

NATIONAL

GEO
DATA

POLICY FORUM

SUMMARY REPORT



N A T I O N A L

G E O
D A T A

P O L I C Y F O R U M

**Present and Emerging U.S. Policies
Governing the Development, Evolution, and Use of the
National Spatial Data Infrastructure**

SUMMARY REPORT

PREFACE

The first National Geo-Data Policy Forum was held on May 10-12, 1993, in Tyson's Corner, Virginia. The objective of the National Geo-Data Policy Forum was to examine policies related to the evolution and use of the National Spatial Data Infrastructure (NSDI). A second goal was to identify issues concerning spatial data technology and its use by all citizens. Policy makers from the public and private sectors offered ideas on the myriad issues and questions related to the NSDI and learned of concerns that their organizations must address. The links that connect the NSDI to the Clinton Administration's National Information Infrastructure were identified and discussed. The forum offered participants an opportunity to define the NSDI's role in carrying out technology policy.

On the first day of the forum, senior policy makers provided an overview of trends in spatial data development and use. Over the following day and a half, plenary sessions, panel discussions, and workshops presented different perspectives on the effectiveness of existing spatial data policies, the need for new national policies to support the NSDI, and the directions these policies are likely to take. Appendix A lists the speakers and the topics for each forum session.

Intended to be a biennial event, the forum was sponsored by organizations and associations interested in policies related to spatial data. They represented federal, state, and local governments, and the private sector. The 1993 forum was organized by a board of directors composed of members from:

- the Federal Geographic Data Committee (FGDC), a federal interagency committee organized through Office of Management and Budget Circular A-16;
- the private sector, including (in alphabetical order) the Computer Sciences Corporation; the Data General Corporation; E-Systems, Garland Division; Electronic Data Systems/Graphic Data Systems; the Environmental Systems Research Institute; Federal Sources, Inc.; GIS World, Inc.; the IBM Corporation; the Intergraph Corporation; the SPOT Image Corporation; and Sun Microsystems Federal, Inc.;
- five professional societies, which provided industry-wide and state and local government perspectives: the American Congress on Surveying and Mapping (ACSM), the American Society for Photogrammetry and Remote Sensing (ASPRS), AM/FM International, the Association of American Geographers (AAG), and the Urban and Regional Information Systems Association (URISA); and
- the GIS World Education and Training Institute.

The forum board of directors thanks the companies (listed in alphabeti-

cal order) that provided financial support for the forum: the Computer Sciences Corporation; the Data General Corporation; E-Systems, Garland Division; Electronic Data Systems/Graphic Data Systems; Genasys II, Inc.; the IBM Corporation; the Intergraph Corporation; and the SPOT Image Corporation.

The board also appreciates the support of the forum's cooperating organizations: *Federal Computer Week*, the Institute for Land Information, and IVHS America.

This report is a summary of remarks made at the National Geo-Data Policy Forum. It paraphrases the ideas offered by speakers and participants, and they do not necessarily represent the views of the forum's board of directors, program committee, or sponsors.

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NATIONAL GEO-DATA POLICY FORUM SUMMARY REPORT

Introduction

A recent National Academy of Sciences report defines the National Spatial Data Infrastructure (NSDI) as

. . . the means to assemble geographic information that describes the arrangement and attributes of features and phenomena on the Earth. The infrastructure includes the materials, technology, and people necessary to acquire, process, store, and distribute such information to meet a wide variety of needs.¹

A fragmented infrastructure exists today. What remains to be built is a cohesive framework and a mechanism that can harness the resources and knowledge of the entire spatial data community.

Issues that must be confronted and resolved to build the NSDI are summarized in this report. Permeating the discussion at the May 1993 forum was an urgent demand for action and leadership. During the closing session, the phrase "Ready, . . . Fire, . . . Aim!" was evoked, not as criticism of past and ongoing efforts to define and build the NSDI, but as an expression of the need to stop talking about the NSDI and start constructing it. Virtually without exception, interested parties from all sectors—academic, private, and public—want action rather than more discussion.

Trends in Technology and Data

The ability to process large volumes of data is improving continuously. The costs of computing, including processing and storage costs, are decreasing, partly because of the increased use of open software architectures that encourage third-party vendors to develop add-on products. Computers are smaller and more portable. The ability to create customized products is increasing. Data sensors are increasing in capability and decreasing in cost. Future sensors will collect immense volumes of data.

Communication networks are becoming ubiquitous and are working much faster. Voice, video, and data communication technologies are merging and becoming less distinct. Low altitude polar satellites and other technologies are providing new options for personal communications devices. Technology allows people to communicate constantly and instantly regardless of their locations.

¹National Academy of Sciences Mapping Science Committee, 1993, *Toward a Coordinated Spatial Data Infrastructure for the Nation*. Washington, D.C., National Academy Press, p.16.

The falling costs of computing are changing the traditional roles of data producers and consumers. The growing appetite for data is creating a mass market, and consumers increasingly reach out electronically to determine what data are available. Decreasing sensor costs allow consumers to be collectors and publishers of positional, audio, and visual data. Consumers have come to expect more customized data and services.

Computing is becoming more personalized, and the opportunities for “democratizing” data are increasing. Concern about the related issues of privacy, security and authentication of information, liability, and access to data also is increasing.

More data are available, and technologies such as geographic information systems integrate large volumes of disparate data. Data volumes and integration requirements are being driven by the complexity of environmental and economic problems. Better data base management systems, friendlier user interfaces, and more sophisticated networking tools will be needed to take full advantage of the quantities of data that are becoming available.

The Players

The Private Sector

Competition and profit motivate the private sector. A global market drives an agile private sector to provide new goods and services and to adopt new techniques and technologies quickly. The private sector plays a key role in developing value-added data products, often based on data provided by the public sector. The country’s robust geospatial data industry relies in part on Federal policies that provide national data coverage at low cost and without copyright.

