The underlying problem with 9-1-1:

Rescuers can't help citizens if they can't locate them

How Ohio found a solution by building a better map

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The Problem

Lives are lost every day across the country in highway crashes, house fires, medical emergencies and natural disasters -- but never should they be lost because emergency crews can't locate those in need of help. Tragically, inaccurate map data causes this to happen more often than anyone wants to admit.

Alarmingly high map error rates have been found in many areas across the country, placing lives needlessly in danger every day. In Minneapolis-St. Paul and the State of Texas, for example, 85 percent of map data was found to have some degree of error, according to a 2011 report from the Communications Security, Reliability and Interoperability Council. In addition, a review of 50 recent data validation reports from across the country uncovered errors or omissions in more than 70 percent of 9-1-1 datasets. This means the vast majority of citizens in these areas may not be located quickly – or perhaps at all –when they are in need of emergency services.

Ohio recognized this troubling problem with 9-1-1 mapping and developed a solution that was hailed as a best practice by the U.S. Department of Transportation in its 2011 Transportation for the Nation strategic plan. It's called the Location Based Response System (LBRS) and it is saving lives as well as taxpayer dollars every day in the Buckeye State.

"Good mapping can make the difference between life and death," says Dave Blackstone, GIS Manager for the Ohio Department of Transportation.

What makes Ohio's system so impressive is the field verification – versus traditional geocoding along street centerlines with address ranges – that goes into building the map. Field verification allows for precise plotting of residential and commercial structures to within +/- 1 meter, and makes note of address anomalies and road obstructions that could otherwise slow first responders.

"With LBRS, we have literally been able to cut minutes off the arrival time of responders because of our ability to give better directions," says Monte Diegel, 9-1-1 Administrator for the Mercer County, Ohio, Sheriff's Office. Error rates have dropped to low single digits in most Ohio counties with LBRS.

"The importance of extremely accurate map data for 9-1-1 can't be overstated," says Ron Cramer, president of Digital Data Technologies Inc., an Ohio-based mapping software company that pioneered the technology behind the field verification process used in LBRS.

In addition, the map data stored in LBRS is able to meet the vastly different needs of state, county and municipal governments across Ohio, allowing the state to slash redundant spending, increase efficiency and save countless lives.

Imagine what it could do in your state.

Finding a Solution

Before LBRS, ambulances were being dispatched to the wrong side of a jurisdiction because of inconsistent or erroneous map location data. Precious minutes were being lost trying to figure out how to circumvent a drainage ditch that showed up as a road on 9-1-1 dispatch mapping software. A house number was out of sequence, forcing deputies to drive up and down a road searching for the location of a suicide call before it was too late. The stories were numerous and endlessly frustrating. Some were heartbreaking – especially because lives might have been saved with more accurate and consistent, shared mapping data. But responders were doing the best they could with the data they had.

"People's lives were on the line and we could not locate them – even though we thought we had good map data," says Kim Hambel, Communications Supervisor for the Muskingum County, Ohio, Sheriff's Office. "It was frustrating beyond words."

Almost 10 years ago, Ohio began building a better map from the ground up, in hopes that it would alleviate many of these problems. Digital Data Technologies Inc. was involved in this process from the start because company officials realized the life-saving impact more accurate map data could have across the state – and even the country.

Field verification is the cornerstone of Digital Data's mapping software. Without physically driving each and every highway, state route, county road, municipal street and neighborhood cul-de-sac within a jurisdiction, maps cannot be truly accurate. After all, relying on street centerlines with address ranges may be the industry norm, but doing so carries serious drawbacks. For example:

> *"People's lives were on the line and we could not locate them – even though we thought we had good map data."*
>
> *- Muskingum County, Ohio, Sheriff's Office*

- Approximately 20 percent of address ranges differ from the Master Street Address Guide (MSAG) to what is actually at street level.
- Actual addresses don't conform to conventional addressing standards at least 50 percent of the time – and that's a conservative estimate.
- Between 3 percent and 5 percent of all addresses are outliers or anomalies.

Not to mention any new developments that pop up, roads and bridges that close or become impassable, traffic patterns that change, and other hallmarks of thriving areas that make routing emergency vehicles enormously difficult with inferior or outdated map data.

Kim Brandt, 9-1-1 Coordinator for Van Wert County, Ohio, knows this is true.

"The original map system sold to us by a different company was expensive and very unreliable. We were lucky if it was correct 20 percent of the time," Brandt says. "We did not accept that map solution."

Neither did more than three-quarters of Ohio's 88 counties. They all voluntarily and independently decided to ditch their old map systems and start collecting and contributing highly detailed, more reliable map data to the Ohio Location Based Response System where it can be referenced by all levels of government for the benefit of all citizens.

Map data that has been field verified and regularly maintained is 97 to 99 percent accurate – and includes all outliers and anomalies since they have been pinpointed during field verification and noted on the database.

In addition, field verification assigns individual address points to all apartment and condo units, strip mall storefronts and every trailer within mobile home parks (typically 8 percent of all address points). Address points are also assigned to popular landmarks and points of interest within a jurisdiction where emergencies may occur, such as a public park or pool, but don't have commonly known or posted addresses. Having such detailed, accurate map information at dispatchers' fingertips adds greater confidence, speed and life-saving potential to 9-1-1 response.

Map data that has been field verified and regularly maintained is 97 to 99 percent accurate. Is your map that good?

"These maps are used multiple times every single day," Brandt emphasizes. "They save time for responders not only by locating the caller but also because the dispatcher can give crossroads to the responders so they know exactly where they are going when they leave the station."

"By going to a new, field-verified mapping system, when we take a 9-1-1 call, in a matter of seconds we know exactly where that residence is on that road– whether it's a quarter-mile back or along the road," says Hambel of Muskingum County. "We're not guessing where locations are anymore. We have pinpoint-accurate addresses. Even if it's out of sequence, we have no trouble finding the residence. We know exactly where to send the personnel and the proper equipment."

Other highlights of Ohio's LBRS

- All data in the Location Based Response System has to meet specific state standards in order for it to be accepted. The most accurate data in the system is field verified to ensure precision mapping and includes site-specific address locations – not just address ranges on road centerlines.

- Because it is field verified, all LBRS data boasts positional accuracy to +/- 1 meter. By comparison, the latest 2010 TIGER data used by the U.S. Census Bureau is accurate to +/- 7.6 meters.

- The LBRS is updated regularly to ensure accuracy. Although the state only requires counties to update data annually, most are choosing to update more frequently – some as often as daily. This creates an extremely reliable system for routing emergency responders since even short-term road closures can be noted & avoided.

