The Changing Geospatial Landscape

A Report of the

National Geospatial Advisory Committee

January 2009

Preface

In January of 2008, the Secretary of the Interior formed the National Geospatial Advisory Committee to provide advice and recommendations related to the management of Federal and national geospatial programs. This diverse committee is comprised of 28 experts from all levels of government, academia and the private sector.

In our first year of deliberations we have endeavored to create a common level of understanding as it relates to geospatial technology, policy and programs that exist in the public and private sector. Many of our discussions have revolved around the need for a common sense of history – where we have come from – and the need for a common vision – for where we hope to go.

The committee has developed this white paper to describe the changes and advancements the community has witnessed over the past three-plus decades and to set a context from which in part we will base our future deliberations. While this paper is not meant to be all-inclusive in chronicling the growth of the industry, we do believe it captures the major milestones and identifies several of the major issues that lie ahead. We encourage the reader of interest to follow our deliberations and progress at www.fgdc.gov/ngac.

Anne Hale Miglarese
Chair, National Geospatial Advisory Committee

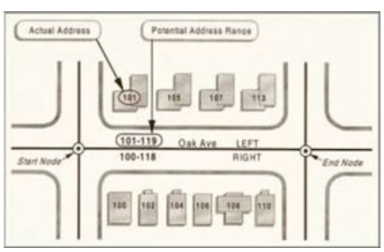
PRACTICALLY OVERNIGHT, access to terabytes of geographical information, much of it in three dimensions, has changed the way people work, live and play. We rely on a host of location-based technologies via our desktop computers, PDAs and even our cell phones. These services fuel a market estimated at $30 billion per year and represent a major information technology growth sector. The primary reasons mainstream commercial applications have emerged are that a wide variety of businesses have taken advantage of investments and policy decisions made by the United States government during the past thirty years, and burgeoning technology innovations. These innovations include the Internet, communications infrastructure, detailed digital mapping, robust data management systems, advancements in modeling the earth's sphere, the creation of a constellation of global positioning system (GPS) satellites, and more.

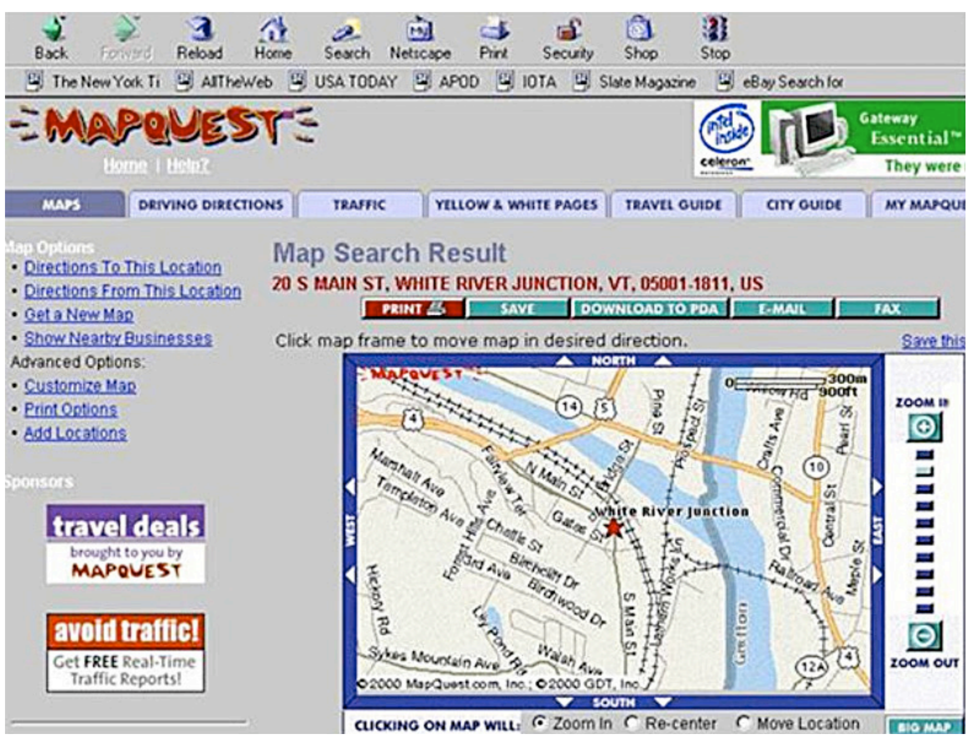
Enlightened public policies now support shared geospatial technology, thereby fostering a strong international commercial market. For continued benefit to society, it is incumbent upon the nation's policy leaders to understand these points: the government's role in creating and developing these services, how much the landscape has changed during the past 30 years, and what leaders must do to ensure continued advancement in geospatial technology in the future.

A brief history of influential events, digital roads, GPS and location awareness

The detailed street maps that support Web-based mapping applications and in-car navigation systems can be traced to the innovations made by the Census Bureau approximately forty years ago. Since the initial creation of digital street maps, designed to support the 1970 Decennial Census, the street map data industry has evolved into two multibillion-dollar European companies.

The initial experiments were expanded in the mid 1980s when the Census Bureau teamed up with the US Geological Survey to generate the first nationwide digital street map with address ranges. This became the TIGER system that supported the 1990 Census and forever changed the way we interact with maps. In 1996, MapQuest leveraged these intelligent street maps to build a Web-based system that could determine the geographic location of a street address and display it on a map. MapQuest was an overnight sensation that received 1 million hits in its first 30 days (now 40 million per month). The sale of





TIGER data (above); early MapQuest

MapQuest to AOL for $1.1 billion in 1999 represents a landmark in the evolution of the geospatial technology and marks the date when location-based services officially became part of mainstream Internet business.

