WHITE PAPER ON THE OHIO LOCATION BASED RESPONSE SYSTEM

OHIO GEOGRAPHICALLY REFERENCED INFORMATION PROGRAM

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AUGUST 2004 DRAFT

1 NEED FOR BETTER INFORMATION

INTRODUCTION

Despite our scientific prowess, mankind cannot harness nature. Disasters such as tornadoes, hail storms, floods, and fires still plague us.

As a people, we are increasingly aware that the world can be a dangerous place. The realities of the 21st Century influence how we live our lives. Terrorism is not a nightmare, it is a reality.

In order to prepare for and respond effectively to naturally-caused and man-made emergencies, local and state officials must have access to accurate information about the ***locations*** of people, places, and things. Locations might refer to street addresses, voter or school districts, census tracts, or geographic coordinates. No matter what the form, knowledge of locations allows us to identify where people, places, and things are.

Without ready access to reliable data about locational information (often referred to as *spatial* data), local and state officials are compromised in their efforts to deliver emergency services, relocate displaced citizens, and provide medical aid and support to impacted areas. These officials must be in a position to track and monitor emergency operations and disaster mitigation; and orchestrate responses over a potentially wide area. We must be able to react quickly, effectively, and efficiently. Critical tasks such as toxic plume analysis cannot be accomplished without knowing details of population configuration (for example, where are the factories and schools?), inhabitant densities, as well as prevailing and forecasted meteorological conditions.

There is no reliable "crystal ball" to predict where the need to mobilize, respond and evacuate at risk areas will occur. Critical spatial data must be available for the entire state of Ohio in order to protect her citizens.

This document describes the need for a statewide approach to gathering, storing, and disseminating spatial data. It also describes on going and future efforts by the Office of Information Technology's Ohio Geographically Referenced Information Program office to coordinate and manage a Location Based Response System (LBRS) developed in concert with Ohio's 88 counties. It also summarizes the costs and benefits of the LBRS.

OHIO'S SPATIAL INFORMATION PAST

Our state has a rich history. Admitted to the Union in 1803, Ohio was not a territory carved from a set of natural boundaries. Instead it was created through a series of purchases and grants.

> Ohio became the experimental site of the…public land surveying and sale system. But it was muddied by prior claims from Virginia and Connecticut, and the need to set aside lands for Revolutionary War claims. So, a number of different surveying systems were employed and a variety of speculators, military bounty claimants, and individuals acquired lands in the Ohio Territory.[1]

According to the Bureau of Land Management in October 2003[2], thirteen different surveying systems (in addition to the Public Land Survey System) are extant in Ohio. These systems are listed in Table 1-1.

Survey Systems Unique to Ohio		
U.S. Military Survey (OH 1797)	West of the Great Miami (OH 1798)	Scioto River Base (OH 1798)
Ohio River Base (OH 1799)	Muskingum River Survey (OH 1800)	Virginia Military Reserve (OH 1790)
Twelve Mile Square Reserve (OH 1805)	Ohio Company Purchase (OH 1788)	Symmes Purchase (OH 1788)
Connecticut Western Reserve (OH 1796)	Firelands (OH 1796)	Donation Tract (OH 1789)
Between the Miamis, north of Symmes Purchase (OH 1802)		

Table 1-1
Ohio Surveying Systems
Bureau of Land Management

According to the Ohio Historical Society's World Wide Web page, "Ohio lands were surveyed and sold by the federal government, private individuals, and by two other states, Virginia and Connecticut. Since parts of the state were surveyed at different times, Ohio was divided into areas called survey "districts" or "land grants."[3] These grants are portrayed in Figure 1-1.

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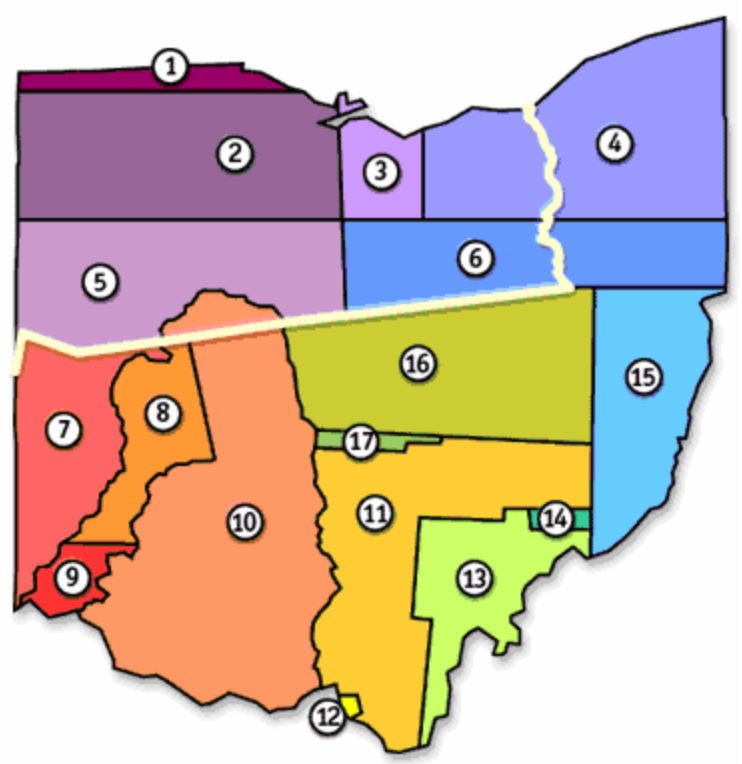
[1] See *Introduction to Ohio Land History* at http://users.rcn.com/deeds/ohio.htm

[2] See *Survey Systems in the United States* at http://www.blm.gov/cadastral/manual/nextedition.htm

[3] http://www.ohiohistorycentral.org/ohc/nature/geograph/using/landgrants.shtml



Key to Map Sections		
1. Michigan Survey	2. Congress Lands (1820)	3. Fire Lands
4. Connecticut Western Reserve	5. Congress Lands (1819)	6. Congress Lands
7. Congress Lands	8. Between the Miamis	9. Symmes' Purchase
10. Virginia Military District	11. Congress Lands	12. French Grant
13. Ohio Company Purchase	14. Donation Tract	15. Seven Ranges
16. U.S. Military District	17. Refugee Tract	

Figure 1-1
Sources of Ohio Lands
Figure taken from Historical Society Website

Why is the history of Ohio's lands worth mentioning? Because the state's creation amalgamated 17 areas laid out using 14 different surveying systems. Today, keeping track of land, people, and **locations** is largely the province of county governments. And Ohio has 88 of them. So there are 88 differing approaches taken to collecting information about real estate, roads, natural resources, school districts, and the countless other signs of our "built environment."

While there are many local government functions being supported by the activities of the counties within the state (e.g., taxation, public safety, education), the lack of a coordinated statewide framework of geographic information continues to hinder state

agencies, particularly those involved with disaster preparedness. In addition, counties often find that format, currency or completeness issues complicate information exchange with other jurisdictions.

OHIO'S SPATIAL INFORMATION PRESENT

State, regional, and local government groups routinely collect information about locations.

Technology Helps Meet Threats

Rapid technological changes (computers, communications, the Internet), an increasingly sophisticated public, and demand for new and improved products and service are producing an equally rapid change in the way governments do their work and support their citizens. Governments at every level are building information infrastructures of computers, databases, applications programs and automated products and service to better serve their constituencies.

Put in a statewide context, these changes present exciting opportunities and equally dangerous possibilities. If all levels of government work together, the information infrastructure will have an impact similar to the interstate road system—a critical catalyst for unprecedented growth and development and a significantly improved quality of life. When local and state governments fail to work together, millions of dollars may be spent duplicating a costly and inefficient information infrastructure that could actually retard economic development, increase costs, and limit access to comprehensive governmental products and services.

Examples of this information infrastructure include digitized (electronically mapped) roads or street centerlines and addresses. Across Ohio, governmental organizations are capturing, updating, and maintaining information on road/street centerlines and/or addresses. This information is captured to support such varied applications as transportation studies, E-911, emergency management and response, public safety, assessment, permitting, asset inventory, pavement management, and vehicle routing.

No definitive source exists for an up to date and complete (federal, state, county, township and municipal) transportation network in Ohio, nor is a single source available and accessible for governments to build their spatial applications. What does exist are several disparate sources, all having differing degrees of currency, spatial accuracy, and completeness. If development of a statewide framework of data layers is not established—specifically street centerlines with address ranges—government will continue to spend money mapping the same geographic areas over and over again—using different standards, scales, and accuracies. This will hinder interoperability within state government and safety officials will continue to be unable to conveniently share spatial data to effectively protect our citizenry in a timely fashion.