Success stories

Saving lives: Every second matters

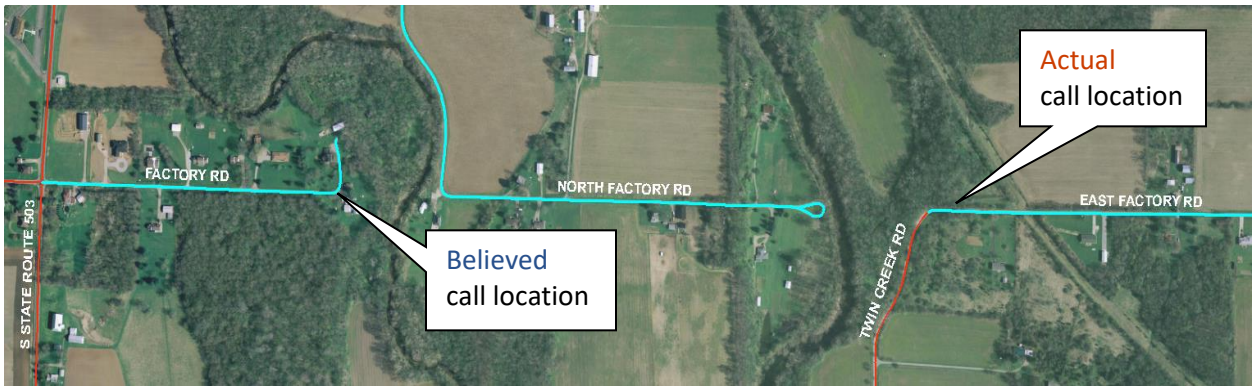
In an emergency, response times are critical. The first few minutes can make the difference between life and death. So mistakenly dispatching an ambulance, fire engine or police cruiser to the wrong address or using mapping data that provides only address ranges rather than precise locations can prove disastrous. "If we can provide a dataset that gets them there a few minutes early, you can't put a price on that," says Blackstone with the Ohio Department of Transportation.

Sheriff's Offices and EMS crews throughout Ohio know the accuracy of field-verified LBRS data has saved lives. "With LBRS, we have literally been able to cut minutes off the arrival time of responders because of our ability to give better directions," says Diegel of the Mercer County Sheriff's Office.

For example, before LBRS, responders trying to find 12847 Wabash Road in Mercer County might end up nearly a mile south of the actual location, using only street centerlines and address ranges to plot the address.

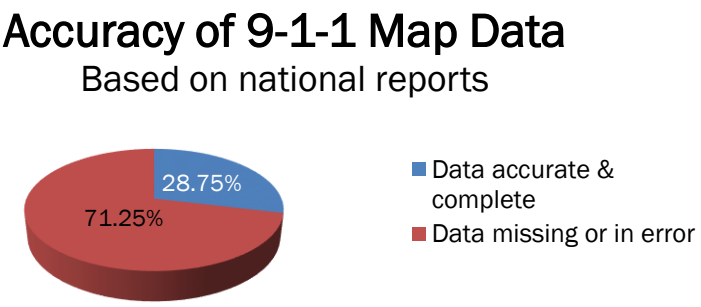
> *"With LBRS, we have literally been able to cut minutes off the arrival time of responders because of our ability to give better directions."*
>
> *- Mercer County, Ohio, Sheriff's Office*

Similarly, in Preble County, a call to 7164 Factory Road previously geocoded to a stretch of road that abruptly ended before the desired location was reached even though the address range plotted it within that area.



Backtracking to reach the correct section of road where the address actually was located requires a four-mile trip around neighboring roadways as the road ends and resumes several blocks away – not once, but twice. That's four or more minutes of response time that can now be saved since the county proactively had all the addresses field verified to increase accuracy. Now, the exact location of a call from that address can be pinpointed the first time, and a long, potentially life-threatening delay can be avoided.

Address anomalies and other mapping errors like this that can slow down emergency response time are rampant across the country.



In Ohio, Van Wert County was experiencing error rates of roughly 80 percent using off-the-shelf data in their 9-1-1 dispatching software prior to joining LBRS in 2005. Now, even if a caller doesn't know where he or she is, the field-verified data utilized by AccuGlobe® Dispatch, which enables the county to harness the information-rich attributes of LBRS data, can help emergency response personnel locate them at least 99 percent of the time to an exact location, says Brandt. In fact, once when a car drove into the side of a house, the LBRS data showed the call as coming, not just from the home's address, but from the precise side of the house where the car was located.

"The data is highly accurate because of the way it was collected and verified," Brandt says. Perhaps that's why AccuGlobe is being used across the country by some of the nation's largest Public Safety Answering Points (PSAPs) for situational awareness displays.

"We get people in our county that need assistance, but don't have any idea where they are," says Jim Southward, Emergency Management and Homeland Security Director for Richland County, Ohio. "With the maps that Digital Data Technologies provides us through AccuGlobe, we can really help those people out."

> *"The [AccuGlobe] data is highly accurate because of the way it was collected and verified."*
>
> *- Van Wert, Ohio, 9-1-1 Coordinator*

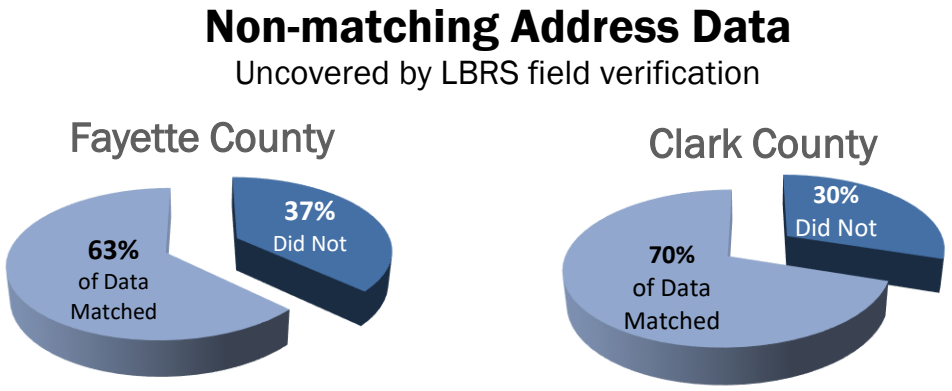
"The big benefit is 9-1-1," agrees Blackstone. "The ability to save a life. There are just errors. A road is closed; it's been relocated. To us, it's an inconvenience. But some 9-1-1 operators use that same dataset. So what might make us late for a meeting might cost someone else their life."

