The National Integrated Land System – A "Field to Fabric" Solution

Leslie CONE and Carsten BJORNSSON, USA

Key words:

SUMMARY

This presentation will show how the National Integrated Land System (NILS) is used to integrate survey data into a GIS. NILS's consists of a centralized GIS architecture, a geodatabase, and four custom applications; Survey Management, Measurement Management, Parcel Management and GeoCommunicator. The Survey and Measurement Management applications provide surveyors with tools for importing, analyzing, and manipulating survey data to create a measurement network, called the legal description fabric. Parcel Management uses the legal description fabric to create survey-based parcels such as tax lots, maps, planning parcels, etc. The survey and parcel data are vertically integrated to maintain and synchronize spatial and topological relationships. The GeoCommunicator, through web services, publicizes cadastral survey and land management information and data from NILS like federal surface management agency boundaries, federal surface management agency contacts, and land and mineral use record information. Additionally, the NILS custom applications include a set of workflow management tools that work with ESRI's ArcGIS surveying application allowing the BLM to standardize and automate many of their business processes. A demonstration of NILS's will show how survey data is developed from field to fabric in GIS and how the data is distributed and used by the public.

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1. BACKGROUND

The Bureau of Land Management (BLM) is responsible for cadastral survey, land and mineral use authorization, and resource management of the public lands. Not until recently was there an easy way to share this data within our agency, with other agencies, or with the general public. The National Integrated Land System (NILS) project provides a common solution for the sharing of land record information within the government and the private sector. NILS is a joint project between the BLM and the U.S. Forest Service in partnership with states, counties, and private industry to develop a common data model and a set of software tools for the collection, management, and sharing of land survey data, cadastral data, and land record information.

Illustration 1: Examples BLM's multiple-use responsibilities

The BLM, an agency of the U.S. Department of the Interior, manages more land (261 million surface acres) than any other U.S. Federal agency. Most of this public land is located in 12 Western states, including Alaska. The Bureau, which has a workforce of about 11,000 employees, also administers 700 million acres of sub-surface mineral estate throughout the Nation. The BLM preserves open space by managing the public lands for multiple uses, including outdoor recreation, livestock grazing and mining, and by conserving natural historical, cultural, and other resources on the public lands.

Illustration 2: Public Lands Managed by the BLM

The U.S. Forest Service manages federal lands, known collectively as the National Forest System, located in 44 States, Puerto Rico, and the Virgin Islands. The lands comprise 8.5 percent of the total land area in the United States. The natural resources on these lands have major economic, environmental, and social significance for all Americans.

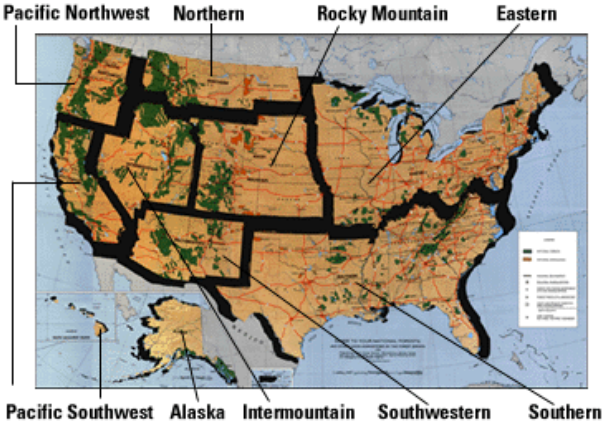


Illustration 3: National Forest System

The National Integrated Land System (NILS) Project was initiated to create a business solution for land managers who face an increasingly complex environment of complicated transactions, legal challenges, and deteriorating and difficult-to-access records. This complex environment is made even more challenging when considering that the BLM is responsible for overseeing public land, and the corresponding records which date back over 200 years. The number of records managed by the BLM is in the billions.

The National Integrated Land System (NILS) is a joint project between the BLM and the USDA Forest Service (USFS) in partnership with states, counties, and private industry. NILS is an integrated land management system that includes a common data model and software tools for the collection, management, and sharing of survey data, cadastral data, and land records information. NILS provides a complete “field to fabric” technology solution using GIS technology to facilitate cooperative land management and better decision-making among all land managers (Cone, 2004).

