2) systems and disseminated through Web technologies, taking advantage of robust COTS software.

The prototype of the developed COP gathers tactical information from the current C2 systems (SIMACET for land operations, MCCIS for navy operations, ICC for air operations, and SIJE for joint operations). In addition, there are ongoing developments to collect information from other existing C2 systems and types of information such as meteorology, signals intelligence (ELINT, COMINT), etc.

The information may be accessed by authorized commands connected to the network through standard Web browsers. The level of information available depends on the user profile.

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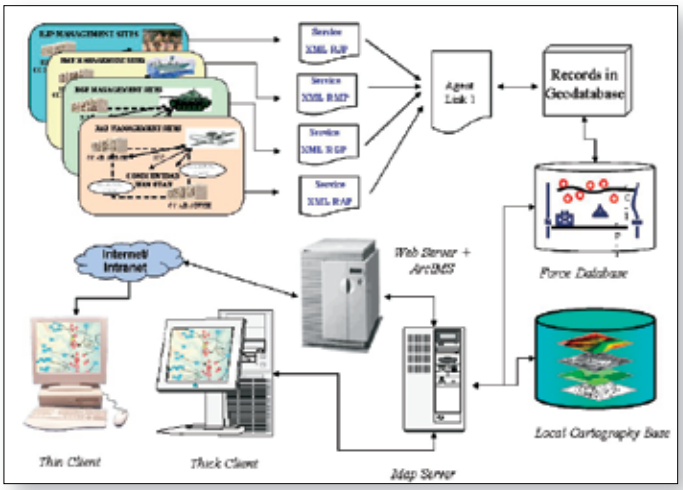
To interact with the COP spatial representation, the end users can pan, zoom in/out, query, apply filters to the layers, and perform other GIS functions. Furthermore, the COP situation is refreshed regularly so that the commander can make decisions accurately.

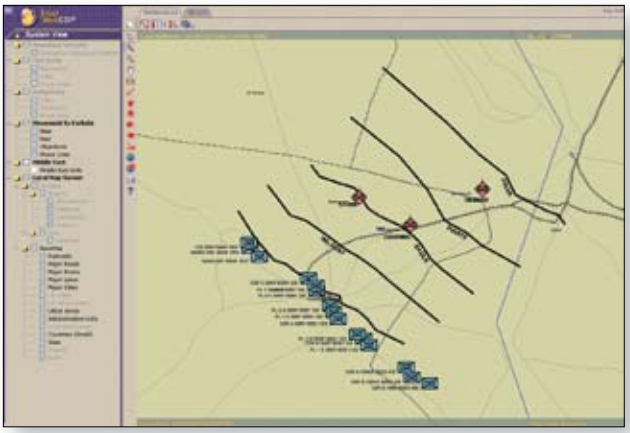
The Area Command and Control of the General CIS Office has led this project, assisted by the following companies:

- ISDEFE (the company for technical assistance of the Ministry of Defense)
- Software AG
- Sistemas de Información Territorial, S.A. (SITESA)

It is expected that the prototype will evolve in 2006 to include more information as well as more functionality, ensuring high levels of performance at the same time.



Joint WebCOP, a Service-Oriented Architecture Framework for Internet-Based GIS



Introduction

Improving the ability of U.S. war fighters to visualize the battlefield has never been more important. Joint WebCOP is a Web-based common operational picture (COP) being developed by the Global Command and Control System (GCCS) Family of Systems (FoS). It takes advantage of a service-oriented architecture (SOA) to aggregate maps and data from multiple services into a common view using standard Internet browsers. The popularity of Internet-based GIS technologies has provided a mechanism for sharing and distributing GIS data and processing. Technologies such as ArcIMS, Web Map Server (WMS), Web Feature Server (WFS), and Styled Layer Descriptor (SLD) provide the basis for distributing GIS processing using an SOA. The Joint WebCOP takes advantage of this architecture to provide a COP aggregated from numerous command and control (C2) services.

Overview

Joint WebCOP uses the Commercial Joint Mapping Toolkit (C/JMTK) and OpenGIS standards as a framework for developing scalable GIS capabilities that integrate existing data sources and user functionality. This framework distributes data access and map production to existing C2 systems, reducing the processing performed on the Joint WebCOP server. Distributed C2 systems perform the majority of the processing and deliver a simple map image or XML data to the Joint WebCOP server. Using SOA, the Joint WebCOP server joins a vast network of systems that cascade data from server to server using OpenGIS formats. Joint WebCOP augments current capabilities by providing a Web browser interface to the COP and an open, extensible, and loosely coupled architecture that can quickly accommodate new data sources and user functionality.

Capabilities

Joint WebCOP provides a simple, intuitive, familiar user interface, enabling soldiers to view critical information without extensive training. Any platform with network connectivity and a Web browser may now view the COP. Multiple data feeds are available via SOA. Joint WebCOP is a framework for integrating systems, not just data. Joint WebCOP uses custom-developed provider interfaces to display data from any data source or existing system, furnishing additional functionality specific to the provider.