Reducing errors & confusion

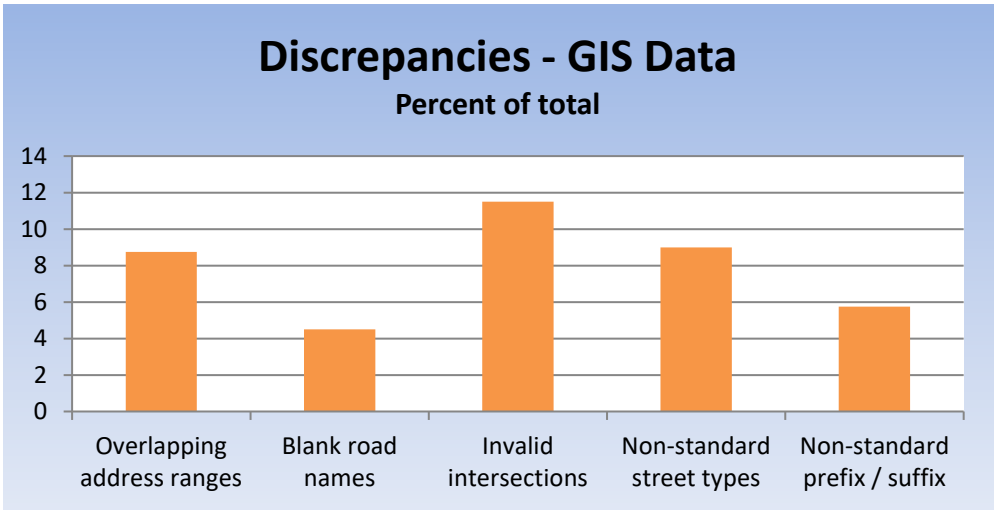
Having all government entities within a county – and most counties across the state – referencing LBRS data has helped eliminate inconsistencies in map data. In Erie County, this was particularly important since that county is Ohio's smallest, but is still home to 17 different addressing authorities. Before LBRS, that typically meant 17 different sets of map

data and a lot of potential for confusion and errors. "There was no centralized addressing authority," says Erie County GIS Advisory Board Secretary Mark Wroblewski. "What we had in those independent databases wasn't consistent." And quite frequently, the information was inaccurate or out of date.

In Fayette County, errors were found in 4,236 records – or 37 percent of the county's data – after Digital Data Technologies Inc. was hired to field verify each and every address point throughout the county. This field verification was done in preparation for Fayette County to start participating in LBRS. A similar error rate was found in Clark County, where 16,882 records – or 30 percent of the county's database – had non-matching address data when field verified by Digital Data Technologies for LBRS participation.



Similar error rates can be found throughout the country. In an analysis of more than 1.5 million road centerlines from more than 30 "typical" PSAPs, discrepancies were found in 30.28 percent of data when comparing Geographic Information Systems (GIS) data to Master Street Address Guides (MSAG). The most common discrepancies are detailed here:



LBRS, with its field verified data, eliminates such discrepancies and has removed the guesswork involving roads with multiple names or non-intuitive access points. It can even locate wireless callers with spot-on precision. "LBRS mapping has truly stepped up the game in the fact that we are now able to pinpoint nearly every wireless 9-1-1 caller to within feet," says Diegel of the Mercer County Sheriff's Office.

That feature came in particularly handy when Mercer County law enforcement was trying to capture a subject wanted on an arrest warrant. The subject initially fled a local scrap yard when officers were closing in on him, but later called 9-1-1 and said he wanted to turn himself in. In a failed attempt to outfox authorities, he gave his location as inside a garage not far from the scrap yard, but the 9-1-1 call mapped him, instead, as being in a wooded area nowhere close to the address he had given the dispatcher. A K9 team was called in and tracked the subject to the location in the woods shown on the wireless call. The subject was successfully taken into custody.

"Without question, the LBRS mapping has sped up our ability to get responders to the right location the first time," Diegel says.

In Sandusky County, while collecting field-verified data in order to start fully participating in LBRS, officials there learned that 20 percent of rural addresses in the county previously had location errors of at least a quarter of a mile. Ten percent had location errors of at least a half-mile, and 5 percent had location errors of a mile or more. That is a frightening premise both for first responders and for those in need of emergency services.

Having field-verified addresses and top-notch call-tracking software incorporated into the data submitted to LBRS is paramount to lessening confusion and increasing public safety.

"It is reassuring to see the caller location almost immediately on a map that we know is correct," says Jason Roblin, Director of the Huron County, Ohio, Emergency Management Agency, which relies on AccuGlobe technology in its 9-1-1 dispatch centers. "I have talked to some multinational companies that do mass notification and who use geocoding to drive their system. While it works well for their application, we have become accustomed to a higher standard. I just can't imagine using anything less accurate for emergency response."

Preparing for Next Generation 9-1-1

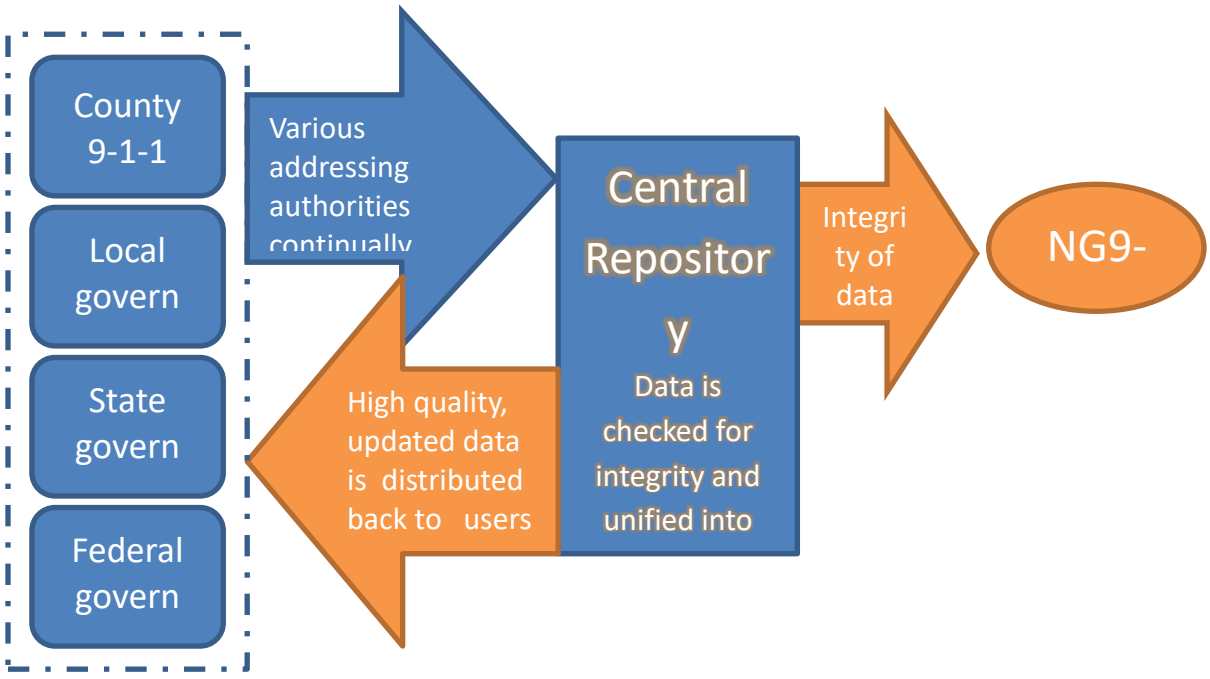
Ohio's LBRS has also positioned the state to be well ahead of the pack in complying with Next Generation 9-1-1 (NG9-1-1) efforts. NG9-1-1 requires a single, unambiguous, site-specific civic address to be matched to every 9-1-1 call – including those coming from apartment complexes, office buildings and mobile home parks. Using a blanket address for an office building, for example, will no longer be good enough. Every suite within the building will need to have its own, individual address.