The NILS "field to fabric" concept initiated the development of a common land data model that integrates the world of surveying with GIS. This concept is fundamental to preserving the accuracy and quality of the survey data and providing methodology to maintain the integrity of the Public Land Survey System (PLSS) coordinates. The NILS land data model supports a statewide PLSS measurement and computational network stored and maintained in the NILS database. A goal for NILS is to minimize data conversions. To meet this goal, the survey-based data are re-constructed as measured features in NILS.

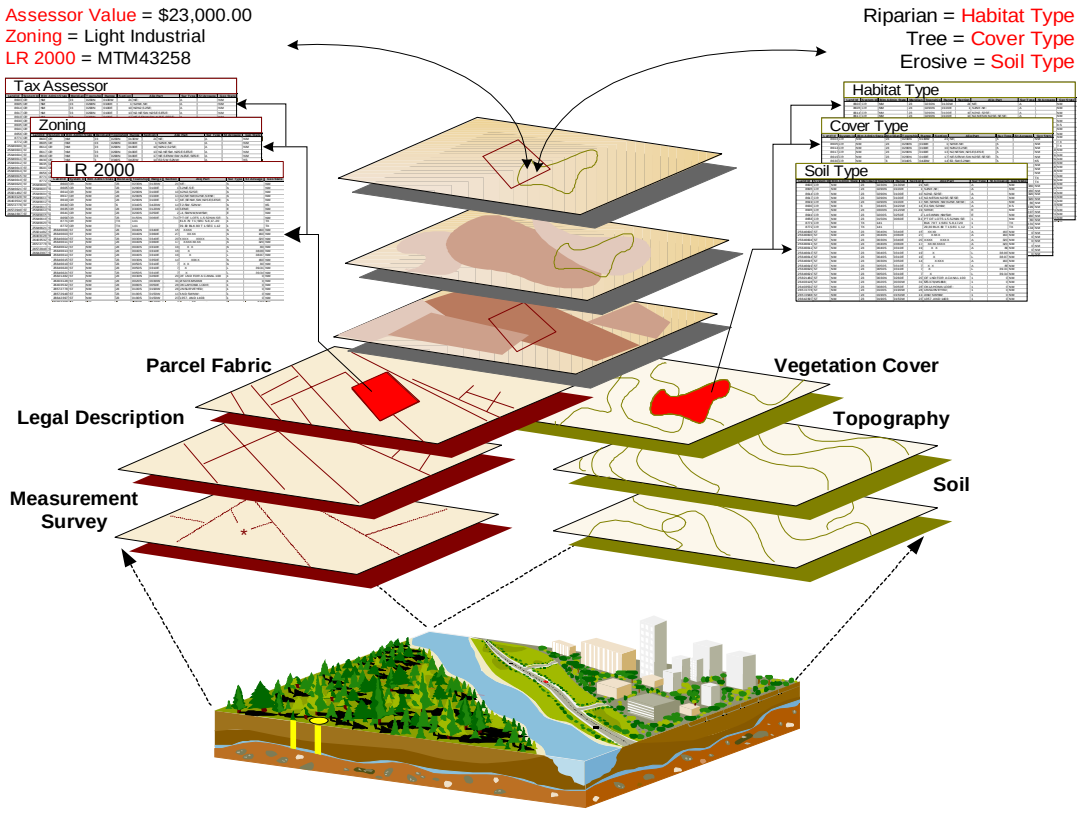
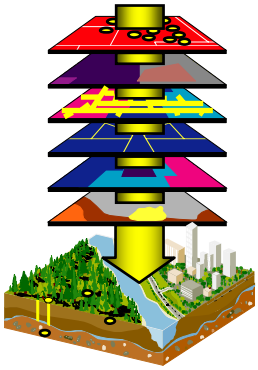


Illustration 4: The NILS Vision

Using GIS technology, NILS has greatly facilitated cooperative land management and improved decision-making among all land managers. Moreover, it has provided the BLM, the Forest Service, additional partners and the general public with improved tools for efficient multiple-use management of the national forest and public lands.



