Commonwealth of Pennsylvania
Statewide NG911 GIS Strategic Plan

March 2019

EXECUTIVE SUMMARY

Background and Purpose

Geospatial Information System (GIS) data is a foundational element of next generation 911 (NG911). Pennsylvania's transition to a NG911 environment greatly expands the need for a robust GIS capability on a local, regional and statewide scale. PEMA, in consultation with the Pennsylvania GIS community, developed this Statewide NG911 GIS Strategic Plan as a supplement to the Statewide 911 Plan. This Statewide NG911 GIS Strategic Plan represents the first revision to the Statewide NG911 GIS Strategic Plan adopted in December 2016.

The purpose of the Statewide NG911 GIS Strategic Plan is to:
- Function as a collaborative tool for the advancement of GIS across Pennsylvania.
- Educate and inform Pennsylvania GIS stakeholders about NG911.
- Construct a viable path to obtain and/or develop, maintain, aggregate, and standardize GIS data needed for NG911.
- Actively engage state, regional, county, and local jurisdictions in the development and maintenance of GIS data and workflows to support NG911 and public safety.
- Identify and implement strategies for cost savings and efficiencies.
- Serve as a foundation for statewide funding decisions related to GIS in support of NG911.

NG911 and GIS in Pennsylvania

Today, our 911 system is facing technical challenges that have a direct impact on the ability of public safety answering points (PSAPs) to continue providing critical services to both the public and first responders. Consumer communications technology has outpaced improvements and capabilities in 911 and the public safety community in general. Our current 911 infrastructure is largely comprised of old, less flexible, and soon-to-be-obsolete technology. Pennsylvania's focus under Act 12 has been planning and preparing for NG911. The question is not if Pennsylvania should deploy NG911, but rather, how should Pennsylvania deploy NG911. There is no option for not deploying NG911.

NG911 is a necessary transition from Pennsylvania's current, decades old legacy 911 system infrastructure to an internet protocol (IP) based 911 system. NG911 will require a complete upgrade of the E911 network to a shared IP network called an Emergency Services Internet Protocol Network (ESInet). The implementation of a statewide ESInet will provide the necessary architecture to support several critical NG911 call-routing components known as Next Generation Core Services (NGCS). NGCS are defined as, "the base set of services needed to process a 911 call on an ESInet." As NG911 functionality is achieved, GIS data is uploaded to the NGCS, which is used to validate caller location and the correct PSAP to which the call should be routed. To facilitate the implementation of NG911 in Pennsylvania, PEMA intends to procure a statewide ESInet and NGCS system as a service.

Coordination of the many GIS efforts across the Commonwealth to meet NG911 requirements has necessitated a fundamental change in PEMA's interactions with Pennsylvania GIS stakeholders because it is not practical for PEMA to maintain the required datasets for NG911 for the entire Commonwealth. Significant effort must be made by each jurisdiction to ensure that mission critical GIS data layers are accurate, maintained on a regular basis, and conform to NG911 requirements. Common GIS processes must be implemented statewide to aggregate local GIS data into a statewide dataset, ensure the data meets NG911 requirements, and provision the data into the NG911 system for call delivery. PEMA continues to

solicit the involvement of Pennsylvania GIS stakeholders in the development and maintenance of GIS plans, policies, and procedures for NG911.

PEMA and the Pennsylvania 911 community understand that many of the GIS goals and priorities contained in this Plan could be leveraged to benefit other GIS initiatives in Pennsylvania. Collaboration between GIS stakeholders at all levels of government is critical to minimizing duplication of efforts and establishing a statewide GIS framework to support NG911 in a planned, efficient, and cost-effective manner. It is important to also recognize that continued investment in GIS data and infrastructure will not only have positive impacts on public safety, but will also provide valuable information for decision makers in all levels of government in areas such as economic development, planning, zoning, land use, tax assessments, emergency management, etc.

GIS Goals and Priorities in Support of NG911

The Statewide NG911 GIS Strategic Plan provides Pennsylvania GIS stakeholders with an overview of NG911 along with goals and priorities for implementing a coordinated, comprehensive GIS framework to support NG911. The anticipated result will be the development and implementation of common GIS processes in a coordinated and sustainable manner across Pennsylvania to support NG911 and Pennsylvania GIS efforts in general.

Pennsylvania NG911 GIS Goals and Priorities:
1. Formalize Pennsylvania NG911 GIS requirements.
2. Pennsylvania GIS stakeholder GIS education, outreach, and training.
3. Complete county GIS data assessment
4. Complete statewide aerial imagery data collection
5. Develop common GIS processes to support NG911 call delivery
6. Develop statewide PSAP boundary, provisioning boundary, and emergency service boundary (ESB) GIS data layers
7. Pennsylvania GIS stakeholder collaboration to minimize duplication of efforts and maximize returns on investment
8. Continued prioritization of 911 funds to support NG911 GIS efforts.
9. Establish internal GIS support within the PEMA 911 Office.

Actions Needed to Implement the Plan
- Continuation of supporting 911 legislation.
- Financial support for GIS initiatives.
- Stakeholder engagement at all levels of government with planning, coordination, and implementation of GIS processes in support of NG911.
- Develop the capability, in conjunction with Pennsylvania GIS stakeholders, to address GIS needs and implement GIS support for NG911 in a coordinated, sustainable manner.

1. Introduction

Communication to a PSAP today is primarily limited to a voice call with very little data, which was sufficient when calls were placed on a wireline phone inside a business or residence. NG911 is a necessary upgrade of today's 911 system to adapt to how people communicate today – largely through mobile and digital devices.

NG911 will rely heavily on locally developed GIS data for identifying the location of 911 callers and routing 911 calls and data to the correct PSAP. Significant effort must be made by each jurisdiction to ensure that mission critical GIS data layers are accurate, maintained on a regular, frequent basis and conform to established standards for NG911. Common GIS processes must be implemented statewide to aggregate local GIS data into a statewide dataset, ensure the data meets NG911 standards, and provision the data into the NG911 system for call delivery. PEMA, in consultation with the Pennsylvania GIS community, developed this Statewide NG911 GIS Strategic Plan as a supplement to the Statewide 911 Plan for Pennsylvania GIS stakeholders.

