Abstract: This document provides guidance to aid the development of complete, accurate and current GIS datasets to be used within NG911 systems. Version 1 of the document is limited to PSAP Boundaries.

NOTE: This DRAFT document is not intended for distribution beyond the groups developing or reviewing the document. The document is also not intended to be used or referenced for development or procurement purposes until final publication. All draft material is subject to change and it is possible that the document itself may never be approved for publication.
1 Executive Overview

This document will assist Geographic Information Systems (GIS) and Public Safety Answering Point (PSAP) staff in understanding and adopting best practices related to managing specific GIS datasets in support of Next Generation 9-1-1 (NG9-1-1) deployments. GIS data are at the heart of NG9-1-1 systems. Civic addresses associated with fixed caller locations are validated against GIS data to ensure that they can be mapped. When an emergency call is made, it is routed using the caller’s location along with the GIS boundaries of responder agencies to determine the correct responder.

A program of GIS Data Stewardship is not limited to the initial creation of data – it involves regular access to tabular inputs such as civic addresses and regular maintenance of spatial data such as emergency service boundaries and road centerlines. Ensuring that data used by the NG9-1-1 system are complete, accurate, and current may require cooperation between multiple data contributors and stakeholder agencies. A comprehensive data management approach includes not only continual data input and maintenance but also on-going communication between stakeholders, internal quality assurance, quality control, dealing with external discrepancy reports, and archiving data.

The Next Generation Core Services (NGCS) that validate addresses and route calls in NG9-1-1 systems are the Location Validation Function (LVF) and the Emergency Call Routing Function (ECRF), respectively. The technical requirements and detailed operation of these services within the overall NG9-1-1 architecture are specified in NENA documents referenced in the following sections. As mentioned above, these services use GIS data to validate civic addresses associated with caller locations and spatial queries to direct actual calls to the correct responding NG9-1-1 PSAP (henceforth known as PSAP). The PSAP boundary layer is therefore a critical resource, and the bulk of this document is focused on the compilation and maintenance of this layer. Subsequent versions will consider additional GIS layers used in the operation of the LVF and ECRF. A complete listing of data layers required or suggested for NG9-1-1 operation can be found in NENA-STA-006, NENA Standard for NG9-1-1 GIS Data Model. The considerations of GIS data stewardship in this document will include:

- Datasets needed and how they are used (summarized from other NENA documents)
- Quality measures such as completeness, accuracy, and topological consistency
- Need for coordination and best practices for data exchange
- Recommendations and guidelines for managing NG9-1-1 datasets
- Specific recommendations for creation and maintenance of service boundary layers

The latter part of the document will present a phased approach which incrementally refines and improves PSAP boundaries in concert with NG9-1-1 project milestones.
In sum, the purpose of this document is to support the development of complete, accurate and current GIS datasets to be used within NG9-1-1 systems. These datasets will be used to validate call location information, to route calls to the correct responding agency, and to display locations in context for call handling purposes. Following the recommendations presented will result in more accurate, efficient and reliable operation of GIS data-dependent services within NG9-1-1 systems.
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2 Stewardship of GIS data used by the LVF and ECRF

This document presents best practices and recommendations for creating and maintaining GIS datasets that are used in Next Generation Core Services. Specifically, this document will focus on the datasets that are used by two core services - the Location Validation Function (LVF) and the Emergency Call Routing Function (ECRF). The LVF validates civic locations so that problems with missing or invalid civic locations can be resolved prior to a 9-1-1 call. The ECRF provides information about responder agencies and routes the initial 9-1-1 call to the correct PSAP. The spatial queries performed by the LVF and ECRF are different from the tabular queries used by E9-1-1 for call validation and routing. For these spatial queries to work as intended, it is critical to correctly develop and populate the required GIS layers and to ensure the desired topological relationships between these layers are maintained. This is a change from how location validation and call routing work in Enhanced 9-1-1 (E9-1-1). E9-1-1 makes use of tabular databases to validate and route calls; NG9-1-1 makes use of GIS data and spatial queries. To effectively develop, support, and maintain GIS data for NG9-1-1, it is important to understand how it will be used to validate civic locations and geospaciously route calls.

To support information exchange in i3 NG9-1-1 systems, location information is represented in the IETF PIDF-LO format. Both the LVF and ECRF receive location queries using PIDF-LO.

Note: This document builds heavily upon NENA-STA-005 - NENA Standards for the Provisioning and Maintenance of GIS data to ECRFs and LVFs and NENA-STA-006 - NENA Standard for NG9-1-1 GIS Data Model. It provides applicable guidance to help support the implementation of both these standards. Readers are encouraged to reference both documents for more complete technical and functional standards.

2.1 GIS Layers used by the LVF and ECRF

There are two groups of GIS layers used by the LVF and ECRF – civic location layers and service boundary layers.

2.1.1 Civic Location Layers

Civic location features represent physical street addresses and/or landmarks using points, lines or polygons. When a query involving a civic address is made to the LVF or ECRF, an attempt is made to match the address as provided by an Originating Service Provider (OSP) with a corresponding location based on the address attributes address elements in the GIS layers. Examples of civic location layers include road centerlines (RCL), site/structure address points (SSAP), and building footprint layers.

NENA-STA-005 - NENA Standards for the Provisioning and Maintenance of GIS data to ECRFs and LVFs requires that LVF and ECRF providers handle any combination of civic location geometry types including points, lines, and/or polygons. NENA-STA-006 - NENA...
Standard for NG9-1-1 GIS Data Model has developed content and format requirements for the SSAP and RCL data layers as the most commonly used civic location layers. Future versions of that standard may incorporate other geometry types. It will be up to the 9-1-1 Authority with input from their Next Generation 9-1-1 Core Services (NGCS) Service Provider to determine which layer(s) are most suitable for representing civic locations in the LVF and ECRF.

Note: While civic location layers that are typically available today may be adequate for use in the LVF and ECRF, NENA’s long range vision expects the evolution of GIS data towards greater accuracy and precision. As such, it is recommended that 9-1-1 Authorities and GIS Data Providers consult NENA-STA-005 - NENA Standards for the Provisioning and Maintenance of GIS data to ECRFs and LVFs - GIS Data Recommendations, Tradeoffs, and NENA Long Range Vision. As additional guidance is developed, GIS Data Providers will need to remain aware of these potential enhancements and/or changes which may include 3D location support for NG9-1-1 call routing and sub-parcel and sub-address polygon support for building, floor, suite, room, etc.

2.1.2 Service Boundary Layers

Service boundary polygons show the geographic extent for a particular agency, such as a PSAP or responder agency. Service boundaries are used by the ECRF during routing requests, and they are used by the LVF to validate whether a given location is routable.

Two fields that are required to facilitate call routing in NG9-1-1 within GIS Emergency Service Boundaries are the “Service URN” and “Service URI”. A Service URN identifies a particular category of resource (PSAP, Law Agency, Fire Agency, etc.) within an Emergency Services IP Network (ESInet). A Service URI provides the network address for a given resource. For a complete detailed functional and interface specification for LVFs or ECRFs, please refer to NENA-STA-010, NENA Detailed Functional and Interface Standards for the NENA i3 Solution.

When a location is queried in a LVF or ECRF, this query specifies the requested service, using a “Uniform Resource Name” or URN. The Service URN identifies a particular category of resource (e.g. PSAP, law enforcement, fire, EMS, coast guard, state police). As defined by NENA standards, PSAP and emergency service boundaries must be attributed with specific URN values that have also been registered in the NENA Registry System (http://technet.nena.org/nrs/registry/urn-nena-service-responder.xml) (NENA-STA-010 - NENA Detailed Functional and Interface Standards for the NENA i3 Solution). The most commonly used values are:

- PSAP – “urn:nena:service:sos.psap”
- Police – “urn:nena:service:responder.police”
• Fire – “urn:nena:service:responder.fire”
• EMS – “urn:nena:service:responder.ems”

The ECRF then performs a spatial query using the Service URN at the given location. If a feature is found, the network location for that service is returned as a “Uniform Resource Identifier” or URI. The Service URI identifies the network location for the responder agency and is used to route the call to that agency.