Geographic Information Systems or GIS can be traced back to the 1960s when the concept was invented by Roger Tomlinson for the Canadian government (Coppock and Rhind 1991). In a span of over 40 years, GIS has emerged as a major, international tool and science to provide spatial understanding of geographic concepts. ESRI (Environmental Systems Research Institute of Redlands, California), subsequently, was selected by the Bureau and the U.S. Forest Service to provide the GIS technology.

Illustration 5: GIS Integrates Information

NILS provides the user with tools to manage land records and cadastral data directly from field survey measuring equipment, through mathematical computations into lines and points to create legal land and parcel descriptions to be used in mapping, resource management, and land record creation and maintenance. This "Field to Fabric" concept implies the development of a common land data model and a set of GIS tools that unifies the worlds of surveying and GIS. This unification concept is fundamental for land records managers and maintainers of cadastral mapping databases to improve the accuracy and quality of the data to create standard land descriptions and cadastral data that can be used by anyone. NILS also includes the GeoCommunicator which is a website for searching, accessing and dynamic mapping of data that is of interest to land managers.

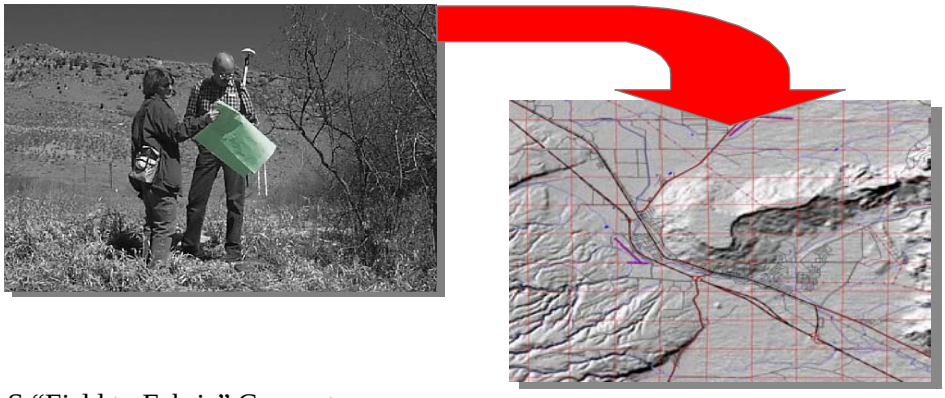


Illustration 6: NILS "Field to Fabric" Concept

The foundation of NILS consists of ESRI's ArcGIS technology. Using industry standards such as Common Object Model (COM) and Object-Oriented (OO) technology, the selected COTS software provides a modern development platform for NILS, replacing all outmoded stovepipe systems. When needed, OO software engineering techniques will be used to extend the COTS in order to meet specific NILS user needs.

NILS is developed in four modules: Survey Management (SM), Measurement Management (MM),
Parcel Management (PM), and GeoCommunicator.

