Current Status of 911 Geographic Information Systems Technologies

Final Report

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THE NATIONAL 911 PROGRAM

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Executive Summary

The delivery of public safety services always has been reliant on location.

- Where is the emergency?
- How do responders get to the emergency?
- Which responders are closest to the emergency?

The integration of geographic information systems (GIS) into 911 is a logical partnership that will greatly enhance the life-safety mission. Next Generation 911 (NG911), powered by the geo-positional services of GIS, will allow for the dynamic location of the emergency caller. But GIS for NG911 must be seamless across jurisdictional boundaries and between next generation networks—Emergency Services Internet Protocol (IP) networks (ESInets). This seamless fabric of GIS data and the required collaborative development and maintenance efforts present many challenges for jurisdictions tasked with supporting NG911's geospatial requirements.

The National 911 Program (Program) within the National Highway Traffic Safety Administration (NHTSA) realizes that the success of NG911 heavily relies on the success of GIS at the local, regional, multi-regional, state and tribal levels, and that much assistance is needed to ensure successful development and maintenance of the geospatial fabric, without gaps in coverage, across the United States. To this end, the Program sponsored several nationwide information gathering sessions to ascertain the challenges to success being encountered by GIS data stewards at all levels of government and across a wide array of GIS stakeholders within and parallel to public entities. The Program has a vested interest in every GIS program that supports NG911 achieving success.

The National 911 Program is located within the National Highway Traffic Safety Administration at the U.S. Department of Transportation. The Program's mission is to provide federal leadership and coordination in supporting and promoting optimal 911 services. This federal "home" for 911 plays a critical role by coordinating federal efforts that support 911 services across the nation.

It is important to note that the National Tribal Geographic Information Support Center (N.T.G.I.S.C.) enthusiastically participated on behalf of tribal communities across the United States. The Program recognizes the sovereignty of Tribal Nations and greatly appreciates the participation of N.T.G.I.S.C. volunteers. Details are provided in this and subsequent reports; tribal communities will need to partner with state 911 programs to access NG911 networks and services since there is not a national NG911 implementation.

1 Introduction

The National 911 Program (Program), within the National Highway Traffic Safety Administration (NHTSA) at the U.S. Department of Transportation (USDOT), is sponsoring an evaluation and documentation of the current status of geographic information systems (GIS) used by stakeholders within the nationwide 911 community. The Program is seeking awareness into the status of data readiness, interoperability, and sustainability; program capabilities at the local, regional, and state levels; and supporting infrastructure, standards, and governance bodies.

To achieve this goal, the Program, with the assistance of a consultant, assembled GIS stakeholders from local and national GIS and 911 organizations as well as industry representatives to gather their first-hand experiences regarding the benefits of and challenges to national GIS interoperability and 911 GIS data sharing. This report provides a summary of the findings from a series of interactions with the GIS stakeholder community.

2 Background

The Program works with states, technology providers, public safety officials, and 911 professionals to ensure a smooth transition to updated 911 systems that take advantage of new communications technologies. The Program also creates and shares a variety of resources and tools to help 911 systems.[1]

Over the last four decades, the natural evolution of the GIS industry did not organically align geospatial technology to intersect with the needs of Next Generation 911 (NG911), although a logical relationship between the two technologies exists. The marriage between GIS and NG911 has created many challenges for local, regional, and statewide GIS programs, and a flood of various solutions have emerged—based on each vendor's interpretation of NG911 standards.

To overcome these challenges, the Program first sought to understand the full scope of impediments to success, as perceived by the GIS stakeholder community.

[1] 911.gov

3 Methodology

There are thousands of 911-centric GIS stakeholders across the country, each with valuable insight to add to this effort, and there are varying opinions regarding the number of participants in an information gathering session to achieve maximum productivity. To balance the need for the widest selection of participants and remain productive in the sessions, the project team settled on 12 stakeholders. However, each stakeholder also had to represent a standards or governance organization with which they could collaborate for input to the project.

GIS stakeholders were active members of the following:

- National Association of Counties (NACo)
- National States Geographic Information Council (NSGIC)
- National Tribal Geographic Information Support Center (N.T.G.I.S.C.)
- National Association of State 911 Administrators (NASNA)
- Association of Public-Safety Communications Officials (APCO) International
- National Emergency Number Association (NENA)

The stakeholders also varied by jurisdiction size (state, regional, and local; sparse and densely populated) and geographic location.

Participants were asked to be prepared to discuss the following at the facilitated session:

1) Define success in implementing GIS for NG911.
2) Top three roadblocks to successfully developing the GIS data used for geospatial call routing for NG911.
3) Your biggest GIS success since beginning the NG911 migration.
4) What can the Program implement, change, and/or support to advance the development of GIS to meet NG911 requirements?

The hybrid in-person and online facilitated session was well attended, and stakeholder participation was both energetic and fruitful. Conversation flowed readily from one topic to the next, and stakeholders provided valuable insight into the challenges with their efforts as well as those of the membership in their respective associations.

