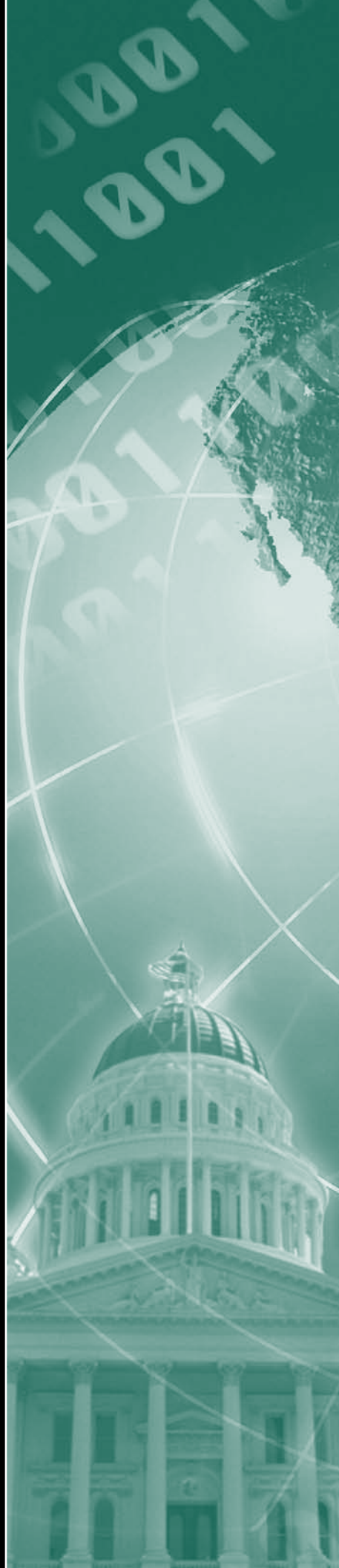
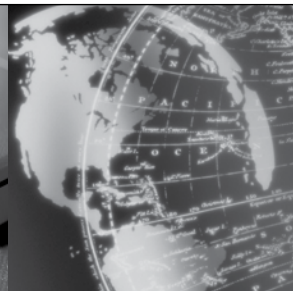
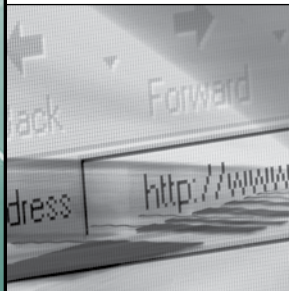


PLACE MATTERS:

Geographically Enabling Government



Introduction: Strategy to Improve Public Service

Government is constantly changing to improve organization and services to the governed. An important element of such change is the identification and application of systems and tools to support the governance process. Over the past few decades, information technology (IT) systems have significantly improved both the effectiveness and efficiency of government service delivery. In particular, the Internet has brought a commonality to existing technical infrastructures and extended their value to new channels, thereby creating the opportunity to conduct the people's business in new ways.

Identifying and extending commonality across the enterprise (IT) investment portfolio is the road to the Promised Land for today's information technology executives. At all levels of government, significant investment is being made to further implement Service-oriented Architecture (SOA) as a framework for establishing application independence from information technology while maintaining compliance with IT standards and systems.

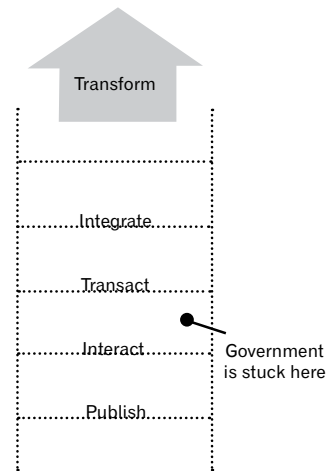
In the mid-1990s, P.K. Agarwal, director of California's Department of Technology Services, created what has since become known as "P.K.'s Ladder," an operational progression toward e-government that developed over time into PITIT – Publish, Interact, Transact, Integrate, and Transform. The lower rungs were relatively easy to mount but the climb has become more difficult with each step. Unfortunately, many governments seem to have gotten stuck between interact and transact.¹

At the same time, the importance of integrating location-specific components into government systems of all types is increasing. The addition of a location component together with a broad array of associated attributes brings a context and specificity to government information that makes it more useful for all consumers, from policymakers to the general public.