### Geospatial call routing – ECRF GIS Query

**Input:** The geocoded location of a civic address or the location coordinate (x,y) of the 9-1-1 call in PIDF-LO format and the Service URN = urn:nena:service:sos.psap

**The provided location intersects the corresponding PSAP Boundary that includes attributes for Service URN and Service URI.**

Service URN = urn:nena:service:sos.psap
Service URI = Service URI of the PSAP

**Mechanism:**
Point-in-polygon Spatial Query

**The ECRF returns the Service URI attribute value for the corresponding boundary that was intersected by the location input.**

Service URI = the URI for the PSAP (PSAPD@PSAPdomain.com)

**Output:**
Service URI from the PSAP Boundary polygon

### 2.1.3 PSAP Boundary

#### 2.1.3.1 Layer Information

#### 2.1.3.1.1 Description

The boundary that defines the geographic area for which a Public Safety Answering Point (PSAP) has emergency request/call handling responsibility.
2.1.3.1.2 Purpose

As stated in the NENA GIS Data Model, “this layer depicts the polygon(s) and related attribute information that defines the geographic area of all PSAP Boundaries within a given 9-1-1 Authority’s geographic coverage area. The PSAP Boundary layer may have one or many PSAP Boundaries contained in the layer. Each PSAP Boundary defines the geographic area of a PSAP that has primary responsibilities for an emergency request. A geographic location can only have one designated primary PSAP. This layer is used by the ECRF to perform a geographic query to determine to which PSAP an emergency request is routed. An emergency request is routed within the i3 core elements based upon the geographic location of the request, provided by either a civic address, or geographic coordinate or geodetic shapes as defined in NENA-STA-010, or the current NENA i3 Standards document.”

2.1.3.1.3 Intended Use

From a practical standpoint, the PSAP Boundary should reflect the geographic extent for which a PSAP has 9-1-1 emergency request responsibility. This area is represented by the Administrative ESN (Emergency Service Number) and the associated ESZ (Emergency Service Zone) in the MSAG today. The Administrative ESN is associated to your MSAG and should directly correlate with the ESZ. An ESZ is “a geographical area that represents a unique combination of emergency service agencies (e.g., Law Enforcement, Fire and Emergency Medical Service) that are within a specified 9-1-1 governing authority’s jurisdiction. An ESZ can be represented by an Emergency Service Number (ESN) to identify the ESZ.” Special consideration should be given to include the entirety of a site or area that may be defined by parcels, jurisdictional boundaries, water features, or other boundaries. Defining and agreeing on these shared boundaries could be challenging and may require the cooperation of PSAP Authorities and local responding agencies. In addition, PSAP Boundary attributes need to reflect current, accurate and routable Service URNs and Route URIs.

The primary use for the PSAP Boundary is to route call/emergency requests for NG9-1-1. In NG9-1-1, the PSAP Boundary will be provisioned by the Spatial Interface (SI) to the Emergency Call Routing Function (ECRF) and Location Validation Function (LVF). Call routing in the i3 environment is a function of spatial queries and boundaries. The ECRF uses a spatial query that intersects the location of the call/emergency request to the PSAP Boundary and is used to route the call/emergency request to the appropriate PSAP. A call/emergency request location may either have a location based on geocoding (geocoding from road centerline or address point or address polygon) or a geographic coordinate (latitude/longitude).

If a PSAP does not receive emergency call requests for a particular Class of Service, refined routing of the call will be handled based on conditions that are defined as part of a Policy Routing Rule (PRR). Distinguishing between Class of Service for which calls get routed to...
the correct PSAP is a function of the Emergency Service Routing Proxy’s (ESRP) Policy Routing Function (PRF). This document focuses on development and maintenance of the PSAP Boundary layer; additional layers that may be developed to handle special routing conditions are not a focus of the document at this time.

To ensure that PSAP Boundaries are usable for NG9-1-1, it is critical that PSAP boundaries are free from gaps and overlaps and take into account topological relationships.

2.2 Data Quality challenges

2.2.1 GIS Data Synchronization

NENA-INF-008 - NENA NG9-1-1 Transition Plan Considerations Information Document provides guidance for NG9-1-1 transition planning. Included in this document are database transition considerations that provide recommended next steps. One of the most important steps to preparing GIS data for NG9-1-1 is the process of data synchronization. As stated in the Executive Overview of INF-008, "If an Authority that provides GIS data for 9-1-1 use has not performed this reconciliation work it should take up the task at the earliest opportunity as such reconciliation is viewed as a first step in NG9-1-1 data transition." This data synchronization is invaluable because it ensures that GIS data is synchronized with MSAG and ALI data and it serves as a bridge between the databases used for E9-1-1 and those used for NG9-1-1. Failure to complete this step will be costly both in time and resources, and will ultimately delay the development of GIS data that will help be migrated towards NG9-1-1.

2.2.2 Topology

Topology describes the spatial relationships between GIS features and needs to be considered when developing or maintaining NG9-1-1 GIS layers. When a specific relationship between features is desired, topology rules are developed.

For example, when a spatial query is performed to find which PSAP should handle a call, one PSAP and only one PSAP should be returned for any given location. In this example, to ensure this desired behavior, topology rules should be created stating that GIS features in the PSAP service area boundary layer should not overlap and there should be no gaps between PSAP service areas. For more information on gaps and overlaps in PSAP boundary layers, refer to section 2.3.2.1.2.

2.2.3 Coordination Roles and Responsibilities

Entities involved in GIS data creation and maintenance must collaborate with the 9-1-1 Authority on which data source will be considered authoritative and what workflow will be used to provide GIS data to the SI. Authoritative data sources are those agencies whose day-to-day operations and official decisions determine the content of the PSAP service area
boundary and civic location data that will be provided to the SI. Since there may be
multiple data sources, it is essential to spell out what rules and policies will govern the
compilation, creation, and ongoing edits to the GIS data. 9-1-1 Authorities are by definition
the authoritative sources for PSAP boundaries used by LVF and ECRF. Local government
departments will generally be the authorities for address number assignment, street
naming, and the mapping of place name boundaries and road rights of way. Since PSAP
service areas are not always exactly aligned with political jurisdictions, and often aggregate
multiple jurisdictions, there may be more than one civic location or addressing data source
within a given PSAP service area. The extent of jurisdiction for each data source needs to
be carefully delineated. Ultimately, the 9-1-1 Authority determines which source of GIS
data is considered authoritative and should be provisioned to the LVF and ECRF.

2.2.3.1 GIS Data Provider

A GIS Data Provider creates and maintains GIS data to be provided to the SI based on
agreed upon rules and policies. A GIS Data Provider may create and maintain the original
source data and/or may aggregate source data from multiple GIS data sources into a NENA
standards-compliant format. If there are multiple candidate sources of civic location and
address data within the same area, the GIS Data Provider must work with the 9-1-1
Authority to determine which GIS data source should be used. For a given dataset, the GIS
Data Provider is responsible for maintaining consistency between all data sources and the
GIS data provided to the SI. A GIS Data Provider may provide civic location data for all or
only a portion of the PSAP service area. Each GIS Data Provider is responsible for
performing quality control checks on the data within their area and ensuring that it
conforms to NENA standards. Data from a GIS Data Provider should be delivered in final
form, ready for use within the LVF and the ECRF.

2.2.3.29-1-1 Authority

A 9-1-1 Authority is a State, County, Regional, Tribal or other governmental entity
responsible for 9-1-1 service operations in a given area. A 9-1-1 Authority may be
composed of one or more PSAPs. The 9-1-1 Authority may assume the role of GIS Data
Provider for the service area boundary, or it may delegate that function to another entity.
Similarly, for civic location data, the 9-1-1 Authority may work with multiple GIS data
sources within its service area to create and maintain civic location layers, or it may
designate one or more GIS Data Providers and specify the provisioning area for which each
is responsible.