4 Findings

The original intent of this effort was to discover the current status of GIS used by all stakeholders within the national 911 community. The Program sought to understand the benefits of and challenges to national GIS interoperability and 911 GIS data sharing.

The project team quickly discovered that local and regional challenges exist as impediments to state or multi-state successes, and these must be overcome before nationwide interoperability can be achieved. Three common themes dominated the conversation—the right next generation GIS team, acquiring and maintaining GIS data, and funding.

KEY GAPS

- Building and maintaining the right GIS team for the job
- Acquiring and maintaining NG911 GIS data
- Funding

4.1 Building and Maintaining the Right Next Generation GIS Team

The stakeholders agreed on the structure necessary to realize the successful development and maintenance of NG911 GIS data. Where differences began to appear was in how the GIS program was thrust into the NG911 implementation. Jurisdictions that are adapting existing GIS programs to also support the geospatial needs of NG911 likely are missing a champion to support funding and administrative support needs. Conversely, when a jurisdiction must build NG911 GIS capabilities, the effort regularly is led by a champion with these connections but lacks the technical capabilities or sufficient staff to meet the requirements of NG911.

The local GIS team structure widely varies across the country with a mix of centralized GIS services provided by a team of skilled professionals, federated GIS staffing within government agencies sharing a centralized database management system, and contractor-supported GIS data development and maintenance. The consensus of the stakeholders is that hiring and retaining qualified GIS staff is a challenge, especially in rural regions, and success in supporting the geospatial needs of the NG911 migration requires having the right team in place. The difficulty in building the right NG911 GIS team is finding qualified staff willing to work for the pay offered by most local government agencies. It costs a great deal of time, money, and GIS data quality when there is turnover in a GIS position supporting NG911.

The geospatial job market is competing for the limited qualified professionals available to fill the multitude of open positions. This leads to higher-than-normal turnover rates, especially in lesser pay markets, inconsistency in data maintenance procedures, and delays in achieving NG911 readiness. Stakeholders offered regional GIS teaming agreements and resource sharing as possible mitigation strategies (see Section 4.1.1, GIS Staffing Shortage).

Building on the work of the SAFECOM and National Council of Statewide Interoperability Coordinators (NCSWIC) Next Generation 911 (NG911) working group[2], the stakeholders developed what they collectively deemed as the best team to support the NG911 migration's geospatial needs. The right team structure includes a project champion who recruits members and maintains team focus. The champion must receive support from 911 leaders, administration, and the elected governing body for the jurisdiction. Addressing is necessary for 911, and the local addressing coordinator(s) are equally crucial to the next generation GIS team. Finally, the GIS data stewards for road centerlines; site structure address points; fire, law, and emergency medical services (EMS) response boundaries; and 911 operational GIS data round out the team. NG911 further necessitates active coordination between neighboring jurisdictions. The next generation GIS team from every jurisdiction also must interact with their counterparts in neighboring jurisdictions. Missing just one member from this team places the successful implementation and ongoing operation of geospatial components of the NG911 system at risk.

Not all GIS data is strictly NG911 GIS data, and the data stewards must be trained to understand not just the needs of NG911 GIS but why NG911 GIS must be maintained to such exacting standards. According to the United States Geological Survey (USGS), "a data steward, or data manager, is a person responsible for overseeing the lifecycle activities of a set of data products …"[3] Not all GIS data supporting NG911 is owned or maintained by the 911 authority. For example, the data steward for road centerlines may be a department of transportation or public works. Address points may be the responsibility of planning, property tax, or utilities.

The key role of the project champion is to understand and align the goals of these independent players. The project champion understands both the holistic view of how that data supports the goals of each independent organization and the GIS data needs of NG911. The project champion also identifies holes in GIS data coverage and seeks out the appropriate GIS and non-spatial data stewards. The project

[2] With support from the Cybersecurity and Infrastructure Security Agency (CISA), the working group released a Geographic Information System (GIS) Lifecycle Best Practices Guide to support public safety partners in the transition to NG911. https://www.cisa.gov/blog/2020/11/17/new-guide-provides-gis-best-practices-ng911-transition

[3] Stewardship | U.S. Geological Survey (usgs.gov)

champion recognizes when vital team members are missing and seeks new candidates. The current landscape in the GIS industry makes this last role the most difficult to fulfill.

4.1.1 GIS Staffing Shortage

It is a good time to be in the GIS profession. Far more GIS jobs are posted daily across the country than there are qualified candidates. Skilled professionals with only two to three years' experience can quickly move into more technical and higher-paying jobs. GIS is a highly technical, hands-on scientific profession with many specialties. There is a vast difference in the skills necessary to build and maintain data for printed maps, analytics used in intelligence or crime analysis, and the GIS requirements for NG911 and 911 operations. The stakeholders unanimously agreed that professionals with niche skills and experience in both GIS and 911 (or public safety) are the rarest of the GIS specialists.