To engage the private sector, the NSDI must provide immediate, quantifiable, and tangible benefits. The private sector can work with the public sector to reduce the risks associated with new efforts and to ensure the stability and continuity of these efforts. The private sector has demonstrated its ability to support the public sector in applications involving the security and confidentiality of data, but the public sector has been slow to use private sector support in geospatial data operations and maintenance.

The private sector worries about liability, privacy, and intellectual property rights. Companies will resist sharing geospatial data that may be advantageous to competitors. The private sector can be affected significantly by public sector actions. Government procurements and standards influence private sector investment decisions. Policies that ensure fair and equal treatment of the private sector are mandatory.

The Public Sector

Public sector agencies use geospatial data to accomplish their missions. Governments are changing from producers to consumers of data, and the

role of government as a primary data provider is decreasing. Yet the public sector will continue to help ensure the quality and consistency of data and public access to data.

Reuse of government data can provide wider benefits to the economy than those gained in an agency's initial application. Some federal government agencies' traditional missions have included disseminating data; others have not. Office of Management and Budget Circular A-130 will make dissemination of data a responsibility for all federal agencies that collect data.

Public agencies obtain funds from four sources. One is general revenues. This path is increasingly insecure because of budget shortfalls and a reluctance to raise taxes. A second means is to pay for a project from savings realized by using new technology. These savings are difficult to calculate and demonstrate. A third mechanism is to garner support from other programs. To do so, new efforts must provide benefits, be well understood and widely desired, and be tied to the contributing agency's mandate. A final method is to obtain funding from customers through fees and other charges, although some view such fees as taxation without authority.

A difference was observed between the approaches taken by federal agencies and by state and local government agencies in resolving issues. Federal approaches concentrate on organization and methods instead of action. State and local governments emphasize action. They often must respond more quickly to issues, resulting in an approach that was characterized as "ready, fire, aim" and "just do it!"

Pricing policies for access to publicly produced geospatial data embody philosophical differences between the federal government and state and local governments. Federal policies mandate that, as a general principle, access to federally produced data should be priced at the cost of reproducing and distributing data, but should not include the costs of collecting data. A trend in state and local governments is to price data to recover the costs of both collecting and maintaining data.

Partnerships

Budget difficulties and policies encourage the development of public-private partnerships, as well as contracting for and privatization of goods and services traditionally provided by governments. Partnerships among private and public sector players can greatly reduce the individual participants' large costs of collecting and maintaining digital geospatial data. The success of partnerships depends on a spirit of cooperation, flexibility, equality, communication, and consensus on technical and policy issues. Successful cooperation stems from an understanding of the goals, benefits, and incentives of the partnership. Benefits include gains that could not be

obtained by the partners independently and reduced risk. Incentives include financial resources, as well as nonfinancial contributions such as the provision of goods and services. In addition to the direct benefits and incentives, a synergy often develops that yields gains that are larger than the sum of the partners' contributions.

Flexibility is paramount, and a structure should be developed to address new needs, expectations, and problems. Equality does not necessarily mean a strict 50-50 formula, but it does mean respect for the rights and needs of partners and an effort to achieve consensus on issues. Risks and rewards should be equitably shared. Two-way communication is vital. Technical and policy issues that require consensus include standards, data content, and data access. Agreements should ensure the ability to integrate the accomplishments and contributions of the partners.

All partnerships are different, and participants have different strategic goals and tactical roles and responsibilities. These roles and responsibilities should be assigned to the partners who can best or most economically undertake the required tasks. Potential partners need to be involved in discussions from the start.

An effective approach is to keep original partnership agreements simple and to build on initial successes. Formal agreements usually are needed to establish directions for partnerships, identify responsibilities and expectations, and secure the commitments of the partners. Agreements on policy and technical issues may be reached at different levels in the partners' organizations.

Private sector partners may have special concerns. Industry requires that potential partnerships limit risk and provide a certainty of return over a defined period of time. Government entities might select partners from the private sector competitively and reopen competition for the opportunity periodically. In these cases, the length of the partnership should allow a reasonable period for return on investment. Industry involvement can reduce bureaucratic conflict among government partners.

Several problems may arise in geospatial data partnerships. Participants may drop out and rely on their ability to access public data. Often, partnerships provide for data collection but not for data maintenance. Memoranda of understanding among government entities may be difficult to enforce. Personnel turnover is frequent in government entities, and the resulting lack of continuity of individuals involved in a partnership may cause problems.

Competition and the use of multiple sources of data may be more efficient than partnerships in some situations. A final aspect of partnerships is that some groups, such as the press, can never be partners because of their adversarial relationships to other organizations.

Standards

Standards enable applications and technology to work together. Standards foster commerce, encourage efficiency and effectiveness, help reduce costs, protect investments in data against technological change, and can lead to increased availability of more accurate, complete, and current data. A single standard for a particular function may not be possible or desirable, although the number of standards should be small.

The evolution of conventions in music provides a good example of the advantages of standards. Before standards for the written representation of musical notes existed, the only way to share music was verbally through traveling musicians, a cumbersome method that limited transmission. Through the centuries, the development of standards for encoding, composing, recording, and broadcasting music has resulted in simple, fast, and easy ways of disseminating music. Standards can provide similar advantages for digital geospatial data.

Tools, applications, and data affect each other, and processes for developing standards must consider these interactions. Data and related activities can be considered at the conceptual, logical, and physical levels, and standards may be needed at each level. Different skills are needed to develop standards for each level, and people should work at the level at which they are the most knowledgeable. Although users must be involved closely when standards are developed, they should be protected from the many details that must be addressed. Standards often require a long time to develop, but good standards usually are long lived.