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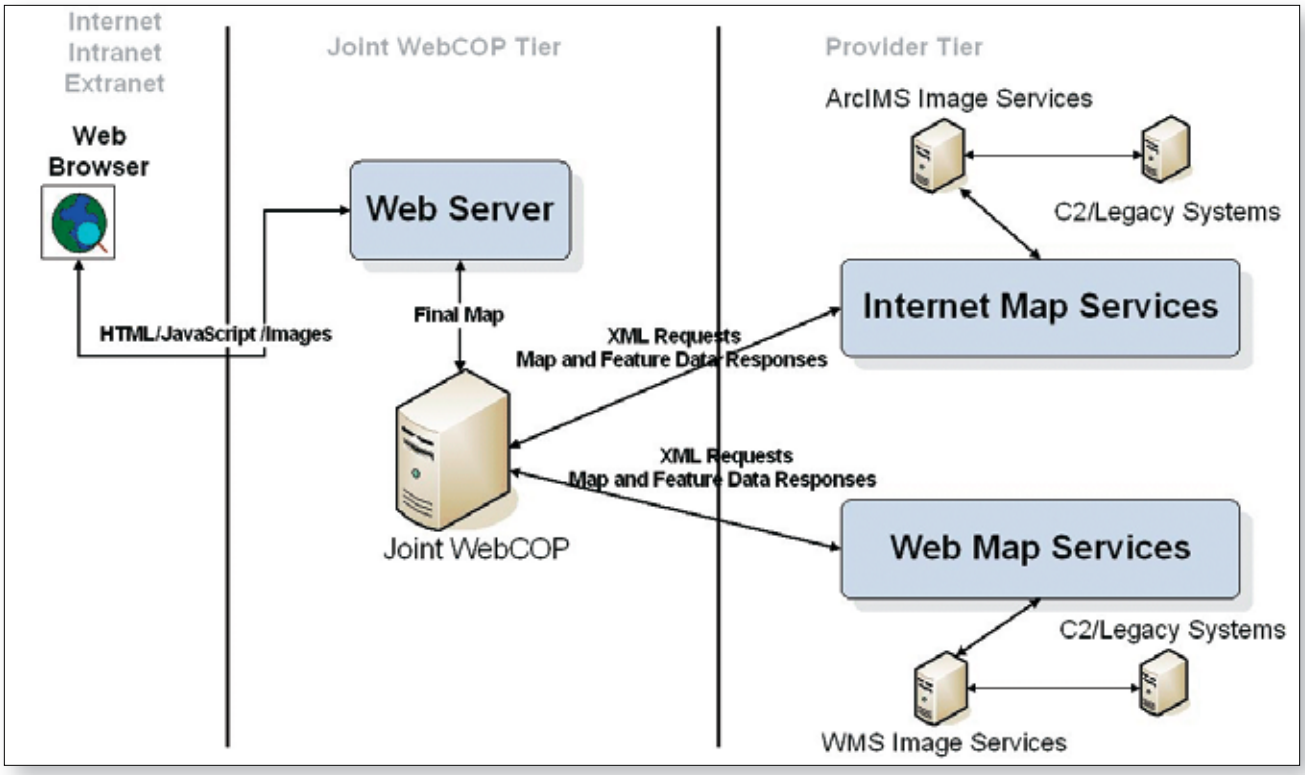


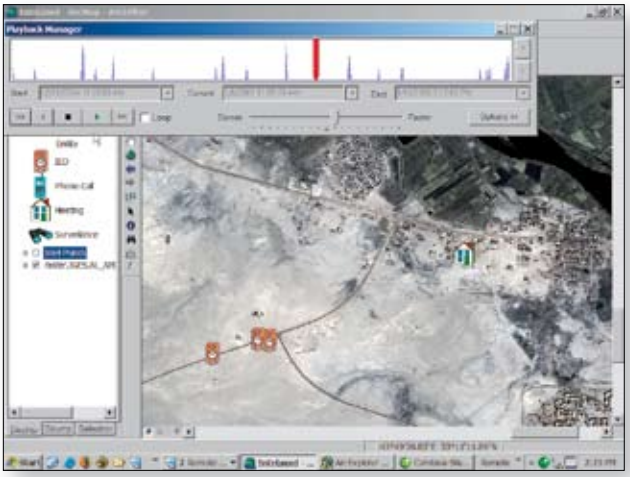
Benefits

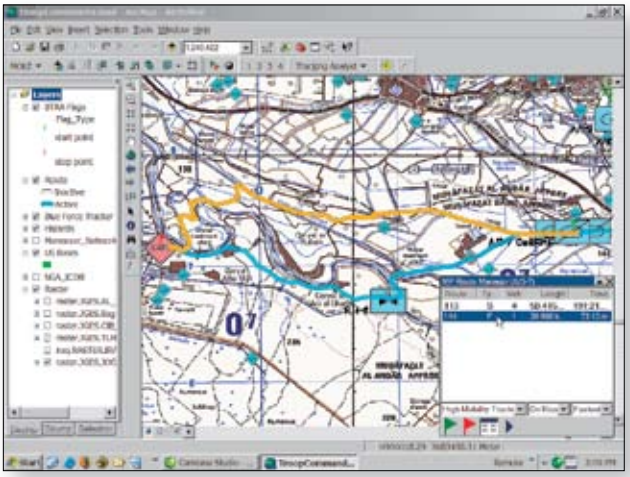
- Provides an SOA for interacting with distributed C2 systems via ArcIMS, ArcSDE, WMS, and WFS to integrate custom data and functionality
- Provides a COP composed from multiple distributed data sources
- Provides an interface to view multiple systems using only a Web browser
- Increases scalability

Summary

Joint WebCOP is a collaborative development effort among GCCS-A, GCCS-M, GCCS-J, Theater Battle Management Core System (TBMCS), and DISA. A demo Web site is available at www.jointwebcop.com.

Joint Geospatial Enterprise Services





Introduction

Profound changes in science and technology are providing U.S. soldiers with better tools to accomplish their missions, yet in the constantly evolving world of geospatial services operating within a netcentric environment, the volume of programs, platforms, and formats is endless. To better enable soldiers to navigate this complex environment, the U.S. Army Engineer Research and Development Center's Topographic Engineering Center (ERDC-TEC) developed a test bed with a Joint Geospatial Enterprise Services (JGES) capability to build a bridge between the war fighter, the command center, and the national level of the National Geospatial-Intelligence Agency (NGA).