This paper will explore opportunities to leverage the ubiquity of the Internet, investment in Service-oriented Architecture and

progress toward e-government transformation through the integration of enterprise level, server-based geospatial technology.

P.K.'s Ladder or PITIT: Publish, Interact, Transact, Integrate and Transform



Definitions: Coming to Terms with Server-Based GIS Consolidation

GIS

Geographic information systems are an organized collection of computer hardware, software, geographic data, and personnel designed to efficiently capture, store, update, manipulate, analyze and display all forms of geographically referenced information.

SOA

A Service-oriented Architecture is a collection of services that communicate with each other. The services are self-contained and do not depend on the context or state of the other service. They work within distributed systems architecture.

COP

A common operating picture is a geospatial display that serves as a common repository of information for decision-makers based on the critical organizational processes of information management, knowledge creation, sense-making and decision-making.

SERVERS

Servers are computers that share resources (applications, files) with other computers (clients) on a network. For example, a Web server will send resources (Web pages, images, sounds) in response to requests from a Web browser (i.e., Netscape Navigator).

CONSOLIDATION

Consolidation is the reversal of server sprawl (caused by the rapid addition of servers by growing organizations and which creates new layers of cost in terms of capital and people needed to operate, manage, and upgrade new servers). Consolidating physical systems and the servers on which they operate helps organizations lower total cost of ownership of servers, optimize server utilization, increase operational efficiency and improve manageability.

GIS for Governmental Planning, Response & Service Delivery

People have long appreciated the power and visual nature of a wave and today's waves are not confined to the seashore. News reports cover waves of immigrants, economic waves, waves of terrorism and waves of disease such as Mad Cow or Bird Flu. How significantly we are affected by any particular wave depends largely on our location and a progression of time; factors of interest to individuals, but critical components of government planning, response and service delivery. Today, events, people, timelines and maps are the defining elements of government action. Hurricane Katrina proved to be a tragic and expensive demonstration of how critical it is to have timely and accurate information available to policymakers when the wave breaks, no matter what kind of wave it is.

President Bush, in talking about federal government preparations for a possible pandemic flu outbreak, says this: "By creating systems that provide continuous situational awareness, we're more likely to be able to stop, slow, or limit the spread of the pandemic and save American lives. To respond to a pandemic, the American people need to have information to protect themselves and others."²

Server-based geographic information systems (GIS) create the ability to integrate information from a wide variety of systems and deliver the kind of critical situational awareness the president is calling for.

Dr. Clare Broome, Senior Advisor to the Director of the Centers for Disease Control and Prevention, told a Congressional subcommittee in 2004, "the earlier an event is identified and understood, the sooner it can be contained and further cases prevented. Recently, the varying international experiences with SARS demonstrated how large a problem can develop when a communicable disease is not responded to quickly and disease spread occurs."³

Outbreak management involves a series of activities that need to occur at the local, state and federal levels once a disease event has been identified. Information technology is especially useful in managing the information about an event, such as the number of possible cases, the identification of possible exposures, and common locations where a disease agent may have been spread.⁴

The need for accurate, timely, location-specific information applies to any significant event where trend analysis and prediction inform planning and response. By incorporating specific data about when and where an event has taken place, geospatial systems are able to literally create a picture of the current situation and offer alternative scenarios for the future.

At-A-Glance: Value Proposition of Server-based GIS Consolidation

- Shared systems across multiple agencies and jurisdictions
- Once-redundant software components, application functionality and data become shared resources
- Optimization of capital expenditures
- Reduced footprint in hosting environment, reducing floor space and power needs
- Simplified architecture
- Reusable software components
- Added flexibility and resiliency
- Savings in software licensing
- Lowered cost per CPU

Collaboration Among Governments: *Formerly Discrete Public Entities Tied Together Through Shared GIS Repository*

Public entities' ability and need to share data at the federal, state and local levels is not limited to times of national crisis. In fact, sharing spatial data has opened doors to more general data sharing, become a model for intergovernmental cooperation and helped put aside historical turf issues. Jared Shoultz, director of the Division of Public Health Informatics at the South Carolina Department of Health and Environmental Control, says that the GIS community is not territorial, at least in one important respect: "It's my data, stay away," is not something you will hear from professional GIS people."⁵