The stakeholders further asserted that it is far more effective to secure a person with GIS skills and teach them the intricacies of the 911 arena than to take a 911 professional and teach them GIS. The important distinction, however, is that the GIS professional is reassigned or newly hired to support 911 and not a shared resource with another agency requiring a very different skillset. The risk to this approach, especially for many rural jurisdictions, is the investment in training cannot be recovered before the GIS professional uses their newly acquired training and experience to secure a new position at a higher paying jurisdiction. Limited staffing and budget constraints often lead a jurisdiction to cross-train staff who use GIS as part of their full-time job, but are not formally trained on GIS and cannot dedicate the time necessary to fully support the needs of NG911.

Stakeholders offered ideas for mitigating these issues:

- Adopt a remote work option allowing GIS resources to live in more urban environments but work for rural jurisdictions
- Share costs and resources between 911 centers to offer higher pay
- Form or join a regional or multijurisdictional cooperative with centralized GIS capabilities

None of these ideas, however, mitigate the disparity between the number of skilled GIS professionals with 911 expertise and the thousands of open GIS jobs across the country. In June 2022, the online professional networking site LinkedIn listed over 15,200 GIS jobs[4]. The stakeholders asked that the Program, in cooperation with their federal partners, work with institutions of higher learning to add 911 GIS to the list of specialties and 911 topics to the curriculum.

[4] www.linkedin.com Search criteria "GIS " with a trailing space in the quotations filters out job listings for "reGIStered" dietician, nurse, surveyor, etc.

4.1.2 GIS Vendor NG911 Credentialing

The GIS vendor community is converging on the 911 industry to fill the workforce gap to achieve successful GIS data preparation within the tight timelines presented by NG911 migration schedules. Similar to the array of individual GIS professional expertise within specific concentrations (e.g., parcel mapping, infrastructure, environmental, planning), GIS firms generally focus on one or two areas of GIS support. Firms specializing in parcel mapping or watershed management most likely do not know or truly understand the importance of strictly adhering to national NG911 GIS standards. The stakeholders identified vendors reaching outside of their areas of expertise to secure market share within the 911 arena as a broad problem. This risk is further amplified by the lack of GIS capabilities at the local level to properly perform quality control on the services and GIS data provided by the vendor.

The stakeholders expressed the need for a national or federal prescreened next generation GIS vendor list to use as a control for proposals from potential vendors. Jurisdictions required to award to the lowest bidder could avoid low bid, low capabilities companies by requiring all proposing vendors to be on the federal registry.