Mission/Overview

ERDC-TEC manages a JGES science and technology (S&T) program for testing, evaluation, and experimentation of critical geospatial services and to make needed architecture a reality in the netcentric environment. The JGES S&T program promotes the use of geospatial technologies to allow data management, collection, exploitation, visualization, and dissemination of geospatial data/information from any available national or tactical source. It provides a dynamic, customizable, common operational picture and tactical decision aids to allow rapid analysis and situational awareness based on the best available information across the network, especially from soldiers on the ground.

A driving force behind the JGES S&T program is assisting in spiraling technologies to the field more quickly. The JGES S&T program focuses on creating geospatial netcentric services built to fit within the structure of different architectures. Therefore, the JGES S&T concept was created to partner with other DoD agencies, federal agencies, private industries, and academia to develop and influence geospatial standards, policies, and procedures.

Capabilities

The initial technology focus areas for the JGES S&T program in spiral one included soldier as sensor using mobile GIS technology, discovery services using metadata portal concepts, high-resolution sensor exploitation, geodatabase synchronization, spatially and temporally explicit link analysis, terrain reasoning services, and 3D terrain visualization. It leveraged commercial and government off-the-shelf technology. Through the use of five operational vignettes, spiral one demonstrated the need of netcentric geospatial services for current and future battle command systems to many high-level military decision makers.

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Spiral two built on lessons learned and building blocks in spiral one: integration of the Stryker Brigade database; enhanced data discovery, synchronization, interest management, and alerts services; setting up a Defense Geospatial Intelligence Network site; additional terrain reasoning services; various live feeds into the user-defined operational picture; enhanced data entry, data synchronization, and interest management on handhelds; and further prototyping of Force XXI Battle Command, Brigade-and-Below-like capabilities.

Spiral three and beyond will focus on direct engagement with program executive offices, military battle labs, or future centers—across all services and industries—to further develop and promote the use of network-centric geospatial technologies within emerging battle command and ISR programs.

Benefits

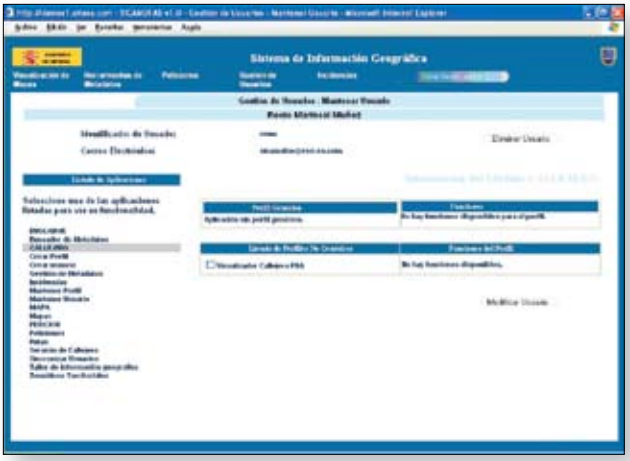
The JGES S&T program will continue to evolve and provide an environment and open architecture.

- Geospatial technologies can be integrated while supporting research and development efforts.
- Identify geospatial enterprise services (GES) gaps and focus future research efforts to address these gaps.
- S&T will support transition of GES technologies to Programs of Record (POR) and continue support for POR and others on a reimbursable basis.
- Integrate, experiment, analyze, evaluate, and demonstrate GES technologies with various DoD research centers, industry, and academia.
- Develop, prototype, and evaluate new geospatial concepts and services.
- Understand the goodness of geospatial information and how it affects the commander's decision-making process.
- Greatly improve data/information access.
- Avoid costs associated with redundant databases.
- Foster data reuse.

Summary

The JGES program was created to better enable horizontal integration while providing a test bed for research that supports U.S. soldiers. ERDC-TEC director Bob Burkhardt concluded, "As the program continues to develop and mature, it will provide better solutions for the GIS needs of the commander and war fighter, further enabling every soldier as a sensor and empowering our army in its missions."

Implementation of a Cartographic, Meteorological, and Oceanographic Information System for the Spanish Armed Forces



Prologue

Between 1999 and 2001, the Spanish Ministry of Defense (MOD) conceived the Director Plan CIS for the development and adaptation of the Spanish Armed Forces to new technologies, establishing as its objective the normalization, modernization, and professionalization of the resources and systems employed. The plan seeks the optimization of every resource involved in obtaining those systems. This effort of optimization of resources pursues the following goals:

- Promote the usage of COTS within the information systems of MOD. The usage of the current standards and emerging technologies permits concentration of effort in the specific functionalities of the applications instead of the developments of basic spatial capabilities already provided by GIS.
- Reduce the total life cycle cost. The usage of COTS contributes to significantly decrease the time spent in the development of new applications.
- Strengthen scalability and portability. The usage of COTS based on open standards architectures for the applications will allow them to run on heterogeneous platforms.
- Ensure interoperability. Through using standard products, the level of internal and external (NATO countries) interoperability will increase.
- Increase the efficiency of end users. Employing similar man-machine interfaces for all the applications simplifies deployment and significantly reduces training costs.
- Optimize administrative issues. The usage of standard products simplifies the technical and administrative/financial management of the systems and applications. Consequently, it works in favor of saving money in acquisitions and maintenance too.
- Preserve security effectively. The fulfillment of security requirements in the treatment of information may be simplified thanks to its unique management.

The execution phase of the plan began in 2002 through the fulfillment of several concrete actions to meet the requirements of MOD. For this purpose, the General CIS Office was created. Within the framework of the MOD objective to obtain 37 information systems, the Cartographic, Meteorological, and Oceanographic Information System for the Spanish Armed Forces (SICAMOFAS) was acquired.