In situations where there are multiple GIS Data Providers, as for example where local data
are aggregated to a regional or statewide service area, the 9-1-1 Authority needs to specify
exactly how and by whom local data will be reviewed and edge-matched. Additionally, they
will need to specify how boundary issues are resolved and how final quality control
measures are performed before the data are provided to the SI. For example, the 9-1-1

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Authority may determine that data must be returned to the original GIS Data Provider for review and correction if edits are needed, or the 9-1-1 Authority may assign the responsibility for reviewing data and making corrections over the entire service area to one of several GIS Data Providers.

In all cases where multiple datasets are being aggregated by a higher-level agency or a third party, there should be a clear understanding between the GIS Data Providers and the 9-1-1 Authority on who is empowered to edit the GIS data and what sorts of changes they can make. All discrepancy reports resulting from NG9-1-1 system operations should be communicated by the system operator to the entity designated by the 9-1-1 Authority to resolve discrepancies for a given provisioning area or service area. Best practice requires that any edits made by a higher-level agency or a third party are done in consultation with, and transmitted back to, the GIS Data Provider.

2.3 General Recommendations for Developing and Managing NG9-1-1 Service Boundary Layers

2.3.1 When possible, aggregate NG9-1-1 GIS layers to regional or statewide dataset(s)

If every GIS Data Provider across a state or region creates and maintains their own civic location and service boundary layers independent of neighboring GIS Data Providers, it will create a number of challenges. One way to overcome these challenges is to aggregate the layers to regional or statewide datasets. By having aggregated layers, it can enable the following across a region or an entire state:

- Improves database integrity across a state or region by having a common schema
- Ensures a common projection within the state prior to providing the layer to a NGCS Provider
- Enables the creation and application of consistent topology rules across the aggregated dataset
- Facilitates resolution of topology related issues, especially gaps or overlaps between neighboring features
- Provides a single layer that could be used to coordinate service boundaries along state or international borders
- Creates a common layer that can be used to support interaction with one or more NG9-1-1 service providers within the state
- Provides a common dataset that can be used to engage a neutral third party to help with service boundary reconciliation
The absence of regional or statewide layers will increase the coordination role for 9-1-1 Authorities and require each authority to determine with each of their neighbors how to coordinate and resolve issues with NG9-1-1 layers. Additionally, the absence of regional or statewide datasets will make it more difficult to determine the status of NG9-1-1 service boundary development both within a region, or a state, and nationwide.

2.3.2 Considerations when developing Service Boundary Layers

The boundaries of many PSAPs today can be approximated by other boundaries that represent the extent of a defined geographic entity such as a county, city, town, or township. However, the PSAP boundaries should not be confused with these administrative or jurisdictional boundaries. When creating PSAP boundaries for NG9-1-1, it will be important to consider any existing agreements impacting how 9-1-1 calls are routed today. In some instances, these may be formal agreements between PSAPs defining their areas of responsibility. However, in many cases, this will be more informal, relying upon how the two PSAPs have chosen to represent call routing in today’s MSAG ESN values.

It will be necessary for PSAPs to understand where calls are routing in order to make a determination on whether it makes sense to continue to route calls in this manner or to route calls to a different PSAP in NG9-1-1. There will be instances where it makes sense to have calls routed to a different PSAP based on other considerations.

Examples of these considerations may include but are not limited to:

- Existing extent of the area for which the PSAP receives calls based on the MSAG
- More efficient location-based PSAP call routing (i.e. – to minimize transfers)
- Legacy wireline telecommunications boundaries such as Local Exchange Carrier (LEC) or Local Access Transport Area (LATA) boundaries
- Fire/EMS/Law Enforcement response zones or Emergency Service Zones (ESZs)
- Radio dispatch coverage areas
- Areas with automatic mutual aid or mutual-dispatch (i.e. CAD2CAD) agreements
- Natural or manmade geographic features that serve as natural breaks for handling or responding to calls for service (mountain ridges, bodies of water, levees, etc.)
- Other administrative boundaries (military bases, national parks or forests, universities)
2.3.3 Recommendations for Service Boundary Layers

2.3.3.1 Use state or county level boundaries from the US Census as a starting point

While there is typically better feature resolution in local or state datasets, it will be challenging to start with smaller datasets, aggregate them over a larger area, and then coordinate the edge-matching of neighboring service boundary features to resolve gaps and overlaps. Instead, it is recommended to use US Census TIGER state or county boundaries as a starting point for delineating service boundaries. This dataset is preferred for a number of reasons as described in the following sections.

2.3.3.1.1 Absence of an existing PSAP Boundary Layer

In most cases, 9-1-1 Authorities already have a number of GIS data that supports E9-1-1, but most do not have a separate layer for PSAP boundaries. Because of this, it will be important for 9-1-1 Authorities to create PSAP boundaries that depict the coverage area of their PSAPs.

2.3.3.1.2 No gaps or overlaps

PSAP boundaries are not allowed to have gaps or overlaps with neighboring PSAP boundaries. A location that falls within a gap would mean that the ECRF is unable to use the PSAP boundary layer to identify which PSAP should receive the call. Similarly, a location that falls within overlapping PSAP boundaries would mean that the ECRF is unable to determine which PSAP boundary should be used to route the call. Gaps and/or overlaps between neighboring PSAP boundaries must be reconciled in order to ensure proper functioning of the layer when used in the LVF and ECRF.

The graphic below depicts overlapping service boundary features that come from different sources. In the larger map, the boundaries appear to align, however the inset clearly shows that the boundaries overlap one another. When data from different sources is aggregated, there will be gaps and/or overlaps. However, since the TIGER files don’t have gaps or overlaps, they could be used as a starting point for service boundaries, especially for agencies that generally cover an entire county.
2.3.3.1.3 Common boundaries along state and/or international borders

Since the TIGER layers are already edge-matched along the state lines, it will eliminate gaps and overlaps along the boundary and will serve as a common demarcation point for service boundaries.

If neighboring 9-1-1 Authorities from both states agree that a service boundary should extend in either direction beyond this boundary, then a new polygon can be carved out on that side of the boundary and correctly attributed.

NOTE: Per NENA-STA-006 - NENA Standard for NG9-1-1 GIS Data Model, “When an Emergency Service Boundary crosses into one or more states, the Emergency Service Boundary SHOULD be split at the State Boundary or State Equivalent with the State and the Emergency Service Boundary NENA Globally Unique ID being the only difference in the attributes.”
2.3.3.1.4 Shorelines shouldn’t be used to depict service boundaries

Emergencies don’t just occur on dry land. When a caller is located in a major body of water or on a bridge over a body of water, it will be necessary to know which PSAP should receive the call and which response agencies are available to respond to a call from that location. As a result, PSAP boundaries SHOULD cover major bodies of water. For service boundaries that cover offshore waters, the service boundaries should generally include all offshore waters that are included in the TIGER features for the county or state. Since the TIGER dataset already includes these offshore waters, it makes sense to consistently use the offshore extent from these features when depicting service boundaries along coastal areas. This will enable a more consistent coverage for coastal service boundaries across the country.

The graphic below shows two renderings of a county boundary. The first boundary has a very detailed shoreline, and the second has a more generalized boundary that extends to include coastal waters. The second option is preferred for service boundaries because it ensures that calls from offshore will get routed to a PSAP. From there, the PSAP can use the other emergency service boundaries to determine which agencies might be able to respond to that location. For example, if the call should be transferred to another agency with marine resources such as the US Coast Guard, then a service boundary for that responder agency should be available to facilitate the handling of the call.
The TIGER files not only delineate offshore waters, they also draw simpler lines to denote the county and state boundaries in interior waters such as the Great Lakes, or in larger bays, sounds or bodies of water such as the Chesapeake Bay or Puget Sound.

Note: The only times when a shoreline should be used to delineate a service boundary are when two neighboring 9-1-1 Authorities agree to use the shoreline as their shared boundary, or when no agency for the given Service URN would handle the call past the shoreline.

