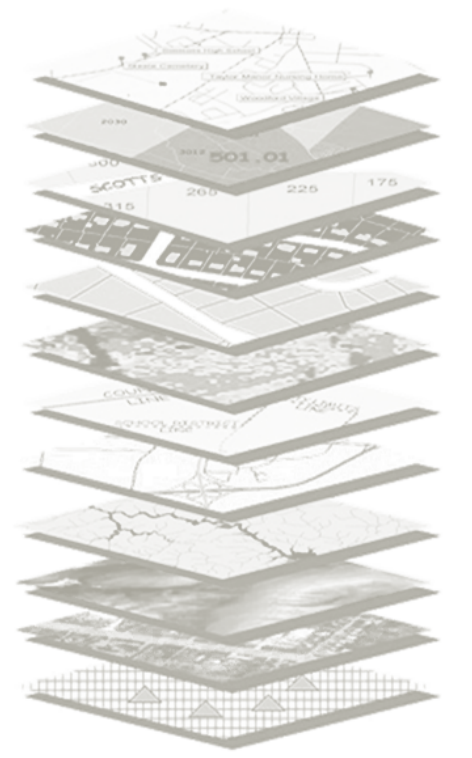
GeoComm

Looking Beyond Data Synchronization for Mission Critical GIS Data



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Preface

Public safety and Geographic Information Systems (GIS) staff know the new reality for 9-1-1 is GIS playing a mission critical role in future systems. Several agencies are already completing their transition to Next Generation 9-1-1 (NG9-1-1); therefore, other public safety agencies can learn from those implementations as they build their own systems and finalize the associated GIS processes.

As a follow up to the previously published white paper, *What You Need to Know about the Spatial Information Function, Role of a SIF in NG9-1-1*, this white paper focuses on three areas to define and discuss the processes between GIS and public safety which go beyond synchronizing the Automatic Location Identification (ALI) database and Master Street Address Guide (MSAG) with the GIS data. This includes:

- Area of focus #1: Locally authoritative GIS data
- Area of focus #2: GIS data aggregation
- Area of focus #3: GIS support to ESInet and PSAPs

In addition, this white paper specifically looks at the importance of partnerships and collaboration throughout NG9-1-1 implementation and provides examples and lessons learned of two jurisdictions: the North Central Texas Council of Governments (NCTCOG) and the State of Maine Emergency Services Communication Bureau (Maine ESCB) as they undertook their transition to NG9-1-1 as well as Geo-Comm Inc. (GeoComm's), work with establishing their future systems.

Background Information

What is the Role of GIS in NG9-1-1?

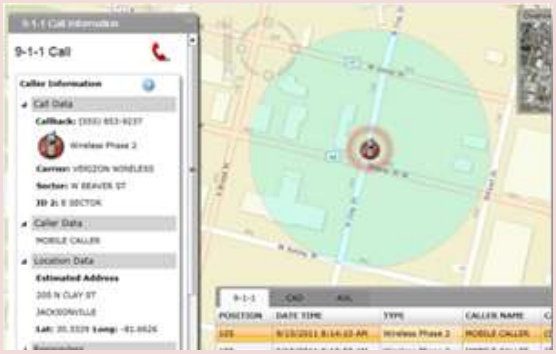
Tactical Mapping

GIS plays numerous roles in traditional 9-1-1 systems and provides an even more critical role in NG9-1-1. Since the late 1990s, GIS is most commonly used to provide tactical mapping for 9-1-1 telecommunicators, Computer Aided Dispatch (CAD) dispatchers, and emergency responders. Tactical mapping systems reduce emergency response time by identifying the location of emergency calls on a map and computing best routes to the scene for emergency responders.

Call Routing

In NG9-1-1, GIS is used to determine which PSAP to route a 9-1-1 call to, based on the call location, and also for location validation prior to a caller making an emergency call. This method of call routing enables better accuracy which will in turn reduce the number of 9-1-1 call transfers due to misrouted 9-1-1 calls, reduce emergency response times, and save more lives and property; a primary goal of emergency responders, public safety management, and stakeholders.