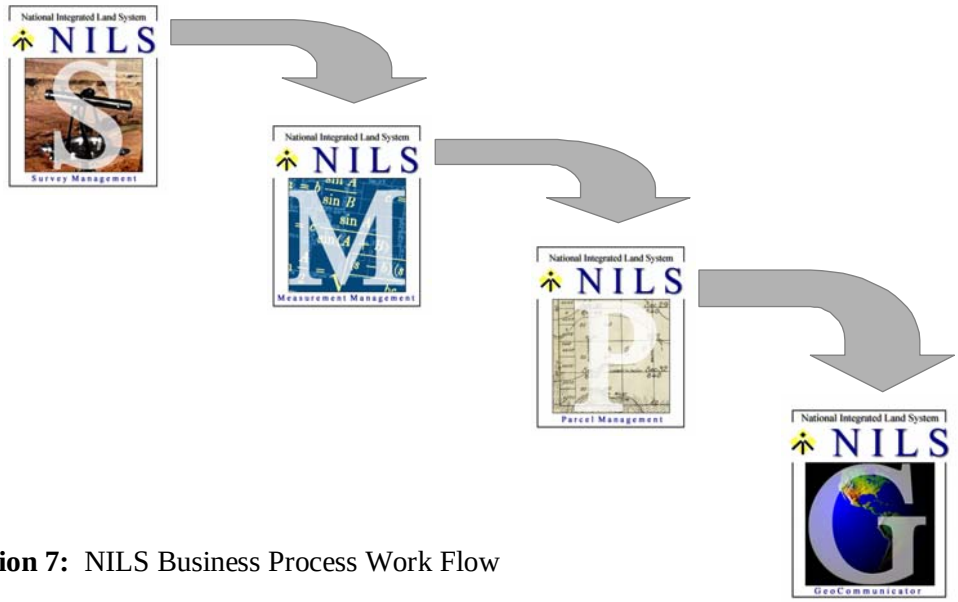


Illustration 7: NILS Business Process Work Flow

Survey Management supports the capture and processing of field data. Being a part of an Enterprise GIS data from a variety of sources like townships, topo-maps, ortho-photos, scanned plat data etc., can be downloaded to support disconnected field data collection. From the field data collection, survey field notes and survey plats can be generated. Field collection entails the use of hand-held units and laptops to provide the computation capabilities for larger surveys.

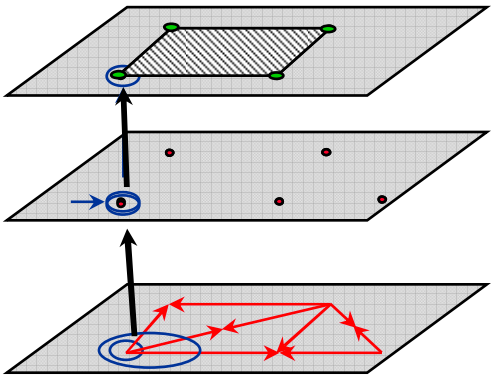


Illustration 8: Relationship of features to survey and measurement data.

Measurement Management allows for the combination of measurement data from a variety of sources and reliabilities to create a seamless PLSS network. Measurement Management supports a suite of functions that allows for the transformation of plat survey data into a statewide PLSS measurement network to produce the best coordinate. From this, functions are provided to automatically generate or update the legal descriptions polygon features with nominal descriptions, linking legal descriptions from LR2000 and adjust spatial location and extent of each feature. This is referred to as the legal description fabric. The legal description fabric can then be used to create, maintain and display land and mineral use records in the parcel fabric.

Survey Management and Measurement Management are specific applications to create and maintain the PLSS network. The applications are based on ESRI's object-oriented technology and the PLSS data is stored within the Geodatabase. To build and implement the SM and MM applications, a geodatabase design had to be defined and software to perform the migration of survey data and functions to qualify and maintain the survey data had to be developed.

Parcel Management provides a process for managing land records and cadastral data stored in the database model. It provides custom GIS feature classes, tools, and procedures for editing land records in a transactional, history tracking environment. From the application, users can edit and construct the legal description fabric and create the required parcel fabric like maps and reports of ownerships, land use rights, tax assessments, and others.

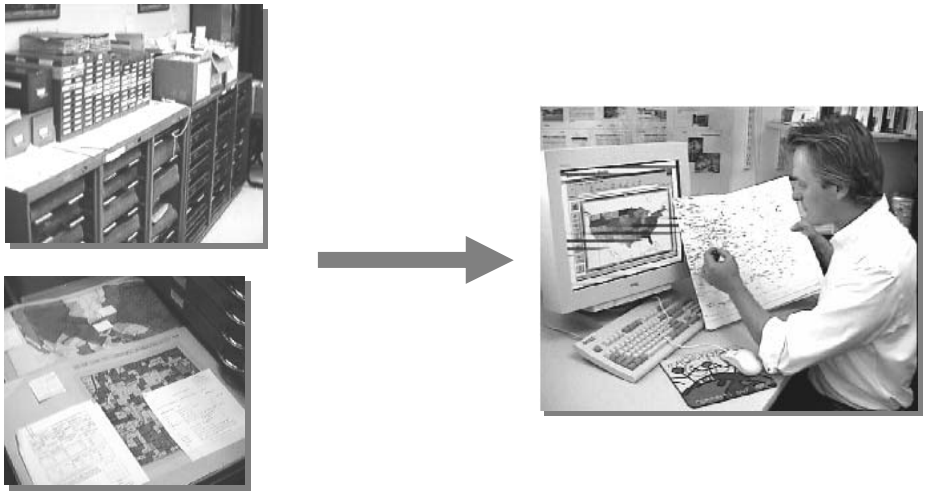


Illustration 9: The Parcel Management Module is the business process necessary to maintain land records in an automated environment

GeoCommunicator is a website that provides searching, accessing, and dynamic mapping of data for Federal Surface Management boundaries, Mining Claims, Land and Mineral Use Records, and the Public Land Survey System from the BLM's NILS and the Legacy Rehost 2000 System (LR2000). GeoCommunicator is meant to be a valuable visual tool that compliments the BLM's LR2000 system. The website is located at http://www.geocommunicator.gov.