The need to keep street map and address data current resulted in the creation of Geographic Data Technology (GDT) and Navteq, which have recently been acquired by European companies. GDT was initially purchased by the Belgium company TeleAtlas in 2004, and is now being acquired by TomTom, a Dutch personal navigation supplier. Navteq has been purchased by the Finnish telecom giant Nokia for eight billion dollars. The fact that a major telecom company would place that kind of price tag on geospatial data and technology demonstrates the value of these assets and points toward further vertical integration of location-based services, especially on cell phones and PDAs.

The Global Positioning System satellite network

Even though detailed digital street maps provide the basis for spatial search and navigation, they do not actually show consumers their immediate locations. This task is handled by another American innovation: the global positioning system, or GPS. GPS was designed in the mid 1970s to support U.S. Department of Defense missions. In the mid 1990s, the 24 satellites that formed the GPS Operational Constellation made it possible to locate geographic coordinates without reference to any landmarks or features on Earth. By recording signals from at least four of the satellites, these GPS receivers were able to determine the X, Y and Z coordinates of the receiver anywhere on the Earth's surface or on an aircraft. Since 2000 almost any GPS receiver is able fix a location within a few meters of its actual location.

The accuracy of GPS can be enhanced by a network of land-based survey stations that provide precise coordinates required for surveying. This precision is made possible by the development of a highly accurate model of the earth's shape. A series of enlightened federal policy decisions opened this military system to commercial applications and has spurred a huge new international commercial market. Consequently, creative entrepreneurs have coupled these incredible and inexpensive tools to build hundreds of applications that support the public's insatiable appetite for location-based information.

Personal navigation device

As the cost of GPS receivers has plummeted, the range of applications has skyrocketed. Personal navigation systems manufactured by GPS technology companies such as Garmin and TomTom represent the integration of digital maps and GPS technology. The demand for navigational assistance has been at the forefront of this trend and has been a major boon to car rental agencies. Furthermore, inexpensive personal navigation systems that cost a few hundred dollars have become popular consumer items.

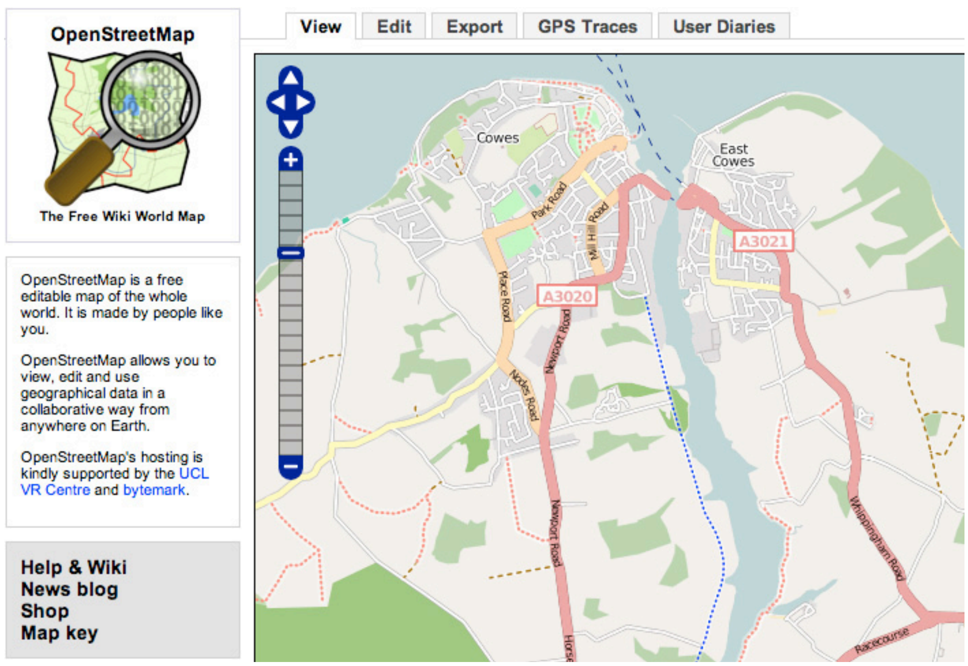
Some models provide users with task status as well as real-time location information such as traffic conditions, and can even track other people and assets. This tracking capability is now widely deployed to follow the movement of children, employees, criminals, vehicles and even fish. A pet products company sells a GPS dog collar; for a monthly fee, owners can track their pets' locations. The fact that other people can follow your movements (geo-tracking) with or without your permission or knowledge elicits a variety of reactions ranging from comfort to reluctant acceptance to outrage. In fact, some academics have labeled geo-tracking "geo-slavery."

Telecom companies such as Nokia join in a vision of the future that places a high value on accurate geographic information. They plan to embed geospatial technology in the next generation's social psyche in the same way email has become ubiquitous to this generation. An example of such innovation is the Apple iPhone, whose embedded GPS receiver wirelessly accesses the Internet anywhere in the world and integrates its location coordinates with both self-contained and Web-accessible applications. Imagine a MapQuest application on a cell phone that shows the current location of the device. Once people can fix their locations and transmit these coordinates to other devices, a full range of applications is possible. These include location-based services (find the closest automatic teller machine), advertising (get a coupon for a discount at a fast food restaurant around the corner) or social networking (find nearby friends).