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In this context, the General CIS Office launched late in 2003 a formal process to choose a GIS vendor as a standard for implementing the architecture objective for the Digital Geographic Information System of Defense. ESRI technologies were submitted for the benchmark testing.

The benchmark lasted five months and involved completing commercial and technical questionnaires; presentations; demos; visits to current customer references with enterprise GIS; and finally, the benchmark itself, which was required to pass demanding testing related to interoperability, raster and vector processing, creation of a continuous cartographic database, 2D and 3D analysis, development of GIS applications, and digital/analogical dissemination of information.

In the end, the General CIS Office chose ESRI technology for the mandatory GIS components for the Digital Geographic Information System of Defense.

Scope of the System

As a whole, the system will assume the functions of acquisition, preparation, and exploitation of digital geographic information. The functions of cartography acquisition (carried out by external sources) will be a task of the Cartographic Coordination Unit; the functions of preparation will be the responsibility of the Cartographic Harmonization Service (SAIG); and finally, the tasks of exploitation will be the responsibility of Geographic Support Devices (also known as Local Geographic Sections) in support of end users located in Land Forces, Air Force, Navy, and Joint Command headquarters; Intelligence Agency; and the Central Organization.

Objectives

- The system will be the only one for the whole MOD. Technical resources will be provided for the management of the tools.
- The Digital Geographic Information System of Defense must be a useful tool to support decision makers, so it must provide to every echelon the required information.
- The Digital GIS of Defense must meet the requirements related to definition, access, analysis, editing, integration, publication, and dissemination of spatial data for MOD systems, within command and control as well as general purpose environments.
- The digital geographic information will be structured in spatial databases according to a specific data model. This data may be general purpose as well as specific command and control data. The data management may be either distributed or centralized, depending on need.
- The Digital GIS of Defense must include facilities to distribute digital spatial data to any unit or dependence regardless of its location (national or deployed abroad).
- It must work within a telecommunications infrastructure network with enough bandwidth including the massive exchange of data through LAN and WAN. On one hand, there will be a command and control WAN that will be connected to the Spanish and NATO tactical environments. On the other, there will be an enterprise general purpose WAN with more than 35,000 workstations connected.
- The system will deliver Web services when necessary.
- The system will incorporate the tools for following up incidents as well as the necessary mechanisms to implement security policy.
- The system will guarantee timely acquisition or production of spatial resources according to STANAGs or ISO standards.
- The system will be open to guarantee interoperability between national and international (NATO) systems.
- The Digital GIS of Defense will allow the display of information stored in the spatial database according to rules established by Spanish defense mapping agencies, catalogs of conventional symbology, and STANAGs.

The architecture of the Digital GIS of Defense is formally called Digital GIS Target Architecture. It is organized in several connected nodes through a WAN to allow the flow of geographic and tabular information.

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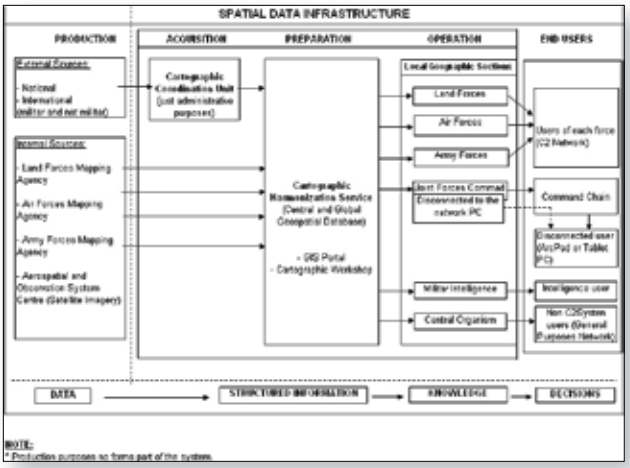


Description of the Project

SICAMOFAS provides information stored in a relational spatial database management system according to the data models established by Spanish defense and nondefense mapping agencies and NATO standard symbology such as APP6A (STANAG 2019) and other current geography STANAGs.

SICAMOFAS is composed of a customized data model, which is capable of including, in a global and integrated way, cartographic products coming from several data sources (military and civilian) and two applications, the GIS Portal Toolkit and the Cartographic Workshop.

Data Model

The sources of information vary from vector, raster, DEMs, CAD, etc. They have been stored in the relational database management system with ArcSDE at the node called Cartographic Harmonization Service. This is a huge repository of spatial information that feeds the geodatabases of every node within Local Geographic Sections: Joint Forces, Land Forces, Navy, Air Forces, Intelligence, and General Purpose nodes.