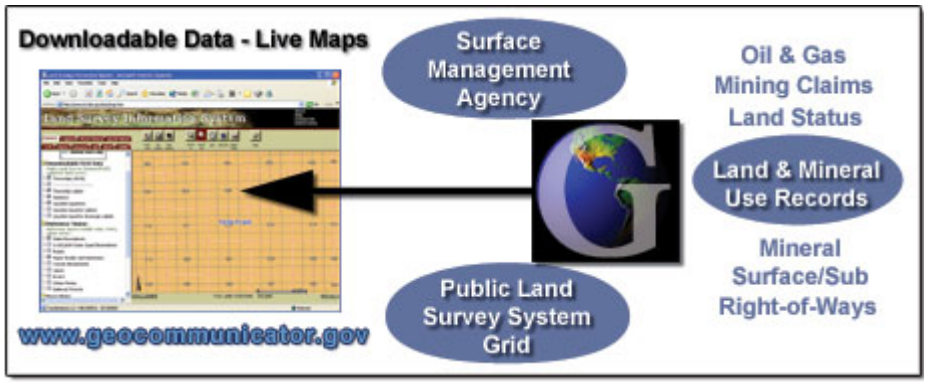


Illustration 10: The GeoCommunicator website allows you to download data and live maps.

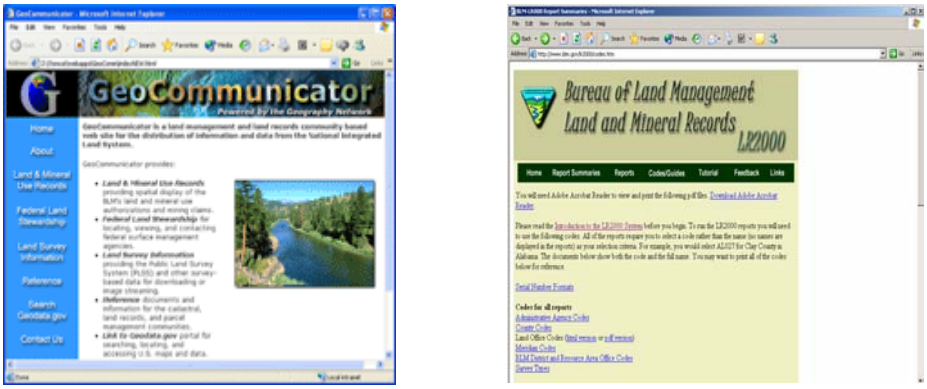


Illustration 11: The GeoCommunicator shares a common database with LR2000.

Since approximately 74% of all Bureau business is spatial, NILS is designed to support an enterprise GIS approach. As stated by Mary Gauvain of the University of California, "Spatial understanding is vital to everyday functioning." By properly collecting data and updating records in a systematic, transactional manner, NILS provides any PC user with a true spatial viewing of all systems, including internet access to a number of new spatial products. One of these new spatial products will include a 'smart' Master Title Plat, that provides land status in a user-friendly format.