2.3.3.1.5 Keep it simple... “Cut it out”

In many cases, service boundaries can be approximated by a county boundary, however there are often several PSAPs or response agencies within a given county. Instead of drawing each service boundary from scratch, it may be easier to start with the existing TIGER county boundary and use GIS editing tools to “cut out” a new polygon for each agency located within the county. In the example below from Collier County, FL, most of the county is served by the Collier County PSAP. However, there is also a separate PSAP for the City of Naples. There are a number of GIS tools that can be used to “cut out” the area in the city from the polygon for the county to create separate polygons for both PSAPs.
2.3.3.1.6 **PSAP boundaries do not always follow jurisdictional boundaries.**

While a number of PSAPs provide service for a single jurisdiction (e.g. city, county, township), the PSAP boundary typically does not precisely follow legal or jurisdictional boundaries. When this occurs in a place where no PSAP boundary layer exists, it is very easy to assume that the PSAP serves the same area as the jurisdiction boundary. This assumption can lead to confusion as to which PSAP is responsible for a given area. The coverage areas for a PSAP should not be assumed, and coordination between neighboring 9-1-1 Authorities will be needed to correctly depict the service boundary for each PSAP.

In the graphic above, the PSAP boundary for Collier County, FL is shaded in purple and red lines denote the county boundaries. Calls from extreme northwestern Monroe County are not handled by the PSAP in Monroe County, but should instead be routed to the Collier County PSAP. While the Collier County PSAP primarily serves the geographic area of Collier County, the PSAP boundary should NOT be confused with the jurisdictional boundary. In this example, this portion of Monroe County can be “cut out” from the existing Monroe County polygon and attributed correctly so it will route to the Collier County PSAP instead. Resolving this type of scenario will require working with the neighboring PSAP.
2.3.4 Additional Recommendations for other Layers impacting boundary functionality

2.3.4.1 Civic locations represented by more than one GIS layer should be synchronized when possible

When more than one civic location GIS layer is present (for example both SSAP and RCL) it is strongly recommended that the layers be synchronized with one another as much as possible. When an address is matched to an SSAP feature and the same address is matched to a road centerline feature, there are instances where the location of these matches may vary by some distance. When the discrepancy is large, it typically means that there is an issue with the attribution and/or the placement of one or both of the GIS features. This type of a discrepancy reduces the confidence in the location of the civic address, thereby lowering the confidence in the call being routed to the correct PSAP or response agency.

2.3.4.2 Neighboring GIS Data Providers should resolve duplicate GIS features

As mentioned previously, GIS layers supporting E9-1-1 often include GIS features beyond the PSAP's area of responsibility. If these layers are used as a starting point for developing NG9-1-1 layers, there is a possibility that a single civic location could be represented in layers provided by different GIS Data Providers. By identifying and resolving which GIS Data Provider is responsible for maintaining the GIS features in question, it will eliminate the duplication in GIS data and help to identify the locations of civic addresses that would be expected to fall within PSAP and other service boundaries.

2.3.4.3 Road Centerlines should be split at PSAP boundaries.

When geocoding a civic address against a road centerline feature, the provided civic address is matched to a single road centerline feature and the estimated location of the address is typically interpolated along the feature, based on where the address falls within the address range. In instances where a road centerline feature is not split and crosses a PSAP boundary, it will be impossible to ensure that a call referencing that civic address would be routed to the correct PSAP. Instead, the road centerline feature should be split into two features and the attributes updated to accurately depict the correct PSAP for that civic address.

2.3.5 Coordination Layers

2.3.5.1 Snap-to-points

Snap-to-points are points occurring on a border that represent where data from one GIS Data Provider ends and another begins. The establishment of these points will provide a location to which participating GIS Data Providers can snap their corresponding data element such as a road centerline to ensure coincidence and edge matching across borders.
and between datasets. These are not formal or legal boundaries and represent an agreed upon location for data maintenance purposes only. In some cases, the GIS Data Providers may be neighboring jurisdictions. However snap-to-points could also be used when GIS data for major roads is managed by a state agency and local and/or secondary roads are maintained by a county or smaller jurisdiction.

While the NG9-1-1 GIS Data Model does not require snap-to-points or centerline connectivity, it is implied that centerlines must be broken at the PSAP boundaries. This requirement is discussed further in the Topology section. If there is a segment that crosses a PSAP boundary but there is not a break in the centerline segment, it will be difficult to ensure that the geocoded address will be placed in the correct PSAP possibly impacting call routing. In order to resolve this, it is necessary to break road centerline segments at the PSAP boundary. In the event that the PSAP boundary needs to move one way or another along a centerline segment, then it is recommended to adjust the snap-to-points first and then update / synchronize the related GIS datasets.

The creation of snap-to-points can serve as a single focal point for discussions along these maintenance boundaries since there may be several iterations of address point, road centerline and PSAP boundary refinement and synchronization with ALI and MSAG data.

2.3.5.2 Maintenance lines to depict the edge of boundaries

• Benefits: Help to facilitate boundary discussion
• Serve as a communicated hand-off point for data maintenance/coordination
• Can help with topology between layers (for example between boundaries and road centerline)

2.4 Phased approach for creating and maintaining the PSAP Boundaries

As PSAP boundaries have use cases for E9-1-1, NG9-1-1 and transitional states between both, and as PSAP boundaries can be continually refined, it is recommended that the PSAP boundary layer is created and updated in a phased approach. The recommended phases are:

• First Phase – Initial Development
• Second Phase – Modification and Refinement
• Third Phase – Preparing the Layer for NG9-1-1 Requirements
• Fourth Phase – Long-term maintenance

NENA-STA-006 - NENA Standard for NG9-1-1 GIS Data Model describes the schema and field definitions for the PSAP boundary layer. This schema can be extended and applied to the phased approach in order to populate field attributes at the most relevant time.
creating PSAP boundaries using the phased approach, it is recommended that some
attributes are populated in the First Phase by the GIS Data Provider while the remaining
fields are populated in the Third Phase by the GIS Data Provider in coordination with their
9-1-1 Authority and NGCS Provider. The primary goal of the phased approach is to
front-load data development and refinement work so that some coordination issues can
begin to be addressed prior to selecting a NGCS provider. While this approach is not a
requirement, it is strongly recommended because it provides neighboring 9-1-1 Authorities
an opportunity to identify and resolve PSAP boundary placement concerns prior to NG9-1-1
deployment. Additionally, it helps to ensure that some baseline GIS layers are available
when the 9-1-1 authority begins to work with their chosen NGCS provider.

2.4.1 First Phase - Initial Development (Estimated PSAP Boundaries)

It is strongly recommended when creating this layer to follow the recommendations in
section 2.3 of this document. This first phase requires minimal attribute population.

While the ultimate goal of the PSAP boundary dataset is to represent the geographic extent
of the MSAG, the purpose of the First Phase is to determine and/or obtain a suitable
dataset that can roughly define the footprints of the participating PSAPs. This preliminary
dataset will be a coarse and approximate representation of the PSAP’s coverage area
derived from existing data sources that will be further modified and refined during
subsequent phases.

In some instances, 9-1-1 Authorities may have an existing PSAP boundary layer, however
in many cases; 9-1-1 Authorities may not have a specific layer for PSAP boundaries. This is
a typical scenario, especially when the PSAP provides 9-1-1 service to a specific city,
county, town or other specific defined jurisdictional area. While the PSAP boundary does
not necessarily follow this boundary, the First Phase involves estimating the boundary. The
US Census TIGER county and incorporated place files may provide a suitable estimated
boundary.

Regardless of the data source, when choosing to use an existing data source as the
foundation for PSAP boundaries, it is recommended that a state or region agree upon a
dataset that is seamless and does not contain topological discrepancies such as gaps and
overlaps. This is especially critical when creating PSAP boundaries at a smaller scale, at the
regional, and/or statewide level(s) because the initial First Phase PSAP boundaries will
serve as the basis for discussion and refinement in the later phases of development. By
eliminating gaps and overlaps from this initial discussion, it focuses coordination between
neighboring 9-1-1 Authorities, PSAPs and their GIS Data Providers on the placement of the
existing polygon boundaries to meet mutual needs.