The purpose of the Statewide NG911 GIS Strategic Plan is to:
- Function as a collaborative tool for the advancement of GIS across Pennsylvania.
- Educate and inform Pennsylvania GIS stakeholders about NG911.
- Construct a viable path to obtain and/or develop, maintain, aggregate, and standardize GIS data needed for NG911.
- Actively engage state, regional, county, and local jurisdictions in the development and maintenance of GIS data and workflows to support NG911 and public safety.
- Identify and implement strategies for cost savings and efficiencies.
- Serve as a foundation for statewide funding decisions related to GIS in support of NG911.

While this Statewide NG911 GIS Strategic Plan is a charter for the development of statewide GIS support for NG911, it also must remain flexible as needs, circumstances, and technologies change. The Plan will be reviewed and updated annually to identify current NG911 GIS goals and priorities during this time of transition. The Statewide NG911 GIS Strategic Plan is not intended to be an operational or tactical plan. The document is intended to facilitate continued improvement in 911 service and to serve as a foundation for statewide decisions related to 911.

The contextual overview of Pennsylvania NG911 goals and priorities provided in this Plan is meant to foster collaboration among the many state, regional and local GIS programs providing data and support to the statewide NG911 migration.

2. NG911 and GIS Overview

The systems and components currently utilized to route 911 calls to PSAPs are based on technology originally designed in the 1970s. The conventional process of call routing is suitable for less than 30 percent of all 911 calls placed in the U.S. today—and that percentage continues to decrease annually. Additionally, the technology that supports this type of legacy call-routing process is at or near end of life, with communications service providers in the process of decommissioning the legacy, circuit switched networks in favor of IP and wireless technologies.

NG911 is a necessary transition from Pennsylvania's current, decades old legacy 911 system infrastructure to an IP based 911 system. NG911 will require a complete upgrade of the E911 network to a shared IP network called an ESInet. The implementation of a statewide ESInet will provide the necessary architecture

to support several critical NG911 call-routing components known as Next Generation Core Services. NGCS are defined as, "the base set of services needed to process a 911 call on an ESInet."

NG911 call-routing reflects the transition from static, tabular-based routing to dynamic geospatial call routing as enabled through the development of a strong GIS foundation and utilization of NGCS. While public safety GIS and GIS-supporting programs currently exist in the Commonwealth at the local, regional and state levels, these programs vary widely in maturity, capability and focus. Pennsylvania GIS stakeholders must come together to implement common GIS processes statewide to aggregate local GIS data into a statewide dataset, ensure the data meets NG911 standards, and provision the data into the NG911 system for call delivery.

2.1 What is NG911?

The National Emergency Number Association (NENA) publication, *NENA Master Glossary of 9-1-1 Terminology,[1]* defines NG911 as a system comprised of hardware, software, data and operational procedures to:

- Provide standardized interfaces from call and message services to support emergency communications.
- Process all types of emergency calls including voice, text, data and multimedia information
- Acquire and integrate additional emergency call data useful to call routing and handling.
- Deliver the emergency calls, messages and data to the appropriate PSAP and other appropriate emergency entities based on the location of the caller.
- Support data, video, and other communications needs for coordinated incident response and management.
- Interoperate with services and networks used by first responders to facilitate emergency response.

2.2 How a NG911 System Works for 911 Call Delivery

Pennsylvania's NG911 system will consist of three main components for 911 call delivery: the originating network, the statewide ESInet and NGCS system, and the terminating network. Figure 1 on the next page outlines a logical view of the architecture for Pennsylvania's NG911 system. This figure illustrates the originating service provider (OSP) interconnection points into the NG911 system [far left of the diagram], the statewide ESInet and NGCS system utilized to deliver 911 calls to the PSAP [middle or blue-highlighted section], and the hand-off to local or regional agencies that receive the 911 calls and manage their local GIS data [far right of the diagram].

For clarification purposes:

- **Originating Network** - The portion of Pennsylvania's NG9-1-1 system that delivers the 911 call from the 911 caller (the call-maker) to the ingress point of the statewide ESInet.
- **Statewide ESInet and NGCS System** - The portion of the Pennsylvania NG911 system that transports, via IP, the 911 call from the Originating Network to the Terminating Network. In actual practice, this may be from the legacy network gateway (LNG)/border control function (BCF) to the router/switch located within the same physical structure that houses a PSAP's call-handling equipment (CHE).
- **Terminating Network** - While not a network by itself, the terminating network is representative of the PSAPs.