While this may sound cumbersome, having more precise map data will greatly improve the ability of first responders to locate callers – or devices that generate 9-1-1 calls. After all, with NG9-1-1, requests for emergency assistance don't have to come from a land line or cell phone. They can come from a sensor sending data of smoke and high heat in a building, or a personal medical device that is triggered by heart attack symptoms, or even a telematics signal from an overturned tractor in a farmer's field. Yet all of them will need to be located. That's why, in NG9-1-1, the location of these devices will need to be pre-validated against the local 9-1-1's GIS data in advance of any emergency call so the location can become part of any 9-1-1 call from that device. This will allow calls to be automatically routed to the proper Public Safety Answering Point (PSAP). It sounds complicated, but every NG9-1-1 system will need to be able to handle this more sophisticated level of emergency communication – and having highly accurate GIS data will be paramount to its success.

In Next Generation 9-1-1, the location of any device that makes an emergency call will need to be pre-validated against the local 9-1-1's GIS data. Is your map data precise enough to handle that?

With the field-verified data already incorporated into Ohio's LBRS through Digital Data Technologies' efforts, the vast majority of counties in the Buckeye State are already prepared for the NG9-1-1 rollout. In fact, Digital Data's NG9-1-1 Emergency Call Routing Function (ECRF) is designed specifically to comply with the National Emergency Number Association (NENA) i3 standard and includes superb call routing performance. With this technology behind it, LBRS will become the cornerstone for reliable mapping and, in turn, building emergency routing databases in the future.

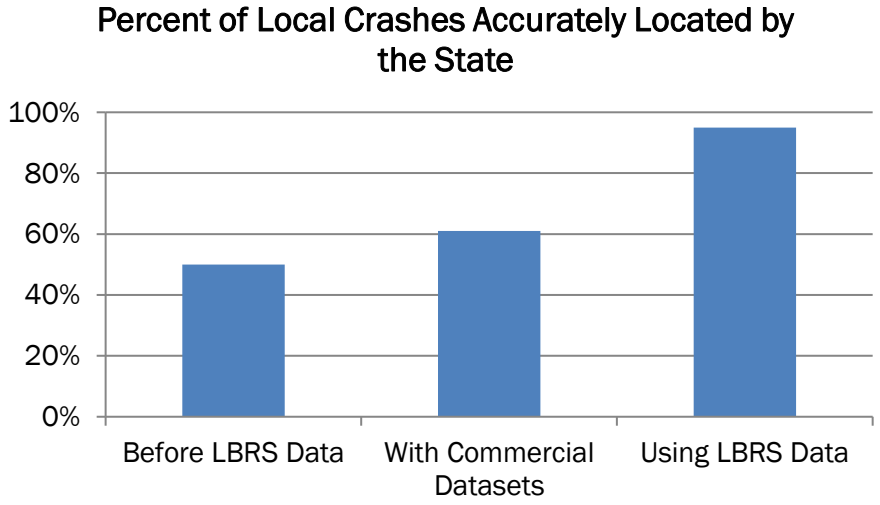
Data Integration & Dissemination



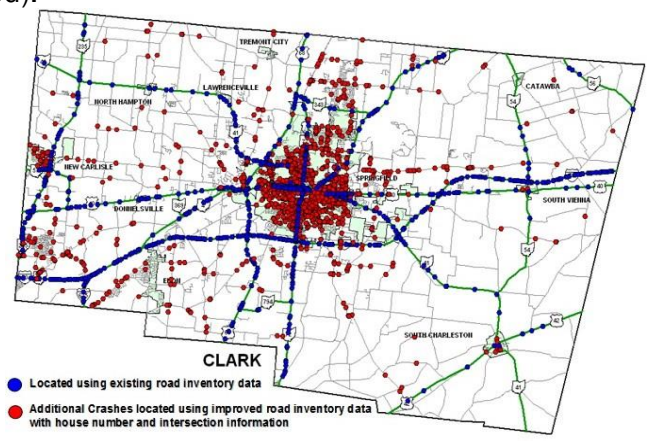
Creating safer roadways

More than 386,000 crashes took place on Ohio roadways in 2002 – the year before the first pilot of LBRS was launched in Fairfield County. Of those crashes, only 27 percent occurred on the "state system" of interstate highways, U.S. routes and state routes, which the Ohio Department of Transportation (ODOT) is directly responsible for maintaining. While ODOT could accurately locate about 85 percent of the crashes that occurred on that state system, it could only establish locations for about 50 percent of the remaining 282,000 crashes because they took place on local roadways or streets and detailed local map data, such as street names and specific addresses, simply weren't available to the state at that time.

Even when using commercial datasets, purchased at taxpayer expense, only 61 percent of local crashes could be accurately pinpointed by the state. But when LBRS data came on the scene, the state's ability to identify local crash sites went up to more than 90 percent. "That's extremely important since the bulk of our crashes do occur on that local system," says ODOT's Blackstone.



Perhaps an even better illustration of how LBRS data can enhance state crash data can be seen in the map below. It shows the crash locations in Clark County that ODOT was able to locate using its own network prior to LBRS (blue dots) compared to those located after incorporating LBRS (red).