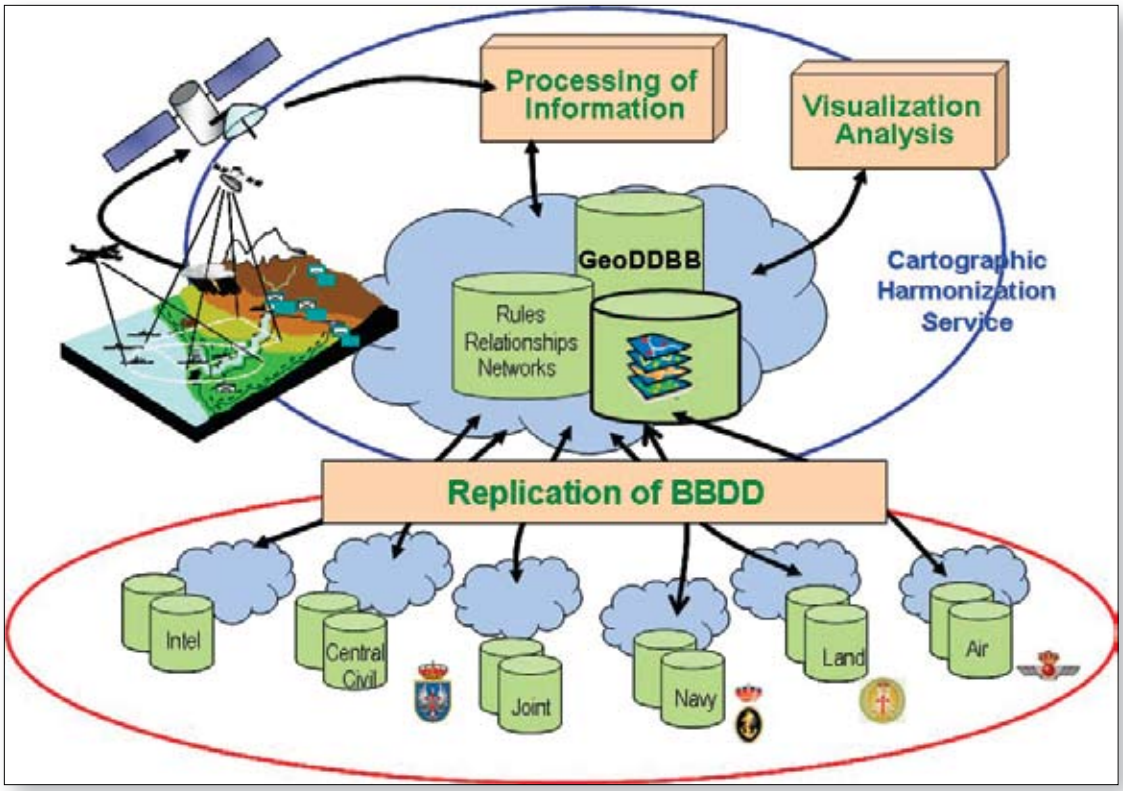
Cartographic Workshop

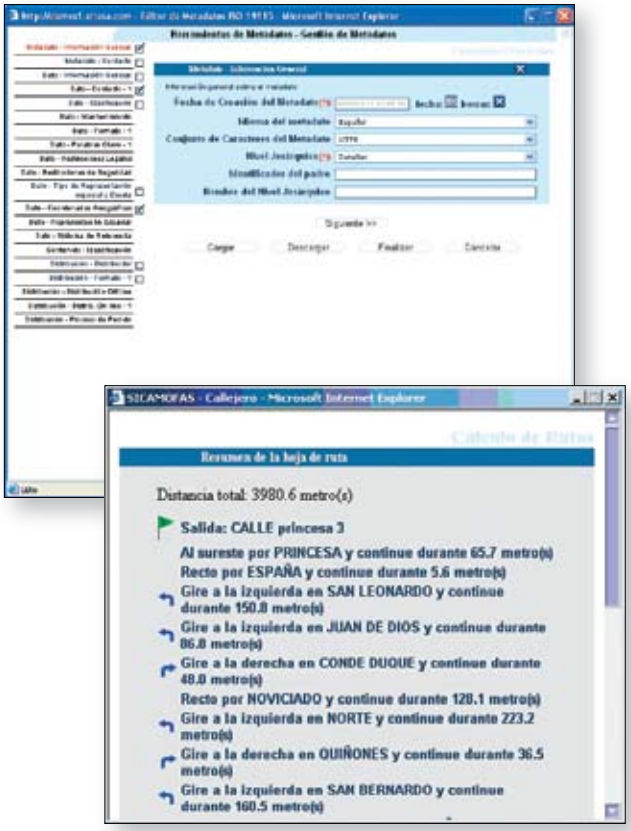
This component manages the spatial data available in the enterprise repository of information. It receives the raw data from the mapping agencies (NGA, Spanish Armed Forces, Civilian Mapping Agencies, etc.) in different data formats, such as CAD, raster, DEM, orthophotos, satellite imagery, gazetteer, place-names, catalogs, and others, to preprocess, structure, store, and maintain the information. ArcGIS Desktop is used as a thick client to carry out this critical mission. Some customized tools have been developed to store standard military products (Vector Map [VMAP0, VMAP1], Digital Nautical Chart, S-57, Digital Terrain Elevation Data [DTED0, DTED1, DTED2], Compressed ARC Digitized Raster Graphic [CADRG], and cartography of the Land Forces Mapping Agency at 1:50,000 and 1:250,000 scales) as well as civilian (street maps, DEMs, National Topographic Model 1:25,000, Corine LandCover, etc.).

GIS Portal

This Web facility contains several applications, as follows:

- Geographic visualization: This allows the visualization of all available cartography, possessing functionalities for pan, zoom, identify, selection, measure, search of elements, printing of maps, and creation of thematic maps. This application can locate and convert coordinates.
- Street maps: This permits searches in the available street maps of Spanish cities as well as routing calculation between two or more points (ArcGIS Network Analyst).
- Metadata manager: This permits the user to inventory the metadata through an editor and maintain it within a defined workflow. The metadata follows the Spanish standard NEM (Spanish Metadata Kernel), which is an ISO 19115 profile.
- Metadata searcher: This permits the user to search geographic information by means of metadata.
- Request manager: This permits the end user to request a particular cartography not available in the portal. The customized requests are conducted through access to standard forms to obtain the cartography in a supported digital format or paper (analog). This tool will make use of the ArcIMS Data Delivery extension so that it is easy to download data quickly in many standard spatial formats.
- Technical support facility: This application has been developed to allow the end user to inform system administrators of problems and anomalies detected in any piece of software or application of SICAMOFAS.
- Management of suggestions: This permits the end user to provide feedback to system administrators to enable the evolvement of the project.
- Management of end users: With this facility, system administrators can manage the access of every end user to not just the different applications of the portal but the functionalities enabled for them as well. This is done through the creation and management of profiles linked to each different group of users.