---

[1] NENA Master Glossary of 9-1-1 Terminology NENA-ADM-000.22-2018, 04/13/2018
https://cdn.ymaws.com/www.nena.org/resource/resmgr/standards/NENA-ADM-000.22-2018_FINAL_2.pdf
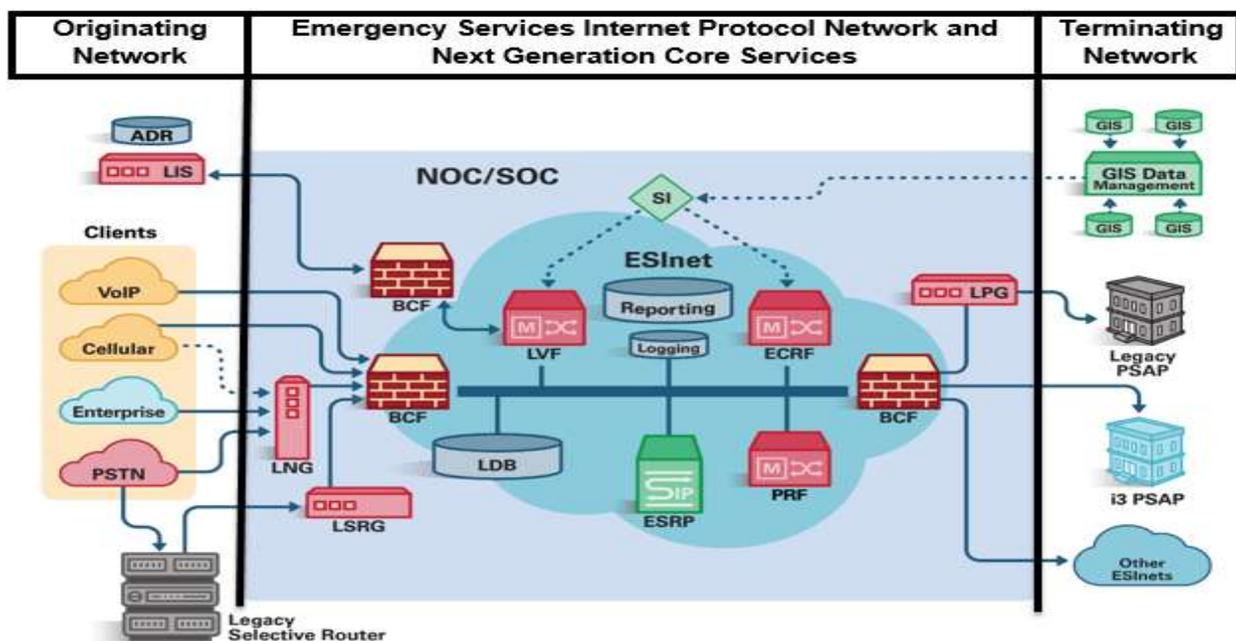
Figure 1. Commonwealth of PA Logical NG911 System Model

OSPs will access the statewide NG911 system in a similar manner to how they access our current E911 network. In NG911, regardless of the access technology, the OSP recognizes when the consumer dials the digits 911, but instead of routing the call to a selective router, the OSP routes the call to a point of interconnection (POI) to the statewide ESInet and NGCS system. It is anticipated these POIs will be located strategically throughout the Commonwealth to allow cost effective access to the statewide ESInet and NGCS system. After the OSP passes a security check to enter the ESInet, it will provide the call and all available data about the call. A NG911 core service receives that data and determines the PSAP that should receive the call, and another service routes the call and data to that PSAP. The call and associated data are presented in the same manner as a telecommunicator receives it today.

2.3 GIS Components of Pennsylvania's NG911 System

The process for performing location calculations is fundamentally different in an NG911 environment. NG911 service cannot be implemented without the NGCS, and the NGCS cannot be deployed without accurate GIS data and refined GIS data-management processes. NGCS will require statewide seamless GIS data for a successful NG911 system implementation and operation.

Next Generation Core Services

The Emergency Call Routing Function (ECRF), emergency services routing proxy (ESRP), location validation function (LVF), and policy routing function (PRF) are integral NGCS needed for NG911 call routing. As OSPs achieve functionality outlined in the National Emergency Number Association's NG911 i3 standard (i3)[2], the GIS data is uploaded to the LVF, which is used to validate subscriber locations, and the ECRF, which is responsible for determining the correct PSAP to which the call should be routed. The ESRP is the component that determines the routing based on input from the ECRF and routes the call based upon identification of the proper location or policy. The PRF contains routing rules that are set based on

---

[2] NENA i3 Standard
https://www.nena.org/page/i3_Stage3

pre-established rules or variables that determine where a call should route in overflow or special predefined scenarios. Once these components are enabled, the Commonwealth will be performing i3-compliant geospatial routing.

GIS

Pennsylvania's NG911 system will rely heavily on locally developed GIS data for routing 911 calls to the correct PSAP. GIS data is created and maintained by various jurisdictions and authorities in Pennsylvania. A successful NG911 implementation will require not only proper coordination between different entities who maintain GIS data, but also a streamlined workflow to prepare GIS data for provisioning into NGCS in a timely manner. Per the NENA Standard for NG911 GIS Data Model (NENA-STA-006.1-2018) the following GIS data layers must be available for the ECRF and LVF to function, and are required for call taking and dispatch operations[3]:

- **Road Centerlines** - Represents the estimated centerline of a real-world roadway.
- **Site/Structure Address Points** - Ideally represent the location of a site or structure or the location of access to a site or structure. Site/Structure Address Points can also represent landmarks.
- **PSAP Boundary** - Defines the geographic area of a PSAP that has primary responsibilities for an emergency request. Each PSAP boundary layer must align with adjoining PSAP boundaries to assure there are no gaps or overlaps.
- **Emergency Service Boundary (ESB)** - Defines the geographic area for the primary providers of response services.
- **Provisioning Boundary** - Defines the area of GIS data provisioning responsibility, with no unintentional gaps or overlaps.

These five GIS data layers are the basis of NG911 call routing. The PSAP boundary defines what PSAP will answer the emergency call, the ESB layer will determine what dispatch agency will respond, the road centerline and address points layers will pinpoint where the responder needs to go, and the provisioning boundary describes who is responsible for submitting the GIS data.

In a NG911 environment, local GIS data is used to accomplish the same functions as tabular data and Selective Router perform in the current 911 environment. The ability to perform location validation functions and routing functions using a NG911 system will depend on the currency, standardization, quality, and accuracy of the GIS data being used.

The NENA Standard for NG911 GIS Data Model also provides strongly recommended and recommended GIS data layers that may aid ECRF and LVF functionality. PEMA is supporting a statewide NG911 GIS data gap analysis that is expected to be completed in 2019. A key task of the statewide NG911 GIS data gap analysis is to formalize Pennsylvania NG911 GIS requirements. The requirements will define a common data model, required GIS data layers, and set minimum accuracy benchmarks for master street address guide (MSAG), automatic location information (ALI), and GIS data synchronization to be attained before local data is integrated into a statewide dataset. Recommendations and best practices for creating and maintaining road centerline and site/structure address point layers will be provided as part of the Pennsylvania NG911 GIS requirements.