[MM/DD/YYYY]
In making the determination for an appropriate data source for the PSAP boundary file, it is important to consider the geographic extent of coverage and the data sources available at those scales.

Once a dataset is selected as the foundation for the PSAP boundaries, the GIS Data Provider is responsible for populating the attributes listed in the table below. For the Display Name, the GIS Data Provider should work with the 9-1-1 Authority to get this information.

```
PSAP Boundary Schema - First Phase Attributes
Responsible Role: GIS Data Provider

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<th>Descriptive Name</th>
<th>Field Name</th>
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</tbody>
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2.4.2 Second Phase - Modify and refine the PSAP boundaries

The Second Phase involves the modification and refinement of the boundary created in the First Phase. In order to ensure that the PSAP boundaries properly support the LVF and ECRF, it will be necessary to assess the placement of the PSAP boundary relative to civic location layers. In some cases, the boundary may need to be adjusted and in other cases, the civic location features may need to be moved so the PSAP boundary includes the correct civic location features.

MSAG/ALI/GIS Data Synchronization

As mentioned in Section 2.2.1, prior to use in NG9-1-1 call routing, it will be necessary to synchronize and reconcile GIS layers with MSAG and ALI data. This is critical because Emergency Service Numbers (ESNs) associated to civic locations on either side of the boundary need to correspond with the correct PSAP. This has an impact on PSAP boundary development because at a minimum, the PSAP boundary should encompass the civic locations that are included in today's MSAG for a given PSAP. However, it is common for the attributes from the GIS layers, MSAG tables and ALI records to not be in sync with one another.
In situations where the Second Phase is started before this data synchronization occurs, time spent on coordinating and refining boundaries will be duplicated. It is recommended to perform data synchronization either prior to the Second Phase or at the beginning of the Second Phase. If synchronization has not yet occurred, then this phase has the potential to be the most time consuming. Data synchronization requires iterative steps to perform detailed data review, quality assurance and quality control (QA/QC), and data editing. It also is heavily dependent on coordination between 9-1-1 Authorities, PSAPs and their respective GIS Data Providers, and will also rely greatly upon coordination between neighboring authorities. All parties will need to coordinate to ensure that there is agreement upon which civic location features are assigned to each PSAP. They will also need to agree on the depiction of the boundary to best represent those decisions.

**Recommended Steps to Manage Refinement of PSAP Boundaries:**

The following steps are recommended to manage the process of development and refinement. It is important to note that this is an iterative process and these steps will be repeated, as needed, until data validation and synchronization results have met the agreed upon data requirements. It should also be noted that the First Phase boundaries should be a prerequisite for refining the PSAP boundaries. In some cases, additional checks or refinement to the existing PSAP boundaries and related GIS datasets may exist, but that is dependent upon individual LVF or ECRF providers.

1. Perform data validation and synchronization to identify data inconsistencies:
   - Multiple iterative tasks to compare GIS street centerline and/or address point datasets to service provider MSAG/ALI datasets to find discrepancies
   - Ensure that MSAG data is represented in the GIS street centerline and/or address point datasets

2. Resolve data synchronization issues that don’t impact the PSAP boundaries:
   - 9-1-1 Authority, PSAP, and GIS Data Provider review and resolution of discrepancies fully contained within the PSAP’s responsibility area in associated datasets
   - Requires internal coordination between the 9-1-1 Authority, PSAP and GIS Data Providers

3. Identify data synchronization issues that may impact neighboring 9-1-1 Authorities and their associated PSAPs and GIS Data Providers:
   - 9-1-1 Authority, PSAP, and GIS Data Providers review and identify discrepancies at borders of a PSAP’s responsibility area
4. If available, make use of coordination layers (see Section 2.3.4)

5. Resolve border data synchronization issues (road centerlines and/or address points, snap-to-points) and refine the related datasets:
   - 9-1-1 Authority, PSAP, and GIS Data Providers review and resolve discrepancies at borders of a PSAP’s responsibility area in associated datasets
   - Must be done in coordination with neighboring 9-1-1 Authority, PSAP, and GIS Data Providers
   - Determine how best to resolve the discrepancies to ensure seamless coverage across PSAP boundaries
   - Discrepancy resolution may impact GIS street centerline and/or address point and snap-to-point datasets associated with a PSAP’s responsibility area
   - Ensure snap-to-points represent the agreed upon edges of a PSAP’s area of responsibility

6. Update the PSAP boundary to take into account any data changes to road centerlines and/or address points in Step 5.
   - Adjustments made to PSAP boundary to ensure that GIS street centerline and/or address points associated with a PSAP’s responsibility area are encompassed by the associated PSAP’s boundary file
   - Ensure that new topology errors (gaps, overlaps) are not introduced
   - Ensure that existing topology errors (gaps, overlaps) are resolved

2.4.3 Third Phase – NG9-1-1 Readiness Support – Add Third Phase Attributes

In the Third Phase, the remaining fields from the PSAP Boundary schema in NENA-STA-006, NENA Standard for NG9-1-1 GIS Data Model should be populated. These fields support call routing and will be used by the NGCS Provider for a number of purposes. These fields should only be populated by the GIS Data Provider based on guidance and discussions between the 9-1-1 Authority and the NGCS Provider. This is essential in order to ensure that the features will correctly support location validation and call routing.
PSAP Boundary Schema - Third Phase Attributes

**Responsible Roles - GIS Data Provider, 9-1-1 Authorities and their NG9-1-1 Core Service Provider**

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<tr>
<th>Descriptive Name</th>
<th>Field Name</th>
<th>M/C/O</th>
<th>Type</th>
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<td>O</td>
<td>D</td>
<td>--</td>
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<td>M</td>
<td>U</td>
<td>254</td>
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</tbody>
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### 2.4.4 Fourth Phase - Long-Term Maintenance

The Fourth Phase of the PSAP Development and Maintenance process establishes a long term maintenance routine. The previous phases were concerned with the actual development, refinement and modification, and finalization of the PSAP boundary file to support initial implementation into NG9-1-1 services. This final phase emphasizes the continued maintenance tasks associated with sustaining the PSAP boundary file in an NG9-1-1 environment.
The long term maintenance of the PSAP boundary file will require those tasks as outlined in the Second and Third Phases. The PSAP boundary file will evolve as 9-1-1 Authority, PSAP, and GIS Data Provider’s business requirements change. As a result, the continued maintenance of the PSAP boundary will require on-going updates. As underlying GIS data is updated, the data validation tasks should be completed to ensure adequate synchronization across the supporting datasets. By maintaining this level of data integrity, the potential for misrouting emergency requests can be minimized.

2.4.4.1 Data Maintenance Workflows

A critical component to the long term maintenance phase is the establishment of workflows associated with data maintenance and error reporting. For all PSAP and GIS authorities, it is recommended that intra-agency and interagency workflows be established to facilitate the continued coordination and maintenance of the PSAP boundaries and related GIS datasets. By establishing such guidelines, the efficiency and reliability of provisioning GIS data to support NG9-1-1 services can be maintained to an acceptable and agreed upon level between participating PSAP and GIS authorities.

2.4.4.2 GIS Data Updates

Business process developments within a PSAP’s area of responsibility may trigger subsequent GIS additions and/or modifications to data such as street centerlines and/or address points. As a result, due diligence should be made to verify the potential implications on the corresponding PSAP boundary file. For example, GIS modification occurring near the edge of a PSAP’s area of responsibility may have implications on the corresponding PSAP boundary itself, as well as adjacent PSAP boundary(s). GIS modifications occurring well within the interior of a PSAP’s area of responsibility may have little to no impact on the corresponding boundary. In these circumstances, it is imperative to coordinate with neighboring 9-1-1 Authorities, PSAPs, and GIS Data Providers to establish proper agreement on where and how the impacted PSAP boundary(s) should be realigned to appropriately meet the needs of each PSAP’s business requirements.