Thin Disconnected Client

A thin client was developed in the framework of the Cartographic Workshop as well as the GIS Portal.

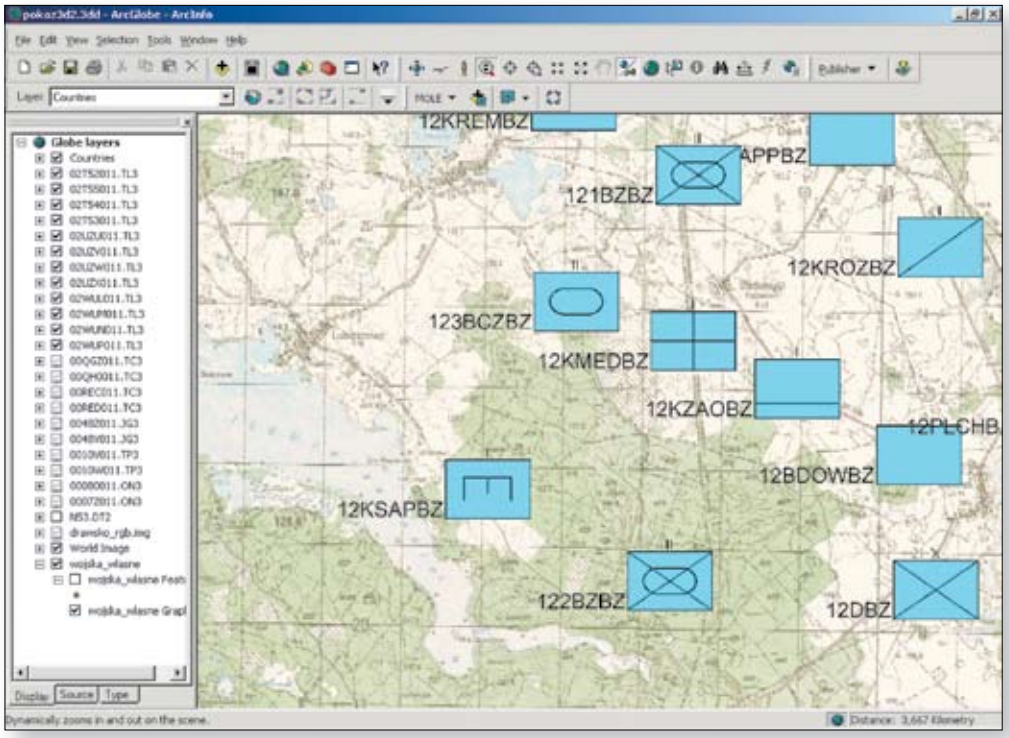
Cartographic Workshop: The customized functionality allows insertion of pictures in a determined location.

GIS Portal: The developed functionalities are similar to those available for intranet browsers. They include

- Visualization of maps
- Street map
- Metadata searcher
- Management of cartography requests (includes cartography downloading)

The implementation of these GIS services for the Spanish defense community of users is providing clear benefits in data access and management, among other advantages. The deployment of the system and some new applications will continue to be developed during 2006 and 2007, as planned.

ArcGIS Tools Usage at National Defence University War Game & Simulation Center in Poland



The War Game & Simulation Center (WG&SC) is a fully functional war-gaming center, providing tactical and operational levels of war training and exercises to Polish and others' defense staffs. ArcGIS 9.1 tools were used to prepare for and conduct training exercises.

ArcGIS Desktop is used for map underlay preparation for the Joint Theater Level Simulation (JTLS) system used at WG&SC.

ArcGIS with the ArcGIS Military Analyst extension is used for multistation representation of a current tactical situation generated by the JTLS system on the CADRG map underlay.

ArcGlobe™—with ArcGIS Military Analyst—is used for 3D representation of a current tactical situation on the satellite photos underlay.

Moreover, ArcGIS is used for the preparation of maps and subject layers, reducing staff training needs.