When an NG9-1-1 call is being routed, an Emergency Services Routing Proxy (ESRP) queries an Emergency Call Routing Function (ECRF) to determine to which PSAP to route the call. The ECRF query contains the location of the device calling 9-1-1. This location may be a civic location (house number / street address) or a geodetic location (a latitude / longitude coordinate, circle, ellipse, polygon, or arc-band). The ESRP will query an ECRF with the location of the device and the type of service being requested (such as 9-1-1 or a selective transfer from the 9-1-1 center to a responding agency). The ECRF will intersect the location provided in the query against a map of the PSAP service area boundaries to determine the PSAP which should receive the call.



To route 9-1-1 calls based on location, an ECRF must be provisioned with GIS data depicting the PSAP service area boundaries. Map layer(s) such as street centerline or address points are needed in the ECRF to determine civic address locations.

Location Validation

In addition to being used when routing 9-1-1 calls, NG9-1-1 systems use GIS data before a 9-1-1 call is placed. As Communications Service Providers (CSPs) prepare subscriber records for 9-1-1, they must confirm subscriber records have addresses usable for 9-1-1. This process is similar to checking an Enhanced 9-1-1 (E9-1-1) ALI record for MSAG validation. In this case, a Location Information Server (LIS) queries the Location Validation Function (LVF) with the location in question. The LVF examines its GIS database to see if the address is valid for 9-1-1. The GIS data provisioned to the LVF is identical to the GIS database provisioned to the ECRF.

Introduction

Public safety agencies have begun laying the foundation for the move to NG9-1-1 by taking the necessary steps to transition their current 9-1-1 systems. The current legacy or E9-1-1 system is not intended nor designed to receive calls and data from new and emerging technologies such as smartphones and tablets. Therefore, 9-1-1 systems are utilizing new technology and processes in order to perform functions that can handle text and video communications.

GIS is an essential part of future NG9-1-1 systems. Preparing existing GIS databases and operations to meet NG9-1-1functionality is a key step in transitioning to an NG9-1-1 system. This preparation includes synchronizing the ALI database and MSAG with the GIS data. The process involves updates to existing attributes and the addition of new attributes.

National Emergency Number Association (NENA) has been emphasizing the importance of data synchronization and data synchronization testing for several years. In 2009, NENA released Synchronizing Geographic Information System databases with MSAG & ALI, NENA 71-501, Version 1.1, an informational document intended to assist in the synchronization testing and adjustment process. As public safety agencies move forward with NG9-1-1 systems, this NENA document lays the data accuracy foundation regarding GIS replacement of the MSAG in the NG9-1-1 system.

In an NG9-1-1 system, GIS will be the mission critical database utilized for location validation and call routing in the system. With NG9-1-1, GIS personnel will be asked to support public safety needs to an even larger degree than in the past. Local and state governments will be faced with new challenges which will need to be address. Challenges such as: How will this new public safety GIS requirement affect GIS operations of today? Who will be taking on this responsibility?

There are three basic areas of focus regarding on-going processes between GIS and public safety that need to be addressed:

- Area of focus #1: Locally authoritative GIS data
- Area of focus #2: GIS data aggregation
- Area of focus #3: GIS support to ESInet and PSAPs

GIS departments and public safety agencies must define new relationships, develop partnerships, collaborate on processes, and have a thorough overall understanding of GIS and its role in NG9-1-1. This will ensure reliable and accurate 9-1-1 GIS databases are in place for public safety systems. Agencies have learned there are key areas which need to be addressed regarding on-going processes between GIS and public safety for locally authoritative GIS data, regional and statewide GIS data

aggregation, and GIS support to the ESInet and PSAPs. Relationship development and solution handling will vary between jurisdictions. As a result, it is crucial that conversations between GIS and public safety departments for local, regional, and state jurisdictions occur early on in the NG9-1-1 planning process.

Area of Focus #1: Locally Authoritative GIS Data

Accurate 9-1-1 base maps are needed to assist in achieving a positive outcome in a 9-1-1 emergency event. NG9-1-1 data requirements will impact the current processes at local jurisdictions and at PSAPs who currently develop, enhance, and maintain their GIS data. Therefore, understanding the new requirements for GIS data structure, additional layers, and validation and routing fields is critical.