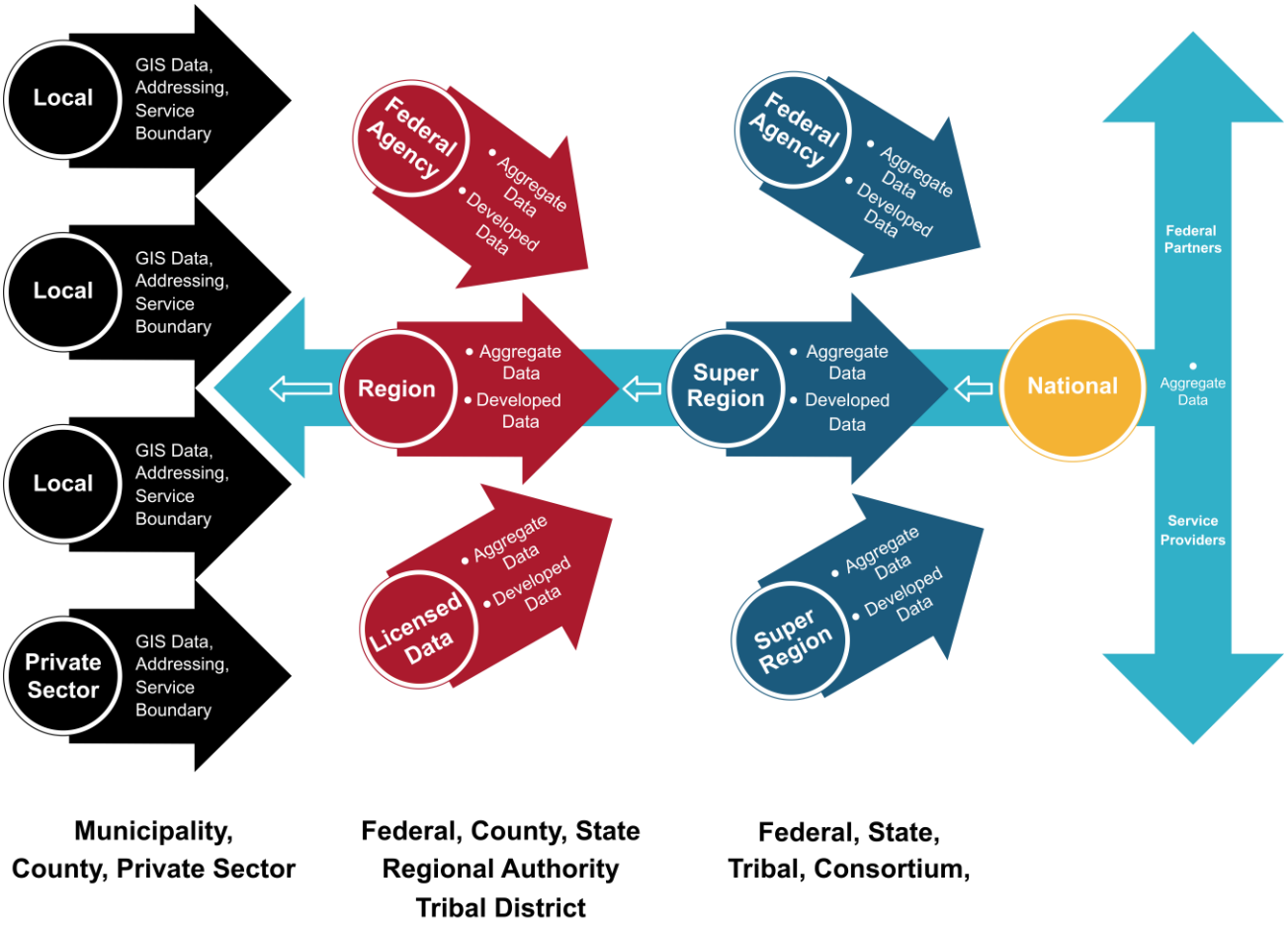
4.1.3 Tribal Concerns

Many tribal nations are reluctant to create, compile and share addressing information for the members of their tribal communities. Efforts such as 911 addressing and participation in a state-run NG911 program must first be approved by the tribal council. Similar to many local government jurisdictions, there is a need for education and outreach to leadership in the tribes to support the need for GIS staff, hardware and software.

4.2 GIS Data Supply Chain

The stakeholders presented many concerns regarding the availability of GIS data to support NG911. There is a definitive line between the “haves” and “have nots” in terms of GIS capabilities. Far too often, that line or several lines are drawn in a single 911 center’s area of coverage.

The stakeholders settled on the phrase *GIS data supply chain* (represented in the figure below) to describe how GIS data is delivered from the local data steward to the next generation core services (NGCS) in support of the NG911 solution.



There are as many versions of this workflow as there are data aggregators. Conceptually, a high-level GIS data supply chain supporting the NG911 environment would be designed to bring the most accurate and current GIS data available into the environment as quickly as possible and provide a feedback loop for necessary data edits. A single 911 center potentially could have many local data stewards.

The GIS data can be sourced from a wide variety of data stewards. Utility companies—public and private—are an excellent source of addressing information for example. When building a local GIS address dataset, partnerships with utility companies can be invaluable. In return for sharing the location data with local authorities, the utility companies receive clean address information. This sharing of data is only possible when all parties understand the importance of adopting open GIS data practices.

The stakeholders expressed frustration with public and private GIS data stewards who view the GIS data as proprietary, protected, or as an opportunity for profit and therefore are not willing or able to share the GIS data within the 911 community. Stakeholders requested that the Program further

promote open data efforts such as the National Address Database (NAD) and the United States Geological Survey (USGS) National Map Corps[5] as best practices.

Any one local data steward can break the GIS data supply chain for a single 911 center or multiple 911 centers across multiple states if the process is forced to work with outdated data or with a coverage gap in the datasets.

NENA has developed numerous documents during the past 20 years to provide public safety answering points (PSAPs) and GIS professionals with guidelines and requirements for building and maintaining GIS data layers for use in public safety operations. However, each implementation is different, and there is not a single best practice or standard for assembling NG911 GIS data for integration into the NGCS. NG911's ESInet component is designed to build a network of networks, tied together to form a single, coast-to-coast interoperable 911 service capable of serving the whole country. Without seamless GIS data for the entire country, this lofty goal will be unrealized.

4.2.1 Base GIS Data

Road centerlines and site structure address points were developed and in use, supporting other business functions before 911 considered using them for geospatial routing in NG911. These foundational GIS datasets support planning, utilities, vehicular routing, crash mapping, and billing applications, along with 911 and public safety.

NG911 places unique requirements on these GIS data that, although necessary, many times conflict with the specifications set forth by other applications. To include the attribution formatted as necessary for each application, many times the GIS data attribute table can become large and cumbersome. Stakeholders identified user confusion as a side effect accompanying the expanding use of these base data.

Addressing information in some jurisdictions is hundreds of years old and does not meet current addressing standards. This data must be transferred into a geospatial format and forced to function in a strict environment. Many jurisdictions do not have addressing ordinances or have multiple addressing authorities with conflicting addressing practices. Addressing can be assigned by an addressing authority still maintaining non-digital records, which results in the address never being recorded geospatially. The disconnects between addressing authorities and GIS data stewards result in bad or missing location data in rural and urban and small and large jurisdictions.

