2003
Cambridge Conference
www.cambridgeconference2003.com
Ordnance Survey
Romsey Road
SOUTHAMPTON
SO16 4GU
United Kingdom

Maps as Infrastructure: *The National Map*

B J Ryan
Associate Director for Geography
United States Geological Survey

M A Domaratz
United States Geological Survey

Paper 2.1

Ordnance Survey

Maps as Infrastructure: *The National Map*

B J Ryan and M A Domaratz
United States Geological Survey

Barbara J. Ryan is Associate Director for Geography at the U.S. Department of the Interior's U.S. Geological Survey (USGS), the nation's largest civilian mapping agency. She has policy oversight and national program responsibilities for the agency's mapping, remote sensing, and geography programs. *The National Map* is being constructed under her leadership.

Michael A. Domaratz is a member of the Geography headquarters group of the USGS. His responsibilities include implementing *The National Map* through his roles for coordinating activities in support of homeland security, and coordinating with the Bureau of the Census, and supporting internal USGS activities related to transportation data.

Continuing efforts to anticipate and guard against future disasters have heightened discussions about actions needed for collective security and prosperity. The United States Government noted that geospatial data have an important role to play in every aspect of homeland security: detection, preparedness, prevention, protection, response, and recovery (Federal Geographic Data Committee, 2002). For the United States, the events of September 11, 2001 and their aftermath reminded the Nation of a lesson taught by periodic major disasters: geospatial data must not only be available, but they must be readily accessible and in a form in which they can be combined with other information. These data must be available before (for planning), during (for emergency response), and after (for recovery) events (Ryan, 2002).

As the geospatial community participates in these discussions, it has been quick to add that these data have utility far beyond those of supporting homeland security. Much if not most of the data used to respond to disasters have been developed for other purposes. These data are essential to many aspects of a successful society. Among the most obvious are ensuring a healthy and vital economy, aiding community development, managing land and natural resources, providing for emergency response and management, supporting the scientific and research enterprise, and ensuring public health and safety. These interests are pursued by public, private, and nonprofit organizations, as well as by individuals. They span subjects as broad as a nation’s political economy, geographic scales ranging from individual farm fields to the globe, and time scales from the immediate to the prehistoric.

The renewed appreciation of the broad and elemental utility of geospatial data, especially those data that serve as a framework for many applications, has helped to spur a new understanding of geospatial data: their role as an element of a society’s infrastructure. In the case of geospatial data, the term infrastructure not only includes the broad sense of an underlying foundation, but also the more specific idea of basic facilities, services, and installations needed for a functioning community or society.

National mapping organizations are among the first to appreciate the magnitude of such an infrastructure. In the case of the United States, the U.S. Geological Survey’s (USGS) 55,000 topographic maps provide the only topographic synthesis that is national in scope, comprehensive, accurate, and consistent across jurisdictions. The fifty-year effort to achieve national coverage was an immense engineering feat, accomplished by a dedicated work force, physical plant, and management structure.

While perhaps satisfactory for the 20th century, this infrastructure will not serve society well in the 21st century. Society demands ever more current and accurate geospatial data. A number of new technologies provide expanding opportunities to collect, maintain, access, and use these data. Falling costs of these technologies allow more organizations and individuals to undertake these tasks. A consequence of these factors is a move from a "one size fits all" solution to a more flexible, more vibrant demand for geospatial data.

The organizations and individuals that use these data have common needs that offer opportunities for partnerships. The shared interests of Federal agencies and other public organizations, notably State, regional, and local governments, provides opportunities for partnerships. Private sector investment in the development and maintenance of data provides opportunities to work with those organizations, albeit often on a different basis than agreements with public-sector organizations.

Data, opportunities for partnerships, and new technologies provide the components of the geospatial data infrastructure for the 21st century. The question is, how can they be organized so that they meet individual needs, and also contribute to meeting the broader need for a topographic synthesis that is national in scope, comprehensive, accurate, and consistent across jurisdictions – the role traditionally filled by the products of national mapping organizations.

Components of a New Infrastructure: *The National Map*

For the United States, the USGS developed the concept of *The National Map* – the means by which USGS and its partners provide the Nation with current, accurate, and consistent basic spatial data, including digital data and derived topographic maps, and deliver spatial information that is current (U.S. Geological Survey, 2001). The components for *The National Map* include a basic set of high-quality data that enables the development and implementation of many applications, but does not unnecessarily compete with them; the adoption of an operational approach that takes advantage of a network of organizations to develop, maintain, and provide access to data; an organizational and business approach based on partnerships with other public and private sector organizations; and leadership and management.

Data

Characteristics for data in *The National Map* include:

Content: For *The National Map*, content includes high-resolution orthorectified imagery and surface elevation data; vector feature data for the themes of hydrography, transportation, structures and related infrastructure, boundaries of governmental units, and administrative boundaries of publicly owned lands (attributes will include unique feature identifiers and minimal associated descriptive information); geographic names; and land cover information. The USGS plans to ensure the availability of these data themes. Additional attribute extensions to these basic data, and additional themes of data, such as those for land ownership and natural resources, also are important to the national interest. While USGS may not participate in the actual development of these data, *The National Map* will provide a means of accessing and using them.

Currentness: Ideally, content will be updated when a change occurs on the landscape. The ultimate goal is that new content be incorporated within seven days of a change on the landscape. An intermediate goal is currentness of six months for urban areas, and three years for rural areas.