A 2005 National Governors Association issues brief entitled *The View from the IT Industry — What States Can Do to Improve*

Government Efficiency and Service Delivery highlights several environmental projects that demonstrate interstate cooperation. Delaware, New Jersey, New York and Pennsylvania have each implemented the Delaware Bay Project, which pulls together live, up-to-date information from each state and presents it visually on the Internet, with interactive tools to query the data and generate custom maps. Illinois, Indiana, Kansas and Ohio partnered to pool data in real time on the Internet to help environmental scientists analyze carbon dioxide levels in soil. Soil samples were collected using handheld GIS technology to record the time, date and location from where the sample was taken.⁶

Extending the Value of Mission-Critical Systems

Since its inception, the central theme of digital government has been transforming the citizen experience. Moving people from "in line" to "on-line" expanded the capacity of government. The migration of government to Internet architectures and infrastructure extends the value of the mission-critical systems that support the core functions of government. Government's capacity has conventionally been defined in terms of human and physical resources, supported by a patchwork of technologies that have grown up around various processes.⁷

Some leading jurisdictions are now finding that server-based GIS allows them to increase their capacity by making it possible to easily integrate with legacy technologies. To put it more directly, server-based GIS (also known as server GIS) allows governments to extend the value of existing mission-critical systems, and creates the opportunity for governments to take full advantage of investment in existing GIS databases.

For example, the city of Philadelphia began working hard in 2000 to revitalize neighborhoods through residential housing and business development. The mayor asked his information service staff to build upon the existing city investment in GIS and create self-serve online tools for

residents and businesses. The solution needed to be shared between different departments and organizations working with the city, but not require GIS expertise to successfully operate the analysis.

With the help of a commercial partner, Philadelphia created a Web-based economic development tool that helps users make decisions about where to develop a business site, based on a set of geographic decision factors. The system uses GIS server software, which connects Web applications to powerful geo-processing tools and functionality. Users are given a menu of geographic priorities such as proximity, transit lines or business districts, and are able to determine whether the site is in an economic incentive zone or wireless Internet coverage area. System users are also given a menu of various demographic factors such as age, per capita income and educational attainment. Based on this menu of decision factors, users weigh their preferences by giving some factors high "prefer" scores or other factors low "avoid" scores, or leaving other factors neutral. After weighing these factors, users are presented with a map showing hotspots, or the most desirable business locations. Users can pan and zoom on the map from a citywide overview to a street-by-street analysis.⁸

Indianapolis & IndyGIS

The city of Indianapolis and Marion County continue to build on two decades of experience in re-imaging government through server GIS. IndyGIS is a mature software system that has been in existence since 1986. In 2004, the city implemented a Customer Relationship Management (CRM) system and call center that accepts 1,300 calls per day or approximately 300,000 calls per year. Residents can request services or information regarding pothole repairs, snow removal, zoning violations, stray animals and trash pickup. Citizens can submit and view service requests online and are notified via e-mail about the status of their request.

To support this effort, the city implemented a server GIS solution that employs Services-oriented Architecture (SOA). This strategy allows the city to directly integrate six enterprise databases operating within a Storage Area Network (SAN), and uses Simple Object

Access Protocol (SOAP) and Extensible Markup Language (XML) Web services with the call center CRM system. The use of a SOAP/XML Web service means that the functionality can be used in other applications without modification. Server GIS adds a location element to every service request or information query, creating a geographic advantage that the call center can leverage into shorter response times for work crews, spatial analysis of service requests, and providing up-to-date, high quality maps that display the service request information.

As a result, the city has seen an increase in management efficiency, accurate call facilitation and management, and can better determine how service requests were resolved.⁹

An Architectural View of GIS: *Server GIS & Service-oriented Architecture: Present. Transform. Involve.*

Subject Matter Experts Use Desktop Systems to Develop & Publish Server GIS Content

Historically, desktop client/server-type GIS applications have been very valuable to government. In fact, desktop GIS may still be the context most familiar to many people. However, GIS today is used not only on the desktop but also in centralized database management system (DBMS) environments that support multiple GIS users. Server GIS software takes users beyond the traditional function of creating a query and receiving a response. With server GIS, subject-matter experts are able to update and edit databases and initiate, review, alter and re-run sophisticated GIS processes. All of these typical desktop functions are now available through a browser interface. Simplified access has moved GIS out of the realm of technical experts and made it now easily available to everyone.