[5] https://www.usgs.gov/core-science-systems/ngp/tnm-corps

Stakeholders expressed many hindrances with developing and maintaining 911 addressing:

- Migrating 200-year-old addressing information into next generation specifications
- Different schemas for NG911 and computer-aided dispatch (CAD) systems
- No single point of contact for addressing information
- Multi-point addressing (mobile home park, strip malls)
- Need for multiple address levels
  - Public addresses
  - Hazardous materials (HAZMAT) rooms within addressed buildings
  - Detailed addressing such as schools, public buildings
- Addresses not assigned by the local authority or by multiple non-authoritative sources
- Post office (PO) box issued as an address for utility accounts without a physical address being recorded, which leads to a site structure without an address point
- Residents and businesses self-assigning addresses

Stakeholders highlighted the importance of assigning addresses locally and supporting the local role of this responsibility. However, without national guidance and standards, to include workflows that incorporate 911 and GIS needs, and further public education, 911 services will continue to suffer from location-based issues.

4.2.2 NG911 GIS Data

Beyond the road centerlines and site structure address points base layers, NG911 also requires several service boundary datasets to perform the location validation and call routing functions. Descriptions of and standards for these data are available in the *NENA Standard for NG9-1-1 GIS Data Model*. Service boundary data in NG911 must be coordinated with neighboring entities to mitigate 911 call delivery delays caused by gaps and overlaps within these datasets and to ensure that response agency service boundaries that are not coincident with jurisdiction or PSAP boundaries are properly drawn and attributed.

Five Required Layers

1. Address Points
2. Road Centerlines
3. PSAP Boundary
4. Provisioning Boundary
5. Emergency Services Boundary

The NG911 service boundary polygon datasets do not need to adhere to a jurisdictional boundary; in many cases, these boundaries are not coincident. Although the level of coordination between jurisdictions, especially those without advanced GIS capabilities, was the most common hurdle for managing NG911-specific GIS data, the stakeholders highlighted several other challenges to developing and maintaining a seamless network of 911 service boundaries:

- Coordination of GIS and response leaders from all affected jurisdictions
- Natural divisions such as waterways or natural peaks change over time
- Managing frequent/multiple response boundary changes
- The public safety industry has not defined parameters to identifiable geographic boundaries
- Response agency written agreements do not match actual field response
- GIS professionals are placed in a role of mediator rather than a recorder of boundaries
- No single source for response service boundaries
- Lack of local and national governance documentation

The wide-ranging array of GIS capabilities, or lack thereof, across the country creates an ineffective environment for cooperative GIS data development and hinders the creation of a national fabric of next generation GIS data. This issue is highlighted by the complex nature of service boundary topology, which can only be maintained when adjoining entities collaborate and maintain boundaries in tandem.

4.2.3 GIS Data Standardization

Local, regional, statewide, and national standards govern the development and maintenance of road centerline and site structure address point GIS data for NG911. However, these GIS data are used for much more than NG911 and need to retain that usefulness, especially since these data have been in use outside of NG911 for decades. The stakeholders identified many challenges to GIS data standardization during the facilitated session.

GIS data governance is severely lacking for all uses of GIS data. Standards bodies have created conflicting recommendations for GIS data that require the maintenance of two attribute tables for the same GIS dataset. The development of road centerlines to support vehicle routing, for example, has long expected that one-way road segments are drawn in the direction of travel. This can be in direct conflict with the NG911 requirement that road segments are drawn from lowest to highest address. Errors generated by the NG911 systems can be flagged with an exception code to allow the GIS data to be provisioned into the NGCS without changing the data. However, the lack of universal exception codes, rules for allowing exception codes, and even standardized criteria for identifying errors makes it virtually impossible to construct a national aggregate GIS dataset for NG911.

Some jurisdictions sell GIS data to offset the cost of GIS services and data development. Related restrictions placed on data sharing in these jurisdictions limit the availability of GIS data for collaborative data development and error resolution. Although there is a national standard establishing the formatting of GIS data to facilitate sharing of NG911 required datasets[6], there is not a requirement for sharing the required GIS data for NG911. To achieve nationwide NG911 implementation, the GIS data must exist, be properly formatted, and be shared within the 911 community. This standard should

[6] NENA-STA-015.10-2018 (Originally 02-010) - NENA Standard Data Formats for E9-1-1 Data Exchange & GIS Mapping

go beyond defining the minimum data components required for call routing, responding agency identification, and 911 support services in the interest of interoperable GIS data for NG911 operation to also include the necessity of sharing the data and require GIS data sharing as a prerequisite for receiving federal 911 funding.