2.4 Implementation of NG911 in Pennsylvania

PEMA intends to procure a Commonwealth-wide ESInet and NGCS system as a service to implement NG911 in Pennsylvania. The ESInet and NGCS system will include all systems, components, and functions

---

[3] NENA Standard for NG911 GIS Data Model, Section 3 – GIS Data Model Layers
https://cdn.ymaws.com/www.nena.org/resource/resmgr/standards/nena-sta-006_ng9-1-1_gis_dat.pdf

necessary to deliver all 911 calls in the Commonwealth from the demarcation points of OSPs to the designated terminating network POI for a PSAP. The initial focus of the statewide ESInet and NGCS project will be to upgrade Pennsylvania's current legacy 911 infrastructure for 911 call delivery. Once call delivery is established, the focus will shift to incorporating additional statewide and regional 911 related systems and applications onto the statewide ESInet where applicable.

During the transition to NG911, the NGCS elements will be phased into operation. It should be expected this will be a multi-year transitional period. During this time, call routing will leverage both legacy and IP components. This is necessary to enable the transition between the legacy tabular-based data model and workflow and the IP-based data processes enabled by the LVF. It is understood that GIS data at the local, regional, and Commonwealth levels may not have matured sufficiently to transition immediately to geospatial routing functions. Therefore, NG911 service providers have built in transitional functionality to allow the ESRP to function as an IP selective router (IPSR) while interfacing with the legacy ALI and selective-routing structure to support this transitional phase between legacy 911 and NG911.

2.5 Funding NG911

The planning and transition to NG911 is an extensive, multi-year effort, and completely dependent upon the availability of funds. Pennsylvania's ability to fund the various stages of migration and implementation of NG911 will determine our success and timeline. GIS is a foundational element of NG911. Continued investment in GIS data will not only have positive impacts on public safety, but will also provide valuable information for decision makers in all levels of government in areas such as economic development, planning, zoning, land use, tax assessments, emergency management, etc.

Under Act 12 of 2015, a uniform monthly surcharge fee of $1.65 went into effect as of August 1, 2015. Service providers and retailers forward 911 surcharge collections quarterly to the Commonwealth. 911 surcharge revenue is distributed to Pennsylvania counties through two primary methods under Act 12:

1. **Eighty-three percent (83%)** of the surcharge revenue collected is distributed to PSAPs using a formula based calculation. A PSAP has discretion over how these funds are spent; provided the funds are used for expenses that meet the eligibility criteria established by PEMA, in consultation with the 911 Advisory Board. Pennsylvania PSAPs continue to invest in GIS in preparation for NG911. PSAP reported GIS expenditures were $2.3 million in 2017; an increase of $859,000 or 60% from the previous year.

2. **Fifteen percent (15%)** shall be used by PEMA to establish, enhance, operate or maintain statewide interconnectivity of 9-1-1 systems. GIS has been a top priority of PEMA's 911 statewide interconnectivity grant program for the past two years with over $3 million awarded in grants for local GIS initiatives. PEMA, in consultation with the 911 Advisory Board, have allocated statewide interconnectivity funds to finance a 4 year, $6 million statewide aerial imagery contract.

Providing counties with support for NG911 GIS initiatives continues to be a top priority for PEMA. 911 funds allocated to PEMA to administer Act 12 of 2015 are supporting a statewide NG911 GIS data gap analysis that will focus on NG911 GIS requirements development, stakeholder education, county GIS data assessment, and future NG911 GIS workflow planning. Also, PEMA has executed an agreement with Pennsylvania State University for aerial imagery distribution and management services through Pennsylvania Spatial Data Access (PASDA).

Figure 1: PEMA 911 funded Collaborative Regional GIS Projects in 2018

Looking at 911 funding holistically across Pennsylvania, PEMA's focus is to ensure funding is available to maintain current 911 systems and implement NG911. 911 surcharge collections have averaged $316 million annually under Act 12. In 2017, the total reported expenditures for 911 in Pennsylvania were $362 million. As seen in prior years, the surcharge revenue collected in 2017 was not sufficient to cover the cost of 911 operations, leaving the balance to be funded by other revenue sources.

It is expected that current 911 costs will continue to rise and new costs will be introduced to Pennsylvania's 911 system with the implementation of NG911. The Commonwealth 911 community must take a different approach to ensure funds are available to sustain current 911 systems and implement NG911.

A current set of 911 system requirements, including GIS requirements, will serve as the foundation for detailed statewide planning. Statewide planning efforts will be used to identify technological and operational gaps, facilitate proactive statewide budgeting, and find opportunities for efficiencies and cost savings. Statewide planning efforts will serve as a means to make decisions on how limited 911 funds are used in the most effective manner such as cost savings through statewide purchases or state contracting vehicles. Detailed planning will allow for data-driven and process driven funding decisions for the 911 Program. PEMA intends to work with the 911 and Pennsylvania GIS communities to identify GIS gaps and opportunities in support of NG911 and address those items in a coordinated manner.

The effect will be to transition the allocation of 911 funds to a coordinated, data and process driven environment rather than the complex, competitive environment that has been associated with 911 funding since its inception.

3. Pennsylvania NG911 GIS Framework – Goals and Priorities

Collaboration between GIS stakeholders at all levels of government is critical to minimizing duplication of efforts and establishing a statewide GIS framework to support NG911 in a planned, efficient, and cost-effective manner. GIS data must be harvested from and maintained by authoritative sources when possible. GIS data must be maintained, aggregated, standardized, and provided to the NG911 system for 911 call delivery.

The following goals and priorities have been established to facilitate continued improvement in GIS across Pennsylvania to meet the needs of NG911. The contextual overview of Pennsylvania NG911 goals and priorities provided in this Plan is meant to foster collaboration among the many state, regional and local GIS programs providing data and support to the statewide NG911 migration.