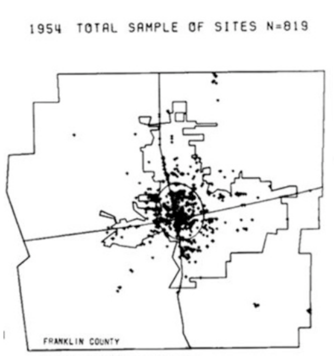
The ability of individuals to accurately determine and record locations in the field is also revolutionizing the way geographic data is collected and compiled. Using GPS-enabled devices, thousands of amateur users act as citizen sensors that routinely create volumes of volunteered geographic information (VGI). For example, citizens in New Jersey are locating and reporting wetland features. People can use personal navigation systems to send data to vendors about changes in road features and points of interest. For example, OpenStreetMap has fostered a worldwide phenomenon in which thousands of participants freely form mapping parties to create their own street maps.

Social mapping capabilities are changing long-held constructs of map production and use. In many parts of the world maps have long been hoarded as military intelligence property. In these regions, map data is now being captured in the field by volunteers riding bicycles or walking. Organizations such as OpenStreetMap process this community data to create maps. Some of these maps may be the only available map for an area. The availability of these maps on the Web puts geography in the hands of everyone.

OpenStreetMap's website



The Evolution of GIS: from Institutions to Virtual Globes



Early GIS

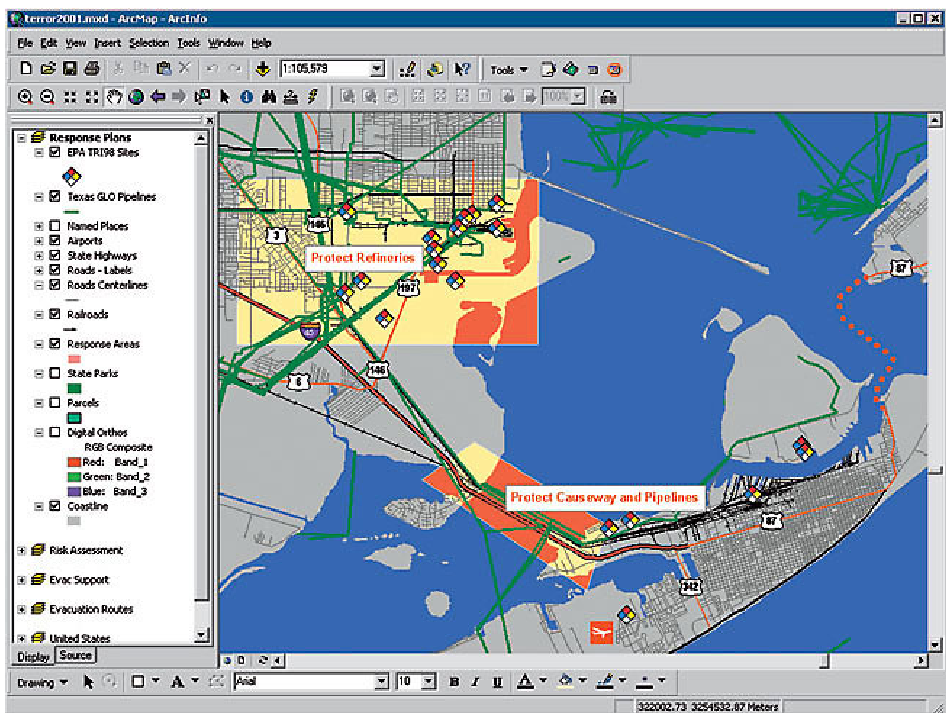
The development of digital mapping software began in earnest in the 1970s with the advent of the first software programs that could convert existing maps into digital data. These early systems ran on large mainframe computers that only existed in large public organizations. In the US, the period was dominated by federal agencies such as the USGS and the Census Bureau that developed their own mapping software to create and maintain digital representations of their existing paper maps. In addition to map generation, these systems were used to conduct inventories of land use and limited integration with other data layers. The Census Bureau developed a system called geocoding to automatically assign coordinates to a street address. These agencies now have employ commercial software for their enterprise-wide geographic information systems (GIS). After a decade, some innovative industries such as timber and utilities, along with a few state agencies and large local governments, were operating their systems on dedicated minicomputers. In a 1983 report the National Research Council suggested that the creation of an integrated, nationwide GIS could conceivably manage millions of tax parcels. This foresight was an inkling of GIS's potential for managing vast spatial data infrastructures.

The decade of the 1980s represented a migration of geographic information technology to affordable integrated graphics workstations and client-server environments, which facilitated the sharing of data across a network. This enabled the technology to be adopted by hundreds of midsized organizations and agencies. These organizations often relied on medium-scale digital databases that had been created by federal agencies. These data sources supported applications based on relatively crude scales such as street centerlines and administrative areas and land use. Tremendous inroads were made in the use of multiple layers of data for planning applications, suitability analysis, reapportionment and other census-based data.

Workstation GIS

Using commercially available software tools from GIS companies such as ESRI and Intergraph, organizations began to create and maintain extensive geographical databases of corporate and public assets. Most of the analysis consisted of projects that addressed specific issues rather than the daily business activities of an organization. These projects were performed by skilled technicians who knew how to find and use the proper set of software tools and the output was often a printed report with tables and maps. Dramatic advancements were made in tools to manage images and model terrain. Commercial digital image processing tools from companies such as ERDAS could convert aerial photographs into geographic data. At that time, digital photography technology was limited and satellite data was only useful for large-scale reconnaissance of activities such as agricultural production.