Development of Additional Data Layers

While the NENA NG9-1-1 GIS data model has not yet been released, agencies can begin looking at additional NG9-1-1 functionality required of the GIS data, such as the need to develop additional data layers.

Both NCTCOG and Maine took steps to first define polygon services boundaries representing PSAP, law, fire, medical, and community boundaries. These data layers are needed beyond basic location data. Maine is also in the process of developing a statewide address point layer and a medical transport service boundary.

Service boundaries are intended to reflect information required by public safety. The community boundary reflects the community information represented in the MSAG, which may or may not be reflected in a jurisdiction's community boundary used for other purposes.

State of Maine

Maine's ESCB is the state agency responsible for 9-1-1 across the state. There are 26 PSAPs in Maine, and the Bureau plays an integral part in the PSAPs' total operation. Each PSAP has between two and twelve Answering Position Units (APUs) that receive wireline and wireless Enhanced 9-1-1 emergency calls.

In the summer of 2014, Maine completed deployment of a statewide NG9-1-1 system with a modern Internet Protocol (IP)-based network, capable of meeting current and future public safety needs. This deployment made Maine one of the first states in the nation to deploy an NG9-1-1 system based on NENA i3 standards. By utilizing leading edge technology, the robust, redundant, and secure statewide emergency system provides the platform for PSAPs to receive voice, video, pictures, and text messaging, thereby enhancing and improving public safety for the 1.3 million citizens in Maine.

Enhancement of Existing Layers

Enhancement of local existing GIS data layers involves making existing attributes accurate and developing additional attributes. When a jurisdiction is preparing for an NG9-1-1 transition or determining if the GIS data is ready to replace the MSAG for mission critical response, synchronization testing is strongly recommended.

Synchronization ensures the civic location information in the 9-1-1 database will meet or exceed the current accuracy levels in the GIS database. To ensure the desired levels of accuracy existed in their individual data layers, NCTCOG and Maine began working with their databases far in advance of the system implementation.

Reviewing the accuracy of existing GIS attributes and developing additional attributes are both required to enhance existing public safety data layers. Location and service boundary data must reflect the current MSAG information, and with the new location validation and call routing functions, additional data attributes will be needed. Specific attributes will be outlined in the NENA GIS data model when it is released.

Maintenance of the Data Layer(s)

A maintenance plan to keep GIS data up-to-date and accurate is critical and will exceed the needs of public safety today. In current 9-1-1 systems, the MSAG database is referenced for location validation and call routing. The database is monitored and updated daily, if needed. Correspondingly, as GIS databases will take the place of the MSAG for NG9-1-1 systems, a similar monitoring and update schedule should be established for updating the GIS data layers.

NCTCOG

NCTCOG is a regional planning commission (RPC) serving a 16-county area in the Dallas/Fort Worth area. Specifically, NCTCOG's Regional 9-1-1 Program administers 9-1-1 services for a 15-county area which includes PSAPs with a total of 145 answering positions and approximately 285 9-1-1 dispatchers. The current call volume for the region is in excess of 1,125,000 9-1-1 calls per year.

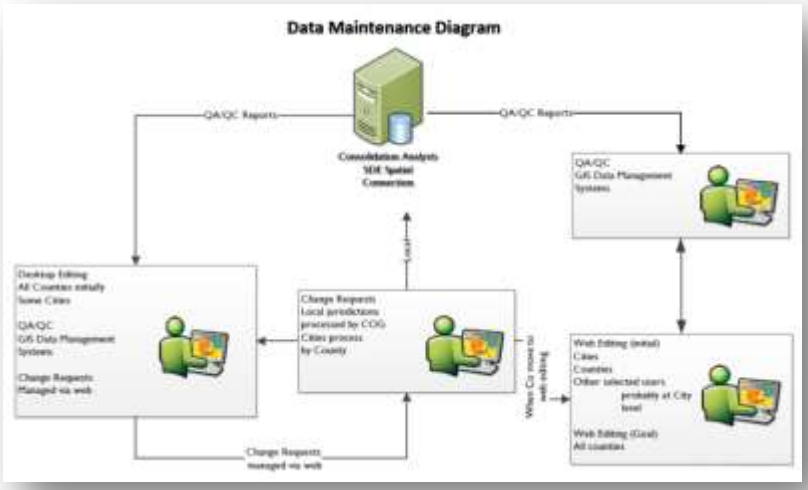
The NCTCOG Regional 9-1-1 Program works with local telephone companies, wireless telephone companies, Voice over Internet Providers (VoIP), 9-1-1 addressing coordinators, and others in the region to ensure each 9-1-1 call reaches the correct communication center with the right location and telephone information. In 2013, NCTCOG became the first agency in the state to route live 9-1-1 calls through a NENAi3 standard ECRF/LVF. They have achieved this level by carefully setting up processes for handling GIS data layer development, existing GIS layer enhancements, and maintenance.