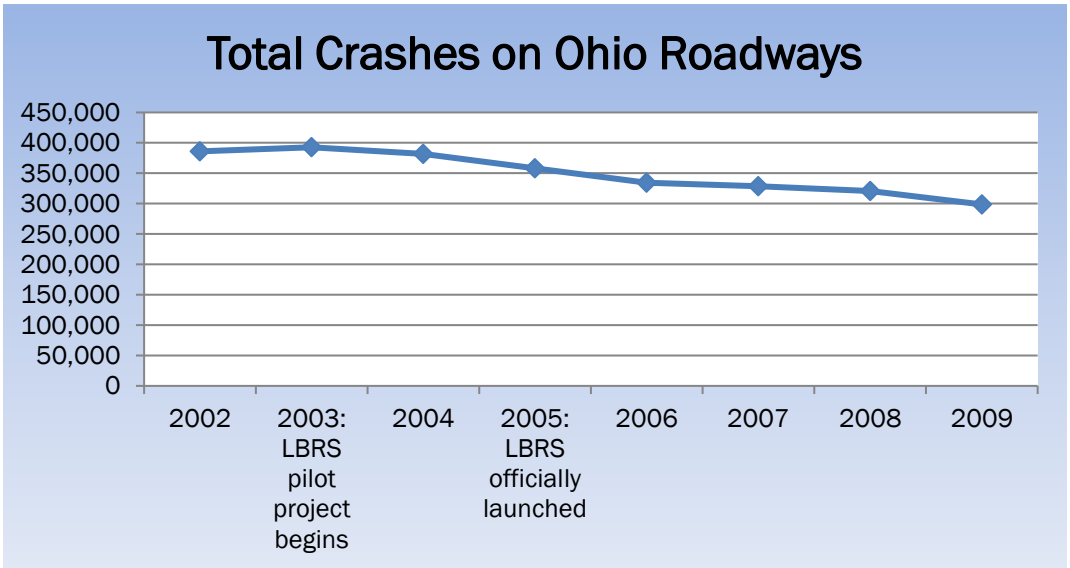
Being able to pinpoint more local crash sites throughout the state carries a two-fold benefit. First, it allows for better crash analysis and preventative measures – such as guardrails, no passing zones or better signage – to be added in an effort to curb additional crashes at those locations. Secondly, it helps Ohio get its fair share of federal safety dollars to finance such improvements to make roadways safer.

If the state had a better method to locate and analyze all of the crashes throughout Ohio back in 2002, there was a potential at that time for an additional $24 million in federal funds to come to Ohio annually, according to a safety analysis performed by the state. As it stands now, with the improved local data available through LBRS, Ohio has not only been able to apply for and receive more federal safety funds annually to address high-crash areas throughout the state, but has received an additional $2.9 million from the Traffic Safety Information program's Section 408 funds to spend on the ongoing development of the LBRS database.

> *"By having better data, we may have prevented someone from being killed."*
>
> *- Ohio Department of Transportation*

"It's a win-win," says Blackstone. "We're getting federal dollars to develop LBRS and, in turn, by using this data in our crash program, we're able to apply for and receive additional federal dollars for the safety program. By having better data, we may have prevented someone from being killed."

To that point, deaths on Ohio's highways in 2009 – the most recent statistics available – were at a historic low, representing the safest year on record for those traveling the state's roadways. In addition, the number of crashes within Ohio has dropped dramatically since the launch of LBRS. In 2009, there were 298,646 crashes on Ohio's state and local roadway systems combined – a drop of 22 percent since 2002.



The National Highway Traffic Safety Administration was so impressed by Ohio's use of its Section 408 funds to build a better dataset to encourage better crash identification and safety improvements that agency auditors told the state they were going to suggest other departments of safety throughout the country consider using their Section 408 funds to develop similar systems.

Clearly, in the safety community, Ohio's LBRS has already become a best practice.

Here's how to start an LBRS-style initiative in your area.

Building a Better Map

The Structure

Studies show that more than 80 percent of data collected, stored and maintained by local governments include some reference to geography. Therefore, it makes sense for LBRS to be built using a ground-up structure, putting counties in the driver's seat since they have the greatest access to – and need for – detailed, accurate map data on a daily basis.

County engineers need to know where every individual road is located. County auditors or assessors need to appraise each individual property. Local planning and zoning officials need to know where new construction projects are happening. So if you're going to embark on a project like Ohio's LBRS, the counties need to be fully on board. You don't want to develop a dataset without local participation because no one else can build or maintain it with the proper degree of confidence.

Counties need to be driving the collection of field-verified map data with the full support and oversight of state government.

Getting the buy-in at the county level doesn't mean just the county engineer or assessor, however. In Ohio, part of the Memorandum of Agreement each county signs with the state includes the stipulation that counties must have buy-in from multiple local entities in order to participate in LBRS. The suggested list includes: county auditor (who, in Ohio, also acts as county assessor), county commissioners, county engineer, county sheriff, county 9-1-1 coordinator, county emergency management director and the county health commissioner. The reason for this is because LBRS was developed to produce a value back to everyone in the county, not just a single entity. Multiple agencies must be involved and supportive from the start to ensure smooth collection of data and proper maintenance of the data once it is gathered and submitted to the state. LBRS is designed to be a community asset, so whole community involvement from the start is paramount.

How LBRS is structured in Ohio

Government Entity	Role
Individual Counties	Project management Data development & quality assurance Data maintenance
Department of Transportation	Program sponsor Data verification Data integration
Geographically Referenced Information Program	Program administration Data dissemination

The full responsibility for producing and maintaining the LBRS map data lies at the county level, but they're in the best position to take on these roles. The state's role is to support and oversee compliance with LBRS standards for the development of the data and ensure it is accurate and available to all. By acting as the sponsor and administrator for the program, the state can link all levels of government together seamlessly.

The Standards

Since county, state and federal officials all have different needs for using map data, building a single, unified map that could be shared among all levels required finding a common interface and fusing together many layers of information. It also required getting various agencies to speak the same language. For example, state law enforcement officers typically identify roadway segments using route numbers and mile posts. Local law enforcement officers, however, use street names and address numbers. For LBRS to be user-friendly to both segments of law enforcement, a simple translation program had to be incorporated that allowed street names and addresses to be converted to route numbers and mileposts and vice versa.

Once details such as these were worked out, the next step was making sure all data collected for LBRS would adhere to the same level of detail and accuracy across all counties. This was done by establishing a clear set of standards for data collection and a process for state officials to verify that the standards had been met.

In order to be accepted into Ohio's LBRS, all county data submitted must:

- Be spatially accurate to +/- 1 meter horizontally and +/- 3 meters vertically;
- Include verified address ranges;
- Contain field verified, site-specific address points;
- Associate site addresses to digital street centerlines;
- Identify alternate street names, such as Main Street also being known as Route 40.

These standards were based on a field-verification system developed and used by Digital Data Technologies Inc. to ensure the most accurate mapping possible on a local level.

Having field-verified, site-specific addresses paired with centerline data eliminates all the guesswork involved in locating a specific property. With address ranges, interpolating must be done, which essentially means making educated guesses about where, within a given address range, each individual property may be located. Anomalies – like an odd-numbered address being located on the even-numbered side of the street, or long lanes that leave one dwelling tucked far behind other nearby houses located closer to the road – cannot be accounted for when using address ranges. In Ohio, typically 3 to 5 percent of addresses were anomalies in a given county. And accuracy is vital when multiple entities rely on a singular map.