By the 1990s, improvements in computer hardware and software provided a watershed for the democratization of computing and GIS software. Agencies migrated their GIS from UNIX to Microsoft Windows operating systems and from specialized workstations to common personal computers. Software was accessed through easy-to-use graphical user interfaces (GUIs). Performance improved as the industry provided faster and cheaper



GIS for emergency response

processors, graphics cards and storage systems. These advancements meant that powerful GIS software could be used both by technical "chauffeurs" who created projects and by non-technological professionals such as decision makers, planners, scientists and students. Consequently, GIS was successfully adopted by thousands of local government and business users.

Other events improved the level of common user adoption. Ready and free access to digital versions of Census TIGER files and US Geological Survey topographic quadrangles provided a fundamental base map of the nation that could be added to GIS mapping projects. Universities established teaching labs and helped to train a labor force familiar with geospatial science and applications. By the end of the decade, personal computers were linked to internal networks and the Internet. These advancements allowed for free online Web mapping services that could be easily accessed and used by average citizens. The era of location-based advertising emerged. Commercial GIS software expanded to include hundreds of tools to integrate different kinds of information, process images, perform site analysis, support decisions and generate high-quality cartography.

GIS software could incorporate digital imagery and computer aided design (CAD) and it could generate publication-quality maps. Satellite imagery with 15-meter resolution was also widely available and GPS technology was changing the way surveying and earth measurements were performed. It should also be noted that during this period the traditional paper map-based National Mapping Program operated by the US Geological Survey was all but eliminated. This topographic map series had provided the blueprint for the development of much of the nation and provided critical information for development of our natural resources. It can be argued that the reduction of this program has greatly diminished the federal role as authoritative source of geospatial information.

In the 21st century there has been steady increase in the number of commercial desktop software users who are able to create, maintain and analyze an extraordinary range of geographic information. Moreover, the emergence of the complementary, new generation of Web-based GIS has made it often irrelevant as to whether an application is running on a desktop or across the Internet. This new computing environment has essentially enabled the integration of a geographic perspective within almost every possible information domain.

GIS professionals rely on desktop software to develop tools, and they use the Internet to deploy them to a vast array of consumers. These people are producing a seemingly limitless range of applications such as realistic three-dimensional visualizations and tools for integrating geospatial technologies with spreadsheets and other standard databases. This transparency has been fostered by open systems and open data standards that result in enterprise environments, which provide services on the open Web. From a technical viewpoint, it is important these applications be built with reusable software components that have been developed with object-oriented and scripting languages.

GIS on mobile devices

Many traditional barriers to participation in the geospatial data environment have disappeared. Rather than maintaining large staffs and infrastructure, organizations can now build entire applications without purchasing or storing any data or large toolkits. These capabilities have opened the door for GIS professionals to serve an exciting new market with customized applications, support for executive decision-making, and simplified tools that meet the needs of the task-specific or casual user.

The ability of networks to link to remote servers has empowered a new breed of knowledge experts and mobile and location based services, as well as traditional GIS professionals. The creation of huge server farms spread across extensive broadband networks has eliminated the need for users to acquire, download and store massive volumes of data and imagery. Often, images and pre-rendered maps are accessed for geographical context and

Google Earth application on iPhone

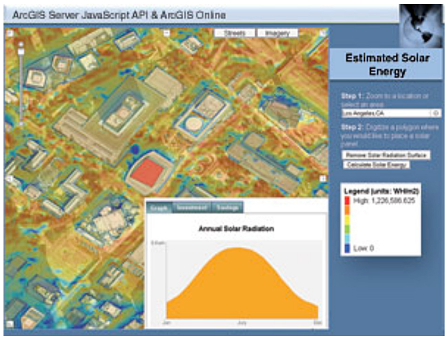
the spatial search or analysis is conducted on a remote server.

Applications that once were performed by an application specialist on a desktop are now pushed to a server and quickly and seamlessly accessed by a host of users on a wide range of devices. This has enabled handheld devices to become powerful tools. Thousands of GIS professionals employed by the Census Bureau and hundreds of other organizations can go into the field with an inexpensive handheld device to capture new attributes or update existing ones and wirelessly transmit this data back to the office. Similarly, average citizens can now access Google Earth on their iPhones to determine their current location or to find a good restaurant.

Some experts suggest that emphasis should shift toward the technical and institutional infrastructure to support the distribution of geographic information throughout society. These spatial data infrastructures (SDI) are frameworks that incorporate technologies, policies, standards and human resources to store, process and distribute vast amounts of data across many organizations and among governments. In the United States, the development of SDIs began in 1994 when President Clinton issued an executive order to create the National Spatial Data Infrastructure (NSDI) and form the Federal Geographic Data Committee (FGDC). This mandate validated the essential role geographic information plays in modern society. The order drove systems to be better coordinated and less redundant. Less emphasis was placed on products and more attention was given to processes, knowledge infrastructure, capacity building, communication and coordination. In an Internet-based world, value reaches beyond simply sharing data, and extends to judging data quality and to determining data fitness for consumption. With this, came the necessity to document data in a manner similar to documenting a library's book catalog. Database quality and content took on a different meaning as public agencies published their data via Web browser-based applications that allowed average citizens to query and view detailed information about their property.