It is important to note that after such modifications to NG9-1-1 GIS data and PSAP boundaries occurs, the Second Phase data validation and synchronization tasks should be repeated until synchronization across the supporting datasets has achieved an appropriate and agreed upon level of completeness. Error Reporting/Feedback Loop

The interdependency of GIS data workflows and NG9-1-1 business requirements will require an effective procedure by which 9-1-1 Authorities, PSAPs, and GIS Data Providers can communicate data discrepancies and resolutions. Error reporting and/or feedback mechanisms can be an effective pathway to provide critical information to both data providers and end users. As the scale of implementation grows in size, this concept becomes a more crucial component of the implementation itself as it provides a single
means to streamline communication between all stakeholders and facilitate the coordination process.

3 General Conditions Common to all NG9-1-1 GIS Data Layers

While methodologies for GIS data development vary by jurisdiction, NENA has established standards for NG9-1-1 GIS data, so that there are several characteristics that are common to all NG9-1-1 GIS layers. These include the following:

3.1 Use of Coordinate Systems within NG9-1-1 systems

Per NENA-STA-010 - NENA Detailed Functional and Interface Standards for the NENA i3 Solution, all GIS data that exists within NGCS MUST be in World Geodetic System of 1984 (WGS84). While the local GIS data may be kept in any geographic or projected coordinate systems, it MUST be able to be transformed into WGS84, either by the GIS Data Provider or the SI provider.
Recognizing that conversion always introduces some error, it is recommended per NENA-STA-006 - NENA Standard for NG9-1-1 GIS Data Model, that NG9-1-1 systems use WGS84 natively. Regardless of the projection used by native data, any re-projection to WGS84 will require transformation steps. These transformation steps will minimize error and reduce or eliminate the chance of creating unnecessary overlaps and gaps. The transformation steps will vary depending on your native projection and the GIS software used for data development and maintenance. Advice from a geodesist, registered surveyor, or your SI provider is recommended for minimization of transformation errors.

3.2 NENA Globally Unique IDs (NGUID)

Per NENA-STA-006 - NENA Standard for NG9-1-1 GIS Data Model, each feature in GIS data layer must be assigned a NENA Globally Unique Identifier (NGUID). The NGUID differs from other unique identifiers as it is designed to completely differentiate each feature submitted by a GIS Data Provider from any other feature that could exist within a consolidated nation-wide GIS dataset. The NGUID is comprised of three distinct parts: a locally unique ID, which can be numeric and/or text; the ‘@’ symbol; and an Agency ID, which is a domain name as defined in NENA-STA-010 - NENA Detailed Functional and Interface Standards for the NENA i3 Solution and can be obtained from any DNS registrar.

When creating a locally unique ID, the ID must be unique across all data layers maintained by the GIS Data Provider. As an example, in a situation where a road centerline with a unique ID of 012345 and a PSAP boundary with a unique ID of 012345 both exist in the same dataset, although each feature might have an ID unique within its respective layer, it is not unique when all layers are taken into consideration. As such, NENA-STA-006 - NENA Standard for NG9-1-1 GIS Data Model uses a prefix suggestive of the layer in which the NGUID is found. Using this methodology with the above example, the road centerline’s locally unique ID would be RCL012345 and the PSAP boundary’s locally unique ID would be PSAP012345, making the unique ID values truly unique within the dataset.

Note: The prefix suggestive of the layers is only one method of creating a truly unique locally unique ID. If a locally unique ID that does not contain the prefix suggestive of the layer is used then every feature must have a locally unique ID that is unique amongst all layers.

Although NENA provides an example within NENA-STA-006 - NENA Standard for NG9-1-1 GIS Data Model of an NGUID, early adopters have identified other possible ways of representing locally unique IDs. Additional examples of locally unique IDs may include:

- Use of layer name, local ID and FIPS code
  - Example: {layer}.{local ID}.{FIPS}
    - rcl.11065.12011
• Use of layer name, local ID, PSAP Name and State
  o Example: {layer}{local ID}{PSAP}{State}
    ▪ rd11065floydsotx

• Use of Database GUID, PSAP Name and State
  o Example: {Database GUID}.{PSAP}.{State}
    ▪ 9b1966d8-5e6e-4857-a86f-b417d15b7c5d.floydsotx

Note: Each of these examples of locally unique IDs would then be appended with the ‘@’
and the Agency ID to form an NGUID. When an Agency ID is used, it provides an easy
understanding of the data ownership and/or 9-1-1 Authority.

Types of Unique Identifiers used in the above examples:

Local ID – an independent attribute created and maintained by the operator; not
necessarily automatically generated by the native GIS software or a database.

Database GUID – a “global unique identifier” purposefully added to a dataset, and
maintained by the GIS software or a database. (Example:
9b1966d8-5e6e-4857-a86f-b417d15b7c5d)

Note: When developing a method to create the NGUID, it is a good idea to document the
method used within the metadata. Documenting within the metadata ensures that the
process can be consistently followed without having to solely rely upon institutional
knowledge of how the NGUID was developed for the data layer.

Reference NENA-STA-006 - NENA Standard for NG9-1-1 GIS Data Model section on NENA
Globally Unique IDs (NGUID).

Maintenance of NGUIDs

NGUID creation and maintenance should be a coordinated and documented process
between all parties involved. It is important to note that the NGUID maintenance process
will differ based on GIS data workflows within various levels of the GIS data maintenance
hierarchy (for example: city, county, regional, or statewide data aggregation). The NGUID
need not be maintained at the most local level, but may be managed at a larger,
aggregating level.

A locally unique ID is strongly recommended as it typically serves as the basis for NGUID
creation regardless of the level at which the NGUID is maintained. A locally unique ID
supports tracking errors and discrepancies back to their source. It is a best practice for
each entity maintaining GIS data to have at a minimum a locally unique ID; however, this
COULD also be a NGUID. If only a locally unique ID is managed, there should be a process
in place to be able to construct a NGUID through an Extract, Transform and Load (ETL) or
similar process. (For example, a defined ETL process which appends the layer name (AP,
PSAP, RCL) and agency ID to create the NGUID. If an agency coalesces data from multiple
data sources, it is important to be able to differentiate the separate data sources once the
data is coalesced into the regional dataset.

The NGUID and locally unique IDs should be stable for as long as possible to support the
reporting and resolution of errors from a quality control process, including the discrepancy
reporting. It is understood that circumstances may arise that require NGUID re-assignment.
An example of this may be a NGUID maintenance process change that results in
recalculation of the NGUIDs within a dataset. While this may be necessary, complete
NGUID re-assignment should be avoided if possible.

3.3 Accuracy and Precision

3.3.1 Horizontal Accuracy

As defined in the NENA-STA-006 - NENA Standard for NG9-1-1 GIS Data Model, the
horizontal accuracy of GIS data layers SHOULD meet the National Spatial Data
Infrastructure's (NSDI) “National Standard for Spatial Data Accuracy” at a scale of 1:5000.
This equates to a horizontal accuracy of +/- 13.89 feet at 95% confidence.

Where the GIS represents areal features or legal boundaries with a point (such as a
centroid for a building footprint or parcel) this standard is not applicable, but the GIS
feature SHOULD fall within the corresponding area or boundary.

Note: The area represented by Site/Structure Address Points can vary greatly in size.
Consequently, Site/Structure Address Points should be considered accurate if they fall
within the polygon or area uniquely identified by that address [NENA-INF-014].

3.3.2 Vertical Accuracy

Based on evolving standards, regulations, and technological capabilities, it can be expected
that it will become increasingly frequent that accurate vertical/elevation information will be
arriving to PSAPs regarding where a call originated. It will be equally important for GIS
professionals to incorporate vertical data and accuracy requirements into datasets used to
support NG9-1-1.

Note: Since the initial version of this document focuses on PSAP boundaries, vertical
accuracy guidelines for GIS data are not yet available, but will be added to
recommendations for additional development work.
3.3.3 GIS Database Precision

GIS database precision relates to spatial reference and refers to the number of significant digits used to store spatial coordinates within a GIS database. Coordinate values for GIS features are stored with a level of precision that is set within the GIS database.