Desktop GIS: To the Enterprise & Beyond

As governments integrate location-specific capabilities into information systems, architectures are becoming more networked and service oriented. Under a Service-oriented Architecture model, server GIS and other IT services are delivered via the same standards-based Web

services and messaging protocols, such as XML and SOAP, used in mainstream business and enterprise computing frameworks.

Connecting Data to Place Gives Context to Government Transparency

Now that people with Internet access routinely view driving direction maps and satellite images of their neighborhoods, they are beginning to understand the true power a geographic information system has to create a big picture of meaningful associations. The information contained in spatial interrelationships — human behavior, economic activity, community infrastructure and natural resources — are examples of the variables that figure into public policy decisions. Putting these variables in proper balance provides answers to questions such as, where should the new airport be built? Which homes are in a flood zone? What will be the boundaries of the new school district? How can reductions in the snow removal budget be implemented fairly and with the least disruption to traffic flow? Using integrated enterprise GIS to help answer such questions begins to provide meaningful context to government transparency and public information.

Orchestrate. Integrate. Collaborate.

Enabling Transactions through Web Services & Efficient Updating & Editing of Databases

As P.K.'s Ladder demonstrates, government has found it difficult to move up the ladder from publishing and interacting to robust and meaningful transactions. Server-based GIS gives government the ability to create centralized applications that are affordable and easy to install, upgrade and maintain, and make them available via shared Web services.

Browser Interfaces Make GIS Invisible to the Consumer

The complexities of GIS processing can be essentially eliminated for the consumer. Server-based GIS makes it possible to run applications from a browser or thin client, thereby making the viewing, printing and basic application operation invisible to users.

The state of Minnesota captured its GIS integration philosophy in the *GIS Enterprise Conceptual Architecture Design* released in 2004. The state describes its efforts to integrate GIS services this way:

The overarching goal of this effort is to establish an efficient mechanism to leverage existing resources and readily share information while empowering agencies to be responsible stewards of their own data. The 'system' is an Internet-based confederation of resource providers and consumers brought together through a centralized coordination function; similar to a 'yellow pages' of geospatial data and other resources. It leverages past investments in spatial data but does not require the aggregation or centralization of data or functionality. Using a simple browser interface, consumers find services then directly interact with the resource providers.¹⁰

Business Logic. Transact. Engage.

Web Services Are the Next Generation of GIS Technology

At the enterprise level, a central GIS takes advantage of the shared data management capabilities of DBMS (Database Management Systems) technology. However, some GIS users, particularly those engaged in multi-jurisdictional efforts, may need more than centralized systems for information sharing and collaboration. Recently, some users have begun using GIS Web services for data sharing and Web publishing. Specific user communities have established formal frameworks and participate in National and Global Spatial Data Infrastructures (NSDIs and GSDIs). These loose federations share GIS content and processing logic through GIS portals on the Web.¹¹

Back-Office Processing of Enterprise GIS Databases

Server GIS adheres to IT standards, so it is easy to rapidly GIS-enable many current business systems and applications, thereby creating more opportunity to extend the useful life of IT investment. Interoperability and compatibility with enterprise architectures is supported for a variety of programming languages, databases or commercial off-the-shelf (COTS)

applications. Examples include tax assessment, transportation monitoring, environmental monitoring, permitting and CRM and enterprise resource planning (ERP) applications.¹²

Internet Delivery of Comprehensive GIS Functionality

Leading organizations have learned that adopting an enterprise approach to planning, acquiring and using GIS tools provides an opportunity for organizations to get more for their GIS dollar. In some instances, multiple jurisdictions have come together to share the costs of infrastructure and data, resulting in lower costs for all. Concurrently, the interrogation and presentation of geospatial data came to the Internet, effectively democratizing GIS to a universe of users well beyond the original constituency of experts.

While the Internet opened up the world of "smart maps" to users from the outside in, public agencies from tribal, local, state and federal governments had been working for years to open access to rich geospatial resources from the inside out.

Integrate. Consolidate. Centralize.