Much emphasis in the 21st century has been placed on providing accurate data to support decision-making. In the public and commercial arena, these decisions are diverse. Organizations want to know how to pursue an enemy on a battlefield; what are the best land use alternatives for combating global warming; where should police be assigned to reduce crime; what areas are at risk for West Nile Virus; what is the best site to build new schools; or what are the route logistics for efficient delivery truck fleet management. At a personal level, people want to know how to get to a party, where to vote, what neighborhood is a good location to buy a house, where to find their friends, and how will an ambulance find them when they call 911.

Today's citizens, taxpayers, and homeowners have an entirely different set of geographic information needs and expectations than people did thirty, twenty or even eight years ago. They want to access geographic information from home through powerful, inexpensive personal computers by means of broadband networks. People accustomed to social Internet structures are as interested in publishing as they are in consuming information. They will readily participate in Facebook's "what are you doing now" dialog. Today's generation of Internet users are often armed with their personal navigation system, are repeat consumers of Google Earth data, and expect easy-to-use applications such as seeing their homes and relational values. They flock to sites such as Zillow.com and Cyberhomes.com to view the value of their property and observe the trends in their neighborhoods. This cyberspace generation has high expectations of geographic technologies. They expect to link to their local assessor's records. They expect detailed, recent aerial photography, and, even better, with bird's-eye views at four different oblique angles. In reaction to these demands, local governments are incorporating GIS into their enterprise-wide IT environments. Waukesha, Wisconsin, for instance, reports that scores of business decisions relating to everything from E911 to school zoning are driven from a parcel-based GIS because



GIS application calculates solar energy potential in Boston

it is the expected norm.

Development approaches change dramatically when designing systems that meet the needs of users who are homeowners and taxpayers. Governor O'Malley of Maryland recently stated,

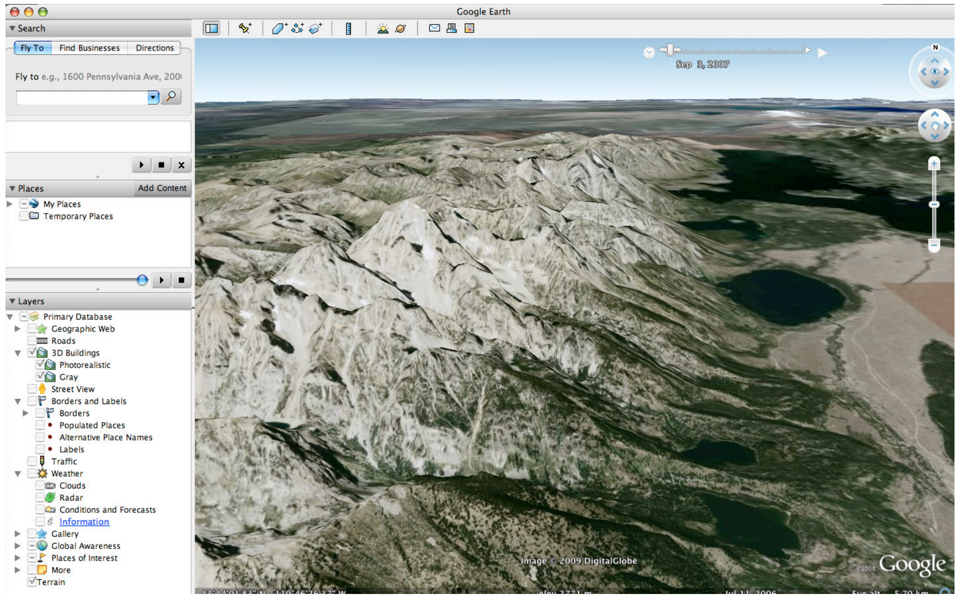
> …I'd like you to consider the answer to this question – why is it that virtually any display of GIS technology quickly inspires someone one to ask the timeless question, "…Can you show me my house?…" Through the power of mapping, we were able to create our city's [Baltimore] first-ever complete inventory of housing stock including the ownership information that could be used and accessed by mangers of boarding and cleaning crews, by those responsible for policing, those responsible for inspections, those responsible for filing the lien on the property after cleaning, those in the city's housing department responsible for clearing title, and taking title, and those responsible for disposing of title so the property could be redeveloped and returned to the tax rolls.

To meet the expectations of these new users that include citizens, public employees, and real estate-associated professionals, a unified approach is required. Property lines must be accurately depicted, images must display fine details (new additions and renovations), and 3D terrain models must model the flow of water through a neighborhood. These needs can only be met by investments in new data and geographic information tools that integrate vast amounts of very high-resolution data that is often measured in terabytes.

The Evolution of GIS: the new white board

The previous discussion suggests that the evolution of geographic information technology into mainstream consumer applications had its origins in investments and innovations made by the federal government. At the beginning of this transformation, a single individual or sometimes a small group of scientists could post information into a single computer and see limited results. But barriers still existed for that group to publish results to a wider audience. Now, current IT infrastructure encompasses federated, Web-based, and private-sector approaches. This changing landscape affects and is affected by the federal government as well as multi-collaborative stakeholders. Significant advances in technology have changed the relative roles of different stakeholders as well as the markets' environment. It is hard to ignore the importance of the recognition by Microsoft, Apple and Google of the business case for location-based searches and applications in changing a field that was once dominated by the public sector GIS professionals. Now the resulting data and software generated by the dedicated GIS community can be leveraged by the exploding group of casual GIS consumers.