Transitional systems may require both the MSAG and GIS data to be maintained for a period of time. In these systems, the MSAG and GIS data updates should occur simultaneously. The GIS edits should feed into MSAG updates; though how and when those MSAG updates occur will likely vary based on the system design and maintenance plan.

There are several factors which need to be considered when establishing GIS maintenance processes; a starting point for discussing the considerations are included below. Of those, quality assurance/quality control processes are of utmost importance.

- ☐ How will local GIS departments support needs of public safety moving forward?
- ☐ How will the corresponding GIS edits be handled?

- How will the resource information pertaining to edits be communicated into the maintenance process?
- Is the MSAG still being maintained?
- What is the required timeline for completion of the edits?
- What Quality Control/Quality Assurance (QA/QC) process will be completed and by whom?



The importance of GIS data quality control mechanisms and processes cannot be overstated as routing 9-1-1 calls to the closest responding agency depends on accurate, complete, and timely GIS data. Establishing QA/QC processes can uncover issues relating to synchronizing the MSAG and GIS data and other issues which may affect NG9-1-1 functionality.

An example of a basic QA/QC process would be to check for gaps and overlaps within service area boundary polygons. This is a common error that could create a critical misroute during 9-1-1 call processing. It is important to understand what QA/QC processes are being completed, who will be responsible for fixing errors when they are reported, and the timeframe in which the errors need to be fixed. For successful NG9-1-1 systems, GIS departments should fully understand public safety functions and requirements, including how the need for accurate and up-to-date GIS data will be met on an on-going basis 24x7x365 days per year.

When considering the counties in their region, NCTCOG knew locally authoritative GIS data would require development, enhancement, and maintenance. NCTCOG recognized the Addressing Coordinators in each county were vital to ensuring a reliable NG9-1-1 system would be in place. The Addressing Coordinators serve as the first point of contact for issuing or changing an address, the input of GIS data in the MSAG, ALI and GIS databases, and providing data back to NCTCOG on a daily basis via replication/synchronization.

Once the data is received, NCTCOG conducts QA/QC via a web-based system to compare the data, making sure address points fall in the correct service area boundary for the ECRF. At the end of week, the data is provided back to the county along with a QA/QC report. If the data

does not match, it is flagged and reported and the Addressing Coordinator fixes the GIS data.

Once correct, the data is posted to a database to be provisioned to the NG9-1-1 system. Several software tools, processes, and workflows were required to ensure up-to-date data was available to maintain accurate data layers. The NCTCOG NG9-1-1 implementation included:

- A NENA i3 standard ECRF/LVF to replace traditional tabular MSAG systems
- A web-based change request process to extend NCTCOG's ability to manage their public safety GIS data to the web, allowing counties and cities the ability to contribute to their GIS system
- A public safety GIS data management tool which fully supports the on-going GIS maintenance of NCTCOG's NG9-1-1 map data
- A web-based workflow management system which provides NCTCOG with a streamlined workflow for managing GIS related errors and improves the communication between NCTCOG's GIS data end users and those users responsible for the GIS maintenance
- Deployment of an Esri ArcGIS-based ECRF/LVF GIS data provisioning software application into NCTCOG's existing enterprise geospatial data management system to provision the GIS data from the master NG9-1-1 GIS data set into the ECRF

A strong maintenance plan for local GIS data is critical to the health of a NG9-1-1 system. Regardless of the approach and systems used, parties involved in MSAG and GIS data maintenance will need to exercise collaboration, strong communications and working knowledge of PSAP needs and NG9-1-1 requirements.