State, regional, and local governmental units need to collaborate and develop a location based response system to identify, monitor, and respond to natural and man-made disasters within the state. This will be an Ohio asset that ensures location-based data is secure and available to the public safety and emergency response agencies that depend on them for the delivery of their services.

Numerous at risk facilities exist within the state in both highly populated and sparsely populated areas. These include such facilities as Ohio's nuclear power plants and reservoirs across the state.

A terrorist act can happen anywhere. The release of toxic chemicals in a rural area could have a chilling effect outside of highly populated areas, while the nightly news apprises us of a chemical plume's progress toward large population centers. Similar concerns have been raised about the transportation of nuclear waste through the state and the impacts an accident could have on Ohio.

Along with manufactured threats, there is the continuing threat of natural disasters. Recent evidence of this would be the tornadoes and high winds that swept through Northeastern Ohio in November destroying or significantly damaging 160 homes with an additional 500 homes damaged over five counties in 2003. Since 1997, Ohio has experienced more than nine natural disasters (floods, high winds and tornadoes) costing Ohio approximately $132.3M in damages, excluding the November event.

Geographic Information Systems are Operational in Many Counties

Currently, 41 counties reportedly have operational Geographic Information Systems (GIS) programs. About 19 counties are developing GIS programs, with another 7 counties either planning for or contemplating GIS implementation. A snapshot of GIS development status as of 3/19/2004 is shown in Figure 1-2.

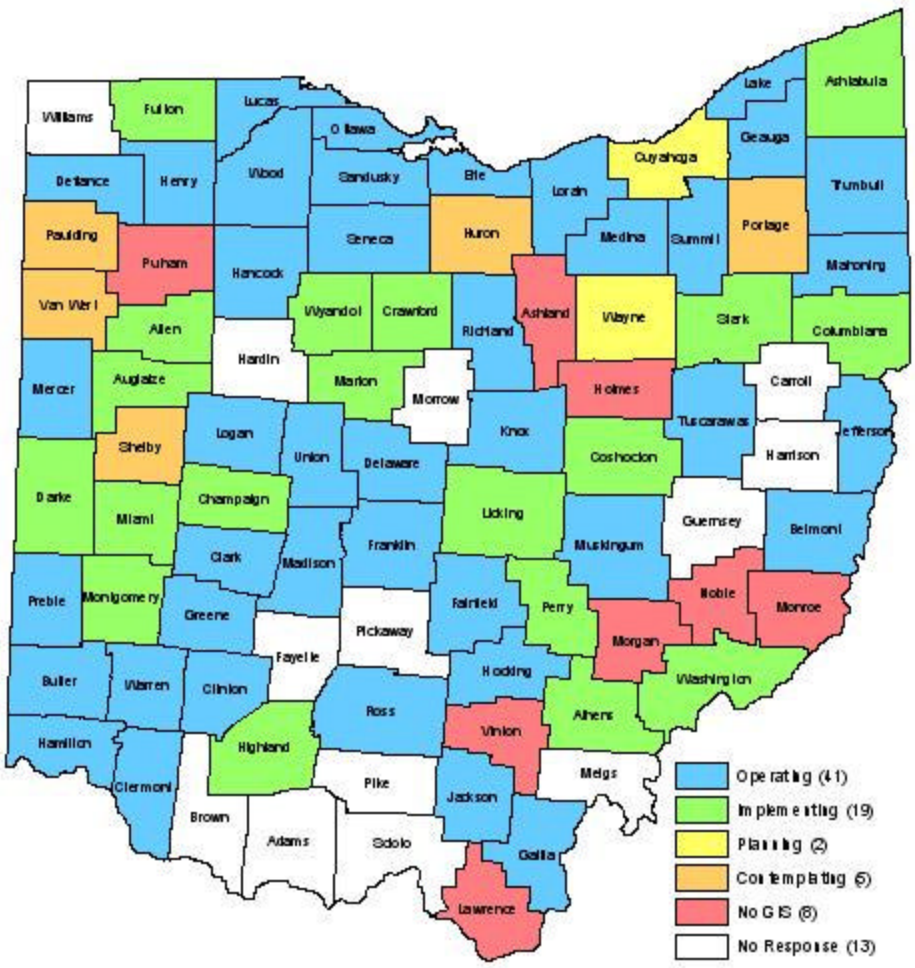


Figure 1-2

Map of County GIS Development as of 3/19/2004

There are many definitions of GIS in professional literature, but a fairly simple one calls the technology:

> 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.[4]"

This definition fails to convey the fact that data costs are always very significant during system development, and that those costs continue as the system is enhanced to support more and more business processes. OGRIP estimates that on a statewide basis, local governments along with electric and gas utilities have spent between $80M and $100 Million on digital mapping, GIS hardware and software, application

[4] ESRI (Environmental Research Systems Institute), Redlands, CA

development, and conversion of hard copy maps into digital files. This is a conservative estimate, since over $15 million has been committed to spatial data development projects by Franklin County and the City of Columbus.

Synergies that could be realized by making data available to other governmental groups through Vertical Integration are seldom achieved. In part this is because the granularity of information— the amount of detail— needed by differing levels of government varies from group to group. Figure 1-3 presents a graphic look at this concept.

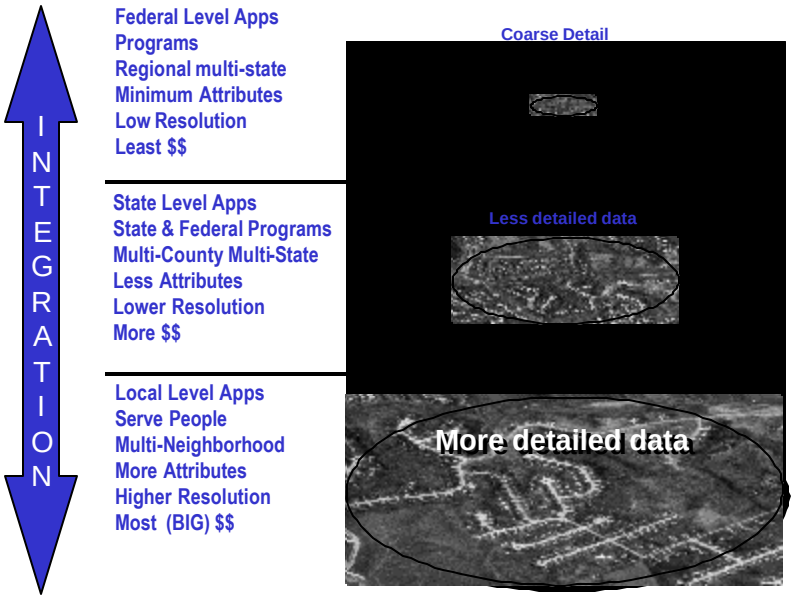


Figure 1-3
Vertical Integration among Governmental Levels

Not only are local governments developing data for their GIS programs, so are state and federal agencies. Because the various levels of government tend to develop data that addresses their own business needs, data resolution and content are often different for similar agencies. For example, a County Engineer may keep data on drainage washouts, but that data may be too site-specific for ODNR to use in analyzing larger watersheds.

Lack of information integration often results in duplicative mapping and system development costs. In other words, often the same geographic area is mapped at one scale for one purpose (e.g., farmland protection), and at some other scale for a differing reason (e.g., new highway design). In addition, file formats and software differences may inhibit data sharing.

Examples of Ohio Data Problems

Figure 1-4
Address Range Example

Street segments and addresses are among the most basic, but necessary, spatial information structures. Each segment of a street (shown as the horizontal line connecting two vertical lines in Figure 1-4) can be uniquely identified by its "from" and "to" nodes. In the figure, the "from" and "to" nodes are street intersections.

A computer can read the node identifiers and find, in a database, the "left" and "right" address ranges. The term "left: means the left side of the street running from the "from" node to the "to" node. Conversely, right addresses are on the right traveling in the same direction. So the "from" node in the example above is the intersection on the left, and the "to" node is the intersection on the right. In the figure, the address 50 Main Street (shown as a point with the value of "50 Main St.") is called out as being half-way between number 2 and number 98. The computer *interpolates* this value and point placement from the street range values.