Vendors need to physically drive every road in a county in order for the data to be truly accurate and reliable.

The Muskingum County Sheriff's Office has experienced, firsthand, the life-saving benefits of field verified map data. That department once received a 9-1-1 call from a male threatening suicide, but the call was coming from a shed 100 yards behind a main residence. "Because we had aerial photos, we saw the structure was down a lane," says Hambel. But because the county had previously contracted with Digital Data Technologies Inc. to drive all the roads in the area to verify the data seen on the photos, the Sheriff's Office also knew there was another road – unseen in the aerial photo – that connected to that lane. "With the old mapping system, we wouldn't have known that little road came off there," Hambel says. "We would've had no idea how to access the property and surround the shed while talking to him." This story had a happy ending. Yet without field-verified data, who knows what the outcome might've been?

"There are a lot of mapping systems out there that will guess what an address is instead of field verifying it. When a life is on the line, I don't want to guess. I want an accurate location."

- Muskingum County, Ohio, Sheriff's Office

Gathering such detailed addressing information is a challenge for some vendors, state authorities say. Some try to use the county's appraisal data, only to find that less than half of those addresses are site-specific. Vendors need to physically drive every road in a county and pick up the site-specific addresses in order for the data to be truly accurate and reliable – and ensure acceptance by the state.

"There are a lot of mapping systems out there that will guess what an address is instead of field verifying it," Hambel says. "When a life is on the line, I don't want to guess. I want an accurate location of where that address is at. That's how it saves lives."

The Funding

Data creation is roughly 60 percent of the cost of developing an LBRS. Another 20 percent is the cost of verifying and validating the data that's collected. The final 20 percent of the price comes from data integration tools, including quality control and modification of data.

So where does all the money come from?

In Ohio, the initial seed money for LBRS came from the e-Secure Ohio Initiative with counties being responsible for 50 to 60 percent of a project's cost. The State's contribution to a county was based upon a formula using the number of addressable structures and miles of public roads within a county.

As a direct result of the early benefits realized through the LBRS project, additional funding sources were identified in the form of safety grants passed through the Ohio Department of Transportation and the County Engineers Association of Ohio. These safety dollars were allocated in a similar fashion based on total number of crashes within a county.

In addition, some counties have been able to direct a portion of the monthly cell phone surcharges they receive through 9-1-1 to help fund the continued development of Ohio's digital LBRS mapping data.

State officials say it is paramount for individual counties to be a financial partner in developing an LBRS to instill a sense of ownership in the project and resulting data. To that end, counties must enter into a Memorandum of Agreement with the state to secure funding. And the state does not release funding for LBRS development to counties until the county provides data that meets the state-defined standards for program acceptance. Counties may contract with an outside vendor to collect this data or they may develop the information on their own. Either way, the Office of Information Technology, Ohio Geographically Referenced Information Program and the Ohio Department of Transportation provide technical guidance throughout the process.

The Maintenance

A database is only as good as the information that goes into it. That's why maintaining and updating the LBRS data regularly is vital to its ongoing success. The responsibility for data maintenance falls to individual counties because they are closest to the data and they have the most vested interest in keeping it current. After all, they rely upon it every day to keep citizens safe.

Many Ohio counties use a secure maintenance application program from Digital Data Technologies Inc. called DDTI Data Maintenance, which has the LBRS state standards built into it. This allows anyone, from a part-time zoning inspector to the County 9-1-1 Coordinator, to make edits or additions to the system and have them automatically published and available within minutes in many cases.

> *"What used to take hours and days to verify is now completed in minutes via computer."*
>
> *- Crawford County, Ohio, EMA*

"It's dynamic and user-friendly," Wroblewski says. "Everyone can use it."

Everyone benefits from regular data maintenance, too, especially when new developments are built, roads close or bridges are out.

"Improper data takes important time when dispatching a 9-1-1 call," says Southward. "DDTI has a system that updates the information on a regular basis and we find it to be very accurate."

DDTI Data Maintenance even allows small, but significant, map details such as fire hydrants, street signs, traffic signals, school zones and railroad crossings to be plotted precisely by local authorities, if desired. That, too, can be extremely beneficial to rapid 9-1-1 response.

"When there's a structure fire, we're able to tell the fire department there's a hydrant right around the corner," says Hambel of the Muskingum County Sheriff's Office. "Or, if it's way out in farmland where there's no hydrant, we can tell them where the closest pond is. We can look at the map and say, 'There are water supplies here and here,' and we can see where the road and the pond are relative to each other. We have exact locations and aerial photos."

Although changes to LBRS data can be made as frequently as counties desire for their own purposes, the state only requires annual updates from each participating county. The goal is to fit the LBRS maintenance within the existing maintenance process already in place at the county level. Because of that, most counties choose to update their information more frequently than once a year. Some even do daily updates that can be published and distributed automatically to the County GIS database so everyone using the data has access to the most accurate and up-to-date version.

" DDTI is the best company I've ever dealt with."

- Muskingum County, Ohio, Sheriff's Office

"These datasets are living things that are always growing and changing," says Mike Thorbahn, GIS Coordinator for the Ottawa County Auditor's Office. It's a "big plus," he adds, to be able to maintain the data at a local level.

"Our old style of maintenance was all completed in-house and we were not crossing the t's and dotting the i's," says Tim Flock, Director of the Crawford County Emergency Management Agency. "With the DDTI maintenance, we always have the most current version once we log in. It is stored off-site for continuity of operations, it can be downloaded daily ... and DDTI runs a verification on changes made. This program has helped Crawford County regain control of its mapping and 9-1-1 address issues. What used to take hours and days to verify is now completed in minutes via computer."

Even small errors can be easily worked around. "The mapping allows even a mistake [in our computer-aided dispatch system] to be handled without incident as the mapping will help direct our responders directly to the location," Flock adds.

"If there's a question, I can call the tech support people and they're always available and responsive," Hambel says. "DDTI is the best company I've ever dealt with."

The Outcome: Collaboration

LBRS provides a bridge between counties, state agencies and the federal government. It makes sharing data between these entities easier because all levels of government are now speaking the same language and looking at the same datasets. Having such a unified foundation for map data has been instrumental in breaking down jurisdictional boundaries between organizations and, in turn, enhancing service to all Ohio citizens. After all, emergencies do not respect jurisdictional boundaries and mutual aid often comes into play.

Emergencies do not respect jurisdictional boundaries. Having one set of unified map data improves mutual aid response and, in doing so, enhances services to all citizens.