3.1 Formalize Pennsylvania NG911 GIS Requirements:

Goal:
Adopt Pennsylvania NG911 GIS requirements in the following areas to be used to normalize GIS datasets at the local level, ensure all Pennsylvania PSAPs achieve a minimum GIS capability, and to guide planning efforts and progress towards NG911.

- Required GIS data layers for NG911
- Pennsylvania NG911 GIS data model
- Synchronization and accuracy benchmarks for MSAG, ALI, and GIS data.

In addition, PEMA seeks to develop best practices for creating and maintaining the road centerline and site/structure address point GIS data layers for Pennsylvania specific situations.

Background:
Act 12 requires PEMA to establish and publish annually uniform requirements relating to technology, NG911 technology, administration, and operation of 911 systems in consultation with the Board (35 Pa.C.S. § 5303 (a) (8).

PEMA anticipates completing a statewide NG911 GIS data gap analysis in 2019 that will focus on NG911 GIS requirements development, stakeholder education, county GIS data assessment, and future NG911 GIS workflow planning.

Action Steps:
- Execute contract with vendor to perform statewide NG911GIS data gap analysis.
- Develop and adopt, in consultation with the PEMA NG911 GIS Working Group, Pennsylvania NG911 GIS data requirements to include required data layers, GIS data model, and accuracy requirements for synchronization of MSAG/ALI/GIS datasets.
- Develop best practices for creating and maintaining the road centerline and site/structure address point layers in the following areas:
  - Road centerline segmentation and placement
  - Naming and addressing conventions for transportation situations including interstates, highways, interchanges, rest areas, and on/off ramps.
  - Address ranges

- o Point placement for special cases to include multiple addresses with one parcel and one parcel with multiple polygons.
- Publish Pennsylvania NG911 GIS Requirements and Best Practices Guide

Anticipated Results:

The Pennsylvania NG911 GIS Requirements and Best Practices Guide will be an authoritative document that can be used by local jurisdictions as a guide in updating their GIS data to meet the needs of NG911. In addition, a formalized set of Pennsylvania NG911 GIS requirements will:
- Establish requirements and expectations to normalize GIS datasets maintained at the local level.
- Guide statewide GIS planning efforts for infrastructure and processes in support of NG911.
- Set accuracy benchmarks to attain before local data is aggregated into a statewide dataset.
- Identify GIS gaps, opportunities, and specific areas for data remediation to make the best use of limited financial resources
- Facilitate data and process driven management of the 911 Program.
- Allow for effective oversight to measure compliance with 911 system requirements.

3.2 Pennsylvania GIS Stakeholder Education, Outreach, and Training.

Goal:

Educate Pennsylvania GIS stakeholders on GIS standards, requirements, assessment, workflows and other topics necessary for preparing and maintaining local GIS data for use in a Commonwealth-wide NG911 system.

Background:

The complexities of implementing a GIS program, combined with the vast intricacies of NG911 and the requirements it places on GIS data, will require immediate and ongoing training for the PEMA staff, external GIS data stewards, and NG911 stakeholders, to ensure that all participants are well-versed in the importance of their efforts for 911 and public safety.

Action Steps:
- Complete in-person educational session for each of Pennsylvania's seven (7) 911 regions as part of the statewide NG911 GIS data gap analysis.
- Provide a recorded webinar on PEMA's website that can be accessed by GIS data stewards at any time that covers NG911 GIS requirements and workflows.
- Provide NG911 GIS education at various platforms such as 911 Advisory Board meetings, State Geospatial Coordinating Board meetings, Pennsylvania GIS conferences, PA NENA conference and the PA APCO conference.
- Identify and support training opportunities working with Pennsylvania GIS stakeholders.

Anticipated Results:
- Pennsylvania GIS community understands what NG911 is and the GIS requirements for a NG911 system to perform 911 call delivery.
- Foster partnerships and collaboration between GIS representatives at all levels of government to plan and coordinate GIS efforts, minimize duplication of efforts, and enhance public safety GIS in general across Pennsylvania.

3.3 Complete County GIS Data Assessment

Goal:
Complete an assessment of each county's GIS data to determine their level of compliance with adopted Pennsylvania NG911 GIS requirements. In addition, complete a comparison of MSAG/ALI/GIS data to determine each county's synchronization rate.

Background:
PEMA, working with the Pennsylvania GIS community, intends to formalize NG911 GIS requirements. These requirements will be used as a guide to assimilate various GIS data sets and layers into an authoritative statewide dataset that can be used for NG911 call routing. In addition, the NENA standard for NG911 GIS data model recommends a 98% match rate between MSAG/ALI/GIS data to minimize call routing and dispatching issues in a NG911 environment.

PEMA anticipates completing a statewide NG911 GIS data gap analysis in 2019 that will focus on NG911 GIS requirements development, stakeholder education, county GIS data assessment, and future NG911 GIS workflow planning.

Action Steps
- Execute contract with vendor to perform statewide NG911GIS data gap analysis.
- Obtain current MSAG, ALI, and GIS datasets from Pennsylvania counties.
- Assess each county's GIS data to determine their level of compliance with adopted Pennsylvania NG911 requirements and each county's match rate between MSAG/ALI/GIS data.
- Issue each county a GIS data analysis report. Each county will have a conference call with the vendor following the delivery of the GIS data analysis report to discuss results.

Anticipated Results:
- Counties provided with recommendations for remediating their GIS data to Pennsylvania NG911 GIS requirements.
- Recommendations will provide data that can be used for coordinated planning and identification of opportunities to remediate data.
- Data available that can be used to identify specific initiatives or set funding priorities that help advance Pennsylvania towards NG911.

3.4 Complete Statewide Orthoimagery Data Collection

Goal:
Provide Pennsylvania GIS stakeholders with a current statewide orthoimagery dataset.