This structure is an example of *topology*, or the ability of objects in a GIS database to know *to what they are connected, and to what they are adjacent*. This data structure is common to virtually every local government GIS database. It is what enables dispatching software to send fire trucks or ambulances to an address, or to generate driving directions (with a map) to Grandma's house on the Map Quest site on the worldwide web.

Address ranges, which are critical to any location based response system, are incomplete across Ohio. While the largest area of concern is in southeastern Ohio, this is far from the only problem area. Figure 1-5 notes road segments in red that are missing a critical component. It also represents segments of new roads yet to be addressed (as in Delaware County) and rural route addresses that don't conform to address range designations.

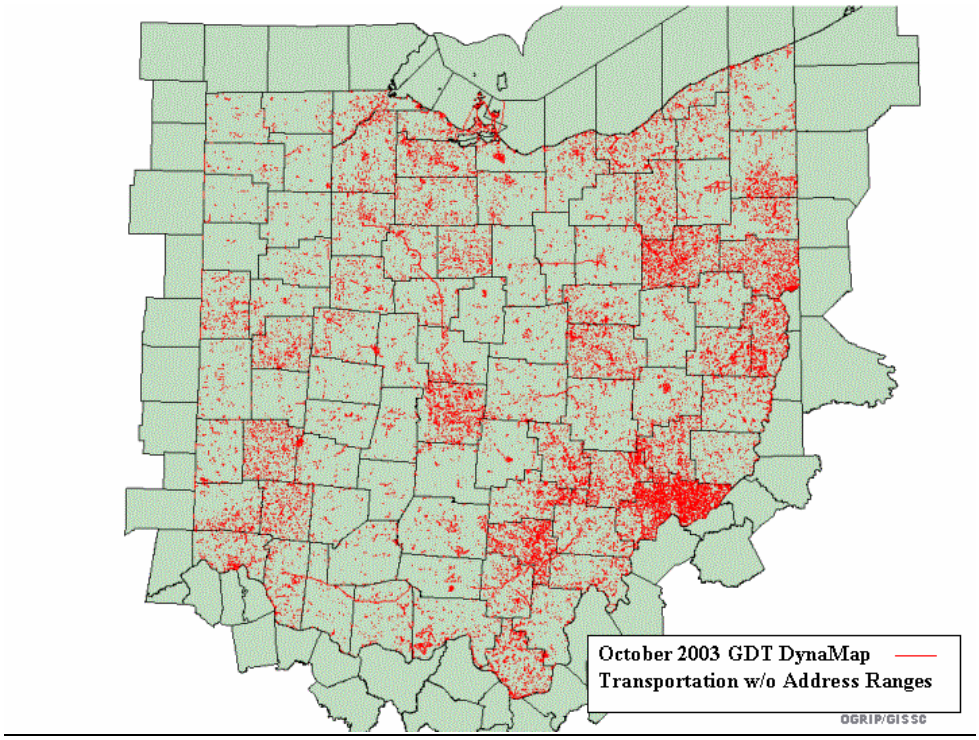


Figure 1-5
Road Segments Lacking a Significant Address Range Component

Besides incompleteness, another problem with address ranges sometimes occurs in the interpolation function. An example of this is represented in Figure 1.6. In that depiction, the yellow line represents State Route 103 and each blue dot is a field verified site address. The red dots represent structures without an address that is visible from the street. The green pin represents the results of geocoding 18955 SR 103 to an "off the shelf" address range. Software interpolated the address along the segment of road using this incorrect address range. The true location of 18955 SR 103 is highlighted at the bottom of the image.

Interpolation can misrepresent locations if they are not verified and validated. If an emergency responder were dispatched to this address, the delay in finding the right location and the minutes added to responding could result in increased property loss or even loss of life.

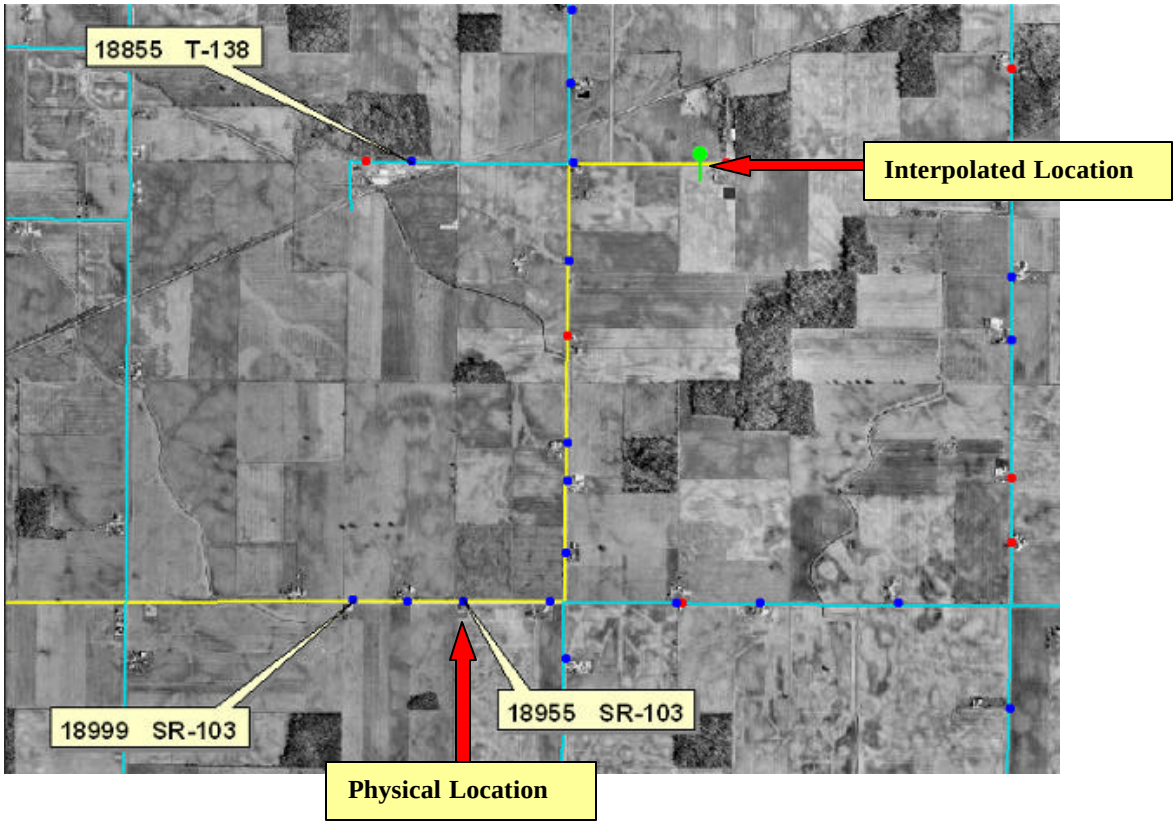


Figure 1-6
Interpolation Error Example

To demonstrate the variances in accuracy, currency and completeness, Figure 1-7 provides an overlay of the various street centerline data sources available for Madison County, Ohio. This data is depicted on a Digital Orthophoto Quarter-Quadrangle (DOQQ). USGS Digital Line Graph (DLG) transportation data was not displayed, since it is, on average, 27 years out of date.

This readily displays the difference in accuracies, currencies and completeness of the data sources. The digital information displayed represents differing data sources for an area in Madison County. In some cases, representations of streets have been found to be off by as much as 1300± feet, with stated average accuracies between 40± to 167± feet depending on the source data used. Also, the differing levels of currency are apparent based upon the capture of new roads. The county data (shown in green) has more positional accuracy, is more current and complete.

Figure 1-7
Example of Conflicting Accuracy

The green street centerline portrays Madison County GIS data provided by the County Auditor. This has a high degree of spatial accuracy (positional representation on Earth) and is complete. For the Auditor to perform assessment functions, it must be maintained and up-to-date. Therefore, the county has a vested interest in keeping these data sets current.

If this county data is presented over a more current image, the construction is readily apparent. Figure 1-8 is a depiction of the same area and data over a 1999 image.

Figure 1-8
Madison County SID Image from 4/1999

To date, the state has not leveraged local governments' investment in detailed spatial data due to lack of funding and inconsistency in the data as well as the fact that a few as five years ago very little local data existed to support a statewide program. The LBRS will leverage this spatial data and save taxpayer dollars by developing a mechanism for ongoing maintenance of a spatial dataset for and by state and local government partnering – with centerlines and addresses being the first of numerous vertically integrated spatial datasets in Ohio.