For instance, Erie County's 9-1-1 system, which relies on LBRS data for dispatching, includes the entire city of Vermilion, part of which is located in Lorain County, as well as the village of Milan, which bumps up against Huron County. Prior to LBRS, counties rarely found a need to share information or services. Yet it is vital to public health and safety for first responders to be able to assist neighboring residents when needed, and to read from the same set of map data when responding to emergencies across county lines.

"As more and more counties come on board, we see our neighbors' information and can transfer calls quicker and more accurately and save time for that 9-1-1 caller," says Flock of Crawford County.

"We now have the data to help people who are not from our county and need assistance in a life or death situation," adds Southward. "We get a lot of calls on county lines. LBRS saves lives by us having the ability to send the correct first responder."

In Erie County, building its part of the LBRS database was also the catalyst for establishing the Erie County GIS Advisory Board, a consortium of 26 agencies that share the cost of maintaining the county's GIS system. The smallest township may contribute $500 annually to the maintenance fund, while the largest city may contribute $13,000, but the benefits of collaborating have paid off for all. "If they each had to go out and hire vendors to do the work, or do their own application independently, it would cost tens of thousands of dollars, maybe even hundreds of thousands of dollars," Wroblewski says. "So there's a huge cost savings there."

There's also a fair amount of inner-county and cross-county synergy being built to the benefit of all citizens. "There's a lot of networking that happens because of this," Wroblewski says, noting that the relationships built as a result of LBRS have allowed him to develop a "virtual staff" of other professionals he can call upon as resources for different projects or for advice. "It's been a wonderful thing for Erie County."

It's been a unifying force for Ohio, too. Departments on various government levels that were independently building their own maps for their own needs are now working with one another to build a singular map that works for everyone. In doing so, Ohio is saving money, time and lives throughout the Buckeye State.

More financing strategies

Saving money by eliminating redundancies

The basic philosophy behind LBRS is: Capture it once; use it a bunch – and maintain it. After all, when highly accurate geographic information is painstakingly collected using taxpayer money, it should be placed in a user-friendly public repository that can be easily updated and shared with *all* levels of government for the benefit of *all* citizens. That's where the savings start to come in.

In 2000, local governments in Ohio along with electric and gas utilities were spending an estimated $80 million to $100 million on digital mapping activities, not to mention all the GIS hardware, software and application development that went into maintaining the maps.

Locals were spending taxpayer dollars to develop street and roadway maps for their own purposes. County engineers, auditors, and city officials were spending tax dollars independently of each other to develop property and roadway maps of the same areas to their own specifications. County 9-1-1 coordinators were spending tax money to buy commercial datasets to route emergency vehicles.

Add to that, the tax money spent by the Ohio Department of Transportation to maintain the State's Roadway Inventory, separate from the counties. Even the U.S. Census Bureau was spending tax dollars to develop their own version of the local roadway network. The duplication of effort was extensive.

With LBRS data now available and accessible to all levels of government, redundant mapping – and spending – has been greatly reduced. In addition, workers are wasting less time and taxpayer money searching for accurate map data.

A sampling of LBRS users

Agency name	Function LBRS data supports
9-1-1 Dispatch / First Responders	Pinpoint call location; better response time
Departments of Public Safety	Improved crash analysis; jurisdictional data
Departments of Development	Enhanced economic development efforts
Departments of Commerce	Location of underground tanks
Departments of Taxation	Streamlined sales tax
Bureaus of Motor Vehicles	Tax district determination
County Health Departments	Improved disease and outbreak tracking
County Emergency Management Agencies	Enhanced coordination & response capabilities
County Boards of Elections	Easier voter precinct determination
County Engineers	Better road inventories, planning capabilities
County Auditors/Assessors	Faster, more accurate assessments
U.S. Census Bureau	More precise map data; demographic analysis

Securing more federal & state funding

In a 2001 report to Congress by the U.S. Census Monitoring Board, the estimated funding loss to counties, based on eight federal programs, was as much as $2,913 per uncounted individual. Using this estimate, and Ohio's average household size of 2.48 individuals, at least one Ohio county made itself eligible to collect millions in additional federal funding annually -- simply by checking its field-verified LBRS data against the Local Update of Census Address (LUCA) program.

Fairfield County was able to use the accuracy and availability of LBRS data to identify and provide proper verification of 863 additional households within its borders that had previously been overlooked by the U.S. Census Bureau, according to Fairfield County GIS Administrator David Burgei. Including these additional households in the Census count means an estimated $6.23 million in additional federal funding can be channeled into Fairfield County *each year* for programs such as Head Start, Community Development Block Grants, Low Income Home Energy Assistance Programs, school lunch and breakfast programs, and child support enforcement. These are just a handful of the programs that counties receive federal funding to support each year, based upon the latest Census counts. Other Ohio counties have also used LBRS data as an independent benchmark to check the accuracy of Census data and realized similar results.

One Ohio county made itself eligible to collect roughly $6 million in additional federal funding by using field-verified LBRS data to identify hundreds of households initially overlooked by the U.S. Census Bureau.

Because of this, the Census Bureau has expressed an interest in incorporating Ohio's LBRS data into the maintenance process for its TIGER Map Modernization program. Data accepted into the program would alleviate the need for the Census Bureau to spend federal taxpayer dollars recreating data that has already been developed at the local level to a higher degree of accuracy than required by the Census.

With LBRS, everybody wins. Being able to identify any missing address points in the Census data can ensure counties are receiving all the federal funding their residents are entitled to receive each year. And having the Census Bureau incorporate LBRS data into its database can save taxpayers money. Counties have also found the return on investment from identifying missing household data, alone, can be more than enough to offset the development cost of their LBRS program in the first year. And this is money that will be available to these counties on an annual basis.

In addition, local governments and taxpayers are benefitting from the accuracy of LBRS data when it comes to the annual distribution of gas taxes. Ohio gives out approximately $41 million each year in gas taxes, based on the road mileage in each county. Without proper road mileage data and precisely mapped county lines, disbursements can end up in the wrong hands. Clearly, there are many ways counties can recoup the funding spent on gathering field-verified data for an LBRS.

Creating efficiencies & streamlining programs

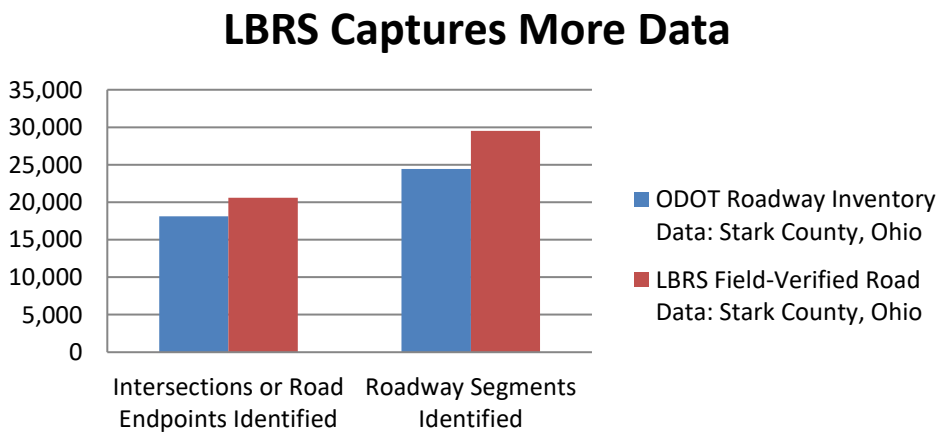
The advent of LBRS was expected to increase productivity approximately 10 percent – or four hours per work week – among state agency employees whose job functions routinely included working with mapped data, according to a statewide cost-benefit analysis.