Area of Focus #2: GIS data aggregation

Preparation and Provisioning

One key question jurisdictions are asking is how their local GIS data will be provisioned into the NG9-1-1 system and whether it will be provisioned directly from the local jurisdiction or entered into a regional or statewide database and then provisioned from there. The answer may vary across different NG9-1-1 systems, but regardless of the system, the entity responsible for provisioning the data should be aware of public safety standards and requirements.

GIS data provisioned to the system should conform to the NENA GIS data model. Optional or conditional fields should be present if attributed by the local stakeholders. Often times, local authoritative GIS data sources develop their own GIS data models and use geodetic systems (coordinate systems and projections) which conform to local GIS application requirements. These may differ from the common GIS data model and geodetic system used by the regional or statewide NG9-1-1 system.

Spatial Information Function (SIF)

To integrate GIS into the core 9-1-1 functional elements of call routing and location validation, the

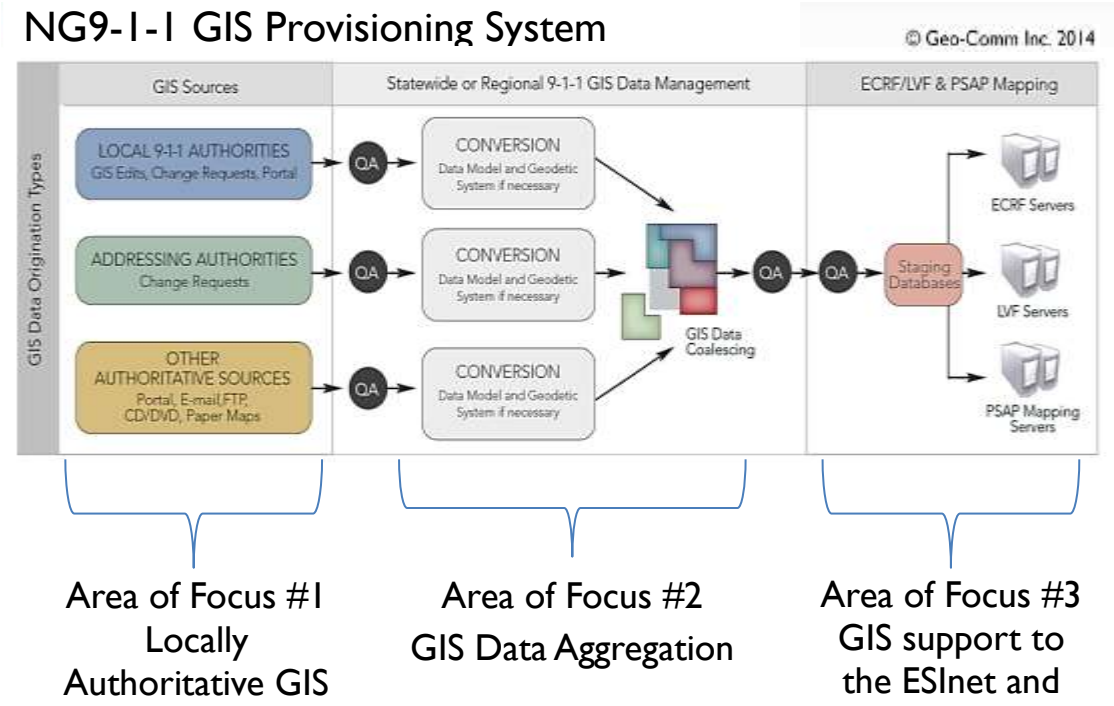
NG9-1-1 system includes a Spatial Information Function (SIF). The SIF is a specialized form of GIS and may be implemented on a conventional GIS with appropriate interfaces. The SIF is not standardized by NENA i3 but a method of replicating layers from the master SIF to external databases is. The ECRF/LVF provisioning interfaces use this mechanism.