The health and safety of Ohio's citizens will be better protected if the inconsistencies in street centerline data are eliminated through a consistent program that includes participation by both state and local agencies. The Ohio Location Based Response System is the right program at the right time.

2 THE LBRS VISION

The eSecureOhio initiative—comprised of an enhanced Wide Area Network and the Location Based Response System (LBRS)—is intended to address needs for coordinated data access between state agencies. The LBRS will provide a statewide, current, accurate, and accessible street centerline and addressing system that will be collaboratively maintained as an Ohio Asset by local and state resources.

The LBRS will leverage all funding, whether state or local, since data will be utilized in the spirit of "Capture it once, use it a bunch." Creating the LBRS will enhance emergency preparedness and response, promote more effective economic development, and support a more secure life for each of Ohio's citizens.

BACKGROUND

LBRS is a component of a much larger initiative that OGRIP has been pursuing for more than five years – a comprehensive spatial data development program for Ohio. The State recognizes the need to develop framework data layers to support the creation of enterprise-wide applications. In addition, the state must assume the role of data facilitator to promote information exchange among the three levels of government, academia, and the private sector. The development of statewide framework data layers will increase interaction and collaboration by providing a common foundation on which to better share data. Creating an explicit data sharing environment will help make relevant information available in a timely manner. In turn, this will allow policy makers to make more informed decisions and react quickly to unforeseen events.

In 1999, OGRIP identified critical spatial data framework layers for Ohio in support of this comprehensive program. The OGRIP Council approved and endorsed Ohio's Spatial Data Framework Layers in 2000, consisting of the following six framework layers:

1. Geodetic Monumentation
2. Imagery
3. Transportation
4. Hydrography
5. Cadastre
6. Cultural BoundariesIn early 2001 OGRIP created framework task forces for each framework data layer. A seventh task force was created to concentrate on Metadata, or *data about data* to support the sharing of spatial information. These task forces, consisting of individuals in all levels of government, the private sector and academia, meet regularly to address issues associated with the development of a comprehensive program for Ohio. To support the LBRS and the task forces,

OGRIP developed an Ohio County GIS Profile that provides all 88 counties with a mechanism to report and update information pertaining to their spatial data holdings, status, and GIS related activities.

The Location Based Response System will consist of all of the components of Ohio's Spatial Data Framework, the first major component being street centerline and address information, identified by the OGRIP Council and in the Spatial Data Management Cost Benefit Analysis as being critical to Ohio's future. The LBRS will enhance the State's ability to provide a coordinated response to requests for data to Local, State, and Federal agencies such as FEMA and the Office of Homeland Security.

UNDERLYING PRINCIPLES AND CONSTITUENT PARTS

Principles of Data Sharing and Economy Drive the LBRS

The Ohio Location Based Response System (LBRS) constitutes an important part of the state's comprehensive GIS program. The mechanisms—technology, databases, protocols, and agreements—that jointly support the LBRS are known as *GIServeOhio*.

There are a number of key principles that form the philosophical underpinnings for the LBRS and the eventual realization of GIServeOhio. Among these principles is the idea that once geographic information is collected with public funds for the benefit of the public at large, the information should be shared with other levels of government. In other words, the elimination of redundant data collection is a driving force for the creation of the LBRS.

The catchphrase that has been adopted to typify this approach is: "*Capture it Once, Use it a Bunch*." This idea is particularly applicable to migration of information from the local government environment to regional, state, and federal spatial data users. The federal government is the largest user of spatial data in our country.

Capture it once, use it a bunch summarizes the *Vertical Integration* of spatial information that was noted as missing in Section 1 of this document. Presently, data exchange from local governments to state agencies and federal users is, for the most part, a one-way street. Creation of the LBRS establishes a mechanism for state and potentially federal government to monetarily support the spatial data activities at the local level, providing benefit to all levels of government. In this way, taxpayer investments are maximized, so taxpayer dollars are minimized.

GIS has slowly changed relationships between levels of government over the last 10 years, positioning Ohio (and the nation) to take advantage of this unique tool.

> *"Geographic Information Systems (GIS) technology is a horizontal technology; it integrates information from diverse sources. The value of GIS is realized when*

> *multiple data sources of good quality are layered on top of a base map to show the relationships between geography and a collection of economic, environmental, health, social and infrastructure factors".* [5]

The Location Based Response System (LBRS) will provide this foundation or base map, as well as create a mechanism for vertical integration for maintenance and future collaboration, where each level of government can work in concert with the other.

The LBRS and GIServeOhio Link All Levels of Governments

The functional vision of the LBRS is portrayed in Figure 2-1, appearing on the following page.

The major functional participants of the LBRS are portrayed in four interlocking circles. One of these circles represents the county GIS organizations within the state. These interact directly with the state's Comprehensive GIS program, while also supporting Emergency Response, E-911, emergency preparedness, and Health groups within their own geographic boundaries. The overlapped area between the counties and emergency response groups represents the shared (regional or state) focus of large-scale emergency planning and response. Here the LBRS will provide the amalgamation of geographic data from multiple counties as needed to support a broader view of emergency management capabilities.

Counties continue to have their own views of local data as noted in the box adjacent to the emergency response domain and county GIS. Local information maintenance occurs in support of emergency management and is largely the province of telephone companies (to support E-911) and updating of the county's Master Address File. These functions are part of the normal flow of updates that keep the whereabouts of citizens, noxious materials, and public facilities available to local Public Safety officials.

[5] The Value of GIS in Government, G. Kreizman, Gartner, Research Note 20, May 2002

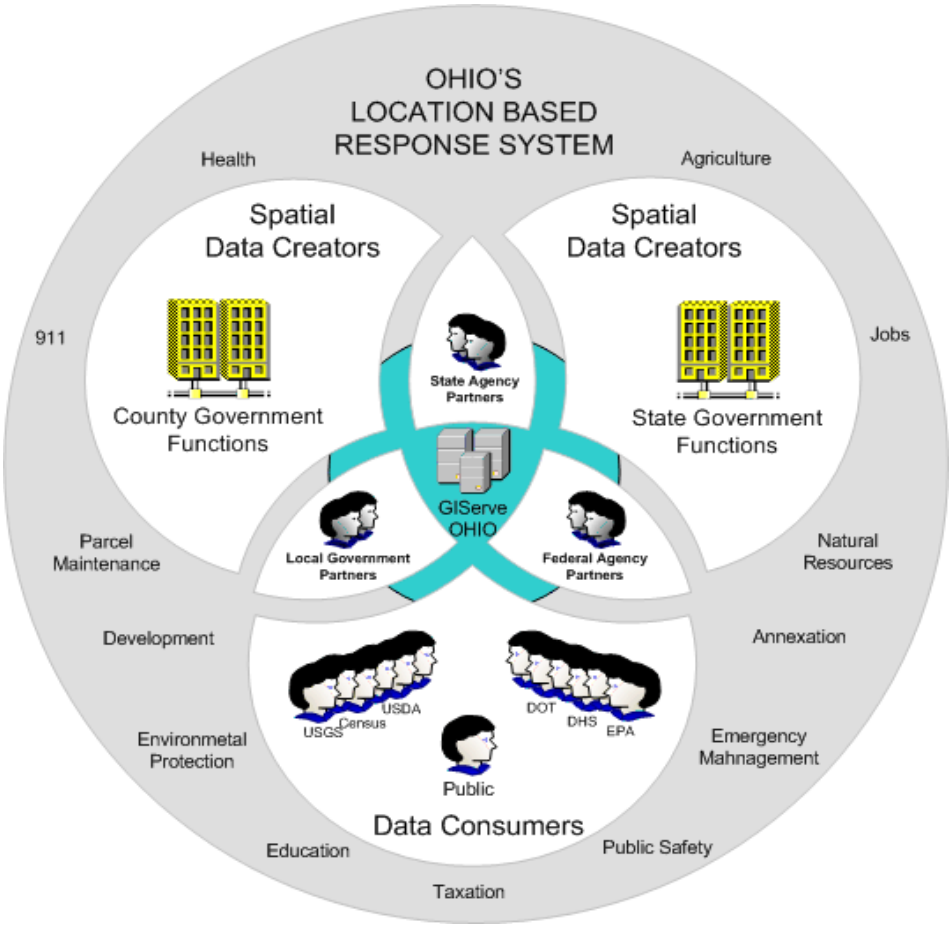


Figure 2-1
LBRS Functional Vision

Arranged around the edge of the circle are some of the agencies that use spatial information to support their business functions. Those portrayed are representative of even more departments who could regularly use spatial data if it were available to them on a more convenient basis. The LBRS is designed to make access to these groups more affordable, reliable and timely.