Enterprise Server & Database Consolidation is Well Underway

Public officials work daily to make better decisions, create more livable communities and meet the expectations of the public, all on a budget. Integrated and consolidated GIS can do much to help accomplish these goals — but only if it is affordable.

Pierce County, Wash. has known for some time that making GIS affordable means making GIS part of a consolidated and centralized service delivery strategy. Linda Gerull, Pierce County GIS manager, explains. “A central GIS data resource can more efficiently support the organization and deliver tools to use the data than scattered GIS experts in departments,” Gerull says. “Reviewing data redundancy, data incompatibility and data inaccessibility is one way to justify an enterprise GIS. The benefit comes from sharing and combining resources, not from ‘stove pipe’ mapping solutions for specific needs.”¹³

Pierce County learned that by centralizing infrastructure and consolidating servers, much of the cost can be driven out of GIS for the customers they serve in 25 county departments and 10 subscribing agencies. A few years ago, Pierce County had 27 GIS machines with 45 CPUs, their hardware had reached operational capacity and it was all they could do just to maintain the machines. If GIS users wanted another application, the county had to buy another server. After three years of patchwork management, the county discovered it had three different operating systems, three different middleware solutions with different versions of GIS running, and a maintenance and support nightmare. Any common maintenance function, such as adding security patches, was problematic and could lead to unexpected downtime.

Gerull and her counterparts quickly realized that to adequately support customers, they would need a more robust infrastructure and simplified and consolidated hardware architecture. Pierce County was able to reduce the number of devices used while increasing capacity and reducing complexity.

Linda Gerull says blade server technology was key to the strategy, adding capacity while consolidating what had been server proliferation. “Our configuration is now transitioning to four blade centers (56 CPUs) for applications, two eight-ways for the central database, a development server and a new 6 terabyte storage system with tape backup,” she explains. “We will maintain several of the existing ... machines for applications that need special security.”

Gerull says the county has realized both qualitative and quantitative benefits through the migration:

Machine count alone tells only part of the story. We are expecting to save about \$3 million over three years. The savings come

*from staff savings, capital expenditure as well as software licensing. We’ll be able to consolidate our licensing. Additionally, we will save on power and floor space. We have a shortage of floor space and power in our data center. The blade centers are so compact in their design and architecture that we have dramatically decreased our floor space and power needs. It has been such an improvement to our responsiveness and ability to make adjustments quickly. A lot of times, we get in a situation where we have to do something quickly, and it has allowed us the ability to do that.*¹⁴

The experience in Pierce County is a harbinger of what lies in store for other jurisdictions willing to make similar changes. For its part, the city of Mesa, Ariz. is another that is benefiting from GIS infrastructure consolidation. Jason Bell, an IT services leader, believes that by moving to a consolidated environment, Mesa will ultimately be able to reduce their licensing expense by nearly 75 percent.¹⁵

Benefits Accrue from Integration, Database Sharing & Centralized Data Management

The state of Wisconsin enthusiastically adopted the enterprise approach to GIS, recently creating a geographic information officer (GIO) position to lead the statewide coordinating body for Wisconsin Enterprise Geographic Information System (WEGIS) services. Wisconsin believes that delivering GIS services in an enterprise fashion will improve critical services to state agencies and citizens at an overall lower cost by sharing infrastructure (hardware and software), resources (people), and processes across state agencies.¹⁶

Extending the Life & Usefulness of Databases, Applications & Workflow

States are seeing that a consolidated GIS repository can serve as the foundational technology for public service innovation. The South Carolina Community Assessment Network (SCAN) is an interactive data retrieval system for community assessment, planning and health practices managed by the state Department of Health and Environmental Control. The SCAN structure provided the means to meet their original goal: making statewide public health data available to policy officials and the public.¹⁷ However, South Carolina is not stopping there. They have a broader goal.