As a practical matter, this means 9-1-1 authorities building and maintaining GIS data systems for 9-1-1 should consider GIS data management components to be part of the SIF. In addition, they need to include interfaces to their GIS systems for provisioning GIS data and updates into NG9-1-1 ECRF/LVF i3 functional elements. This white paper does not fully detail the full functionality of a SIF; however, further information is available within GeoComm's previous white paper, *What You Need to Know about the Spatial Information Function Role of a SIF in NG9-1-1*.

While not required in NENA standards, GeoComm recommends SIFs include QA/QC mechanisms tuned for 9-1-1 GIS data, such as MSAG to GIS synchronization during NG9-1-1 transitional periods, service area boundary gap/overlap checking, and various address point and road centerline checks.

SIFs should have a conversion function to transform GIS data from local data models and geodetic systems into the common model for the coalesced NG9-1-1 GIS database.

On the following page is an end-to-end NG9-1-1 GIS data management workflow diagram depicting the commonly used shared SIF approach. The middle component labeled "Statewide or Regional 9-1-1 GIS Data Management," as well as the input and output interfaces, comprise the SIF. The arrows moving GIS data from the coalesced GIS dataset and into ECRF/LVF and PSAP mapping servers is provided by the SIF provisioning interfaces. Thus the diagram depicts a conventional GIS with multiple authoritative inputs, GIS data QA/QC, transformation, coalescing, gap/overlap checking, and finally provisioning to ECRF/LVF with the appropriate interfaces.



In lieu of a self-operated SIF system, agencies may opt to go with an NG9-1-1 GIS Managed Services approach. A number of 9-1-1 GIS vendors, such as GeoComm, provide 9-1-1 GIS data management applications and other services allowing 9-1-1 authorities to provide locally authoritative GIS updates. Through this approach, GIS data normalization, QA/QC, error reporting and feedback, and safe and secure provisioning into NG9-1-1 ECRF/LVF systems and other third party PSAP mapping systems are performed.

Collaborative Approach

When the State of Maine began to plan for their system, they pursued an NG9-1-1 GIS Managed Services approach and determined the GIS data edits would feed updates to the MSAG. There has been collaboration and partnerships developed between Maine ESCB GIS department and GeoComm to define procedures and schedules which allow for a cross-check of GIS and MSAG updates to ensure the two databases are synchronized and updates occur simultaneously. The system includes:

- a NENA i3 ECRF/LVF
- a SIF to support address management between addressing officers across the state and the Maine ESCB
- a 9-1-1 PSAP mapping system delivered over the statewide ESInet to 26 PSAPs

Cooperation will continue through the coalescing process and decisions will be made to determine if the local, state, or regional level will be responsible for the data maintenance.

Area of Focus #3: GIS support to the ESInet and PSAPs

Report Processing

GIS and public safety must work together to address basic areas of focus to have an accurate and working system. A critical piece is relying on the support of GIS in the ESInet and at the PSAP. Support of GIS in an NG9-1-1 system goes beyond getting the data into the system in a timely fashion. It also involves discrepancy and log report processing and local PSAP support.

Reports and logs will come from the system itself and possibly from the local PSAP. These reports will document process status and discrepancies. Reports and logs will vary in priority. The provisioning agency may not have the responsibility to process the discrepancy; however, the resolution may result in edits to the local map data. The GIS provisioning and data maintenance plan should accommodate daily provisioning of local edits due to discrepancy reports.

Questions to consider regarding logs and discrepancy reports:

1. What types of logs and discrepancy reports will be delivered and how?
2. What is the frequency of the reports?
3. Who is responsible for processing a discrepancy report or reviewing a log?
4. Who is responsible for QA/QC of database changes due to the report?
5. Who is the point of contact for addressing the maintenance and provisioning requirements?