While the initial creation of the LBRS relies on the road network and addressing system to tie data from the state's counties together, the longer term view is that these other elements will be exchanged between and among governmental groups on a regular basis. Certain state groups, such as Taxation, could more equitably administer programs with enhanced access to information about parcels and taxing districts. Significant state-level users of spatial data such as ODOT and ODNR could create programs to value-add information that could be returned to the county GIS databases, as well.

Of the data consumers, the most significant users include the US Geological Survey (USGS), the Census Bureau, and (not pictured) the Department of Homeland Security.

The LBRS will provide a common set of geographic information that will assist agencies in providing a coordinated response to events. Creating the LBRS will help state agencies to report environmental and demographic information more effectively, since the data will be more current and more accurately reflect local conditions throughout the state. Initiatives such as the National Map can be addressed most effectively by the state, acting on behalf of the county GIS groups. This assumption of responsibility for information dissemination will free up county staff to attend to other, more pressing, matters such as updating new roads and addresses, correcting missing addresses, or updating corporate boundaries as a response to annexation.

GIServeOhio Constituent Parts are Technology and People

GIServeOhio, like any other technology implementation, will actually be a series of components that together comprise the whole.

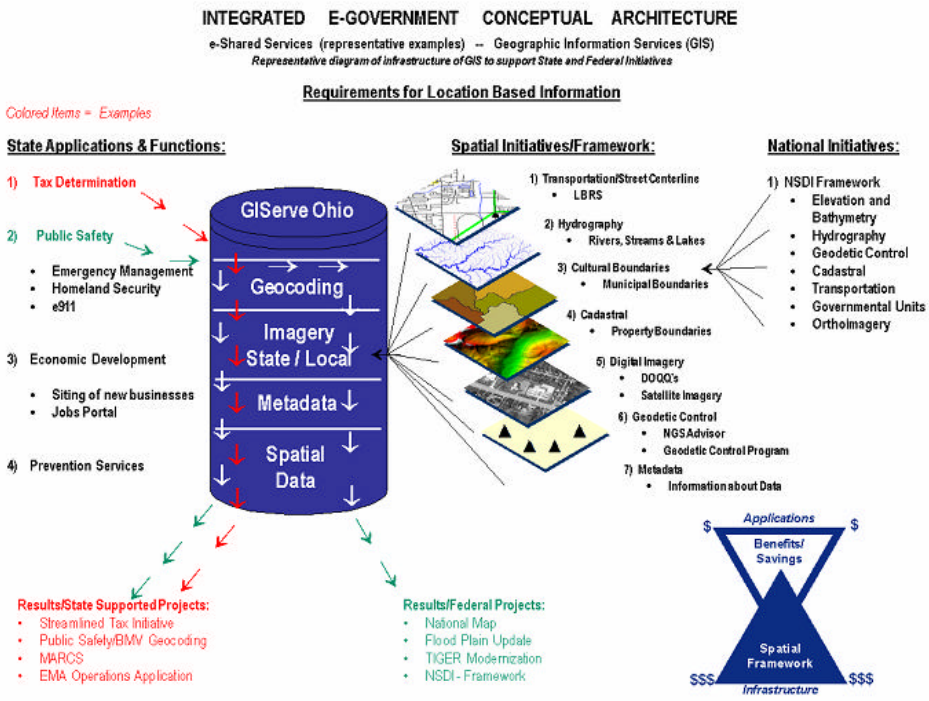


Figure 2-2
GIServeOhio Components

While the key pieces have been identified, many integration factors need to be addressed prior to building the GIServeOhio platform. The most challenging of these may be the organizational/institutional factors involving the creation of a new way of doing business between State and local government. Nurturing these relationships will need to be "tended" in much the same way as you would a garden. Pieces of GIServeOhio will include the following key components.

Hardware consists of the computing devices, peripherals and networks that furnish the means by which location based information is stored, retrieved, and disseminated.

Hardware *is perhaps the best-understood and least contentious portion of the system. Network and user security are issues that will need to be addressed with real-time access to data being an identified goal of the program. As a consequence of providing high accessibility to spatial data, network throughput based on anticipated use is a concern that needs to be addressed. Hardware used for data storage is not an issue.*

Software includes the operating system, specialty (GIS), and data management software tools that together create the environment in which LBRS data is collected, stored, managed, and displayed.

Software, *once a concern because data constructs vary from software vendor to software vendor is becoming less of an issue with readily available conversion utilities. ESRI (Environmental Systems Research Institute), Intergraph, Bentley Systems and Autodesk have been identified as suppliers of GIS software to Ohio county governments. Relational Database Management System (RDBMS) software will be used to house county LBRS data within the GIServeOhio platform.*

Data is the system component that contains the graphic (mapped) information about the locations of roads and other features, as well as the attribute (alphanumeric and other "non-graphic") data linked to the locational information.

Data *for the LBRS will come mainly from Ohio's 88 counties. Currently, data specifications for the creation and delivery data that will be transmitted to OGRIP are under review. Through its work with local Government OGRIP is well aware that there will not be a one-size-fits-all solution to data development or maintenance and will strive to create requirements that can be tailored to individual county processes and capabilities. While OGRIP does not intend to impose data format or addressing standards on local government, a minimum set of LBRS specifications is required to assure conformance to LBRS standards if local government is to continue their participation in the LBRS program. OGRIP has and will continue to engage local government in the specification process with an eye toward conforming LBRS specification to existing maintenance procedures at the local level. Metadata standards must be created to capture the source of the data and means by which it was collected. OGRIP intends to provide access to additional foundational data sets beyond roadway centerline and address attribute information. Standards for format and content for each thematic element remain to be developed.*

Staff consists of personnel trained in the effective use of GIS and other related software packages who support users within state agencies, as well as representatives from collaborating local government groups.

Though LBRS will be created initially with reliance on assistance from other line departments (e.g., ODOT), an increase, reassignment, or dedication of personnel to work on the LBRS must occur as LBRS data becomes more integral to the use of spatial data within state government.

Institutional relationships include the data-creation and data-sharing environment that will exist at the nexus of OGRIP (on behalf of state agencies), the 88 county governments within Ohio, and national entities such as USGS, the National Geospatial Intelligence Agency (NGA), and others.

The creation and maintenance of successful institutional relationships will be a key factor in the long-term success of the program. The current instrument for the creation of these relationships is a Memorandum of Agreement (MOA) between state and local government. These too are being reviewed with an eye toward providing a agreement that is flexible enough to adjust to the specific needs of a particular county, and as with the maintenance of data, OGRIP understand that a single MOA may not serve all partnerships due to varying levels of expertise or ability on the part of a local government to support the ongoing requirements of the LBRS.

Applications are the result of applying software functionality to data in order to create some meaningful product. An "application" might be a user interface, a data quality checking routine, or a web-based security and/or data dissemination mechanism, to name a few examples.

Applications *must be developed to check, inventory, and disseminate data to system users. Under the current GIServeOhio vision, data maintenance will be the responsibility of county data creators. Nevertheless, OGRIP staff may be asked to forward data to sister state agencies in a format unlike that in which the data is maintained.*

THE LBRS VISION SUPPORTS MULTIPLE PROGRAMS

While the Location Based Response System is a construct of the state of Ohio, it nevertheless provides a bridge between its counties, regional data users, state agencies, and the federal government. The vision of public service demonstrated in this program will doubtless be an example for many other states in our Union.

Studies show that over 80% of data collected, stored, and maintained by local governments includes some reference to geography. Each of the primary government constituencies is included in the LBRS/GIServeOhio vision. The following four tables summarize representative programs and/or business functions that enhanced access to timely spatial will support.

Local Government	Vision Component
County GIS Programs	State counterparts can take on the job of disseminating data on demand; Creation of transportation data can serve as a catalyst toward enhancing

	GIS capabilities throughout county government
E-911 initiatives	Improved response capability, current off the shelf data has resulted in error rates of up to 80%; Use of MAF in adjacent counties will provide standardization where it may not exist
Public Safety	Normal updates (address, etc.) for adjacent jurisdictions will be available through the LBRS to enhance accident reporting and improvement planning
Emergency response and preparedness	Increased access to other data from around the state will increase efficient planning and provide for better coordination between responding agencies
Local Health Districts	Will provide the ability to track and respond to outbreaks more
GASB Efforts	Tracking assets by location will promote compliance
Megan's Law compliance	Current address availability will promote compliance by improving the spatial accuracy of address locations

Table 2-1
LBRS Vision and Local Government

Regional governments are characteristically under-funded. The LBRS will help them leverage data from county groups as well as state agencies.