The earth is a huge study area. It can be divided into pieces of various sizes and studied at macro or micro scales. For some applications, such as tracking hurricanes, scientists can rely on relatively coarse-grained information but need it updated in real time. Conversely, a civil engineer may require centimeter-level precision when constructing a new bridge. The history of geographic information applications has been one of making trade-offs. A person could either study large areas at crude levels of detail or small areas in fine detail. As we approach the end of the first decade of the 21st century, these trade-offs no longer apply. Perhaps no application exemplifies the success of this better than Google Earth. When released in June 2005, Google Earth represented a paradigm shift that shook many of our established perceptions about geospatial data. It offered multi-scale, full earth visualization that was free, easy to use and provided a dynamic sense of travel. Even though several examples of large-scale, robust geospatial databases existed, none could match Google Earth's ability to fly virtually to any place on Earth and visualize information at fine detail. Because it is free and easy to use, its success has skyrocketed over the past three



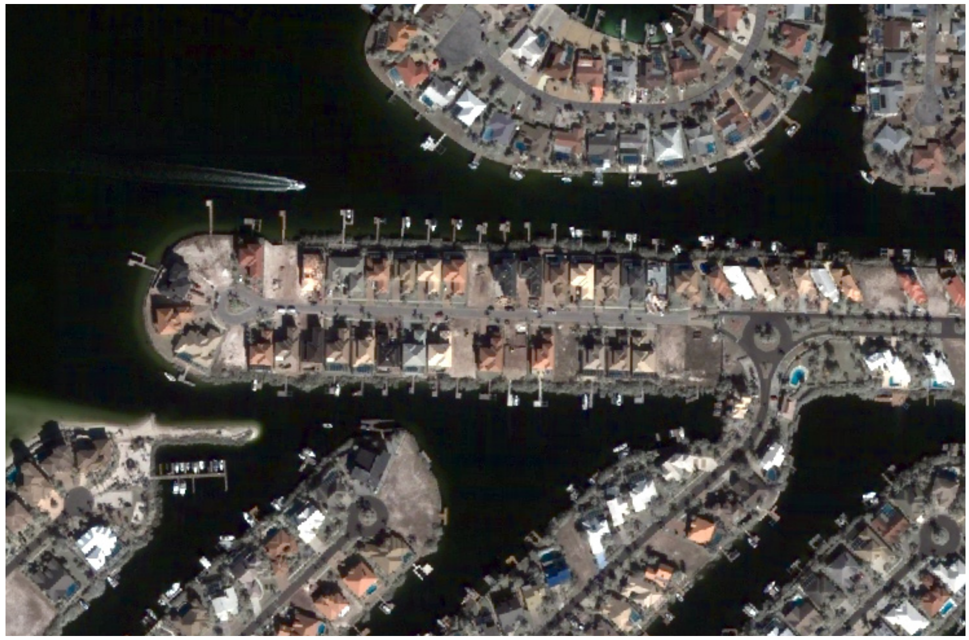
Google Earth

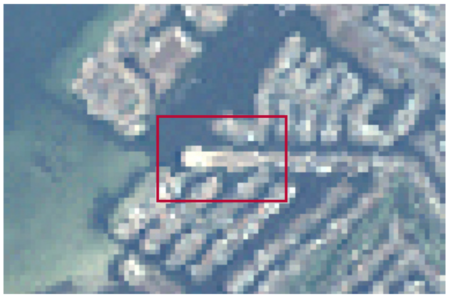
years. Content from scores of sources (National Geographic, New York Times, YouTube etc.) has been geographically tagged.

A recent article, "Armchair Archaeology" in The Economist, describes how Google Earth is changing the way archaeologists "make discoveries, develop theories and plan expeditions." The archeologist states, "Google Earth gives you free access to imagery that would otherwise cost a fortune and require specialist training to make use of." A conservative estimate of the number of Google Earth users is more than 100 million. The net result is that in just three decades, the number of geographic data users has grown from tens of thousands, to a few hundred thousand and then almost instantaneously jumped to hundreds of millions. Its impact has been widely documented in the popular press by experts such as James Fallows of Atlantic Monthly who considers Google Earth to be the fourth major innovation in popular computing (along with text editing, the Internet, and the Web). It is so mainstream that it has been the subject of New Yorker cartoons and Google Earth for Dummies is now a popular reference. More importantly, Google Earth has actually become a common platform for hosting and sharing geographically referenced content of all kinds. In many ways, the mapping service has emerged as the new geographic whiteboard, with hundreds of millions of users posting, consuming and comparing data collaboratively on a common earth study area. This simple-to-use visualization tool is valuable complement to the professional GIS tools that continue to be used to develop content, execute spatial analysis and perform modeling to support businesses and governments across the country. The value of spatial data and visualization is being realized simultaneously by casual users and professionals.