Background:
During development of the initial Statewide NG911 GIS Strategic Plan in 2016, PEMA solicited feedback from the local and regional GIS programs across the Commonwealth. This outreach effort focused on determining what services or assistance, if provided by PEMA, would be most beneficial to the local GIS user community. The most common response was the provisioning of remote-sensing data on a regular, recurring schedule. These remote-sensing products provide a foundation for the creation and maintenance of NG911 foundational data. Road centerlines, a required NG911 GIS data layer for call delivery, can be derived from orthoimagery.

PEMA executed a contract in March 2018 to obtain digital, high-resolution aerial imagery for the Commonwealth. The premise of the aerial imagery program is that PEMA will provide imagery data to local jurisdictions in exchange for creating, maintaining, and sharing the required GIS data for NG911.

Action Steps:
- Collect aerial imagery of Pennsylvania in Spring 2019.
- Orthoimagery is produced and passes independent quality assurance checks.
- Data is provided to PASDA for distribution.

Anticipated Results:
- Current orthoimagery is provided to all jurisdictions in the Commonwealth.
- All products acquired under this program will be public data
- Enables creation of data essential for NG911 implementation and operation
- Enables multiple agencies to optionally acquire enhancements and supplemental GIS products
- Decreases costs to obtain new geospatial data
- Moves toward a uniform base map for the entire Commonwealth
- Substantial cost savings over individual collection efforts

3.5 Develop Common GIS Processes to Support NG911 Call Delivery

Goal:
Develop and implement policies, procedures, and workflows to collect local GIS data, compile the data into a statewide dataset, ensure the data meets NG911 requirements, and providing the data into the NGCS for 911 call delivery.

Background:
Call delivery in today's 911 system is based on a phone number. In NG911, all requests for emergency services are associated with a location. NG911 allows for call routing and dispatch decisions to be made on the most current GIS data available. It is not practical for PEMA to maintain the required NG911 GIS data sets for the entire Commonwealth. A federated model of data creation and maintenance—whereby the data stewards retain ownership of and responsibility for the data—creates an environment wherein the most current GIS data is available directly from the source. The aggregation and sharing of these datasets must be automated and occur each time a dataset is updated.

While the division of GIS data development, maintenance, and attribution responsibilities across many data stewards at the local and regional levels of government adds some risk to the 911-data-provisioning process, these risks are dwarfed by the gains in data quality and interoperability while spreading the individual commitment of resources across multiple entities. The figure on the next page depicts the logical GIS data flow from the local jurisdiction to the ESInet.

The spatial data from individual jurisdictions must be aggregated and checked for errors prior to being loaded into the NG911 system. The data validation may be tiered, beginning at the regional level prior to statewide aggregation by the ESInet provider. Error checking will identify issues that could cause delays in the NG911 process. Errors such as overlapping road centerlines or address ranges, gaps or overlaps in PSAP or ESB boundaries, or duplicative/incorrect street names and/or addresses should be checked for and can be identified at any stage of the data flow.
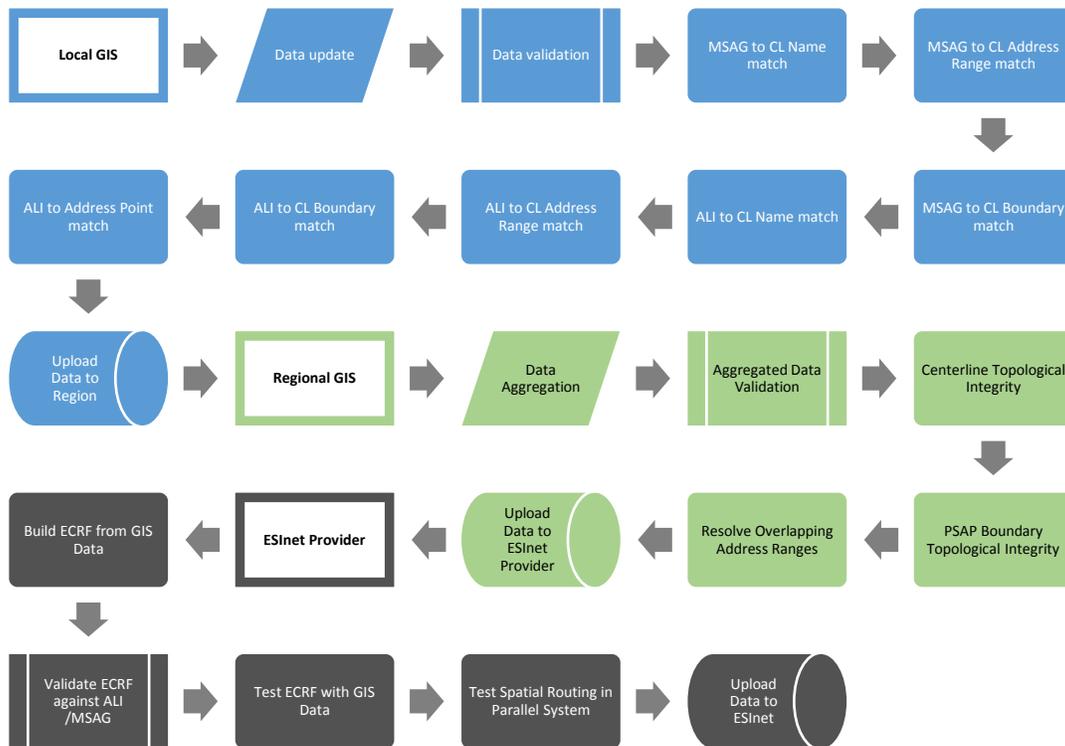
Figure 2: Logical Data Flow Model

As part of the statewide NG911 GIS data gap analysis, a report will be provided by the vendor that includes next steps for Pennsylvania in regards to GIS for NG911. The report will cover options for Pennsylvania to manage GIS data necessary for NG911 inclusive of quality control, data layer development and maintenance, data synchronization, and consolidating GIS data into a statewide dataset for NG911 purposes through county personnel using existing mapping and analytics platforms or vendor solutions. The report will specifically cover:

- Options for tools and processes to remediate and/or integrate local GIS data for NG911.
- Options for NG911 GIS workflows that include roles, responsibilities, and activities.
- Options for QA/QC processes

Action Steps:
- Review report and recommendations from the statewide NG911 GIS data gap analysis.
- Develop a course of action to implement a statewide GIS framework in support of NG911.
- Identify gaps, opportunities, and funding priorities to implement the framework in a coordinated manner.