Regional Agency Function	Vision Component
Transportation Planning	Enhanced planning capabilities will follow more timely data availability
Solid Waste Siting	By combining development patterns and demographics, waste sitings can be determined strictly by need and least environmental
Development Tracking	Better geographic information will yield more accurate inventories of development and provide for improved growth planning
Economic Development	More current demographics, development data, traffic and transportation data will lead to more appropriate commercial/industrial development
Census Reporting	Enhanced access to local government data will improve capabilities for demographic analysis

Table 2-2
LBRS Vision and Regional Government

From a state's perspective, there are numerous programs and projects that the LBRS supports.

State Agency	Vision Component
Emergency Management Agency (EMA)	Better addresses, statewide, mean more thorough planning and enhanced response capabilities
Ohio Administrative Knowledge System (OAKS)	Support asset management and eventual property reporting
Multi-Agency Radio Communications System (MARCS)	Replace the circa 1998 transportation data to better respond to incidents; Build new Response Zone boundaries based on improved geography

State Agency	Vision Component
Ohio Security Task Force	Enhanced planning and response capabilities; Improved ability to track and manage assets spatially
Department of Transportation	Provides a framework for the interoperability of state legacy data; Better road inventories will promote fairer revenue sharing; Relief realized as a result of decreased maintenance responsibilities may be channeled toward local government to help with the ongoing maintenance and support of the system
Department of Natural Resources	Statewide consistency in coordinates and addresses will mean more accurate environmental assessment and tracking
Department of Job and Family Services	Child care and facility identification will be more accurate; Supports ongoing efforts to geocode program participants
Department of Health	Supports the Ohio Disease Reporting System (ODRS) for disease and outbreak tracking; Facilitation of a coordinated response and planning for acts of bioterrorism; More comprehensive statewide data will lead to a more effective department with regard to program and funding distribution; Improved ability to perform epidemiological studies
Department of Taxation	More effective administration; aids Tax district determination
Department of Education	School district determination
Public Safety	Jurisdiction determination (ensuring appropriate distribution of funds)

State Agency	Vision Component
Department of Agriculture	Identification of agricultural premises to support the federal Animal Identification Program; Location of hazardous materials and chemicals in rural areas (farm tanks –above ground)
Department of Commerce/Fire Marshall	Location of explosive materials, nuclear waste, underground tanks (inspection, relationship of materials to day care centers, nursing homes, etc.)

Table 2-3
LBRS Vision and State Agencies

Federal agencies are also accounted for the in the LBRS vision.

Federal Government Programs	Vision Component
National Map	State becomes the “one stop shop” for national map data
National Spatial Data Infrastructure NSDI	Dissemination of standards can be built into routine updating
NIMA/USGS 133 Cities Initiative	Support for Ohio participants through GIServeOhio
Homeland Infrastructure Feature Level Data (HIFLD)	Provide a conduit to DHS that saves staff time at both the county and federal level
Geospatial One Stop	GIServeOhio supports the GeoSpatial One Stop model
TIGER Modernization	LBRS provides accurate maintained centerlines and address ranges
FEMA First Responders	Real time support anywhere in the state of Ohio

Table 2-4
LBRS Vision and Federal Government

3 BUILDING THE LBRS

OVERVIEW

The Location Based Response System will help protect the health, safety and welfare of the citizens of Ohio. The LBRS will play a key role in a secure technological infrastructure that disseminates location based data to intergovernmental agencies that are responding to such emergencies as floods, tornadoes, hazardous chemical spills, or terrorist action. The LBRS will significantly enhance the state's ability to provide a coordinated response to emergency situations as well as requests for data to local, state and federal agencies such as FEMA and the Office of Homeland Security.

OGRIP believes that the eSecureOhio Project is a critical component of Ohio's future and GIS Infrastructure. This data will be at an accuracy that can support and integrate data and activities with state/local/county level data.

OGRIP has promoted vertical integration of spatial data for several years. The eSecureOhio project, along with the development of many statewide Task Forces focused on spatial data creation and data sharing are the first steps in an integrated solution for state and local government. When the LBRS is operational, this integrated approach will become a reality within 5 years.

The Development Process

The core of the LBRS will be GIServeOhio, the conjunction of technology, institutional relationships, qualified staff, and applications that will make it possible to receive, store, and display data from the state's counties. Many of the technologies of which GIServeOhio will consist are well known. On the other hand, a number of procedural and technical challenges are being addressed and will be overcome as the project unfolds.

Differing County Profiles Suggest Differing Approaches

Ohio's 88 counties range from very agrarian, rural settings to urban environments, some of which have sustained significant growth rates since the 1980s. As a result of variations in the means that technology is employed to support county business, the state's counties fall into one of four categories of spatial data users.

A number of urban counties have developed GIS programs to support their normal operations. A few of these counties have created centerline files with address ranges and share this information with local emergency management staff as a matter of course.

The second group of counties is those who are still adopting spatial information systems technology. This category includes some urban counties that have, for one reason or another, been a bit slower in adopting GIS technology than those counties whose system development began before 1990. This group also includes some suburban counties that have been adopting the technology to keep up with burgeoning populations, along with various kinds of development.

The third group of counties that have held back in developing geographic information systems because of (1) a lack of automation to deal with everyday governance, or (2) an inability to concentrate fiscal resources, make up a third group of counties. These organizations may not have begun spatial data systems development, but they are making plans to do so.

The fourth category of county consists of those smaller, sparsely populated enclaves that do not experience enough growth or development to afford or recognize the need for the tools that automated spatial data systems provide. It may be that these counties are never in a position to adopt and support the technologies adopted in their urban counterparts.

Major Development Steps

Creating a successful LBRS program within the state of Ohio will necessitate certain cultural changes on the part of the state's 88 counties, as well as changes in business processes for state agencies. OGRIP, the lead state agency for spatial data coordination, has never before had such a highly visible operational focus.

Counties have not pledged previously, as they will under the terms of the state-authored Memorandum of Agreement (MOA), to perform GIS database updates for delivery to the state on a timely basis. Additionally, the LBRS, GIServeOhio and the stakeholder groups will need to adopt a series of data standards that can be adhered to by all.

Some of the steps in GIServeOhio development are listed here. This listing is not comprehensive, but each of the cited activities should be undertaken in a more or less serial fashion. In some cases, events are already overtaking the order of tasks. These steps will likely comprise the bulk of system development activities for the following year.

1. Expand the Business Case/Gather Support

The genesis of the LBRS idea and its justification are largely completed. OGRIP staff needs to continue to manage expectations and keep participants, lawmakers, and other stakeholders abreast of the progress being made.

2. Secure Funding

After several years of grass roots efforts, the state has made an appropriation for the LBRS. Continued communications must be continued in this area, as well.

3. Define Institutional Setting (MOA)

Through the efforts of individual counties and state agency staff, an MOA has been prepared that has been through the review cycle in several jurisdictions. The institutional setting includes providing an administrative home for GIServeOhio and refining the role of LBRS and its relationship to the GIServeOhio spatial data clearinghouse. The core MOA is being reviewed currently (August 2004) for editorial modifications.

4. Define Technical Approach

Several Pilot projects are underway to address several technical issues, including questions about data structures, maintenance procedures, dissemination methods (e.g., Internet, magnetic media, etc). From these pilots, OGRIP is identifying some of the major areas for standardization and protocols and defining appropriate architectural standards for the present and near-term future.

5. Develop System Design

An overall system design will be prepared and completed by early Fall 2004 as part of a current consulting contract.

6. Program Staffing

GIServeOhio cannot be successful without competent dedicated staff. OGRIP is working to identify staff requirements and begin the process of classifying and advertising for technical resources. One additional staff member has been added to the OGRIP contingent with explicit duties in the area of communications and system development. The need for additional technical staff for GIServeOhio is plainly manifest. OGRIP needs to follow through and hire the initial GIServeOhio staff.

7. Engage Early Adopters

Over the past several years many counties have developed centerline and address information that could be adapted to the LBRS. OGRIP is in the process of developing partnership agreements that will be encourage these early adopters to participate in the LBRS Program

8. Develop RFP for Data Development

To accommodate variations in capabilities for data development and maintenance within each of the four categories previously described, an RFP to solicit data development firms will be prepared. This RFP will identify the potential methods (e.g., ground GPS-based data collection, existing aerial raster or compiled imagery, reprocessing of existing centerline data) that may be used to collect centerline data to the accuracy envisioned for the LBRS. In addition, the means of creating address ranges will also be identified.