Positional Accuracy: The approach is to take advantage of the best-positioned data available for an area. The minimum specification is the positional accuracy on USGS topographic maps. For some themes, nationwide coverage of data better than the minimum specification already exists. More accurate data will become the norm for urban areas, areas of special interest to the Government and industry, and for themes of data such as transportation for which there is high demand for accuracy. In addition, the plan for *The National Map* acknowledges that users interested in large geographic areas often do not need such detailed data. These needs can be met with lower resolution data, some of which will be derived from more detailed data, and others that will be developed separately.

Operational Capability

The system takes advantage of a confederation of components, some operated by USGS, and others not. A very generalized data flow starts with organizations making data available to *The National Map*. Some of these data are integrated into national coverages that are held in USGS-operated databases. The management of these data holdings may change to a more distributed approach as technologies and interests warrant. Other data become part of, and available through, *The National Map* as part of a distributed network of servers linked through the Internet. Some servers are operated by USGS, and many are operated by other participating organizations. The status of this network is monitored using a catalog that includes the inventory of participating organizations and web services, and basic information that aids users in their interactions with *The National Map*. Services available or under development include basic map viewing through a web browser, downloading data, making a plot file for a map that can be downloaded for local printing, and web mapping services to which applications can be associated. Access is available “around-the-clock” through the Internet. Users have the ability to specify combinations of data and geographic areas of coverage.

Organizations’ Roles and Partnerships

The success of *The National Map* will rely on sustainable partnerships. The USGS will seek partnerships and business arrangements with other organizations to develop and operate *The National Map*. USGS personnel are being relocated to work directly with partner Federal, State, or other public organizations, private industry, and universities. Federal agencies are identifying needs and developing and executing plans for collaborative data development and maintenance. State, regional, and local partners are coordinating and undertaking data development efforts to meet their needs and, where interests align, are beginning to maintain and operate *The National Map* for their areas. *The National Map* relies on private organizations to provide analysis and visualization tools, to develop standards-based open technology and processing standards, and to provide data acquired under contract. Discussions are ongoing regarding means by which licensed data from the private sector can be included. The USGS works with university faculty on relevant research topics. Needed additional efforts include working with libraries to support public access to *The National Map*, and with volunteers to help detect changes on the landscape.

Roles for the USGS are (1) guarantor of national data completeness, consistency, and accuracy, (2) organizer responsible for awareness, availability, and utility of *The National Map*, (3) catalyst and collaborator for creating and stimulating partnerships, (4) integrator and certifier of data from participants, (5) owner and data producer when no other sources for needed data exist, and (6) leader in the development of geospatial data standards.

Leadership

Fundamental to the leadership of an enterprise such as *The National Map* is the understanding that skills such as coordination, collaboration, and management are essential. Major tasks include educating leaders about the essential role of geospatial data in achieving national goals, leading the mapping community in a way that provides sufficient stability but allows for flexibility and creativity, ensuring a supply of basic geospatial data that can be used and extended for many purposes, reaching out to cooperate with other data providers, investigating ways to take advantage of new technologies, and adopting business models and practices that take advantage of changes in needs, organizations, and technologies.

There are many ways in which leadership is exercised. In the area of technology, activities include understanding roles that technologies can serve, and helping the mapping community to take advantage of these technologies. Examples include support for managing and serving large geospatial databases, participation in public-private cooperation to develop open geographic information technology and processing methods, and partnerships with private organizations that customize Government data for specific markets. Another activity is pooling and focusing public expenditures on spatial data, and providing these data for secondary uses.

This leadership is provided in the context of larger government initiatives. In the United States, *The National Map* builds on a policy framework laid out through the National Spatial Data Infrastructure and efforts of the Federal Geographic Data Committee over the last decade. It also is a part of the Bush administration's electronic government initiative for geospatial data, Geospatial One-Stop.

Finally, there must be a physical manifestation of the benefits from coordination. The tangible result of coordination must be the delivery of accessible, easily integrated geospatial data – data that are uniformly presented as *The National Map*. The question of how to offset the increased costs to organizations that participate in this new type of national infrastructure, especially the costs borne by local governments, also must be addressed. In the United States, the situation parallels that for the federal interstate highway system created in the 1950s and 1960s. That system was designed initially for defense purposes, funded predominantly by the federal government with some state matching funds, and was constructed by private contractors to national standards of consistent signage, road grade, and design. It provided the base for a nationally connected network based on common standards and practices, and was supported by consistent funding for development, use, and maintenance. The result not only increased national security, but also substantially improved interstate commerce. A similar approach for building *The National Map* will yield similar benefits to the many applications of geospatial data.

Maps as Infrastructure

Governments depend on a common set of base information that locates and describes the Earth's surface and features as a tool for land and natural resource management, economic and community development, and health and security services. Private industry, nongovernmental organizations, and the general public also create and use these geographic data.

To meet these needs, an infrastructure is needed that provides current, accurate, and nationally consistent basic spatial data. This infrastructure must build upon the ways in which geospatial data are developed, maintained, and used. Major components of the infrastructure include data, an operational capability to maintain and access them, organizations serving different roles and working in partnership, and leadership. National mapping organizations are positioned well to organize this infrastructure, although through a much different approach than they have used in the past.

References

Federal Geographic Data Committee (2002), "Homeland security and geographic information systems", (*Federal Geographic Data Committee*), Available: http://www.fgdc.gov/publications/homeland.html (Accessed: 2003, June 13)

U.S. Geological Survey (2001), "*The National Map*: Topographic mapping for the 21st century", (*The National Map*), Available: http://nationalmap.usgs.gov/report/national_map_report_final.pdf (Accessed: 2003, June 13)

Ryan, Barbara J. (2002), "One Year After: A USGS Perspective", in Geospatial Solutions, vol. 12, no. 9, p. 56–57.