Anticipated Results:
- Mechanisms are identified and implemented to work towards a true seamless, gapless statewide NG911 GIS dataset.
- Workflows are implemented to move GIS data out of local GIS systems into an authoritative statewide GIS dataset.

3.6 Develop statewide PSAP boundary, provisioning boundary, and ESB layers

Goal:
Develop statewide PSAP boundary, provisioning boundary, and ESB GIS data layers.

Background:
Per the NENA Standard for NG911 GIS Data Model (NENA-STA-006.1-2018) the PSAP, provisioning and emergency service boundaries must be available for the ECRF and LVF to function and are required for call taking and dispatch operations.

PSAP Boundary:
The primary use for the PSAP boundary is to route 911 calls in a NG911 environment. Each PSAP Boundary defines the geographic area of a PSAP that has primary responsibilities for an emergency request.

This boundary layer depicts the polygon(s) and related attribute information that define the geographic area of all PSAP boundaries within a given 911 authority's jurisdictional area. The PSAP boundary may contain data for one county, multiple counties, or partial areas of one or more counties, depending on previously established local governance arrangements that define a PSAP's primary jurisdictional area.
The PSAP boundary layer is used by the ECRF—a NGCS functional element—to perform a geographic query that determines the primary PSAP for an incoming 911 call. The geographic location information associated with the call must be provided using a civic address, geographic coordinates, or geodetic shapes as defined in NENA Detailed Functional and Interface Standards for the NENA i3 Solution.

Provisioning Boundary:
The provisioning boundary layer defines jurisdictional areas for local GIS data stewards who are vested in the creation and maintenance of spatial data in their respective jurisdictions. Data updates and error corrections within the defined provisioning boundary must be approved and submitted by the appointed GIS data steward. Each provisioning boundary only has one individual or entity operating as the provisioning authority, and there can be no gaps or overlaps between adjacent boundaries.

The provisioning boundary must be agreed to by all adjoining data-provisioning providers. The associated polygon layer can be used for geoprocessing by the ECRF to identify and exclude erroneous features that lie beyond the boundary; it also can be used by the Forest Guide to determine coverage for a data-provisioning authority. (The Forest Guide is an element of the Location-to-Service Translation [LoST] protocol that helps to determine the correct emergency call routing based not only on the location of the caller, but also jurisdictional factors.) The provisioning boundary will be a mandatory layer in the Commonwealth's schema structure.

When provisioning data for the ECRF and LVF through the spatial interface (SI)—both are NCGS functional elements—the locally appointed 911 authority must submit GIS data for its geographic area of jurisdiction only, and must ensure that the data is inclusive of its geographic area of jurisdiction.

Emergency Service Boundary:
An ESB layer defines the primary geographic area of law enforcement, EMS, and fire responders. Each emergency service boundary layer may contain one or more polygon boundaries that define the primary emergency services for that geographic area. There must be a separate emergency service boundary layer for each type of service discipline. Each individual layer for the identified responder disciplines is used by the ECRF to perform a geographic query that determines which responding agencies are responsible for

providing emergency services for the location of a 911 caller. In addition to a primary PSAP's use of this information to identify the appropriate units for dispatch, emergency service boundary data aids the selective transfer function and Emergency Incident Data Document (EIDD) delivery to another PSAP for dispatch.

Action Steps:
- Define a common data model for PSAP, provisioning, and emergency service boundaries.
- Publish guidelines and best practices document for developing boundary data layers.
- Prioritize 2019 statewide interconnectivity funds to assist with boundary layer development.
- Support boundary development workshops or sessions between county GIS data stewards.

Anticipated Results:
- Development of seamless, gapless statewide PSAP, provisioning, and emergency service GIS boundary layers to serve as an accurate representation of a PSAP's response area and to route 911 calls to a PSAP using a NG911 system.

3.7 Pennsylvania GIS Stakeholder Collaboration

Goal:
Coordinate GIS efforts between Pennsylvania GIS stakeholders at the federal, state, regional, county and local levels to leverage existing infrastructure, minimize duplication of efforts, manage GIS expenditures, and maximize returns on investment.

Background:
GIS programs in Pennsylvania must work in a collaborative environment, both across jurisdictional boundaries and vertically through all levels of government to implement NG911. GIS efforts related to NG911 will not only benefit NG911 but also provide the opportunity for Pennsylvania GIS stakeholders to collaborate and coordinate efforts to improve GIS in a cost-effective manner. A coordinated approach will increase the availability of robust, accurate and current data across Pennsylvania while maintaining or even reducing the cost to taxpayers. Much progress has been made in the coordination between Pennsylvania GIS stakeholders with the establishment of the State Geospatial Coordinating Board and the PEMA NG911 GIS Working Group.

The State Geospatial Coordinating Board (GeoBoard) was created in 2014 to provide advice and recommendations to the Governor and the citizens of this Commonwealth on geospatial issues and provide uniform data standards, coordination and efficiency in geospatial policy and technology issues among Federal, State and local government agencies, academic institutions and the private sector." PEMA is a voting member of the GeoBoard and actively coordinates GIS initiatives with its members.

PEMA established a GIS working group to guide and coordinate GIS initiatives in support of NG911. This group of GIS professionals is comprised of members from PEMA, County GIS Professionals Association, PSAPs, the 911 Advisory Board's technical subcommittee, State Geospatial Coordinating Board, and state agencies like DEP, PennDOT and OA. Members of this group provide subject-matter expertise and work to ensure that PEMA's initiatives are aligned with the needs and capabilities of the stakeholder jurisdictions.