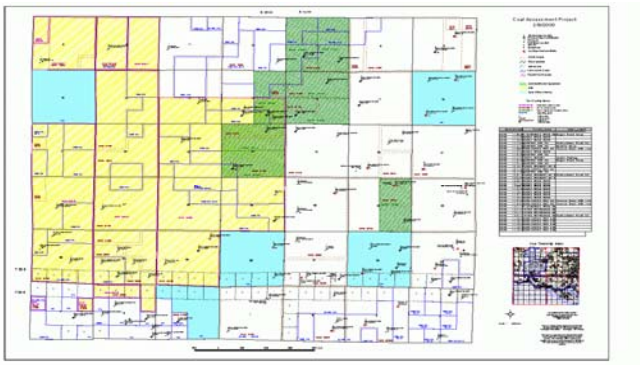


Illustration 12: Example of 'smart' Master Title Plat, BLM's land status plat

The overall goal of NILS is to provide a true "field to fabric" boundary business solution. Fabric is defined by the BLM as the net/grid infrastructure depicting the cadastral (land) data. It includes control, coordinates, boundaries, land descriptions and land units (parcels) necessary to manage and display land. NILS addresses the need for a common solution to parcel-based information, shared resources for collecting and maintaining data, and improving communication mechanisms.

In effect, NILS is leading an inexorable drive for standardization. In the past, many individual states maintained their own systems for recording land data. NILS ensures a standardized data model and applications that are beneficial to both the Bureau as well as the general public. This is the concept of sharing common tools and data. Since user requirements and data capture requirements will change over time, the NILS architecture has been designed to accommodate those changes. The use of COTS software ensures that NILS will continue to be maintainable. In contrast to earlier generations of GIS, NILS is built on a true enterprise architecture. This means that evolving business needs and requirements drive the evolution of the system.

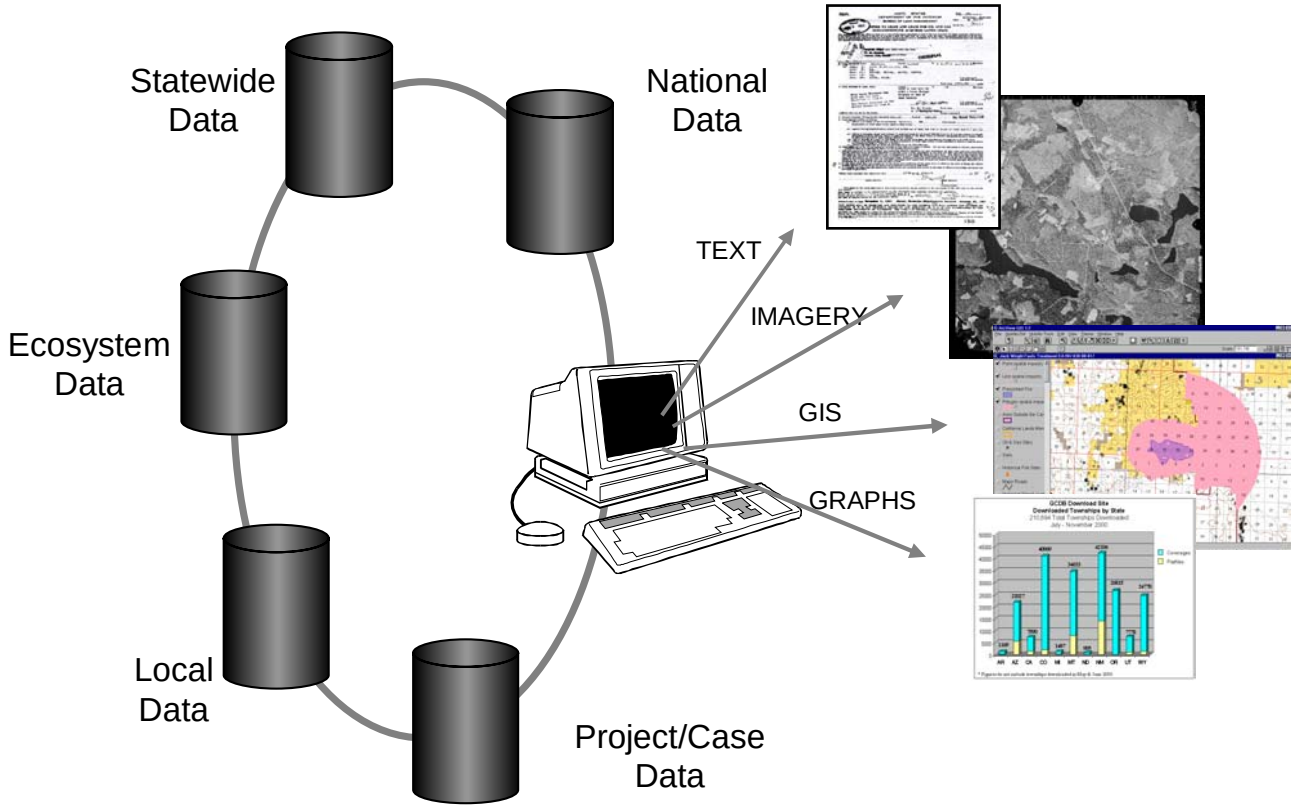


Illustration 13: Concept of automated land information provided to users via desktop access to a variety of data sources