When merging data from different GIS databases, differences in the precision value of the GIS databases may create slivers and gaps when consolidating the data into the LVF and ECRF. At this time, NG9-1-1 has no established standard for geodatabase precision. As a best management practice, regions may want to establish a GIS database precision that they will use within their GIS databases in order to minimize the impact that spatial database precision introduce.

3.4 Metadata

As defined in NENA-STA-006 - NENA Standard for NG9-1-1 GIS Data Model:

“Metadata is a file of information that captures the basic characteristics of the data and information resource. It represents who, what, when, where, why, and how of the resource. Metadata is strongly recommended to be included and available for each GIS data layer described in this document.”

When maintaining metadata, it is important to document any limitations or constraints of the data including but not limited to the intended use of the data and completeness of the layer. NENA strongly recommends that metadata is developed and maintained for NG91-1-1 GIS data layers. Additionally, state and/or local laws, and agency or provider requirements may include compliance with specific metadata standards and formats.

Below are general questions and concepts to consider and make sure are discussed, as relevant, in metadata for each GIS data layer.
Additional references pertaining to metadata are available at https://www.fgdc.gov/metadata/geospatial-metadata-standards.

4 Impacts, Considerations, Abbreviations, Terms, and Definitions

4.1 Operations Impacts Summary

This document is intended to provide guidance only, and does not require PSAPs or 9-1-1 Authorities to adopt or follow the methodologies provided. The level of impact on Operations is related to the degree to which GIS programs have been established and are maintaining GIS data to NG9-1-1 standards. Additional impacts may be dependent on workflows chosen and the level of precision targeted. It is worth noting that GIS data benefits 9-1-1 services by increasing location precision (not necessarily spatial accuracy), both in the PSAP and in an NG9-1-1 i3 routing environment.
GIS data has vital applications for both 9-1-1 Authorities and PSAPs. Today, 9-1-1 Authorities may or may not support GIS layers for use within the PSAP. GIS data is essential for location validation (both civic and geodetic) and geospatial call routing in the i3 environment and 9-1-1 Authorities will be responsible for provisioning of maintained GIS data to their NG9-1-1 network. Further, the development, maintenance and stewardship of GIS data per NENA NG9-1-1 GIS Data Model (NENA-STA-006) may have additional impacts, including "... to meet local, regional, and other organizational needs...."

4.2 Technical Impacts Summary

The focus of this document is limited to the development and maintenance of GIS data. The technical impacts of this document on Customer Premise Equipment (CPE) and network hardware are negligible.

In terms of software impacts, the methodologies used for GIS data creation, and the precision associated, may impact the accuracy of the networks' geospatial routing decisions. Additionally, considerations may need to be made to the potential impact to CAD software assignment of resources, mapping solutions, vehicle routing and other software that require GIS data.

4.3 Security Impacts Summary

Security concerns regarding GIS data are minimal. Although GIS attributes are not the subject of this document, it is worth noting that GIS datasets as a whole (the combination of the geographic data and related attributes) may contain confidential, proprietary and/or sensitive information that must not be introduced into the public domain. Certain data are confidential under many state laws. Such information is considered confidential when included in databases and on maps used by entities in the provision of emergency services. Such information may also be considered proprietary. Sensitive information implies a loss of security when disclosed to others. Such information may include wireless cell tower locations, military bases, refining facilities, airports, water treatment and distribution facilities, law enforcement facilities, federal offices, emergency management information and resources, and power generation / distribution facilities.

More information about data, information, and guidelines for data and physical security can be found in the NENA Security for Next-Generation 9-1-1 Standard (NG-SEC), NENA Standard 75-001.

4.4 Recommendation for Additional Development Work

- Stewardship information for Road Centerlines
- Stewardship information for Emergency Service Boundaries
• Stewardship information for Address Locations
• Stewardship information for Sub-Addressing
• Stewardship information for Policy Routing
• Stewardship information for Data Aggregation
• Stewardship information for Boundaries depicting Primary versus Secondary PSAP Status for Call Routing
• MSAG Conversion Service (MCS) – See = NENA-STA-010 - NENA Detailed Functional and Interface Standards for the NENA i3 Solution
• Geocode Service (GCS) – See = NENA-STA-010 - NENA Detailed Functional and Interface Standards for the NENA i3 Solution
• Map Database Service (MDS) – See NENA-STA-010 - NENA Detailed Functional and Interface Standards for the NENA i3 Solution
• Additional guidance is needed for sites to manage the transition to a next generation environment.

4.5 Anticipated Timeline
The time to implement these guidelines will be contingent upon the resources applied by a local government or other entity to develop, manage and/or provide the data.

4.6 Cost Factors
Following the methodologies outlined in this document can have both financial and human resource cost implications when developing GIS data. The amount of resources required to develop and properly maintain GIS data as noted in this document may range from significant, if existing data either does not exist or needs to be modified to follow any guidelines listed herein, to minimal if data exists and meets the accuracy needed for 9-1-1 use.

For those with existing data, implementing one or more of these guidelines will involve reevaluating current workflows and processes. This could potentially be a manual, labor intensive and time-consuming effort.

For those considering how to build GIS data from scratch, these guidelines should have a negligible cost impact beyond those resources planned for developing this type of data.

4.7 Cost Recovery Considerations
Collaborating, coordinating and sharing the cost of data development and maintenance with neighboring 9-1-1 entities and other stakeholders outside of 9-1-1 may offset the cost of collecting and maintaining high quality data. Other stakeholders include local and state...
planning departments, engineering, taxing authorities, and public / private partnerships
with utilities, development permitting organizations, and other organizations. Consistent
data development, scrubbing, and maintenance will benefit all stakeholders.

4.8 Additional Impacts (non-cost related)
The information or requirements contained in this NENA document may have additional
impacts, based on the analysis of the authoring group. The impacts expected may include:

- Highly accurate location validation
- Ability for geospatial routing
- Better performance of some 9-1-1 applications
- Reduced probability of misrouted calls
- Improved response time
- Improved communication of response location
- More efficient use of limited resources
- Note: Additions/edits referencing the LVF/ECRF

4.9 Abbreviations, Terms, and Definitions
See NENA Master Glossary of 9-1-1 Terminology, NENA-ADM-000 [1], for a complete listing
of terms used in NENA documents. All abbreviations used in this document are listed
below, along with any new or updated terms and definitions.

<table>
<thead>
<tr>
<th>Term or Abbreviation (Expansion)</th>
<th>Definition / Description</th>
<th>WG Recommendations for Master Glossary: (THIS COLUMN WILL BE DELETED BEFORE PUBLICATION)</th>
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[MM/DD/YYYY]
| **9-1-1 Authority** | A State, County, Regional or other governmental entity responsible for 9-1-1 service operations. For example, this could be a county/parish or city government, a special 9-1-1 or Emergency Communications District, a Council of Governments or other similar body.  
Also known as:  
AHJ (Authority Having Jurisdiction)  
9-1-1 Governing Authority  
9-1-1 Administrator | • (DA)Don’t add  
• (U)Update  
• Other (text suggestions) |
| **ALI (Automatic Location Identification)** | The automatic display at the PSAP of the caller’s telephone number, the address/location of the telephone and supplementary emergency services information of the location from which a call originates. |  |
| **CAD (Computer Aided Dispatch)** | A computer based system, which aids PSAP Telecommunicators by automating selected dispatching and record keeping activities. |  |
| **CLDXF (Civic Location Data Exchange Format)** | A set of data elements that describe detailed street address information. See Section 3 of the NENA Master Glossary or NENA-STA-004 CLDXF |  |
| **Data Domain** | An enumerated listing or range of valid values that may be used as an attribute. If no Data Domain is provided, then any value that meets the format criteria may be used. | N |
