An individual observes another person that appears to be in need of emergency assistance and makes the decision to place a call to 9-1-1. The 9-1-1 call is routed to the appropriate Public Safety Answering Point (PSAP) via an emergency communications network, and the 9-1-1 telecommunicator answers the call and records vital information that answers:

Where is the emergency happening?
What is the emergency?
When did the emergency happen?
What is your callback number?

During the course of the call, responders are dispatched to the emergency and accurate location information is key throughout the call in order to determine:

The physical location of the calling device
The correct PSAP the call is routed to
Depiction of the caller’s location within PSAP and responder mapping systems
The closest available response units to dispatch
The best routes and driving directions and other information about the location of the emergency
This emergency scenario illustrates how in existing, quick decision-making mission critical 9-1-1 environments accurate location information is crucial. In a Next Generation 9-1-1 (NG9-1-1) system, the accuracy and reliability of the Geographic Information System (GIS) data will be even more essential. GIS data will be the primary means for accurately routing any emergency calls and responding to emergency incidents.

GeoComm has been partnering with 9-1-1 authorities on GIS readiness in 9-1-1 environments for over 22 years, and we recommend approaching GIS readiness for NG9-1-1 in three steps:

1. **Assess** your 9-1-1 standards, review your GIS data for accuracy, and educate stakeholders and the public on the importance of accurate GIS data.

2. **Improve** your GIS data by cleaning up the GIS data, develop new data and datasets, and ensure there is Master Street Address Guide (MSAG), Automatic Location Information (ALI), and GIS data synchronization.

3. Develop a plan to **Maintain** the on-going quality, consistency, and integrity of local, regional, and statewide GIS datasets.
Across the nation many local authorities, regions, and states are following this process and investing their resources to improve GIS data for mission critical 9-1-1 use. This eBook primarily focuses on the road to GIS data improvement after the GIS data assessment steps have been completed. Improvement of GIS data means operational and technical priorities that focus on:

**NG9-1-1 GIS Layer Development and Enhancement**

**Quality Assurance/Quality Control**

**Establishing a Continuous GIS Data Review and Update Process**

These improvements are necessary in order to ensure your jurisdiction is meeting specific requirements for GIS data structure, synchronization, and accuracy. The benefits of developing and implementing a GIS data improvement project include:

- Faster response times for 9-1-1 services
- Improved NG9-1-1 data readiness
- Extensive enhancements to publicly-shared data such as address points
- Improved data accuracy, typically impacting multiple government departments
- Compliance with nationally-recognized public safety standards
NG9-1-1 GIS Layer Development and Enhancement

According to the NENA informational document 71-501, a minimum 98% synchronization rate between MSAG, ALI, and GIS data is recommended before the GIS data is considered viable for use in a NG9-1-1 system.

The GIS data assessment resulting from the **Assess** phase should provide a comprehensive picture of where your jurisdiction stands compared to industry standards and any local, regional, or statewide standards.

To improve the accuracy of your GIS dataset for NG9-1-1, start by reviewing the initial **data assessment** and determining which key GIS map data layers need to be developed or enhanced.

With your assessment results in hand, you can begin the process of working through your improvement approach by correcting the discrepancies and improving the synchronization results and GIS data.
The possible GIS map data layers that will be developed and/or enhanced include:

- Road Centerline Layer
- Emergency Service Boundaries Layer
- Community Boundaries Layer
- Site/Structure Layer
- MSAG Community Boundaries Layer
- PSAP Boundaries Layer

Developing or improving the layers for attribute and spatial accuracy is important for many reasons. In NG9-1-1, attribute accuracy is vital because it allows the landline telephone records to match the GIS in the Location Validation Function (LVF) and Emergency Call Routing Function (ECRF) and prepares them for use during a 9-1-1 call. Spatial accuracy is also important as it determines to which PSAP a call is initially routed and to which emergency responders a call can be transferred from the PSAP based on location.

For example, a PSAP mapping system queries an ECRF provisioned with a Site/Structure layer or Road Centerline layer and underlying polygon boundary layer. This occurs in order to extract the additional location data from the Uniform Resource Identifier (URI)/Uniform Resource Locator (URL) attribute field to allow for call transfers to the correct responding agency for that location.
Your **Road Centerline layer** will need to be updated if your assessment uncovers inconsistencies or discrepancies. For example, overlapping address ranges will need to be corrected, as the road centerline ranges will be used to route incoming landline calls if a matching address point does not exist. Road layers also require a close look at ALI database synchronization to ensure all addresses are locatable.

Discrepancies should be investigated and corrected when possible using existing GIS data layers and local authority-provided resources as a guide. Keep in mind that road layer updates will include looking at not only address range issues, MSAG, and ALI database synchronization but also field structure, road name attributes, and spatial aspects such as feature placement and topology.