Employees in the Ohio Department of Transportation, however, have become considerably more efficient by using LBRS data. According to Blackstone, before LBRS, it took an average of 10 days for ODOT workers to collect updated road mileage information from a single county to determine proper gas tax distributions. Now, being able to get the bulk of the necessary information directly from LBRS, it only takes ODOT workers an average of three days per county to collect the same data. That's an average productivity increase of 70 percent.

Similarly, private sector businesses can save time and expense by using the many-layered LBRS datasets – and these savings can be passed along to government entities. For instance, an Ohio-based company called Traffic Safety Analysis Systems & Services (TSASS) typically charges up to $3,000 per intersection to analyze crash data. However, if there's an LBRS dataset for the county in which that intersection resides, TSASS only charges $500 because so much more data is readily accessible to the company. That's an 83 percent cost savings for the county or city engineer and a huge time savings for the company.

"In areas that do not have LBRS datasets, we spend twice as much time locating the crashes accurately to datasets that are not complete," explains Jeremiah Glascock, Crash Data Project Lead and GIS Systems Manager for TSASS. Sometimes roads or road names that officers describe in their reports are missing from incomplete datasets, for example. Other times, there is no address point data at all, making it extremely difficult to map the crash appropriately to the roadway.

In Stark County, alone, LBRS identified 13 percent more intersections or road end-points, as well as 20 percent more roadway segments than ODOT did in its own roadway inventory. In addition, LBRS identified 164,250 individual address points in Stark County, while ODOT data didn't identify any.



Having easy access to detailed LBRS data can also increase efficiency by avoiding unnecessary expenditures in the first place.

"Perhaps the most added benefit of having LBRS is the county's ability to determine not only those intersections that are problems, but also to discount those that are not," Glascock says. So, for example, when Mr. Jones calls the city or county engineer complaining about all the crashes taking place at the intersection near his house and demanding that a stop sign be installed, TSASS can easily look at the data for that intersection and determine whether a stop sign is, in fact, warranted.

On a state level, the Department of Administrative Services - Office of Information Technology has incorporated LBRS data into its Enterprise Geocoding Service. This provides state agencies with access to locally developed and maintained location information. For example, the Ohio Department of Taxation has incorporated this LBRS-enhanced geocoding service into the Streamlined Sales Tax application for vendors, providing a point-of-sale determination of the correct tax rate based on the address of the purchaser. The service is available to brick-and-mortar businesses as well as for online purchases. A similar process is being used in the Ohio Bureau of Motor Vehicles when citizens register their vehicles. Addresses typed into that system automatically use the State's Enterprise Geocoding Service to determine the associated township or municipality, so gas tax revenues can be more accurately distributed to local jurisdictions based on the number of vehicles registered there.

The net result of having more accurate address locations that are locally developed and maintained is more efficient government and a more accurate and equitable distribution of taxes back to local jurisdictions.

Stimulating the state economy

Another benefit of LBRS is its capacity to support economic development activities and encourage new businesses to locate – and existing businesses to expand or remain – in Ohio. LBRS allows developers to easily access and display the geographic information they need to determine the best locations within the state to build or expand various facilities. For instance, LBRS data, when combined with other datasets, can be used to identify where utilities are located, what properties have quick access to the highway, the proximity of railroads and airports to a certain parcel of land, and where floodplains are located. Data housed in LBRS can also be tied to other databases, like county parcel records, and sorted by property size, allowing all the locations of undeveloped parcels of a certain size, to be located with a few keystrokes.

LBRS data can help developers quickly find key information about land uses and proximity to desired resources, allowing for better business development tools.

Positioning for the Future

Transportation for the Nation

Ohio's LBRS partnership was cited as a best practice for statewide road inventory creation in the 2011 Transportation for the Nation (TFTN) Strategic Plan. The U.S. Department of Transportation specifically noted that the accuracy of LBRS data and the collaboration of organizations required to build Ohio's LBRS could serve as a model for the nation. Clearly, Ohio is well-positioned to meet future state reporting requirements associated with this initiative to build a nationally shared transportation dataset.

BroadbandUSA

The National Telecommunications and Information Administration (NTIA) was pleasantly surprised by Ohio's ability to supply all-inclusive coverage maps as part of the BroadbandUSA initiative. This initiative is aimed at expanding broadband into more rural areas so police stations, fire stations, hospitals and major businesses in those areas will have adequate coverage. When complying with the request to compile coverage maps for the initiative, Ohio offered site-specific data that wasn't originally required, prompting one official to note that Ohio was "far and away ahead of the other states because of LBRS."

Disaster Response

LBRS was built to be the cornerstone for emergency response in the event of a statewide or local catastrophe, such as a major tornado outbreak or flooding. After all, government entities at any level are far better positioned to respond to unpredictable events when more accurate geographic information is available. That point was driven home quite powerfully after Hurricane Katrina hit the Gulf Coast in 2005. Ohio sent GIS professionals to Southern Mississippi and Louisiana to assist with the recovery effort, but what they found were entire areas without accurate map data from which to work. All the street signs, highway signs and other traditional reference points had been blown down or washed away. Without good map data or visual markers to assist the crews, it became quite challenging to locate utilities, find specific neighborhoods and even just navigate the area. "We looked at that and said, 'We, as a state, need to develop a statewide resource we can use in case something similar happens here, to minimize these logistical issues,'" says ODOT's Blackstone.

Homeland Security

LBRS can also help Ohio rapidly respond to man-made disasters, such as chemical spills, the release of toxic chemicals into the air or nuclear power mishaps. Identifying affected facilities or areas, as well as the best evacuation routes, can be done quickly with LBRS data and the coordination it allows between all levels of government. In addition, an emergency manager can use LBRS to promptly ascertain the location of all hospitals, fire stations, police stations, airports and the present capacity of every major roadway in the area.

LBRS has put Ohio ahead of the curve in supplying its citizens with precise, updated map data that eliminates redundancies while increasing efficiency and saving lives.

Can your map data do that?