Health control not only deals with disease and environment; it also extends to complex social, economical and political issues. The flexibility of GIS allows it to address all these issues and communicate to various

audiences in a single format. Adapting GIS and making it available to the people of South Carolina fits the mission of the division: "To provide the right information to the right people in the right time and format."¹⁸

An example of that mission in action is the South Carolina Emergency Management Shelter Tracking Application. Through this application, the state provides emergency management support to both professional emergency managers and the general public. For example, during a hurricane or other emergency situation, people are provided with a map of their neighborhood, a list of open shelters that can accommodate more people and driving instructions from their home address. State emergency managers, American Red Cross officials and others with appropriate system privileges are able to designate shelters as open or closed, show

occupancy and staffing levels, designate new shelters in an emergency and add them to the tracking system, and even create a list of shelter inhabitants. Lessons learned recently from Hurricane Katrina have shown how important it can be for officials to know where and who (by name) has evacuated.¹⁹

The application removed bureaucratic complexities and brought different agencies together on a common platform. It enhanced interagency coordination and made decision-making processes easier and faster by providing real-time updates and changes. The general public has the ability to be much more rapidly prepared to face an emergency situation, thanks to the foundation created by the SCAN system.²⁰

Data. Publish. Display.

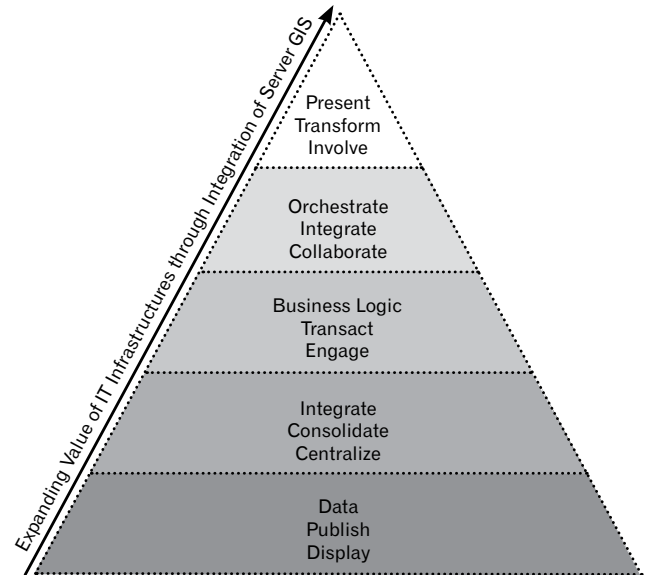
Government is Often Data Rich but Information Poor

The South Carolina SCAN system is also a good example of how an integrated GIS creates a whole greater than the sum of its parts. SCAN ties the state and all of South Carolina's counties together through a single system and provides interactive, real-time access to public health statistics online. Users can tailor information to specific needs from one of the available data sets and produce tables, maps, charts, trend-lines and bar charts accordingly.²¹

Jared Shoultz sees it this way: "GIS is not something to be added at the end; it should be considered at the beginning when systems are first designed."²²

When GIS capability has been appropriately integrated, government has been able to greatly improve decision-making and service delivery in a wide variety of areas. Internet mapping is now a foundational piece of building permit systems, public safety crime incident analysis, fire infrastructure management and business license issuance and management.²³

Service-oriented GIS



Conclusion: Delivering Public Service with Server GIS

The idea that geographic information systems are closed, proprietary systems is no longer valid. GIS has become a foundational technology and is now relied upon by the public sector to inventory assets, identify sociopolitical boundaries, classify land use, create maps and support decisions and plans. Geographic information is widely distributed on the Web and routinely integrated into thousands of applications and services. Enterprise GIS platforms conform to open standards and enterprise IT frameworks so users can incorporate GIS in any application, on a variety of computing and mobile devices, and use geographic information accessed from databases and Web services in almost any format.

Enterprise GIS is proving to be an important natural component of the larger effort to build distributed systems around the principles of Service-oriented Architecture (SOA). Consolidated and integrated GIS extends and supports public entities' investment in SOA. Bringing the two together is an effective way to consolidate silos of redundant

application functionality and data from throughout an organization. Fewer software licenses and servers translates into cost savings in capital and operating budgets. Application consolidation onto fewer platforms reduces software life-cycle costs.

In addition, investments in enterprise GIS, SOA and Web services can be extended, leveraged and focused to create a common operating picture (COP). A common operating picture is a geospatial display that serves as a general repository of information for decision-makers based on the critical organizational processes of information management, knowledge creation, sense-making and decision-making.²⁴ A COP can make it much easier and even less expensive to administer the day-to-day business of public administration. What people expect in crisis, they also expect during the routine decision-making of government and their own daily interaction with government. We the people, the owners of government, deserve nothing less.