According to NENA standards, a basic requirement for GIS data layers is synchronization to the Road Centerline layer. The jurisdiction may choose to include the Site/Structure layer. The requirements for both GIS data layers include a 98 percent match rate, which must be achieved for each of the following categories:

- MSAG high range to road centerlines
- MSAG low range to road centerlines
- ALI to road centerlines
- ALI to site structure address points
Your **Emergency Service Boundaries layer** should be reviewed for topology errors and inconsistencies identified between the ALI database, MSAG, and Emergency Service Boundaries. NG9-1-1 attributes, such as route URI and service numbers, should also be added to the Emergency Service Boundaries layers to bring GIS data schema in line with the standards developed during the assessment and industry standards. These standards define a common data model and set minimum accuracy benchmarks that should be attained before local data is integrated into an NG9-1-1 GIS dataset.

The **Municipal Boundary and County Boundary layers** should include NG9-1-1 attributes in order to ensure the GIS data schema meets future NG9-1-1 needs. Improvement to these layers should include correction of gaps and overlaps between boundaries, therefore, ensuring topological accuracy between municipal and county boundaries and road centerlines. A GIS topology is a set of rules and behaviors that model how points, lines, and polygons share coincident geometry.
For example, adjacent features, such as two counties, will have a common boundary between them. Breaking road centerlines along county and municipal boundaries helps to ensure the county and municipal attributes are accurate for each road segment.

In addition to the above layers, **Site/Structure layer** is becoming increasingly important and may also need to be updated. The Site/Structure layer is sometimes referred to as the Address Point layer.

<table>
<thead>
<tr>
<th>Potential updates of the Site/Structure layer will include information such as:</th>
<th>Field structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Road name</td>
<td></td>
</tr>
<tr>
<td>ESN and community attribution</td>
<td></td>
</tr>
<tr>
<td>ALI synchronization</td>
<td></td>
</tr>
</tbody>
</table>

In an NG9-1-1 system, the ECRF will first try to locate an incoming landline call using the site/structure layer, so it is important that points are at the correct location and all ALI database entries are represented.
The **MSAG Community Boundary layer** represents communities within your MSAG and is used to populate the MSAG community field in your road centerline and Site/Structure layer. This layer should be refined to mirror the community information in the MSAG and/or ALI database and ensure:

- **No gaps and overlaps exist between boundaries**
- **Topologically accuracy with respect to the road centerline layer**
- **Accurate MSAG community boundaries are depicted**

In an NG9-1-1 system, the **PSAP Boundary layer** is the most important GIS data layer as it will be used for initial routing of 9-1-1 calls to the correct PSAP. Like with other boundary layers, it is critically important that no gaps or overlaps exist between polygons representing different PSAPs.

As you develop and initiate your improvement plan, all levels of government should expect to be involved in the NG9-1-1 GIS standards development regardless of whether the NG9-1-1 implementation project is being managed at the local, regional, or state level. Without the combined
efforts at all levels, as well as informing or educating stakeholders, you’re GIS data improvement project may not achieve the full potential for success.

**In addition**, even if you are not actively transitioning to an NG9-1-1 system, your data will be improved for the current system and ready for any future system. Therefore, future technologies should also be taken into account for any standards developed or layers enhanced or added. If you do not yet have these map data layers, they can be developed by using existing county GIS data layers, publically-available GIS data layers, and/or other locally authoritative-provided resources.

Many regions and states undergo projects where they are enhancing current 9-1-1 systems and interoperability while also preparing for an NG9-1-1 system. A common approach for regional and statewide GIS data improvement projects is to **improve** the road centerline and Site/Structure layer by developing a GIS dataset for the coverage area of the jurisdictions involved.

**Benefits**

- GIS data improvement projects bring numerous benefits to public safety organizations as well as other local, regional, and state government offices.
- Upon completion of the improvement efforts, the GIS dataset becomes part of a system that improves interoperability across the PSAPs in the jurisdiction, allowing the PSAPs to more easily serve as backups for one another, if needed.
- Therefore, as a region or state prepares for NG9-1-1, they will benefit by having a GIS dataset for the coverage area that is available for use in the future for call routing using latitude/longitude and civic locations.
Quality Assurance/Quality Control

GIS data improvement and enhancement projects for a 9-1-1 system do not end with layer creation. An important step in creating and maintaining a Site/Structure layer for 9-1-1 is first developing a Quality Assurance (QA) process, and following it with ongoing Quality Control (QC).

QC is an integral part of your GIS data readiness. It is crucial to identify and correct GIS data errors before problems are realized during the course of an emergency. You should also establish a routine QC process that would be conducted of the Road Centerline layer, Site/Structure layer, and Boundary layers.