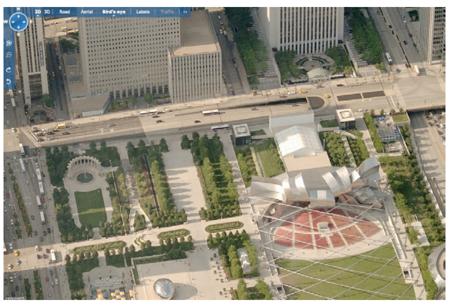
Considerations amidst the sea change

The demonstrated public appetite for spatial information will require a substantial, educated GIS workforce to meet the demand. The Geospatial Information and Technology Association reported that the geospatial sector has steadily increased by 35% a year, with the commercial side growing at an incredible rate of 100% annually. The US Department of Labor predicted that geospatial was one of the three technology areas that would create the most jobs in the coming decade and importantly these are high tech and good paying jobs. All of these changes in terms of users and expectations have turned the traditional governmental and commercial relationships upside down. Most noteworthy has been the dramatic shift of the federal government from being the primary provider of geographic data to that of a major consumer. With a few exceptions for administrative regulations such as the decennial census and flood plain boundaries, local governments create their own data from in-house resources or commercial providers. In times of emergency, the federal government must acquire the most detailed and current data from these local governments. With companies such as Microsoft and Google as customers, commercial data providers – Navteq, TeleAtlas, Pitney Bowes, First American – are doing a brisk business.





High-resolution imagery: Landsat 30-meter image (above) compared with Digital Globe/Quickbird 1-meter image (right)

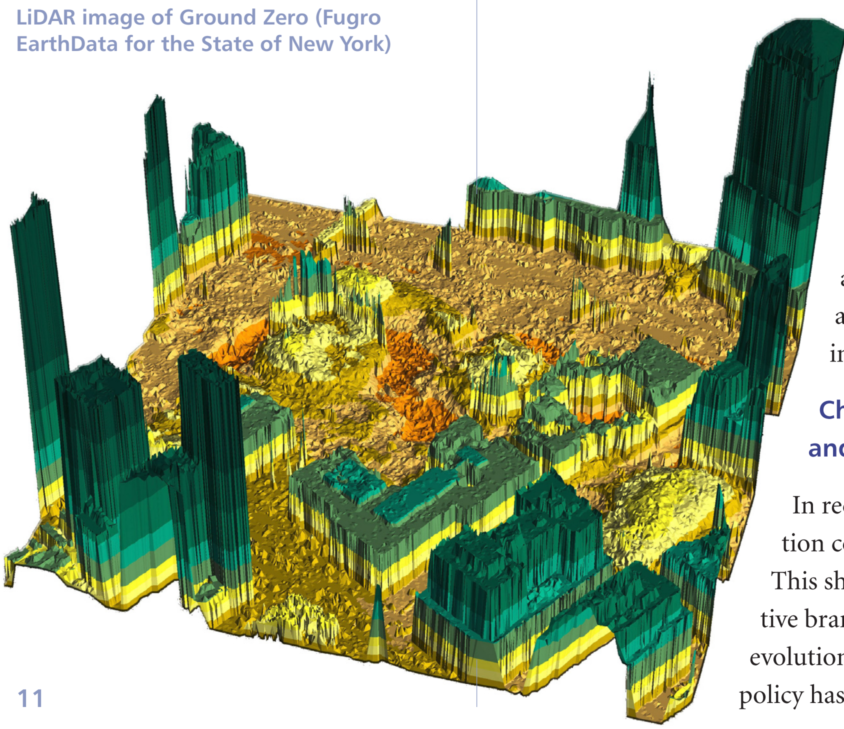


Bird's Eye View of Chicago on Microsoft Virtual Earth

Demand for high-resolution imagery from both aircraft and satellite platforms has increased. The recent launch of GeoEye-1 provides a glimpse of the new relationships between private and public organizations. This satellite-based camera is capable of collecting black-and-white images with a 0.41-meter ground resolution and 1.65-meter color images. The major customers for these images are the National Geospatial Intelligence Agency and Google. Aerial photography companies are competing to put fleets of aircraft in the air. These aircraft are equipped with sophisticated digital cameras that can capture huge quantities of geographically registered images. The imagery capabilities allow for billions of pixels, each covering an area as small as a few inches. Pictometry offers data that provides four-inch pixel images from five viewpoints. Applications such as Microsoft's popular Birds Eye View produce images that have added a whole new perspective to house hunting.

Airborne lasers that collect detailed elevation data (Light Detection and Ranging or LiDAR), provide three-dimensional geographic visualization. These lasers have been characterized as the equivalent of sending thousands of surveyors into the field to collect X, Y and Z coordinates. As a result it is possible to improve the accuracy of flood plain determination and the potential impact of sea level raise in coastal areas.

LiDAR image of Ground Zero (Fugro EarthData for the State of New York)



Changing roles require new partnerships and policies

In recent decades a shift has occurred within the data production community from government to private sector providers. This shift has been encouraged by Congress and the executive branch. A good example of this phenomenon has been the evolution of U.S. commercial remote sensing space policy. The policy has sustained and enhanced the domestic remote sensing industry while advancing and protecting national security and foreign policy interests. The increased involvement of private sector data providers has been fostered by professional organizations and associations such as American Society for Photogrammetry and Remote Sensing, American Congress on Surveying and Mapping, and Management Association for Private Photogrammetric Surveyors that support public-private partnerships. (A complete list of the members of COGO, the Coalition of Geospatial Organizations, is on page 13 of this document.) Consequently, government's role has shifted from data producer to coordinator, partnership facilitator, and manager. This, in turn, has resulted in significant growth in the number, size, capacity and capabilities of the US private geospatial community. This community is the most robust in the world, engaged in serving the domestic market and is a significant exporter of services, data and technology to serve a growing global market.