Topics for which standards would be useful include accommodating different views of data, security, algorithms, data dictionaries, schema designs, data query and reporting, and metadata (descriptions of data and their quality). Standards for data exchange are important, and the Spatial Data Transfer Standard is expected to meet this need.

Standards development should be based on a knowledge of industry trends, it should fill a void, and it should be timely. Some issues for which standards are desired will work themselves out through competition in the marketplace; other issues will become obsolete because of technological innovations.

Government, industry, and the research community have important roles in developing standards. Government can promote the creation of standards and facilitate their development by inviting the participation of different communities. In many technologies, such as communications networks, market pressures encourage industry to develop needed standards, and government intervention is unnecessary or harmful. For some technologies, basic research is needed to provide a sound foundation for

standards. Government can help by stimulating and supporting research in these specialties.

The adoption and use of standards also require resources. The more rigorous a standard is, the greater the research and development costs. The adoption of standards can be slow, partly because those who reap the benefits of standards often are not those who have borne the costs of creating and implementing them. Government can encourage the adoption of standards by requiring their use.

Current Policy Issues Relevant to Geospatial Data

Data Pricing

Information can be viewed as the currency of good government. Public access to data used in government decisions is fundamental to ensuring that governments account for their actions. Access to these data must be equitable. Privacy must be protected. These principles are the foundation of freedom of information legislation at all levels of government.

Government agencies gather data to accomplish their missions. This data gathering is usually funded through the agencies' budgets, and the public receives benefits through the agencies' programs. A current debate focuses on who should receive benefits that result from access to public data, especially when the data are used for private gain.

Speakers from the library community, public interest groups, and the information industry agreed that publicly funded data are public assets. These data strengthen the economy, develop knowledgeable citizens, and promote better decisions on public and private matters. Aggressive pricing of these data by governments will reduce such benefits. The speakers noted that release of these data does not decrease their value to government agencies. There is no difference between data dissemination and access to government records. Government data access policies should be based on (1) a realization that data are useful to the public; (2) equitable, nondiscriminatory access to data as a public right; (3) fees that recoup only the costs of delivering information to individual requestors, (4) limited or no copyright or restrictions on use of government data; and (5) use of Federal, national, or international protocols and standards to ensure the maximum usefulness of the data.

Concerns were expressed that government agencies would use pricing mechanisms to editorialize, to stop access to potentially embarrassing data, and to encourage use of data favorable to the government. Government agencies are established to deliver programs, not data; the tasks required to market data may distract agencies from their missions and encourage agencies to cater to specific clienteles. Library community representatives urged that government data be made available through libraries, which can

provide technical assistance to unskilled users and feedback to government agencies. Information industry speakers, noting the unique and important role of the private sector in developing value-added products based on government data, said government data pricing policies should not discriminate against any sector of the market. Public interest group members observed that the desire to derive revenue from data conflicts with the public sector's responsibility to protect data about individuals.

Arguments for allowing government agencies to recover more than the costs of dissemination also were advanced. Government agencies, including state and local governments in the United States, see data as a source of revenue. Both economic and public policy viewpoints were offered. From an economic perspective, geospatial data are not free, and a strong institutional framework is needed to create and maintain geospatial data. Organizations and individuals who use these data, especially for private gain, should contribute to their capture and dissemination. Copyright and other restrictions on use do not prevent access to government data, but instead protect the public's investment and intellectual property rights. These restrictions allow the government, as a steward of the public's property, to receive income to support data programs. Currently, differential pricing aids access by the academic community and others requiring subsidized access. Policies requiring government agencies to release data at the cost of dissemination often result in the release of raw data that must be processed to be usable. The value-added industries that provide these services impose fees that raise the price of data and thereby restrict access, especially for small organizations and for individuals. The revenues earned by pricing data above the cost of dissemination could provide more usable data and better services that could increase data usage at lower costs to the taxpayer. One speaker demanded proof that data priced at the cost of dissemination resulted in better decisions. Access at the cost of dissemination can continue only as long as a government's resources support that approach, and it was suggested that most governments can no longer afford such policies. Fees are more popular than taxes as a means of providing revenues. Finally, government policy should strengthen the domestic economy in the international marketplace. Data are key resources in the information age, and policy makers should consider the advantages they might inadvertently confer on foreign competitors by imposing policies requiring access at the cost of dissemination.

From a policy perspective, government accountability is mandatory, and public record laws are designed to ensure access to records related to government decisions. But access to information related to government decisions does not require access to entire data bases. An opposing view held that governments are liable not only for actions that they take, but also for actions that they should have taken based on information available to

them. In such instances, accountability requires access to all information available to a government agency.

The debate was summarized by several observers. Data pricing policies should balance the desires to encourage economic activity and provide service to the public on the one hand, and the need to obtain revenues, especially for services and benefits provided to individuals, on the other. The different approaches represent a conflict between the ideals of Jeffersonian democracy and access to information, and the realities of successful competition in the international marketplace. These goals are contradictory, and policies cannot be made that support both views. Differences in data pricing policies will prevent collaboration. Data pricing policies are being developed during a difficult economic period. This circumstance should be considered when developing these policies.

A final observation was that government agencies that provide data at the cost of dissemination and those that seek to recover additional costs have different relationships with their clients. Buyers of data sold to recover costs will view these data as a product; they will expect agencies to stand behind their products, and agencies will acquire reputations based on the quality of their products. This relationship to clients will entail additional concerns related to data quality, customer service, liability, data redistribution and related incremental errors, and responsibility for products derived from public data; it will also result in increased costs for government data.

Liability

Liabilities that users seek to impose on data and software providers are a current focus of information technology law. Exposure to liability is increased by several trends in the community: the use of data from unknown sources and of unknown quality; the availability of value-added data products that may disguise the quality of the underlying data; the increasing use of data in mass market and other business applications; and the growing base of naive users who are not familiar with geospatial data and their limitations. Much of the law is new and there are few precedents. Laws vary by jurisdiction, with most of the pertinent law based on state legislation.