For example in the Road Centerline layer quality control process you will be conducting the following QC tasks:

- Identifying overlapping address ranges and ranges with odd/even and from/to inconsistencies
- Locating unbroken and unsnapped intersections
- Identifying missing or invalid values in pertinent attribute fields
- Ensuring proper road name standardization
- Identifying road segments longer or shorter than a specified length
For **Site/Structure layer**, QC tasks will include checking for items such as addresses missing attributes, address spacing issue, visual reviews, and more.

The QA process will ensure the quality of the **Emergency Service, Municipal, MSAG Community, and PSAP** by looking at topology, missing attributes, and duplicate attributes.

**Establishing a continuous GIS data review and update process**

After the map data updates are complete, it will be important to determine if there are any remaining errors and the effects of those errors on the ALI database and MSAG. Enacting the process of continuous comparing of the ALI database and MSAG to the map data layers will be necessary during the upcoming **maintain** phase.

In regional and statewide GIS data improvement projects, once the Road Centerline and Site/Structure layers are developed, quality control checks can be performed on both layers.

When planning for a GIS data improvement project to **assess, improve, and maintain** GIS data for current and future 9-1-1 system, it is important to understand that the process of improving your data for current 9-1-1 operations and future NG9-1-1 operations should not be expected to come without challenges.
What’s Next?

Prepare for common GIS data improvement challenges:

- Some areas of the country have found that securing funding to initiate an improvement project is a challenge.
- Others have found that the GIS data improvement efforts move slower than was anticipated because there is a lack of 9-1-1 knowledge to initiate the GIS data improvements.
- Lack of time to dedicate to staff training to maintain the public safety GIS data and/or cost limitations and it can be costly to create a fully-staffed department with this capability.

So, as you plan the improvement approach that is the right fit for your organization, it is important to prepare for these common obstacles.
Stakeholder education is likely to play a big role in addressing the challenges and overcoming funding and/or staffing issues. Local PSAP, county, or state stakeholders, may not understand why GIS data readiness is necessary in the transition to NG9-1-1. Therefore, starting with some basic education and examples of the improvements that are needed will keep everyone working together.

Remember that stakeholders may not be involved with GIS or 9-1-1 on a daily basis, so be prepared to provide actual visual examples of the improvements needed in order to work towards securing the appropriate funding or staff time requested.

Know the number of issues to be resolved, the anticipated time involved, and the funding desired to accomplish the improvements. Also, be prepared to discuss the risks of not improving the GIS data such as non-compliance with industry standards, lack of GIS process efficiencies, overly complex GIS data, and most importantly misrouting of 9-1-1 calls.

Visual example of alignment issue and correction:
Potential issues and the corrected examples to share with stakeholders include:

- Overlapping Address Ranges
- Aerial Alignment Issues
- Street Centerline Topology Issues
- Inconsistent Address Point Placement
- ALI Database Records Not Found in GIS Data
- Multi-Layer Topology Issues
- Emergency Service Boundaries Issues

When stakeholders see and hear about GIS data issues, learn about the return on investment justifications of improvement efforts such as saving lives and property and improving response times, it helps “makes the case” for the importance of GIS readiness.

Hopefully, you now have an even better understanding of the potential improvements that may be needed in order to prepare your GIS data for NG9-1-1 and for the challenges of the Road along the way. Your GIS map data improvement goals can be achieved by implementing accurate data, following industry best practices, and developing a comprehensive QA/QC approach.
Down The Road

Looking further down the Road to GIS data readiness for NG9-1-1...you've implemented operational and technical priorities that focus on:

- NG9-1-1 GIS layer development and enhancement
- Quality assurance/quality control
- Continuous GIS data review and update process

These priorities will help ensure there is continued GIS data review and updates occurring as new roads and structures are built or changed.

You know you have the most accurate GIS data available, and 9-1-1 calls are being routed to the appropriate PSAP via an Emergency Services IP network. The location information received is highly reliable, and 9-1-1 telecommunicator can answer that emergency call and send help where needed. Your GIS team and public safety team as well as your telecommunicators and responders are informed and able to make quick decisions in a mission critical 9-1-1 environment.

You navigated the Road; your GIS data is ready for NG9-1-1.
GeoComm (www.geo-comm.com) was founded in 1995 to provide county governments with turnkey emergency 9-1-1 development services. Over the subsequent 22 years, the company has grown to serve more than 12,000 dispatchers in 800 emergency 9-1-1 call centers in the United States, helping to keep more than 84 million people safe. Today, GeoComm has a national reputation as a leading provider of geographic information and communication systems. The company’s systems route emergency calls to the appropriate call center, map the caller’s location on call taker or dispatcher maps, and guide emergency responders to the scene of the incident on mobile displays within police, fire and ambulance vehicles. GeoComm’s GIS services provide standardized processes for ensuring timely GIS data delivery and current, accurate data produced by public safety GIS experts using current and emerging NG9-1-1 GIS data standards.

GeoComm’s mission: When seconds matter, we help save lives and protect property by providing essential, innovative, location-based solutions to public safety professionals.

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