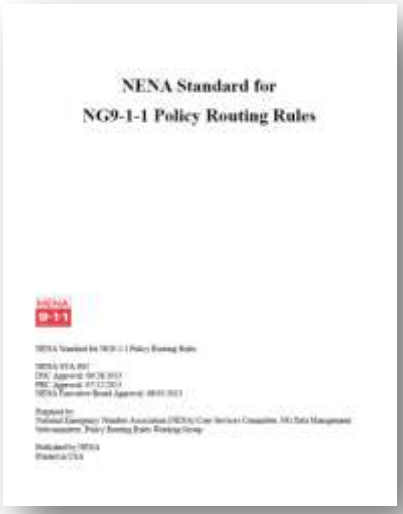
Local PSAP Support

As regions and states begin to operate NG9-1-1 systems, the PSAP applications must be supported and maintained. The GIS data in an NG9-1-1 system should be mirrored in the tactical mapping as closely as possible. GIS agencies may be asked to increase the update frequency and asked to consider the GIS data accessibility beyond the PSAP boundary. Data in the NG9-1-1 system is a subset of the data used at the PSAP. PSAPs will need to determine the frequency of updates and how in sync they desire to be with the GIS data in the NG9-1-1 system. While a daily update may be preferred, PSAPs need to be aware this may not always be feasible. It is possible GIS data updates uploaded to standalone or CAD mapping applications may be difficult to process on a daily basis.

The PSAP support plan should also outline the different data layers used in the PSAP mapping application. The data layers used locally vary from PSAP to PSAP. The dataset required for NG9-1-1 functionality is only a subset of data used by telecommmunicators when processing a 9-1-1 call. There are various types of reference data such as hydrology, railroads, fire hydrants, and many more. These will not be loaded into the NG9-1-1 system but will be needed within the PSAP. Data layers adjusted on a frequent basis and critical for caller location determination should be noted and scheduled for PSAP system updates as frequently as possible.

Another topic PSAPs need to address is data accessibility. One key feature of an NG9-1-1 system is the ability to automatically route calls to a different PSAPs based on a set of predetermined policies. For example, PSAP A may be down due to a natural disaster, so their calls will be automatically routed to PSAP B. For successful routing and outcome of a 9-1-1 call, all involved will need to think about accessibility of GIS data beyond their PSAP boundary.

When looking at the topic of data accessibility, Maine ESCB chose to manage the updates to the web-based tactical mapping application software and complete execution of the PSAPs' policy rules. For Maine's 26 PSAPs, being part of the NG9-1-1 system means meeting policy routing requirements and increasing collaboration with neighboring PSAPs to ensure policy routing rules can be followed and map data is available. Agencies must agree on how and when data will be accessed, based on policy routing rules. *STA-003 NENA Standard for NG9-1-1 Policy Routing Rules* offers more information on this topic.


NENA Standard for
NG9-1-1 Policy Routing Rules

NCTCOG and Maine learned that to have a fully compliant NENA i3 ESInet, support at the PSAP and/or county level should be requested for:

1. GIS Maintenance (new functionality requiring synchronization testing functions)
2. GIS Discrepancy report processing (may be handed within the maintenance software)
3. Updates within GIS data subsets
4. Discussions regarding GIS data accessibility related to Policy Routing Rules

Conclusion

Public safety and GIS staff are working to develop the systems and processes necessary for GIS to play a mission critical role in future 9-1-1 systems. Staff are looking beyond data synchronization and establishing the partnerships and processes necessary for successful NG9-1-1 implementation. To develop on-going processes between GIS and public safety which address locally authoritative GIS data, regional and state wide GIS data aggregation, and GIS support to the ESInet and PSAPs, NCTCOG and the Maine ESCB did just that.

We learn from these examples that even after NG9-1-1 implementation, there continue to be enhanced collaboration and streamlined workflows developed for managing GIS-related errors. The key to a successful system includes forward-thinking, collaboration, training, and development of practices and policies jointly support 9-1-1 and emergency communications.

About Geo-Comm, Inc.

GeoComm (www.geo-comm.com) was founded in 1995 to provide county governments with turnkey emergency 9-1-1 development services. Over the subsequent 19 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 for local, regional, and state government agencies. The company's systems route emergency calls to the appropriate call center, map the caller's location on a dispatchers map, and guide emergency responders to the accident on mobile displays within police, fire, and ambulance vehicles.

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

Contact us today to learn more about GIS services, the Spatial Information Function, and other NG9-1-1 related topics.

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