Several types of liability related to data products were reviewed. Contractual liability is based on a breach of the provisions specified in a contract under which a data vendor supplies data or an associated data base product. Negligence is failure to take reasonable care to protect users of the product in preparing data or data base products. Fraud is willful production of erroneous data or data base products. Negligent misrepresentation results from careless provision of inaccurate information. Strict liability results from proof that a product is defective or is designed poorly and is unreason-

ably dangerous.

Courts have ruled differently on issues related to more traditional forms of publishing. Some courts have held that publishers of printed works have no liability for erroneous information in their products. Others, notably those considering aeronautical charts, have held publishers liable for erroneous information.

Providers are protected by using standards and reporting truthfully the condition and limitations of their data; thus developments such as the Spatial Data Transfer Standard and the draft metadata standard will be helpful. Actions such as providing products in shrink-wrapped packages with disclaimers attached also may help.

The law usually assigns different liability to public and private sector providers. Under the concept of sovereign immunity, governments typically are relieved from some liability for actions taken as part of their ministerial functions. Activities such as data sales make governments more like private sector providers, and may force governments to accept more liability.

A disclaimer, which may accompany a copyright notice, could state that the producer assumes no liability for use of the data and that only qualified persons should use the data. Although these disclaimers may help to limit liability, they will not do so if a court rules that there is liability without fault (*i.e.*, strict liability).

Privacy

Privacy and confidentiality concerns have increased greatly because of the large volume of available data, the growing number of data producers and users, and the integration of data from different sources. Federal protection for data about individuals includes requirements that individuals consent to the release of data concerning them, that individuals have the right to access and amend information, that the use of Social Security numbers to identify individuals be restricted, and that collecting information on individuals' political activities is prohibited. The law allows individuals to collect for damages caused by improper activities. Federal agencies are required to prove that information about individuals is required to accomplish their missions.² Data about individuals can be shared among government agencies, but only by signed agreement. Recipients are constrained in the ways that they can use and disseminate such data. Privacy laws also regulate the interception of communications. State legislation offers similar protection. In the United States, restrictions on handling data about individuals apply to government organizations. In Europe, commercial use of data about individuals also is regulated.

²The newly revised Office of Management and Budget Circular A-130 requires each federal agency to detail its activities related to the collection and management of data covered under privacy constraints.

Failure to protect personal data can cause great harm to individuals. Harm can take the form of intrusive direct marketing, unfair zoning practices, inequitable allocation of government resources, erosion of national sovereignty and the rights of aboriginal peoples, and new types of media voyeurism and tabloid television. For example, remotely sensed data can reveal information about an area not available to its residents, eroding their ability to control their resources effectively. The integration of census and realty information can be used to steer members of ethnic groups to specific neighborhoods.

Some practices have frustrated the intent of privacy laws. The requirement for consent of affected individuals has been reduced to a simple notice given when data are gathered. The reduction of waste, fraud, and abuse has become the typical mission-related reason for agencies to collect and share data about individuals. Other laws, such as those permitting the widespread use of Social Security numbers for identification, contradict legislation protecting data about individuals. Because harm often is intangible, it is difficult to establish dollar amounts and collect damages. Suggested solutions include legislation to require agencies to describe clearly the mission-related reasons for holding data about individuals, to require that an individual consent in each instance when personal data are released, and to enact standards of harm with specific dollar amounts that agencies would have to pay for violations. Congress has proposed legislation to correct these inadequacies, but support will be needed to enact such legislation. An approach used in Europe, Canada, Australia, and some states is the creation of federal privacy commissions, supplemented by state and regional groups, to oversee and hear complaints about violations of privacy.

The use of copyright was suggested to protect data about individuals. Copyright gives a producer both economic and privacy benefits. The economic benefit is provided by the monopoly granted to the producer, and the privacy benefit is provided by the First Amendment to the Constitution. The right of free speech includes the right not to speak, and copyright allows producers to limit the dissemination of unpublished works that were generated as self expression or for other limited purposes. Copyright protection could be used to limit data distribution and the purposes for which the data may be used. Copyright also could specify controls on handling the data. Legislation would be required to allow federal agencies to use this method; they are currently precluded from using copyright under a 1977 law.

In summary, an approach is needed that balances the uses of data about individuals against the rights of individuals. For government, there are lawful uses for data about individuals. The private sector can use data about individuals to deliver goods and services more efficiently. However, data

about individuals also can lead to social control and can be used in other harmful ways.

Summary of Current Federal Policies and Policy Trends

Several federal policies related to geospatial data were evaluated. The Office of Management and Budget will issue a revised Circular A-130 soon³. The revised circular will require agencies to protect their investments in data through better planning and management and to release their data at the cost of dissemination. Exceptions may be created by law. Some speakers and participants thought such legislation was desirable. Others suggested that the federal government's budget deficit could cause the government to consider data as a source of revenue.

Circular A-130 instructs Federal agencies to recognize the strategic value of information and the need to integrate data within agencies and between agencies and other entities. Information managers must be strategic partners in accomplishing agencies' missions. Limited, incompatible *stovepipe* (single-purpose) data collection programs and policies continue to persist in federal agencies.

Budget justifications for investments in technology should clearly state the relationship of new technology to agency missions. The benefits and beneficiaries of investment, measures for performance, and means of funding programs should be clearly stated.

Federal standards, such as the Spatial Data Transfer Standard, may be prerequisite to data sharing. Adoption of the standard is progressing, but the true effect of the standard is not known yet. Much work remains to be done on standards.

The changing world situation is causing policy shifts. Economic concerns are displacing military threats. Classified technologies and data are being declassified and commercialized.