The relative shifts in data production from the federal government to the private sector and state and local government call for new forms of partnership. Furthermore, the hodgepodge of existing data sharing agreements are stifling productivity and are a serious impediment to use even in times of emergency. There is an urgent need to reexamine the relationships between data providers and users to establish a fair and equitable geospatial data marketplace that serves the full range of applications. When the federal government was the primary data provider, regulations required data to be placed in the public domain. This policy jump-started a new marketplace and led to the adoption of GIS capabilities across public and commercial sectors. However, these arrangements are very different when data assets are controlled by private companies or local governments.

Insistence on database ownership is an expensive policy. When the Census Bureau was updating the street networks to prepare for the 2010 Census, it could not take advantage of the existing commercial data from Navteq or TeleAtlas; therefore, the government spent hundreds of millions of dollars to develop a duplicate version of street centerlines. The Bureau which pioneered the field has attempted to assemble street network data collected from more than 4,000 local governments. They found that data often did not exist, was incompatible or was unavailable because of local licensing policies. Similarly, the federal government's need for tax parcel information has proven a costly venture. Critical information about the use, value and ownership of property is needed by FEMA, the Forest Service, and HUD, for emergency preparedness or response at times of hurricanes or wildfires – or even to monitor the current foreclosure problems. Unfortunately, no arrangements have been made for the federal government to acquire the detailed property-related data that it needs to make responsive decisions. Ironically, private companies such as the online real estate service Zillow are often better prepared than the federal government to support these critical decisions.

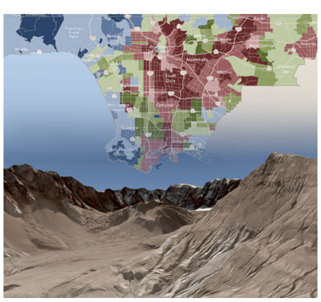
The dramatic shift in the relative roles of the federal, state and local governments has been monitored by several institutions and advocacy groups. For example, the National Research Council, which oversees the Mapping Science Committee, has conducted numerous studies identifying trends and recommending changes that would improve efficiency and coordination of geographic information. State governments have also emerged as an increasingly important source of intermediate level geographic information coordination.

As early as 1989, several state GIS managers convened as the National States Geographic Information Council (NSGIC) to establish a forum for coordinating GIS projects and government investments. This group provided an early indication of the existence of duplicative efforts and the potential of redundant government activities. NSGIC is one of the most active proponents of spatial data infrastructure projects and almost every state now has a state GIS coordinator. NSGIC has an active agenda and is working closely with the FGDC for new initiatives. One of these initiatives is Imagery for the Nation. It is a model for new partnerships in which the federal government provides partial funding to acquire high-resolution digital imagery collected by commercial data providers, with the option for state and local governments to "buy-up" for higher-resolution data. This data will be placed in the public domain and will be freely available to all sources including commercial entities such as Google and Microsoft who will use this data to fuel their product and service offerings to the marketplace

Nearly all the data, technology and applications we see today can be traced to innovative policies and government practices of the past. As such we require similar innovative policies now to keep pace with this remarkable sea change. Government-based geographic information providers can no longer think of themselves as a players outside of or immune from the community of private sector, state, local or even public stakeholders. In many cases these stakeholders have embraced technology and processes which have rapidly outpaced anything the federal government can provide. At a minimum, what is needed is a commitment to improved spatial data, recognition of the place of multiple stakeholders in this brave new world, and coordinated investment.

Although phenomena such as the Zillow Website's millions of hits, cars equipped with navigational devices, and phones embedded with location-based services for locating friends are fascinating, the greatest value of the spatial data infrastructure still lies in illuminating complex policy problems. If we as a country are sincere about resolving universal concerns such as global warming, sea level rise, and affordable health care, the Federal government needs to adopt innovative policies supporting a dynamic and robust spatial data infrastructure, an initiative that was promised more than 15 years ago. The members of the National Geospatial Advisory Committee look forward to working with the Obama Administration and the geospatial community in formulating recommendations on the adoption and or revision of spatial data policies and programs that can empower better decision-making through geography at all levels of government and in private enterprise.

The founding members of the Coalition of Geospatial Organizations: American Congress on Surveying and Mapping (ACSM); American Society of Photogrammetry and Remote Sensing (ASPRS); Association of American Geographers (AAG); Cartography and Geographic Information Society (CAGIS); Geospatial Information Technology Association (GITA); GIS Certification Institute (GISCI); International Association of Assessing Officers (IAAO); Management Association for Private Photogrammetric Surveyors (MAPPS); National States Geographic Information Council (NSGIC); University Consortium for Geographic Information Science (UCGIS); Urban and Regional Information Systems Association (URISA). Founding advisory organizations are: National Association of Counties (NACo); National Emergency Number Association (NENA); Western Governors Association (WGA); American Planning Association (APA)



Cover illustration: Montage of Mount St. Helens (DigitalGlobe via Google Earth) and a GIS-produced map of Los Angeles, CA (courtesy GreenInfo Network).

This report was prepared by a subcommittee of the National Geospatial Advisory Committee. This report was approved at the October 2008 meeting of the NGAC. Subcommittee members: **Dr. David J. Cowen**, Distinguished Professor Emeritus, University of South Carolina (Chair); **Dr. Sean Ahearn**, Professor of Geography, Director, Center for Advanced Research of Spatial Information (CARSI), Hunter College – CUNY; **Mr. Michael Byrne**, GIS Architect, State of California Office of Statewide Health Planning and Development. The subcommittee would like to thank ESRI and the National Geographic Society for their assistance in the preparation of this report.

For information about the National Geospatial Advisory Committee, please visit

http://www.fgdc.gov/ngac

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