The stakeholders also identified the disparity between current standards and the real world (e.g., multiple road names, non-compliant addresses, place names as addresses) as an impediment to successfully integrating local GIS data, validating regional data, and composing state and national GIS data for NG911. Achieving the requisite GIS data compliance to national standards simply is not possible without changing addresses and updating road centerline names and ranges. The clash between the logical need in 911 for these changes and the emotional response from the public affected by the changes delays or ends the process. Synchronized, consistent, and frequent education and outreach from all levels of government to the public is necessary to garner universal acceptance of this necessary process.

4.2.4 National Address Database

The National Address Database[7] (NAD) seeks to provide a single source for accurate and up-to-date addresses across the nation. Addresses are critical to transportation safety and are a vital cornerstone of NG911. They also are essential for a broad range of government services, including mail delivery, permitting, service delivery, disaster aid distribution, and school siting. To meet this need, USDOT partners with address programs from state, local, and Tribal governments to compile their authoritative data into the NAD. While the stakeholders widely agreed that the NAD is a valuable tool in implementing NG911 nationwide, other potential and valuable uses for the NAD were identified.

The proliferation of web-based mapping applications (e.g., MapQuest, Google Maps, Bing Maps) and the reliance on private delivery providers present numerous challenges for addressing authorities. Establishing the NAD as the authoritative source for these vendors to acquire addressing information would relieve thousands of jurisdictions of the responsibility (and burden) of contacting the many delivery and mapping providers and ensure the tens of thousands of edits made each year in the GIS data are included in all applications, regardless of a jurisdiction's size or influence.

Some errors realized by the jurisdictions but not being corrected by these services include:

- Rural postal city versus actual jurisdiction
- Road name misspelling
- Incorrect street type
- Incorrect address

[7] https://www.transportation.gov/gis/national-address-database

- One-way direction
- Timely inclusion of new streets and addresses.
- Proper identification of city, county, township, or Tribal entity

The NAD holds the opportunity to directly assist in the NG911 migration and reduce tertiary burdens on GIS entities working to correct addressing issues across multiple platforms. However, to be fully successful, the NAD, NG911, and many other operational GIS capabilities rely on every GIS data steward adopting an open data policy. Once personally identifiable information (PII) is stripped from the address points, there is no reason to hold address points as sensitive data. Further, the sharing of these GIS data likely will lead to improved data quality and the addition of valuable attributes created and maintained by agencies beyond 911.

4.2.5 Tribal Concerns

Similar to the need for staff, a lack of sufficient outreach and education has contributed to the reluctance of tribal nations to share their GIS data, or any location information. Federal outreach has met with some resistance but seems to be gaining traction again. The N.T.G.I.S.C. appreciates the efforts of the National 911 Program and seeks additional support in the form of outreach and education to tribal elders on the importance of GIS data to the life-safety mission.

4.3 Funding

The implementation and ongoing operation of GIS are expensive. The accuracy and update frequency requirements to support NG911 increase the operating costs. Stakeholders cited a lack of funding assistance for GIS data maintenance and a local understanding of the level of effort to properly maintain the GIS data to NG911 standards as a frequent reason for project delays and failures.

Next generation GIS development is not a linear process; unless there is zero change in a jurisdiction, there will always be changes to the GIS data to be implemented. Addresses are updated, eliminated, and added. New road centerlines must be drawn and attributed. Existing road centerlines broken at new intersections, and the attributes must be updated to reflect the new segments. Service boundary layers change with new development, requiring updates to response areas due to the growth in neighboring jurisdictions. Current Enhanced 911 standards require the legacy data tables to be updated daily with new information or corrected based on errors discovered during daily PSAP operations. The target turnaround for GIS data updates is within 72 hours—a goal that presently is far out of reach for the vast majority of jurisdictions.

Educating local and regional leaders on the necessity of GIS to NG911 is the first step to overcoming this issue. However, many jurisdictions simply cannot afford to hire highly skilled, specialized GIS

staff to fill this gap or secure the contracted services to the degree necessitated by NG911 GIS standards.

4.3.1 Funding Sources

The authority for imposing 911 fees also varies by state, although every state allows a 911 fee that is often associated with wireline, wireless, or Voice over IP (VoIP) telephone service.[8] These fees range from a few pennies to several dollars per month, and most states have defined allowable uses for these funds. Although GIS is required for NG911 systems, GIS may or may not be on the state list of allowed expenditures. When allowed, the funding may be limited to data only and not staffing, data collection, and/or ongoing GIS data maintenance.

The Federal Communications Commission (FCC) establishes and maintains an authoritative list of permitted expenditures for 911 funds, on which GIS is identified[9]. A state or local 911 authority currently cannot add allowable uses beyond this list but also is not required to include all permitted uses in their respective allowable expenditures. The GIS community frequently requests and widely supports the Program developing national guidance on GIS expenditures for NG911 and highlighting GIS data creation and maintenance as a priority for funding via 911 funds. Further, as a requirement associated with using 911 funding for GIS initiatives, state and federal 911 funding sources should require the sharing of next generation GIS data throughout the 911 ecosystem. Data sharing will enhance 911 services on the local, state, and federal levels while developing an unduplicated resource for all government and private entities that relies upon accurate and current address information.