Current federal policies and procedures related to procurements must be revised. The time required to procure large systems can be many years. There is increased emphasis on the use of open architectures and commercial sources.

Office of Management and Budget Circular A-16 emphasizes the coordination of geospatial data activities of federal agencies and partnerships with non-federal communities. The diversity of agency missions, enabling legislation, and budget authorization and appropriation responsibilities fragment federal geospatial data activities. The executive branch has made some progress in cutting across federal agencies and in overseeing their activities. The Federal Geographic Data Committee has helped in such efforts, but it needs more clout to improve its effectiveness.

³The revised circular was issued shortly after the forum, on June 25, 1993.

The National Spatial Data Infrastructure

Definition, Organization, and Needs

The NSDI will provide a framework for linking members of the geospatial data community by providing better communication among data users and producers and the ability to find and locate data. Steps to building the NSDI include improving means of communication, developing common procedures and standards, and developing data sharing and production partnerships based on common interests. Contributions must come from all sectors. The evolution of the NSDI will depend heavily on improvements achieved by competition in the private sector.

To be successful, a *national* infrastructure must include participants from government, industry, and academia. The NSDI must accommodate the needs and contributions of many disciplines, each having its own paradigms and languages. There are tens of thousands of potential participants. To work effectively together, participants must have open minds and cooperative spirits. A mechanism through which participants can develop a shared vision, exchange views, resolve concerns, and move forward is vital. A means of determining if the NSDI is on track and on schedule also is important.

Physically, the NSDI will be based on a widely distributed, electronically connected network of organizations, computers, and data. In this environment, the need to adhere to standards will be crucial. The NSDI must be secure, be stable, provide continuity, allow the use of existing data, be able to recover from disasters, and provide some level of guaranteed performance. The NSDI will provide access to all spatially related data, not just maps.

Some participants argued that the NSDI already exists, and that the basic problem is to improve its performance. Others noted that parts of the NSDI may exist, but they are fragmented, and current approaches may not be suitable for the rapidly changing needs, abilities, and composition of the geodata community. Sensitivity to the roles of current participants will be important in developing the NSDI.

Based on discussions at the forum, two models of the NSDI were articulated.

Proponents of the first consider the NSDI to be a thing. They emphasize data sharing. Critical activities are deciding who should lead and what data are needed (including issues of resolution, content, and currentness), designing a business plan, and getting the political support and resources needed to proceed. Effort should concentrate on the subset of geospatial data that support many applications and can be shared.

Supporters of the second model consider NSDI to be a process. Critical activities include developing standards, improving research and education,

and building the means of communication. Sharable data may be by-products of this approach rather than a central concern. The elements required for this approach exist, and the basic problem is to organize them. Participants in the collective enterprise must be committed to its goals and may need to reexamine these goals periodically, but this approach does not require central control or a business plan.

Policies are needed to encourage the development of the NSDI. They must be stable enough to permit investments to be amortized and therefore cannot change every 3 or 4 years. Policy makers must be sensitized to the potential benefits a robust NSDI could yield. Participants must identify the common benefits that would result from the NSDI and overcome the emotional and communication barriers that hinder their ability to work together.

The long-term health of the NSDI depends on education in three areas: educating future professionals, retraining current professionals, and incorporating geospatial data and techniques in elementary and high school curricula. Education can provide a powerful lever for future investments by building a basis of knowledgeable and supportive users. Training needs are especially critical in data access and data quality. These needs are related to the needs for better metadata. Training could be modular and conducted through Internet⁴. Increased availability of improved data would be a major dividend of the investment in training.

Research is needed on many aspects of NSDI. The draft metadata standard is a good first effort, but improvements are needed. An implementation method and field testing must follow, and the standard must be user-oriented. The Spatial Data Transfer Standard provides a framework, but the means of using it are not specified. Models for shared applications must be developed, and applications should shape their development. Research is needed on visualizing geospatial data (especially data quality), and on dealing with uncertainty in geospatial data. Work is needed on data sharing, privacy, liability, and other organizational issues.

The funding needed for NSDI research will be forthcoming only in response to clearly stated needs and it should come from both the private and public sectors. Identifying current support for geospatial research would be a good start. In addition to the academic community, private industry has a tremendous core research ability. This capability will be tapped only if industry finds potentially profitable investments for its research and development efforts.

⁴ A network of networks, Internet is a worldwide web of academic, business, and government electronic communication networks connected through a common suite of protocols.

Leadership

A common complaint was the absence of a focal point for organizing and rallying political and policy support for the NSDI. NSDI, when compared with issues such as health care and education, is not in the mainstream of national consciousness. Yet the backing of policy makers is vital to the success of the NSDI. Support will grow when policy makers understand the contributions the NSDI can make to resolving mainstream issues. Support from technologists will not be sufficient. In addition, the relationship of the NSDI to other national programs, such as the National Information Infrastructure must be more clearly articulated.

Leadership is needed to provide a vision for the NSDI, and to unify the disparate parts of the geodata community. Leadership also will be needed to help the community resolve the difficult issues encountered in developing and financing the NSDI, determining the roles and responsibilities of members of the geodata community, and resolving conflicting goals within it. At a minimum, a forum where participants can raise and resolve issues is needed. Without such a forum, separate geographic, disciplinary, and other islands of development will continue to emerge, but the critical mass needed for the NSDI to evolve will not be achieved.

The cry "Who's in charge?" was repeated several times. The need for a single group to provide leadership was asserted. Others asked if it was sensible to believe that any one person or group could take charge. Of greater priority are developing trust, removing barriers, improving communications, and establishing standards. For example, although Internet evolved with some funding and guidance from the National Science Foundation, it is largely a grass-roots effort of thousands of organizations.

Three alternatives for NSDI leadership were offered: federal leadership, federal leadership with the advice of representatives from the non-federal community, and an alliance composed of representatives of different sectors of the geodata community.