Contact Information

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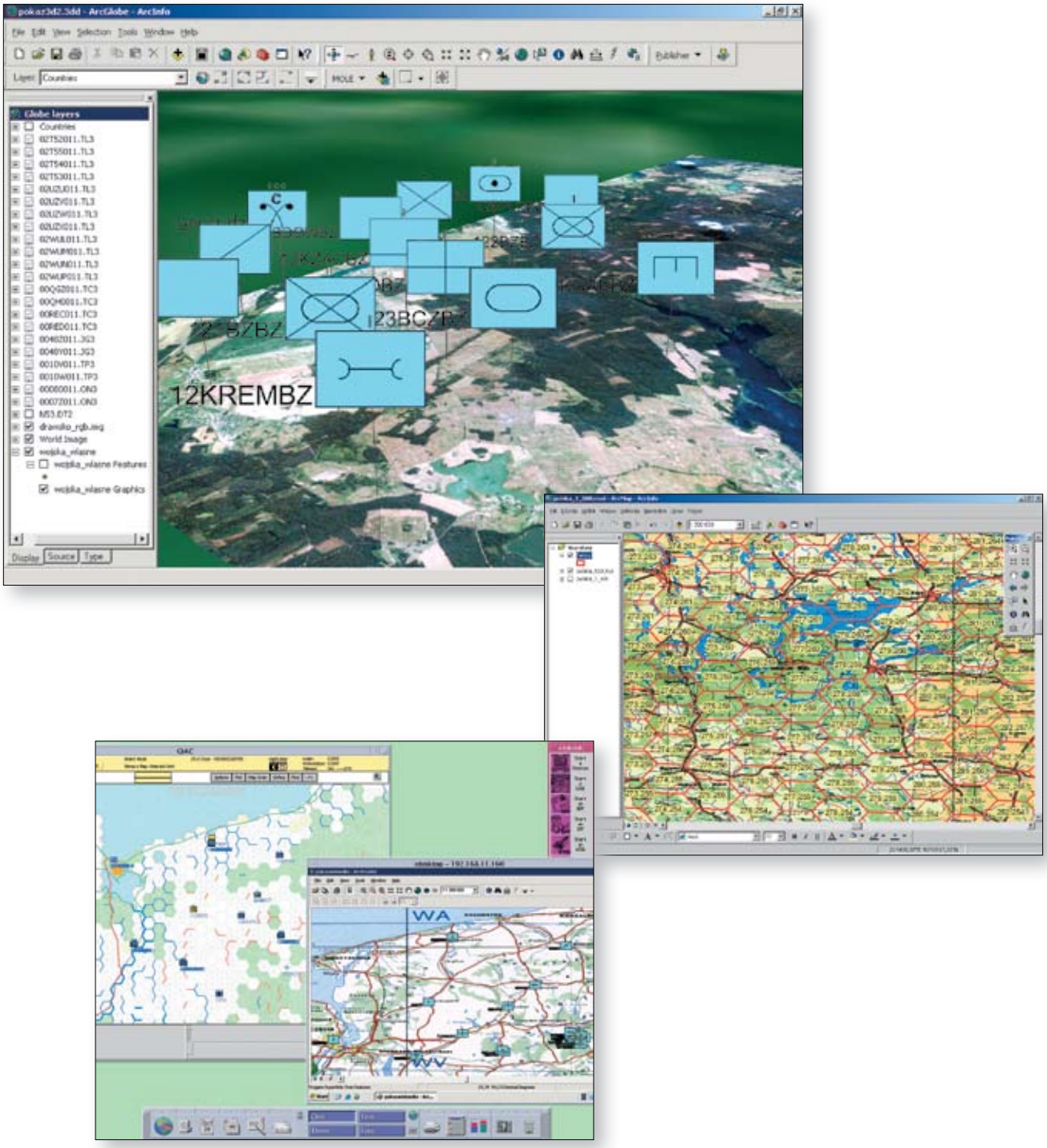
ArcGlobe - ArcInfo
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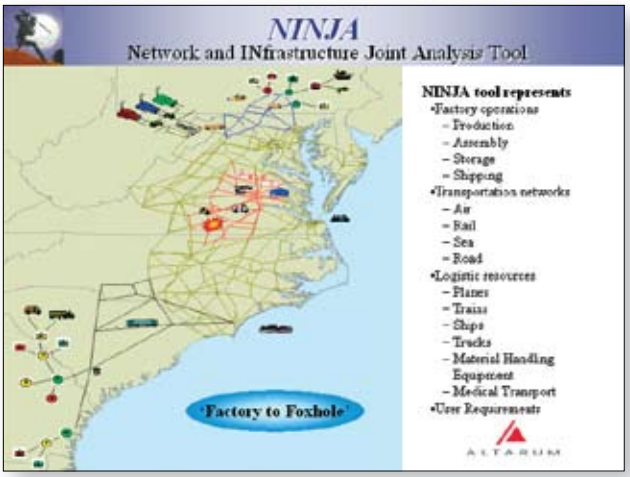
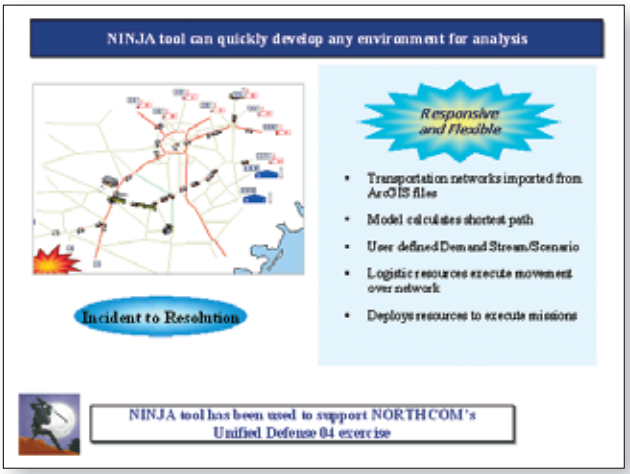
Network and Infrastructure Joint Analysis Tool



Factory to Foxhole Logistic Model



Mass Casualty Evacuation Model

Overview

Altarum's Network and Infrastructure Joint Analysis (NINJA) tool is an Arena®-based simulation used to analyze strengths and weaknesses of logistic networks across existing or national infrastructures. NINJA can be used to determine required resource quantities and capabilities through timely and accurate analyses with a single, user-friendly analysis tool. NINJA has been used in support of the Defense Program Office for Mission Assurance.

Capabilities

The NINJA tool enables the analyst to model logistic processes from factory to foxhole by providing a structure to capture factory processes, transportation networks, and the end user processes. Terrain and network information can be imported into NINJA from ArcGIS data files. The data layers provide the layout of the area with its buildings, roads, rails, and other relevant elements, together with the attributes of each piece of infrastructure.

The NINJA tool provides an innovative way to evaluate critical infrastructure protection plans by quantifying the impacts of resource failures and reduced capabilities. NINJA shows the logical representation of a scenario with stochastic simulation and geographic information from ArcGIS files. The animation feature allows the user to visualize network utilization and assess both model fidelity and the impact of alternative network conditions.