The stakeholders also highlighted the need for future federal funding to include specific funding for next generation GIS, including the collection, maintenance, and implementation of GIS datasets required for NG911 operation. Federal 911 grants should prioritize GIS data maintenance and sharing. To ensure that the funds are being spent responsibly, locally or with a qualified vendor, completing services towards the strategic goals of NG911, initiatives funded through these grants must have proper guidance and oversight to ensure the expenditures align with the project goals of the national rollout of NG911.

4.3.2 Strategic Partnerships

NG911 is designed to be a nationwide fabric of 911 networks functioning interactively. The next generation of GIS also must work collaboratively across stakeholders, between jurisdictions, and through all levels of government. Many multijurisdictional GIS efforts have been successful in

[8] https://www.nena.org/general/custom.asp?page=911RateByState
[9] The FCC "Ending 9-1-1 Fee Diversion Now Strike Force Report (9/23/21); section 2.2.1 Allowable Use; 911 Geographic Information Systems.

developing and maintaining GIS data for other applications, some for decades. These consortiums, councils of government, or regional groups also can provide GIS to multiple jurisdictions where independent GIS efforts are out of financial and technical reach.

Conversely, frequently there is a disconnect between local GIS and the 911 leadership. GIS frequently is guilty of unfamiliarity with the NG911 GIS standards, instead continuing to develop and maintain the GIS data in the manner to which they are most accustomed. The 911 leadership working towards NG911 readiness procrastinates on engaging county GIS due to a lack of understanding either the time requirements necessary to bring GIS data into NG911 compliance or lack of understanding what GIS is or how it is integrated with NG911. Organizations like the National States Geographic Information Council or National Association of Counties play a vital role in providing outreach and education and promoting the advancement of these critical relationships.

GIS has supported dozens of other programs before NG911. These programs share the need for the same GIS data as NG911, and funding is available to help offset the cost of GIS data development and maintenance. The Program indicated that traffic safety grants from NHTSA might be used for GIS that supports both traffic safety improvements and the NG911 migration.

The Program recognizes that strategic partnerships are extremely valuable to this effort and funded a separate stakeholder information gathering session specifically aligned to the GIS partner agencies. Further findings from this session will be detailed in a parallel report.

4.3.3 Tribal Concerns

Tribal communities accepting grant or 911 fee funds may be subject to the same rules and regulations as local and regional government-run 911 programs. Questions raised regarding funding of NG911 efforts in the tribal community include the following:

- When federal grant funds are awarded, does the awarding agency(ies) have the same authority and audit oversight with a tribal nation as they do with a state or local 911 authority?
- If the tribal authority diverts funds (as some states have), what enforcement for this diversion of funds does the state or FCC have?
- Do tribes have the authority to levy their own 911 fees within their nation?
  - Can they set their own fees?
  - Have any done so?
- If the tribe receives 911 funds collected by the state or local 911 authority for the member on their lands, are they bound by the same rules of fund use as other governments in the state?

5 Conclusion

The most accurate, most current GIS data is developed and maintained locally through collaboration with local, regional, tribal, and federal partners. GIS programs are expensive, and the highly skilled, niche staff are at a premium. Open data sharing and policies with efforts such as the NAD increase return on investment and improve GIS data quality. The lack of local GIS capabilities or prescreened GIS vendors with a history of quality GIS data development in the NG911 arena is jeopardizing the rollout of NG911 and placing the ongoing operation of geospatial call routing at risk. The deficiency in leadership's understanding of GIS, NG911, and the relationship between the two further exacerbates the threats to success. The realization and ongoing availability of next generation GIS is not possible without a continuous, sufficient funding stream and supporting legislation.

The 911 and GIS communities must embrace a calculated approach to NG911 success—less racing to implementation and more coordinating along the migration path.

Acronym Dictionary

Acronym	Term	Definition
ALI	Automatic Location Identification	Tabular reference for the current 911 system. Defines destination PSAP for every landline telephone number and cellular tower.
CAD	Computer-Aided Dispatch	A computer-based system that aids PSAP telecommunicators by automating selected dispatching and record-keeping activities.
CLDXF	Civic Layer Data Exchange Format	A set of data elements that describe detailed street address information. All components are spelled out – no abbreviations.
COOP	Continuity of Operations Planning	A plan to implement continuity of operations to ensure that primary mission essential functions continue to be performed during a wide range of emergencies, including localized acts of nature, accidents, and technological or attack-related emergencies.
E911	Enhanced 911	A telephone system that includes network switching, database, and PSAP premise elements capable of providing automatic location identification data, selective routing, selective transfer, fixed transfer, and a call back number
ECRF	Emergency Call Routing Function	A functional element in an ESInet. The ECRF is a Location to Service Translation (LoST) protocol server where location information (either civic address or geo-coordinates) and a Service Uniform Resource Name (Service URN) serve as input to a mapping function that returns a Uniform Resource Identifier (URI) used to route an emergency call toward the appropriate PSAP for the caller's location or toward a responder agency.
ESInet	Emergency Services IP Network	Managed IP network that is used for emergency services communications, and which can be shared by all public safety agencies. It provides the IP transport infrastructure upon which independent application platforms and core services can be deployed, including, but not restricted to, those necessary for providing NG911 services.
ESZ	Emergency Service Zone	A geographical area that represents a unique combination of emergency service agencies (e.g., law enforcement, fire/rescue, and