The experience of other nations, such as Sweden and the Netherlands, the European Community, and in various states may provide guidance on how to proceed.

Data Template

Of fundamental importance to the NSDI are data that provide a basic description of the landscape. These key data are referred to as the *topographic template* or *core data*. This template provides a base to which attribute information can be attached and thematic data sets can be registered or from which other data sets can be derived. The template provides a spatial context, permits spatial queries, and provides the glue that permits disparate data sets to be used together.

The geospatial data that form the template must be nationally consistent, available at different resolutions (for different regions and within one region), current, in digital form, relatable to other data, and used ubiquitously. The United States has several different, unrelated data sets that meet some of these criteria, and a clearer definition of the template is needed. One suggestion was that the template be comprised of geodetic control or other positioning aids, digital elevation data, and digital orthophotography. Another suggestion was that street centerline data with addresses, cadastral data, or hydrology data be included.

Template data must be kept current. Local governments and entities such as utilities often know of changes first, but individually they are responsible for only small parts of the country. Federal and state governments are responsible for larger areas and are more accustomed to integrating data, but they often do not require the detail needed by local authorities and are not aware of changes at local scales. A process is needed that receives the contributions of local authorities, processes their data, and adds them to the template. This approach harnesses the best abilities of the potential partners.

Outlook

The challenge of creating the NSDI is enormous. The NSDI can be considered to be supported by three pillars: data, technology, and organizations. Two pillars, data and technology, enable the country to realize the best return on its investment. The dynamic natures of data and technology stand in sharp contrast to the conservative nature of the third pillar— institutions—which often respond sluggishly to change. The institutional pillar is composed of many groups and organizations, each motivated by different purposes and contributing to the NSDI in different ways.

Partnerships and standards development are two major strategies for promoting development of the NSDI. Partnerships will succeed only in an environment of cooperation, understanding, and willingness to share benefits and risks. Standards provide the technical means to work together. To be a help rather than a hindrance, standards must fill a void, be timely, and reflect industry trends.

Policies for creating the NSDI must respond to the evolving roles of the private and public sectors, the pricing of data, liability regarding data, and protection of information about individuals. Forum participants disagreed about most of these issues, especially over the pricing of public data. Public policy formulation in a democracy is an exercise in compromise.

As to the NSDI itself, much work will be needed to define its benefits more precisely, obtain political support and funding, and understand the

roles and responsibilities of participants. Most importantly, an arena is needed where participants can discuss the complex and sometimes conflicting needs identified during the forum, identify courses of action, establish partnerships, and build the NSDI.

To move that process forward, the forum organizers agreed to sponsor future meetings at which participants can continue the discussions, define specific roles, and develop plans for implementing the NSDI.

Appendix A

SESSION TOPICS AND SPEAKERS

May 10, 1993

Master of Ceremonies

Dallas L. Peck, U.S. Geological Survey, 101 National Center, Reston, Virginia 22092; 703-648-7411.

Keynote Address: *The National Spatial Data Infrastructure*

Michael Nelson, Office of Science and Technology Policy, Executive Office of the President, Washington, D.C. 20500; 202-395-6175.

Summary of Mr. Nelson's Remarks: Policies required for the NSDI span the spectrum of the national information infrastructure proposals. The Clinton Administration outlined its vision of the role of technology in the country's economic future in the February 22, 1993, report *Technology for America's Economic Growth, A New Direction to Build Economic Strength*.

The development of world class technology is critically important to economic growth. Government will aid the evolution of this technology by funding technical research and development, establishing a world class business environment through tax and regulatory policies that encourage investment and business, encouraging more and better education of scientists and engineers, and investing in the information infrastructure needed for the 21st century.

These investments include working with industry to fund hardware, software, communication network development, and training; supporting information infrastructure technology and application programs; and making the infrastructure accessible throughout the economy. Reforms are needed in telecommunications policies to establish a stable regulatory environment appropriate for modern technology that will encourage the private sector to deploy these technologies.

Efforts to reinvent the federal government are underway through the National Performance Review, being lead by Vice-President Gore. Information technologies are considered to be the key to large gains in productivity. Also of interest is better dissemination of federally held data. The country currently has "silos of data, yet ignorance persists everywhere" because we lack means by which the public can find and access those data. The country needs to make better use of its investment in data.

Plenary Session: *Trends in Spatial Data and Networking*

David Rhind, Director General, Ordnance Survey, Ramsey Road, Maybush, Southampton SO9 4DH, United Kingdom; 44 07 03 792559.
John Gage, Director, Science Office, Sun Microsystems Computer

Corporation, 2550 Garcia Avenue, MS/UMTV 29-230, Mountain View, California 94043-1100; 415-336-0553.

Panel Discussion: *Policy Trends in Infrastructure, Data, and Networks*

Questions for Panelists: Based on the trends in information infrastructures, spatial data, and networks described by Messrs. Rhind and Gage, what policies currently in place contribute to effective and productive development and use of geographic information technologies? What policies require changes to be more effective? What new policies must be developed? How are information technology policies currently established? What are public and private sector roles in creating these policies? Are current practices adequate? How should they be changed? What are the policy development or implementation steps that need to be taken right now to improve the development and use of geographic information and associated technologies in public agencies and the private sector?

Tom Hewitt, Federal Sources, 7926 Jones Branch Drive, Suite 1000,

McLean, Virginia 22102; 703-883-1991, *moderator*.

JayEtta Hecker, General Accounting Office, 441 G Street, NW., IMTEC-Tech World, Washington, D.C. 20548; 202-512-6451.

Dr. Kenneth Daugherty, Defense Mapping Agency, 8613 Lee Highway, Fairfax, Virginia 22031-2137; 703-285-9138.