Summary

NINJA is an existing modeling and simulation tool designed to help decision makers identify critical resources and infrastructure, evaluate possible vulnerabilities to those critical elements, and help determine the best mitigation strategies. Using existing models, real-time situational analyses can be performed during an actual crisis or critical event.

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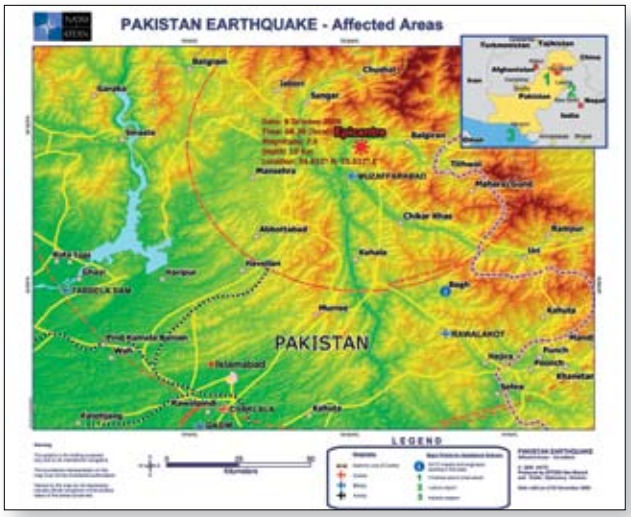
ALTARUM

GIS Support to NATO's Pakistan Earthquake Relief Operation

More and more frequently, large organizations are analyzing how to improve the knowledge assets of their business units to effectively respond to a rapidly changing environment and, therefore, to adapt their overall decision processes. As a result, in September 2002, from a knowledge management standpoint, the Situation Centre (SITCEN) of NATO Headquarters established the Geospatial Branch to support key decision makers for operations and exercises.

The branch is currently using ArcGIS 9.1 with its 3D Analyst, Geostatistical Analyst, Spatial Analyst, and Military Analyst extensions. ArcIMS 9.1 has also been deployed to better serve the headquarters' intranet users.



The majority of the geographic products, created with the use of ESRI ArcGIS software, were mainly adapted to support ongoing NATO operations by combining place-names, lines of communication, a database of events, and intelligence information. However, progressively the GIS capabilities have been expanded to support the definition and coordination of NATO-approved relief operations triggered by the Euro-Atlantic Disaster Response Coordination Centre (EADRCC).

In 1998, the EADRCC was created as a focal point for coordinating disaster relief efforts of the 46 Euro-Atlantic Partnership Council (EAPC) nations in case of natural or technological disasters within the EAPC geographical area. In October 2005, NATO received a disaster assistance request from Pakistan, and the North Atlantic Council approved the strategic airlift for transportation of disaster relief offers from EAPC nations in response to Pakistan's request. The Council likewise agreed, pending consultations and endorsement in the Senior Civil Emergency Planning Committee with Partners, to allow the EADRCC to work in conjunction with the NATO military authorities to coordinate the response of EAPC nations that were willing to channel their assistance through this mechanism.

In this instance, NATO SITCEN Geospatial Branch provided support to the EADRCC by producing a shaded relief map representing all known lines of communication, the exact place of the catastrophic event, and a 50 km range and a 100 km range from the event's epicenter.

During this critical phase of a crisis or relief operation, when consultations between key decision players take place and the terms of the whole operation are defined, the support of geospatial information can significantly contribute to the evaluation of the lines of communication to be used, taking into consideration environmental constraints. ESRI ArcGIS software has proved to be compatible with the demanding requirements of an organization such as NATO in the most effective way.

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Submit Your Story for Print

Each article in this publication represents a real program that is making a difference in defense and intelligence communities. Sharing experiences lessens program risk, reduces cost, and fosters understanding of the road map toward seamless spatial information infrastructures in defense.

It is ESRI's intent to produce this publication at least once a year. For those interested in featuring a program in the next edition, please read the instructions below.

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ESRI features defense and intelligence programs from around the world that make use of GIS. The aim is to communicate capabilities and benefits of the program, not to advertise a system integrator or solution provider.

Text

- All text submissions should be in either Microsoft Word format or plain text.
- There must be one to three paragraphs of text. The standard format is Title, Overview paragraph, Capabilities paragraph, and Benefits paragraph.
- Include imagery, pictures, graphics, and screen shots. There must be captions for each screen shot, image, graphic, and picture submitted.
- Point of contact information: Include appropriate names, titles, affiliations, addresses, phone numbers, fax numbers, e-mail addresses, and Web URLs for the contacts. Example: For more information, contact …
- Please do not embed digital graphics in the text, document, or word-processed file. Digital graphics must always be sent as separate files.
- Original screen shots should be a minimum of 96 dpi. TIFF, BMP, or EPS is preferred.
- Photographs as JPEG are accepted.
- Imagery, map output, and photographs should be 300 dpi or higher.
- Send only "unclassified" text, screen shots, pictures, photographs, imagery, and graphics.
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Questions?

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For more than four decades, ESRI has been helping people make better decisions through management and analysis of geographic information. With more than 4,000 skilled employees worldwide, we work with our business partners and hundreds of thousands of people who use GIS to make a difference in our world.

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At ESRI, we focus on promoting the value of GIS and its applications throughout the world and pay close attention to our users' needs. Our software development and services respond to our customers with products that are easy to use, flexible, and integrated. Our technology is multi-disciplinary, productive, and valuable to our users.

We have a strong commitment to educating our customers through ESRI's various training programs. ESRI is a socially conscious business and invests heavily in issues regarding education, conservation, sustainable development, and humanitarian affairs.

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