Endnotes

- ¹ P.K.'s Ladder. Image taken from *Prove IT*, Center for Digital Government, 2006, page 13, Figure 2.
- ² <http://www.whitehouse.gov/news/releases/2005/11/20051101-1.html>
- ³ <http://www.cdc.gov/washington/testimony/Bi7142004201.htm>
- ⁴ Ibid.
- ⁵ Conversation with Jared Shoultz, director of the Division of Public Health Informatics at the South Carolina Department of Health and Environmental Control. May 17, 2006
- ⁶ <http://preview.nga.org/Files/pdf/ViewfromtheITIndustry.pdf>
- ⁷ http://www.nicusa.com/pdf/EGOV_Citizen2010.pdf
- ⁸ <http://www.avencia.com/aveClients.asp?ID=41>
- ⁹ <http://www.esri.com/library/fliers/pdfs/cs-indianapolis.pdf>
- ¹⁰ <http://www.gis.state.mn.us/pdf/MNGISConceptualArchitectureDesign.pdf>
- ¹¹ <http://www.fgdc.gov/nsdi/nsdi.html>
- ¹² See <http://www.gsdi.org/> and <http://www.esri.com/news/arcnews/spring04articles/enabling-it.html>
- ¹³ <http://www.geoplace.com/uploads/IndustryInterview/gerull.asp>
- ¹⁴ <http://www.geoplace.com/uploads/IndustryInterview/gerull.asp>
- ¹⁵ Interview with Jason Bell, IT services leader and Andy Wright, IT engineer, City of Mesa, Arizona May 16, 2006
- ¹⁶ http://www.doa.state.wi.us/docs_view2.asp?docid=5462
- ¹⁷ http://www.scdhec.gov/co/phsis/biostatistics/presentations/ppgis_files/frame.htm
- ¹⁸ http://www.scdhec.gov/co/phsis/biostatistics/presentations/ppgis_files/frame.htm
- ¹⁹ <http://scangis.dhec.sc.gov/dhecshelters/>
- ²⁰ Interview with Jared Shoultz, director of the Division of Public Health Informatics at the South Carolina Department of Health and Environmental Control. May 17, 2006
- ²¹ <http://scangis.dhec.sc.gov/scan/aboutscan.htm>
- ²² Interview with Jared Shoultz, Director of the Division of Public Health Informatics at the South Carolina Department of Health and Environmental Control. May 17, 2006
- ²³ <http://www.esri.com/news/arcnews/spring04articles/enabling-it.html>
- ²⁴ Adapted from work by Evidence Based Research, Inc.

© 2006 e.Republic, Inc. All rights reserved.
100 Blue Ravine Road
Folsom, CA 95630
916.932.1300 phone
916.932.1470 fax
www.centerdigitalgov.com

Underwritten by:



With annual sales of more than \$610 million, ESRI remains the world leader in the geographic information system (GIS) software industry. Our business involves the development and support of GIS software for all types of organizations — from the one-person office to multinational corporations to innovative Internet GIS solutions. www.esri.com



Stratus Technologies provides customers worldwide with services and systems designed to provide complete, continuous-availability solutions for critical computer-based operations. With its Continuous Processing® technology, Stratus serves government, public safety, transportation and logistics, telecommunications, and many other industries that require continuous availability for the proper functioning of their businesses. www.stratus.com

104007

CENTER FOR
DIGITAL
GOVERNMENT

Acknowledgements:

Todd Sander, Senior Fellow for the Center for Digital Government, former CIO for the city of Tucson and former Deputy Director of the Washington State Department of Information Services

Paul W. Taylor, Ph.D., Chief Strategy Officer for the Center for Digital Government and the Center for Digital Education

The Center for Digital Government, a division of e.Republic, Inc., is a national research and advisory institute on information technology policies and best practices in state and local government. Through its diverse and dynamic programs and services, the Center provides public and private sector leaders with decision support, knowledge and opportunities to help them effectively incorporate new technologies in the 21st century.

The Center's special reports and papers provide two decades of experience and insight into the most important policy and management issues facing governments, and offer strategic approaches for planning and implementing technology, funding sources, and case studies from jurisdictions.