Acronym	Term	Definition
		emergency medical service) that is within a specified 911 governing authority's jurisdiction.
ETL	Extract, Transform, Load	Three database functions that are combined into one tool to pull data out of one database, properly map the fields to the schema of a second database, and place it into the other database.
FCC	Federal Communications Commission	An independent U.S. government agency overseen by Congress, the commission is the United States' primary authority for communications law, regulation, and technological innovation.
GIS	Geographic Information System	A system for capturing, storing, displaying, analyzing, and managing data and associated attributes which are spatially referenced.
ILA	Interlocal Agreement	An agreement among governmental jurisdictions or privately owned systems, or both, within a specified area to share 911 system costs, maintenance responsibilities, and other considerations.
IP	Internet Protocol	The method by which data is sent from one computer to another on the ESInet, Internet, or other networks.
IT	Information Technology	The use of any computers, storage, networking, and other physical devices, infrastructure, and processes to create, process, store, secure, and exchange all forms of electronic data.
LVF	Location Validation Function	A functional element in an NGCS that is a LoST protocol server where civic location information is validated against the authoritative GIS database information.
MLTS	Multi-Line Telephone System	Communications equipment comprised of common control unit(s), telephone sets, control hardware and software, and adjunct systems used typically in enterprise settings such as hotels, government agencies, commercial offices, and campuses.
MOA	Memorandum of Agreement	A document written between parties to cooperatively work together on an agreed upon project or meet an agreed upon objective.
MSAG	Master Street Address Guide	Tabular reference for address validation in the current 911 system. Defines all possible addresses within a jurisdiction.

Acronym	Term	Definition
NENA	National Emergency Number Association	Standards body for 911 and NG911.
NG911	Next Generation 911	NG911 refers to an initiative aimed at updating the 911 service infrastructure in the United States and Canada to improve public emergency communications services in a growingly wireless mobile society.
NGCS	Next Generation Core Services	The base set of services needed to process a 911 call on an ESInet. Includes the ESRP, ECRF, LVF, BCF, Bridge, Policy Store, Logging Services, and typical IP services such as DNS and DHCP. The term NGCS includes the services and not the network on which they operate.
N.T.G.I.S.C.	National Tribal Geographic Information Support Center	Also known as Tribal GIS, N.T.G.I.S.C. is a non-profit organization with an objective to provide assistance to Native American tribal governments and organizations regarding GIS technology.[10]
PBX	Private Branch Exchange	A private telephone switch that is connected to the public switched telephone network.
PSAP	Public Safety Answering Point	The entity responsible for receiving 911 calls and processing those calls according to a specific operational policy.
RDBMS	Relational Database Management System	Software that gives users the ability to update, query and administer a relational database.
REST	Representational State Transfer	An interface that transmits domain-specific data over HTTP without an additional messaging layer such as SOPA or session tracking via HTTP cookies.

[10] TribalGIS.com About Us page: https://tribalgis.com/aboutus

Acronym	Term	Definition
RMS	Records Management System	Public safety RMS are often interfaced to public safety communication centers. RMSs are sometimes accessed directly through computer systems deployed within communication centers for research and analysis purposes.
SDE	Spatial Database Engine	An umbrella term that describes how virtualization and abstracting workloads from the underlying hardware can be used to make information technology (IT) infrastructures more flexible and agile.
SI	Spatial Interface	A standardized interface between the GIS and the functional elements that consume GIS data, such as the ECRF and/or LVF.
SLA	Service Level Agreement	A contract between a service provider and the end user that defines the level of service expected from the service provider.
SOP	Standard Operating Procedure	A written directive that provides a guideline for carrying out an activity.
SQL	Structured Query Language	A standardized programming language that's used to manage relational databases and perform various operations on the data in them.
TFOPA	Task Force on Optimal Public Safety Answering Point Architecture	The federal task force directed to study and report findings and recommendations on structure and architecture in order to determine whether additional consolidation of PSAP infrastructure and architecture improvements would promote greater efficiency of operations, safety of life, and cost containment while retaining needed integration with local first responder dispatch and support.
VoIP	Voice Over Internet Protocol	Telephone service provided through the internet rather than traditional telephone lines. This includes fiber-optic and coaxial cable services such as Comcast and Time Warner, and purchased devices like Ooma®, Google Voice, or magicJack.