The focus of the working group includes identifying operational gaps, determining feasible solutions to address these gaps, and establishing an enterprise-wide approach for maintaining awareness and understanding of all GIS data and software applications throughout PEMA.

Action Steps:
- Continuing work of PEMA NG911 GIS Working Group to guide GIS policies and procedures in support of NG911.
- Coordinate with State Geospatial Coordinating Board members to determine what short- and long-term requirements can be met by existing infrastructure - specifically, server, data storage, network services and enterprise licensing agreements (ELAs) for software and operating systems necessary to operations, or leveraging the State's current GIS repositories for data intake and dissemination.
- Create and maintain a GIS tools repository to host various scripts and extract, transform and load (ETL) processes that can be shared among the GIS departments to create and prepare GIS data for NG911.

Anticipated Results:
- Established processes to standardize core spatial data creation, collection, dissemination, and maintenance at state, regional and local levels across the Commonwealth that:
    - leverage existing infrastructure where possible,
    - minimize duplication of efforts,
    - Plan and manage GIS expenditures, and
    - Maximize returns on investment.

3.8 Continued prioritization of 911 funds to support NG911 GIS efforts

Goal:
Provide financial support county GIS efforts that help progress Pennsylvania towards NG911.

Background:
PEMA, in consultation with the 911 Advisory Board, have recognized the importance of supporting GIS efforts across Pennsylvania that develop or enhance GIS data for public safety and have made GIS a funding priority of the Statewide Interconnectivity Grant Program for the past two years. Using the results of the statewide GIS gap analysis, PEMA intends to work with the PEMA NG911 GIS working group to identify specific projects to support with statewide interconnectivity funding in 2019.

Action Steps:
- Analyze results of the statewide NG911 GIS data gap analysis to identify GIS initiatives that progress Pennsylvania towards NG911.
- Develop GIS funding priorities for statewide interconnectivity funds.
- Develop project guidelines to ensure funds help Pennsylvania progress towards NG911 in a coordinated manner.
- Solicit grant applications in July 2019 for GIS projects.

Anticipated Results:
- Statewide interconnectivity funds are provided to counties for GIS projects that assist the Commonwealth with progressing towards NG911.

3.9 GIS personnel in the PEMA 911 Office to Support NG911

Goal:
Add GIS personnel in the PEMA 911 Office to coordinate and support NG911 GIS efforts.

Background:
Implementing the recommendations in this GIS Strategic Plan will require a great deal of management and oversight. PEMA must hire a GIS manager to facilitate GIS efforts in support of NG911. This person will require the assistance of a GIS analyst to provide support to the regional and local jurisdictions. This team will be responsible for program oversight and leading the coordination, development and ongoing maintenance of the public safety GIS program.

The PEMA GIS manager, in addition to coordinating all GIS efforts across the agency, will be the champion for implementing the recommendations in this NG911 GIS Strategic Plan. PEMA will rely heavily on the support of data stewards at the local level for the creation and maintenance of GIS data supporting NG911. To further this effort, PEMA, must maintain open communications with, and provide support to, the GIS staff at the jurisdictions in consultation with 911 Coordinator or designee. The GIS manager would provide education and outreach to the local GIS authorities to maintain a regional approach toward achieving NG911 program success. Due to the significant scope of implementing a statewide public safety GIS program in support of NG911, PEMA should hire a GIS analyst to support the GIS manager in day-to-day activities.

Action Steps:
- Recruit and hire GIS personnel to support a statewide public safety GIS program in support of NG911.

Anticipated Results:
- GIS personnel will be available in the PEMA 911 Office to guide and coordinate GIS activities in support of NG911.

4. Road Map – Tasks and Milestones

Note: GIS Goals and priorities will be further defined once a contract is executed with the selected statewide ESInet and NGCS vendor.

NG911 GIS Strategic Plan – Key Tasks and Milestones		
Goal/Priority	Initiative	Schedule
3.9 GIS Personnel	Hire GIS Manager in the PEMA 911 Office	1st Quarter 2019
3.1 Requirements	Award statewide NG911 GIS gap analysis contract	1st Quarter 2019
3.1 Requirements	Publish Pennsylvania NG911 GIS Requirements and Best Practices Guide	2nd Quarter 2019
3.4 Imagery	Complete statewide orthoimagery acquisition	2nd Quarter 2019
3.4 Imagery	Accept buy-up requests for the Fall 2019 collection cycle	2nd Quarter 2019
3.2 Training/Education	NG911 GIS education at the PA APCO Conference	2nd Quarter 2019
3.2 Training/Education	NG911 GIS education at the PA GIS Conference	2nd Quarter 2019
3.8 Funding	Finalize GIS funding priorities and project guidelines for the 2019 Statewide Interconnectivity Grant Program	2nd Quarter 2019
3.2 Training/Education	Complete seven (7) regional in-person education sessions	3rd Quarter 2019
3.2 Training/Education	NG911 GIS education at the PA NENA Conference	3rd Quarter 2019
3.3 Data Assessment	Complete data assessment and provide each county with a GIS Data Assessment Report	3rd Quarter 2019
3.8 Funding	Accept 2019 grant applications for GIS projects	3rd Quarter 2019
3.9 GIS Personnel	Hire GIS Analyst in the PEMA 911 Office	3rd Quarter 2019
3.6 Boundary Layers	Create statewide PSAP, provisioning and ESB boundary layers	4th Quarter 2019
3.5 GIS Processes	Review Statewide NG911 GIS Data Gap Analysis Final report and recommendations to manage GIS data necessary for NG911 and develop a course of action for a statewide GIS framework to provision local GIS data into the NGCS.	4th Quarter 2019
3.4 Imagery	Finalize 2020 remote-sensing collection plan based on 2019 efforts.	4th Quarter 2019
3.7 Collaboration	Continued GIS stakeholder collaboration through the GeoBoard and PEMA NG911 GIS Working Group	Ongoing