Bruce McConnell, Office of Management and Budget, Old Executive Office Building, Washington, D.C. 20502; 202-395-3785.

Dr. Ray Williamson, U.S. Congress, Office of Technology Assessment, 600 Pennsylvania Avenue, SE., Washington, D.C. 20510; 202-228-6448.

Panel Discussion: *Public Perspectives on Policies Affecting Development and Use of Geographic Information*

Questions for Panelists: What are the major policy challenges faced by your organization that affect your ability to use geographic information technologies successfully? What are the critical factors to successful use of geographic information technologies? What factors most impede your ability to use geographic information technologies? How critical is cooperation with other organizations in your use of geographic information technologies? What are your concepts of the value of a NSDI? What carrots and sticks are needed to ensure cooperation? Who should be responsible for developing the NSDI? How should the NSDI be funded?

Dr. Jerry Mechling, Programs on Strategic Computing and Telecommunications in the Public Sector, John F. Kennedy School of Government, 79 JFK Street, Cambridge, Massachusetts 02138; 617-495-3036, *moderator*.

Honorable Richard J. Varn, Iowa Senate, 3163 Sandy Beach Road, NE., Solon, Iowa 52333; 319-363-9196.

Honorable Randy Johnson, Commissioner, Board of Hennepin County Commissioners, A-2400 Government Center, Minneapolis, Minnesota 55487-0240; 612-348-3088.

Dr. John Bossler, Ohio Center for Mapping, 1216 Kinnear Road, Ohio State University, Columbus, Ohio 43212; 614-292-1612.

Doyle G. Frederick, U.S. Geological Survey, 102 National Center, Reston, Virginia 22092; 703-648-7412.

Michael F. Goodchild, University of California, National Center for Geographic Information and Analysis, 3500 Phelps Hall, Santa Barbara, California 93106-4060; 805-893-8049.

Panel Discussion: Private Sector Perspectives on Policies Affecting Evolution of the National Spatial Data Infrastructure

Questions for Panelists: What is the role of the private sector in development of the NSDI? How is specific private sector participation determined? What are the effects of existing policies on private sector development, marketing, and use of geographic information technologies? Is there need for a geographic information industry association to consolidate private sector views for interaction with the public sector? Could an NSDI alliance foster public-private cooperation?

Robert Marx, Geography Division, U.S. Bureau of the Census, Washington, D.C. 20233; 301-763-5636, *moderator*.

Lawrence Ayers, Intergraph Corporation, 2051 Mercator Drive, Reston, Virginia 22091; 703-264-5717.

Jack Dangermond, Environmental Systems Research Institute, 380 New York Street, Redlands, California 92373; 714-793-2853.

Barry Ingram, Electronic Data Systems, 13600 EDS Drive (A25-A53), Herndon, Virginia 22071; 703-742-2634.

Peter Marino, E-Systems, P.O. Box 660248, Dallas, Texas 75266-0248; 214-661-1000.

Joyce Rector, PlanGraphics, Inc., 202 West Main Street, Suite 200, Frankfort, Kentucky 40601-1806; 502-223-1501.

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May 11, 1993

Master of Ceremonies

David A. Nystrom, U.S. Geological Survey, 519 National Center, Reston, Virginia 22092; 703-648-4637.

Plenary Session: *Status and Current Activities of the National Spatial Data Infrastructure*

NSDI Concepts, Contents, and Participants

Nancy Tosta, U.S. Geological Survey, 590 National Center, Reston, Virginia 22092; 703-648-5725.

Standards, Private and Public Sector Perspectives

Cliff Kottman, Intergraph Corporation, 2051 Mercator Drive, Reston, Virginia 22092; 703-264-7120; and Stephen Guptill, U.S. Geological Survey, 519 National Center, Reston, Virginia 22092; 703-648-4520.

Large Data Base Management Issues—EOSDIS

Judith Feldman, Hughes Applied Information Systems, Inc., Space and Communications Group, 7375 Executive Place, Suite 100, Seabrook, Maryland 20706; 301-805-0332.

Data Base Maintenance

Robert Marx, Geography Division, U.S. Bureau of the Census, Washington, D.C. 20233; 301-763-5636.

Panel Discussion: *Issues of Public Access to Data, Data Fees, and Copyrights*

Questions for panelists: What effects are information technology policies having on access to information? When should data fees be charged? How are these fees set? How does electronic access to information affect fees and fee-setting practices? If data fees are charged, must data use be policed? Who does this? What data are copyrightable? How are electronic copyrights protected? What policies are necessary to ensure availability of geographic information to the maximum number of appropriate users?

Ed Spar, Council of Professional Associations on Federal Studies, 1429 Duke Street, Suite 402, Alexandria, Virginia 22314-3402; 703-836-0404, *moderator*.

Duncan M. Aldrich, University of Nevada Libraries, Reno, Nevada 89557-0044; 702-784-6579.

Hugh Archer, South Carolina Water Resources Commission, 1201 Main Street, Suite 1100, Columbia, South Carolina 28201; 803-737-0067.

Michael Blakemore, National Online Manpower Information System (NOMIS), Unit 3P, Mountjoy Research Center, University of Durham, Durham DH1 3SW, United Kingdom; 44 091 374 2468.

James Love, Taxpayer Assets Project, Center for Study of Responsive Law, 12 Church Road, Ardmore, Pennsylvania 19003; 215-658-0880.

Steven Metalitz, Vice President and General Counsel, Information Industry Association, 555 New Jersey Avenue, NW., Suite 800, Washington, D.C. 20001; 202-639-8262.

Scott Cameron, Office of Management and Budget, New Executive Office Building, Washington, D.C. 20503; 202-395-6822.

Luncheon Speech

Introduction

Allen Watkins, U.S. Geological Survey, 516 National Center, Reston, Virginia 22092; 703-648-5747.