9. Develop SOPs and Application Designs

Data maintenance and update procedures must be addressed to provide all counties with access to the tools and mechanisms necessary for local government to provide current data to the state. The GIServeOhio clearinghouse will need to establish a set of standard operating procedures (SOPs) that it will use in accepting, checking, and edgematching data as it is received from counties. In addition, it will almost certainly need to build applications to automate everyday procedures, reporting, and data dissemination. The extent of these applications is not yet known, since the detailed functional requirements of the clearinghouse have not yet been determined. If the clearinghouse is to function smoothly, these SOPs and applications must be codified and put into place.

10. Implement GIServeOhio Clearinghouse

Once staff has been brought on-board (or while staff in cooperating state agencies are "holding down the fort"), the clearinghouse function can be implemented. This should begin in a test mode with limited access initially from outside groups.

11. Select and Contract with Data Development Contractor

Following release of the RFP for a data development contractor (step 11), LBRS/OGRIP staff will review submittals and credentials. After a competitive process, a contractor or contractors will be selected and contract negotiations can begin.

12. Code and Test Needed Applications

While GIServeOhio can begin operations without implementing the applications needed to make it thoroughly functional, it will be far more effective when maintenance, storage, display, and dissemination applications have been completed and tested.

13. Complete Early Adopter Data Acceptance

The data from early adopter counties (and those picked for early participation because of criticality issues), should be accepted and published in GIServeOhio. This work will likely go more quickly following development of the applications noted in step 14.

14. Perform System Audit

When the initial loading of the clearinghouse database has occurred, staff has been retained, and applications have been developed, OGRIP should carry out a system audit. This is an appropriate activity once significant progress has been made, because the techniques to be used in introducing each of the categories of counties will evolve as time passes and circumstances dictate that modifications to some processes be made.

15. Modify System as Required

Results of the audit should be translated into procedural modifications as needed before moving in the next phase of system development.

16. Contract with Category Two Counties

With a data development contractor selected, system applications and SOPs implemented, GIServeOhio clearinghouse staff can begin the next phase of the project and begin working with Category 2 counties.

FUNDING AND TIMING CONSIDERATIONS

The state of Ohio needs to provide the ability to intertwine numerous solutions– at differing levels of government – and integrate these solutions so the collective sum is more than its parts. The focus of this effort is the development of an Ohio Asset.

The state of Ohio has earmarked over $7,000,000 in capital funds to focus on the development of the LBRS through state and local matching funds. The funding will support the creation, conflation and attribution of street centerlines, centerline address calibration, address ranges, site addresses, and jurisdictional boundaries through the development of LBRS sub-systems in each county. The state will provide matching funds for spatial data development through agreements and to support the on-going maintenance of these spatial features in a mutually determined frequency. The state of Ohio is also pursuing federal funding to support this initiative as well.

OGRIP has requested $1,600,000 in general funds for the development of a robust clearinghouse, data sharing standards, spatial metadata development and additional framework layers to support the LBRS and numerous other projects at the state.

GPS centerline data collection technology provides the most accurate, useful centerline networks in the shortest amount of time and at the lowest cost. Intelligent, three-dimensional road centerlines with accurate address ranges provide an excellent means by which to integrate data from legacy systems and overlay on top of a digital orthophoto image. Qualified firms can convert the GPS data in various data formats to meet the state's need, including ArcInfo coverages, shapefiles and other applicable formats. If usable county data exists, the qualified firms would integrate or conflate (reposition) this information with developed centerline and address data to create a seamless statewide

centerline and address range coverage. Field verification of existing address locations remain a key component in the creation of the LBRS Address database

The development and creation of centerlines for the remaining counties will be accomplished over 4 fiscal years. Centerlines will be captured and implemented on a county-by-county basis. Centerlines will be developed in conjunction with the Ohio Department of Transportation Linear Reference File structure for increased benefits. The definition of this data structure is currently under discussion with ODOT and OGRIP. State and local government participants will accomplish quality control, quality assurance, validation and verification of final deliverables. Local knowledge will ensure street names and aliases; address ranges are complete, displayed correctly and in their appropriate spatial positions.

The majority of costs for this endeavor are associated with data capture and the creation of the Ohio Asset. The physical capture of the center of the road and corresponding addresses for structures. There are three general phases for data creation with the location based data system:

1. Data Creation (60% of the cost)

- Capture of road centerline
- Address range and structure address capture

2. Verification and Validation (20% of the cost)

- Review completeness of existing centerline
- Review positional accuracy of information
- Validate and verify centerlines and attribution

3. Data Integration Tools (20% of the cost)

- Tools to integrate, conflate, or adjust data
- Develop criteria for integration
- Perform quality control and quality assurance

These phases would be contracted for services with qualified firms. These percentages per phase are broken out in Table 3-1 by fiscal year.

Phase of Data Creation	FY03 – FY04	FY05 – FY06	FY07 – FY08

Data Capture	$ 900,000	$1,800,000	$1,200,000
Data Verification and Validation	$ 300,000	$ 600,000	$ 400,000
Data Integration	$ 300,000	$ 600,000	$ 400,000

Table 3-1
Anticipated Expenditures by Fiscal Years

Besides the obvious benefits of emergency preparedness, quick response, and the safety and well-being of the citizenry of Ohio, the information captured and maintained through the development of the LBRS will have a significant impact on federal, state and local government. The LBRS will be the underpinning of integration of other location-based data, such as jurisdictional boundaries, taxing districts, school districts, etc.

Memorandums of Agreement (MOAs) will be developed for each participating county that define the roles and responsibilities of the state and local government partners for collaboration to:

a) Obtain state funding
b) Assist in the validation of data
c) Assist in the maintenance and update of this data.
d) Establish County GIS Management teams and encourage multi-agency participation in the development of the LBRS subsystem.
e) Establish sustainable partnerships between the counties and the state for the development and maintenance of the LBRS

The administration, development and management of existing MOAs with local government, state government, as well as the federal government will be handled through OGRIP.

4 BENEFITS

Benefits, like beauty, are often in the mind of the beholder. This section of the LBRS White Paper lists some of the benefits that will occur as a result of implementing the Ohio Location Based Response System database and GIServeOhio. Though few of these benefits can be quantified at this time, many of them can be demonstrated through anecdotes or examples.

THE LBRS WILL PROVIDE PROGRAM SUPPORT FOR STATE GOVERNMENT

The LBRS supports Governor Taft's eCorridor initiative by integrating economic and demographic information by location. In turn, this will encourage new businesses to locate or remain in Ohio, giving the state a competitive advantage over other states. It creates a foundation for new business opportunities for location-based services for our citizens, which increases our economic drawing power for high tech companies. In the past economic analysis has been accomplished on an ad hoc basis hindering our ability to respond rapidly to changing conditions or *ad hoc* requests.

The LBRS allows requests to be done comprehensively and more quickly providing the necessary edge in enticing businesses to reside in Ohio. It has the potential to improve both public and private sector perception of government in several ways. Taxpayers, especially businesses, will recognize the State's actions as ones that benefit their operations and ability to do work. The enhanced consistency of spatial data products and increased collaboration paints a picture of more effective and efficient government business processes and government's attention and commitment to protecting our citizens' safety.

Many state agencies will see specific benefits from the LBRS. For instance, the Department of Transportation (ODOT) anticipates that the LBRS will help create a more effective crash reporting system[6]. LBRS data will provide a more consistent and higher accuracy address database with which to map crash locations. In turn, that will improve ODOT's ability to analyze the potential physical causes of accidents and evaluate various statistical characteristics. Both the departments of Public Safety and Transportation can see potential benefits deriving from the implementation of LBRS and creation of the GIServeOhio function on behalf of the motoring public. These benefits include a more equitable apportionment of funding to counties based on road mileage within the jurisdiction.

[6] See http://www.dot.state.oh.us/strategicinitiatives/SI2003/03SI3.asp

As noted in Section 2 of this White Paper, other key agencies and state programs will see immediate benefits from LBRS development. These include the Emergency Management Agency (enhanced access to comprehensive statewide addressing), Ohio Disease Reporting System (more reliable spatial data for reporting and tracking), Ohio Security Task Force (improved ability to pre-plan and make informed decisions in the case of emergencies), and the Department of Natural Resources (more accurate determination of environmental impacts).