| **ECRF** (Emergency Call Routing Function) | A functional element in an ESInet which is a LoST protocol server where location information (either civic address or geo-coordinates) and a Service URN serve as input to a mapping function that returns a URI used to route an emergency call toward the appropriate PSAP for the caller’s location or towards a responder agency.  
- External ECRF: An ECRF instance that resides outside of an ESInet instance.  
- Internal ECRF: An ECRF instance that resides within and is only accessible from an ESInet instance. |
<p>| <strong>EMS</strong> (Emergency Medical Service) | A service providing out-of-hospital acute care and transport to definitive care, to patients with illnesses and injuries which the patient believes constitute a medical emergency. |
| <strong>ESN</strong> (Emergency Service Number) | A 3-5 digit number that represents one or more ESZs. An ESN is defined as one of two types: Administrative ESN and Routing ESN. |
| <strong>ESZ</strong> (Emergency Service Zone) | A geographical area that represents a unique combination of emergency service agencies (e.g., Law Enforcement, Fire and Emergency Medical Service) that is within a specified 9-1-1 governing authority’s jurisdiction. An ESZ can be represented by an Emergency Service Number (ESN) to identify the ESZ. (Refer to ESN) |
| <strong>Geospatial Call Routing</strong> | The use of specialized software and GIS data to route an emergency call to the appropriate PSAP or emergency service provider based on the civic location or geographic coordinates provided with the call. |
| <strong>GIS (Geographic Information System)</strong> | A system for capturing, storing, displaying, analyzing and managing data and associated attributes which are spatially referenced. |
| <strong>GIS Data Provider</strong> | A person or group who is responsible for maintaining authoritative GIS data for a given service area. |</p>
<table>
<thead>
<tr>
<th><strong>LVF (Location Validation Function)</strong></th>
<th>A functional element in an NGCS (Next Generation 9-1-1 (NG9-1-1) Core Services) that is a LoST protocol server where civic location information is validated against the authoritative GIS database information. A civic address is considered valid if it can be located within the database uniquely, is suitable to provide an accurate route for an emergency call and adequate and specific enough to direct responders to the right location.</th>
</tr>
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<tbody>
<tr>
<td><strong>MSAG (Master Street Address Guide)</strong></td>
<td>A database of street names and house number ranges within their associated communities defining Emergency Service Zones (ESZs) and their associated Emergency Service Numbers (ESNs) to enable proper routing of 9-1-1 calls.</td>
</tr>
<tr>
<td><strong>NENA (National Emergency Number Association)</strong></td>
<td>The National Emergency Number Association is a not-for-profit corporation established in 1982 to further the goal of “One Nation-One Number.” NENA is a networking source and promotes research, planning, and training. NENA strives to educate, set standards, and provide certification programs, legislative representation, and technical assistance for implementing and managing 9-1-1 systems. <a href="http://www.nena.org">www.nena.org</a></td>
</tr>
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</table>
NG9-1-1 (Next Generation 9-1-1) Services

"Next Generation 9-1-1 services" means a secure, IP-based, open-standards system comprised of hardware, software, data, and operational policies and procedures that

(A) provides standardized interfaces from emergency call and message services to support emergency communications;

(B) processes all types of emergency calls, including voice, text, data, and multimedia information;

(C) acquires and integrates additional emergency call data useful to call routing and handling;

(D) delivers the emergency calls, messages, and data to the appropriate public safety answering point and other appropriate emergency entities based on the location of the caller;

(E) supports data, video, and other communications needs for coordinated incident response and management; and

(F) interoperates with services and networks used by first responders to facilitate emergency response.

REF: Agreed to by NENA, NASNA, iCERT, and the National 9-1-1 Office representatives on 01/12/2018.

NGCS (Next Generation 9-1-1 (NG9-1-1) Core Services)

The base set of services needed to process a 9-1-1 call on an ESI net. Includes the ESRP, ECRF, LVF, BCF, Bridge, Policy Store, Logging Services and typical IP services such as DNS and DHCP. The term NG9-1-1 Core Services includes the services and not the network on which they operate. See Emergency Services IP Network.
<table>
<thead>
<tr>
<th>NGCS (Next Generation 9-1-1 (NG9-1-1) Core Services) Provider</th>
<th>A NGCS provider is an entity providing one or more of the Next Generation 9-1-1 Core Services (NGCS) elements.</th>
</tr>
</thead>
<tbody>
<tr>
<td>NGUID (NENA Globally Unique ID)</td>
<td>A globally unique ID generated and maintained with a GIS database by combining a 'locally unique ID' (an alphanumeric string unique within the aggregated local GIS database) and the 'Agency Identifier' (a domain representing that authority).</td>
</tr>
<tr>
<td>PIDF-LO (Presence Information Data Format – Location Object)</td>
<td>Provides a flexible and versatile means to represent location information in a SIP header using an XML schema.</td>
</tr>
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</table>
| PSAP (Public Safety Answering Point)                          | An entity responsible for receiving 9-1-1 calls and processing those calls according to a specific operational policy.  
  - Primary PSAP: A PSAP to which 9-1-1 calls are routed directly from the 9-1-1 Control Office.  
  - Secondary PSAP: A PSAP to which 9-1-1 calls are transferred from a Primary PSAP.  
  - Alternate PSAP: A PSAP designated to receive calls when the primary PSAP is unable to do so.  
  - Consolidated PSAP: A facility where multiple Public Safety Agencies choose to operate as a single 9-1-1 entity.  
  - Legacy PSAP: A PSAP that cannot process calls received via i3-defined call interfaces (IP-based calls) and still requires the use of CAMA or ISDN trunk technology for delivery of 9-1-1 emergency calls, |
<table>
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<tr>
<th>SI (Spatial Interface)</th>
<th>A standardized data replication interface used to publish GIS data to the functional elements that consume GIS data, such as the ECRF, LVF, Map Database Services, etc.</th>
</tr>
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<tr>
<td>Topology</td>
<td>The spatial relationships between adjacent or neighboring GIS features.</td>
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<tr>
<td>URI (Uniform Resource Identifier)</td>
<td>A URI is an identifier consisting of a sequence of characters matching the syntax rule that is named &lt;URI&gt; in RFC 3986. The characters allowed are from a very limited set: the letters of the basic Latin alphabet, digits, and a few special characters. It enables uniform identification of resources via a set of naming schemes. A URI can be further classified as a locator, a name, or both. The term &quot;Uniform Resource Locator&quot; (URL) refers to the subset of URIs that, in addition to identifying a resource, provides a means of locating the resource by describing its primary access mechanism (e.g., its network &quot;location&quot;). The term &quot;Uniform Resource Name&quot; (URN) has been used historically to refer to both URIs under the &quot;urn&quot; scheme [RFC2141], which are required to remain globally unique and persistent even when the resource ceases to exist or becomes unavailable, and to any other URI with the properties of a name. An example of a URI that is neither a URL nor a URN is sip:<a href="mailto:psap@example.com">psap@example.com</a>.</td>
</tr>
<tr>
<td>URN (Uniform Resource Name)</td>
<td>A URN is a type of URI. Uniform Resource Names (URNs) are intended to serve as persistent, location-independent, resource identifiers and are designed to make it easy to map other namespaces (which share the properties of URNs) into URN-space. An example of a URN is urn:service.sos. RFC 2141</td>
</tr>
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</table>
UTC (Universal Coordinated Time) | The primary time standard in the world based on the time zone in Greenwich, England. Also known as Zulu or Greenwich Mean Time (GMT). Time provided by National Institute of Standards and Technology (NIST) and United States Naval Observatory (USNO).
---|---
WGS 84 (World Geodetic System 1984) | The World Geodetic System reference coordinate system used by the Global Positioning Systems and in cartography and navigation.

5  Recommended Reading and References

[1] NENA Master Glossary of 9-1-1 Terminology, NENA-ADM-000
[4] NENA GIS Data Collection and Maintenance Standards, NENA 02-014
[10] NENA Standards for the Provisioning and Maintenance of GIS data to ECRF and LVFs, NENA-STA-005
[12] United States Census Bureau, TIGER Products
ACKNOWLEDGEMENTS


NENA Board of Directors Approval Date: [MM/DD/YYYY] (Will be added by the CRM.)

NENA recognizes the following industry experts and their employers for their contributions in development of this document.

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**Special Acknowledgements:**

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