The eventual goal of NILS is to replace all paper records with digital, GIS data.
NILS is a business driven solution that is parcel based. This includes all boundary data (surveyed and unsurveyed), along with common tools for both measurement management and parcel management. NILS is playing a major role in reducing redundancy and ensures the modernization and accessibility of public land information for generations to come.

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AUTHOR BIOGRAPHY

Leslie Cone serves as the Project Manager for the Bureau of Land Management (BLM) and U.S. Forest Service joint development project entitled the National Integrated Land System (NILS). The goal of this project is to provide integrated spatial data across the landscape in order to support ecosystem-level resource planning and management through the development of a common data solution and tool sets for managing cadastral and land record (parcel) data. This project is being developed in partnership with ESRI, counties and states and by providing a common data solution and tool sets will support decision making at all levels and provide better access to the country's land records. In addition to managing the NILS project, Leslie also manages BLM's Land and Resources Project Office.

Prior to this, Leslie managed BLM's Legacy Rehost Project (LR 2000) Y2K project and BLM's Automated Land and Mineral Record System's (ALMRS) Release 2. ALMRS was a project to automate BLM's land and mineral records.

Before becoming a Project Manager, Leslie was the Roswell District Manager (1992-1996), where she was responsible for overseeing the resource management of a nine-county district that includes 4 million acres of public lands and another 10 million acres of mineral estate. Leslie has been with the BLM for over 31 years and has held a variety of positions, including Area Manager, Indio (1983-88), Resource Area and Project Manager, NBEI Team (1979-83), and Communications Coordinator, ALMRS Project (1989-91). Ms. Cone completed the Department of the Interior's Management Development Training Program in 1989 and the Senior Executive Service Candidate Development Program in 1999.

Ms. Cone holds a Bachelor of Science degree in Forestry and Outdoor Recreation from Colorado State University and a Masters degree in Public Administration from the University of New Mexico.

Since 2002, **Mr. Bjornsson** has as team lead worked with building an application to manage the federal cadastral network (PLSS). This application migrates 225 years of cadastral survey data into the federal cadastral geodatabase and allows users to manage cadastral data through a set of developed geodetic survey functionalities. This application encompasses a field-to-fabric solution for collecting survey data in the field to its incorporation into a nationwide database of cadastral survey data. This project leverages ArcGIS, Survey Analyst, and ArcSDE.

In 2003, Mr. Bjornsson acted as Lead Consultant for a Land Record and Survey application for the San Diego Water Authorities. This project allows the Water Authority to incorporate, adjust and evaluate third party survey data into a cadastral network to manage rights and interests along their water transmission lines.

From 1997–2001 Mr. Bjornsson was an Assistant Professor in GIS and Planning for the Department of Economics, Forest and Landscape, Unit of Landscape, The Royal Veterinary and Agricultural University of Denmark (KVL). While he was primarily responsible for GIS

software acquirement and implementation, he also directly contributed to the continued development of the University curriculum in GIS, Cartography and Surveying.

From 1991 to 1993 Mr. Bjornsson was a Research Assistant at Aalborg University where he participated in GIS development and implementation. He further functioned as a lecturer and supervisor for International Students on the International Technology Planning.

CONTACTS

Leslie Cone
Project Manager
Bureau of Land Management
PO Box 25047
Denver, CO 80227
USA
Tel. + 1 303 236 0815
Fax + 1 303 236 6691
Email: lcone@blm.gov

Carsten Bjornsson
Project Manager/Consultant
ESRI
380 New York St.,
Redlands, Ca, 92373
USA
Tel. + 1 909 793 2853/
Fax + 1 909 307 3014
Email: cbjornsson@esri.com