These anticipated benefits will occur because of factors such as more effective use of staff time (spatial data will be more readily available), mapping/data gathering costs avoided because of the ability to make use of local governments' data to support state business functions, more effective use of technology as standards for spatial data are introduced and adopted by multiple departments, and the ability to streamline current business functions that cannot take advantage of data availability at knowledge workers' desktops in real time. OGRIP estimates that productivity will be increased 10% (four hours per week) for any workers in state agencies whose job functions routinely include working with mapped data.

THE LBRS WILL BENEFIT LOCAL GOVERNMENTS

Local governments will benefit from implementation of GIServeOhio within the LBRS. Because each county will have access to detailed information about the land outside its own boundaries, a number of already-realized benefits of technology deployment will be realized even further. These include some specific examples from Ohio counties.

Ohio Anecdotes

Estimates show counties are losing up to $3000 dollars in federal funding for every individual uncounted by the Census Bureau. Delaware County has provided information to Census identifying many households that were not counted at the last census. With the implementation of the GIServeOhio database, counties will verify households by verifying addresses and (potentially) identify undercounting by enumerators.

Van Wert County was experiencing error rates of up to 80% using off-the-shelf data in their 911 dispatching software. This fact prompted them to look at LBRS as an alternative. New dispatching software is capable of matching a point file if it exists; if the point doe not exist, it falls back to a centerline for geocoding. Site verified addresses would supplant centerline interpolation in most cases. LBRS will offer counties the same ability to make their dispatching function more reliable.

With the LBRS in place, both state and local EMA and first responders will be working with the same set of geographic features. In the past, these groups (and others, such as the National Guard) have had to make do with data derived from USGS quadrangles. This data can be 25-30 years out of date and in many cases is no longer an accurate

representation of features, as they currently exist. LBRS data will help eliminate confusion resulting from multiple data sources save time, improve coordination, allow responders to plan for and react to situations with appropriate resources.

Intangible (Non-Quantifiable) Local Government Benefits

Cost-Avoidance Decision-Making

By having access to additional geographically referenced data (and being able to access it in a manner consistent with their own data), county staff will be able to enhance opportunities to utilize cost-avoidance decision-making. In other words, counties will be better able to foresee field conflicts with neighboring jurisdictions, schedule maintenance that could be performed in concert with adjoining counties, and perform least-cost planning for capital expenditures by including one or more neighboring jurisdictions.

Response to Unpredictable Events

Counties will be better positioned to respond to unpredictable events when more accurate geographic information is available. The financial benefits of this ability could be quantifiable only after the event, such as a major storm.

Benefits of More Improved Pre-Planning

With LBRS data available, counties will be able to realize benefits from more efficient pre-planning and coordination for emergency response. For instance, by identifying key facilities with more accuracy, evacuation routes could be more clearly defined and alternatives could be quickly enabled if storms made one or more routes impassable. The monetary value of this benefit could be calculated after an event.

Improved Constituent Services

By being able to respond more completely to requests for information about the features of the county, county staff will offer improved constituent services. This is an example of the ability to provide more (and better) content to answer constituent requests and to more quickly offer responses to requests for information.

Enhanced Constituent Perception

Each of the previous statements about benefits will, in turn, yield an increase in constituent perception for local government workers. This should also assist in supporting the concept of *seamless government*.

Cost Avoidance Benefits for Local Governments

These benefits arise from avoiding expenditures and/or increasing revenue.

Limiting Staff Growth

By placing more data at the fingertips of the existing staff, one potential benefit of the LBRS will be to help limit the number additional staff needed by counties. Provided GIServeOhio provide data in real time in an easily manipulated interface, this benefit should be achieved.

Revenue Enhancement

By having more accurate data about common boundaries with adjoining jurisdictions, some counties may find that properties thought to be in one jurisdiction are, in fact, in another. Special districts, school districts, and other jurisdictional boundaries may be reevaluated after LBRS implementation to be sure that revenues that might be collected are, in fact, being collected.

MAJOR STATEWIDE THEMES SUPPORTED BY THE LBRS

The creation of the LBRS will help support numerous activities at all levels of government. It will increase the accuracy, completeness, confidence and reliability in site location determination. The LBRS supports numerous multi-level government functions. These functions include the following areas.

Economic development

Unfortunately, Ohio's job loss figures over the preceding three to four years continue to have an effect on the quality of life throughout the state. Making jobs is likely to be a major theme in the 2004 presidential election, with one party symbolically making Ohio the state to put their candidate over the top and capture the party's nomination.

LBRS data provide a framework that will allow economic developers to enhance existing or develop new applications that can find and display the locations of skilled workers who are looking for work. When tied to up-to-date spatial data demographic information will assist companies find semi-skilled workers as well, and portray the best locations for various kinds of light and heavy manufacturing labor.

There has been a renewed War Between the States in our country for at least the last 20 years. Highly visible companies (e.g., Toyota, GM, and Mercedes-Benz) ran highly-

publicized competitions to locate manufacturing facilities in the optimum location for available labor, reasonable wage expectations, logistical possibilities, and tax incentives.

How can the state quantify the benefit to either capturing a business not already located within the state, or persuading one already in state to expand within the state borders? What is the value of the benefit?

The ability to answer questions about locations and quality of life throughout the state will make the LBRS database of great value to Department of Development staff. Local and regional governments, as well, will be able to access GIServeOhio and answer questions about their own prospects as well as those of other competing counties.

Public Safety

Location information is very important to Public Safety officials, field, and office workers. In part, this is because studies have shown that crime occurs in recognizable patterns throughout an area. If Police can discern these patterns, lives and property can be saved.

The LBRS promises to enhance the accuracy and accessibility of spatial data to support Public Safety applications. In addition to Police, Fire officials need enhanced access to spatial data.

From the State Patrol to the cop on the beat, the LBRS will assist in keeping Ohio's citizens a little more secure. Federal officials will likewise have access to this data. This means that the citizenry can sleep a bit more restfully after the LBRS is implemented and operational.

Emergency Management, Preparedness, and Response

Preparation for emergencies is ultimately a local function—, by that we mean that a detailed local knowledge of the terrain, demography, and character of a place is needed in planning for, responding to, and managing the details of any emergency situation.

While federal officials feel, since September 11, 2001, that planning for unknown dangers should be a function of the government in Washington, many state and local officials believe that they can do a better job since they know their own back yards. Indeed, Department of Homeland Security officials have publicly commented that they cannot presently make use of detailed local GIS databases because they contain more information than DHS analysts can handle.

The LBRS will benefit all levels of government in this key area. First, LBRS will collect the detailed data that local governments have created. The data that is disseminated to state agencies and federal groups will likely be generalized. To say "generalized" we

mean some of the details will be taken out. This will make files smaller and specialty groups can dither (remove details) that are not germane to what their mission is. Secondly, LBRS will retain only the most current version of any single data element. The data available through GIServeOhio will be as current as the county GIS staff is able to make it. Thirdly, GIServeOhio is expected to be open twenty-four hours a day, seven days a week, providing Internet access to data in real time. While all protocols have not yet been firmly established, entities with the greatest need for data in real time will be granted access in conformity with privacy laws and similar stipulations.

The financial benefits of having high-quality local data are almost incalculable. How does one value lives saved because of adequate and informed pre-planning. What is the economic value of establishing several evacuation routes in the face of an impending major storm? What value could we place on the ability of planners to anticipate a nuclear incident and pull off an evacuation without incident?

Under stress in response mode, an emergency manager may want to know the location of all water facilities, addresses for facilities with hazardous substances, hospital locations, fire stations, and the present capacity of every major road in a three county area. How can s/he react with confidence in that stressful time if the data is not at hand? LBRS and GIServeOhio will be able to offer that data in a comprehensive and comprehensible way. How would we assign a dollar value to that functionality?

Bioterrorism

Few threats are more frightening that bioterrorism. Introducing disease or sickness into the world for the purpose of killing one's own species has such grave philosophical implications that the majority of the countries in the world have vowed not to do so. Yet such a threat to our families and ourselves has a chilling effect on us.

Entities such as water providers are particularly vulnerable (in theory) to attacks via chemical or biological agents. How do we assign a benefit value to the ability of a water utility to find the source of man-made contamination and deal with it within a few hours? What happens when multiple attacks occur over a larger area and damage is done to a number of different groups in far-flung jurisdictions?

LBRS data will help take a regional or statewide approach to dealing with these kinds of attacks, should they occur.