Honorable George Brown, Jr., U.S. Congress, 2300 Rayburn House Office Building, Washington, D.C. 20515-0542; 202-225-6161.

Summary of the Remarks: Geographic information systems hold great promise for improving the ability to extract new meanings from data. The technology is just starting to scratch the surface of its potential. Geographic information systems and related data, such as those captured by satellites, provide a means through which institutions can work together that will proliferate in everyday use.

Geographic data are vital to decision making based on information instead of guesswork. In the United States, decisions requiring geographic data are made by thousands of local governments, small businesses, and individuals. Access to data and sharing them are critical in this decentralized environment. Lack of access to data, and the related issues of data copyright and pricing, are the greatest barriers to achieving the promise offered by the technology. These issues must be resolved for the geographic information systems revolution to succeed, and the solutions must involve federal, state and local governments and the private sector. The basic questions are (1) whether the rewards of increased access are greater than the revenues generated by sales of data, and (2) whether access to data yields better decisions. Congressman Brown offered a personal observation that improved access yields greater rewards and better decisions.

Efforts to commercialize the Landsat program offer a case study to consider in developing the NSDI. Arguments were made that the private sector was best positioned to ensure that the products of the program would meet the needs of the market. The federal government was urged to restrict its efforts to developing standards, supporting research and development, and providing an infrastructure for data dissemination. Experience proved that conditions were not as tidy as predicted; the market was not large enough and needs were not met. In response to this experience, Landsat 7 was justified on the basis of the federal government's global change and national security programs. The data will be made widely available to others. This approach is not unique to the United States; all other nations subsidize their remote sensing programs.

Panel Discussion: *Liability, Privacy, and Confidentiality Issues Related to Geographic Data*

Questions for panelists: Who is liable for the accuracy of geographic information? Who can be held liable in the case of damages? How do liability and privacy policies affect the availability, distribution, and use of geographic information? Is it possible to protect privacy? What are the best ways to do so? Are there technical impediments to protecting confidentiality and privacy in electronic networks? How might the impediments affect development of the NSDI?

Harlan J. Onsrud, National Center for Geographic Information and Analysis, 5711 Boardman Hall, University of Maine, Orono, Maine 04469-5711; 207-581-2175, *moderator*.

William E. Baugh, Jr., Assistant Director Information Management Division, Federal Bureau of Investigation, Ninth and Pennsylvania Avenue, NW., Room 5829, Washington, D.C. 20535; 202-324-3000.

Jacob Frank, Vice President and General Counsel, Data General Corporation, 4400 Computer Drive (A212), Westboro, Massachusetts 01580; 508-366-8911.

Julien Hecht, Law Offices of Miles and Stockbridge, 10 Light Street, Baltimore, Maryland 21202; 410-727-6464.

Wayne Madsen, Computer Sciences Corporation, Integrated Systems Division Headquarters, P.O. Box 302, Moorestown, New Jersey 08057; 609-231-9709.

Shari Steele, Electronic Frontier Foundation, 666 Pennsylvania Avenue, SE., Suite 303, Washington, D.C. 20003; 202-544-9237.

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May 12, 1993

Master of Ceremonies

David A. Nystrom, U.S. Geological Survey, 519 National Center, Reston, Virginia 22092; 703-648-4637

Panel Discussion: *Partnerships in the Development of the National Spatial Data Infrastructure*

Questions for panelists: What partnerships are necessary for development of the NSDI? What policies are needed to foster these partnerships? What are public and private sector roles in establishing and maintaining the NSDI? What steps must be taken now to develop the NSDI? What incentives contribute to successful partnerships? What actions or activities cause partnerships to fail?

Randy Murphy, Administrative Services, Lake County, 18 North County Street, Waukegan, Illinois 60085-4357; 708-360-6672, *moderator.*

John Antenucci, PlanGraphics, Inc., 202 West Main Street, Suite 200, Frankfort, Kentucky 40601-1806; 502-223-1501.

John Lutz, Knoxville/Knox County GIS, City/County Building, 400 West Main Street, Room L1-03, Knoxville, Tennessee 37902; 615-521-2641.

Richard Taupier, National States Geographic Information Council, Executive Office of Environmental Affairs, 100 Cambridge Street, Boston, Massachusetts 02202; 617-727-9800 extension 260.

Dan Toohey, Intelligent Vehicle-Highway Systems (IVHS) America, 176 Massachusetts Avenue, NW., Suite 510, Washington, D.C. 20036; 202-973-7872.

Captain Melvyn Grunthal, National Geodetic Survey, National Ocean Service, National Oceanic and Atmospheric Administration, 1315 East-West Highway, SSMC 3, Station 9553, Silver Spring, Maryland 20910; 301-713-3222.

Panel Discussion: *Conference Review and Where Do We Go From Here?*

Questions for panelists: Based on what you have heard during the forum, what are the key policy debates relative to the NSDI? What options exist for resolving these debates? Who is responsible for implementing these options, and what are critical first steps?

Gene A. Thorley, U.S. Geological Survey, 590 National Center, Reston, Virginia 22092; 703-648-5743, *moderator.*

Joseph Astroth, Electronic Data Systems, 13736 Riverport Drive, Maryland Heights, Missouri 63043; 314-344-8423.

Michael F. Goodchild, University of California, National Center for Geographic Information and Analysis, 3500 Phelps Hall, Santa Barbara, California 93106-4060; 805-893-8049.

Clifford W. Greve, U.S. Geological Survey, 516 National Center, Reston, Virginia 22092; 703-648-5753.

David Rhind, Director General, Ordnance Survey, Ramsey Road, Maybush, Southampton SO9 4DH, United Kingdom; 44 07 03 792559.

Appendix B

NATIONAL GEO-DATA POLICY FORUM PROGRAM COMMITTEE

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